

### ► Methane conversion

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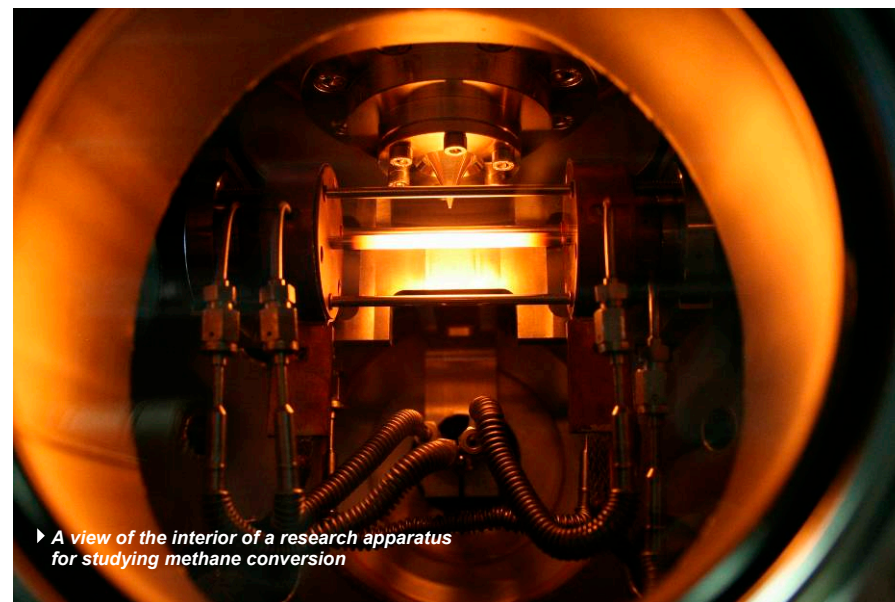
### ► Project-involved institutions



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## Catalysis for Supplying Energy

Price explosion in crude oil prices



► A view of the interior of a research apparatus for studying methane conversion

The recent dramatic price jumps in crude oil and fuels are clear signals of future long-term fossil fuel shortages. Still, 100 billion cubic metres of natural gas are simply burned away during production every year simply because of a lack of a cost-effective transport method.

Natural gas is up to 98% methane. If one succeeds in chemically converting methane into a valuable or liquefied substance, then mankind can gain a significant time buffer before its departure from oil. This would make the transition to renewable energy sources significantly easier.

► Methane conversion has become a central research topic of UniCat.

## Catalysis for Supplying Energy

### ► Natural gas reserves will last at least another 60 years.

Worldwide crude oil reserves are projected to last another 40 years. It is estimated, on the other hand, that natural gas reserves will hold up at least another 60 years. Simply burning off natural gas during production is an unacceptable waste of resources. The quantity of natural gas that is simply torched away during processing is enough to supply Germany and France combined.

To produce valuable base chemicals from methane, it must be first “activated”. This step is quite complex mainly because there is a high risk the methane will burn completely already during the activation process.

One long-term goal of UniCat is to convert methane into ethylene through oxidative coupling, thus making industrial use possible. Ethylene is a very precious industrial raw material for manufacturing various chemical products such as polyethylene film and packaging. Up to now the chemical industry has met demand by using crude oil.

### ► Studying the single steps of methane conversion

At the UniCat Cluster of Excellence, efforts are currently underway to solve the problem by getting down to the basics. The first step is to investigate the single steps of oxidative methane-coupling. Using the rates of the single partial steps, a model is being developed that describes the exact time process of reaction at the catalyst. This provides the foundation for the synthesis of new catalytically active materials and the development of new catalytic reactors.

## Catalysis for Supplying Energy

### ► Up-Scaling

To carry out investigations on up-scaling oxidative methane-coupling, a mini-plant facility is being built by the involved engineers. The plant will act as a bridge between chemical experiments conducted in the laboratory and the reactors like those used in industry.

Up-scaling plays an important role in successfully transferring research results to industrial application. The simple up-scaling of reactors, pressure vessels and piping by a specified factor in general does not in itself take us to the target. The arrangement and sizing of the plant components and the residence time of the substances in the systems often decide whether a reaction leads to the desired product.

### ► Baking an XXL cake

To demonstrate this, let us take a moment to conduct a thought experiment. We've invited a large number of guests for afternoon tea and cake. To bake the cake, we produce a huge amount of cake batter. And to save time, we put the entire cake batter in one shot inside a single, especially large baking form.

As every housewife already knows, if we do not deviate from the recipe instructions by lowering the baking temperature and increasing the baking time in accordance to the cake batter quantity, then we'll end up with a cake that is burnt on the outside and still raw inside.