

Storage – Perspectives from Northwest Europe



Coordinating energy research for a low carbon Europe

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Structure

- Past appraisal
- Current activities
- Some key challenges
- Bankable storage – what does it mean?
- How much storage capacity do we need?
- What next?

Past and ongoing appraisal

- Regional and national capacity estimates
- Largely based on volumetric estimates of theoretical storage capacity
- Examples include:
 - GESTCO
 - UK Storage Appraisal, CO₂ Stored
 - Norwegian Atlas
 - Netherlands
- Results in estimates of very large *but theoretical* storage capacity
- Insufficient detailed knowledge for developers to choose specific sites

What is the point?

- To provide policymakers with data to enable them to decide if CO2 storage is feasible in their country ✓
- To allow potential storage project developers to select putative sites for detailed site appraisal ✓
- To allow governments to plan CCS infrastructure ✗
- To catalyse the provision of storage 'services' ✗

Site-specific appraisal



- UK:
 - CO2 Stored: High-level appraisal of over 500 possible sites
 - Detailed site investigations for storage permits at Goldeneye & Endeavour
 - Five sites appraised in detail (desk study & simulations) from 20 screened
- Norwegian site appraisal for three sites – Statoil
- Netherlands appraisals for ROAD (1st and only storage permit awarded) – P18 & Q16

All very good but is it enough...?

- What do developers need from storage appraisal?
 - Portfolio of sites in the right places & available when needed
 - Enough capacity (guaranteed)
 - Efficient (good value) injectivity
 - Always available and flexible
- What do regulators & policy makers need from storage?
 - Safe and permanent containment
 - No risk to other resources
 - Efficient use of subsurface
 - Jobs and economic returns

So what do we do?

- Linear chain CCS projects have not been very successful in Europe
- Need to rethink:
 - Provide transport & storage service to enable multiple capture projects to invest
 - Both industry and power
 - Provide guaranteed and flexible storage service
 - Focus on clusters to enable FIDs

What does this mean in practice?

- Transport and storage separate business from capture
- Public investment to provide a 'portfolio' of bankable storage options
- Strategic planning of infrastructure
 - Routes
 - Capacities
 - Design

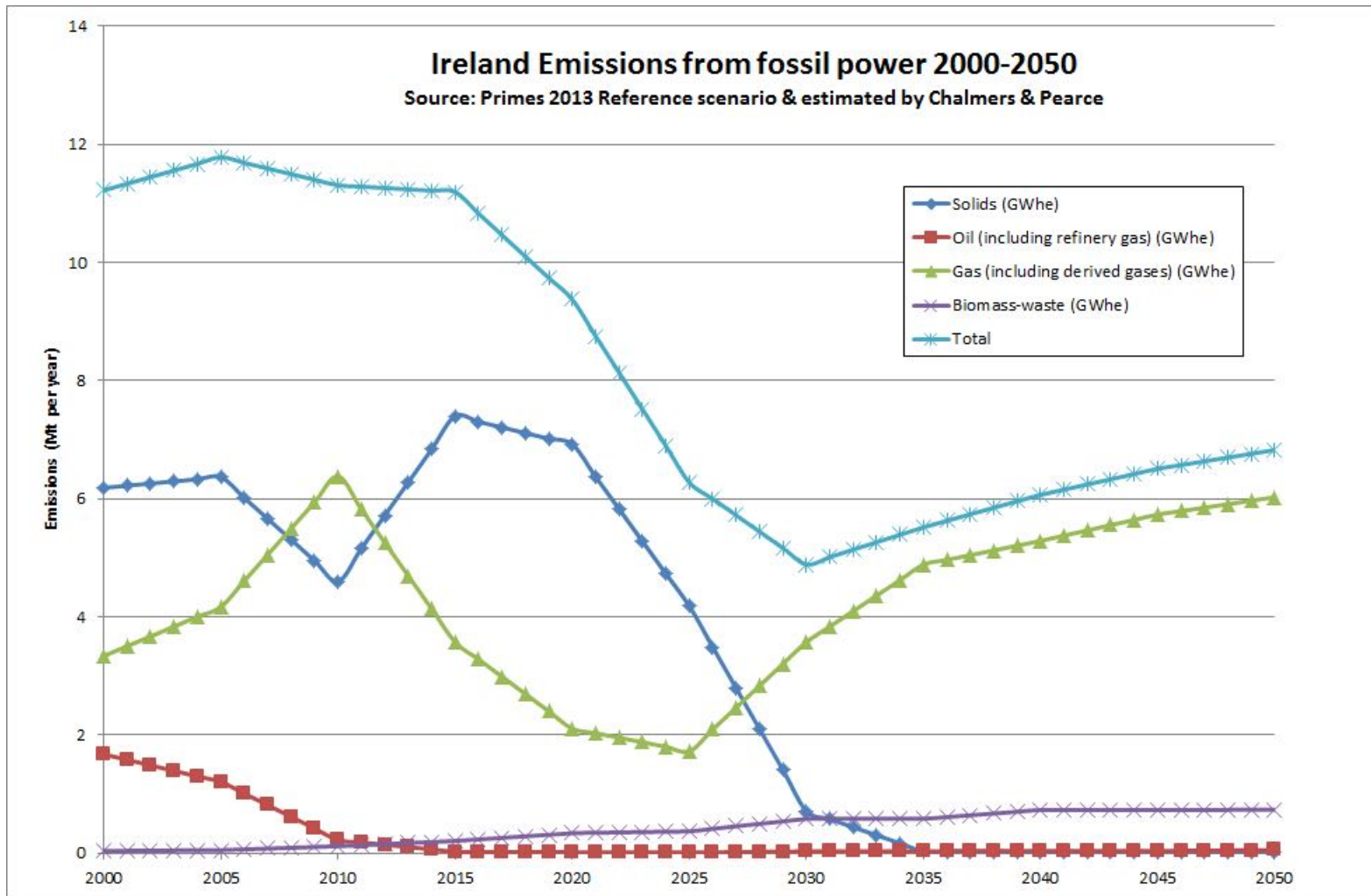
What is bankable storage?

- *“...a bankable site is a storage site that has been evaluated such that sufficient confidence exists in technical and cost elements, to support final investment decisions for commercial-scale projects.”*
- IEAGHG, 2011/10, Sept 2011
- This means:
 - Storage permit obtained
 - All FEED completed
 - Only three sites are (almost) at this stage (Goldeneye, Endurance, P18) though Sleipner and Snohvit could be

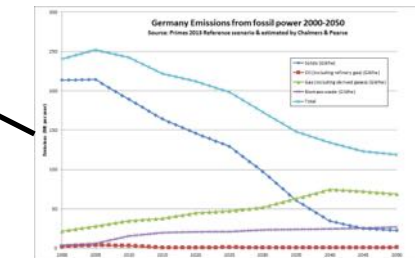
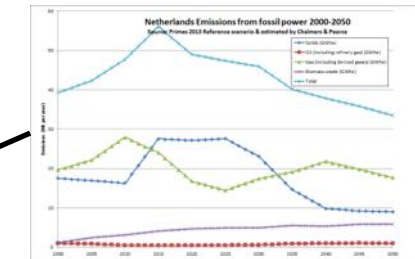
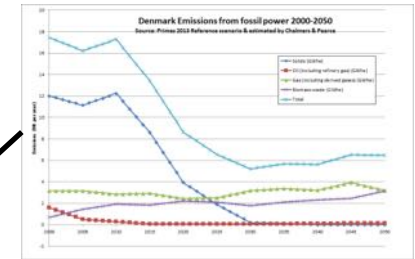
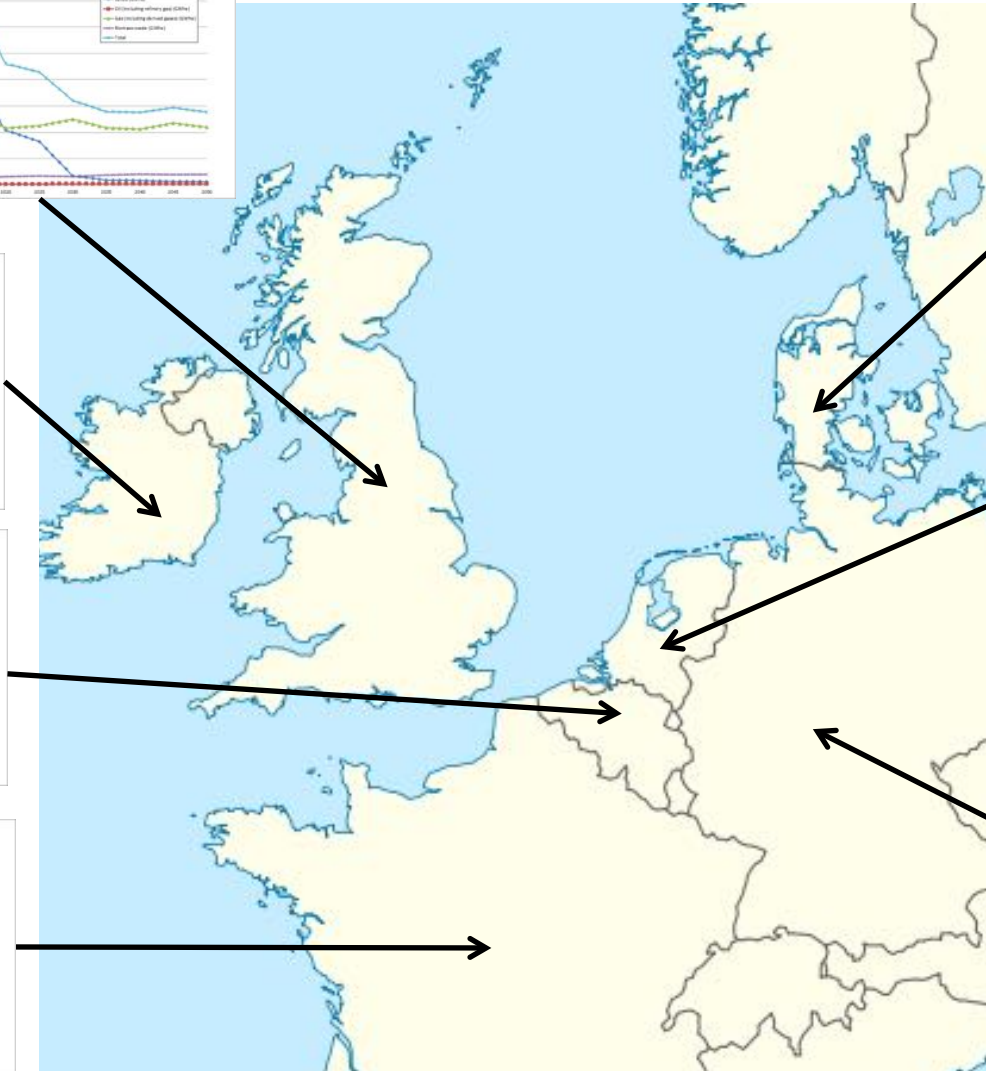
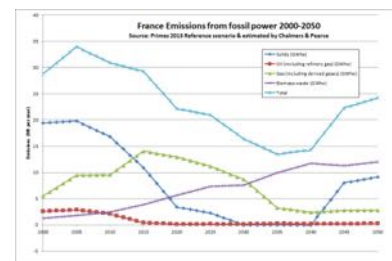
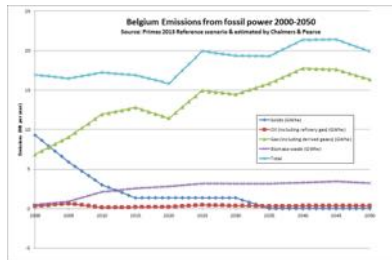
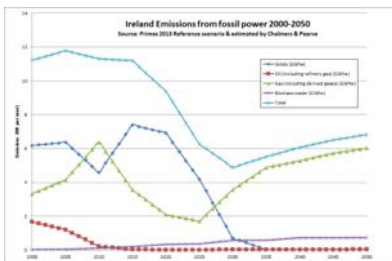
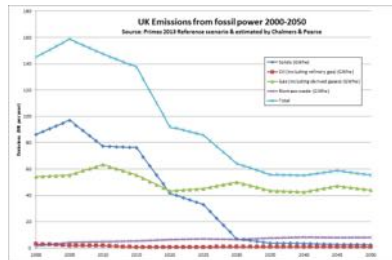
How much capacity do we need?

- Estimate emissions from Primes 2013 reference scenario
- Simulations of electricity generated by fuel type in GWhe pa to 2050 taking account of current MS & European policies
- Estimate emissions per fuel type and sum cumulative emissions
- Note:
 - Only fossil-power (industrial emissions excluded)
 - Norway excluded
 - Assume 90% capture rate on all emissions

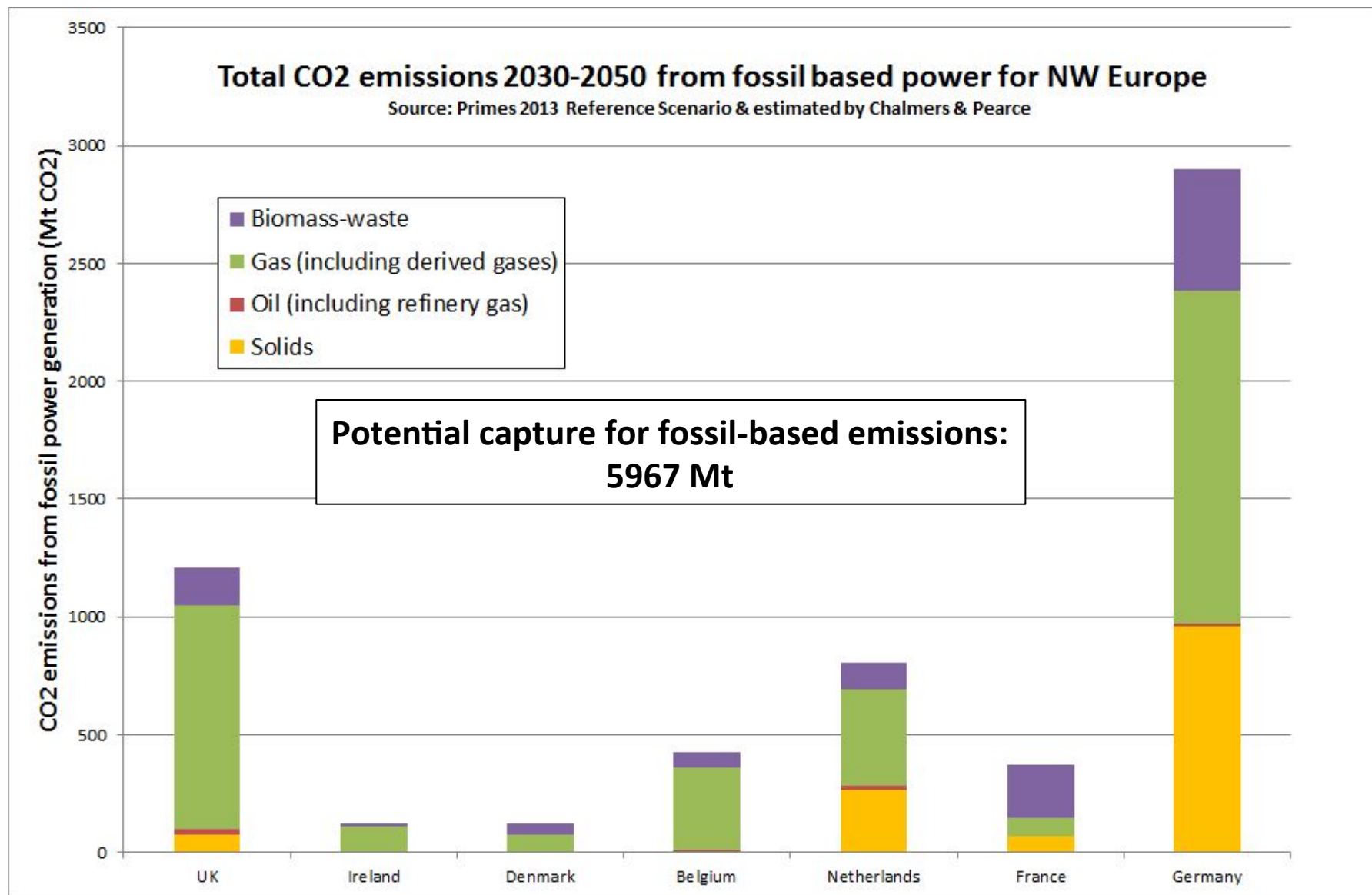
Example of emissions to 2050 from fossil power



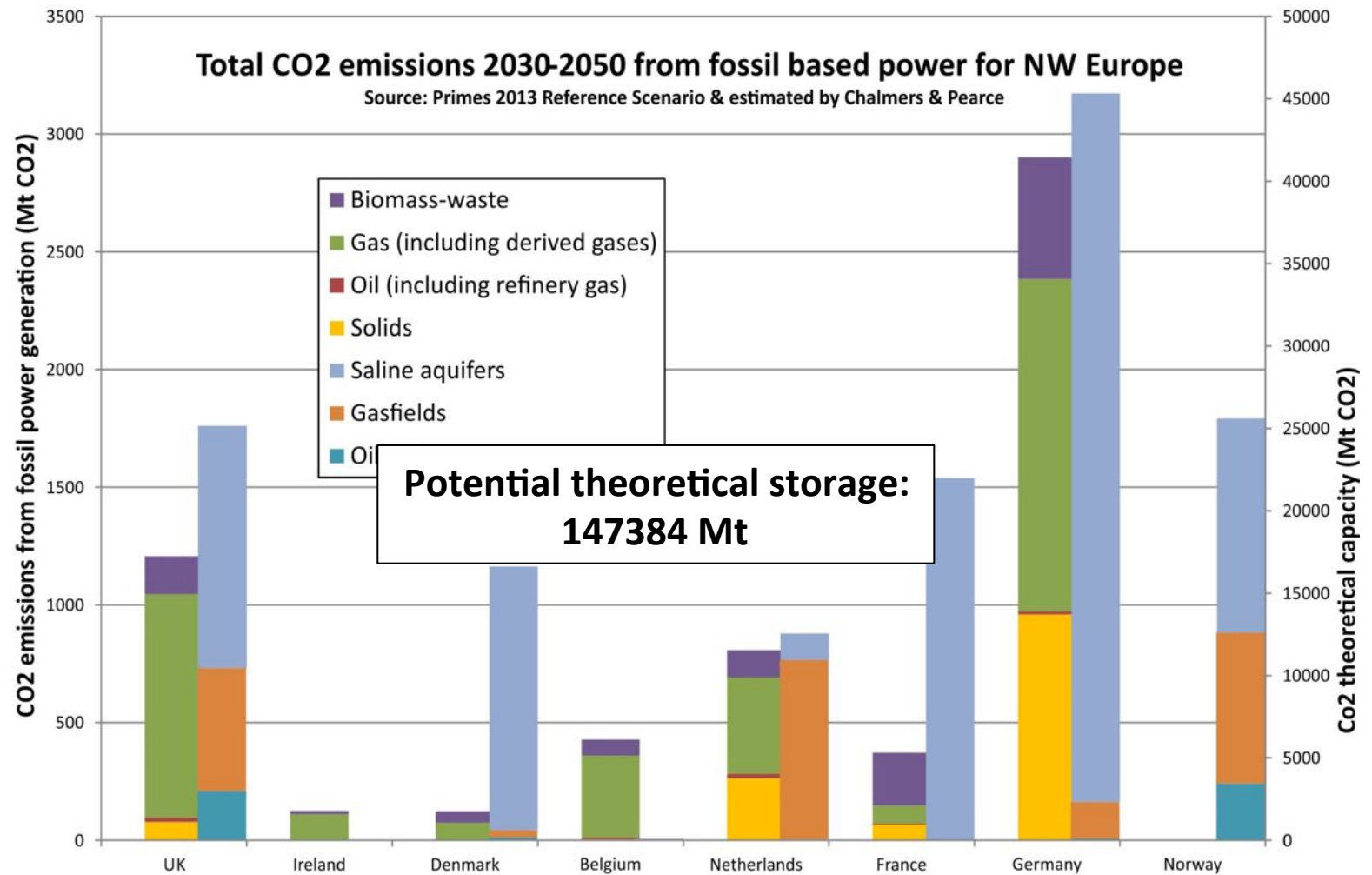
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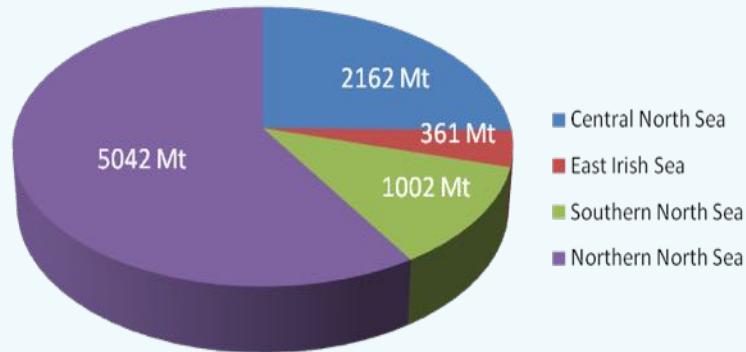
How much capacity do we have?



Storage capacities of credible storage in UK

Region

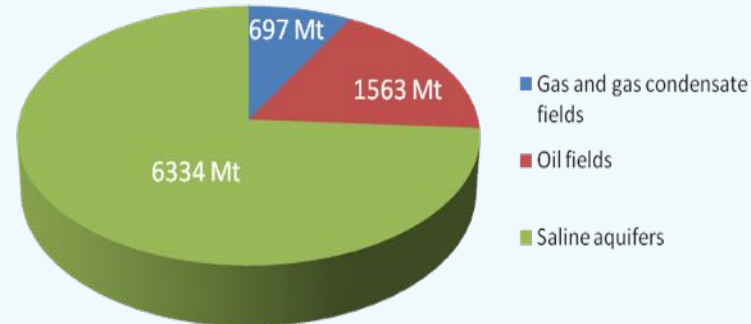
Storage capacity of basic score units grouped by region



Total: 8567 Mt

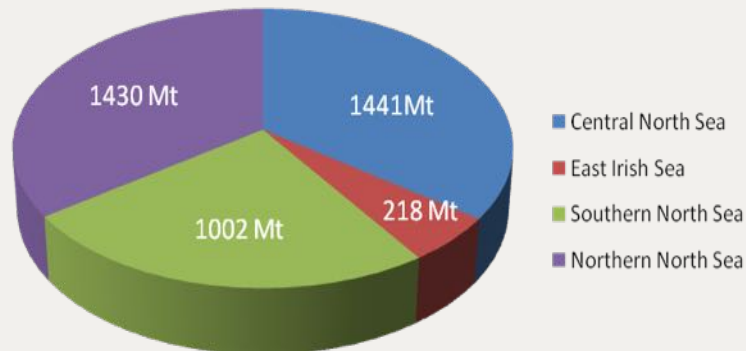
Unit designate

Storage capacity of basic score grouped by unit designate



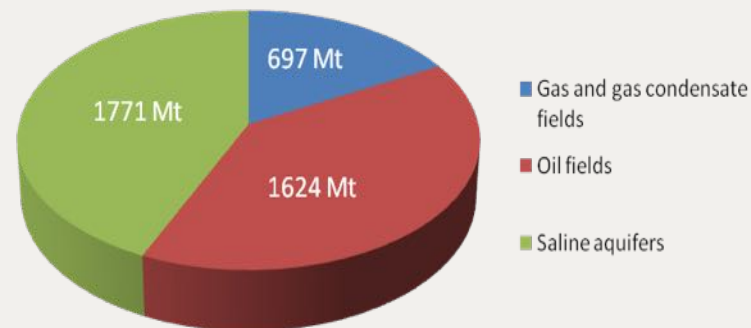
Basic

Storage capacity of commercial feasibility grouped by region



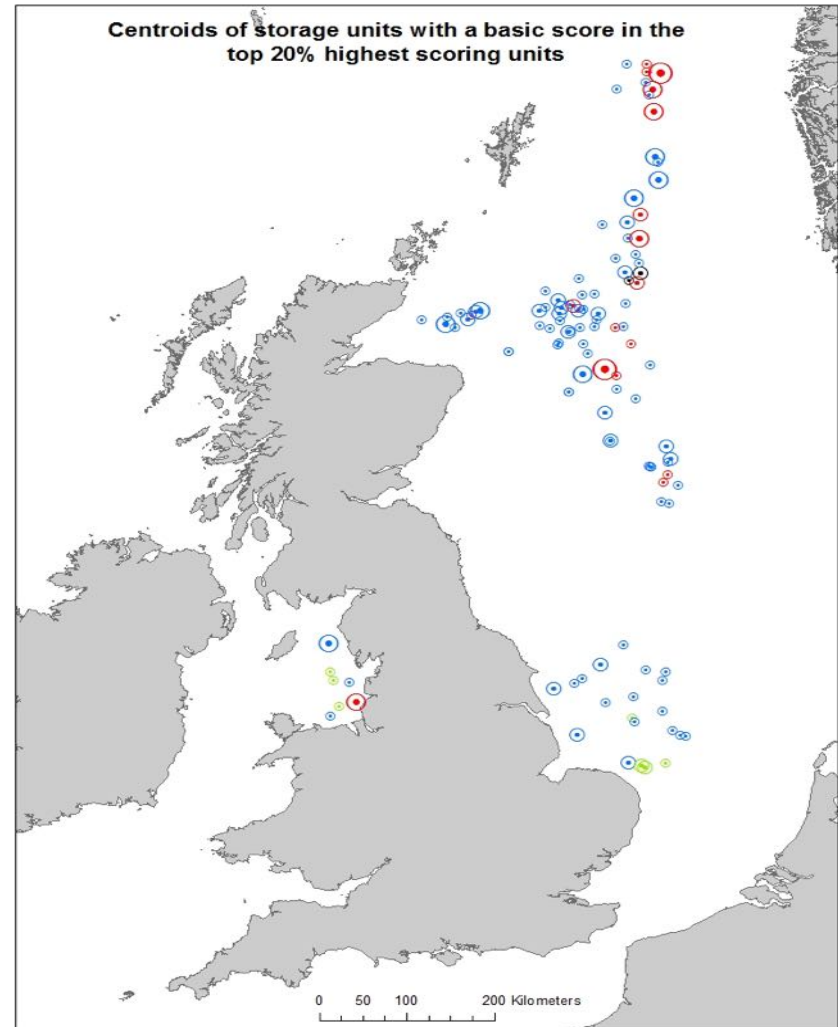
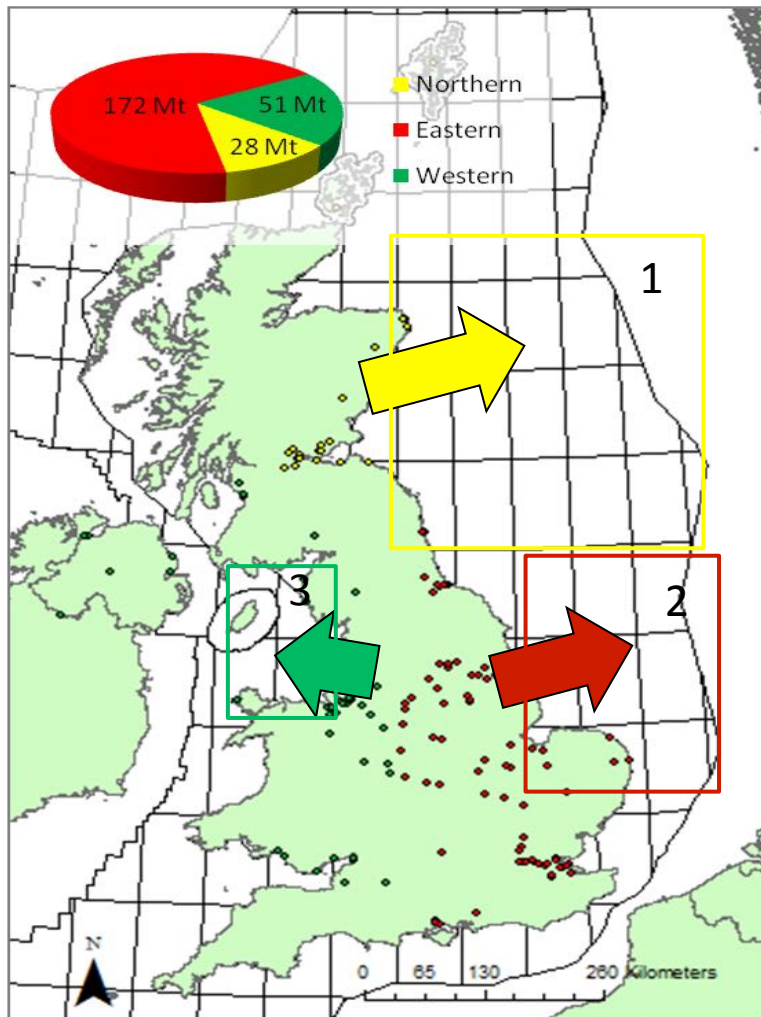
Total: 4091 Mt

Storage capacity of commercial feasibility grouped by unit designate



Commercial

How do we develop storage to meet national and regional capture requirements?



Summary

- Theoretical capacity has been identified
- Detailed appraisal started to provide a portfolio of sites
- Not yet bankable storage as need to connect to transport and undertake (pre-)FEED for costs
- How do we select sites to enable transport and storage provision to develop?
- Are clusters a reasonable approach?
- How do we enable appraisal to make sites bankable?