

**iCRAG**

IRISH CENTRE FOR RESEARCH  
IN APPLIED GEOSCIENCES

## **GET-SET: Geo-storage in the Energy Transition: Science, Engineering, Technology**

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<https://www.ucd.ie/earthsciences/research/sustainablegeoenergy>

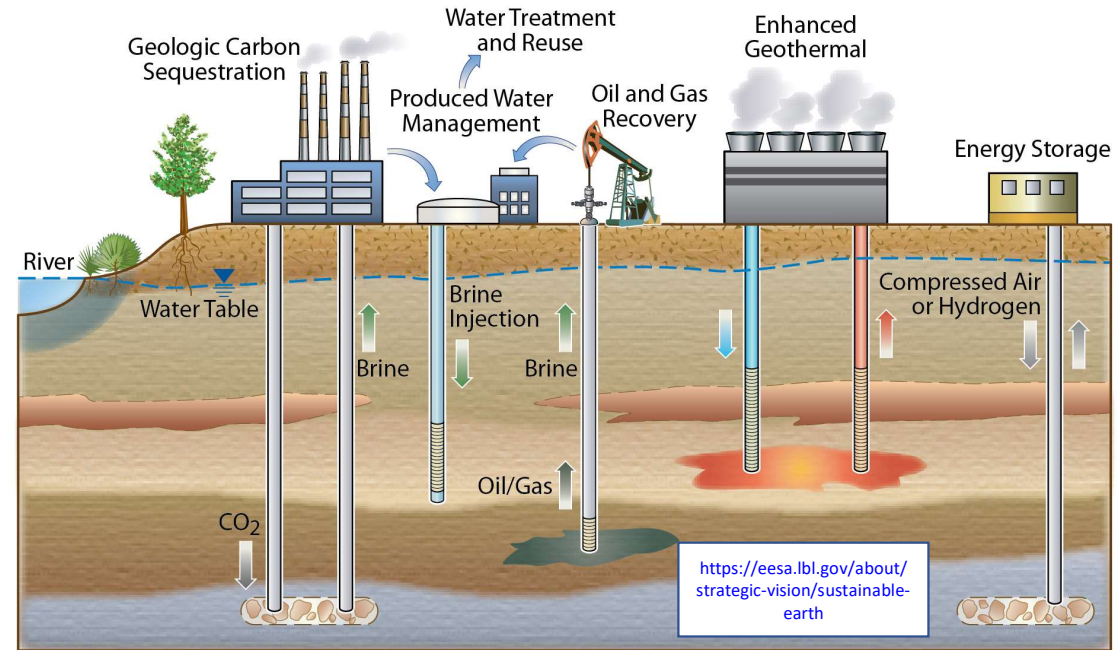


# Ready, GET-SET, Go!

**G**eo-storage in the  
**E**nergy  
**T**ransition  
-  
**S**cience,  
**E**ngineering,  
**T**echnology



Newly formed Sustainable  
GeoEnergy Group in UCD

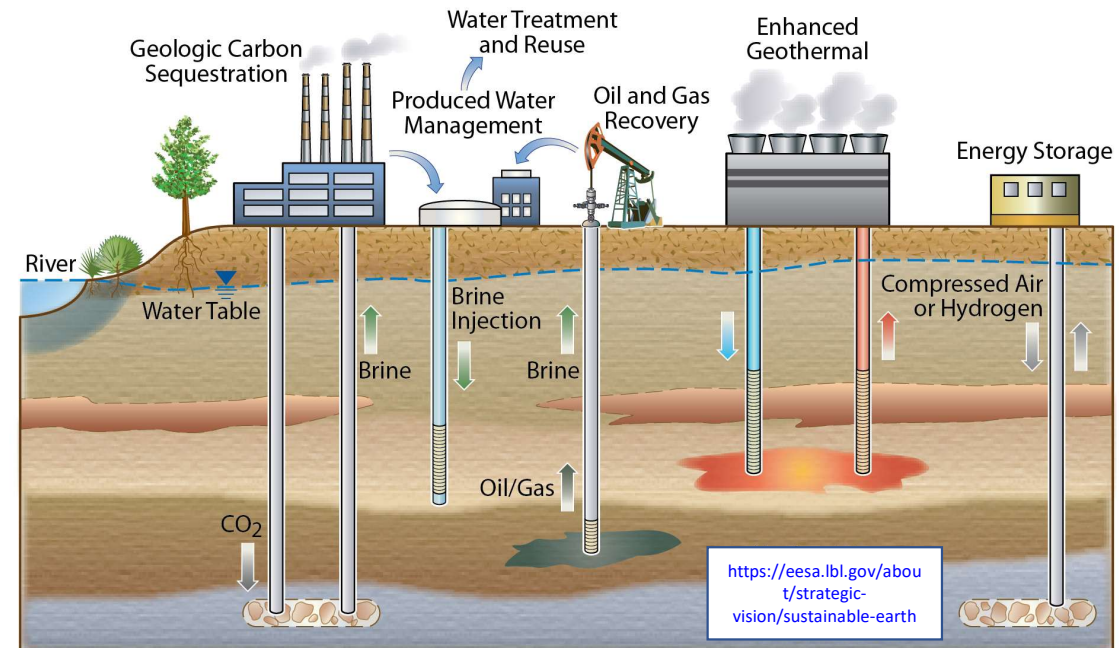


<https://eesa.lbl.gov/about/strategic-vision/sustainable-earth/>

*Characterization of the potential for  
subsurface geological storage*

# Ready, GET-SET, Go!

- GeoStorage Applications in Ireland
- Carbon capture and storage (CCS)
- Hydrogen storage
- Alternative energy storage options
  - Compressed air energy storage (CAES)
  - Aquifer thermal energy storage (ATES)



- CCS to help reach net-zero targets of Paris Agreement
- GeoEnergy storage to minimise waste and balance intermittency of Ireland's sustainable wind energy resource

# Ready, GET-SET, Go!

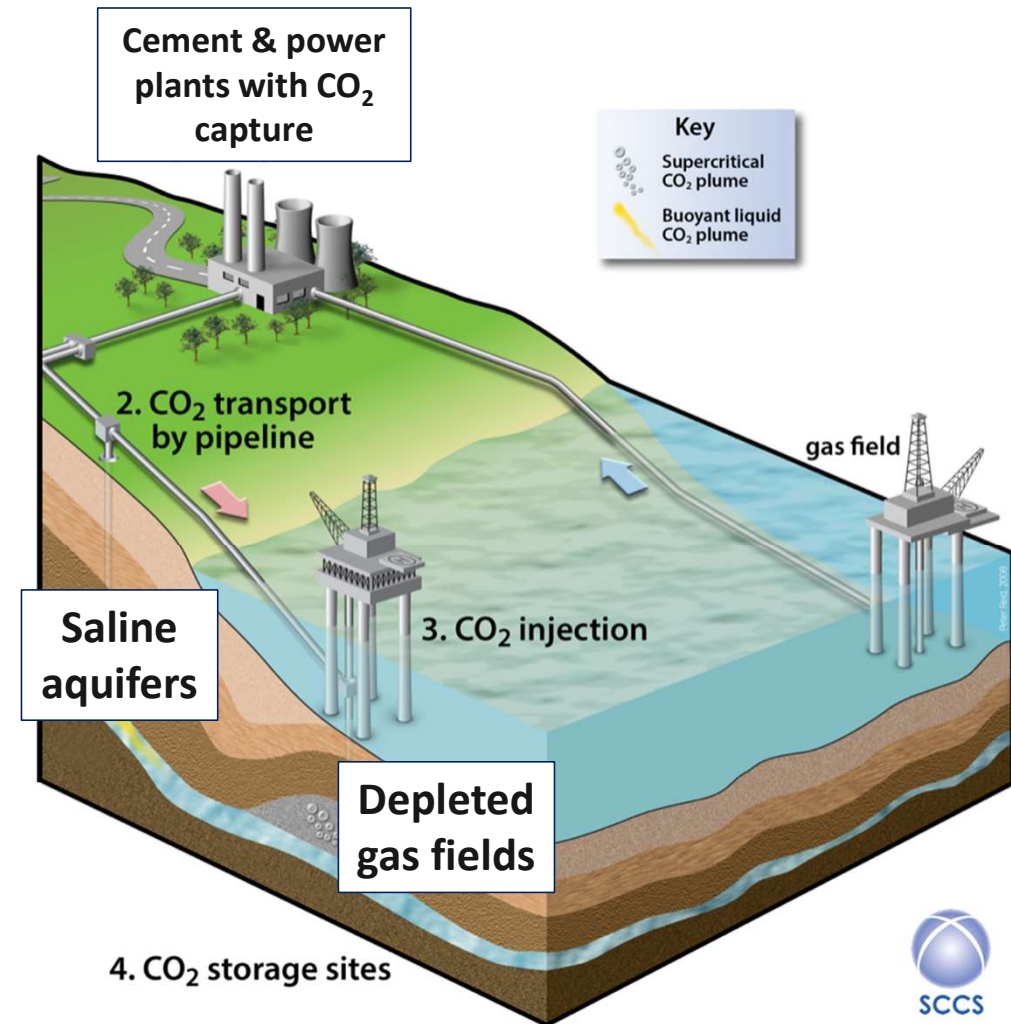
- GeoStorage Applications in Ireland
- **Carbon capture and storage (CCS)**
- Hydrogen storage
- Alternative energy storage options
  - Compressed air energy storage (CAES)
  - Aquifer thermal energy storage (ATES)

➤ Focus of talk on CCS but synergies exist in subsurface characterization required for the various applications



# What is Carbon Capture & Storage (CCS)

- **Capture** of CO<sub>2</sub> emitted from point sources: power plants (coal, gas fired) or industrial processes (e.g. cement, alumina)
- **Transport** of the captured and compressed CO<sub>2</sub> (usually in pipelines)
- **Underground injection** and geologic storage of the CO<sub>2</sub> into deep underground rock formations





# Why consider CCS in Ireland ?

Models require **significant use of CCS technology** to limiting global warming to 1.5°C (IPCC, 2021).



In Ireland, CCS could be used with:

- (1) **Gas powered electricity generation – reliable low-emissions electricity**
- (2) **Decarbonise heavy industry (e.g. cement)**
- (3) **Deliver negative emissions**
  - Bioenergy with CCS (BECCS)
  - Direct air capture with CCS (DACCS)
- (4) **Facilitate production of low-carbon blue-hydrogen**

## POLICY DEVELOPMENTS

The unprecedented **European Green Deal and Climate law** converting the political commitment to climate neutrality into a legal obligation, has led to the development of additional EU policy supportive of CCS.



EU Innovation Fund



Global CCS institute  
2021

# Calls for CCS in Ireland



Models with **CCS required** with CCGT power plants, becoming operation in 2031-2040



**Negative Emissions Technologies: CCS with bioenergy and direct air removal** has the greatest potential scale and permanence



States CCS required to **decarbonize cement manufacturing, oil refining, incineration**



CCS, with the **correct pricing** incentives, could be an **attractive option for the island of Ireland**

## Climate Action Plan 2021



An Roinn Comhshaoil,  
Aeráide agus Cumarsáide  
Department of the Environment,  
Climate and Communications

**CCS Deployment** in industrial sector will help achieve 51% reduction in emissions (**CCS retrofit 2 out of 4 cement plants**)

**Policy framework and roadmap** to be developed for CCS

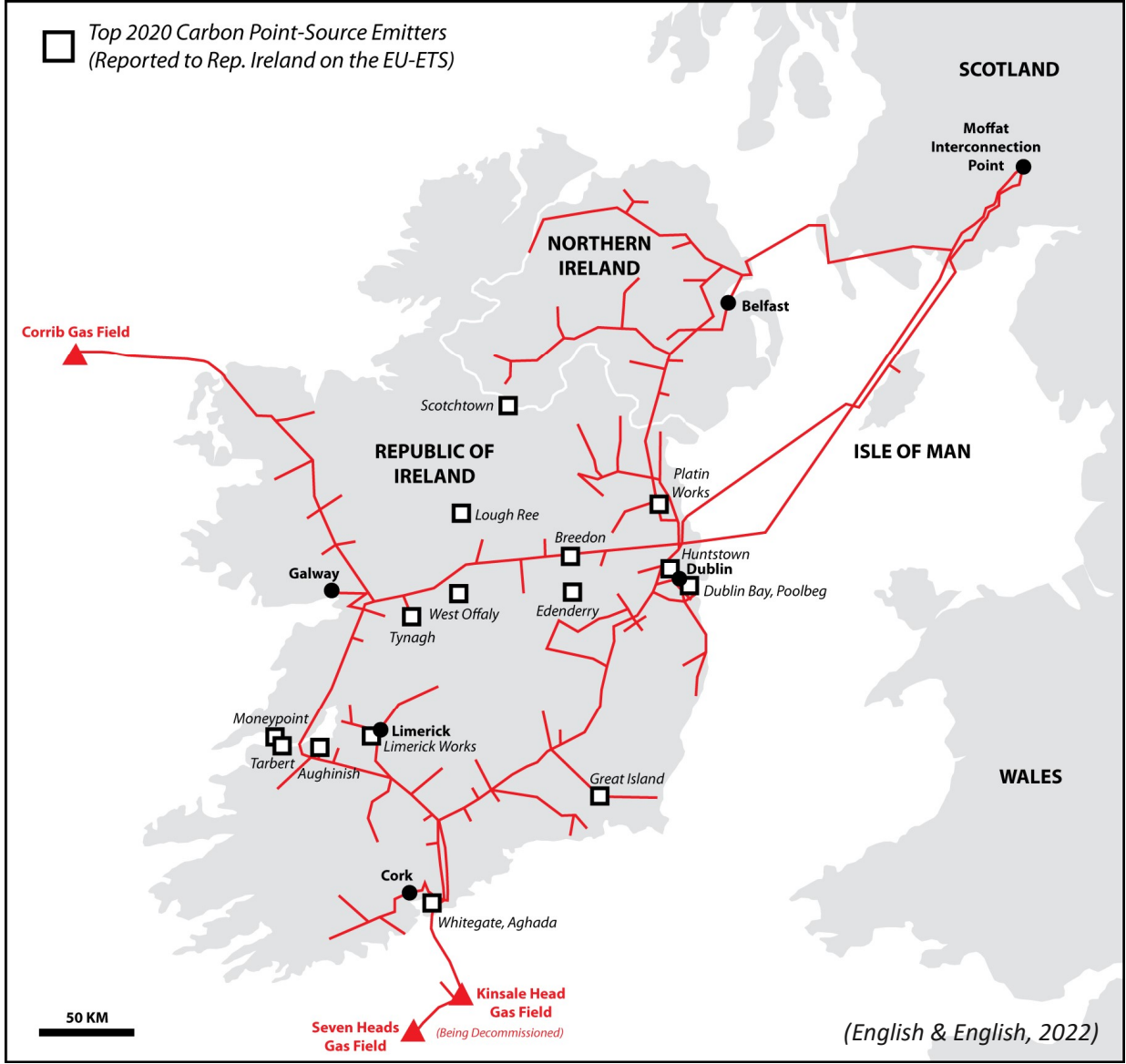
**Industrial CCUS deployment** to reach net zero by 2050 in heating/cooling sector

# Top Carbon Emitters (2020)

- Top point source CO<sub>2</sub> emitters (EU-ETS) for CCS

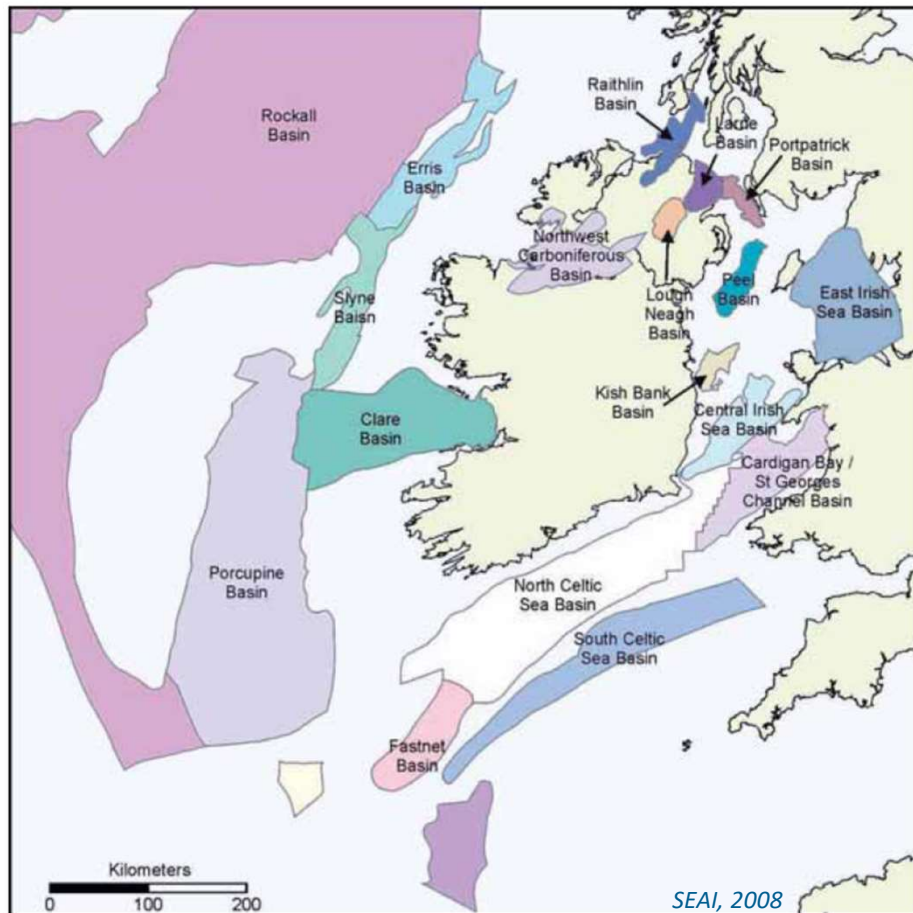
- **Electricity generation** 7.4 Mt

- **Heavy Industry**
  - Cement (4) 2.7 Mt
  - Aughinish Alumina 1.2 Mt





# Ireland's Potential for Offshore CO<sub>2</sub> Storage

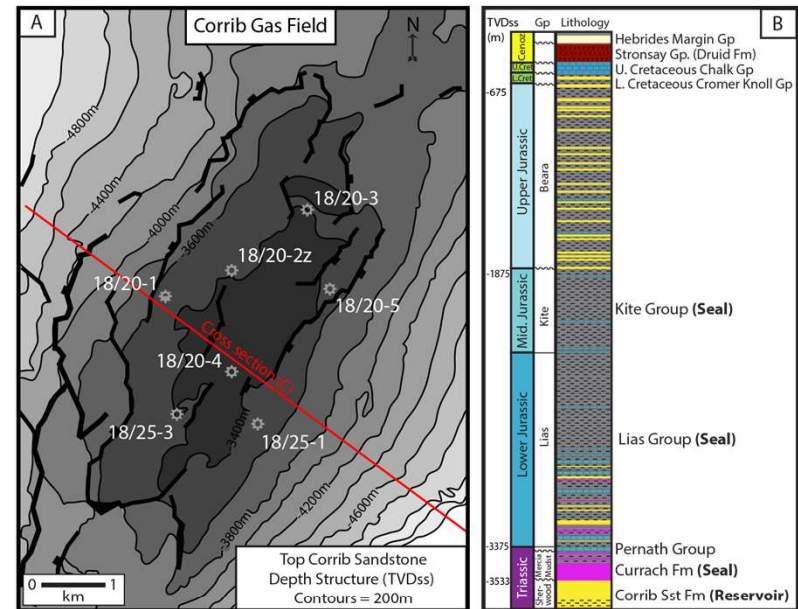


- Previous scoping studies have identified CO<sub>2</sub> storage potential in the Irish offshore (e.g. Lewis et al., 2009)
- Celtic Sea Basins
  - Depleted gas field (Kinsale Head)
  - **321 Mt storage capacity** (English & English, 2022)
- West of Ireland Basins
  - Producing gas field (Corrib)
  - **44 Mt storage capacity** (English & English, 2022)
  - Additional potential in saline aquifers of Slyne Basin
- Also, alternative energy storage potential
  - Including Irish Sea (i.e. proximity to Dublin)

# Objective: Characterize Ireland's Geostorage

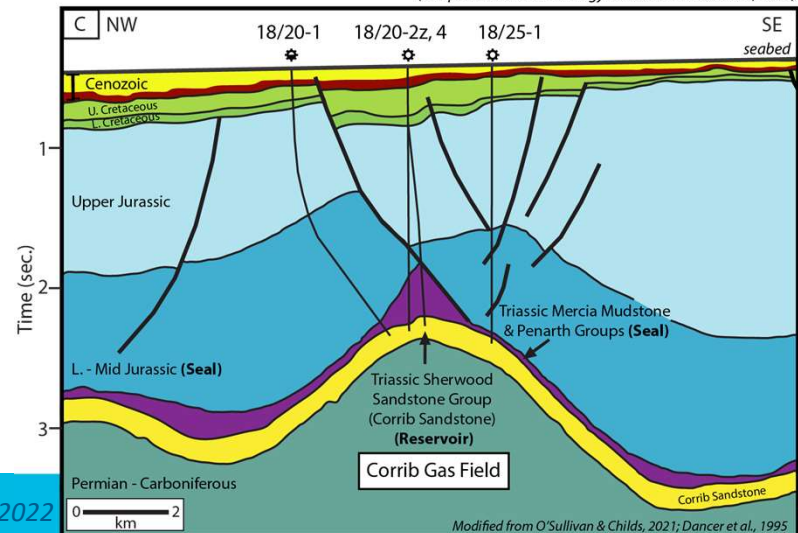
## GET - SET

- *Capacity*
- *Injectivity*
- *Seal Integrity*



Modified from Dancer et al., 1995

Corrib Field Stratigraphy (18/20-1)  
(adapted from Merlin Energy Resources Consortium, 2020)



Modified from O'Sullivan & Childs, 2021; Dancer et al., 1995

## Objective: Characterize Ireland's Geostorage

=> *Subsurface models required for resource & risk assessment*

### Capacity

- Structural Mapping
- Stratigraphic analysis of storage complex
- Reservoir Characterization
- Pressure & Temperature
- Aquifer Hydrodynamics
- Volumetric estimates

### Injectivity

- Static Model
- Dynamic Models (Field)
- Injectivity at Wells
- Well Placement
- Phase Behaviour of CO<sub>2</sub>
- Mineral Reactions
- CO<sub>2</sub> Flow over Time
- Volumetric estimates

### Seal Integrity

- Limits to Reduce Risk of:
  - Induced Fracturing
  - Seal Breach & Leakage
  - Fault Reactivation
- Secondary Seal Systems

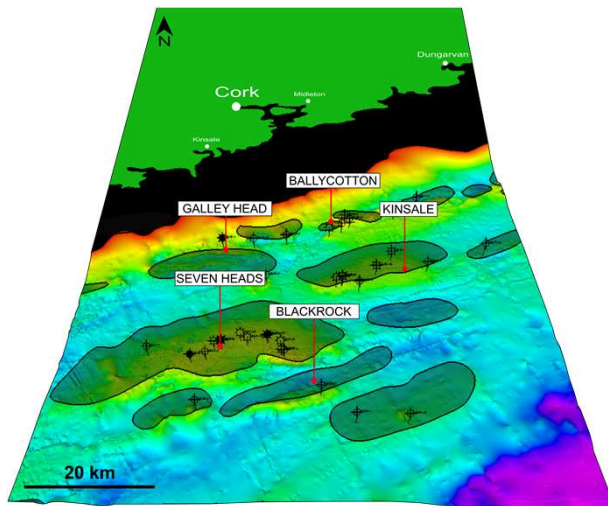
# Objective: Characterize Ireland's Geostorage

## *Ongoing Post-Doc Projects Currently Progressing iCRAG 2*



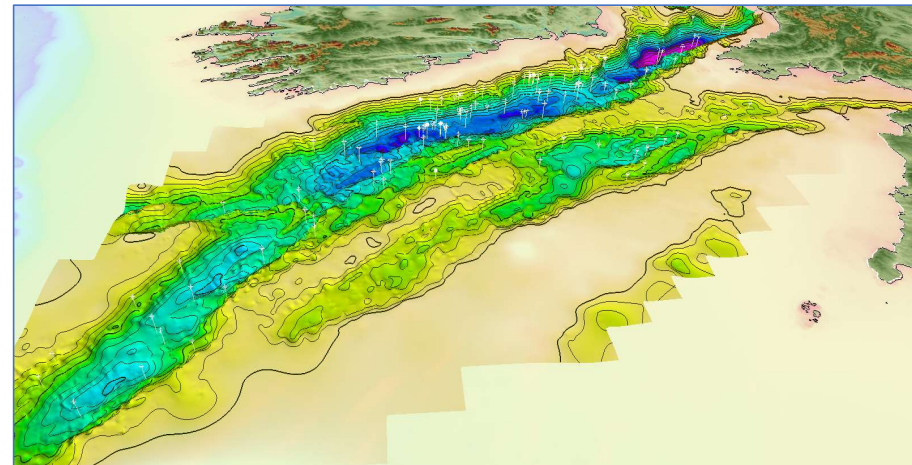
Scoping of structural CO<sub>2</sub> storage potential in the Celtic Sea Basin

Pablo Rodriguez-Salgado



CO<sub>2</sub> Hydrate sealing potential for CCS, HydSeal

Srikumar Roy



Impact of fault geometry on predictions of fault reactivation

Janis Aleksans

# Ready, GET-SET, Go!

- **G**eo-storage in the **E**nergy **T**ransition: **S**cience, **E**ngineering, **T**echnology
- GeoStorage Applications in Ireland: CCS, Hydrogen, Energy Storage
- Objective: Characterize Ireland's Geo-Storage Potential
- Multi-Year Research Project currently in Scoping Phase
- Feedback & Expressions of Interest welcome ([Kara.English@ucd.ie](mailto:Kara.English@ucd.ie))



iCRAG



UCD School of Economics  
Scoil na hEacnamaíochta UCD



THE UNIVERSITY  
of EDINBURGH

<https://www.ucd.ie/earthsciences/research/sustainablegeoenergy>

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