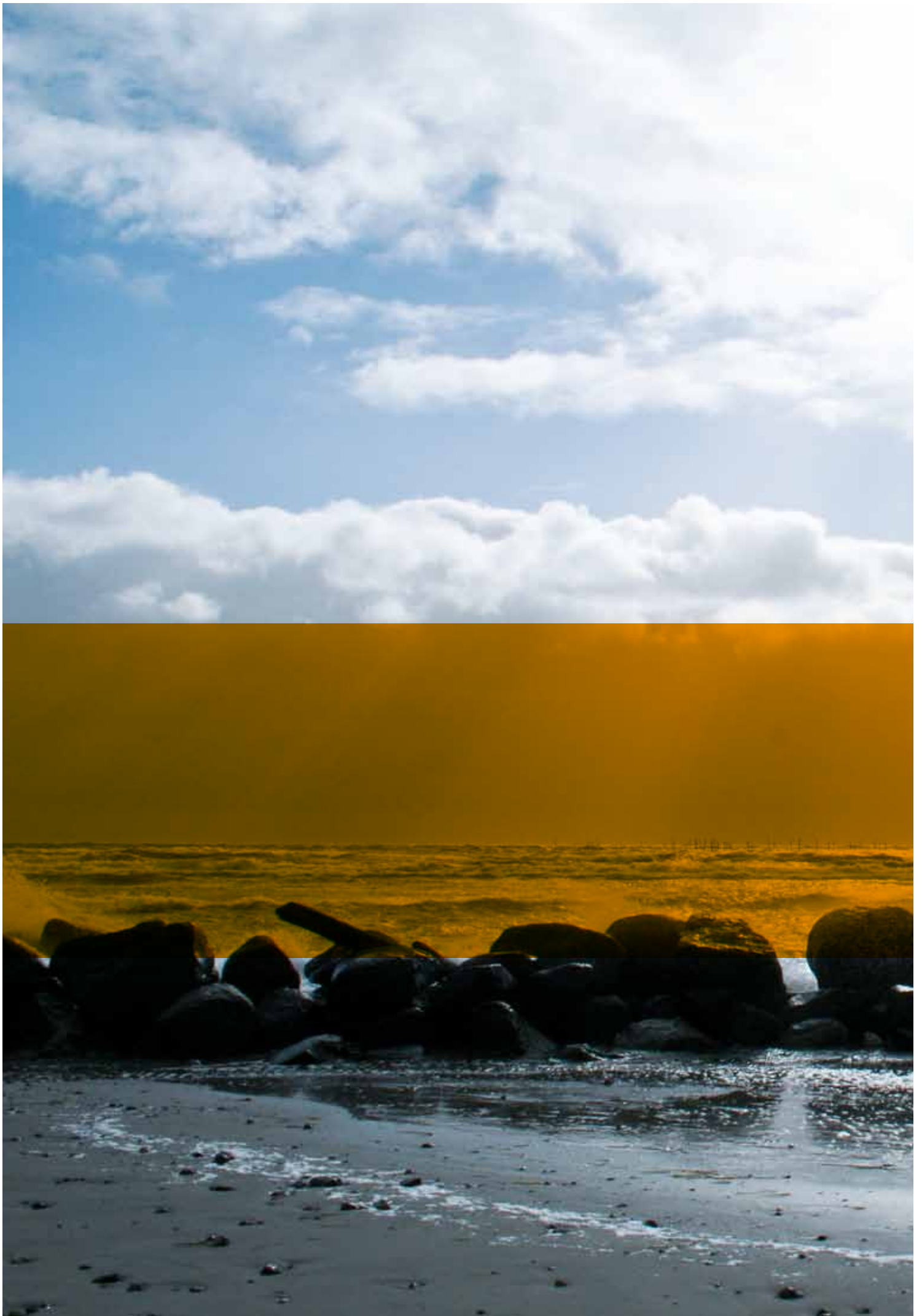


TOPSOE FUEL CELL

RETHINKING ENERGY







Change this view?

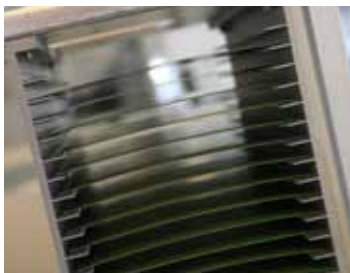
Some things have to change in order for others to remain.

Topsoe Fuel Cell is building the bridge to a clean and efficient energy supply of the future.

That's how we are rethinking energy.



About us



Planar SOFC fuel cells in process rack

Focus

Topsoe Fuel Cell produces high temperature solid oxide fuel cells (SOFC). Topsoe Fuel Cell, founded in Denmark in 2004, is a company within the Haldor Topsøe Group.

Our dedication to SOFC technology is based on its remarkable feedstock flexibility, allowing the use of any hydrocarbon fuel – available from natural resources, synthetic or biomass, and hydrogen once it becomes part of the energy infrastructure.

A second and equally important reason for our commitment to SOFC fuel cells is the efficiency of the technology – the SOFC technology offers very efficient energy conversion, providing the highest electrical efficiency among fuel cell technologies.

As OEM supplier we provide the core of the SOFC system supplying SOFC technology to our industrial partners.

Origin

As a subsidiary of Haldor Topsøe we benefit from a vital base of core competences and a history going back to 1940. Fuel processing combined with production skills using ceramic processing and catalyst manufacture are examples of core competences within the Topsøe Group.

SOFC technology features a number of other complex technical challenges which are addressed in collaboration with Risø National Laboratory for Sustainable Energy. Together we have developed the materials and processes for the production of anode supported SOFC fuel cells. The collaboration arrangement between Risø and Topsoe Fuel Cell secures Topsoe Fuel Cell exclusive ownership of any proprietary right of the SOFC development.

In-house SOFC manufacture



Scaling up

The 5 MW production facility in Lyngby, Denmark, completed in 2008 is a giant leap towards commercialisation. The cell production capacity is sized to cover the planned demonstration effort within the company as well as with collaboration partners. Through the investment in this facility we demonstrate various cost cutting possibilities while also increasing the SOFC fuel cell performance.

The facility combines state-of-the-art processes with elements of automation in order to decrease the cost of our SOFC technology. It is built in modules where new processes and equipment can be implemented as these are developed. SOFC fuel cells

in different dimensions and geometries can be produced on the same equipment.

On a mid-term basis, we will scale up further by 20-50 fold, increasing the capacity to meet the demands of the pre-commercial market.

Stacking the cells

We develop and manufacture stacks for mobile and stationary applications. Even before the inauguration of the new stack assembly facilities, the capability of designing and producing a large number of stacks with repeatable performance was demonstrated.

We provide SOFC units where the stack is integrated with the fuel processing and other high-temperature system com-

ponents – the PowerCore™ – providing our industrial partners easy access to the SOFC technology.

Our OEM supply can vary from stacks to PowerCore™.





Products



Stack

Our different SOFC stack designs vary in capacity and geometry depending on application. Several stacks beginning with 200 W DC power output are available.

PowerCore™

The PowerCore™ is the core of a fuel cell system, as it integrates the stack with fuel processing and includes all high temperature components in one compact unit. All hot components are thermally insulated within the PowerCore™ envelope for easy integration in your commercial product. Specific PowerCores™ are provided for various applications – mobile as well as stationary.

System

We develop unique fuel cell systems. We understand the complexity of the system and the requirements for the

different components. We support you in finding the best solution for your SOFC-based power system.

Fuel processing

We apply both catalytic partial oxidation (CPOx) and steam reforming fuel processing which allows use of a wide range of fuels such as natural gas, diesel, biogas and alcohols.

The SOFC technology provides internal reforming of methane as an inherent feature.

Range

The Topsoe Fuel Cell product platform includes a natural gas and a diesel based PowerCore™ in the low power range (1-5 kW).

For larger stationary applications we apply different modules reaching capacities of 10 kW and upwards.

Product integration

The integration of a PowerCore™ into a power system is a joint effort: Our conceptual system know-how secures the right operation and optimisation of your commercial product using Topsoe Fuel Cell technology. Your application know-how and design for cost and high volume manufacturing ensures a superior end product.

Cooperation

We work closely together with our cooperation partners. Our partners integrate our products into power systems and other SOFC applications. Topsoe Fuel Cell develops and manufactures the stacks, the stack module or the PowerCore™ as OEM supply.



APU



MICRO CHP



DISTRIBUTED GENERATION

Applications

SOFC technology may add value in many different applications. At Topsoe Fuel Cell we have chosen to focus on a number of high value market segments: APU, MicroCHP and Distributed Generation. Topsoe Fuel Cell's product platform strategy is designed to maximise synergy in this development. Currently we focus on 1-5 kW PowerCore™ units for stationary and mobile application with single stack technology using natural gas and diesel as fuels. With time, the product platform will be expanded with higher power levels and different fuels.

APU

There is a growing need for auxiliary power units (APU) for power supply off-grid, for elimination of idling of the main diesel engine of vehicles and for replacing internal combustion engine generators at places where quietness and absence of diesel odour matter, e.g. motorhomes and yachts.

We provide a diesel based PowerCore™ for integration into an APU. The PowerCore™ is designed to fit the strict space and weight requirements of the transport industry applications. The dynamic power response is instant and meets the load changes on board.

If the capacity of the standard 2.5 kW unit does not meet your power requirement, a special design can be made.

MICRO CHP

Combined heat and power generation in your own house is one of the most efficient ways meeting residential energy requirements.

We offer a 1 kW PowerCore™ unit enabling you to reach total efficiencies above 90% based on natural gas as fuel. The PowerCore™ meets the emission standards of today. Our conceptual system know-how supports the integration of the PowerCore™ in your microCHP application.

Currently the PowerCore™ is based on natural gas which is the most common distributed fuel for stationary application. The microCHP will also run on biogas, either pure biogas or added to the natural gas grid.

DISTRIBUTED GENERATION

Large scale energy savings and reduction of carbon emissions can be achieved through distributed generation of power and through Combined Heat and Power (CHP).

Given the high electrical efficiency of the SOFC technology 50% of the fuel can be saved compared to an engine-based CHP unit of the same power capacity.

Starting at 10 kW we provide units at different levels of integration from stack module to PowerCore™.

We are developing stack modules which integrate the proven SOFC technology to achieve an electrical power of 250 kW and eventually enter the megawatt range.



Moving ahead



Quality assurance is a key step in the manufacturing process

Cells, stacks and PowerCore™

During the development of the SOFC fuel cell it became evident that the high energy conversion efficiency could only be reached by integrated design of all hot components. Any component influencing the hot thermal balance of the system needs to be integrated into a PowerCore™, thus saving energy by elimination of thermal losses. No matter if the fuel is diesel, natural gas, biogas or hydrogen, the need is the same – high fuel efficiency.

Focus on commercialisation

Our organisation reflects our ambitions to bring the technology to the market through integrating partners. We have a dedicated staff in the design and demonstration department. The test facilities include a large number of stack test units, PowerCore™ units and critical single components. This will expedite access to the technology for our present and future partners.

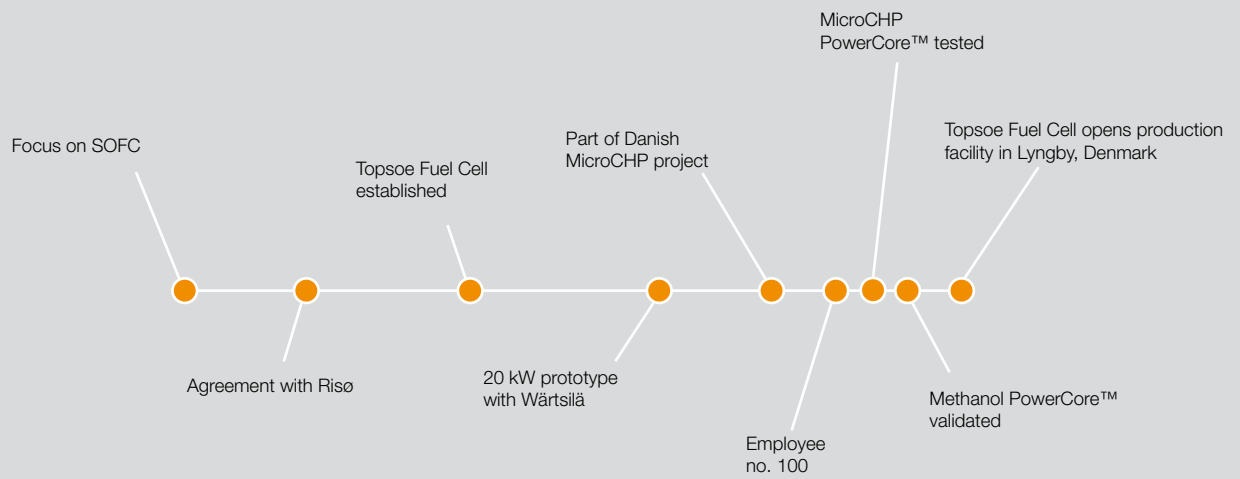
We have sufficient production capability within our new 5 MW facility to supply the on site demonstration phase taking the technology one step further towards commercialisation. We believe that securing the OEM production capacity in due time before larger on site demonstration takes place shows our strong commitment.

Funding

Topsoe Fuel Cell's parent company Haldor Topsøe is market leading within heterogeneous catalysis and supplies catalysts and process design for oil refineries, chemical plants and the energy sector.

Topsoe Fuel Cell has secured a substantial number of grants and funds from organisations such as the Danish state's PSO and EFP funds, EU DP, the Danish National Advanced Technology Foundation, the European Union's Sixth and Seventh Framework Programmes as well as the European Union's LIFE Environment programme. The parent company, Haldor Topsøe, funds the balance.

Milestones



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