

sunliquid[®] Technology: Low Carbon Cellulosic Ethanol for Sustainable Mobility

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Clariant – a global leader in specialty chemicals focused on innovation and adding value with sustainability

COMPANY GLOBAL FOOTPRINT ¹ (2021)

11,537

Total staff (FTE)

4,327

Sales 2021 (CHF m)

COMPANY FOOTPRINT IN EU¹

5,798

Total staff (FTE)

1,568

Sales 2021 (CHF m)

SUSTAINABILITY COMMITMENTS (2020)

2030

Ambitious environmental targets set with absolute GHG emission reduction targets from 2019-2030

-40%

Scope 1+2



-14%

Scope 3

MEMBER OF



¹ Total Group incl. discontinued operations (excl. Business Unit Masterbatches)

Clariant's cellulosic ethanol platform is capturing added value as the world accelerates decarbonization efforts



Why now?



DEFOSSILIZATION

Public pressure & supporting policies (e.g. REDII/III) are increasing the deployment of **more sustainable solutions**



MARKET DEMAND

Cellulosic ethanol market is expected to grow at **>60% CAGR** from 2022 to 2030. Production solely from **non-edible material**.



COMMERCIAL OPERATION

Commercial sunliquid® plant in Romania completed and currently in start-up phase



Why sunliquid® TECHNOLOGY?



LEADING TECHNOLOGY PROVIDER

>16 years of experience from continuous pre-commercial **operations & own commercial plant under start-up** and 5 globally sold licenses



CO₂ REDUCTION

CI score reductions by utilizing advantaged feedstocks (negative CI scores are possible considering carbon capture)

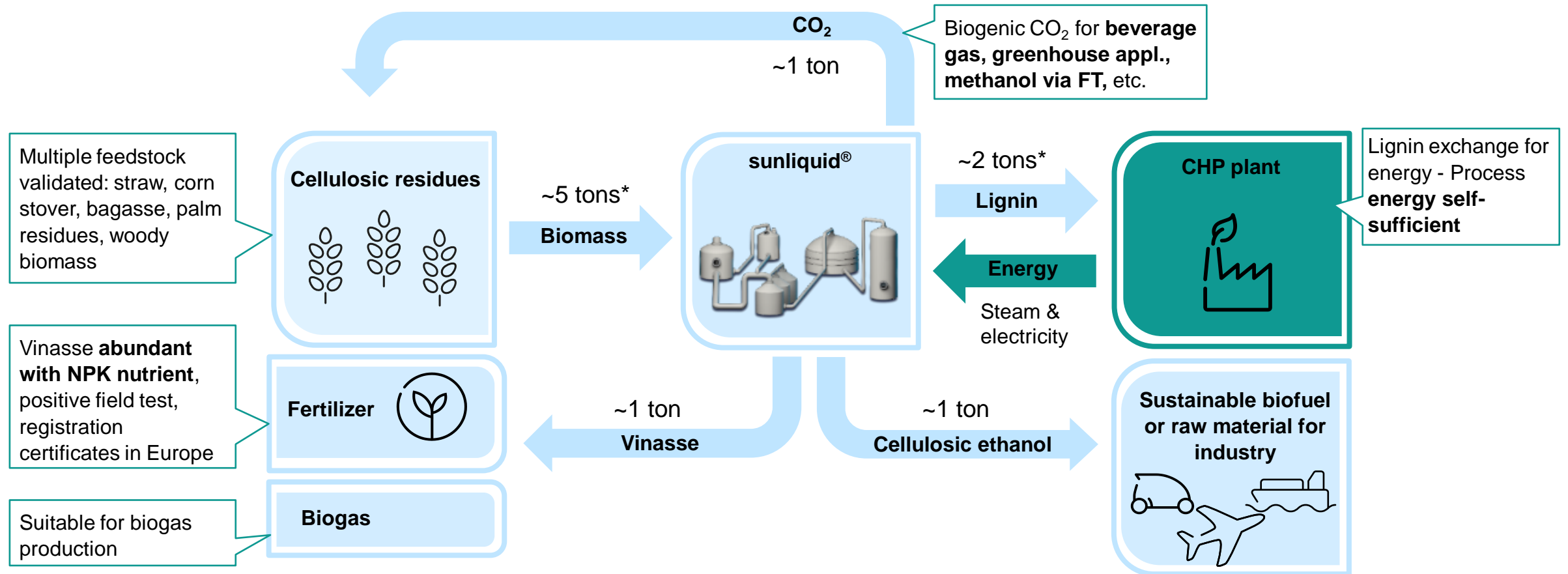


PLATFORM SOLUTION

Versatile platform solution beyond **cellulosic ethanol** with bioethanol as feedstock for various applications from SAF to bio-based chemicals

Clariant's sunliquid® technology provides carbon neutral biofuels & is a prime example for a circular economy solution

sunliquid®: TECHNOLOGY & PROCESS



* based on dry matter

Clariant's first sunliquid® plant in Podari, Romania completed, all units operational and first commercial cellulosic ethanol produced



Key Facts (Podari, 10ha Area)



Nominal plant capacity: **50,000 TPY** of **cellulosic ethanol** by processing **250,000 TPY** of **straw** (locally sourced)



Mechanical construction and commissioning finished, **ramp-up proceeding**:

- Enzyme & yeast production
- Mechanical & thermal pre-treatment
- Hydrolysis, filtration, fermentation
- Distillation



Greenfield combined heat & power (CHP) plant for energy independence by GETEC



Process by-products lignin & vinasse can be fully utilized for **energy generation and fertilizer usage** under evaluation



Opening Ceremony took place on May 31st, introducing the plant to key stakeholders.

First commercial cellulosic ethanol announced on June 14th.












Clariant's sunliquid® cellulosic ethanol plant in Podari: From Groundbreaking to Opening

sunliquid® technology converts a broad range of lignocellulosic feedstock



sunliquid®: Wide range of Lignocellulosic Biomass

 sunliquid® technology





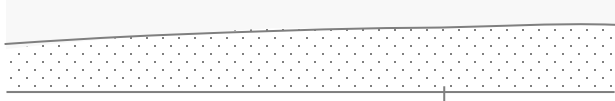






 Wheat Straw	 Forestry Residues	 Rice Straw	 Cane Bagasse
 Corn Stover	 Cane Tops & Leaves	 MSW & Others ¹	 Empty Fruits Bunches

The sunliquid® process shows a flexibility on a broad range of feedstock. Process conditions & biocatalysts were developed & performance runs executed in our pre-commercial plant in Straubing

In addition, about 30 residues were tested in lab & pilot scale, including rice husks, sorghum, coffee ground, seaweed, grapesed straw, corn fiber.

¹Other feedstocks including oat hulls, barley straw, miscanthus/energy crop

Bioethanol is primarily used in the mobility sector – significant upside potential from sustainable aviation fuels & bio-based chemicals exists

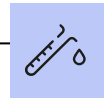
 Primary applications	 Market drivers	 Market outlook (indicative)	
 <p>Mobility sector (cars)</p>	<ul style="list-style-type: none"> - Fueled by increasing blending rates as result of strong regulations - Conventional vehicles as primary usage in mobility sector (>80% for 2030 estimated) 	<p><i>„Large application field with growth rates in 2G sector“</i></p>  <p>Today 2030</p>	 Today's focus
 <p>Sustainable aviation fuels (SAF)</p>	<ul style="list-style-type: none"> - Tighter regulation for CO₂ emissions in aviation - Technological advancements (e.g., Alcohol-to-Jet) enabling strong growth rates 	<p><i>„Future market with accelerating growth especially from 2030 onwards“</i></p>  <p>Today 2030</p>	 Future upside potential (>2025)
 <p>Bio-based chemicals</p>	<ul style="list-style-type: none"> - Increasing demand for sustainable products from renewable sources - Opportunity to achieve significant greenhouse gas reductions (i.e., for Scope 3) 	<p><i>„Future market with steady & slightly increasing growth“</i></p>  <p>Today 2030</p>	

With a track record of 16 years, sunliquid® has gained a top position in the cellulosic ethanol market with 5 licenses sold



sunliquid® has a 16-year Track Record with plants on **Pre-commercial** and **Commercial Scale** using **Integrated Enzyme Production**

Historical Development



2006

Research Facility



2012

Pre-commercial Plant



2017 - 2021

Five Licenses Sold Globally



2021+

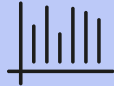
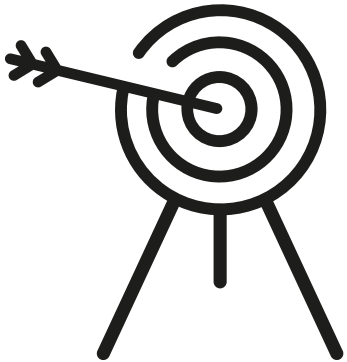
Commercial Plant Completion & Start-Up



Business Description

- sunliquid® is the **leading 2G bioethanol technology** focused on **cellulosic ethanol**
- The **business model** focuses on **R&D advancements** and thus offers its **licensees a cutting-edge sustainable technology**
- sunliquid® has its own dedicated **R&D facility** (DE), a **pre-commercial** (DE) and **commercial plant** (RO)
- The proven **proprietary cellulosic ethanol technology of sunliquid®** includes unique combination of chemical-free pre-treatment and on-site enzyme production enabling **cost-efficient operations**

sunliquid® advanced biofuel projects constitute a highly attractive opportunity to participate in the growing market of advanced biofuels



Sustainable **cellulosic ethanol plants** based on **sunliquid® technology** offer opportunities to participate in the **prospering market for advanced biofuels** supported by **EU legislation**



sunliquid® is the **only technology** with a **16-year track record** with project experience from **five licenses sold globally** and **own commercial plant** in start-up phase



Process features, like **integrated enzyme / yeast production**, target to **lower production costs**



Beyond cellulosic ethanol as a **drop-in fuel**, sunliquid® can be expanded to a **production platform** for **sustainable fuels (e.g. SAF)** and **bio-based chemicals**



sunliquid® supports **sustainability targets** by reducing **carbon intensity** of **biofuels and chemicals**

Thank you!



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