

2017

## **CIRCULAIRE ECONOMIE**

### **Presentatie**

Frans Brüning

[www.khe.eu](http://www.khe.eu)

**Referenties**



**Client:**  
ChainCraft

**Project:**  
Confidential

**Location:**  
Confidential

**Year:**  
2016

**Capex:**  
Confidential

**Type of work:**  
Basic engineering

**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

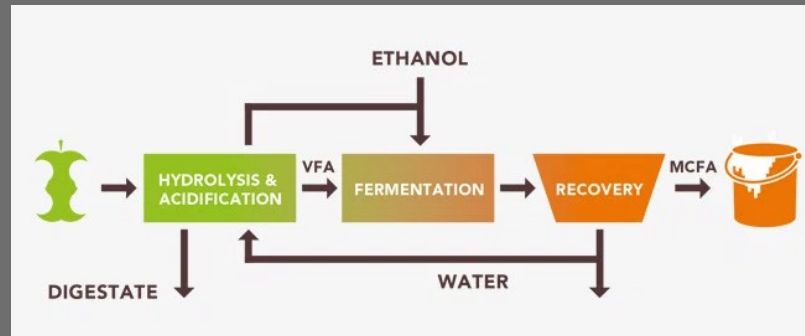
*Global experience, local approach*

## Chainkraft

### Waste to bioproducts

**Description:**

ChainCraft (former Waste2Chemical company) develops proprietary mixed culture fermentation processes to produce biochemicals from low grade organic residues like food waste, agricultural residues or the organic fraction of municipal solid waste. The first aimed biochemicals, Medium Chain Fatty Acids (MCFA) can be used as building blocks in existing and new applications in markets for lubricants, plasticizers, polymers, coatings, animal feed and flavours and fragrances.



**Type of work:**  
Basic engineering



**Client:**

DSD

**Project:**

Ethanol production from Sugar beet

**Location:**

The Netherlands

**Year:**

2015-2016

**Capex:**

Confidential

**Type of work:**

Engineering consultancy

## DSD BV

### Bio-ethanol

**Description:**

Plant derived sugars and starches are used in different industries as a substrate for fermentation process. Generally plant materials are subjected to numerous pretreatment steps in order to facilitate the extraction of useful molecules such as sugars. This leads to a usage of substantial amount of water and energy. Given the increasing importance of the plant-derived chemicals, the improvement to the conventional process are highly essential. KH Engineering operates as an engineering company in chemical industry and KH looks for new technologies to facilitate the transition to a more sustainable industry. As a part of this vision, KH has established many contacts with technology developers. One of our partner technology developers uses vacuum extrusion in order to break open the cells walls of sugar beets and make the sugar molecules available for fermentation. The aim of this project is to investigate financial and technical feasibility of the new pretreatment technology for sugar beets.



**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

**Scope of Work:**

In this project, the conceptual process design of a ethanol production plant which uses the new sugar beet pretreatment technology is performed. An economic analysis (CAPEX, OPEX, Cash Flow, Pay-Back Period, Return on Investment, etc.) of the designed plant is made. A comparison between the conventional and the new process is included in the project.

## Confidential Client

**Client:**

Confidential

**Project:**

Feasibility and conceptual design of the brewery of the future

**Location:**

Confidential

**Year:**

2015-2016

**CAPEX:**

Confidential

**Type of work:**

Conceptual Engineering

## Brewery of the future

### Brewery

**Description:**

With the current focus on environmental sustainability of consumer products, brewers are determined to continue to lead the way. The rapidly increasing global demand for beer in combination with cost fluctuations and legislative pressure, drive the need for innovation further.

Brewers have been brewing beer for centuries and have in-depth knowledge of the process. A "fresh" perspective from non-brewers might bring the out-of-the-box innovation that enable brewers to take their sustainability measures one step further. The brewers are in need of an integrated approach that goes beyond "sectoral thinking" in terms of water- and energy footprinting and applies best practices from other industries.



**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

**Type of work:**

The aim of the assignment is to create a new process design in order to further reduce the environmental impact of their brewing process. This new design shall also describe a clear business case.

- Feasibility study
- Conceptual engineering
- Project management
- Consultancy
- Economic evaluation





**Client:**  
Solazyme/Suikerunie

**Project:**  
New production plant

**Location:**  
The Netherlands

**Year:**  
2015

**Capex:**  
Confidential

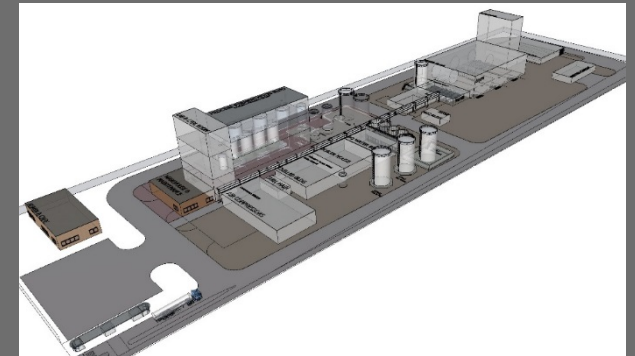
**Type of work:**  
Counter Cost Estimate

## Solazyme/Suiker unie

### Food

#### Description:

Industrial biotech company Solazyme produces high value products by using algae microorganisms. Solazyme uses heterotrophic algae strains which need sugar to grow and produce high value components. Therefore, Solazyme and Suiker Unie looked for a potential Algal production facility to be built in The Netherlands. KH Engineering has been requested to perform a CAPEX estimate analysis.



**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

#### Type of work:

The initial factor based Cost Estimate prepared by Solazyme in cooperation with Suiker Unie, has been challenged by making a counter estimate. The counter estimate has been set up in an object-based Estimating environment using Aspentech Capital Cost Estimator © as Estimating engine/framework. The resulting Cost Estimate was – although only conceptual design data was available – preliminary quantity based. In parallel, a concept 3D model has been made by “Estimating” to feed key figures and logics of the plant into the Estimating model. Due to the object-based quantitative approach, the resulting Cost Estimate has given a clear view of the cost of all different parts of the plant, supporting decision making.



## Energy transition Bridge (ETB)

### Energy

**Client:**

EnTranCe (university Groningen)

**Project:**

Energy Transition Bridge (ETB)

**Location**

Groningen campus

**Year:**

2014 -2015

**Capex:**

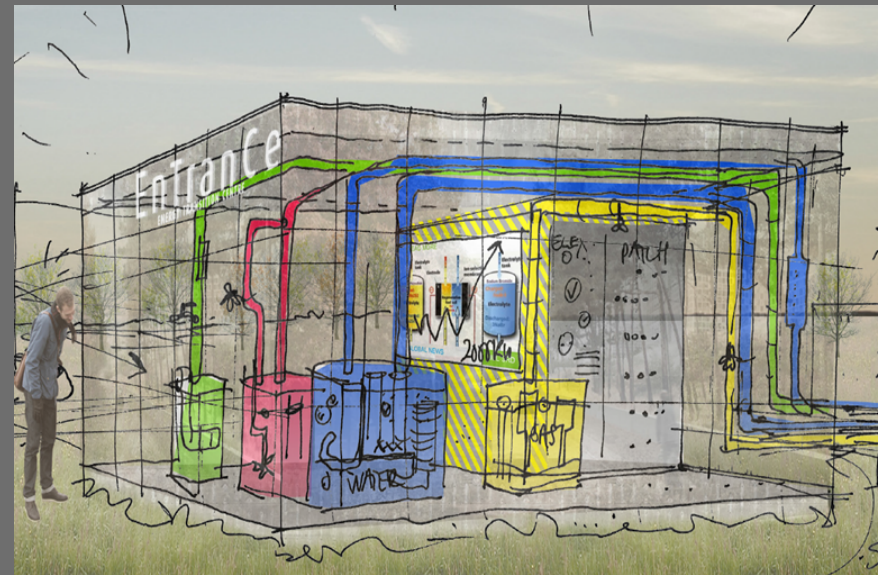
Euro 1.6 million

**Type of work**

Conceptual, Basic, Engineering package for detail & construction

**Description:**

Time to market project. Create a place to be of applied sciences for businesses and innovations. Set up the utilities, facilities, pilotplants for new technologies. Create the best possible network to develop plans into energy products which services the energy market demands. Together with the CUB (Central Utility Building) the ETB provides a distribution network of utilities, data, data-exchange for and between the connected pilotplants.



**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

**Type of work:****Approach:**

Create consensus between principal and stakeholders during interactive sessions (I-room).

**Scope Conceptual:**

BOD, PFD's, mass balance, Prelim.control & safeguarding Philosophy (C&SP)

**Scope Basic:**

3D model, PFD's, Hydraulic calculations. Scope of work Incl. drawings for detail engineering & construction, C&SP, Piping product & Service Index, E&I drawings.

## Algae Biorefinery Pilot Plant

### BioProcess/Food/Chemicals

**Client:**

TNO

**Project:**

Algae Biorefinery Pilot Plant

**Location:**

The Netherlands

**Year:**

2014

**Capex:**

Confidential

**Type of work:**

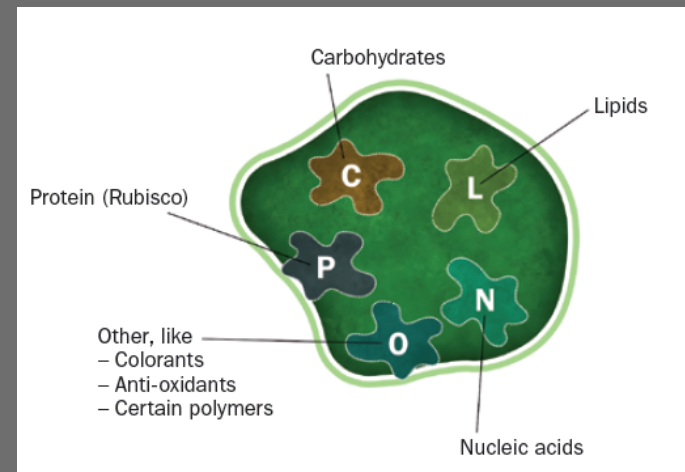
Engineering Consultancy

**Description:**

Microalgae are considered as one of the most promising feedstocks for sustainable production of functional ingredients to be applied in food, feed, chemicals and several other materials. Algae contain valuable ingredients, grow very fast and can be cultivated on unfertile soil.

TNO has built a mobile pilot unit called Versatile Algae On-site Raw Ingredient Extractor (VALORIE). VALORIE can extract the specific ingredients from algae as required.

TNO wants to build another pilot plant for one of its industrial partners. Therefore, TNO asked KH Engineering to perform the engineering activities for the pilot plant



**Type of work:**

- Conceptual design
- Detailed engineering
- Inspection of the mobile pilot prior to shipment

**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

**Client:**  
RIVM

**Project:**  
Overview of Biobased  
production processes and  
their environmental impacts

**Location:**  
Netherlands

**Year:**  
2013-2014

**Capex:**  
Confidential

**Type of work:**  
Consultancy

**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

*Global experience, local approach*

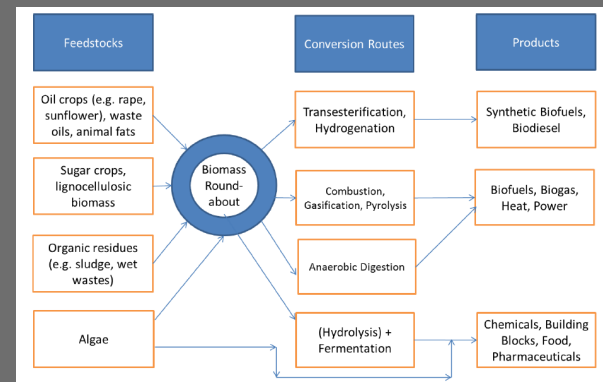
## RIVM

### Health, Safety and Environment

#### Description:

On behalf of RIVM, a study is to explore the environmental impact related to biobased production processes. The report provides an overview of the main biobased process routes that can be distinguished for producing biobased substances:

1. hydrolysis/fermentation;
2. transesterification/hydrogenation;
3. anaerobic digestion;
4. algae;
5. gasification;
6. pyrolysis.



#### Type of work:

In this explorative study on biobased chemicals, the key biobased processes are being described, and for each production route the environmental impact is identified. For two selected chemicals, a comparison is made between the biobased process route and the "conventional" process based on fossil feedstock.



**Client:**

BPF

**Project:**

Upgrading and extension of BPF pilot plants

**Location:**

Delft

**Year:**

2012-2013

**CAPEX:**

37 M Euro

**Type of work:**

Conceptual and Basic Engineering

## Bioprocess Pilot Facility (BPF)

### Pilot Plant

**Description:**

The Bioprocess Pilot Facility B.V. [BPF] is a joint venture of industrial parties and the technical University of Delft. Its main interest is directed towards the Bio-chemicals market with a secondary interest in Food and Pharmacy applications.

A R&D facility dedicated to scale-up is so complex and expensive that it can only be realized in a broad collaboration. This is why a unique multi-purpose facility was developed where companies, universities and knowledge institutions from all over the world can investigate how production processes developed at laboratory scale respond to large-scale conditions. Furthermore they can employ BPF's special set of equipment and expertise to research how these processes can best be scaled up.



**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

**Type of work:**

Upgrading and extension of two existing pilot plants, including definition user requirements, conceptual engineering, basic engineering and procurement services. This entailed:

- A pre-treatment section in which different kinds of biomass material will be treated to convert them to suitable substrates for fermentation or down-stream processing steps
- An 8-m<sup>3</sup> bubble column fermenter and four new fermenters fitted to bench scale pre-treatment capacity
- Additional down-stream processing equipment
- A new plant section dedicated for Food applications
- An Education laboratory equipped with fermentation and down-stream processing facilities



**Client:**

Parenco

**Project:**

Transformation to Biorefinery

**Location:**

Netherlands

**Year:**

2012-2013

**Capex:**

Confidential

**Type of work:**

Consultancy

## Transformation to Biorefinery

### Paper & Pulp

**Description:**

Due to recent technological developments (smartphones, tablet computers, e-readers etc.) and strong price competition from upcoming economies such as China, the European and American paper and pulp industry is facing financial problems due to a decrease in sales. Especially newsprint manufacturers are at risk of going bankrupt and stopping overall production.

In order to shift into a market with an increasing instead of decreasing demand, the newsprint industry is investigating the option of (partially) transforming their business from the production of paper to the production of green chemicals in so-called biorefineries. As a solution to this issue, a biorefinery was designed to use recycled paper pulp, consisting partly of the valuable biopolymer cellulose, for the production of glucose.



**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

**Type of work:**

- Feasibility study
- Market analysis
- Conceptual engineering



## Vito Pilot Plants

**Client:**

Vito

**Project:**

Biopol

**Location**

Antwerp - Belgium

**Year:**

2012 / 2013

**Capex:**

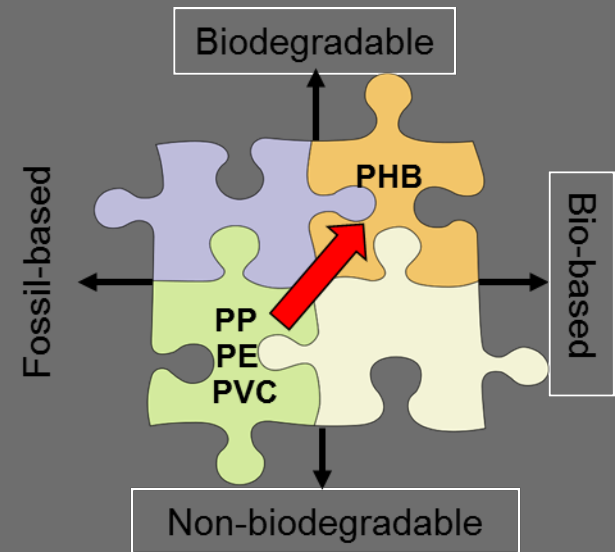
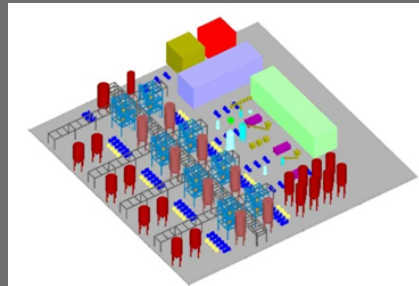
n/a

**Type of work**

Up scaling Pilot Plant

**Description:**

This project aims to develop a new and sustainable technology for the production of the biopolymer polyhydroxybutyrate (PHB) from industrial organic and inorganic waste streams in order to reduce the cost price of PHB. In addition, the further processing of the biopolymer for different applications is being studied in order to determine the influence of this new production process on the properties of the biopolymer.



**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

**Scope of Work:**

KH will start its activities with the preparation of the project design basis, using the results from lab-scale experiments. During this phase several ideas will be worked out, and each can be evaluated on feasibility.

Key elements in this project are:

- CAPEX/OPEX estimate (investimate©)
- Preliminary equipment data, layouts, control strategy
- Project scope definition
- Process and utility flow scheme
- Process description
- Preliminary layout and logistic studies
- Design engineering criteria and standards

- Preliminary constructability review





**Client:**  
AVA-CO2 (Zug, Switzerland)

**Project:**  
Core-unit HTC plant

**Location**  
Relzow / N-Germany

**Year:**  
2012

**Capex:**  
Euro 0.9 million

**Type of work**  
Basic engineering, material selection, Capex estimates, engineering packages for detail & construction including functional descriptions

**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

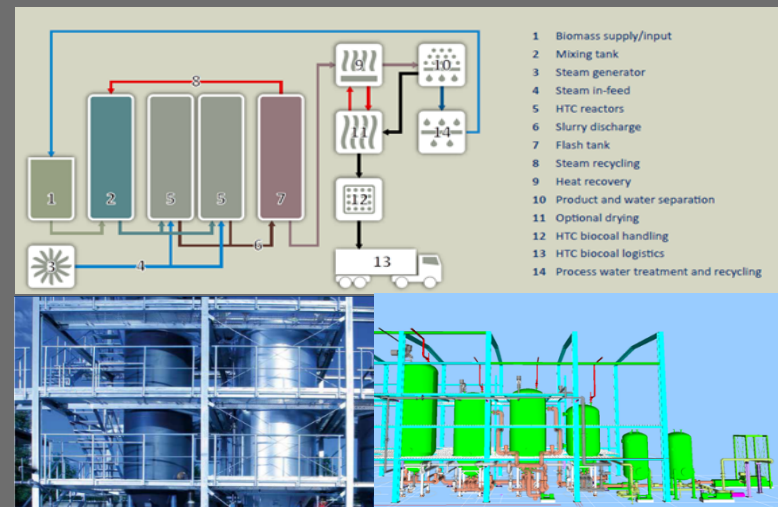
*Global experience, local approach*

## Hydrothermal Carbonisation core unit

### Description:

Since it is possible to recover phosphorus within the HTC process it is "tomorrow's process today" for sewage sludge and other wet biomass.

The hydrothermal carbonisation (HTC) is used for the production of high performance carbon materials and for the energy efficient valorisation of municipal sewage sludge or other wet organic residues. Because no methane and CO<sub>2</sub> are released, the process leads to a carbon neutral "green" installation. KH supports AVA-CO2 not only at every level of engineering, but in many other ways. Such as value engineering sessions, HAZOP's, consultancy, etc.



### Type of work:

#### Approach:

Only in close cooperation with clients engineers it is possible to create innovative solutions. Executed value engineering sessions are a proven example.

#### Scope:

Basic engineering, 3D model, P&ID's, CAPEX estimate, Scope of work Incl. drawings for detail engineering & construction, Piping product & Service Index.





**Client:**  
Corbion Purac

**Project:**  
PPH plant

**Location:**  
Gorinchem

**Contract period**  
12 months

**Capex:**  
1,6 million

**Type of work:**  
Architectural & Civil Works

## Corbion Purac Pharmaceutical

### Description:

The construction of a factory-building suited for the production, preparation and packaging of a powdery substance for the consumer industry. The necessary technical and office areas were integrated within the building. For the connection of this building with other buildings one foot bridge and several pipe bridges have been created.

The activities of KH-Engineering within the entire building process can be described as follows:

**Preliminary design phase:**  
Within this first phase of the project, the floor plans, front views and construction of the building were designed. All this of course by taking into account the location and size of the equipment, the architectural conditions and the legislation towards escape-routes, fire and safety.



**Oil & Gas**  
**Refining**  
**Chemical**  
**Storage & logistics**  
**Energy**  
**Food & Pharma**  
**Heavy industry**



**Client:**  
Cargill Agricola S.A.

**Project:**  
Xingú 30 KT

**Location**  
Pará - Brazil

**Contract Duration:**  
9 months

**Capex:**  
Confidential

**Type of work**  
Lumpsum

**Oil & Gas**

**Refining**

**Chemical**

**Storage & logistics**

**Energy**

**Food & Pharma**

**Heavy industry**

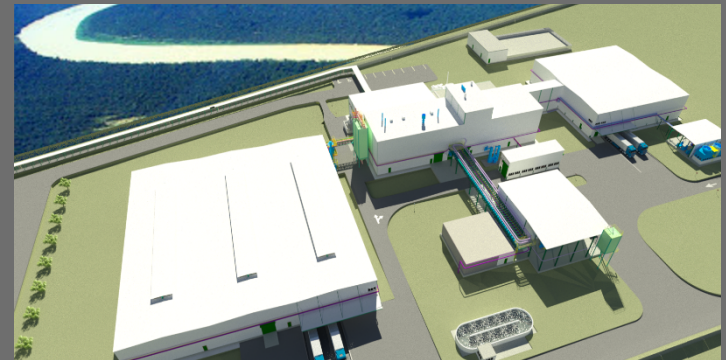
*Global experience, local approach*

## Cargill Agrícola S.A.

### Food

**Description:**

Project involves a cacao mass grass root plant for Cargill Agricola S.A. in the state of Xingú, Brazil. Cargill engineering management is performed by Cargill Cocoa Wormer. Scope of work includes product lines for a capacity of +30 KT Cacao Mass production, including all required utilities, buildings, offices and site development.



**Type of work:**

- KH Engineering used interoffice works for the execution of PDP phase 2B engineering: Cargill (Brazil) – Cargill (Netherlands) – KH Engineering (Netherlands) – Ludan (Israel)
- Plant 3D modelling of equipment and piping;
  - Revit modelling of civil and structural works;
  - Navisworks modelling of site layout;
  - Process Engineering and Design;
  - Project Management;
  - Estimating;
  - Planning/Cost Control.

**BIOPETROL**  
ROTTERDAM B.V.

**Client:**  
BioPetrol

**Project:**  
Methanol Vent System Study

**Location:**  
Rotterdam- Botlek

**Year:**  
2013

**Capex:**  
Confidential

**Type of work:**  
Study

## BioPetrol Botlek B.V.

### Chemical

#### Description:

BioPetrol was informed by I-SZW that information/documentation related to the vent system, handling Methanol vapor, was insufficient. Proof that the system is able to work under normal and abnormal conditions could not be given. The study comprised of three sections:

- 1) Compliance check towards inertisation was done against CEN/ TR 15281 and NFPA 69.
- 2) Hydraulic calculations were done in AFT Fluidflow3™ for all in breathing and out breathing cases individually and operating in network under normal and abnormal conditions.
- 3) The working of the condenser and scrubber in the vent system to purify the gas steams before venting to the atmosphere was checked on capacity and pressure drop with ASPEN Plus®.



**Oil & Gas**

**Refining**

**Chemical**

**Utility & Energy**

**Heavy industry**

**Food & Pharma**

#### Scope of Work:

KH Engineering executed the Study for the project, including:

- Project Management
- Planning/Cost Control
- Instrument Engineering
- Preparation of instrument specifications
- Process Engineering



**Client:**

Te Braake

**Project:**

Tjuchem Biogas Plant

**Location**

The Netherlands

**Year:**

2010

**Capex:**

**Type of work**

B.O.O (Build, Own, Operate)  
Business Case

## Te Braake

### Tjuchem Biogas Plant

**Description:**

Powered by KH Engineering, Ludan Renewable Energy b.v. has signed a contract with an agricultural client to build a 800kWe biogas plant.

Manure, co substrates and energy crops are used in the biogas plants to generate electricity and heat. Future expansion is planned to feed the digestate to four lagoons for growing duckweed. One third of the project value is financed by Ludan Group.



**Oil & Gas**

**Refining**

**Chemical**

**Utility & Energy**

**Heavy industry**

**Food & Pharma**

#### Scope of Work



**Client:**

Sanchiz Group

**Project:**

Sanchiz Group Biogas Plants

**Location**

Spain

**Year:**

2011

**Capex:**

**Type of work**

S.P.C. (Special Purpose Company) & EPC

## Sanchiz Group Sanchiz Group Biogas Plants

**Description:**

Ludan Renewable Energy signed in 2010 with the Sanchiz Group a contract for the development, construction and operation of 3 biogas plants in Albacete, Spain. Each biogas plant will be integrated in a pig farm of the Sanchiz Group and is designed to treat swine manure and other organic wastes. The heat of the CHP will be used for the heating of the farm stables. The biogas plants located at the farm Pequechin and the farm Ingapor will be 350 kW installations. The plant located at the Granja de Ves farm will be a 250 kW installation.



**Oil & Gas**

**Refining**

**Chemical**

**Utility & Energy**

**Heavy industry**

**Food & Pharma**

**Scope of Work:**

# Colophon

Ronald den Toom	Business Development	<a href="mailto:ronald.den.toom@khe.eu">ronald.den.toom@khe.eu</a>
Kees Vonk	Business Development	<a href="mailto:kees.vonk@khe.eu">kees.vonk@khe.eu</a>
Leo Disse	Process Consultancy	<a href="mailto:leo.disse@khe.eu">leo.disse@khe.eu</a>
Serdar Erdag	Consultancy Business case	<a href="mailto:serdar.erdag@khe.eu">serdar.erdag@khe.eu</a>
Erik de Boer	Cost Estimate	<a href="mailto:erik.de.boer@khe.eu">erik.de.boer@khe.eu</a>
Hans Niessen	Fermentation expert	<a href="mailto:hans.niessen@khe.eu">hans.niessen@khe.eu</a>





[www.khe.eu](http://www.khe.eu)

General: [info@khe.eu](mailto:info@khe.eu)

### **KH Schiedam**

Jan van Galenstraat 2  
3115 JG Schiedam, The Netherlands  
Tel: +31 (0)10 2088 888  
Fax: +31 (0)10 2088 777

### **KH Antwerp**

Uitbreidingstraat 80  
2600 Antwerp, Belgium  
Tel: +32 (3) 2182500  
Fax: +32 (0)32182501

### **KH Amsterdam**

Kabelweg 21  
1014 BA Amsterdam, The Netherlands  
Tel: +31 (0)20 5817200  
Fax: +31 (0)20 5817299

### **KH Promaen**

Zilverschoon 30,  
6922 GV, Duiven, The Netherlands  
Tel +31 (0)316 251818

### **KH Zaandam**

Korte Hogendijk 4  
1506 MA Amsterdam, The Netherlands  
Tel: +31 (0)88 348 73 00  
Fax: +31 (0)88 348 73 99

