



# GREEN ECONOMY

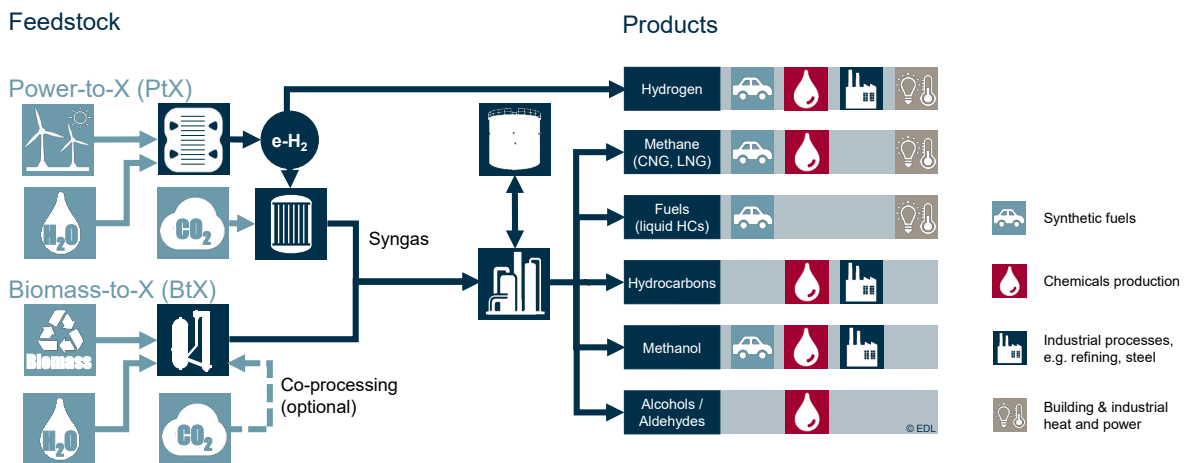
The upcoming years are decisive for the energy transition. Carbon neutrality, renewable energies and sustainable growth are the challenges of our time. Only with local and sustainable energy and economic cycles, we can safeguard our future and save consequential costs. As a competent partner, the Pörner Group supports the industry in improving its carbon footprint and in switching from fossil fuels to renewable energy sources using sustainable Power-to-X and Biomass-to-X solutions. With the Pörner Group as your process plant engineering contractor you will have all options for a 'green production'.

## PÖRNER GROUP: THE HOME OF GREEN ENERGY

Sustainable mobility, environmentally friendly energy generation as well as an efficient use of energy and natural resources are essential for sustainable growth.

According to the EU Renewable Energy Directive (RED II), the share of renewable energy in Europe needs to be in-

creased to 32 % by 2030. The Pörner Group will support the industry in these projects with expertise in engineering and technology. The use of PtX / BtX technologies in all areas of transport and energy as well as in the industry is of special importance.



PtX and BtX technologies for the generation of hydrogen and synthesis gas as base material for a sustainable industry in all sectors.

We offer the whole range of PtX technologies from generation of hydrogen / synthesis gas through to the production of synthetic fuels and base chemicals. So, PtX facilitates an intelligent sector coupling between

electricity, heat, transport, chemistry and industrial processes, thus making the required magnitude of decarbonization possible in order to meet the climate objectives.

# GREEN RESSOURCES

## GREEN RESOURCES FOR GREEN PRODUCTS

Based on our extensive knowledge in process engineering and wealth of experience in plant construction, we offer complete solutions for the industry. Combined with third-party technologies, we always find the optimum solution for demanding tasks in the green tech area.

The most important resources are renewable electricity, biomass and CO<sub>2</sub>. From these you can obtain sustainable synthetic products such as:

- Natural gas (bio methane, SNG)
- Hydrogen
- Methanol
- Fuels (gasoline, diesel, kerosene)
- Waxes / hydrocarbons for the chemical industry.

Our Pörner Group experts have the knowledge for the entire process chain from CO<sub>2</sub> extraction, gasification of wood, etc. through to the production of fuels and products..

### WOOD AND WASTE WOOD – THE GASIFICATION OF TORREFIED BIOMASS

High-quality 'green syngas' can be generated from storm-damaged and wind-blown timber, fallen dead wood, waste wood or old constructional timber. With adequate post-treatment, such as gas purification or methanation, it can be further processed into bio methane or hydrogen.

Torrefaction is a thermal treatment of biomass at temperatures typically between 250 and 280 °C. It is performed under atmospheric pressure and in absence of oxygen, which results in a partial pyrolytic decomposition and drying of the biomass. Using the two-stage gasification technology the versatile biosynthesis gas as well as biochar are generated. Biochar is a solid, dry material that can be used for example as activated carbon for water or flue gas purification, as fertilizer or as charcoal.

Torrefaction changes the properties of the biomass so that it has an increased energy density / calorific value, no longer decomposes, can be packaged, transported and stored more easily as pellet and can be used as a homogeneous and continuous feedstock for combustion and gasification applications.

Synthesis gas from torrefied biomass is a versatile, scalable and cost-efficient way of producing renewable energy sources.

In the Netherlands, Torrgas B.V. is already realizing, the gasification technology for torrefied waste wood, with Pörner as engineering partner. TAF Freiberg / DBI – the knowledge center for gasification technology – deliver the gasification equipment.



1 MW pilot plant with the Torrgas / TAF / DBI process for the production of synthesis gas from torrefied waste wood in Delfzijl / The Netherlands; a 25 MW plant is planned



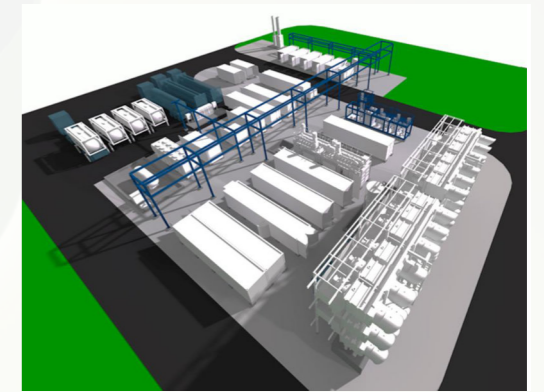
### FLEXIBLE PtX TECHNOLOGY FOR THE PRODUCTION OF HIGH-VALUE PRODUCTS

Our PtX technology covers a wide range of both feedstock and products. CO<sub>2</sub> can be used either from ambient air or from industrial point sources. Hydrogen / synthesis gas is generated by electrolysis using renewable power. An efficient PtX overall process is ensured based on processes that have been further developed and adapted by EDL to obtain the final products.

Since decarbonization of the aviation industry is most difficult, the focus is set on the production of renewable jet fuel from air. It is to be expected that this area will cause 25 % of all CO<sub>2</sub> emissions in the transport sector by 2050.

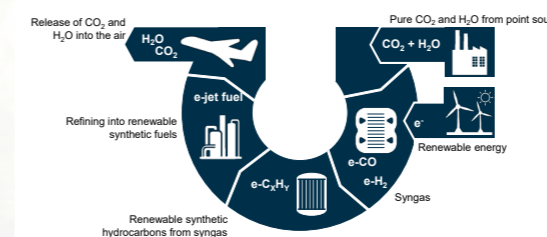
**Key benefits** of renewable jet fuel made from CO<sub>2</sub>, water and renewable electricity:

- 100 % climate neutral
- Reduction of NOx emissions by 12 – 25 %
- Reduction of particulate emissions by 95 %
- Up to 15 % less fuel consumption
- Hardly any water consumption
- No new logistics infrastructure and no new propulsion systems needed.

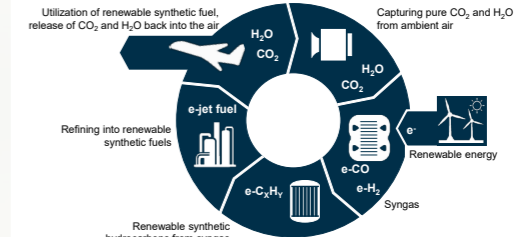


3D model of a plant for the production of 1,000 l/d renewable jet fuel from ambient air, planned at Rotterdam The Haag Airport – groundbreaking for a climate neutral aviation industry.

This makes synthetic fuels an excellent alternative to fossil fuels.



Open carbon cycle



Closed carbon cycle

Classic oil refineries can use PtX products such as green hydrogen, green methanol or green Fischer-Tropsch hydrocarbons to improve their CO<sub>2</sub> balance and increase the portion of renewable fuel.

# GREEN ECONOMY



## GREEN HYDROGEN THANKS TO PTX

Green hydrogen generated exclusively from renewable electricity by electrolysis of water, is an essential part of the energy transition. It is not only a versatile energy source, but also ideal as flexible storage medium for volatile wind or solar power. It also plays an important role in sector coupling.

Hydrogen or its reaction products produced through PtX technology can decarbonize areas where renewable electricity can hardly be used directly, as in cement or aviation industries. Additionally, hydrogen is used as feedstock in numerous industrial processes and can soon replace conventional feedstock, e.g. in steel production.



## PLASTIC WASTE - VALUABLE RAW MATERIAL FOR THE INDUSTRY

The constant increase in plastic waste has become a global issue. This waste can be reused e.g. by raw material recycling. With the proprietary EDL depolymerization technology of the Pörner Group, polyolefinic plastic waste is converted into valuable feedstock for the production of fuels and chemicals. This makes plastic waste a valuable raw material for the industry again.



Engineering and construction of a plant for the production of 4,000 TPA fully synthetic waxes from polyethylene and polypropylene through depolymerization; Webau / Germany, 2016

## CUSTOMER BENEFITS

### 1. Technology competence

As a company specialized in technology and plant engineering and construction, the Pörner Group acts as integrator and combines new as well as already proven third-party technologies with its own technologies and know-how in various areas such as water, CO<sub>2</sub> and co-electrolysis, dry reforming, methanation, methanol synthesis, Fischer-Tropsch synthesis, hydrocracking, isomerization and biomass gasification.

### 2. Experience

With our knowledge and experience in refinery processes, hydrogen and synthesis gas generation as well as in using renewable energy sources, we create for our customers holistic solutions for environmentally friendly production plants.

### 3. Integrated project management

With decades of international experience, the Pörner Group manages projects from the basic concept to the entire engineering, procurement and construction supervision right up to commissioning, training and predictive maintenance.

**A progressive and sustainable production is important in order to reduce global warming while taking into account economic feasibility. With our solutions, we support you along the way to CO<sub>2</sub> neutral processes and production. Contact us!**