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Getting ready for phase 2 and phase 3

Luke Warren, CCSA

6th Carbon Capture London Conference

26th March 2015

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CCSA Members

Members across the full CCS chain (capture, transport, storage) as well as service sector and academic community

2Co Energy
Allen & Overy
Alstom Power
AMEC Foster Wheeler
BG Group
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Capture Power Ltd
Carbon Clean Solutions
CCS TLM
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CO2Tech Centre Mongstad
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Tees Valley Unlimited
UK CCS Research Centre
Zurich

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Contents

- Policy and political context impacting CCS
- Current Competition
- Enabling Phase 2 (leading to 3)
- CCS R&D and innovation

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Climate policy

- UK legally binding 80% CO_2 reduction target by 2050
  - Electricity sector largely decarbonised by 2030
- ETI, IPCC, IEA: CCS key component of lowest-cost mitigation pathway
- 2030 power sector decarbonisation target considered in 2016
- CCC recommendation on 5th carbon budget end-2015
- EU 2030 Climate and Energy Package
- Paris climate talks, Dec. 2015

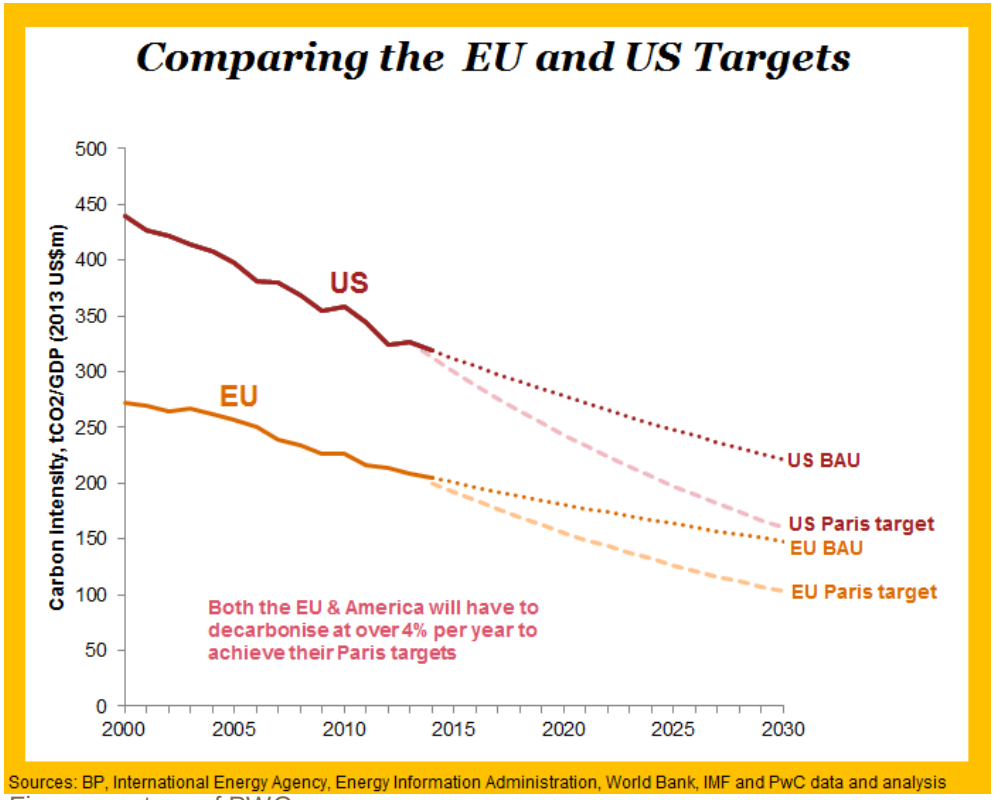

Figure courtesy of PWC

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UK policy context

Electricity Market Reform

- Feed in Tariffs with Contracts for Difference (CfDs) available to all low-carbon technologies (CCS, renewables & nuclear)
  - *"The ultimate aim of these reforms to the electricity market is to create a competitive environment in which low-carbon technologies compete fairly on price and so deliver the best deal for the consumer"*

CCS Commercialisation programme "Outcome"

- Outcome: "*As a result of the intervention, private sector electricity companies can take investment decisions to build CCS equipped fossil fuel power stations, in the early 2020s, without Government capital subsidy, at an agreed CfD strike price that is competitive with the strike prices for other low carbon generation technologies*"

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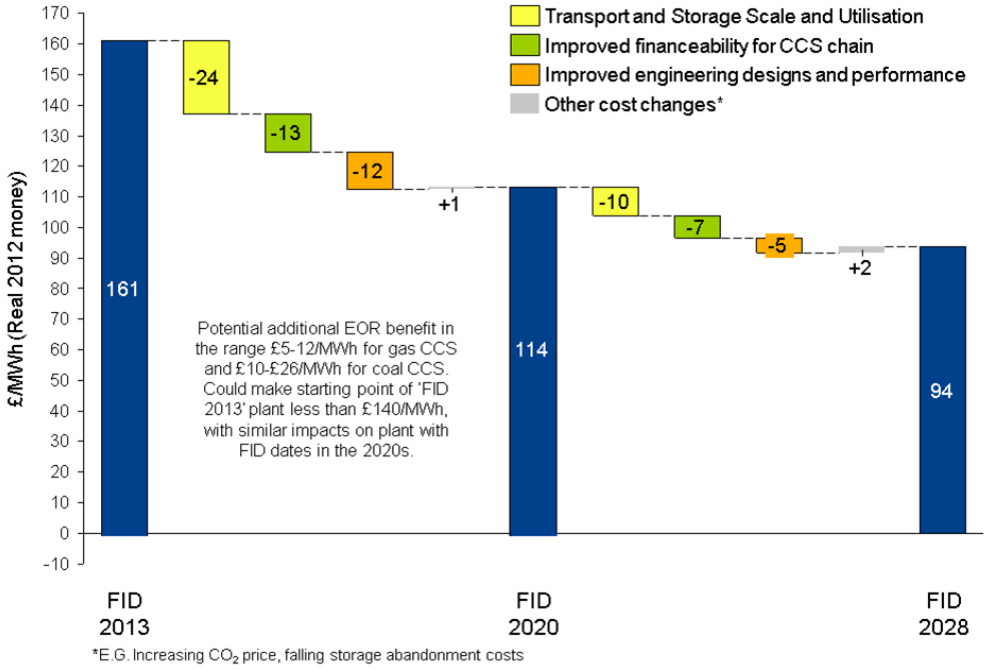
CCS Cost Reduction Task Force

UK CCS Cost Reduction Task Force

"UK gas and coal power stations equipped with CCS have clear potential to be cost competitive with other forms of low-carbon power generation, delivering electricity at a levelised cost approaching £100/MWh by the early 2020s, and at a cost significantly below £100/MWh soon thereafter"



Current perspectives on costs

- Political consensus on CCS – however has to represent VFM
- Energy prices election issue – e.g. Labour energy price freeze
- "CCS industry should...cost-competitive with offshore wind by 2025 and onshore by 2030"

- Levy Control Framework spend almost doubling by 2020
- Scrutiny of energy costs only set to increase
- RES auctions have delivered significant cost reductions

- Rapid CCS cost reductions by mid-2020s (<£100 MWh)
- Requires modest installed capacity – societal costs limited
- Sharing infrastructure and co-ordinated clusters key

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UK CCS Commercialisation programme

Phase 1 - CCS Competition

- Support; £1 billion capital and Feed-in-Tariff (FiT) revenues
- Two projects selected and undergoing FEED studies

Phase 2 – projects developed alongside and subsequent to competition

- Primary support from CfD FiTs for low-carbon electricity
- At least three commercial-scale CCS projects under development

Phase 3 - Commercial CCS

- CCS competing with other low-carbon technologies on cost
- UK Government analysis - up to 13 GW CCS deployed by 2030

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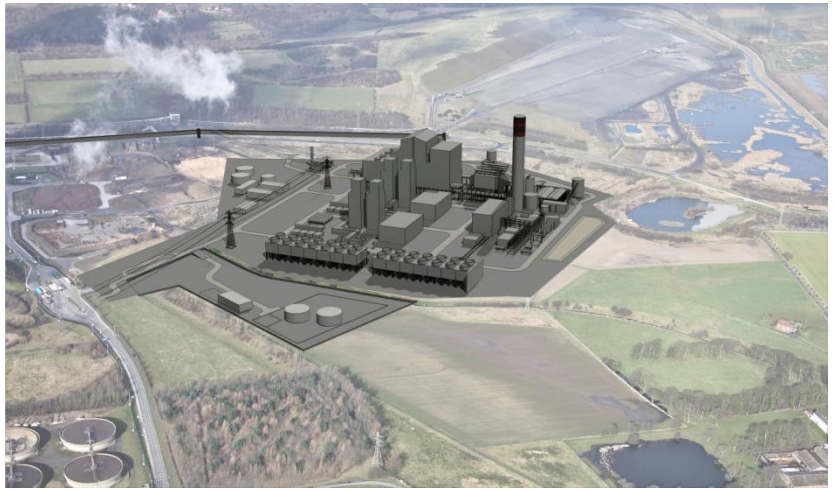
Phase 1 -CCS Competition

White Rose

- Drax, North Yorkshire, England
- 304MW oxy-fuel project
- Alstom, Drax, BOC, National Grid
- FEED contract signed 20 Dec 2013 and commenced 13 Jan 2014
- FID in 2015/2016
- Design work on a larger capacity CO_2 pipeline enabling shared infrastructure and facilitation of further CCS projects



WHITE ROSE CARBON CAPTURE & STORAGE PROJECT

http://www.whiteroseccs.co.uk/

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Phase 1 -CCS Competition

Peterhead

- Peterhead, Scotland
- 340MW Post-combustion capture plant retrofitted to existing CCGT
- Shell and SSE
- Storage offshore in depleted gas field – Goldeneye
- FEED signed 20 Mar 2014
- 10 mt CO_2 stored over 10 years

http://www.shell.co.uk/gbr/environment-society/environment-tpkg/peterhead-ccs-project.html

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Delivering phase 1 - Competition projects

- Next 12 – 18 months critical to future of UK CCS
- Need to deliver 2 competition projects
  - Provide early cluster infrastructure in key regions
  - Developing 0 or 1 project constrains CCS opportunity
- Maintain £1 billion grant + CfDs in current LCF
  - DECC: "over £1 bn" LCF available under central scenario by 2020 / 21
- Cost reduction TF: first projects £150 – 200 MWh
  - Need to articulate early infrastructure and rapid potential for cost-reductions unlocked by phase 1

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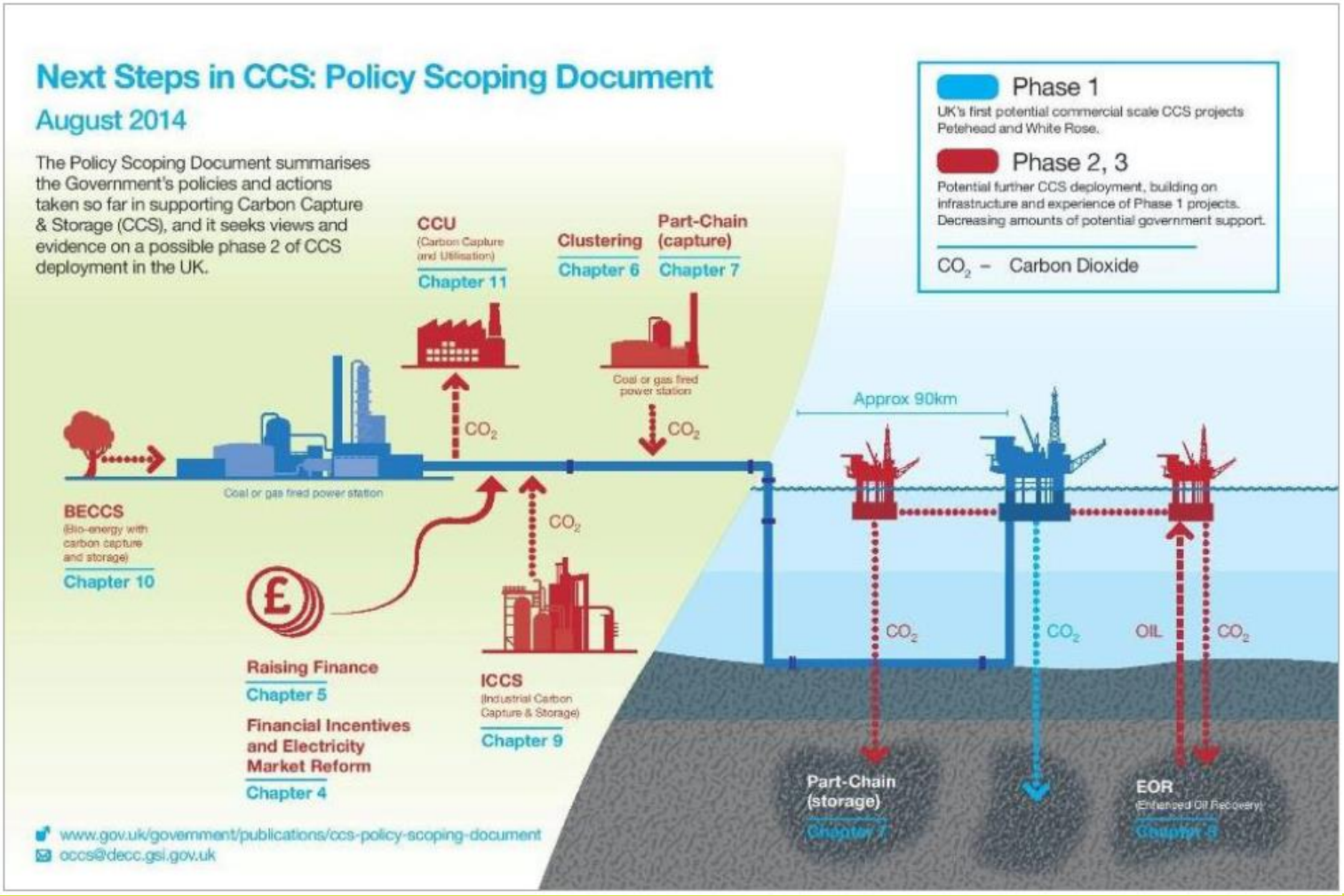
Moving into phase 2 and 3



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Enabling investment in phase 2

Power CCS investment mechanism

- EMR gives us the legal framework for phase 2
- Develop CCS CfD terms (FF indexation, rebasing, contract length, etc.)
- Develop CCS CfD allocation framework – establish route to market
- Offtaker of Last Resort open to CCS?
- Mechanism to support low-carbon flexible generation?

Industrial CCS investment mechanism

- PWN CCS power generation eligible for CfDs? Could support some projects
- Need an appropriate investment mechanism for process CO_2 emissions
- Process to allocate and fund investment mechanism

Market and infrastructure for phase 2 CCS

Size and timing of market for phase 2

- Must have parallel deployment of competition and phase 2
- Perhaps 1.5 GW CCS CfDs allocated over 2015 – 2020?
- Current LCF expires 2020/21 – phase 2 realistically operating post-2020
- Need to encourage pipeline of projects to come forward
- Build confidence use ‘technology minima’ instead of targets?

Delivering storage and transport capacity

- Infrastructure established through the Competition key
- Terms for phase 2 accessing infrastructure, e.g. financial securities for CO_2 storage?
- Incremental investment to ‘step-out’ from 5/42 and Goldeneye stores
- Role for CO2-EOR and supportive fiscal regime

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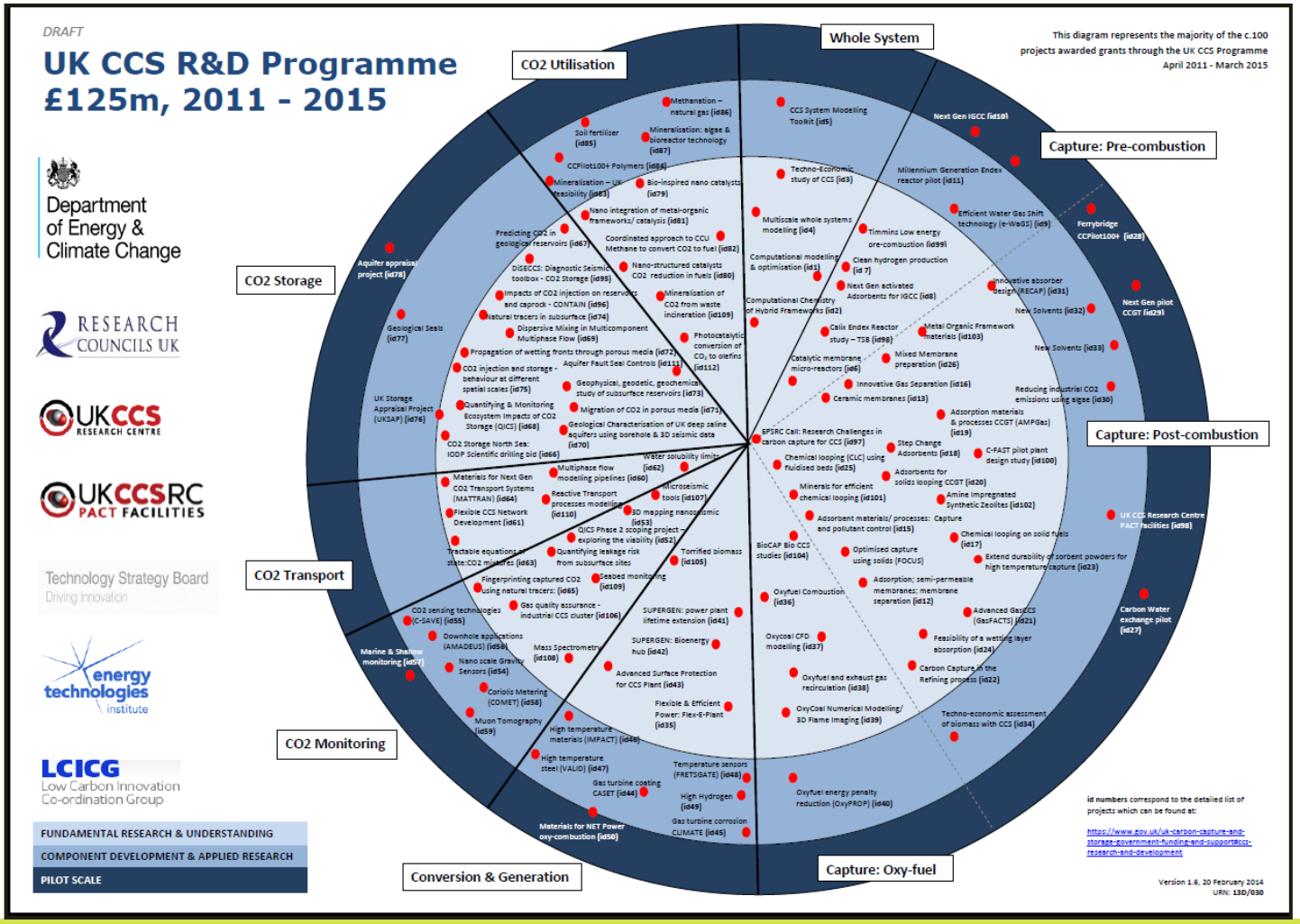
UK CCS R&D and innovation



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Existing approaches to informing R&D

Advanced Power Generation Technology Forum (APGTF) Strategy

- Recognises need for cost reduction and competitiveness with other low-C technologies
- Identifies 150 RD&D needs contribute to cost-reduction (2/3 short-term; 1-10 yrs)
- Funding resources << funding needs; Further prioritisation / ranking needed?

Research and Pathways to Impact Delivery (RAPID)

- Assesses future knowledge-related needs, does not prioritise identified gaps
- Cross-reference with 2011 APGTF strategy provide some assessment on priorities (Incomplete cross-referencing of 2013 Strategy)

Not clear whether APGTF or RAPID processes have resulted in prioritisation of research themes

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CCSA perspectives on future R&D

- Support for CCS deployment only assured if clear potential to be cost-competitive
- DECC funding for CCS R&D and innovation justified on contribution to cost reductions
- Given Government's absolute priority to cost-reduction all CCS proponents should demonstrably support narrative and delivery of cost-reductions
- Need to prioritise and support R&D that clearly supports delivery of the Outcome (Cost-competitive CCS)

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Possible improvements

Conclusions CCSA, RAPID, APGTF workshop held Nov. 2014;

- Update RAPID reflect most recent APGTF priorities
- Identify subset of priorities that can support phase 2 projects
- Introduce assessment criteria to account for timeliness & cost reduction
- Split funding into near- & long-term impacts (weighted towards former)

Possible next steps;

- Understand budget required to deliver priorities
- Identify any funding gaps for priorities against existing funding routes

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Summary

1. Climate change back on the political agenda

2. The cost and value narrative of CCS critical

3. The big decisions on CCS be made by next Government

3. Successfully conclude CCS competition
   - Deliver two projects – initiate two regional CCS-hubs
   - Retain £1 bn and access to CFDs

3. Bring forward phase 2 CCS projects
   - Complete CCS CfD design and allocation methodology
   - Develop industrial CCS policy

4. Focus R&D and innovation funds where best support Outcome