

# Expertise in plant engineering.

High tech for White Biotechnology.



# Learning from nature. Biotechnological methods for industrial processes.





Nature shows us how: biomass as a sustainable raw material. Complex processes that transform this material into high-quality products – while making optimal use of the available energy and without polluting the environment. White Biotechnology also utilises renewable raw materials, and models itself on processes that occur in nature. For several years now, these biotechnological methods have been gaining more and more cross-industry importance. The development of prices and the availability of, especially, crude-oil-based materials, the strict requirements imposed on various industries concerning the environmental safety of their processes and, above all, the “technological revolution” in biosciences are major driving forces behind this development. Moreover, White Biotechnology offers great opportunities to create new, modified and optimised products.

This is exactly where the business activities of Linde-KCA-Dresden GmbH come into play. As an internationally active plant engineering company and proven specialist in the field of biotechnology, we are the ideal partner to support your project with our expertise, commitment, efficiency and customised services.



## Anticipating, innovative, sustainable. Biorefineries.

Industrially, biomass is processed in biorefineries. Biorefineries are the large-scale plants of the future.

One characteristic of biorefineries is their high complexity. Their planning and realisation demands specific technological know-how in the areas of biotechnology and chemistry as well as experience in the handling of large-scale projects – both are core competencies of Linde-KCA-Dresden. Moreover, biorefineries implement innovative technologies that present alternatives to conventional chemical-industrial

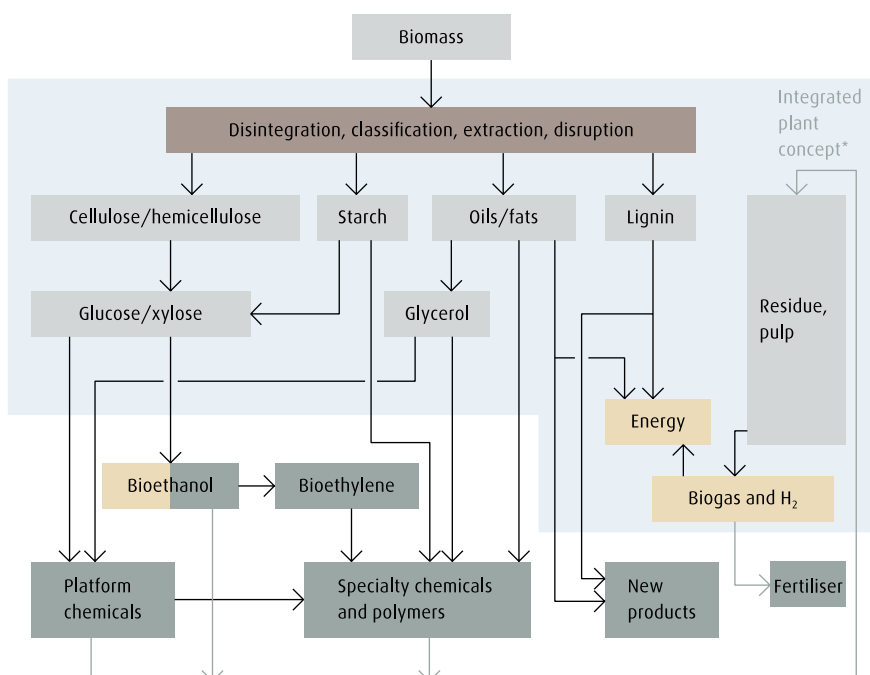
processes. These technologies are the main focus of current developments. As a technology corporation, Linde is actively participating in this area and, working closely together with research and the manufacturing industries, develops its own partial processes for biorefineries.

With its core competence in plant engineering, Linde-KCA is available for the planning and construction of partial plants for the production of individual product groups as well as for the realisation of complete biorefinery plants.

The chart below shows a possible scheme of a biorefinery as an integrative overall concept for the biochemical and physicochemical conversion of renewable raw materials into valuable products under (optimally) complete utilisation of biomass. Within this framework, the key to sustainable economic management is the combined production of chemicals, basic materials and fuels while covering the biorefinery's own energy demand from waste and side channels. In the scheme presented here, processes such as fermentation and biocatalysis with the corresponding purification lines for bioethanol, platform chemicals and new products, but also purely chemical processes for ethylene from ethanol and the polymerisations are possible. Not shown here are so-called biomass-to-liquid processes that consist of a thermochemical production of synthesis gas from biomass and a subsequent synthesis to liquid products such as fuels. These can, however, definitely be part of a biorefinery concept.

### Exemplary flow chart of a biorefinery

■ Biomass/raw materials ■ Processes ■ Energetic products ■ Material products  
 — Product channels — Side product channels \* Use of energetic products within the plant



### We build plants for the product groups

#### Enzymes

#### Carbohydrates

- Starch
- Sugar
- Glucose
- etc.

#### Biopolymers

#### 2G biofuels with by-products

#### Platform chemicals

#### Food additives

- Amino acids
- Vitamins
- etc.

# Using potentials. White Biotechnology in multifaceted application.

Starch, a polysaccharide from glucose units, serves as a raw material for the creation of a large number of products in the food industry and is processed for various technical applications. With a continuously increasing annual demand of currently 50 million tonnes, it is the most important renewable plant material after cellulose and vegetable oils.

Depending on geographic and climatic conditions, varying processes for the production of starch from wheat, corn, potatoes, peas, rice or tapioca are applied. The optimal realisation of the different processes is carried out by an experienced project team from Linde-KCA.

For Food Retail & Production CS GmbH (FRP CS GmbH), Linde-KCA-Dresden, as the consortium leader, is realising a plant for the production of wheat starch and starch derivatives from grain at the chemical and industrial park Zeitz/Tröglitz (Saxony-Anhalt). The range of services from Linde-KCA-Dresden includes the overall project management as well as the planning, procurement, installation and commissioning of the technology.

The starch factory in Zeitz will be put into operation in the third quarter of 2009 and will start with an annual production capacity of 120,000 t. The factory consists of starch and gluten extraction, an A-starch modification, corresponding drying facilities as well as all necessary side and packing facilities.

3D CAD model of the Zeitz plant for the production of modified starch (in construction)





Pectin modification at the turnkey plant for the production of pectin in Malchin

Carbohydrates such as cellulose, starch and sugar are dominating raw materials for both White Biotechnology and the chemical industry of the future. Plants for the production of different carbohydrates from vegetable raw materials thus form the basis for the further development of this key industry.

At Malchin (Mecklenburg-Western Pomerania), Linde-KCA built a turnkey monoplant for the production of pectin from citrus fruits for Citrico (a Cargill Group company). The range of services from Linde-KCA-Dresden included the overall planning, procurement, installation and the commissioning of the plant.



View into a modern biotechnology plant for the production of food additives

**Linde-KCA reacts to the multifaceted applications of White Biotechnology in the different industrial branches. Here are some examples:**

- Linde-KCA has engineered a biotech plant in Switzerland for the production of starter cultures for dairy products and assisted the realisation of the facility.
- In Great Britain, Linde-KCA has a reference concerning the planning and construction of a plant for the production of vitamins.
- Linde-KCA has developed master plans and studies for plants for the production of enzymes, the starch-based production of biopolymers as well as a pilot plant for the production of second-generation bioethanol.

# Professional planning, successful realisation. Into the future with Linde quality.

Linde's plant engineering expertise in the field of biotechnology is concentrated in Linde-KCA-Dresden GmbH. With our experience and our know-how, we are responsible for the economical construction of your plant – at the handover date defined and in excellent quality. Our references show that we are one of the leading companies worldwide for the planning, delivery and construction of industrial biotechnology plants.

It is a clear indicator of successful realisation if all parts come together smoothly, and even more so when projects get bigger. That's why we have transformed our previous project experiences into planning and control tools that can be customised for your project and lead it to success.

## We plan and realise

- Greenfield plants or retrofitting during ongoing production
- Entire plants or fully assembled plant sections
- Research, pilot or large-scale plants

## Our range of services

- Feasibility studies
- General planning
- EPCM services
- Turnkey plants

On top of that, we can consult and support you in the development of your project idea for an investment plan.





## Optimally consulted from the very beginning. Trust our expertise in plant engineering.

Our employees are extremely well-trained and highly motivated specialists. They have long experience and up-to-date process know-how in the areas of planning and plant engineering. Apart from engineers of all fields, numerous biotechnologists and natural scientists also work within our teams – as intermediaries between research and technology. This means you get the best conditions for the successful realisation of ambitious biotech projects.

### Investing safely from the very beginning

From early on, and parallel to research and development, we support small start-up and large biotech companies in process development and conversion into practical, economical plants. Within the framework of feasibility studies, we analyse the process risk and estimate the investment costs. This gives you a solid base for your investment decision.

### Technological know-how

With our technological expertise in our traditional areas of operation, biotechnology and chemical plant engineering, we are optimally prepared for your projects in White Biotechnology and able to develop safe, cost-efficient, high-quality solutions for you.

### Our overall concept

Our responsibility does not end with process technology. Because on top of that, we provide all engineering disciplines necessary for the construction of your plant with our in-house specialists and can thus ensure a highly competent realisation of the entire project.

# Leading projects to success. Integrated, efficient project management.

The success of your project depends on the observance of quality, costs and time limits. Our project management ensures this success. The basis of our operational method is an integrated management system that presents the activities and documents of all assembly sections in all phases of planning and in their interaction. From this system, not only the chain of due dates and the work flow can be derived – the description of the correct planning depth at any given point in time also allows for efficient quality and risk management.

The central control tool of the project realisation is the Linde Project Management System. In this system, all data come together: from calculation, time scheduling and personnel planning, specification and ordering of equipment through to materials handling, the generation of item lists and construction site management. It allows for efficient controlling and the early reporting of due dates, physical progress and costs.

Our controlling plays a key role. The project progress and cost plans which are implemented at the start of the project are periodically updated. That way, deviations from the planned progress can be recognised early on and necessary measures can be initiated. This enables us to keep an eye on all important factors for our joint success and to react flexibly to current developments at any given time.

We pay particular attention to the interfaces between the participating assembly units and to subcontractors. Engineering managers coordinate and monitor a correspondingly efficient processing and ensure that all operational steps are carried out quickly and smoothly. Leading and coordination of all assembly units, procurement, site management and commissioning are carried out by Linde personnel.



Application of the Linde Project Management System for efficient planning ...



and safe project execution on the construction site

## Linde-KCA. Your strong partner for White Biotechnology.

Currently, the utilisation of renewable raw materials and the application of modern biotechnological methods for industrial production processes are experiencing an enormous boost.

As a technology corporation, Linde, together with research and the manufacturing industries, is actively participating in the development of innovative processes and their implementation in large-scale plants. Moreover, we can access our experience as a well-known plant manufacturer in our traditional business areas of chemical and biopharmaceutical plants. This means that you can profit from our know-how synergies in planning and realisation.

Trust our expertise and rely on a strong partner. In the course of the last 10 years, Linde-KCA-Dresden GmbH has built numerous large-scale plants all over the world. That's why we can also convert your process into an environmentally friendly and economical operation – quickly, safely and efficiently. Just ask us!

# Planting seeds for the future.

Our customers' success is our success. With innovative technologies and our employees' extensive know-how, we are consistently turning our customers' goals into our own – in a fair, transparent and cost-conscious manner. Therefore, every plant we build is a reference for the next one – creative in its concept, efficient in its implementation.

As one of the leading companies in the planning and construction of chemical, gas, biotechnological and pharmaceutical plants, we offer our customers the security of consistently high quality standards. In cooperation with reliable business partners, we combine capacity and expertise in order to realise projects of any dimension.

We regard every assignment as a chance to define a new market standard and to expand our strong international position. Driven by our own performance capability, it is our goal to make the name Linde a globally recognised seal of quality, with plants that speak for themselves – and for us.

## Linde-KCA-Dresden GmbH

### Postal address:

Postal office box 210353  
01265 Dresden  
Germany

### House address:

Bodenbacher Strasse 80  
01277 Dresden  
Germany  
Phone +49.(0)351.250-3512  
Fax +49.(0)351.250-4816  
lkca.biotech@linde-kca.com  
www.linde-kca.com

### Office Moscow:

115114, Moscow  
Letnikovskaja ul. 10,  
building 2, 8th floor  
Russia  
Phone +7.495.9871223  
Fax +7.495.9871224  
lkca.moskau@linde-kca.com

### Linde-KCA-Dresden GmbH

Bodenbacher Strasse 80, 01277 Dresden, Germany  
Phone +49.(0)351.250-30, Fax +49.(0)351.250-4800, [www.linde-kca.com](http://www.linde-kca.com)