CEPG / CETC-O

CANMET Energy Technology Centre R&D Oxy-Fuel Combustion for CO_2 Capture

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Presentation Outline

- Program Objectives & Background
- Project Overview
- Oxy-Fuel Program Key Accomplishments
- Canadian R&D Environment
- Future Directions

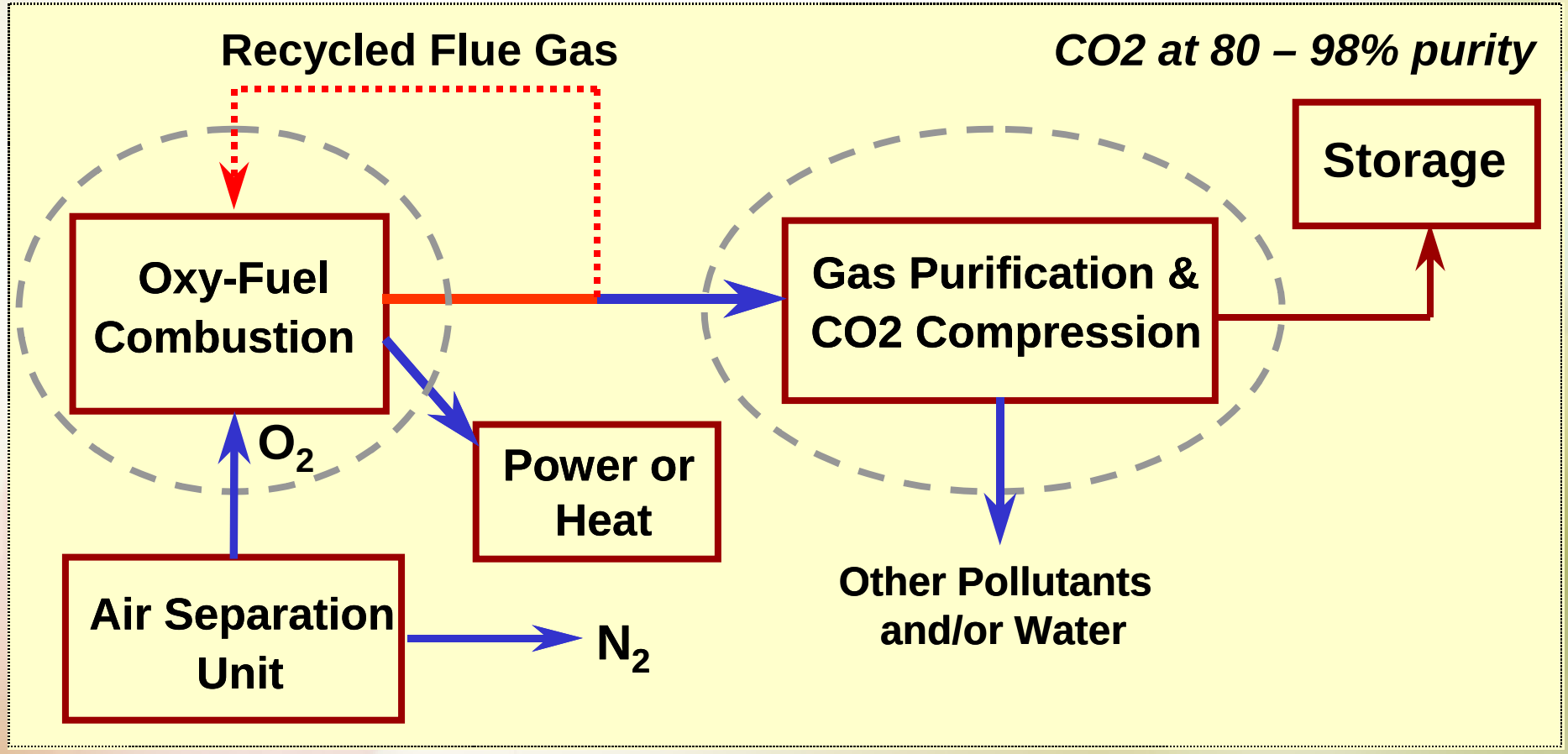
CANMET-Industry CO_2 Consortium Program Objectives & Background

Pursue fundamental and pre-competitive research to explore the capture of CO_2 from fossil fuel power plants using oxygen enriched combustion technologies:

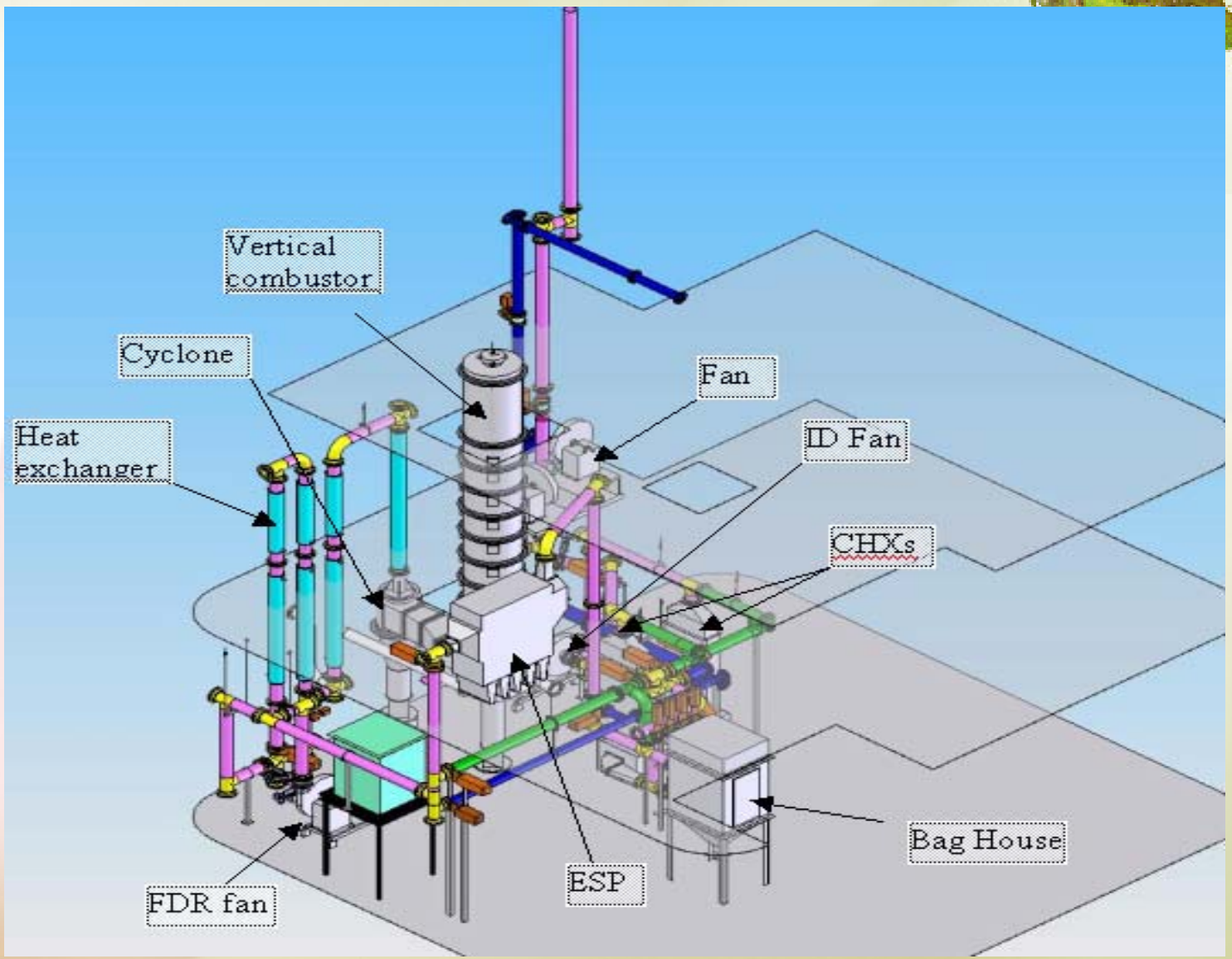
- Near-term objective: Commercial demo of first generation oxy-fuel combustion for CO_2 capture
- Long-term objective: Development of the next generation of oxy-fuel combustion technology

- Started in 1994 and is currently in Phase 8
- Funding: ~ $1M CDN per year
- Participants: B&W, Ontario Power Generation, SaskPower, Alberta Energy Research Institute, US DOE, and Government of Canada

Zero-Emission Oxy-Fuel Combustion



Vertical Combustor (VC) Facility

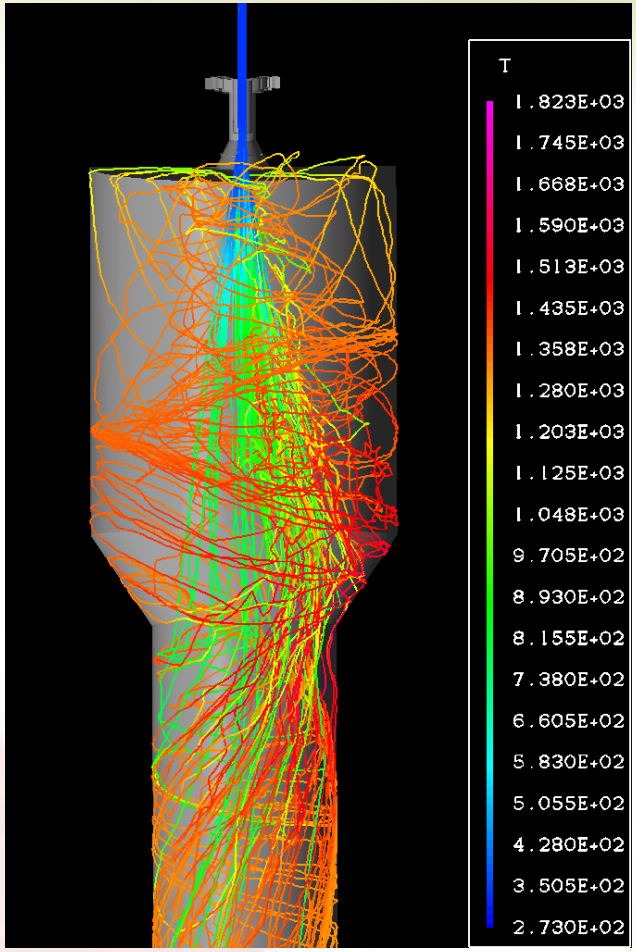


Vertical Combustor (VC) Facility

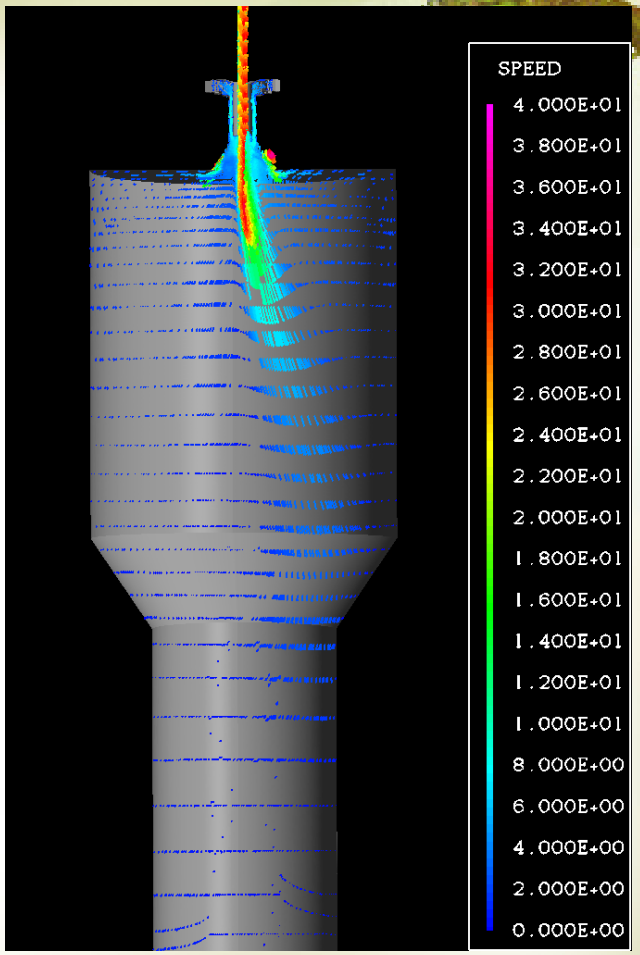
Advanced Features and Capabilities

- Has a nominal thermal output of about 0.3 MW. Different fuels including NG, oil, coal and coal slurry can be burned in air- or oxygen-fired mode in an efficient and controlled way
- A versatile and unique testing platform for oxy-fuel combustion
- Can be used to develop novel integrated multi-pollutant control technologies, including SOx, NOx and Hg removal
- Highly modular and flexible to implement different combustion processes
- Equipped with advanced process monitoring and control systems

CANMET-Industry CO_2 Consortium CFD Modelling



Tracks of coal particles colored by temperature (range 273-1823 K)



Velocity vectors on x-section colored by speed (range 0-40 m/s)

CETC-O Oxy-Fuel Program – Key Accomplishments

- CETC-O pioneered research and development in oxy-fuel technologies and CO_2 capture over the past decade
- Extensive pilot-scale experimental investigations with coal and natural gas
- Study characteristics of oxy-fuel combustion with flue gas re-circulation
- The research work has generated a unique knowledge database and analytical tools to facilitate the implementation of this technology
- Test results show that oxy-fuel technology can be used to retrofit existing PC fired power plants for CO_2 capture with minimal modifications to the boiler system with lower NO_x emissions

CETC-O Oxy-Fuel Program – Key Accomplishments (cont'd)

- Oxy-fuel burner design and testing to minimize NO_x emissions
- CFD model developed and applied to model oxy-fuel combustion and to assist burner design
- Develop computer simulation tools and models for oxy-fuel combustion feasibility studies and concept evaluation
- Development of the integrated emission control technology
- Carleton University - develop a zero emission micro gas turbine using CO_2 as working fluid and a 100 MW scale-up unit
- University of Waterloo - develop technologies for CO_2 capture from hydrogen plants
- More than 30 papers published in journals and conference proceedings

Canadian R&D Environment

- Canadian utilities are very pro-active in GHG abatement R&D
- Canadian Clean Coal Technology Roadmap calls for a demo plant by 2012
- Canadian government supports the demonstration of clean coal technology as well as CO_2 capture and storage technology
- Diverse geographies and energy sources require specific technology approach, i.e. gasification is favoured in Alberta (oil sands industry needs H_2), oxy-fuel/amine scrubbing is more suitable in Saskatchewan (lignite coal)
- EOR and ECBM offer significant opportunities for economic CO_2 capture and storage
- Large storage potential in Western Canadian Sedimentary Basin

CANMET-Industry CO_2 Consortium R&D Directions

- Commercial demonstration of the technology
- Past R&D emphasized retrofit
- Current and future activities will target:
  - Moving towards 2nd generation of oxy-fuel combustion systems for power generation - minimizing recycle flow
  - Better integrated emission control technology
  - Developing efficient variants for advanced power/heat generation cycles
  - CO_2 capture, compression and performance testing
  - Gas turbine using CO_2 as working fluid
  - Application of oxy-combustion to CFB