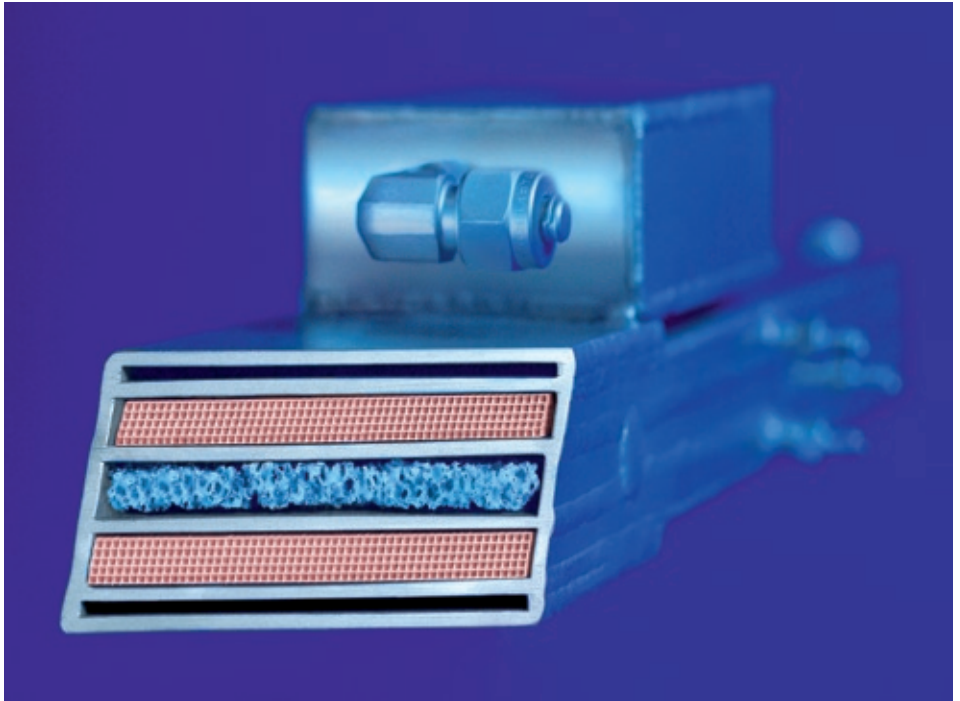




Reforming –  
everything's possible!



Micro steam reformer with burner for hydrogen generation from bioethanol. The ceramic pore burner in the center is set between two parallel honeycomb structures, coated with catalyst.

**Feel free to ask!**

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Fuel cells are suitable as future on-board electricity generators for cars, buses and trucks. Additionally they are particularly suitable as a portable electricity supply. Decisive for market penetration is to find suitable fuels which are presently available on the market to end customers.

Fraunhofer ISE develops reformer systems to generate hydrogen out of gaseous or liquid fuels such as natural gas, liquified petroleum gas, ethanol, gasoline, diesel or kerosene. In fuel cells, the hydrogen can be converted into electricity and heat. At Fraunhofer ISE, we develop reformers in the power range from 100W<sub>el</sub> up to 20kW<sub>el</sub>, catalysts, gas treatment systems and control strategies.

**Does your application have specific requirements?** We match our reactors to fit your specifications.

**Are you looking for high efficiency and long-term stable catalysts?** We characterize different catalysts in our automated long-term test stand.

**Are you looking for a complete, autonomous energy supply?** We will gladly integrate our reformer in a complete system with fuel cell, battery and power management.

**Are you interested in production and marketing?** We transfer our know-how to your product and qualify suitable suppliers. We are happy to inform you about the exploitation rights associated with our processes and constructions.



Fully automated test stand for steam reforming of natural gas.



Test stand for autothermal reforming of diesel for use on ships.



Fully automated system for autothermal reforming of desulphurized kerosene Jet A-1 to supply a SOFC.

### Technologies

At Fraunhofer ISE, we develop reactors for reforming gaseous and liquid fuels using steam reforming, partial oxidation or autothermal reforming. In addition, we have experience with pyrolysis processes.

To optimize reaction conditions, we carry out detailed screenings of catalysts and analyze them with respect to yield, selectivity and durability. We are working cooperatively with many well-known manufacturers. If requested, we also contribute our own work in catalyst development.

For gas purification, we perform a water-gas-shift reactor and, if needed, a successive, fine purification reactor by means of selective methanation, membrane separation or pressure swing adsorption as an aftercleaning stage.

Based on our experience obtained from constructing numerous, automated, complete systems for different power ranges, we choose customized peripheral components. High-quality test stands enable us to perform qualification tests both on our own developments and on commercial components. This serves as the basis for the development of the control electronics and the safety technology.

### References

Together with German companies in the heating sector, we have developed natural gas reformer systems for fuel cell heating devices.

Furthermore we successfully demonstrate liquid gas reforming. This development finds application in leisure activities and was commissioned by a German supplier for campers.

For the on-board electrical supply of airplanes, we have constructed a test system with a 5 kW<sub>el</sub> solid oxide fuel cell for generating hydrogen from kerosene. In addition, we integrated a compact desulphurization unit. We carried out this work in a consortium with Airbus and Liebherr Aerospace.

Ansaldo Fuel Cells S.p.A. commissioned us to construct a reformer for the autothermal reforming of diesel for an auxiliary power unit (APU) on ships. This reformer supplies a molten-carbonate fuel cell with a nominal power of 20 kW<sub>el</sub>.

For the German Federal Ministry for Economics and Technology and together with our industry partners, we are developing a 300W<sub>el</sub> PEM fuel cell in combination with a micro-reformer for ethanol. In this system, the reformer, the shift reactor and the CO fine purification are all integrated into a single compact unit.

### Competence

Since the 1990s, Fraunhofer ISE has been carrying out research and development on fuel cells and hydrogen generation. We are continuously active in international research networks, and we cooperate closely with industry partners. We foster an intensive transfer of knowledge with our numerous suppliers. Fraunhofer ISE is certified according to DIN EN ISO 9001:2000.

Experience and know-how:

- complete automated systems for hydrogen generation
- controls and safety technology
- development of reactor concepts from material selection to flow simulations
- screening of commercial materials and components
- long-term tests for investigating degradation effects

### What can we do for you?