European Energy Research Alliance (EERA) CCS Joint Programme

Jonathan Pearce

Storage Subprogramme Coordinator

CCS Deployment after 2020

- First successful demonstrations of the full CCS chain, including capture, transport and storage.

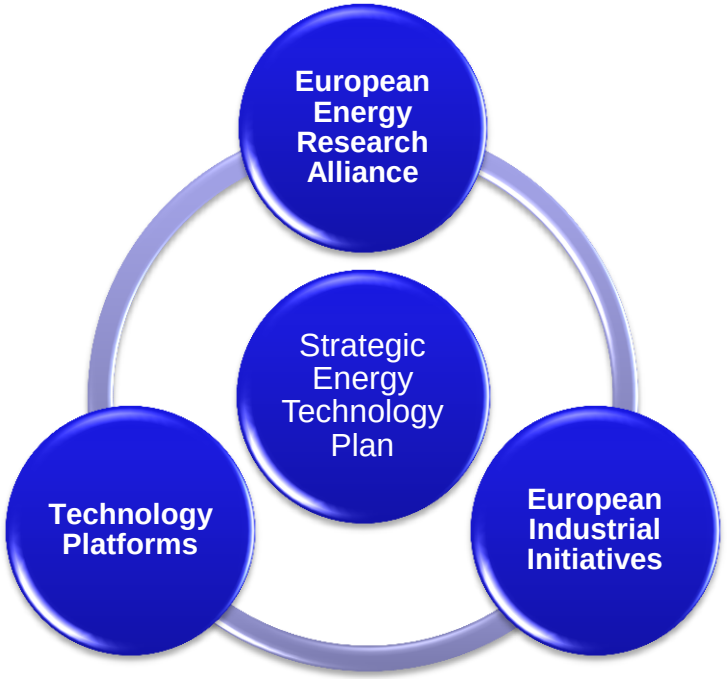
Demonstration projects (EEPR, UK Commercialisation)

- What is needed to wider deployment?
  - Cost competitive and energy efficient CO_2 capture.
  - Confidence in storage technologies, based on subsurface knowledge and understanding.
  - Flexible integrated infrastructure

EERA Objectives

European Energy Research Alliance

- EERA required by the European Strategic Energy Technology Plan
- The main objectives of the EERA are to:
  - accelerate the **development** of new energy technologies;
  - work towards a long-term, durable **integration** of excellent research capacities dispersed across the EU;
  - strengthen Europe's capacity to initiate and **execute** large high-risk, high-gain R&D programmes.

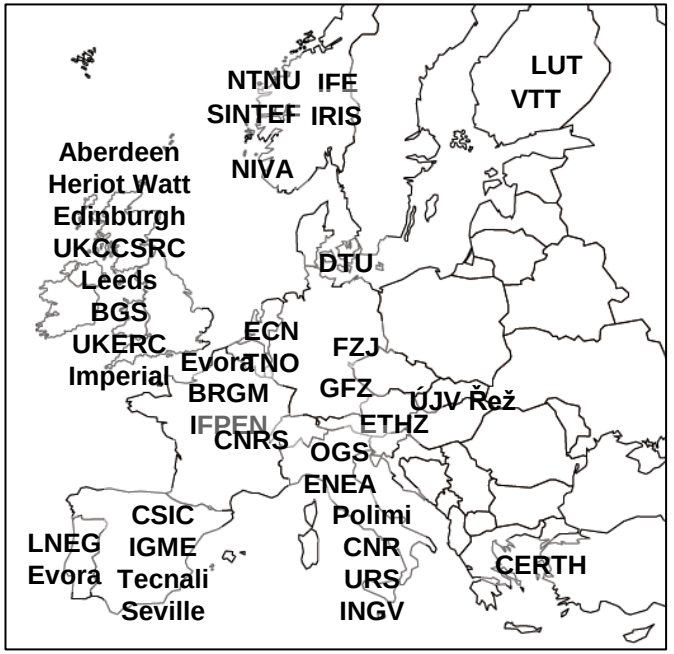


What is EERA?

- An alliance of leading organisations in the field of energy research.
  - More than 150 participating organisations
    - About 3000 professionals full time with in-kind contribution of €~450m
    - Applied research up to the point of demonstration
- EERA streamlines and coordinates national and European energy R&I programmes (Joint Programmes).
- A number of Joint Programmes covering different low carbon technologies (wind, geothermal, PV, CCS etc)

EERA CCS Joint Programme

- Membership:
  - Over 40 member organisations
  - Commitment > 300 py/y
  - Operative since 2010



- Our vision:
  - EERA CCS shall be the European authority on CCS R&I. We are the European team of excellence in CCS R&I.

About the UKCCSRC

The UK Carbon Capture and Storage Research Centre (UKCCSRC) **leads and coordinates a programme of underpinning research on all aspects of carbon capture and storage** (CCS) in support of basic science and UK government efforts on energy and climate change.

The Centre brings together nearly 200 of the UK's world-class CCS academics and provides a **national focal point for CCS research and development**.

http://www.ukccsrc.ac.uk

Centre funding

- Initial core funding for the UKCCSRC is provided by **£10M** from the **Engineering and Physical Sciences Research Council (EPSRC)** as part of the **RCUK Energy Programme**
- This is complemented by **£3M** in additional funding from the **Department of Energy and Climate Change (DECC)** to establish new capital facilities that will support innovative research
- **10 partner institutions** have contributed **£2.5M**

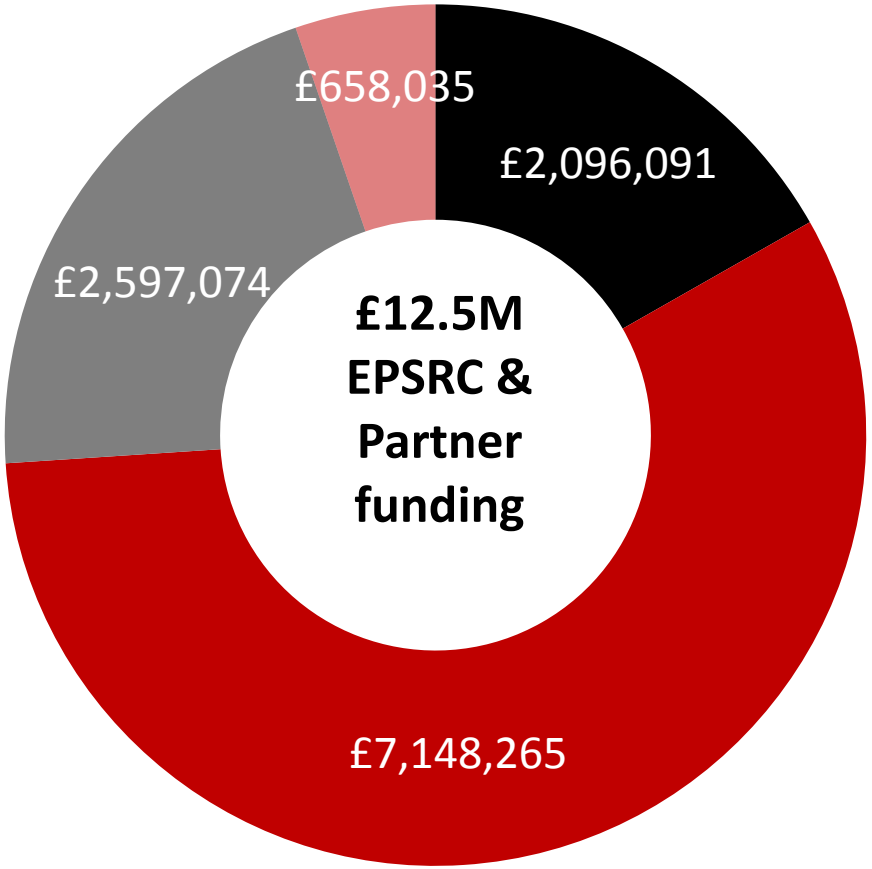
EPSRC Engineering and Physical Sciences Research Council

Energy For a Low Carbon Future

Department of Energy & Climate Change

Strategic priorities

- Create an effective virtual Research Centre
- Deliver a coordinated programme of CCS research
- Develop sustainable CCS research capacity and infrastructure in the UK
- Build effective communication links and networks with CCS researchers and implementers



Working internationally

- Key objective is to engage with the **Horizon 2020** (H2020) programme to facilitate Centre Member's participation in research and innovation
- UKCCSRC is a member of the **European Energy Research Alliance (EERA)**
  - Provides transport and storage coordinators
- Co-ordinate research effort across major **European Centres of Excellence in C**CS
  - Links to infrastructure sharing via **ECCSEL**
- **International Travel Fund** – allowing UK researchers to collaborate globally
- **International Speaker Programme**
- The UKCCSRC works with a broad range of **international partners** to advance CCS research and development

EERA CCS priorities

- Structure the European CCS R&I Landscape
  - MS incentives for Joint Programming
  - Incentives- Integrated Research Programme call of H2020
  - Topics (non exhaustive)
    - Capture on Gas-fired power plants
    - Industrial CCS
    - Storage pilots
- EERA CCS Strategic Research Agenda
  - Give EC and Member States a consistent priority plan for R&I and Infrastructure Needs
  - Prioritise key scientific and technical issues
  - Both short- and long-term R&I needs

Defining research needs

- European Industrial Initiative
  - Launched in June 2010 & refreshed in 2013
  - To initiate a CCS demonstration program.
  - Identifies research priorities as part of SET plan
  - Joint document developed by EC, ZEP and EERA
- SET Plan Integrated Roadmap
- EERA Strategic Research Agenda
  - Inform Horizon 2020 and national R&D priorities

Storage subprogramme objectives

- Site characterisation to meet permit requirements
  - Improved predictive (flow, geochemical, geomechanical) models, and underpinning data, of storage site behaviour.
- Demonstrating permanent containment
  - Detection and quantification of leakage and its impacts
- Safe and efficient storage
  - Storage optimisation and remediation and mitigation.
- Storage interactions with other uses (new)
  - Strategic management of the pore space
- Achieved through experimental research and pilot-scale tests

Summary

- EERA CCS JP:
  - Addressing research to enable wider deployment beyond 1st generation demos.
  - Working with EC, ZEP and EII to identify CCS research priorities.
- Storage research priorities
  - Smaller pilots provide facilities to develop storage technologies.
  - Supporting research will reduce risks, increase efficiencies, lower costs, maximise resources and facilitate wider deployment.

Zero Emissions Platform

- Founded in 2005, the European Technology Platform for Zero Emission Fossil Fuel Power Plants (ZEP) is a unique coalition of stakeholders united in their support for CO2 Capture and Storage (CCS) as a key technology for combating climate change.
- ZEP serves as advisor to the European Commission on the research, demonstration and deployment of CCS.
- The European utilities, petroleum companies, equipment suppliers, scientists, academics and environmental NGOs that together form ZEP have three main goals:
  - Enable CCS as a key technology for combating climate change.
  - Make CCS technology commercially viable by 2020 via a demonstration programme.
  - Accelerate R&D into next-generation CCS technology and its wide deployment post-2020.

ZEP's view of CCS development

Demo phase	Early Commercial	Widespread deployment
• 3-4 demos by 2020 • Business case • MS backing • R&D • Knowledge sharing	• ETS recalibration • 2030 cap • CO_2 storage clusters • R&D	• Commercial • Large-scale infrastructure • Industry & power emissions captured

Overview of CCS R&D pilot projects

- **CAPTURE:** > 20 capture facilities, around 10 facilities are still operational
- **STORAGE:**
  - 2 commercial scale projects: Sleipner and Snovhit
  - 4 R&D pilot projects: K12B, Ketzin, Hontomin & Lacq
  - 2 EOR commercial projects in Hungary and Turkey
- **CCS DEMO projects**
  - ROAD is FID ready
  - UK competition
  - Norway

The case for pilot-scale storage

- Context:
  - Potential storage formations/regions quite well known across Europe
- Capacity estimates reflect the grade of exploration and data availability and suggest sufficient storage capacity for commercial implementation.
- Strong focus on capture R&D in the past (especially from industry)
- No significant knowledge gap for demonstration storage projects, however there is still R&D-demand:
  - Process level
  - **Pilot scale**
  - Accompanying Demo-scale

Motivation for storage pilots

- Urgently establish up to six new CO_2 pilot storage projects, EU-wide by 2016
- Combining a few demo-scale projects with a significant number of (less costly) pilots, full European coverage is assured.
- Focus on deep saline aquifers – on- and offshore
- Select storage sites which enable meaningful, scientific R&D
- Support the deployment of Europe's CO_2 transport infrastructure
- Maximize the benefits of CCS for local communities

Future storage research – objectives (based on ZEP deliverables for storage pilots)

- Spatial development of the CO_2 plume – steering, control mechanisms, saturation distribution, re-production of CO_2
- Improved resolution of geophysical mapping, particularly in saline aquifers with sparse data
- Improved static and dynamic modelling tools
- The fate of CO_2 – dissolution, residual trapping and associated time-scales, pore-scale processes, re-sublimation of CO_2 in the pore network, saturation fronts, processes at grain surfaces, impact of wettability and subsequent change.

Future storage research – objectives (based on ZEP deliverables for storage pilots)

- Pressure build-up – monitoring and control, water production, combined CO_2 storage and geothermal heat production
- Integration of full value chain, including operation of CO_2 storage facility, such that CO_2 production facility has maximum availability.
- Improved knowledge of hydraulic properties of faults (sealing or not, methods, resolution, remediation)
- Wells and equipment; cheap wells for exploration and observation, cheap recompletion equipment (e.g. plastic liners), durable long-life monitoring
- Well closure and abandonment procedures.

European Energy Research Alliance (EERA) CCS Joint Programme

Jonathan Pearce

jmpe@bgs.ac.uk