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WOOD-BASED BIOREFINERIES PAVE THE WAY TO SUCCESSFUL BIOECONOMY

Sari Mannonen, Vice president, UPM Biofuels

FAO, AFCSI meeting, Rome

5.4.2018

UPM today

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UPM BIOREFINING

pulp, plantations, **biofuels**, timber

UPM ENERGY

UPM RAFLATAC

UPM PAPER ASIA

UPM PAPER ENA

UPM PLYWOOD

BIOCHEMICALS

BIOKOMPOSITES

SALES €10 BILLION • **PERSONNEL** 19,100 • **PRODUCTION PLANTS** 54 • **SHAREHOLDERS** 90,000 +

Megatrends drive demand for sustainable and safe solutions

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Biofore fits well into the changing world

- Population growth, urbanisation
- Resource scarcity, role of renewables
- Digitalisation
- Climate change
- Responsibility and compliance

- Efficient use of renewable materials and energy
- Renewable and recyclable products
- Innovations and new businesses
- Responsibility integrated in all operations

Evolution of wood usage

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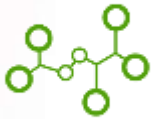

Biomolecules

- Biofuels
- Biochemicals

Fibres

- Pulp
- Paper
- Packaging
- Tissue
- Labelling materials
- Biocomposites

Logs

- Sawn timber
- Plywood

Trees

- Energy

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THE CHALLENGE – CLIMATE CHANGE

Climate change is driving search for greenhouse gas (GHG) savings

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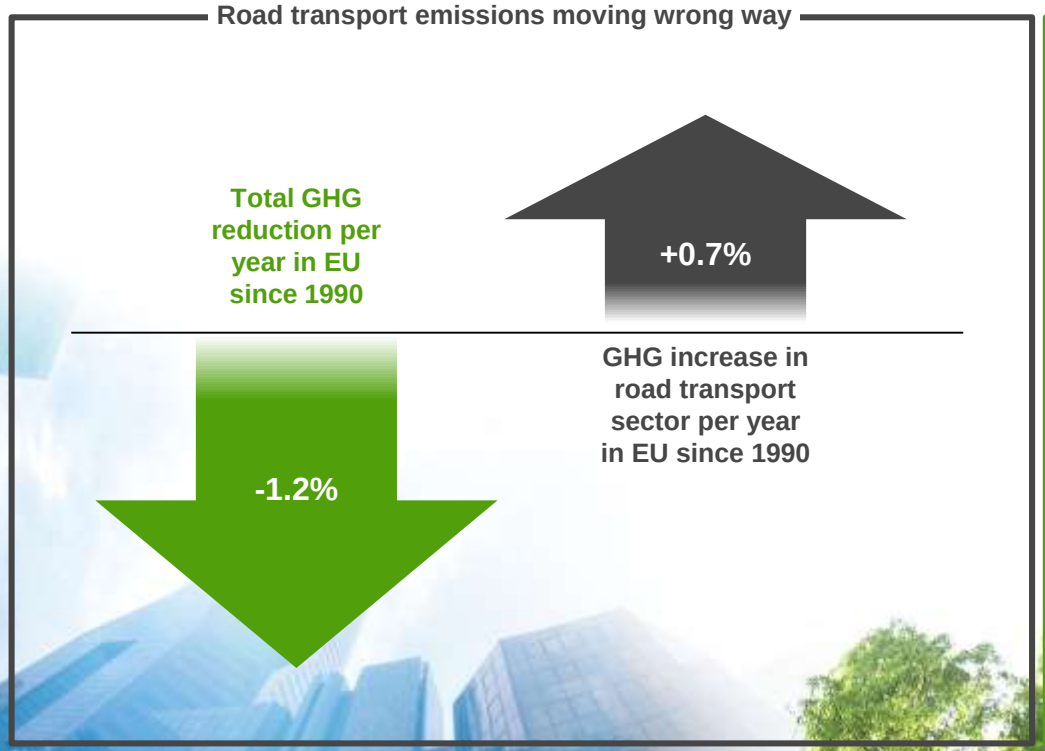
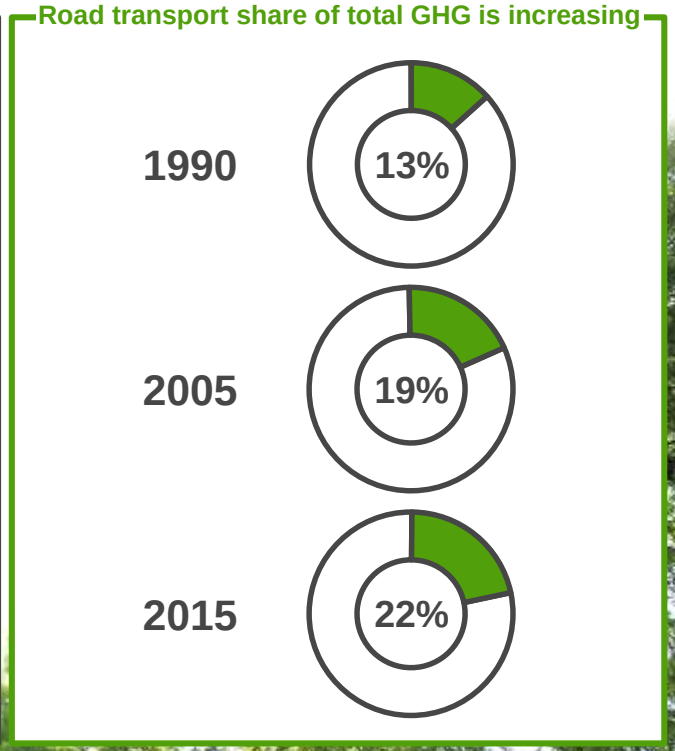
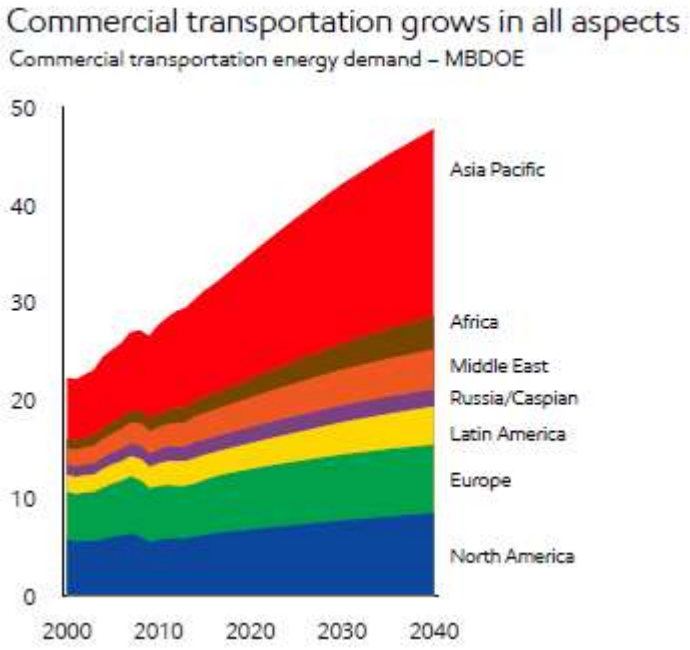
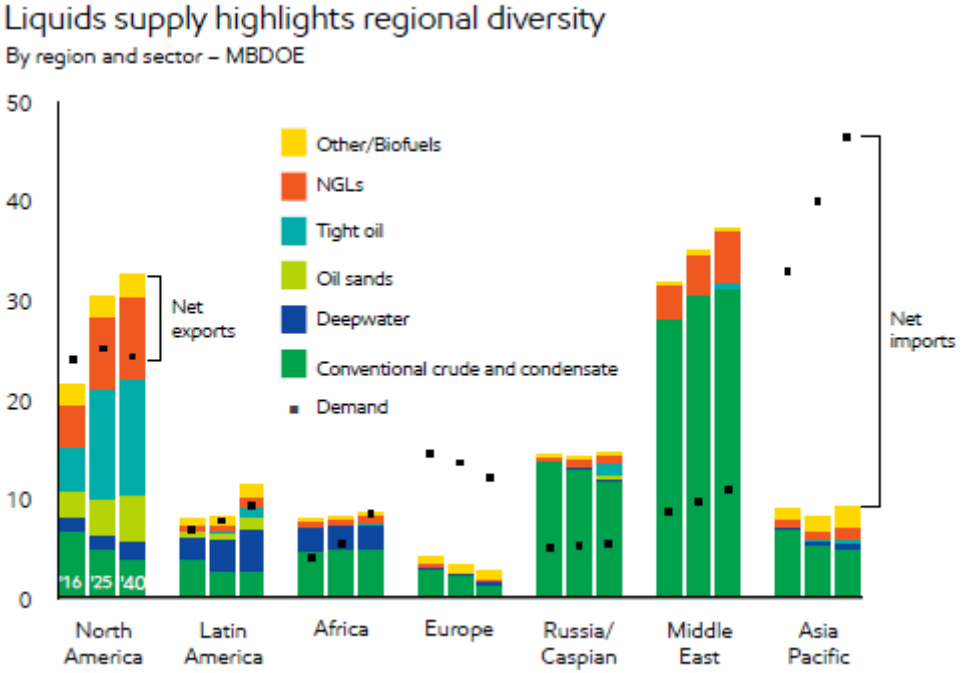




Source: EEA

Exxon global outlook for energy 2018 – transportation & liquids supply





Significant emission cuts needed in transportation sector

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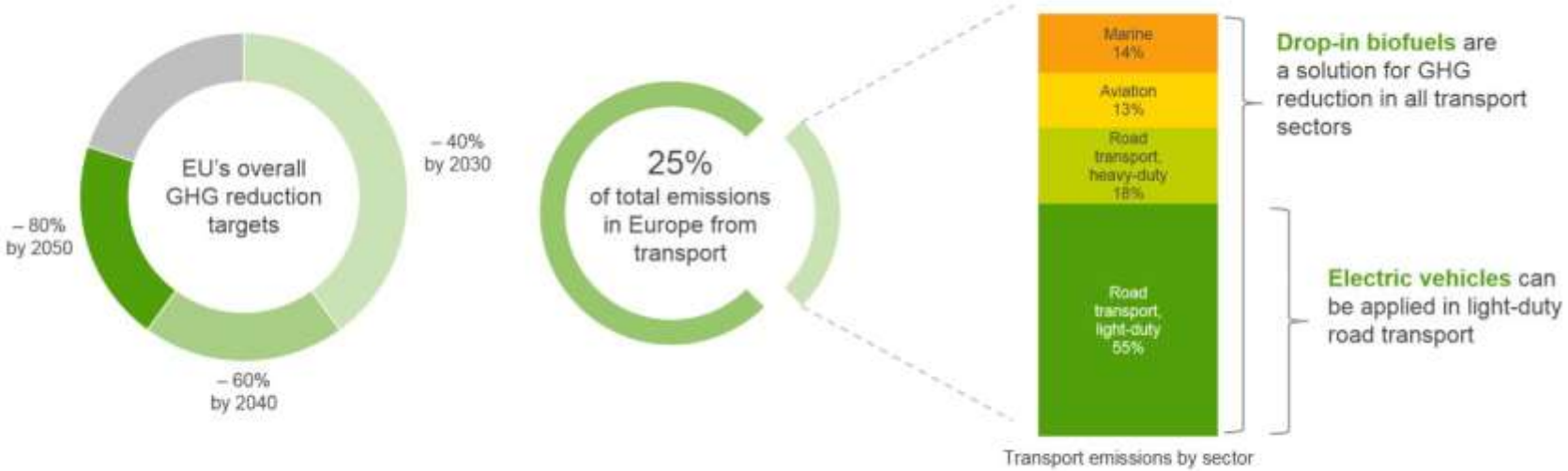
EU's greenhouse gas reduction targets cannot be met without significant emission cuts in transport – actions needed in all sectors



Biofuels are needed in road transport energy mix to meet EU's GHG-reduction targets

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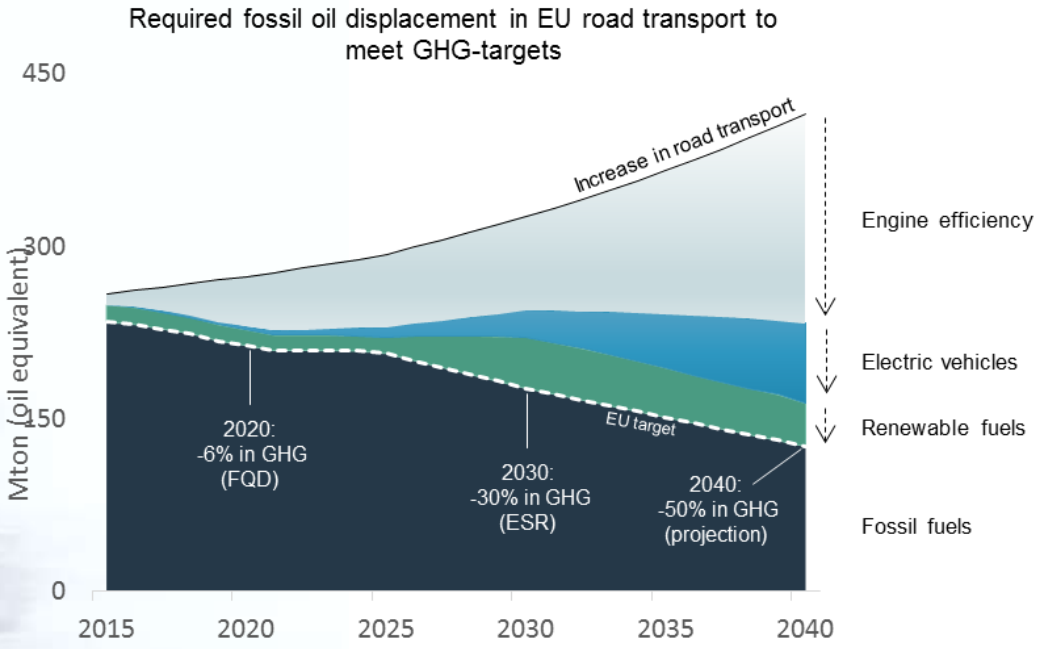

Source: UPM analysis based on Bloomberg and WoodMackenzie

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UPM´S WOOD-BASED BIOFUELS

UPM's journey in advanced biofuels

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2006

UPM published its plans to become a significant **producer of advanced biofuels**

2008

Development of various technologies. **Hydrotreatment** process development started in UPM R&D

2012

First investment decision of 179 M€ for UPM Lappeenranta biorefinery. Produces renewable diesel from tall oil.

2015

UPM Lappeenranta biorefinery in commercial production in January. **Sales of UPM BioVerno starts** in Finland.

2016

Business case proven. Establishing UPM **Biofuels Development Programme** evaluating growth opportunities

2017

Expanding UPM BioVerno diesel & naphtha sales to Scandinavia and EU

UPM Kaukas, Lappeenranta, Finland

Industrial evolution of the world's most versatile forest industry integrate

9
4
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UPM KAUKAS

1. Main gate
2. Mutteri office
3. Research Center (NERC)
4. Biorefinery
5. Bio-power plant
6. Pulp mill
7. Sawmill
8. Paper mill
9. Effluent treatment plant

UPM Lappeenranta Biorefinery

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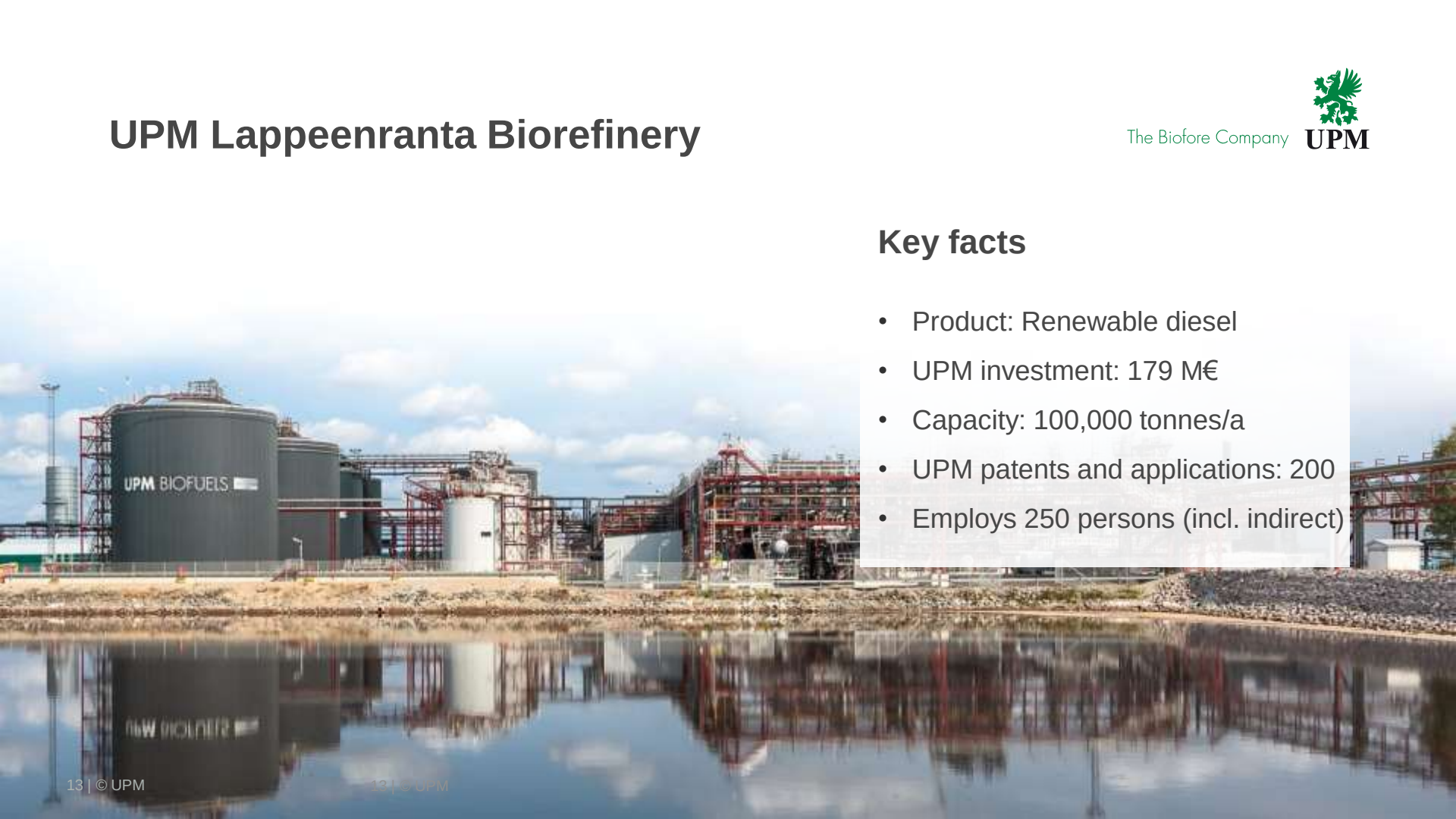

Key facts

- Product: Renewable diesel
- UPM investment: 179 M€
- Capacity: 100,000 tonnes/a
- UPM patents and applications: 200
- Employs 250 persons (incl. indirect)

13 | © UPM

Crude Tall Oil (CTO) – a residue of pulp making process as raw material

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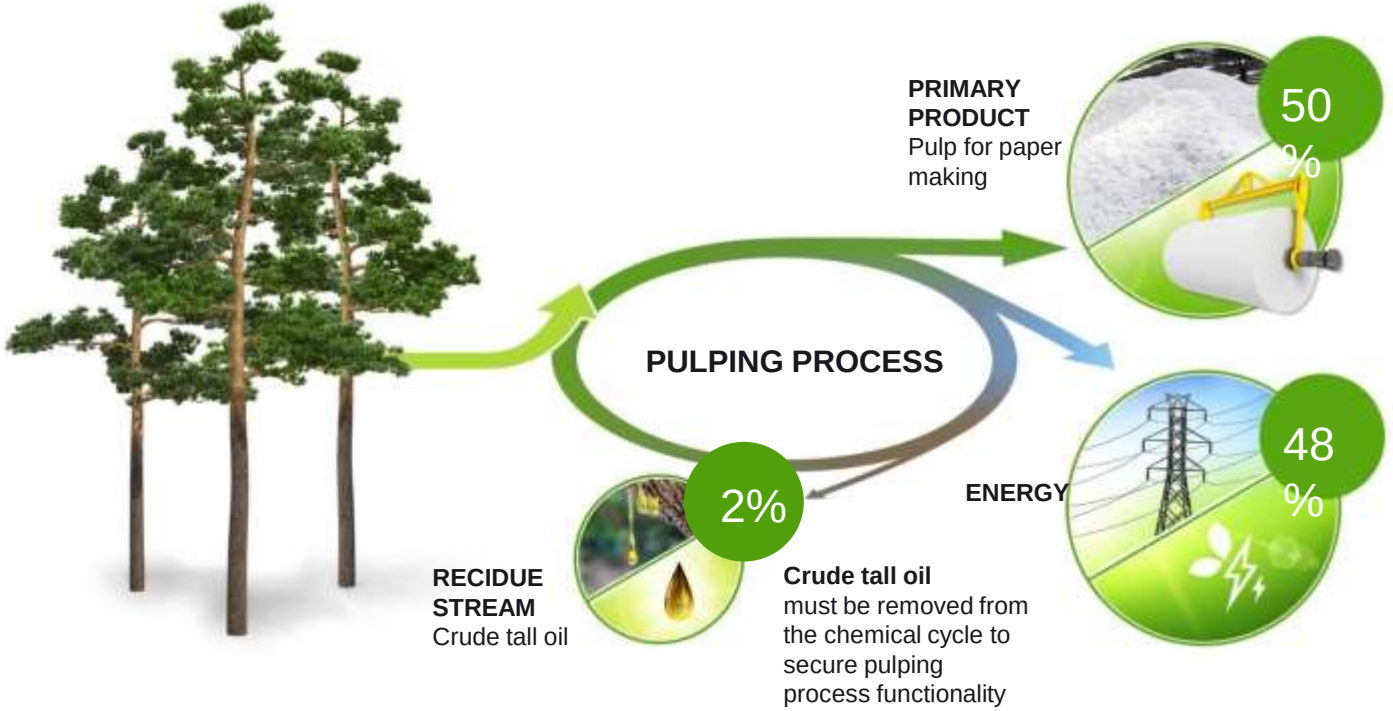

UPM renewable diesel and naphtha production process

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CRUDE TALL OIL

A residue of chemical pulping process containing natural extractive components of wood.

PRETREATMENT

Crude Tall Oil is purified: salts, impurities, solid particles and water are removed.

HYDROTREATMENT

Pretreated Crude Tall Oil is fed together with make-up and recycled hydrogen to the reactor where the chemical structure is modified. Reaction water is separated and directed to waste water treatment.

FRACTIONATION

Remaining hydrogen sulfide and uncondensable gases are removed. The remaining liquid is distilled to separate renewable diesel.

RENEWABLE DIESEL

High quality advanced biofuel suitable for all diesel engines.

RENEWABLE NAPHTHA

Advanced renewable biocomponent for gasoline or raw material for bioplastics.

UPM BioVerno renewable diesel
- Top of the line sustainable biofuel

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OXYGEN FREE HYDROCARBON

100 %

RENEWABLE FEEDSTOCK

100 %

CO_2 EMISSIONS (VS. FOSSIL FUEL)

-80 %

IN FOOD CHAIN

0 %

UPM Biofuels in existing and future end-use

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Fuel retail

Dedicated green fleets

Marine/Aviation

UPM BioVerno naphtha in bioplastics - Case Dow & Elopak

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- 100% renewable and recyclable wood-based carton
  - **UPM Biofuels** produces wood-based UPM BioVerno naphtha
  - **Dow** converts naphtha to renewable resins to manufacture bioplastics (PE)
  - **Elopak** coats wood-based beverage carton with wood-based bioplastics
- Every tonne of UPM´s wood-based naphtha reduces one tonne of fossil raw materials
- Entire value chain ISCC Plus certified

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UPM IS INVESTIGATING OPPORTUNITIES IN WOOD-BASED CHEMICALS

New business opportunities for UPM

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Biofuels

- High volume products
- Economies of scale
- Drop-in applications

Scaleup

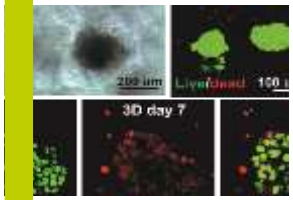
Biochemicals

Biorefinery Chemicals

- Bio-based chemical building blocks

Market entry

Biofibrils



- Life science prod. e.g. cell culturing and medical care

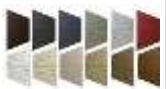
Lignin

- Performance chemicals

Market entry

Biocomposites

- Terrace materials
- New applications, e.g. acoustics pr.



Scaleup

Biochemicals biorefinery targeting to produce bio-MEG, bio-MPG and lignin from hardwood

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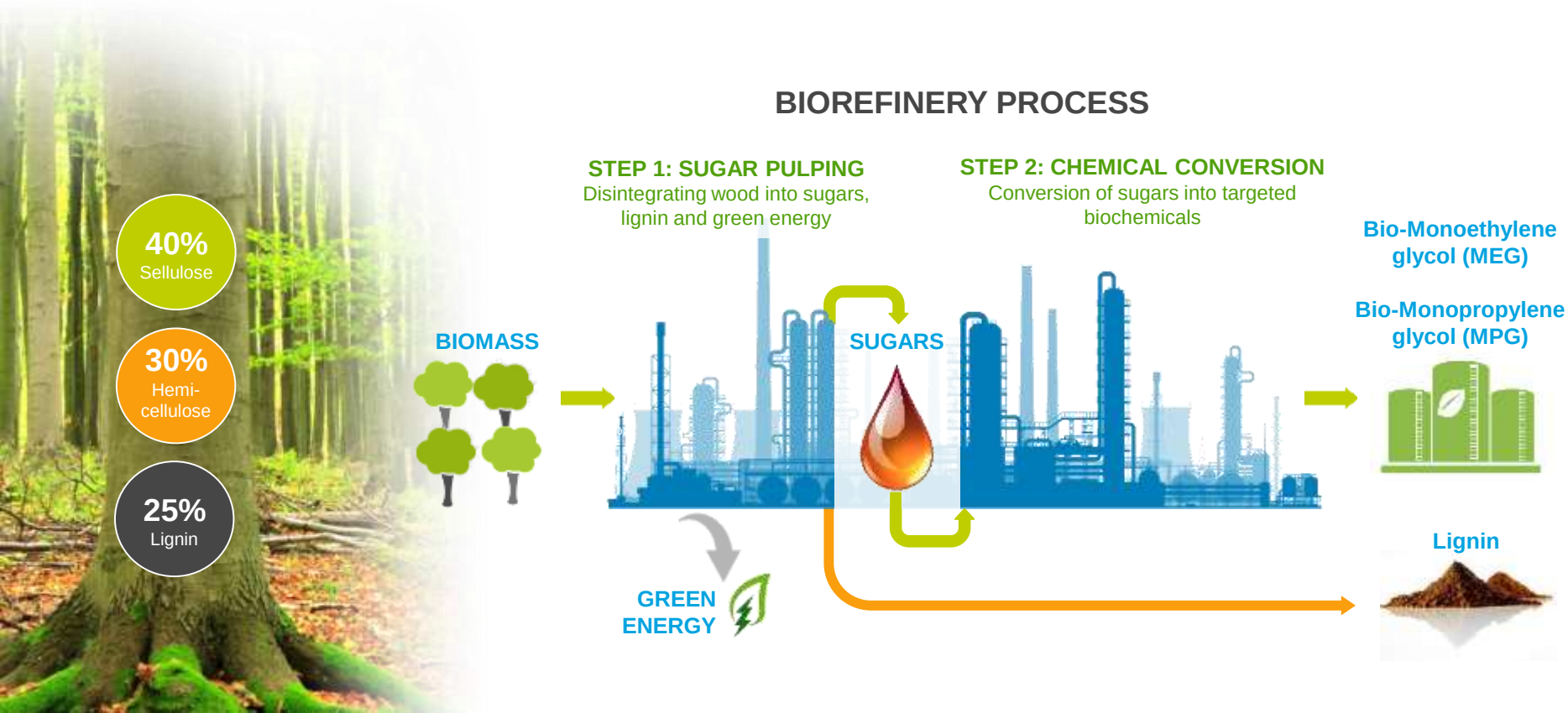

Biochemicals products are sustainable and competitive drop-in alternatives for brand owners

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bMEG
Mono Ethylene Glycol

- Existing fossil-based market
- Market demand > 26 mio tons
- CAGR >3%
- Application examples:


Textiles


Bottles & Packaging


Deicing fluids

bMPG
Mono Propylene Glycol

- Existing fossil-based market
- Market demand >2 mio tons
- CAGR >5%
- Application examples:


Composites


Pharma & Cosmetics


Detergents

Lignin

- Performance chemical
- Application driven
- Strong IP position
- Application examples:


Wood resins


Plastics


Foams & Coatings

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UPM IS STUDYING OPPORTUNITIES FOR GROWTH IN BIOFUELS

UPM studies the feasibility of possible new Biorefinery in Kotka, Finland

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- Environmental impact assessment (EIA) started
- Planned capacity: 500,000 tonnes advanced biofuels
- Several sustainable feedstock different from UPM Lappeenranta Biorefinery
  - e.g. solid wood biomass and Brassica carinata
- Technology differs from Lappeenranta biorefinery
  - conversion of solid biomass and hydrotreatment
- Biofuels regulation decisions in Finland and EU will impact the future investment consideration

Mussalo, Kotka, Finland – the area of dismantled power plant formerly run by Pohjolan Voima

Driving cleaner traffic

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