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The ETI CCS Programme – Supporting Roll Out of CCS in the UK

Canada – UK Workshop 16th March 2015

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What is the ETI?

- The ETI is a public-private partnership between global energy and engineering companies and the UK Government.
- Targeted development, demonstration and de-risking of new technologies for affordable and secure energy
- Shared risk
- Whole energy system view



ETI members



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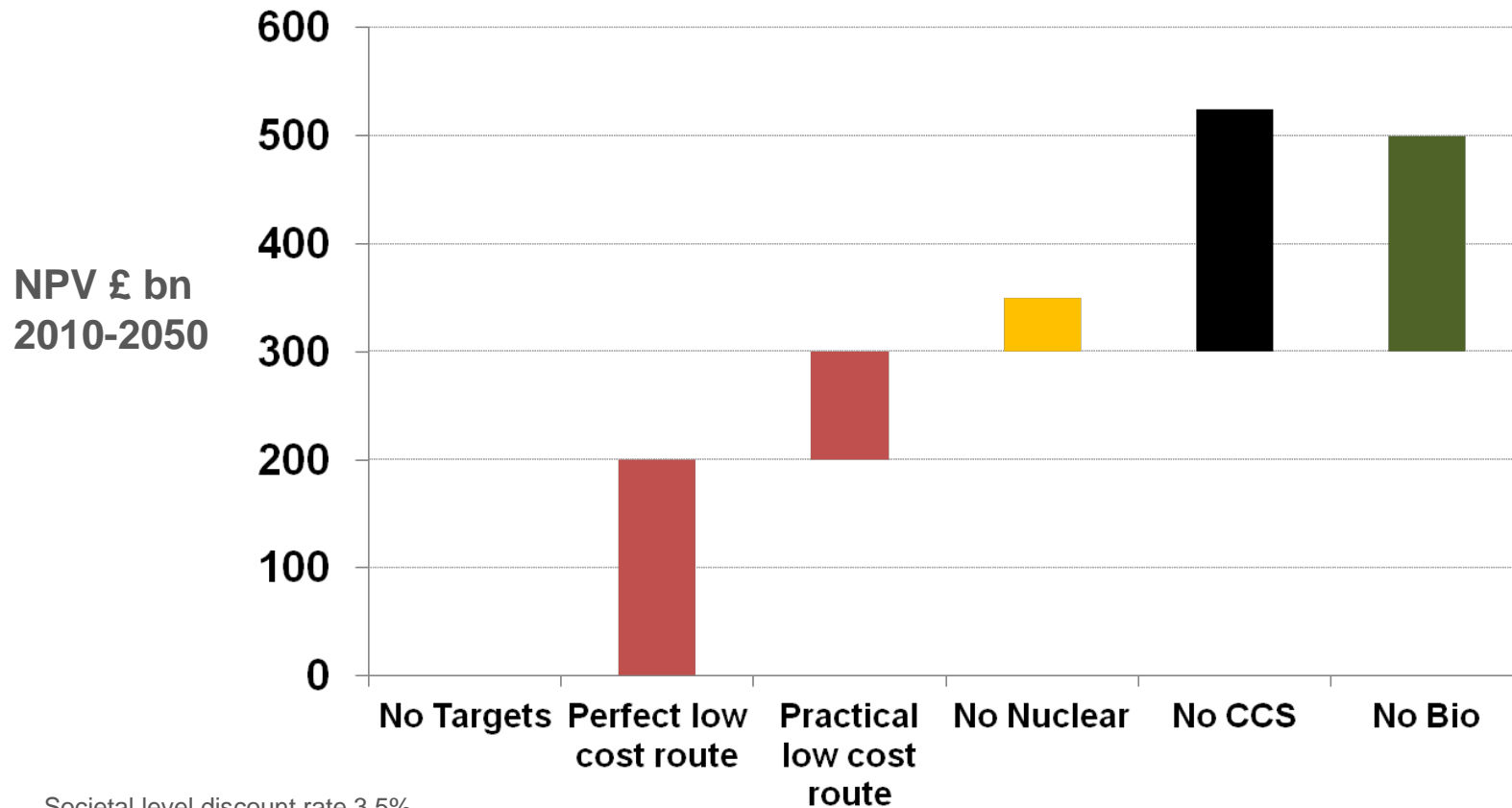


THE VALUE OF CCS



Getting the UK energy system to 2050

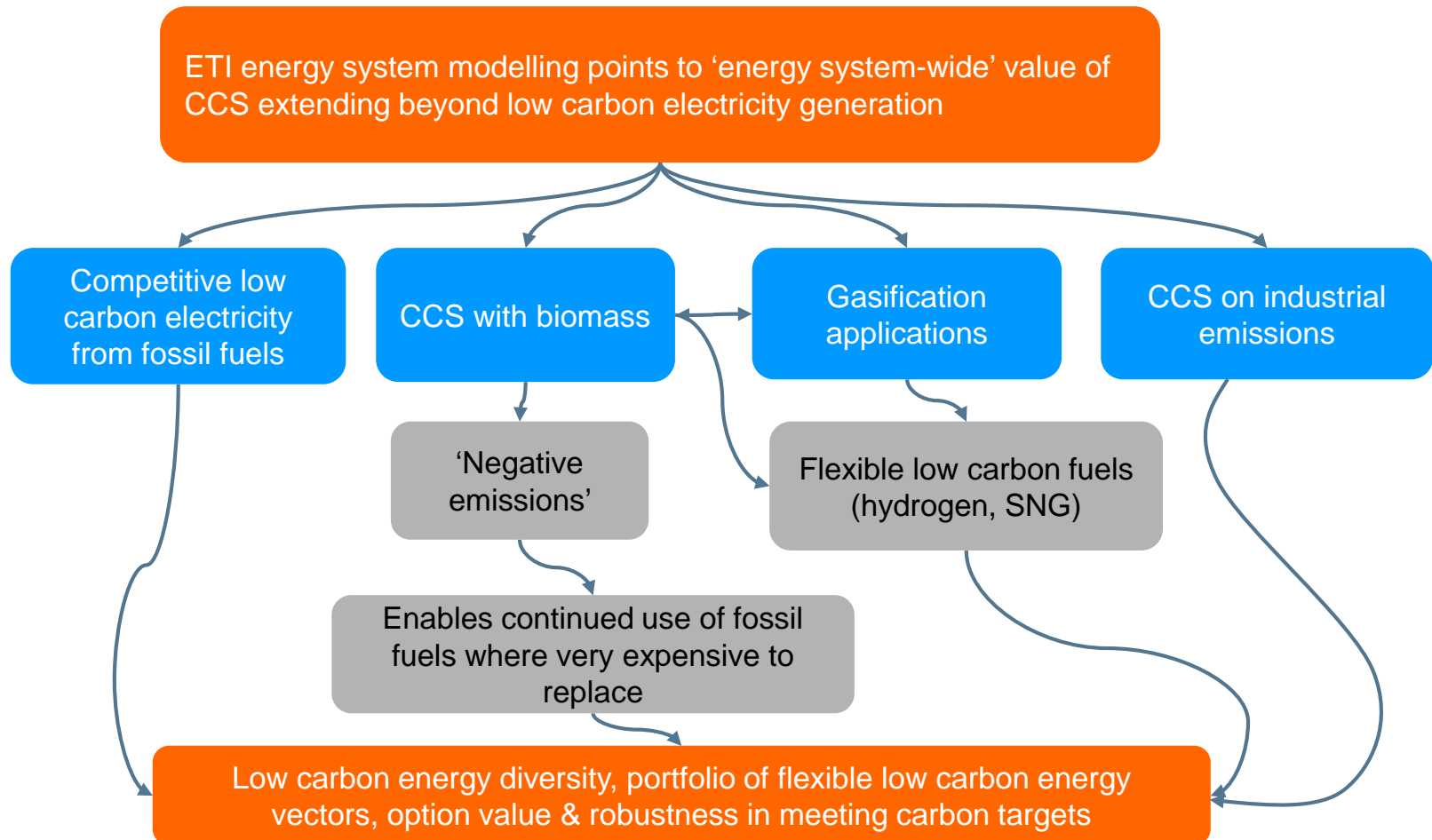
Incremental 2010-2050 cost of delivering national energy system which meets CO2 targets



Societal level discount rate 3.5%



CCS is high value as it creates options



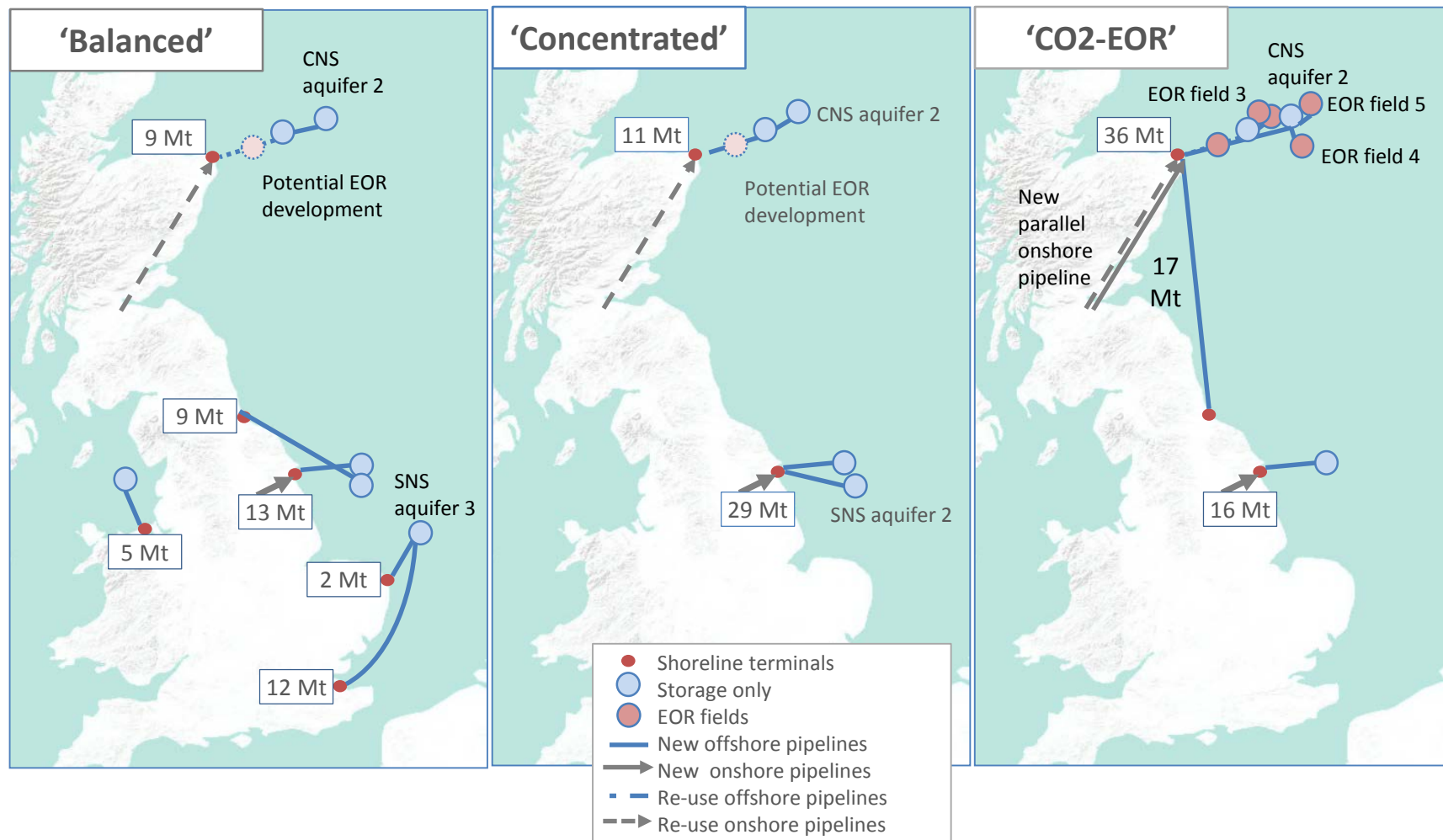


CCS Roll out in the UK

- Phase 1 (now – 2020)
 - DECC Commercialisation Competition
 - FEED studies for ‘White Rose’ and ‘Peterhead’ projects
 - Capital support for at least one project plus ‘Contracts for Difference’
- Phase 2 (now to ~2025)
 - Follow on projects
 - Supported by bespoke CfDs
- Phase 3 (2025 onwards)
 - CCS is a competitive low carbon technology in the UK energy system
- UK Ambition – up to 13GW by 2030
- ETI has developed three potential scenarios leading to ~10GW (plus industrial emissions) by 2030



Potential 2030 scenarios for the UK





CCS Scenarios – Key Requirements for CCS Development

- Timely implementation of both CCS Commercialisation Programme projects
 - Act as strategic hubs supporting lower cost Phase 2 projects
- Early investment in physical appraisal to expand the promising 5/42 and Captain aquifer stores and appraise further sites
 - Requires public funding or creation of sufficiently strong incentives to bring forward private investment
- Enable early investment decisions by ‘Phase 2 projects’
 - award a further 3 appropriately designed CfDs by 2020
- Stimulate a robust project development pipeline by delivering clear signals to investors and project developers about the scale and strength of policy (levy control framework support) commitment to developing CCS

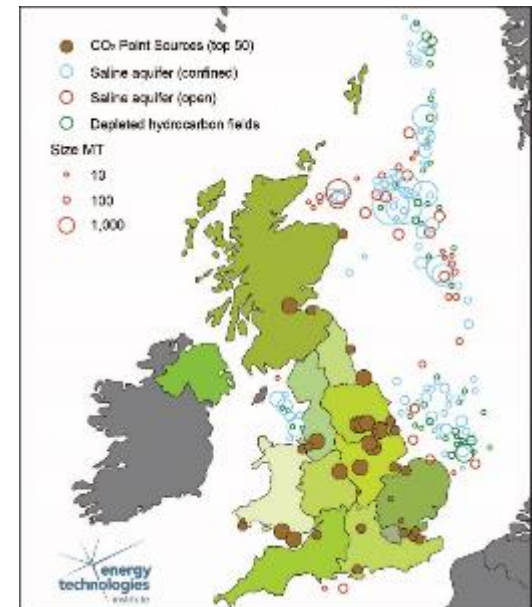
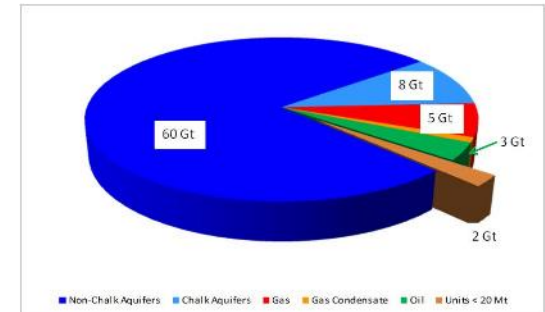


ETI PROGRAMME: CREATING THE BUILDING BLOCKS



Storage Appraisal

- ETI has delivered, through a £4m investment in the UK Storage Appraisal Project:
 - Realistic, defensible & fully auditable assessment of potential CO₂ storage capacity in the UK
 - Overall estimate of capacity
 - Unique & comprehensive GIS storage database
 - Capacity
 - Security of storage
 - Economics
 - Underlying data
- Database licensed to The Crown Estate and British Geological Survey
 - Launched in 2013, as CO2Stored
 - Available free to academia and by subscription to industry





Capture – Benchmarking Technologies

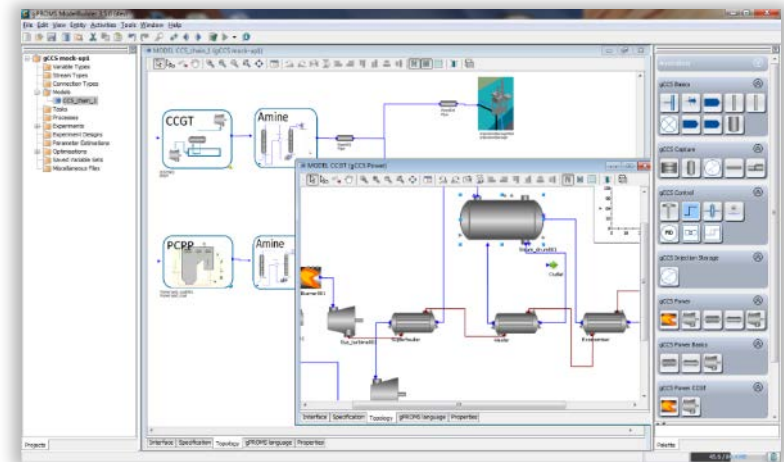
- ETI has delivered:
 - Independent, consistent techno-economic performance benchmarks for current technologies – peer reviewed by CCS SAG:
 - pre-combustion
 - post-combustion (coal and gas)
 - oxyfuel
 - Study on impact and opportunities for biomass with CCS
 - Dedicated and co-firing
 - Objective selection of ‘game changing’ capture technologies for coal and gas power for ETI Investment
- Continuing technology scouting – objective assessment of upcoming technologies





CCS System Design and Operation: System Modelling Toolkit Project

- Toolkit based on PSE's gPROMS platform
 - Involvement of CCS domain experts (CO2Deepstore, E.ON, EDF & Rolls-Royce)
 - Comprehensive toolkit enabling full-chain models of CCS systems
 - Power generation (coal, gas)
 - Capture
 - Compression
 - Pipeline
 - Wellhead & injection
 - Steady state and dynamic simulation
 - State of the art physical properties engine (gSAFT)
- Commercial product (gCCS) launched by PSE in July 2014





ETI PROGRAMME: SECURING PHASE 1



CCS Storage site development

- ETI provide £2M support to the National Grid programme to appraise a Southern North Sea aquifer
- Drilling successfully completed in August 2013
- Results confirmed quality and capacity of the store
- ETI working with National Grid on analysis of results
- Site will be used for White Rose demonstration project



Images courtesy National Grid



Storage – Measurement Monitoring and Verification

- £5M MMV Project launched in April 2014
 - Project will develop and demonstrate MMV system for marine and shallow subsurface monitoring
 - Aim to have MMV system proven and ready for application by DECC commercialisation projects in 2018
 - Project led by Fugro GEOS, with Sonardyne, National Oceanographic Centre, BGS, Plymouth Marine Labs and University of Southampton

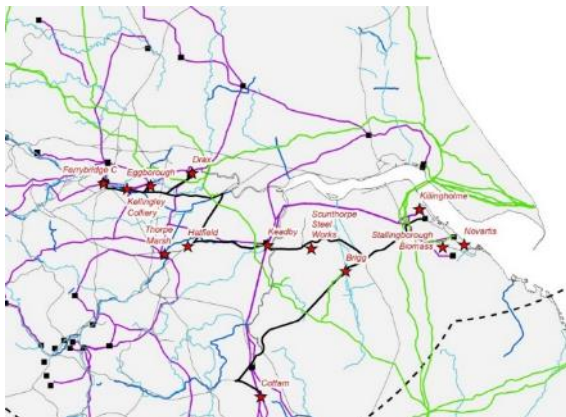




ETI PROGRAMME: ACCELERATING PHASE 2



- Opportunity to develop 'low cost, low risk' GW scale power project, supported by CFD
 - Rapid reduction in cost and risk by appropriate selection of technology, location and use of existing assets
 - Attractive to developers and investors with a low to moderate risk appetite
 - Be robust to the developing circumstances in CCS, potentially allowing companies to share risk through a co-venturing model

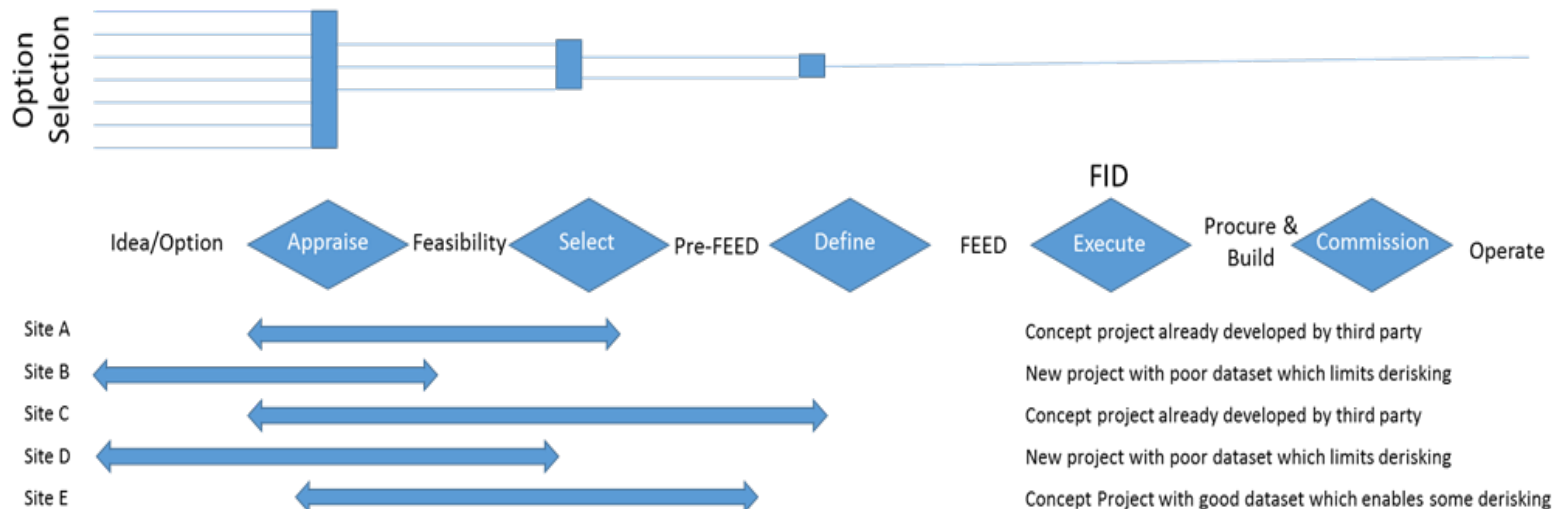


- ETI aims to support early stage development project
 - Create investment case for identified project
 - Learnings/insights to catalyse further projects
- Expect launch of Request for Proposals in Q2/2015



UK Strategic UK CCS Storage Appraisal Project

- Sustain a storage development trajectory that services 10GWe - 50Mt/a of storage operational in 2030
- Down-select a portfolio of 5 stores for detailed de-risking: build on Phase 1 infrastructure
- Provide options that will support Phase 1 decisions and early Phase 2 options
- Develop commercial scale, low cost and risk options towards full appraisal in the 2020-2026 period (and hence operation by 2030)
- Estimate and schedule and resources needed to get down selected stores fully appraised and then operational
- Make results available to current and potential future stakeholders
- £2.5M funding provided by DECC, commissioned and delivered by the ETI



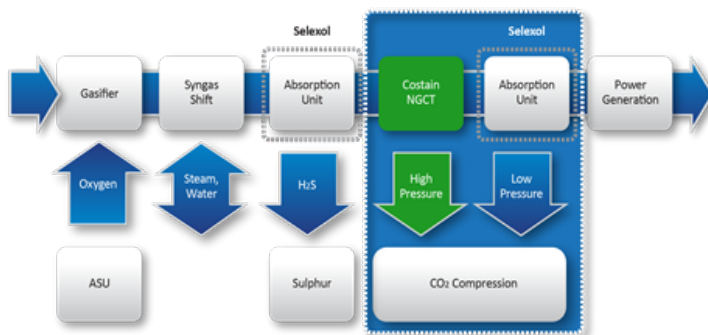


ETI PROGRAMME: TECHNOLOGY FOR PHASE 3 - AND BEYOND



Next Generation Capture Technologies

- Post-combustion capture from CCGTs
 - Pilot-scale development of novel solid adsorption technology based on rotating bed
 - Project led by Inventys (Canadian SME), supported by UK engineering
 - Projected reduction of LCOE of over 10%



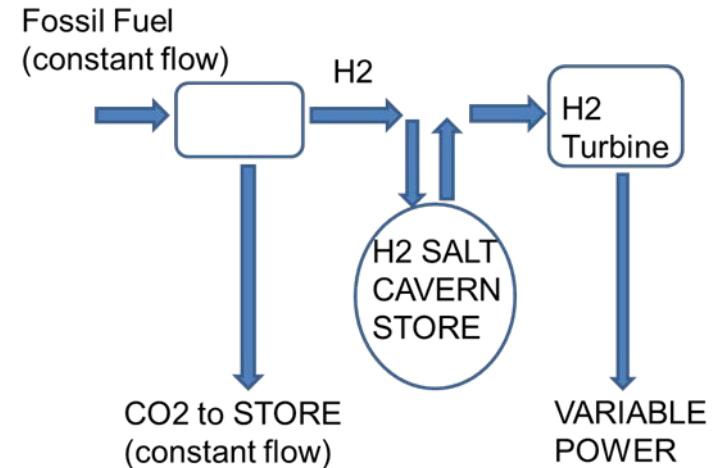
- Pre-combustion capture for coal:
 - CO₂ capture by physical separation
 - Technology developed and project led by Costain
 - Projected reduction of LCOE by 6.5%
 - 95% capture readily achievable
 - £3.5M FEED study completed
 - Aim to build 17 MWe pilot plant



Hydrogen - a clean energy source

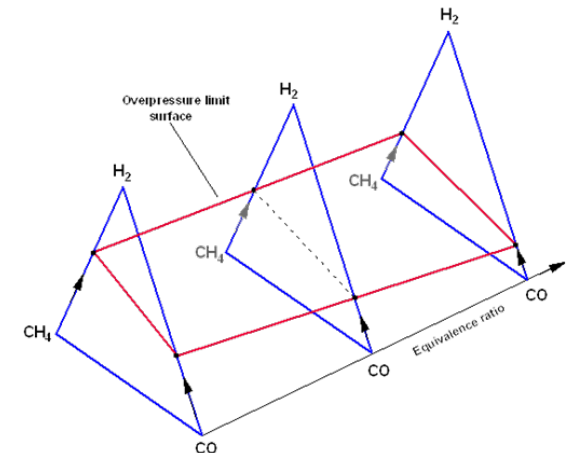
Hydrogen Storage & Flexible Turbines

- Use of salt caverns to store hydrogen
- Allows intermittent use of clean energy for power, or other users
- Alternatives to fossil fuels examined
- Cost effective vs alternatives



High Hydrogen

- Understanding limits on safe use of hydrogen-rich fuels in power production by GTs and engines.
- Laboratory test work completed
- Large scale test rig in Buxton recently commissioned





BRINGING IT ALL TOGETHER



A clear CCS infrastructure development plan to 2025 is emerging

Development pathway set by DECC's commercialisation programme

Pursue network development

- Secure, low cost, multiple emitters (gas, coal, chemicals)
- Expandable with rapid ramp up capability

New CCS power plant needed

- 2 GW of new gas plant
- 1 GW of new coal plant

Develop at least 2 Hubs

- Humber Hub (SNS) appears to have the lowest overall cost

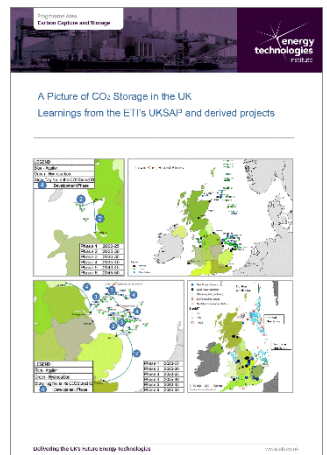
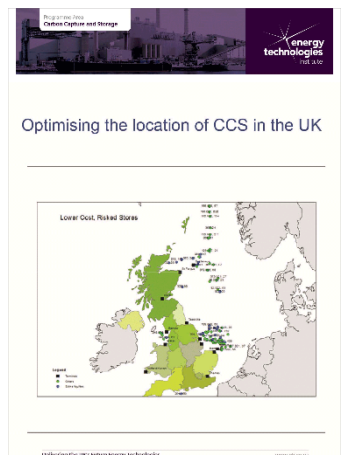
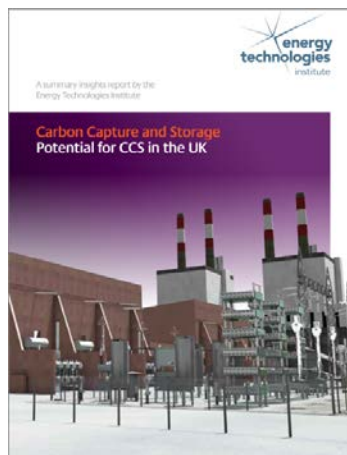
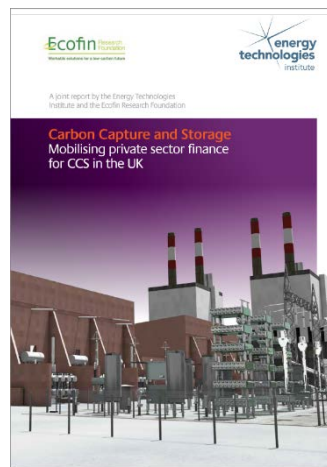
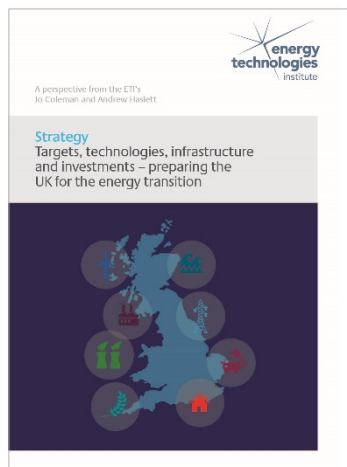
7 New Aquifers need to be appraised

- One appraised every year between 2018 and 2025

	Investment cost to 2025 (£Bn 2010)
Generation	3.2
Capture	2.5
Transportation	0.5
Storage	0.7
Appraisal	0.2
TOTAL	7.1 (3.9 for CCS)



ETI: Building Confidence, Sharing Knowledge





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