

**German Federal Ministry of Economics and Technology (BMWi)**

**Up-date on  
Carbon Capture and Storage Activities in Germany**

As reported at the Berlin meeting the German energy market is dominated by the use of fossil fuels which represent 60% of primary energy consumption. Looking at power generation only fossil fuels will even account for up to 80 % of primary energy consumption (electricity generation) around the year 2020 if the phasing out of nuclear energy is executed as agreed between the government and industry.

On the other hand, Germany being a party to the Kyoto protocol is very much committed to the reduction of greenhouse gases. In the framework of the European burden sharing Germany committed itself to a reduction of 21% in CO<sub>2</sub> emissions by 2012.

CO<sub>2</sub> reduction is still a top priority on the political agenda in Germany and is again mentioned in the coalition agreement of the German government. The government's keen interest in this issue became visible in the Energy Summit organised by Chancellor Angela Merkel on 3<sup>rd</sup> April 2006. On the other hand industry's commitment continues to be very high which became clear even before the Summit when RWE announced the construction of a € 1 billion (\$ 1.3 billion) demonstration power plant on IGCC basis on 30<sup>th</sup> March 2006. More information can be found in the slides attached to this up-date.

The development of economic and environment friendly power generation technologies is of particular interest in Germany as around 40,000 MW of power generation capacity will have to be replaced within the upcoming 20 years. The role of energy policy is to set framework conditions to meet both objectives, the economic and environmental aspects (whilst) always considering the security of supply. Most modern technologies substantially reduce CO<sub>2</sub> emissions or at least compensate an increased share of fossil fuels. However, these technologies still need R&D to be economically viable and public funding of this work is seen as one aspect of efficient energy policy.

The 5th Energy Research Programme “Innovations and New Energy Technologies” adopted in June 2005 provides the political frame for the German COORETEC R&D concept.

The COORETEC concept is based on the two major technology routes, efficiency increase and Carbon Capture and Storage (CCS). These two technology routes are interlinked. Germany regards the increase in process or component efficiency as precondition to CCS as increased efficiency minimises the amount of CO<sub>2</sub> to be captured and the energy consumption and the high investment costs caused by CO<sub>2</sub> capture can thus be reduced. Both specific energy penalties and cost increase with lower efficiencies. However, an advanced, highly efficient power plant combined with CCS can still be expected to have a higher efficiency compared to the worldwide average of power plants today.

Germany is not fixed to just one capture technology path. As outlined in Berlin all major alternatives for both pre- and post-combustion technologies are covered by R&D projects while the different maturity stages of the processes are well taken into account. This is demonstrated by projects like COORIVA (gasification processes), ADECOS and OXYCOAL Ac (both on oxy fuel). All these projects were already touched in more detail at the Berlin meeting and as only six months have passed by since then there are no major additional results to report on today.

Regarding CO<sub>2</sub> storage progress could be made over the past six months in the frame of the CO2SINK project, which is one of our CSLF recognised projects. The question of a suitable source of CO<sub>2</sub> to be injected at the Ketzin site has been solved.

While the development of capture technologies is part of the COORETEC initiative, work on geological storage is rather concentrated in the framework of the GEO-TECHNOLOGIENprogramme which shall be described in more detail in the following paragraphs:

This programme has two foci with respect to CCS, one is an estimation of the storage potential of depleted oil and gas fields, coal seams and aquifers, and the other one is on the chemical behaviour of CO<sub>2</sub> stored underground.

A portfolio of 10 research projects concerning the underground storage of CO<sub>2</sub> was started in 2005 under the umbrella of the national research programme GEOTECHNOLOGIEN. The projects, carried out in strong cooperation between science and industry, represent a key element in the organisation of German research in the field of CO<sub>2</sub> capture and storage and are another knot in the national network that is active in both European and international projects.

The budget for a first three-year funding phase is about 8 Million Euro. 6.7 Million Euro are assumed by the Federal Ministry of Education and Research; another 1.3 Million Euro are contributed by the industrial partners. All projects focus exclusively on technologies for geological storage. Due to environmental concerns, ocean storage of CO<sub>2</sub> is not included in the research programme; nor is the capture of CO<sub>2</sub>. The latter is addressed in the framework of the German COORETEC-Programme, funded by the Federal Ministry of Economics and Technology.

The overall aim of the integrated joint projects is an assessment of the various options for underground CO<sub>2</sub> storage in Germany and the provision of a profound scientific basis for decision-makers. Forthcoming research projects focus on the development of innovative technologies and processes for the safe underground storage of CO<sub>2</sub> in Germany and their implementation in demonstration projects. Key topics are:

- Evaluation of potential storage sites and storage technologies
- Baseline characterisation (e.g. geology, reservoir/caprock features)
- Storage operation (injection technologies, EOR/EGR potentials)
- Development/implementation of reliable short- and long-term monitoring techniques
- Development and evaluation of strategies for the elimination, transformation and permanent immobilisation of CO<sub>2</sub>

A detailed overview of all projects is published in the March edition of the *Greenhouse Issues* of the IEA Greenhouse Gas R&D-Programme.

Beside the national programmes the German Federal Government highly appreciates the initiatives driven by the European Commission within its framework programme towards the development of CCS technologies. Many of those projects meanwhile recognised as CSLF projects include German participants from industry and science. Furthermore national funding (as with the CO2SINK project) is provided if appropriate and necessary.

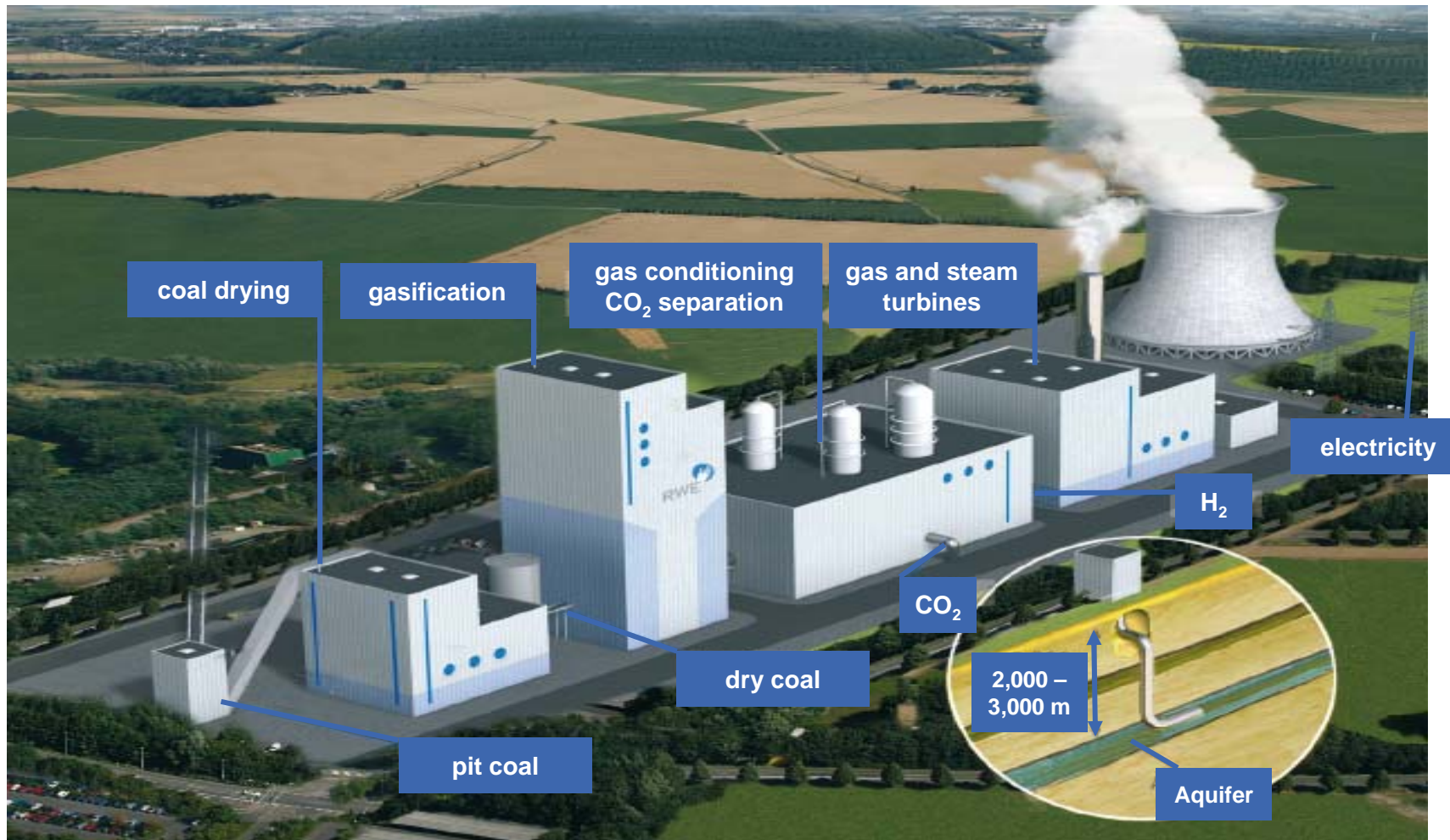
The German Federal Government is very well aware of the fact that CCS can only be realised as a carbon mitigation option if it is accepted by the public. Some studies on the acceptance of CCS by the public are underway or will be launched in the near future. Additionally the number of related workshops, seminars and conferences is steadily growing.

Further information is available for you under the respective web-sites [www.cooretec.de](http://www.cooretec.de) and [www.geotechnologien.de](http://www.geotechnologien.de) .

New Delhi, 4 April 2006

Statement for the CSLF-Meeting New Delhi

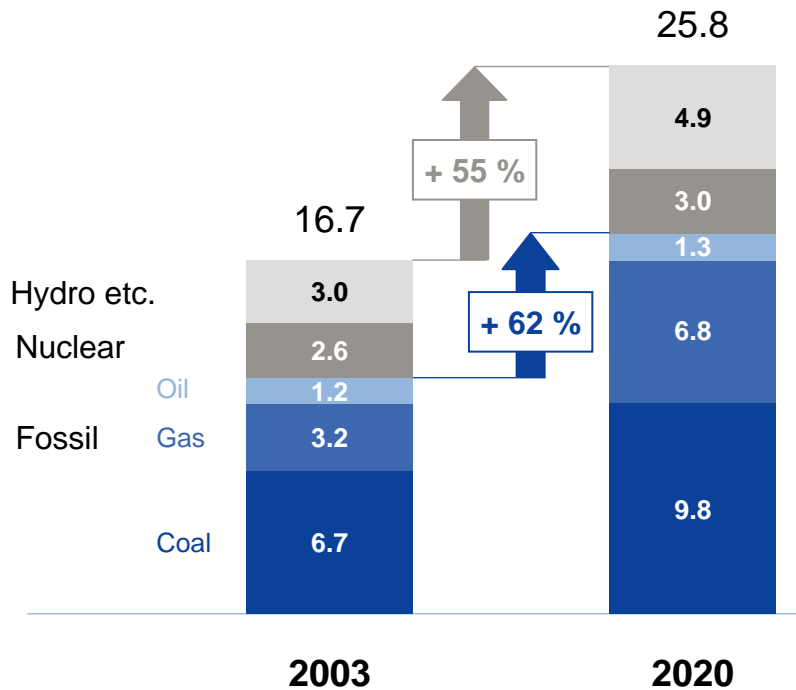
# Lighthouse Project of RWE's Climate Strategy: The zero-CO<sub>2</sub> power plant



# The significance of fossil sources in the energy mix



Global power generation in bn MWh



Source: IEA, World Energy Outlook, 2004 Edition

Growing world energy consumption calls for increased use of fossil energy sources

Global climate protection needs efficient technologies and policies

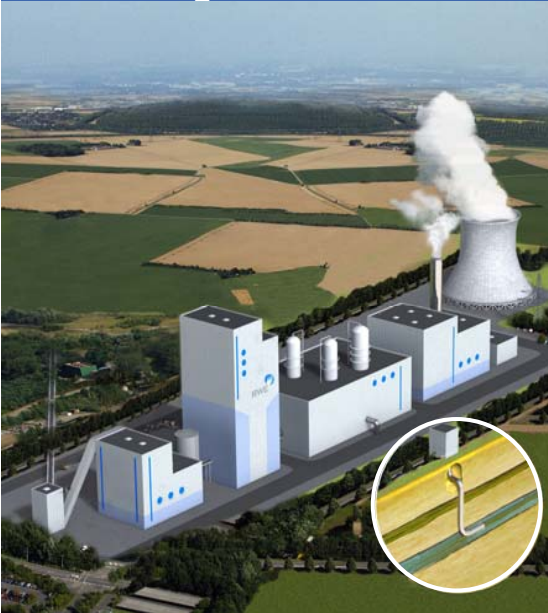
- Global solutions
- Inclusion of threshold and less-developed countries
- Implementation of JI and CDM
- Intelligent technological solutions for CO<sub>2</sub> reduction

RWE accepts challenge in all fields

# RWE Power develops power plant technologies for the future



Technology for the day after tomorrow:  
Zero-CO<sub>2</sub> power plant



Zero-CO<sub>2</sub> IGCC power plant with CO<sub>2</sub> storage

Technology for tomorrow:  
Efficiency increase



Dry lignite-fired power plant

Today's technology:  
Retrofit options

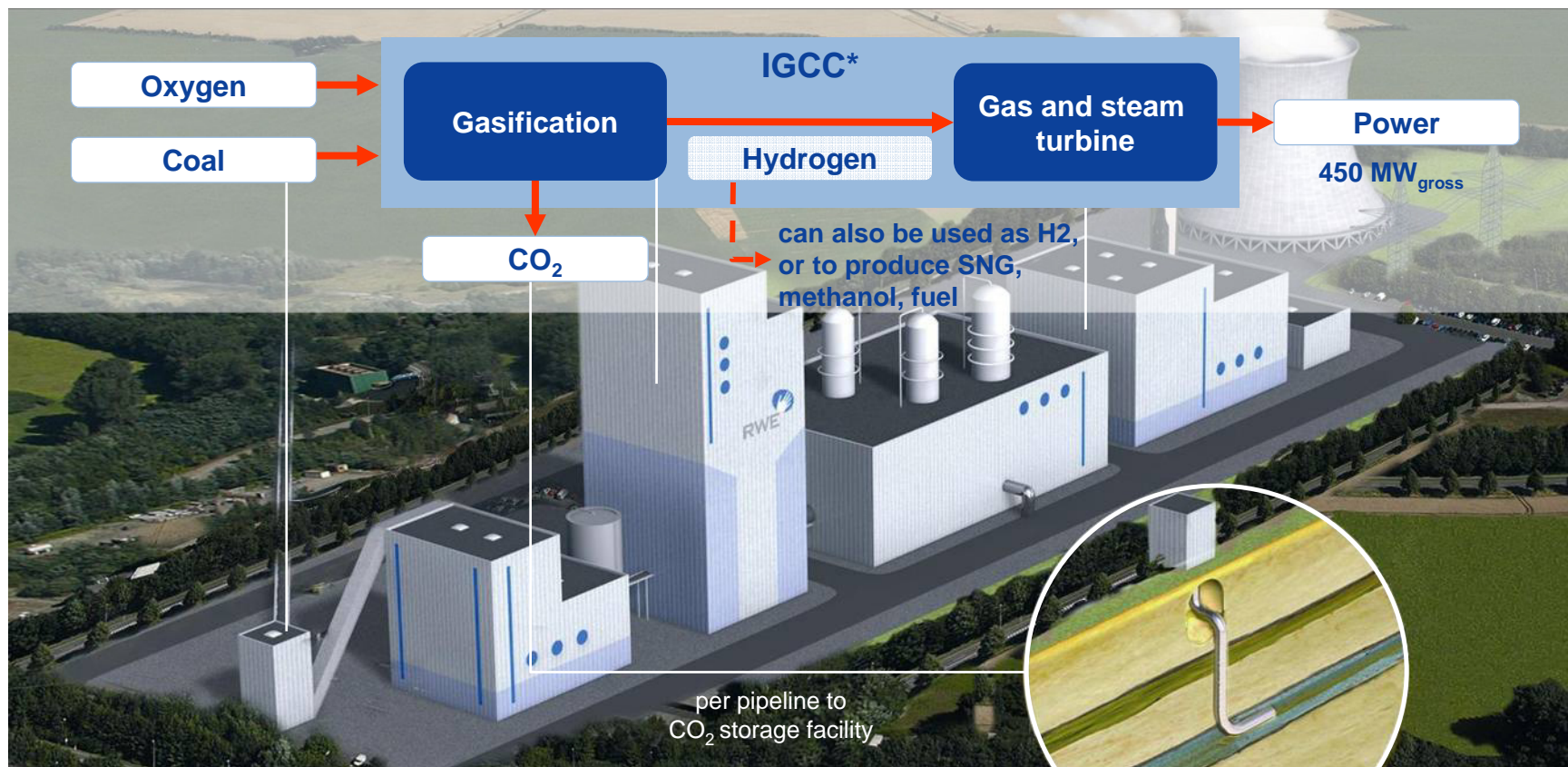


CO<sub>2</sub> scrubber for advanced steam power plants



# Power generation with CO<sub>2</sub> capture and storage: RWE is pushing forward the IGCC technology

RWE is the only company with in-house know-how in power plant and gasification processes (RWE Power) and basic knowledge for CO<sub>2</sub> storage (DEA)



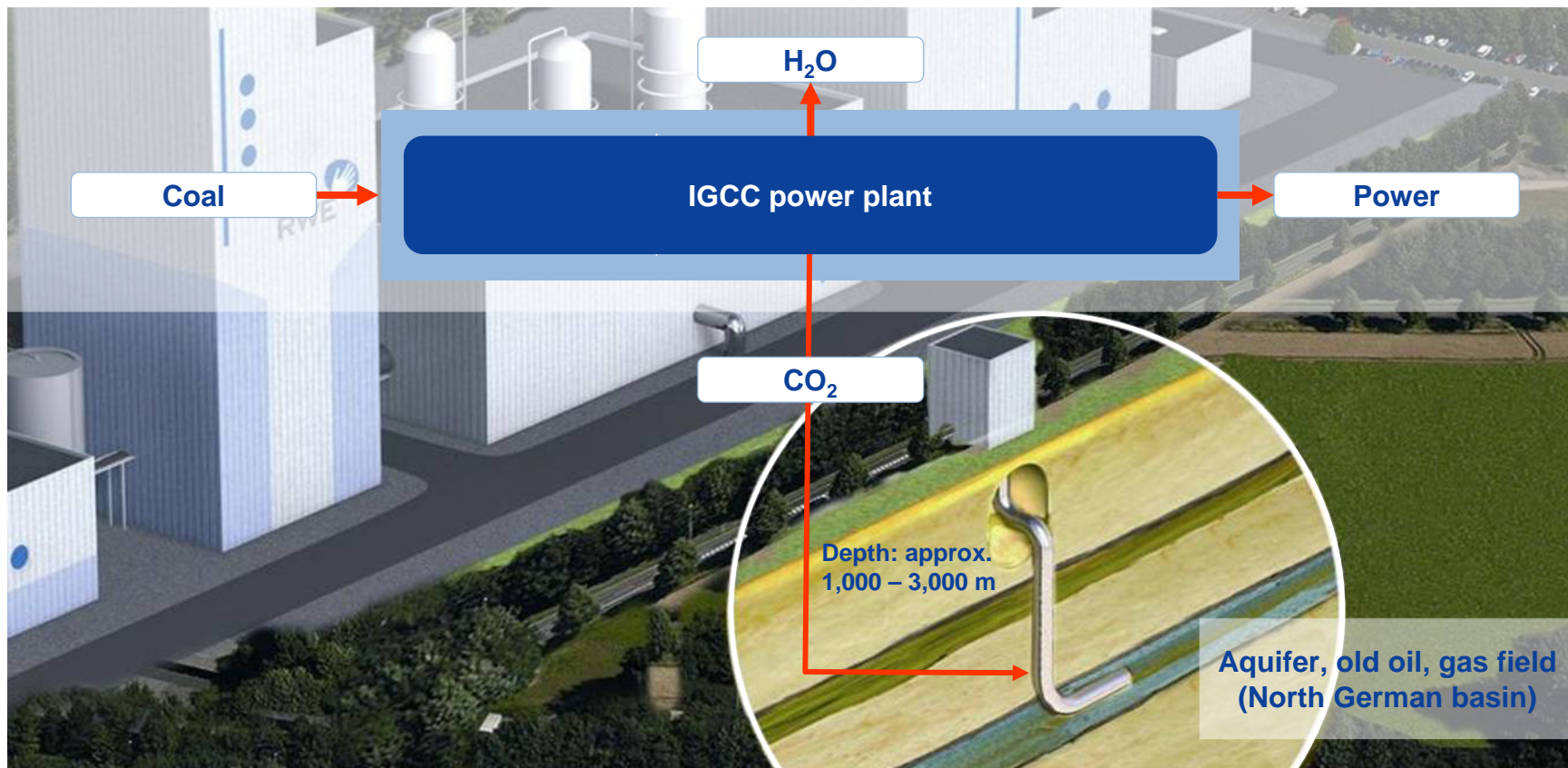
\*IGCC = Integrated Gasification Combined Cycle



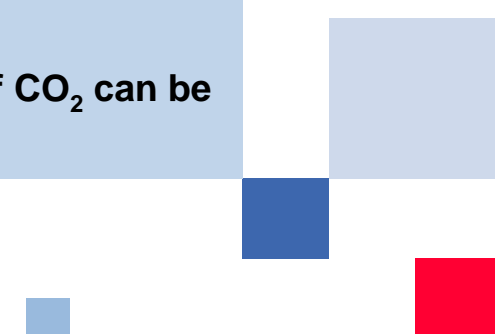
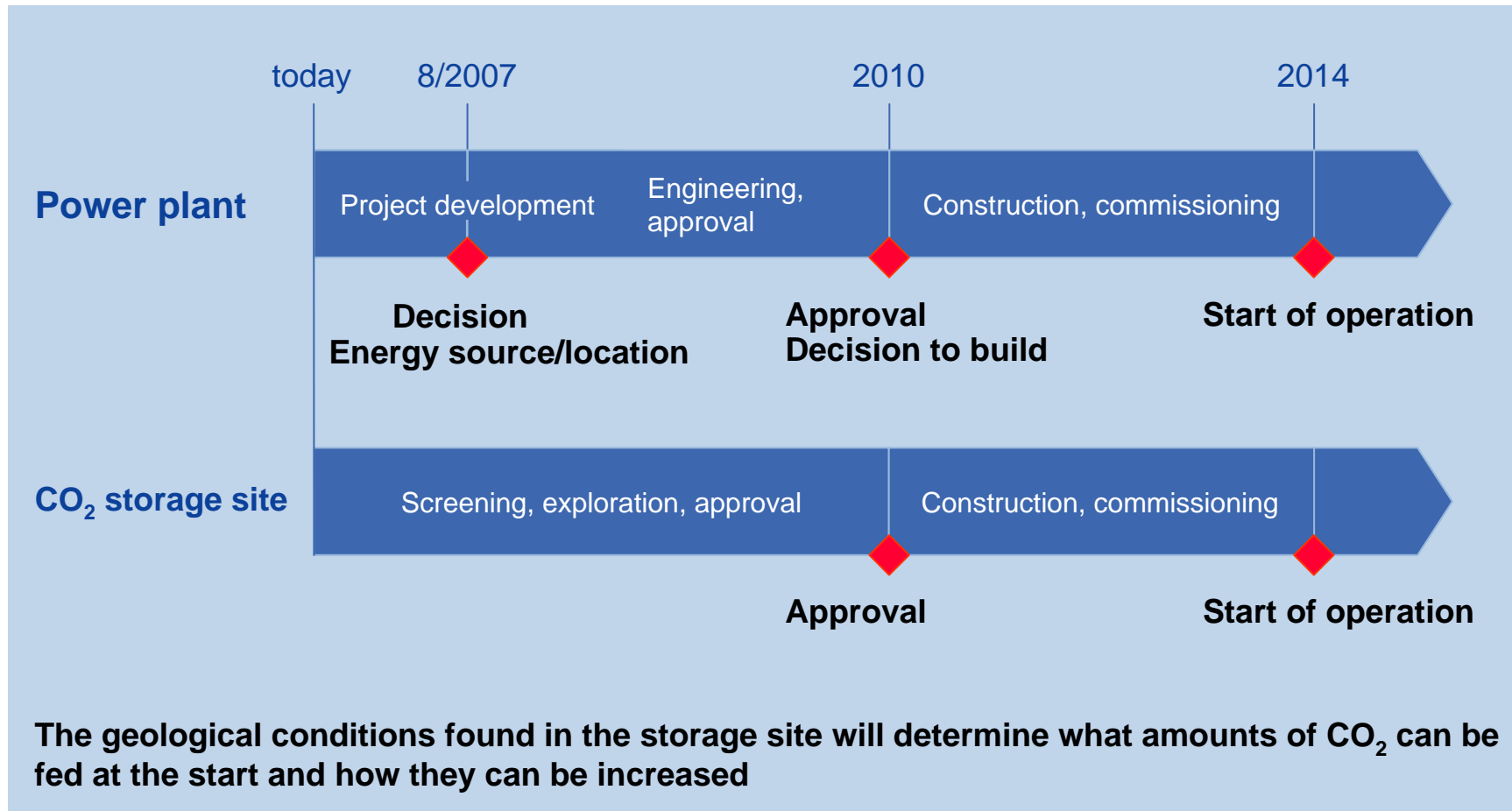
# CO<sub>2</sub> storage in case of the IGCC power plant



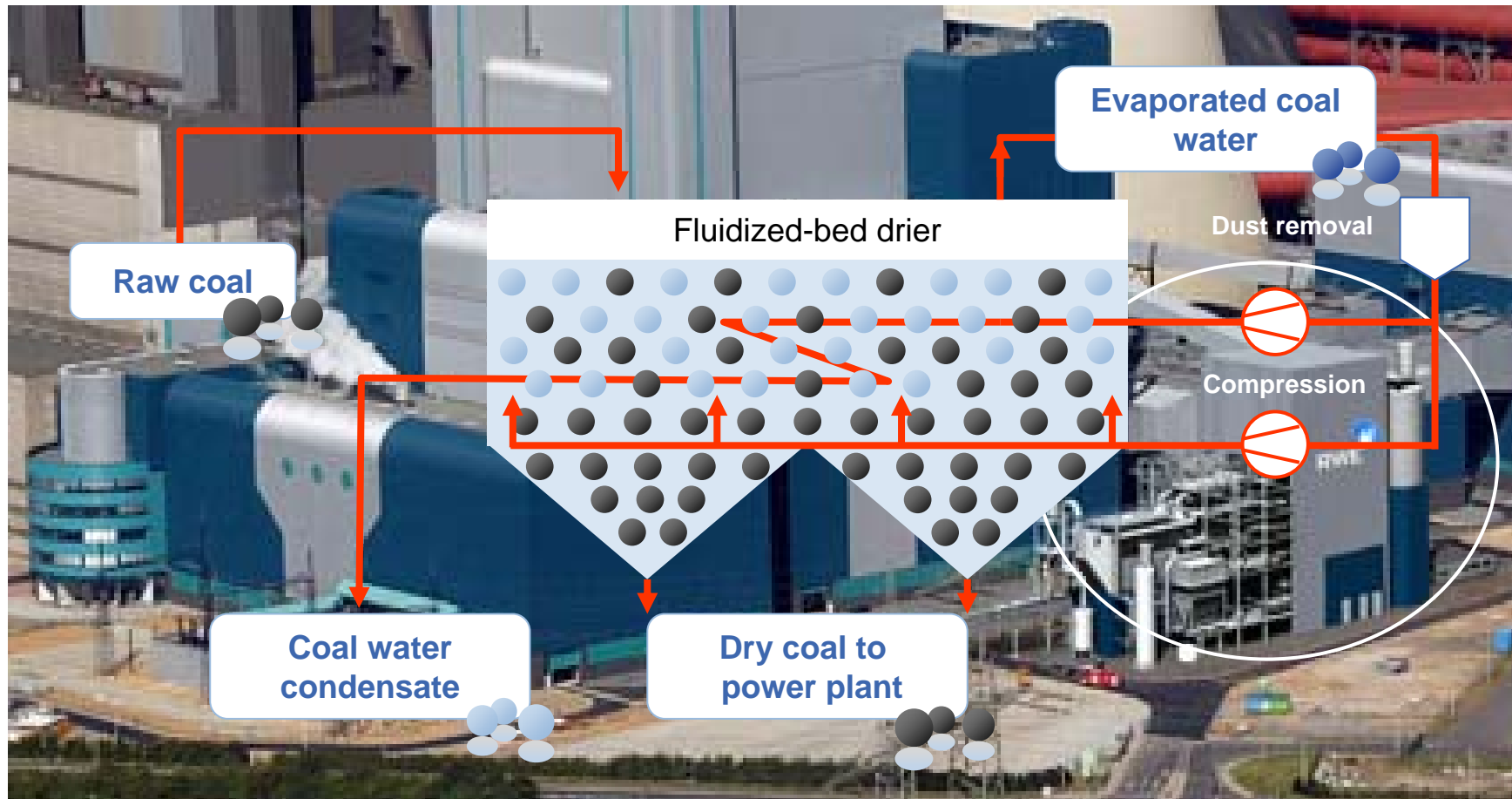
CO<sub>2</sub> is liquefied in the power plant using high pressure, transported per pipeline and permanently stored in great depths.



# Swift implementation until 2014 calls for parallel development of power plant and CO storage facility



# WTA drying technology of RWE Power



# Efficiency increase through new power plant technology

## Example: RWE's fluidized-bed drying process



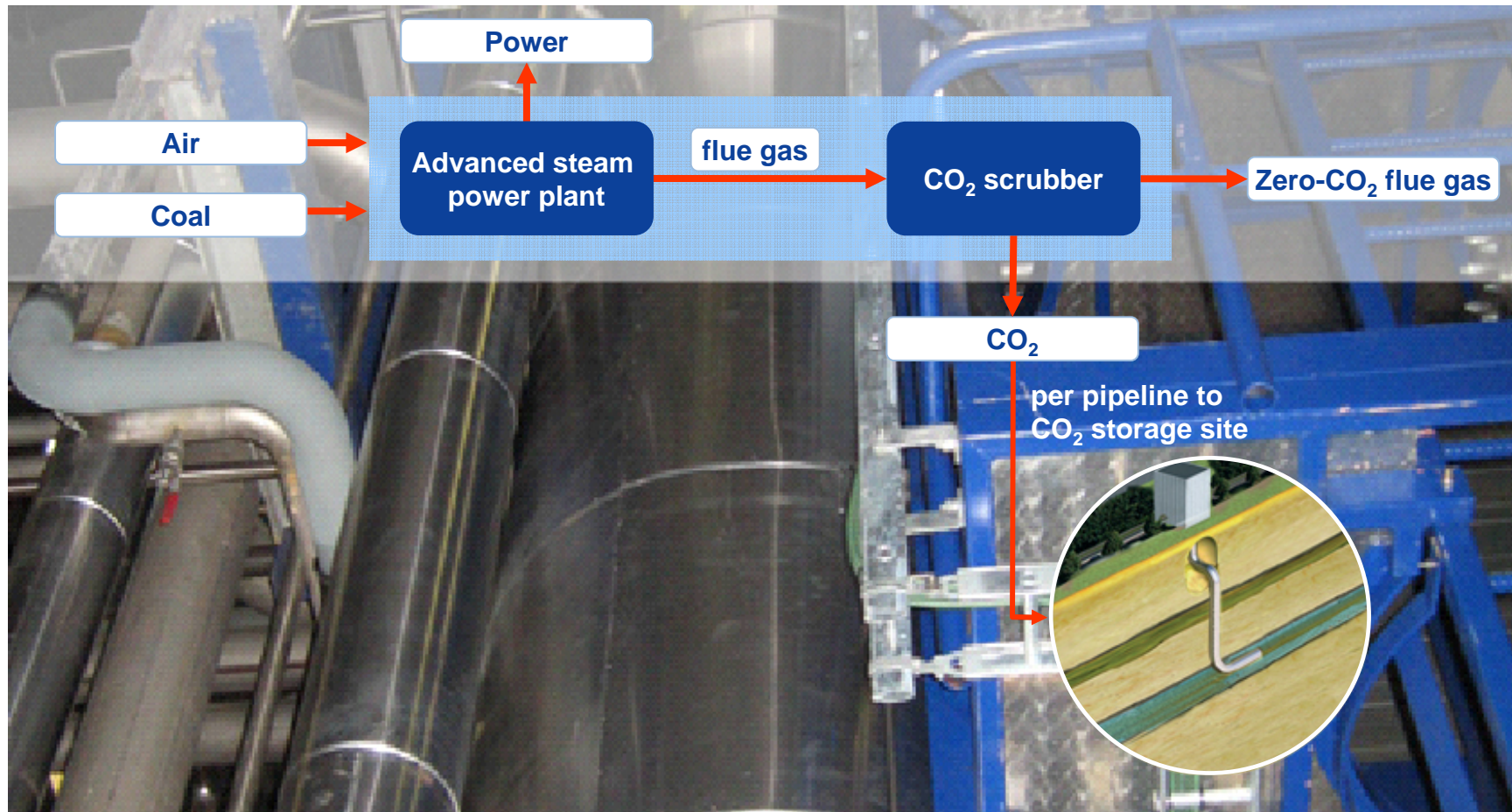
- 4% points efficiency increase
- Some 1 mill. t CO<sub>2</sub> compared to today's technology (2 x 1,100 MW)
- RWE's own development
- Final step to maturity: construction of prototype WTA at Niederaußem BoA unit and testing
- Ground-breaking ceremony in June 2006
- Project costs: €50 mill.

Prototype WTA coal-drying plant at Niederaußem BoA



# RWE is further developing CO<sub>2</sub> scrubbing – for lignite and hard coal

Technology suitable for retrofitting existing power plants and those being built



## Development steps towards early availability of the CO<sub>2</sub> scrubber

- Development of new scrubbing agents in the context of the EU CASTOR project/ test facility at Esbjerg PP (DK)
- Creation of partnerships with suppliers and chemical industry for development and optimization
- Plant trialling in lignite-fired power plant of RWE
  - until 2008: pilot project
  - from 2009: demonstration plant (start of engineering)
- RWE budget: approx. €90 mill.

