

bse engineering
Less buildings, more solutions

In cooperation with

BASF
We create chemistry

Power-to-Methanol at Small-Scale

*Flex*Methanol

10 & 20 MW Module

flexible
operation

proven
technology

mild
condition

tailor-
made
catalyst

skid-
mounted

Standardized *Flex*Methanol Units

Our Vision

Mankind has always dreamed about endless energy sources produced from air and water which also save the climate. Already today we can tap natural resources like wind and solar power to provide unlimited liquid energy with pure CO₂ and H₂ from water electrolysis. The CO₂ and power from renewable

sources are by far unused resources. Methanol, however, is a product that is already used as fuel. A mass market with premium prices has been established for this application. H₂ will then be electro-chemically produced when power is cheap. In the consequence, *Flex*Methanol with a modularized construction increases the value of power in existing stations by transforming power to a liquid form.

*Flex*Methanol means profitable at all times

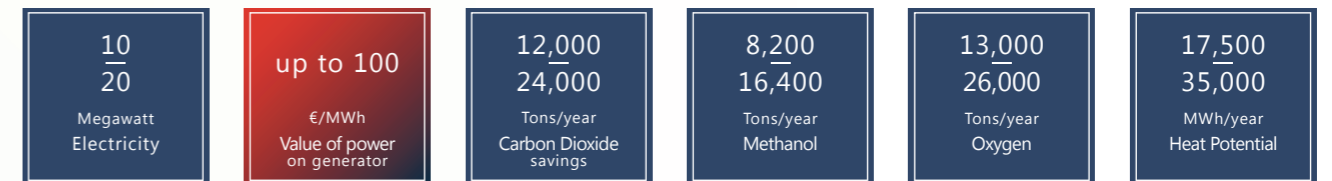
*Flex*Methanol will enable economically viable transformation of excess current and off-gas CO₂ into the chemical energy storage in small-scale and delocalized production units. Core of the plant is the tailor-made catalyst of BASF to convert CO₂ without a cost intensive prior water-gas-shift reaction.

*Flex*Methanol consists of 4 industrially available process steps (electrolysis, CO₂ scrubbing, methanol synthesis, distillation) as 10 and 20 MW module. The modules are scalable up to 100 MW and thermodynamically interconnected with the

existing asset. This increases the total efficiency of the process. *Flex*Methanol stabilizes the revenues significantly by operating in two ways depending on the power price. If the price is above the internal marginal price the plant feeds into the grid. Otherwise the plant uses the excess current to produce H₂ through discontinuous electrolysis. In a second step, methanol is produced from CO₂ and H₂, thus leading to a valorizing of excess current and CO₂ off-stream gas. In the second process step, BASF's catalysts will be used for the methanol synthesis step. Those catalysts have been further tuned and adapted for this specific process to enable the most efficient production of methanol. Methanol is one of the most important basic chemicals used in numerous industrial applications. For example, it is used in the biodiesel production or blended into gasoline. Did you know that in China, 200 million cars run with methanol blends? How about 150 million cars in Europe with methanol as antiknock agent?

**Ready.
Proven.
Profitable.**

*Flex*Methanol 10 & *Flex*Methanol 20

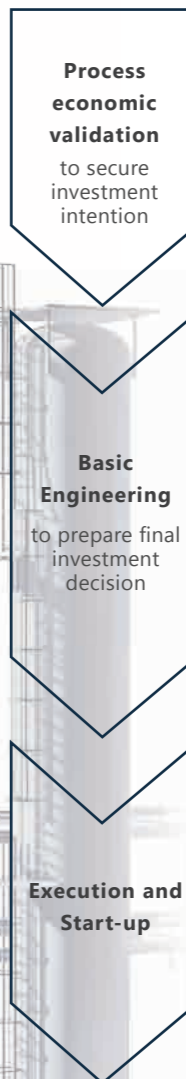


based on 8,760 hours

Performance

Flexible Operation Flexibility range 10-120 % < 15 seconds	Tailor-made BASF Catalyst High activity / stability, optimized for flexible operation	No tars, no waste Methanol synthesis works on pure gases without any impurities
Highly efficient 55-74 % efficiency on electricity used, heat integration	Low investment CAPEX ≤ 3,000 €/kW	Biodegradable Amines Environmentally friendly and low risk of approval
4 industrial available process steps Reduction of technical and operational risks	No water-gas shift reaction There is no need for capital cost intensive Steam Reforming	Mild process conditions Low pressure 40 bar, 240 °C
Electrolysis Free choice, can be defined together	Skid-mounted pre-fabricated Thus short construction time and short start-up time	Gas Loop Operation Complete conversion of carbon to methanol hot-standby

Execution Steps



In cooperation with

AkerSolutions

- Provider of unique CCUS technology
 - Just Catch - standard and modular design
 - Robust and environmentally friendly solvent
 - Verified performance on waste incineration, cement, coal and gas fired power plants
- www.akersolutions.com



- World leading chemical company
 - Pioneer of methanol synthesis
 - Largest catalyst company worldwide
- www.catalysts.basf.com

bse engineering

- Business Developer
 - Engineering and process provider
 - Plant integration
 - Exclusive BASF - Catalyst supplier
- www.bse-engineering.eu

InfraServ KNAPSACK

- Over 180 engineers
 - Over 100 years experience
 - Process development
 - Conceptual design
 - Basic, detail engineering
- www.infraserv-knapsack.de

SULZER

- Most complete portfolio of distillation components
 - The leading expert and solutions provider for continuous, single-/multi-stage distillation
 - Taylor-made design of highly efficient separation process
- www.sulzer.com

We are an experienced & strong consortium who works with passion & skills to provide the best solution for your business.

100 % Premium Fuel with the use of wind and solar energy	100 % Premium Fuel with the use of regenerative raw material	100 % Premium Fuel with the use of recycled non-renewable waste
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Climate-friendly fuel in a premium market.

Low carbon economy has to circle more carbon to become resource efficient.

*Flex*Methanol brings reindustrialisation for:

- Waste incineration plants
- Paper mills
- Heat driven process
- Fossil power plants

More Sustainability
Less Carbon Dioxide.

bseengineering

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