Enabling the next phases of CO2 storage

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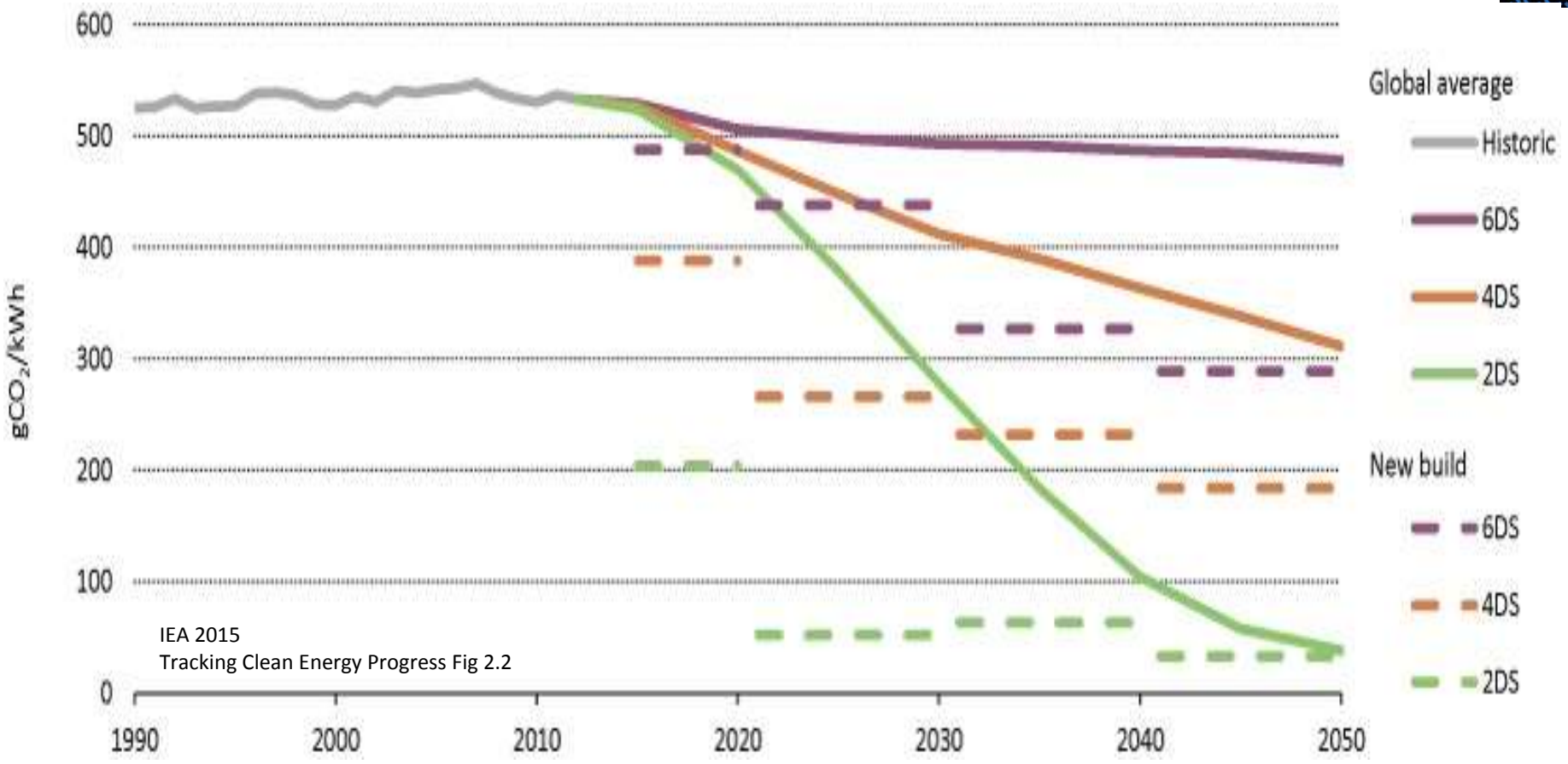
Carbon embedded in electricity is constant

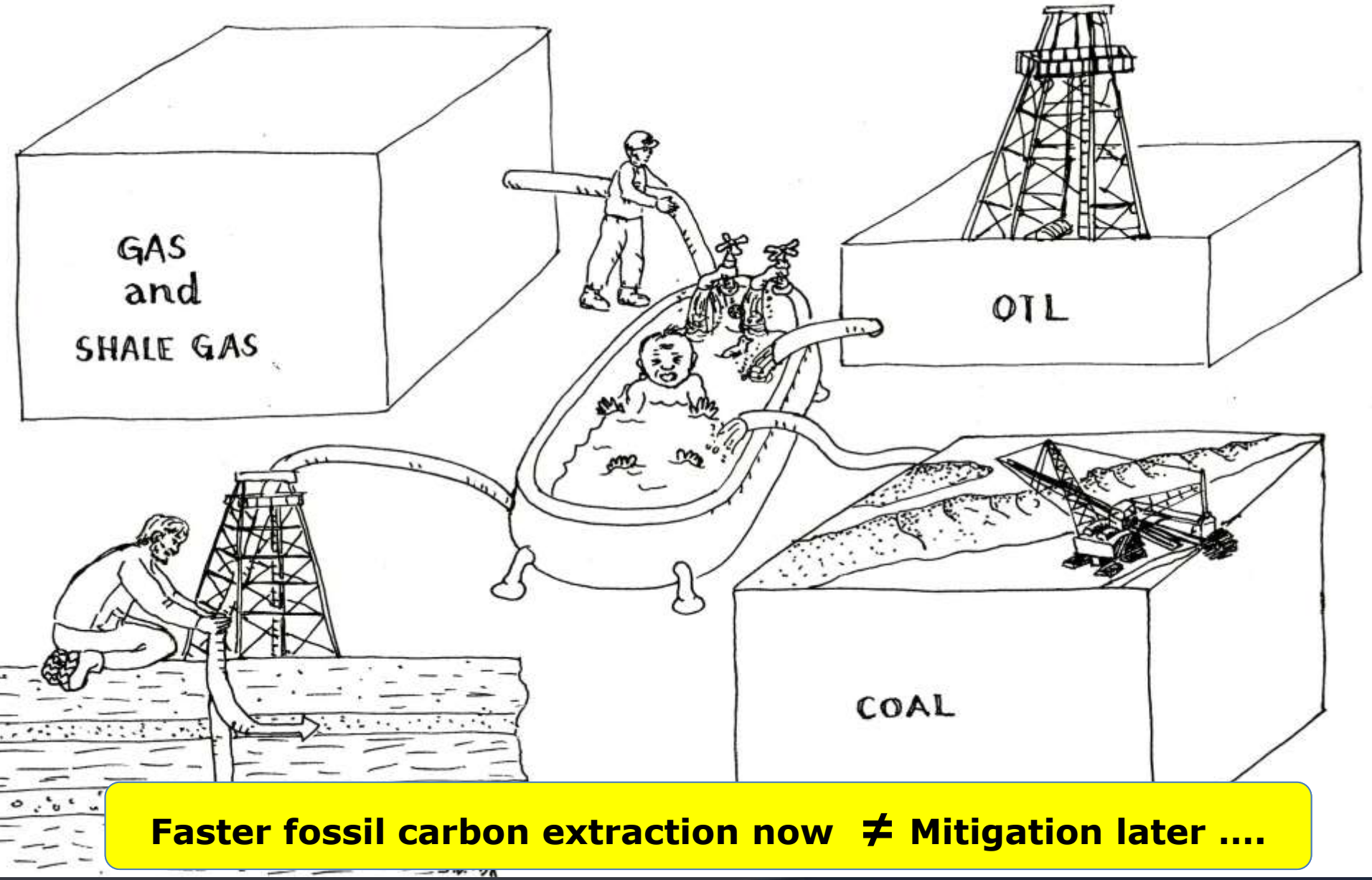


Power sector (all sources) has not decarbonised at all since 1990

Grow

Progress is very slow. Likely 4 to 6 C warming
CCS not needed to prevent 2C, but to reduce 4C ➔ 6C

Avoiding a carbon bubble
1 tonne CO2 out = 1 tonne CO2 in

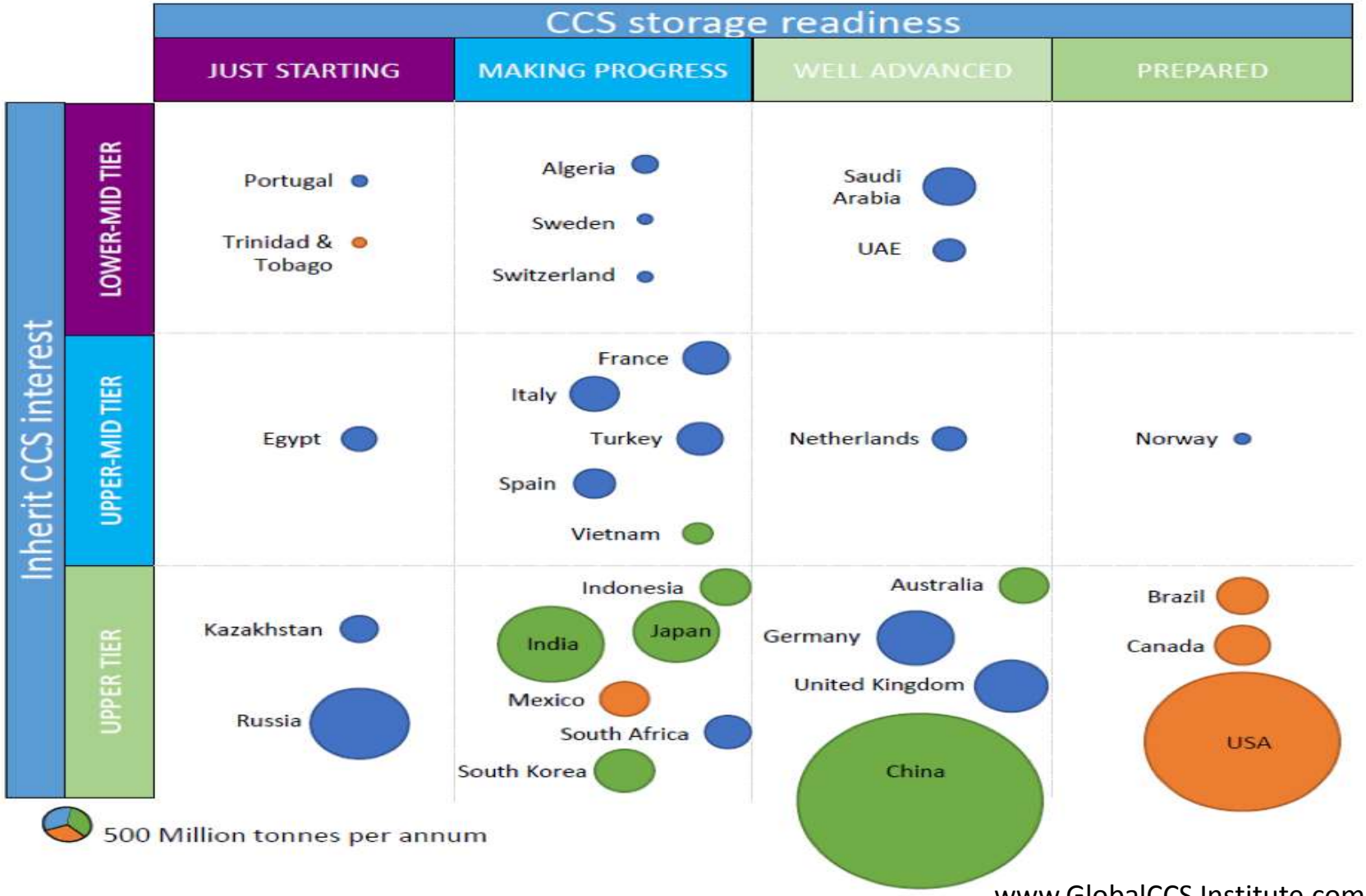


Faster fossil carbon extraction now ≠ Mitigation later ….

Global : storage ready ?

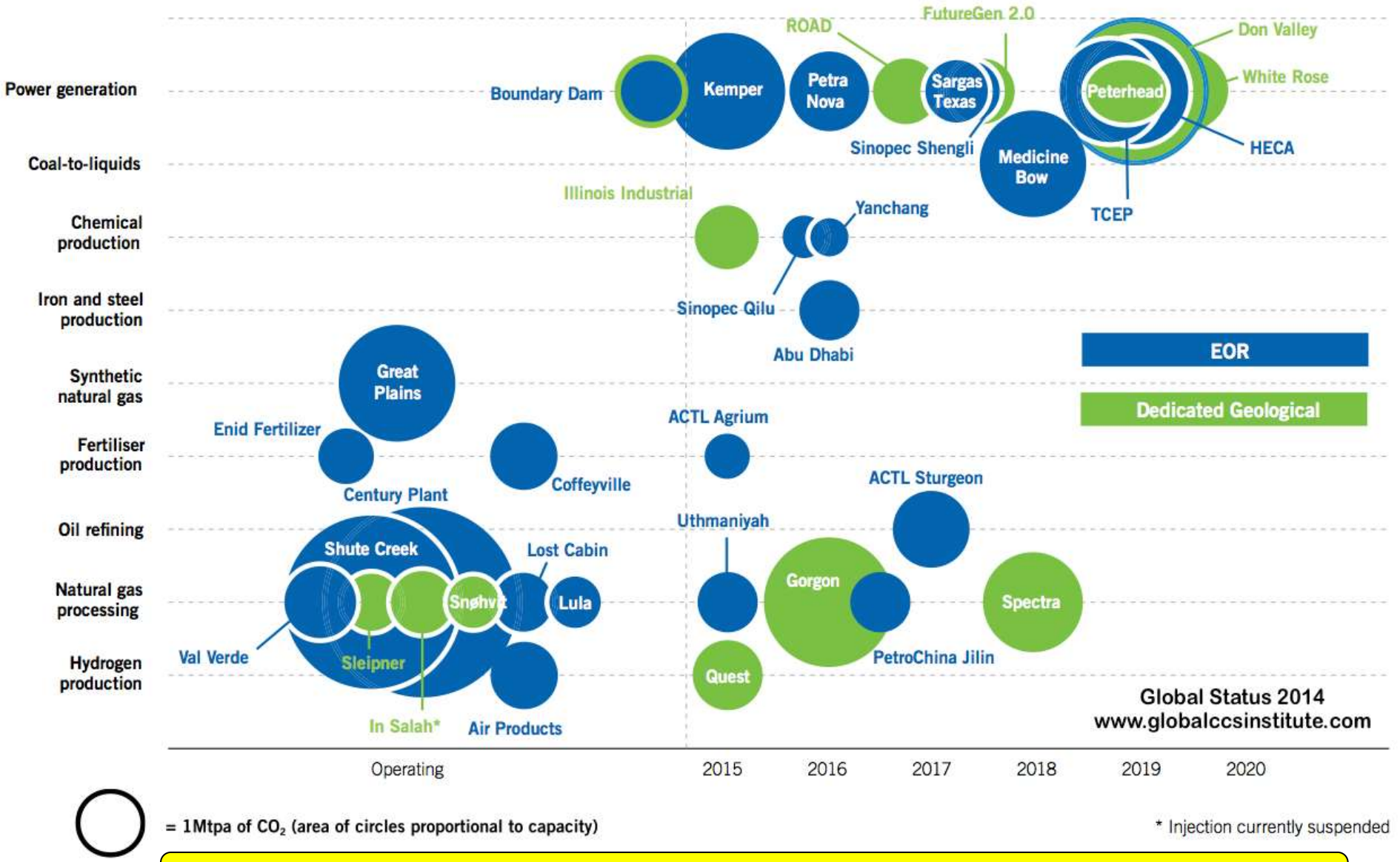
Figure 2: Assessment of the 2014 storage readiness assessment versus the CCS interest

Ball size relates to 2012 CO_2 emissions from fuel combustion (Source: CO_2 emissions from fuel combustion Green: Asia-Pacific, Orange: Americas, Blue: Europe, Africa, Middle East, Eurasia.



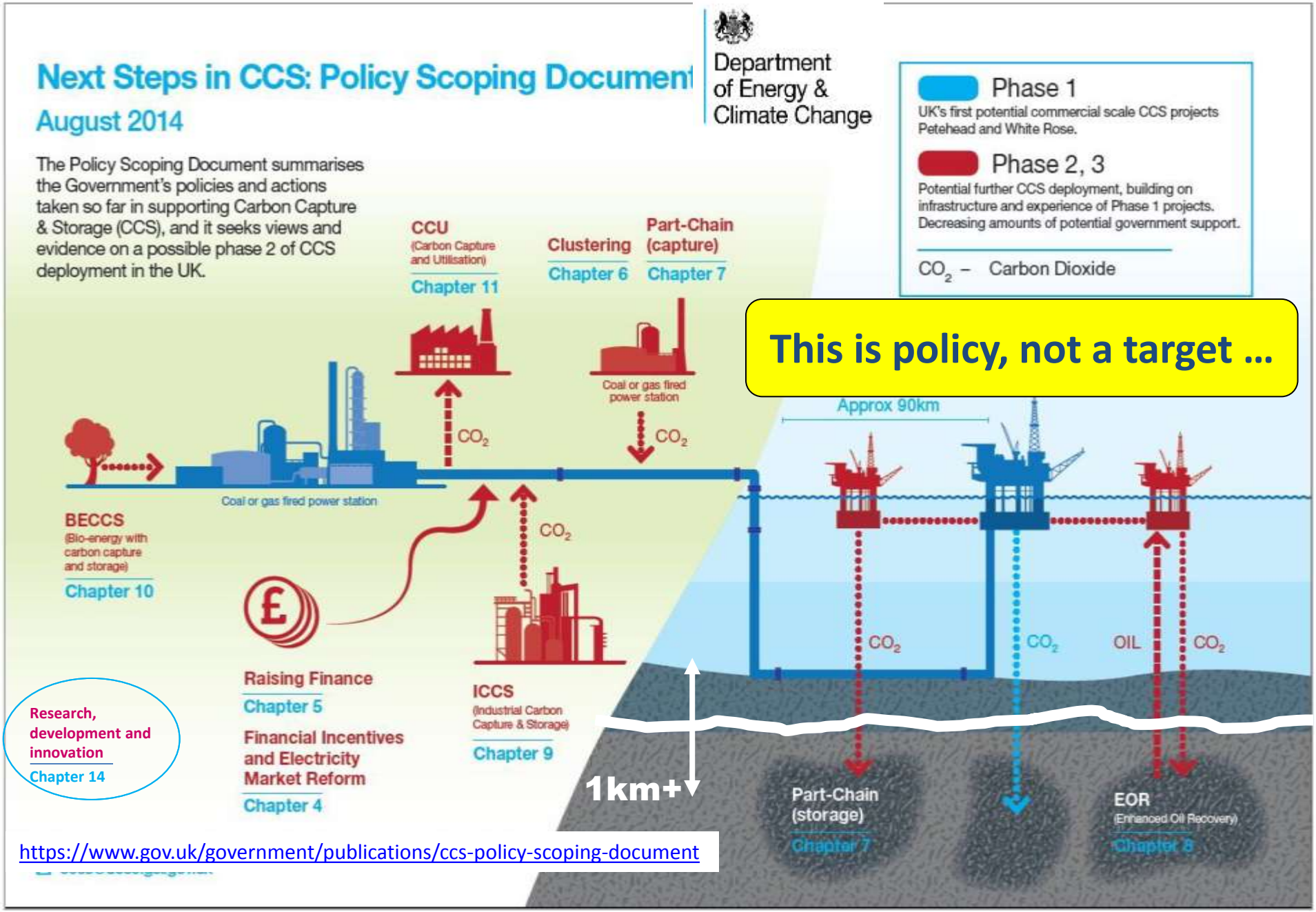
www.GlobalCCS Institute.com

Global: project pipeline



Good progress to 2020, then …. STOP. Need to plan Now

UK plans “Phase II & III” after first two projects



https://www.gov.uk/government/publications/ccs-policy-scoping-document

North Sea: offshore

- Offshore ability essential for storage of CO2
- Commercial continuity needs $50 or more oil price
- Low oil price means decommissioning becomes the new industry
- OGA has CCS within its remit – leasing (England) and licensing, but its not explicit in Energy Bill 2015 (HoLords Mon 7 and Wed 9 Sept)
- Possibility of lower cost small hydrocarbon industry to 2050

CCS Problems

1) Capture cost 2) Storage uncertainty 3) Business confidence

Meaning Public subsidy off electricity price – no real market

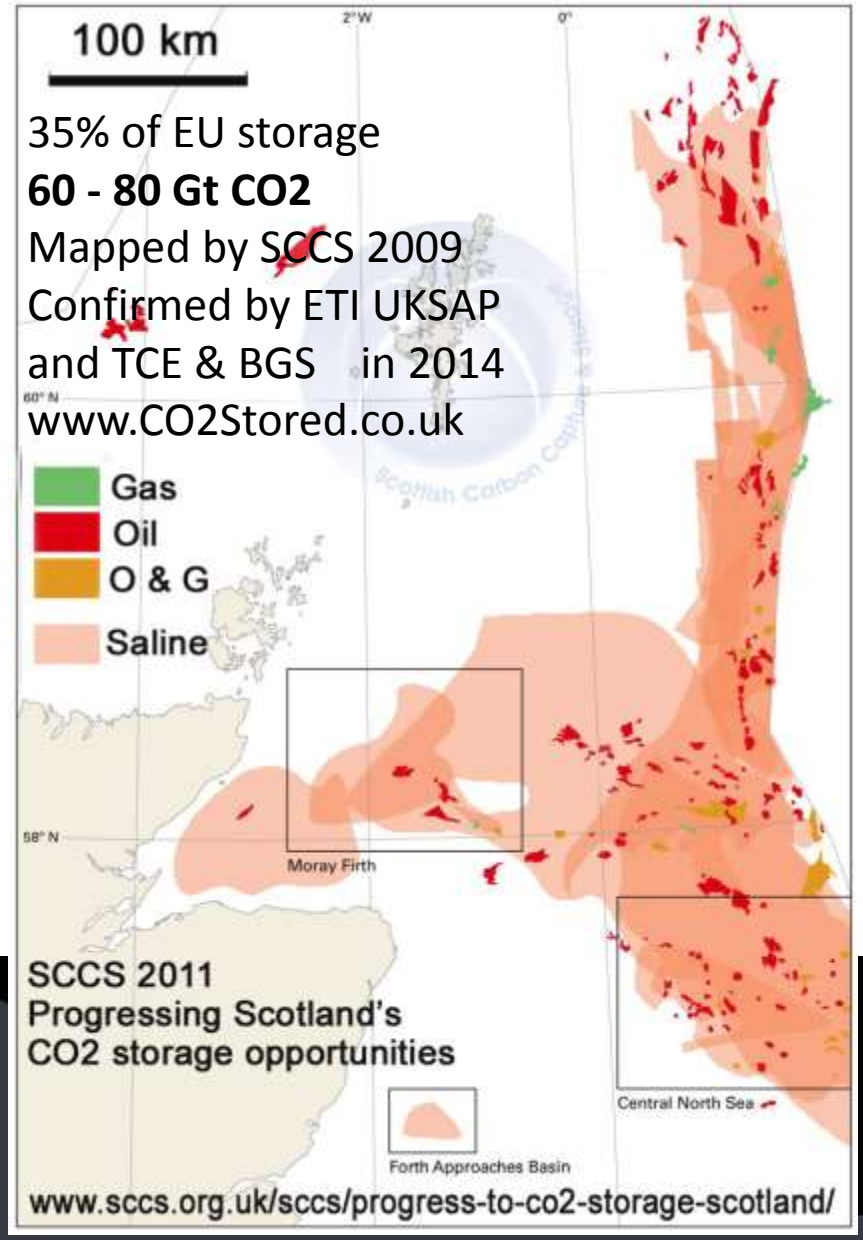
Oil and Gas Authority

Monday 7 September 2015

DECC junior minister Lord Bourne said during a Committee Stage hearing in the Lords on the Energy Bill that carbon capture and storage **(CCS) remains central to the government's approach to decarbonisation**. Labour Peers had tabled an amendment to the Bill that would have changed the primary objectives of the new Oil and Gas Authority (OGA) so as to incorporate a focus on CO2 transportation and storage. Lord Bourne said that **more time was needed to evaluate how the OGA could take forward its role in supporting CCS development**, but he acknowledged that the new regulator would have "an

Who is the CCS leadership ??
OCCS (policy), OGA (Licensing), and Scottish Government (leasing)

Lots of storage offshore



- "In principle" storage resource needs to be transferred into commercial certainty
- There are established methods of resource to reserve conversion
- DECC StratUKSAP project by Pale Blu Dot will establish 1,500 Mt

UK Blockages converting resource to reserve

1) More data is available at no or low cost from OGA (seismic, dynamic fluids, boreholes)

Borehole basics available. Need fluids injection and production and pressures.

Also lower cost seismic access. www.co2stored.co.uk is a good start, but needs more data

2) A big enough storage demand is created to interest global

carbon

CCS still seen as "expensive novelty" a.k.a. major investment liability.
How to turn into an opportunity ?

UK Blockages converting resource to reserve

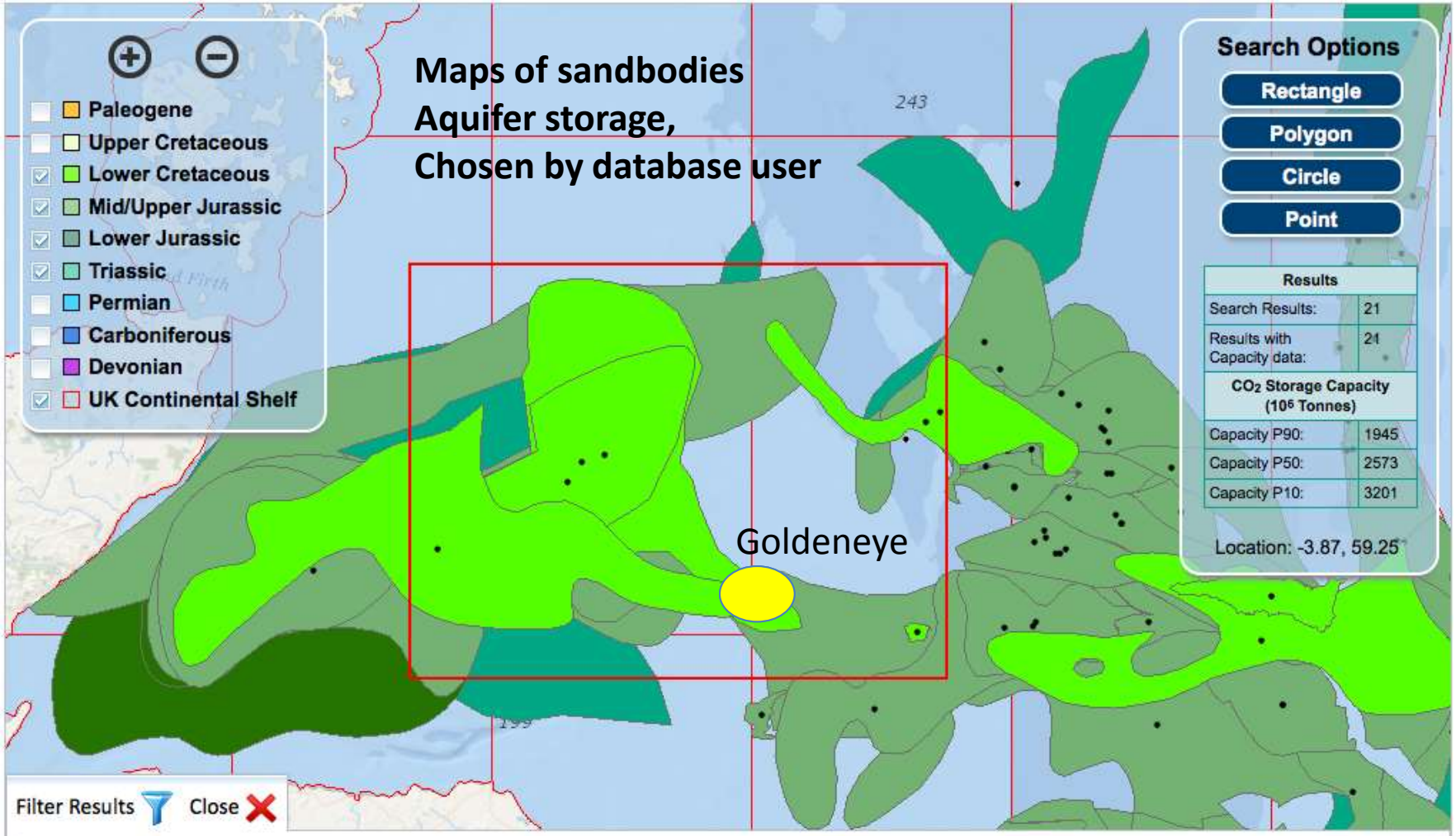
3) Effective cost reductions

A) co-located multiple storage users in one layer,

A) stacked different layers, (multiple injection depths, shared monitoring)

A) [illegible] (makes useable porespace)

Captain Sandstone: Central North Sea. MultiStore project release Thursday 10 Sept 2015 (SCCS)



Filter Results Close

Age	Unit ID	Description	Area	Unit Designate
Mid/Upper Jurassic	171.000	Stroma_020_03	Central N	
Mid/Upper Jurassic	170.000	Stroma_014_15	Centra	
Lower Jurassic	131.000	Mains_012_26	Centra	
Triassic	71.000	Hopeman_012_24	Centra	
Triassic	19.000	Lossiehead_012_25	Centra	
Triassic	36.000	Skagerrak_014_19	Centra	

Step –out additions Follow-on reservoirs access from secure store
UK CO2Stored database

UK Blockages converting resource to reserve

4) Profitable CO2-Enhanced Oil Recovery can attract oil companies.

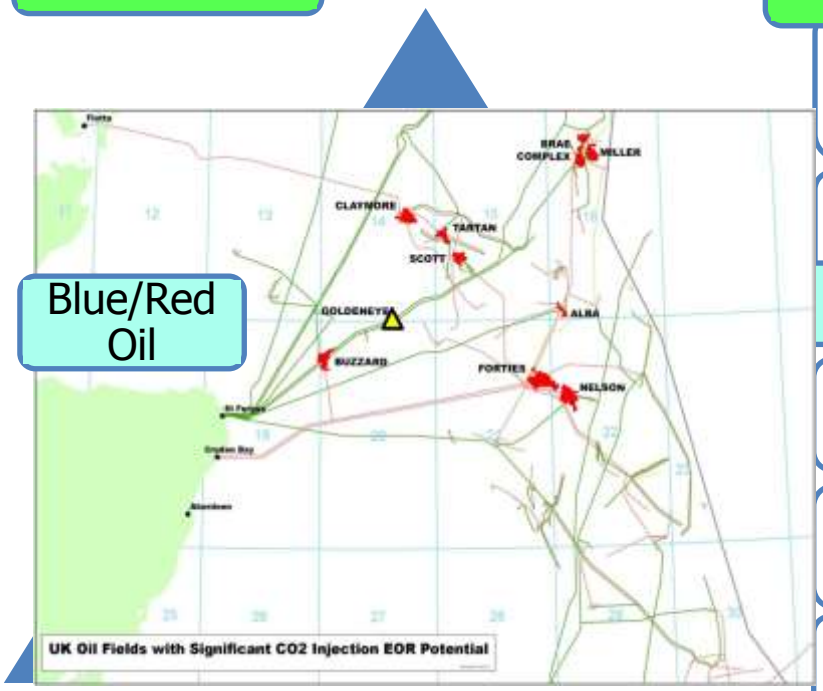
But needs reliable oil price more than $60 /bbl

CO2-EOR stores carbon

Green Oil

Blue/Red Oil

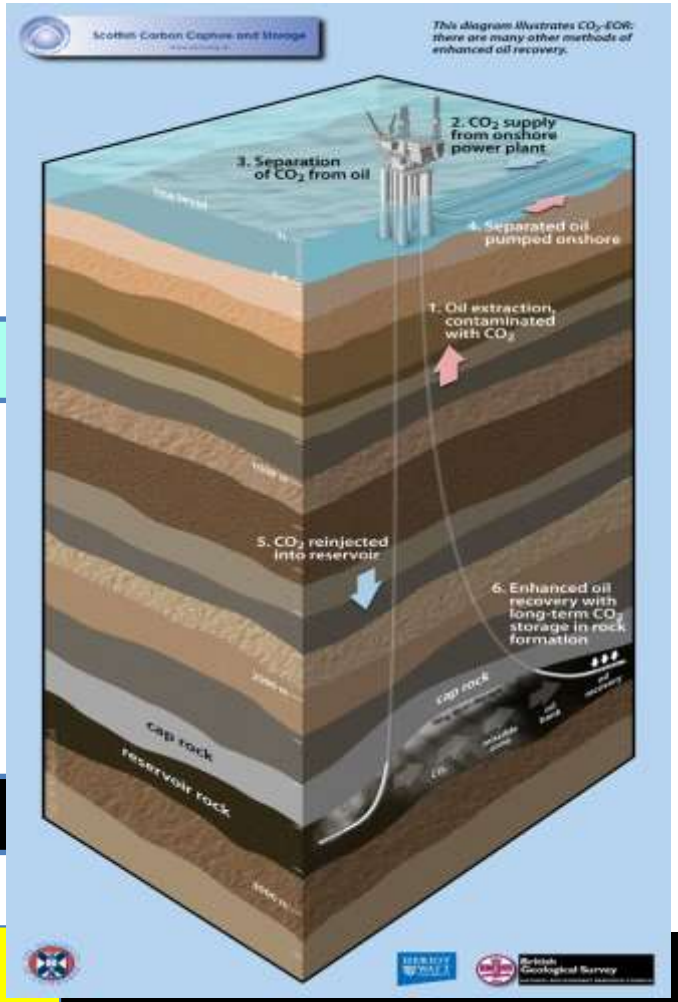
Black Oil



Pure CO_2 injection
UK (Forties) 24
Saudi 40
CO_2EOR 54 - 60
US domestic 56
Mexico 82
CTL 113
CO_2EOR 129 - 135

Data from (Mangmeechai, 2009)

All values in $kgCO_2e/bbl$



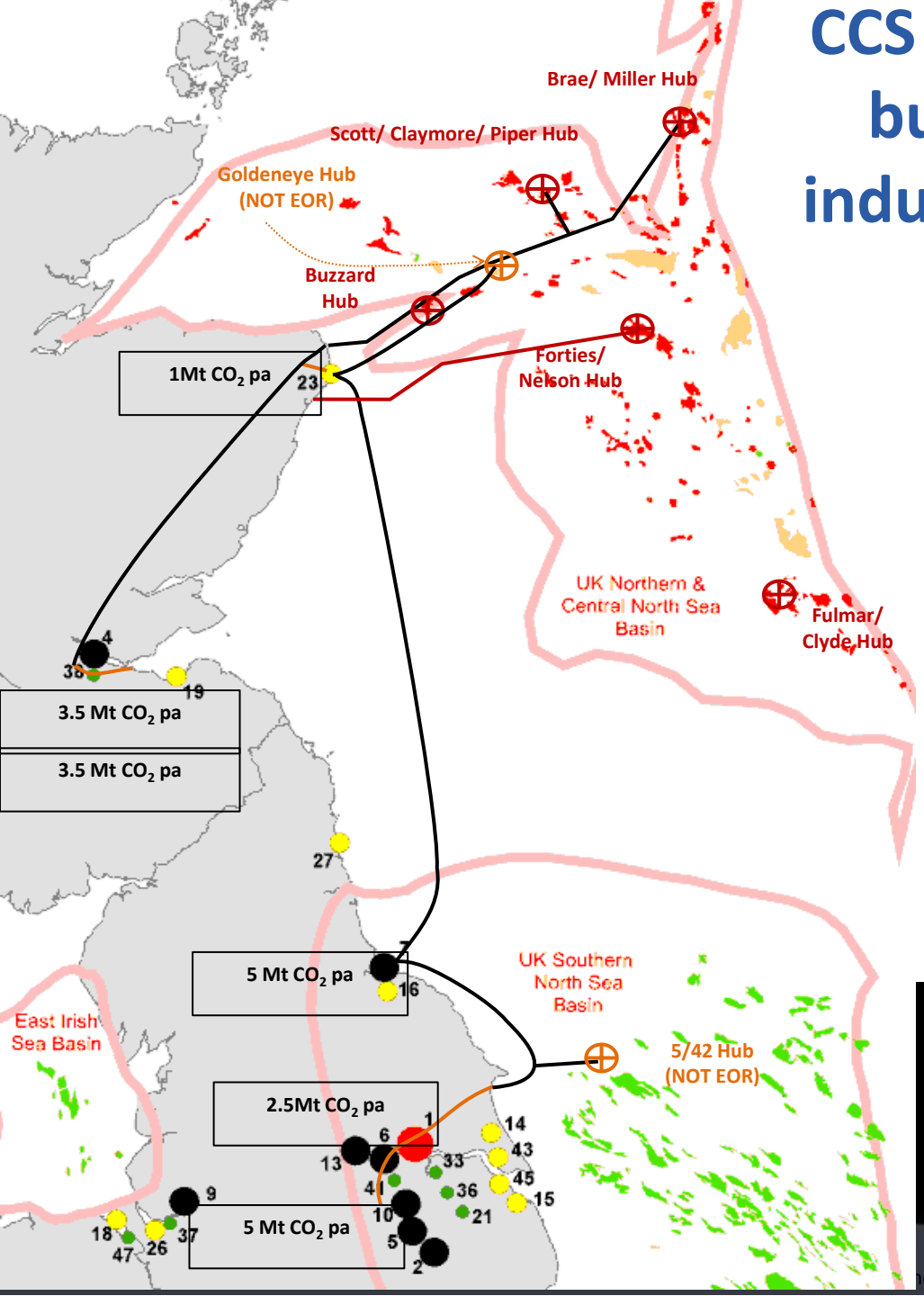
CO2-EOR can produce extra oil with less carbon cost than more "difficult" oil

If CO2-EOR followed by CO2 disposal → stored C

Rapid CO2 storage with Profit

project

CCS can be helped by EOR: but needs an active oil industry to make it happen

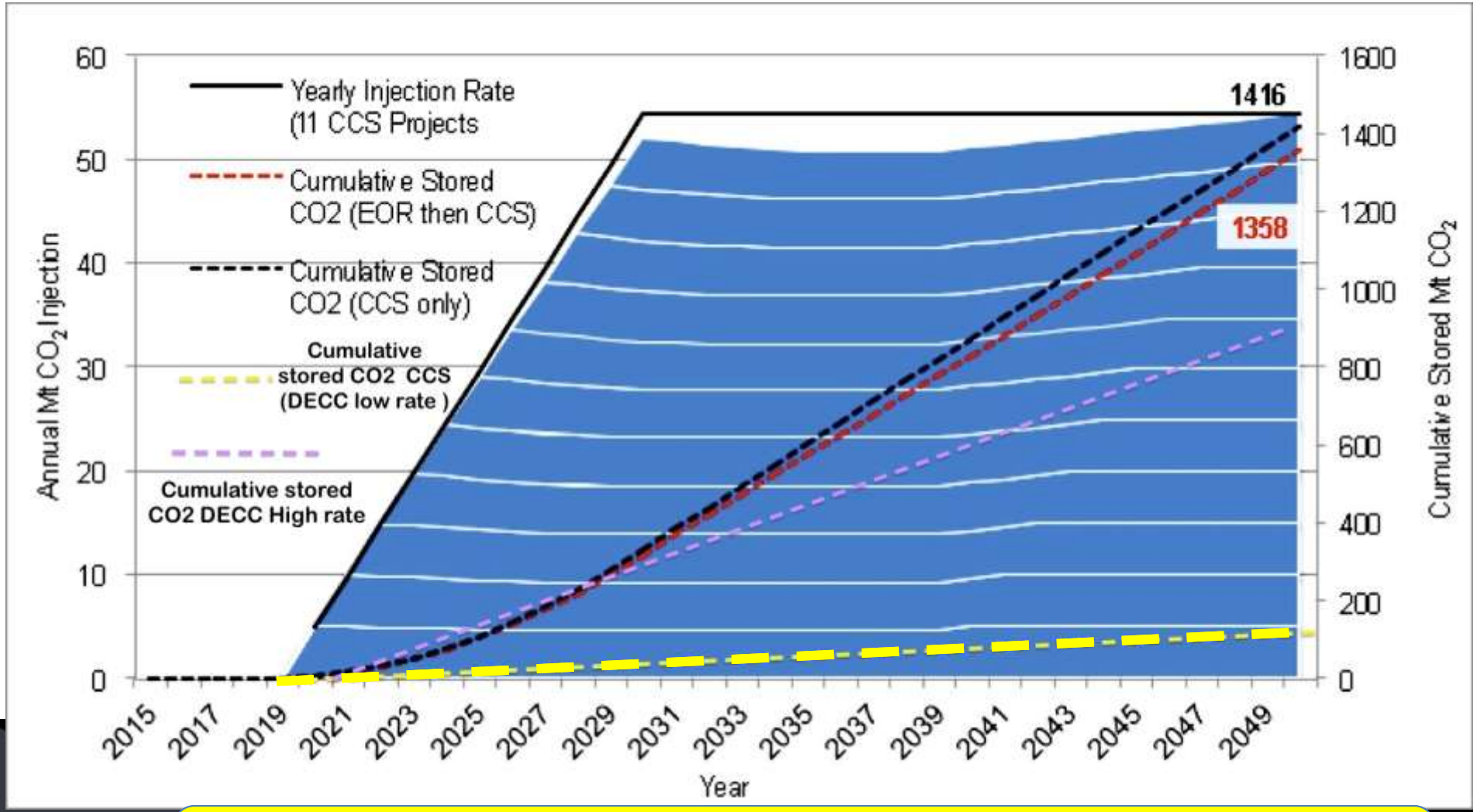


One view :

CO2-EOR – unlocks 1 to 3 Billion barrels of extra oil, UK & NO.
Produces £ 37 Bn tax.

National PROFIT on CCS, installs pipes and capture operating from 2021

CO_2-EOR accelerates storage



CO_2-EOR acceleration stores 12x more CO_2 by 2050, Compared against Government-led development rate

Example CCS-EOR IGCC coal : Caledonia

Uses existing store appraisal and pipes

Captain sandstone formation for added storage if needed

Primary CO2 Injection for EOR Hub Development

Drives incremental 30,000 bopd of oil recovery, or 330 million barrels over CCEP's 30 year plant life, plus added amounts from other sources

CO2 store starts at Goldeneye Field proven by Peterhead

Existing offshore pipelines + new Peterhead pipeline

St Fergus

Aberdeen

Peterhead creates St Fergus as CO2 hub → imports UK and UE

Existing Feeder 10 pipeline Linking central Scotland and the central North Sea

Grangemouth

Edinburgh

CCEP #1: 570MW Plant at Grangemouth
CCEP #2: Another power plant and/or industrial CO_2 sources in Central Scotland to fill Feeder 10 to capacity

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News story
£4.2m for CCS research Grangemouth

From: Department of Energy & Climate Change
First published: 27 March 2015
Part of: Low carbon technologies

Second of a kind IGCC Power Plant (After TCEP) with 90+% carbon capture 3.8MT/yr – no pollutants

Phase 2: Integrated coal Gasification and CCS. Makes heat, H_2, chemicals …. And electricity. Proven storage at Goldeneye provides confidence.
Phase 3: Follow-on is 3.8Mt CO2/yr – enables EOR and reduced carbon

North Sea: next storage actions

- Offshore ability essential for storage of CO2. **Engineering is ready**
- Pipe building to **create momentum for CCS** as a follow-on industry
- **Develop projects** : confidence in numbers, size, policy and profits
  50Mt/yr CO2 in 2030
- **Data availability** – fluids, seismic, pressures – **Pale Blu DECC 1,500Mt**
- Less cost: equipment sharing – **(on) offshore re-use pipe clusters**
  - CO2 – EOR (accelerate and income)

Reduce system cost
Remove project risk