Horizon 2020
European Union Funding
for Research & Innovation

BBI JU

Bio-based Industries
Consortium

INEA
The Innovation and
Networks Executive Agency

REWOFUEL

REsidual soft **WO**od conversion
to high characteristics
drop-in bio**FUEL**s

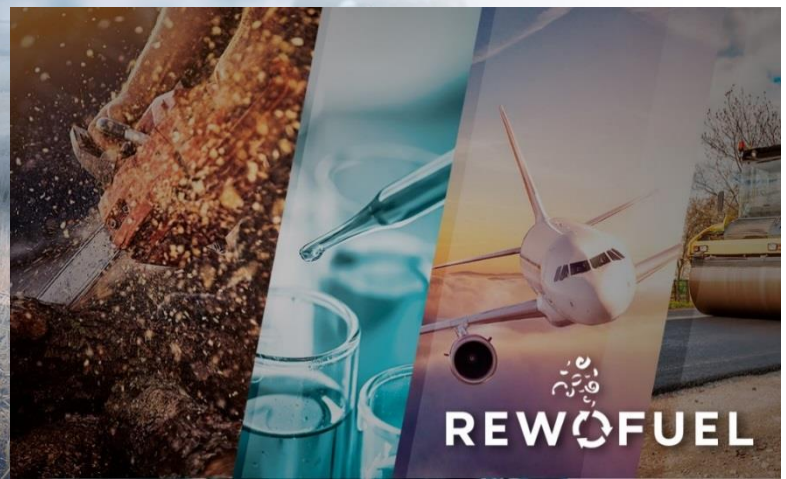
Optisochem

OPTimized conversion of
residual wheat straw to
bio-**ISO**butene for bio based **CHEM**icals

ACI's European Fuels Markets & Refining Strategy Conference

Francfort-Germany March 27th, 2019

REWOFUEL & OPTISOCHEM: Demonstrating the Production of High-Performance Biofuels & Biochemicals From Residual Wood & Straw



Bernard CHAUD – P1 GBE

REsidual soft WOod conversion
to high characteristics
drop-in bioFUELs

- **European consortium led by Global Bioenergies for a 3 year duration,**
- **started June 2018**
- **Objective : Industrial demonstration of the conversion of softwood residues into high performance gasoline and jetfuel**
- **19.7m€ project 70% financed by the EU via the H2020 program**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792104.
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P1 Global Bioenergies

P2 graanul invest

P3 SEKAB

P4 NESTE ENGINEERING SOLUTIONS AB

P5 ENERGIE INSTITUT an der Johannes Kepler Universität Linz; JKU JOHANNES KEPLER UNIVERSITÄT LINZ

P6 IPSB Ingénierie de Procédés Sucres et Biotechnologies

P7 TechnipFMC

P8 Aj AJINOMOTO; AJINOMOTO ANIMAL NUTRITION GROUP; AJINOMOTO ANIMAL NUTRITION EUROPE

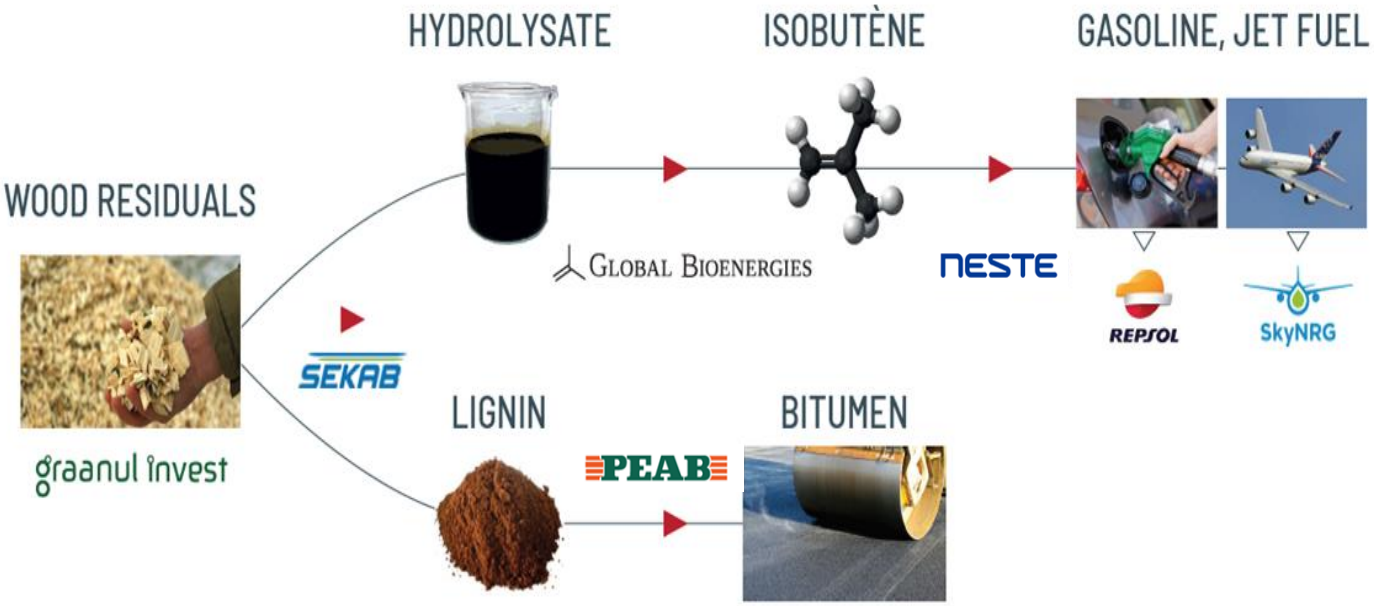
P9 SkyNRG

P10 PEAB Peab Asfalt

P11 REPSOL

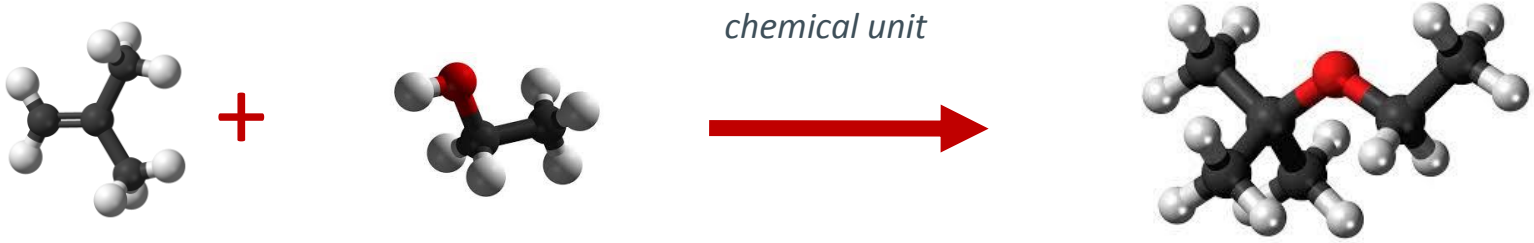
absiskey INNOVATION SPIRIT

Process routes and application



Bio-isobutene to full-bio-ETBE

REWOFUEL



Isobutene Ethanol ETBE

- ETBE is an octane booster additive reducing the level of ultrathin particles at the exhaust pipe. Can be added up to 22% in European gasoline.
- "Traditional ETBE" is only 37 % renewable as only the ethanol part is bio-based.
- We can produce full-bio-ETBE, 100% renewable, and thus increase the renewable fraction in gasoline up to 22%.

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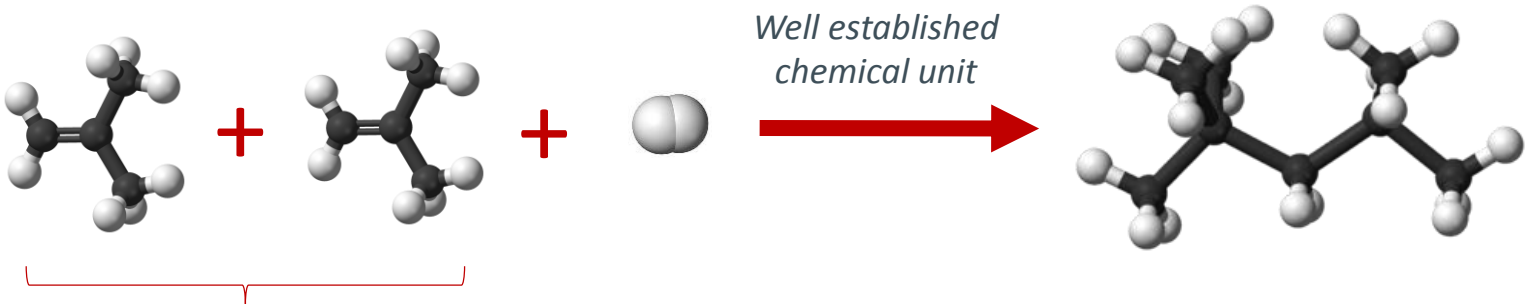
Bio-isobutene to bio-isooctane

REWOFUEL



- Isooctane is the gold standard for gasoline engines (octane rating 100)
- It can be blended at a high level (>30%) in fossil gasoline batches, much higher than the ethanol blendwall of 10% for unmodified vehicles
- It has specific high premium markets in specialty fuels

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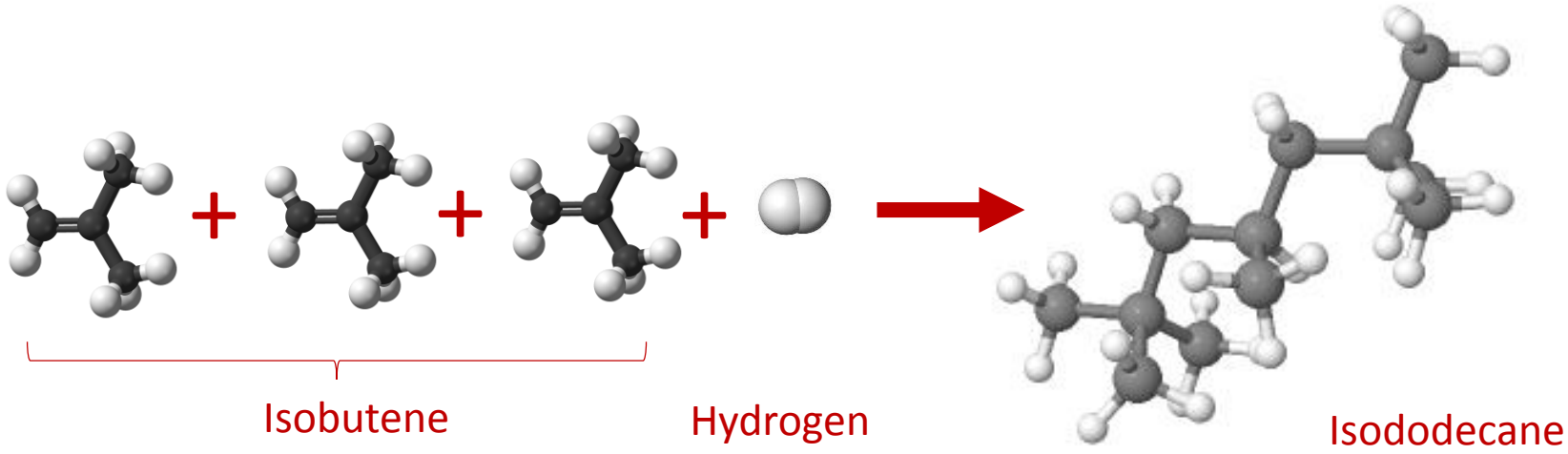
Bio-isobutene to Jetfuel bio-component

REWOFUEL



Isododecane is a high performance component for Jet-fuel

Similar process has been ASTM approved for blending up to 50% into jet fuel.

One of the very few options for introducing bio-components into jetfuel formulation

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SkyNRG

COPRODUCTS

- Deactivated micro-organism: protein-rich feedstock for FEED industry

AJINOMOTO ANIMAL NUTRITION GROUP

AJINOMOTO ANIMAL NUTRITION EUROPE

- Residual liquid streams: biogas production

SEKAB

- Residual mineral stream: fertilizer

SEKAB

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BBI JU

Bio·based Industries
Consortium

- *European Consortium project led by Global Bioenergies*
- *4 years project started June 2017*
- **€16.4 million** *project, Granted* **€9.8 million by BBI-JU** under Horizon 2020
- ***Objective: to demonstrate chemical applications of residual-straw based bio-Isobutene***

"This project has received funding from the Bio Based Industries Joint Undertaking (BBI JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 744330. This publication reflects the views only of the author, and the BBI JU cannot be held responsible for any use which may be made of the information contained therein."

Global Bioenergies

CLARIANT

INEOS
THE WORD FOR CHEMICALS

TechnipFMC

JKU
JOHANNES KEPLER
UNIVERSITÄT LINZ

IPSB
Ingénierie de Procédés
Sucres et Biotechnologies

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Global Sustainability analysis of entire Value Chain

Feedstock sourcing and hydrolysis

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Wheat straw sourcing → Wheat straw hydrolysis → Wheat straw hydrolysate

Bio-IBN production

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IBN fermentation & purification → Bio-IBN

Bio-IBN conversion to end products

INEOS
THE WORD FOR CHEMICALS

Bio-IBN → IBN Oligomerisation → Bio-DIB, Bio-TIB, Bio-TeIB

Bio-IBN → IBN Polymerization → PIB

Process Integration & Engineering

- Focus on Fermentation — IPSB (Ingénierie de Procédés Sucres et Biotechnologies)
- Focus on Purification — Technip

Legend

- Market applications
- Feedstock sourcing
- Intermediate Product
- Bio-sourced building-block
- Conversion unit

Bio-IBN validation for following Polymer End-products

Polyisobutene (PIB)

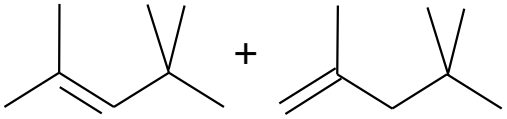
- Low MW range of 180 - 6000
- Viscous liquid polymer
- Applications: lubricants, greases, adhesives, sealants, cling films

- Medium - High MW range of 50,000 - 4,000,000
- Rubbery solids/elastomers
- Applications: sealants, chewing gum

- Cross-linkable Butyl Rubbers for Tire lining
- MW range of 50,000 to 1,000,000
- Copolymer of isobutylene & isoprene

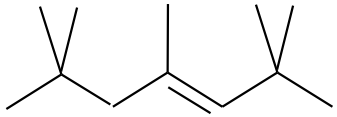
Bio-IBN validation for following Oligomer End-products

Diisobutene (DIB) & al.



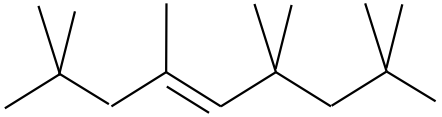
Diisobutylene (DIB)

Applications:
antioxidants, resins, initiators, anti-UV, metal extraction, anti-wear additive



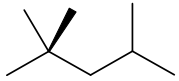
Triisobutylene (TIB)

Applications:
chain transfer agent



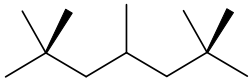
Tetraisobutylene (TeIB)

HYDROGENATION



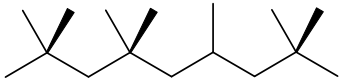
Isooctane (IO)

Applications:
Reference fuel, Racing car fuel



Isododecane (IDD)

Applications:
Reference fuel, Phlegmatizer, Cosmetics



Isohexadecane (IHD)

Applications:
Cosmetics

Rewofuel & OPTISOCHEM projects – facts and green jobs

The EU produces approximately each year:

- **145 million tons of forestry residues**
- **100 million tons of non-exploited wood which accumulates in our forests**
- **122 million tons of available agricultural residues**

These 2 value chains would therefore enable the supply of several hundreds of plants in Europe!

100 plants would:

-Cover 3% of European gasoline and Jetfuel needs (160 millions tons total per year)

-Create 6 000 direct jobs and 30 000 indirect jobs