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**Cronfa Datblygu
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FLEXIS

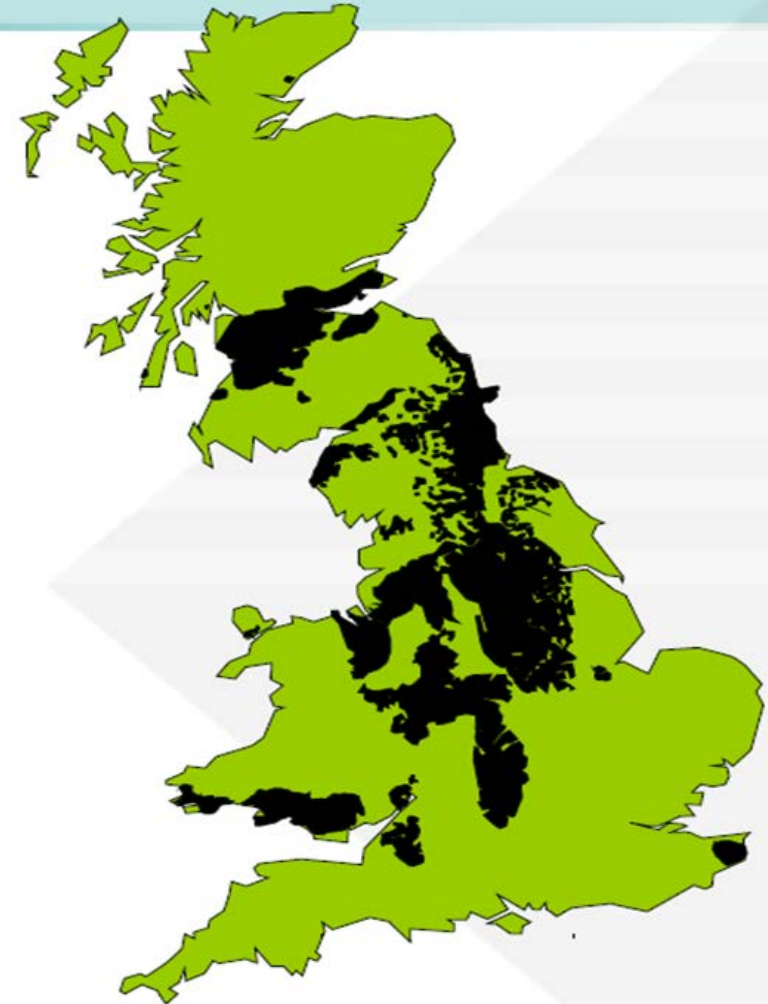
SMART ENERGY FOR OUR FUTURE
YNNI CALL AR GYFER EIN DYFODOL

Mine Water Heat Recovery

- **7.7 million** properties on UK Coalfield
- **2 million** sit on the shallow coal workings
- Many areas have flooded mine workings in the near sub-surface

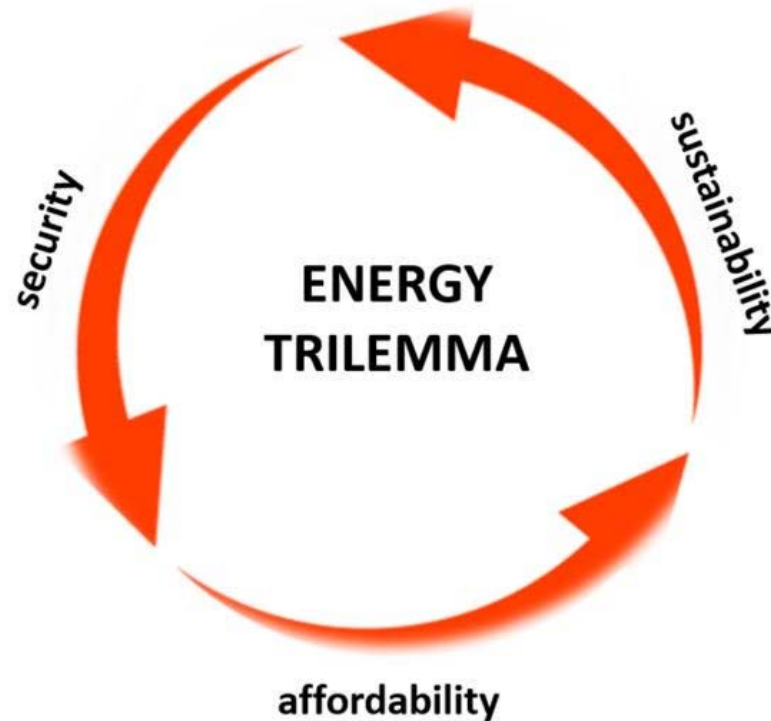
Potentially a large resource

The UK Coalfield



Drivers for Exploitation

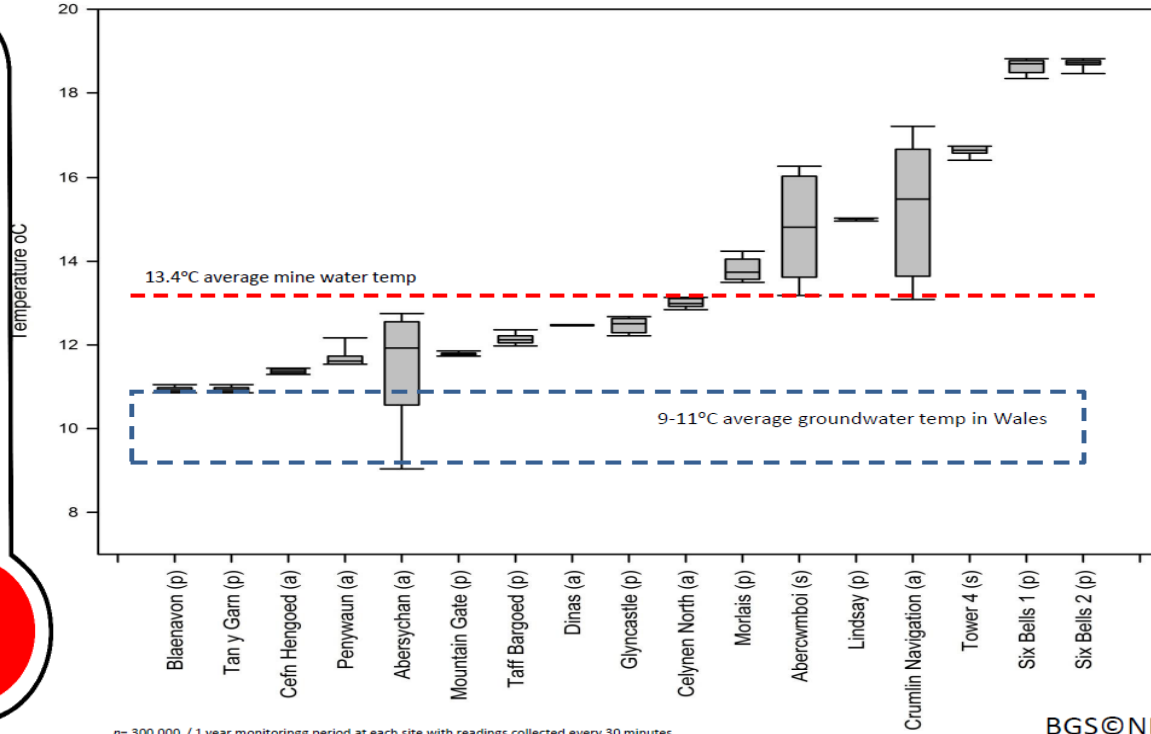
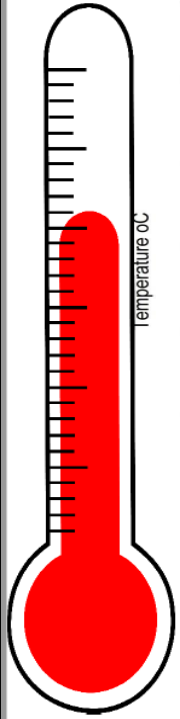
- Community heating/cooling provide answers to



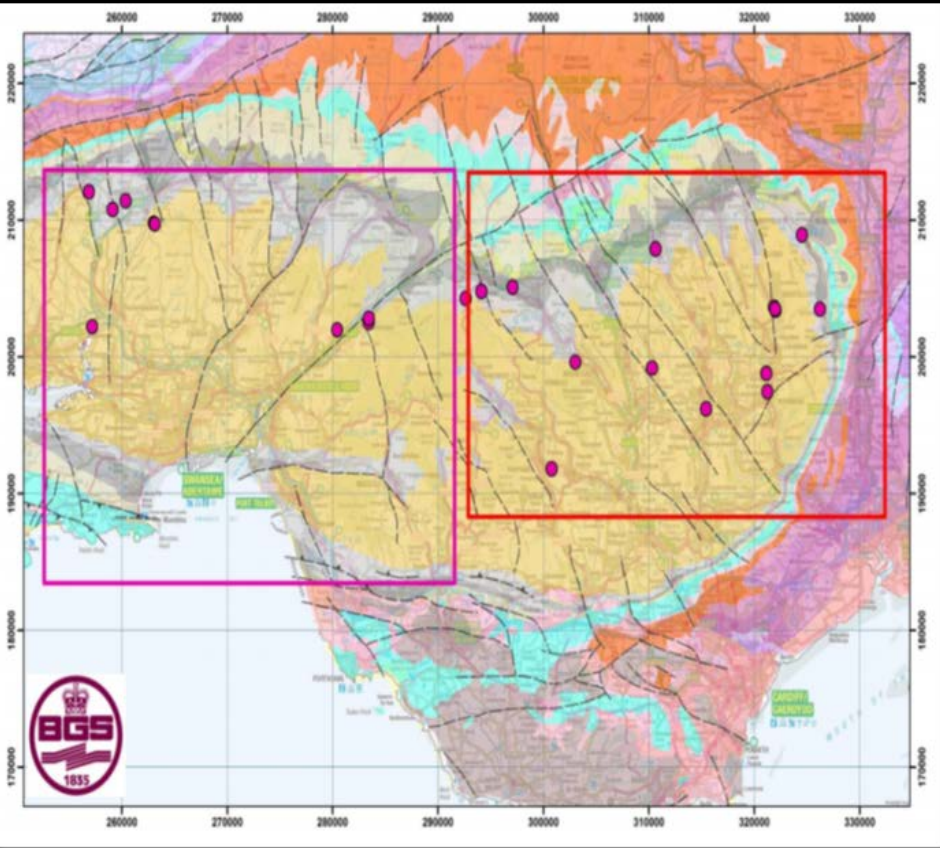
- Mine water can provide a focus for sustainable regeneration of former mining areas, demonstrating a new renewable energy resource that can deliver heating and cooling for sustainable communities

Surface Discharged Mine Water Monitoring

RANGE OF MINE WATER TEMPERATURES



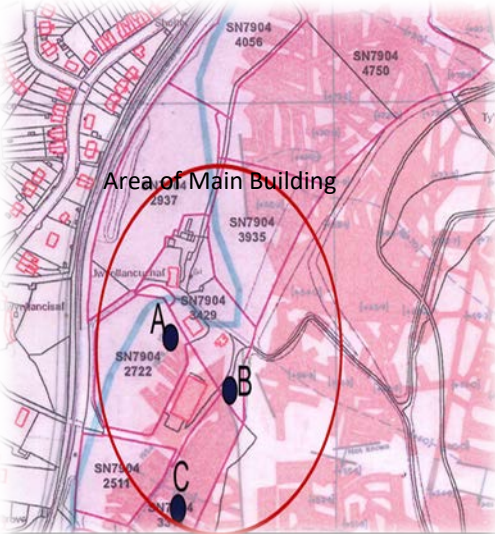
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Demonstration Site: First in Wales



Mine Workings near the building

Location	Crynant in the Dulais valley
Building and fuel Type	Farmhouse with workshops and adjoining physiotherapy business; Oil and Electric
GSHP system	Space heating and hot water; 30kW
Borehole	2 Nos. 65m Deep borehole
Flow rate	7 m ³ /hr
Operational since	April 2014



Heat pump with data collection and logger system



Drilling in action



Abstraction and Discharge borehole



System data acquisition at site



Heat From Abandoned Coal Mine

In- situ Temperature
@ 21°C
Rest Water Level
@ 92 m bgl
Mineworkings
@ 225 m bgl

Heat Generation Models
Centralised @ 70°C
De-Centralised @ 20°C

Potential to CUT fuel cost

Ground Exploration

Generation & Finance



**Caerau Minewater
Project**



In House Solutions

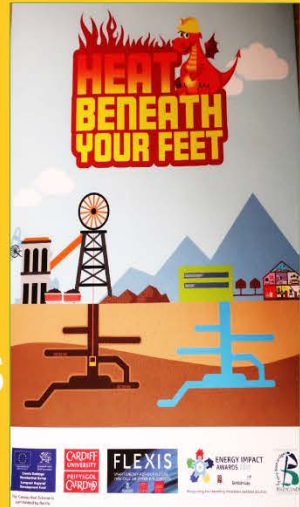
Engagement

For Insulated House
Peak: 5.1 kW
Annual Heat: 7888 kWh

Total Heat Demand for Study Area
Peak: 6.20 MW
Annual Heat: 12519 MWh

**Highlighted the
STRENGTHS of
the project**

**Identified the
KEY ENABLERS
within the
community**





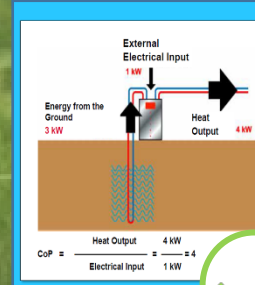
Affordable

Low Running Costs



Local Heat Source

Turning environmental liability into an economic asset



Energy Efficient

Due to higher water temperature Heat pump COP ~4-6



Low Carbon

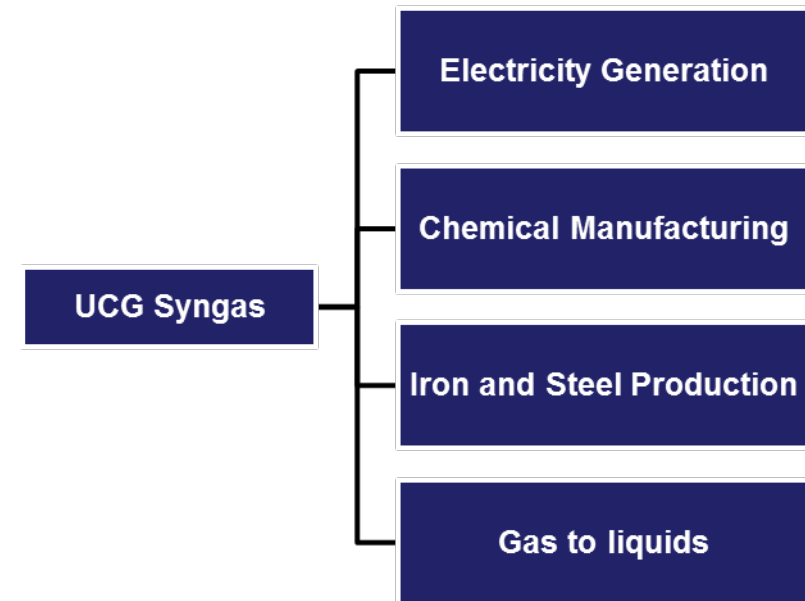
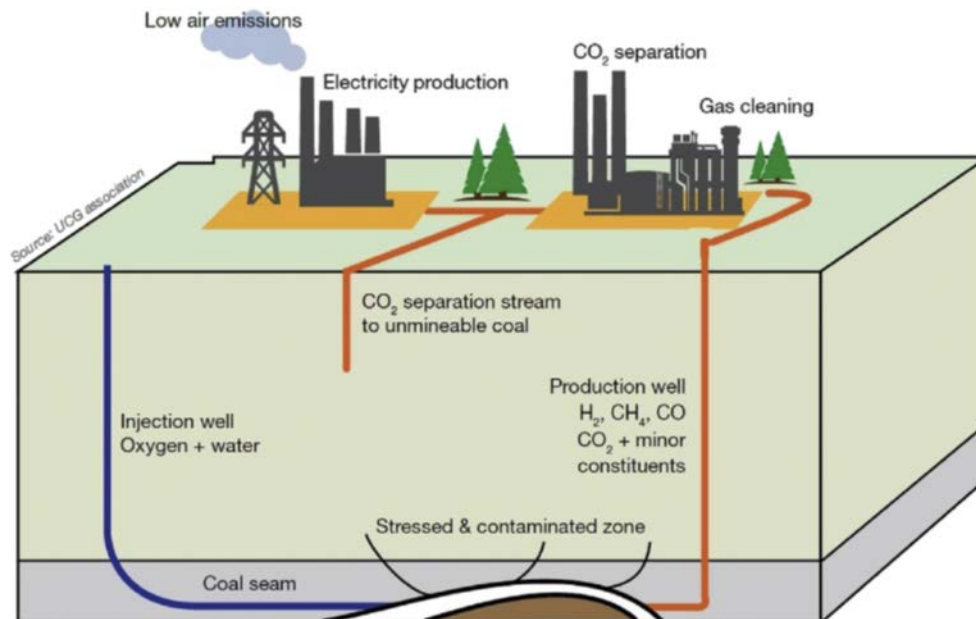
Reduction up to 90% compared to mains gas



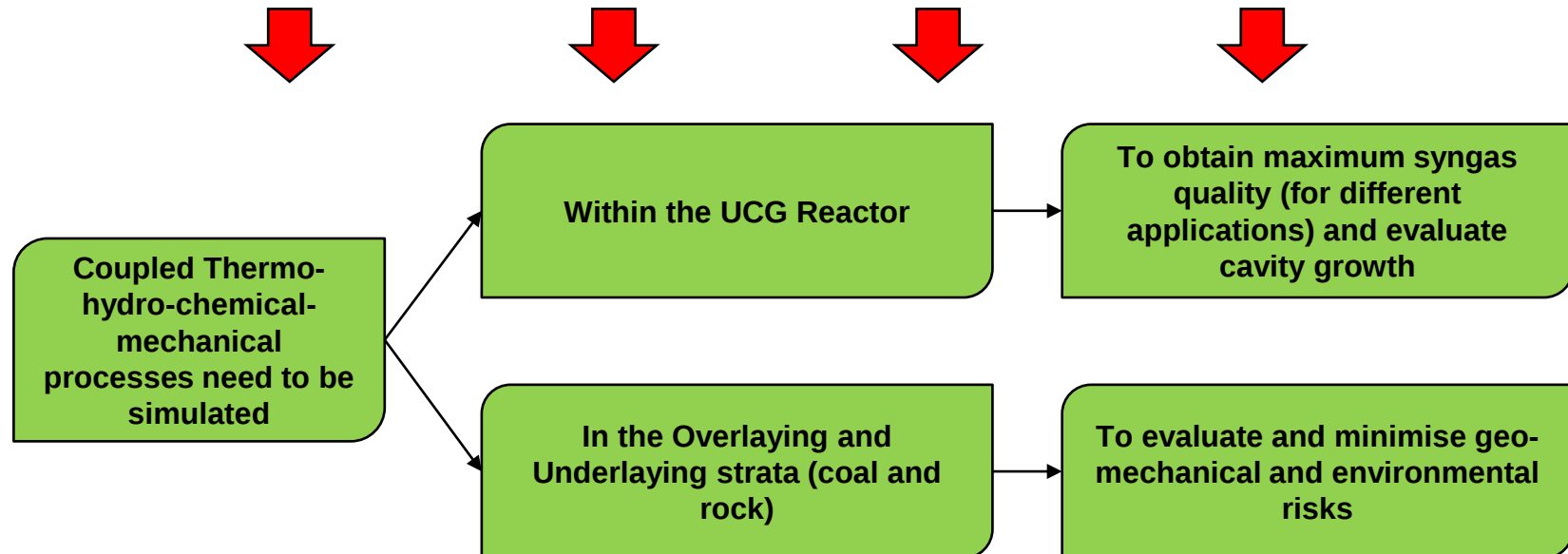
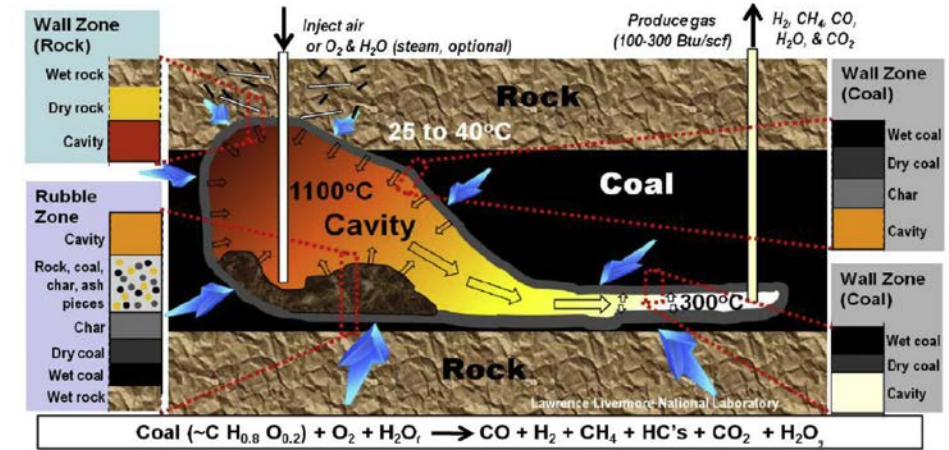
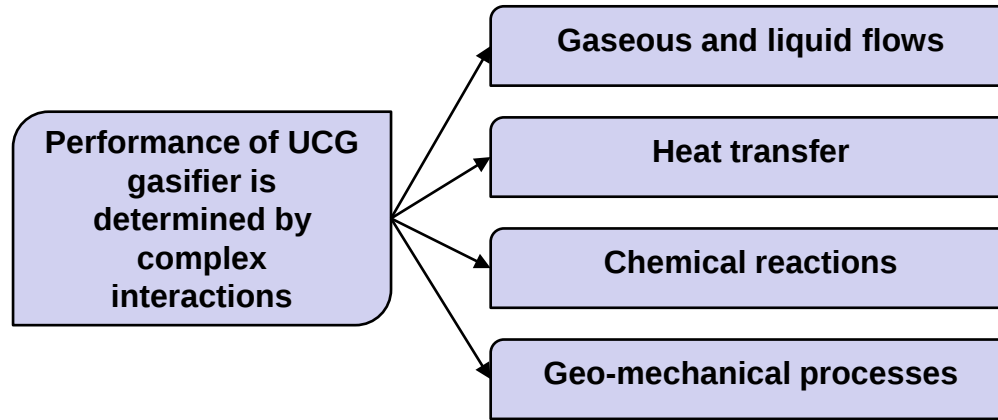
Underground Coal Gasification (UCG)

- **Process of converting coal in situ into a combustible gas**

- Injection of O_2 /Air and H_2O , to obtain SYNGAS (H_2 , CH_4 , CO , CO_2)
- Clean coal technology with significant economic and environmental benefits over conventional underground mining and surface gasification
 - Low operating costs, minimal surface disturbance, potential for UCG-CCS



UCG – Aspects considered



Coalbed Methane (CBM)

Coalbed Methane (CBM)

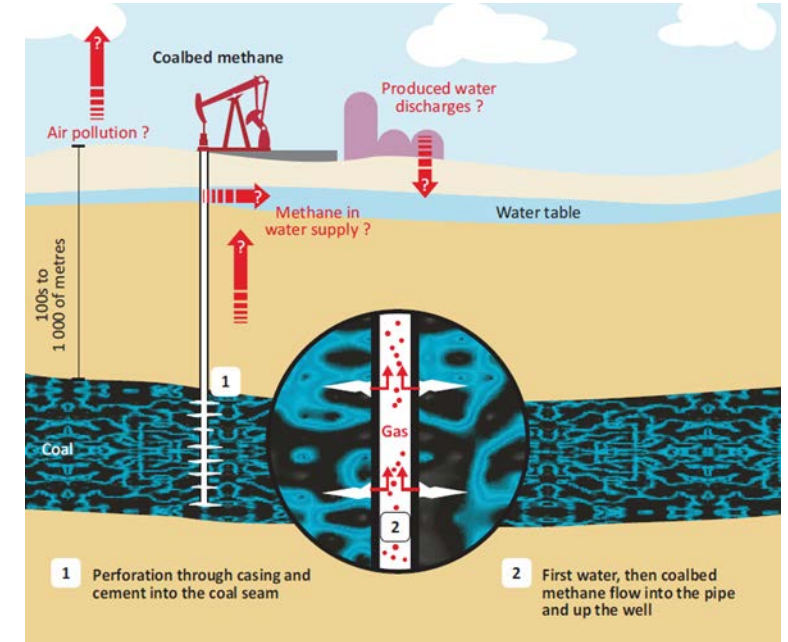
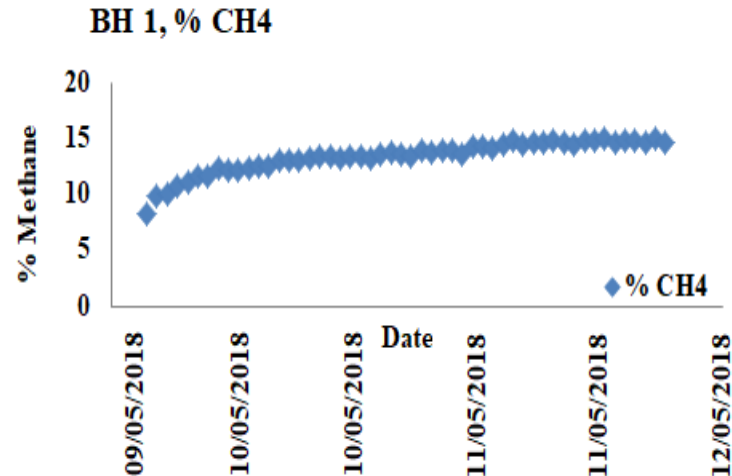
Investigating the potential for undertaking CBM from unmineable coal beds

Understanding the baseline geochemistry of the potential CBM sites

Laboratory experiments (Adsorption and Flow measurements)

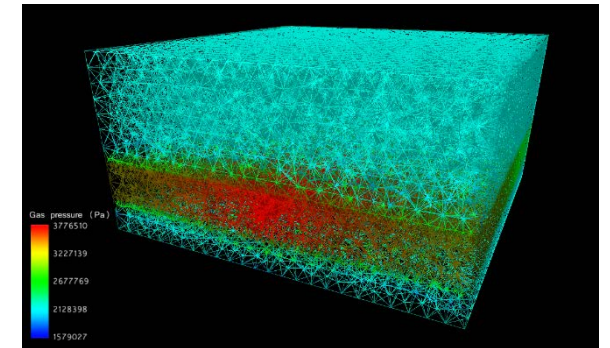
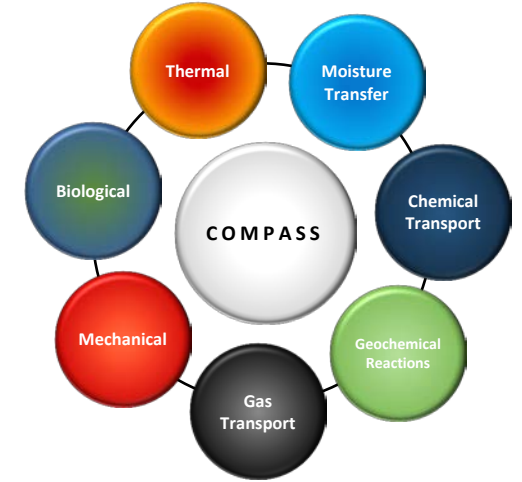
Numerical Modelling (COMPASS code)

Field tests and chemical analysis (water, soil/rock, air)



MEGA+ Project – GRC's role

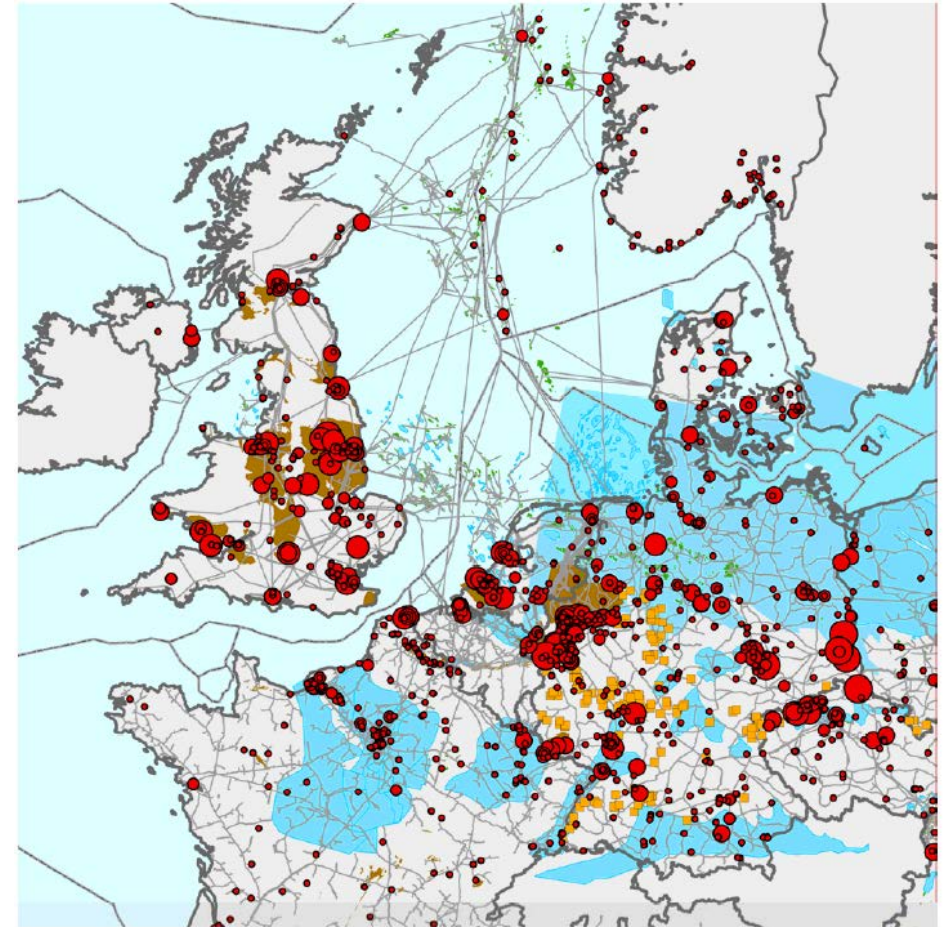
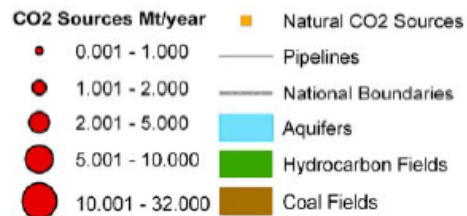
- Coupled numerical modelling of CBM-UCG-SNG operation in selected study areas
 - Thermodynamic modelling of the UCG process and THCM modelling of the UCG at the reactor scale and surrounding field
 - Model coupling and up-scaling
- Verification of the high pressure UCG options in small-scale gasification tests and sample characterisation
- Preparation of best practice guidelines for CH₄ oriented UCG



CO₂ sequestration in coalbeds

- Failure to enact CCUS will lead to overshoot of Paris Agreement 1.5 °C ambition (IPCC, 2018)
- Coal regions collocated with industry
- CO₂ adsorption provides storage security
- CO₂-ECBM recovery to offset costs
- Avoidance of additional emissions from CBM
- Excess storage capacity (2:1 ratio CO₂:CH₄)

GeoCapacity maps of Sources & Sinks



South Wales Coalfield

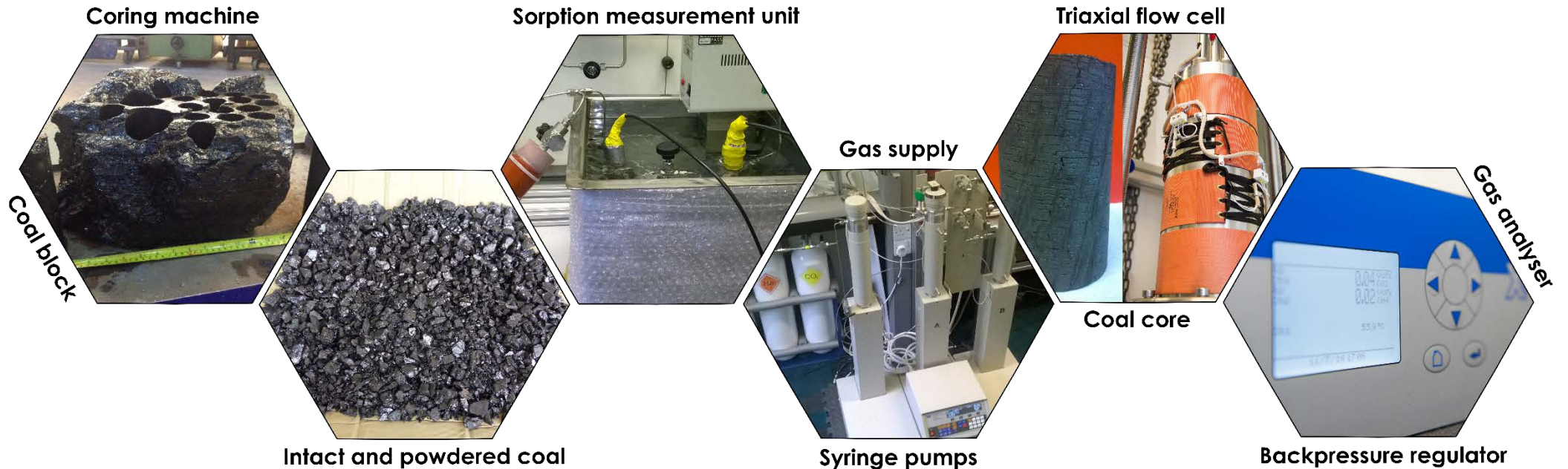


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Laboratory experiments

- Seren Multipurpose Gas Lab
 - Adsorption-desorption measurement unit for powdered and intact coal samples
 - Flow measurement unit – triaxial cell for coal cores up to 200 mm in length and 100 mm diameter

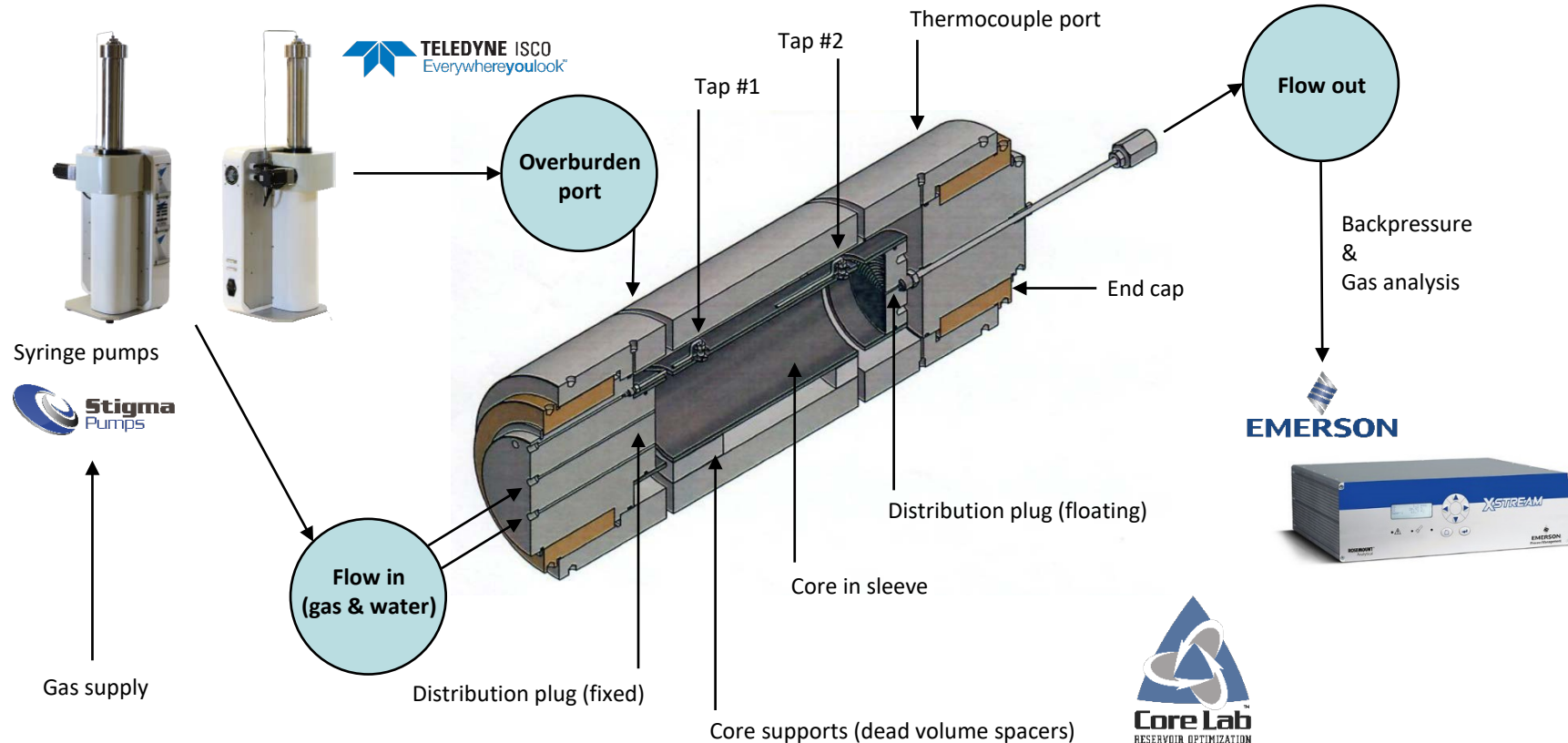


Laboratory experiments

- Pressure-tapper hydrostatic core holder

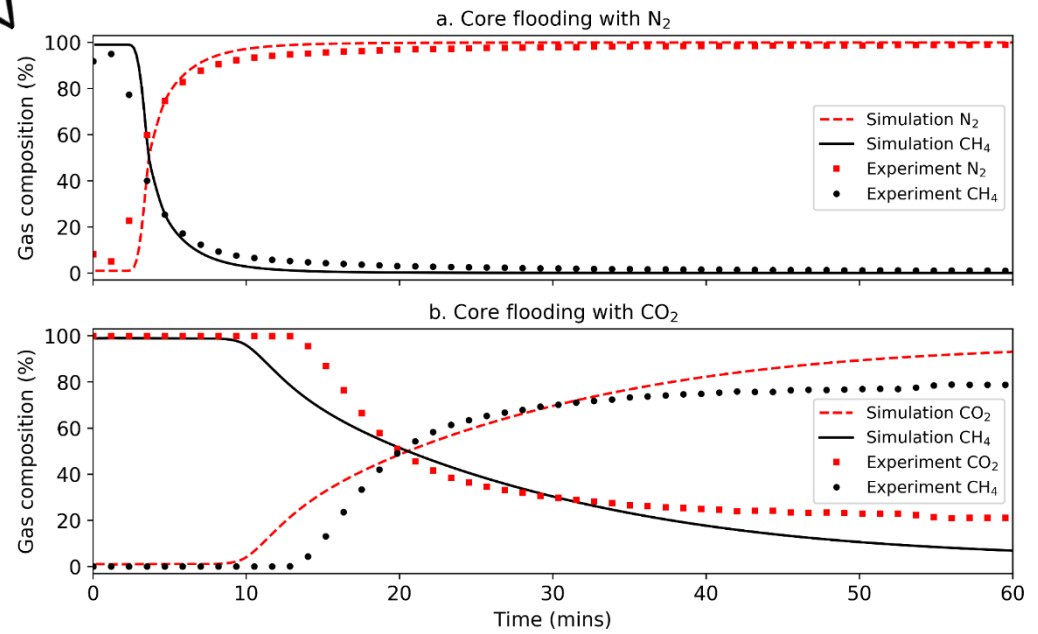
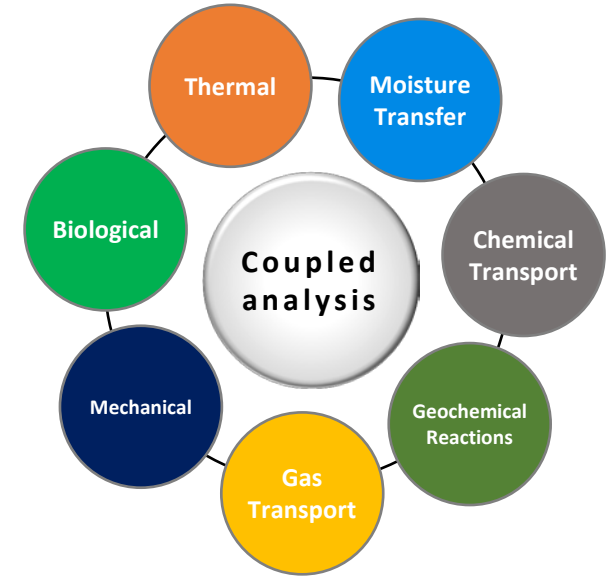
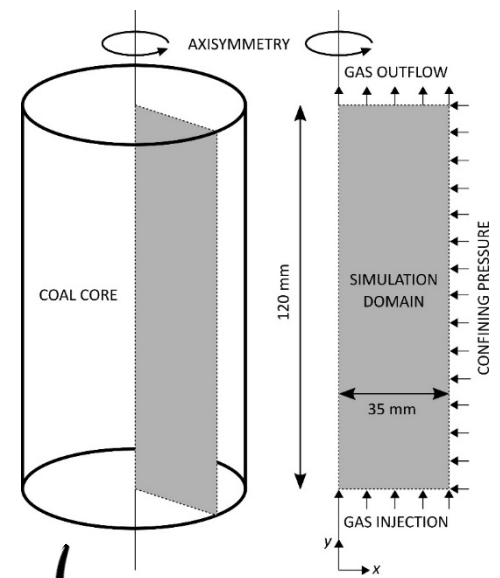
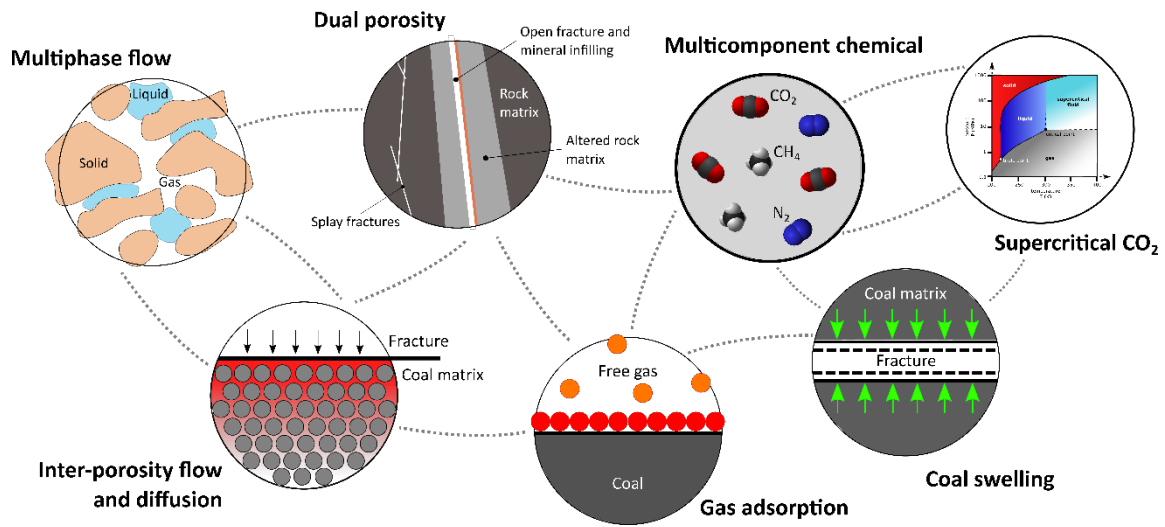
Specification

- Core dimensions : 600 mm L x 100 mm Ø
- Working pressure / temp : 700 bar / 150 °C
- Stainless steel body
- Hastelloy C wetted parts (corrosion resistance)
- Pressure taps at 200 mm & 400 mm
- Supercritical CO₂ injection and overburden pressure
- Cost £100k



Numerical modelling

- CO₂ transport and storage behaviour
- Focus on coal swelling
- Hybrid dual porosity-discrete fracture model
- Larger scale applications





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Thank you
Diolch yn fawr