



sunliquid[®]: From Idea to Commercial Implementation of Cellulosic Ethanol

CLARIANT 

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Biofuels & Derivatives

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what is precious to you?



Health » Breathing in Delhi air equivalent to smoking 44 cigarettes a day

International B

Breathing in Delhi air equivalent to smoking 44 cigarettes a day

By Huizhong Wu, CNN

🕒 Updated 1446 GMT (2246 HKT) November 10, 2017



On the street, residents tied scarves around their faces and made makeshift masks

News & buzz



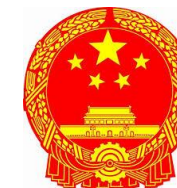
John McEnroe times what M Navratilova ge



Power, sex ar weekend of is Trump presid

YOUR WEAR
WHAT MAT
TO YO

India & China push to advanced 2G EtOH



INDIA highlights:

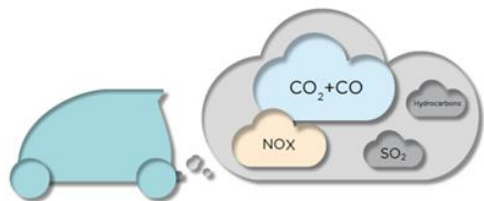
- Lead by Ministry of Petroleum & Natural Gas
- Implementation of E10 mandate by 2022
- **Gap fulfilled by 12 2G EtOH plants**
- **Plants operational by 2022**
- **Indian oil companies mandated to build 2G plants in 11 regions**
- First tender wave completed

CHINA extension of bioEtOH production:

- Lead by National Energy Administration and National Development and Reform Commission
- Establish open market and mechanism
- Limit grain ethanol, encourage non-food ethanol
- **Nationwide biofuel E10 blending by 2020**
- **By 2025 realise significant supply of 2G EtOH ethanol**

The air pollution challenge in India & China

Reasons for air pollution:



Car exhaust gas emission & industry emission
causing city air pollution, especially in the economic zones



- **Straw burning on the field** after harvest causing smoke, especially in the agriculture area.
- Coal burning
- Emissions from city construction

CLARIANT solution:



Use straw to produce 2G EtOH:

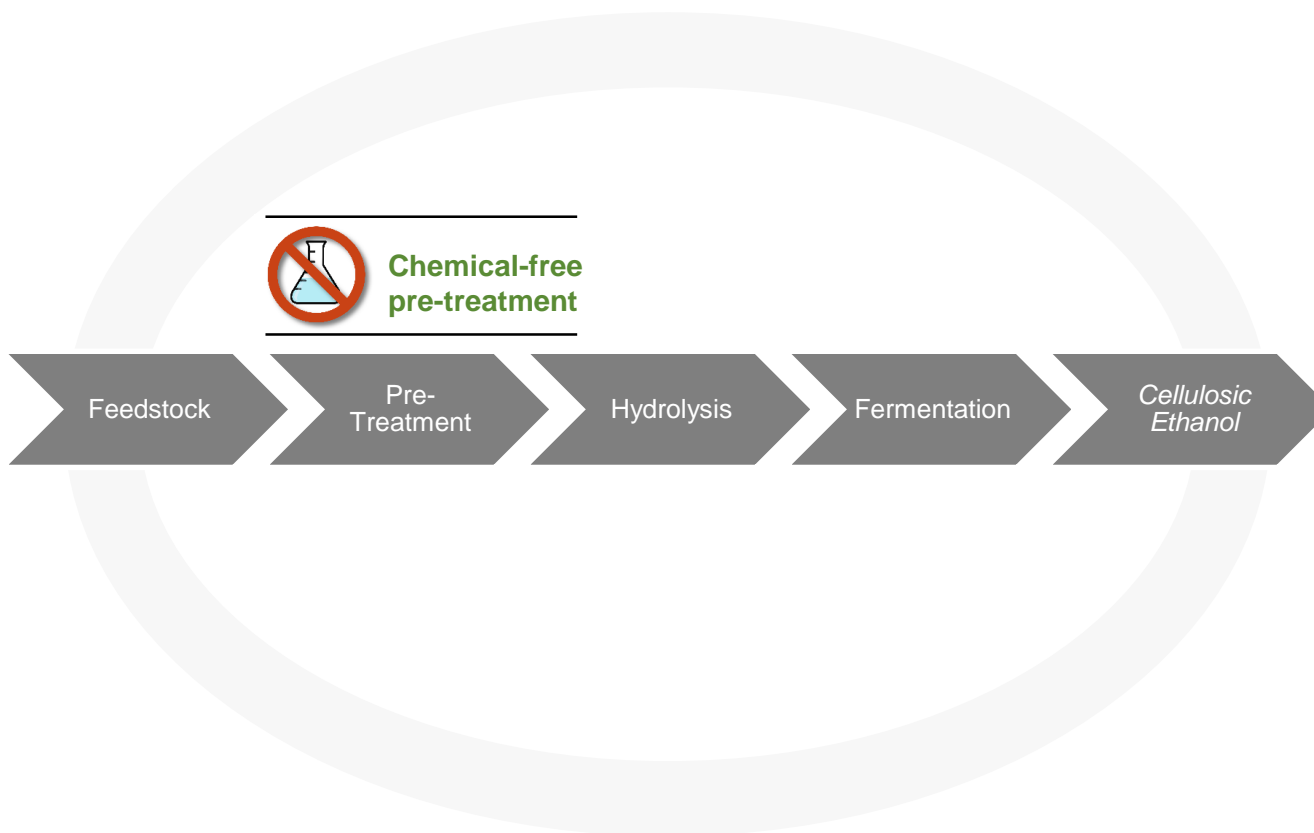
- Reduce air pollution
- Increase farmer income
- Convert residues into fuels



EtOH blending into gasoline can:

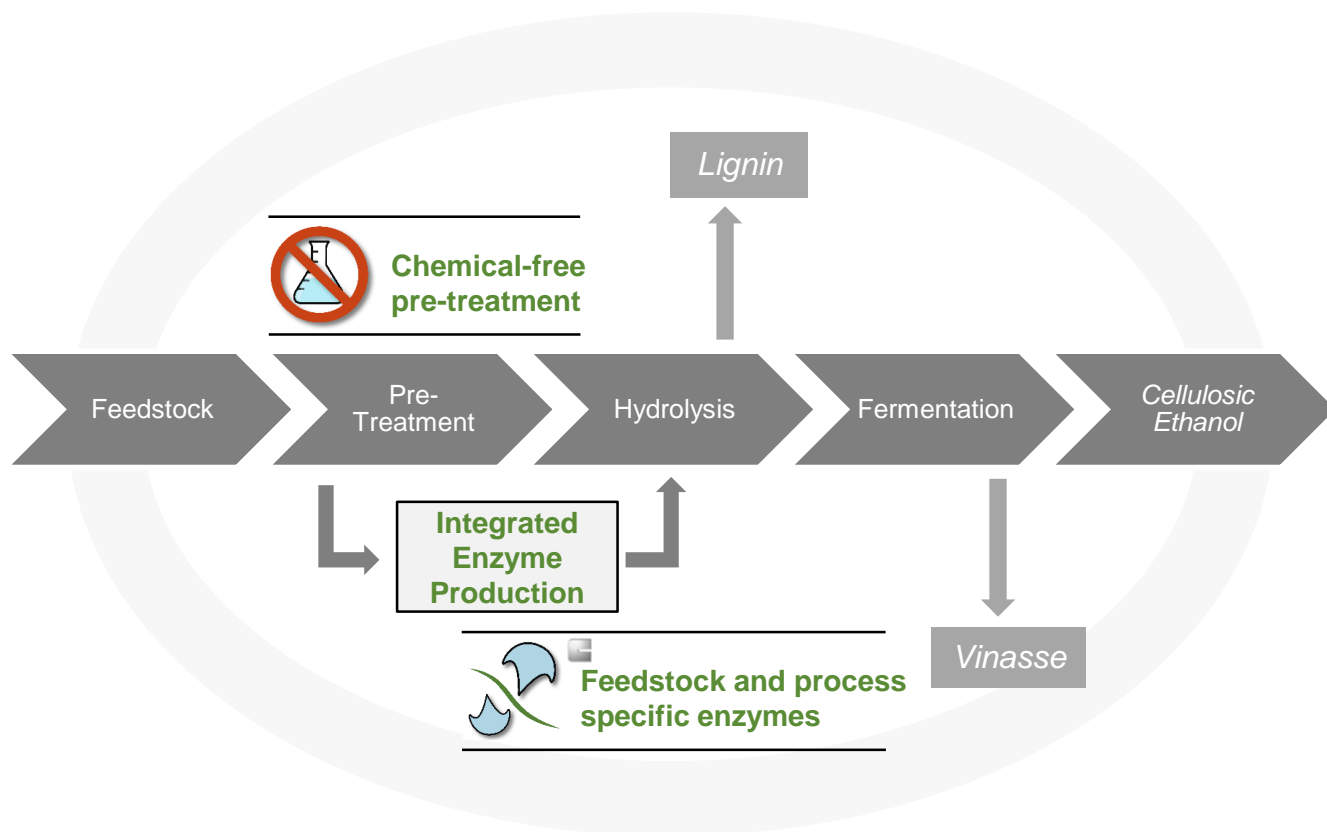
- Increase gasoline combustion efficiency
- Efficiently reduce exhaust gas emission
- Replace MTBE as additives in gasoline

Fully integrated 2G EtOH production



The **chemical-free** mechanical and thermal **pre-treatment** enables an optimal hydrolysis. Purification steps are unnecessary and makes for a safer and more environmentally friendly process.

Fully integrated 2G EtOH production



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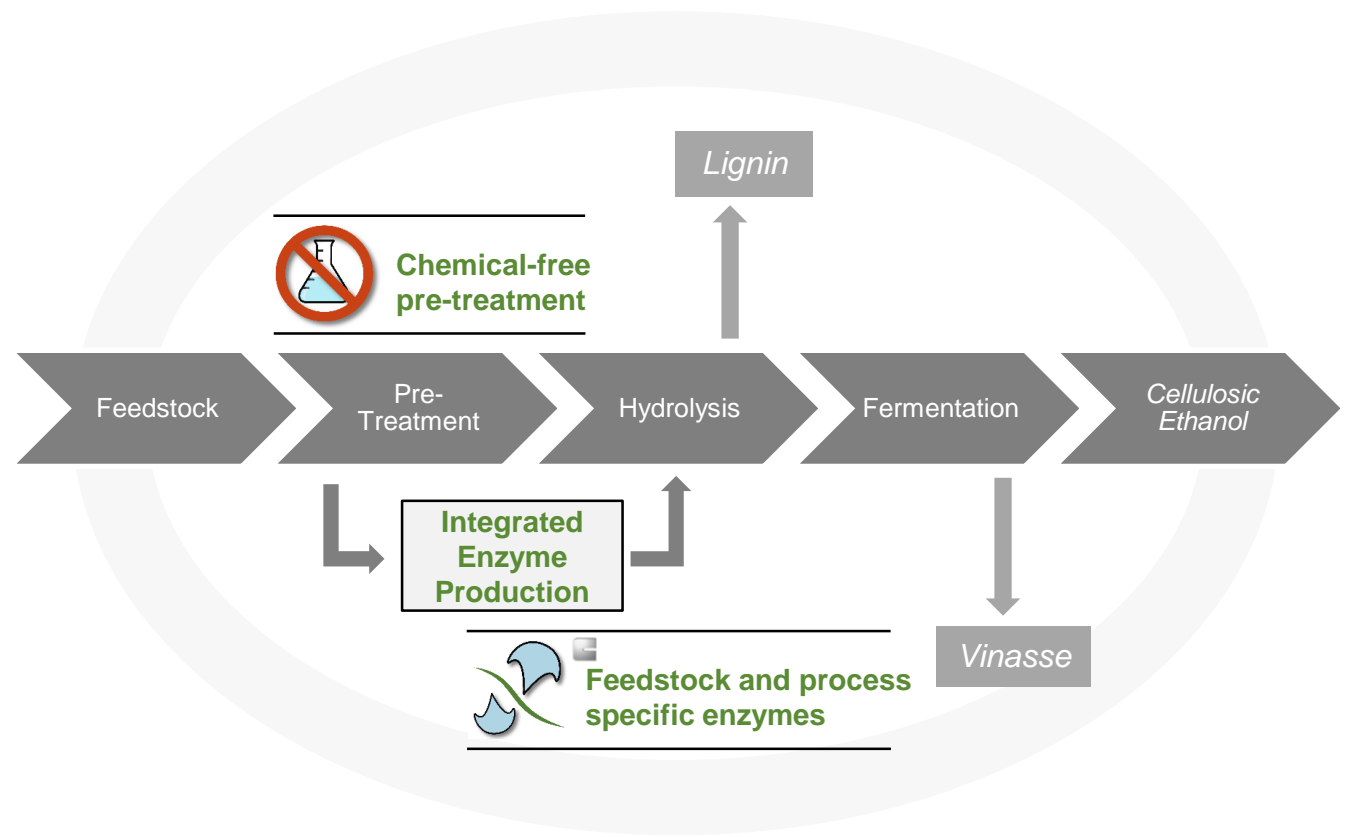
Integrated
Enzyme
Production

Through the **process integrated enzyme production** costs can be reduced to a minimum. Enzymes are produced exactly when and where needed, there are no costs for logistics or formulation and no dependence on external suppliers.



Clariant can quickly adapt **enzymes** to new **feedstock and process conditions**. This achieves a most efficient hydrolysis with maximum yields and makes the process flexible for different boundary conditions.

Fully integrated 2G EtOH production



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The **organism** used for fermentation is **highly optimized** and able to **simultaneously** ferment both **C5 & C6 sugars in a one-pot reaction**. Thus the ethanol yield increases by 50% compared to only C6 fermentation.

Clariant sunliquid EtOH: advantages & enzyme cost comparison

sunliquid 2G EtOH unique benefit



Reduced CO₂ emission

Reduction by 95%



Increased bioethanol yield

Conversion of all types of sugar



Energy self-sufficient

All energy from the lignin combustion



Process integrated enzyme

Significantly reducing the cost



Use of local sources

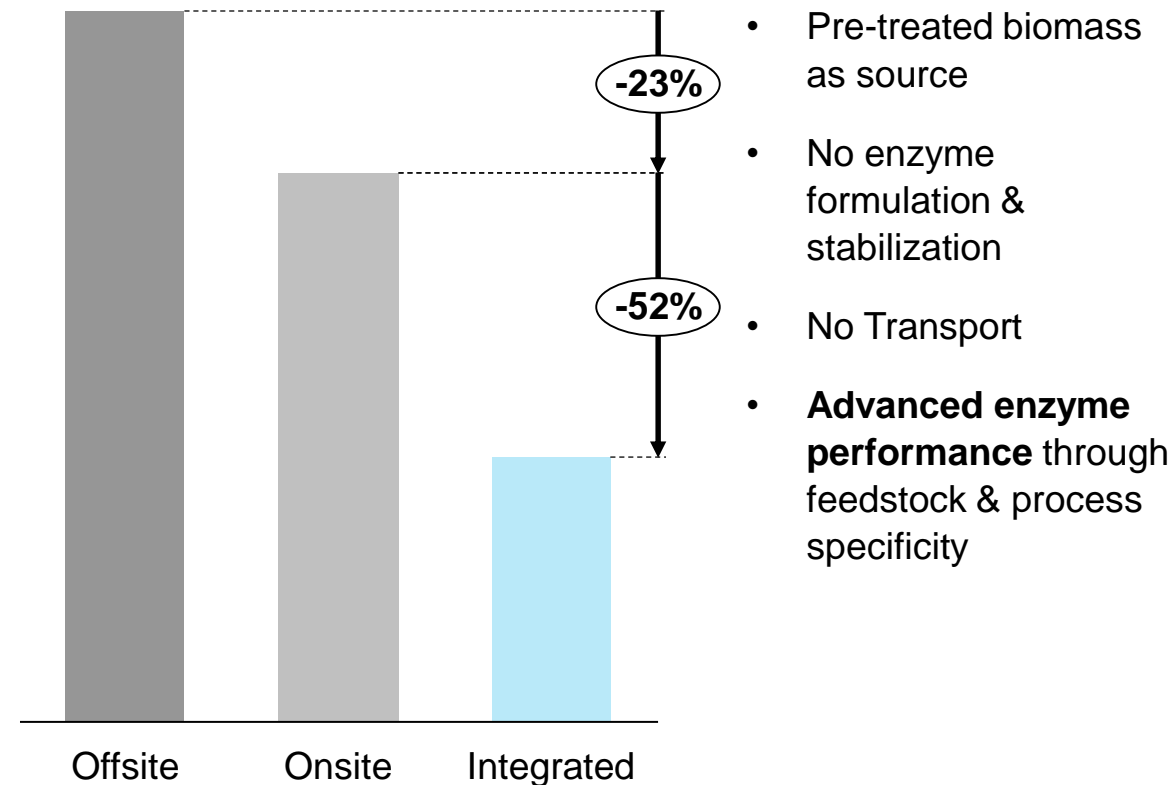
Local specific factor can be taken into consideration



Green jobs

Strengthening of local agriculture business

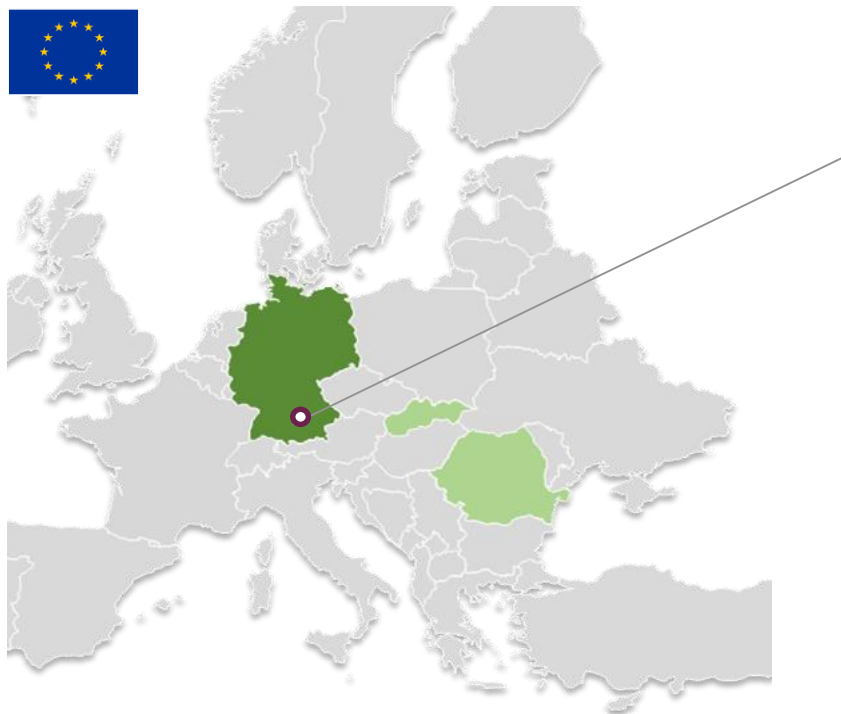
sunliquid enzyme cost comparison*



* includes all operating and capital cost, but does not include transport cost for offsite enzymes which will further increase costs

SOURCE: "Integrated enzyme production lowers the cost of cellulosic ethanol" by Eric Johnson <http://onlinelibrary.wiley.com/doi/10.1002/bbb.1634/full>

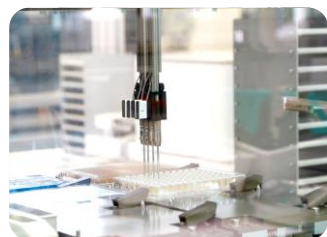
Group Biotechnology Innovation Center in Munich: R&D & pilot



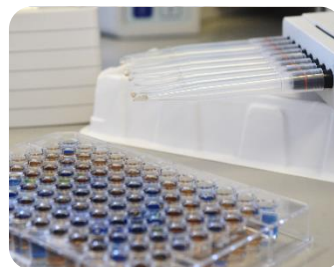
Molecular Biology & Microbiology



High Throughput Screening



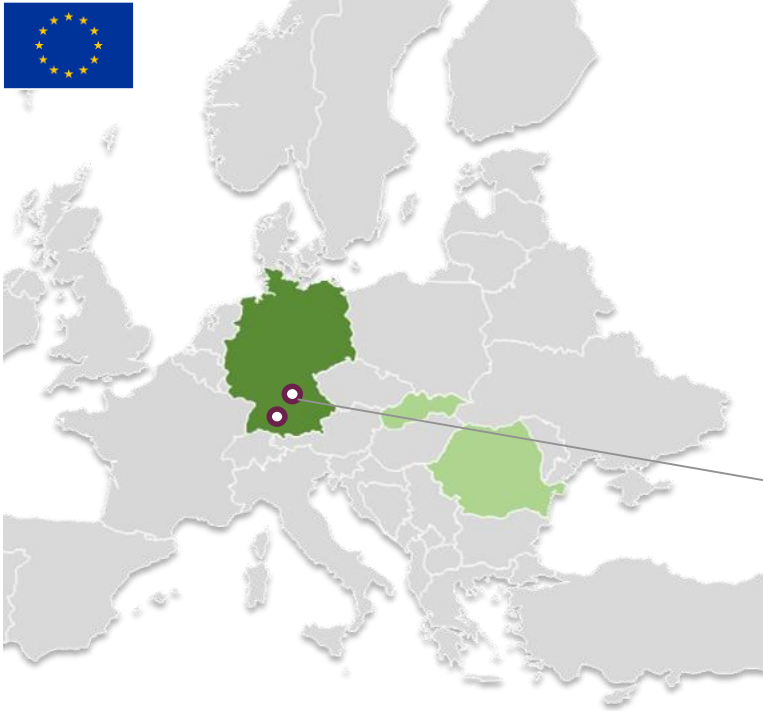
Biochemistry & Analytical Chemistry



Fermentation & Bioprocessing



sunliquid 2G EtOH pre-commercial plant in Straubing



2012

Start of operation

1,000

t/a 2G EtOH

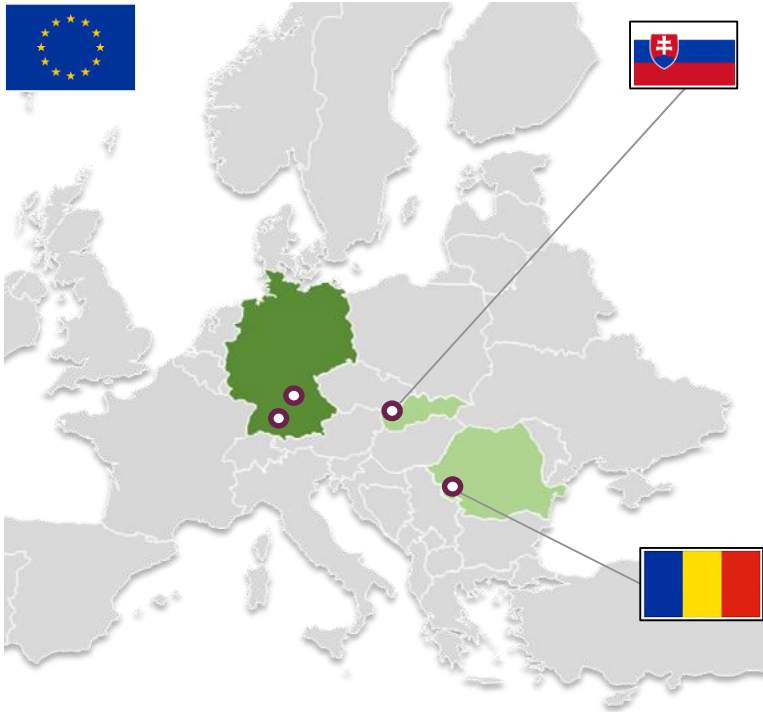
~ 4,500

t/a feedstock
(cereal straw, corn stover,
sugarcane bagasse & others)

~ 5

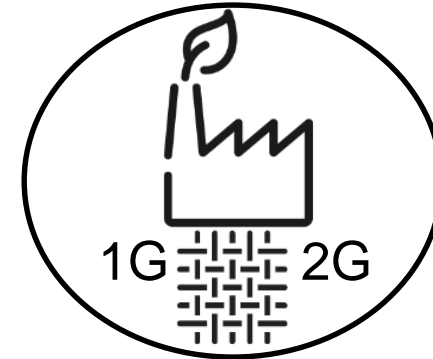
Years confirmation of
commercial-scale design

Clariant sunliquid 2G EtOH commercial projects: on track & currently finalizing detailed engineering



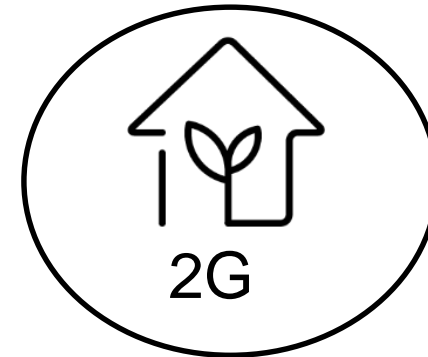
First license commercial plant Slovakia

- First sunliquid® 2G EtOH licence
- Licensed by Slovakia's biggest EtOH producer, Enviral
- Plant capacity 50,000 tpa



CLA flagship commercial plant Romania

- CLA own investment on 2G EtOH flagship plant
- Plant capacity 50,000 tpa
- Ground breaking beginning 2018





“Bio-Based Industry Story of the Year”- Award



Clariant distinguished with the “**Bio-Based Industry Story of the Year**”- Award at the Bio-Based World News Innovation Awards 2018 in Amsterdam for its collaboration with Enviral on a new full-scale commercial cellulosic ethanol plant.

Clariant's commercial plant in Romania



Build, own & operate a FOIK 50 kta **cellulosic ethanol commercial-scale plant** using **local agricultural residues** based on Clariant's **sunliquid® technology**



REGIONAL DEVELOPMENT: GREEN GROWTH AND JOBS

- 100+ Million EUR investment in Romania
- 75+ direct and 300+ indirect jobs, 800-900 during construction phase (in a region with an unemployment rate of more than 20%)
- Additional income for farmer and local businesses: 20+ million EUR
- Additional tax generated: 1 + Million EUR annually for the next 20 years

sunliquid vinasse: biofertilizer back in the field



sunliquid® ethanol commercially deployed

Application as car fuel

- Gasoline-Ethanol blend containing 20% 2G EtOH from CLA's pre-commercial plant tested in Mercedes' fleet
- Test showed attractive environmental profile
- Today's vehicles can already use E20 blends



Mercedes-Benz

Application as truck fuel

- Partnership with Scania for the 2G EtOH-powered trucks used at the CLA Suzano Brazil plant
- Ecotrucks started using 2G EtOH produced from sugarcane bagasse using Clariant's sunliquid® technology



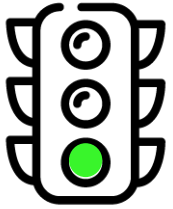
sunliquid® ethanol commercially deployed

Application as cleaning agent

- sunliquid® 2G EtOH from straw replaces 100% of conventional EtOH in Frosch® Multisurface-Cleaner (by Werner & Mertz)
- World's first cleaning solution with 2G EtOH
- Selling in German market with very positive feedback



The time is now to jump on the 2G EtOH bandwagon...



1. Fully proven Integrated process



**2. Supportive legislation...
but mandate binding by 2021**



3. High market demand



4. Commercializing in 2 EU countries



5. Product shortage to meet demand



6. MARKET OPPORTUNITY

- OWN PRODUCTION
- TIME TO INVEST NOW