IFRF ToTeM 41:

Recycled Flue Gas Properties – An Utility View

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Outline

- Indicators of Successful Plant Operation
- Indicators for Oxyfuel Technology
- Flue Gas Recycle Options
- Limits of Recycled Flue Gas Properties
- Conclusions

Indicators of Successful Plant Operation

Overall goal: Return of investment for the company

Power generation goal: Safe, reliable and efficient generation at minimum cost

SafetyF1RST

- **Safety:** Safety First, Healthy conditions for employees, Environmental impact
- **Availability and Operability:** Low commercial risks, high availability, Flexible operation
- **Efficiency**: High plant efficiency, Responsible resource usage
- **Cost:** Economic beneficial, Business case

Indicators for Oxyfuel Technology

- **Safety/Environment:**
  - Likely lower environmental impact
  - Higher CO2, NOX, SOX… concentrations → Risks for employees
  - Other safety challenges e.g. new equipment, O2/CO2 storage…

- **Availability and Operability:**
  - New Technology → Higher commercial risks than conventional generation
  - Concerns regarding availability → Vendor guarantees?
  - Less plant flexibility, Air firing capability (?) → Higher commercial risks

Indicators for on Oxyfuel Technology II

- **Efficiency:**
  - Efficiency drop due to Carbon Capture → More usage of fossil resources

- **Cost**
  - Higher cost than conventional power plants
  - Uncertainties in regulation (CO2 storage)
  - Low prices at carbon emission trading scheme

  → Oxyfuel as a business case uncertain

→ **Oxyfuel is more risky than conventional generation**

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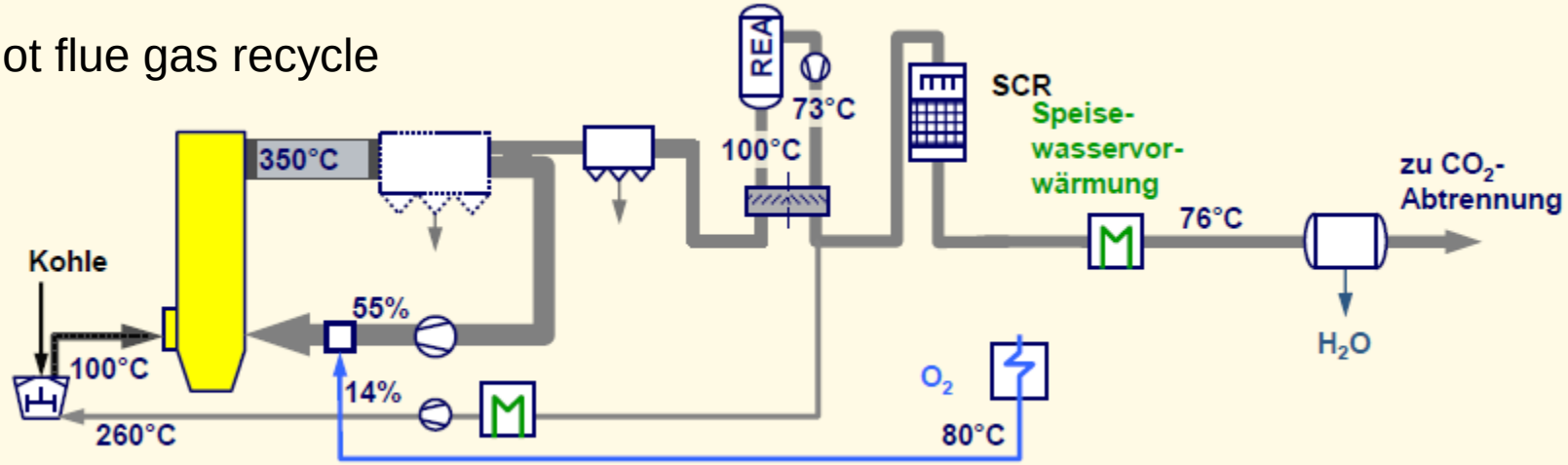
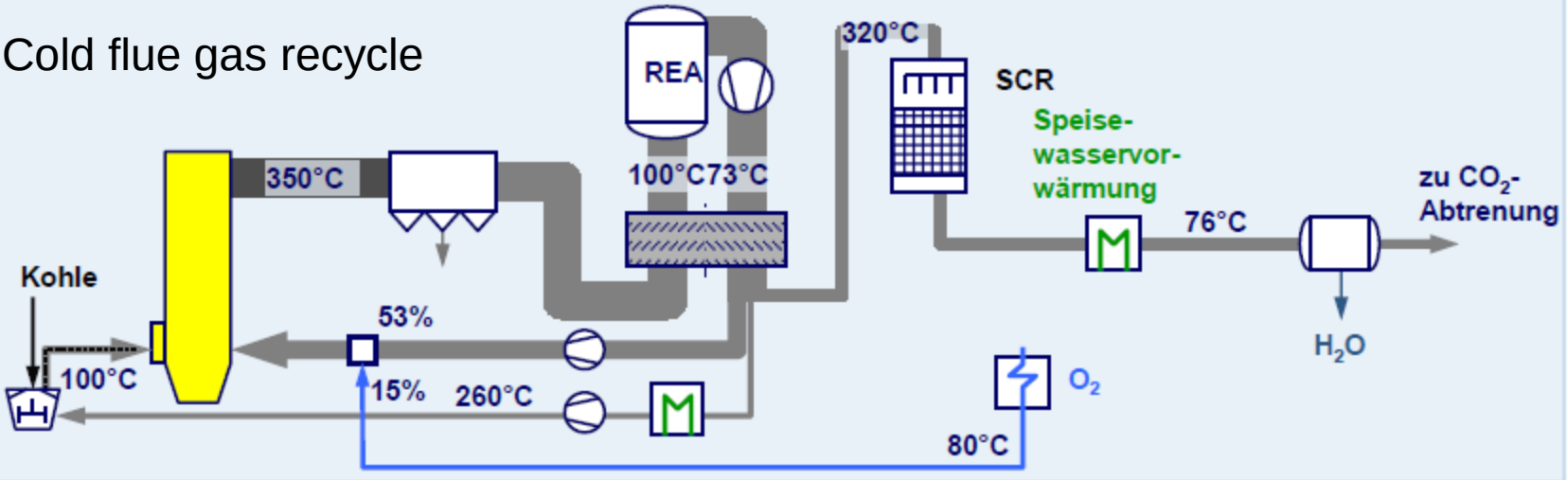
Recycle Options – Two Cases

Hot flue gas recycle



Cold flue gas recycle



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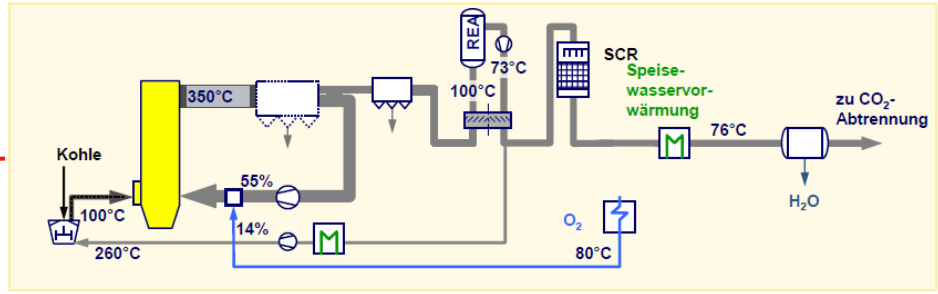
Hot Flue Gas Recycle



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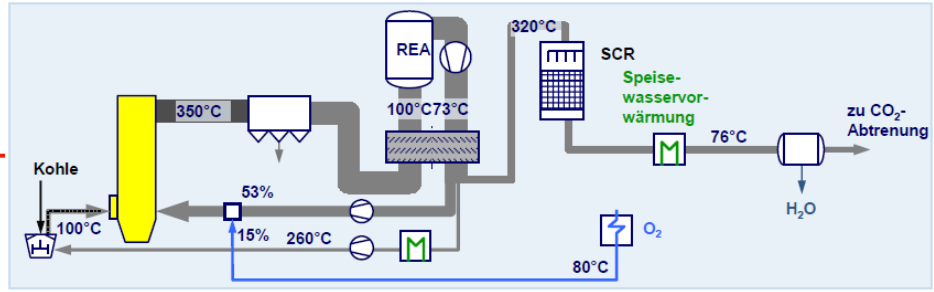
- Mill outlet temperature 100…160 °C
- No high load air operation due to FGD and SCR capacity limits
- Recycled Flue Gas Properties
  - High SOX concentration
    - → SOX level (boiler vendor maximums) 3000 ppm (?)
    - → Above H2SO4 dew point
  - Higher water concentration
- Smaller FGD unit

→ **Higher efficiency** (compared to cold flue gas recycle), but **more risks**:

- Some concerns remain regarding boiler materials
- Capacity limits in air firing

Cold Flue Gas Recycle



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- Mill outlet temperature < 100 °C
- Probably retains higher load air operation capability
- Recycled Flue Gas Properties
  - SOX concentration

    → SOX level ~ 40…80 ppm
  - No dew point concerns due to reheat after FGD
  - Larger FGD unit needed

→ **Lower efficiency** (compared to hot flue gas recycle), but **less risks:**

- No boiler materials issues expected
- Lower pollutant concentration in flue gas recycle

Conclusions

- Oxyfuel is more risky than conventional generation
- Flue gas recycling makes plant operation more complicated than in conventional plants
- Recycled flue gas properties determined by optimizing plant efficiency against operational risks
- Boundary conditions define flue gas recycle option
  - **Hot flue gas recycle** appears more beneficial for Oxyfuel only plant where gas conditions allow this configuration
  - **Cold recycle** allows a higher load in air mode and less acidic gases, but reduce efficiency

Thank you for your attention.

Vielen Dank für Ihre Aufmerksamkeit.

Спасибо за внимание.

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