Energy transitions in the industrial clusters: shielding, nurturing and empowering CCS

Sarah Mander and Clair Gough

UKCCSRC project WP C1

Objectives:

1. Explore the conditions necessary for establishing a social licence to operate (SLO) for CCUS and the future implications for industry and BECCS

2. **Explore the role of industrial clusters in enabling CCUS deployment, applying the concept of 'protective spaces' from sustainability transition management**

   - Adopted a case-study approach combining interviews with key stakeholders and documentary analysis
   - We spoke to 11 stakeholders either from the clusters or working on CCS at a national scale
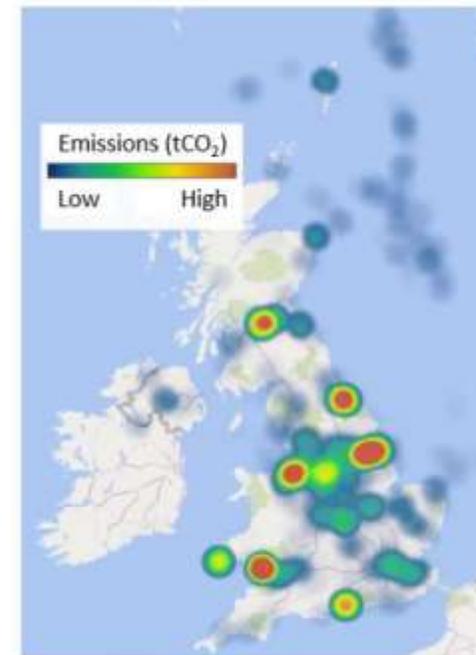   - Insights from interviews were triangulated with documentary data

UK industry and it's emissions
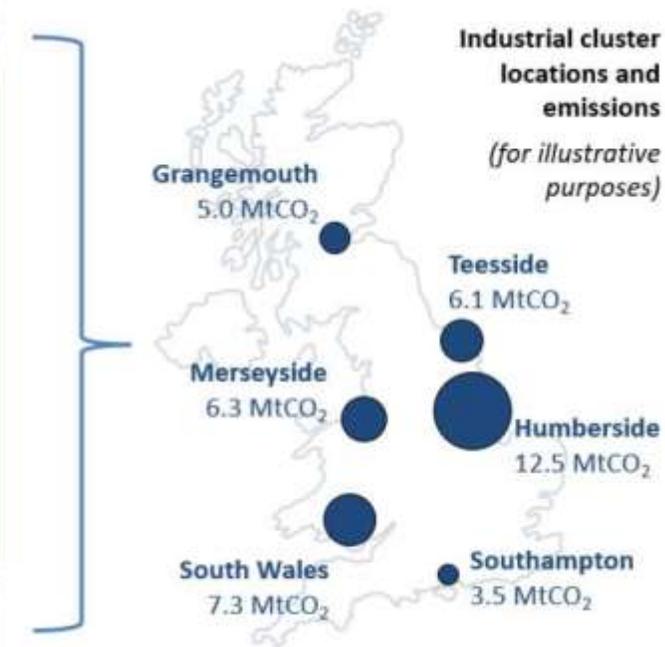
UK industry: (BEIS, 2021)

- 110.0 $MtCO_2e$ in 2018 (CCC, 2020)
- 68% of emissions from large point source, many <u>but not all</u> concentrated in industrial clusters
- directly employs 2.6 million people, >90% of whom are employed outside the coastal clusters (Repowering the Black Country, 2021)
- contributes £170 billion to the UK economy

Industrial decarbonisation: (BEIS, 2021)

- emissions must fall by 2/3 by 2035 and 90% by 2050
- four clusters must have CCS infrastructure by 2030
- one net zero cluster by 2040

Emissions (tCO_2)
Low   High

Industrial cluster locations and emissions
(for illustrative purposes)

Grangemouth
5.0 $MtCO_2$

Teesside
6.1 $MtCO_2$

Merseyside
6.3 $MtCO_2$

Humberside
12.5 $MtCO_2$

South Wales
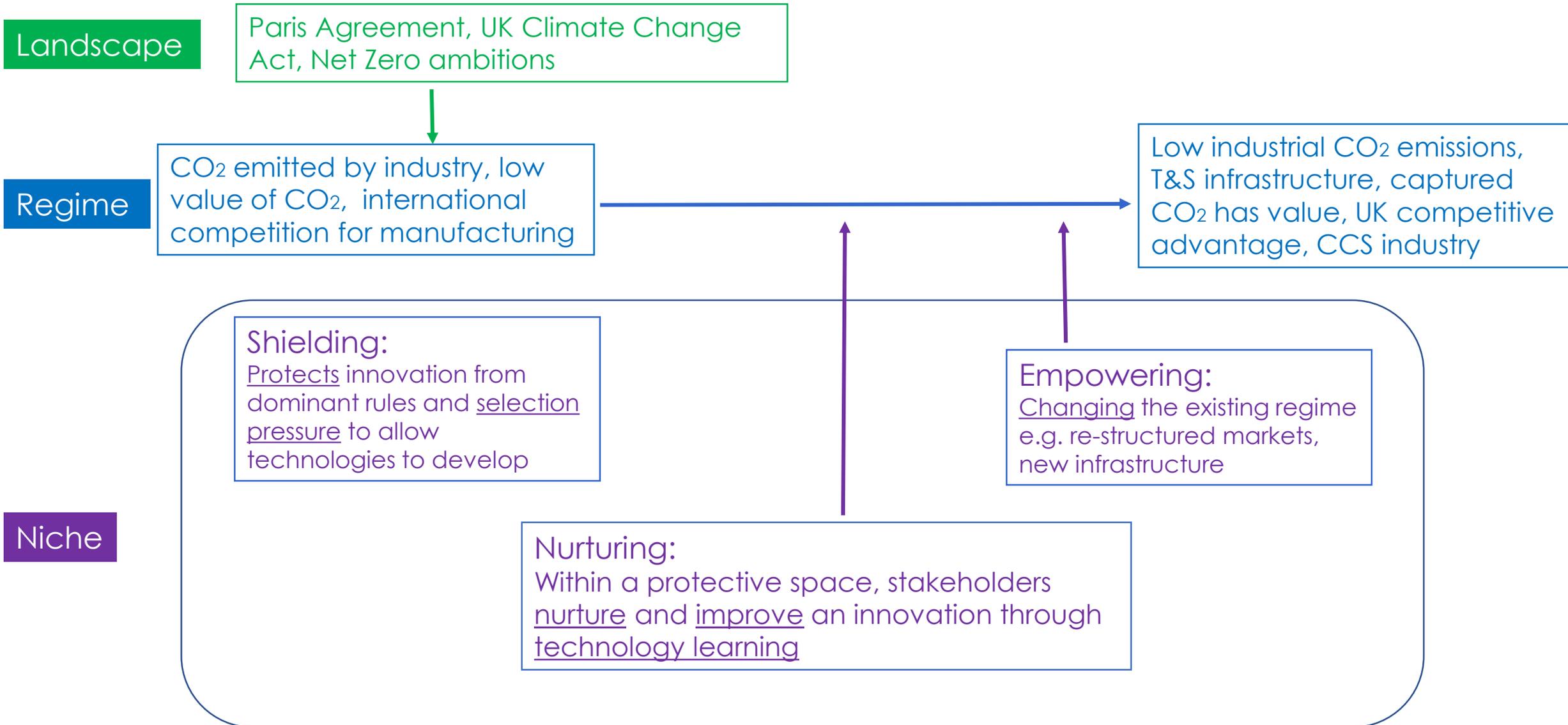7.3 $MtCO_2$

Southampton
3.5 $MtCO_2$

Source: CCC, 2020

Sustainability transitions (Raven et al, 2016; Smith et al, 2014)

A transition takes place due to the interactions between three levels:

- The <u>landscape</u> – external factors which place pressure on the existing ways of doing things, requiring them to change

- The <u>regime</u> – the existing social-technical system (ways of doing something); this includes the existing actors and social networks, rules and institutions and associated technology and infrastructure

- The <u>niche</u> - the space where innovation takes place, and where innovations are protected from dominant rules '*protective space*'

Sustainability transitions (Raven et al, 2016; Smith et al, 2014)

Landscape

Paris Agreement, UK Climate Change Act, Net Zero ambitions

Regime

CO_2 emitted by industry, low value of CO_2, international competition for manufacturing

Low industrial CO_2 emissions, T&S infrastructure, captured CO_2 has value, UK competitive advantage, CCS industry

Niche

Shielding:
Protects innovation from dominant rules and selection pressure to allow technologies to develop

Nurturing:
Within a protective space, stakeholders nurture and improve an innovation through technology learning

Empowering:
Changing the existing regime e.g. re-structured markets, new infrastructure

Shielding (Raven et al, 2016; Smith and Raven, 2012)

Technology advocates must actively develop protective spaces where full chain CCS applications are shielded from mainstream market pressures

- **passive shielding** takes place in existing spaces favourable for a particular innovation
- **active shielding** arises from specific interventions e.g. technology funding, market incentives
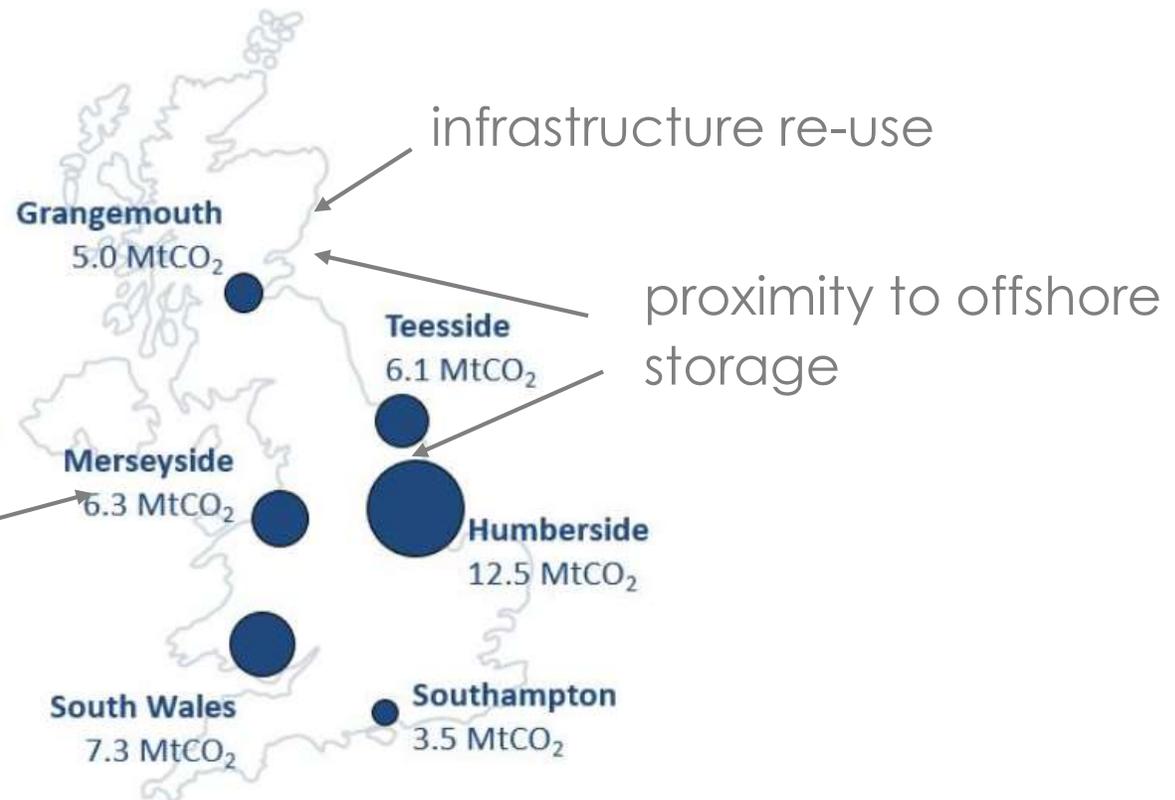
Passive shielding (Smith and Raven, 2012)

passive shielding takes place in existing spaces favourable for a particular innovation:
- Deploying CCS in industrial clusters offers passive shielding compared to power CCS

- direct emissions (high purity CO_2) – low capture costs
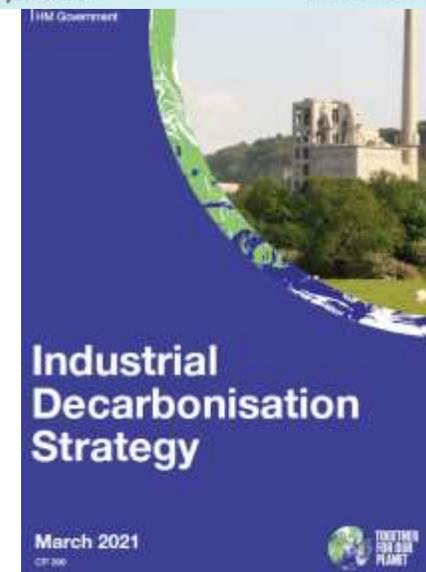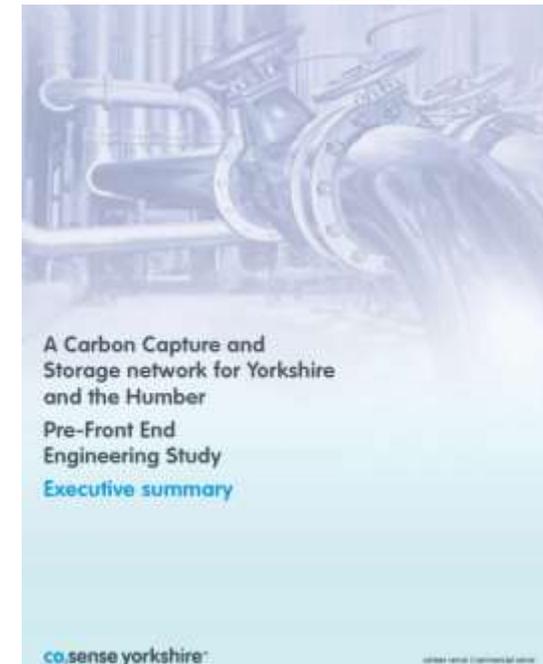- diverse expertise and skilled workforce

- proximity to offshore storage
- infrastructure re-use

infrastructure re-use

proximity to offshore storage

Grangemouth
5.0 $MtCO_2$

Teesside
6.1 $MtCO_2$

Merseyside
6.3 $MtCO_2$

Humberside
12.5 $MtCO_2$

South Wales
7.3 $MtCO_2$

Southampton
3.5 $MtCO_2$

Source: CCC, 2020

Active shielding (Smith and Raven, 2012)

active shielding arises from specific interventions:

- funding from <u>national government</u>, initially offered active shielding for power CCS in the e.g. CCS competitions
- technology specific policies at <u>a regional or devolved level</u> have been key to driving forward industrial decarbonisation in the absence of consistent policy from national government
- post-2017 strategy and funding from <u>national government</u> has focused on industrial decarbonisation

A Carbon Capture and Storage network for Yorkshire and the Humber

Pre-Front End Engineering Study

Executive summary

co.sense yorkshire·

HM Government

Industrial Decarbonisation Strategy

March 2021

Nurturing

Within a protective space, stakeholders nurture and improve CCS through technology learning

- building ***stakeholder networks***
- creating and sharing of ***visions*** and ***roadmaps***
- using these roadmaps to provide the ***strategic framework for learning*** to enable deployment

Empowering

To enable CCS to emerge from a protective space to wide-scale deployment, stakeholders must influence and change the wider regime

- diverse **stakeholder networks** with influence and resources
- **narratives** that **articulate how regulations, business models and institutions need to change** to allow CCS to flourish
- the **alignment of technology narratives** with **current socio-political agendas**

Nurturing

Empowering

building stakeholder networks

stakeholders with influence and resources

visions and roadmaps

narratives that articulate how regulations, business models and institutions need to change to allow CCS to flourish

structured learning beyond technology demonstration

the alignment of technology narratives with current socio-political agendas
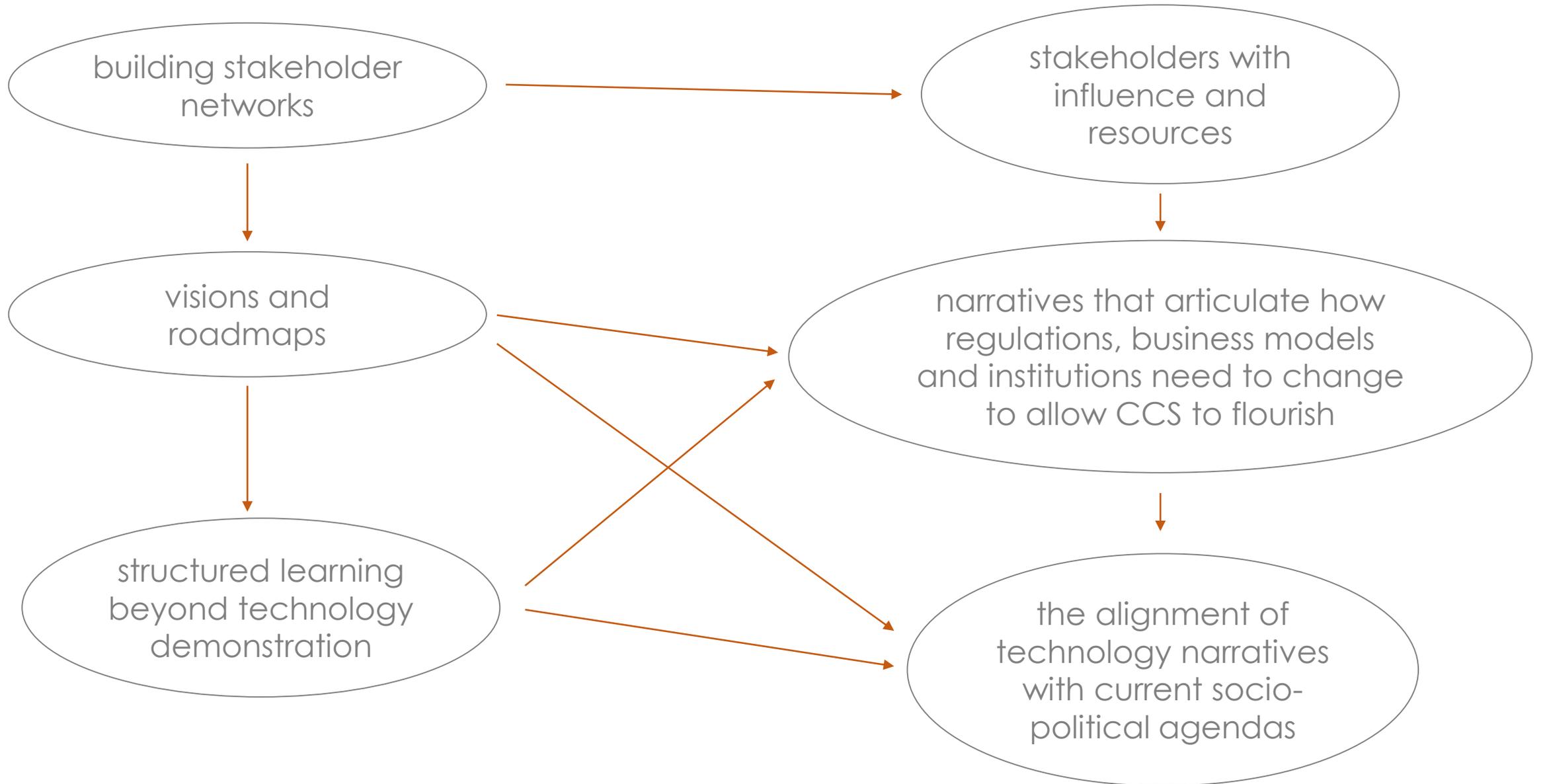
Stakeholder networks (1)

- stakeholder networks must be strong, co-ordinated and able to work together; this does not happen by accident
- regional governments have been key to maintaining a focus on industrial CCS, most notably in Teesside, and must play an active role in the clusters
- post-2017, Government funding has been central to bringing stakeholders together, including local, regional and devolved governments, and rebuilding trust

Guardian Environment Network Environment

What happens if the green quangos are axed?

An examination of how the "bonfire of the quangos" could affect the environmental sector

Stakeholder networks (2)

Cluster networks must include stakeholders:

- from across the whole CCS chain
- including all aspects of the 'regime' e.g. regulations, finance, local government, skills, supply chain, local populations
- able to commit time and resources
- working at different scales including national and international
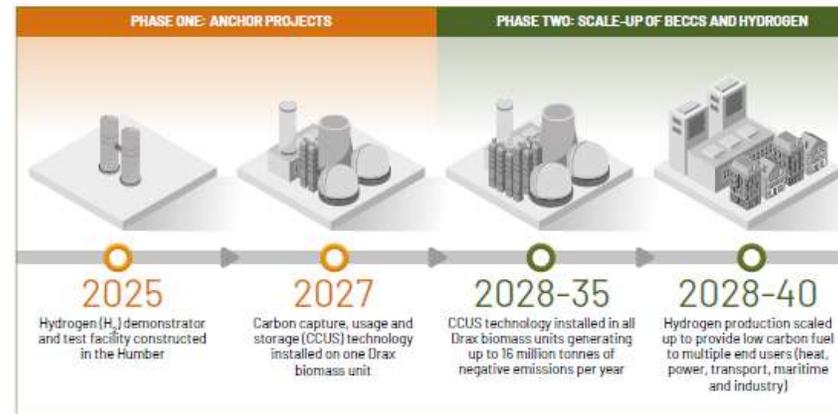- with institutional learning, power and influence

Visions and roadmaps

- achieving deployment requires a clear understanding of the end-point and the steps needed to get there
- this is important where there are many different end-points and routes to choose from
- ensures stakeholders are working to a common goal
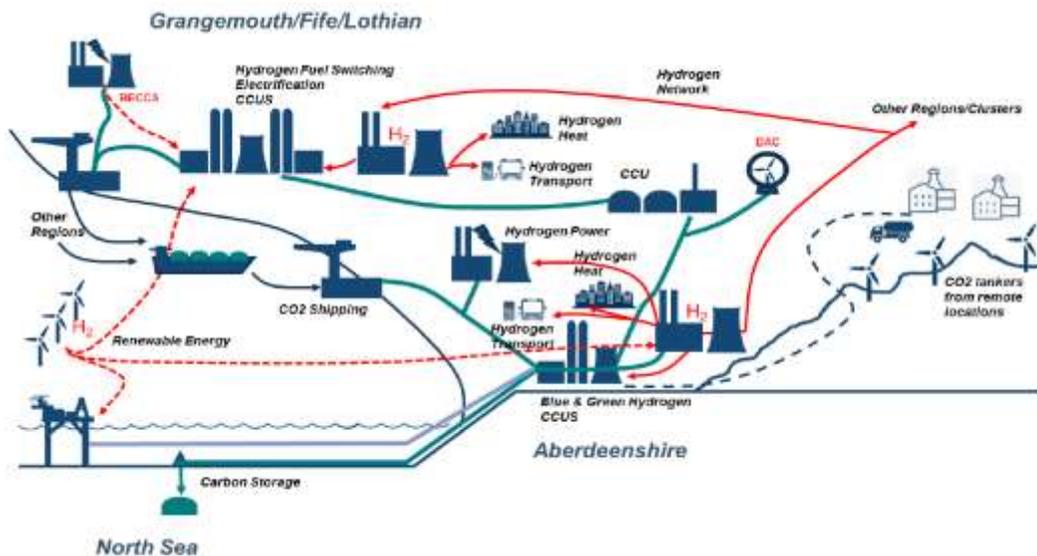
Visions and roadmaps

- emissions from all industry must by cut by 90% by 2050; 56% of emissions are from outside the clusters?(Repowering the Black Country)
- how will industrial decarbonisation be extended to all industry?

Source: Repowering the Black Country (2021)

Source: CCC, 2020
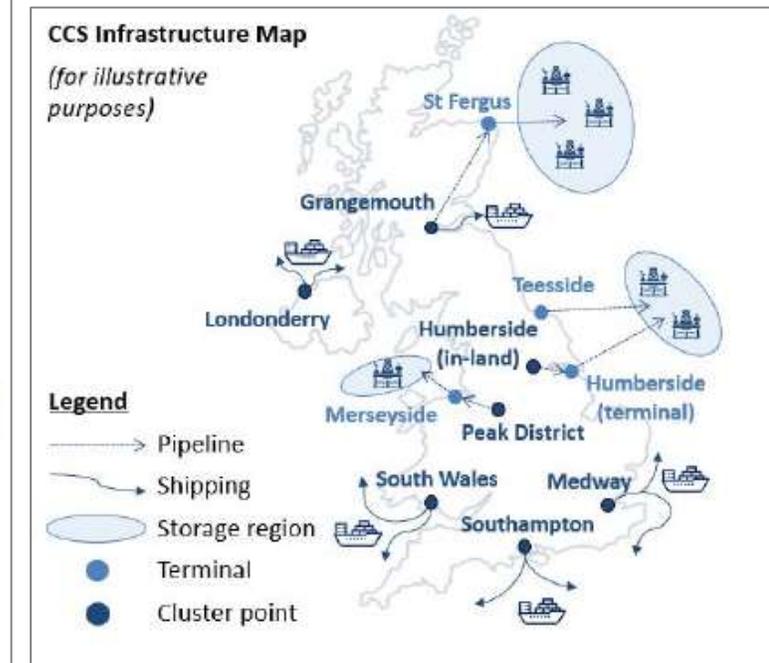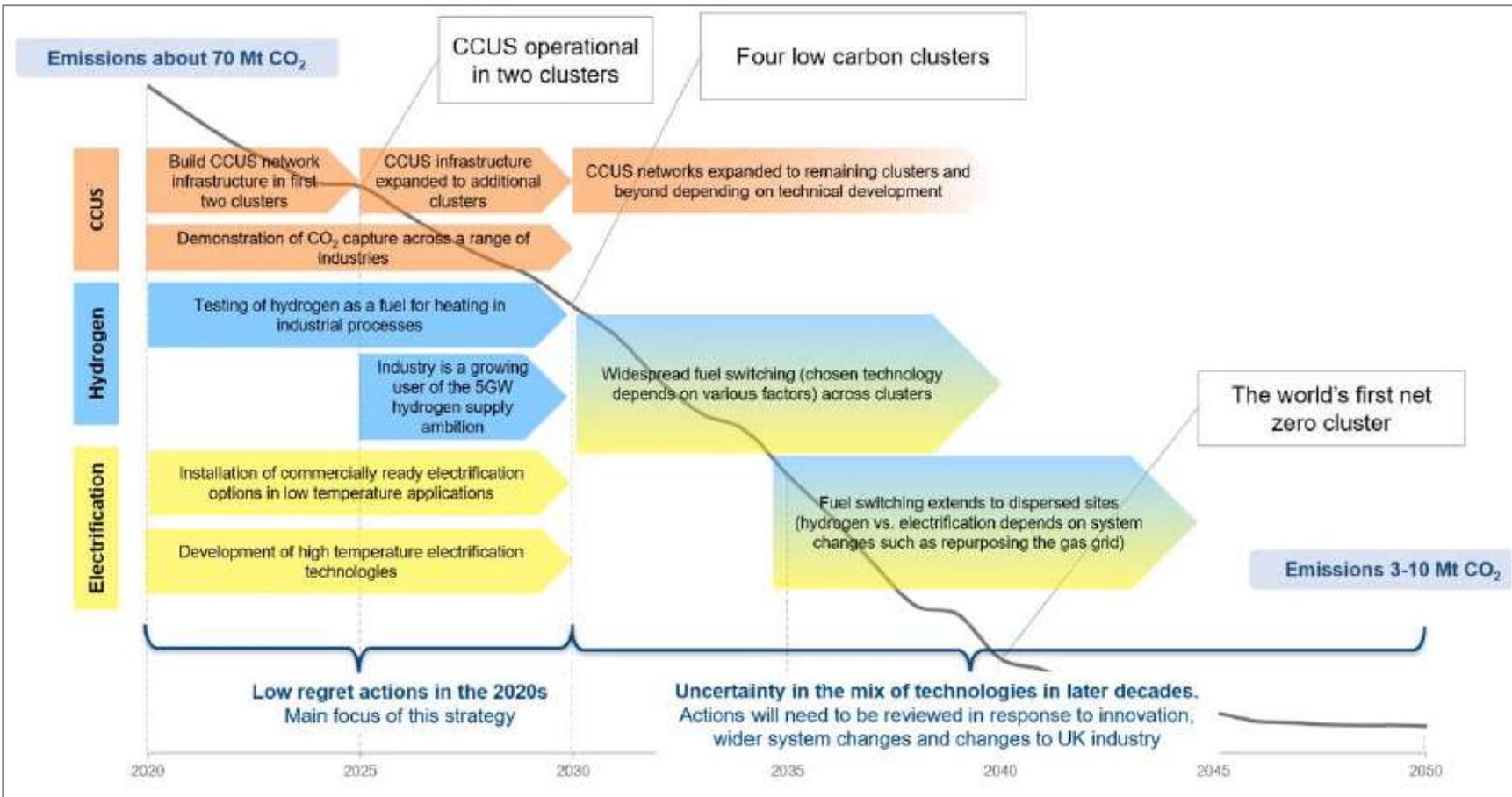
Learning beyond technology demonstration

- technology demonstration is important but only part of the story, need to understand all aspects of deployment
- despite deployment setbacks, there is a good foundation of knowledge about many aspects of deployment, though less about public responses beyond the abstract
- explaining how the regime must change to accommodate CCS
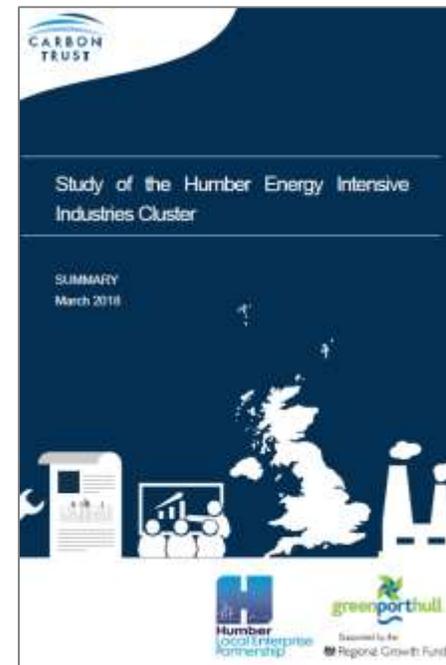
Providing solutions to policy challenges

- clusters have both common and differentiated narratives
- common:
  - safeguarding and growing economies in the clusters
  - net zero
  - cross sector decarbonisation
- differentiated:
  - unique benefits of particular clusters
- CCS narratives must tell a clear story of how CCS can provide solutions to policy challenges
- rich narratives can appeal to the different values that people hold

Conclusions

- industrial CCS has benefitted from the support of regional governments prior to attention from national government
- the cluster approach now offers the opportunity to 'shield, nurture and empower' CCS within a protective space
- stakeholders have a crucial role in shaping the conditions to help CCS thrive
- a just, net zero transition requires widespread deployment of CCS beyond the clusters
- this requires a collective vision for decarbonised industry in the UK
- this vision must be co-designed by stakeholders within and outside of the clusters, across all elements of the CCS regime

Thank you!

s.mander@manchester.ac.uk

@SarahLMander

References

- BEIS (2021). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/970229/Industrial_Decarbonisation_Strategy_March_2021.pdf

- CCC (2020). https://www.theccc.org.uk/wp-content/uploads/2020/12/Element-Energy-Deep-Decarbonisation-Pathways-for-UK-Industry.pdf

- Rob Raven, Florian Kern, Bram Verhees, Adrian Smith(2016). Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases. Environmental Innovation and Societal Transitions 18, 164–180

- Smith and Raven (2012). What is protective space? Reconsidering niches in transitions to sustainability. ResearchPolicy41 (2012) 1025–1036

- Repowering the Black Country (2021) https://ukccsrc.ac.uk/wp-content/uploads/2021/06/21.06.03-Matthew-Rhodes.pdf