NTNU

Norwegian University of Science and Technology

Technological capabilities of power plants with CCS

Energy Transition Workshop

26 February 2018

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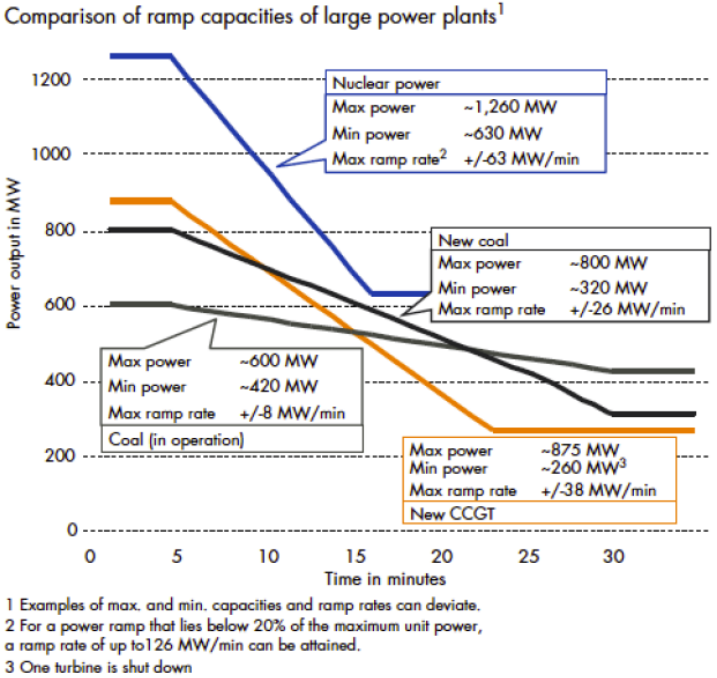
Focus

- Plant level
- Gas-fired power with CCS
- Flexibility provider for power system – *Fast load changes*
- Plant level models ⇔ Power and gas system level models

Gas-fired power as flexibility provider

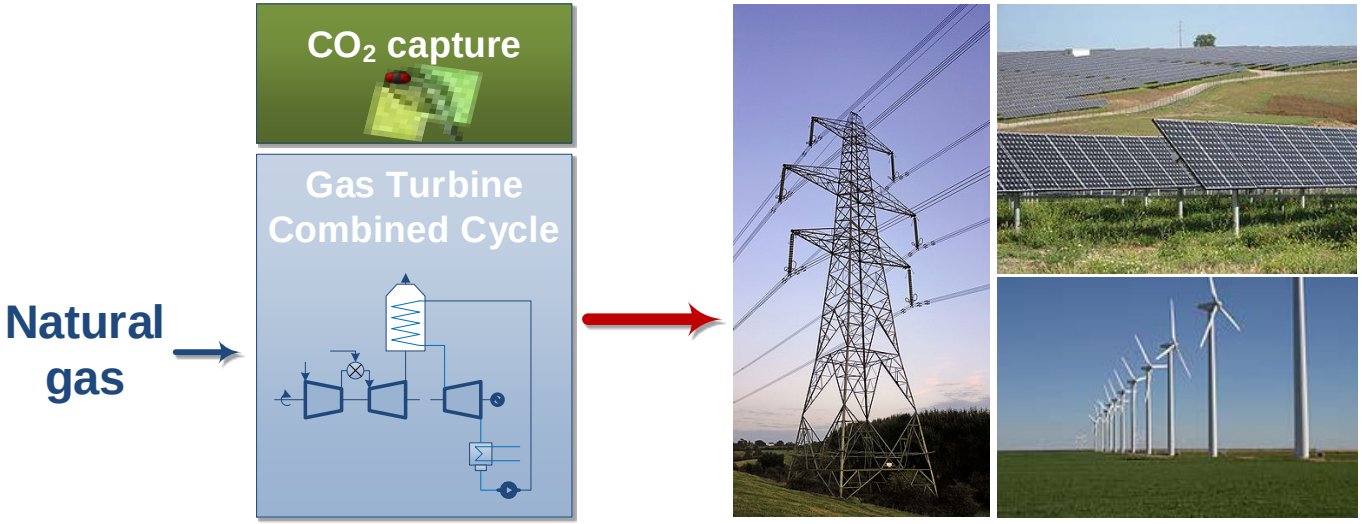
- Gas turbine: 20% load / min
- Combined cycle: 5–10% load / min
- Future scenarios: double the ramp rate
- Comparison coal: 1–8% load / min

- Minimum load (emissions compliant)
- State-of-the-art efficiency: 61.5%

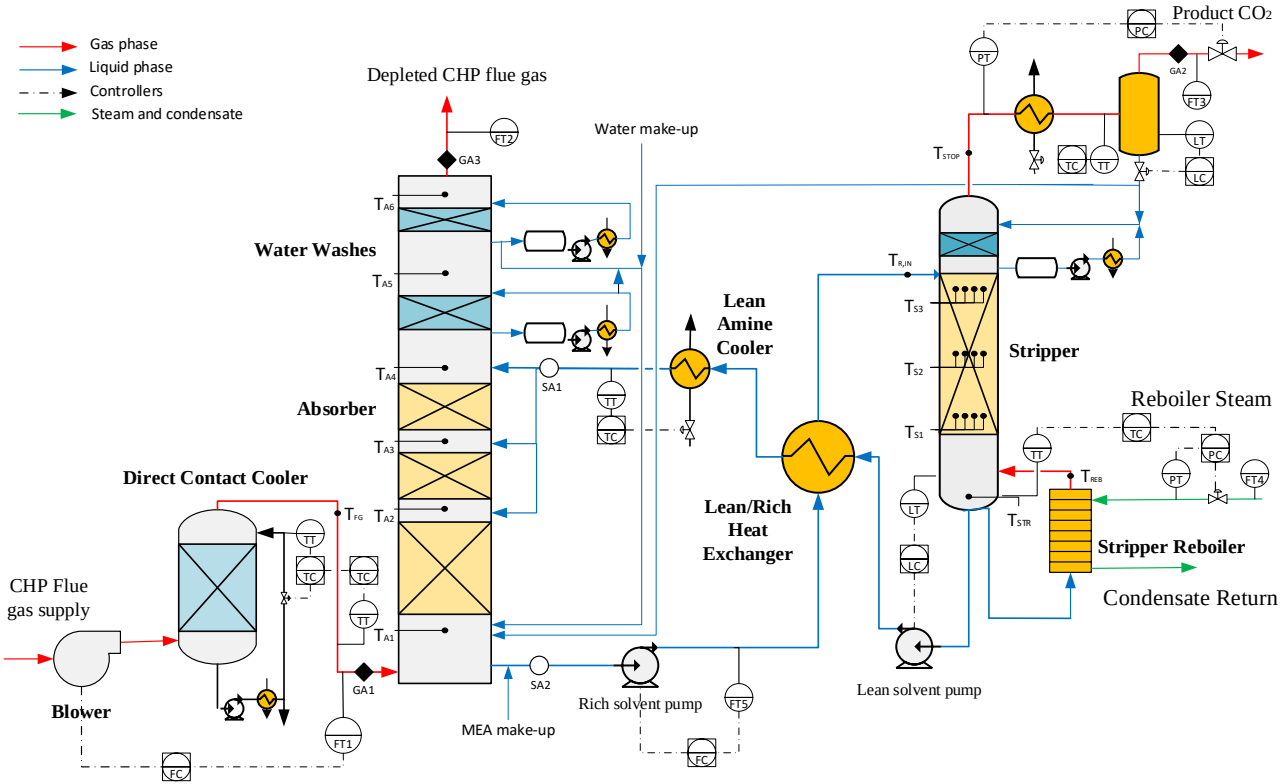


Source: VGB PowerTech

Gas turbines with CCS:
Flexible and efficient?



Modeling and simulation



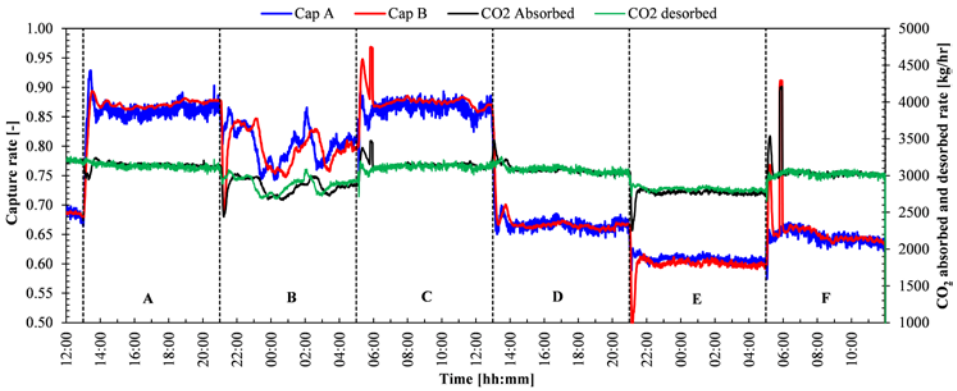
Testing at Technology Center Mongstad

- NTNU – TCM collaboration on flexibility and dynamics
- Test campaign Summer 2017
  - Open-loop response
  - Flexibility scenarios – Ramp rates

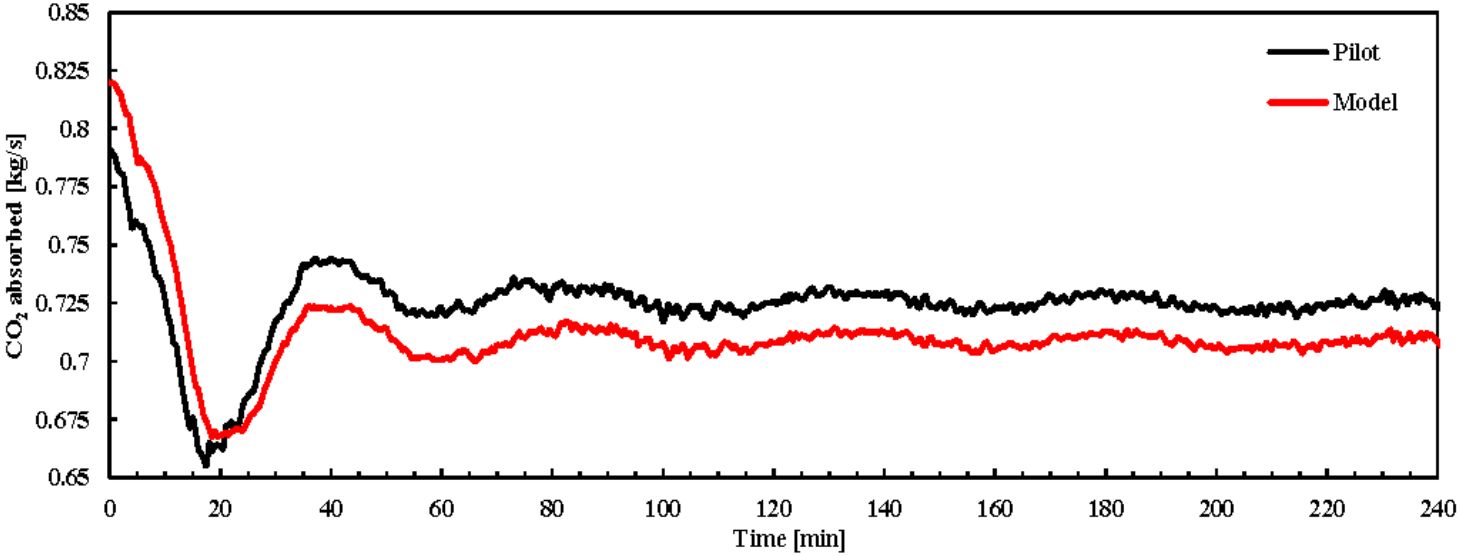
http://www.ntnutechzone.no/en/2017/10/experiments-at-the-worlds-largest-test-center-for-co2-capture/

Results from testing

- Ramp rates tested by manipulating gas flow rate to capture system
- 7.5% (today) to 15% (tomorrow) load ramp rate
- 40% to 100% power plant load
- Capture system can handle it!
  - ➢ Will lag power plant
  - ➢ Operates at less than optimal conditions during transient

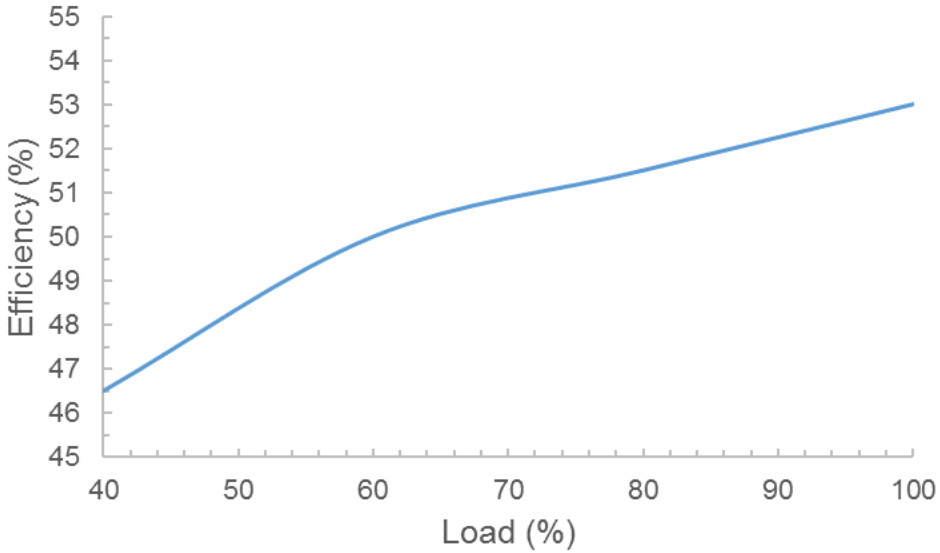


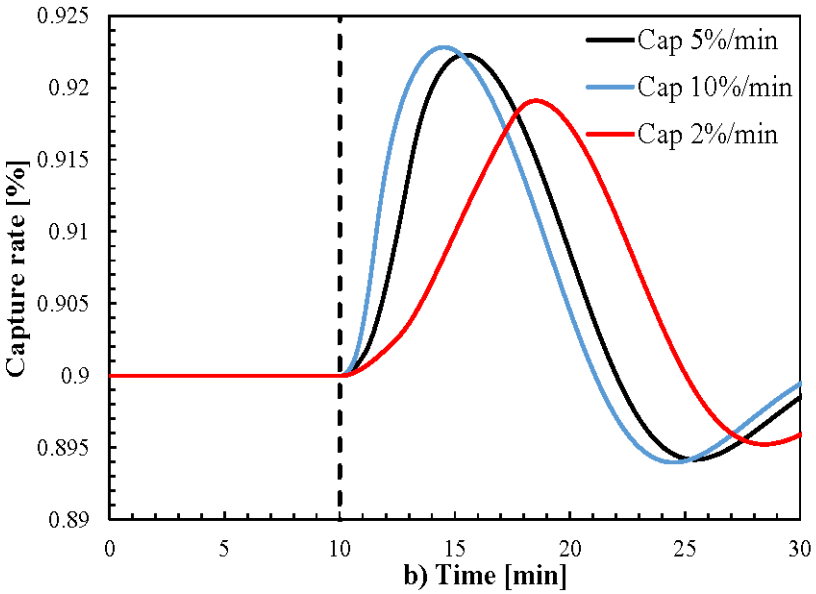
Model validation



c) CO_2 absorbed

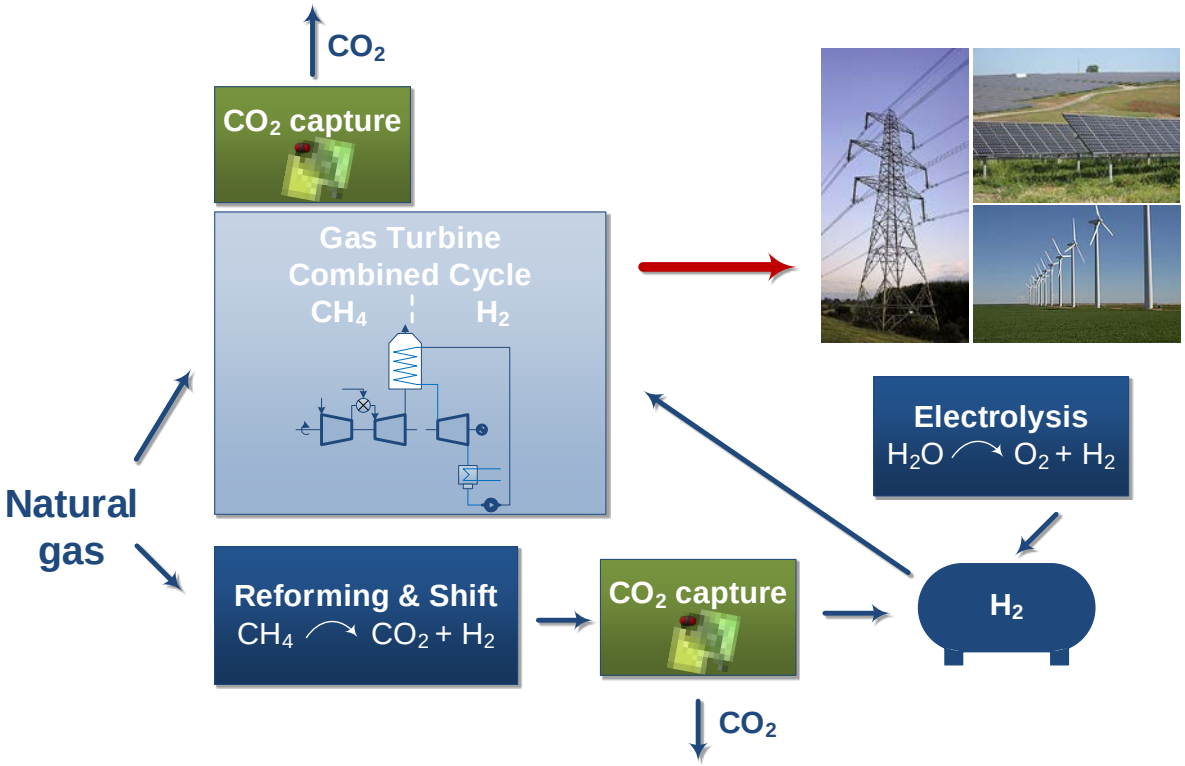
Results from scaled-up simulations





Need for research

Interaction with the power markets and the gas value-chain



Further topics

- Future ramp rates
  - Future gas-fired power with CCS
  - Hydrogen GT ramp rate
- Two-way communication system and plant models:
  1) "Dream" thermal power plant plant from a system's perspective.
  2) Capabilities from a plant's perspective.
- Time resolution in gas and power system models