

Development of Metal Oxides Chemical Looping Process For Coal-Fired Power Plants

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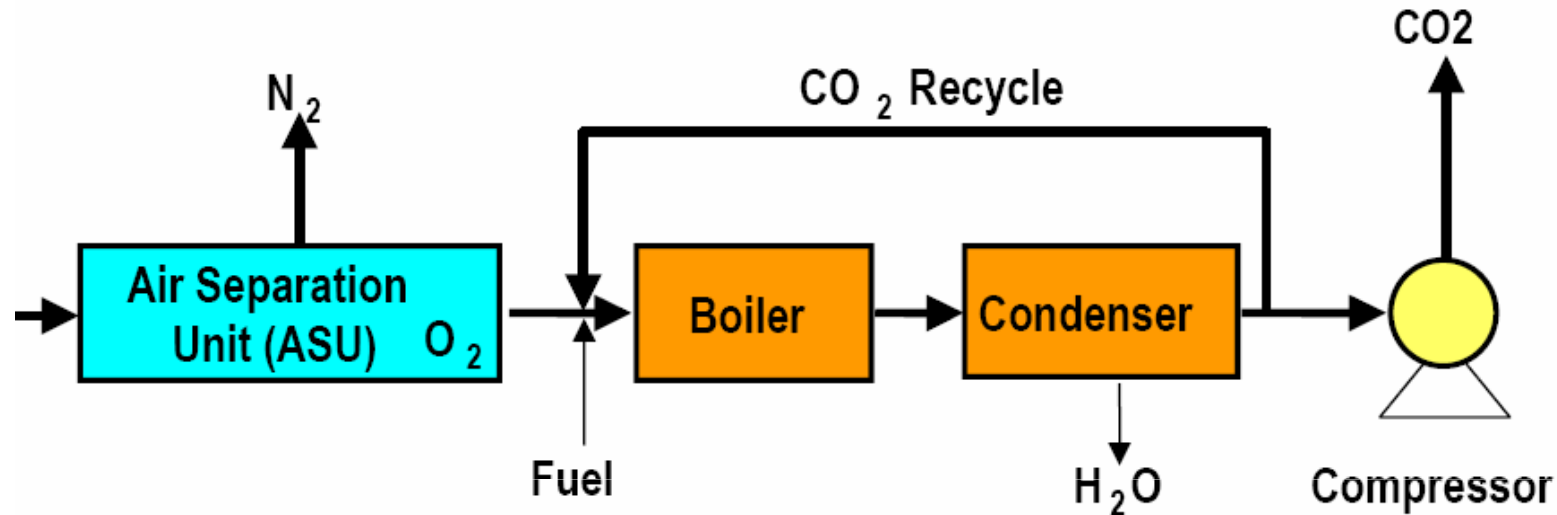




Presentation outline

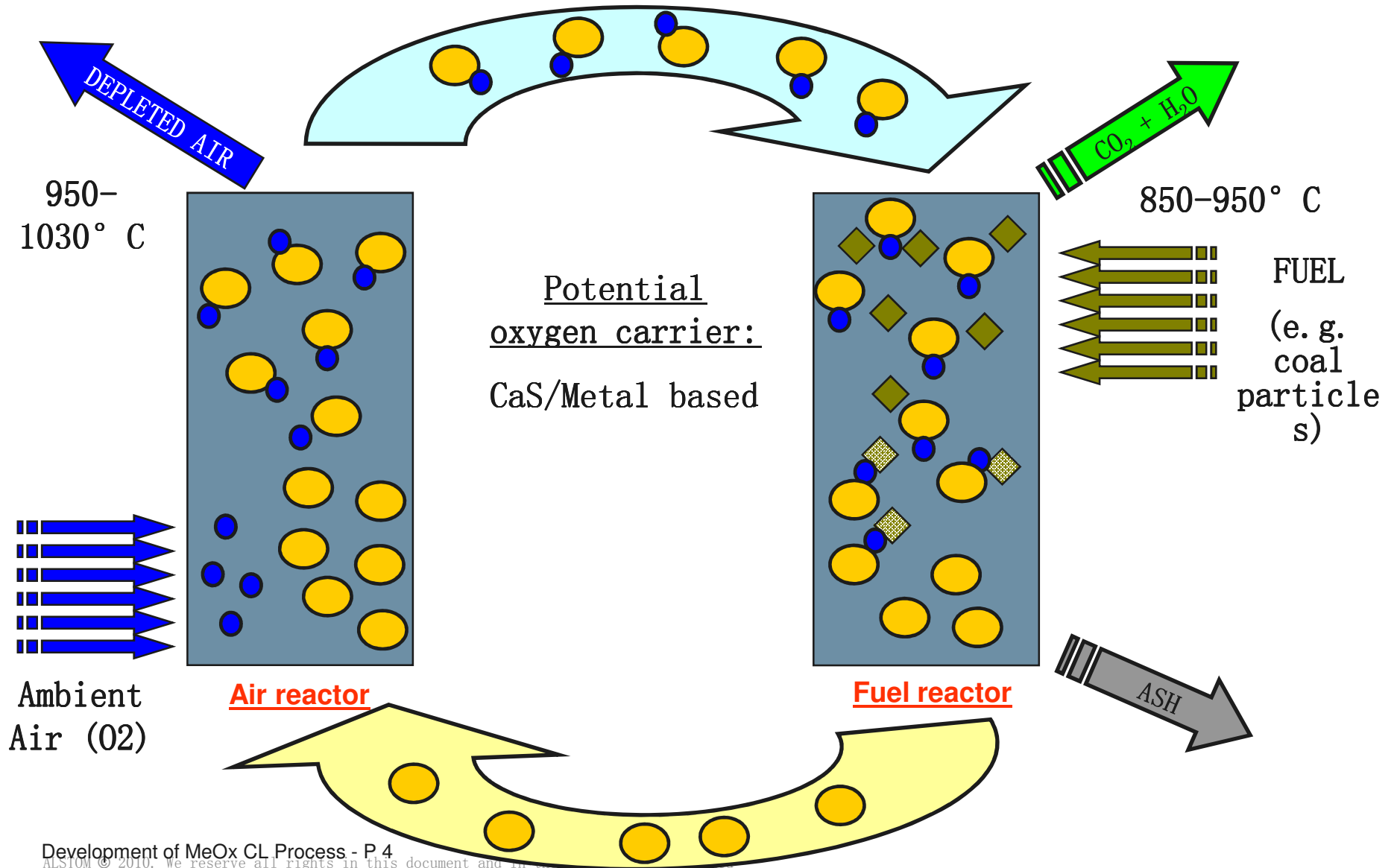


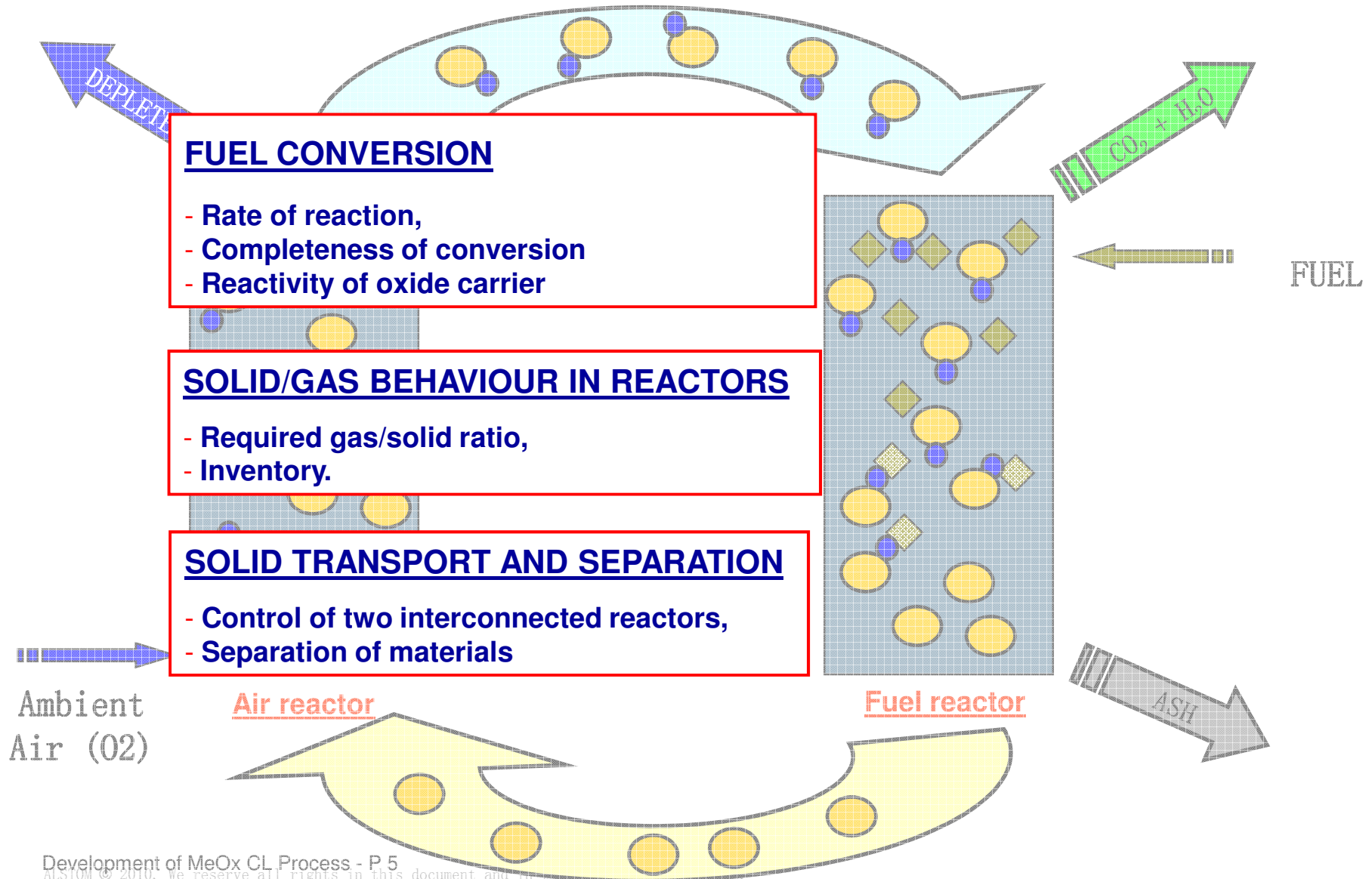
- CLC – principle
- Status of development
- ECLAIR Program
- Summary and Conclusion



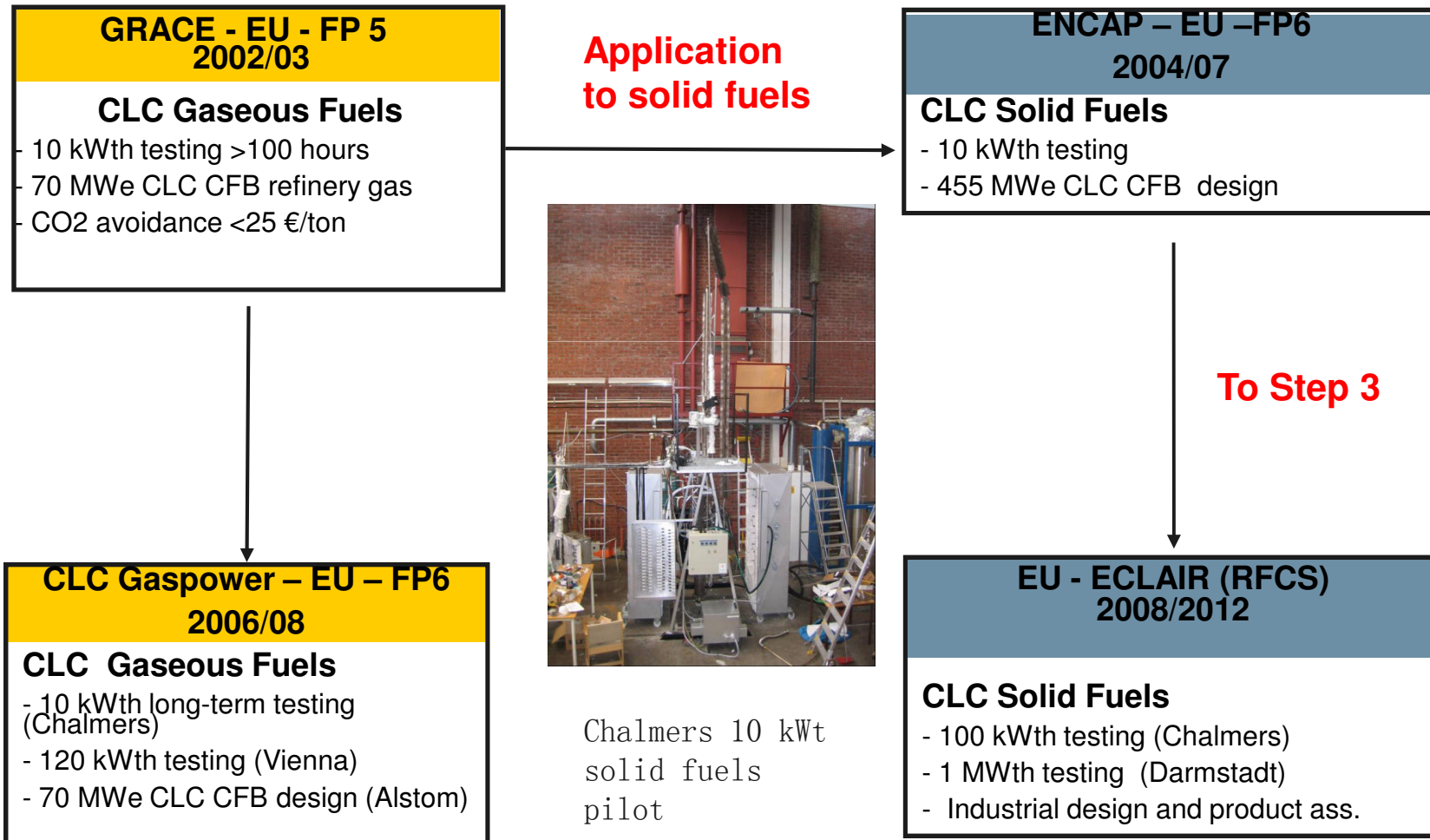
- In oxy PC/CFB units, the Air Separation Unit (ASU) is one of the main sources for efficiency losses,
- Chemical Looping Boilers avoid the ASU, provide the O₂ via solid oxygen carriers.

Potential breakthrough technology: Lowest evaluated CO₂ controlled power generation from solid fuels.

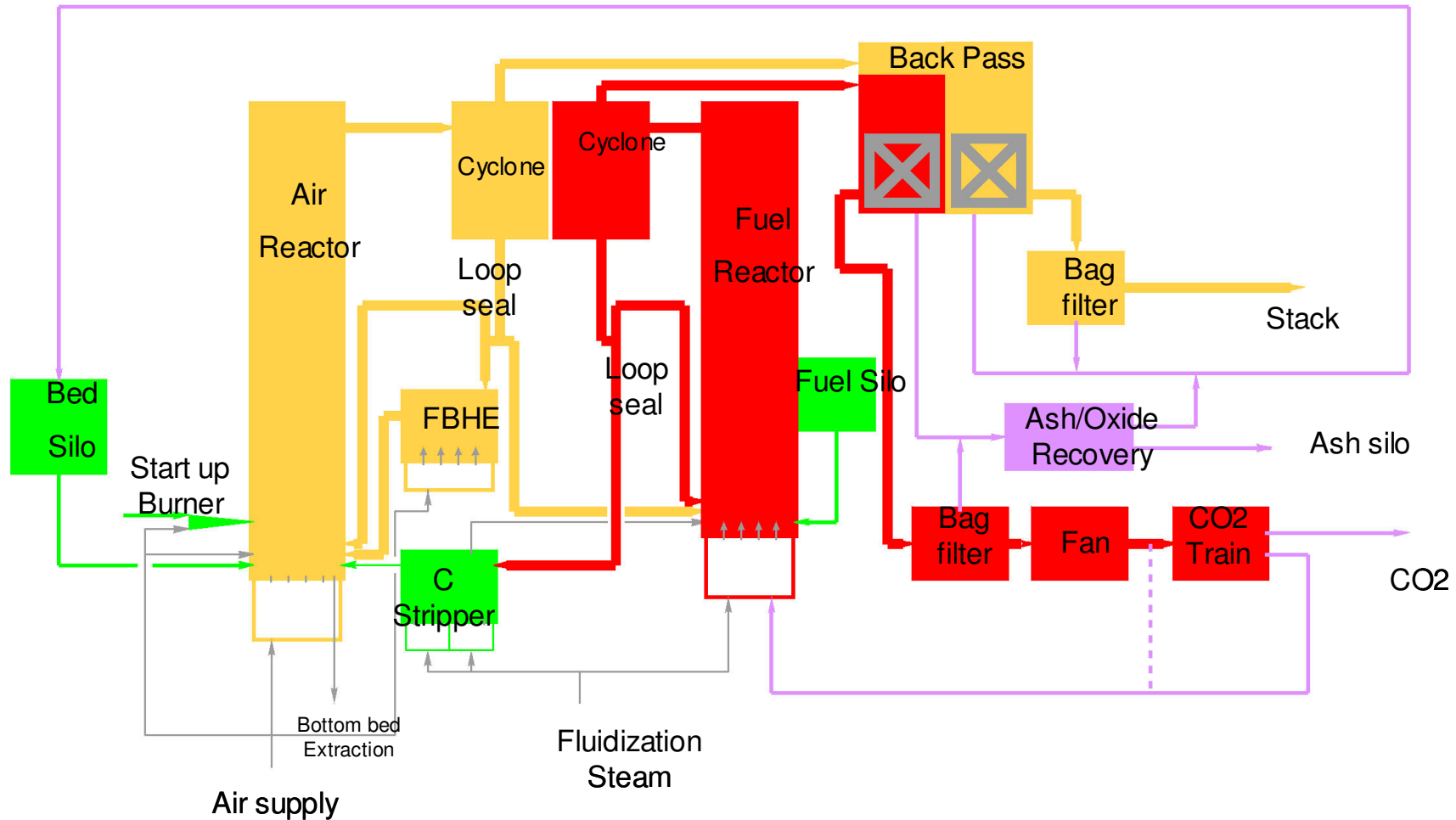




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ALSTOM design concept for a 455 MWe MeOx CLC Power Plant



Development of a new technology requires progressive scale up :

1. Feasibility : bench tests for elementary reactions validation
2. Pilot plant : 0.01-0.1 MWth – Full process loop
3. Prototype : 1-10 MWth - Full process loop for long term operation
4. Demonstration : 30-300 MWth – Pre-commercial unit before market deployment

⇒ Steps 1 and 2 have been realized for MeOx CL

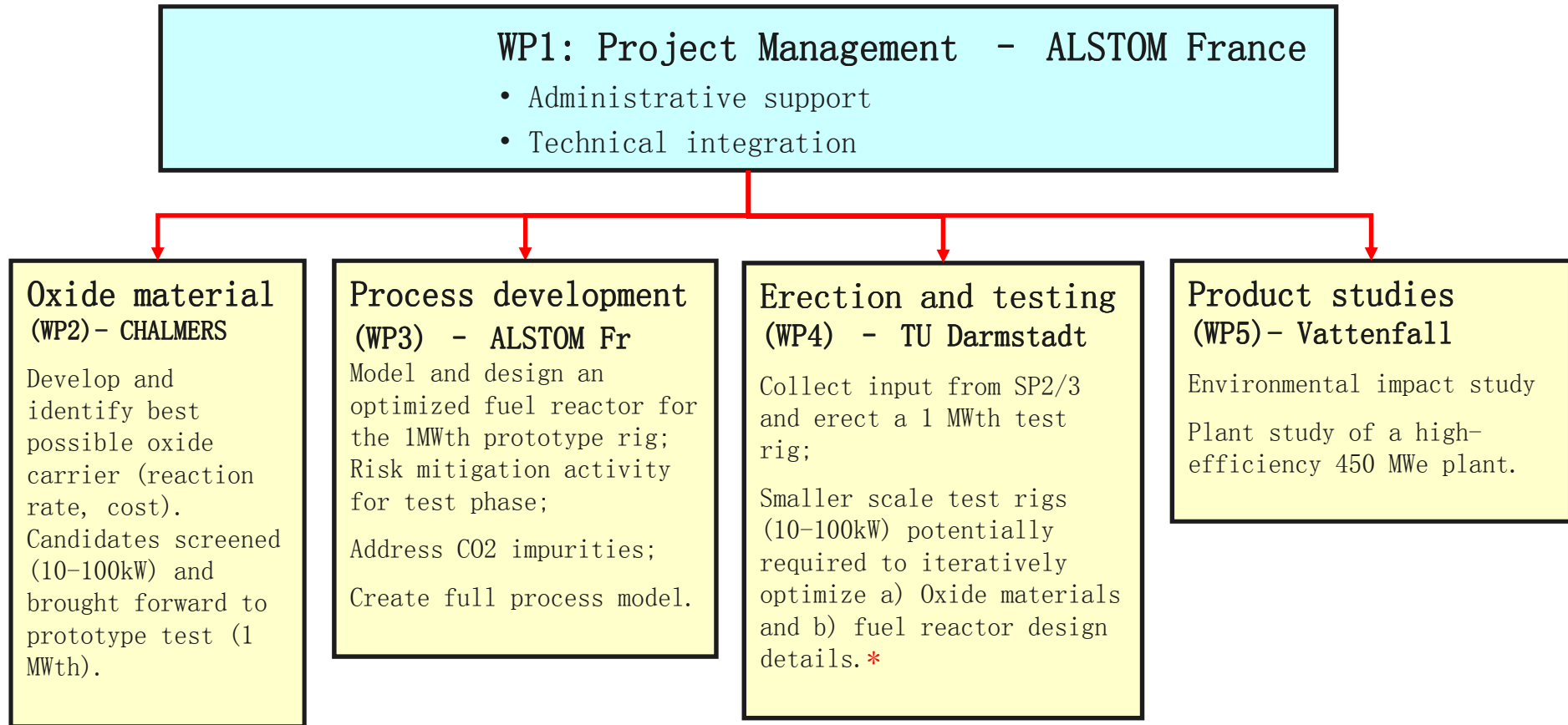
⇒ Step 3 in progress : Construction of a 1 MWt prototype with RFCS funding = ECLAIR Program

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Emission Free Chemical Looping Coal Combustion Process - ECLAIR

- ✓ RFCS – EU contract with TU Darmstadt, Chalmers Univ., CSIC, SINTEF, Air Liquide, Vattenfall.
- ✓ Total budget: 6.5 M€
- ✓ RFCS Funding : 2.27 M€
- ✓ Duration: 48 months
- ✓ Main tasks :
 - Design and operation of a 100 kWth pilot and 1 MWth prototype
 - Long-term CLC operation,
 - Assessment of technical, environmental and economical potential of CLC power plants



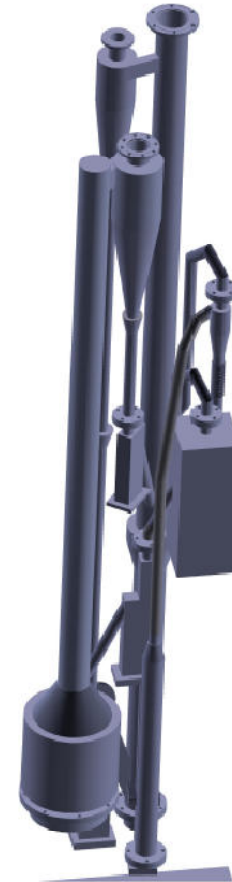


Main technical deliverable:

‘Prepare, design and operate a prototype test rig (1 MWth) that allows an evaluation of the economical and technical potential of CLC on solid fuels.’

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- Selection of oxygen carrier for 100 kW pilot and 1 MWt prototype
 - Comprehensive testing for alternative oxygen carriers
 - Preparation and lab testing of CLOU (Chemical Looping Uncoupled Oxygen) particles based on Copper Oxide
 - Operational tests to characterize oxygen carriers (reactivity, resistance to attrition)

- Design finalized - Reactors under fabrication
- Assembly on site to be started in March
- Commissioning : June/July 10
- Testing of different solid fuels and oxygen carriers with variation of operational parameters



- Dedicated building
- Design of main components finalized in July 09
- Reactors under erection
- Hot Commissioning scheduled in October 10
- First tests with coal scheduled in February 11



- Environmental aspects
 - Environmental impact of oxygen carrier
 - Environmental impact of CLC reactor emissions
 - Global environmental impact of CLC
- Scale up to 450 MWe size
 - Review of CLC Power Plant performance
 - Impact of high steam temperature (700/720 °C)
 - Identification of technical issues

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- CLC is a potential break-through technology in terms of efficiency and economy, which will be confirmed by pilot-scale data,
- ECLAIR program is validating MeOx Chemical Looping Combustion at 1 MWt prototype scale
- Next step before commercial unit will be a subsequent up-scale to 10-50 MWe

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