FLEXI BURN CFB – EU FP7 I 2009-2012

Development of High Efficiency CFB Technology to Provide Flexible Air/Oxy Operation for Power Plant with CCS

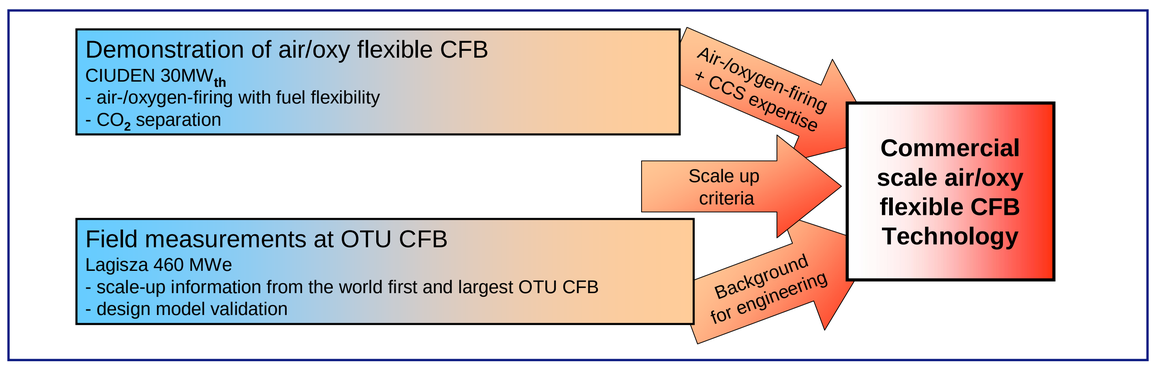
The project aims to develop and demonstrate a power plant concept that allows flexible high-efficiency air-firing of fossil fuels with biomass and oxygen-firing with carbon capture which provides the potential for an almost 100% reduction in CO_2. The use of the Circulating Fluidized Bed (CFB) technology will allow the utilization of indigenous coals and biomass with Carbon Capture and Storage (CCS) thus addressing the needs for climate change mitigation, security of supply and reduction of dependence on imported coals.

Objective

This project combines the CFB's intrinsic advantages (fuel flexibility and low emissions) with oxygen-firing for carbon capture and storage Carbon Capture and storage In oxygen-firing systems the fuel is burned in a mixture of pure O_2 and recirculated flue gas instead of air. The absence of air nitrogen produces a flue gas stream with a high concentration of CO_2, making it much easier to separate the CO_2. CFB technology appears to be ideally suited to oxygen-firing combustion. The overall result of this project will be a power plant design based on the air/oxy flexible CFB concept, ready for demonstration of high efficiency large utility-scale power plant with CCS burning a large variety of indigenous and imported coals from lignite to anthracite as well as co-firing biomass. Demonstration tests with different coals at a first-of-its-kind 30 MW_{th} air-oxygen-flexible CFB pilot facility and validation tests at the world's first and largest supercritical once through CFB (460 MWe Lagisza in Poland) are essential elements in the project to ensure the efficient, reliable and safe design of the commercial scale air/oxy flexible CFB power plant.

Novelty

The primary novelty of the proposed technology is in the full utilisation of all of the new CFB design and process advancements when merging a CFB boiler with a supercritical once through steam cycle and air separation unit together with CO_2 capture unit for CCS. This encourages utilities to take the new technology, which has the built-in capability for CCS, into use and to decommission old, inefficient and highly polluting capacity with lower efficiency and worse emission performance. In air-firing, the higher efficiency has a direct impact on CO_2 emissions due to the reduced consumption of fuel. In addition, by substituting 20% of the coal input with renewable fuels CO_2 emissions can further be reduced by 15-20%. Furthermore, the air/oxy flexible CFB concept is capable of CCS whenever the CO_2 storage is available. At a power plant with full CCS capability, the air/oxy flexible CFB concept serves as a risk mitigation tool that enables power generation during temporary outages of the CO_2 transport and storage facilities. Such features are expected to facilitate investment decisions for highly capital-intensive CCS power plant projects.



Development and demonstration on multiple scales - Principle of demonstration steps towards air/oxy flexible CFB concept.

CIUDEN CCS large scale test Platform which is close to Compostilla Power station.

MAIN ELEMENTS AND THE KEY OBJECTIVES OF THE PROJECT

R&D

Objective: To develop a high-efficiency FLEXI BURN design for a CFB boiler operating with sliding pressure once through steam cycle and air-/oxygen-firing modes by

a) carrying out RTD work to extend the existing elementary knowledge of air-firing to oxygen-firing in a circulating fluidized bed (CFB) boiler that is in a CO_2 - H_2O- rich atmosphere differing considerably from that of normal combustion with air

b) extending and validating design tools for a CFB boiler based on elementary knowledge and experimental data from pilot plants and the commercial-scale field measurements

Technology demonstration

Objective: To demonstrate flexible air- and oxygen-firing with CO_2 capture at a large pilot-scale CFB and verify the operation of a commercial-scale high-efficiency SC-OTU CFB in order to produce appropriate scale-up information by

a) demonstrating air/oxy flexible CFB operation on the 30 MW_{th} scale (air- and oxygen-firing) with different kinds of local fuels and CO_2 capture

b) test campaigns at the world's first and the largest high efficiency SC-OTU CFB of 460 MWe (air-firing)

Concept development

Objective: To develop the overall plant concept for the reliable, safe and economical carbon capture with advanced circulating fluidized bed combustion (CFB) technology that can operate under air- and oxygen-firing mode, enabling CO_2 separation and capture for geological storage by

a) integrating a air/oxy flexible CFB boiler with an air separation unit (ASU) and CO_2 processing unit (CPU) in order to create an optimized overall power plant concept

b) verifying the feasibility and readiness for the utilization of the technology within different regions of the EU

Overall Target

To create the readiness to start engineering of a commercial scale demonstration of an air / oxy flexible CFB power plant with CCS that is applicable to various local conditions within the EU by the end of the project.

THE AIR/OXY FLEXIBLE CFB CONCEPT HAS A SET OF IMPORTANT ADVANTAGES:

- Fuel flexibility in order to decrease dependency on imported coals and in order to improve power plant economics especially with CCS operation
- Operational flexibility in order to apply air-firing and oxygen-firing with CO_2 capture
- Lower NOx production due to reduced and more uniform furnace temperature profiles, and lower SOx concentration in flue gases due to in-furnace capture, thus reducing the need for downstream flue gas cleaning
- New methods to control power plant with air separation unit (ASU) and CO_2 capture
- Overall concept for phased transition into CCS technology with minimised risks through high efficiency air-oxy flexible CFB combustion
- Lower specific CO_2 emissions from the reduced consumption of fuel due to the intrinsic high efficiency of the technology. In addition, by substituting e.g. 20% of coal input with renewable fuels, CO_2 emissions can further be reduced by 15-20%.
- Provides utilities an attractive alternative to take into use the new technology and decommission old capacity with lower efficiency and poorer emission performance

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