



# ENCAP SP 2:

# Pre-combustion capture technologies for different fuels



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Uhde



DeCarbit-CESAR CCS Workshop

*Lurgi*

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# Motivation for the work in SP2

- Stated target of ENCAP is to provide pre-combustion capture technologies in power cycles operated by natural gas, hard coal and lignite.
- SP2 focusses on IGCC and IRCC cycles based on nearly developed technologies, in parallel to SP3 (Oxyfuel), SP4 (Chemical Looping) and SP6 (Novel Pre-Comb. Tech.).
- IGCC cycles without CO<sub>2</sub> capture are well known and developed, but cycles with CO<sub>2</sub> capture have to be designed:
- Technical Incentives for IGCC
  - Pressurized Process → low flow volume flows and small unit sizes
  - High CO<sub>2</sub>-partial pressure → simple scrubbing and regeneration
- For H<sub>2</sub>-rich fuel gases (after pre-combustion CO<sub>2</sub> capture), gas turbine burners (especially premix concept) have to be developed.

# Objectives of the work in SP2

- Development of overall plant outline specification
  - Definition and Analysis of Plant Concepts
  - Optimisation of CO-Shift conversion
  - Development of capture unit integration with plant
  - Data base for benchmark study (comparison with reference cases under SP1)
- H<sub>2</sub>-rich combustion:
  - Elaboration of combustion data base (at DLR) for/and
  - Modeling of H<sub>2</sub>-rich gas combustion (at SINTEF)
  - Development of premix burners for H<sub>2</sub>-rich gases (at Alstom and Siemens)

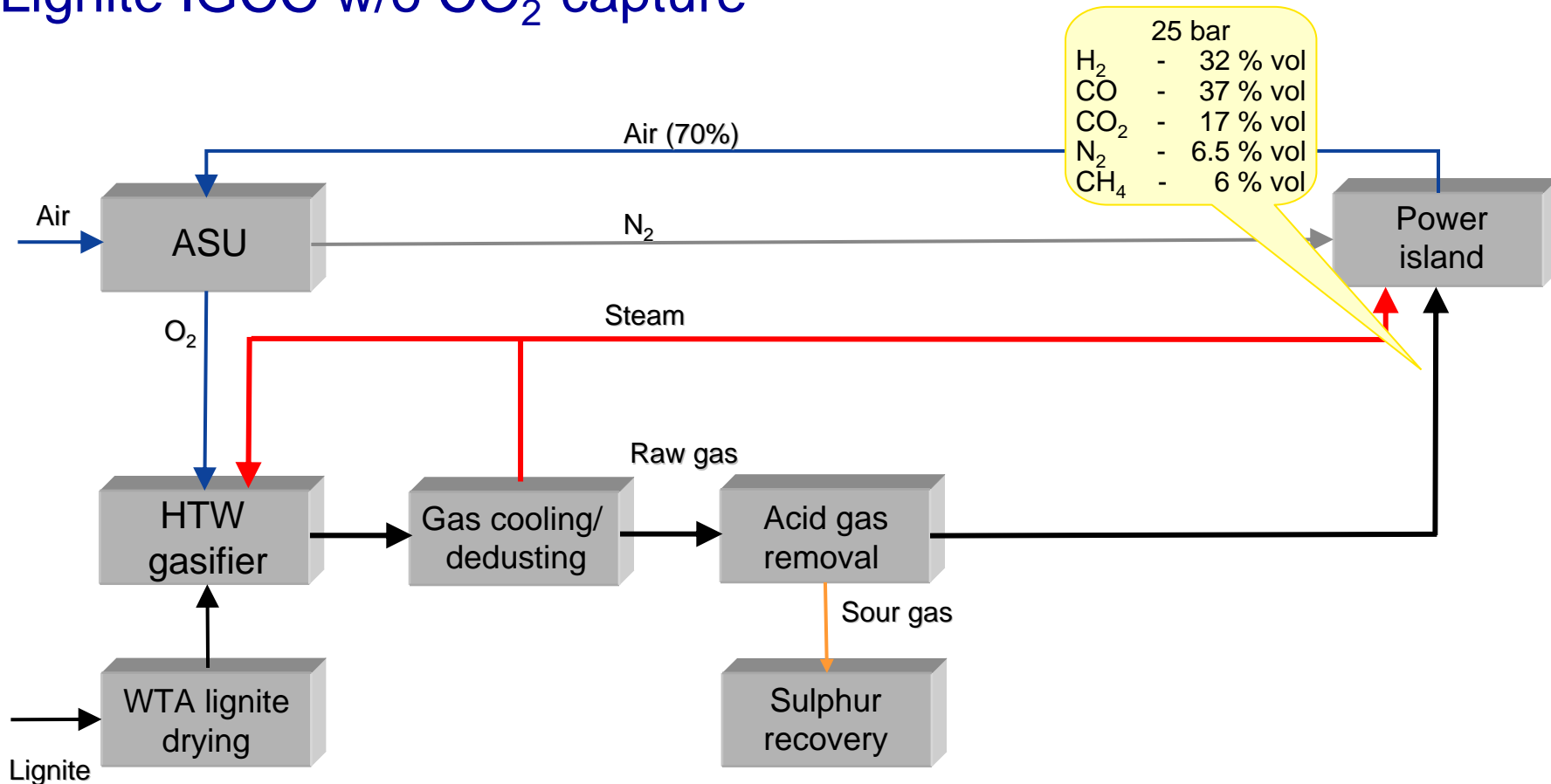
# Design guidelines for IGCC/IRCC

- High maturity of technologies (State-of-the-art 2004)
- High capture rate > 90 % (-> high shift conversion rate)
- High availability (-> redundancy)
- Plant location: greenfield
- CO2 quality: 100 – 150 bar, > 0 °C (Design case, EOR case)
- Plant size based on 2 x V94.3 gas turbine concept
- CO2 avoidance costs 50% compared to year 2004

# Work performed/main results

## IGCC Process Development

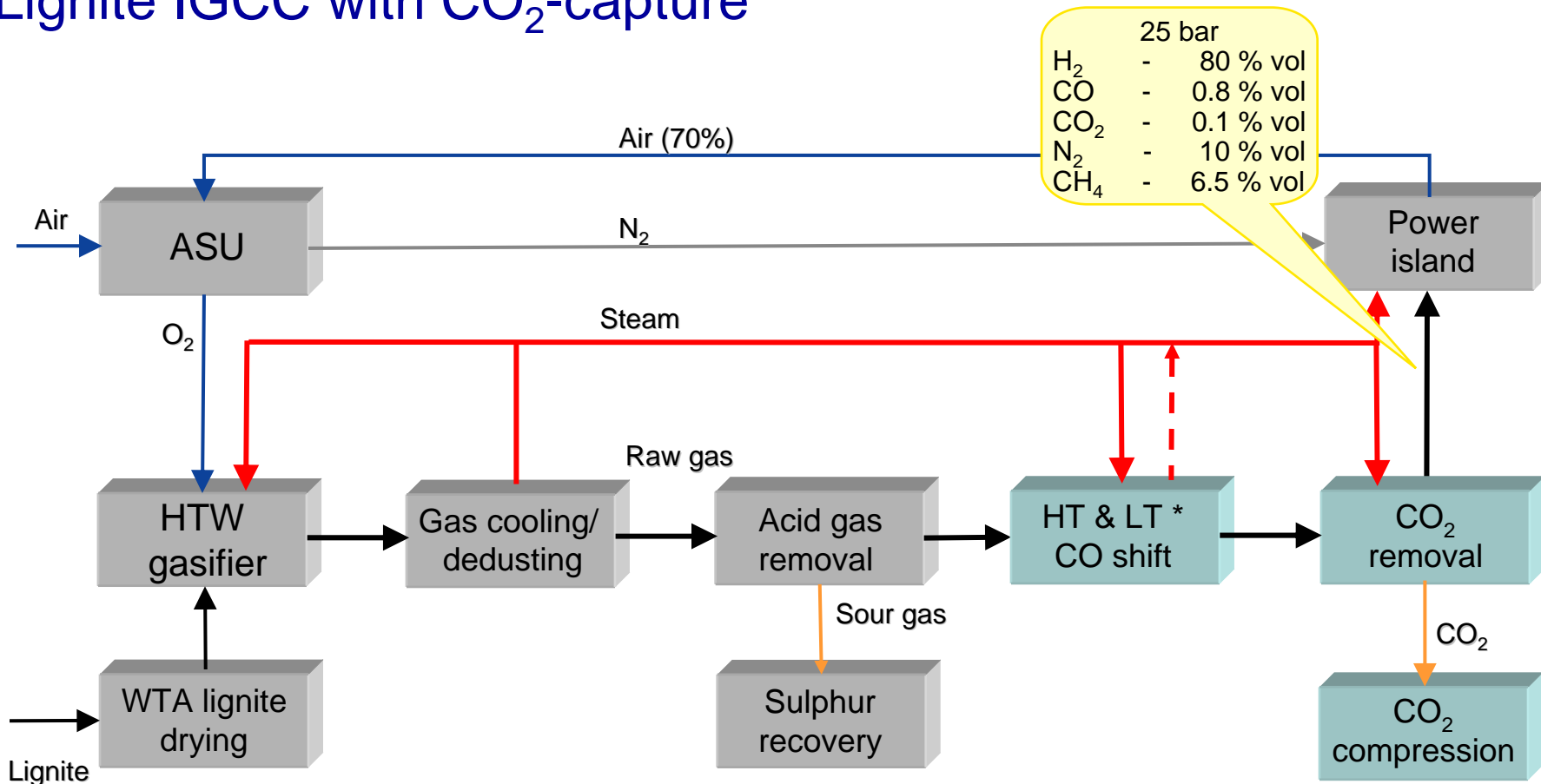
Lignite IGCC w/o CO<sub>2</sub>-capture



# Work performed/main results

## IGCC Process Development

### Lignite IGCC with CO<sub>2</sub>-capture



# Work performed/main results

## Design and technical figures of final concepts

Concept	1*	2	3	4	5	6
Fuel	NG	HC	Lign	NG	HC	Lign
CO2 capture	No	No	No	Yes	Yes	Yes
Gasification	-	Shell	HTW	ATR	Shell	HTW
Gas conditioning	-	-	-	Sweet shift	Sour Shift	Sweet Shift
H <sub>2</sub> S separation	-	MDEA	Flexsorb SE+	-	Rectisol	Rectisol
Sulfur recovery	-	Claus	Clinsulf	-	Claus	Claus
CO <sub>2</sub> separation	-	-	-	aMDEA	Rectisol	Rectisol
Net Power Output (MW)	385	874	826	755	734	717
Net Power Efficiency (%)	56.5	46.3	51.7	41	35.9	40.5
CO <sub>2</sub> capture rate (%)	-	-	-	92.4	92.2	85

\* Documented under SP1

# Main conclusions of ENCAP SP2

- Technology for IGCC with CO<sub>2</sub> capture is basically developed, premix burner excepted.
- H<sub>2</sub> burner development is a challenging topic, but feasible.
- Premix burners are under development, but not finished within ENCAP.
- High penalties observed for CO<sub>2</sub>-capture concepts (complexity, efficiency).
- Economy of concepts depends on CO<sub>2</sub> price (further information see SP1).

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