The IGCC CCS Project of RWE

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Brussels Office
The technology pathways pursued by RWE are marked by the goal of underpinning climate-compatible power generation

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<th>Clean Coal Power</th>
<th>Innovations for today, tomorrow and the day after</th>
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RWE's Clean Coal Power

Application of state of the art technologies
Further development of advanced power plant technology
Development of zero-CO₂ power plants

Efficiency increase (primary measure for CO₂ reduction)
CO₂ capture and storage (secondary measure)

Horizon 1
Horizon 2
Horizon 3

2010
2015
< 2020
**Horizon 2: Efficiencies of over 50% can be reached by lignite and hard coal-fired power plants in 2020**

<table>
<thead>
<tr>
<th>2015</th>
<th>2020</th>
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<tr>
<td><strong>RWE Power development goal:</strong> Dry lignite-fired power plant</td>
<td><strong>Joint development goal:</strong> 700°C lignite/hard coal power plant</td>
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<td><strong>Efficiency:</strong> + 4%-points</td>
<td><strong>Efficiency:</strong> + 4% points</td>
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<td>■ Recovery of drying energy based on WTA* technology</td>
<td>■ New materials allow steam parameters of 350 bar/700 °C</td>
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<td>Demonstration plant for fluidized-bed drying under construction at the BoA lignite power plant in Niederaussem</td>
<td>COMTES-700 Material tests</td>
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<td>Throughput: 110 t/h</td>
<td>NRW PP700 Pre-engineering study for demonstration plant</td>
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<td>Investment: €50 million</td>
<td>(VGB, operators, manufacturers, EU)</td>
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<td>Commissioning: 06/08</td>
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*WTA = fluidized-bed drying with internal waste heat utilization*
RWE Power develops and builds a zero-CO$_2$ 450 MW coal-fired power plant based on IGCC technology incl. CO$_2$ transport and storage; start of operation is planned for 2014.

In parallel, RWE will develop the technology of CO$_2$ scrubbing for future advanced coal-fired steam power plants and as a retrofit option for modern installations.

- RWE Power will focus on CO$_2$ scrubbing for lignite
- RWE npower will perform a feasibility study for a Clean Coal 1,000 MW steam power plant in Tilbury and carry out tests for CO$_2$ scrubbing in hard coal plants.
Power plants with CO₂ capture
Technology lines (Development required)

Conv. PP with CO₂ scrubber (RWE project)
- Coal → Convent. steam power plant → Flue gas cleaning → CO₂ capture → CO₂
- Air
- 1,000 m³/s, 13% vol CO₂

Oxyfuel process
- Coal, O₂ → Boiler → Flue gas cleaning → Condensation → CO₂
- CO₂ / H₂O

IGCC process (RWE project)
- Coal, O₂ → Gasification → Gas cleaning CO shift → CO₂ capture → CCGT with H₂ turbine → CO₂
- 10 m³/s, 45% vol CO₂
The RWE project of a zero-CO₂ 450 MW power plant with CO₂ storage (IGCC-CCS)

- Basic technology: IGCC
- El. capacity: 450 MW<sub>gross</sub>, 360 MW<sub>net</sub>
- Net efficiency: 40 %
- CO₂ storage: 2.3 mill. t/a in depleted gas reservoir or saline aquifer
- Commissioning: 2014
- RWE budget: approx. €1 billion

In RWE Power, RWE has inhouse power plant and gasification know-how and, in RWE Dea as an upstream company, it has basic inhouse know how for CO₂ storage.
IGCC offers favourable preconditions as zero-CO₂ power plant technology

- All process steps are commercially available
- Technical and economic statements are robust
- Power plant can also be operated efficiently without capture
- IGCC has reserves for further reducing classic emissions
- High fuel flexibility, high product flexibility

**Fuel flexibility**

- Nat. gas
- Coal
- Biomass
- Residues

**Product flexibility**

- Gasification
- Gas processing
- CO₂ capture
- CCGT
- CO₂
- Power
- Heat
- H₂
- Synthesis gas (CO+H₂)
- SNG (nat. gas)
- Methanol
- Motor fuels (CtL)

alternative or in addition
RWE has extensive lignite gasification experience

1) HTW – High-Temperature Winkler gasification process
2) HKV – Coal hydrogasification
3) Raw lignite throughput
RWE’s IGCC CCS project - overall concept

- Four coal-based IGCC plants exist world-wide (without carbon capture), some of them having been operated for more than 10 years.
- Commercial-scale coal gasification, gas cleaning, combined cycle and also carbon capture components have been available for a long time now.

There are still 2 development fields left for power plant engineering:
1. Escalation to 900 – 1,000 MWth
2. Combustion chamber development for the 300 MW gas turbine class and H₂-rich fuel gases, with NOₓ limits being observed.
The timetable of RWE's IGCC-CCS project is ambitious and requires support by the overall environment.

### RWE's IGCC CCS project

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<td><strong>CO₂ storage, pipeline</strong></td>
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The development of the CO₂ storage site must be step by step and on several levels

The following tasks must be tackled in parallel:

- Development of standards for the evaluation of CO₂ storage sites and their long-term tightness
- Creation of underlying legal and regulatory conditions
  - Legal norm must be defined
  - Regulatory frameworks below the law level must be created
- Reaching public acceptance

⇒ Joint tasks of companies, policy-makers and authorities
The continuous implementation of innovations and their incorporation into the power plant fleet result in major and sustainable CO₂ reduction.

- **Horizon 1**
  - Efficiency increase by modernization, currently BoA 2/3, hard coal-fired twin unit …

- **Horizon 2**
  - WTA prototype
  - 700 °C test plants
  - First dry lignite-fired power plant
  - 700 °C demonstr. pp
  - First zero-CO₂ IGCC power plant
  - First retrofit/new plant with CO₂ scrubber

- **Horizon 3**
  - New project: 450 MW zero-CO₂ IGCC power plant incl. storage
  - New project: CO₂ scrubbing for conventional power plants

Power plant portfolio: continuous renewal