Linking EU CO_2 sources to storage in 2030 and 2050 UK and Norway

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Dominic Ainger, Steve Argent, (Arup)

- CO2 sources today & future
- CO2 storage across EU27
- Scenarios optimum 2030-50
- Compare other studies

8 months
EU27 + 9
Commission bid
Arup pipes
UoE stores

http://ec.europa.eu/energy/oil/berlin_forum/doc/plenary_meetings/ainger_argent_haszeldine_2010.pdf

TREN / 372-1/C3/ 2009

Working Paper SCCS 2011-01 <www.sccs.org.uk/publications.html>

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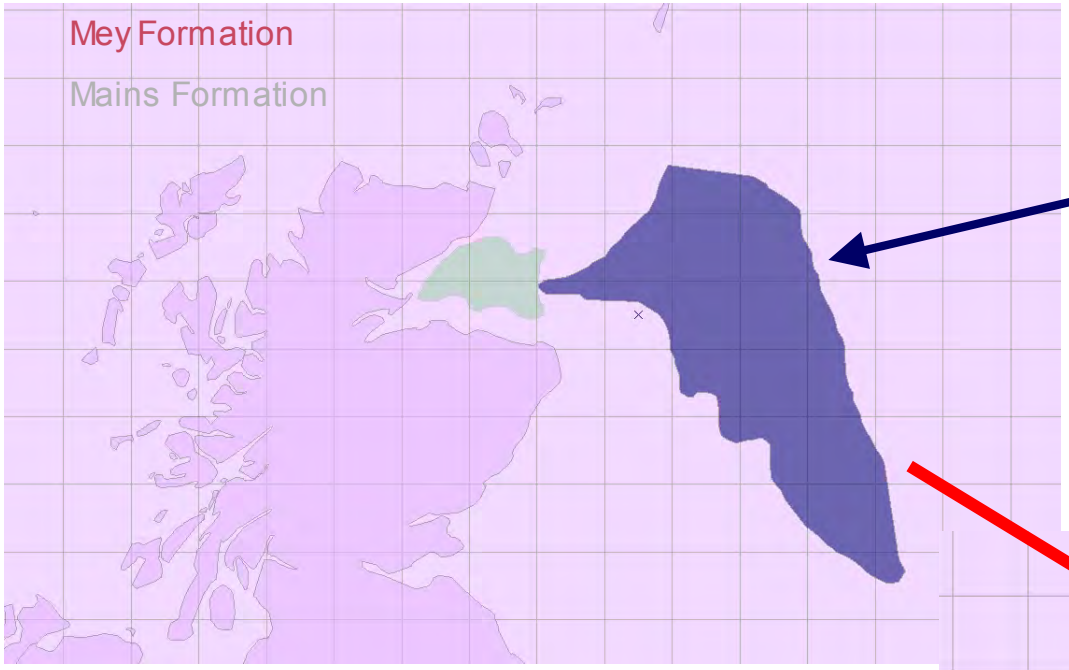
Professor of CCS SCOTTISHPOWER

ARUP

Conversion to Pixels across each 50km square



Aquifers-defined by formation shapefiles

Difficult to represent many aquifers that laterally overly in same geographic area, in 2D.

Potential Solution

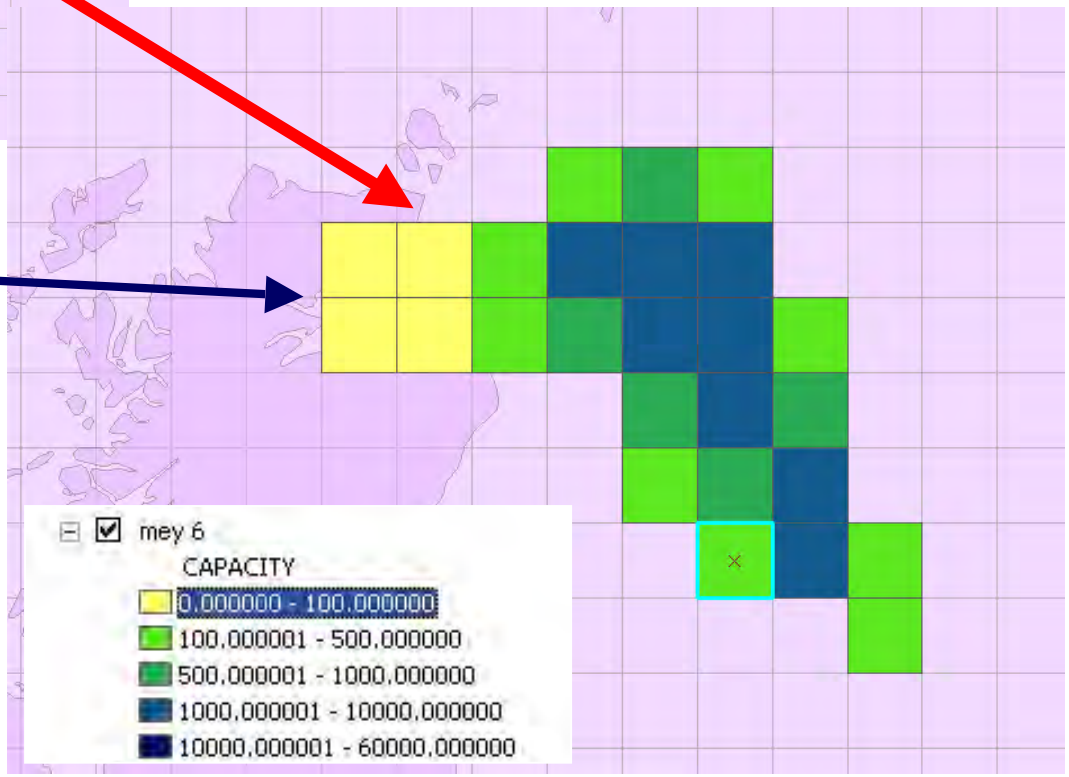
Aquifers compartmentalised by 50x50km grid based on area of aquifer within each square

Allows addition of capacities on an aquifer x aquifer resolution without using the central point as only data point.

Still not representative of thickness

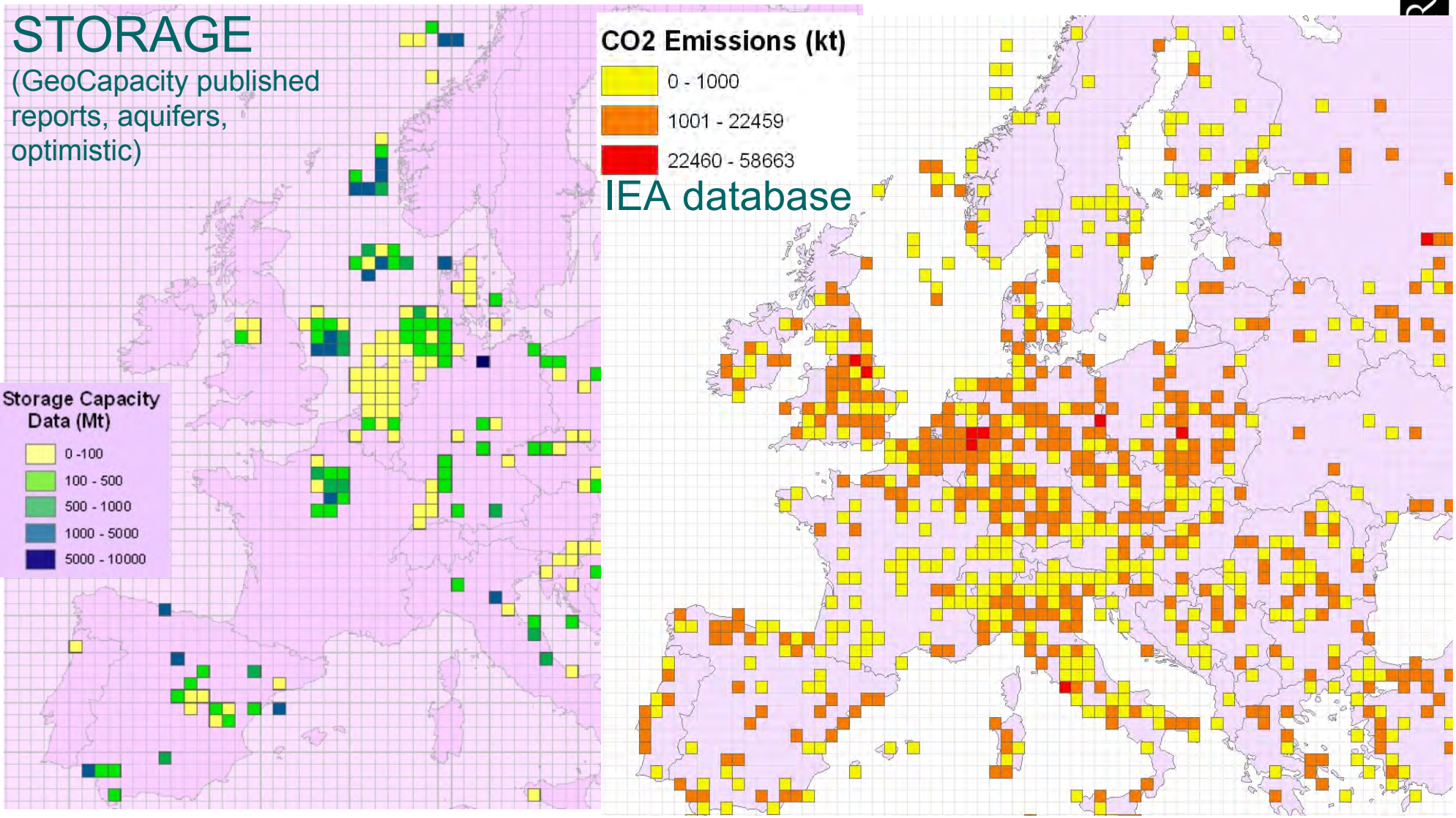
Aquifer x aquifer data available??

Better than GeoCapacity for pipeline scenarios? Higher resolution, less clustered…..

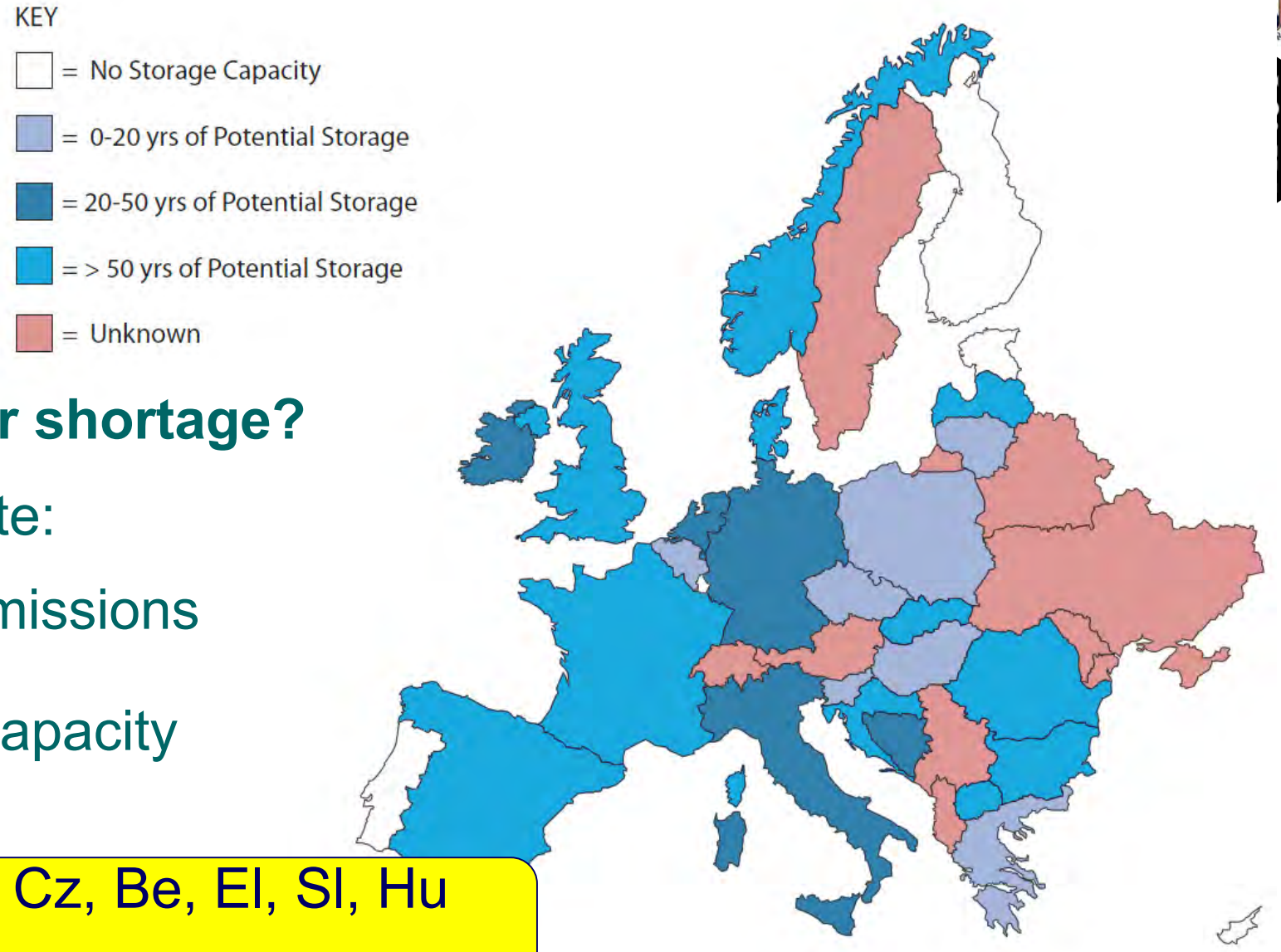


Today

STORAGE: Joule CASTOR, GESTCO GeoCapacity - conservative
EMISSIONS plot large point sources - IEA database



Scoping Evaluation: Storage Duration



Abundance or shortage?

Simple estimate:

present day emissions
and
conservative capacity

< 20yr? Pl, Cz, Be, El, Sl, Hu

< 50yr? De, Nl, It, Ie, (Bosnia)

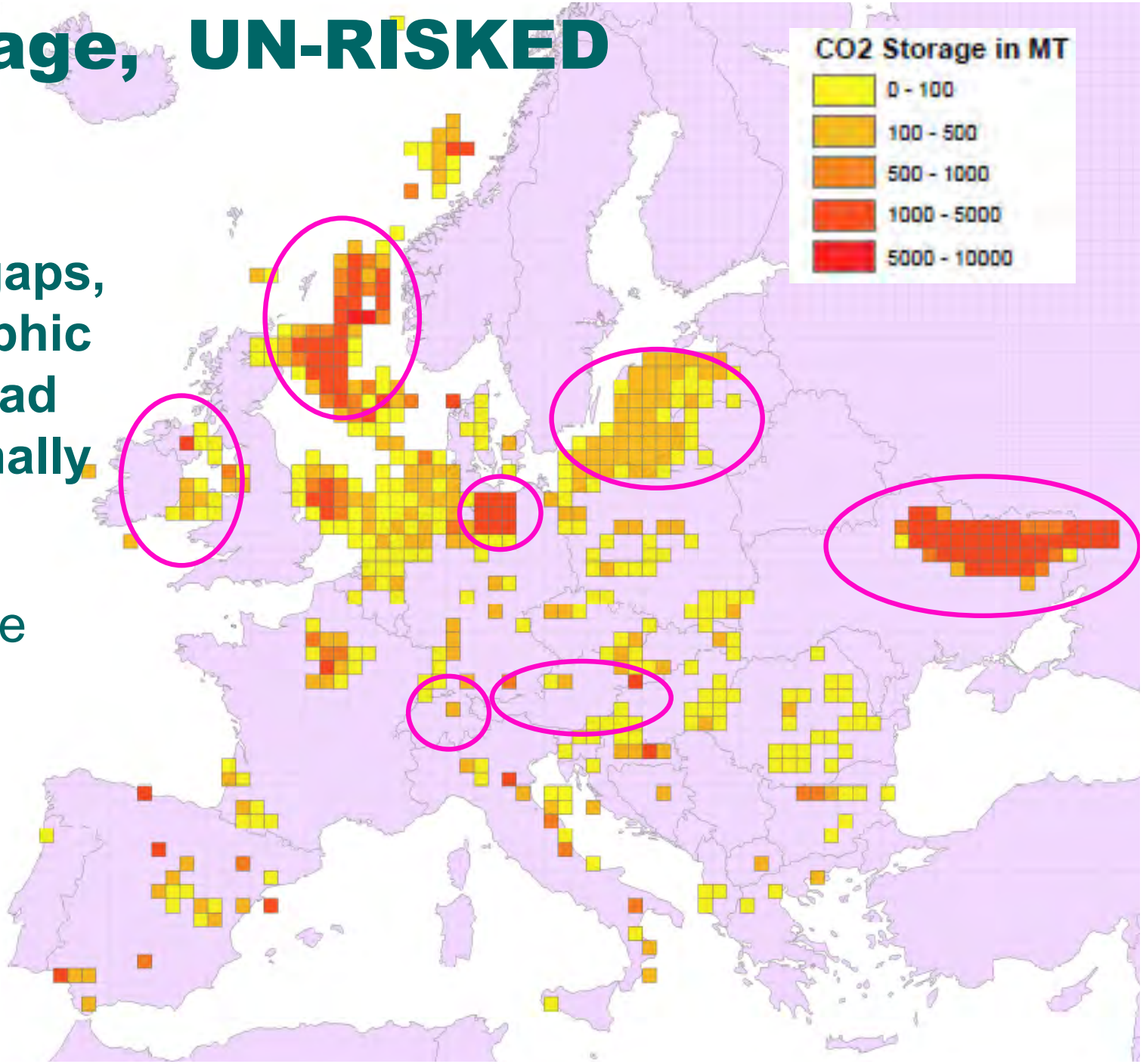
Final Storage, UN-RISKED

EU 50x50 grid.
JRC database
Update, fill in gaps, extend geographic coverage, spread aquifers regionally

NEW:

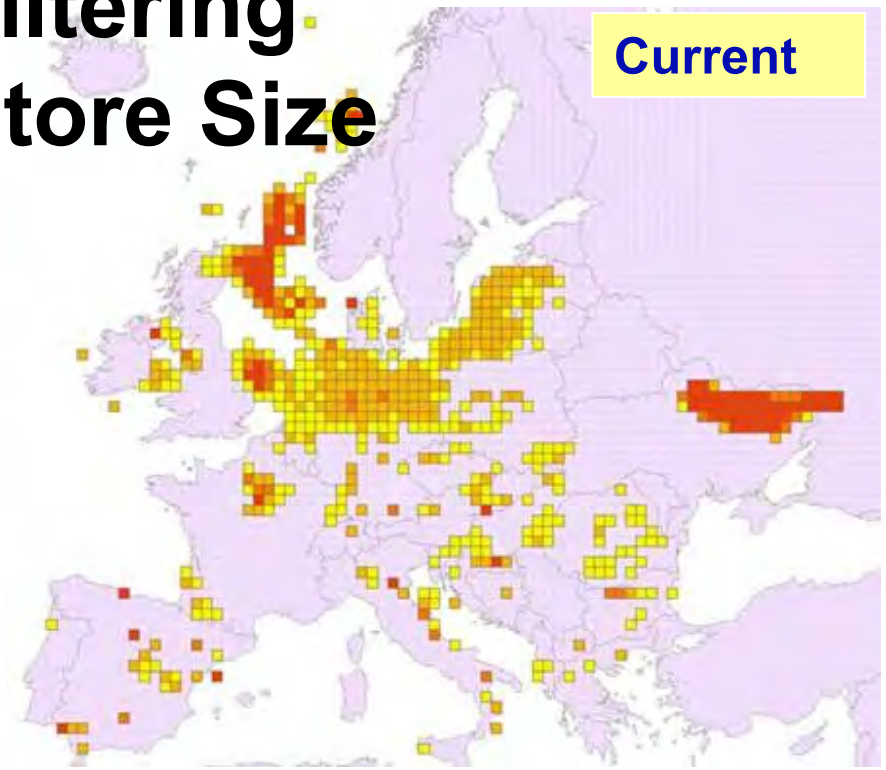
North Sea - large
Ireland
Austria
Switzerland

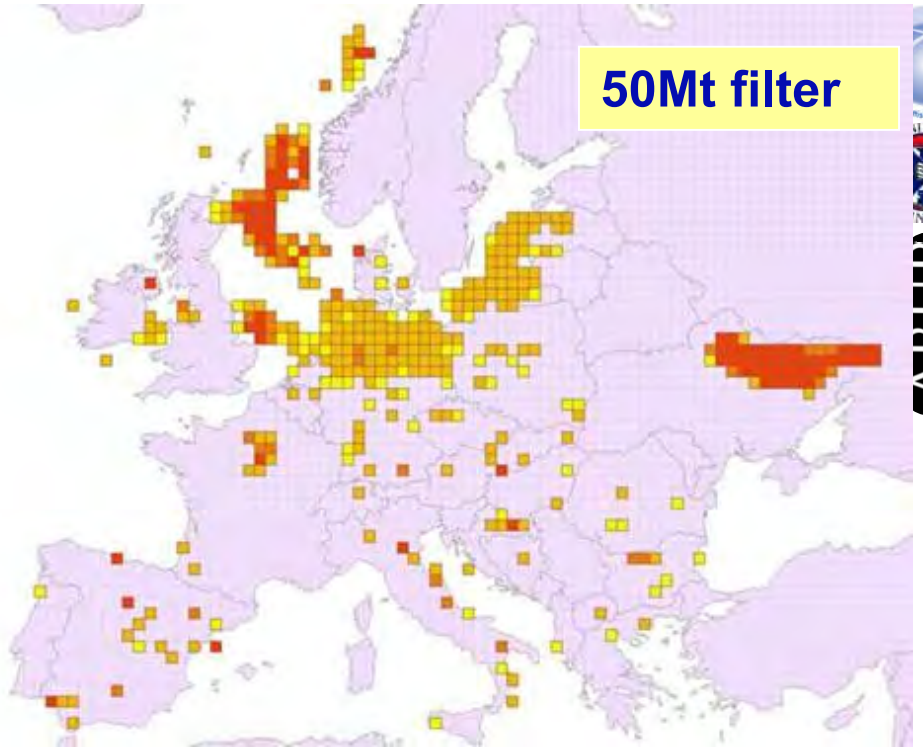
Baltic
Ukraine

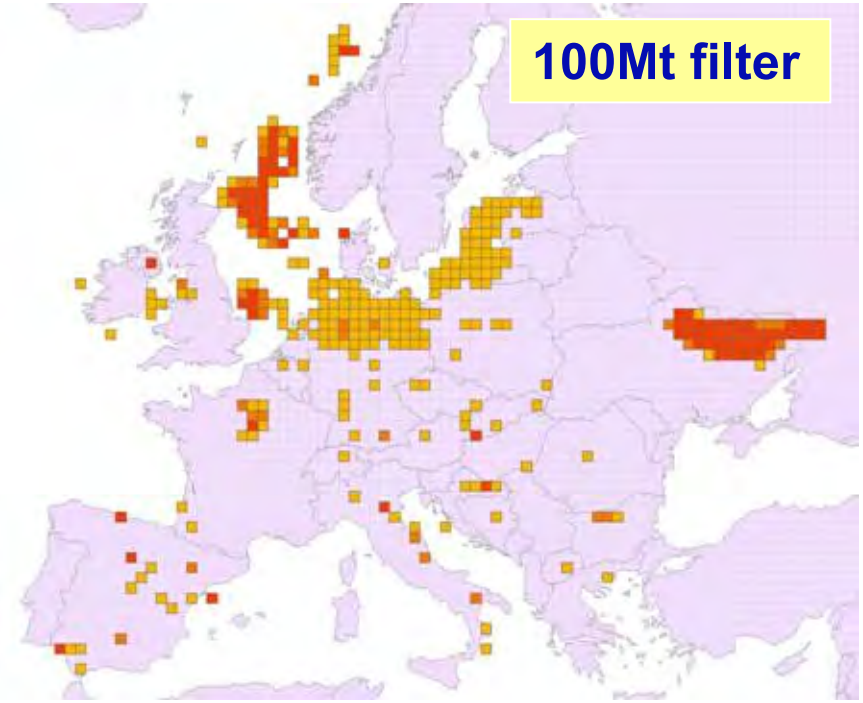


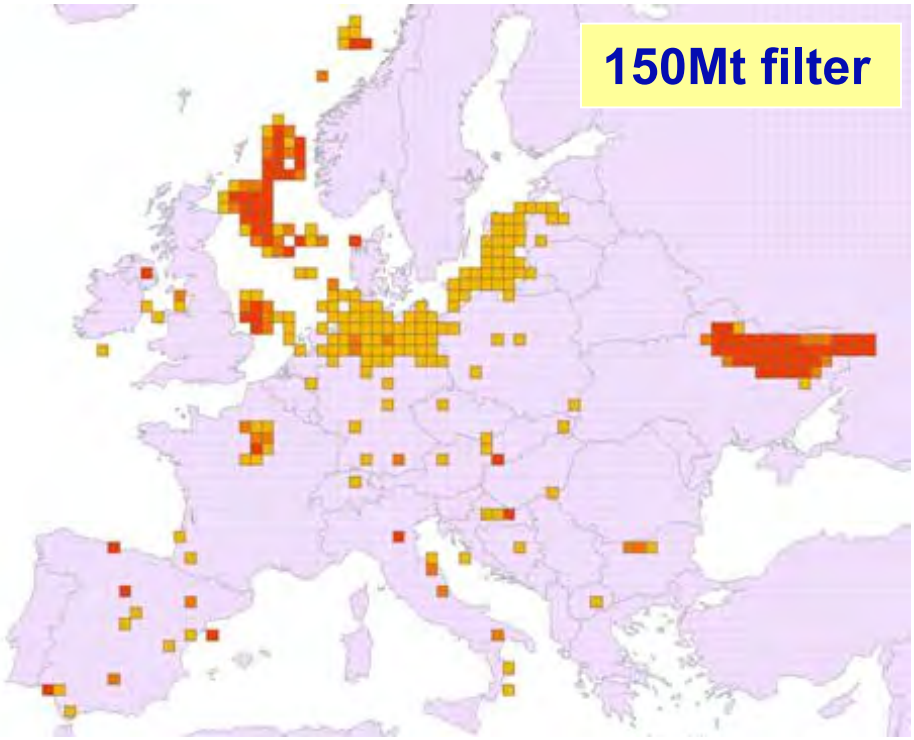
Onshore well spread. North Sea very large - well known. Baltic, Ukraine large - not known

Filtering Store Size



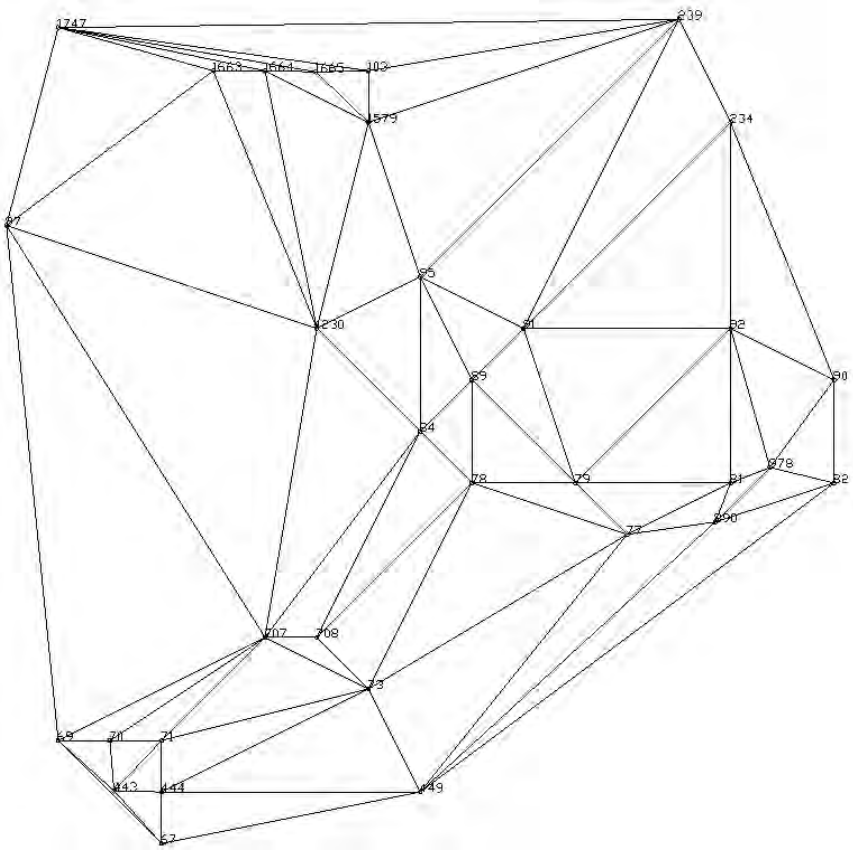




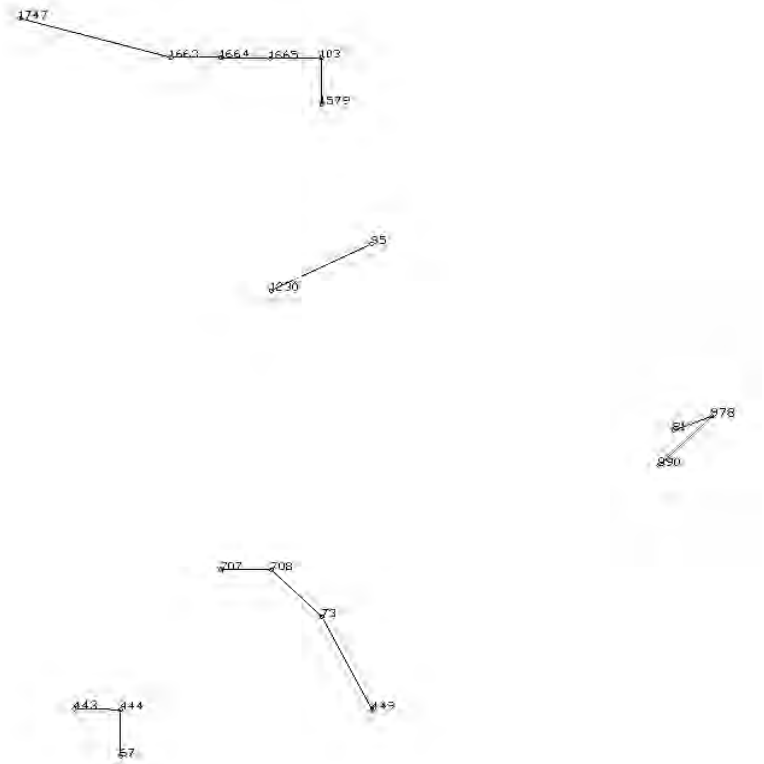


Modelling Methodology

- **Ant Colony Optimisation Algorithm - telephones**
- **Sole optimisation criterion is cost (capital)**



Over-specified network



Optimised network

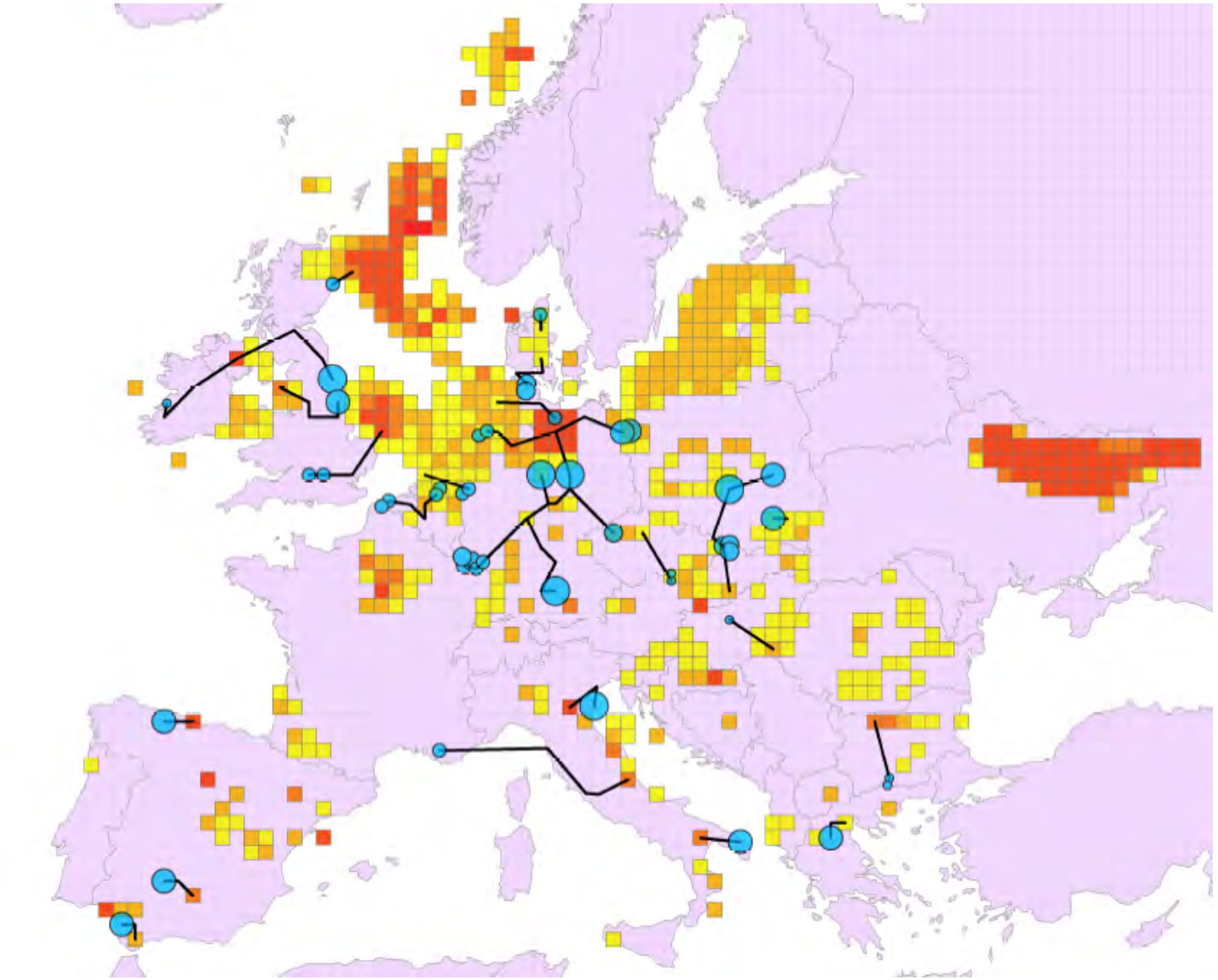
CO2 Transport Infrastructures: Scenarios

- **All storage available**
  - 2030 Low CO2
  - 2030 Mid CO2
  - 2030 High CO2
  - 2050 Low CO2
  - 2050 Mid CO2
  - 2050 High CO2
- **Offshore storage only**
  - 2030 Low CO2
  - 2030 Mid CO2
  - 2030 High CO2
  - 2050 Low CO2
  - 2050 Mid CO2
  - 2050 High CO2
  - 2050 High CO2 North Sea

	Lo	Med	Hi
2030	50	120	350
2050	280	600	800

Captured quantities (MtCO2/yr)

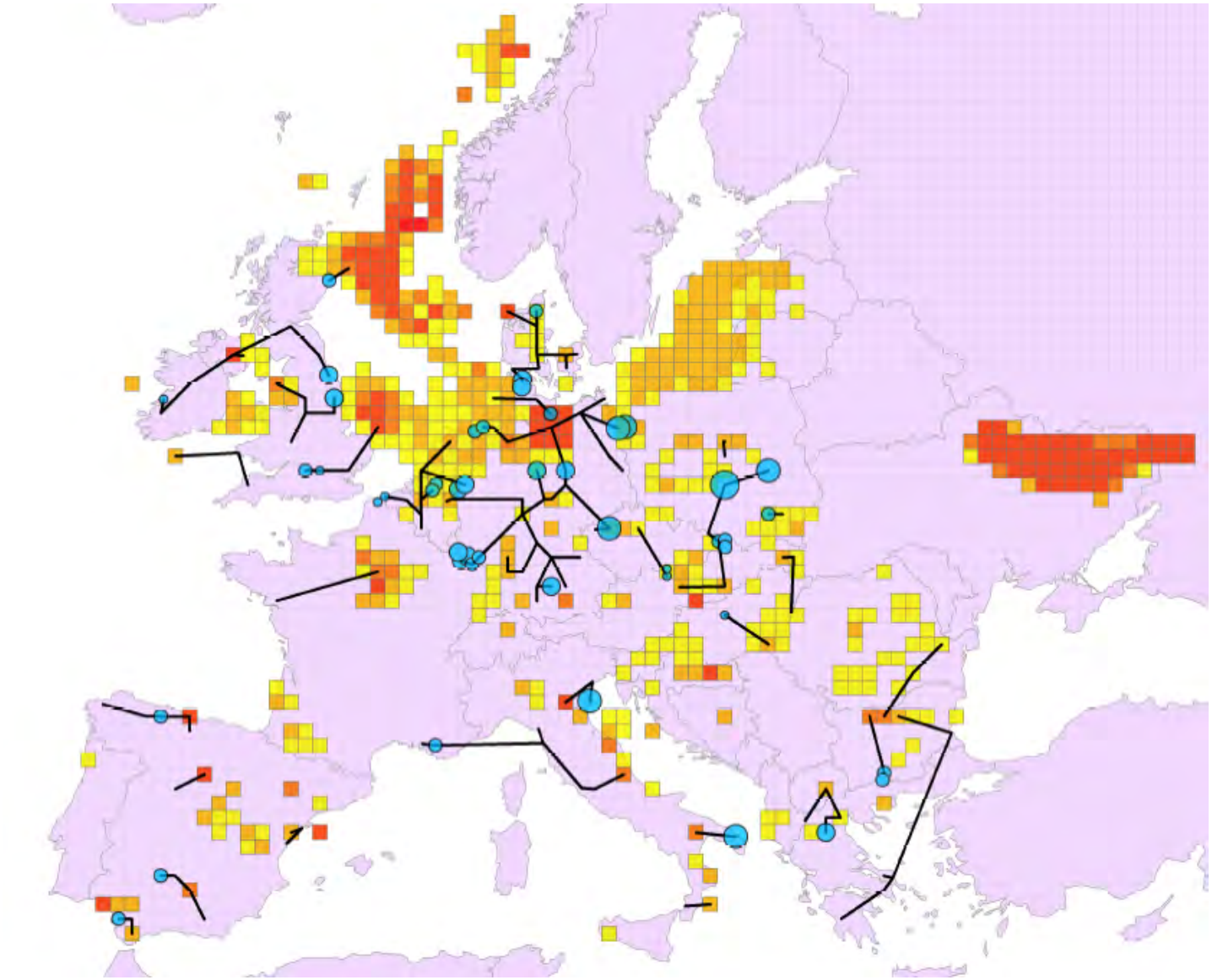
2030 Low; All Storage Available



Simulation does not consider technical ability to develop CO2 storage.

- Future point source of CO2 (Arup & PRIMES predictions)

2030 High; All Storage Available



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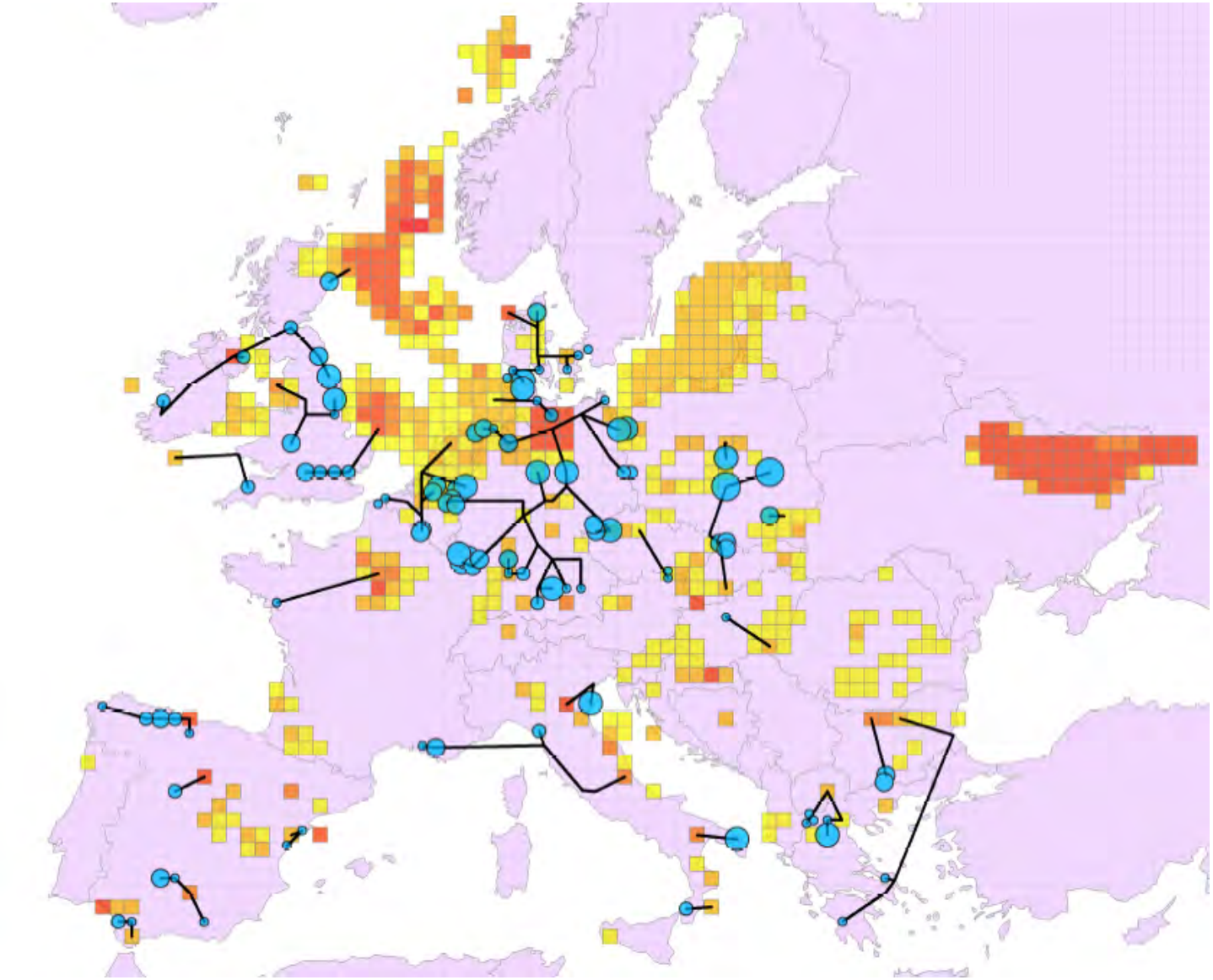

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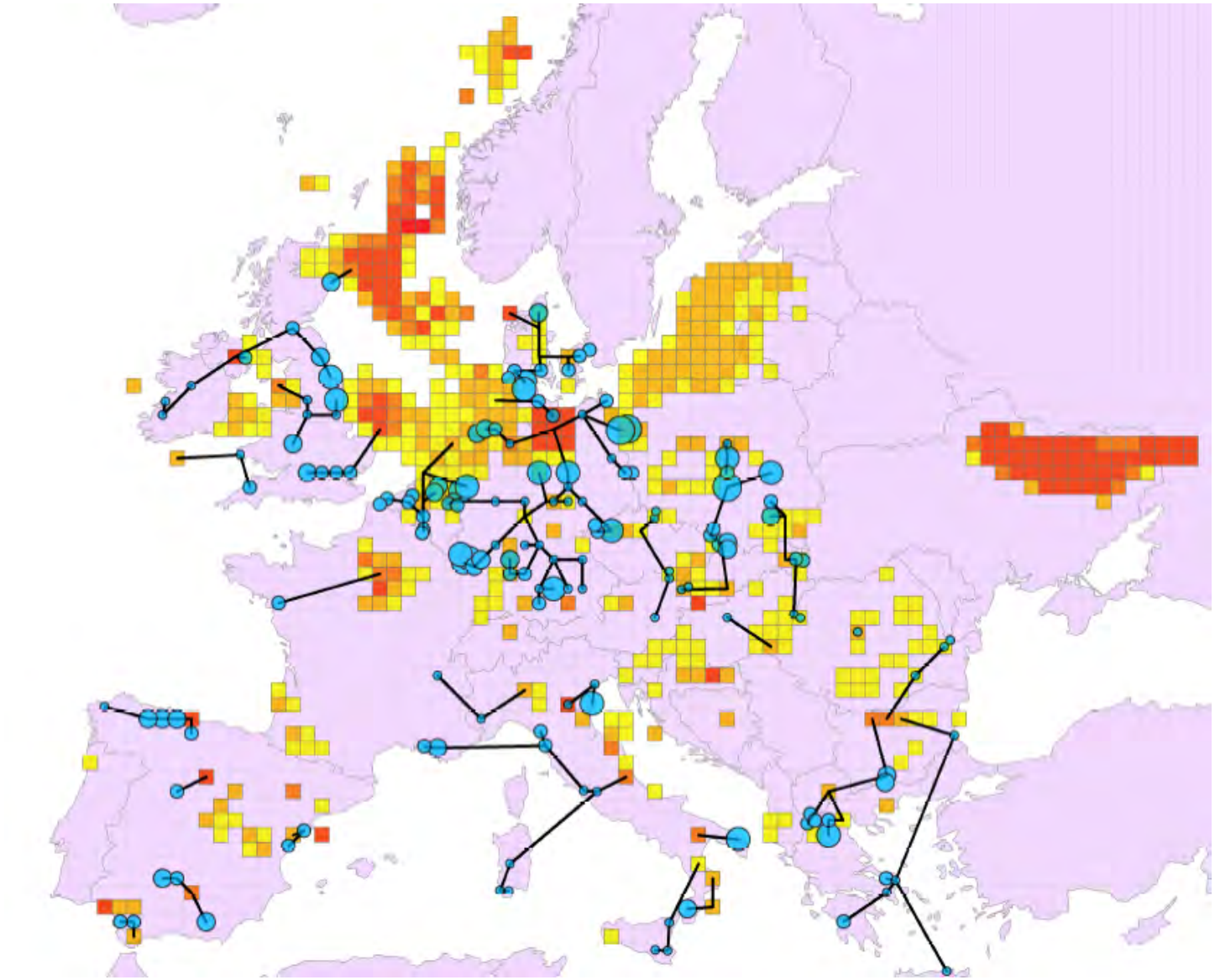

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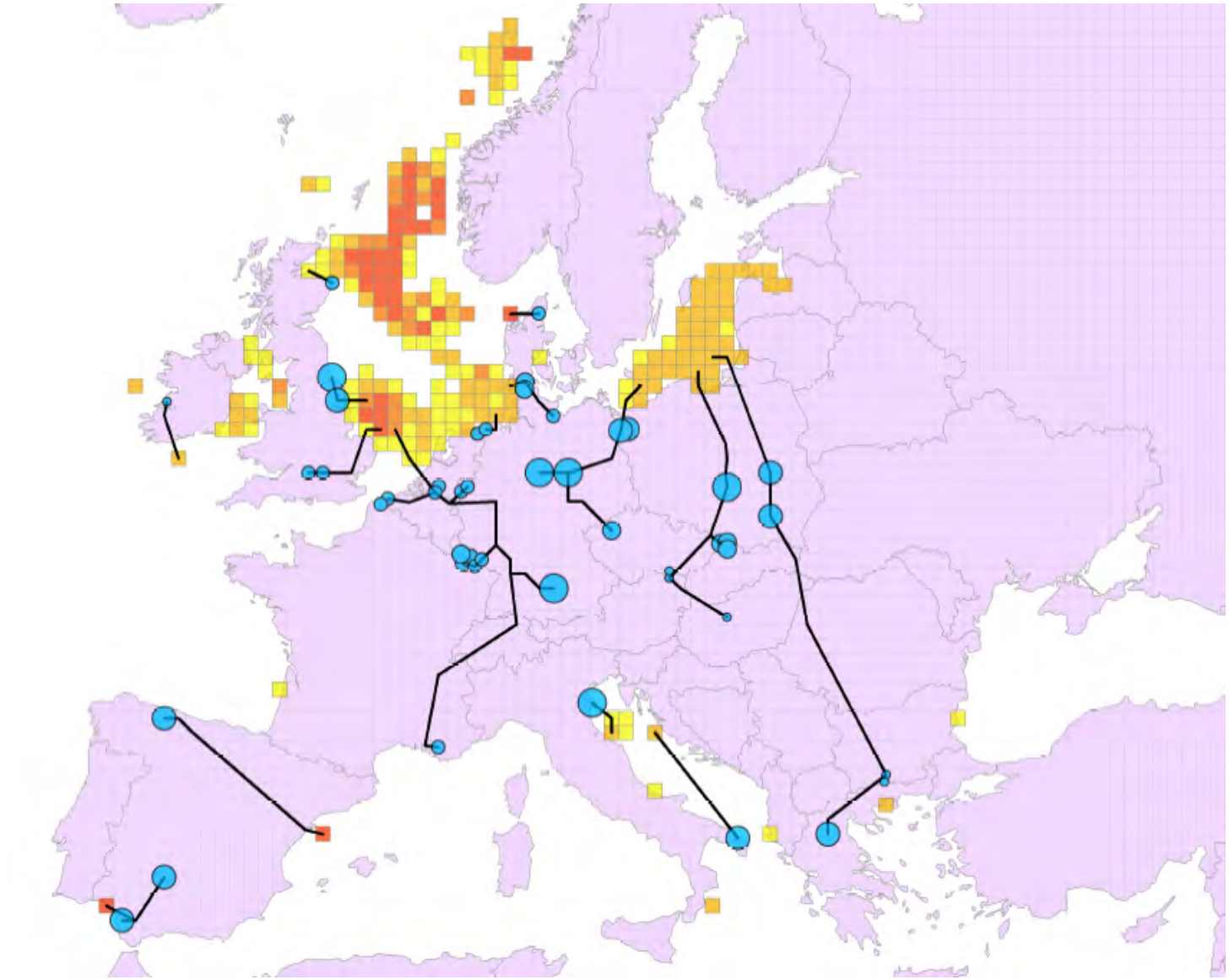

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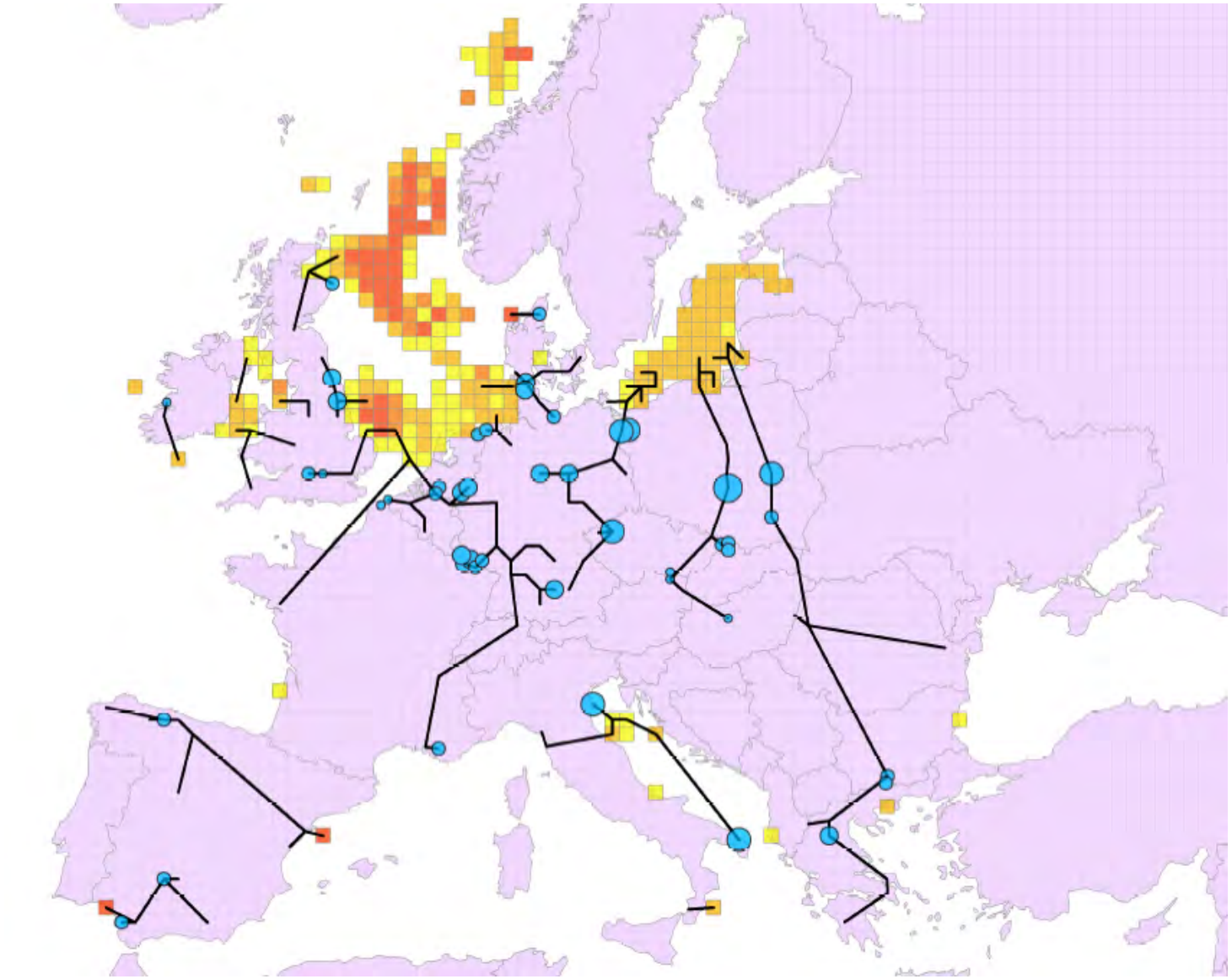
North Sea much more advanced than Baltic, and likely to develop first.

2030 High; Offshore Only



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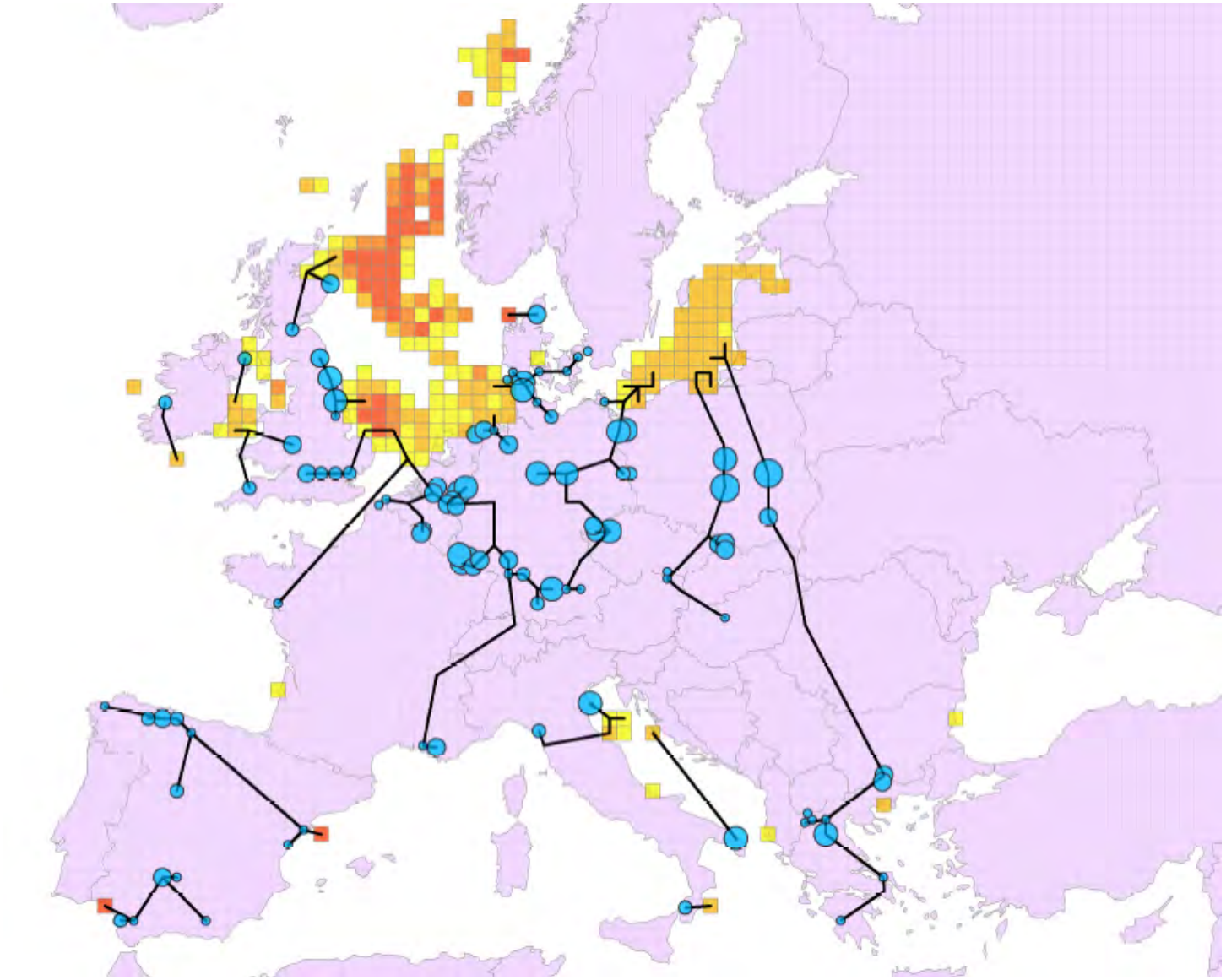

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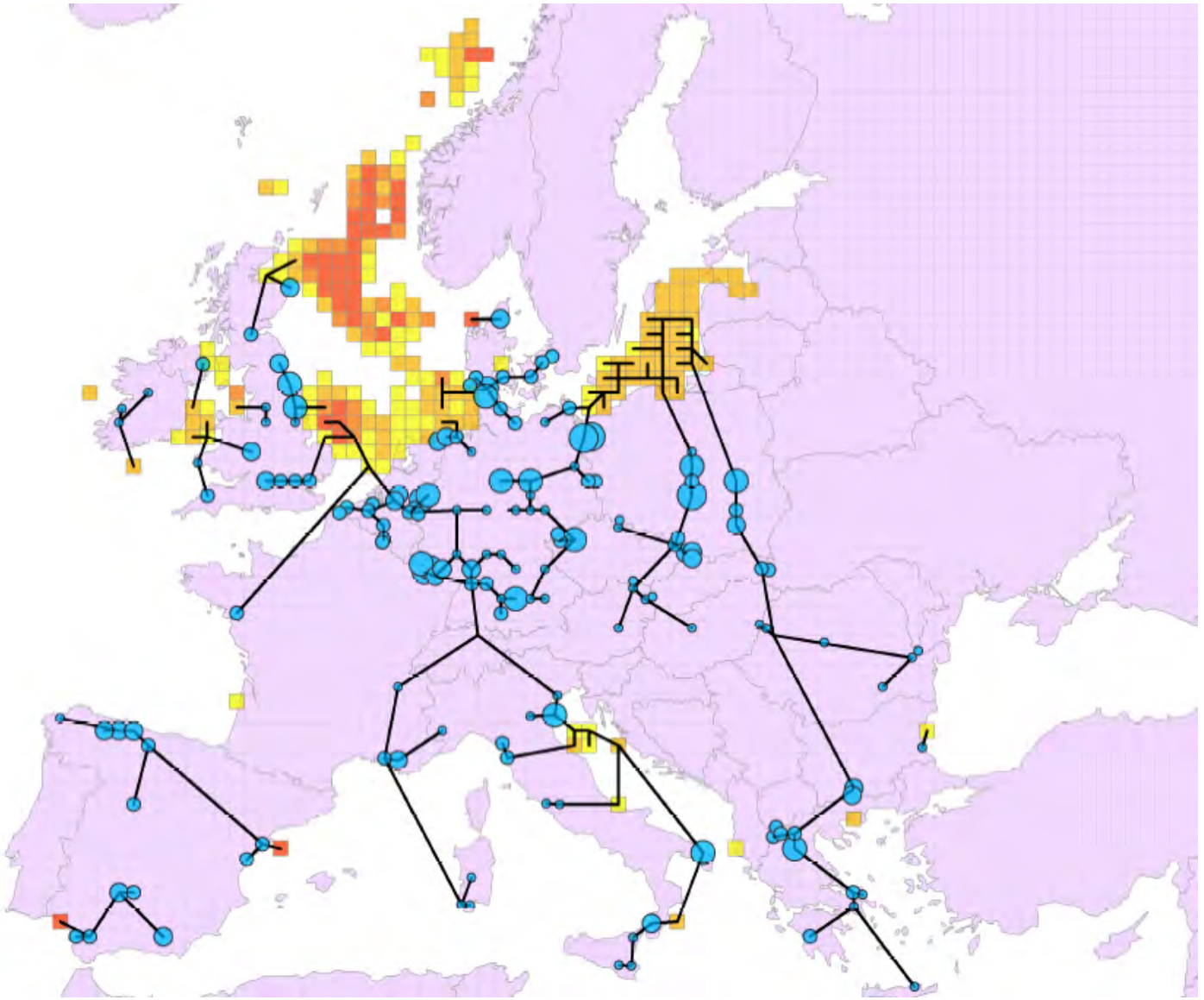

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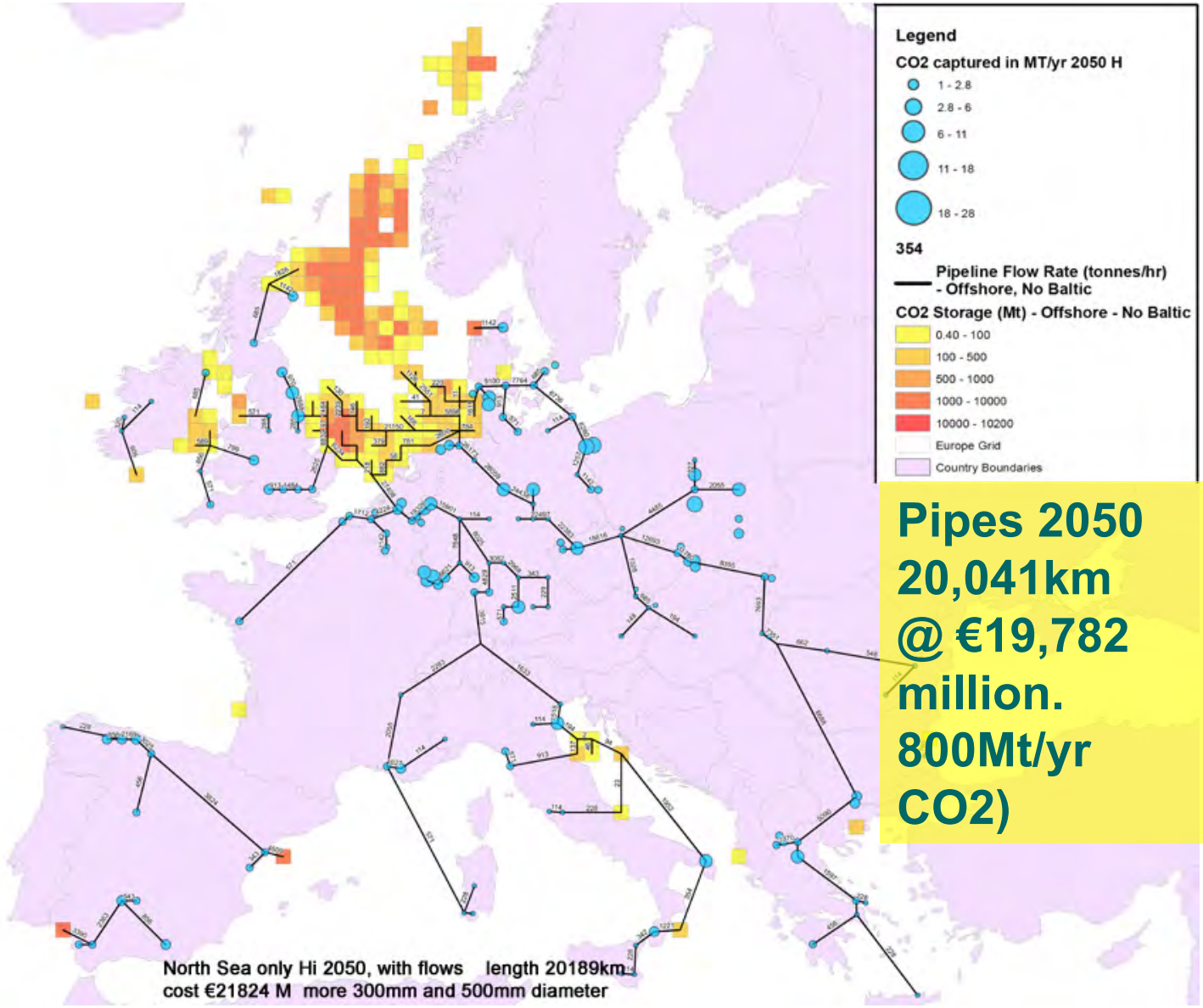
2050 High; North Sea only



Pipes 2050 20,041km @ €19,782 million. 800Mt/yr CO2)

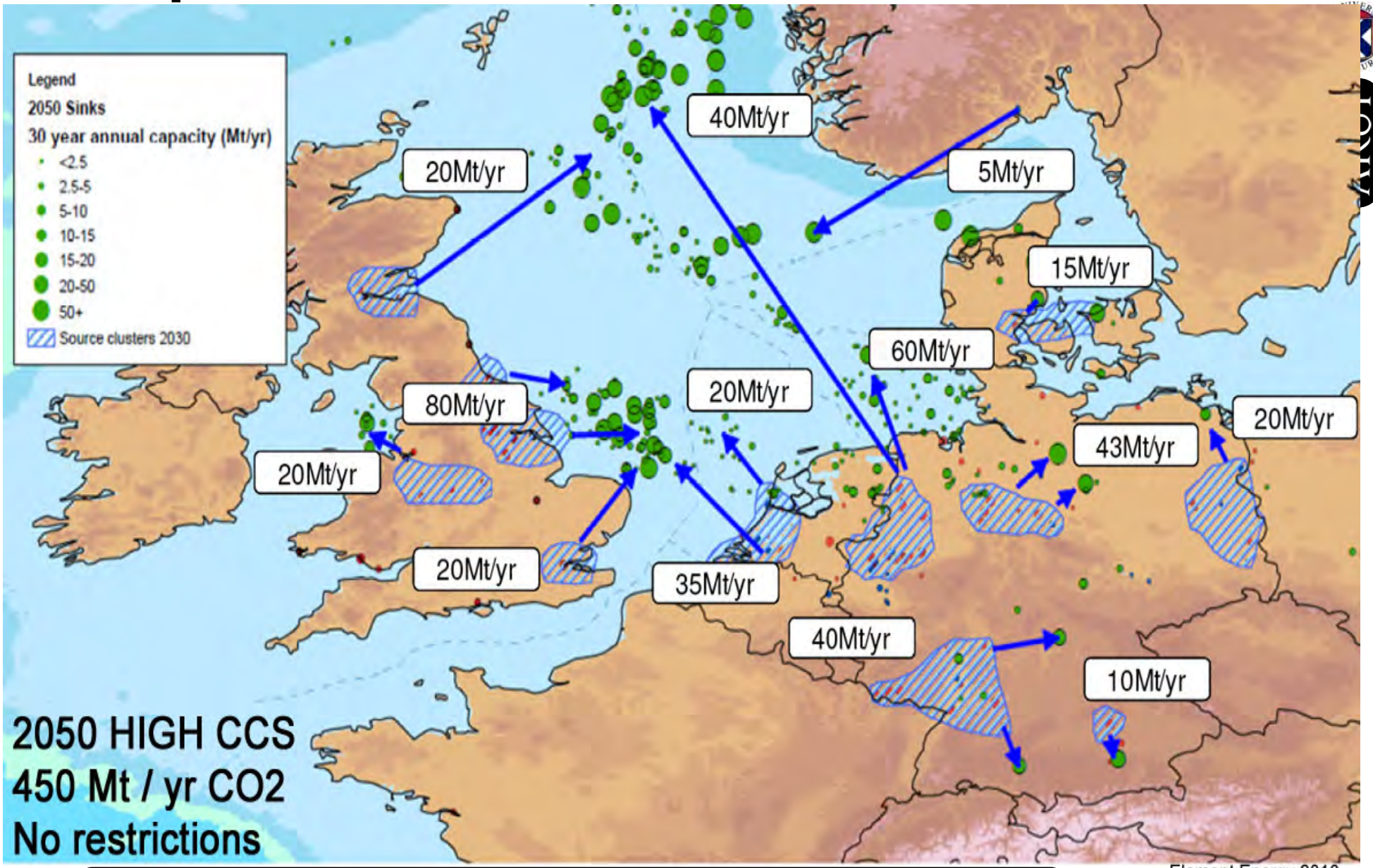
North Sea much more advanced than Baltic, and likely to develop. Fills closest first.

But Southern North Sea relies on only two geology types

Additional cost € 2Bn, due to larger diameter pipes, length 20,189 km

Most realistic : but doesn't use most North Sea ….. ???

Compare One North Sea (NSBTF Element Energy)

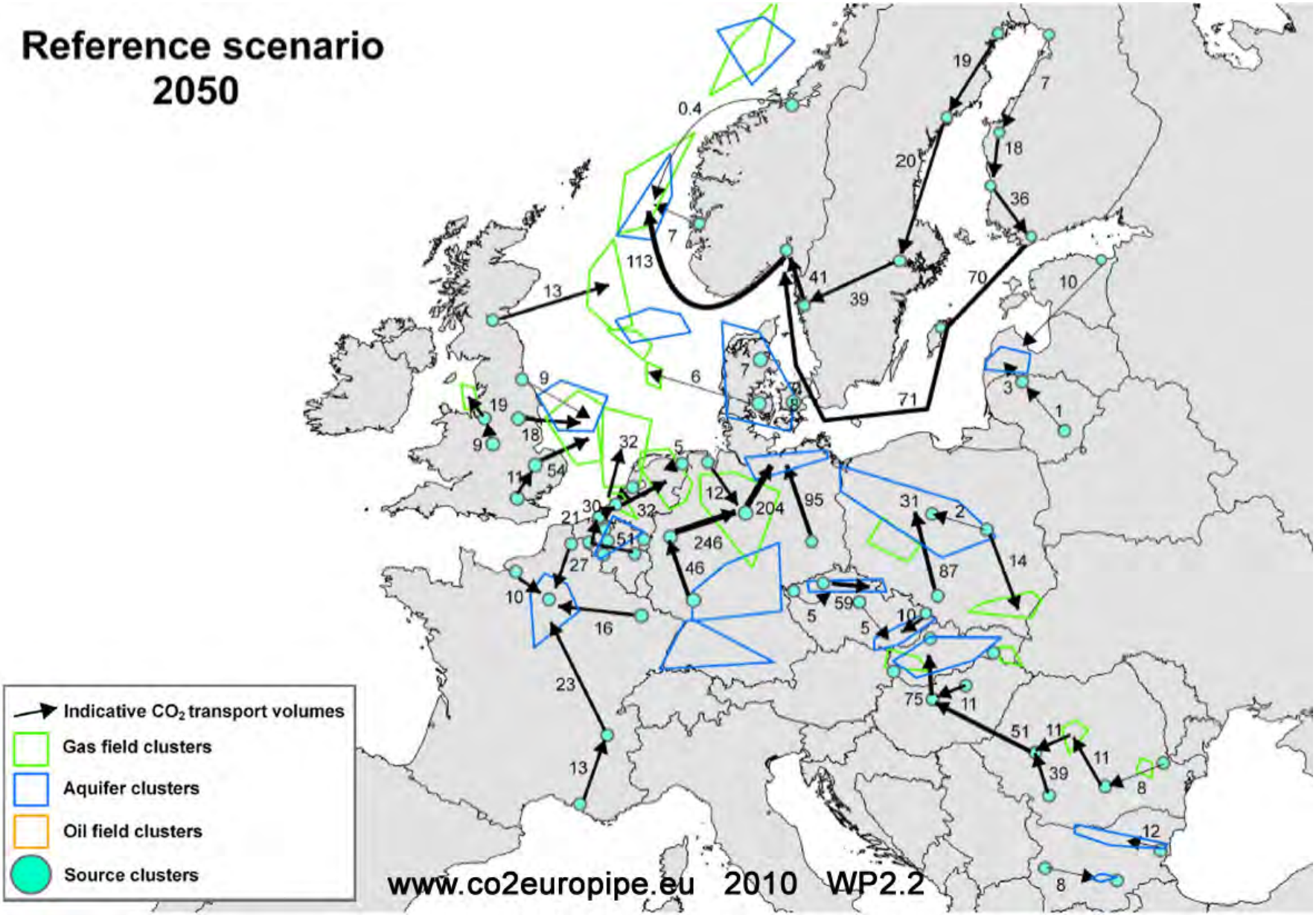


Element Energy 2010
One North Sea
for NPD UK FCO

A to B pipes; no resilience, overall expensive

Compare Europipe (TNO)

2030 = 250 Mt CO2/yr
2050 = 860 Mt CO2/yr

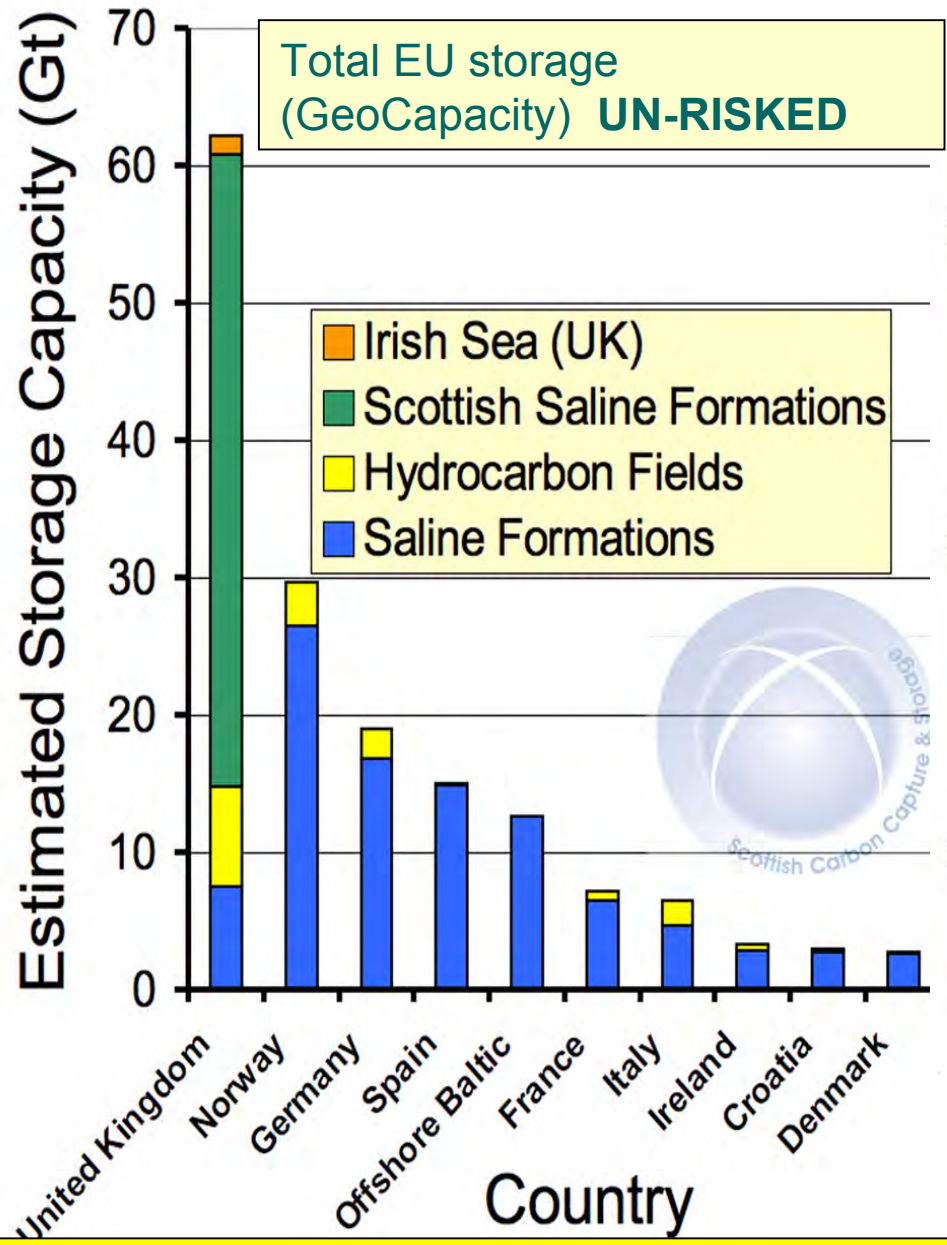


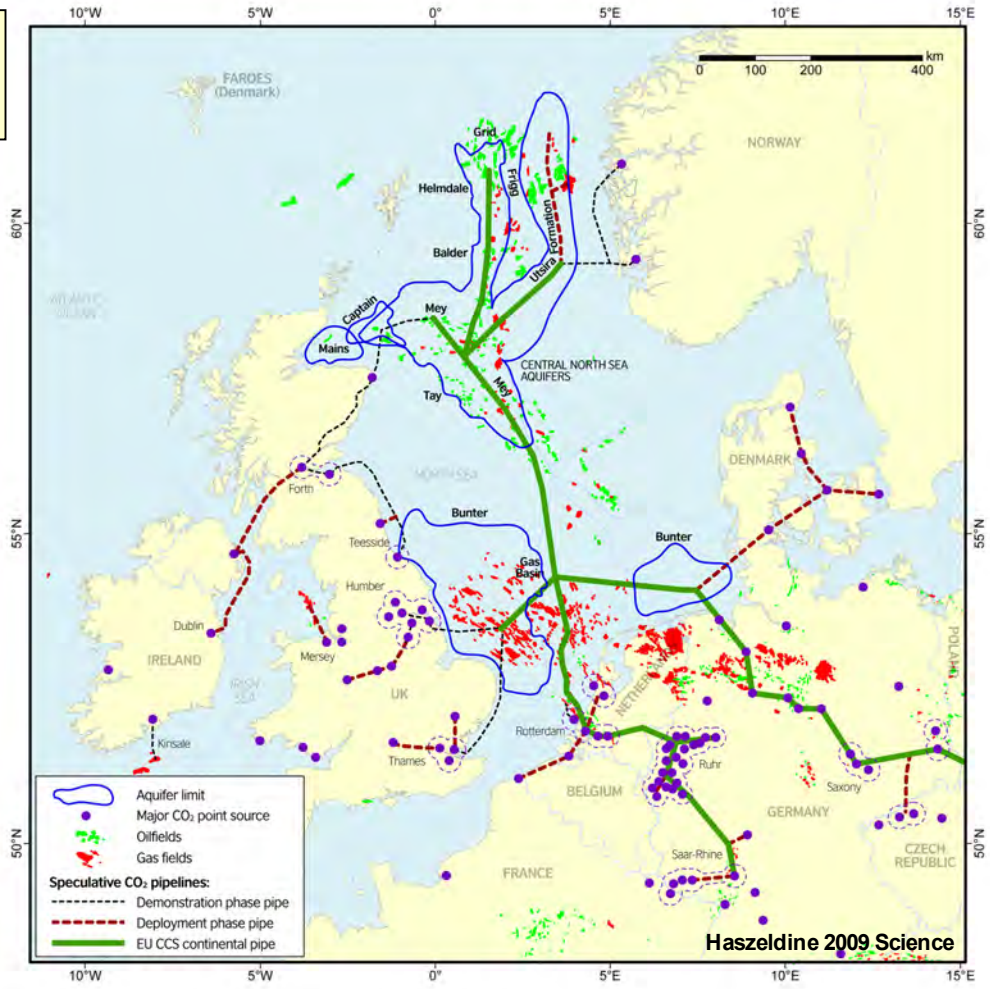
Local hubs, onshore stores, minimal North Sea

Gas pipes to Europe (2007)

Operating long pipes is established

Northern North Sea holds the storage





North Sea storage 100 yr CO2 production from Europe.
But not the first “desktop” choice - UK and No need to validate stores

Summary and needs

1) OFFSHORE storage is vital in ALL scenarios.
   10 year exploration and appraisal lead-in

2) Co-operation of N Sea Regions on storage mapping

3) Validation tests INJECTION and MONITORING

4) TRANSBOUNDARY guidance - from early dates
   - LEGAL - London Convention offshore
   - "QUALITY" pipe gas = composition, water, pressure?
   - LIABILITY - new owner, not original source
   - CONFIDENCE - to build long and oversized pipes

Proposals: Sub-sea test laboratory (FP7)
North Sea common storage maps (GCCSI)

Working Paper SCCS 2011-01 <www.sccs.org.uk/publications.html>