

# Advanced coal technologies: Research for power plants and chemical use of coal in the Rhenish lignite-mining area

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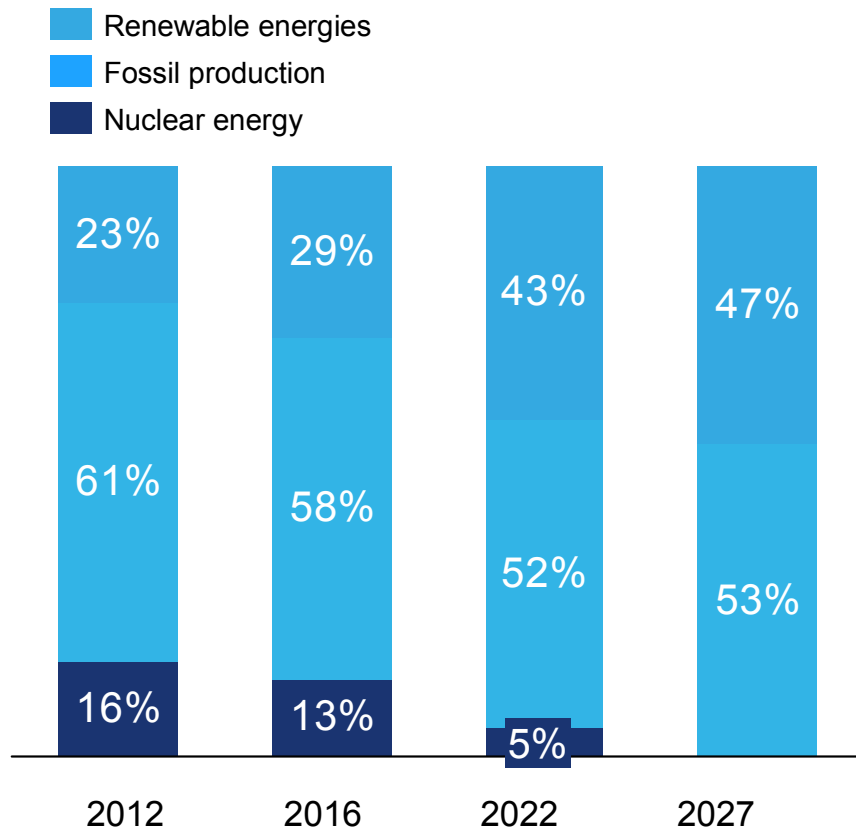
Zukunft. Sicher. Machen.

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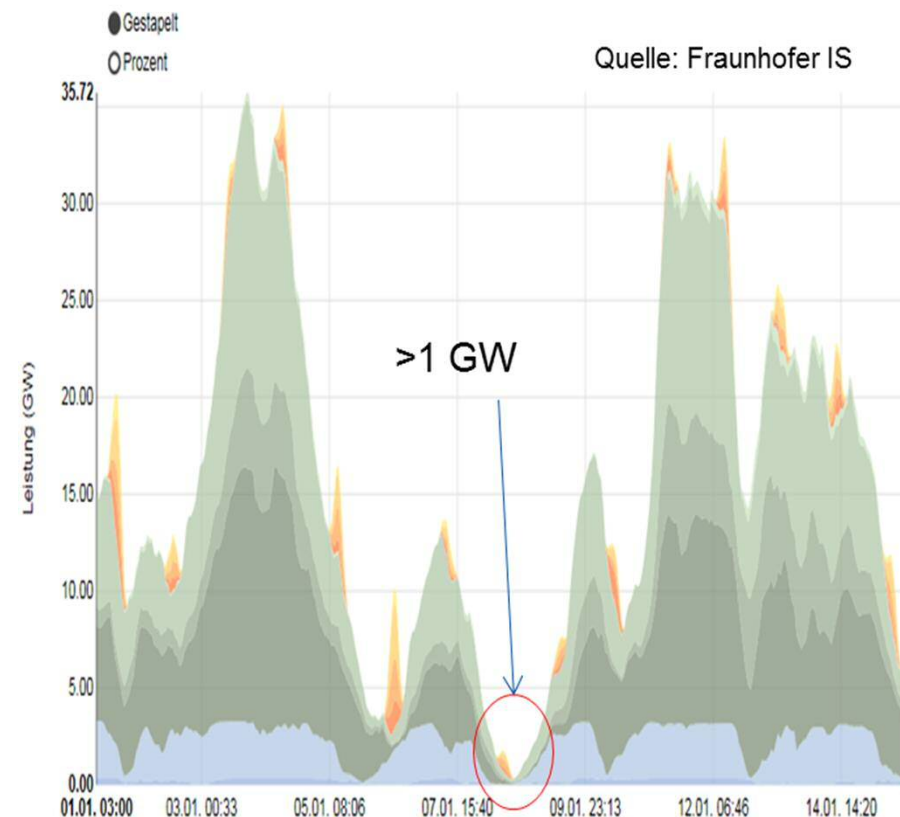
**RWE**

# Conventional power plants remain indispensable in the long term for the provision of guaranteed power

Electricity generation in Germany <sup>1</sup>



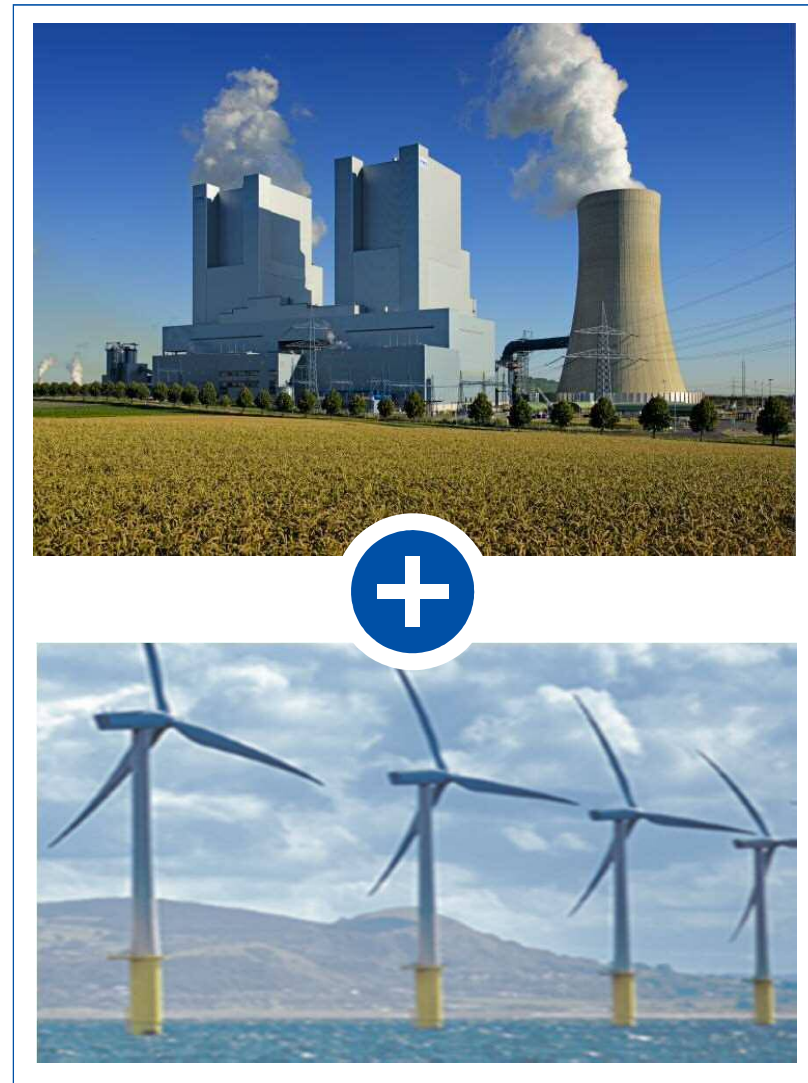
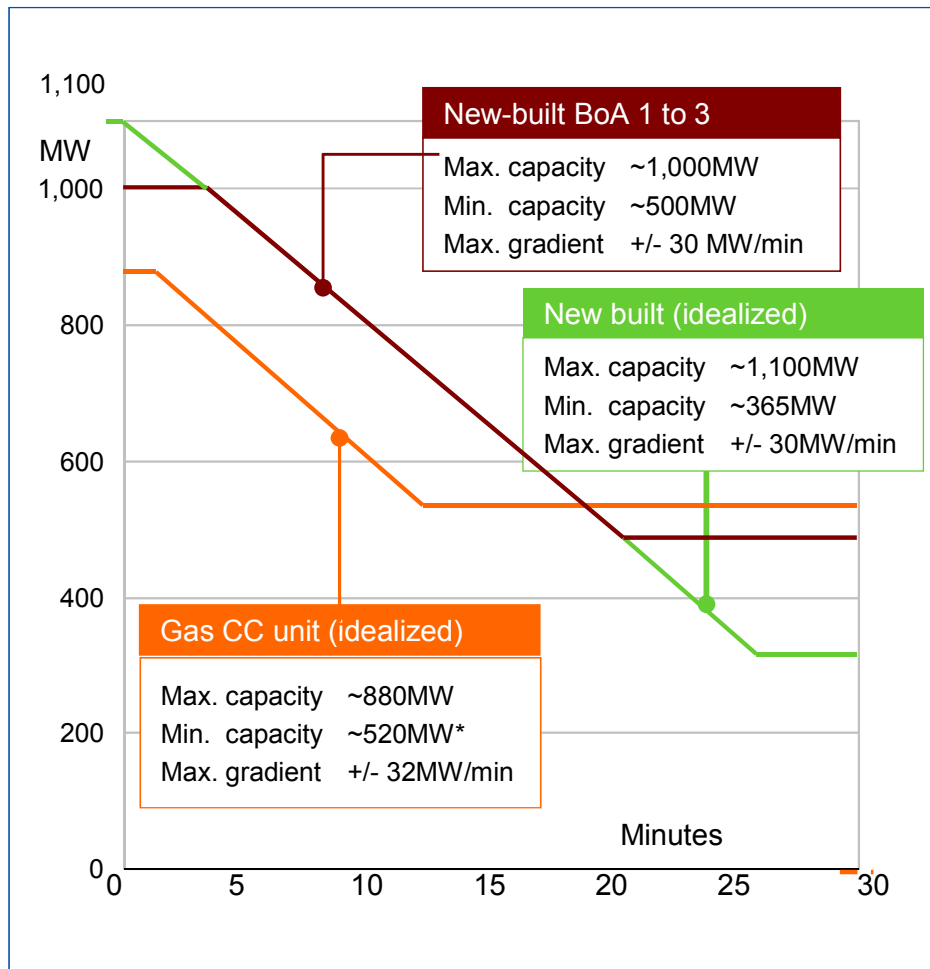
Generation of wind and solar power January 2018



But the role of conventional power plants will change: as a partner of RES, conventional power plants will need to have a high degree of flexibility to fill the production gaps

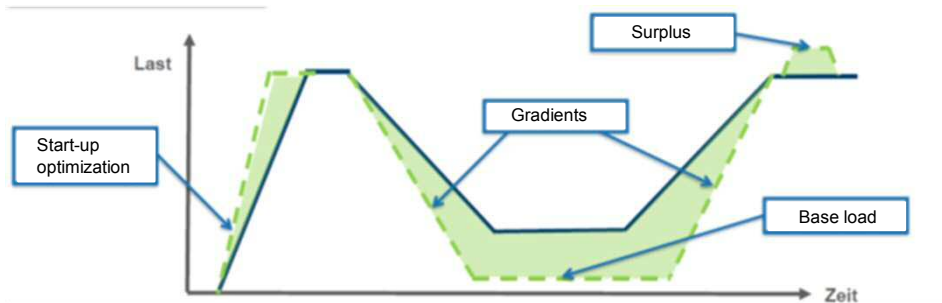
# The existing pp fleet is able to cope with current flexibility requirements thanks to continuous optimization

Flexibility of modern gas-fired units as compared with lignite-fuelled power plants



# Enhancement of flexibility of conventional power plants requires further research & development

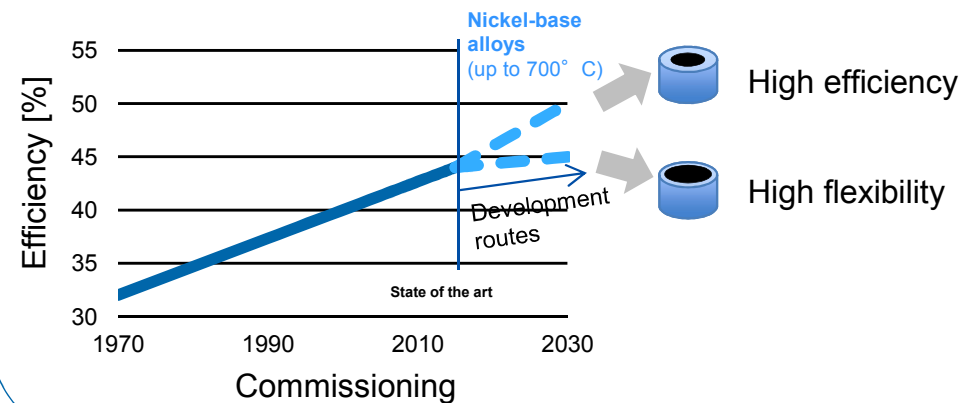
## I&C optimization makes modern power plants even faster



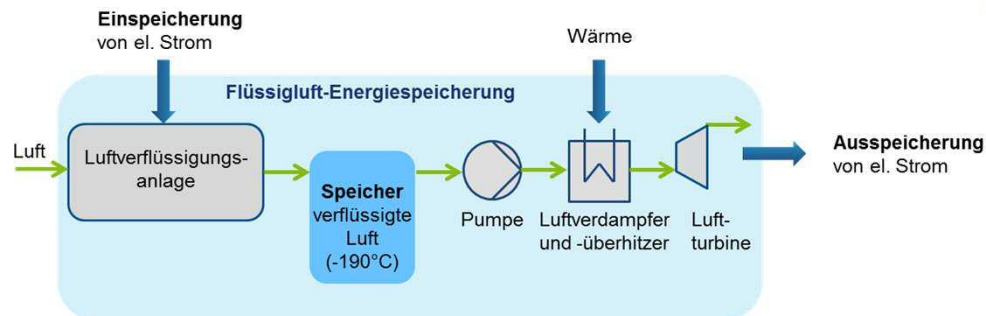
- > Reduction in minimum load
- > Increase in load change rate

## New advanced materials allow increase in flexibility or efficiency

### Efficiency development of lignite-fired plants

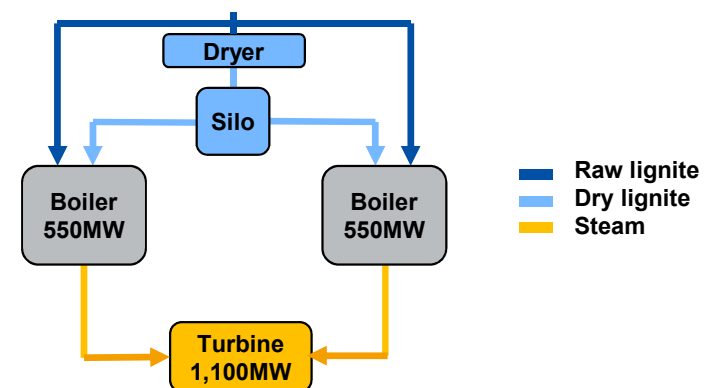


## Integration of energy storage to optimize flexibility and market-compliant electricity production



- > Reduction in minimum load
- > Increase in load change rates
- > Provision of balancing energy
- > Avoidance of shut-downs
- > Support of start-ups

## New pp concepts to increase efficiency and flexibility

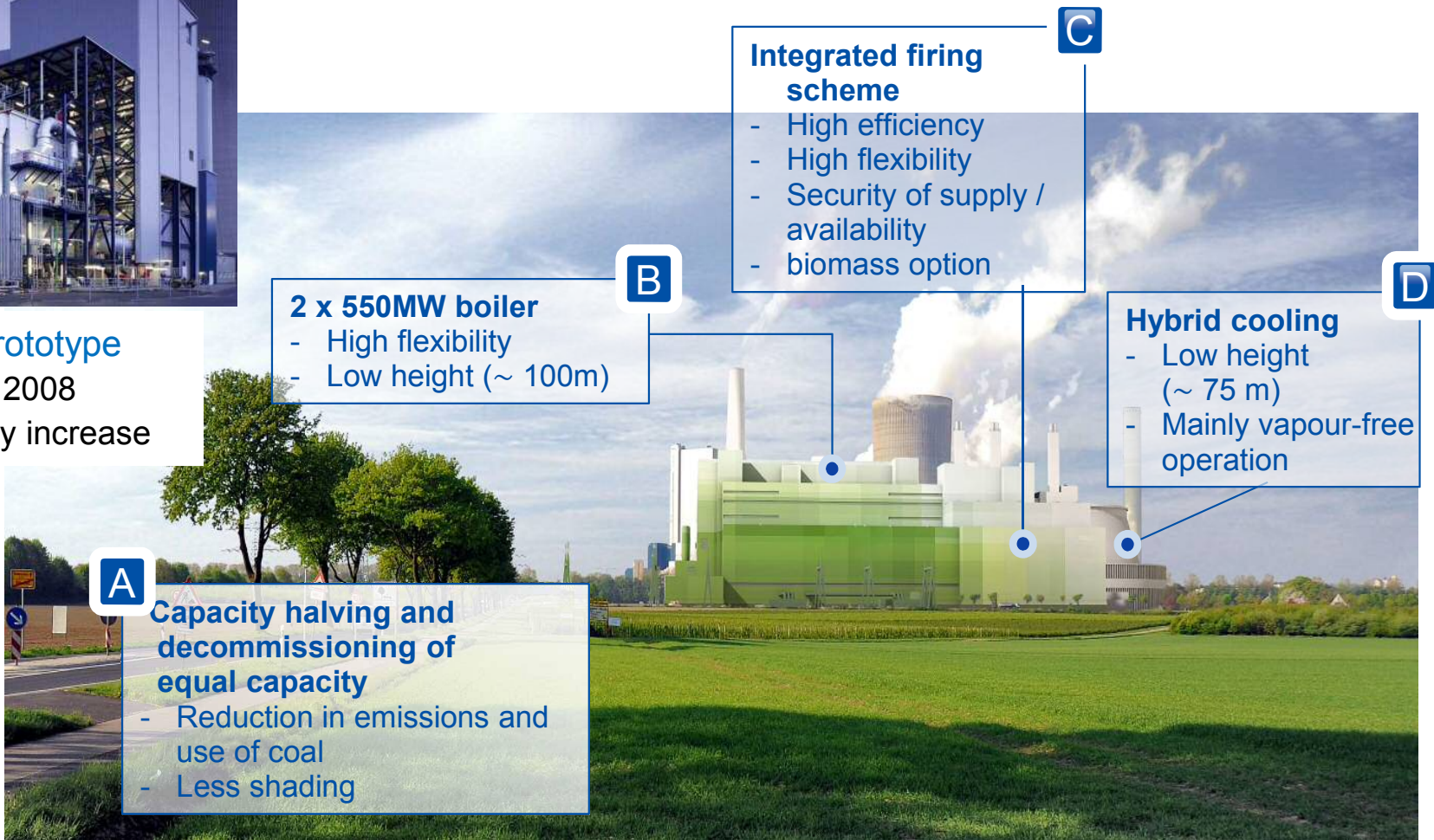




# Dry lignite-fired pp most modern, most efficient and most flexible kind of lignite-based power generation worldwide



WTA® prototype  
Since 2008  
⇒ efficiency increase



# Advanced flue gas cleaning technologies for further emission reductions

**Industrial Emissions Directive**

Basisdaten der Richtlinie 2010/75/EU

NEC-D

NO<sub>x</sub>

Dust

BAT / BVT

Aerosoles

CCS Directive

European Commission

Umwelt Bundesamt

Hg

SO<sub>2</sub>

CO<sub>2</sub>

Mercury reduction

Reliable CO<sub>2</sub> scrubbing

Efficiency increase and further development of flue gas desulphurization

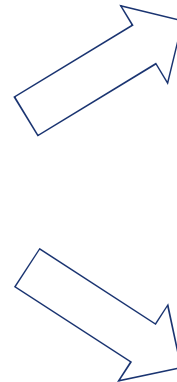


# Lignite as a partner of renewables and reliable carbon supplier for industry

## Opencast mines



- Use of existing infrastructure



## Flexible power plants

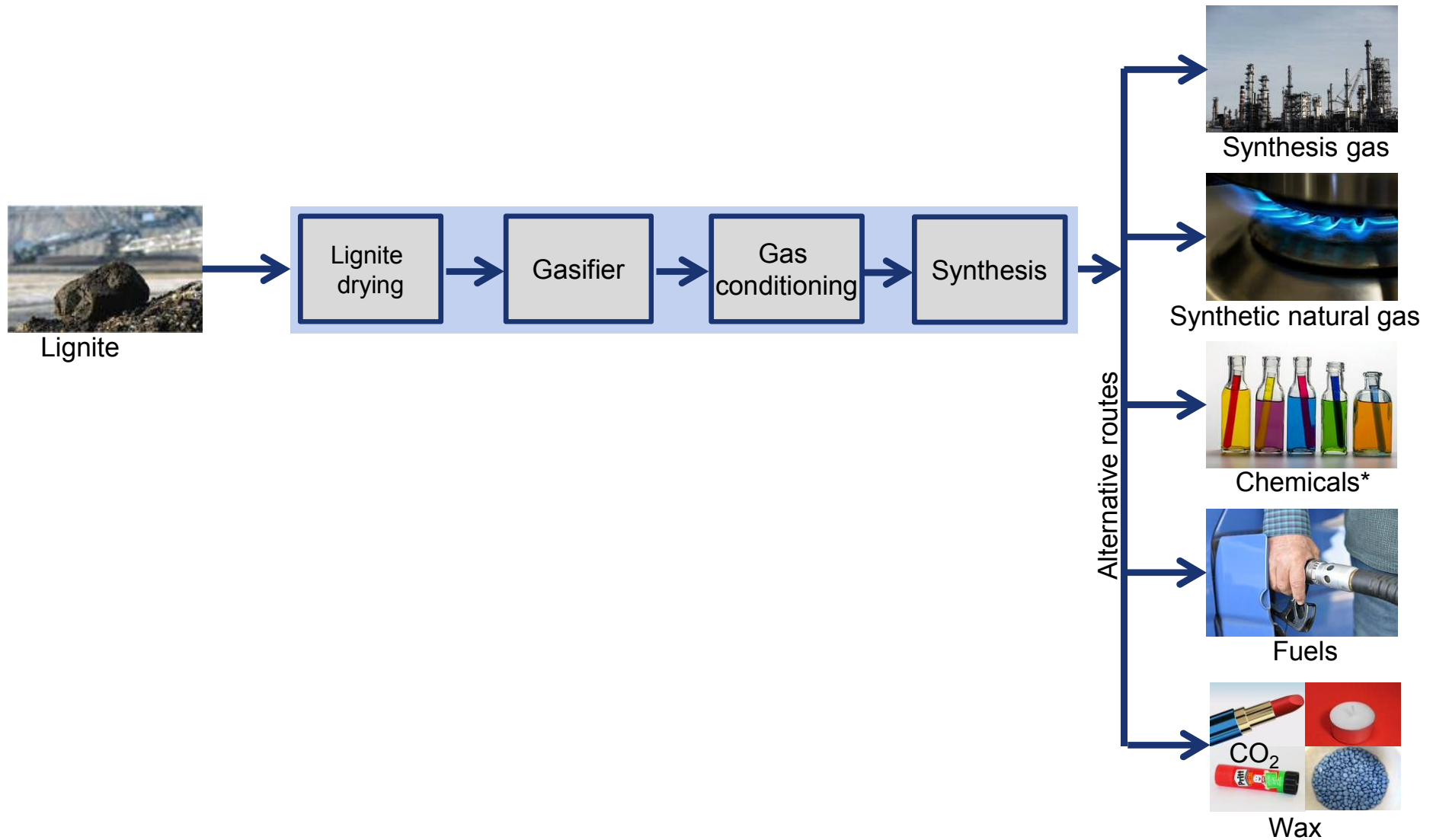


## Chemical use

➤ Lignite could replace crude oil and natural gas as a carbon resource (in part)

➤ Retention of lignite as a domestic energy carrier, security of supply and jobs by expanding the use of lignite as a chemical substance

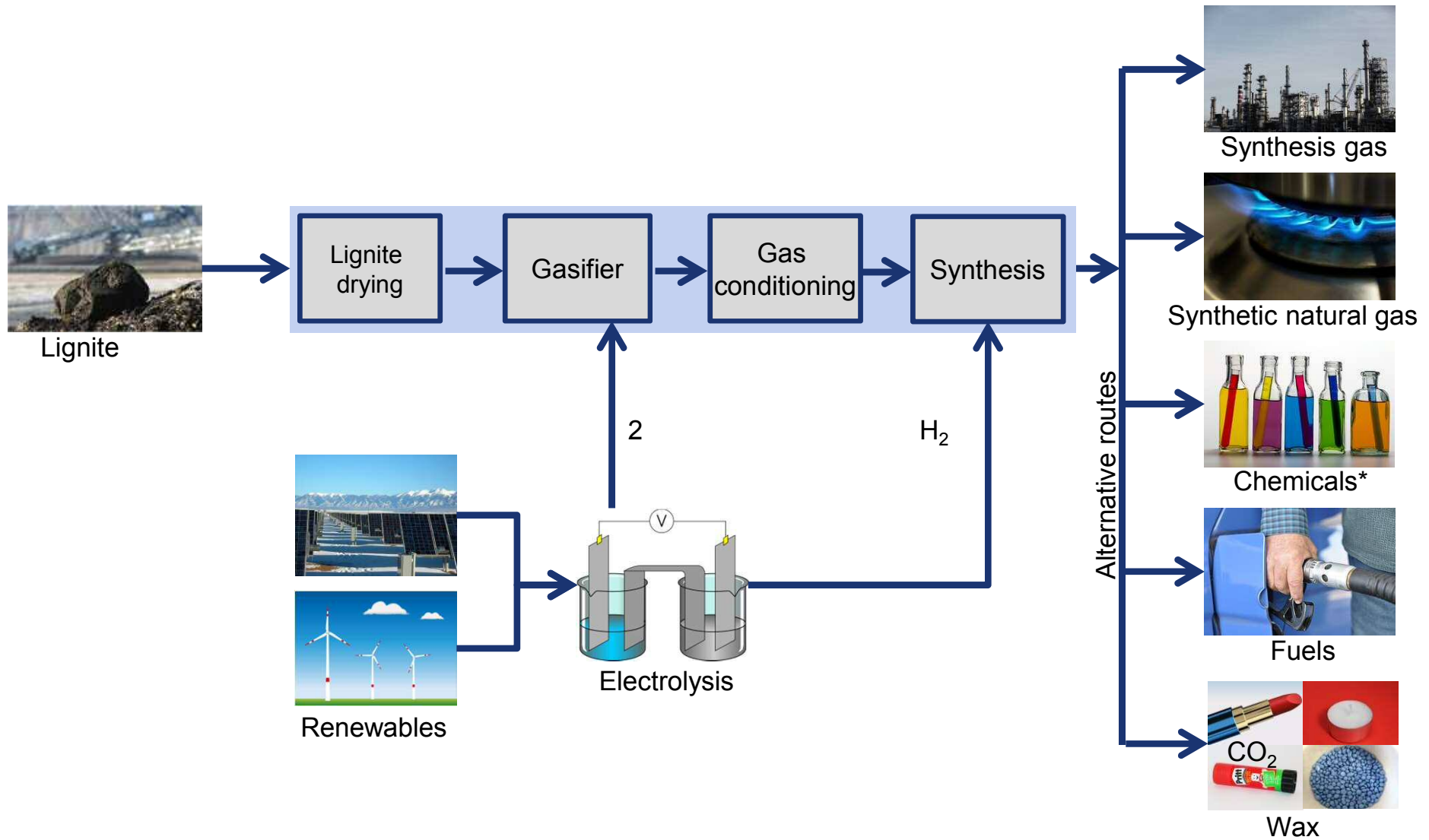
# Chemical use opens up new markets for lignite



\* Naphtha, hydrogen, acetic acid, methanol, ammonia, ...

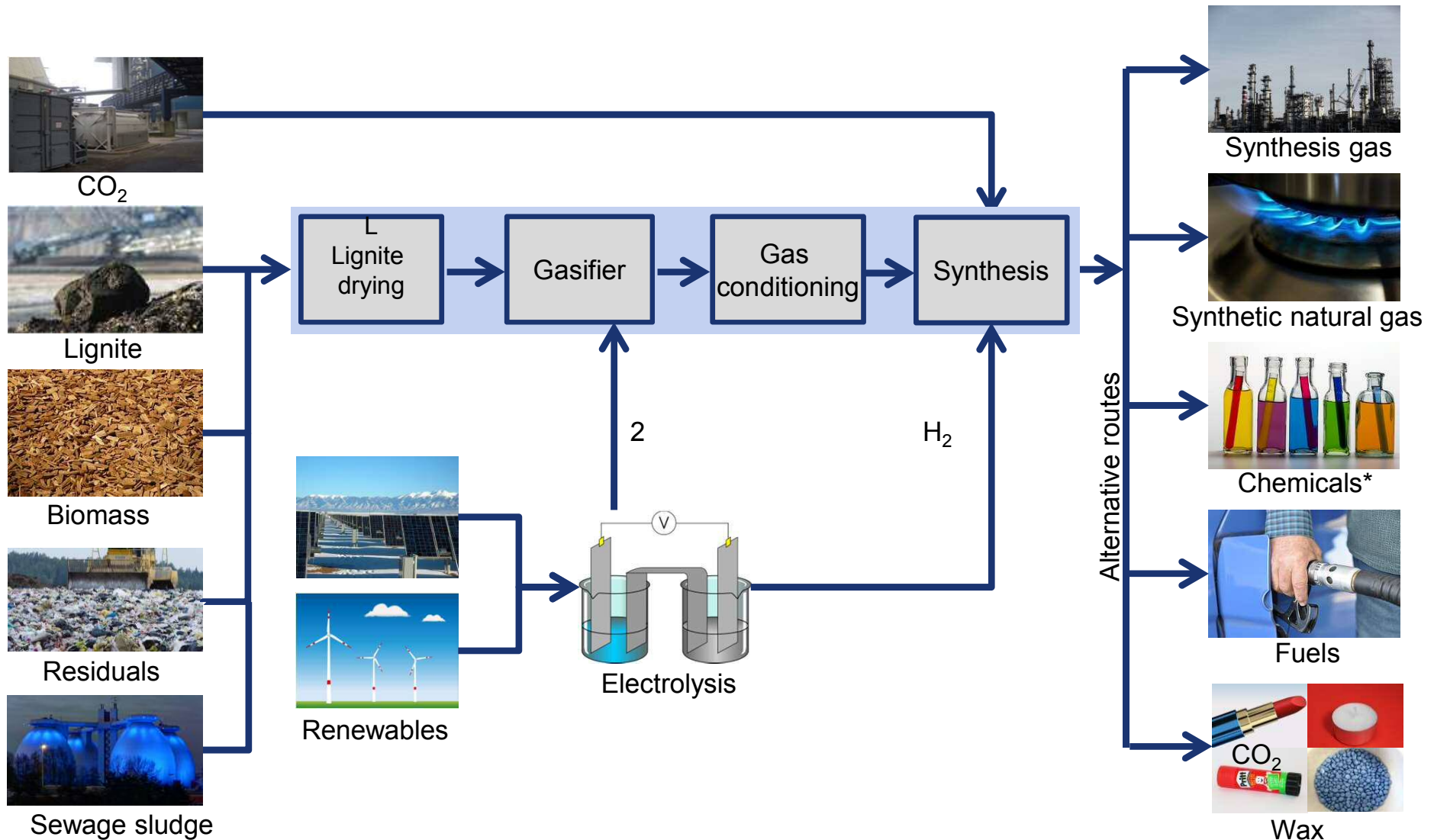


# The integration of renewable energy permits the carbon footprint of chemical use to be reduced



\* Naphtha, hydrogen, acetic acid, methanol, ammonia, ...

# Utilization of biomass and waste materials as first step into a circular carbon economy



\* Naphtha, hydrogen, acetic acid, methanol, ammonia, ...

# RWE project "Fabiene": Adaptation and increase in flexibility

- Project subsidized by BMWi (COORETEC): investment ~ €9m
- Duration: 2016-2020
- Goal: proof of feasibility of whole chain in flexible operation

Gefördert durch:



Bundesministerium  
für Wirtschaft  
und Energie



TECHNISCHE  
UNIVERSITÄT  
DARMSTADT



## HTW gasification



HTW building in Darmstadt

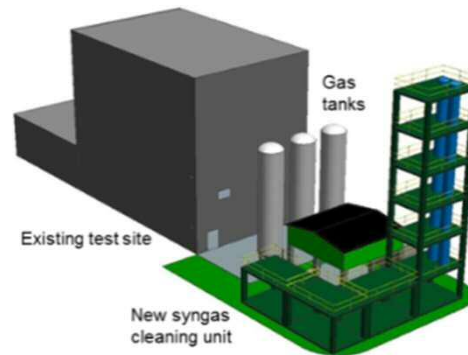
- Commissioned in 2015 with Rhenish lignite
- Currently technical modifications
- Pilot scale:  $0.5\text{MW}_{\text{th}}$



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UNIVERSITÄT  
DARMSTADT



## Gas conditioning



Sketch of planned gas cleaning

- Engineering phase started
- Testing of different gas scrubbing technologies



## Product synthesis

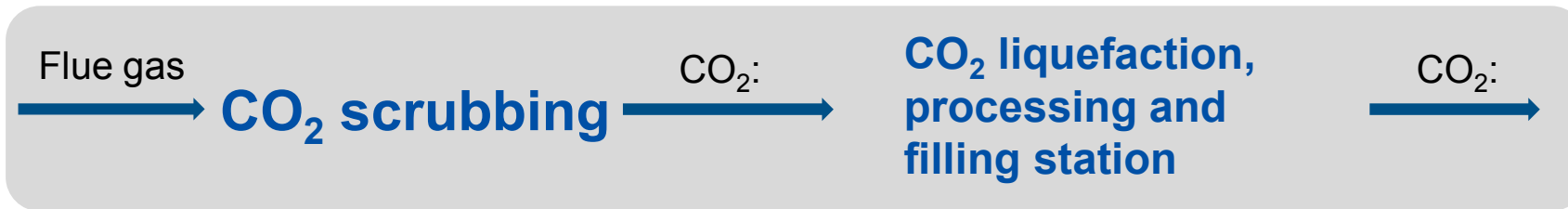


Synthesis test rig in Niederaußem

- First step: Tests with artificial synthesis gas in Niederaußem (ongoing)
- Second step: Tests with "real" syngas in Darmstadt

# CO<sub>2</sub> as a possible source of carbon for sector coupling

RWE pilot plant for carbon capture is point of departure for many new applications

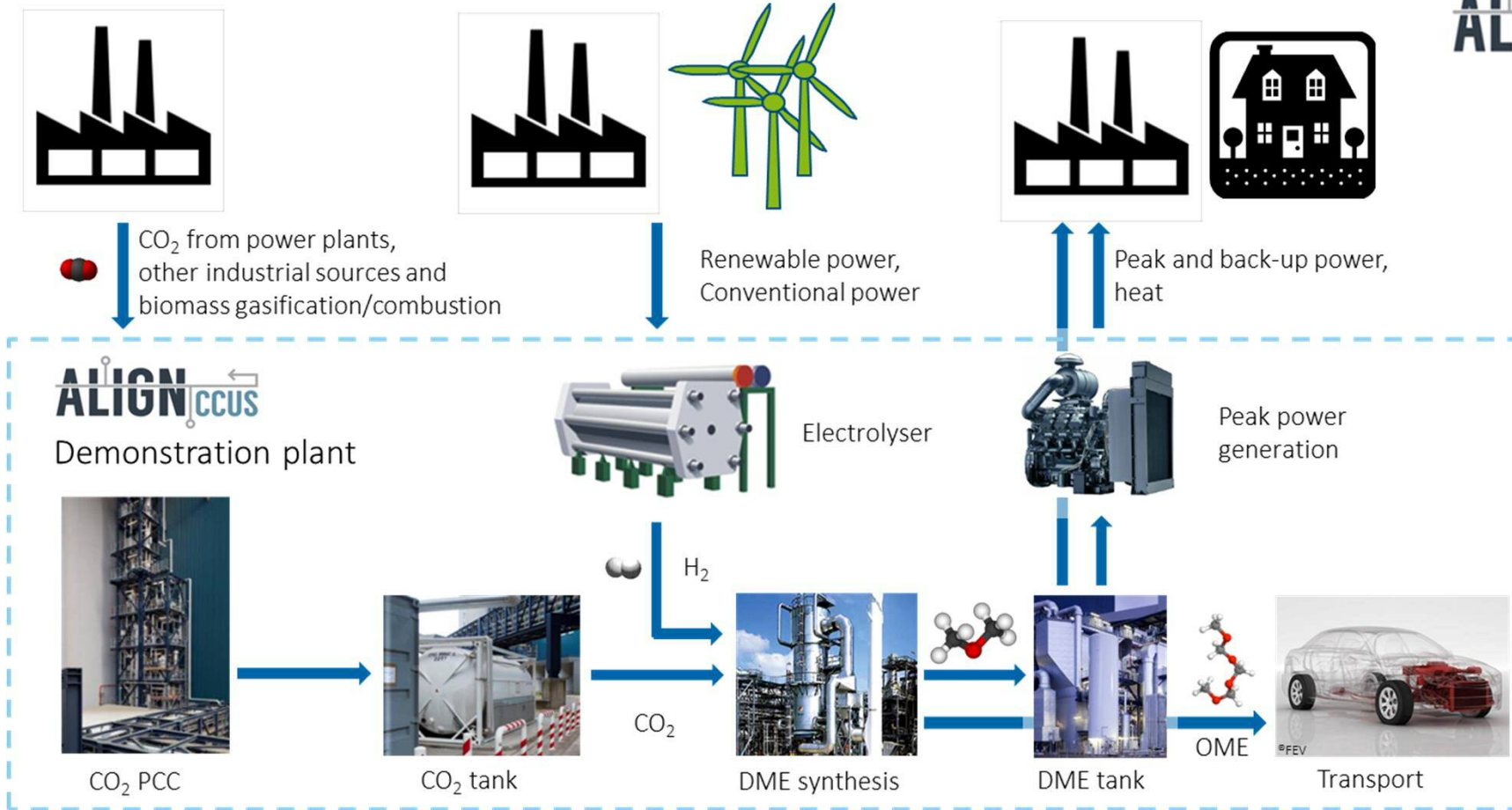


- ▶ The pilot plant has meanwhile been running reliably for more than 60,000 hours
- ▶ Since 2015 cooperation with Algen Science Centre (Jülich Research Centre); use of our CO<sub>2</sub> for producing biokerosene



# Production of eFuels from CO<sub>2</sub> and renewable energy

Innovation Centre becomes platform for CCU pilot plants



➔ Demonstration of full CCU chain for DME/OME synthesis (diesel surrogate)

# Summary

- RES and conventional power stations must act in concert to ensure the power supply of the future. Coal-fired power plants will play an important role in this.
- Apart from the expansion and further development of RES, conventional power plants, too, need to be further developed in terms of flexibility and environmental compatibility.
- Chemical use taps new potential for domestic lignite and ideally complements the use of lignite in the electricity sector. It may also promote the reconciliation between renewables and conventional electricity generation.
- The integration of waste materials and residues as well as CO<sub>2</sub> opens up paths to a sustainable circular carbon economy with increasingly closed cycles (e.g. sector coupling).
- Together with partners, RWE is developing solutions for a secure energy supply and a sustainable circular carbon economy.

# Thank you!



**WTA™**

Since 2008

→ CO<sub>2</sub> mitigation



INNOVATIONSZENTRUM KOHLE  
NIEDERAUSSEM



**REAplus (FGD)**

Since 2009

→ SO<sub>2</sub>/dust mitigation



**CO<sub>2</sub> scrubber**

Since 2009

→ CO<sub>2</sub> capture



**CO<sub>2</sub> filling station**

Since 2011 → CO<sub>2</sub> utilization



**Catalyst testing**

Since 2013

→ CO<sub>2</sub> utilization, P2G