CO_2-EOR and CCS UK North Sea

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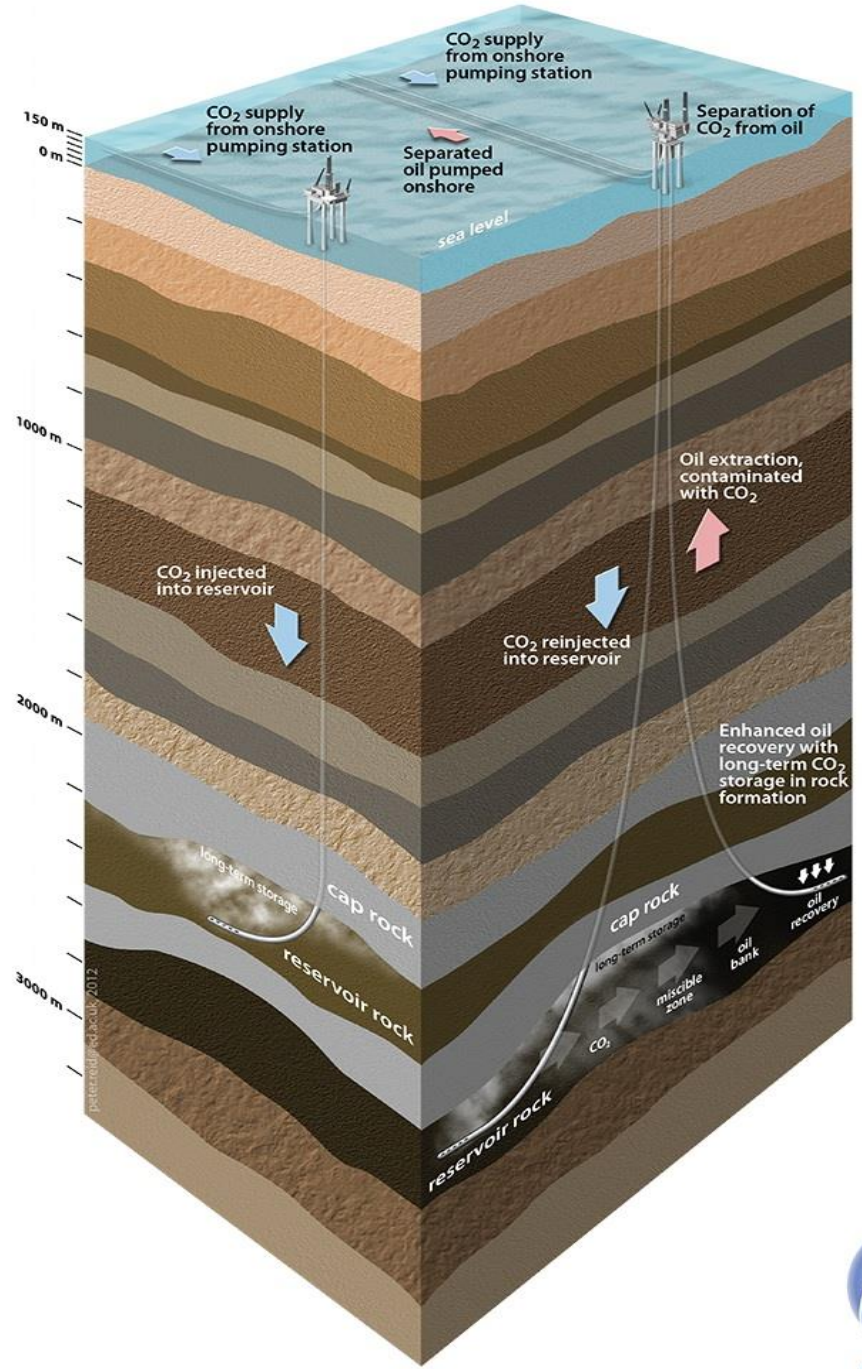

What is CO_2 – EOR ?

Injection of CO_2 into deep oilfield. 20 good fields

Makes the oil less viscous,

Repressurises,

Produces 5 – 15% extra oil

http://www.sccs.org.uk/ccs-with-co2enhanced-oil-recovery

SCCS

This Report: tackling the barriers

- Economics
- Stakeholder
- EOR performance
- CO_2 Management & Environmental
- Legal
- CO_2 Supply

A series of studies Designed and directed by the steering group of the JIP

Enacted *independently* by academic experts, or by recognised consultants

Report – summary versions

Website – full versions (may be commercially limited)

www.sccs.org.uk/expertise/reports/sccs-co2-eor-joint-industry-project

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Basic Questions

- Does CCS need acceleration and money ?
- Does CO_2-EOR need acceleration ?
- Can both of these be combined,
  profitably and environmentally ?

YES

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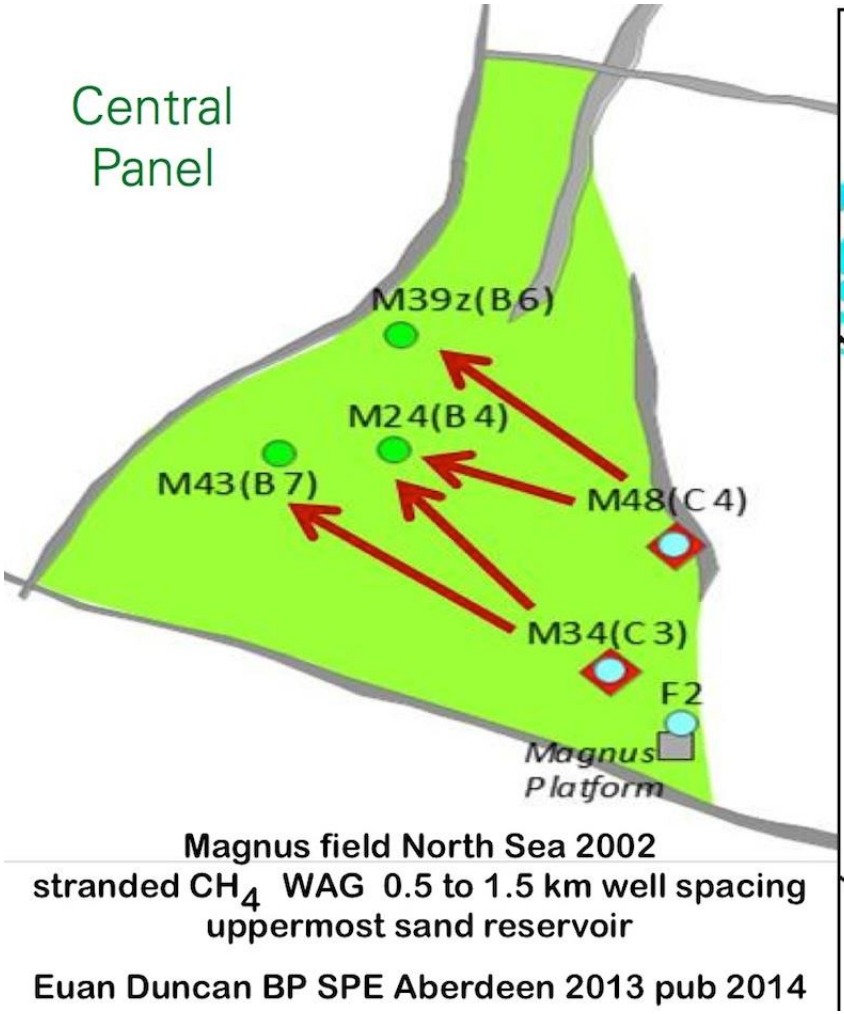
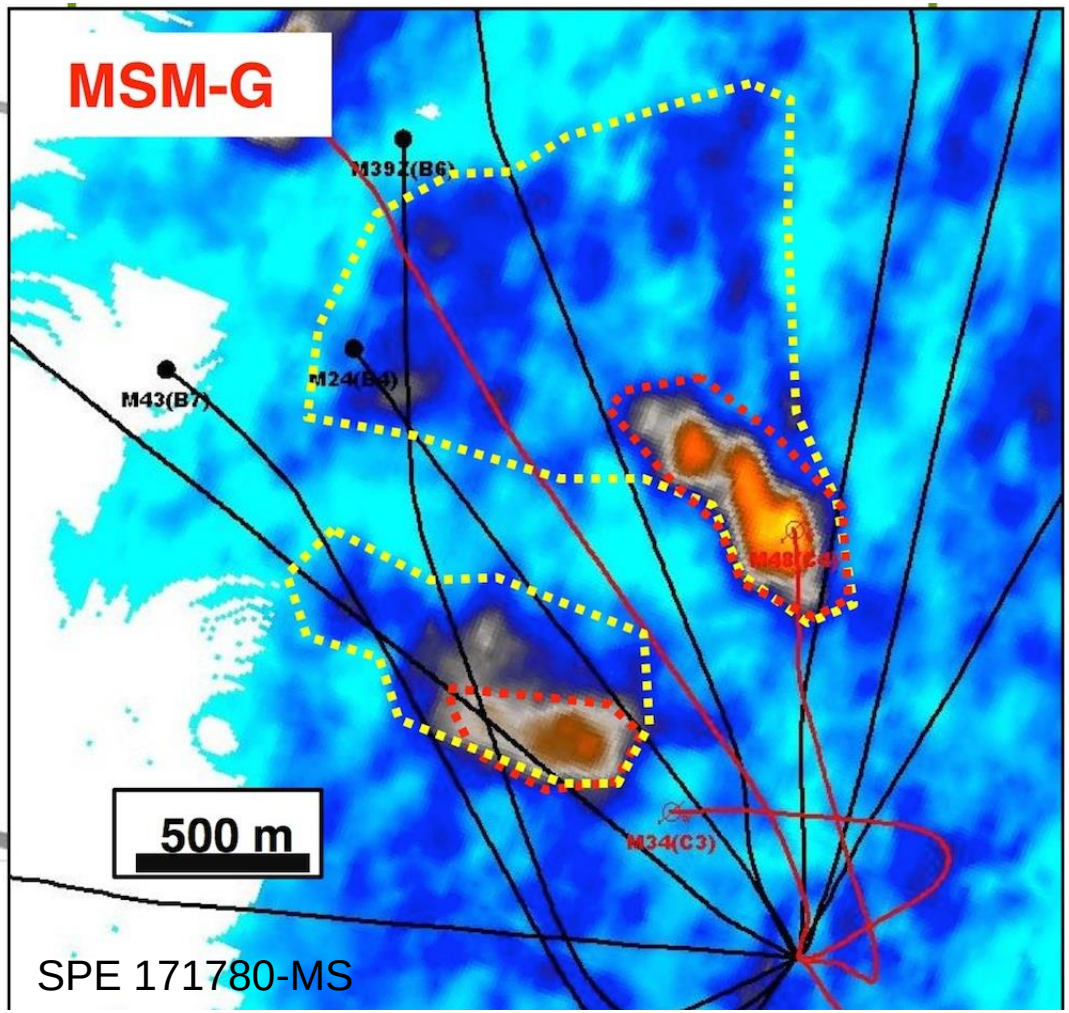
Gas-EOR works in the North Sea



Magnus field North Sea 2002
stranded CH_4 WAG 0.5 to 1.5 km well spacing
uppermost sand reservoir

Euan Duncan BP SPE Aberdeen 2013 pub 2014



SPE 171780-MS

Magnus (BP) uses stranded CH_4, to produce extra oil, 39API
40% of field production in 2012 attributable to gas injection EOR

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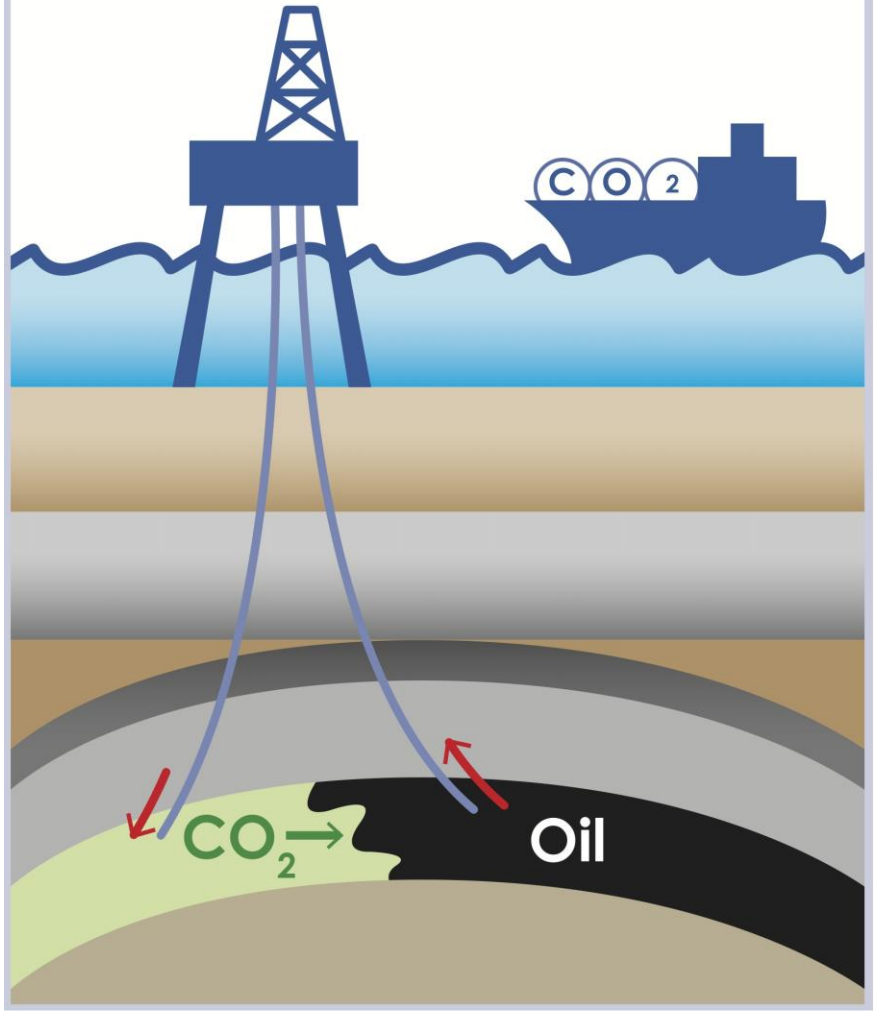
Offshore Fields for CO_2-EOR

Proven Engineering



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CO_2-EOR Economic Multiplier

Value-for-Money

finance help from Government
= **input**

can be measured by the effects
= **output**

Multiplier = activity into wider UK economy

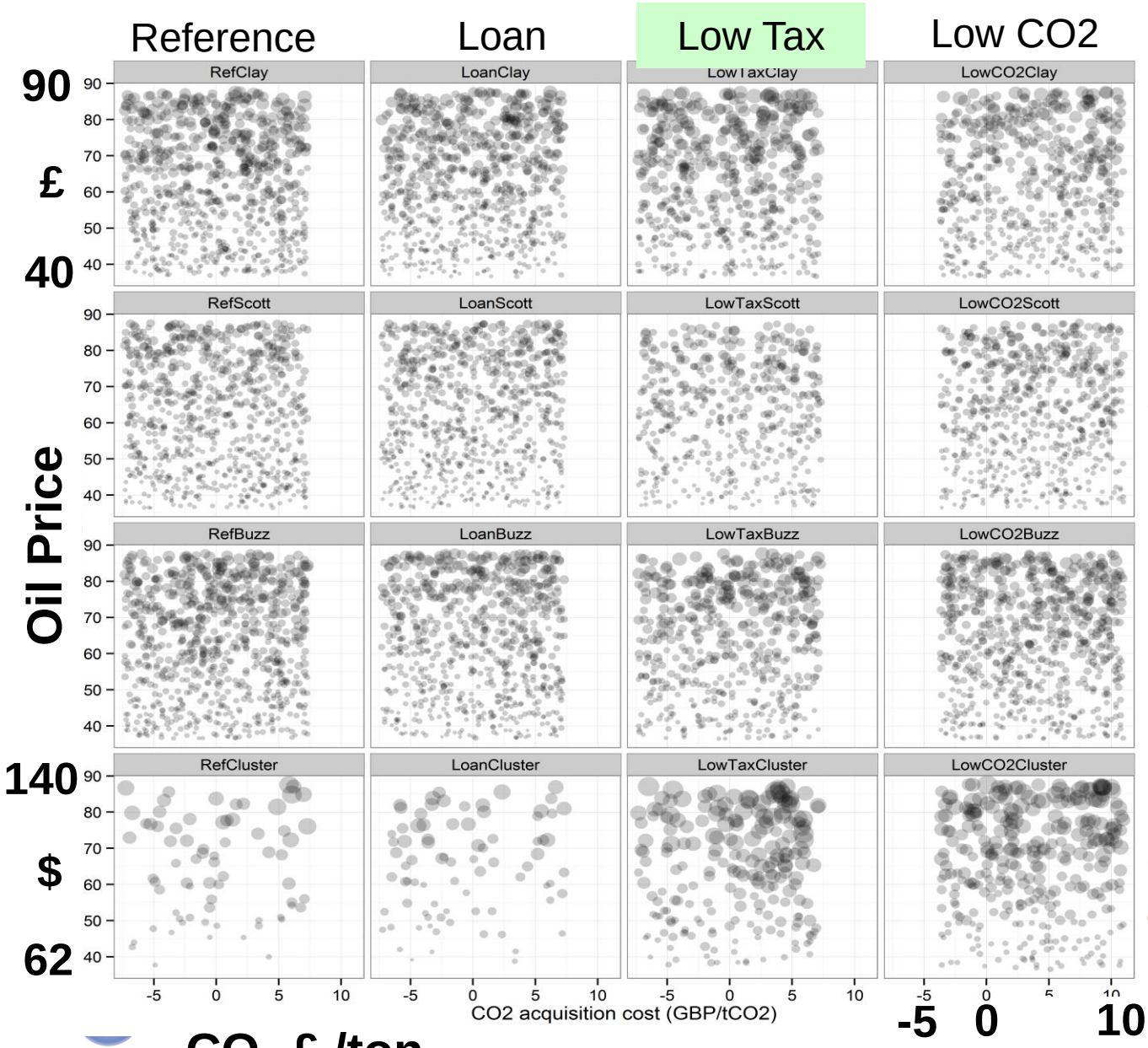
Offshore Wind = 3.3

CCS = pure storage = 2.6

CCS + CO_2-EOR = 7.2

Linkage of CCS, and EOR offshore has LARGEST LEVERAGE
£1 Treasury invested = £7.2 Output

Economic sensitivity oil & CO_2 price



CO_2 £ /ton

Size of dot = NPV

Claymore

Public data only For each field

Scott

Double Monte Carlo: reserves and prices

Buzzard

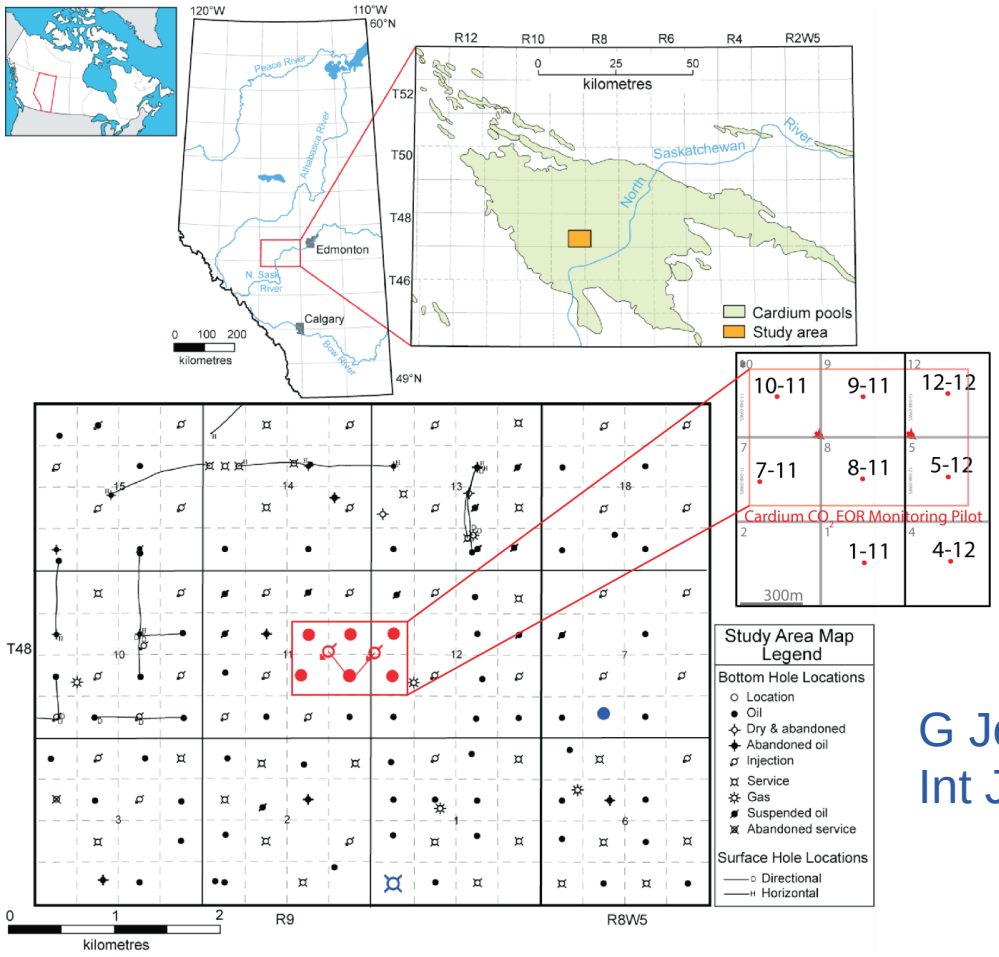
for this evaluation no oil company has provided detailed decision-making inputs

Claymore & Scott

EOR economic at $60

Kris Welkenhuysen,

Case Study – Pembina Cardium CO_2 Monitoring Pilot (PCCMP)



G Johnson et al 2011
Int J GHG Control

Modified from Dashtgard et al. 2008

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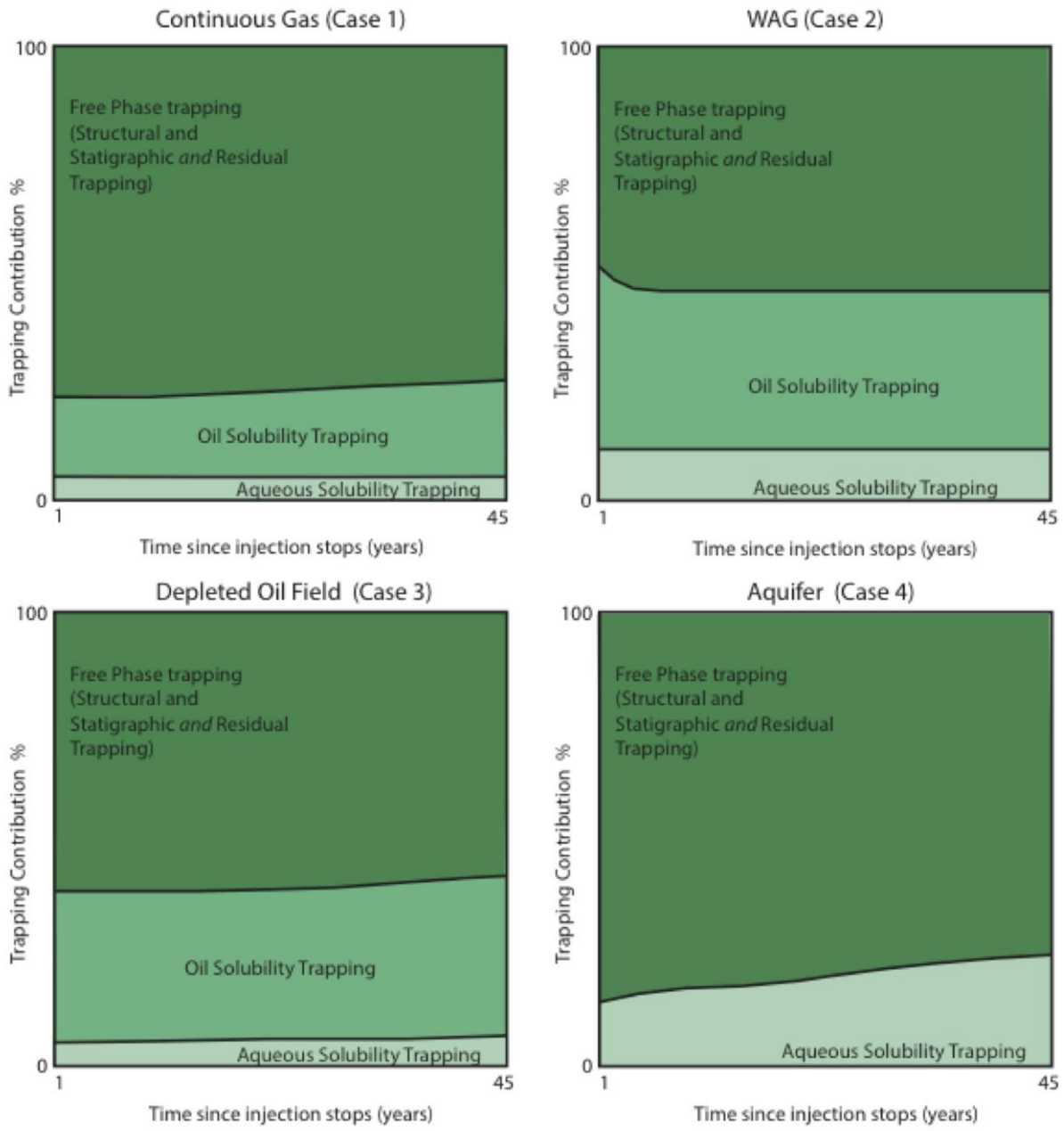
Security of storage



CO2-EOR injection forces CO2 interaction with residual oil and water.

Storage MORE secure than conventional aquifer

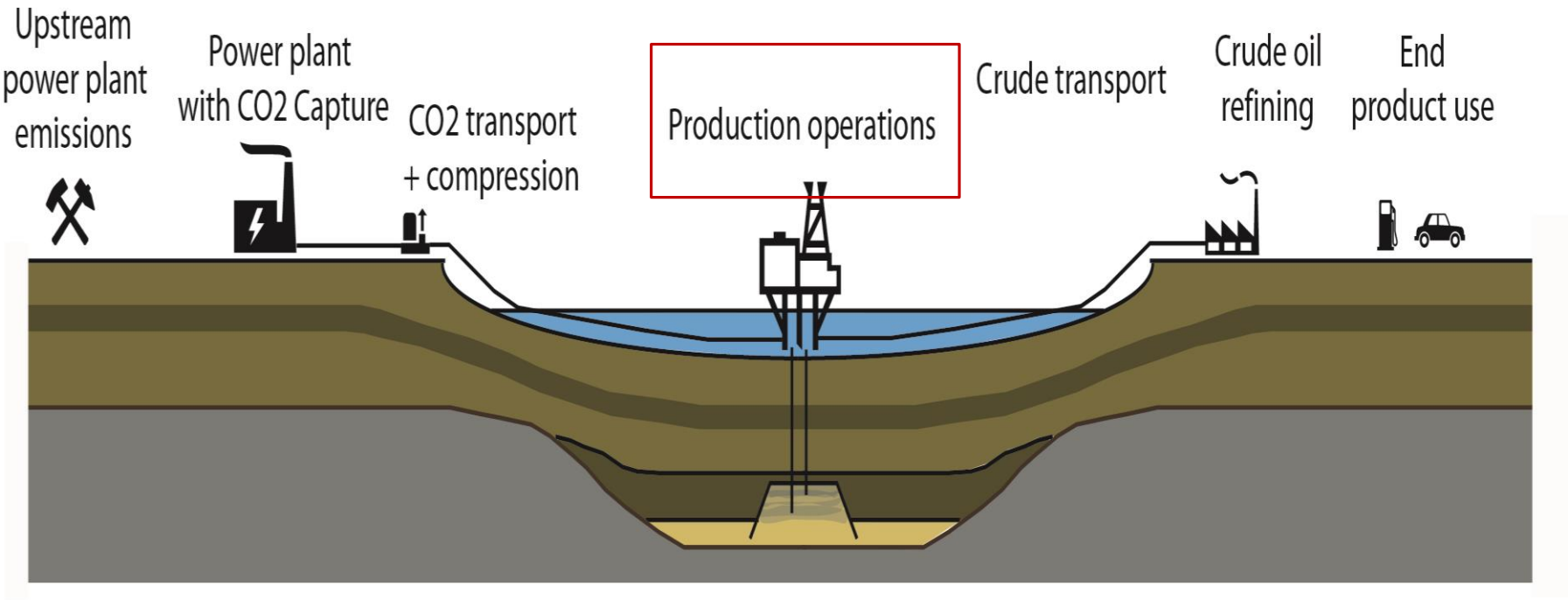
G Johnson et al 2011
Int J GHG Control

Carbon accounting

Common to all CCS projects

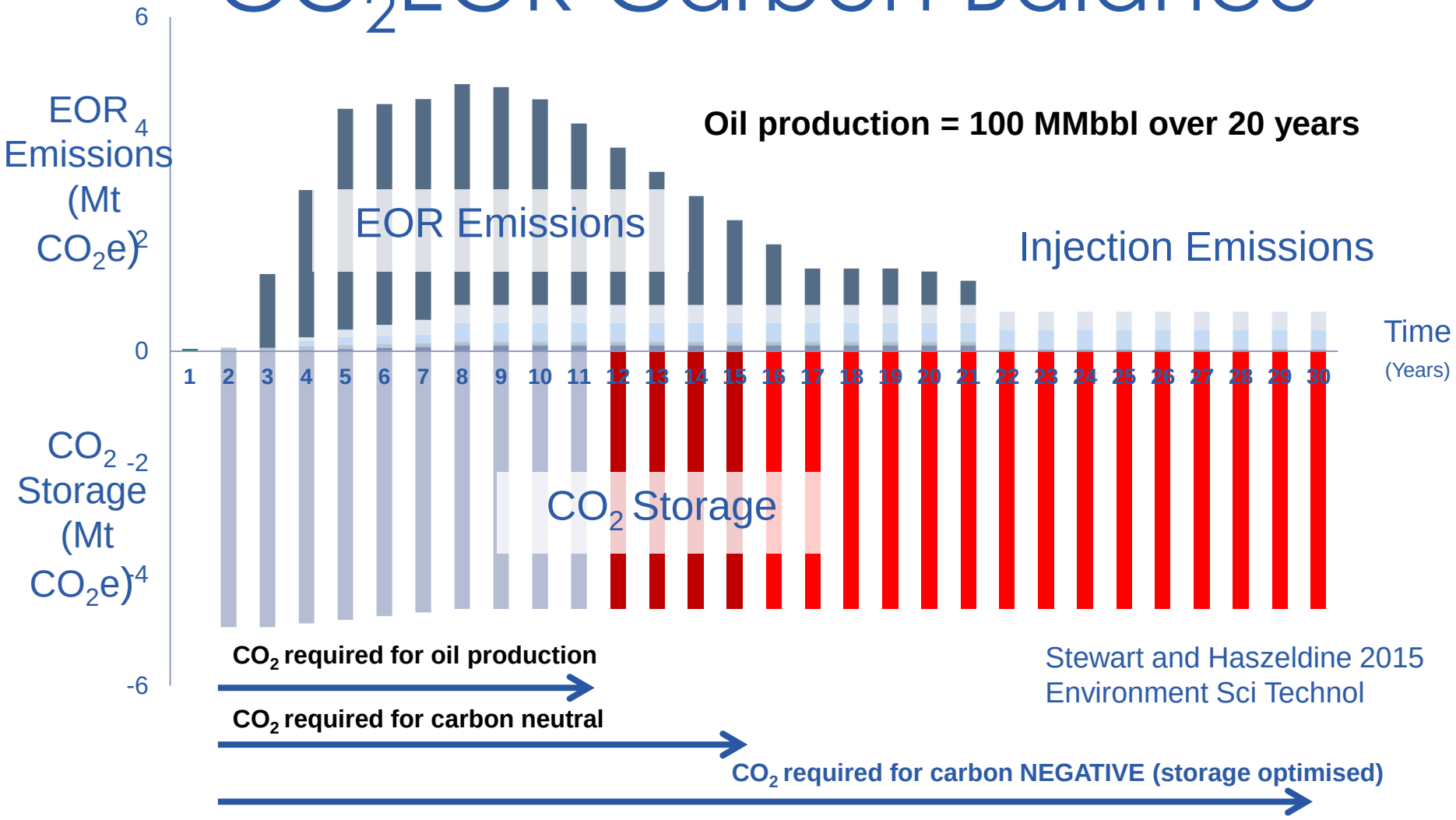
Common to all crude production

Unique to CO_2EOR



Stewart and Haszeldine 2015
Environment Sci Technol

CO_2EOR Carbon Balance



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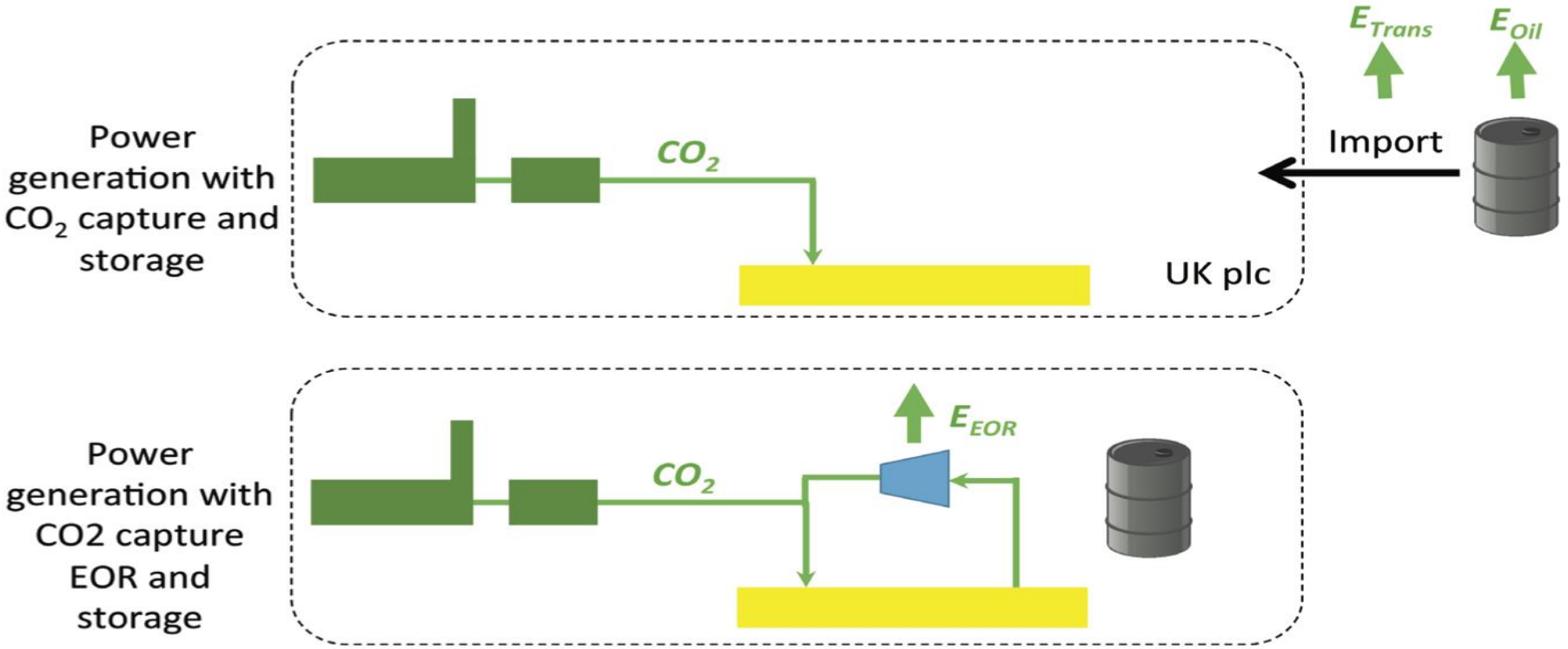
CO_2-EOR Environmental



Compare emissions 3.96 Mt CO_2 of CCS plus imported oil against 4.25 Mt CO_2 emissions CCS + CO2-EOR which produces oil

Minimal additional carbon required to produce 100 Mbbl oil in 10 yrs
Low-carbon electricity unaffected

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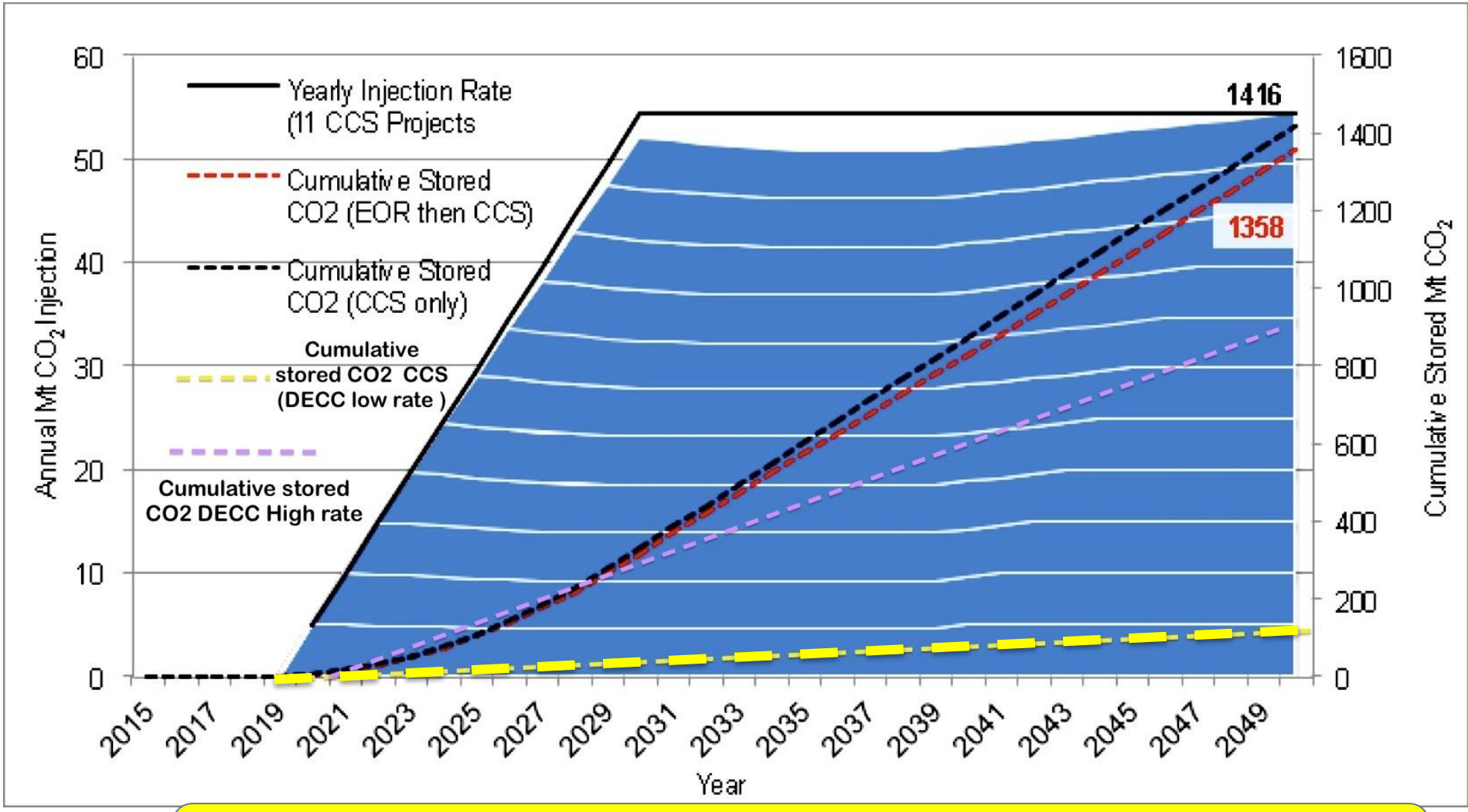
CO_2-EOR accelerates storage



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

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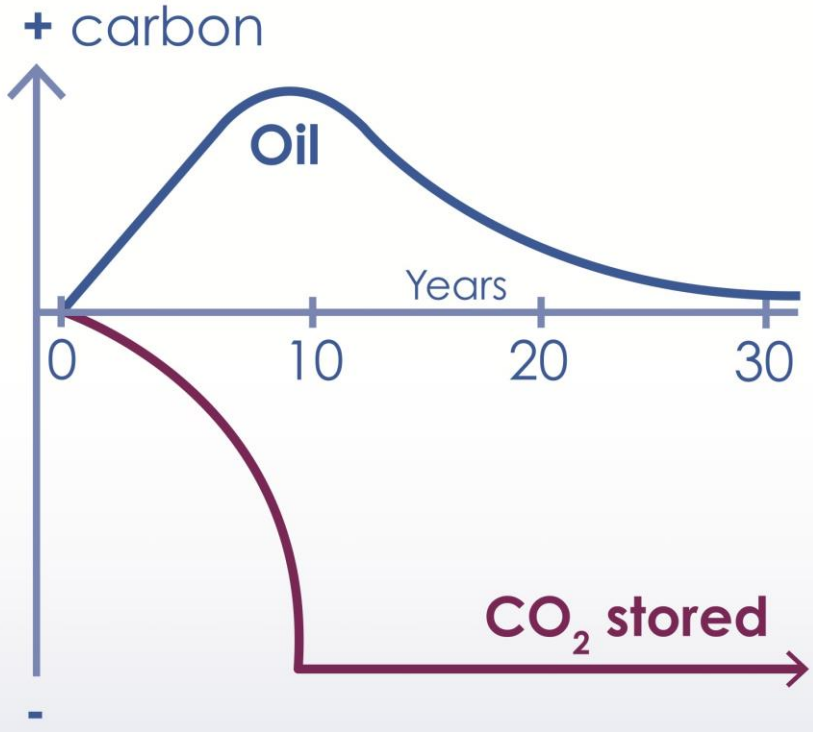
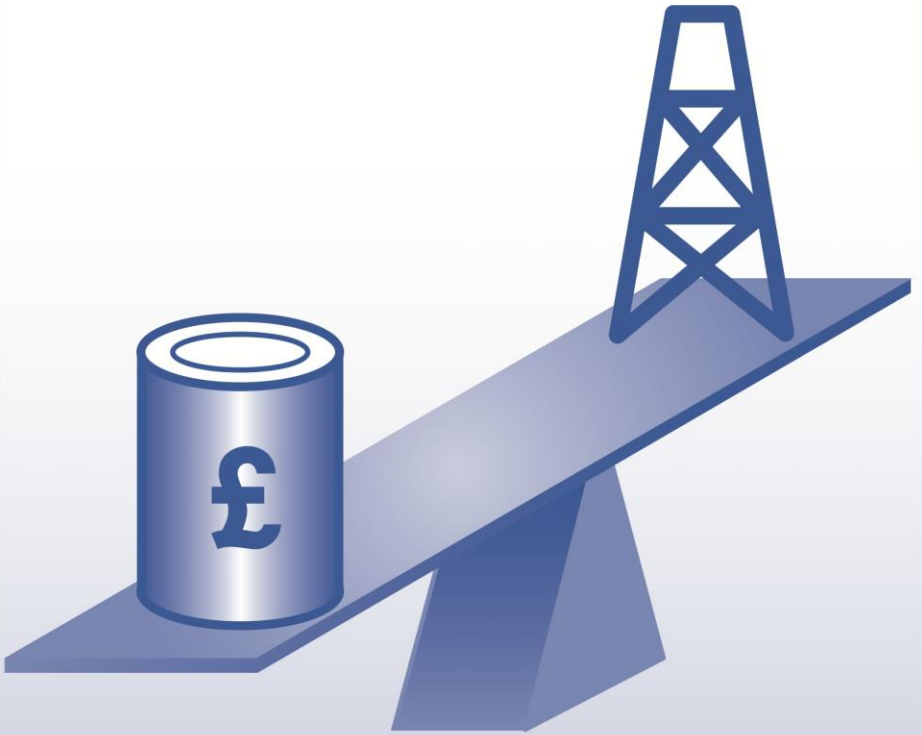
CO_2 Stored

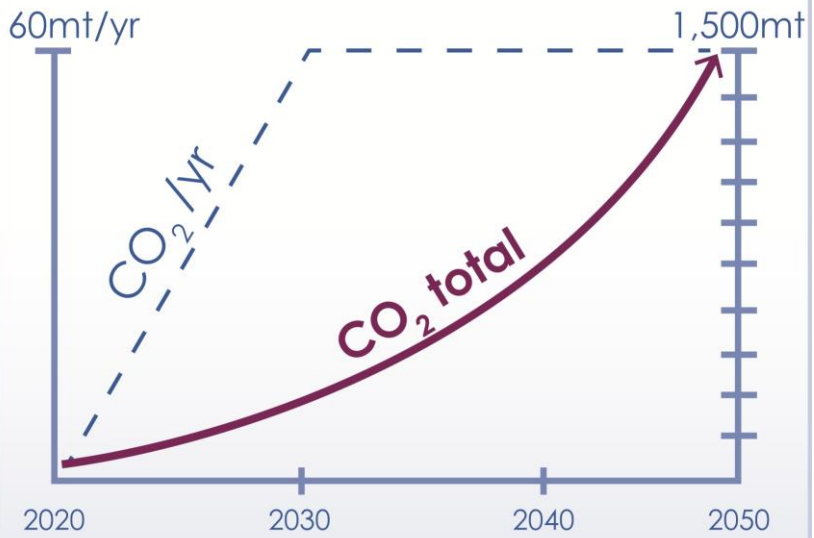


More CO_2
than
produced oil

7 X Economic **Muliplier**



1,500 Mt CO_2 Stored by **2050**



24 GW CCS Gas Power acheived by

2030

CO_2-EOR

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More Oil & Tax **Income**

Green Electricity

Climate **Clean-Up**

http://www.sccs.org.uk/ccs-with-co2enhanced-oil-recovery

CO_2-EOR acceleration stores 12x more CO_2 by 2050, Starts transition of North Sea offshore to sustainable operations

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END