

The National Centre For Carbon Capture and Storage

Dr Sarah Mackintosh
July 2011

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China Australia Geological Storage of CO₂

中澳二氧化碳地质封存





The National Centre for Carbon Capture and Storage (NCCCS) - a joint venture between the University of Nottingham and the British Geological Survey. The Centre brings together researchers across many area to carry out cross disciplinary research in CCS.



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



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Nottingham**

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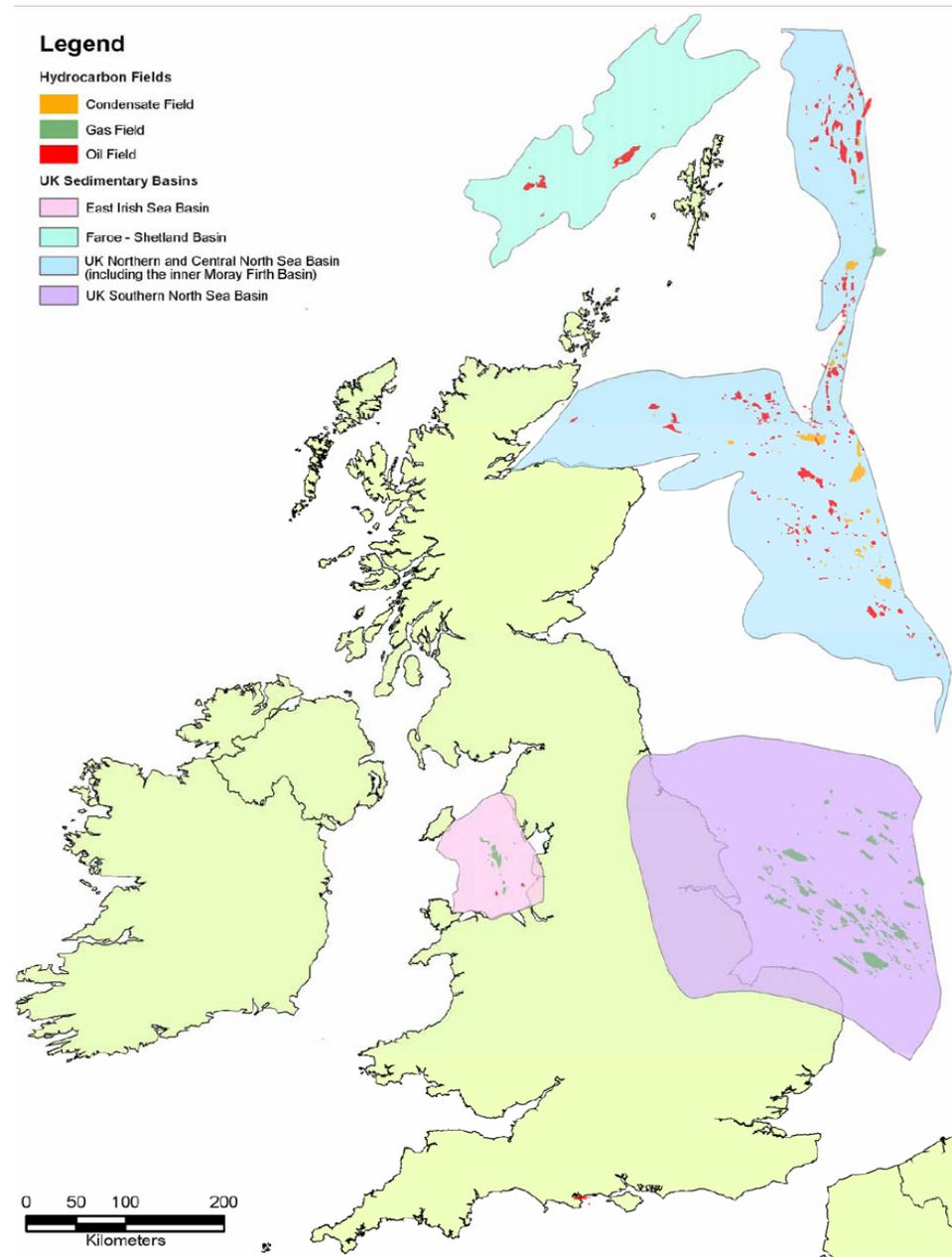


CCS in the UK

- In the UK a legal commitment was made to cut emissions by over 50% by 2027.
- The Government will release a UKCCS roadmap in November.
- Commitment to four UK full size demos – the first of which will be finalised in November.
- 7 UK CCS projects were submitted to NER 300 - European Emissions Trading Scheme for subsidising installations of renewables and CCS.



Good Storage Potential in the UK



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Storage Capacity in the UK

Category	Location	Estimated CO ₂ storage capacity (million tonnes)
Oil fields	Offshore	1175
Gas fields	Offshore	5140
Gas/condensate fields	Offshore	1200
Saline aquifers	Southern North Sea Basin	Up to 14250
	East Irish Sea Basin	Up to 630
	Northern and Central North Sea Basin and other offshore basins	Not quantified but potentially large
	Onshore	Not quantified but potential small
TOTAL QUANTIFIED CO₂ STORAGE CAPACITY		Up to 22395



The Launch of the Centre





Keeping the Engine-Room Clean: CCS in China

Zep Pavilion, Shanghai Expo

October 11th 2010

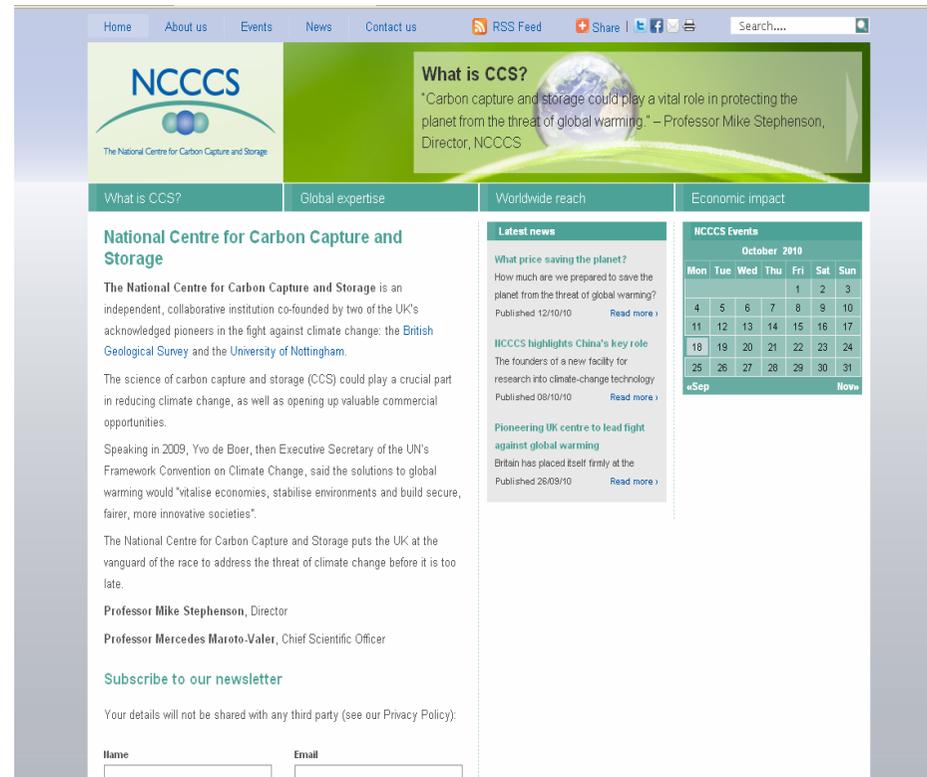




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The University of Nottingham



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What is CCS?

"Carbon capture and storage could play a vital role in protecting the planet from the threat of global warming." – Professor Mike Stephenson, Director, NCCCS

What is CCS?	Global expertise	Worldwide reach	Economic impact																																											
<p>National Centre for Carbon Capture and Storage</p> <p>The National Centre for Carbon Capture and Storage is an independent, collaborative institution co-founded by two of the UK's acknowledged pioneers in the fight against climate change: the British Geological Survey and the University of Nottingham.</p> <p>The science of carbon capture and storage (CCS) could play a crucial part in reducing climate change, as well as opening up valuable commercial opportunities.</p> <p>Speaking in 2009, Yvo de Boer, then Executive Secretary of the UN's Framework Convention on Climate Change, said the solutions to global warming would "vitalise economies, stabilise environments and build secure, fairer, more innovative societies".</p> <p>The National Centre for Carbon Capture and Storage puts the UK at the vanguard of the race to address the threat of climate change before it is too late.</p> <p>Professor Mike Stephenson, Director</p> <p>Professor Mercedes Maroto-Valer, Chief Scientific Officer</p> <p>Subscribe to our newsletter</p> <p>Your details will not be shared with any third party (see our Privacy Policy):</p> <p>Name <input type="text"/> Email <input type="text"/></p>			<p>Latest news</p> <p>What price saving the planet? How much are we prepared to save the planet from the threat of global warming? Published 12/10/10 Read more ></p> <p>NCCCS highlights China's key role The founders of a new facility for research into climate-change technology Published 08/10/10 Read more ></p> <p>Pioneering UK centre to lead fight against global warming Britain has placed itself firmly at the Published 26/09/10 Read more ></p>	<p>NCCCS Events</p> <p style="text-align: center;">October 2010</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr style="background-color: #008000; color: white;"> <th>Mon</th><th>Tue</th><th>Wed</th><th>Thu</th><th>Fri</th><th>Sat</th><th>Sun</th> </tr> </thead> <tbody> <tr> <td></td><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td> </tr> <tr> <td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td> </tr> <tr> <td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td> </tr> <tr> <td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td> </tr> </tbody> </table> <p>«Sep Now»</p>	Mon	Tue	Wed	Thu	Fri	Sat	Sun					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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www.ncccs.ac.uk



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Research

- Critical mass of expertise, approximately 50 researchers.
- Total value of current research ~£2,700,000.
- Research is cross-disciplinary, bringing together engineers, mathematicians, chemists, bioscientists, geographers, geologists and social scientists.



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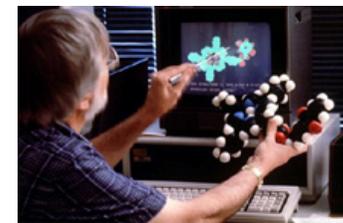
Research Programmes



Mature Processes



Innovative Processes



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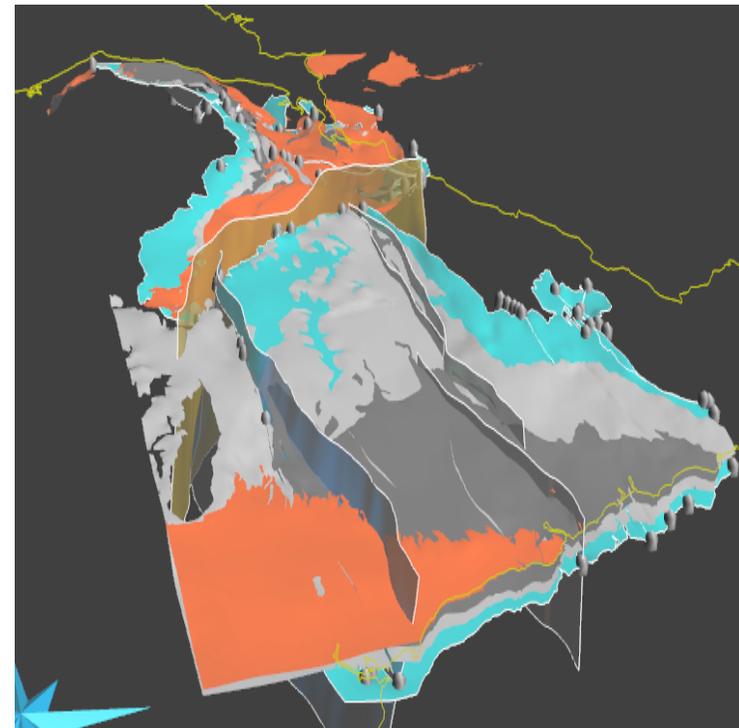
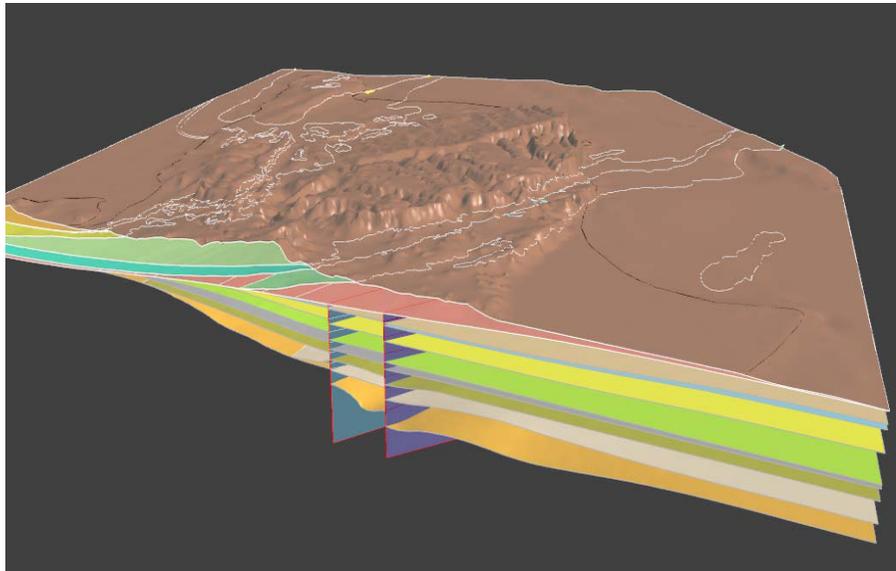
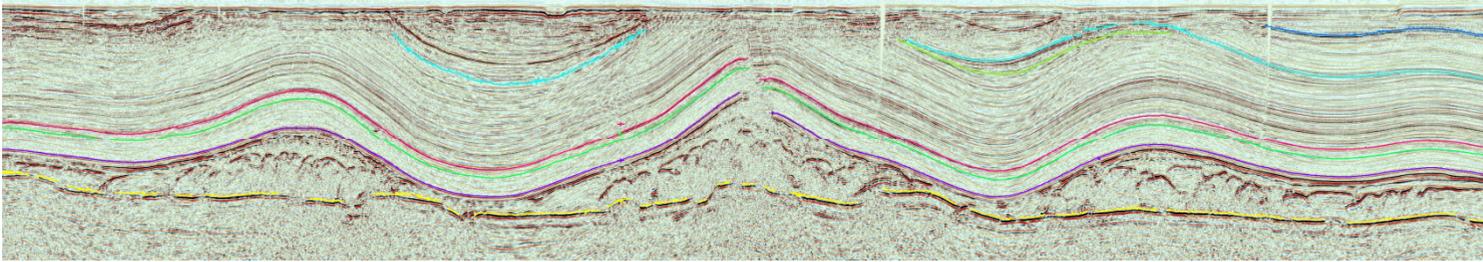


Key Storage Issues for CCS

- Ultimate storage capacity.
- Site performance.
- Monitoring and verification.
- Regulatory Framework.



UK Storage Capacity Static and Dynamic Modelling



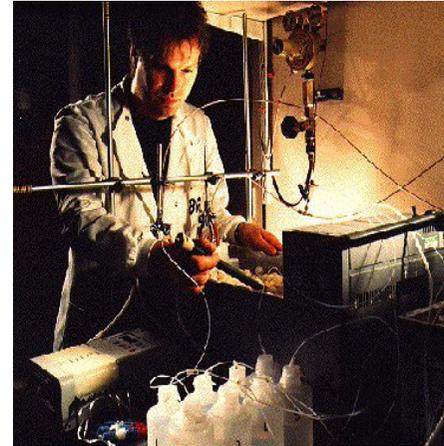
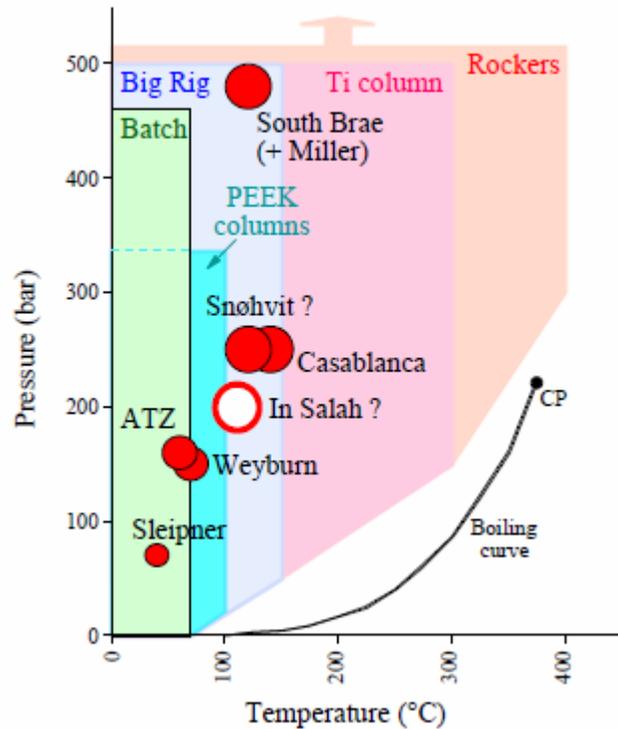
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Long-term Performance Geochemical Stability



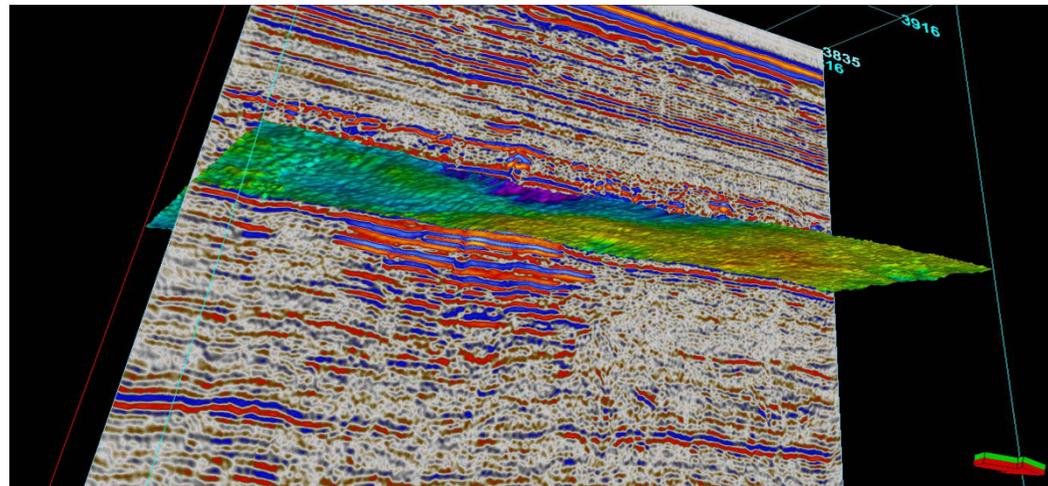
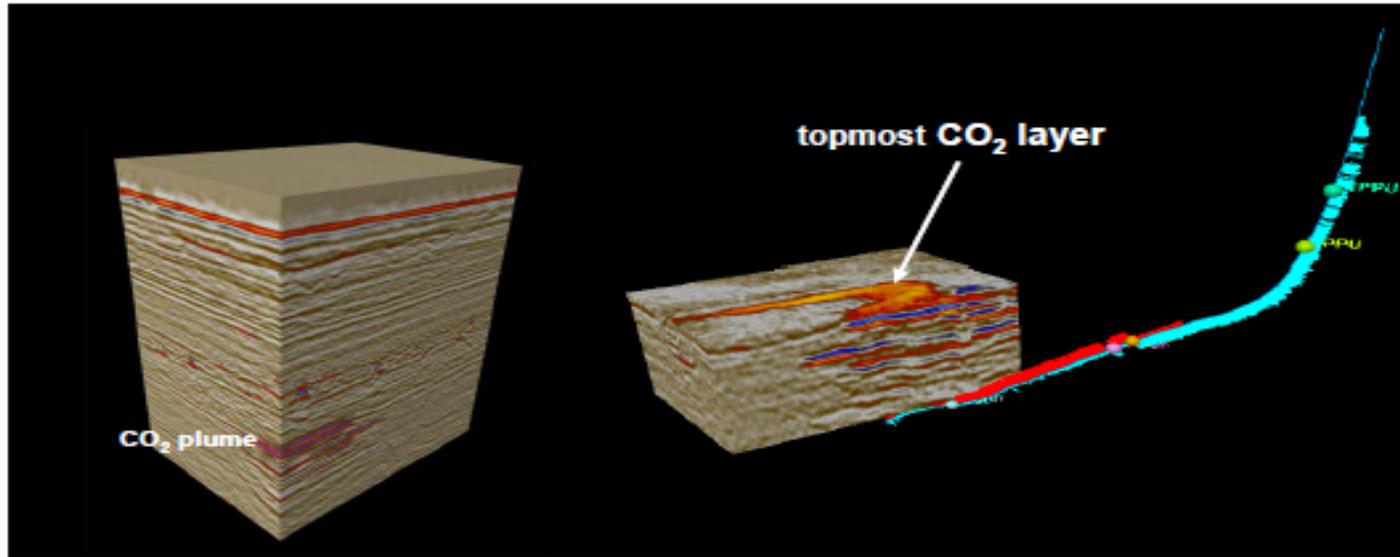
CO₂ sequestration cement/alkaline fluid reactions
 Gas hydrates radioactive waste disposal
 Geothermal systems mineral dissolution kinetics



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Monitoring Research



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Monitoring



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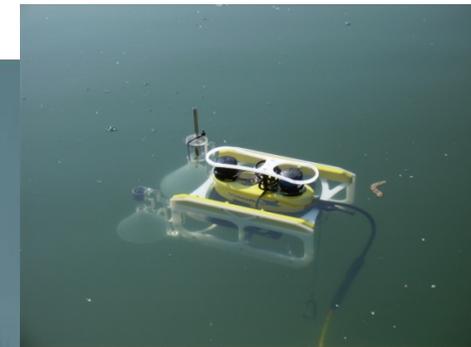
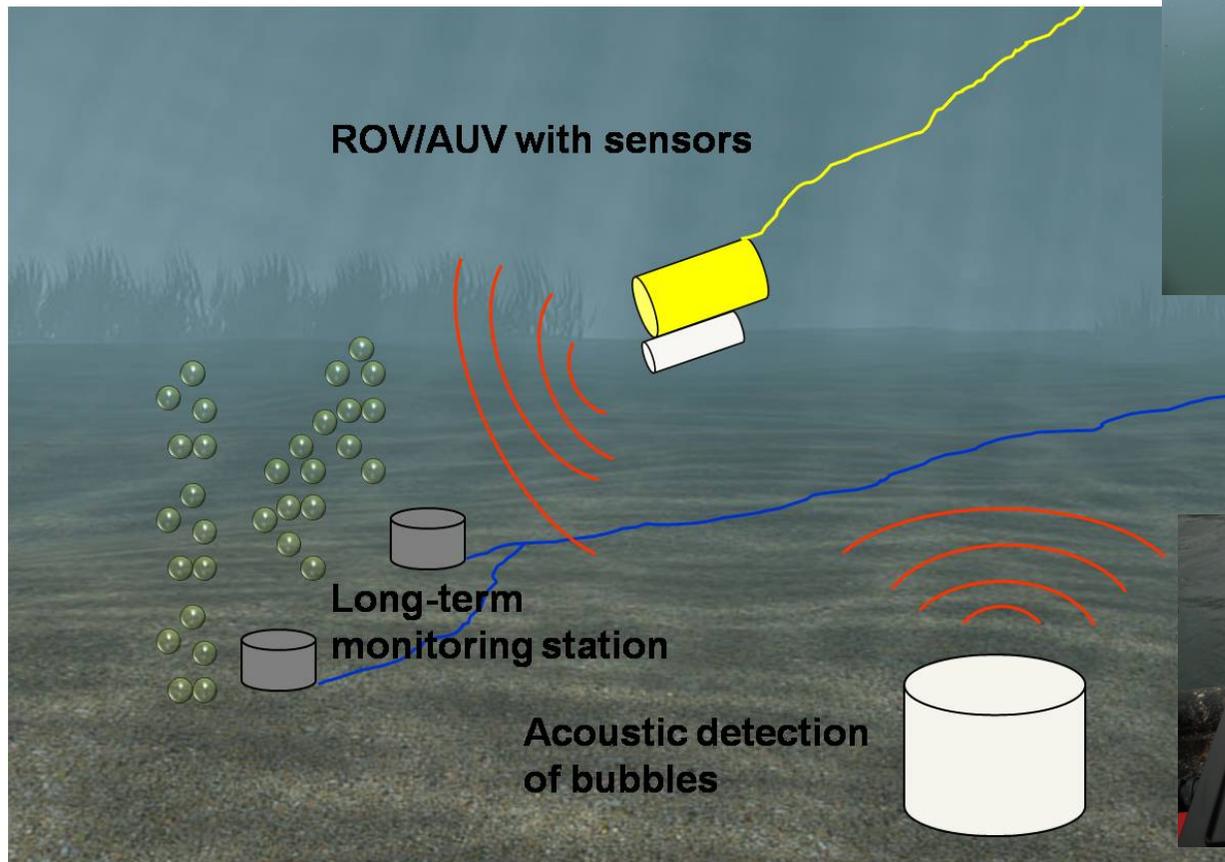
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Dr Giorgio Caramanna, CICCS



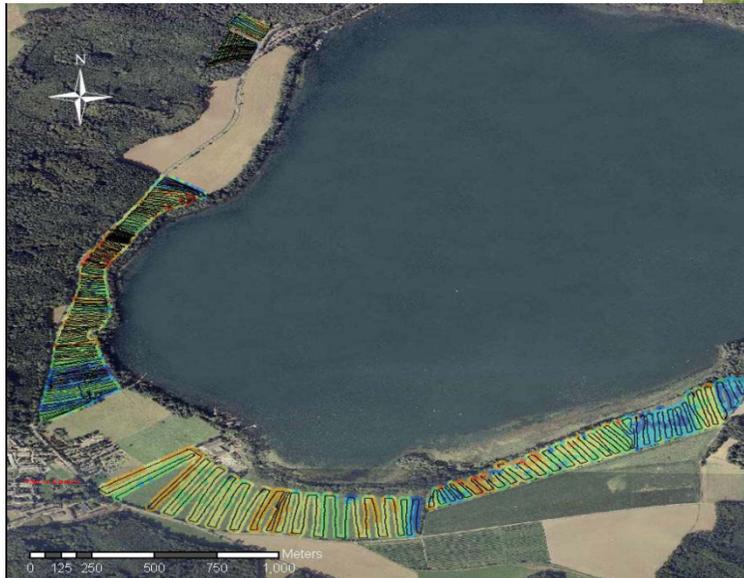
Development and Testing of Monitoring Techniques



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Monitoring Tool Development Areal Atmospheric Measurement



Tested at Laacher See
Deployed at In Salah
New tools at Norwegian field laboratory



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Environmental Consequences of Potential Leaks of Impure CO₂



Artificial Soil Gassing And Response Detection

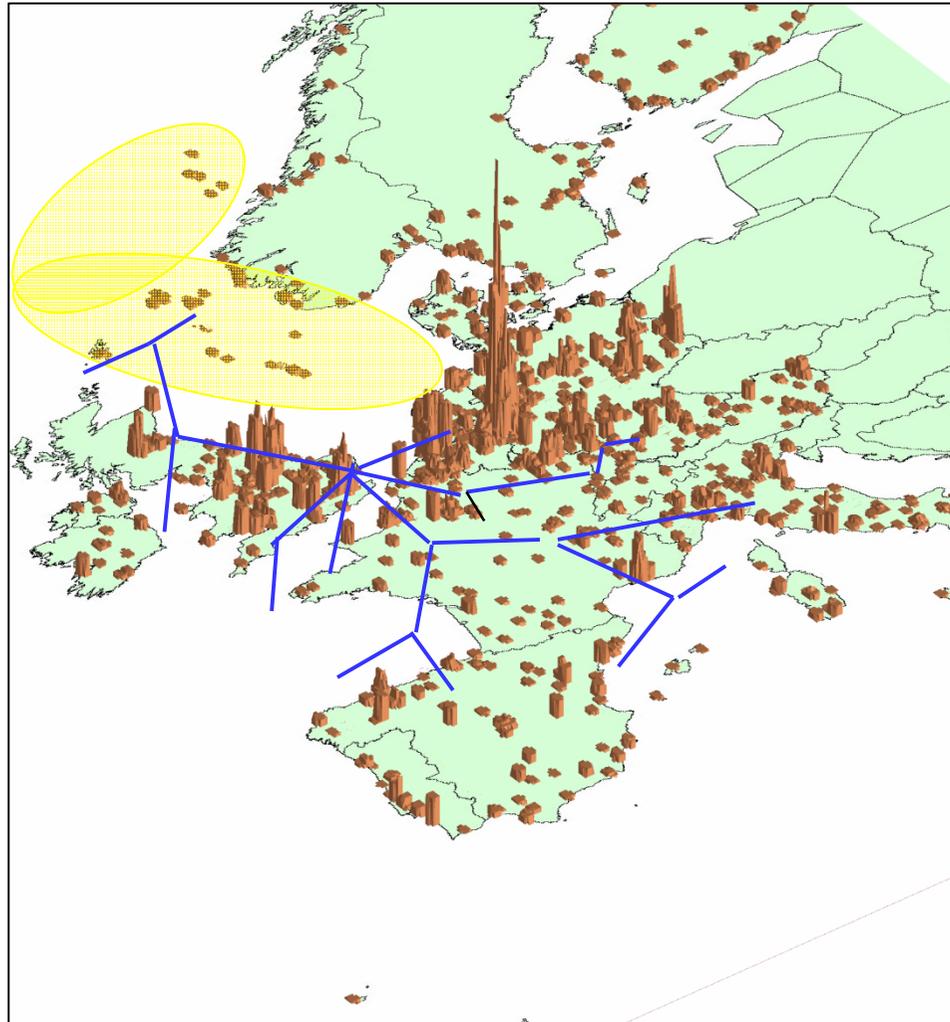


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Transport in Europe



Issues:

- Substantial pipeline system required
~ 150,000 km.
- High cost element.
- Who will pay?
- Develop piece-meal or in a structured development?

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CCS Pipeline and Storage – Capabilities

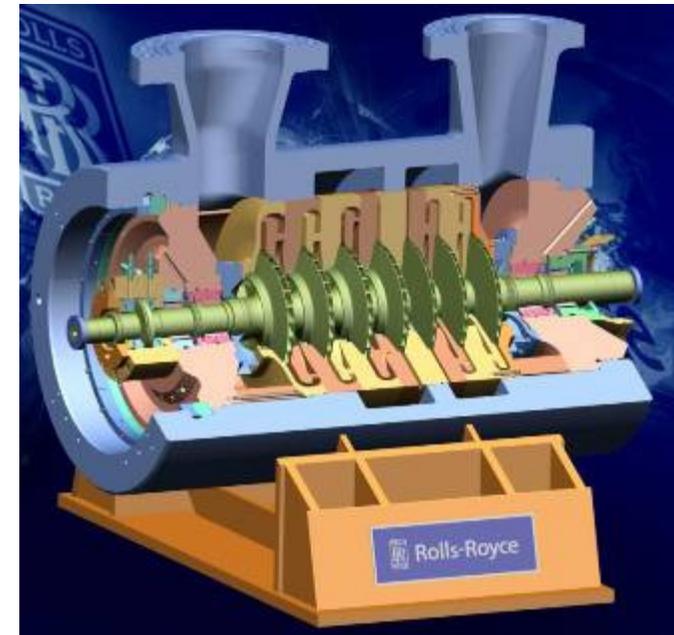
- Mechanical testing and modelling for damage assessment.
- Materials behaviour - analysis of chemical attack.
- Pipeline breach – risk/impact.
- Gas release/plume.
- Pipe to storage – gas flows/thermodynamics.



Optimised Compressors EPSRC/TSB/RollsRoyce/EON



- Innovative CO₂ compression system technologies for commercial utility scale CCS, improving on weaknesses in current CO₂ compression approaches.
- The outcomes of the project will reduce power consumption.
- We also look at the effects of impurities during compression.



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Mineral Carbonation: Lock it in Rock



Mineral Carbonation – the chemical fixation of CO₂ in minerals to form geologically stable mineral carbonates.



Each block is 40% weight CO₂
and contains 3 litres of CO₂



Olivine

Serpentine

Mineral carbonates



Waste concrete



Slag

Industrial by-products may make process more sustainable

- Construction products
- Aggregates
- Mine void filler



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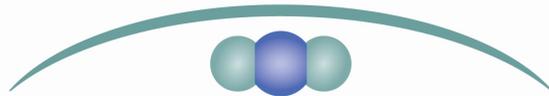
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Mineralisation-UK Towards Large Scale



NCCCS



The National Centre for Carbon Capture and Storage



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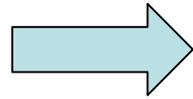
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- Distribution of suitable materials together with an estimate of how much of these could practically be used → economics of CO₂ capture by mineralisation.

- Technologies that could be developed to meet the UK requirements → viability of mineralisation compared to traditional CCS approaches.



Harnessing Solar Light Energy to Convert CO₂ into Fuels



- Inspired by nature – Artificial Photosynthesis.
- Photochemical reduction of CO₂ with water using UV/visible light.

Royal Society Grant & IDTC Integrative Biology Studentship

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Public Perceptions of CCS for Climate Change Mitigation



- We have taken a qualitative approach based on semi-structured interviews which were recorded and transcribed verbatim.
- Respondents were chosen from two areas which have different relationships to the fossil-fuel industry: Mansfield and West Bridgford.
- Understandings of the causes and consequences of climate change appeared to affect the way CCS was viewed.



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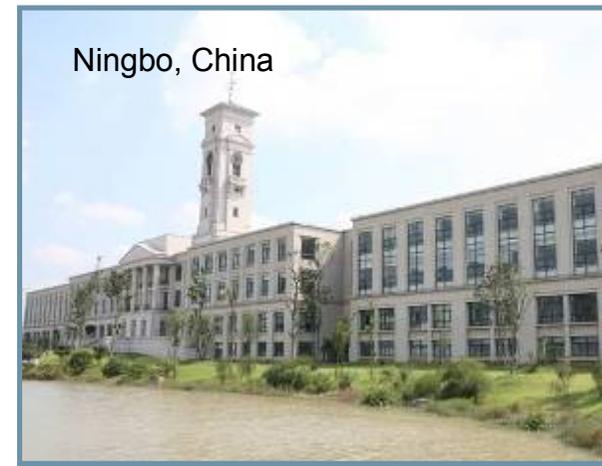
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Other NCCCS Activities Training

Short courses- Following our experience in delivering short courses (3-4 days) in CCS both in UK and China.

MSc/MRes qualification in CCS technologies for full-time and part-time study. Flexible delivery mechanisms.



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Conclusion

- NCCCS encourages international co-operation between industry, academia, policy advisors and government organisations.
- NCCCS has the ability to cover full chain CCS research.
- NCCCS has the ability to provide capacity building in CCS.
- Provide the innovation needed for the wider deployment of CCS.

