

## Division Energy at a glance:

In the Division ENERGY we are dealing with the mobile and decentralized provision and storage of hydrogen and electrical energy having sustainable energy sources in the focus. We rely on the use of our proven microstructured plate heat exchangers, a portfolio of highly active, long-term stable and robust catalysts and established manufacturing technologies.

Our development work covers the entire technology chain from system design, process simulation, catalyst development, durability testing, reactor design, cost-effective manufacturing technologies, system control, system integration to system testing.

We develop individual components and complete ammonia cracker systems as hydrogen supply for combustion engines and all types of fuel cells from conventional and renewable fuels. We conduct research in the field of cracking catalysts, highly efficient cracking reactors and hydrogen purification for the use of ammonia as hydrogen carrier.

Talk to our experts to get the optimum solution for your application!

### Contact

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### Hydrogen carrier ammonia

Mobile and stationary  
energy supply: Reformer  
technology for hydrogen  
carriers

With regard to transport and storage there are considerable hurdles to be overcome before hydrogen can be widely used as an energy carrier. This includes either a high space requirement for storage or otherwise energetically unfavorable conditions. Although toxic in itself, ammonia can become a valid alternative allowing to easily store and transport the required hydrogen.

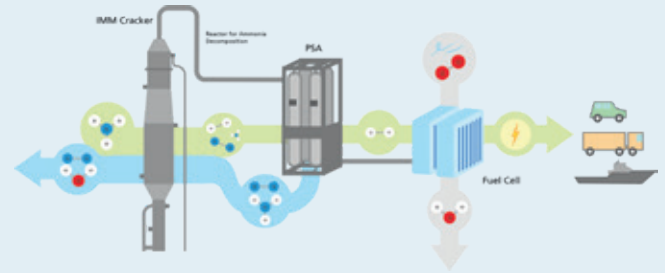
Ammonia is already produced on a large scale in the fertilizer industry, using established processes that are very well controlled in terms of safety, and has a significantly higher biological degradation rate compared to crude oil or derived fuels which is important especially in maritime applications.

Starting from green hydrogen, using renewable energy sources and eliminating nitrous oxide and NOx emissions ammonia has the potential to be a truly climate friendly energy carrier. The future cost of ammonia has been projected as lower compared to alternatives such as synthetic diesel, methanol or compressed hydrogen for many mobile applications.

### What do we offer to our customers?

Our development efforts currently focus on the fields of transport, logistics and manufacturing industry. Relying on our broad expertise in system design, process simulation, catalyst development, reactor design, system control, system integration and system testing we deal with different aspects/deployment scenarios including reactor development and system prototype building.

Hydrogen is generally seen as a beacon of hope in efforts to reduce global carbon dioxide emissions.«



### What are our current deployment scenarios?

#### Infrastructure of gas stations: decentralized supply of hydrogen

- We are developing a refueling module based on innovative catalyst technology and microstructured reactor technology.
- Pure hydrogen is produced from ammonia by splitting and subsequent purification. It can be fed to PEM fuel cells.
- From sustainably produced ammonia hydrogen is generated at hydrogen filling stations for utilization in fuel cell driven vehicles.

#### Transport sector

- We are working as part of an international consortium developing an ammonia-based propulsion system for shipping.
- Ammonia is fed into a SOFC fuel cell and converted into electricity. The catalytic converter ensures that there is no ammonia residue in the exhaust gas. No harmful nitrogen oxides are produced. Only water and nitrogen are released.
- When used as fuel for ships powering electric engines, ammonia is as eco-friendly as hydrogen, but easier and safer to handle.

#### Industrial manufacturing processes

- We are working on the utilization of sustainable "Spaltgas" as a flammable gas mixture for brick production.
- Applying heat, ammonia is split into nitrogen and hydrogen by a new developed "Spaltreaktor" using appropriate catalysts.
- The gas mixture of ammonia and "Spaltgas" can also be fed to combustion engines.