

ETIP Bioenergy_SPM10

Overview on technology innovations, 17th

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A large, stylized white graphic on a green background. It depicts a tree where the branches are human figures with their arms raised. The leaves are replaced by various symbols: a laboratory flask with bubbles, a dove, a butterfly, a house, and an arrow. The overall theme is sustainable growth and community.

Sekab

SWEDISH ETHANOL CHEMISTRY

-Biorefinery Solutions for Conversion of lignocellulosic Residues into
Sugar, Lignin and Ethanol Platforms



The road ahead

Sekab



Sekab IS AN IMPORTANT PART
OF THE **BIOREFINERY** IN
ÖRNSKÖLD SVIK **SWEDEN**



Ownership based in the North of Sweden



EcoDevelopment
in Europe AB

With important collaborations in the region



SHORT ABOUT SEKAB

TURNOVER	SEK 840 million
FACILITIES	Chemical plant, dewatering plant, distribution plant, and demonstration plant In Örnsköldsvik Biorefinery
HEAD OFFICE	Örnsköldsvik
EMPLOYEES	80
OWNERSHIP	Energy companies in the region and private ownership
PRODUCTION	60 000 tonnes of chemicals and 20 000 m ³ biofuels
EXPORT	60 % of sales
PRODUCTS	Mainly Acetaldehyde, Ethyl acetate, Industrial vinegar, Technical ethanol, biofuel ED95 and bioethanol for low mixing
R&D	Large number of own patents and concepts. Rich history of world-leading research.



**ONE GROUP
THREE
COMPANIES
SAME TARGET**

Sekab Biofuels & Chemicals AB



Sekab E-Technology AB



Sekab Forest Technology AB



To contribute to a future where the need for fossil raw materials and fuels is reduced

Bio Acetaldehyde certified according to the certification body ISCC



Chemical products based on bioethanol from wood residues



Biofuels and low blends



Bio Ethyl acetate made from biologically produced ethanol.



Bio Acetic Acid certified according to the certification body ISCC



CelluAPP[®]

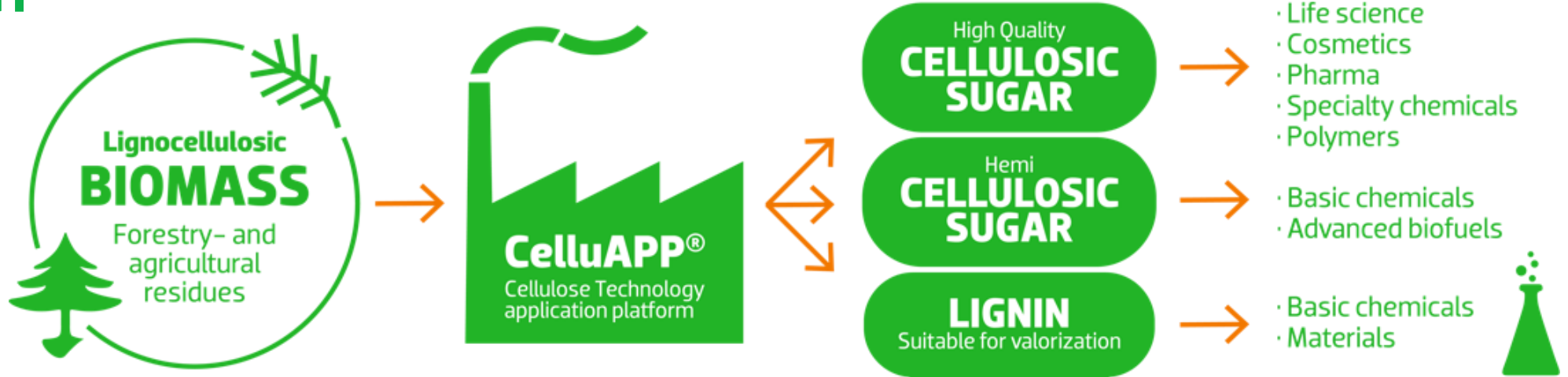
TECHNOLOGY



FROM **WOOD** TO **VALUE**

Sekab

CelluAPP® TECHNOLOGY



BIOREFINERY TECHNOLOGY FOR THE CLIMATE

SEKAB's CelluAPP® technology platform makes it possible to use **residue** from the forest industry, processing industry, agriculture and the food industry to produce new **sustainable chemical products**

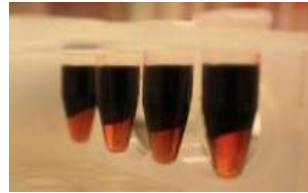
In this way **chemical products and fuel** can be **locally produced** using **local residues** as the raw material. This decreases transportation requirements, **dependence on fossil raw materials** and our impact on our climate.



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The CelluAPP® Technology

Hemicellulose
sugars



Lignin



Cellulosic
glucose



Biogas, bio-oils,
alcohols, acids



Pretreatment

Separation & washing

Enzymatic hydrolysis

Fermentation

Product recovery

- ✓ Steam explosion
- ✓ Particle size measurement
- ✓ Automated feedback control

- ✓ Sugar recovery
- ✓ Washing of solids
- ✓ Sugar purification & concentration

- ✓ Enzyme flexibility
- ✓ Sugar purification & concentration

- ✓ Automated fermentation
- ✓ Product and microorganism flexibility

- ✓ Filtration
- ✓ Distillation
- ✓ Purification



Hands-on experience from more than **15 years** of demo plant operation



**Demo facility since 2004
in collaboration with academia and industry**







Different types of lignin

CelluAPP® PRETREATMENT

Enables efficient enzymatic hydrolysis of cellulose

- Acidic conditions H_2SO_4 , SO_2
- Typical temperature ~ 170-220°C
- **Intended target: Hemicellulose**, not lignin or cellulose

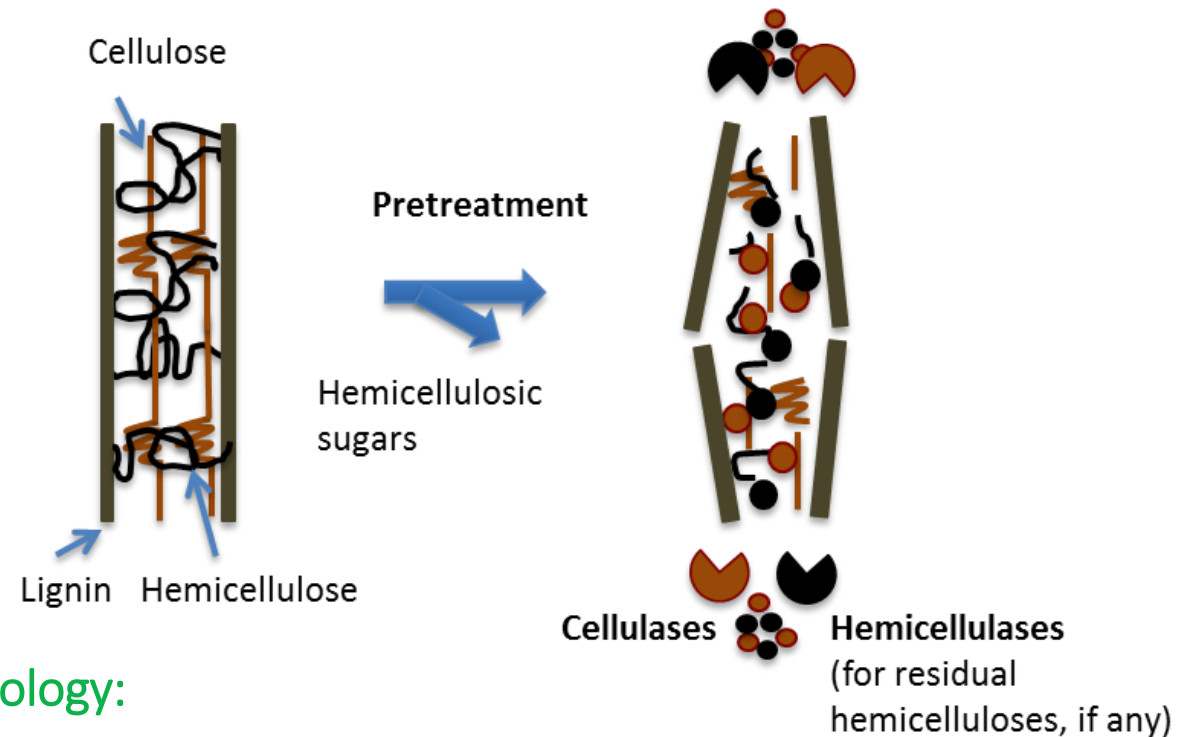
Critical factors:

- Temperature
- Pressure
- Residence time
- Utilized catalyst

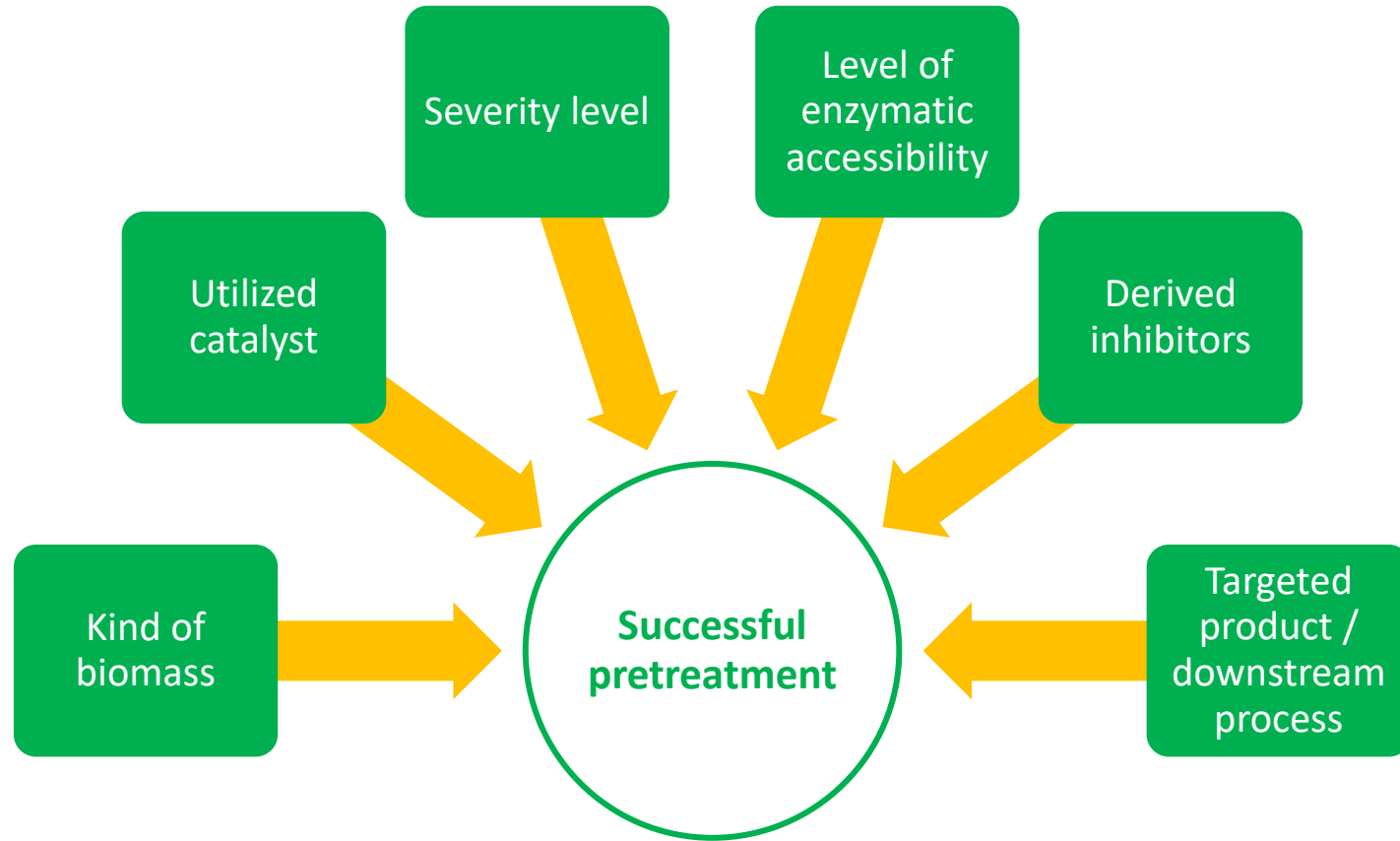
Severity Factor

Advantages of pretreatment system in CelluAPP® Technology:

- ✓ **Faster** and more **efficient** process
- ✓ **High yields** of hemicellulose
- ✓ The cellulose **more susceptible** to enzymatic digestion
- ✓ **Higher glucose yields** from subsequent hydrolysis of cellulose



Impact factors



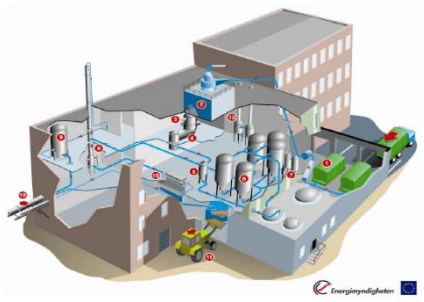


CelluAPP[®] in applications- Projects

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CelluAPP[®] Process

demonstrated in the **BioRefinery Demo Plant**



50.000 total **hours** of demonstration (since 2010).
23.000 hours pretreatment of spruce (softwood).
 Successful product deliveries in EU projects. Around
20.000 hours of pretreatment of a hardwood mix.

Pretreatment

Enzymatic hydrolysis

Fermentation

Separation

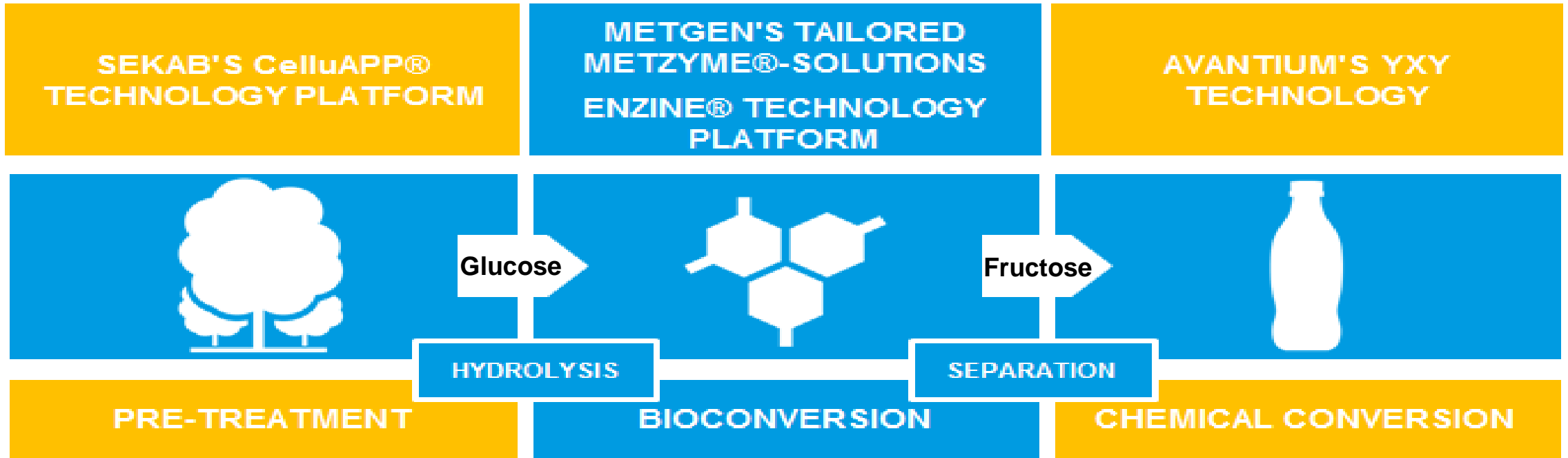
Distillation

EU projects

Project information	Project information	Project information	Project information	Project information
<p>ValChem</p> <p>Grant agreement ID: 669065</p> <p>Project website</p> <p>Status: Grant agreement terminated</p> <p>Start date: 1 July 2015 End date: 30 June 2019</p> <p>Funded under: H2020-EU.3.2.6.</p> <p>Overall budget: € 18 502 703,25</p> <p>EU contribution: € 13 125 940,15</p> <p>Coordinated by: UPM-KYMMENE OYJ Finland</p>	<p>ReTAPP</p> <p>Grant agreement ID: 691414</p> <p>Project website</p> <p>Status: Closed project</p> <p>Start date: 1 November 2015 End date: 30 April 2018</p> <p>Funded under: H2020-EU.3. H2020-EU.2.</p> <p>Overall budget: € 3 340 625</p> <p>EU contribution: € 2 338 437,50</p> <p>Coordinated by: METGEN OY Finland</p>	<p>BioCatPolymers</p> <p>Grant agreement ID: 760802</p> <p>Project website</p> <p>Status: Ongoing project</p> <p>Start date: 1 January 2018 End date: 31 December 2020</p> <p>Funded under: H2020-EU.2.1.4.</p> <p>Overall budget: € 5 351 985,08</p> <p>EU contribution: € 4 362 047,56</p> <p>Coordinated by: ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS Greece</p>	<p>REWOFUEL</p> <p>Grant agreement ID: 792104</p> <p>Status: Ongoing project</p> <p>Start date: 1 June 2018 End date: 31 May 2021</p> <p>Funded under: H2020-EU.3.3.3.</p> <p>Overall budget: € 19 791 556,55</p> <p>EU contribution: € 13 856 301,84</p> <p>Coordinated by: GLOBAL BIOENERGIES France</p>	<p>NewLiEP</p> <p>Grant agreement ID: 869879</p> <p>Status: Ongoing project</p> <p>Start date: 1 August 2019 End date: 31 July 2021</p> <p>Funded under: H2020-EU.3. H2020-EU.2.1.</p> <p>Overall budget: € 4 112 500</p> <p>EU contribution: € 2 878 750</p> <p>Coordinated by: TERRANOL A/S Denmark</p>

RETAPP Value Chain

Rethinking all
plastic packaging



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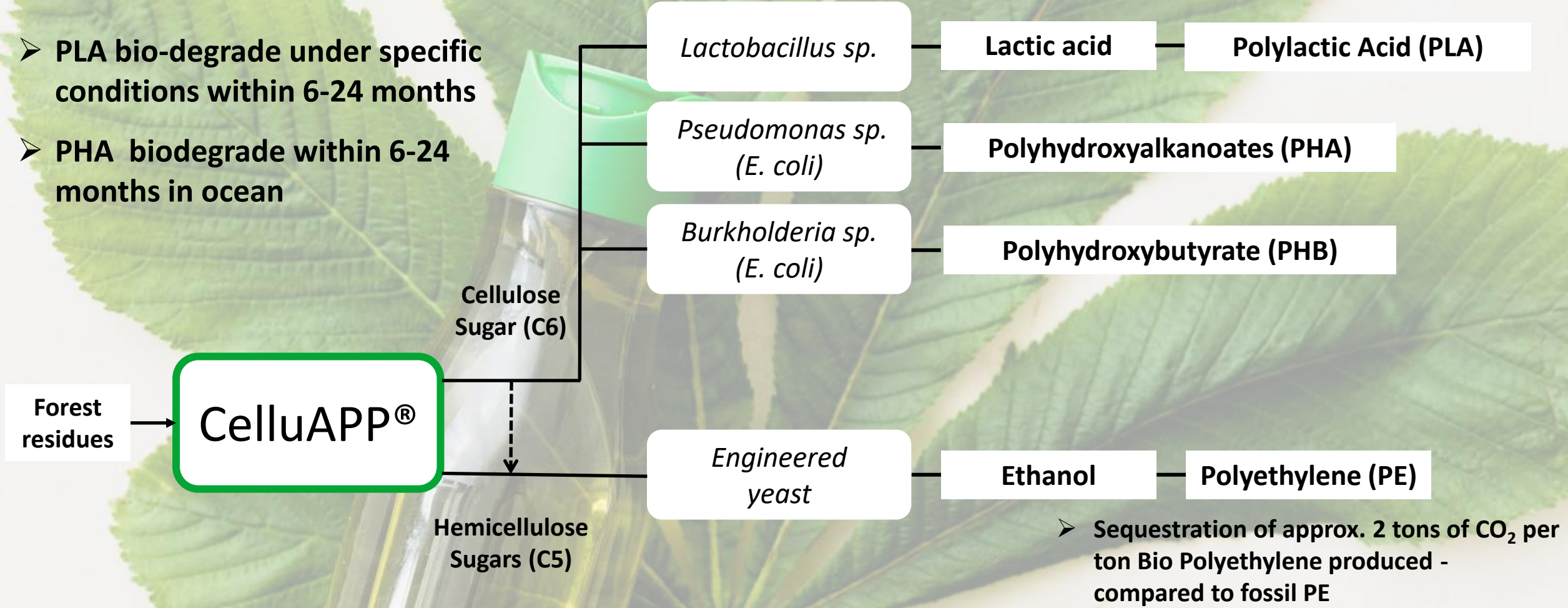
 **METGEN**


avantium

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CelluAPP® SUGAR PLATFORM - Bioplastics

- PLA bio-degrade under specific conditions within 6-24 months
- PHA biodegrade within 6-24 months in ocean



REWOFUEL

REsidual soft WOod conversion to high characteristics drop-in bioFUELS



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

P1  GLOBAL BIOENERGIES

P2  graanul invest

P3  SEKAB

P4  NESTE

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  AJINOMOTO.
AJINOMOTO ANIMAL NUTRITION GROUP
AJINOMOTO EUROLYSINE S.A.S.

P9  SkyNRG

P10  PEAB
Peab Asphalt

P11  REPSOL

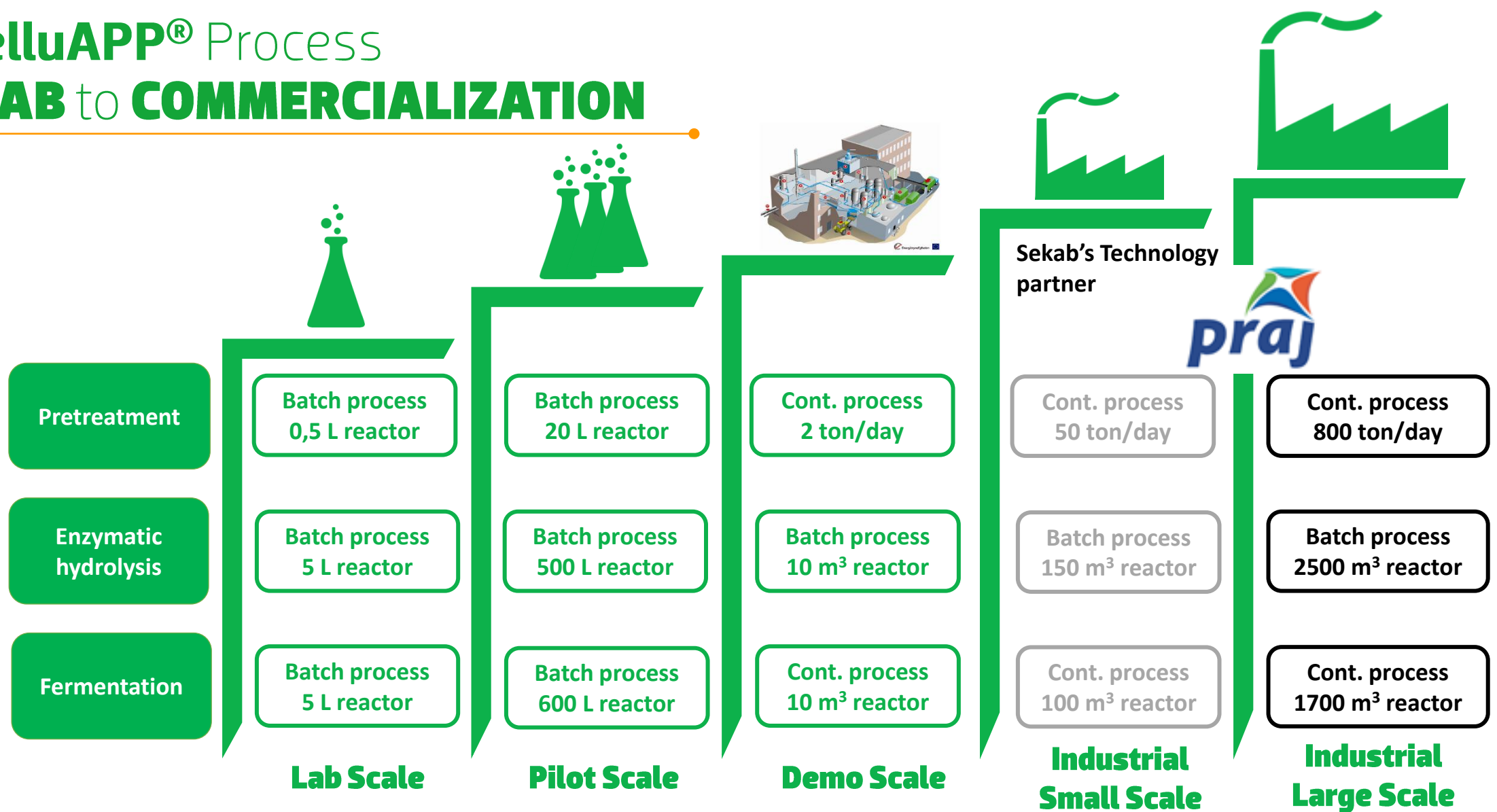
From the Biorefinery Demo plant:

- Delivery of approximately totally 100 ton DM, of soft wood residues to the Biorefinery demo plant, Örnsköldsvik
- 40 ton DM crude residual wood hydrolysate sugar solution for isobutene production
- 10 ton DM residual wood hydrolysate lignin
- The produced lignin from the BDP will be tested at lab in development of lignin-bitumen blend, asphalt mixing and measurement of properties



The CelluAPP[®] Process

from **LAB** to **COMMERCIALIZATION**



Praj + Sekab advantages – in summary to scale up CelluAPP® Technology

Innovations /
technology
patent portfolio

Forest residue
handling
experience



Engineering and
integration
capabilities

Pilot and demo
plants



Resource
strength

Industrial scale
references in
bio-processing



Driving on lignin from the forest – it may be possible!



van gelder

TNO innovation
for life



The time is right
for development



DEVELOPMENT PLAN

cellulosic biomass production plant to be operational in end of 2025

- ✓ advanced bio-ethanol out of sawdust and softwood forest residues
- ✓ Sekab biorefinery plant is expected to produce:
 - ✓ 78 kt of advanced bio-ethanol
 - ✓ 51 kt crude lignin oil, 146 kt lignin
 - ✓ 6 kt bio-gas and
 - ✓ 83 kt bio-CO₂ per year

High-level overview of plant operation

Biomass forestry residues

- Softwood / sawdust
- Softwood / shavings
- Additives:
 - Molasses
 - Bio-ethanol
 - Enzymes



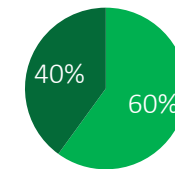
CelluAPP® Goldilocks®

Bio-outputs

- Advanced bio-ethanol
- Crude Lignin Oil (CLO)
- Lignin
- Bio-gas
- Bio-CO₂

Destination markets

- Sweden
- Other markets



CAN WE AFFORD NOT TO **VALORIZE** **SOFTWOOD RESIDUES?**





**What roads should we
take in the future?**

Sekab



THANK YOU FOR YOUR ATTENTION!

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