IEA/NEA JOINT WORKSHOP ON
"POWER GENERATION INVESTMENT IN LIBERALIZED ELECTRICITY MARKETS“

# Investment in Coal-Fired Power Generation

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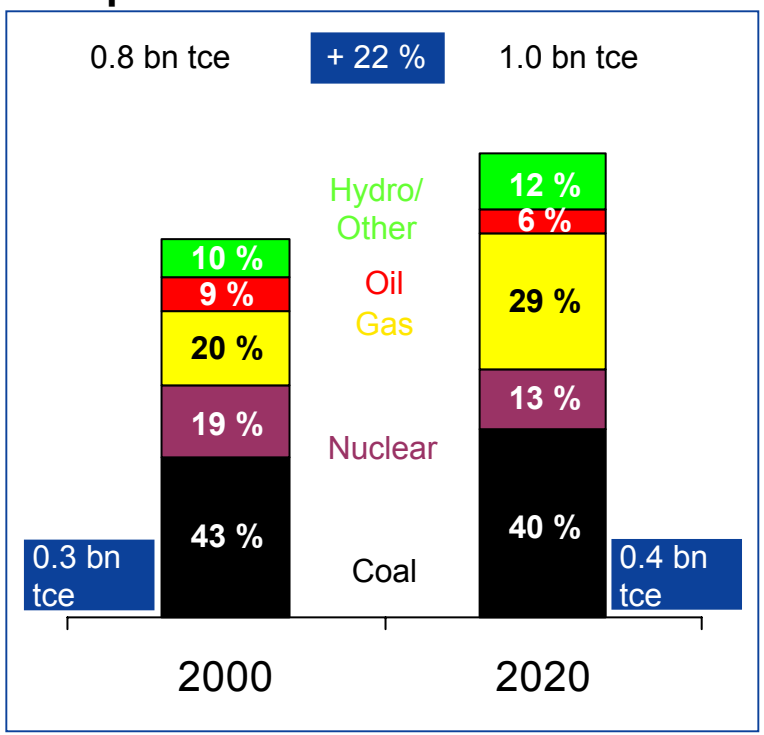
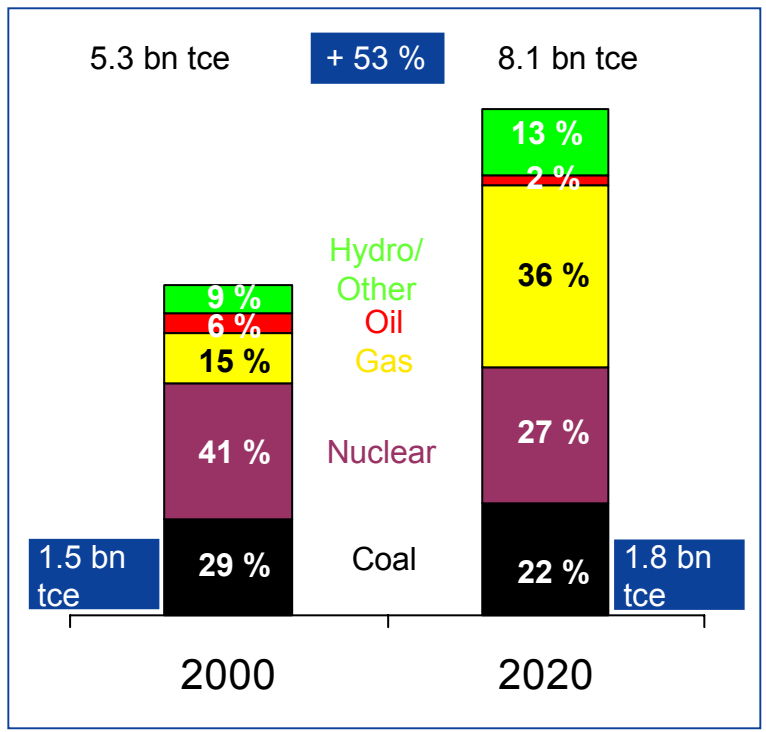
# Significance and Characteristics of Coal-Fired Generation in Europe (1)

## Coal's role in the long-term power generation energy mix

**Europe: EU 15**




**World**

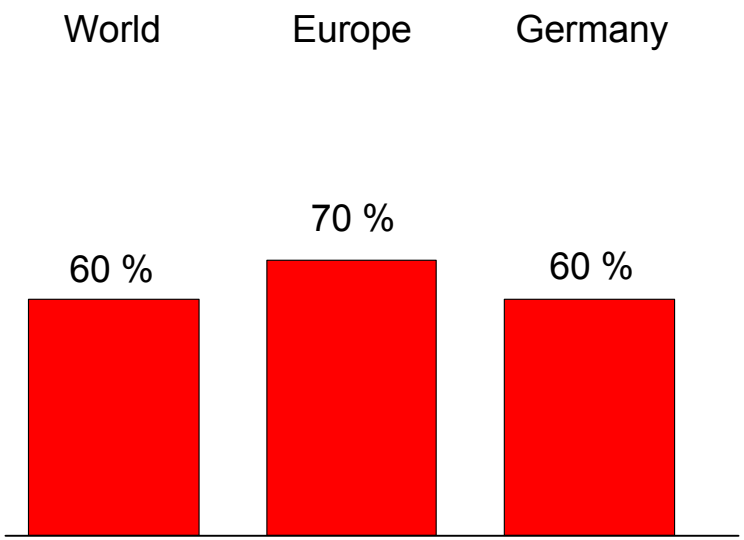



Coal will go on being a crucial pillar of power generation in the long term

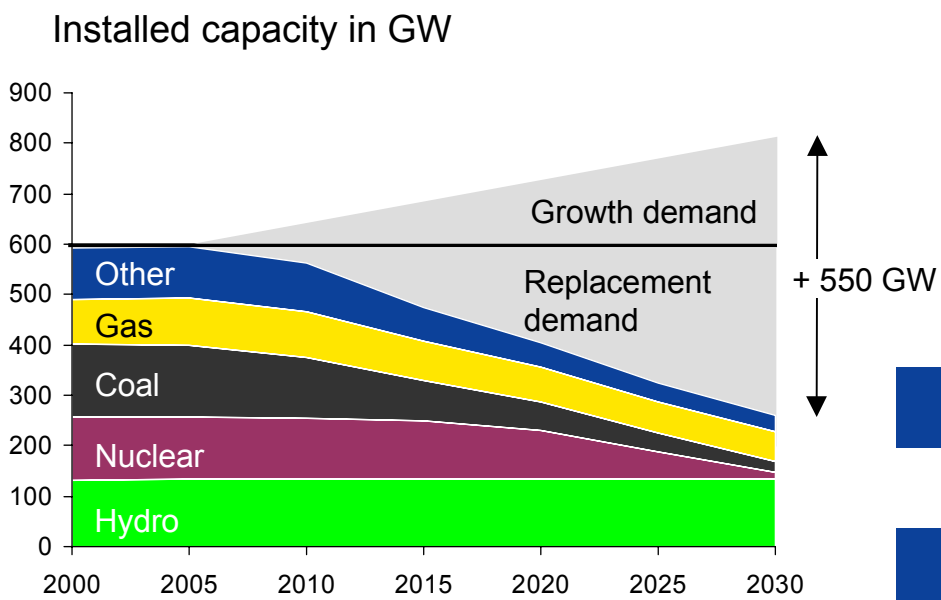
# Significance and Characteristics of Coal-Fired Generation in Europe (2)

## Age structure and demand for new plants

**Share of coal plants older than 20 years**




**Demand for new plants in EU 15**




Substantial replacement investment in coal-fired generation is required to avoid capacity shortages

# Changed Boundary Conditions of Coal-Fired Generation

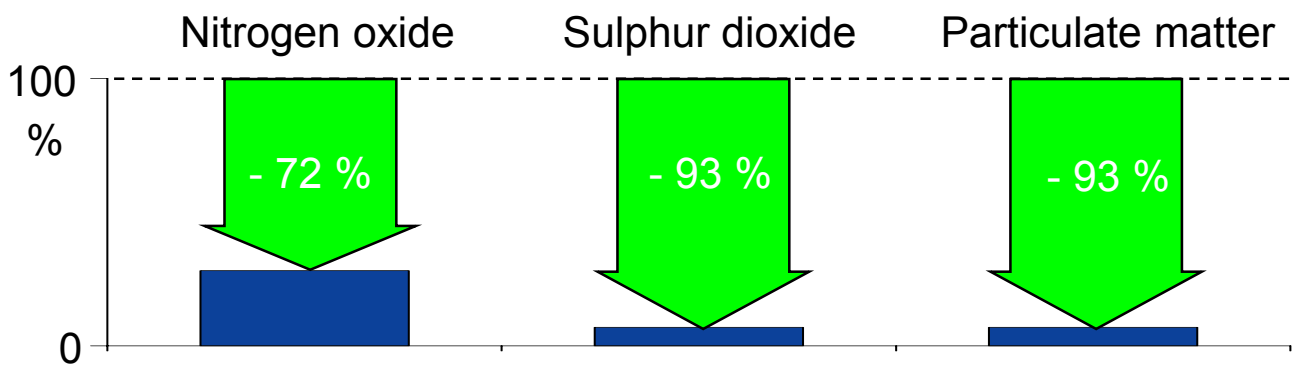
- Liberalization of energy markets
  - Revenue erosion suffered by power plants (in Germany: up to 40 %)
  - Higher demands on flexibility of power plants
  - Replacement/new construction of power plants hardly feasible under economic efficiency aspects
- Stricter environmental standards and regulations
  - Insufficient European harmonization of environmental standards
  - One-sided $CO_2$ penalty through emissions trading
- State interference and support programs in favour of non-coal technologies and generation capacities
  - Further increase in cost pressure and flexibility requirements of conventional power plants

Serious deterioration in boundary conditions of coal-fired generation through full liberalization on the one hand and state control at the expense of coal on the other

# Development, State of the Art and Prospects of Coal-Fired Generation (1)

## Emissions

- Comprehensive flue gas cleanup is standard today in coal-fired generation
- Existing power plants across Europe upgraded by retrofits
  Example: Emission reduction through retrofit of the Rhenish lignite mining area's 10,000 MW power plant portfolio (1983 - 92)



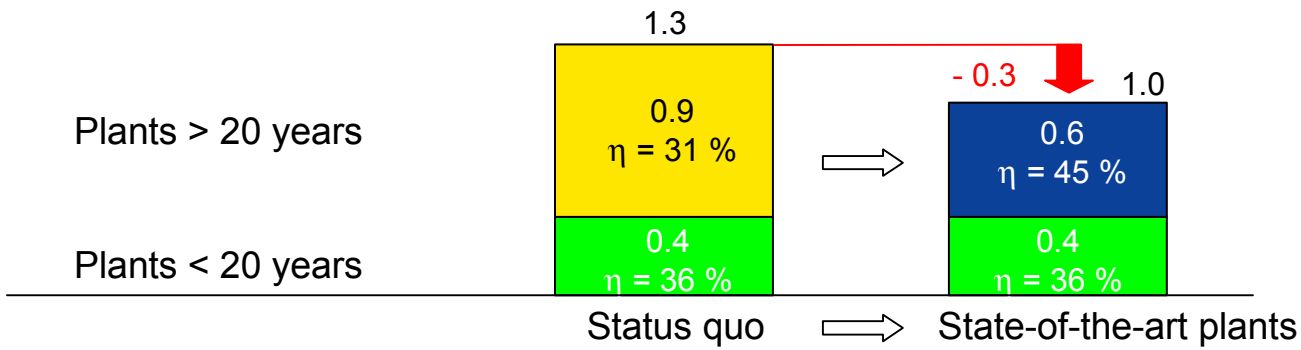

Highly efficient flue gas cleanup guarantees minimum emission levels of coal-fired power plants

# Development, State of the Art and Prospects of Coal-Fired Generation (2)

## Efficiency

- Breakthrough in efficiency increase during the 90s thanks to supercritical power plant technology; efficiency of new plants:


- $CO_2$ reduction through replacement of all power plants that are older than 20 years by state-of-the-art plants: $CO_2$ emissions of European power plants in bn t/a:




**Already today, modern coal technology opens up the largest global $CO_2$ reduction potential**

# Development, State of the Art and Prospects of Coal-Fired Generation (3)

## Focuses of further development

**Efficiency**

- Target: efficiency > 50 % by 2015/20
  - New materials / 700 °C power plant
  - Lignite pre-drying

**Competitiveness**

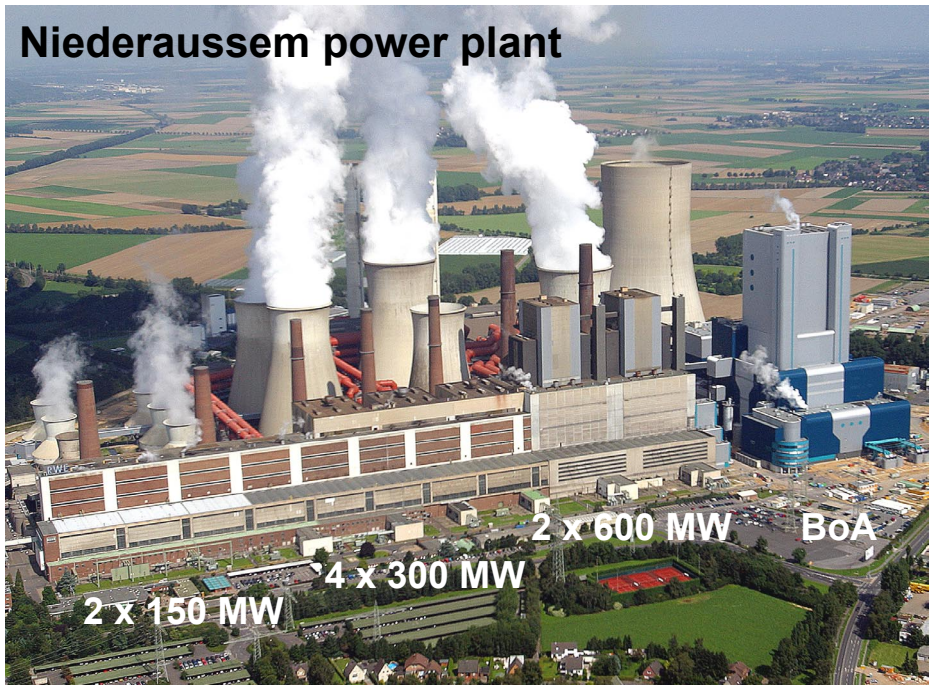
- Cut in investment costs (standardization, capacity increase)
- Increase in availability

**Flexibility**

- Increase in controllability and application range

**Ambitious development targets of coal-fired generation contribute to environmentally compatible and low-cost power supply**

# Power Plant Renewal Program of RWE Rheinbraun (1)




## RWE Rheinbraun:

- Lignite-fired power generation capacity of 10,000 MW at 4 locations, producing some 70 TWh/a of base-load power
- Integrated operation of opencast mines and mine-mouth power plants
- Entire value chain, i.e. from mine to terminal, under one roof
- Comprehensive retrofit measures
  - 80s: flue gas cleanup
  - 90s: turbine upgrade

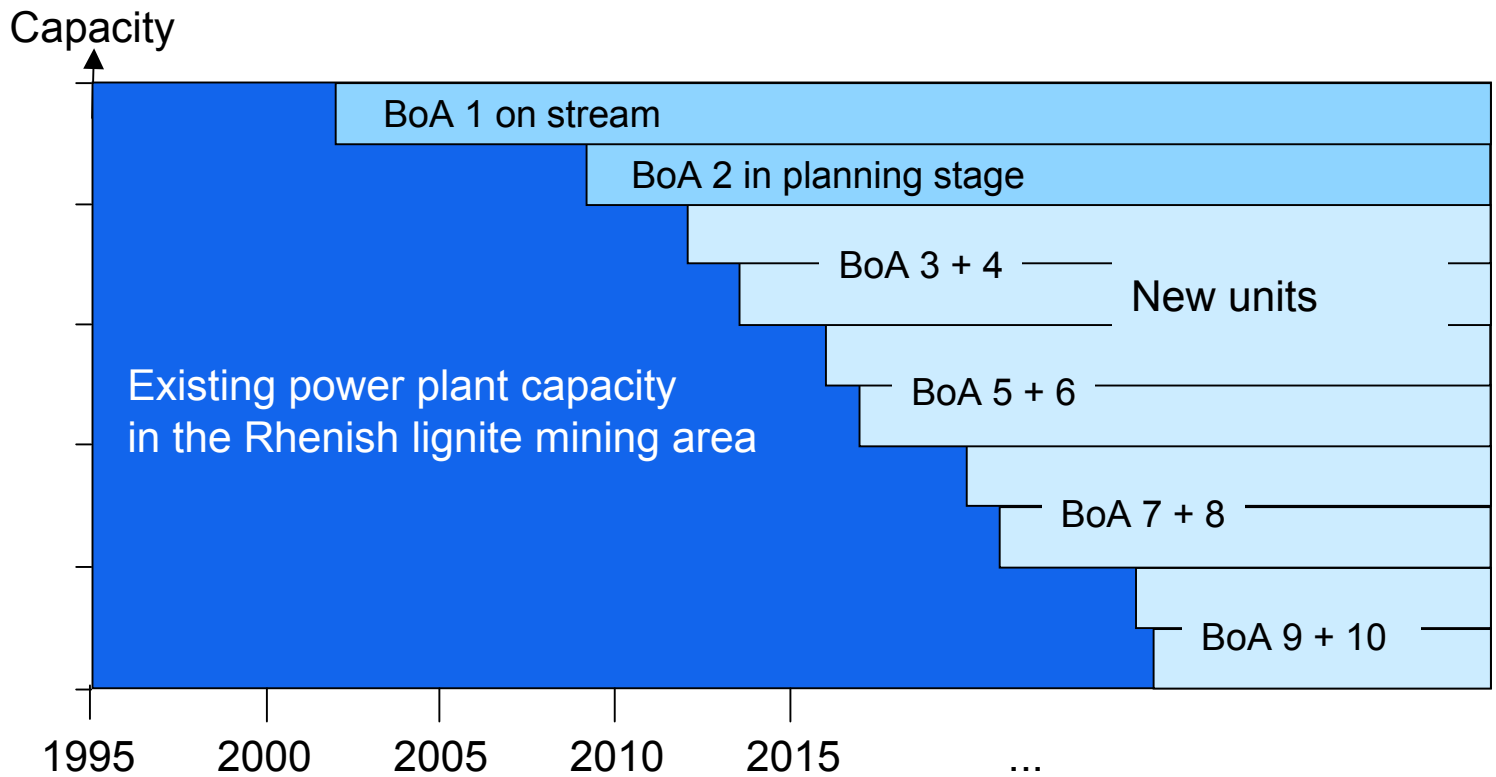
## Power Plant Renewal Program:

- Agreement with the state of North-Rhine/Westphalia: Successive replacement of old plants until 2030 by eco-friendly and climate-sparing state-of-the-art power plants
- In 2002, the first 1,000 MW BoA*) unit of the Niederaussem power plant went on stream
  - global frontier technology in coal-fired power plant engineering
  - net efficiency of more than 43 %

*) BoA = lignite-fired power plant with optimized plant engineering

# Power Plant Renewal Program of RWE Rheinbraun (2)

## Successive renewal of the 10,000 MW power plant portfolio




- Substantially aggravated boundary conditions for BoA 2 already
- Program can only be implemented if long-term planning and investment certainty is given

# Consequences of Changed Boundary Conditions (1)

## Serious deterioriation in investment conditions, Comparison: BoA 1 and BoA 2

| | BoA 1 | BoA 2 |
|---|---|---|
| Project start | 1995 | 2002 |
| Electricity prices | €ct ≈ 4.0 /kWh | €ct 2.3 /kWh |
| $CO_2$ penalty | - | EU Directive |
| Envrionmental regulations | | Stricter environmental and emission regulations<br>EU Large Combustion Plant Directives<br>EU Waste Incineration Directives |

The pressure of liberalization is incompatible with the non-uniform and unpredictable regulations in the fields of environment and climate

# Consequences of Changed Boundary Conditions (2)

## Significantly increased risks in the liberalized market

**Former regulated market:**

Full costs were passed on to the customers via prices

⇒ very limited investment risks

**Today's liberalized market:**

⇒ Wide range of investment risks

- Electricity price development risks
- Fuel price development risks
- Environmental legislation risks
- $CO_2$ penalty risks

For coal, the situation is aggravated by

- Long financing periods
- High capital expenditure

New instruments required for risk management

# Consequences of Changed Boundary Conditions (3)

## New instruments for risk analysis and risk evaluation of investment at RWE Rheinbraun

- Power generation market model

  used to calculate developments in wholesale prices by simulation of the European producer market as a pool market.

  Basis:
  - Range of products including all power plants and options for new plants in Europe with their costs (capital, operation, fuel)
  - Demand curve as identified by separate forecast
  - Fuel prices as identified by separate forecast

  Result:
  - Wholesale prices resulting from a capacity-driven determination of the intersections of supply and demand (hourly)
  - Utilization ratio of the various power plants
  - Shutdown and construction of new plants (The power plant with the highest ROI is built.)

# Consequences of Changed Boundary Conditions (4)

## New instruments for risk analysis and risk evaluation of investment at RWE Rheinbraun (2)

- Corporate planning

  Planning calculations performed for the company covering a period of up to 50 years (corresponding to the life of the mines and power plants) in the form of external accounting, i.e. including
  - income statement
  - balance sheet
  - cash flow statement

  and including/excluding the new investment project.

- Risk management

  Permanent process covering all risk factors that are relevant to lignite production and power generation in the form of continuous monitoring and evaluation of the defined risks

# Conclusions:
# Demands on Energy Policy

- Support necessary a power plant renewal in order to prevent capacity shortages
  - ➔ Investment leeway restricted by liberalization must not be further reduced by additional state control
  - ➔ Political boundary conditions must be created to ensure long-term planning and investment certainty
- Give $CO_2$ reduction a sustainable shape through balanced targets geared to market conditions
  - ➔ Efficiency increase is the best route towards $CO_2$ reduction
  - ➔ New technology for old power plants brings max. reduction, not the latest and highest-cost frontier technology
  - ➔ Innovative technologies need financial support
  - ➔ One-sided $CO_2$ penalty favours gas and nuclear energy but does not solve the problem of energy supply
- Ensure fair competition through uniform European environmental standards and regulations
  - ➔ Power is freely transportable; therefore, uniform environmental boundary conditions are especially important to avoid misallocation