



Bio Base Europe
Pilot Plant

Örestad
September 18, 2013

Boosting the Bio-based Economy



Hendrik Waegeman, PhD

Outline

History

The Pilot
Plant

Projects and
case studies

Outline

History

The Pilot
Plant

Projects and
case studies

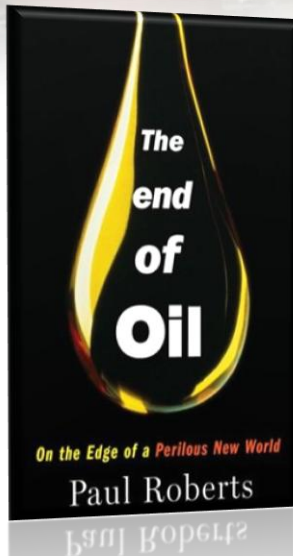
History

Transition to a bio-based economy



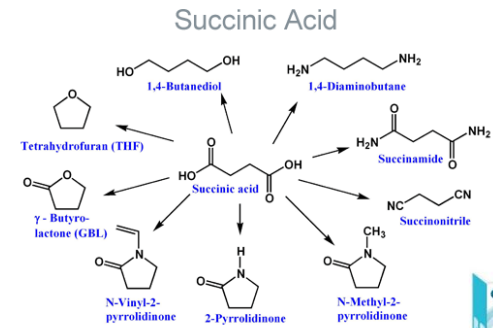
History

Transition to a bio-based economy



History

Transition to a bio-based economy



ECOVER



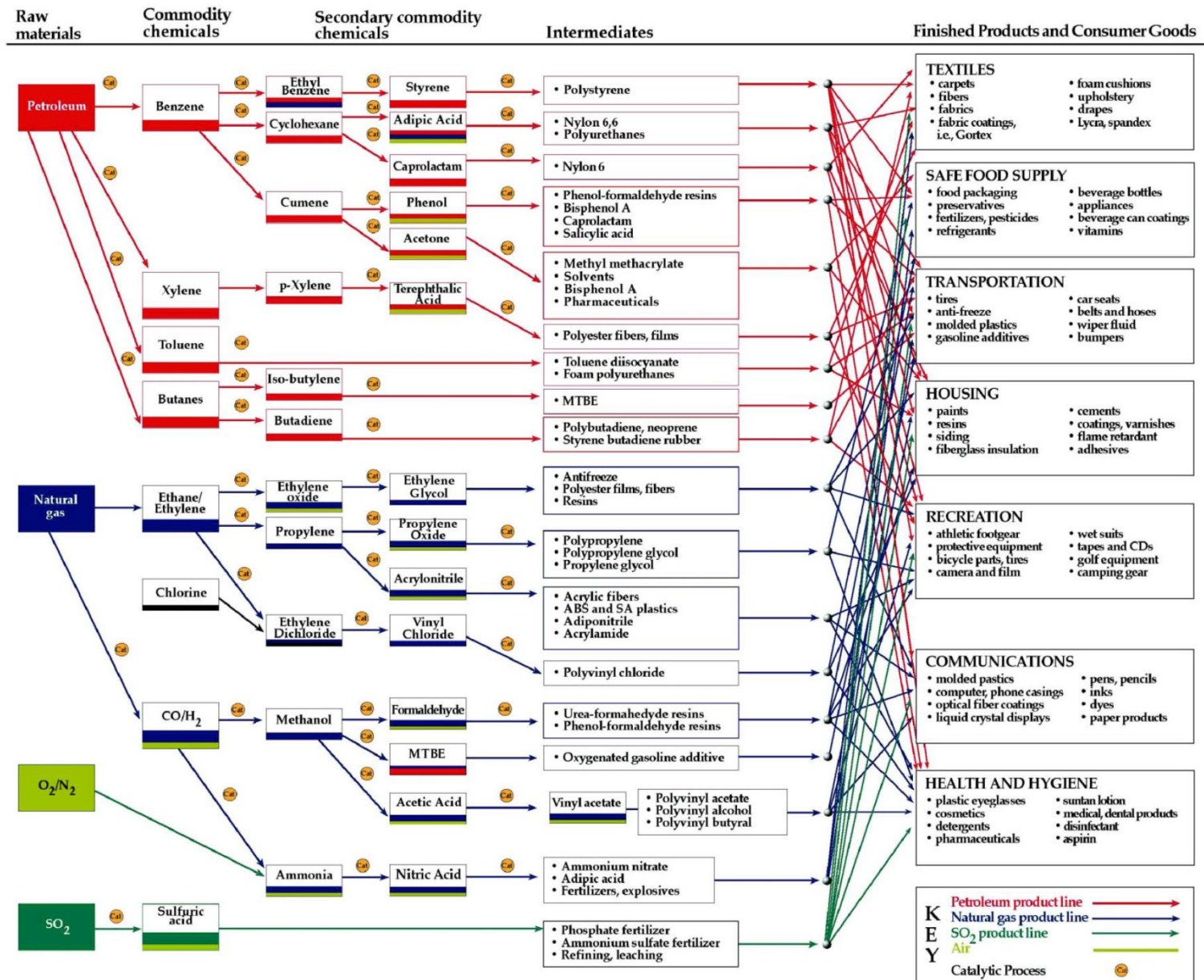


Figure 2 – An Example of a Flow-Chart for Products from Petroleum-based Feedstocks

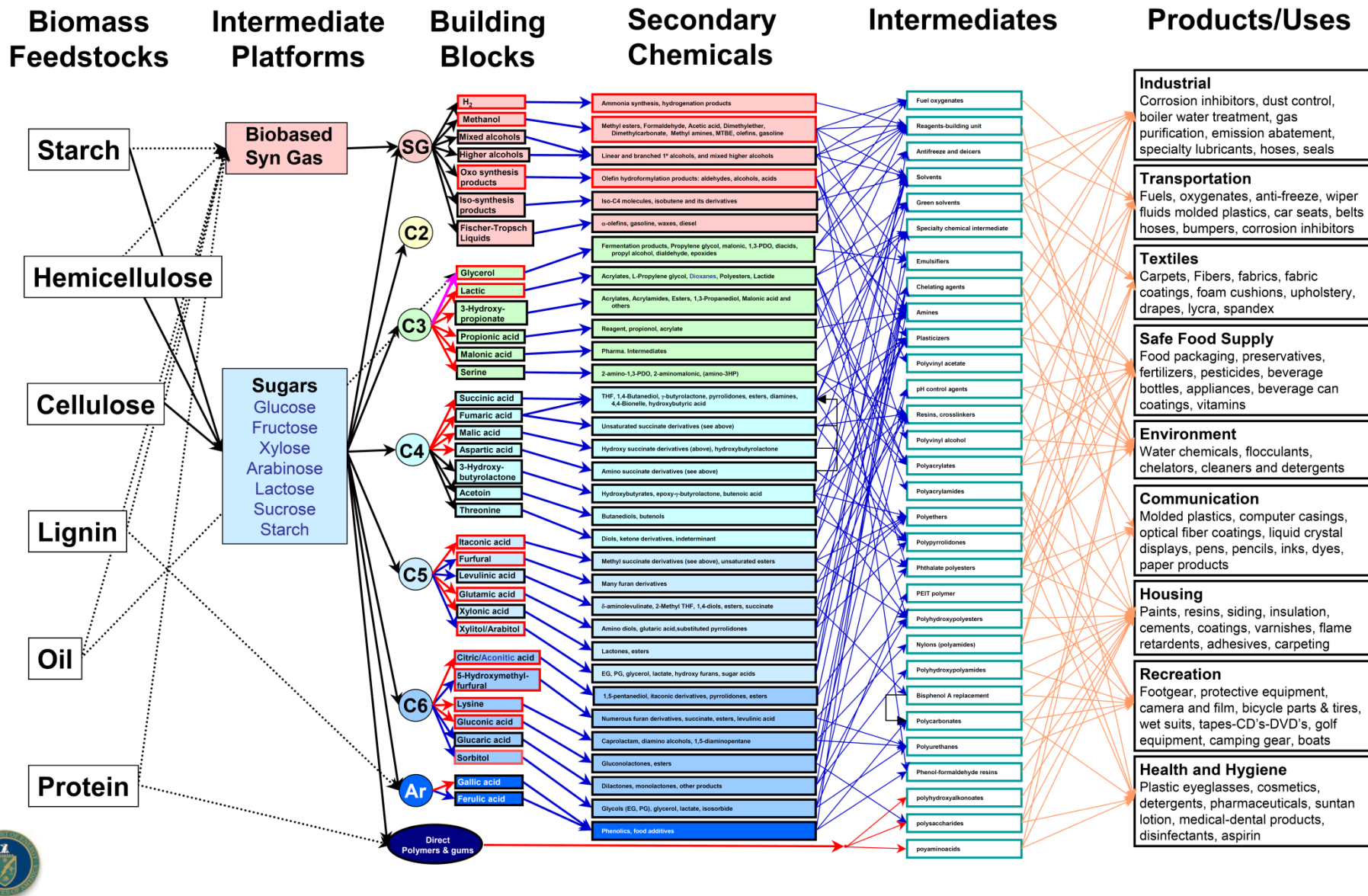


Figure 3 – Analogous Model of a Biobased Product Flow-chart for Biomass Feedstocks

History

The bio-based economy in Belgium



GHENT BIO-ECONOMY VALLEY

A Public Private Partnership for the promotion of sustainable bio-based activities and economic development in Ghent

Ghent Bio-Economy Valley



PUBLIC ORGANISATIONS



INDUSTRIAL MEMBERS



ACTIONS OF GHENT BIO-ECONOMY VALLEY

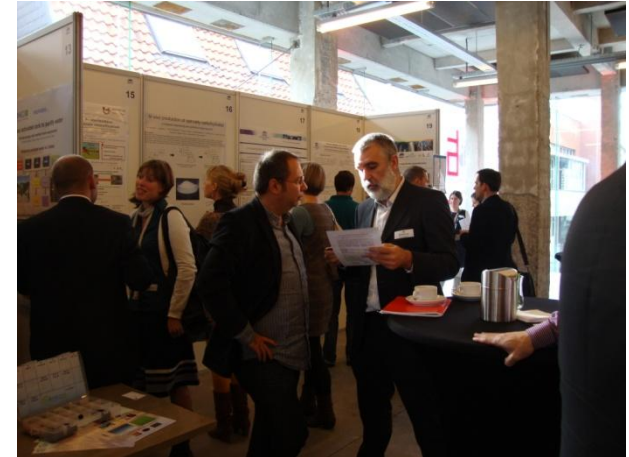
- **Sensitization:** organisation of information campaigns about bio-energy and biobased economy
- **Cluster formation** in the port of Ghent: building synergies between the industrial partners
- **Technological innovation:** building R&D expertise in the field of bio-energy/chemicals

Ghent Bio-Economy Valley

Sensitization



Workshops



Conferences



Guided tours

ACTIONS OF GHENT BIO-ECONOMY VALLEY

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Ghent Bio-Economy Valley

Cluster formation



Ghent Bio-Economy Valley

Cluster formation



300.000 tonnes biodiesel



200.000 m³ bio-ethanol



240 MW bio-electricity

BIOREFINERY RODENHUIZE DOCKS: THE LARGEST
INTEGRATED PRODUCTION COMPLEX FOR
BIOFUELS IN EUROPE

ACTIONS OF GHENT BIO-ECONOMY VALLEY

- **Sensitization:** organisation of information campaigns about bio-energy and biobased economy
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History



A joint initiative of Flanders and The Netherlands
with a total budget of 21 M€

Founding fathers:



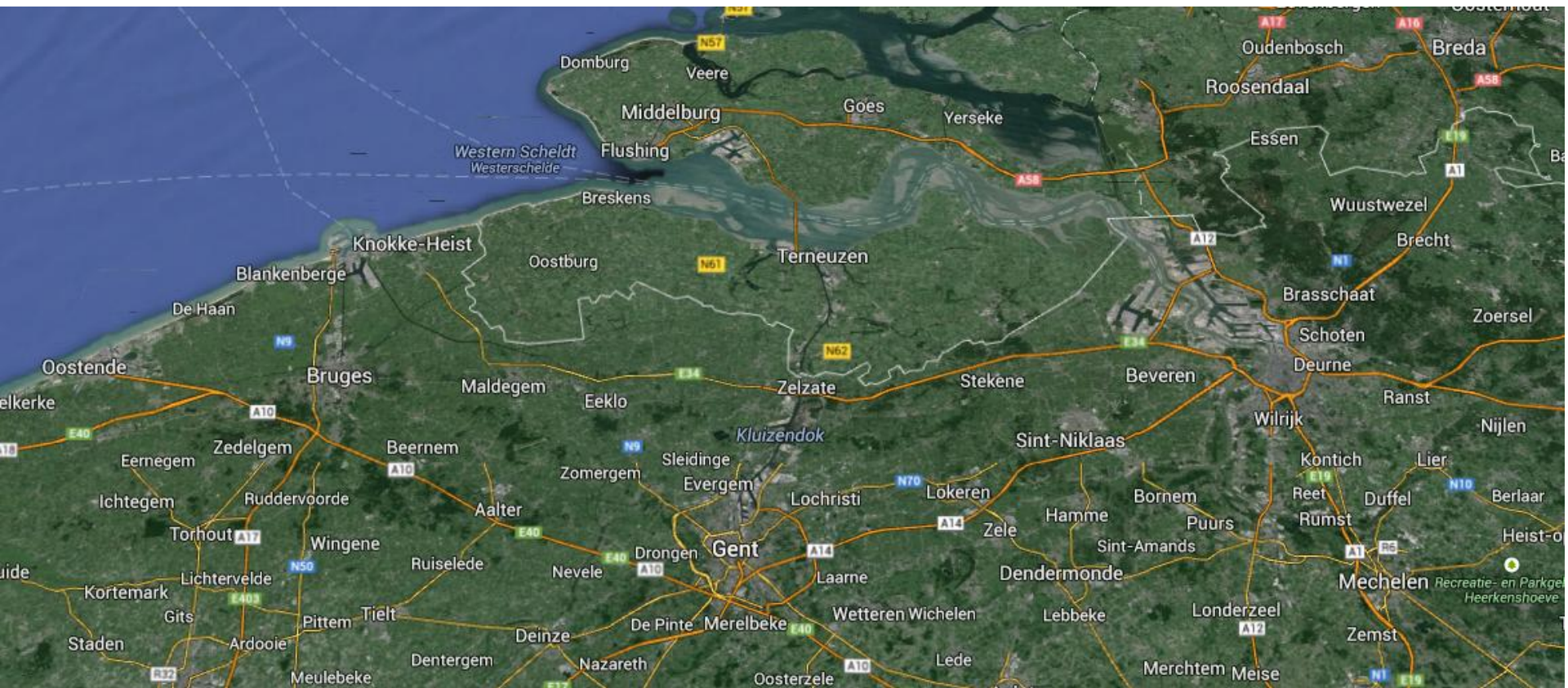
Biopark Terneuzen



**A biopark for the promotion of sustainable
bio-energy activities in the Terneuzen region**

www.bioparkterneuzen.com

Location



Biopark Terneuzen



PUBLIC ORGANISATIONS



INDUSTRIAL MEMBERS



Biopark Terneuzen



ACTIONS OF BIOPARK TERNEUZEN

- **Joining forces** between public and private partners to develop biobased activities in Terneuzen
- **Cluster formation** by building synergies between industrial partners
- Promoting **industrial sustainability**

Biopark Terneuzen





A biopark for the promotion of sustainable bio-energy activities in the Terneuzen region

WarmCO₂

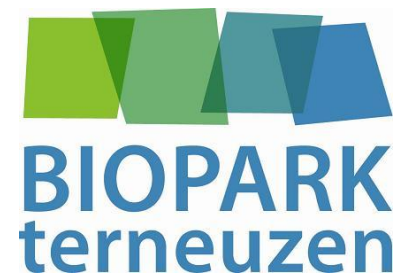
Supply of heat and CO₂ from the Yara ammonia factory to the local greenhouse park

Yara (ammonia factory)



Greenhouse park

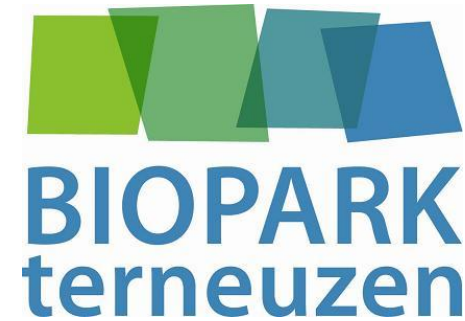
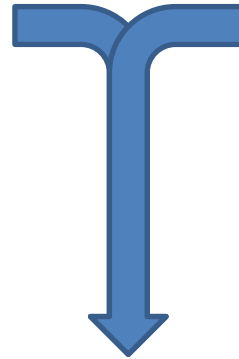




GHENT AND THE CANAL REGION HAVE EXCELLENT CONDITIONS FOR BUILDING THE BIO-BASED ECONOMY

- The Port of Ghent and Terneuzen have traditionally been very strong in the handling of agricultural commodities
- The Ghent region is a world class player in the field of biotechnology
- The bio-fuel production and the BBE Pilot Plant and Training Center are laying the industrial base for building the bio-economy

Rationale

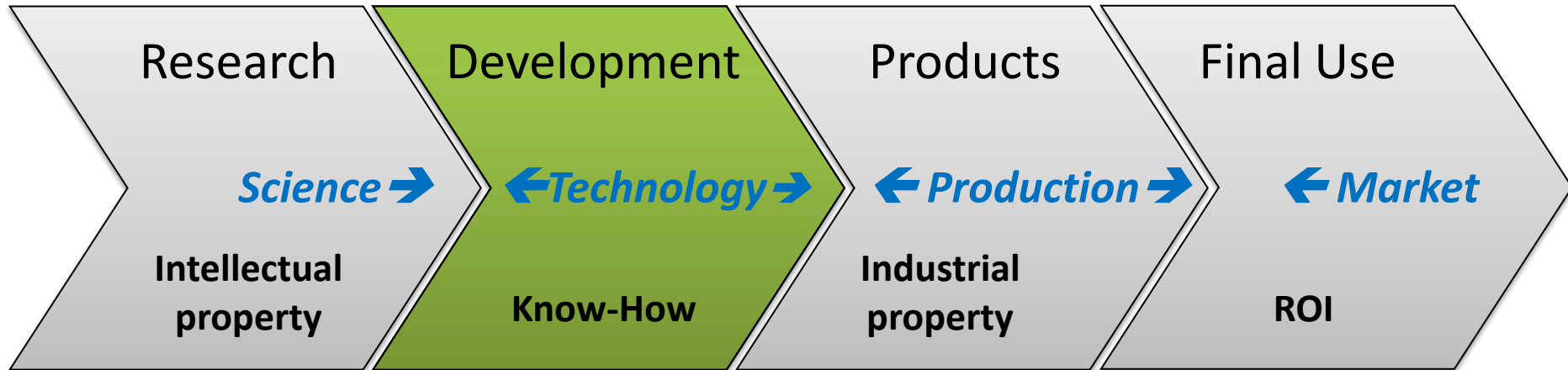


*Hurdles for the development of a sustainable
bio-based economy in Belgium and The
Netherlands*

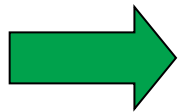


"What's the opposite of 'Eureka!'?"

Problem 1: Gap in the Innovation Chain



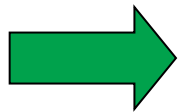
- Knowledge and expertise are present but...
- Insufficient translation of knowledge into industrial innovation
- Not enough value creation on scientific results



**Need for a multipurpose pilot plant
for biobased products**

Problem 2: lack of process operators

- Declining student interest for technical studies
- Shortage of operators for process industries in general
- Lack of visibility of the bio-based economy

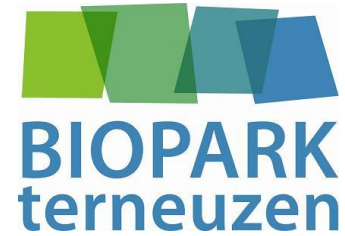
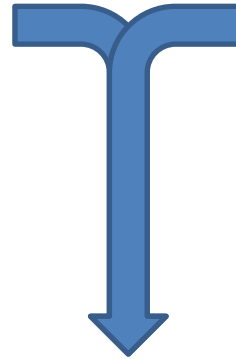


Need for a dedicated training facility for process operators in biobased industry

Funding



Funding



Rationale

2 hurdles for the bio-based economy

Gap in the innovation chain

Lack of process operators
for bio-based industries



Bio Base Europe
Pilot Plant



Bio Base Europe
Training Center



Bio Base Europe

Facts and figures

	Investment in M€	N° of FTEs
BBE Pilot Plant	13	32
BBE Training Center	8	12
Total	21	44

Bio Base Europe Training Center

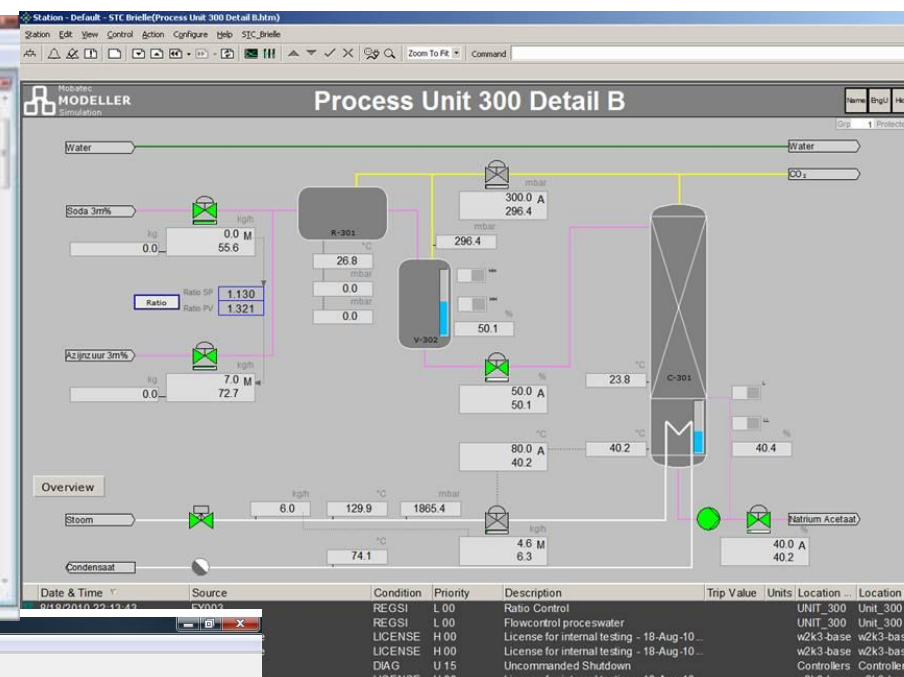
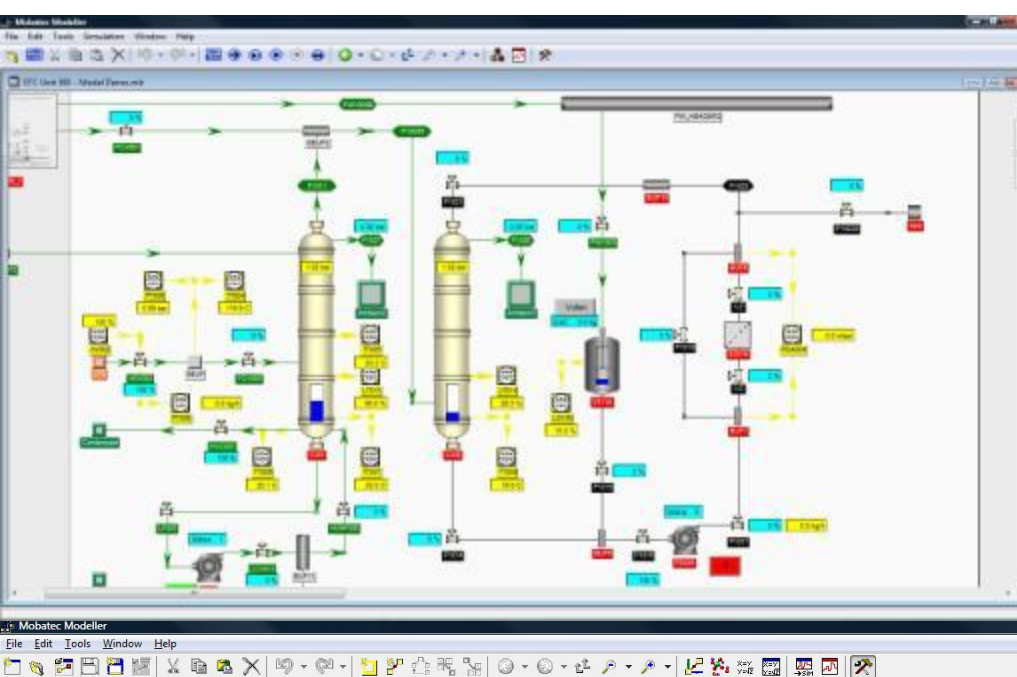


Bio Base Europe
Pilot Plant

Bio Base Europe Training Center

- **Education of students into process operator:**
Tailor made training programs for company process operators
 - Dynamic Process simulators
 - Web-based learning management system
- **Information and Exposition:**
General information on sustainable technologies and bio-based products and processes
- **Networking and encouraging entrepreneurship in the bio-based economy.**

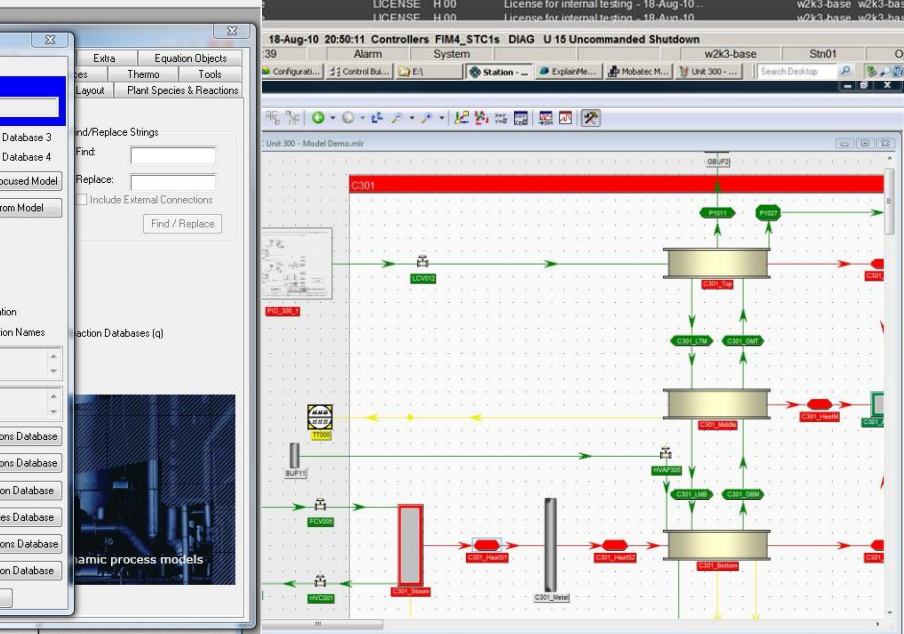




This screenshot shows the 'Cooling Water System (G P&ID)' window. The 'Equations Editor' is open, displaying a list of defined equations and their descriptions. The equations are categorized by class (System, Reaction, etc.) and include various physical and chemical models.

Equations Editor:

- Equation Class:** System, Reaction, Bi-directional Mass Connection, Uni-directional Mass Connection, Phase Change Connection.
- Equation Filter:** All Equations, All Connection Equations, All Reaction Equations, System Equations, Bi-Directional Mass Connections, Uni-Directional Mass Connections, Phase Change Connections, Heat Connections, Work Connections, Reaction Equations, Information Connection Equations, "Fast" Heat Connections.



Outline

History

The Pilot
Plant

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case studies

Location



Attractive location



- 250 000 inhabitants, 70 000 students
- Medieval city: Between 1000 and 1550 Ghent was one of the biggest cities of Europe, bigger than London
- It was one of the cities in Europe that was first industrialized





http://www.lonelyplanet.com/belgium/travel-tips-and-articles/2446



Google



Ghent: Belgium's best kept secret - travel tips and arti...



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Tips & articles

Apr 1, 2011 3:59:19 AM

Ghent: Belgium's best kept secret



View gallery

If you automatically think a trip to [Belgium](#) means a trip to [Bruges](#), think again. The September '09 issue of [Lonely Planet Magazine](#) clues you in to [Ghent](#): the new Bruges...

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Ghent
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Tips & articles

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Lonely Planet's top 10 cities for 2011



GHENT

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Getting there & around
Practical information
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THINGS TO DO

- All things to do (82)
- Activities (3)
- Entertainment (25)
- Restaurants (18)
- Shopping (24)
- Sights (12)
- Tours (0)



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Attractive Location



Mission

**Enable the transition to a
sustainable bio-based economy**

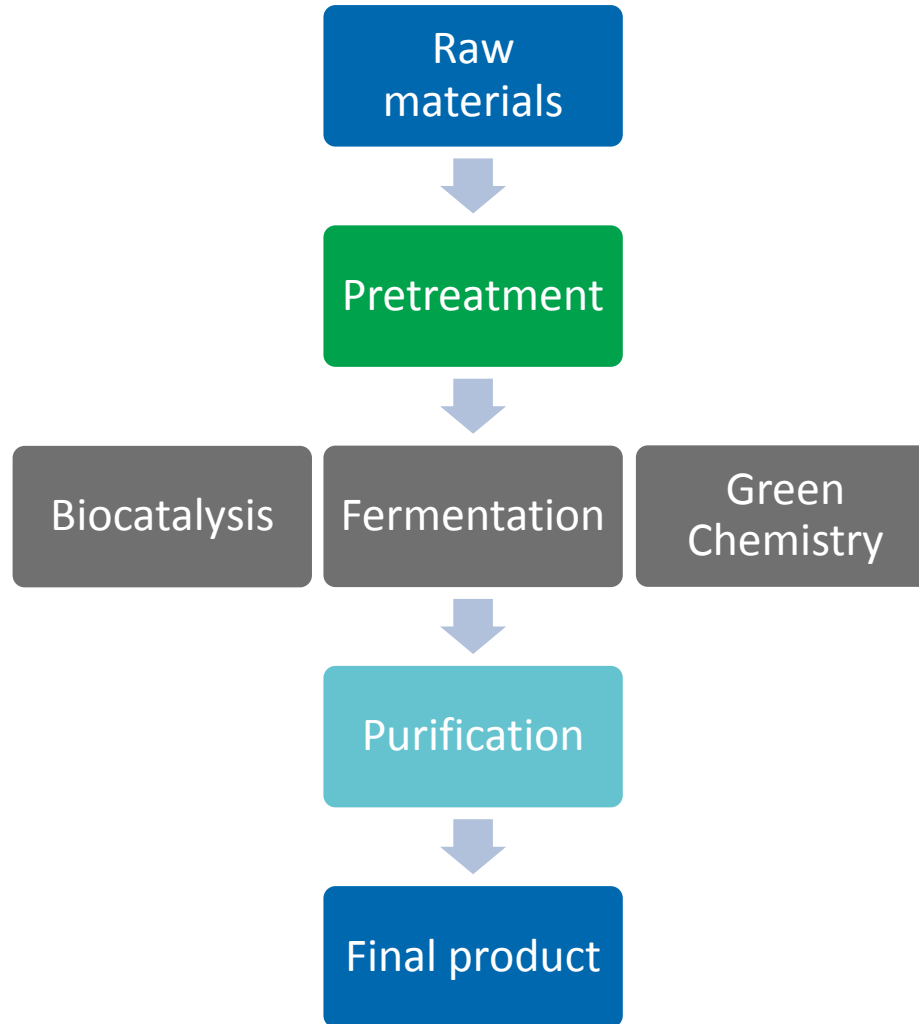
through

**Development, scale-up and custom manufacturing
of bio-based processes and products**

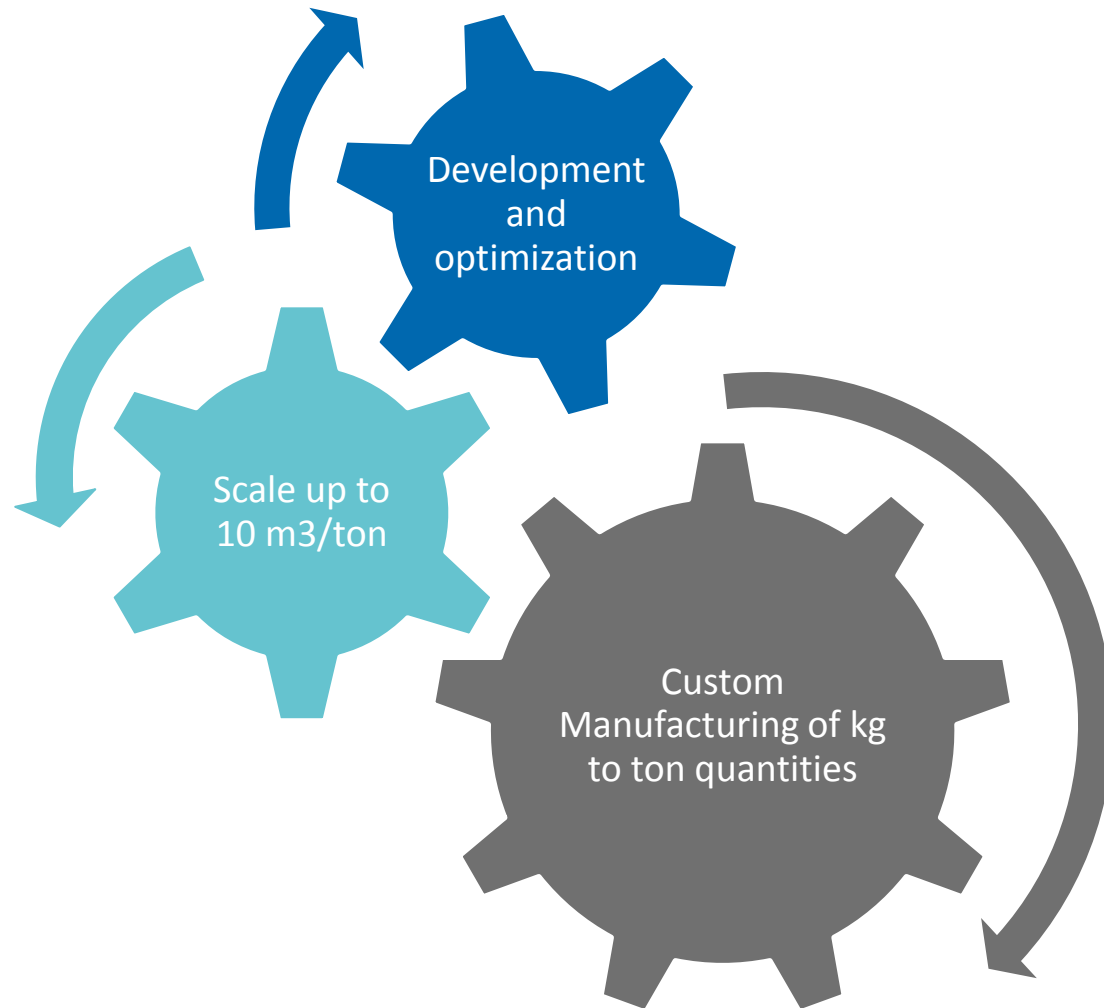
Strategy

‘To cover the whole production chain, from green resource to final product, under one roof’

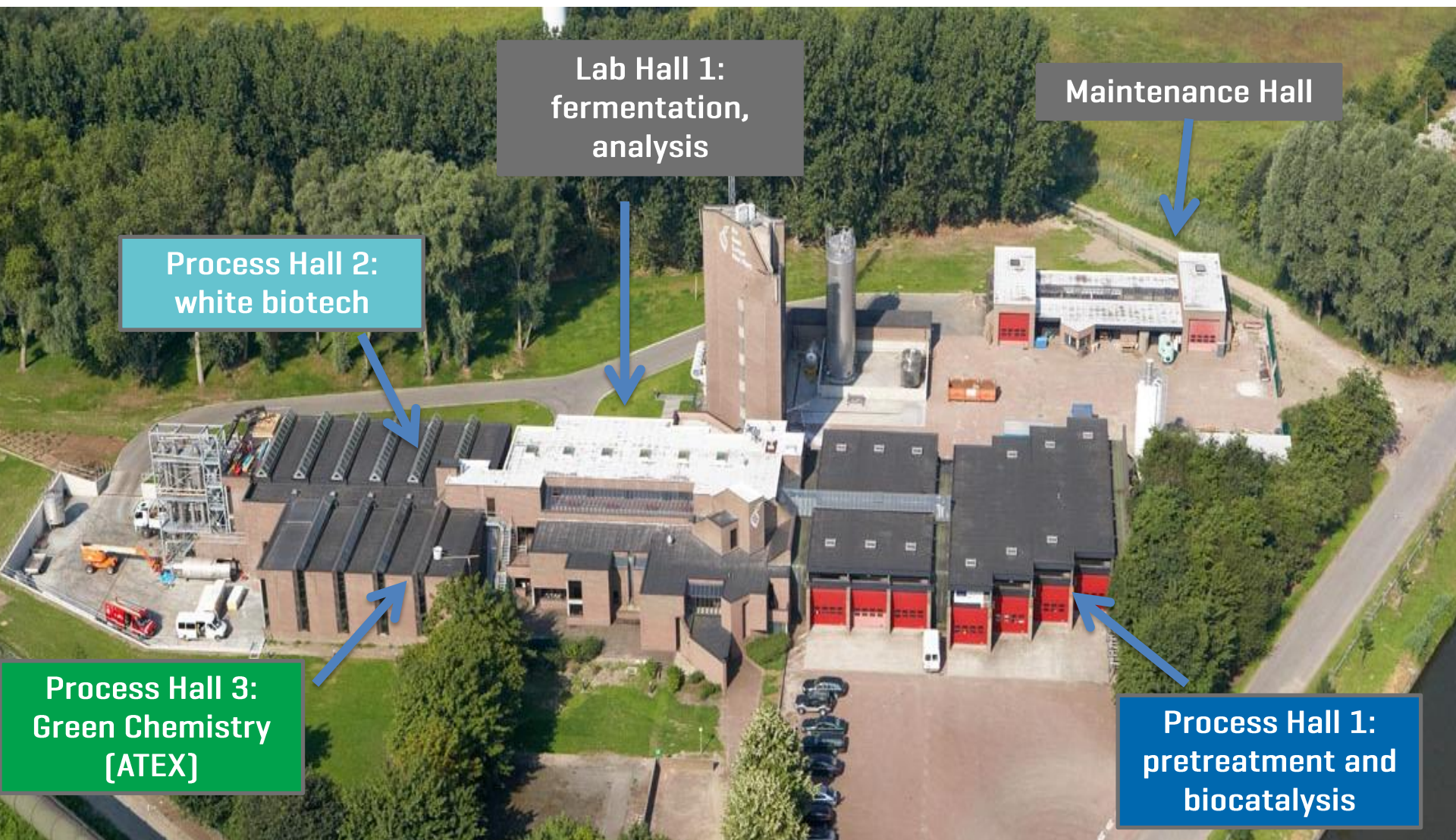
Strategy



Activities



Facility





Process Hall 1: Pretreatment and biocatalysis



Process Hall 2: Fermentation and DSP



Process Hall 3: Green Chemistry and ATEX proof DSP



Laboratory: Analysis and process development

Technologies

Pretreatment

- Mechanical, physico-chemical and enzymatic pretreatment of biomass feedstocks
- e.g. acid hydrolysis, organosolv, ...

Biocatalysis

- Enzymatic conversions in aqueous and two-phase systems
- e.g. chemical conversions and oligosaccharide synthesis

Fermentation

- Batch, fed-batch, chemostat, cell recycle
- Bacterial, yeast, fungal
- e.g. production of biofuels, biochemicals, industrial enzymes

Green Chemistry

- Solvent-based chemical reactions using bio-based feedstocks
- Production of biodiesel

Downstream purification

- Evaporation, micro-, ultra-, and nanofiltration
- Crystallization, ion exchange, chromatography, spray- and freeze-drying
- Solvent extractions

Equipment

Pretreatment

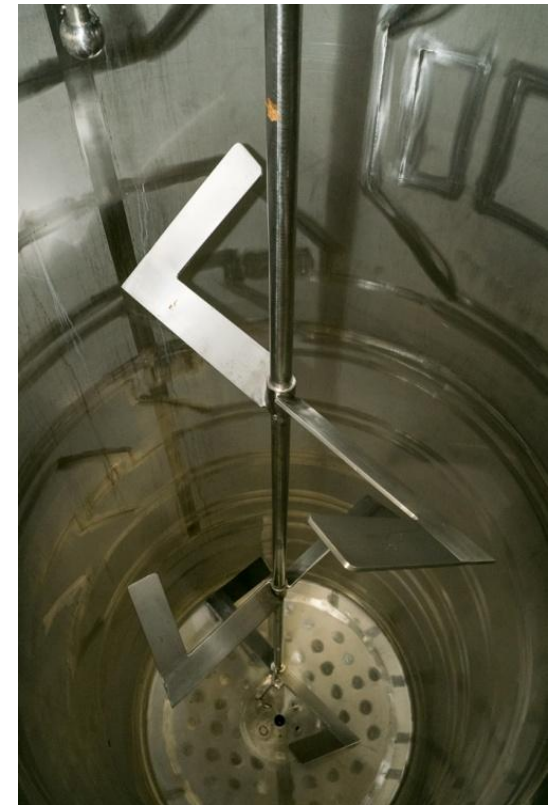
- Mechanical, physico-chemical and enzymatic pretreatment of biomass feedstocks
- e.g. acid hydrolysis, organosolv, ...



Equipment

Biocatalysis

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Equipment

Fermentation

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Equipment

Green Chemistry

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Equipment

Downstream purification

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Equipment

Downstream purification

- Evaporation, micro-, ultra-, and nanofiltration
- Crystallization, ion exchange, chromatography, spray- and freeze-drying
- Solvent extractions



Equipment overview

- Fermentation equipment up to 15 m³
- Biocatalysis equipment up to 4x8 m³
- Green chemical reactors up to 5 m³
- Modular unit operations
 - Micro-, ultra- and nanofiltration
 - Solids dispersion: peddle mixers, pulpers, inline Typhoon mixer, screw press
 - Centrifuges, decanter
 - Ion exchange and chromatography
 - Drying: wiped film, falling film, ovens, vacuum chamber dryer, ...
 - Homogenizer, jet cooker, milling, ...

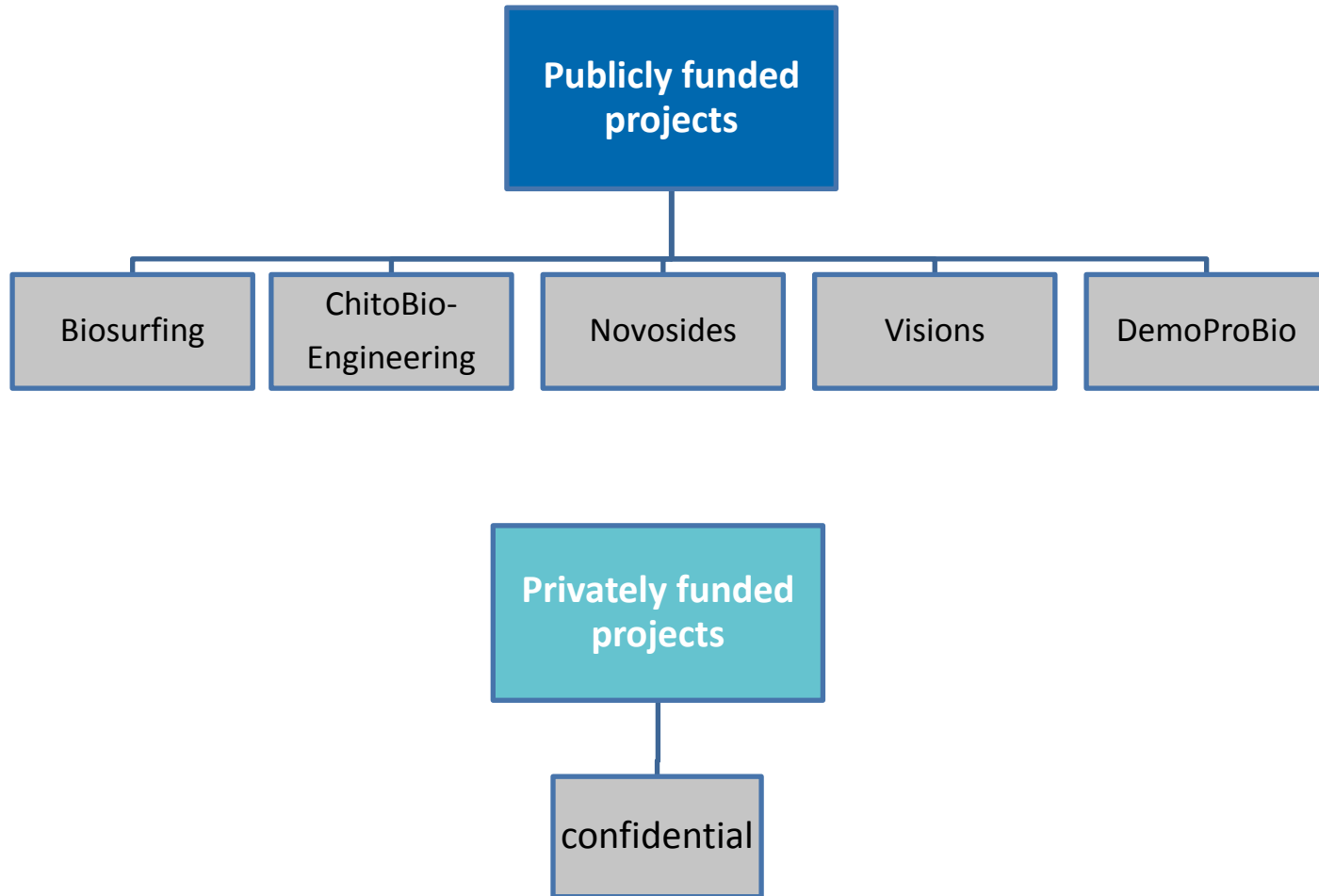
Outline

History

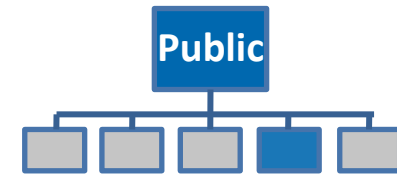
The Pilot
Plant

Projects and
case studies

Projects



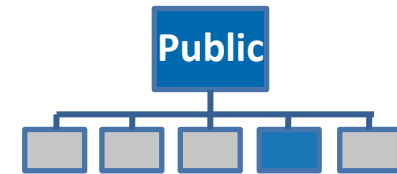
Visions



Goal of the project:

Substrate identification & technological evaluation
to develop 2nd generation activities in Flanders
based on waste streams & co products

Visions



Part 1

- Analysis/survey of available organic waste streams in Flanders

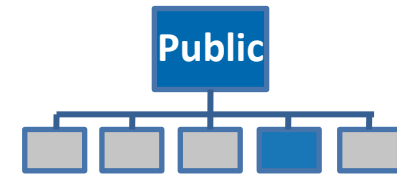
Part 2

- Development of 2nd generation technologies to utilize waste oils and fats and lignocellulose-rich side streams

Part 3

- Implementation of the developed technology in Flanders

Visions

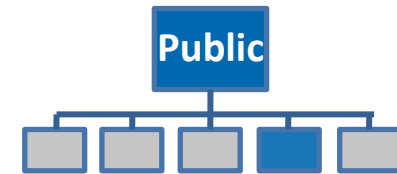


Part 1

- Analysis/survey of available organic waste streams in Flanders



Visions



Part 1

- Analysis/survey of available organic waste streams in Flanders

Lignocellulosic materials

Cat 1: No/ mild pretreatment



Cat 2: Medium pretreatment



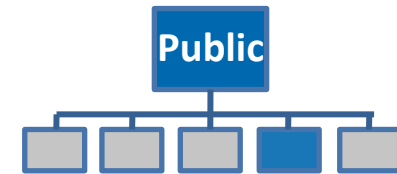
Cat 3: Harsh pretreatment



Fats and oils

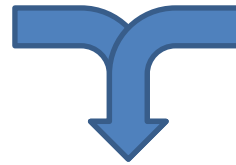


Visions



Part 2

- Development of 2nd generation technologies to utilize waste oils and fats and lignocellulose-rich side streams



WP2: Lignocellulosics

- 1) **Evaluation** of different existing pretreatment technologies **and development** of new pretreatment technologies to pretreat **corn stover** and **paper waste** (lab scale)
- 2) **Scale up** to pilot scale

WP3: Animal fats and cooking oils

- 1) **Chemical and enzymatic conversion** of the fats and oils in **biodiesel** and **oleochemicals**: evaluation on lab scale
- 2) **Scale up** to pilot scale

All the technologies are evaluated and demonstrated on pilot scale!!!

Visions

Case: paper waste



Visions

Case: corn stover



Visions

Case: pruned popular wood



Privately funded projects

Private

Markets

- ❖ Bioplastics, Biofuels, Biosurfactants
- ❖ Pharma
- ❖ Industrial enzymes and whole cell biocatalysts
- ❖ Flavors and fragrances
- ❖ Specialty carbohydrates

Processes [examples]

- **General process development and optimization:** evaluation of new filtration or drying method, optimization of fermentation conditions
- **Pretreatment** (Acid hydrolysis) of alternative **biomass feedstocks**
- **Chemical modification of carbohydrate polymers or plant oils**
- **Scale up** of fermentation processes to 4.5 m³ scale
- **Biocatalytic production of oligosaccharides**
- ...

All projects are confidential

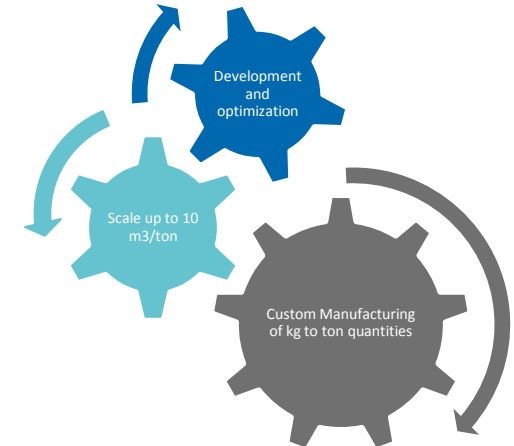








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**Speeding up the development of a
bio-based economy...**