



## Winter School 2017

Co-organised by the 'EPSRC  
Centre for Doctoral Training in  
CCS and Cleaner Fossil Energy' &  
the 'UK CCS Research Centre'

13<sup>th</sup> to 16<sup>th</sup> February 2017

## Winter School 2017

Co-organised by the 'EPSRC Centre for Doctoral Training in  
CCS and Cleaner Fossil Energy' & the  
'UK CCS Research Centre'

Held at the Energy Technologies Building, Room B27,  
Jubilee Campus,  
University of Nottingham

13<sup>th</sup> to 16<sup>th</sup> February 2017

### Aim of the Winter School

The 2017 Winter School will involve researchers from the EPSRC Centre for Doctoral Training in CCS and Cleaner Fossil Energy ([www.ccscfe-cdt.ac.uk](http://www.ccscfe-cdt.ac.uk)) and the UK CCS Research Centre ([www.ukccsrc.ac.uk](http://www.ukccsrc.ac.uk)).

The aim of the Winter School is to aid the development of interdisciplinary knowledge and capacity to apply research in conventional power, fossil energy and carbon capture and storage (CCS) technologies to solve problems in a range of global settings. The Winter School also enables researchers to develop an understanding of technical and social issues surrounding energy, the environment, climate change, development and socioeconomics in the UK.

Researchers will build on their knowledge and understanding provided throughout their research training to demonstrate critical thinking and multidisciplinary engagement aimed at finding novel solutions to real world problems in conventional power, fossil energy and carbon capture.



## Learning Outcomes

On completion of the Winter School, students should be able to:

*a) Knowledge and Understanding:* assess the challenges of advancing fossil energy and CCS research in a range of global contexts; the need for cross-disciplinary understanding and stakeholder engagement when designing research solutions; the importance of cultural, economic, social, political and environmental awareness in enabling effective solutions to research problems.

*b) Intellectual Skills:* engage with a global and multidisciplinary literature; display advanced communication skills which span national and international contexts; develop reasoned arguments which take into account social, environmental and policy frameworks.

*c) Professional Practical Skills:* better present complex arguments and research findings in oral form to a non-specialist audience; collate data and ideas to develop and formulate research plans; network with engineers, social and environmental scientists to seek new solutions to national and global issues.

*d) Transferable Skills:* better define and deliver solutions to real world problems; interact effectively with the public, stakeholders, specialists and non-specialists; succinctly and clearly present complex ideas in oral form.



## Attendees

### Staff

- Prof Colin Snape University of Nottingham
- Dr Anup Patel University of Nottingham
- Ms Diane Vincent University of Nottingham
- Dr Fay Campbell UK CCS Research Centre
- Mr Philip Sharman Evenlode Associates
- Dr Rosemary Whitbread Health & Safety Laboratory
- Dr Allan Jones University of Nottingham

### Keynote Speakers

- Mr John Gale IEAGHG
- Mr Theo Mitchell Carbon Capture and Storage Association
- Dr Robin Irons Uniper
- Ms Ceri Vincent British Geological Survey
- Mr Tony Alderson WSP | Parsons Brinckerhoff
- Mr Jeremy Carey 42 Technology
- Dr Richard Millar University of Oxford

### Students Centre for Doctoral Training in CCS and Cleaner Fossil Energy

- Sarah Angel-Smith University of Nottingham
- Joey Walker Loughborough University
- Robert Stirling University of Nottingham
- David Nichols University of Nottingham
- Lawrence Coghlan Loughborough University
- Haesul Fagcang Loughborough University
- Genevieve Hodgins University of Nottingham
- Oluwaseun Olowojebutu Loughborough University
- Christopher Wiseall University of Nottingham
- Jamie Pulsford University of Nottingham
- Robert Byrne Loughborough University
- Tejas Ashar University of Sheffield
- Thomas Werner University of Nottingham
- Thomas Yelland University of Sheffield
- Lewis Tuck University of Nottingham
- Sophie Goodwin University of Nottingham
- Jonathon Morris University of Nottingham
- Matteo Spanu University of Nottingham
- Lola Vazquez Peraita University of Nottingham
- Richard Seely University of Nottingham
- Rebeca Azpiri University of Birmingham
- Carla Martín Clavé University of Nottingham



**Students UK CCS Research Centre**

- Shreenath Krishnamurthy
- Kelachi Omehia
- Lulwa Almahmeed
- Abdul Aziz Aliyu
- Kazeem Olawale Rabi
- Rachel Wignall
- Suoton Philip Peletiri
- Peng Xie
- Abitha Balashanmugam
- Muhammad Imran Masood
- Hisham Al Baroudi

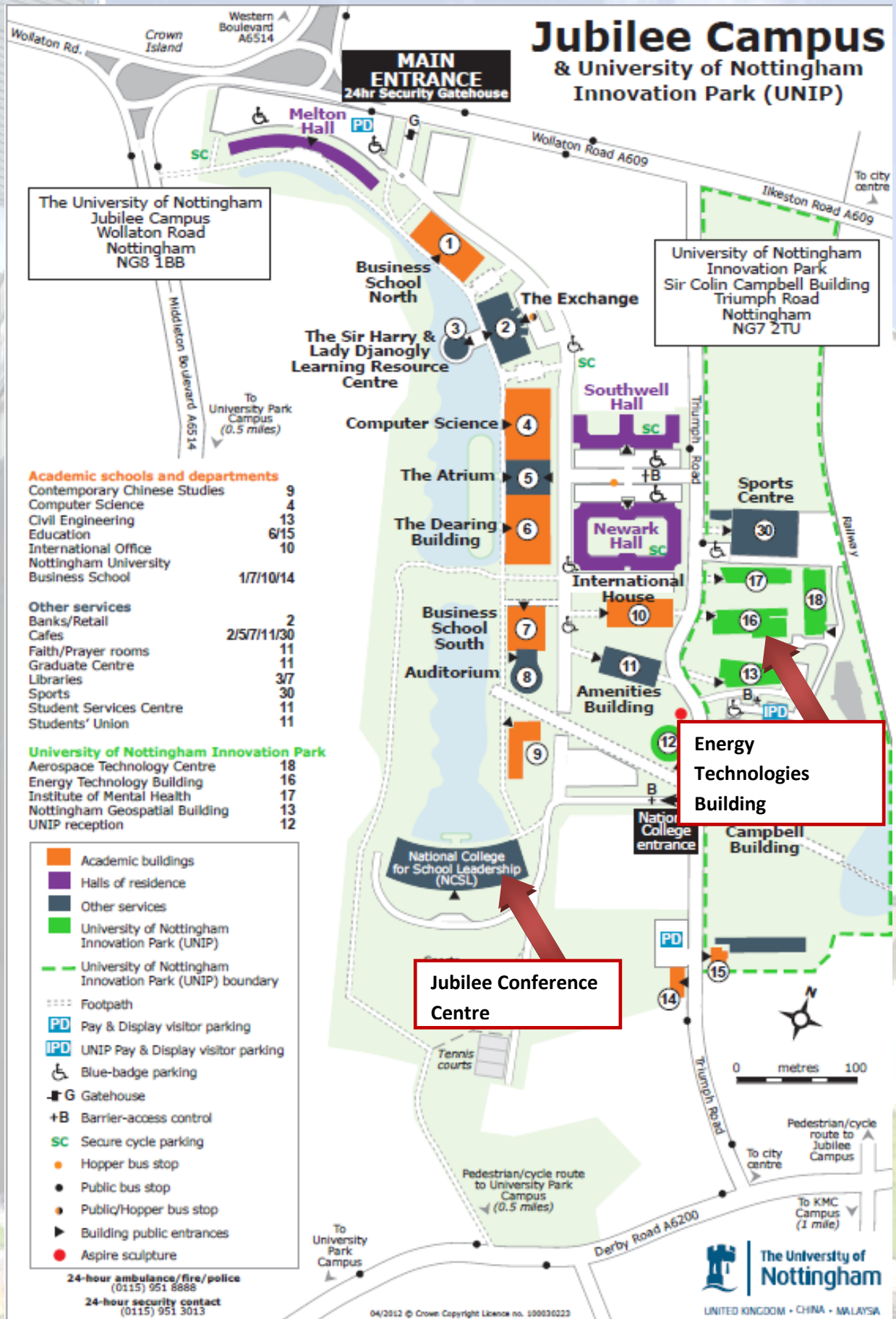
University of Edinburgh  
University of Sheffield  
University of Sheffield  
University of Sheffield  
Loughborough University  
University of Edinburgh  
University of Bradford  
University of Sheffield  
University of Sheffield  
Heriot Watt University  
Cranfield University

**Guests UK CCS Research Centre**

- Lauren Selby
- Lydia Rycroft

British Geological Survey  
IEAGHG

# Map of Venue





## Key Contacts

Prof Colin Snape  
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Ms Diane Vincent  
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Dr Fay Campbell  
[fay@ukccsrc.ac.uk](mailto:fay@ukccsrc.ac.uk)

Dr Hannah Chalmers  
[Hannah.Chalmers@ed.ac.uk](mailto:Hannah.Chalmers@ed.ac.uk)

## Outline Programme

### Monday 13th February

- 12:00-13:00      Arrival of delegates  
Registration and check-in to rooms
- 13:00              Lunch in Room B27, Energy Technologies Building and display  
posters
- 14:00              Welcome introduction
- 14:15              Dr Richard Millar – University of Oxford  
*'Update on the Trillionth Tonne of Carbon'*
- 15:00              Mr Theo Mitchell – Carbon Capture and Storage Association  
*'Current status of CCS in the UK'*
- 15:45              Break and poster session
- 16:45              Dr Robin Irons – Uniper  
*'Conventional power generation in the UK and Europe and the  
Rotterdam 'ROAD' CCS Project'*
- 17:30              Mr Tony Alderson - UK CCS Research Centre  
*'Decarbonising Heavy Industry'*
- 18:15              Break
- 19:00-20:00      Dinner at Petit Paris  
<https://petitparisrestaurant.squarespace.com/>



## Tuesday 14th February

- 09:15 Ms Ceri Vincent – British Geological Survey  
*'CO<sub>2</sub> storage and the Geoenergy Test Bed'*
- 10:00 Mr Jeremy Carey – 42 Technology  
*'CCS economics & financing'*
- 10:45 Break
- 11:15 Mr John Gale – International Energy Agency Greenhouse Gas  
*'CCS now and the challenge ahead post COP21'*
- 12:00 Lunch at Jubilee Conference Centre
- 13:00-13:45 Individual student talks on research  
15 minutes for each presentation and questions

Time	Name	Presentation Title
13:00	Christopher Wiseall	<i>Water Solubility in Carbon Dioxide rich gas mixtures</i>
13:15	Kazeem Olawale Rabiun	<i>Geoelectrical characterisation of geological carbon sequestration</i>
13:30	Oluwaseun Olowojebutu	<i>Modelling of SCR-in-DPF Systems</i>

- 13:45 Break
- 14:00-15:00 Individual student talks on research  
15 minutes for each presentation and questions

Time	Name	Presentation Title
14:00	Genevieve Hodgins	<i>NMR studies of polymer mobility</i>
14:15	Jamie Pulsford	<i>HVOF thermal spray coatings for internal surfaces to replace electroplated hard chrome</i>
14:30	Shreenath Krishnamurthy	<i>Multi-scale engineering toolbox for systematic assessment of porous materials in the context of adsorption and membrane separations</i>
14:45	Haesul Fagcang	<i>Emulation of Twin-Turbo Performance with an Electrified Turbocharger at Altitude Conditions, Using Component-in-the-Loop</i>

- 15:00 Break and poster session

16:00-18:30 Introduction to task for group activity and initial group meetings  
Group work

19:00-21:00 Dinner at Jubilee Conference Centre

### **Wednesday 15th February**

09:00-11:00 Group work

11:00 Break

11:15 Group work

12:00 Lunch in Room B27, Energy Technologies Building

13:00-18:00 Field trip to GE in Rugby

19:00-21:00 Dinner at Jubilee Conference Centre

### **Thursday 16th February**

09:00-11:15 Group presentations

11:15 Break

11:30-12:00 Prize giving (best student talk, best poster) and closing remarks

12:15 Lunch in Room B27, Energy Technologies Building



## Winter School Keynote Speakers

**Mr John Gale**  
**IEAGHG**  
***John.Gale@ieaghg.org***

John Gale has been associated with the energy industry for some 40 years. He has a degree in Pure and Applied Chemistry. He spent 18 years with The British Coal Corporation undertaking work on advanced coal fired power generation options. He then spent 7 years working as an environmental consultant with IMC Group Ltd. He joined the IEA Greenhouse Gas R&D Programme (IEAGHG) in 1999 and managed the Programme's activities on Non-CO<sub>2</sub> greenhouse gases, greenhouse gas abatement in energy intensive industries and geological storage of CO<sub>2</sub> before becoming General Manager in 2008. He also works directly to the Chair of the Executive committee and vice chairs on issues relating to strategic planning, etc., He represents IEAGHG on various IEA committees as required, such as the IEA Working Party on Fossil Fuels and coordinates IEAGHG's input to IEA publications like World Energy Outlook and Energy Technology Perspectives.



**Dr Richard Millar**  
**University of Oxford**  
***richard.millar@physics.ox.ac.uk***

Richard is a climate physicist by training and is interested in how the insights from the latest climate science can be successfully embedded in effective climate policy. His research spans the physical and economic consequences of climate policy and aims to investigate robust pathways to achieving global climate goals of net-zero emissions.



**Mr Jeremy Carey**  
**42 Technology**  
*Jeremy.Carey@42technology.com*

Jeremy has 15 years of technology development and acceleration experience, including a period of 6 years in the power industry where he was the capture lead on the >£1bn Peterhead carbon capture and storage project. Initially a process engineer and then an advanced control engineer in the Oil and Gas Industry, Jeremy later spent 3 years at a small angel funded medical imaging device company where he developed the company's first commercially viable, FDA approved device that was also used by the pharmaceutical industry for wound angiogenesis studies. Jeremy holds a Chemical Engineering degree from Cambridge, a Diploma in Manufacturing and Computing from the Open University and an MBA from Cranfield. He now leads 42 Technology's energy campaign.



**Dr Robin Irons**  
**Uniper**  
*Robin.Irons@uniper.energy*

Robin Irons has worked on emission reduction from power plants for 28 years for the CEGB, PowerGen and E.ON. He has a BSc (Eng) and PhD, both in chemical engineering from Imperial College London. He is the company sponsor for E.ON's R&D work on CCS and also leads a team taking forward a wide range of other low-carbon technologies such as wind, solar PV and energy storage. He is a special professor of Chemical and Environmental Engineering at the University of Nottingham.



**Mr Tony Alderson**  
**WSP | Parsons Brinckerhoff**  
***Tony.Alderson@pbworld.com***



Tony Alderson joined WSP | Parsons Brinckerhoff as CCS Technical Lead in December 2012. He is a Chartered Chemical Engineer with 26 years of experience in the provision of engineering design, technical support and specialist consultancy services to the upstream and midstream hydrocarbons and energy sectors. Tony has expertise in carbon capture, utilisation and storage, gasification, Fischer-Tropsch Synthesis/gas to liquids, clean energy and liquefied natural gas.

Tony's background includes process design, evaluation and simulation, project planning, management and financial control, capital cost estimation and economic/techno-economic evaluation, market assessment and competitor/opportunity analysis. He is also a trained and experienced HAZOP Chairman.

**Mr Theo Mitchell**  
**Carbon Capture and Storage Association**  
***theo.mitchell@ccsassociation.org***



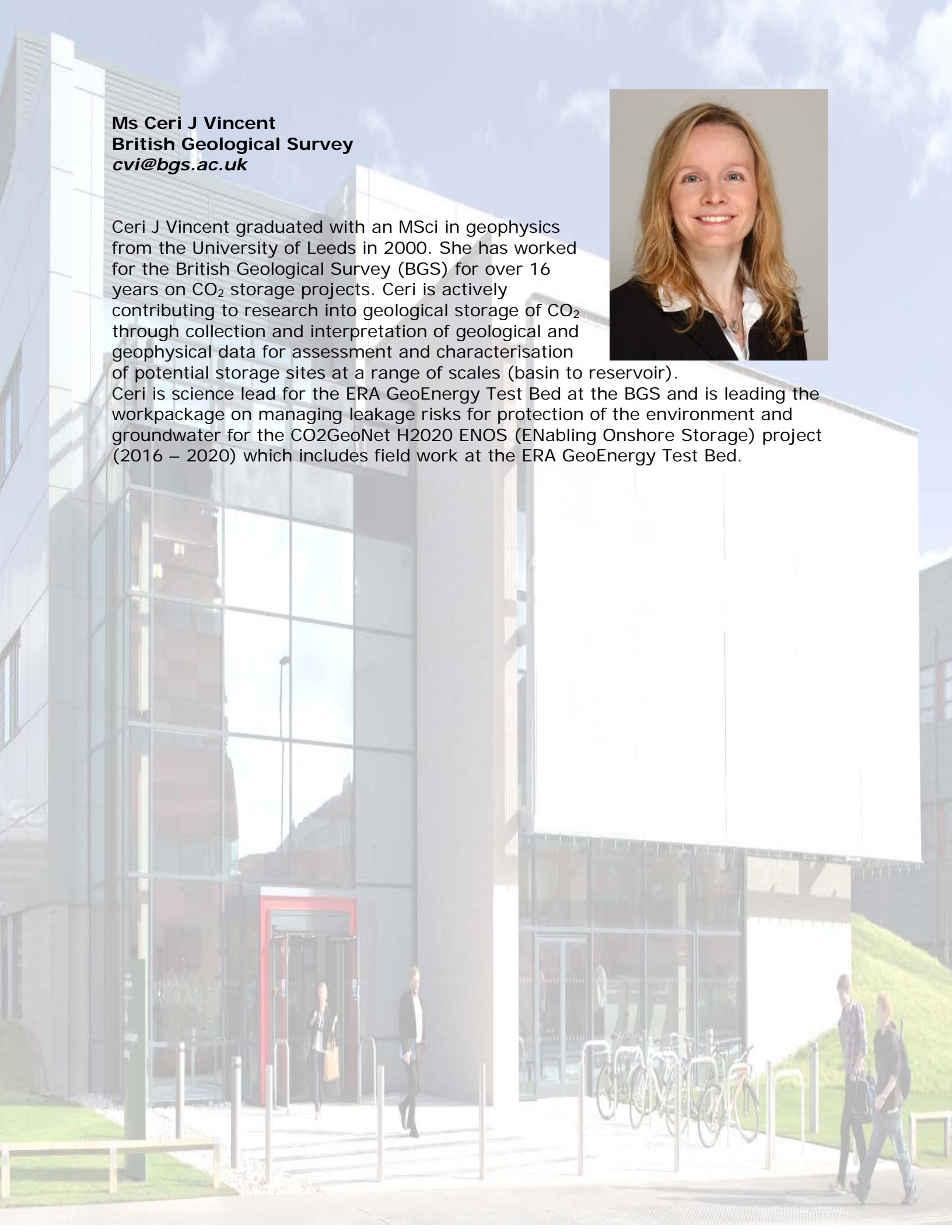
Theo joined the CCSA in 2013 and has since been managing the Association's work on regulatory, policy and technical issues affecting the commercial deployment of CCS in the UK and Europe.

Following consultancy work for the Low Emission Strategies Partnership, Theo spent 3 years working on local government energy strategy with Hampshire County Council before moving to the Anosy region of south east Madagascar to provide strategic advice on climate change adaptation, REDD+ and renewable energy.

Since joining the CCSA as Policy Manager, Theo has taken responsibility for a wide variety of policy issues both in the UK and in Europe, including Electricity Market Reform (EMR), the review of the European CCS Directive, State Aid and the EU 2030 Framework for Energy and Climate Policies.

**Ms Ceri J Vincent**  
**British Geological Survey**  
*[cvi@bgs.ac.uk](mailto:cvi@bgs.ac.uk)*

Ceri J Vincent graduated with an MSci in geophysics from the University of Leeds in 2000. She has worked for the British Geological Survey (BGS) for over 16 years on CO<sub>2</sub> storage projects. Ceri is actively contributing to research into geological storage of CO<sub>2</sub> through collection and interpretation of geological and geophysical data for assessment and characterisation of potential storage sites at a range of scales (basin to reservoir). Ceri is science lead for the ERA GeoEnergy Test Bed at the BGS and is leading the workpackage on managing leakage risks for protection of the environment and groundwater for the CO<sub>2</sub>GeoNet H2020 ENOS (ENabling Onshore Storage) project (2016 – 2020) which includes field work at the ERA GeoEnergy Test Bed.

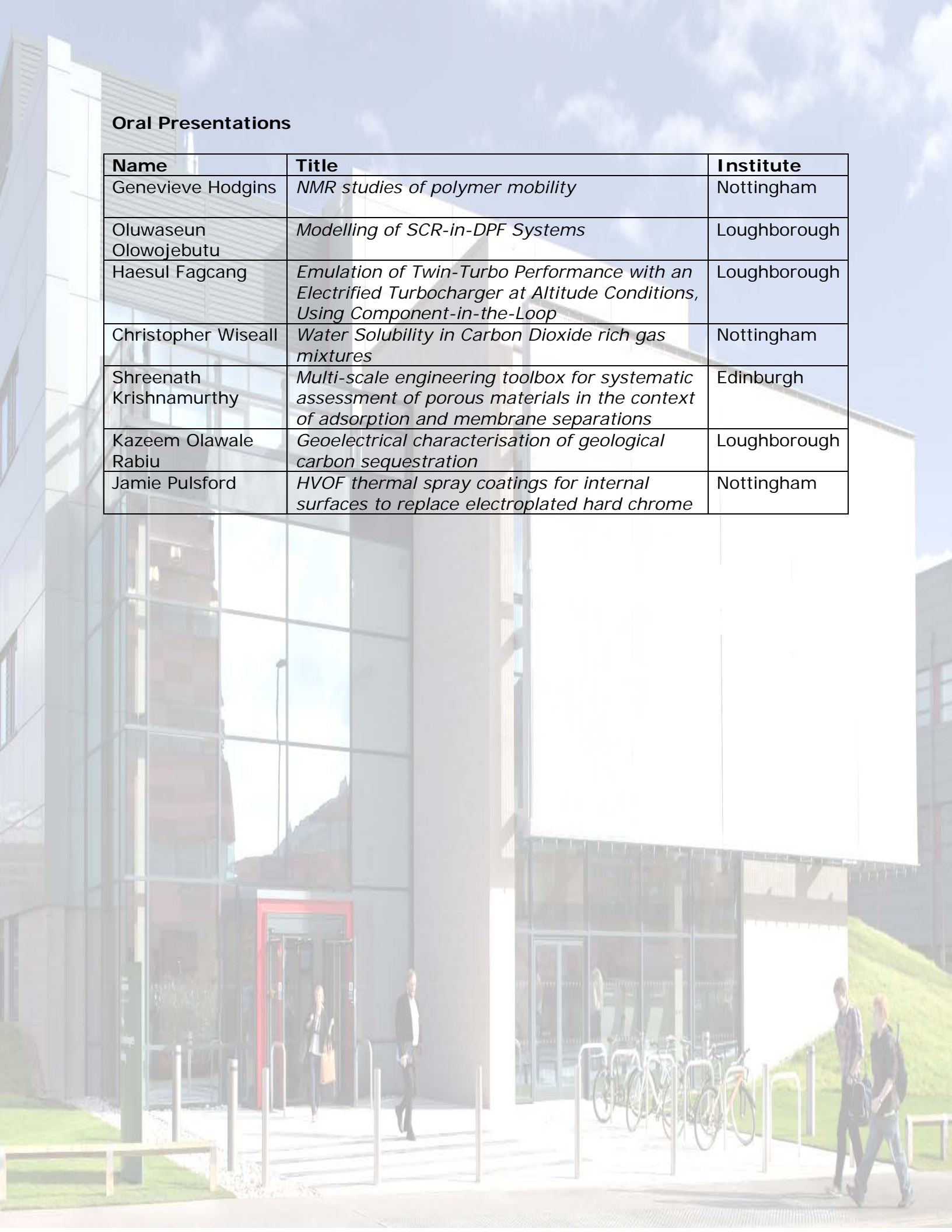


## Posters

Name	Title	Institute
Robert Byrne	<i>The performance of high chromium creep enhanced ferritic steels</i>	Loughborough
Lawrence Coghlan	<i>The Effect of CO<sub>2</sub> on The Oxidation Characteristics of 9Cr Steel</i>	Loughborough
Tejas Ashar	<i>Ignition and flame stability for flexible and efficient operation of power plants</i>	Sheffield
Thomas Werner	<i>Developing high efficient medium to high temperature heat pipes</i>	Nottingham
Thomas Yelland	<i>SNCR-Fuel Additive Based Hybrid Technology for Low NO<sub>x</sub> Pulverised Coal Combustion</i>	Sheffield
Lewis Tuck	<i>Producing Bio-Coal by means of Hydrothermal Carbonization</i>	Nottingham
Sophie Goodwin	<i>Synthesis and Application of Novel Hyperbranched Polymers</i>	Nottingham
Jonathon Morris	<i>Fluidised Bed Combustion of Biomass: Agglomeration</i>	Nottingham
Matteo Spanu	<i>What causes fine filters to block in diesel injection systems?</i>	Nottingham
Lola Vazquez Peraita	<i>Biomass supply chain</i>	Nottingham
Richard Seely	<i>CO<sub>2</sub> injection temperatures - implications for current and future injection operations</i>	Nottingham
Rebeca Azpiri	<i>Pre-combustion CCS via Pressure Swing Adsorption</i>	Birmingham
Carla Martín Clavé	<i>Gas Storage in Salt Caverns</i>	Nottingham
Kelachi Omehia	<i>Increasing the efficiency of CO<sub>2</sub> capture in micro gas turbines using different techniques</i>	Sheffield
Lulwa Almahmeed	<i>Combined cycle gas turbine with CCS</i>	Sheffield
Abdul Aziz Aliyu	<i>Carbon capture and storage</i>	Sheffield
Rachel Wignall	<i>Fingerprinting industrial CO<sub>2</sub> through the use of noble gas and clumped isotope tracers at the carbon management Canada field research station</i>	Edinburgh
Suoton Philip Peletiri	<i>Effects of CO<sub>2</sub> pipeline impurities on pressure drop and phase envelope</i>	Bradford
Peng Xie	<i>CFD modelling of rotating packed bed for CO<sub>2</sub> capture</i>	Sheffield
Abitha Balashanmugam	<i>Green silica for carbon capture</i>	Sheffield
Muhammad Imran Masood	<i>CO<sub>2</sub> capture from biogas using waste biomass based activated carbons in different adsorption systems</i>	Heriot Watt
Hisham Al Baroudi	<i>Anthropogenic CO<sub>2</sub> transport - what options are available?</i>	Cranfield
Lydia Rycroft	<i>Case studies of CO<sub>2</sub> storage in depleted oil and gas fields</i>	IEAGHG

## Oral Presentations

<b>Name</b>	<b>Title</b>	<b>Institute</b>
Genevieve Hodgins	<i>NMR studies of polymer mobility</i>	Nottingham
Oluwaseun Olowojebutu	<i>Modelling of SCR-in-DPF Systems</i>	Loughborough
Haesul Fagcang	<i>Emulation of Twin-Turbo Performance with an Electrified Turbocharger at Altitude Conditions, Using Component-in-the-Loop</i>	Loughborough
Christopher Wiseall	<i>Water Solubility in Carbon Dioxide rich gas mixtures</i>	Nottingham
Shreenath Krishnamurthy	<i>Multi-scale engineering toolbox for systematic assessment of porous materials in the context of adsorption and membrane separations</i>	Edinburgh
Kazeem Olawale Rabiu	<i>Geoelectrical characterisation of geological carbon sequestration</i>	Loughborough
Jamie Pulsford	<i>HVOF thermal spray coatings for internal surfaces to replace electroplated hard chrome</i>	Nottingham







## Groups for Activity

**Activity Leaders:** Philip Sharman, Rosemary Whitbread and Allan Jones

**Mentors:** Sarah Angel-Smith, Joey Walker, Robert Stirling and David Nichols

### Group A

- Robert Byrne
- Jonathon Morris
- Shreenath Krishnamurthy
- Suoton Philip Peletiri
- Sophie Goodwin

### Group B

- Tejas Ashar
- Carla Martín Clavé
- Kazeem Olawale Rabiú
- Peng Xie
- Matteo Spanu

### Group C

- Thomas Werner
- Lola Vazquez Peraita
- Kelachi Omehia
- Abitha Balashanmugam
- Rachel Wignall

### Group D

- Thomas Yelland
- Richard Seely
- Lulwa Almahmeed
- Muhammad Imran Masood
- Lauren Selby

### Group E

- Lewis Tuck
- Rebeca Azpiri
- Abdul Aziz Aliyu
- Hisham Al Baroudi
- Lydia Rycroft



**Field trip - Industrial site visit to GE in Rugby, on Wednesday 15<sup>th</sup> February, 13:00-18:00**

The coach will depart promptly from outside the Energy Technologies Building at 13:00.

**Groups for industrial site visit**

**Group 1**

- Lewis Tuck
- Lola Vazquez Peraita
- Tejas Ashar
- Lydia Rycroft
- Shreenath Krishnamurthy
- Kelachi Omehia

**Group 2**

- Thomas Yelland
- Sophie Goodwin
- Thomas Werner
- Suoton Philip Peletiri
- Abitha Balashanmugam
- Lulwa Almahmeed

**Group 3**

- Matteo Spanu
- Rebeca Azpiri
- Jonathon Morris
- Kazeem Olawale Rabi
- Rachel Wignall
- Abdul Aziz Aliyu

**Group 4**

- Robert Byrne
- Richard Seely
- Carla Martín Clavé
- Hisham Al Baroudi
- Lauren Selby
- Peng Xie
- Muhammad Imran Masood

**AP 06/02/2017**