

## BioCCS event summary

The 'Biomass Fuelled Power Generation with CO<sub>2</sub> capture' was the theme for the Spring meeting held on the 24<sup>th</sup> May 2013, organised by the British Section of the Combustion Institute and the Institute of Physics. This event was co-hosted at Møller Centre by the Computational Modelling Group at the University of Cambridge and cmcl innovations. It focused on the scientific development and techno-economic issues related to realisation of biomass (both co-fired and dedicated) based power generation through combustion, gasification and pyrolysis, with or without the various pre-, post-and oxy-combustion CO<sub>2</sub> technologies.

Following the attendee registration at 09:30 a.m., the formal 'Welcome and Introduction' was made by Prof. Markus Kraft from Cambridge University. As the conference chair, he introduced the speakers and presented an overview of the Bioenergy and CCS activities at Cambridge University.

The introduction was followed by Greg Kelsall's (Alstom) presentation on 'Bio-CCS: The way forward for Europe?'. He presented the carbon-negative potential of Bio-CCS and some of the key conclusions and recommendations from the joint report on BioCCS from the European Biofuels Technology Platform and Zero Emissions Platform. In particular, the need to incentivise 'carbon-negative' technologies and to establish dedicated funding routes for Bio-CCS technology R&D and pilot projects was highlighted. Then, Dr Amit Bhave from cmcl innovations presented the 'Techno-Economics of Biomass based Power Generation with CO<sub>2</sub> Capture (TESBiC)' covering technical parameters (efficiency penalties, regulated emissions, etc.) and economic ones (capital and operating costs, cost of CO<sub>2</sub> avoided, levelised cost of electricity, etc) for a wide range of cofired and dedicated biomass CCS technology combinations. Continuing with the first sessions's techno-economic focus, the third talk by Dr Jeremy Tomkinson from NNFFCC outlined the 'Bioenergy Market and Policies' which included the review of the UK Renewable Energy Strategy and the UK Bioenergy Strategy. Various biomass feedstock options, their timelines and some of the emerging technologies, e.g. waste-to-fuel and synthesis gas based fermentation were also presented and discussed.

The focus was then turned to two industrial power generators which use sustainable biomass feedstocks at their power plants. The first, from Dr Nigel Burdett, Drax highlighted the differences in handling, storage and processing of biomass feedstocks and coal. The importance of a sustainable biomass supply chain, the Drax biomass procurement programme and the most recent results regarding the transformation of cofiring to full biomass based power generation plant were highlighted. Dr Burdett considered sustainability as a major pre-requisite for the growth of biomass for energy production. The presentation was followed by an update on the commissioning and operation of the 50 MW<sub>e</sub> capacity Markinch Biomass CHP plant, presented by Tomas Jumar from RWE npower renewables. In that, the main aspects with regard to the handling of biomass feedstocks (comprising virgin wood, saw mill waste and recycled wood), construction/design of a circulating fluidised bed boiler and the overall project progress were presented.

After lunch, Prof. Jenny Jones from Leeds University presented the technical aspects of 'biomass torrefaction', in particular the process yields, chemistry of torrefaction, grindability, hydrophobicity and combustion characteristics. Torrefaction of biomass was emphasized as a cost-effective option for producing commodity biomass from a wide range of feedstocks, however lack of operational data at pilot and demonstration stage was also pointed out. Dr Ausilio Bauen from E4tech followed with a presentation on 'biomass supply chain issues from power generation perspective'. He emphasized how UK feedstock could play a significant role in the future UK energy system and be competitive with imported biomass. The underlying challenges associated with biomass supply chain, for example, availability and security of supply, cost and stability, logistics, location, and quality along with corresponding examples were also presented. After the presentations addressing the biomass CCS techno-economics, power plant updates and the biomass supply chain; the 'pyrolysis of biomasses and related solids' was the topic for Prof. Allan Hayhurst's (Cambridge University) presentation. He spoke about the role of thermo gravimetric analysis in investigating biomass pyrolysis from the viewpoint of fundamental chemical reaction engineering and heat transfer. This talk was followed by Dr Paul Fennell from Imperial College, who presented the results of his group's recent work on pyrolysis and hydrolysis of biomass in a pressurised spouted bed reactor. In particular the design details of the fluidised bed reactor for steam hydrogasification of coal and biomass

application were highlighted, along with the important safety controls (e.g. pressure relief valves, toxic gas detectors, flash back arrestors, emergence shut-down, etc.) that were established for the upgraded pressurised set-up. The penultimate presentation, by Prof. John Dennis from Cambridge University focused on 'gasification aspects during chemical looping combustion (a basis for understanding emissions)'. In particular the influence of the oxygen carrier used in the chemical looping (oxyfuel combustion CO<sub>2</sub> capture process) process on improving the rate of oxidation of volatile matter was highlighted. Also, the oxygen carrier was shown to not have a significant impact in increasing the rate of gasification of unreactive char from woody biomass. The final presentation of the event was delivered by Michael Priestnall from Cambridge Carbon Capture Ltd. who spoke on the potential of mineral carbonation as a stand-alone option for biomass CCS.

Overall, the presentations were attended by a diverse audience from the industry, academic community, SMEs and the government. The one-day event was able to strike a good balance between the commercial aspects such as techno-economic parameters, bioenergy market, biomass fuelled power plant operation, sustainable biomass supply chain and the more scientific and fundamental aspects related to biomass pre-processing, pyrolysis, combustion, gasification and hydrogasification of biomass. Following the presentations, the event culminated with the Conference dinner organised to celebrate Prof. Allan Hayhurst's 75<sup>th</sup> birthday. The dinner event was attended by not only the Combustion Institute members and the conference attendees, but also by Prof. Hayhurst's past PhD students.