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Building the UK CCS sector by 2030
Scenarios and Actions

Den Gammer for UKCCSRC

8th September 2015

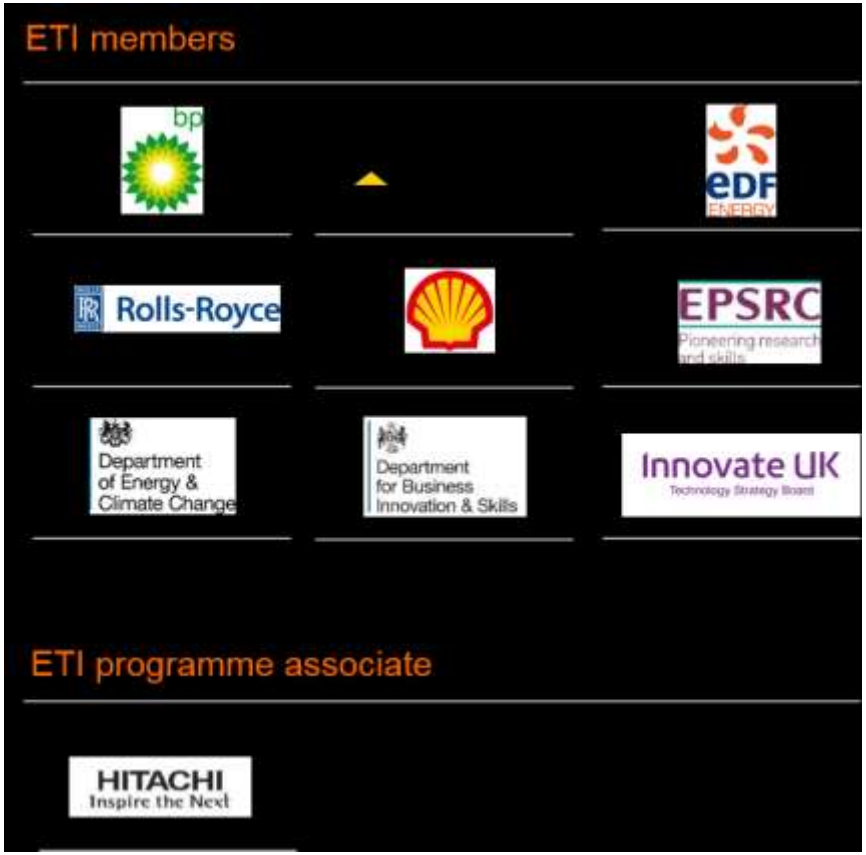
What is the ETI?

- The Energy Technologies Institute (ETI) is a public-private partnership between global industries and UK Government

Delivering...

- Targeted development, demonstration and de-risking of new technologies for affordable and secure energy

- Shared risk



ETI Portfolio

Nine Technology Programme Areas

Delivering...

New knowledge

Technology development

Technology demonstration

Reduced risk

Scenarios - giving target ranges for CCS

- No explicit government target for the “mix” of clean power producers, but

  – Policy and obligation to reduce GHG emissions by 80% by 2050, from 1990 levels.
  – Acceptance of CCC conclusion that power sector decarbonises first (cost)
  – Gas Generation Strategy decarbonisation - 100g CO_2/kWh by 2030 needs CCS
  – DECC published projections in range 1GW – 13GW scenarios by 2030, 5GW CCS in most recent case.
  – CCC 4th carbon budget – 10GW CCS by 2030.

  ETI Scenarios Work (2015)

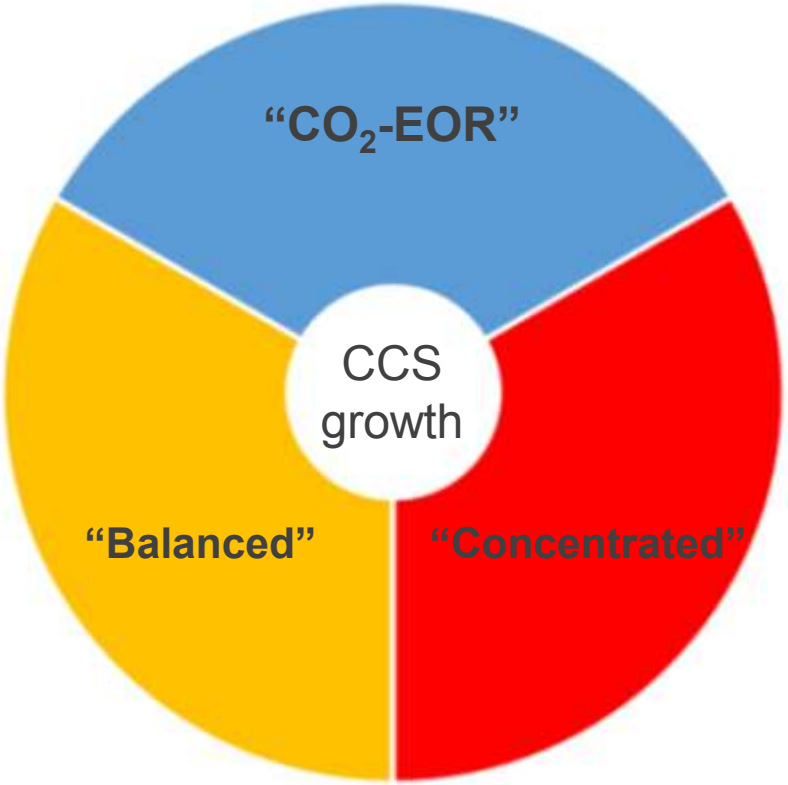
  Balancing a “lowest cost “ pathway solution (higher demand for CCS) with a later start, normal individual project schedules and reasonable risk taking, focuses on

  – 10 GW CCS by 2030 (nominally 50 MT/a)

Three main roll – out scenarios based on policy backdrop

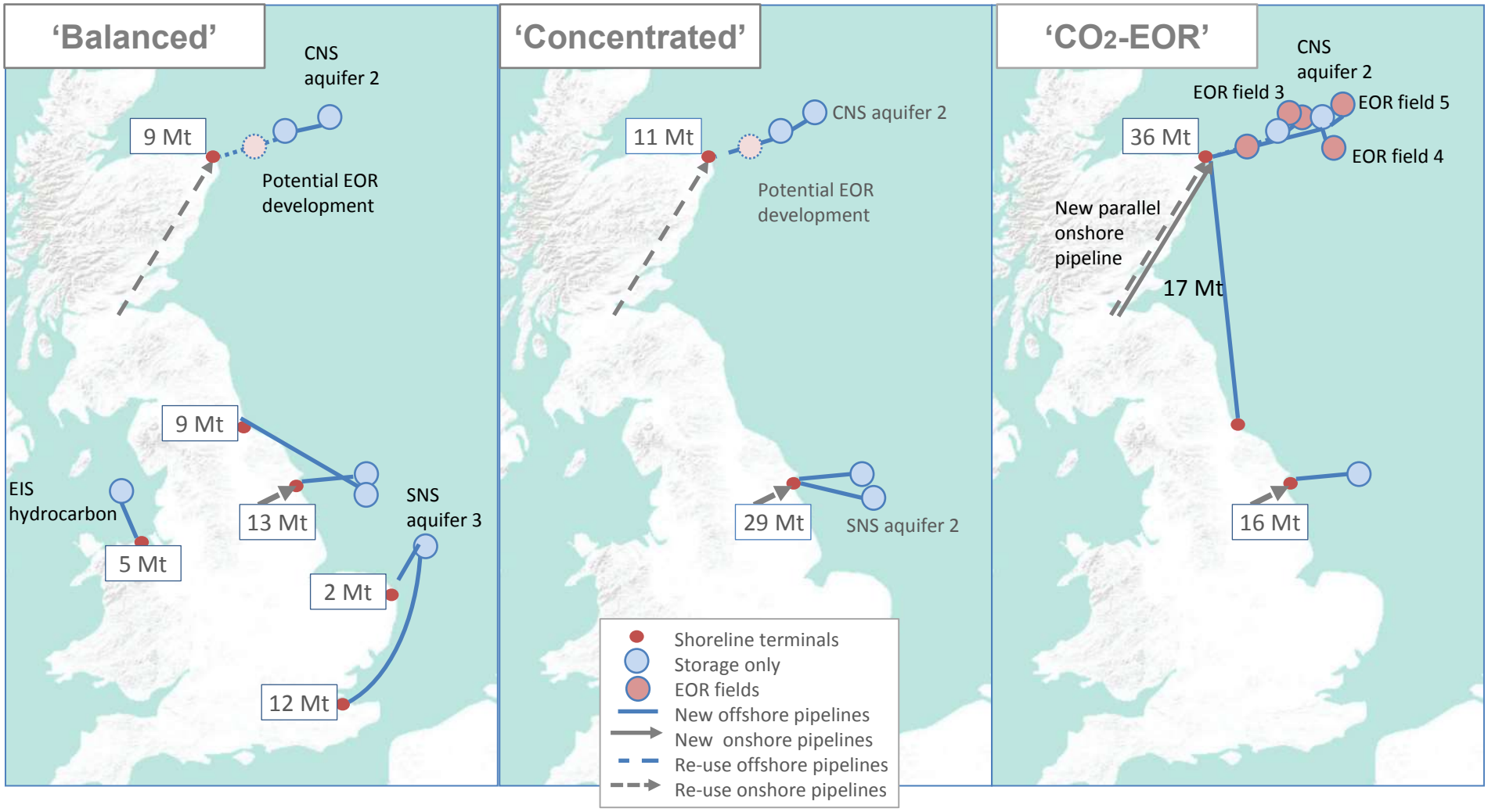
- High CO_2-EOR policy support (e.g. tax incentives)
- CO_2 has a value due to the CO_2-EOR projects

- Push “on all fronts” to win support from diverse stakeholders.
- A variety of regional source clusters
- Multiple fuel sources and capture technologies

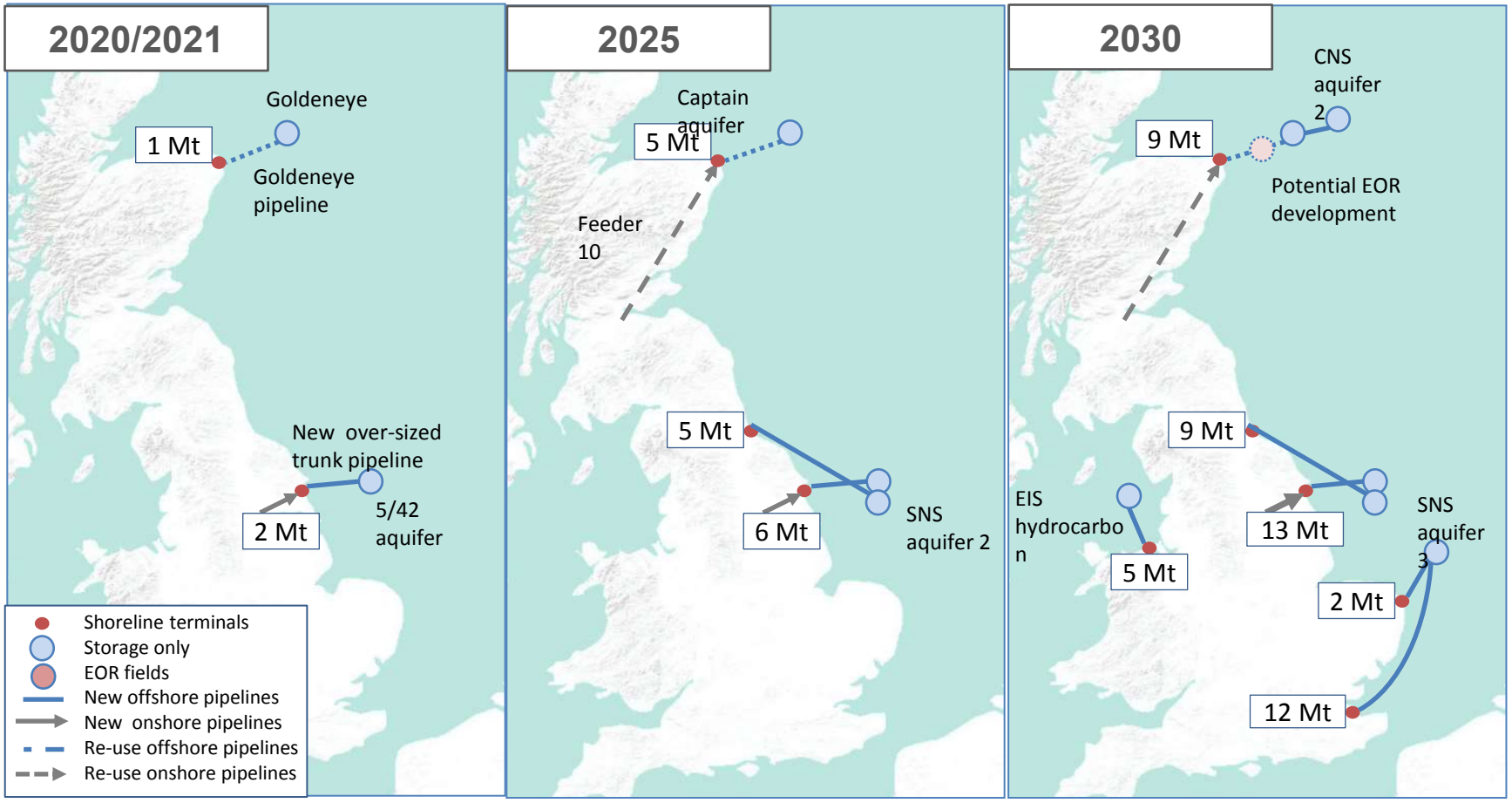


- Geographic concentration around the two competition projects Dominant role for SNS storage and gas CCS

Potential 2030 scenarios for the UK



Balanced Scenario to 2030



Equivalent ESME power carbon intensity (covering all mitigation activities)

2010 – 450 gms/kWh 2020 – 330 gms/kWh 2030 - 75 gms/kWh

Key conclusions on Scenario Work

- 10 GW equivalent scale CCS sector by 2030 is **feasible and affordable** by a range of different paths, based on co-ordinated cluster / hub development

- **Timely implementation of both CCS Commercialisation Programme projects**

- Strike prices at or below **£100 / MWh achievable by 2025** with further potential for cost reduction by 2030
  - Efficient use of stores and transport infrastructure developed under the commercialisation programme is key

- This outcome can be delivered by creating a **supportive policy environment with early action** on critical issues to bring forward timely investment

Technology readiness vs UK readiness

Capture	Status	Current UK CCS Project
Coal - PC	Proven for power/chems	No
Coal - IGCC	Proven for chems	Yes
Coal - Oxy	Pilot – (Multiple)	Yes
Gas - PC	Proven for EOR/chems	Yes
Refinery, Cement, Steel	Pilots	No
Nat Gas	Proven	No
NH3, H2	Proven for chems	No

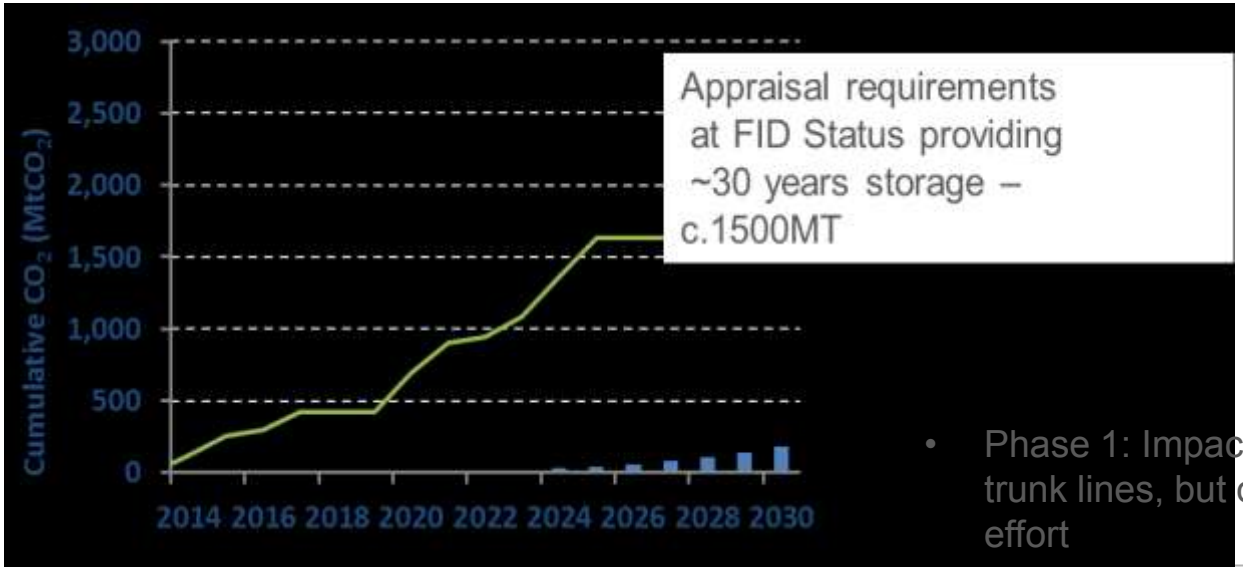
Storage	Status	Current UK CCS Projects
Open Aquifer	Proven	No
Structured Aquifer	Proven	Yes
Dep. Oilfield - EOR	Proven	No
Dep. Gas/Condensate field	Pilot	Yes

Phase 1 competition and "10GW CCS / 50 MT/a"

Project	Store MT p90/p50 (CO2Stored)	Phase 1 Injection MT/a	Power GW	Pipeline MT/a
Peterhead	37/40	1	0.38	10
White Rose	200/500	2	0.44 gross	17

Note 1. The White Rose store has an economic injectivity of around 10MT/a in CO_2Stored

Note 2. The Competition will not de-risk all of the White Rose store capacity

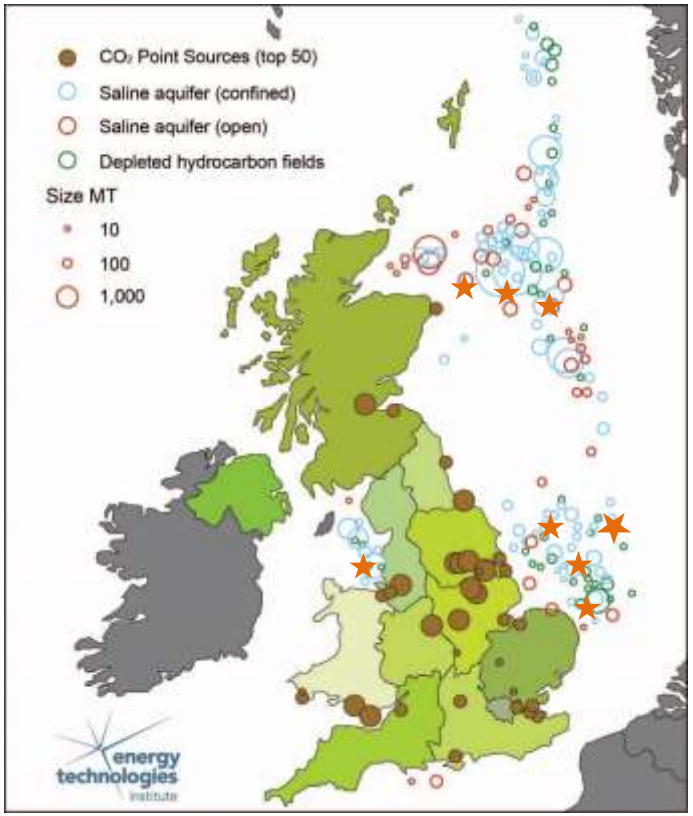


- Phase 1: Impactful investment in main trunk lines, but only a start to appraisal effort

Action on preparedness – Transport and Storage

Address shortage of appraised storage

- Long lead time of 9 years, non-trivial cost £50M
- Reward uncertain
- Step –out projects from Phase 1 projects desirable to reuse infrastructure and lower risk
- Need for scale to lower costs



Appraised stores total <1Gte (CO2Stored 78Gtes)

Strategic UK CCS Storage Appraisal Project

Department of Energy & Climate Change

energy technologies institute

Pale Blue Dot.

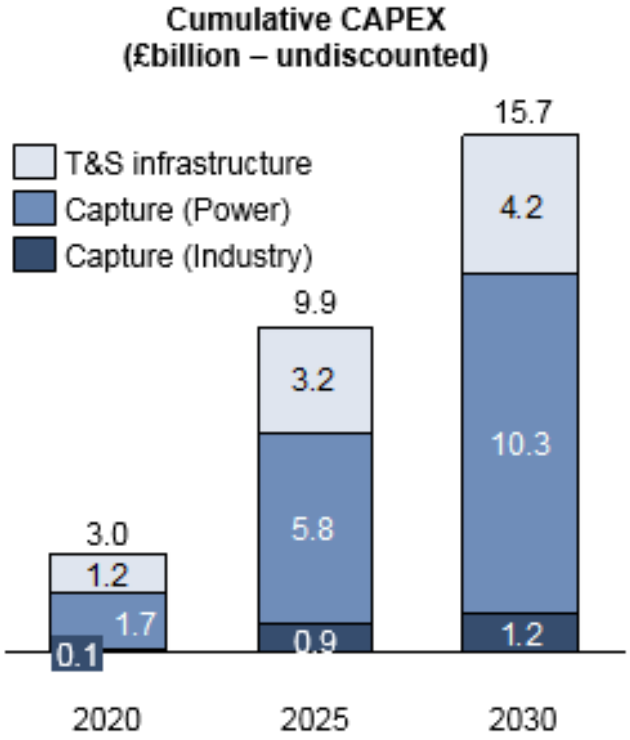
AXIS WELL TECHNOLOGY

Impact of Brine Production on Aquifer Storage Call

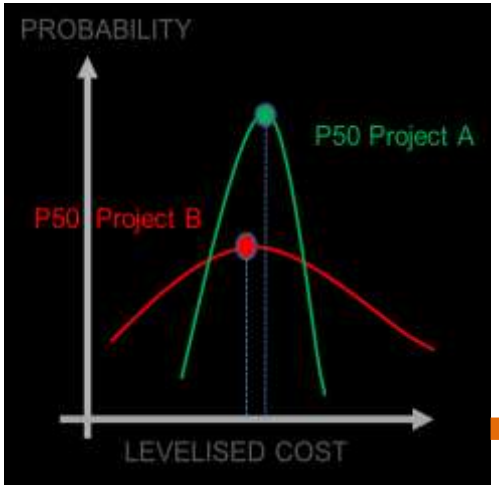
Action on Preparedness - Capture

Address shortage of follow- up projects

- Awaiting outcome of DECC commercialisation project
- Uncertainty on incentives
- Cost reduction in capture plant is required
- But costing in the risk of new technology across the chain may favour lock-in



Capex for the "Balanced Scenario"



ETI Thermal Power Project

Policy

- Governance for infrastructure sharing:
- Strategy for capture readiness:
- Financial incentives for industrial CCS:
- Management of load factor risk for CCS power projects:
- Risk management and governance for EOR:
- Reflecting strategic value in CfD allocation decisions:

Registered Office
Energy Technologies Institute
Holywell Building
Holywell Park
Loughborough
LE11 3UZ

For all general enquiries telephone the ETI on 01509 202020.

For more information about the ETI visit www.eti.co.uk

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Summary of scenarios

Scenario	Costs	Strike prices	Benefits / issues
Concentrated			
Concentrated around first 2 projects; dominant role for gas CCS with SNS storage.	£13.4 bn CfD cost to 2030 £2.2 bn per annum in 2030 £22 bn capex spend	Early Phase 2 projects < £100/MWh by 2025 < £90/MWh in 2030	Fast cost reduction, but limited optionality or deferred costs to 2030s.
EOR-led			
Wood report-style push; market pull for CO_2 for EOR supported by e.g. tax incentives.	£12.2 bn CfD cost to 2030 £2.0 bn pa in 2030 £27 bn capex	Both coal and gas plants < £100/MWh by late 2020's Assumes £20/t CO2 price to EOR	North Sea jobs & revenues Oil & gas production cuts net costs to society. Oil price risk exposure
Balanced			
Mulitple regional clusters, fuels and capture technologies.	£16.7 bn CfD cost to 2030, £3.2 bn per annum in 2030 £31 bn capex	New gas-fired plants < £100 in 2030 as 3rd gen of plants developed	Greater optionality for 2030s roll out Store & technology diversity = risk reduction