THE ASSOCIATION
FOR RENEWABLE ENERGY
& CLEAN TECHNOLOGY

CCUS: Non-Pipeline Transport and Cross Border CO2 transport Call for Evidence

Members meeting 24th June 2024

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Agenda

REA Updates

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Government Vision for NPT

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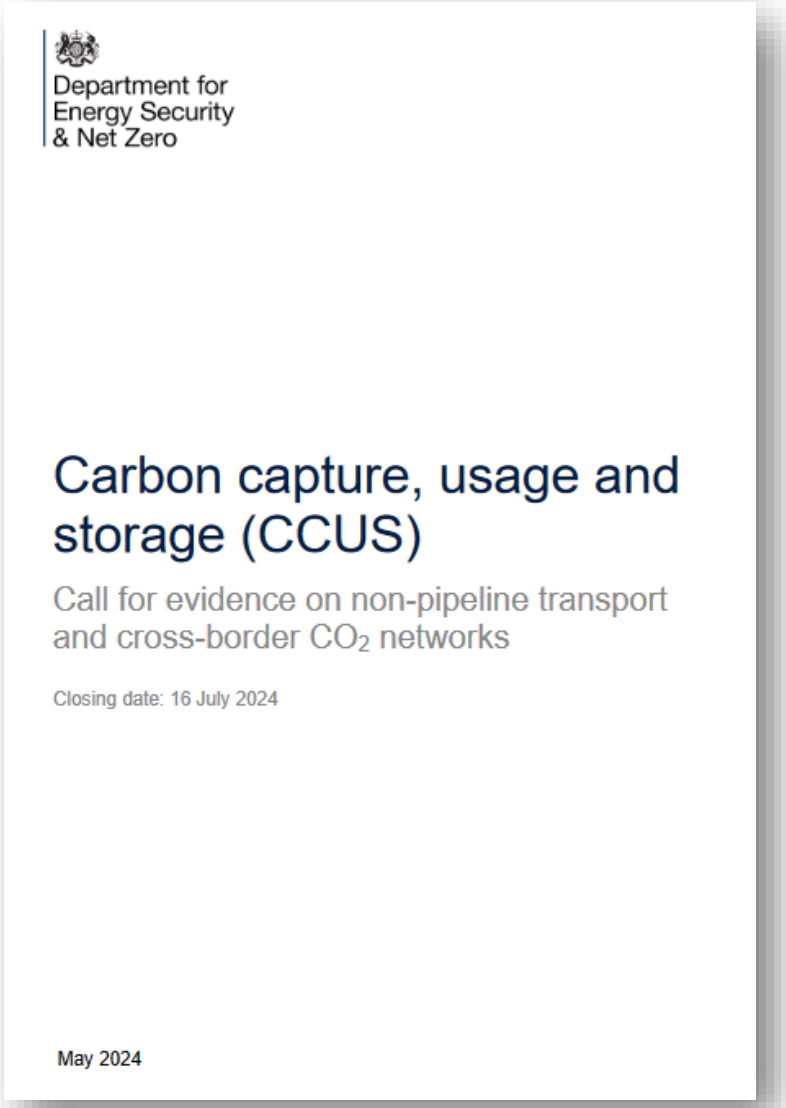
- Project Data,
- Costs
- Financing

CCUS Policy Landscape
- TRI Model
- CCS Network code
- Capture Business models
- Future Allocation Processes
- Cross Boarder Carbon
- Storage

Other Regulatory Controls and Delivery

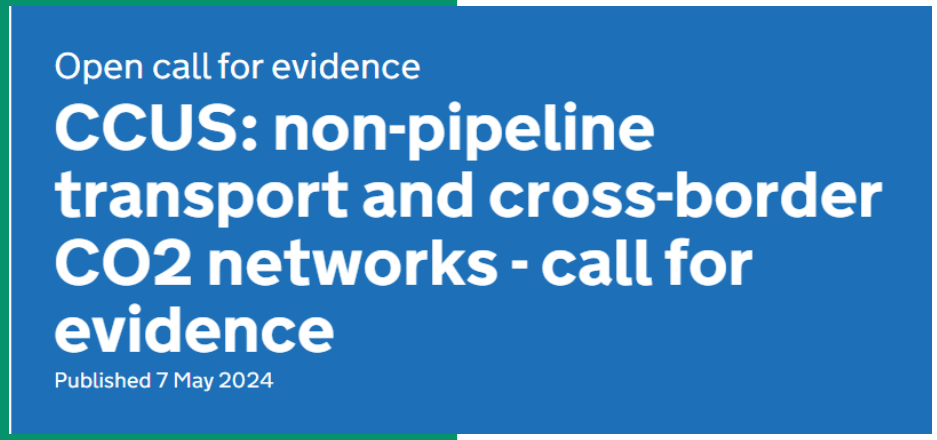


Background

Carbon capture, usage and storage (CCUS) is essential to UK meeting 2050 Net Zero Target

CCUS is important in the decarbonisation of industry (e.g. cement, chemicals, and refining) where process emissions mean that it is the only viable route to decarbonise at the scale to meet carbon budget and net zero targets.

Government committed to a Call for evidence on delivery of Non pipeline transport (NPT) in the publication 'Carbon capture, usage and storage: a vision to establish a competitive market' CCUS Vision publication



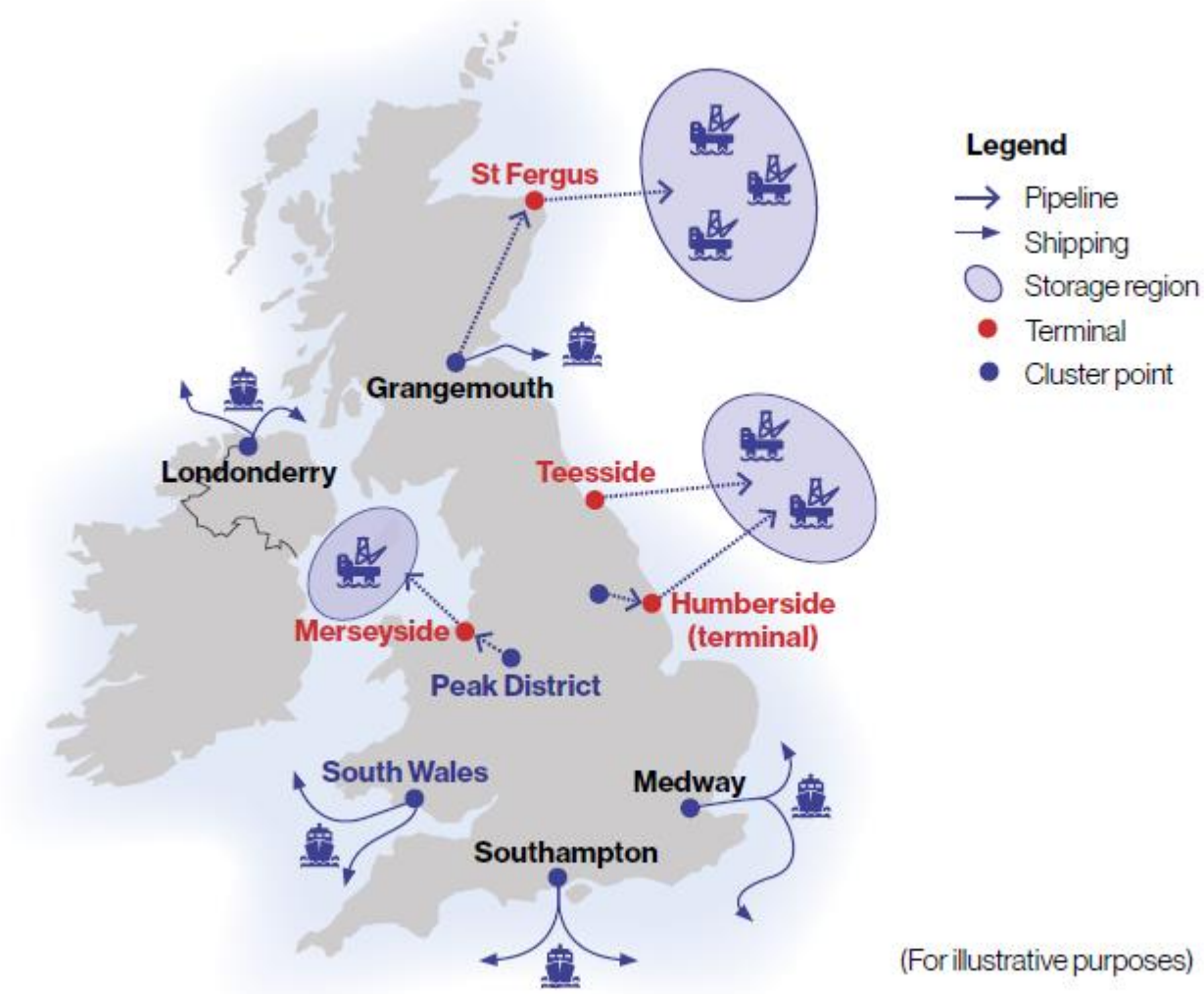
NPT can help decarbonisation across multiple regions and sectors where a pipeline is technically and/or commercially unfeasible

The CCUS Visions acknowledged the role of Cross-border CO2 transport and storage networks with a potentially vast UK offshore storage capacity.

NPT will allow capture projects outside of CCUS industrial clusters or those in clusters but without direct pipeline access to store CO2 offshore

CCUS Industrial Cluster Map (Source Gov.uk)

[Industrial decarbonisation strategy (accessible webpage) - GOV.UK (www.gov.uk)]



Consultation

Consultation

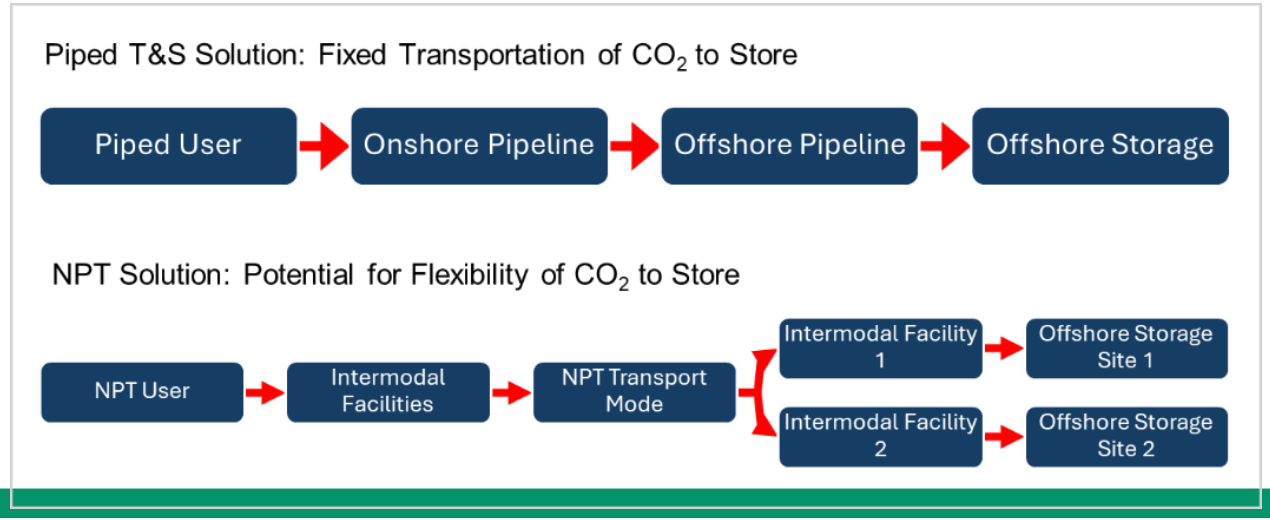
A 3-phase approach:

1. Market creation phase until 2030
2. Market transition phase: 2030-2035
3. Self-sustaining market phase: 2035 onwards

The CCUS Track-2 December 2023 Market Update set out government's proposed Track-2 approach of an 'anchor' and 'buildout' phase and high-level timelines, facilitating future phases of store and network expansion to enable both additional piped and NPT projects.

NPT in the CCUS context is the transportation of CO2 using road, rail, barge, and/or shipping.

NPT solutions and piped T&S networks are likely to deploy in parallel and will be complimentary to one another. Although the piped network and NPT solutions may both be transporting CO2, there are some key differences



Vision for the NPT Sector

Variety of NPT chains

- delivered by all NPT transport modes (road, rail, barge and ship)
- multi-modal solutions for CCUS decarbonisation in harder to access locations
- likely creation of specialist service providers across the NPT value chain
- different NPT value chains likely to have different commercial arrangements to best manage the chain's NPT challenges, expertise and risk appetite

Operational flexibility

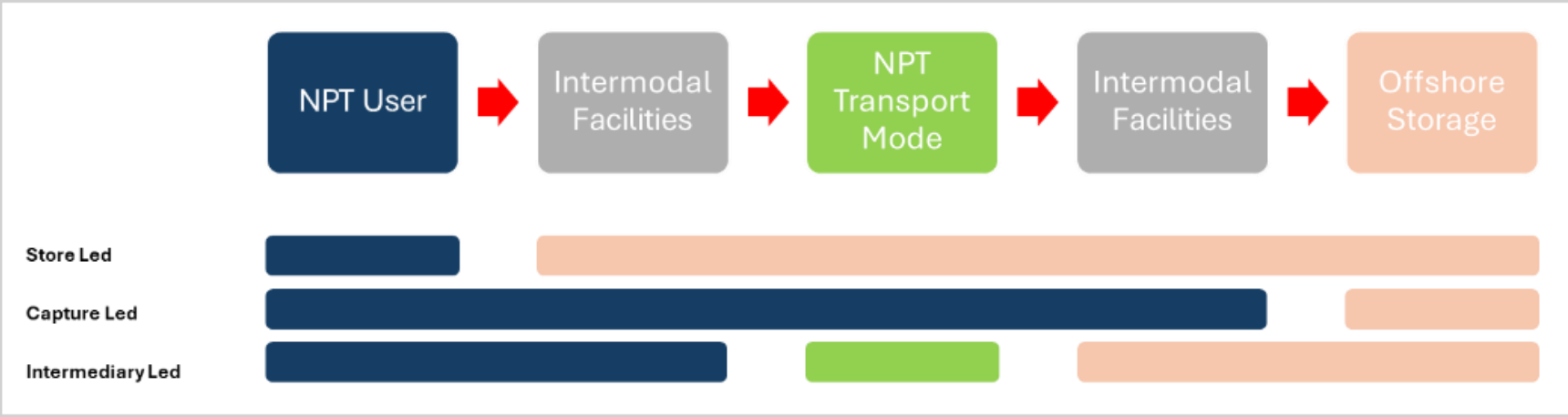
- each CCUS cluster would have NPT connectivity, interconnected NPT users and stores could then connect with fixed piped T&S networks
- charging fee structures may develop for NPT users and cross-border users which react to storage market capacity to optimise store use
- third-party agents may be utilised to support a flexible service provision – potentially as risk taking intermediaries or brokers connecting NPT parties

Competition fuelling system growth

- NPT service providers are not expected to be economically regulated
- competition between NPT service providers should lower costs
- shipping may enable direct-to-wellhead CO2 injection, especially at stores without a local user base. This could potentially be favourable for cross-border users
- NPT users and cross-border users could incentivise storage exploration and appraisal activity

View on the potential vision for the NPT sector

Government understands there to be several different archetypes for the delivery of NPT. These can largely be explained through 3 lenses,



Consultation Questions

*4. Please provide views on the potential long-term vision for the NPT sector.

*5. Which regions and sectors of the economy will benefit most from NPT solutions unlocking CCUS?
- Which regions and sectors of the economy will continue to struggle to deploy CCUS?
- Should the government look to prioritise any particular regions or sectors of the economy for NPT?

NPT Value Chain – Project Data

- Government wants information on potential NPT projects, focusing on technical and commercial delivery, key technical elements, and variations in infrastructure, equipment, and transport solutions. They are keen to understand the different form of commercial arrangements that might develop
- REA not in a position to answer these question directly, as very project specific, however happy to highlight key universal concerns

6. Please provide details of your potential NPT or cross-border solution. Please provide any information on the timing of the project through the initial phase and into the future, and the minimum viable project.

7. Please provide the technical and operational considerations for the major pieces of infrastructure, equipment, and transportation. Considerations may include information on the sizes and numbers of the above, CO2 temperature and pressure conditions, loading/un-loading times and NPT journey lengths and duration. Please also provide the rationale for the technical and operational decisions.

***8.** For the above NPT chain, please provide information on the expected ownership/operatorship (e.g. leasing, owned, shared ownership, etc) and expected commercial/contractual arrangements. Please include when equipment is to be shared between multiple entities or for sole use.

9. Please provide information on the elements in the NPT chain with the longest lead times which could be rate determining in the deployment of the NPT chain. Please provide any information that you have on timelines for delivery of your NPT chain (e.g. project delivery Gantt charts).

***10**. What are the expected transport emissions and fugitive emissions expected within the NPT value chain? Please provide any information on how these emissions can be minimised**.**

NPT Value Chain – Costs

- NPT is expected to have greater technical variation than pipelines.
- Some cost understanding exists but detailed cost breakdowns are needed.
- Cost breakdowns should include devex, opex and capex.
- For Track-1 clusters using piped T&S networks, T&S fees are paid by the capture project and passed through various capture business models (BMs).
- Deployment of NPT projects during the market transition phase may require government support but government need confidence in cost data.

Non exhaustive list of potential cost categories:
- any onshore pipeline required to the send-out facility
- liquefaction
- buffer storage
- loading/un-loading infrastructure
- transport mode (road, rail, barge, ship)
-
- pumping and heating

NPT Value Chain – Costs

*****11. Could the costs associated with the full NPT value chain prevent investment and deployment of NPT solutions? If so, why**?**

12. If available, please provide any assessments that have been carried out to show an NPT solution is more economically viable than a piped solution for your NPT value chain, or that a piped solution is not technically viable.

13. Please provide evidence on the costs associated with NPT. Where possible disaggregated to the nodes delivered by NPT service providers (e.g. after capture plant and before delivery to the T&S network). Where possible, please provide information in relation to the devex, capex and opex of the operation. Please include the stage and Association for the Advancement of Cost Engineering (AACE) Cost Class at which this cost data has been generated, and please share the methodologies and assumptions that have been utilised to generate this data

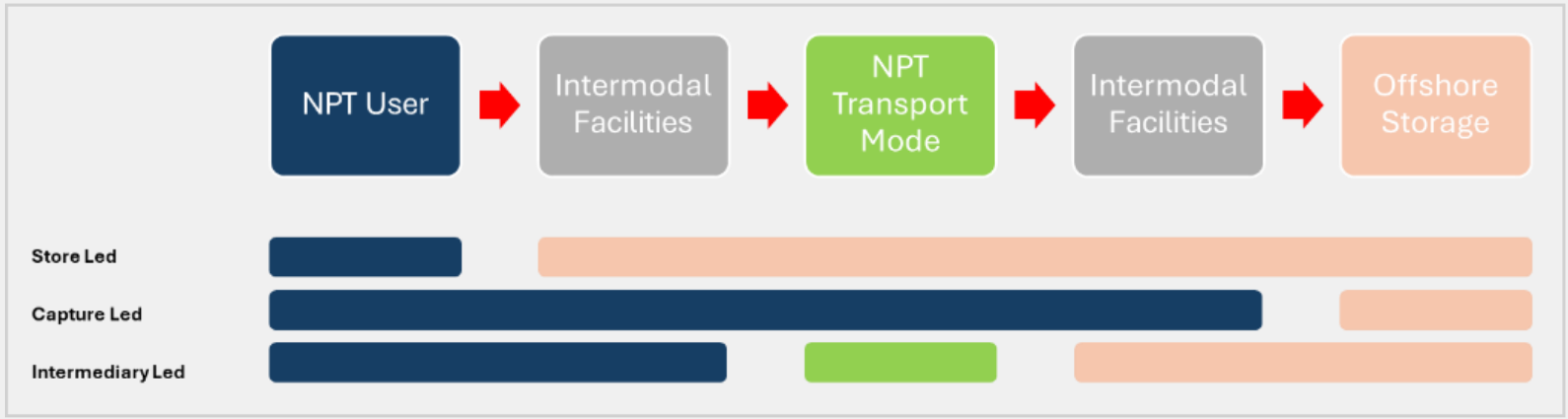
NPT Value Chain – Financing

Government would be keen to understand the views of investors on the different delivery options, particularly in relation to the potential breaking of the full chain and the impact operational flexibility could have.

14. What are the main financing risks with a disaggregated chain, and how do these differ to the full chain piped approach?

15. What are the main financing risks associated with operational flexibility, and how do these differ to the full chain piped approach?

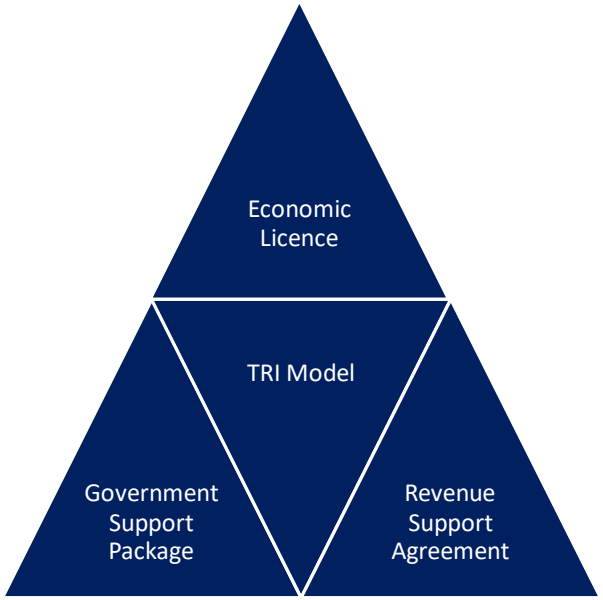
16. Which archetype do you think would be most attractive to investors? Why?



17. What types of financing are best placed to deliver NPT value chains?

CCUS Policy Landscape – TRI Model

- In Track-1, T&SCos are economically licensed due to CO_2 pipelines' monopolistic characteristics however NPT lacks monopolistic traits due to lower entry costs and potential for multiple parallel assets.
- Potential for market dominance in NPT exists, warranting regulatory intervention if non-competitive behaviours arise.
- Government intends to monitor and review this position to address non-competitive behaviours.
- Government involvement will decrease as market risks diminish and the market becomes self-sustaining.
- Government seeks to understand NPT value chains' ability to manage risks associated with connecting NPT users to existing CCUS clusters.



18. Do you agree the rationale for economically licensing NPT service providers does not exist? Or do you believe that some elements in the NPT value chain may still require some kind of economic licencing?

19. Considering the expected deployment timelines for potential NPT projects within the CCUS programme, can the risks associated with the deployment of an NPT value chain be effectively managed commercially between the different actors within the NPT value chain? If not, please provide evidence and rationale why these risks cannot be managed commercially.

CCUS Policy Landscape – CCS Network code

- The Energy Act (2023) allows the government to grant economic licences to the UK's first CO2 T&S network operators. Licensees must maintain and administer a network code.
- The CCS Network Code (the 'Code') will detail commercial, operational, and technical arrangements between users and operators of T&S networks, along with governance arrangements.
- The Initial Code anticipates future needs after Track-1, considering the potential for more diverse users and T&S operations.

For example:

- Section D of the Code distinguishes between the onshore and offshore transportation and storage systems.
- Section D includes a placeholder for future provisions addressing the interface between onshore and offshore systems, acknowledging potential separate licensing and ownership.
- Section H of the Code's charging structure separates onshore and offshore charges, considering that some users, including NPT users, may not use onshore components in the future

20. Please provide details on how you believe that the CCS Network Code would need to be updated to facilitate NPT.

CCUS Policy Landscape – Capture Business models

- In Track-1, capture business models (BMs) were designed for CO2 transfer to T&SCo at piped delivery points.
- Current BMs include: ICC, DPA, Hydrogen production, Power BECCS, Greenhouse Gas Removal.
- During market transition phases, capture BMs may need adjustments to support CCUS, including NPT users.
- Changes to capture BMs could be minor (e.g., updating definitions for NPT) or significant (e.g., altering initial policy rationale for NPT users).
- Also recognise that wider policy development is needed for Low Carbon Hydrogen Standard and GGR Standard and Methodologies.

21. What changes to the Track-1 capture BMs do you envisage being required to make the capture BMs work for NPT solutions? What considerations would be required for power-BECCS and GGR BMs when developing for NPT? Please flag in your response which of the capture BMs you are answering in reference to.

22. How important should consistency in approach between capture BMs be? How important is consistency between NPT users and piped users within a specific BM (e.g. ICC via pipeline and ICC via NPT)?

CCUS Policy Landscape – Future Allocation Processes

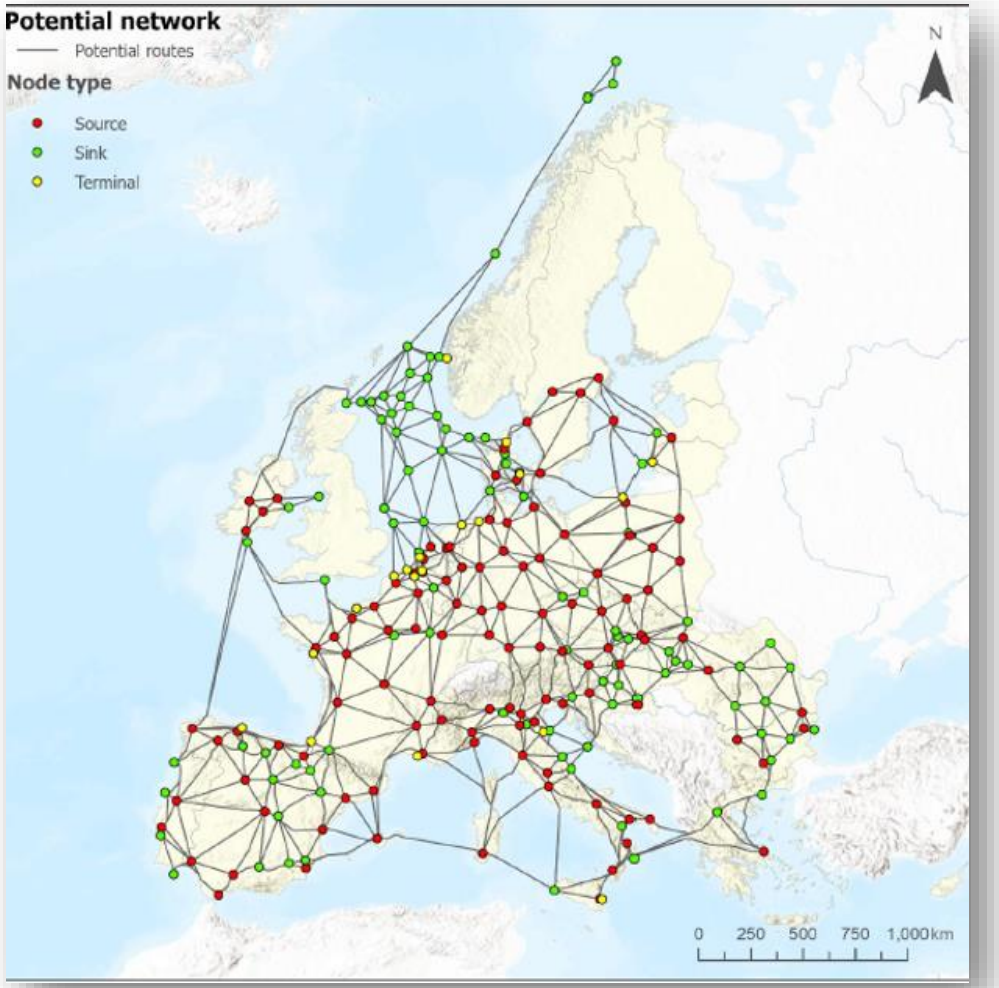
- The CCUS Vision emphasizes transitioning towards more competitive capture project funding allocation processes.
- In Track-1, T&S networks were selected first, followed by piped users in Phase-2.
- T&S solution assessments were conducted separately from piped users in both tracks.
- For NPT projects, the merit of the NPT user depends on their NPT solution.
- NPT infrastructure and commercial arrangements are more varied, requiring careful consideration in the assessment and selection process.
- Consistent approaches are needed to assess NPT users across capture BMs, ensuring like-for-like comparisons.

23. If NPT solutions are assessed against pipeline solutions, would this raise any concerns?

24. If government is to allow all archetypes of NPT, how should an assessment of an NPT value chain be considered to allow comparisons?

CCUS Policy Landscape – Cross Boarder Carbon

- CO_2 transfers between the UK and other nations must comply with GHG emissions frameworks and future carbon trading arrangements.
- NPT networks, supported by CO_2 shipping and port facilities, are crucial for international cross-border CO_2 T&S networks.
- Market growth is expected to initially focus on Northwestern Europe, where the UK is well-positioned geographically and geologically.
- EU aims to develop at least 50 $MtCO_2$ storage capacity by 2030, growing to around 280 $MtCO_2$ by 2040.
- Several CO_2 storage networks are already in development in Europe, with the first likely operational this year.
- Stakeholder input is sought on:
  - The development of the international CO_2 market.
  - Necessary conditions in the UK to support network growth.
  - Steps for government and industry to realize this market opportunity.



CCUS Policy Landscape – Cross Boarder Carbon Questions

25. Please provide views on the potential vision for cross-border CO2 T&S networks in the UK.

26. With regard to Questions 18 and 19 and in the context of establishing cross-border CO2 T&S networks, do you have a view on:
i) whether an economic licensing framework for CO2 T&S might need to evolve to accommodate cross-border T&S networks?
ii) how cross-border CO2 volumes should be viewed within a commercial landscape currently designed for domestically captured CO2 volumes?
iii) how service providers could manage the risks on a commercial basis that would allow for a merchant delivery model?
iv) whether there are any specific changes needed to the current suite of capture business models if CO2 cross-border T&S networks are established?
For each answer please provide further explanation.

27. With regard to Question 20 do you think any changes will be required to the CCS Network Code to ensure cross-border CO2 T&S networks can be established?

CCUS Policy Landscape – Storage

- NPT and cross-border users can access any store enabled to receive their CO2, potentially making stores without a local user base viable.
- NPT networks may reduce demand pressures on piped users and linked stores.
- The UK government seeks to understand technical complexities of stores reliant solely on NPT users versus those using piped or mixed user bases.
- The government also wants to understand potential changes to the risk profile for stores operating solely with NPT users.
- Floating production, storage, and offloading (FPSO) in the oil and gas industry could be adapted for CCUS, shipping CO2 directly to the wellhead for injection.

28. To what extent would enabling NPT users and cross-border users incentivise storage exploration and appraisal activity? If not, why doesn't it?

29. Could a store which is solely reliant on NPT users be viable? What are the technical challenges to operating a store solely reliant on NPT users? How would this operating model impact the risk profile of the project?

30. Please provide evidence for the potential viability of shipping CO2 straight to the wellhead for CO2 injection. Please expand on the risks/barriers and benefits of straight to wellhead shipping.

Wider Development considerations - Other Regulatory Controls

- Government seeks to understand regulatory or legislative barriers that could impede NPT deployment.
- In June 2023, the ETS Authority announced plans consultation on inergrating NPT into the UK ETS framework, allowing deductions for NPT CO2 storage.
- Areas of concern include regulations for transportation modes (road, rail, barge, shipping), temporary storage, and transport infrastructure.
- Government aims to understand planning permission and environmental permitting challenges in the NPT value chain.
- Health and safety challenges related to NPT planning and permitting are a key concern, particularly for CO2 leakage risks.
- Government is interested in understanding the relative risks of different transportation modes and temporary storage vessels for CO2.
- Regulation and permitting of cross-border CO2 T&S networks are crucial, with recommendations to remove regulatory barriers to cross-border CO2 movement.

31. What regulations need to be considered or amended for NPT value chains to deploy (excluding those regulations which are covered in the CCUS policy landscape section)?
32. Do the current processes to comply with existing health and safety or environmental regulations or controls create barriers to NPT deployment when transporting CO2 via road, rail, barge, ship, or processing CO2 at intermodal facilities? If so, what are those barriers, and what would you suggest as an alternative?
33. Are there any specific changes to UK legislation, existing regulations or permitting processes which are necessary to support the development of cross-border CO2 T&S networks?
34. What do you see as the biggest regulatory barriers to the growth of cross-border CO2 T&S networks?

Wider Development considerations - Delivery

- Government seeks to identify technical limitations or infrastructure considerations hindering domestic and cross-border NPT networks.
- CCSA and ZEP's paper outlines steps to develop a European CO2 transport market by ship, emphasizing standardization in CO2 specifications, transport conditions, and metering methodologies.
- Government aims to understand trade-offs between setting higher CO2 specifications for uniform delivery versus managing lower specifications operationally.
- NPT-enabled clusters are assumed to be technically and operationally feasible, but potential limitations need further understanding.
- Fixed infrastructure limitations (e.g., ports, railway capacity) that could impede NPT solutions need assessment.
- NPT and temporary storage could balance network CO2 volumes, complementing variable piped user volumes.
- Skilled workforce is crucial for NPT delivery; addressing the skills gap identified in the power CCUS sector is import

Wider Development considerations - Delivery

35. What are your views on the best approach to creating interoperable CCUS networks?

*36. How should the UK design the standards and specifications for CO2 T&S which offers network users sufficient flexibility in store choice but also provide sufficient protection to core T&S infrastructure? How can the UK ensure that its T&S network design does not impede access to an interconnected and interoperable European system?

37. Are there any technical or operational limitations that may exist that could be a barrier to domestic NPT or cross-border T&S network deployment? Please explain.

*38. Is there any specific foundational infrastructure that must be operational in the UK before UK stores can offer storage to domestic NPT or international customers? If so, what should the UK prioritise?

39. Do you foresee any infrastructure innovations which could speed up the deployment of NPT and cross-border T&S networks and/or reduce associated costs? Please provide any supporting evidence.

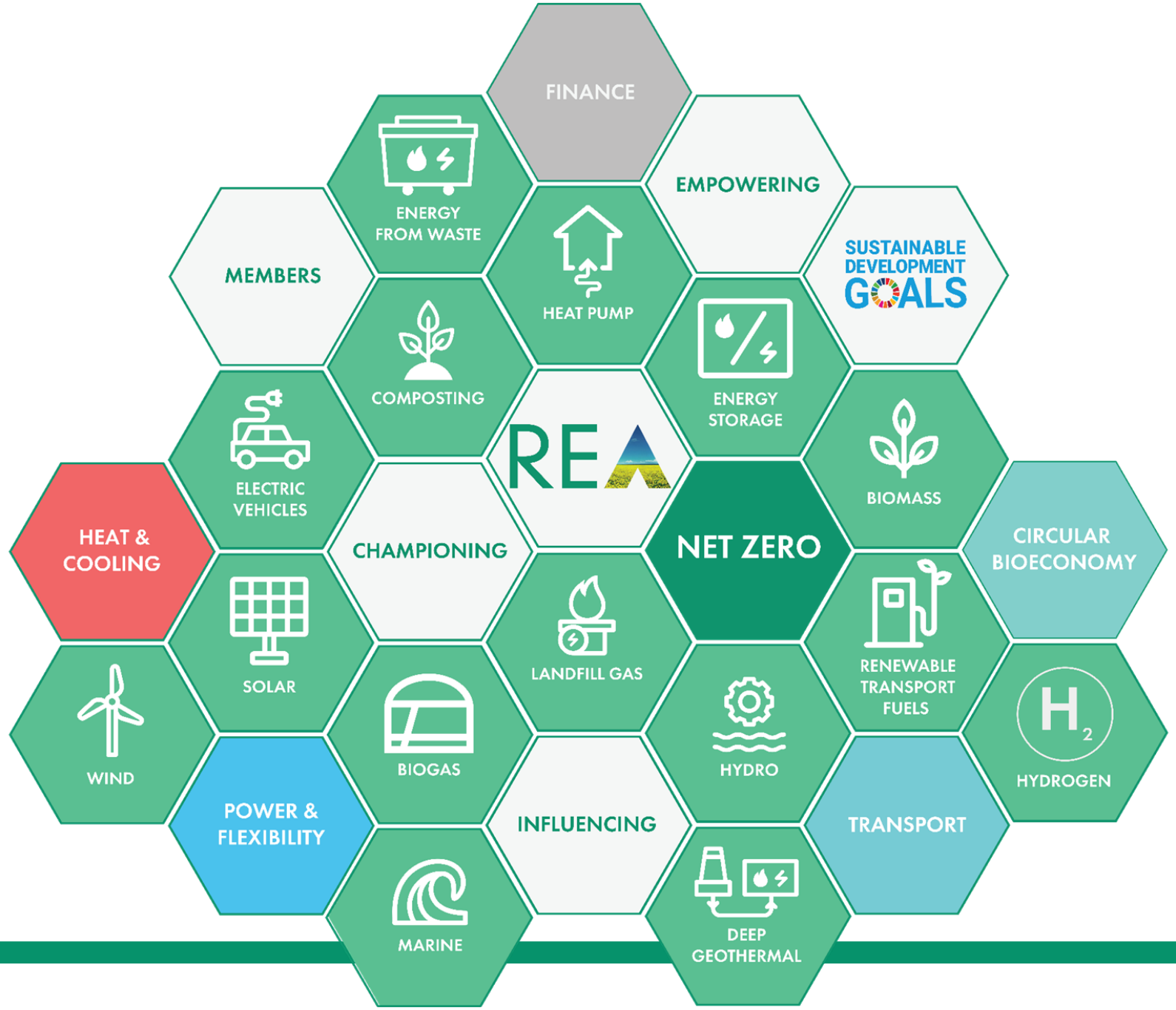
*40. What are your views on other flexible users of CCUS networks, e.g. flexible use of technologies such as DACCS? Do you foresee that NPT and buffer storage could be complimentary to operate alongside a flexible piped user (e.g. projects that could ramp up or ramp down CO2 output, potentially including technologies such as DACCS).

*41. Does the UK have the relevant skills and capability to deliver NPT? Does the UK have a competitive advantage to deliver certain elements of the NPT value chain?

Wider Development considerations - Further Comment

42. What other areas should government be considering for successful deployment of NPT?

43. Please respond with any other comments that are not contained in the above questions.



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