



# **An Introduction to the Biomass and Fossil Fuel Research Alliance (BF2RA) and Overview of Project Portfolio**

**Greg Kelsall, BF2RA Chairman**

**Coal Research Forum:  
Presentation of a selection of projects  
funded through the BF2RA Research  
Programme**

**University of Nottingham, 15 October 2013**

## BF2RA – What is it?

- BF2RA was formed in late 2009. It is a not for profit company that is limited by guarantee
- Membership is open to both the private and public sector
- Members currently include those from the electricity supply industry, equipment manufacture, fuel user and research sectors
- The objectives of BF2RA are to promote research into issues related to biomass and fossil fuels
- BF2RA also organises the annual Coal Science Lecture



**Comprises 7 “world class” energy, equipment supplier  
and coal utilisation companies**

**ALSTOM**

 **BRITISH SUGAR**

**DOOSAN**

*Drax* \*\*

**EPRI** | ELECTRIC POWER  
RESEARCH INSTITUTE

  
**edf**  
ENERGY

**e-on**

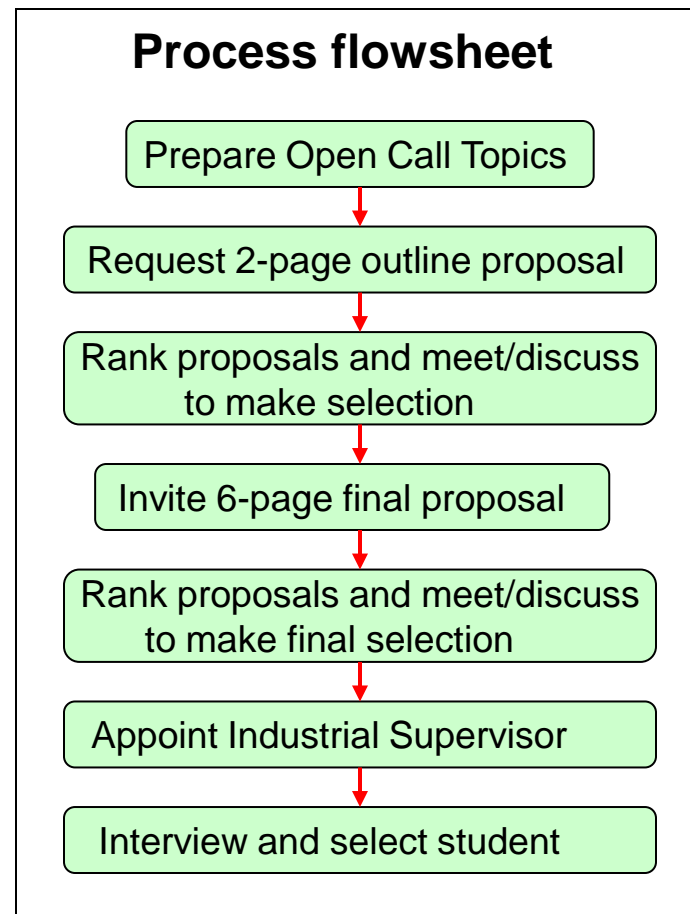
\*\* Drax confirmed as a new member for 2014

## **BF2RA Membership Levels**

- The annual membership subscription for 2014 is as shown below. This subscription may be varied in subsequent years subject to the agreement of the Membership of BF2RA
  - Tier 1 (Fuel / major equipment suppliers/ power generators) £25,000
  - Tier 2 (Users, consultants) £12,500
  - Tier 3 (R&D/ government organisations) £18,000

## BF2RA Funding Model/Open Call Process

- Typically up to £40k per successful project with balance funding coming from academic institution, other third party and/or UK Research Council
- Typically fund 3-4 year PhD projects but can be shorter duration RA projects in well justified cases



**Total time for process~ 9 months**

## Priority Research Themes

Priority research themes for the 2012 Open Call for Proposals were as follows :-

- Utilisation of fossil fuel and biomass
- Materials development
- Advanced cycles for fossil fuel/biomass utilisation and issues relating to performance
- Control of emissions and products arising from fossil fuel and biomass utilisation

Updating these ready for new 2014 Call for Proposals. 4-5 new projects expected to be awarded for Oct 2014 start

- Topic for Session 3 Panel discussion this afternoon

## **BF2RA's project portfolio**

Eleven research projects are currently underway:-

- Dynamic modelling and simulation of supercritical coal-fired power plant with CO<sub>2</sub> capture ability - University of Hull
- Intelligent flame detection incorporating burner condition monitoring and on-line fuel tracking – University of Kent
- Impact of biomass torrefaction on combustion behaviour in co-firing – University of Nottingham
- Avoiding sintering of coal-fired shallow fluidised beds – University of Nottingham
- Milling and conveyance of biomass – University of Nottingham
- A new classification system for biomass and waste materials – University of Nottingham
- Modelling of power plant alloys – University of Nottingham
- Development of a novel feeding system for use with high pressure combustion and gasification systems – University of Sheffield
- Low Temperature Ignition of Biomass – University of Leeds
- Novel Coatings for Biomass Firing – University of Cranfield
- Coated Ferritic Alloys – University of Nottingham



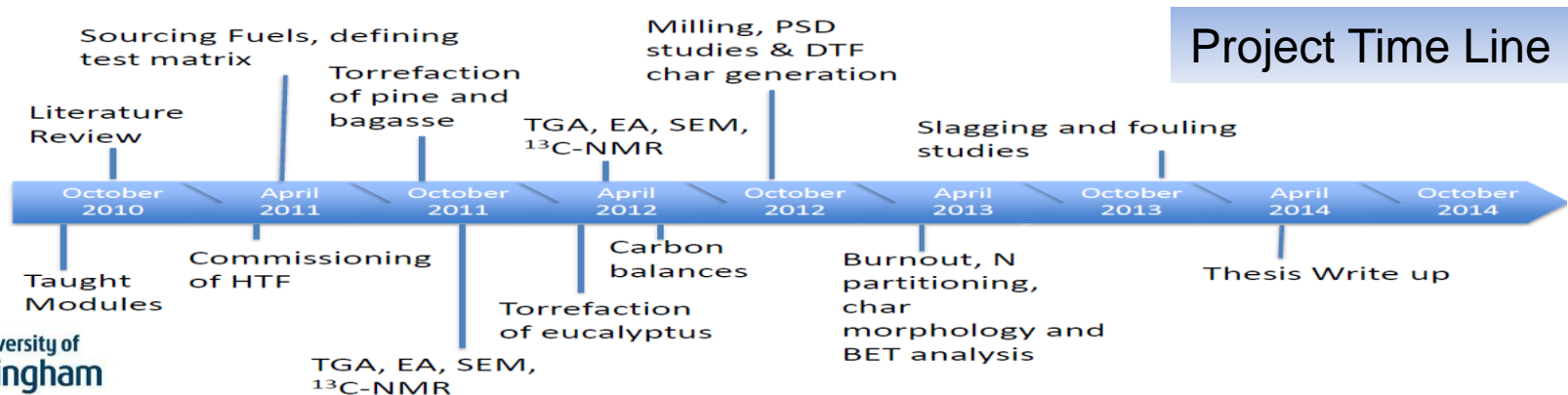
## Impact of Biomass Torrefaction on Combustion Properties in Co-firing

**Researcher:** Umair Hussain (main supervisor - Prof Colin Snape)

**Aim :** Investigate key fundamental issues associated with the development of torrefaction technology to help promote the more widespread use in the UK

### Scope:

- Source fuels/ generation of torrefied samples
- Proximate/ultimate analysis using TGA and EA
- Determination of calorific value
- Scanning Electron Microscopy (SEM) to study visual changes



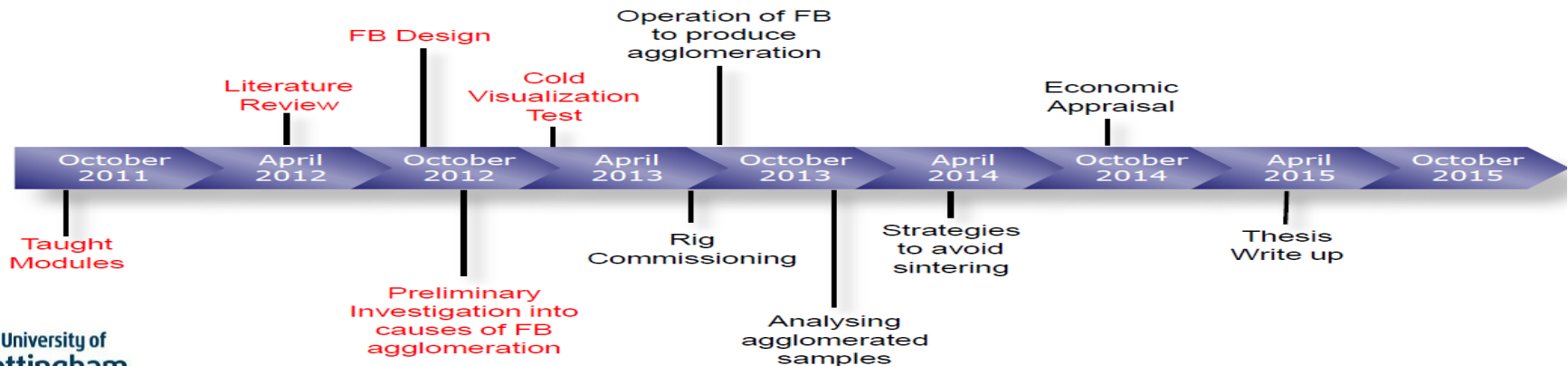
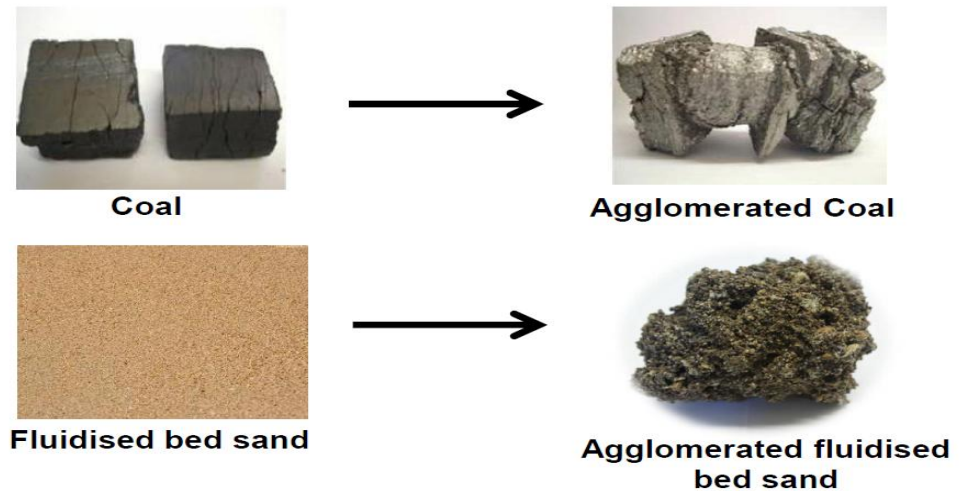


## Avoiding the sintering of coal-fired shallow fluidised beds

**Researcher:** Daniel Afilaka ( main supervisor - Dr Hao Liu)

### Aim :

Investigate the causes of fluidised bed sintering in biomass co-fire and define safe operating modes to avoid sintering

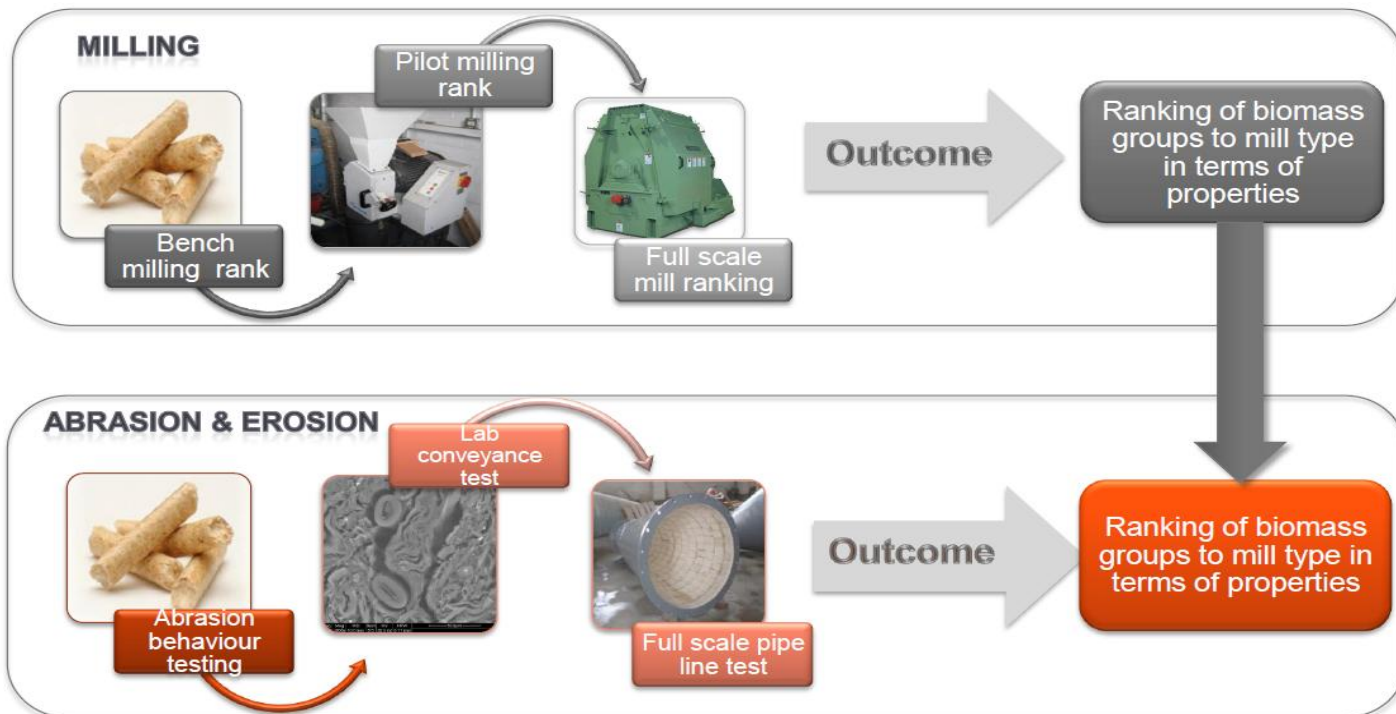


## Utilisation of Fossil Fuels and Biomass – Fuel Preparation & Transportation

**Researcher:** Orla Williams ( main supervisor - Dr Carol Eastwick)

### **Aim :**

To rank and classify grinding, erosion and abrasion behaviour of biomass types to different mills.



## Development of Novel Feeder for Pressurised Systems

**Researcher:** James Craven

**Aim :** develop a novel/ reliable feeder to continuously feed solid fuel into high pressure environments to enhance the commercial viability of high pressure gasifiers/ combustors

### ***Modified Lock-Hopper System as design basis:***

- Uses water as an incompressible fluid
- No use of inert gas for pressurising
- No syngas dilution with inert gas
- Mode 1: No net change in operating pressure- theoretical energy saving compared to a conventional lock hopper of 89% at 50 bar
- Mode 2: No waste of product syngas- theoretical energy saving compared to a conventional lock hopper of 81% at 50 bar



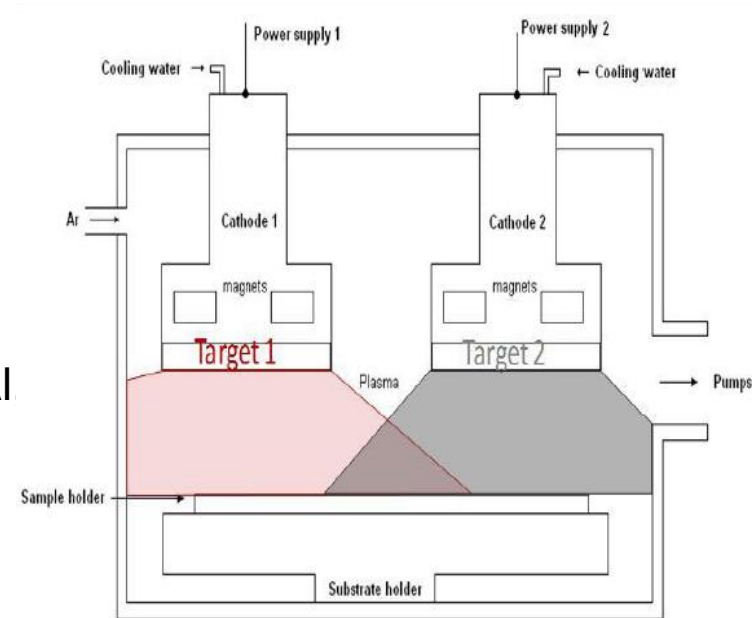
Lock Hopper Test Rig

## Development of Novel Coatings to Resist Fireside Corrosion in Biomass-Fired Power Plants

**Researcher:** Dominika Orlicka ( main supervisor - Dr Nigel Simms)

### **Aim :**

- To develop the best coating composition resistant to fireside corrosion in biomass-fired power plants using a multi-target magnetron sputtering system
- To expose the best coating composition in a specially constructed furnace to simulate the chloride-induced corrosion conditions
- To understand the influence of elements: Co, Cr, Al Ni, Fe on the coatings properties and their role in chloride-based corrosion
- To deposit the best coating composition onto the heat exchanger tubes to identify their thermal stability and confirm the corrosion resistance
- To evaluate the alternative methods of applying the best coating compositions to boiler tubes



**Magnetron Sputtering System**

## Integrity of Coated Ferritic Alloys under High Temperature Creep and Fatigue

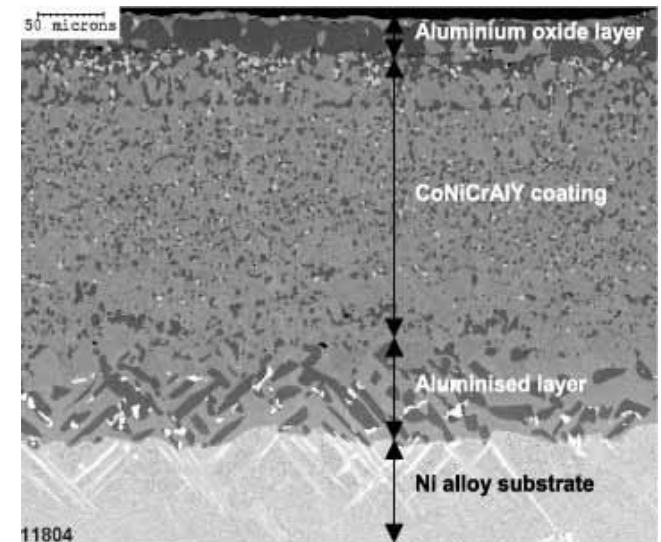
**Researcher:** Thomas Hoey (main supervisor - Dr Wei Sun)

### **Aim :**

Investigate the mechanical and chemical integrity of coated samples subjected to high temperature exposure and steady / cyclic mechanical loadings

### Specific Objectives:

- Gain a better understanding of presently developed coatings and the associated key failure mechanisms
- Rank the potential coatings based on testing results
- Provision of generic understanding of factors limiting coating service life



Typical MCrAlY coating

## **BF2RA's project portfolio- new projects**

Three research projects selected for 2013 starts:-

13. Biomass Exacerbated Cyclic Oxidation of Steels in Steam (BECOSS)- University of Birmingham
14. Biomass cofiring with low volatile matter coals– University of Nottingham
15. Modelling milling of biomass – University of Nottingham

## BF2RA website

### Members' Area – contents list

#### Published Documents

- BF2RA Project Meetings Schedule
- Grant Summary Information
- Minutes of BF2RA Members' Meetings
- BF2RA Progress Review (Technical Officer's Report to BF2RA Members)
- **Project Documentation**
- Call and Proposals Information
- Efficient Fossil Energy Technologies (EFET) EngD Centre

## BF2RA website – example of detailed content

[www.bf2ra.org/members/membersarea/projectdocumentation/..](http://www.bf2ra.org/members/membersarea/projectdocumentation/)

Grant 04 - Nottingham University - Avoiding Sintering of Coal-fired Shallow Fluidised Beds

[Grant 04 EngD Annual Report August 2013](#)

[Grant 04 Meeting Minutes July 2013](#)

[Grant 04 Presentation July 2013](#)

[Grant 04 3rd Progress Report June 2013](#)

[Grant 04 Meeting Minutes January 2013](#)

[Grant 04 Presentation January 2013](#)

[Grant 04 2nd Progress Report December 2012](#)

[Grant 04 1st Progress Report June 2012](#)

[Grant 04 Progress Meeting Minutes June 2012](#)

[Grant 04 Presentation June 2012](#)

[Grant 04 kick-off meeting 8 Nov 2011](#)

[Grant 04 EngD Project Plan Nov 2011](#)

[Grant 04 Daniel Afilaka Presentation 8 Nov 2011](#)

[Grant 04 Project Proposal](#)

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### Engineering Doctorate Progress Report 3

Avoiding Sintering in a Coal Fired Shallow Fluidised Bed

**Afilaka Daniel**

<b>Main Academic Supervisor:</b> Dr. Hao LIU Associate Professor & Reader in Clean Fossil Fuels and Biomass Technologies Department of Architecture and Built Environment Faculty of Engineering University of Nottingham NG7 2RD Tel: +44 (0) 115 840 7674 Email: <a href="mailto:Liu.Hao@nottingham.ac.uk">Liu.Hao@nottingham.ac.uk</a>	<b>Co Academic Supervisor:</b> Dr. Carol EASTWICK Associate Professor Mechanical Engineering Department of Mechanical, Materials and Manufacturing Engineering Faculty of Engineering University of Nottingham NG7 2RD Tel: +44 (0) 115 951 3788 Email: <a href="mailto:Carol.Eastwick@nottingham.ac.uk">Carol.Eastwick@nottingham.ac.uk</a>
<b>Industrial Supervisor:</b> Mr Nick SMALLEY Combustion Area Manager Associated British Sugar Plc. Newark Factory Maakham Road Newark NG24 1DL Tel: +44 (0) 7590485237 Email: <a href="mailto:Nick.Smalley@britsugar.com">Nick.Smalley@britsugar.com</a>	<b>EngD Student:</b> Mr Daniel AFILAKA Research Engineer Efficient Fossil Energy Technology EngD Centre University of Nottingham (Jubilee Campus) Energy Technologies Building NG7 2TU Tel: +44 (0) 7976467204 Email: <a href="mailto:enw042@nottingham.ac.uk">enw042@nottingham.ac.uk</a>

This report will outline the work done relating to the EngD project "Avoiding sintering in a coal fired shallow fluidised bed" during the third six-month period (January 2013 – June 2013). This will include details of the research work that has been undertaken. Also included will be details of academic study and other tasks that have been completed.

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## Avoiding the sintering of coal-fired shallow fluidised bed:

### Third Project Review Meeting

Daniel Afilaka, EngD Research Engineer  
Efficient Fossil Energy Technologies Centre,  
University of Nottingham

Date: 19<sup>th</sup> of July, 2013

Main Academic Supervisor: Dr Hao Liu (University of Nottingham)  
Co - Academic Supervisor: Dr Carol Eastwick (University of Nottingham)  
Industrial Supervisor: Nick Smalley (British Sugar)



## **BF2RA Value to Members**

- World class research with good funding leverage
  - 2.5m€ equivalent programme (at full economic cost) in 2013 increasing to 3m€ in 2014
- Full access to 6 monthly progress reports and final reports via 'member only' area of BF2RA web-site
- Full access to attend any project progress meeting
- Provide Industrial Supervisor for project of particular interest
- Shape the scope of the open call and detail of invited projects
- Member of the BF2RA 'Club'
  - Better understanding of supplier/customer research interests
  - Collective view often better than the individual company view
- Select speaker for annual Coal Science Lecture (London)
  - Primarily funded with BCURA grant + sponsorships



**For further information about BF2RA please:-**

- visit: - [www.bf2ra.org](http://www.bf2ra.org)

or

- email: - [technical@bf2ra.org](mailto:technical@bf2ra.org)

Thank you

