How can Europe develop a market for advanced renewable fuels?

Media Briefing

Moderator: Vanessa Wabitsch

REVOLVE

Housekeeping

- Clarification questions will be taken after each presentation
- General questions will be asked at the end

- Submission:
  - Clarification questions: Mark with ! at beginning
  - Questions for panel discussion can be submitted throughout

- We will try to respond by email to any questions we do not have time to tackle

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 764799.

ADVANCEFUEL

Barriers and solutions for market uptake of advanced renewable fuels

Kristin Sternberg

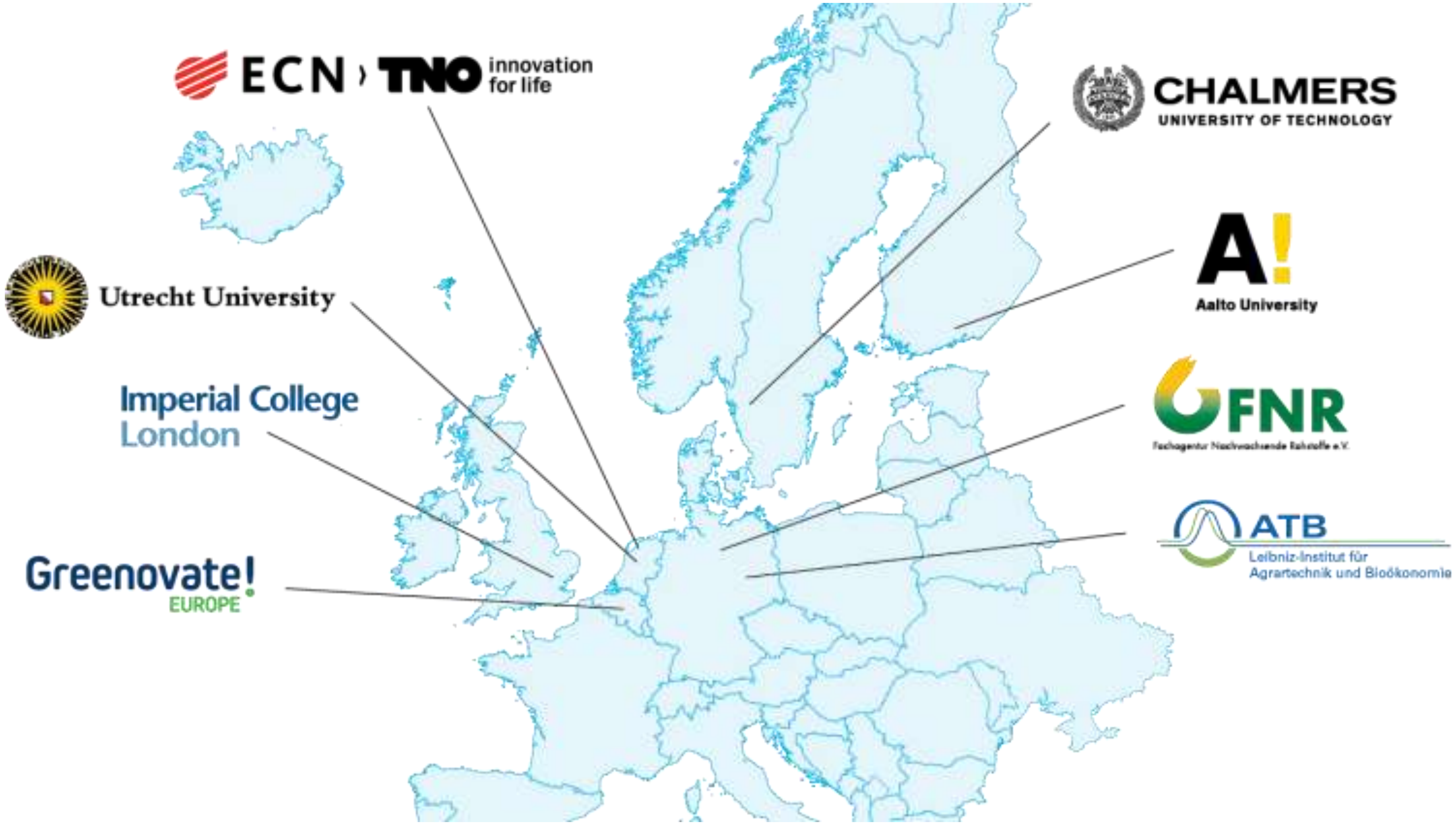
Fachagentur Nachwachsende Rohstoffe (FNR)

Ayla Uslu

TNO

The Project

"Facilitating market roll-out of RESfuels in the transport sector to 2030 and beyond"



- **8 partners** from **7 different countries**
- **Duration: 3 years** (September 2017-August 2020)
- Coordinated by FNR, German Agency for Renewable Resources with the support of the Energy Research Centre of the Netherlands (ECN part of TNO)
- **Funded by the European Commission** under the **Horizon 2020 programme**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N.º764799

Background

- GHG emissions in the transport sector continue to increase creating major challenges to the efforts of reducing the emissions according to the Paris Agreement goals
- Increasing efficiency & moving to zero emission vehicles
- Use of (liquid) advanced renewable fuels : key (short-/ medium term) solution especially for HDV, ships & planes
    - Currently: 5% of total fuels are biofuels; 0,2% from lignocellulosic feedstock
    - Further development depends largely on policy and shaping of technology, sustainable supply chains & markets

ADVANCEFUEL: aimed to support the commercialisation of advanced renewable transport fuels ('RESfuels') by providing stakeholders with <u>new knowledge, tools, standards and recommendations</u> to help <u>remove barriers</u> to their uptake

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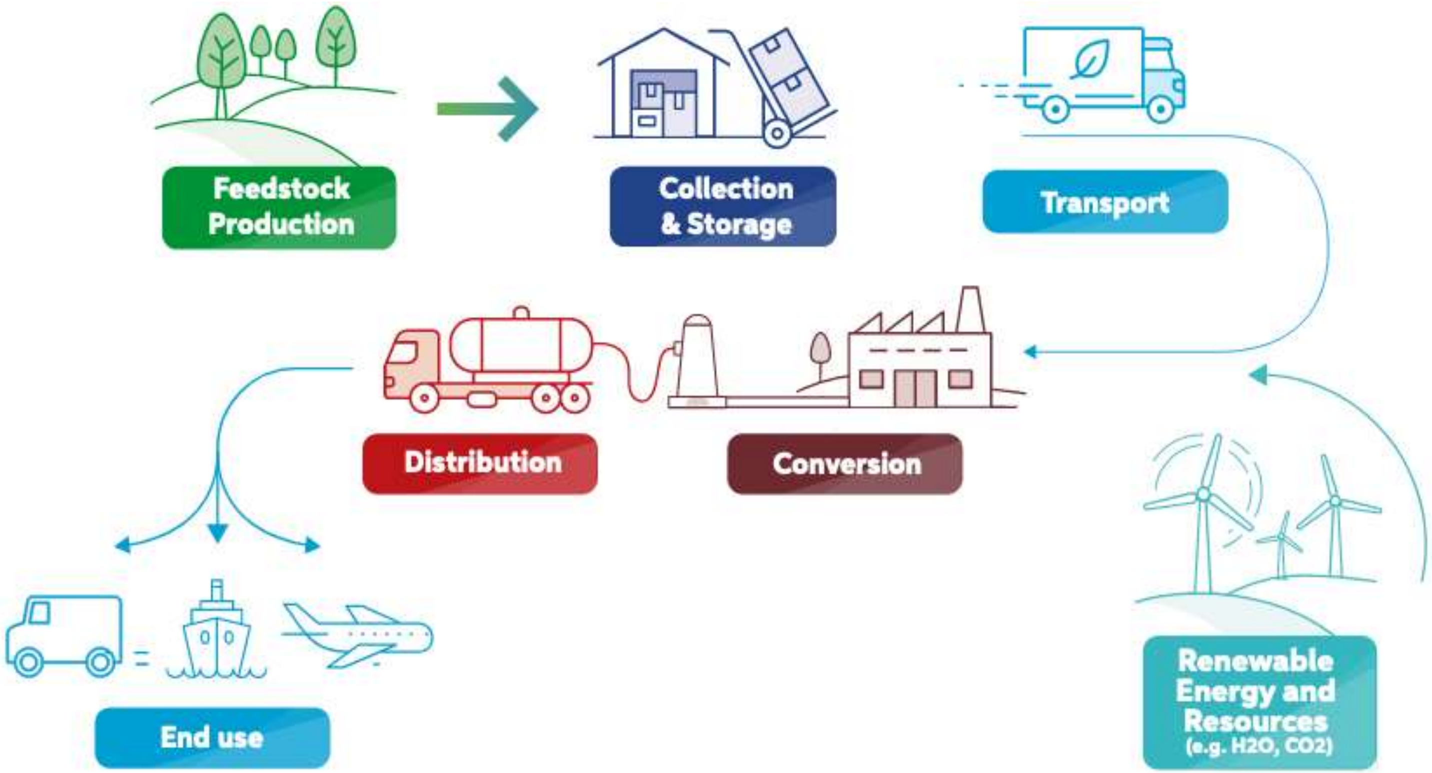
Project Scope

Advanced **RESfuels** refer to **liquid** advanced biofuels produced from **lignocellulosic feedstock** and liquid **renewable alternative fuels** produced from renewable **hydrogen** and **CO_2** streams



FULL VALUE CHAIN APPROACH

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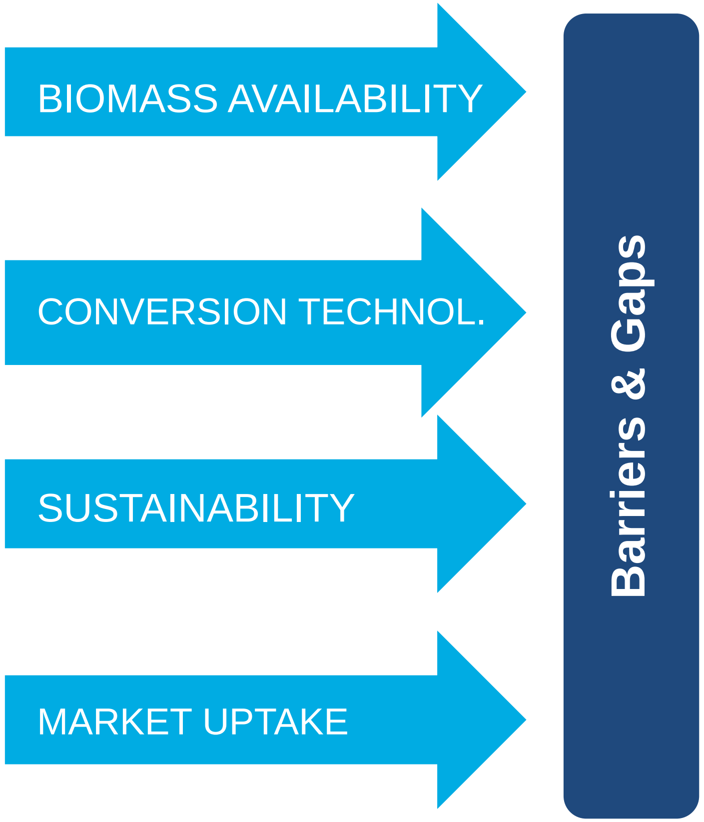
Approach



- **Innovative approaches** to improve biomass availability, with a special focus on new **cropping schemes** and use of **marginal lands**
- **Techno-economic** assessment
- Analysis of **integration** in to existing infrastructures
- Deliver a set of **harmonised sustainability criteria** and indicators
- Recommend measures to **increase market acceptance and end use** of RESfuels

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Policy background

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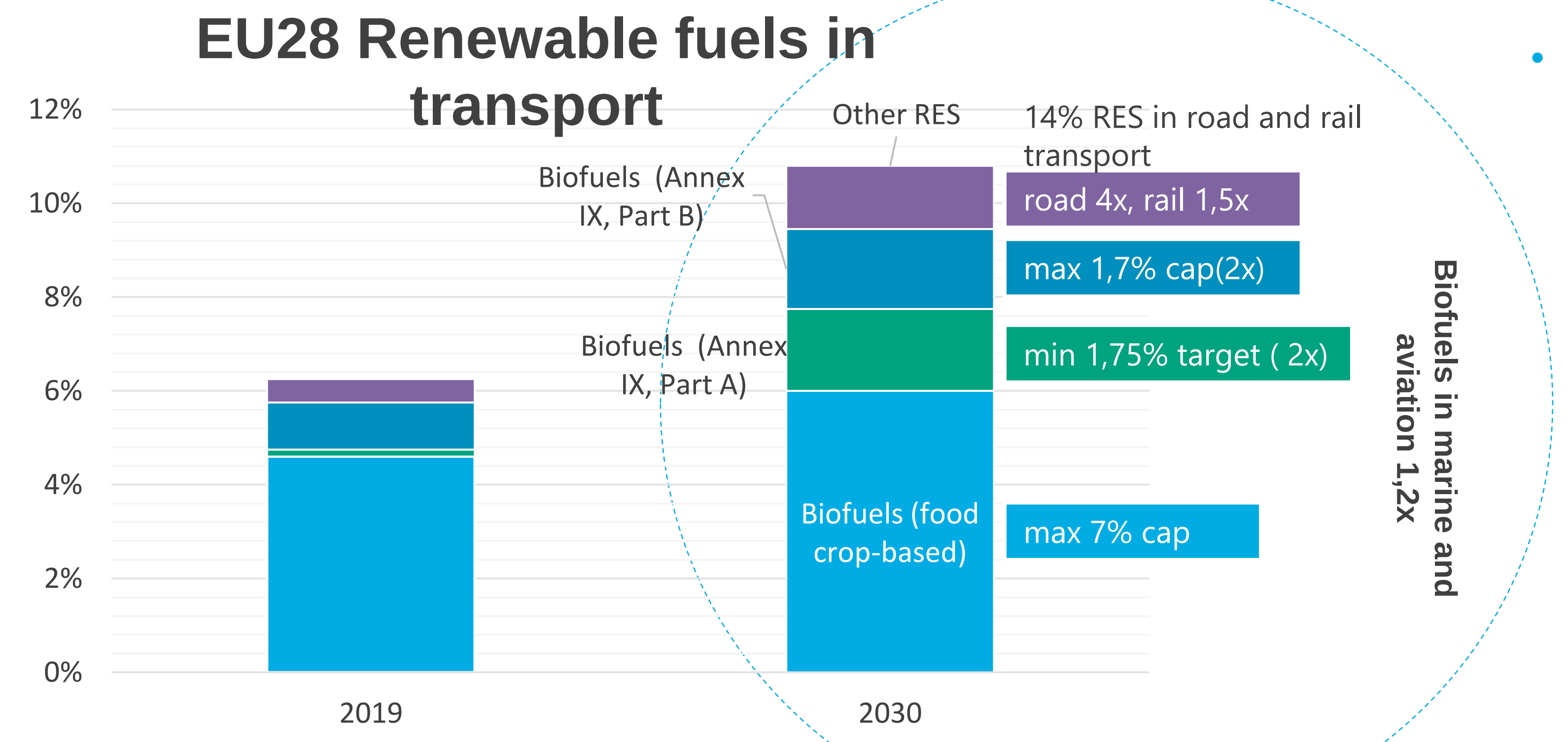
REDII



**No double counting included*
**2019 figures derived from Eurostat, Share*

- Total installed capacity of operational plants is around 300 kt/y, including constructions and planned capacity it can reach to 2 Mt
  - > 0,5% of transport demand

→ **REDII ~200 PJ Part A biofuels**

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Future demand

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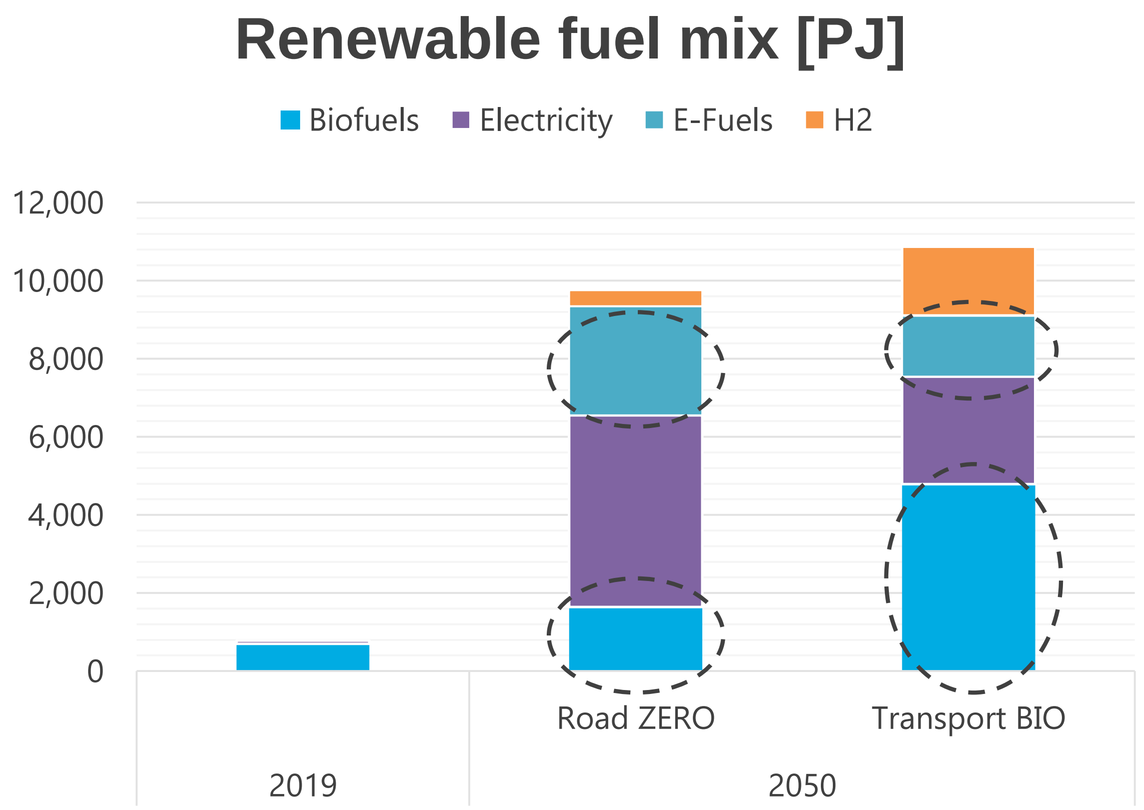
PARIS AGREEMENT

- Transport sector contributions to Paris Agreement:
  - 85% CO_2 reduction in transport sector (including aviation with international extra-EU flights, excluding international maritime) in Europe by 2050 compared to 1990
  - 50% CO_2 emission reduction target for the international maritime sector by 2050 compared to 2008

RESfuel DEMAND



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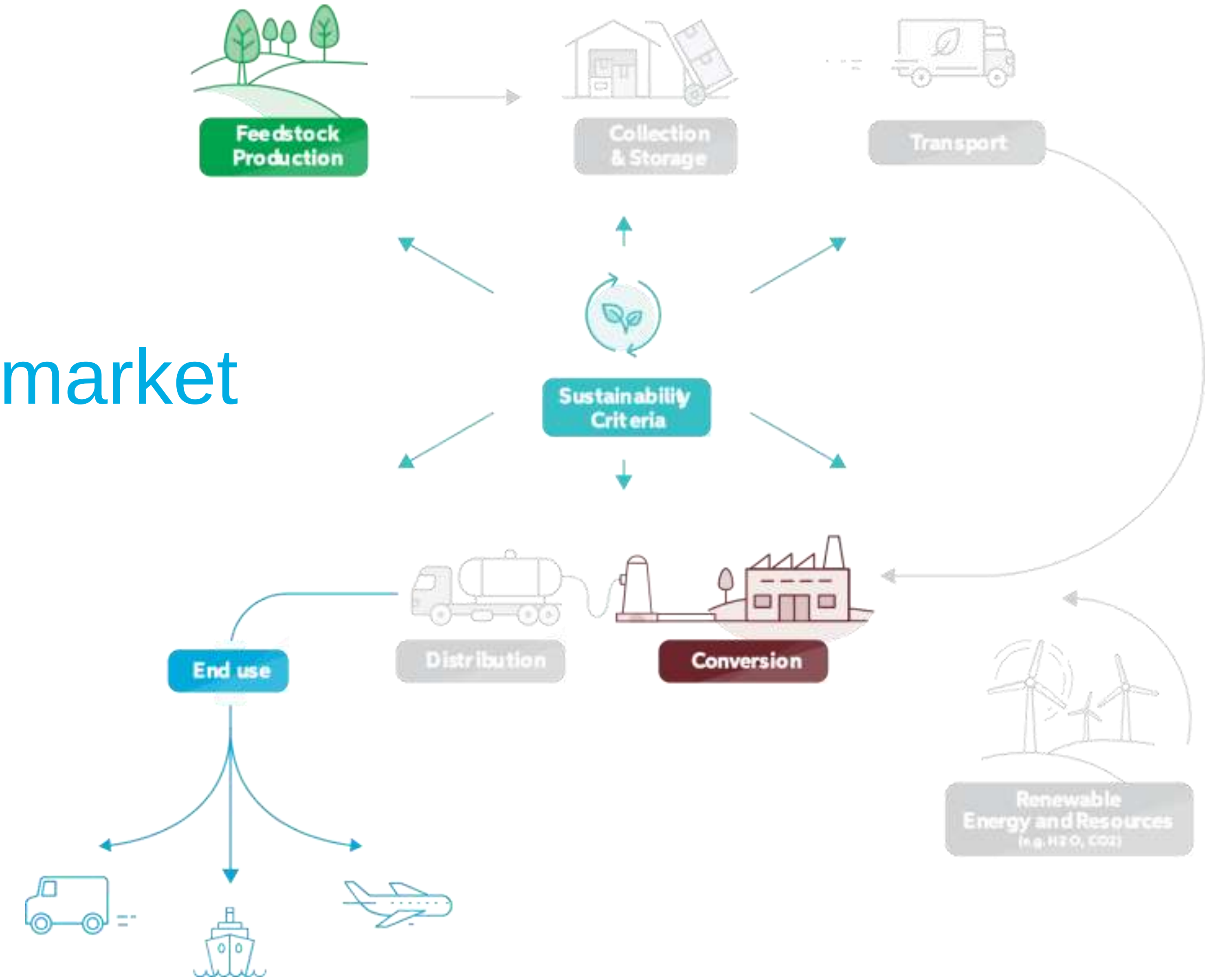
Barriers to market uptake



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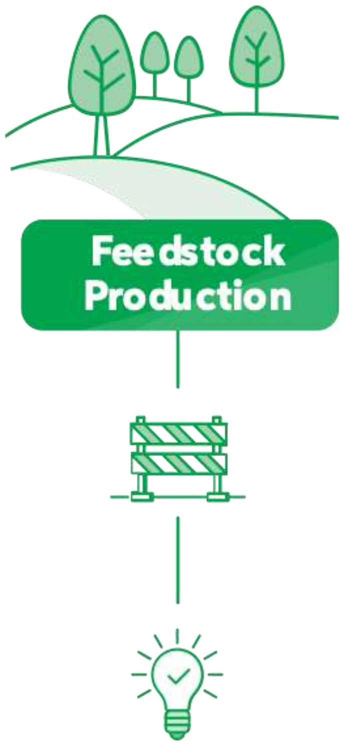
Feedstock supply



- **High costs of feedstocks**
- Lack of clarity about environmental constraints and land availability
- Lack of harmonised regulations

- ADVANCEFUEL project describes innovations in lignocellulosic biomass cropping
- Site specific innovations and the learning effect have the potential to further increase yields of lignocellulosic cropping
  - irrigation of short rotation coppices with waste water to increase yield by 25 to 30%,
  - breeding to allow future Miscanthus planting by seeds may reduce biomass production cost by 7-16% due to reduced input cost,
  - breeding for increased resistance or water use efficiency, sewage sludge application

→ organizations that guarantee purchase and advice for field as well as crop selection and crop management

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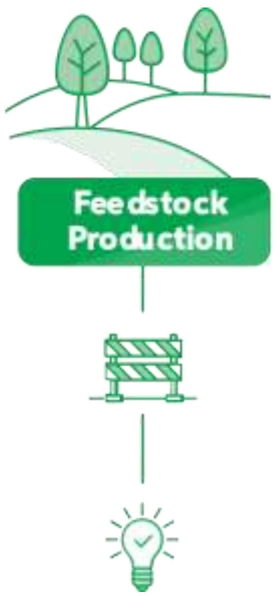
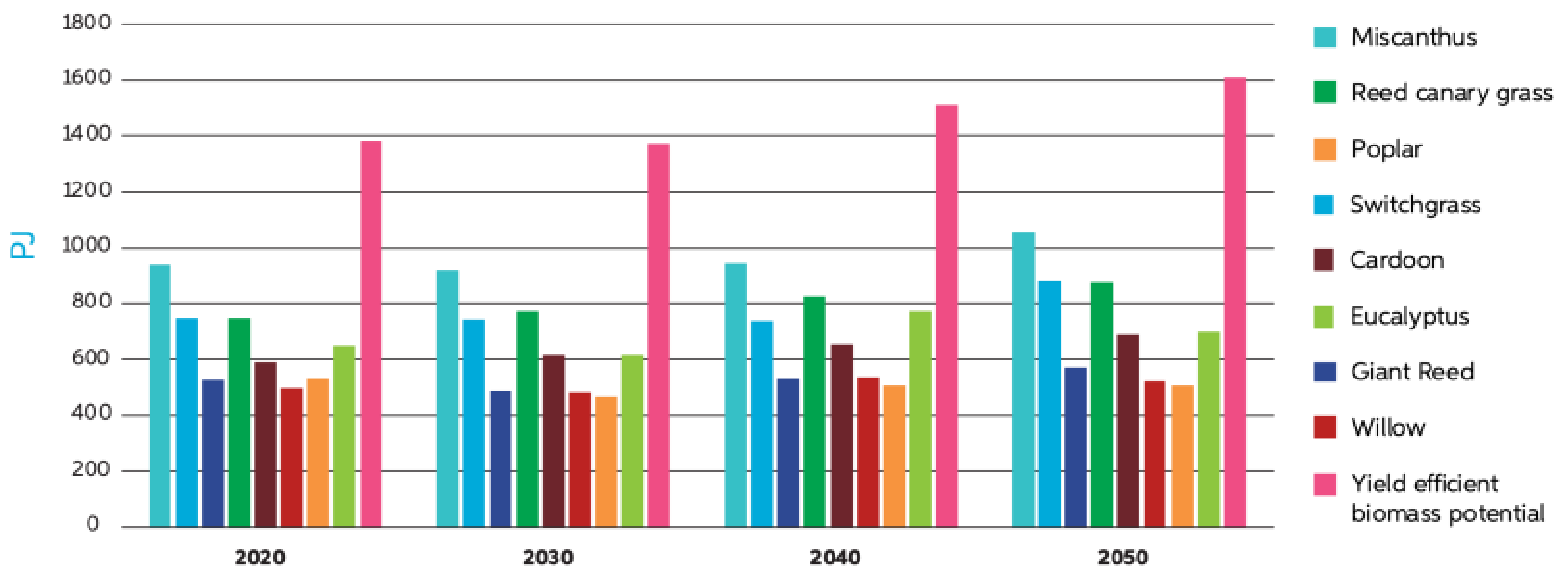
Feedstock supply

- **Lack of clarity about environmental constraints and land availability**
- Lack of harmonised regulations
- High costs of feedstocks

The use of **marginal lands** (*land on which cost-effective food and feed production is not possible under given site conditions and cultivation techniques*)

- A spatial explicit assessment of available marginal land and biomass production on such land





All available land is allocated to one crop

For each location the crop with highest potential biomass yield is selected

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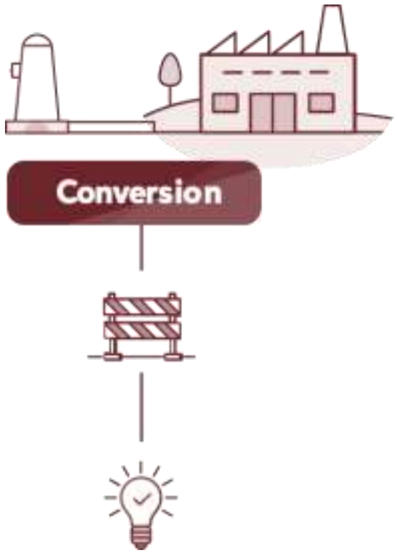
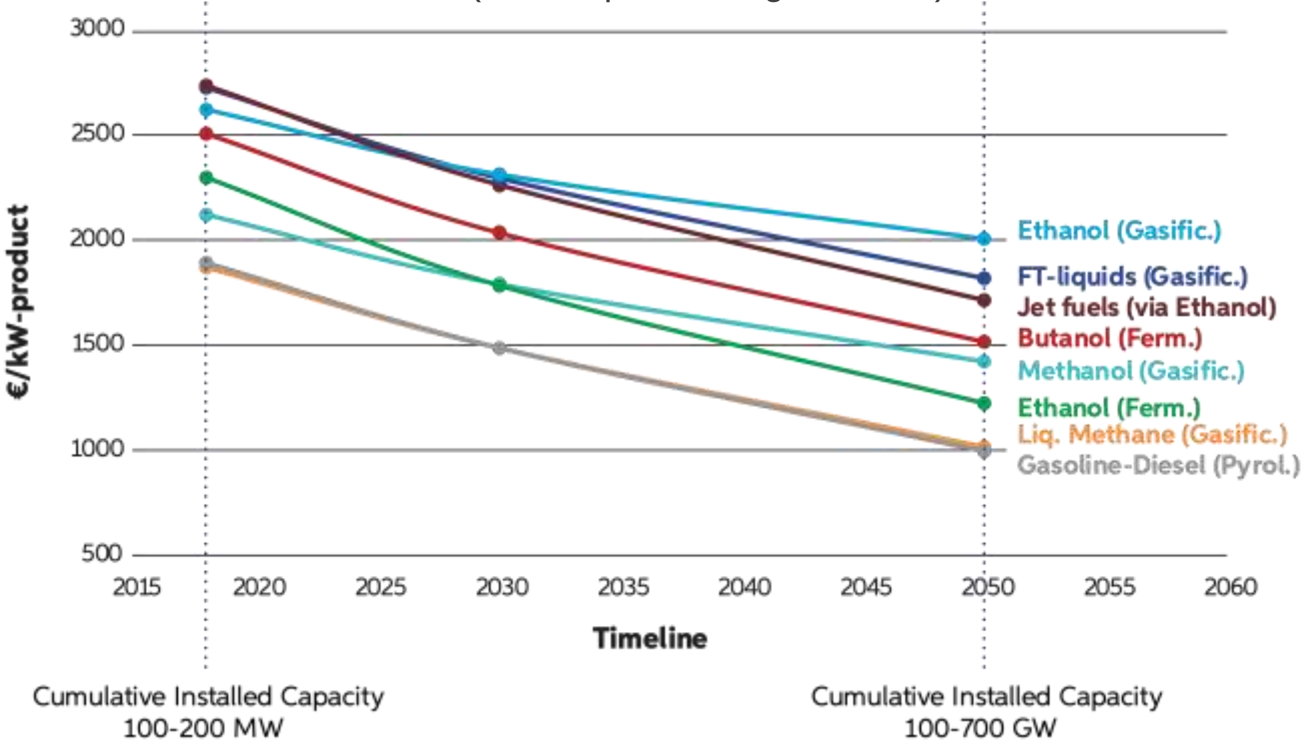
Conversion to biofuels

- **High upfront CAPEX costs**
- Absence of dedicated policy support and access to project finance
- Concerns on stability/security of the industry



- CAPEX reduction through learning
- Integration to existing infrastructure
  - coal power plant sites suitable for construction of bio-oil units
  - oil refineries (i.e., co-processing of bio-oil)



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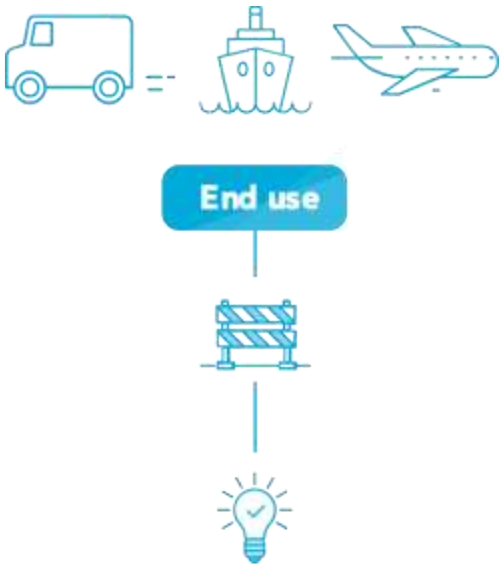
End use



- High production costs compared to fossil fuels
- Absence of structural mechanism to bridge the price gap between renewable and fossil-based fuels

Aviation: biofuel production routes are recognised by ASTM standards :

- Synthetic paraffinic kerosene via Fischer-Tropsch (**FT-SPK, FT-SKP/A**),
- Hydrotreated Esters and Fatty Acids (**HEFA**),
- Alcohol-to-jet (**ATJ**),
- Renewable Synthesized Iso-Paraffinic (**SIP**)

	Road & Maritime
Biomethane (biogas)	Commercially available; Moderate Infrastructure
Biomethanol	Feasible and commercially proven; Low blending wall (max 3% EN228) Requires dedicated engines
BioDME	Technically feasible; Lack of dedicated vehicles and infrastructure
Bioethanol	Commercially utilized; Low blending walls (max 10% EN228); Can be utilized as ED95 in trucks or E85 in FFV; Requires dedicated engines for high blends;
HVO (Renewable diesel)	Commercially utilized
Pyrolysis oil / HTL biocrude	Promising renewable candidate; Low TRL (3-6), upgrading process needed

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Sustainability barriers to advanced biofuels

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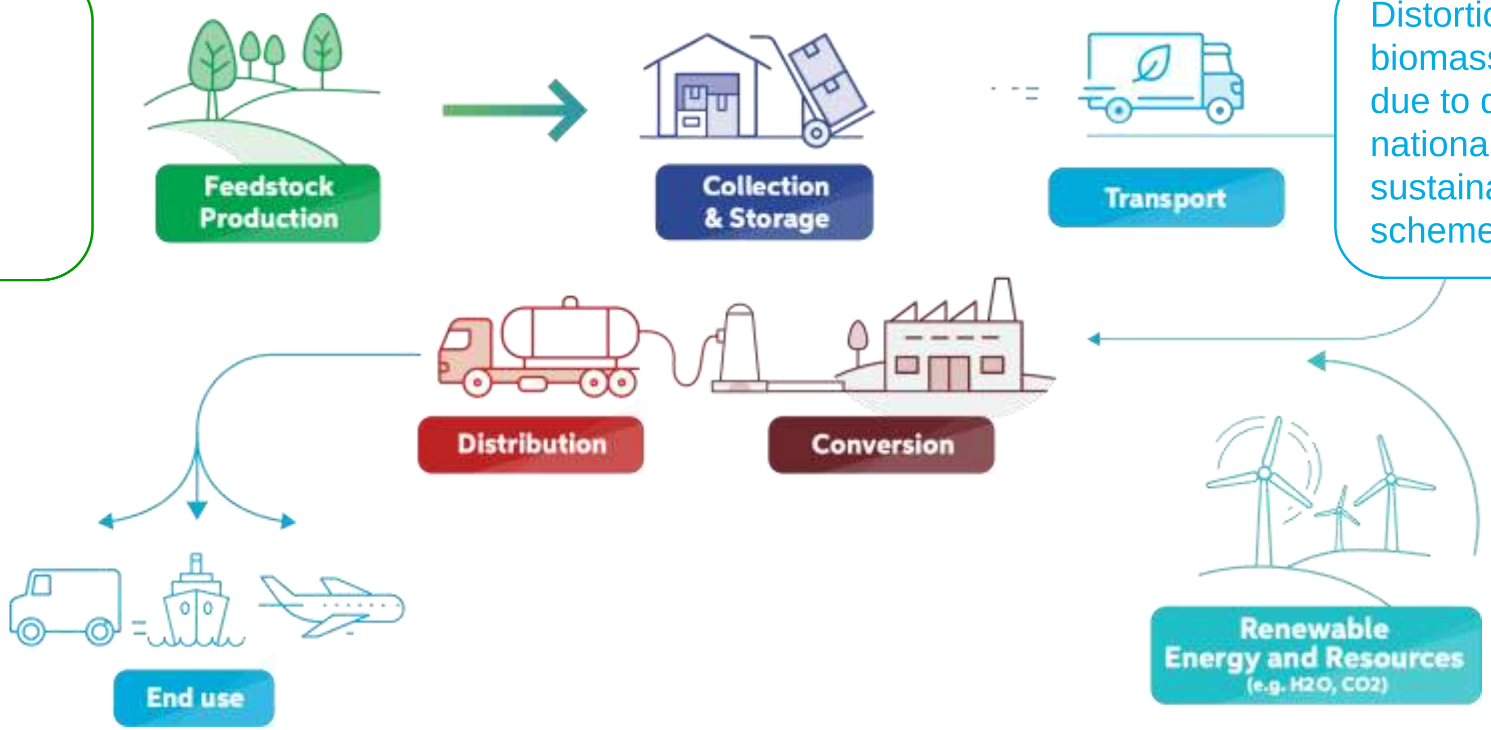
Lack of harmonized regulations mainly for biomass residues



Distortion of biomass trade due to diverging national sustainability schemes.

Poor harmonisation of global rules for RESfuels in maritime and aviation sectors

Lack of harmonised criteria between different bioenergy sectors/outputs.

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Conclusions and recommendations

- Site specific innovations and the learning effect have the potential to further increase yields of lignocellulosic cropping
- The use of marginal lands for lignocellulosic energy crop production is a valuable strategy to provide additional biomass. Availability of data on cropping area in EU and on achievable yields on marginal land need to be enabled for decision making that is based on quantitative data
- Sustainable biomass feedstocks are present in Europe but their efficient and timely mobilisation remains a challenge;
  - → Rural land-use planning must be combined with incentives to produce biomass
  - → Financial support measures should account for costs related to the infrastructure for the logistics related to waste and residue collection, as well as large scale energy crop production, supply and logistics
  - → The roll-out of new innovations will need to be supported

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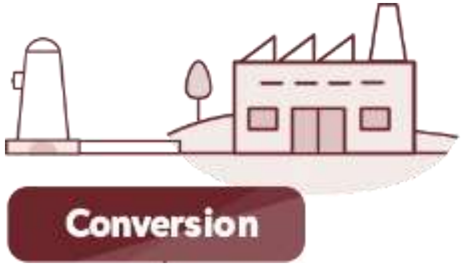

Conclusions and recommendations

- In short- to mid-term (e.g., by 2030) the gap between advanced biofuel production costs and fossil fuels cannot be fully bridged by technical improvements
- At an initial phase, this can be achieved via subsidies, but in the long run the cost to use fossil fuels must be (become) higher than the cost to use biofuels (e.g., via additional CO_2 taxes for fossil fuels).
  - → Tailored financing mechanisms (such as feedstock premiums, feed in tariffs and premiums, CO2 taxes, etc.) are necessary to develop a secure framework to reduce capital investment and uncertainties of production costs;

→ Funding schemes (e.g. European Innovation Fund), banks and financial institutions should increase budget shares for RESfuels in their investment portfolios

→ Research and innovation grants should ensure continuity in funding for RESfuels to overcome technical barriers such as process design (i.e. increase process efficiency) and scale-up considerations

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Conclusions and recommendations

→ Ambitious decarbonization plans require deployment of all renewable options, increased efficiency of the transport system and significant shifts towards more energy efficient transport modes

→ RESfuels are likely to exhibit increased shares first in road transport, however it is critical to enable similar and timely shift to heavy duty vehicles, maritime and aviation which have less alternatives and are more challenging in terms of CO2 emissions reduction. Without tailored targets for these sectors this shift may be difficult to manage

→ E-fuels, produced from renewable electricity and direct air capture, are essential to complement the contribution of advanced biofuels in transport decarbonisation. They can be particularly useful in aviation

→ Biomass to Liquid (BtL) fuels such as , FT liquids, biofuels from pyrolysis co-processing, bioLNG, bioDME must be deployed before 2030 to ensure fossil diesel substitutes are in place to meet the targets

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Thank you
for your attention!

On behalf of the ADVANCEFUEL team

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sunliquid®: the clean, high quality & efficient lignocellulosic platform

CLARIANT

Public

Paolo Corvo
Business Line Biofuels & Derivatives
24.06.2020

what is precious to you?

CLARIANT AT A GLANCE

what is precious to you?

Clariant - A Globally Leading Company in Specialty Chemicals

4 399
Sales 2019 (CHF m)
from continuing operations

692
EBITDA[1] 2019 (CHF m)
after exceptional items from continuing operations

3
Core Business Areas

17 223
Employees 2019
of total Group including discontinued operations

38
Net result 2019 (CHF m)
of total Group including discontinued operations

15.7%
EBITDA margin[1] 2019
after exceptional items from continuing operations

118
Production sites worldwide
of total Group including discontinued operations

[1] excluding a CHF 231 million provision for an ongoing competition law investigation by the European Commission

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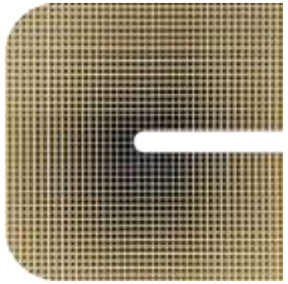
Three Business Areas – the Right Portfolio for Future Growth

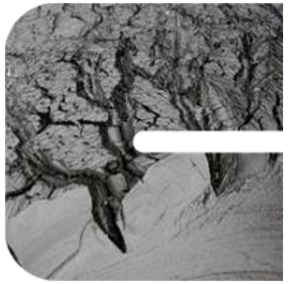
CARE CHEMICALS

BA Care Chemicals comprises the BU Industrial & Consumer Specialties (ICS) which includes Consumer Care, Industrial Applications, Base Products, Food Ingredients and Encapsulation Technologies.



CATALYSIS

BA Catalysis comprises the BU Catalysts and the **Business Line Biofuels & Derivatives**.



NATURAL RESOURCES

BA Natural Resources comprises the BUs Oil & Mining Services, Functional Minerals and since July 2019, also Additives.

CLARIANT

Clariant's continuous focus on innovation and R&D

INNOVATION FIGURES END OF 2019[1]

207 m
of R&D expenditures in CHF

3.2%
of group sales spent in R&D (including discontinued activities)

<3.0%
Growth through innovation[2] (including discontinued activities)

8
R&D Centers

>50
Technical Application Centers

>1050
People in R&D

>125
Scientific collaborations

>6 500
Patents

[1] Total Group incl. discontinued operations

[2] Contains the contribution to growth of the innovation portfolio from both Top Line Innovation and Life Cycle Innovation. Potential cannibalization of existing sales by Life Cycle Innovation has not been excluded.

How can carbon emissions be reduced by advanced biofuels

CLARIANT

what is precious to you?

CLARIANT

Lower emissions from transport urgent for reaching climate goals

TOO MUCH **CARBON IN THE AIR**

In 2018, the transport sector was responsible for

24% of GHG emissions worldwide

and

27% in the EU[1]

TRANSPORT DECARBONIZATION SOLUTIONS FOR ACHIEVING **CLIMATE AMBITIONS**

- Vehicle technology & efficiency
- Energy infrastructure efficiency & development
- Mode shift in transportation
- **Advanced biofuels: key role in decarbonizing transport sector**

[1] Source: International Energy Agency: https://www.iea.org/reports/tracking-transport-2019 and European Environment Agency: https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases/transport-emissions-of-greenhouse-gases-12

CLARIANT

Lignocellulosic ethanol: the ideal candidate for immediate improvement

Made from agricultural residues such as straw, non-food lignocellulosic materials & waste

Carbon negative: among the highest total life cycle reductions in GHG emissions[1]
Considering CO_2 capture or utilization

Fully validated technology
Commercially deployed product immediately lowers emissions

Unrivalled in use
Provides superior energy density in virtually all modes of transport

Low carbon abatement costs
Drop-in solution for existing engines and infrastructure

Enhanced energy security
Domestic production boosts energy independence & long-term security

Local sources & green jobs
Use of locally sourced feedstock & new revenue stream for farmers

[1] EtOH produced with sunliquid reaches > 120% GHG saving, % compared to gasoline including CCU/S (Carbon Capture Utilization & sequestration)
[2] https://www.biofuelsdigest.com/bdigest/2018/11/06/results-are-in-clariants-sunliquid-delivers-6x-lower-carbon-intensity-than-fossil-gasoline/ without CO_2 CCU/S

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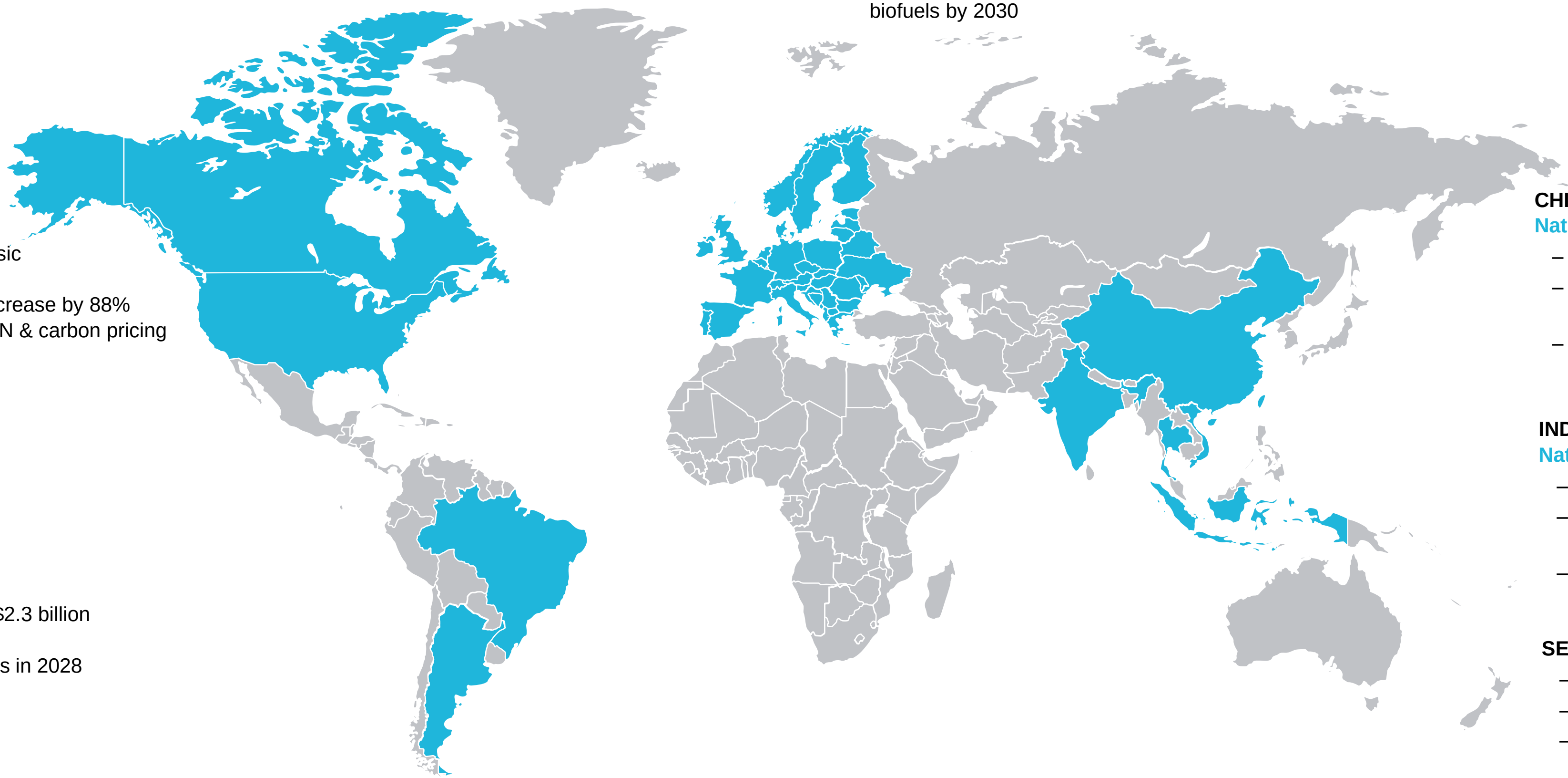
Set for growth: global policies & mandates[1] spur biofuel demand

EUROPE
REDII
3.5% mandate for advanced biofuels by 2030

NORTH AMERICA
Renewable Fuel Standard
- Steady increase of cellulosic biofuel mandate
- 2018–20: final volumes increase by 88%
- Pricing support with D3 RIN & carbon pricing under LCFS California



SOUTH AMERICA
RenovaBio
- In full force since 2020
- Expected investment of ~$2.3 billion in ethanol sector
- Gov. estimate: 47 bio. liters in 2028 vs. 26.7 bio liters in 2018

CHINA
Nationwide E10 mandate
- E10 mandatory in 11 provinces
- E5 as intermediate step expected in 2022, nation wide E10 mandate to follow
- ~13m tons/year for full E10 mandate; non-food based biofuel & 2G EtOH preferred by government

INDIA
National Policy on Biofuels 2018
- E20 (indicative) by 2030
- Ministry of Petroleum & Natural Gas mandated 12 2G EtOH plants by 2022
- JIVAN scheme: ~250 Mio.€ for 2018–24

SE ASIA
- Philippines: push for E10
- Indonesia: E5 mandatory by 2020
- Thailand: Energy Reform Plan – voluntary EtOH blend of 10–20%

[1]World Bioenergy Association
Majority of renewables in transport are policy driven (92%)
Biofuel mandates in force in more than 70 countries

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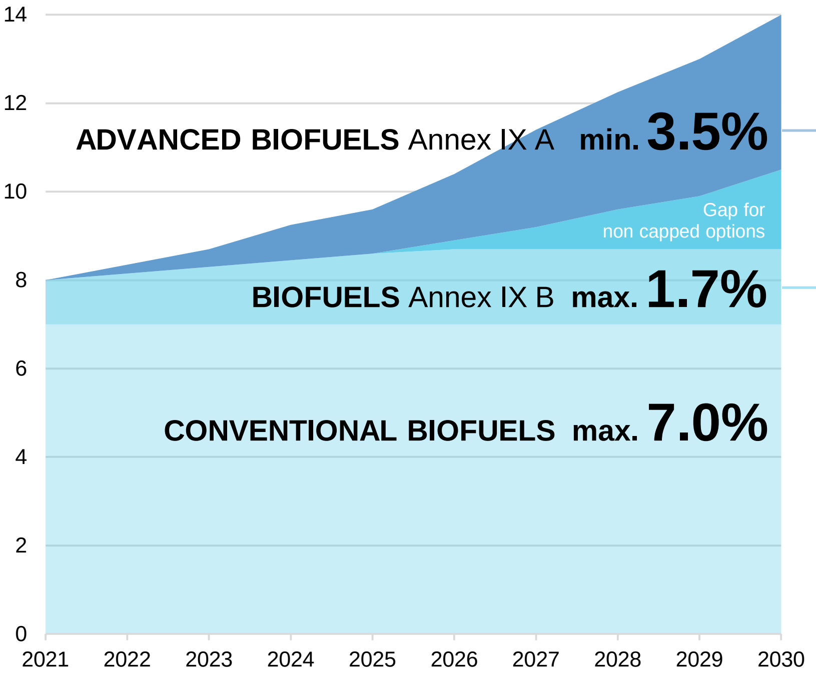
EU market for advanced biofuel under REDII – only Annex IX/A defines advanced feedstocks and fuels

PROJECTED DEVELOPMENT OF (THEORETICAL) SHARE OF RENEWABLE ENERGY SOURCES IN TRANSPORT
up to 2030 based on RED II provisions



[1] Assumption: EU transport fuel demand in 2030 remains at similar levels as in 2016. Total transport fuel demand (road & rail) in 2016: 306.567 ktoe; Source: Eurostat

[2] Source: http://www.etipbioenergy.eu/everyone/advanced-boifuels

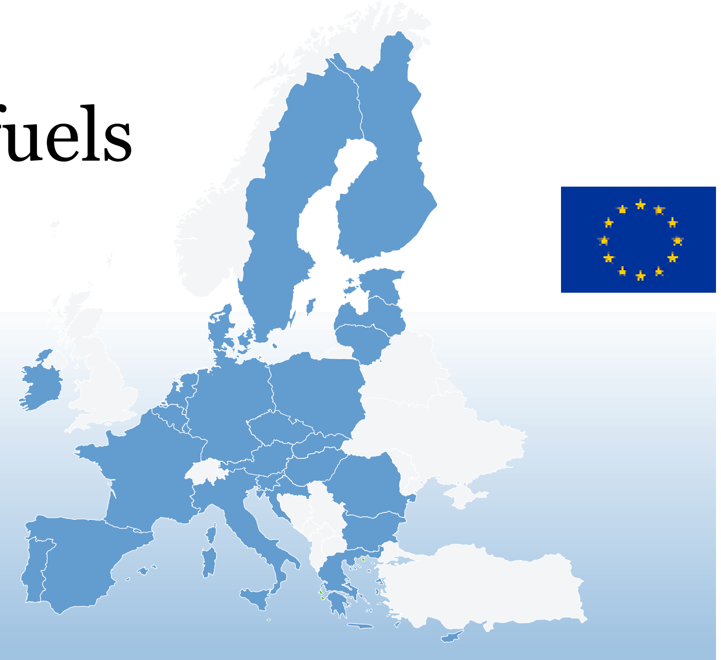
REDII – ANNEX IX[2]

PART A: »advanced« feedstocks and fuels
Targets: 2022: at least 0.2%, 2025: 1%, 2030: 3.5%
Defined feedstocks (excerpt):

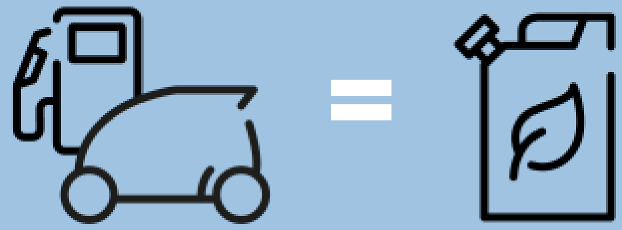
- Straw
- Bagasse
- Nut shells
- Cobs cleaned of kernels of corn
- Other non-food cellulosic material
- Other lignocellulosic material

PART B: not considered as »advanced«
Target: capped to 1.7%

- Used cooking oil (UCO)
- Animal fats categories 1 and 2



3.5% **~ 10 Mio. tons**



targeted share for advanced biofuels of the EU's transport fuel demand[1] by 2030 = of cellulosic ethanol[1]

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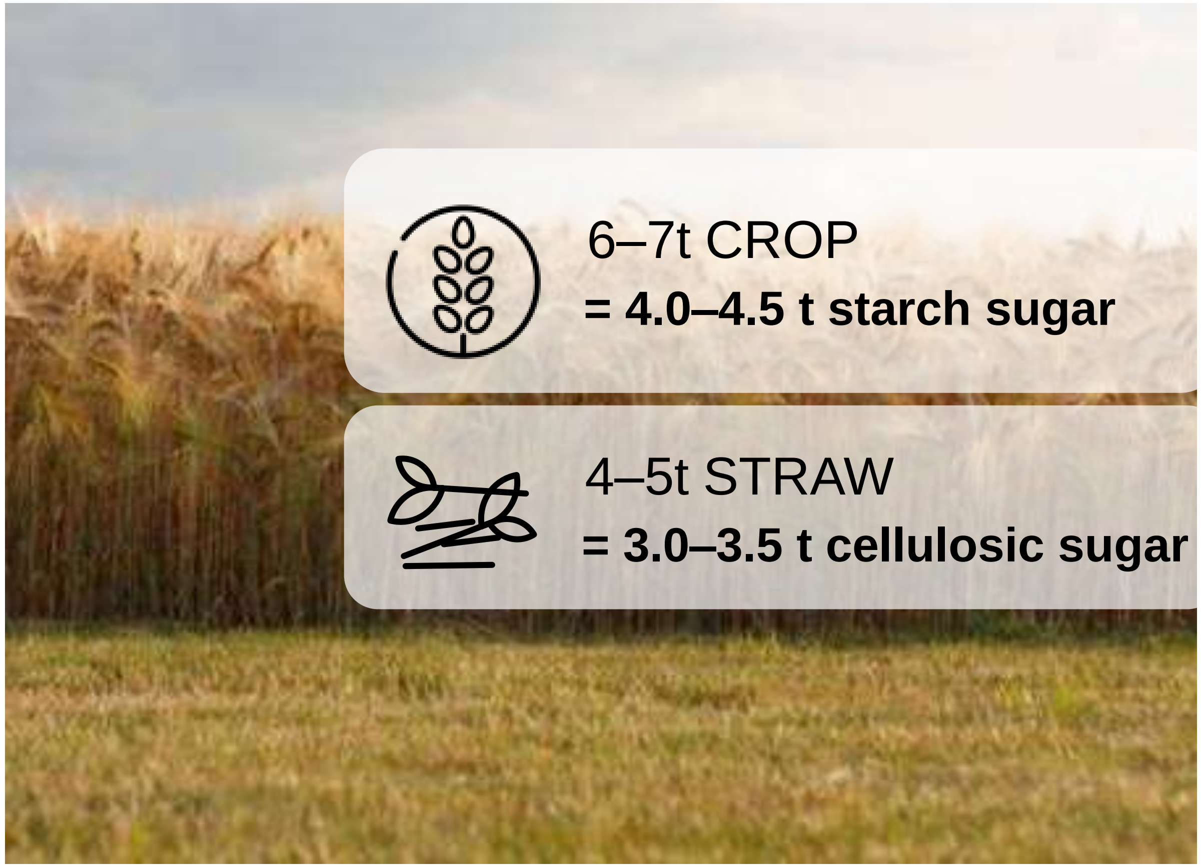
The potential of agricultural residues

What is inside one hectare of cropland?



FEASIBLE BIOMASS FEEDSTOCK TYPE

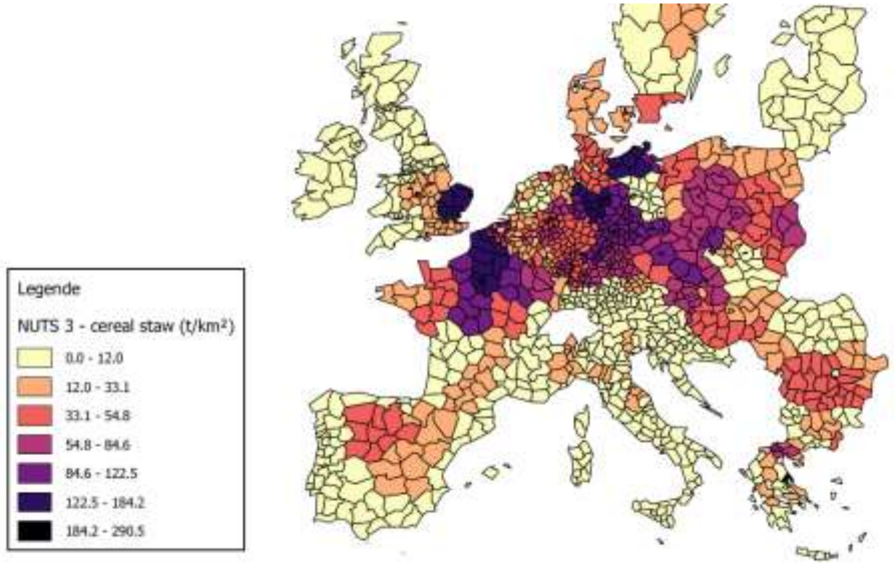
Key message: agricultural by-products are an abundant and underutilized resource

Straw availability in Europe

Europe has a gross straw production of around 500 million tons p.a.

International Council on Clean Transportation (ICCT)[1]

- Availability of agricultural by-products like straw in Europe in
  - 2013 at 122 millions tons
  - 2030 at 139 million tons
- By using innovative technologies, Europe could therefore already produce over 28 million tons (equivalent to about 35 million liters) of cellulosic ethanol
- Assuming an average fuel consumption and an average mileage of 15,000 kilometres per year, this could provide fuel for around 30 million vehicles per year.



Country	Wheat straw net availability in 1.000 t
France	30.582
Germany	19.585
United Kingdom	11.731
Poland	9.158
Romania	8.027
Italy	5.711
Bulgaria	5.054
Hungary	4.197
Spain	4.026
Denmark	3.822
other EU28 countries	19.382
Total	121.279

[1]Source: Stephanie Searle, Chris Malins (ICCT): Availability of cellulosic residues and wastes in the EU, 2013, p. 2, available online at www.theicct.org, accessed on 20.08.2018.

SUNLIQUID®: CLARIANT'S SOLUTION TO DECARBONISE MOBILITY

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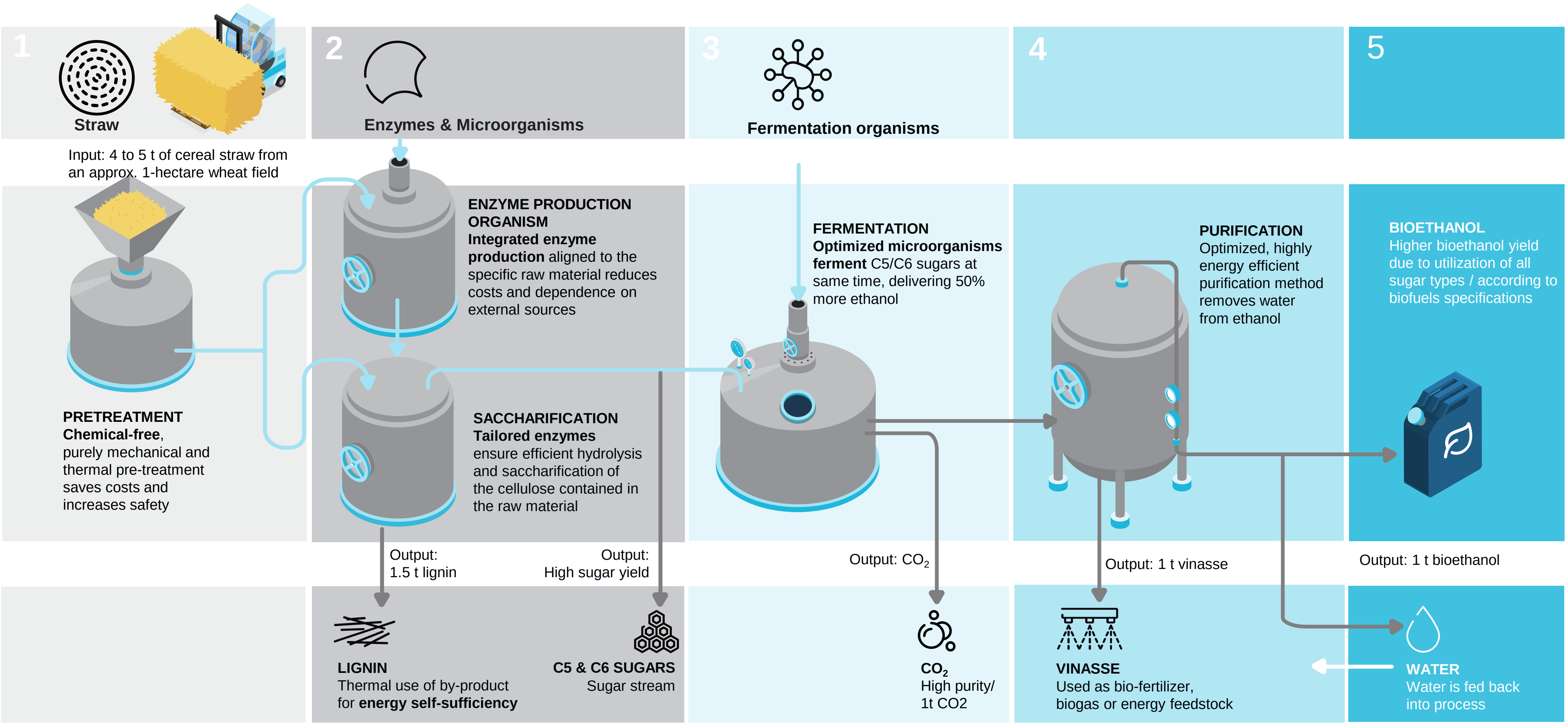
what is precious to you?

sunliquid®: fully integrated & carbon negative process



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BUT that is not all: sunliquid®- the ideal platform for highly sustainable bio-based products

BIOMASS FEEDSTOCK (EXAMPLES)

- Cereal Straw
- Corn Stover
- Miscanthus
- Sugarcane Bagasse

BIOREFINERY/ PROCESS SUNLIQUID

DOWNSTREAM PRODUCT & BYPRODUCTS	EXAMPLE PROJECT COLLABORATION
Cellulosic Ethanol	
Cellulosic Biodiesel	Exxon/Genomatica
Alcohols	
Organic Acids	Undisclosed
Fatty Acids	Undisclosed
Ethylene Oxide	Scientific Design
Hydrocarbons	Global Bioenergies
Enzymes Lignin & Vinasse	

APPLICATION FIELD (EXAMPLES)

- Fuels/ Ethanol & Biodiesel
- Automotive
- Cosmetics/ Sanitizers
- Lubricants
- Plastics

sunliquid®

- **Standalone, flexible sugar platform**
- **Development opportunities** for biobased products
- **Extensive know-how** in biocatalysis, strain optimization and heterogenous catalysis
- **Specifications** can be **adjusted to the need** of the added **downstream processing**

SUNLIQUID® PRE-COMMERCIAL PLANT

what is precious to you?

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Fully integrated process in operation at pre-commercial plant: reliable, stable & continued for >7 years acting as training facility

PRE-COMMERICAL SUNLIQUID® PLANT IN STRAUBING, GERMANY

Fully validated technology: >7 years of testing (1,000 t/a EtOH; ~4,500 t/a feedstock) with scaled-down commercial design reproducing all process steps

Validated pre-treatment: >7 years of operation with standard equipment from leading provider Valmet

Feedstock flexibility: multiple feedstocks tested, identical process with feedstock-specific enzymes & yeast

- Straw
- Miscanthus
- Rice straw/husks
- Corn stover
- Bagasse
- Sugarcane tops & leaves

Your team on site: testing of own feedstock with own team on site; training on plant operation, maintenance, start-up and shut-down

sunliquid® ethanol commercially deployed

Application as car fuel

- Gasoline-ethanol blend containing 20% cellulosic ethanol from Clariant's pre-commercial plant was tested in Mercedes' fleet
- The test showed an attractive environmental profile
- Today's vehicles can already use E20 blends

Application as truck fuel

- Partnership with Scania for the ethanol-powered trucks used at the Clariant Suzano Brazil plant
- The Ecotrucks started using second-generation ethanol produced from sugarcane bagasse using Clariant's sunliquid® technology

Application as cleaning agent

- sunliquid® cellulosic ethanol from straw replaces 100% of conventional ethanol in Frosch® Multisurface-Cleaner (by Werner & Mertz)
- World's first cleaning solution with cellulosic ethanol
- Selling in the local market with very positive feedback

Application as disinfectant

- 40.000 litters of sunliquid® cellulosic ethanol from the demo plant in Straubing were used in the production of disinfectant
- At Clariant's chemical park in Gendorf, the solution was mixed into ready-to-use disinfectant
- The disinfectants were donated to hospitals and auxiliary facilities

COMMERCIAL READINESS: SUNLIQUID® PLANT IN ROMANIA

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Commercial-scale flagship plant in Romania

COMMERICAL SUNLIQUID® OPERATIONS IN PODARI, ROMANIA

Investment: Clariant invests in own greenfield 2G flagship plant in SW Romania (> 100 million euros)

Capacity: 50,000 t/a EtOH; ~250,000 t/a feedstock (e.g. wheat & barley straw)

Job creation: approx. 1.200 (~100 inside plant/ ~300 outside plant/~800 construction of plant)

Economic growth: additional business opportunities for all actors along the value chain (e.g. provides farmers additional source of income)

Training facility: plant serves as training facility for own & client staff

CLARIANT

sunliquid® flagship plant en route to commercialization

CLARIANT PLANT ROMANIA

Approval to invest in building a 50 kta plant in Romania

2017

2018 — **2019** — **2020** — **2021**

GROUNDBREAKING PLANT ROMANIA

12 September 2018

WORKSHOP WITH FARMERS IN OLTENIA

MANAGEMENT TEAM FORMED

ISCC CERTIFICATION

»TECHNOLOGY PROVIDER OF THE YEAR« PRIZE BY DIPLOMAT ROMANIA

* The project receives funding from the European Union’s Seventh Framework Programme for Research, Technological Development and Demonstration under Grant Agreement no. 322386 (FP7 SUNLIQUID) and from the Bio-Based Industries Joint Undertaking under the European Union’s Horizon 2020 research and innovation program under Grant Agreement no. 709606 (BBI LIGNOFLAG)

BBI JU
Bio-based Industries Consortium

VIDEO
SUNLIQUID® COMMERCIAL PLANT
IN PODARI-ROMANIA

CLARIANT

what is precious to you?

SUNLIQUID® REFERENCES

CLARIANT

what is precious to you?

CLARIANT

On the path to success: >7 years of testing, flagship plant, 3 licenses sold

2012

PRE-COMMERCIAL PLANT OPERATIONAL IN STRAUBING

Up to 1,000 t/a output of ethanol

~4,500 t/a feedstock (e.g. straw, corn stover, sugarcane bagasse)

2013

PERFORMANCE RUNS

On corn stover, sugarcane residues, wheat and barley straw

ISCC SUSTAINABILITY CERTIFICATION OF PLANT

2014

E20 FUEL TESTING

With Mercedes Benz & Haltermann

2016

PARTNERSHIP WITH SCANIA

Ecotrucks use sunliquid® 2G EtOH from bagasse in Brazil

COOPERATION WITH WERNER & MERTZ

sunliquid® ethanol in cleaning products

2017

1ST LICENSE DEAL

Enviral in Slovakia

CLARIANT PLANT ROMANIA

Approval to invest in building a 50 kta plant in southwest Romania

2018

GROUNDBREAKING PLANT ROMANIA

12 September 2018

2019

2ND LICENSE DEAL

ORLEN in Poland

MISCANTHUS TESTING IN STRAUBING

Within the framework of EU-funded GRACE project

PARTNERSHIP FOR BIODIESEL RESEARCH

Use of **Clariant's** sugars platform in research with ExxonMobil and Genomatica on new biodiesel process

2020

3RD LICENSE DEAL

Anhui Guozhen/ Chemtex in China

CLARIANT

Commercial sunliquid® plants in the EU

First license commercial plant
Slovakia

ENVIRAL

1G
2G

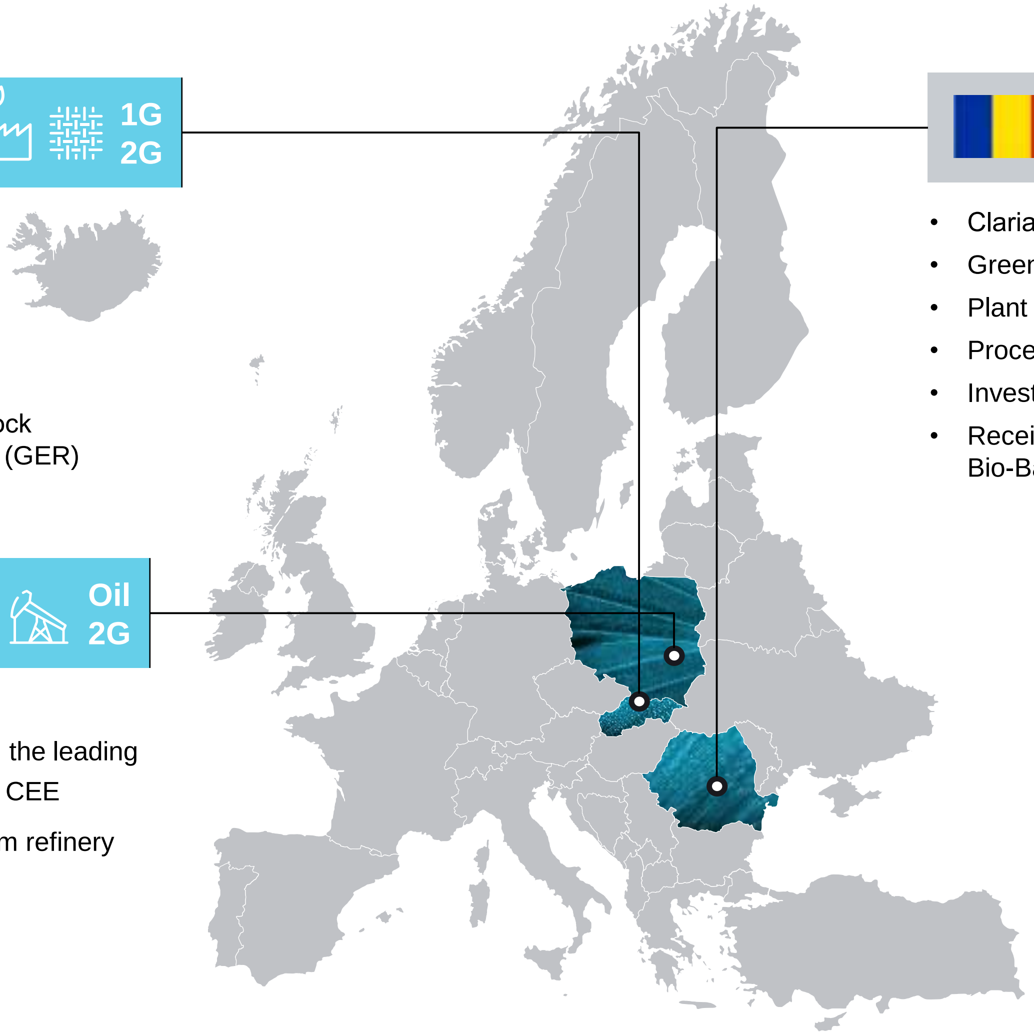
- First license for sunliquid® cellulosic EtOH plant
- Acquired by Slovakia's biggest EtOH producer, Enviral
- 2G plant to be integrated into existing 1G facilities at Enviral's Leopoldov site in Slovakia
- Plant capacity 50,000 tpa ethanol
- Project based on excellent test results of Enviral's feedstock at Clariant's pre-commercial sunliquid® plant in Straubing (GER)

Second license commercial plant
Poland

ORLEN Południe

Oil
2G

- Second sunliquid® cellulosic EtOH license agreement
- Acquired by ORLEN Południe, a member of ORLEN group, the leading player in the fuels and energy market & largest company in CEE
- 2G plant to be integrated into the existing Jedlicze petroleum refinery in south-eastern Poland
- Plant capacity 25,000 tpa ethanol
- Using locally sourced feedstock such as straw



Clariant flagship commercial plant
Romania

2G

- Clariant's own investment in cellulosic EtOH flagship plant
- Greenfield site in Podari, Romania (near Craiova)
- Plant capacity 50,000 tpa ethanol
- Processing 250,000 tons of straw annually
- Investment value: over 100 million Euros
- Receives funding from the European Commission and the Bio-Based Industries Joint Undertaking*

* The project receives funding from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration under Grant Agreement no. 322386 (FP7 SUNLIQUID) and from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation program under Grant Agreement no. 709606 (BBI LIGNOFLAG)

BBI JU

Bio-based Industries Consortium

CLARIANT

Commercial sunliquid® plant in China

Third license commercial plant
China

国祯集团 GUOZHEN GROUP
Chemtex

- Agreement signed for third sunliquid® cellulosic EtOH license/first license deal for sunliquid® in China
- Joint venture (JV) will be formed by Anhui Guozhen Group & Chemtex Chemical Engineering with the intention of realizing full-scale commercial plant
- 2G plant will be built at a greenfield site in Fuyang city, Anhui province in East China
- Planned annual plant capacity: 50,000 tons with an option to double capacity in a 2nd phase
- Using locally sourced feedstock such as wheat straw and corn stover

SUMMARY & OUTLOOK

what is precious to you?

CLARIANT

On our way to decarbonizing global mobility

Key conclusions:

- **Paris agreement,** the **EU's aim** to be **climate-neutral by 2050** & other global climate efforts will fail without **significant increase** of **sustainable energy solutions**
- **Variety of solutions** needed to **decarbonize transport sector** & achieve ambitious climate goals
- **Lignocellulosic ethanol** is a **key solution** & having **countless benefits** to make an **immediate impact**
- **Current market conditions** are favourable for **driving demand for lignocellulosic ethanol** even further

Legislation: global support mechanisms & mandates are current key drivers for strong growth

Feedstock: proven global abundance of agricultural residues → sunliquid® established clear, executable value chain from field to plant in Romania and can support you in replicating it

Technology: sunliquid® proven, fully integrated solution, strong IP, >7 years of stable & continued pre-commercial operations, own commercial plant underway & 3 licenses sold

Business opportunity: low carbon abatement costs for advanced biofuels (no investments into infrastructure or engine adaption) → sunliquid®: attractive business opportunity both on OPEX & CAPEX

R&D: 14 years of unrivalled in-house R&D expertise & continuous improvement program

Sustainability: sunliquid®: carbon neutral solution with clean, high-quality by-products lignin & vinasse

CLARIANT

»We are looking forward to partner with you to drive lignocellulosic ethanol forward«

Paolo Corvo

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Panel Discussion

ADVANCEFUEL

Thank you for your attention!

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