

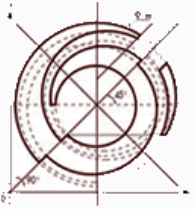
September 2006

ALSTOM

EU-OPEC Roundtable on Carbon Dioxide  
Capture and Storage

**Further R&D Paths for Securing Commercial  
Breakthrough of CCS – The OEM Perspective**

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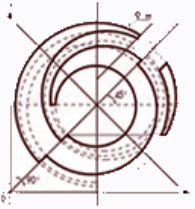
## Topics covered

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Topics covered in the presentation are:-

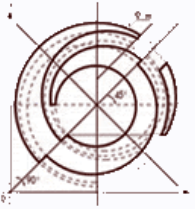
- Zero Emission Fossil Fuel Power Plant
- Carbon capture options for combined cycle power plant



## Technology Platforms (TP)

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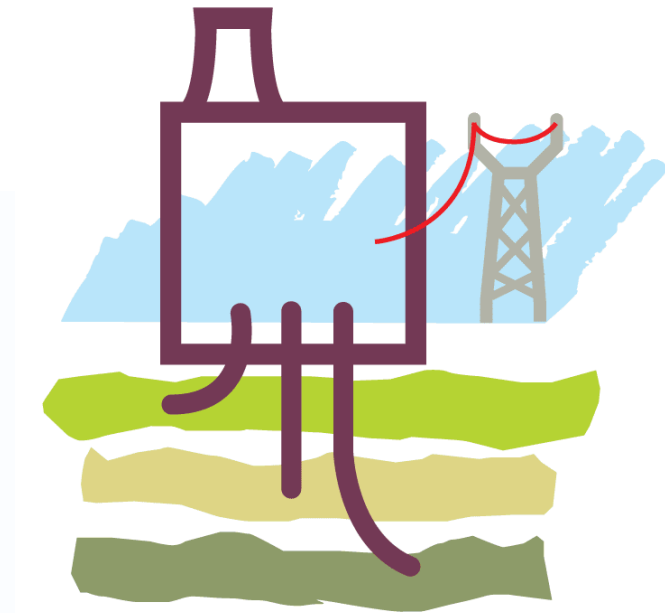
- Up to 30 Technology Platforms in FPVII
- One Technology Platform for Zero Emission Fossil Fuel Power Plants (ZEP)
  - Covers gas, oil, coal fuels
  - Formal launch - 1<sup>st</sup> December 2005
  - General Assembly – 11-12<sup>th</sup> September 2006
  - Strategy Research Agenda – Autumn 2006
- FPVII Work programme – late 2006
- FPVII Call for proposals – early 2007

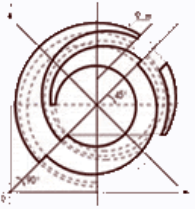


# ZEP Objectives



- Technology Platform Zero Emission Fossil Fuel Power Plant (ZEP)
  - Technology allows use of fossil fuels into foreseeable future AND protects the environment
  - High efficiency combined cycle components and system integration
  - Capture ready plant for short term
  - Zero CO<sub>2</sub> emission plant by 2020
  - Setting fossil fuel plant agenda to 2030





## Structure of ZEP



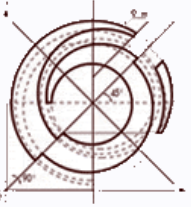
Zero Emission Fossil Fuel Power Plant - open and accessible to all stakeholders

Advisory Council 20-25 members

Co-ordination/Working groups

General Assembly (bi-annual technology forum)

Projects to meet  
recommendations of Strategic  
Research Agenda

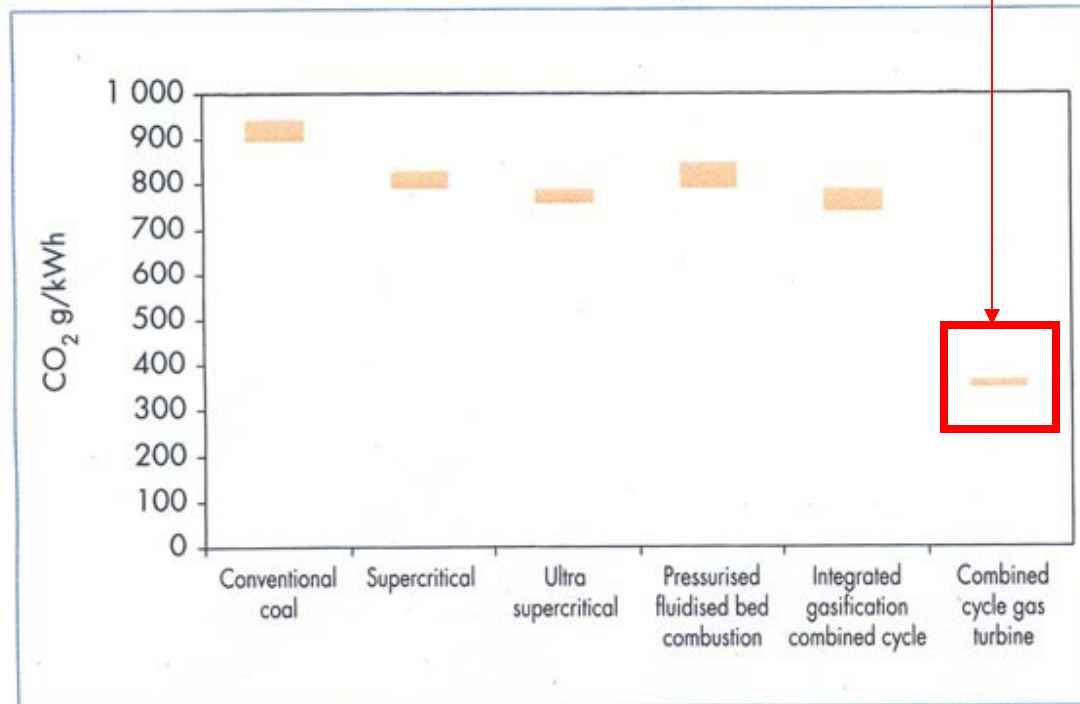


# CO<sub>2</sub> emissions from power plant



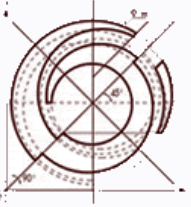
- Gas turbine combined cycle has low CO<sub>2</sub> emissions

Figure 6.4: CO<sub>2</sub> Emissions by Type of Plant



Note: The emissions shown in this chart are based on a range of efficiencies.

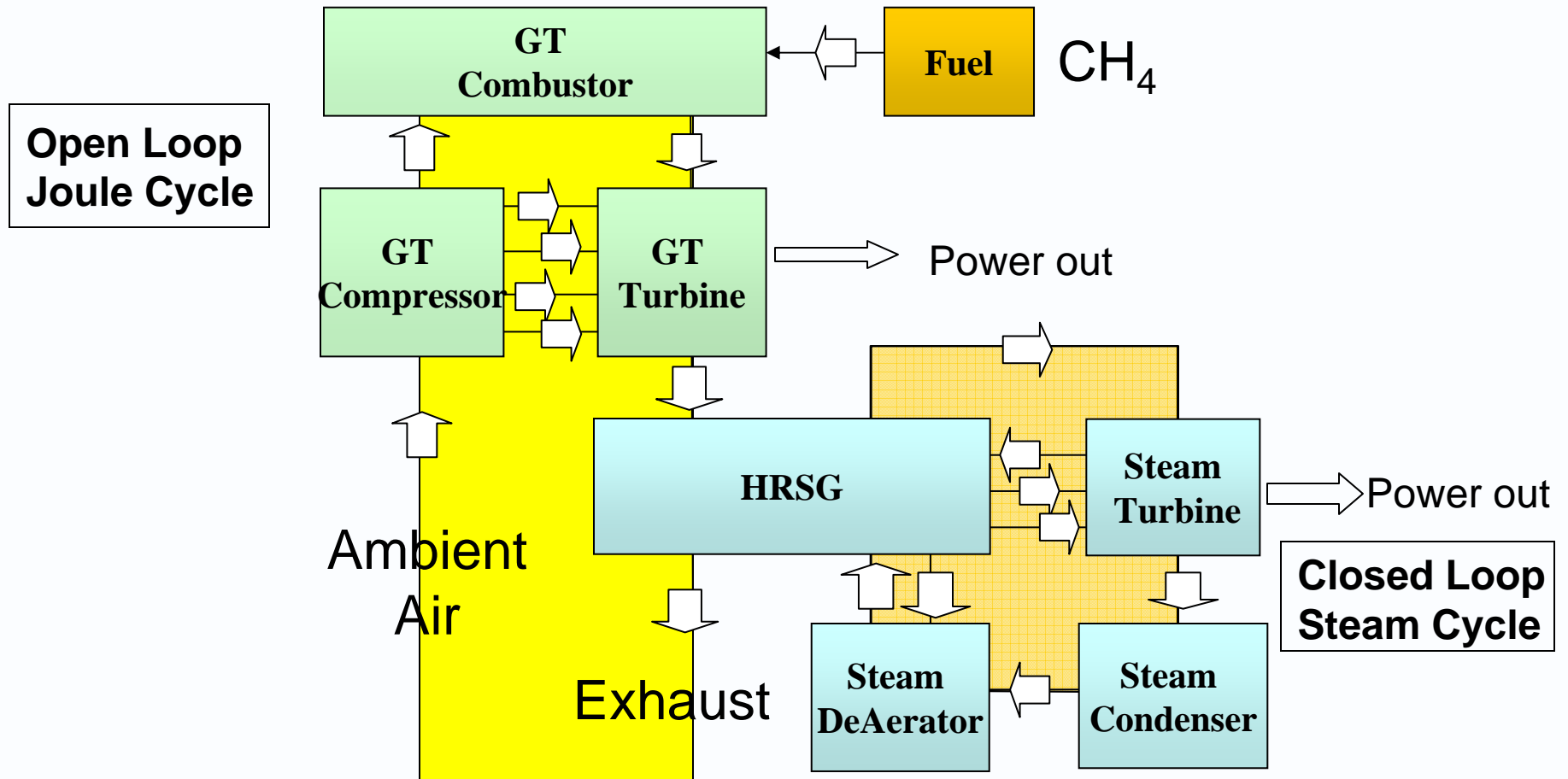
Source: World Energy Outlook 2004

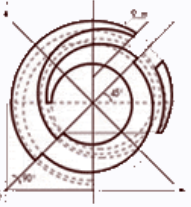


# Advanced, higher efficiency plant

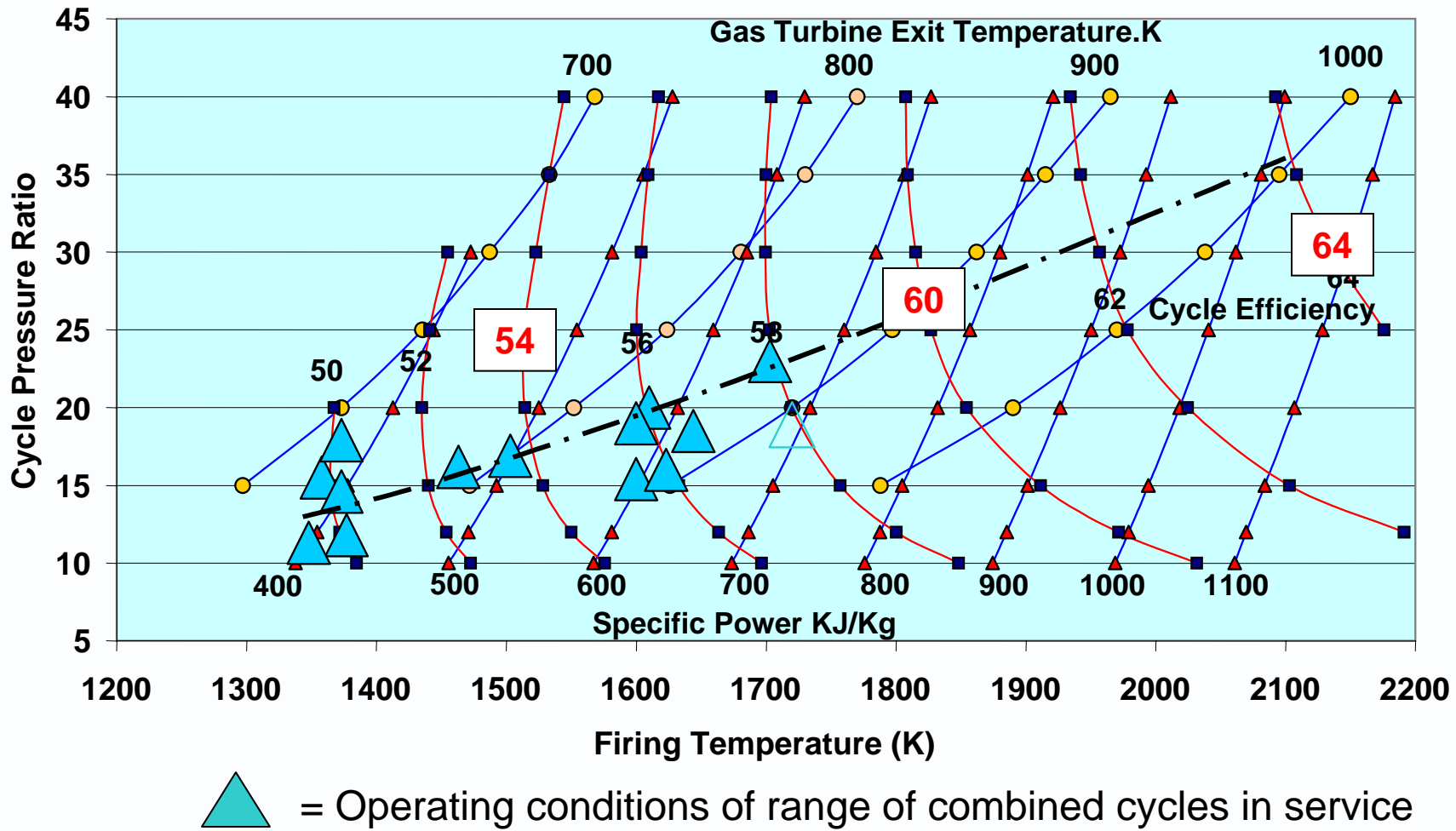


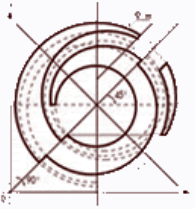
## Combined Cycle





## Combined cycle – the challenge

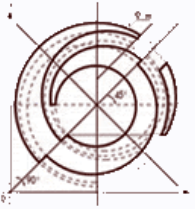




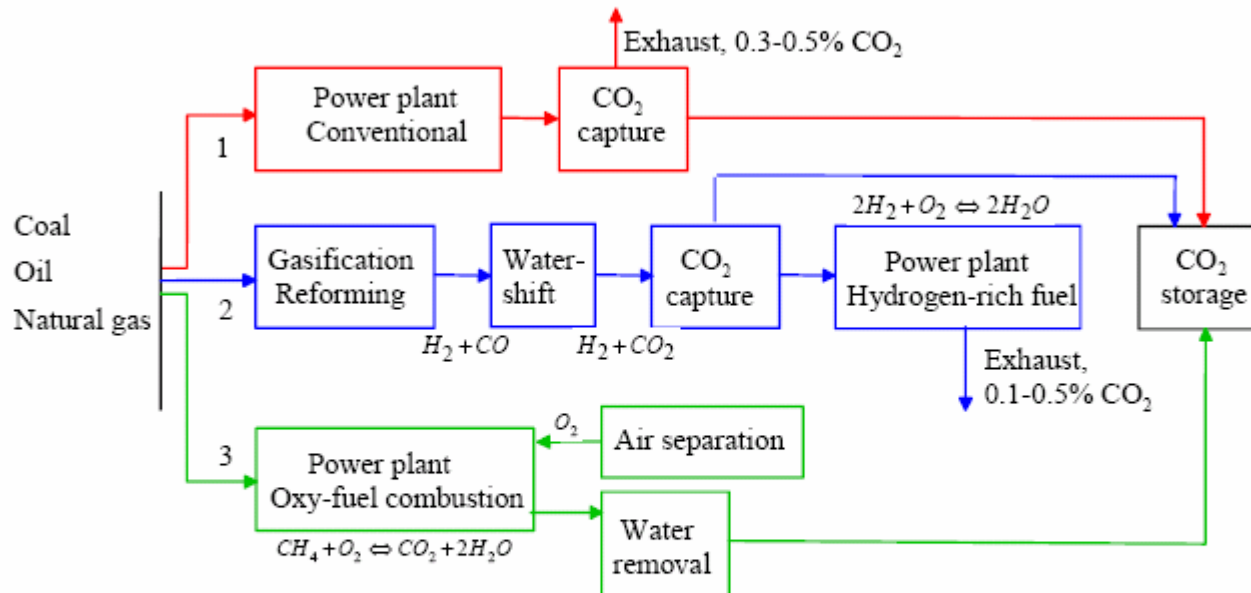
# Zero Emission Power Plant



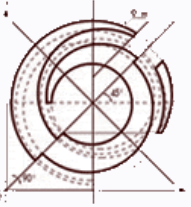
- Three main approaches
  - Pre-combustion
  - Oxy-fuel
  - Post-combustion



## Options for power plant CO<sub>2</sub> capture

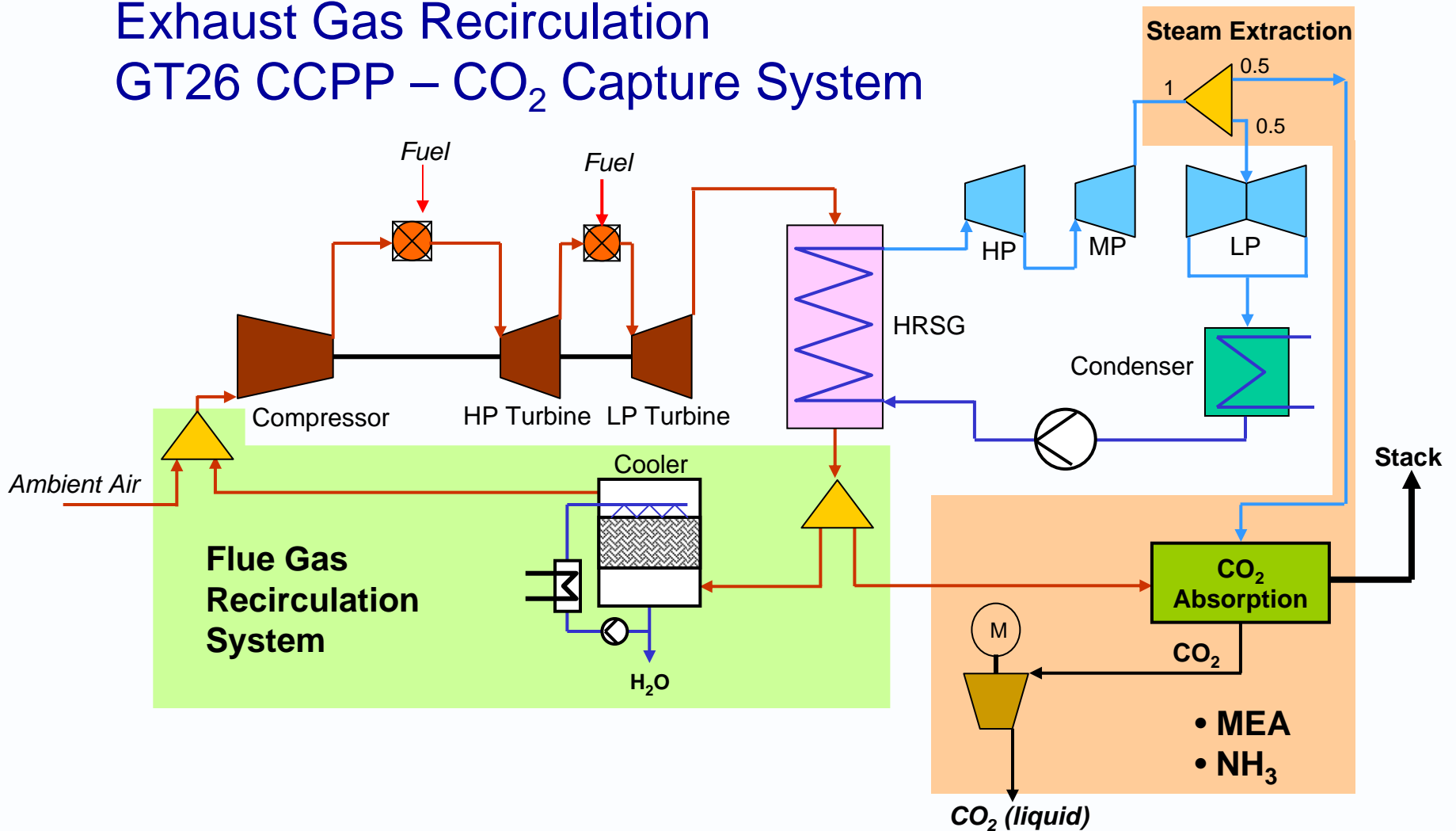


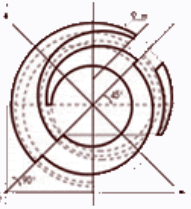
- 1: Post-combustion principle
- 2: Pre-combustion principle
- 3: Oxy-fuel principle = direct stoichiometric combustion with oxygen



# 1. Post combustion principle

## Exhaust Gas Recirculation GT26 CCPP – CO<sub>2</sub> Capture System



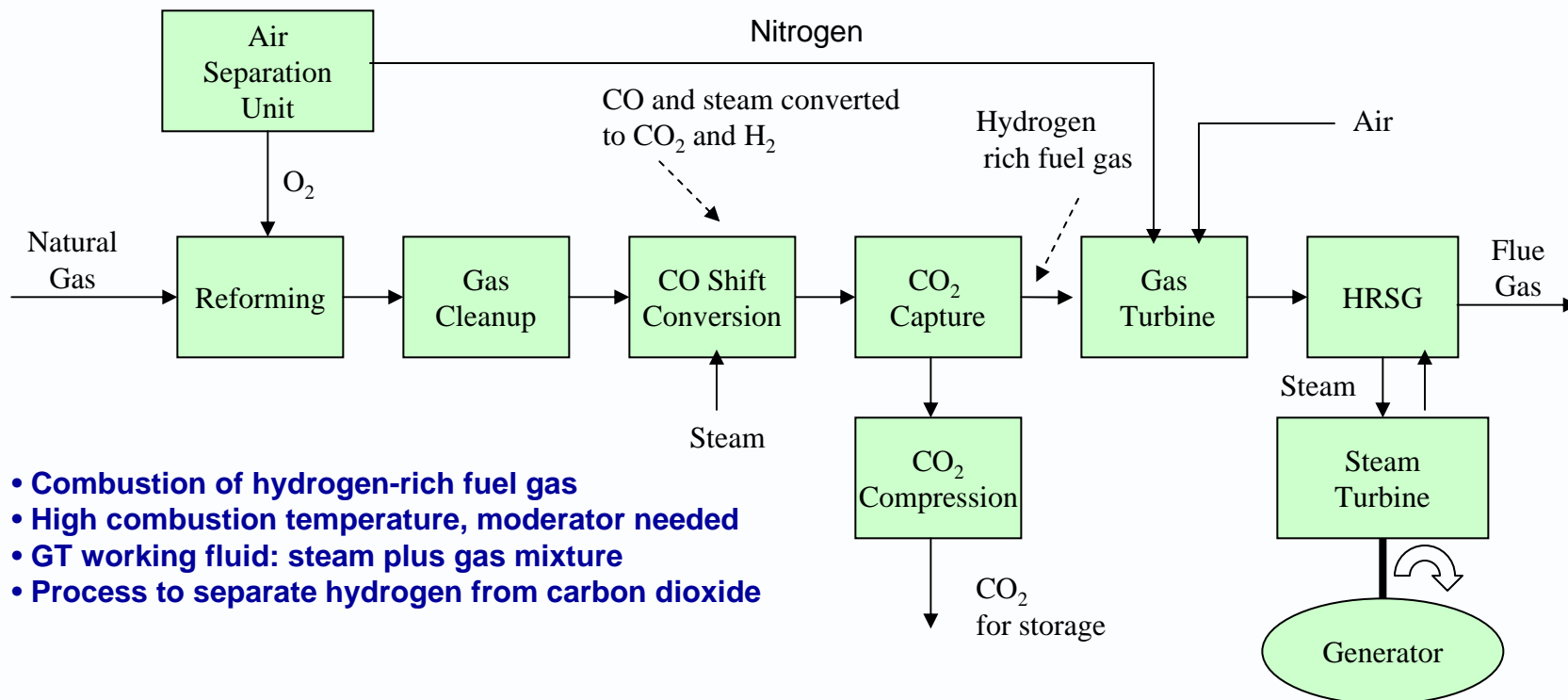


## 2. Pre-Combustion principle

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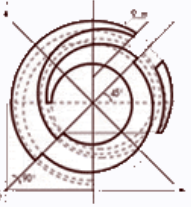
### ● Pre-Combustion Decarbonisation Technologies

Integrated Reforming Combined Cycle (Typical cycle – hydrogen rich fuel)



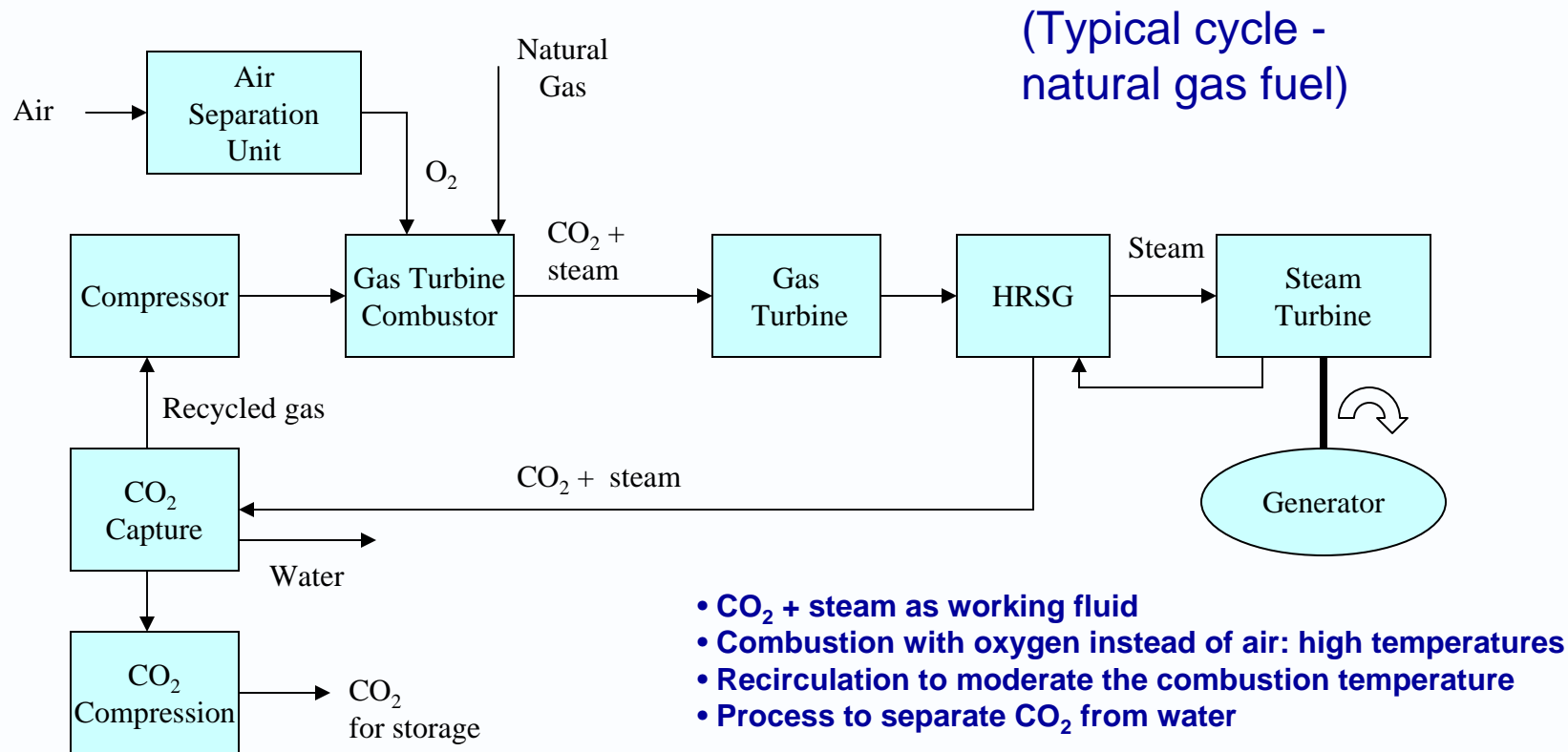
- **Combustion of hydrogen-rich fuel gas**
- **High combustion temperature, moderator needed**
- **GT working fluid: steam plus gas mixture**
- **Process to separate hydrogen from carbon dioxide**

- R&D: gas separation processes and new GT components -

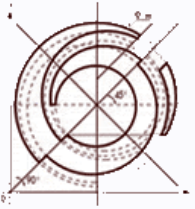


### 3. Oxy-fuel principle

- Oxy-Fuel Decarbonisation Technologies



- R&D: gas separation processes and new GT components -



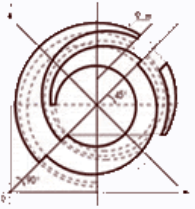
## Priority Areas

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- Multi pollution control for very low emissions of conventional pollutants
- Post-combustion CO<sub>2</sub> removal from gas plant
- Fuel flexibility and H<sub>2</sub> for gas turbine
- Retrofit and new equipment solutions
- Continued research and development



**The Clean Combustion Specialist**



## Potential for collaboration



- Collaboration between partners in EU and GCC possible in ALL areas of FPVII Technology Platform
  - Advanced gas turbine technology
  - Zero emission plant design and demonstration
  - Demonstration of CO<sub>2</sub> capture and use for oil recovery enhancement/disposal in depleted oil fields
- Approaches welcome from potential partners

The background features a blue and white graphic with vertical stripes and a large red curved shape. The Alstom logo is centered in the white area.

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