What role for R&D in delivering cost-competitive CCS projects in the UK in the 2020s?
15 October 2015,
Mary Sumner House, 24 Tufton Street, London, SW1P 3RB

What role for (academic, government-funded) R&D in delivering cost-competitive CCS projects in the UK in the 2020s?

Setting the context

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42 Technology Limited
Meadow Lane, St Ives
www.42Technology.com
Innovate Design Develop | Create Value

The UKCCSRC is supported by the Engineering and Physical Sciences Research Council as part of the Research Councils UK Energy Programme

Pioneering research and skills

About the UKCCSRC

www.ukccsrc.ac.uk

The UK Carbon Capture and Storage Research Centre (UKCCSRC) **leads and coordinates a programme of underpinning research on all aspects of carbon capture and storage** (CCS) in support of basic science and UK government efforts on energy and climate change.

The Centre brings together over 250 of the UK's world-class CCS academics and provides a **national focal point for CCS research and development**.

Initial core funding for the UKCCSRC is provided by £10M from the Engineering and Physical Sciences Research Council (EPSRC) as part of the RCUK Energy Programme. This is complemented by £3M in additional funding from the Department of Energy and Climate Change (DECC) to help establish new open-access national pilot-scale facilities (www.pact.ac.uk). Partner institutions have contributed £2.5M.

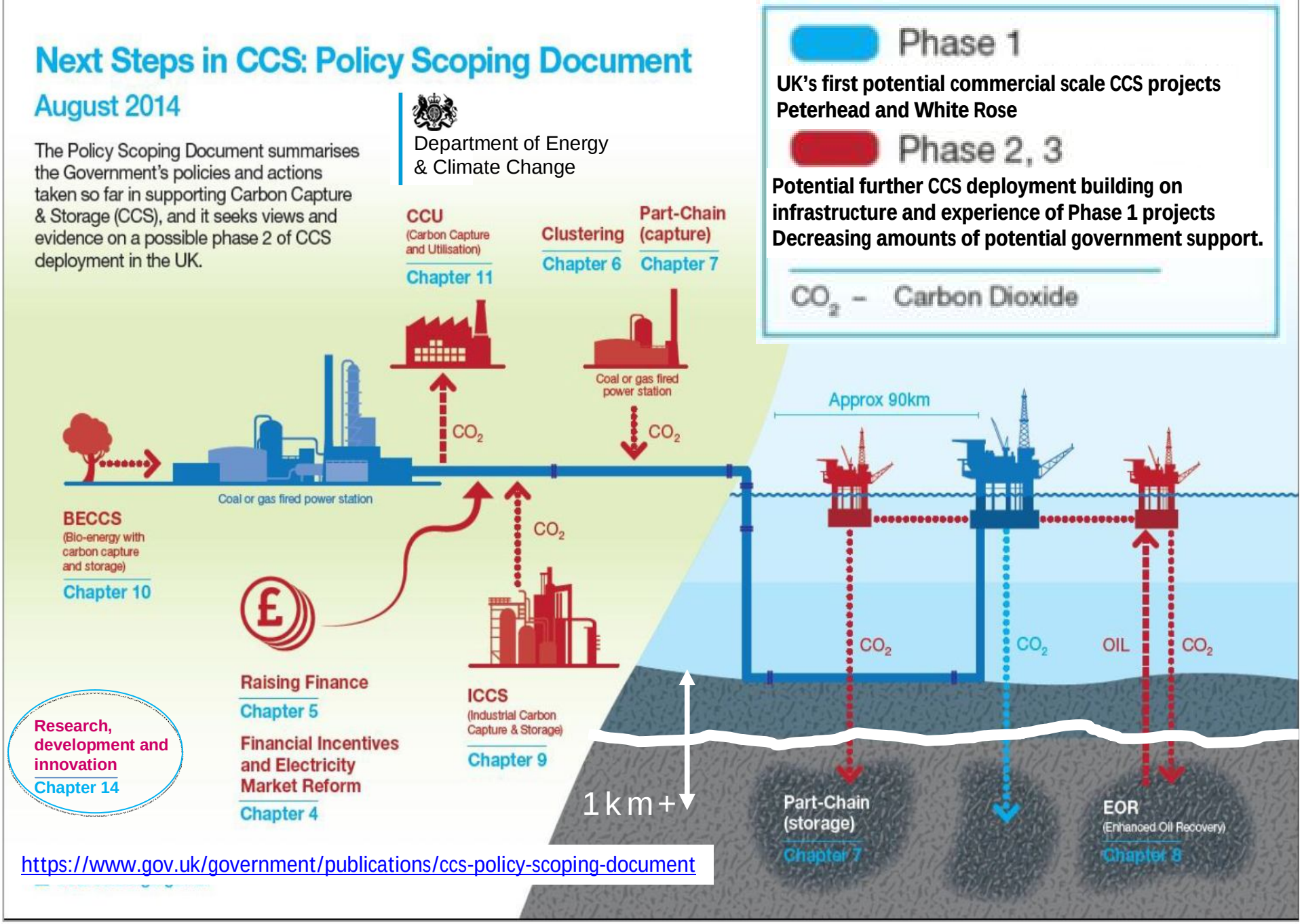
The UKCCSRC welcomes experienced industry and overseas **Associate** members and links to all CCS stakeholders through its **CCS Community Network**.
https://ukccsrc.ac.uk/membership/associate-membership
https://ukccsrc.ac.uk/membership/ccs-community-network

Next Steps in CCS: Policy Scoping Document

August 2014

The Policy Scoping Document summarises the Government's policies and actions taken so far in supporting Carbon Capture & Storage (CCS), and it seeks views and evidence on a possible phase 2 of CCS deployment in the UK.

Department of Energy & Climate Change



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

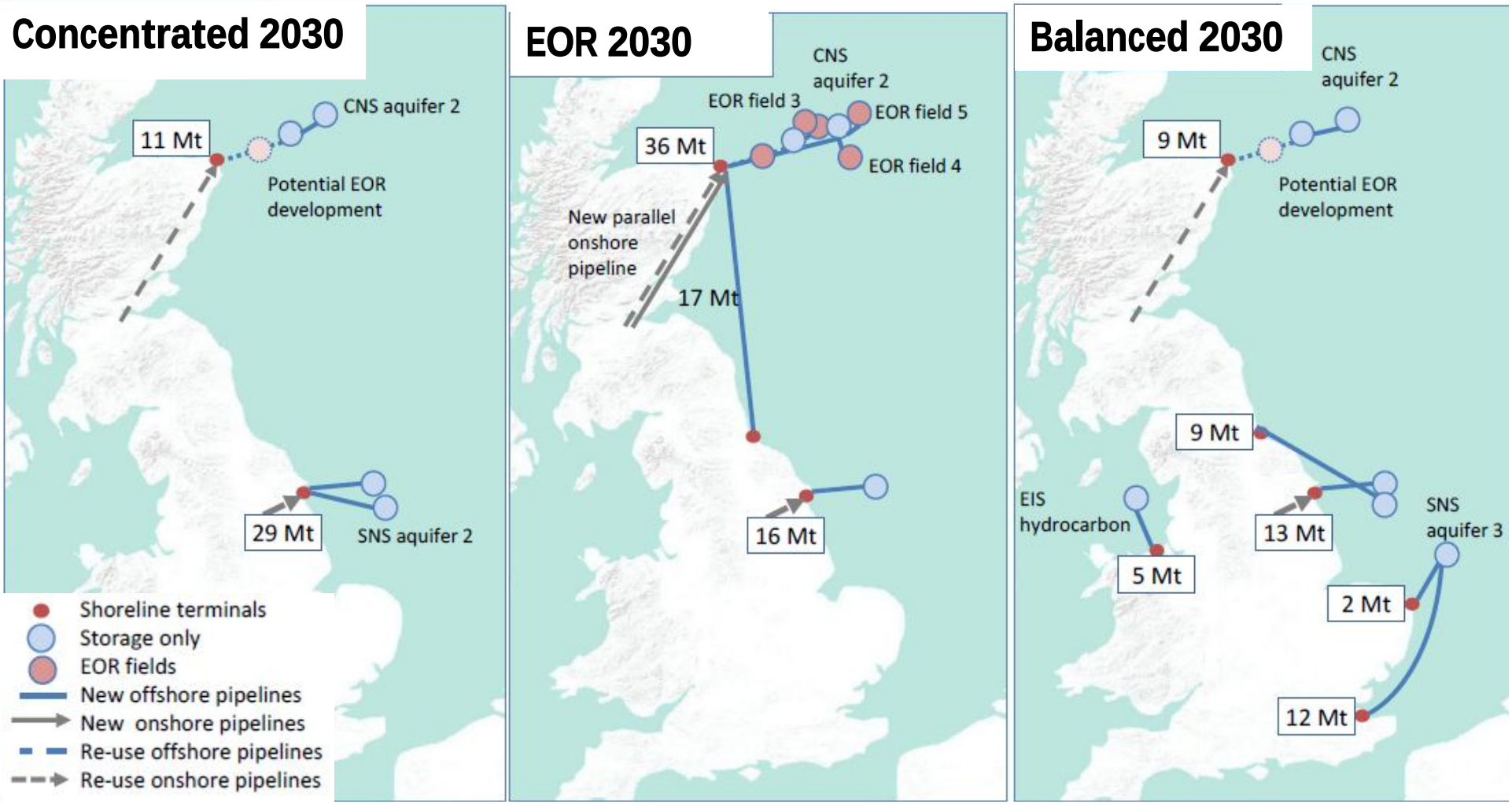
ETI scenarios for 2030 have ~5GW natural gas CCS (+ coal + industry)

CCS Sector Development Scenarios in the UK, May 2015

http://www.eti.co.uk/wp-content/uploads/2015/05/2015-04-30-ETI-CCS-sector-development-scenarios-Final-Report.pdf

Deployment of CCS capacity at scale (i.e. ~10 GW electricity) and infrastructure capable of capturing 40-50 $MtCO_2$/year from power (as part of <100 $kgCO_2$/MWh) and industry by 2030.

Eventual storage target for 2050 scenarios (80% cut in UK emissions) ~ 100 $MtCO_2$/year.



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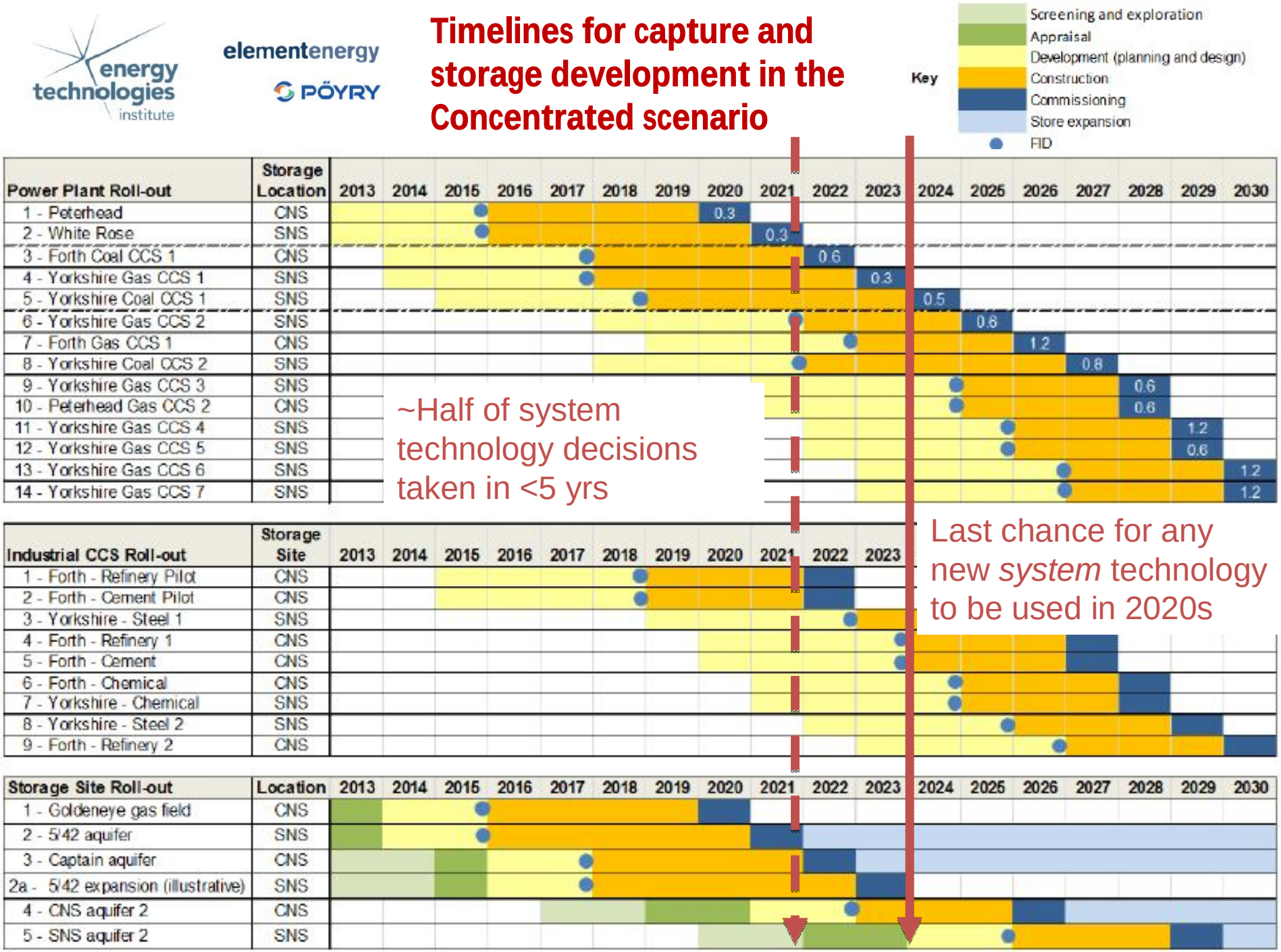
Timelines for capture and storage development in the Concentrated scenario



1. What R&D could reduce CCS costs in the 2020s?

UKCCS RESEARCH CENTRE

R&D applied before ~2023

•Evolution of 'current' technologies
NOT revolutionary new approaches

Why current technologies?

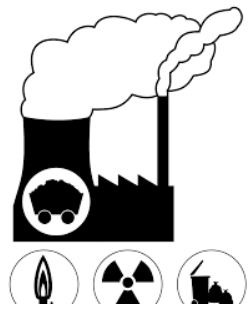
Industry 'clockspeed' of CCS is SLOW. 2023 is almost upon us!

Industry Clock Speed – Time for a complete design-build-test-market product cycle

Weeks Months Years Decades







2. Who should shape the R&D agenda?

People developing / implementing commercial projects to be built / operated in the 2020s

Why developers / implementers?

- Access both proprietary data and public domain
- Access to operational data
- Can enumerate the known unknowns
- Understand where the 'biggest wins' might be
- Positioned to try incremental improvements

BUT – they will need both technical help and funding

3. How can academics contribute to R&D that will evolve 'current' CCS technologies

If only 'current generation' CCS (reference plant at TRL 9 now / soon) is deployable in the 2020s what role for academics if *"academic research is more appropriate at low TRLs?"*

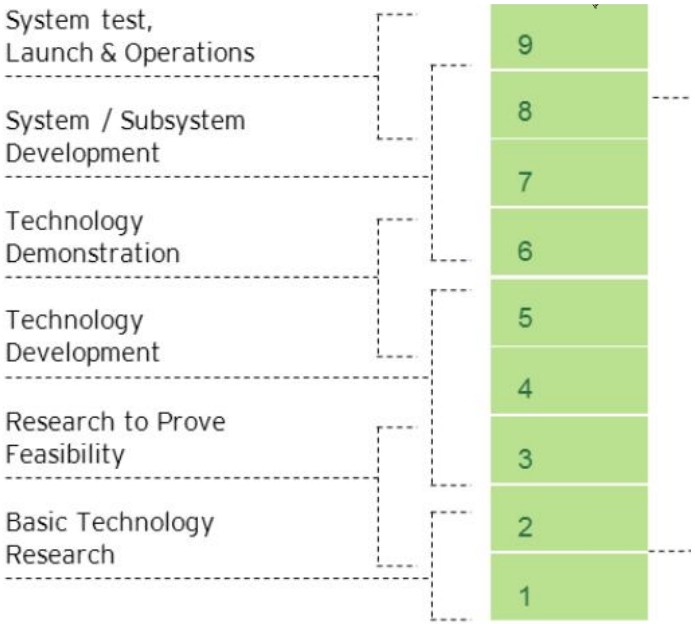
Forget system level TRLs

Consider sub-system / component TRLs

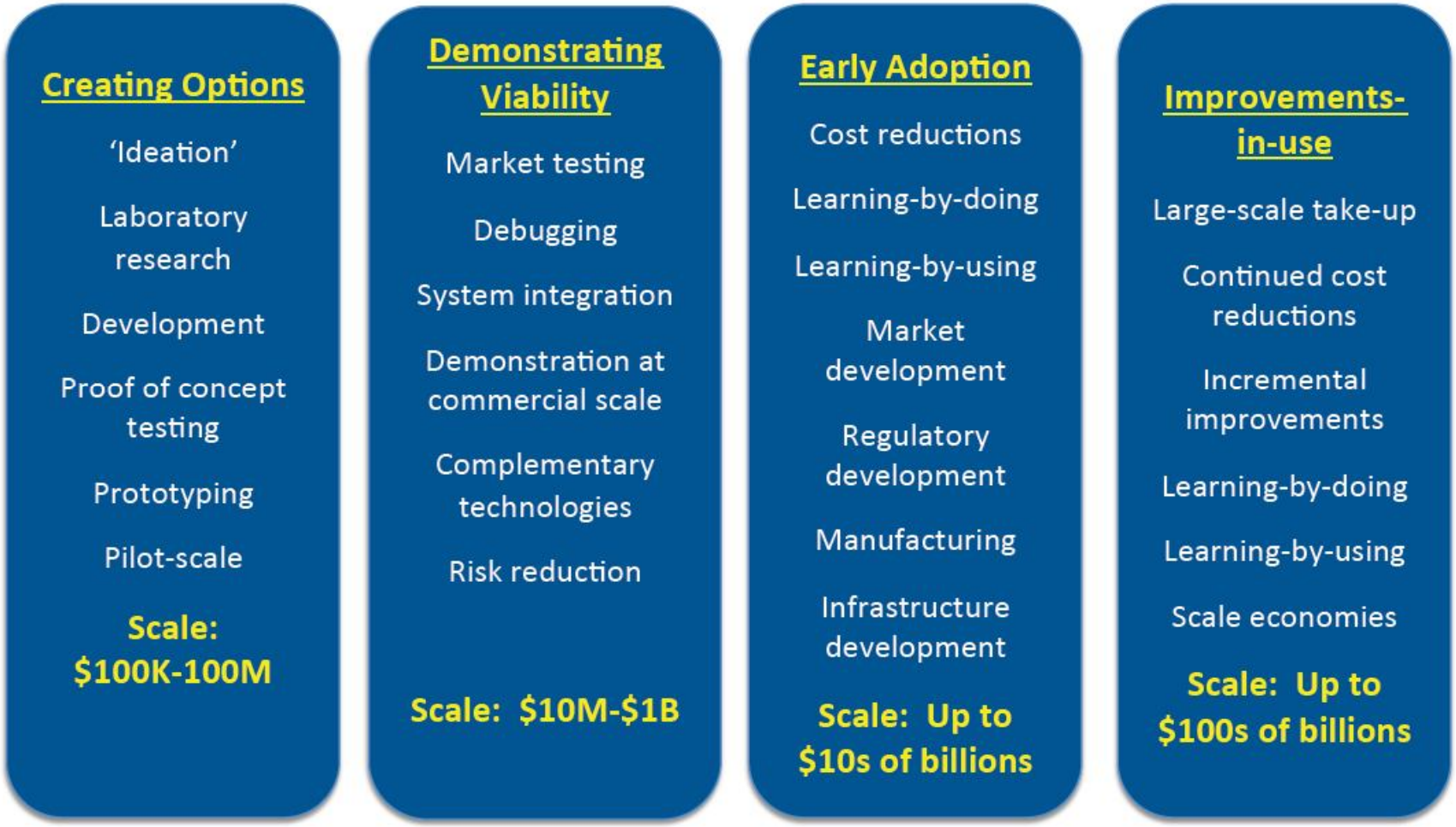
- TRLs for evolving current technologies should be applied to innovation in sub-systems
- improvements to sub-systems can start at TRL 1 *long after* the overall technology is at TRL 9

E.g. NASA Chevrons for noise reduction
http://www.nasa.gov/topics/aeronautics/features/trl_demystified.html

4. Should government fund R&D that will evolve 'current' CCS technologies?

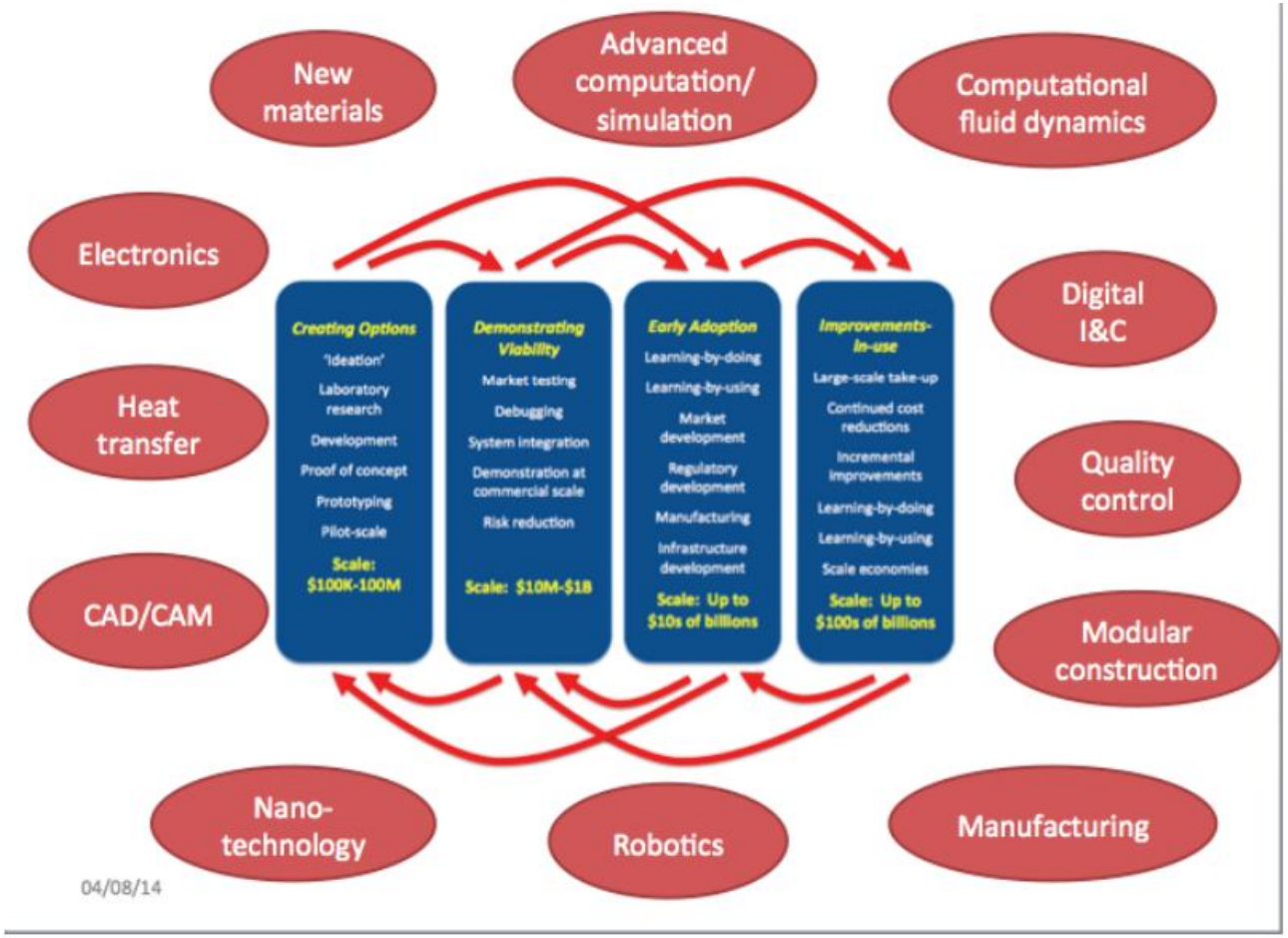


Four stages of energy innovation



From: R.K. Lester, *Regionalizing Energy Technology Demonstrations*, MIT Carbon Sequestration Forum 16, Cambridge, MA, November 12-13, 2014

Basic research is important at every stage of the innovation process (as is the take-up of knowledge from other sectors).



From: R.K. Lester, *Regionalizing Energy Technology Demonstrations*, MIT Carbon Sequestration Forum 16, Cambridge, MA, November 12-13, 2014

Summary

To reduce cost in the 2020s CCS R&D must:

1.Evolve 'current' technologies

- CCS "clock speed" to slow for revolution before FIDs

2.Forget system level TRLs – think CRI

- Focus on sub-systems at low TRL in high TRL systems
- Aim to raise the system CRI to make CCS "bankable"

3.Involve commercial projects to focus the R&D agenda

4.Government must fund research until "bankable" (CRI 6)

5.CCS R&D will continue beyond all our lifetimes

- until the last CO2 storage site is closed and stable;
- R&D continues to deliver value long after the product has achieved full commercial readiness