Bio Base Europe Pilot Plant

Turning Grams into Tonnes

Pilots4U workshop

Brussels, 2018/04/18

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Content

- BBEPP and services its provides
- Case studies
- How to protect the intellectual property rights of BBEPP and its customers

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- **BBEPP and services its provides**
- Case studies
- How to protect the intellectual property rights of BBEPP and its customers

About BBEU

Bio Base Europe Pilot Plant

Multi-purpose pilot facility for bio-based products and processes

Fact and figures

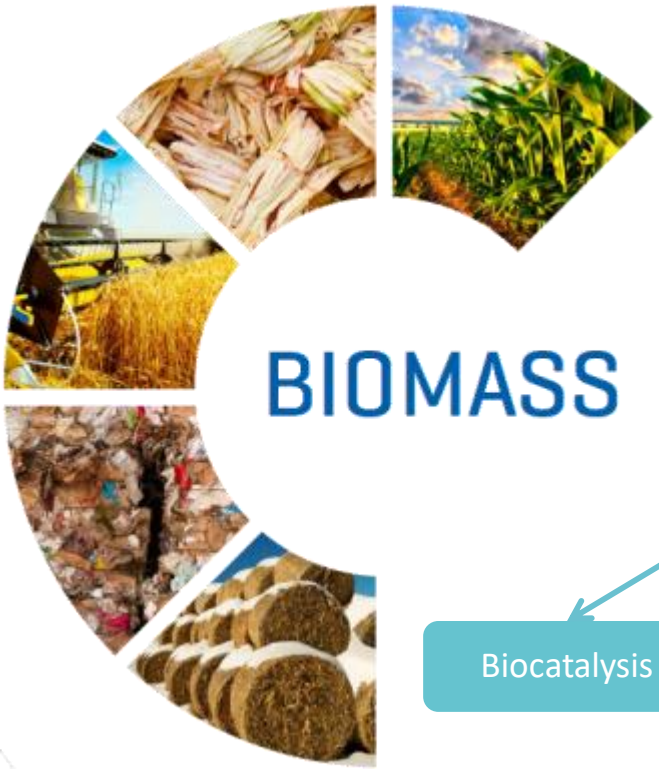
- Independent service provider
- Operational since 2010
- Current number of employees: 70
- No industrial shareholders
- Bilateral projects: > 200 projects for > 100 companies
- Consortium projects: 19 projects ongoing, 13 projects finished

International Organization for Standardization ISO 9001

Food Safety System Certification 22000 FSSC 22000

A one-stop-shop

Bio Base Europe
Pilot Plant



BIOMASS

Pretreatment

Biocatalysis

Fermentation

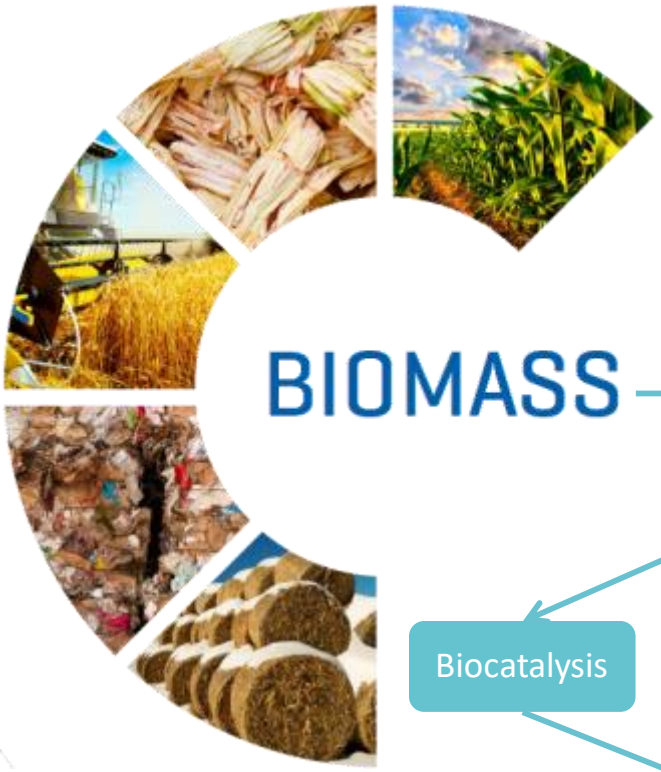
Green Chemistry

Downstream Purification

REFINED PRODUCT

… and beyond

Bio Base Europe Pilot Plant



BIOMASS → Pretreatment

Pretreatment → Biocatalysis | Fermentation | Gas Fermentation | Green Chemistry

Biocatalysis | Fermentation | Gas Fermentation | Green Chemistry → Downstream Purification → REFINED PRODUCT

CO_2 – CO – H2

- ✓ **Abundant feedstock**
- ✓ **GHG reuse and reduction**
- ✓ **Avoid overexploitation of natural resources**

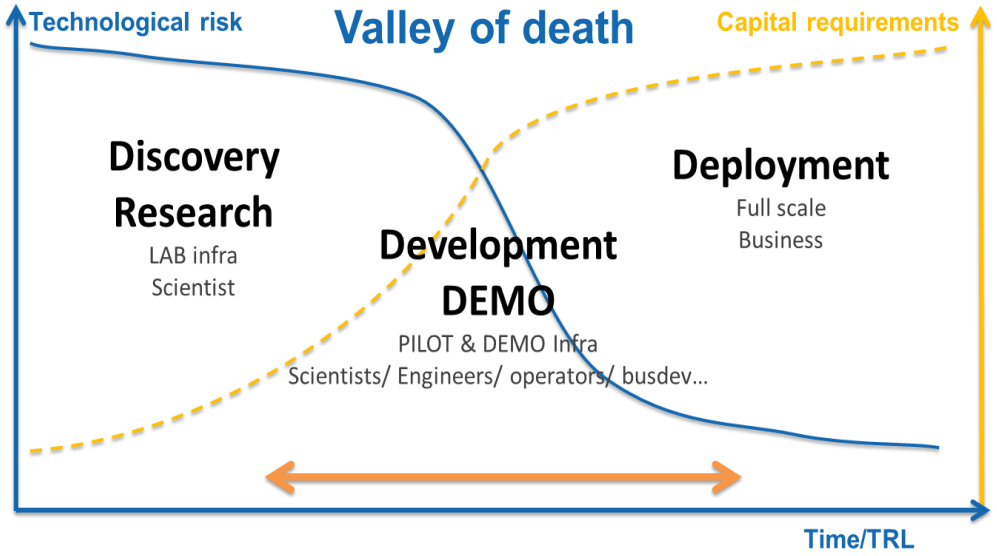
Examples

Bio Base Europe
Pilot Plant

Corn stover
Paper pulp
Oils and fats
Husks, bran, straw
Agro Industrial by-products
Bagasse, beet pulp, seed press cakes
Algae
Non-food crops
Syngas
Defined media: glucose, sucrose, etc.
…

Bio-chemicals
Bio-based building blocks
Industrial Enzymes
Solvents
Polymers
Flavors and fragrances
Protein concentrates
Surfactants
Nutraceuticals
Fuels
Specialty carbohydrates

What's missing?



Shared Pilot Facilities

=

risk sharing & reduction

- SPF play a key role in piloting disruptive technologies
- Scaling gas fermentation vs. conventional fermentations is far from trivial!
- Bridging the ~~valley~~ **canyon** of death

Services

Bio Base Europe Pilot Plant

- Concept design
- Fermentation optimization
- Downstream processing (DSP) development and optimization
- Techno-economic assessment (in-house developed model)

Process Development

- From 10 L to 15 m3 for fermentation + DSP, up to 50 m3 for other processes
- Generation of samples for application research
- Demonstration of technology at larger scale
- Pilot scale data (mass- and energy-balances, …)

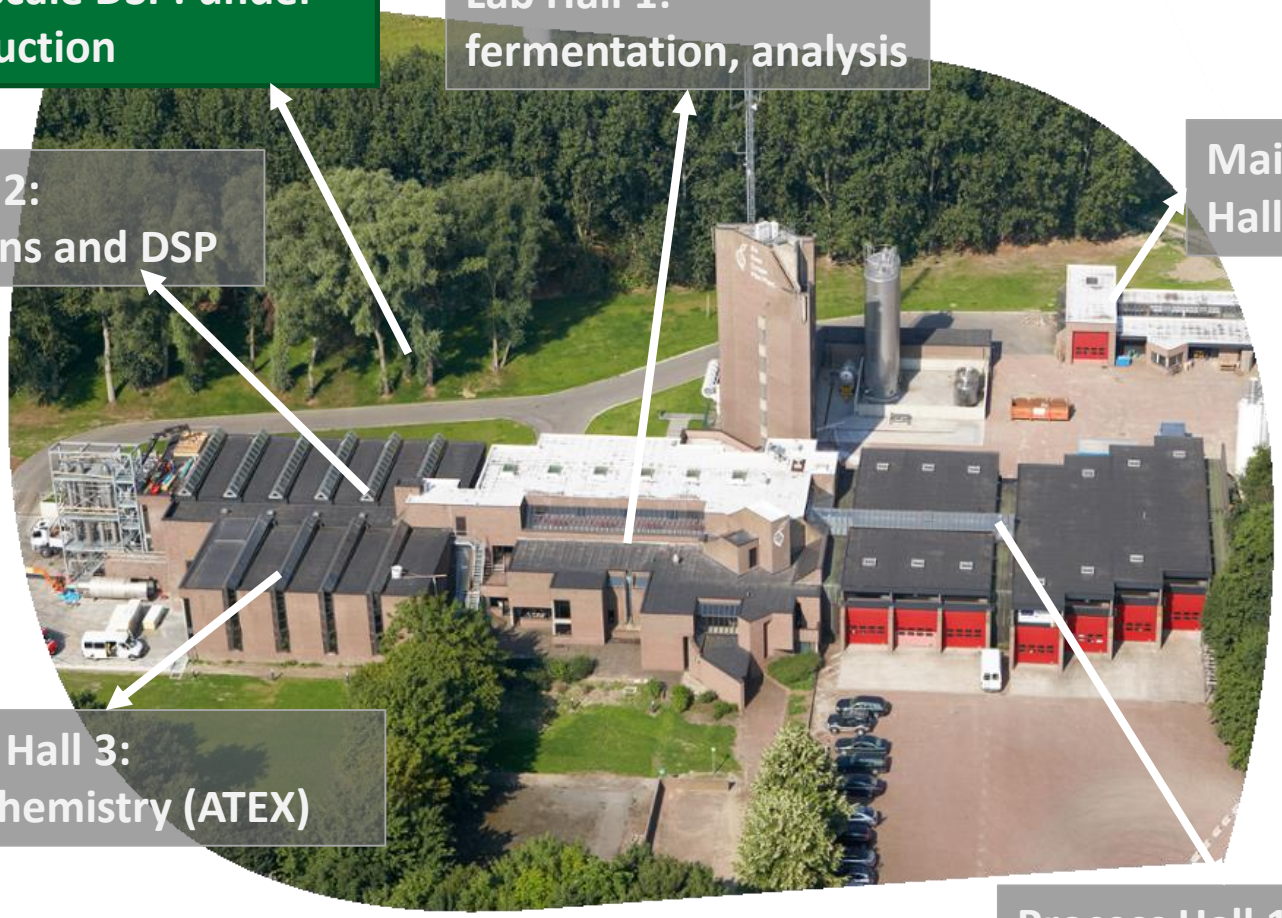
Scale Up

- 1,5 m3, 4,5 m3 and 15 m3
- Fermentation
- (Solvent-)based DSP
- Biocatalysis

Custom Manufacturing

Floor plan and infrastructure

Bio Base Europe Pilot Plant



Process Hall 4:
Large scale DSP: under construction

Lab Hall 1:
fermentation, analysis

Process Hall 2:
Fermentations and DSP

Maintenance Hall

Process Hall 3:
Green chemistry (ATEX)

Process Hall 1:
Pretreatment, DSP and biocatalysis

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Pilot Plant

Process Hall 1

Biomass pretreatment, biocatalysis and DSP

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Process Hall 2

Fermentations and DSP

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Process Hall 3

Green chemistry and ATEX proof DSP

Process Hall 4

Under construction

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Laboratory

Analysis and process development

Business Model
Open Innovation Projects

Bio Base Europe
Pilot Plant

- Independence
- Flexibility
- Confidentiality

Bilateral projects with industry

Confidential

- Bilateral, privately funded
- Intellectual Property remains with customer
- > 200 projects for > 100 companies

Consortia-based projects

- Partly subsidized, partly privately funded
- Building expertise
- Value chains
- Allows publicity and communication

Business Model
Open Innovation Projects

Bio Base Europe Pilot Plant

- Independence
- Flexibility
- Confidentiality

Bilateral projects with industry

Confidential

- Bilateral, privately funded
- Intellectual Property remains with customer
- Over 200 projects for over 100 companies

In few cases resulted in press releases, examples on:

http://www.bbeu.org/pilotplant/category/testimonials/

REG Renewable Energy Group

DUPONT

EVONIK

CONSORTIA-BASED PROJECTS:
Technology development, scale up and building new value chains

Bio Base Europe Pilot Plant

ERA-IB & Horizon2020

MARISURF - **Marine biosurfactants**

ERIFORE - **Circular Forest Bioeconomy**

REHAP - **valuable compounds from forestry residues**

DAFIA – **Biomacromolecules from waste fractions for high value applications**

NANOPACK - **Pilot line production of functional polymer nanocomposites**

FALCON – **Enzymatic lignin degradation**

SuperBio - **Support and partnership in the bio-based economy**

BioCONCO2 - **BIOtechnological processes based on microbial platforms for the CONversion of CO2 from ironsteel industry into commodities for chemicals and plastics**

Regional- Flemish

COOPERATE - **All renewable CCU based on formic acid integrated in an industrial microgrid**

SPICY (**2,3-BDO**) – APPLISURF **(biosurfactants)**

INTERREG projects

BioHArT - **Technology for bio based renewable aromatics**

BIOBASE4SME - **Bio-Innovation Support for Entrepreneurs**

SMARTPILOTS - **Network shared pilot facilities for Bio Economy**

IMPACT - **Building new demonstration equipment for the development of IB**

H2020 BBI-joint undertaking

PULP2VALUE - **sugarbeet pulp into value added products**

CARBOSURF - **biosurfactants & specialty carbohydrates**

DEMETER - **enzymes for anaerobic digestion**

ReSolve - **REnewable SOLVEnts with high performance and improved toxicity profile**

Pilots4U - **A Network of Bioeconomy open access pilot and multipurpose demo facilities**

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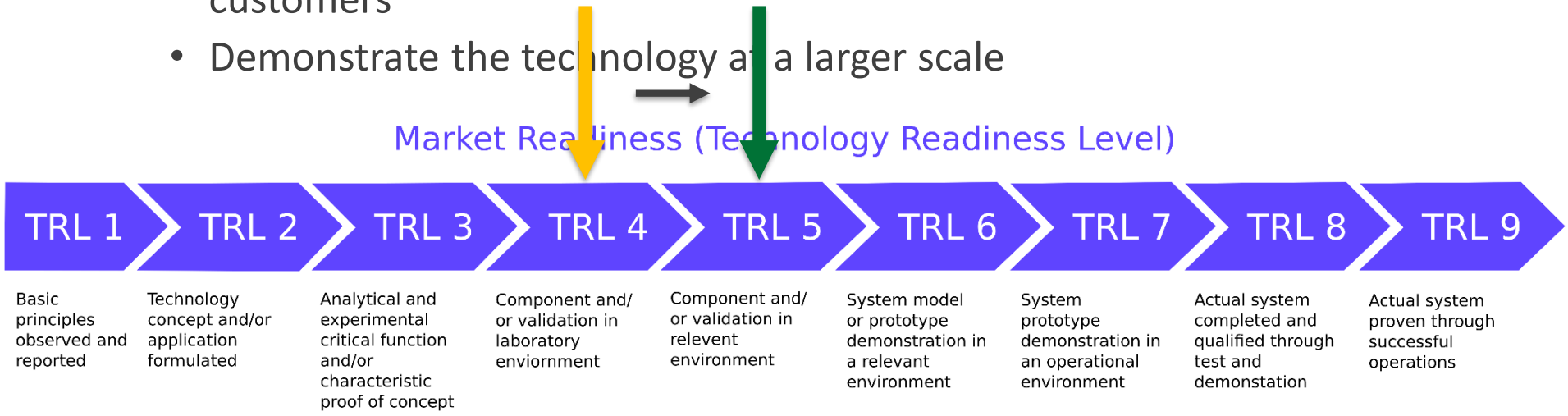
Case study 1

Bio Base Europe Pilot Plant

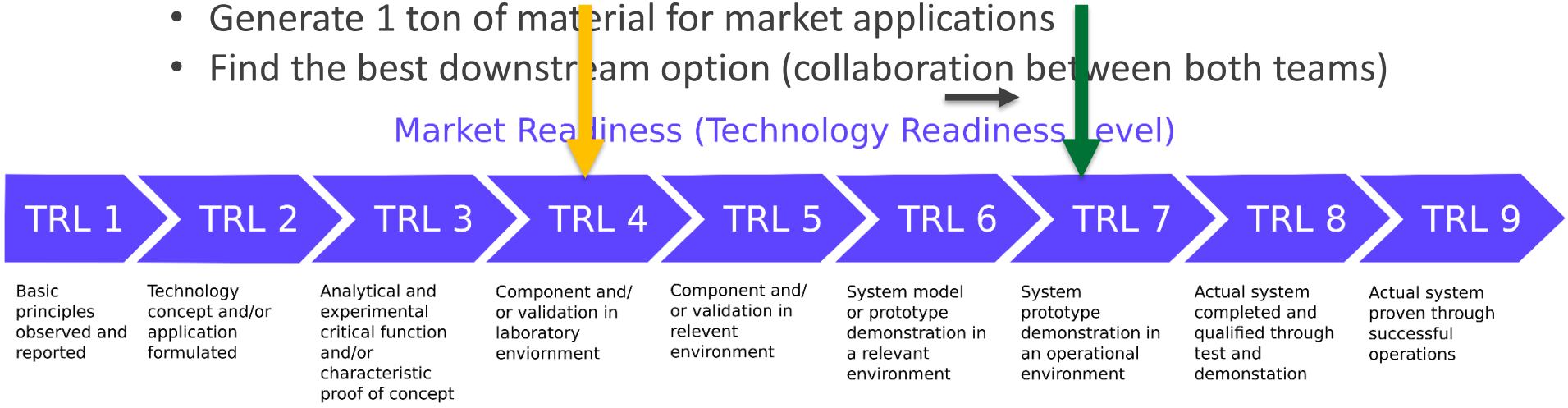
- Scope: demonstration of a new pretreatment technology on 500 L scale for a Dutch company
- Background:
  - The Dutch company had developed the process on lab-scale and validated the process on 20 L scale in house.
  - Goals:
    - They wanted to generate larger volumes to provide to one of their customers
    - Demonstrate the technology at a larger scale



Case study 2

Bio Base Europe Pilot Plant

- Scope: scale up of a fermentation and downstream process from lab to 15 000 L scale for an American company for the production of a specialty chemical
- Background:
  - The strain was genetically modified, the fermentation process was fixed, the downstream was more or less fixed but optimization was possible
  - Goals:
    - Scale up the technology and demonstrate it works
    - Generate 1 ton of material for market applications
    - Find the best downstream option (collaboration between both teams)



Case study 3

- Scope: BBI demonstration project Pulp2Value: biorefinery to extract arabinose, galacturonic acid and microcellulose fiber from sugar beet pulp
- Background:
  - The process was developed and validated on lab and small pilot scale by Royal Cosun
  - Goals:
    - Demonstrate the technology at ton scale
    - Generate sufficient material for market applications
    - Test all the unit operations of the biorefinery in an industrially relevant environment and debottleneck steps where needed

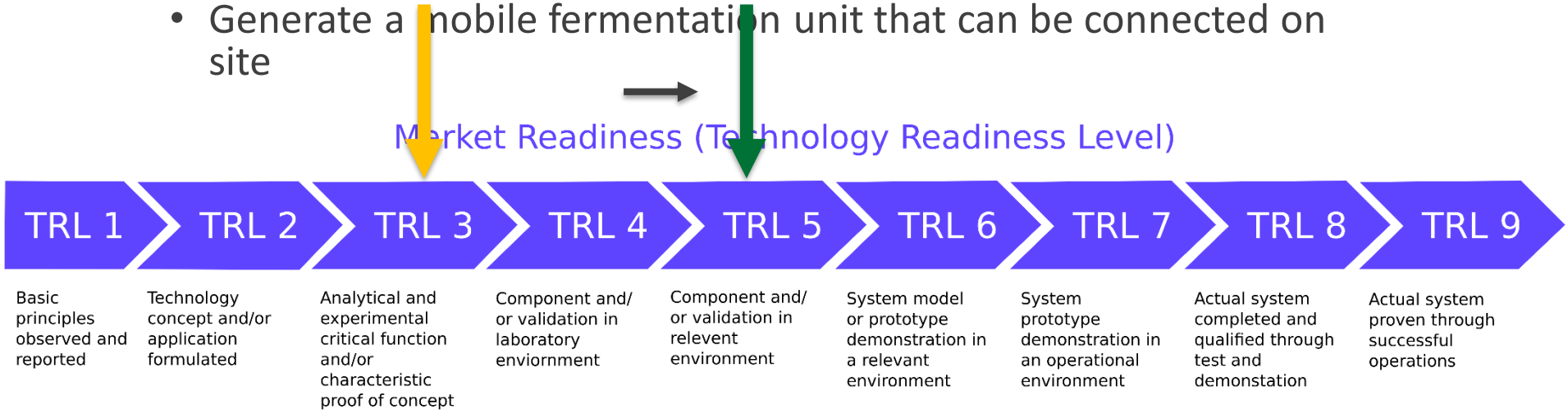
Market Readiness (Technology Readiness Level)

TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
Basic principles observed and reported	Technology concept and/or application formulated	Analytical and experimental critical function and/or characteristic proof of concept	Component and/ or validation in laboratory enviornment	Component and/ or validation in relevent environment	System model or prototype demonstration in a relevant environment	System prototype demonstration in an operational environment	Actual system completed and qualified through test and demonstation	Actual system proven through successful operations

Case study 4

Bio Base Europe Pilot Plant

- Scope: develop a mobile gas fermentation unit within the Horizon2020 project Bio-CONCO2
- Background:
  - BBEPP had multiple collaborations with Arcelor Mittal to test the fermentability of their gases
  - Problem statement: gases are difficult to compress and transport (condensation + technically difficult)
  - Goals:
    - Generate a mobile fermentation unit that can be connected on site



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Case study 1

Bio Base Europe
Pilot Plant

- Scope: demonstration of a new pretreatment technology on 500 L scale for a Dutch company
- IP
  - Background IP Dutch company: the new pretreatment technology
  - Background IP BBEPP: practical knowhow to make the translation from 20 L to 500 L
  - Foreground IP project: no new process steps developed, more extra practical know how generated
- Agreement
  - Dutch company pays a fee for a service
  - Foreground IP can be used by both parties in future projects

Case study 2

Bio Base Europe Pilot Plant

- Scope: scale up of a fermentation and downstream process from lab to 15 000 L scale for an American company for the production of a specialty chemical
- IP
  - Background IP American company: the genetically modified strain (the most valuable asset), the fermentation process, the suboptimal downstream process
  - Background IP BBEPP: know how of what downstream process suits best for which application
  - Foreground IP project: practical scale up of the fermentation process, an optimized downstream process (jointly developed)
- Agreement
  - American company pays a fee for a service
  - Foreground IP on fermentation only to be used by the customer
  - Foreground IP on DSP optimization: within the scope of the agreement (specialty chemical) only to be used by the customer, outside the scope, can be used by BBEPP for other applications

Case study 3

- Scope: BBI demonstration project Pulp2Value: biorefinery to extract arabinose, galacturonic acid and microcellulose fiber from sugar beet pulp
- IP
  - Background IP Cosun: the biorefinery concept
  - Background IP BBEPP: know how of the practical scale up of each unit operation
  - Foreground IP project: practical scale up of the technology
- Agreement
  - DESCA model: each developer owns what he develops
  - Cosun remains the sole owner of the technology
  - BBEPP can use the developed practical know how of each unit operation for other projects

Case study 4

Bio Base Europe
Pilot Plant

- Scope: develop a mobile gas fermentation unit within the Horizon2020 project Bio-CONCO2
- IP
  - Background IP BBEPP: know how of gas fermentation strategies
  - Background IP partners: development of suitable strains for gas gas fermentation
  - Foreground IP project: development of a mobile gas fermentation unit
- Agreement
  - DESCA model: each developer owns what he develops
  - Partners remain the owner of their strains
  - BBEPP solely owns the concept and design of the mobile gas fermentation unit.

Hope to see you soon…

Bio Base Europe
Pilot Plant

Hendrik Waegeman

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