



Accelerating CCS in the UK

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System level strategic planning

Technology development and demonstration

Informs effective decision making

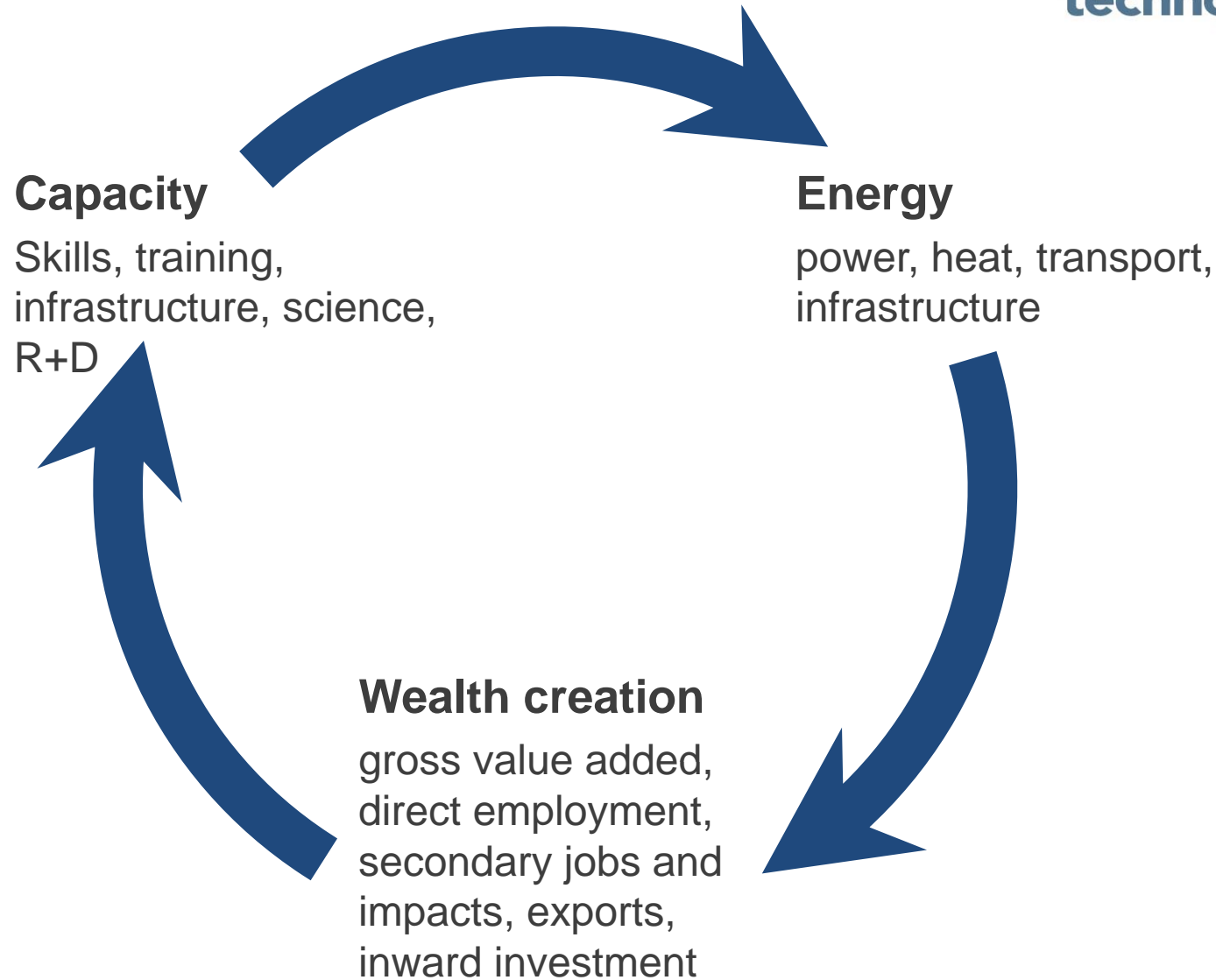
Underpins national energy systems policy

Develops capacity, technology and engineering

Increases investor confidence



Making energy policy work for the UK



What might the UK energy system look like in 2050



- Decided by global developments – not just UK events, decisions and policy
 - UK and global economy
 - Industry and technology developments
 - UK demand changes – scale and segmentation
 - Global socio-political events
 - International market confidence
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- The future is uncertain and we need an energy system design that allows for this





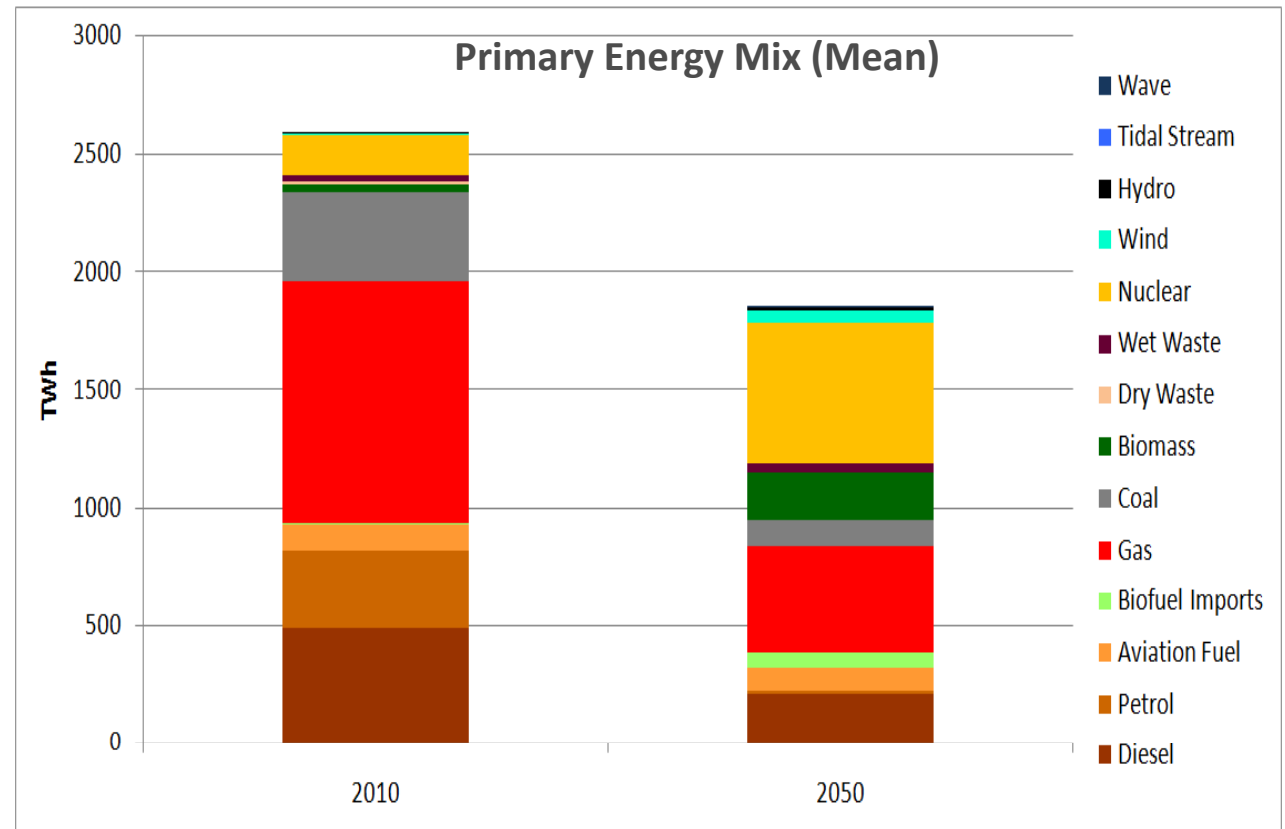
A national energy system design tool
Integrating power, heat, transport and infrastructure
searching for the lowest cost solution

Getting to 2050

UK primary energy diversifies

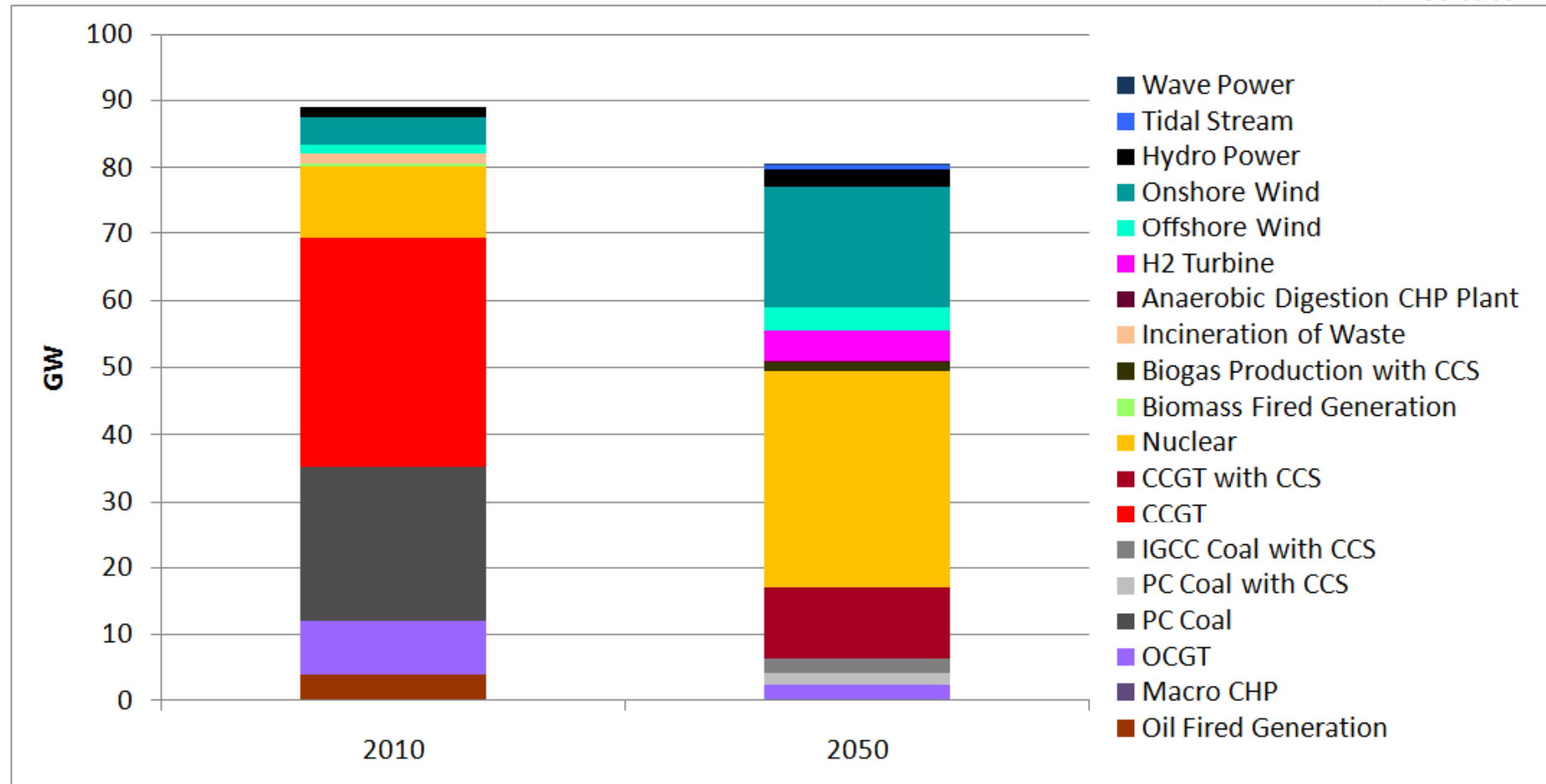
Nuclear and gas are pillars - 50% of energy imported

- Increasing role for nuclear and renewables
- Fossil fuel persists with CCS in power and as gas in heavy vehicles
- Biomass, onshore wind, hydro and imported biofuels become fully exploited
- Wet wastes must be used effectively – includes conversion to biogas
- Increased range and number of key assets



Electricity 2010 = 365TWh, 2050 = 440TWh

UK 2050 power generating capacity

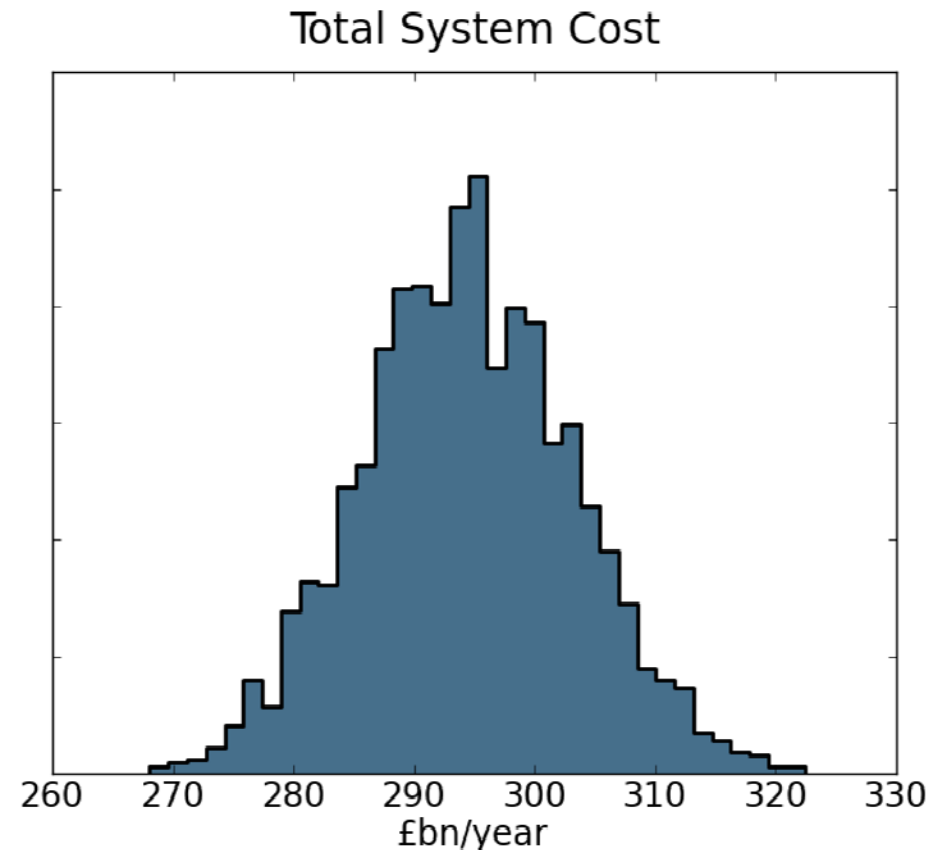


2050 abatement cost is <1% GDP

Biomass and CCS are key levers, nuclear is part of the 'base platform'

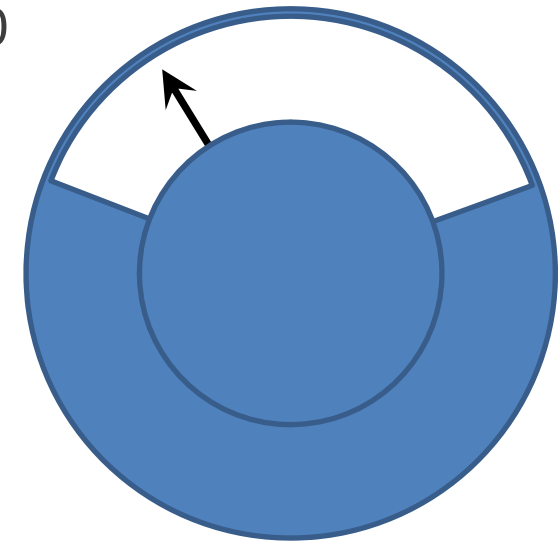
£2010(Mean)/year	
Total system cost	£294bn
Abatement cost	£26bn (0.7% GDP)
Average cost	£51/tCO ₂
Marginal cost	£360/tCO ₂
No biomass	+£44bn
No CCS	+£42bn
No nuclear	+£4bn
No tech devt*	+£106bn

*Assumes current technology cost/performance



Effective national policy needs to focus on things which will 'move the dial'

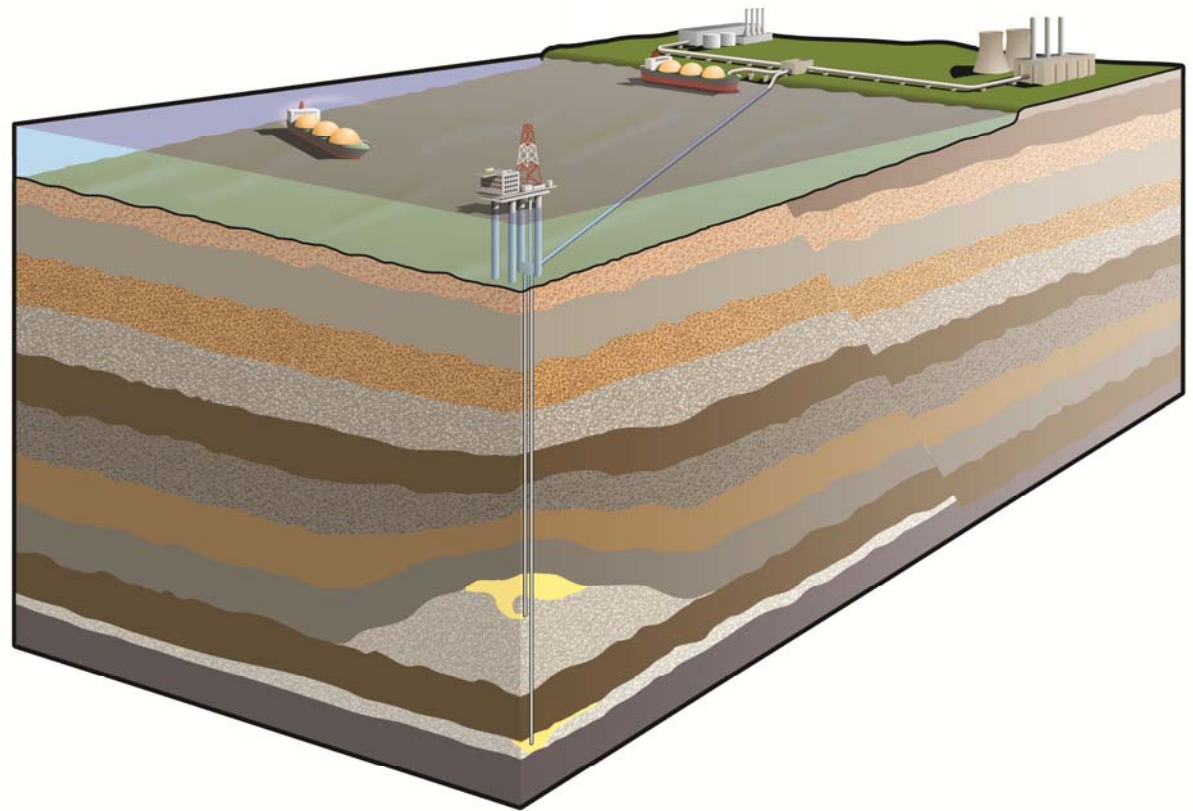
- Focus on the 'big levers' is crucial to maximise impact of scarce resources - money, skills, supply-base and time
- Investment in innovation is critical to reduce costs
- Engagement of industry and consumers is essential
- ETI view immediate development priorities for 2050 as ...
 - Efficiency (technology, consumer demand, storage)
 - Nuclear
 - CCS
 - Bioenergy
 - Offshore wind
 - Gas for transport



CCS

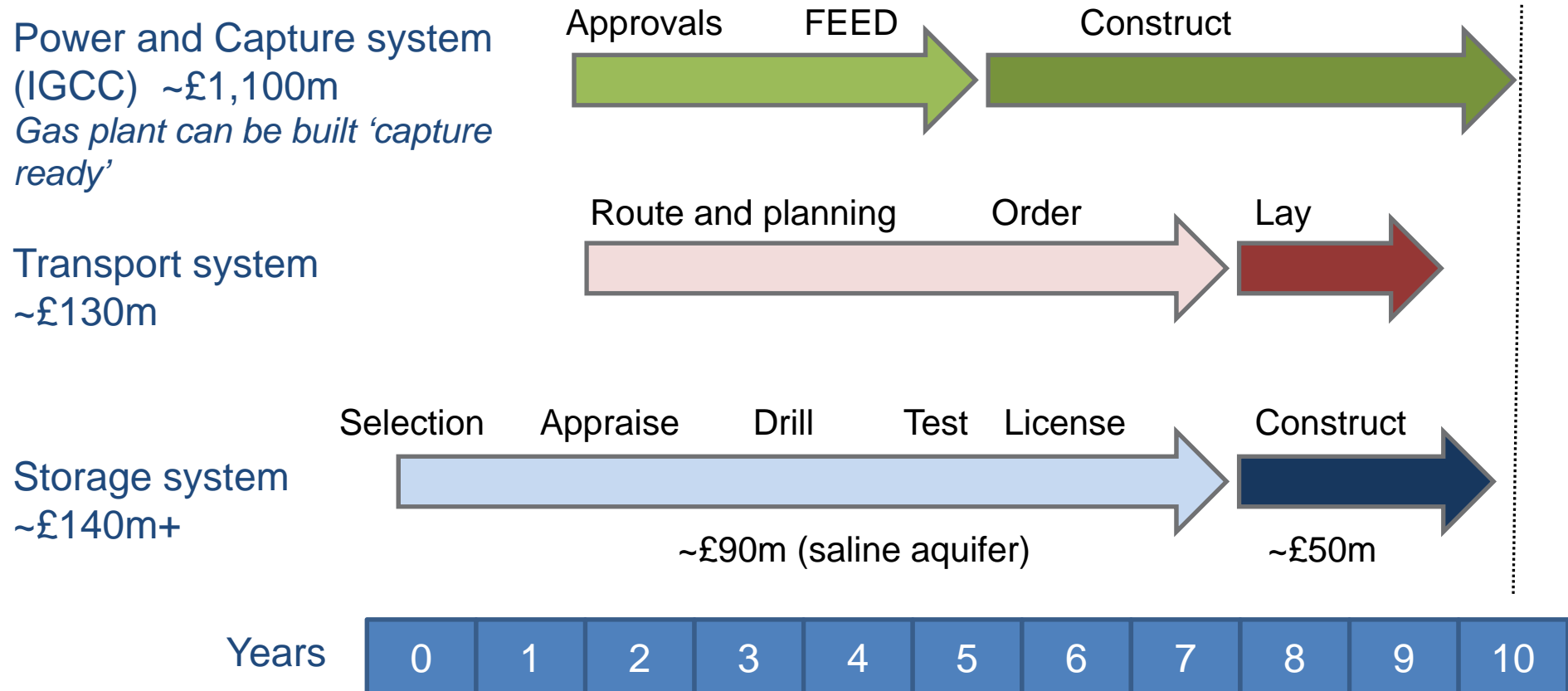
A key lever - particularly combined with bioenergy
Long development time requires early start

- Potentially very wide use
 - Power
 - Hydrogen and ‘Synthetic Natural Gas’ (SNG) production
 - Heavy industry
- ETI investing over £60m in enabling CCS for coal, gas and biomass
 - Improved separation technologies
 - Storage appraisal
 - Transport system design tools



Early demonstration start is essential

Longest lead time item is the most uncertain - storage



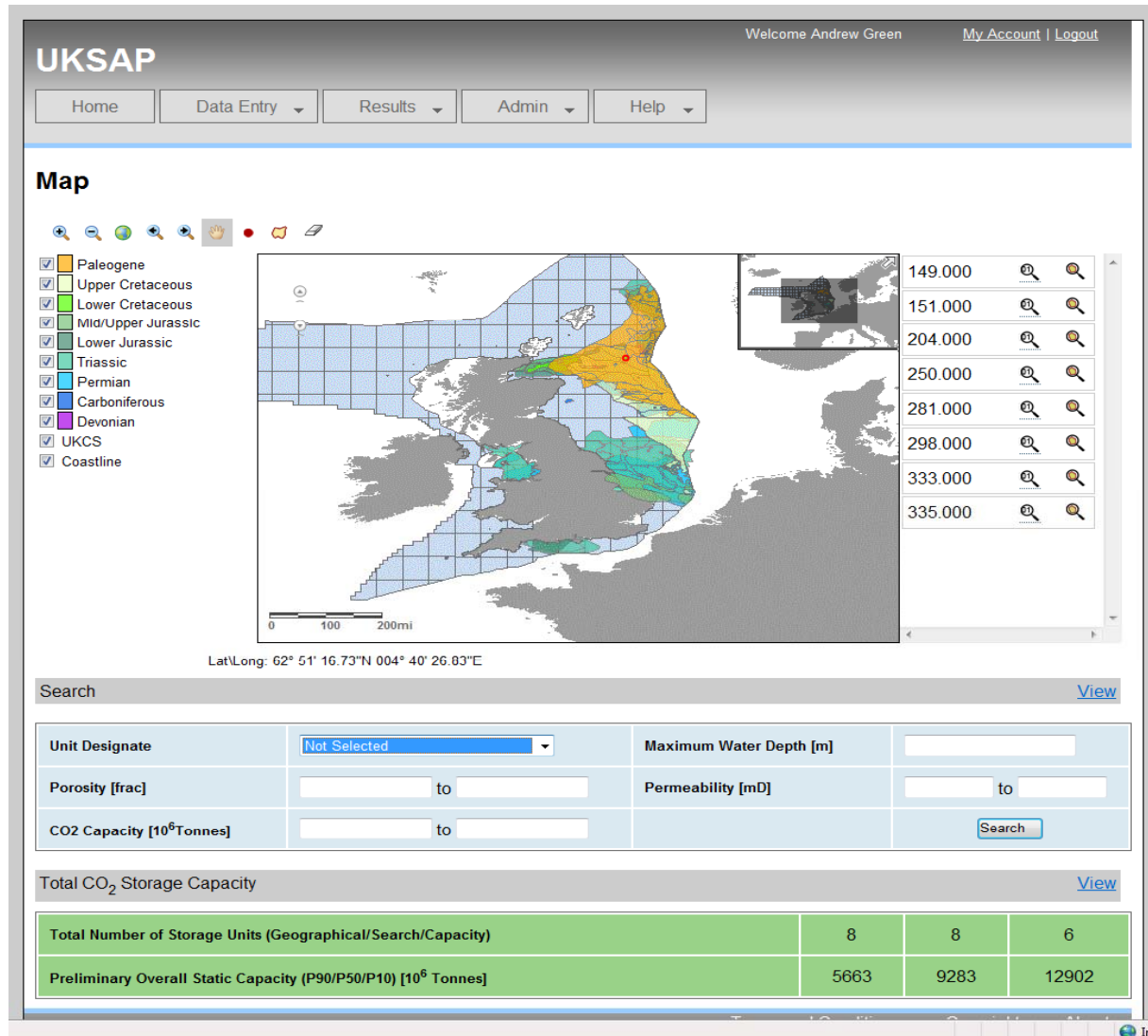
UK CO₂ Storage Appraisal Project



- Realistic, defensible & fully auditable assessment of potential CO₂ storage capacity in the UK
- Unique & comprehensive GIS storage database
 - Capacity
 - Security of storage
 - Economics
 - Underlying data
- Overall estimate of capacity – informing CCS investment decisions

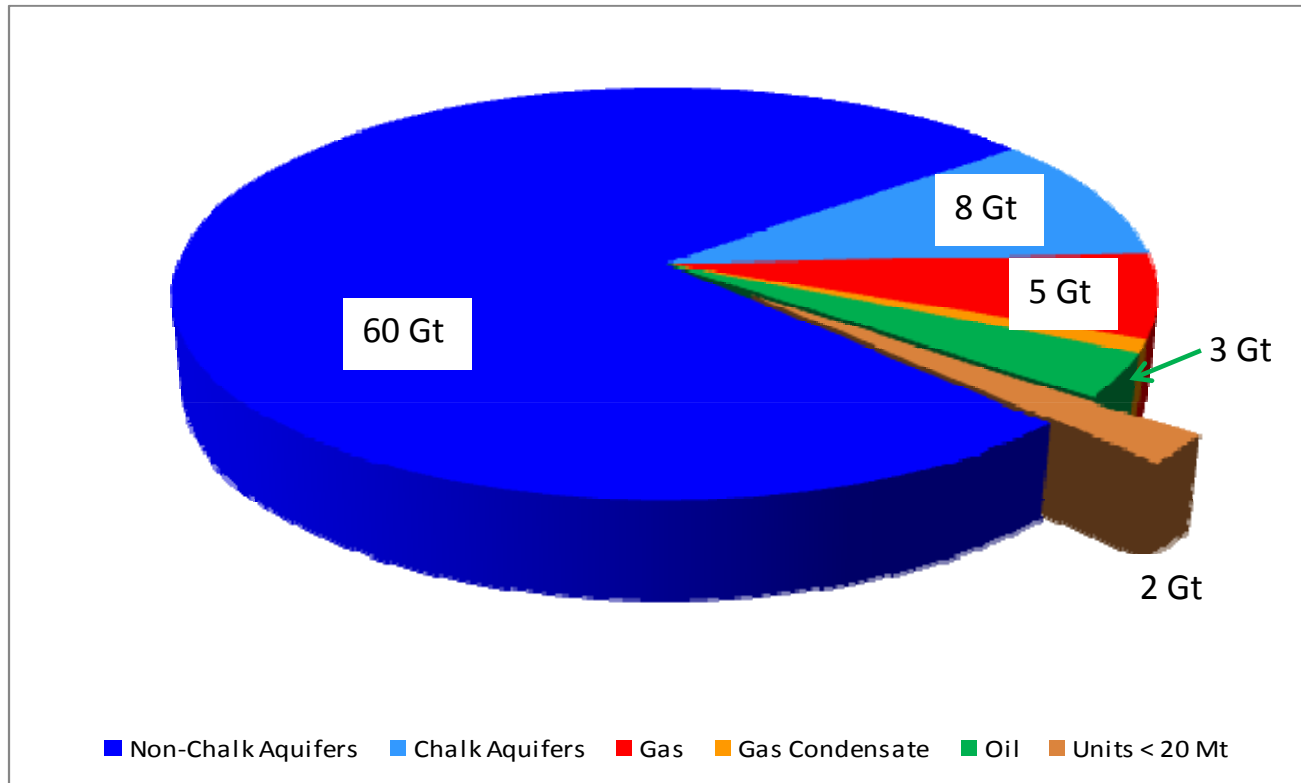


UKSAP Web-enabled Database and GIS



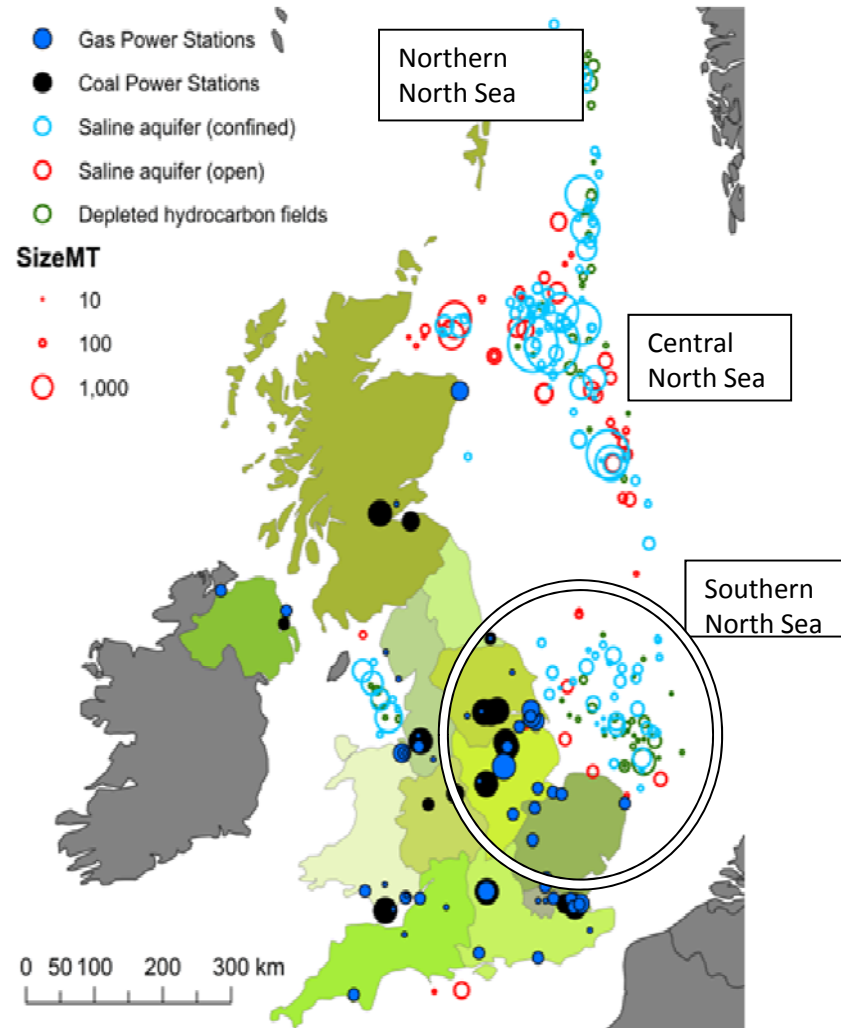
Overall UK CO₂ Storage Capacity

- dominated by saline aquifer stores
- P50 capacity 78GT
- UK requires about 15GT for 100years



- Total 'technical' capacity
 - does not take economics and security of storage into account
- Large number of stores whose final assessed capacity is less than 20 Mt

Where is the storage?



- Viable storage found in all areas studied
- Storage is stacked and clustered – both oil & gas and aquifer
- Opportunities for ‘basin scale’ approaches

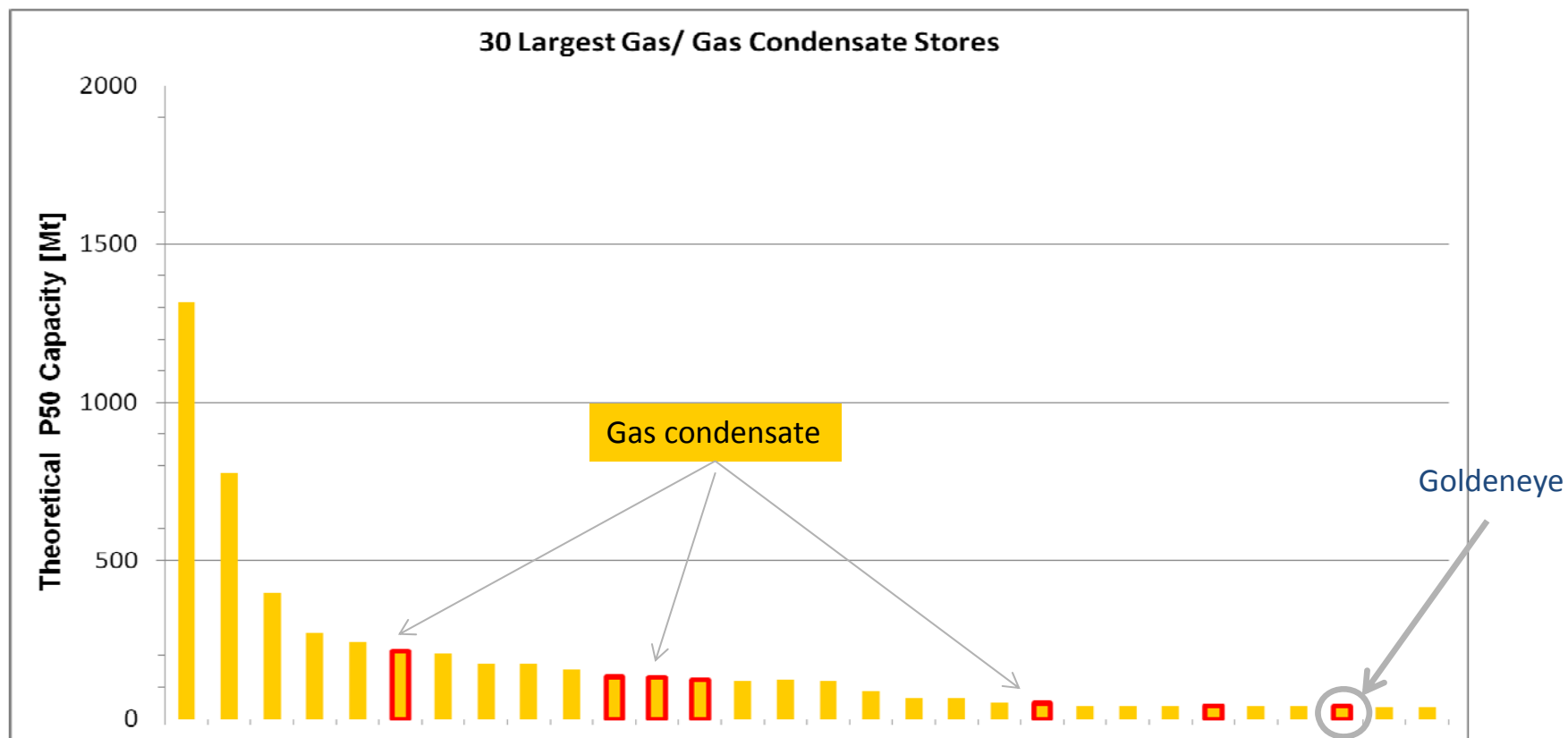
Key:
Black = coal-fired station
Royal blue = gas-fired station
Green = hydrocarbon unit
Light Blue = closed aquifer
Red = open aquifer

Security of Storage

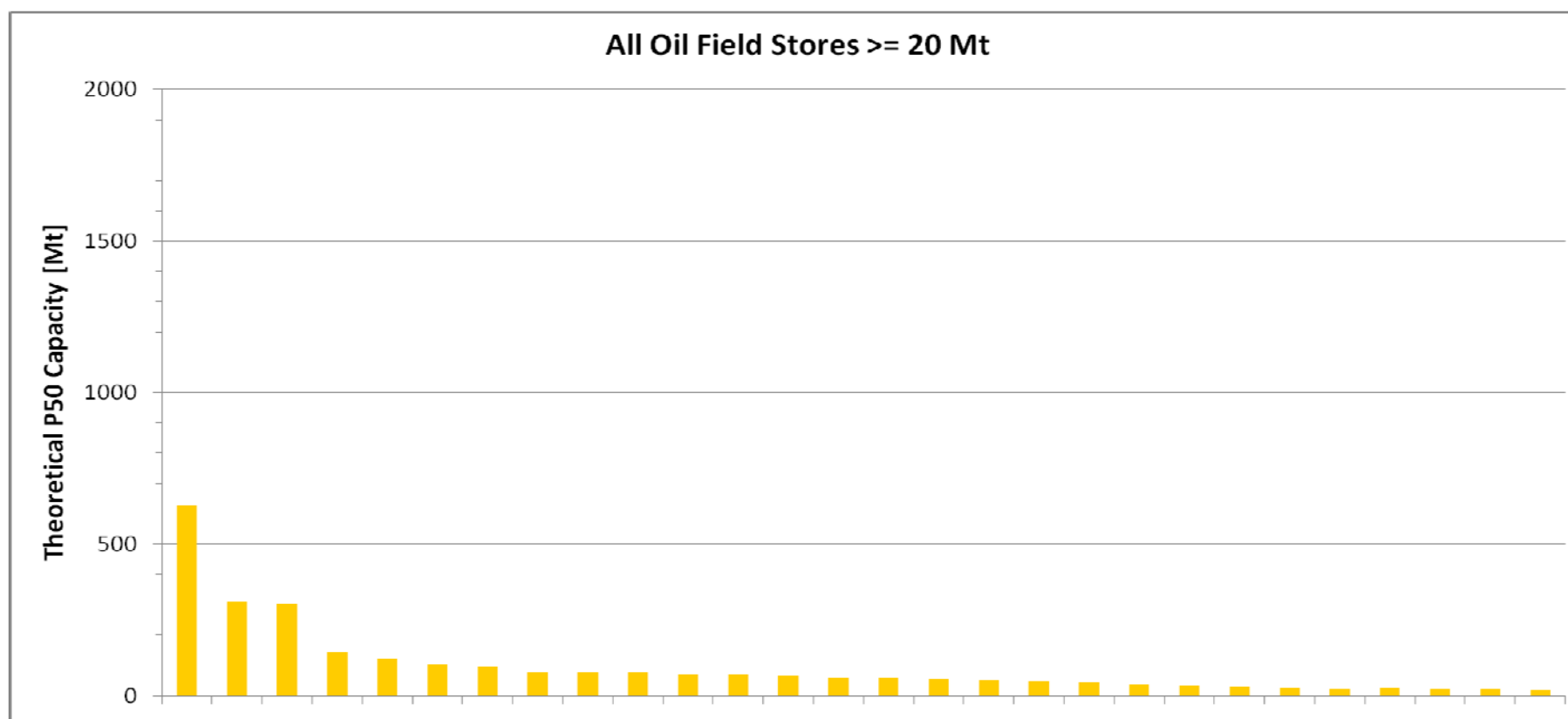
Severity of impact	Low	Formation mineralogy	Seal chemical reactivity Well vintage Formation mechanical integrity Formation salinity	Well density
	Medium	Migration dip direction Seal fracture pressure column Migration national boundary Fault compartment. Diagenesis compartment.	Migration depositional trend Migration structural trend Migration rugosity Migration hydrodynamics Strat compartment. horizontal Strat compartment. vertical	Migration dip mag Migration pressure sinks
	High	Seal lateral degradation Fault vertical extent	Fault density Fault throw	
		Low	Medium	High
		Likelihood of occurrence		

- Security of Storage assessments carried out for all saline aquifer units
 - Consistent methodology
 - 23 risk factors considered

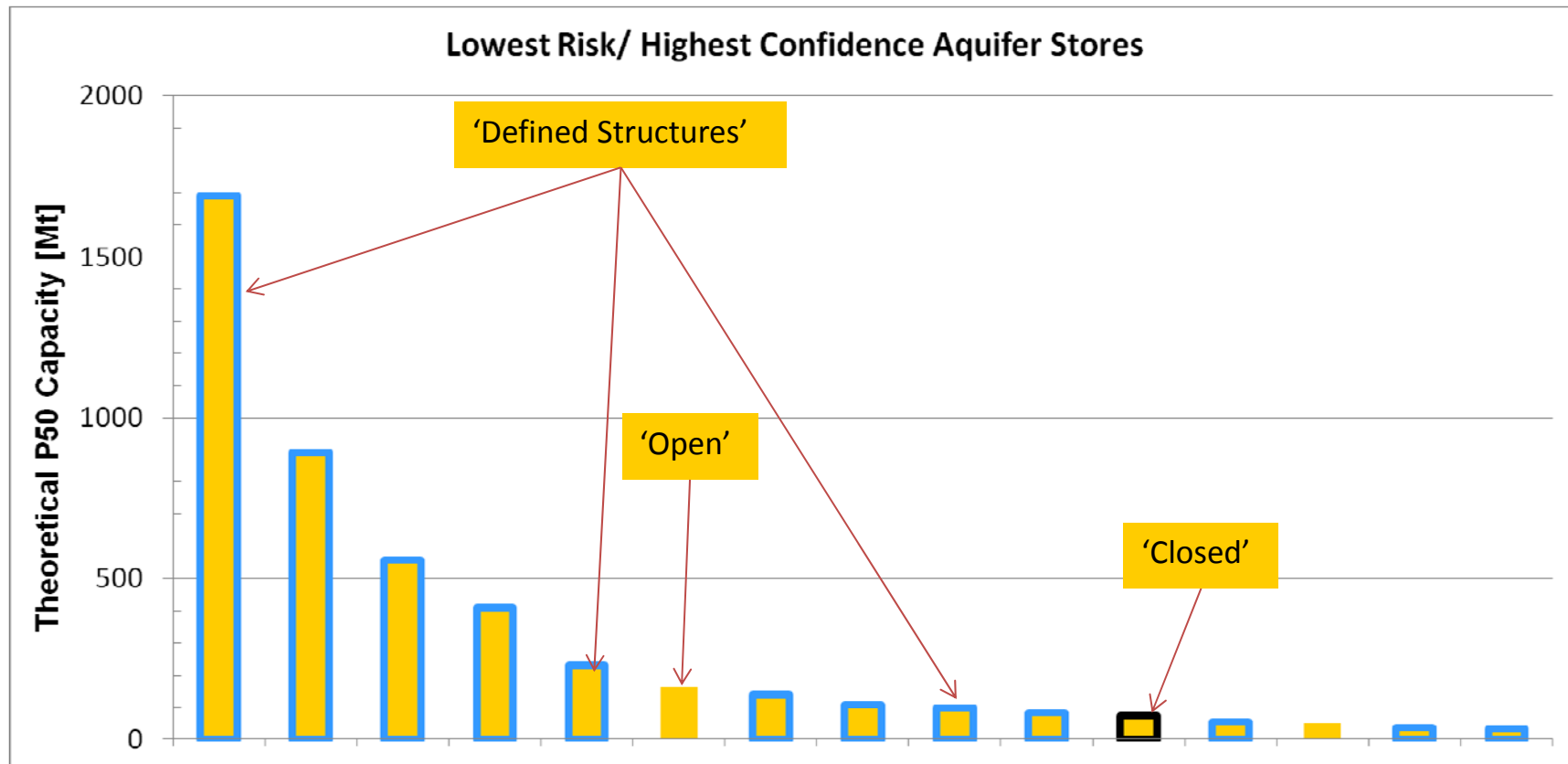
How much storage do we have?



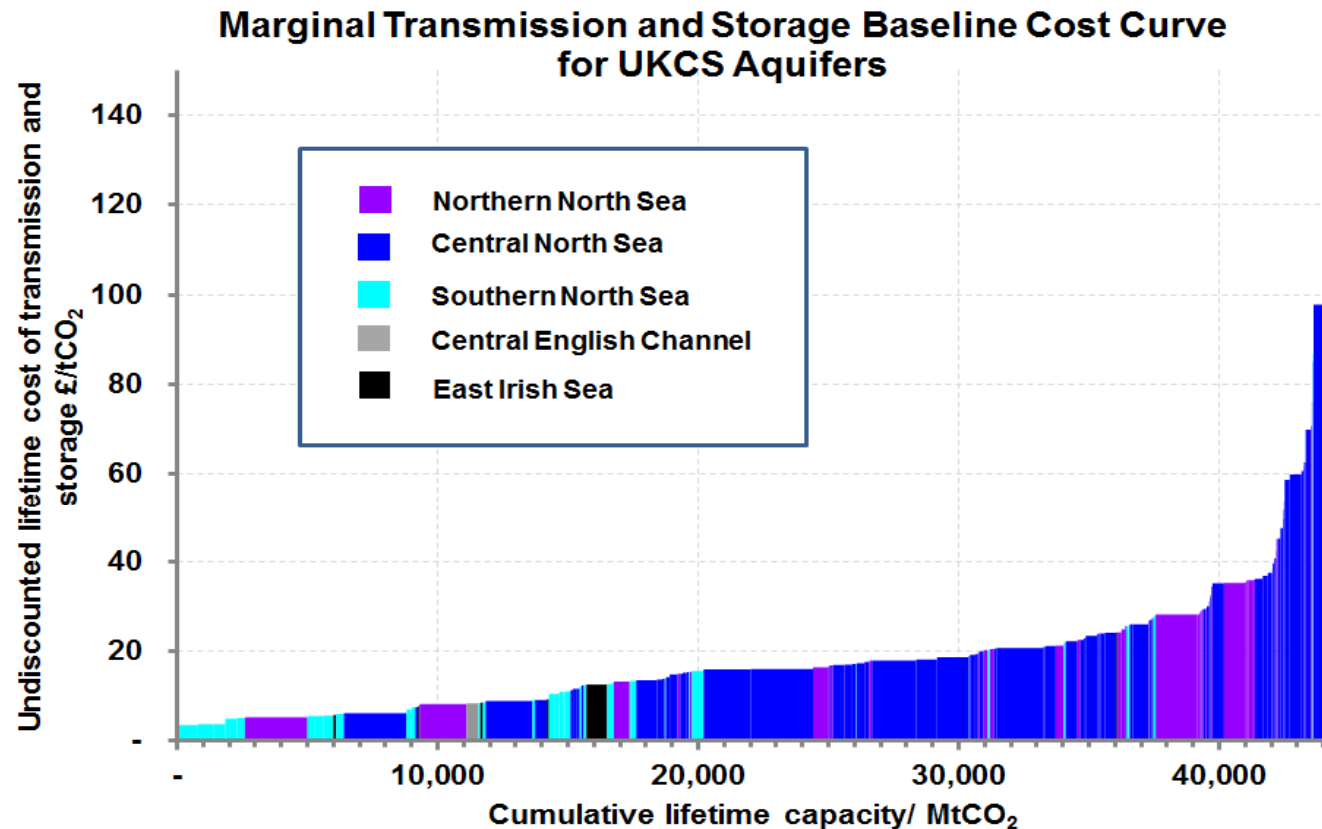
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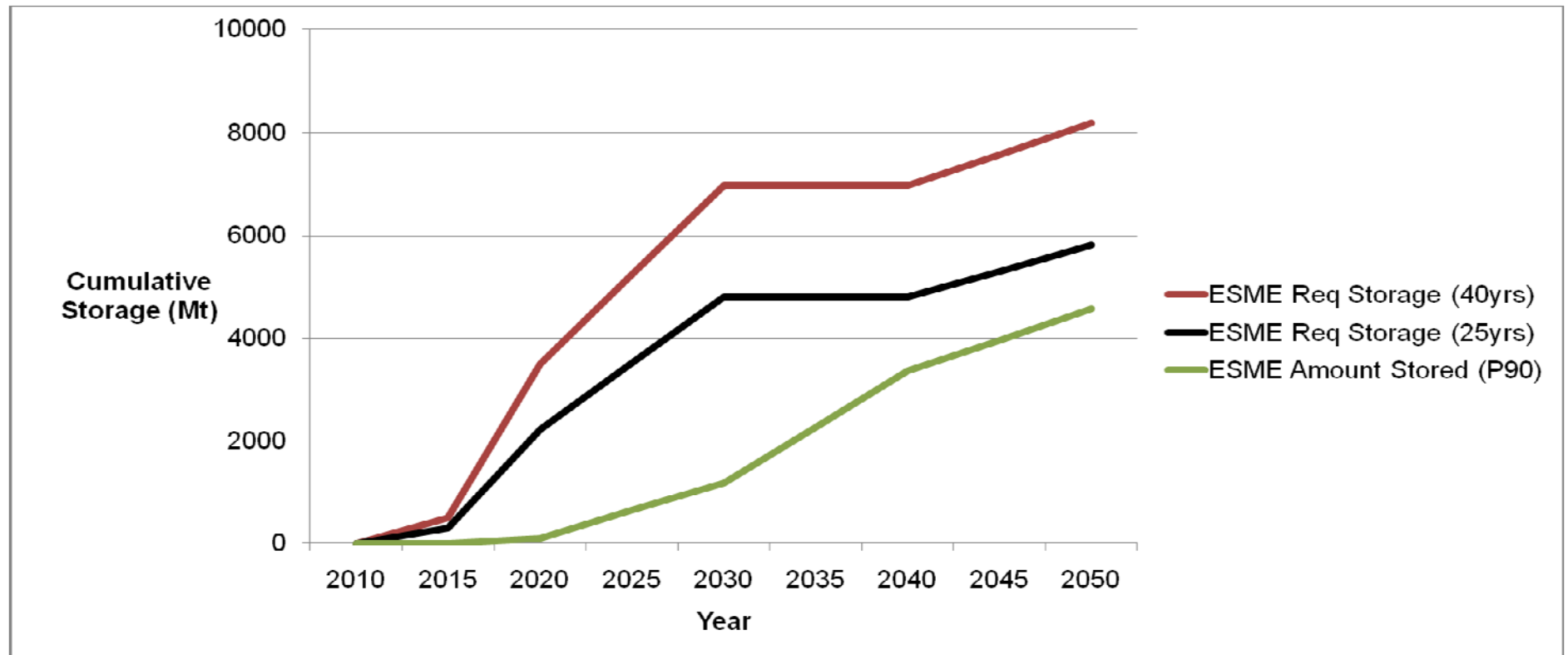
Economics - Aquifers



- Notes:
 - Cost model takes into account key capital and operating costs
 - Costs are undiscounted: higher (initial) risk sites will require larger returns on capital
 - Transport costs are offshore only, and are based on (shoreline) 'point to point' for each unit

Storage capacity

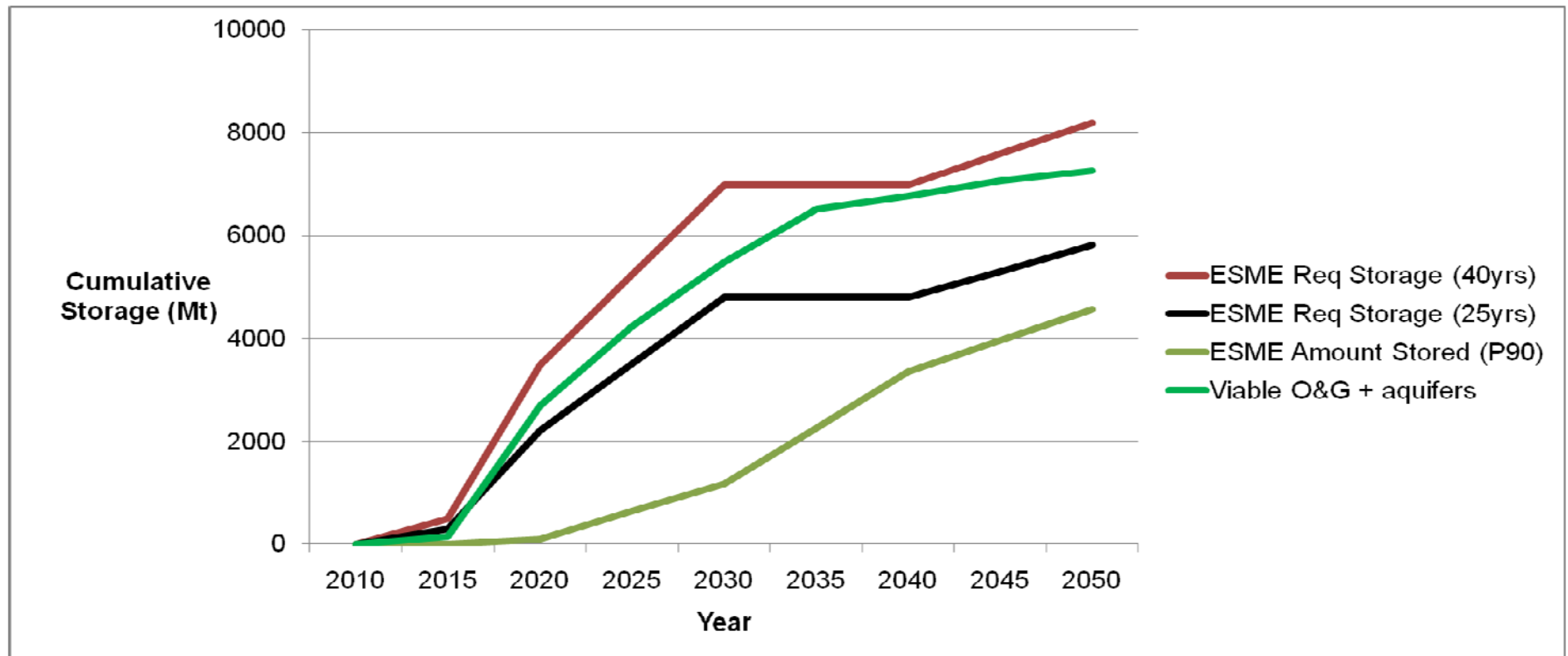
- must be committed in advance of need



- Assumptions:
 - ESME decadal pathway analysis to 2050
 - Storage Requirement = actual to date + 25/40 years for new assets
- Total UK Storage Requirement (100 years) ~ 15,000 Mt (P90)

2050 pathway requires saline aquifers

- “viable” oil and gas unlikely to meet availability needs for capacity or timing

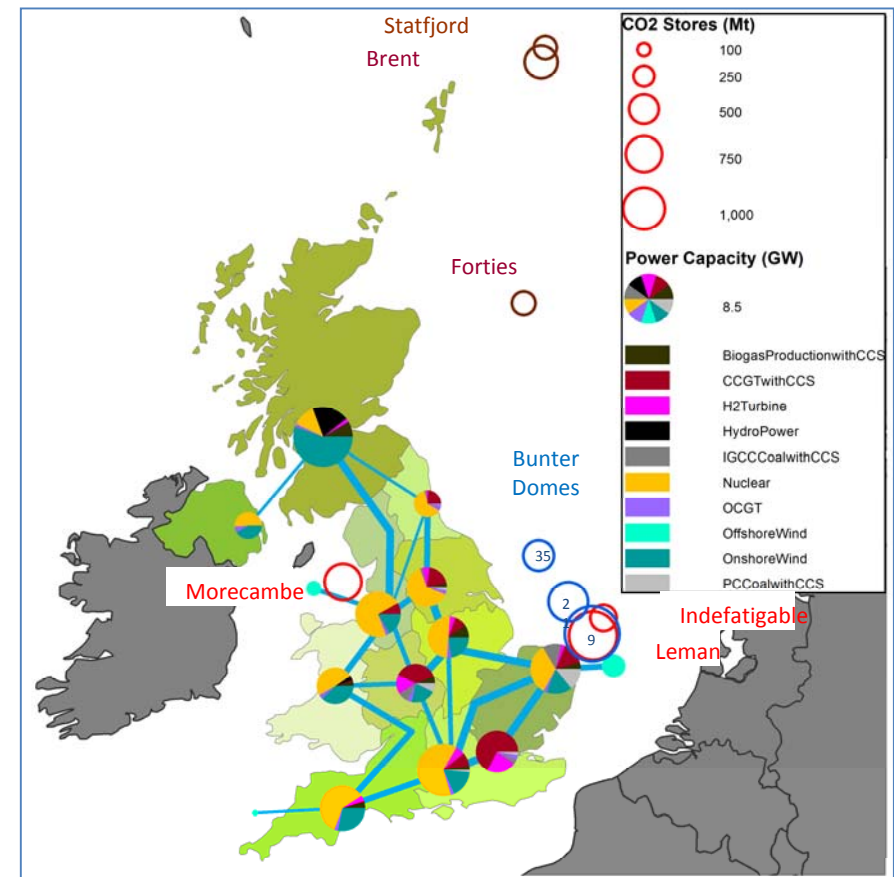


- Based on UKSAP capacity for viable depleted oil & gas reservoirs with 5 year delay
- Availability based on DECC data for Close of Production (smoothed)
- Additional 1,500 Mt appraised aquifer storage available by 2020 rising to 2,700 Mt by 2050

CCS

A key lever - particularly combined with bioenergy
Long development time requires early start on storage

- Potentially very wide use
 - Power
 - Hydrogen and ‘Synthetic Natural Gas’ (SNG) production
 - Heavy industry
- Demonstration projects need to de-risk full value-chain operation and prepare strategic aquifer storage
- ETI investing over £60m in enabling CCS
- ETI UKSAP commercial licensing access currently being finalised
- Strategic management of UK storage required to allow cost effective development and maximisation of resource potential





Delivering low carbon energy technologies

Supporting economic growth

by...

- Informing policy**
- Building partnerships**
- Delivering innovation**
- Sharing risk**
- Creating affordability**



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