

## 2<sup>ND</sup> GENERATION BIOMASS



Wood chips



Grass



Corn stover



Straw

### Biobased Economy

Finite supplies of fossil fuels and raw materials, climate change and peak oil prices force us to learn how to use renewable resources such as lignocellulosic feedstocks, agricultural biomass, or co-product process streams for the production of chemicals, materials, products and (bio)fuels. By (re)using such biobased resources we move towards a biobased economy established through sustainable production processes.

### Research and Development

Scale-up of novel production processes from laboratory to industrial scale currently encounters major bottlenecks. The need for complex equipment to investigate scale-up issues slows down scientific as well as commercial progress. Therefore the BPF is established as an open-access multi-purpose facility where companies, universities and knowledge institutions can investigate innovative production processes on a pilot scale. Onsite joint project execution with the customer is key to a successful project by making optimal usage mutual expertise.



### Modules

The facility has a modular setup, where unit operations can be combined to scale-up/scale-down the required process. For the execution of certain projects, customers might have to test their own equipment at our facility or rent equipment from third parties. In addition, the available equipment might require some modification. We provide these services in agreement with the customer.

### Open Access

Located at the Biotech Campus Delft in the Netherlands, the facility is a centre of bioprocessing expertise and technology. Both its scale and its open nature make the facility unique, in an area that stands at the frontline of the development of the biobased economy. Training opportunities are available for operators, students, researchers and technologists from all over the world.



### Cooperation

The Bioprocess Pilot Facility is funded by TU Delft, the corporate sector, the European Union, the Dutch Ministry of Economic Affairs, the Province of South Holland and the Municipalities of Rotterdam, Delft and The Hague.

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Investing in your future.  
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# Bioprocess Pilot Facility

**BPF**

BIOPROCESS  
PILOT FACILITY

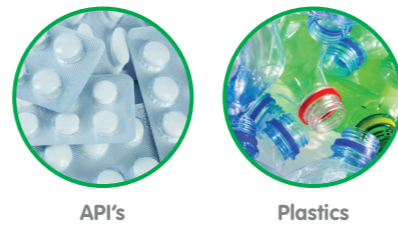
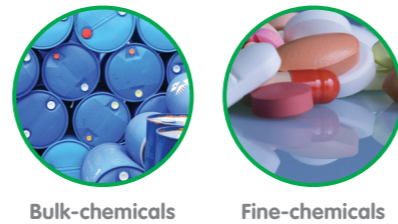
**BPF**

BIOPROCESS  
PILOT FACILITY



# Bioprocess pilot facility for innovations In food

The Bioprocess Pilot Facility B.V. (BPF), situated at the Biotech Campus Delft, the Netherlands, is a unique open access facility where companies and knowledge institutions can develop new sustainable production processes. These processes serve many purposes, such as converting bio-based residues from food production into useful chemicals or fuels. The facility has been specifically designed to enable the transition from laboratory to industrial scale. BPF allows users to construct complex operations by linking separate process modules like: Pretreatment, Hydrolysis, Fermentation and/or Downstream Processing.



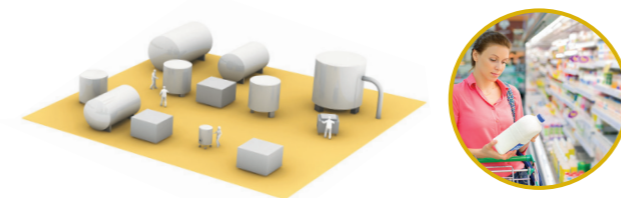
## OPEN ACCESS, CONFIDENTIALITY, IP REMAINS WITH CUSTOMER

- Large variety of scales, technologies and unit operations; covering the full supply chain from a large variety of biomasses to end product
- Long-standing historical track record in bio-process piloting (Fermentation and DSP) including kg-production of material for pre-marketing, pre-clinical, tox or application testing
- Hands-on, professional know-how and experience with scaling up and scaling down of processes
- Proven experience with working under food quality regimes, resulting in reliable engineering as well as process/product data
- Biotech Campus Delft: Perfect embedding in a strong (knowledge) infrastructure and perfect fit with regional developments

## FOOD GRADE

### Fermentation and downstream processing

Processes and products requiring a food-grade quality are prepared in a dedicated area.



## BENEFITS OF SCALING UP / PILOTING AT BPF

- Industrial scale knowledge
- Extensive and hands-on experience with multiple products and processes
- High flexibility in equipment
- 24/7 availability



## Pretreatment and Hydrolysis

After a physical size reduction of the dry residues, the pretreatment of feedstock process can be researched using different experimental set-ups including mechanical, thermal and chemical methods. These processes include steam explosion and acidic or alkaline treatment, offering the customer the opportunity to test a broad range of alternatives for pretreatment. A flexible one-stage and/or two-stage pilot scale installation, followed by hydrolysis and concentration, enables the production of sufficient starting material for a 4 m<sup>3</sup> or 8 m<sup>3</sup> fermentation. In addition, an even more flexible bench scale installation is available, providing a broader choice of pretreatment methods, including solvent handling. After the pretreatment at bench scale, the biomass can be hydrolysed and fermented in 10 L fermentors.

## Fermentation

Our equipment includes lab-scale, 100 L, 300 L, 1 m<sup>3</sup> and 4 m<sup>3</sup> stirred fermentors in which batch or fed-batch processes can be executed. Sterility is achieved by means of steam treatment and/or filtration. The BPF has a licence to work with GMO's. The 300 L and 4 m<sup>3</sup> fermentors are located in an ATEX environment, enabling the addition and/or production of flammable gases and/or liquids.

## Downstream Processing

The Downstream Processing (DSP) unit operations can be combined at the customer's request to create the desired product. The BPF can handle biofuels and (bio)chemicals. In addition, we are also experienced in handling, producing and testing products from the food and pharmaceutical industries. Our technical range includes (membrane) filtration, centrifugation, homogenization, (bio)chemical conversions, chromatography, crystallization, electrodialysis, extraction, evaporation, distillation and several drying methods. The DSP module is located in an ATEX environment, allowing the use of flammable solvents. There are numerous vessels (ranging from 60 L to 4 m<sup>3</sup>, with different material properties and capabilities) available for a variety of process steps. The DSP module is located in an ATEX environment, allowing the use of flammable solvents.

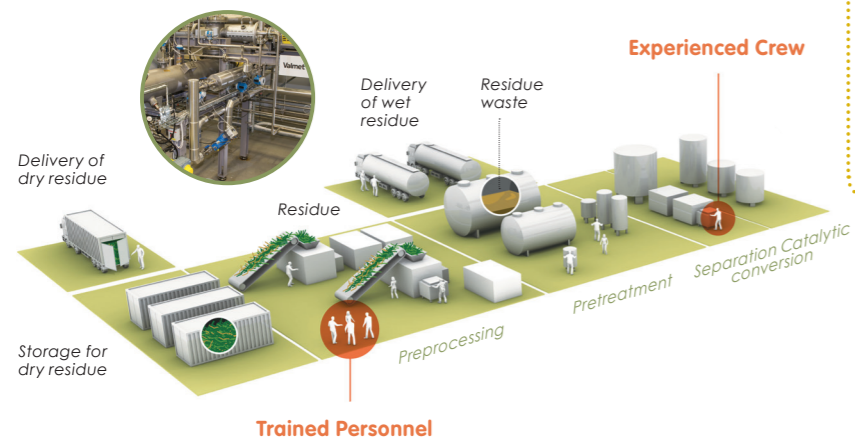
## Food

In a separate building, with dedicated equipment, processes can be tested for the food industry. In fermentors up to 2 m<sup>3</sup> and various downstream processing units, products can be prepared, for instance, as market samples. The food pilot plant complies with FSSC 22000 / ISO 22000 regulations.

## PRETREATMENT AND HYDROLYSIS

### From biomass to sugar

In this module, dry and wet residues can be pretreated, hydrolysed and prepared for the fermentation phase.



## FERMENTATION

### From 10 L to 4 m<sup>3</sup>

In the Fermentation module, bioconversions are executed by means of micro-organisms (bacteria, yeasts or fungi) or enzymes to obtain the intended product.

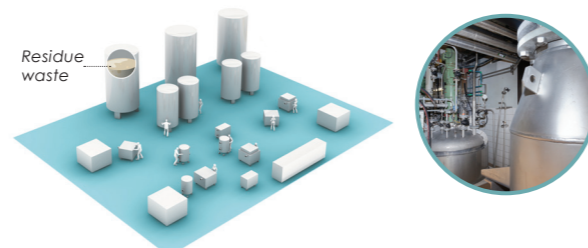


ATEX

## DOWNSTREAM PROCESSING

### Isolation of targeted components

In this module, products are extracted, purified and isolated from the (fermentation) process stream. The unit operations can be combined at the customer's request to create the desired product.



Building blocks, enzymes and pharmaceutical ingredients