NLCCP – DESNZ Call for Evidence Call for evidence on non-pipeline transport and cross-border CO2 networks

Closing date: 16 July 2024

Section	Question	Draft response
Respondent data	1. *Who are you responding on behalf of, and what is your interest in this call for evidence?*	<u>Background to the North London Waste Authority</u> North London Waste Authority (NLWA) is the joint waste disposal authority for north London established by the Waste Regulation and Disposal (Authorities) Order 1985 and is one of six such authorities in England. As such, NLWA is responsible for the disposal of local authority collected waste generated (majority household waste) by seven north London Boroughs (LBs) (the constituent boroughs): Barnet, Camden, Enfield, Hackney, Haringey, Islington and Waltham Forest. The constituent boroughs as Waste Collection Authorities have a legal duty to collect municipal waste and NLWA (as the Waste Disposal Authority), has a legal duty to treat, manage and dispose of that waste. The area served by NLWA consists of over two million residents making NLWA the second largest waste disposal authority in the country by volume of waste managed. NLWA is the sole owner of LondonEnergy Ltd (LEL), which operates an energy from waste (EfW) facility and other waste facilities at the Edmonton EcoPark in Enfield, north London. The Authority is funded almost completely by a levy it places on its constituent borough councils and specific charges for some types of waste. Any surplus funds arisings at the end of each year are reimbursed back to the collection authority's as such no profit is generated. NLWA is currently delivering the largest project in its history, The North London Heat and Power Project (NLHPP) which will deliver a public investment of over £1.2 billion at the Edmonton EcoPark. The NLHPP addresses the need to replace the existing energy from waste (EfW) facility which has been in operation for over 50 years with a new modern Energy Recovery Facility (ERF) capable of processing up to 700,000 tonnes of residual waste and generating up to 78MW of power. <u>The Authority's interest in this call for evidence</u> The NLHPP is expected to be completed by the end of the decade. As such the Authority's amibitions is to deliver an operational carbon capture plant at the Edmonton EcoPark as soon as practicable in the mid-2030s, once the existing EfW facility is demolished. The carbon capture plant will have the capacity to manage the full volume of flue gas generated by the new ERF which will have a maximum throughput capacity of 700,000 tonnes. The ERF is a "dispersed emitter" due to its location in a highly urban, densely populated area. As a result, the North London Carbon Capture Project (NLCCP) is exploring a number of pipeline and non-pipeline modes (including road, rail, inland freight barges and shipping) to transport CO2 from the Edmonton EcoPark site to a range of possible intermediate locations before being transported onwards to permanent storage. A subset of the scenarios are explored in response to question 6 and data is provided as requested in the accompanying excel document. The study results are at an early stage (AACE class 5) and will be refined in coming months as the Authority narrows down the potential options as part of ongoing pre-FEED studies.
	2. *If you consent to members of the team reaching out for clarifications on*	

	responses provided, please provide contact details.	
	3. *Do you give permission for your anonymised evidence to be shared with external advisors for the purpose of technical analysis?*	Yes
Views on the potential vision for NPT Sector	4. *Please provide views on the potential long-term vision for the NPT sector.*	Summary points: • Strong strategic direction will be required from the Government to support the development of CO2 hubs such as rail heads and ports ahead of the market transition phase (2030-2035). Strategic action needs to happen now, rather than waiting for the market transition phase, to secure the vision of a self-sustaining market from 2035 • From the Authority's perspective, the intermediary led model is likely to be preferred option as it allows the development and operation of large-scale intermodal facilities by third parties which will drive economies of scale and reduce costs. • From an operational flexibility perspective, the Authority is expected to prefer secure, medium to long-term costs of transport and storage rather than depending on merchant market with spot pricing method proposed in the consultation. Response Government refers to the creation of 'specialist service providers' which are defined as the "Entities delivering those services that are required specifically to deliver an NPT solution". It is not clear to the Authority who may ultimately fulfil such roles as such the Authority's believes that there is a high risk that the market will not self-organise. The Authority's market engagement to date suggests that T&SCo would be unwilling to serve as an intermediary owing to the dispersed location of the Edmonton EcoPark. In London there will be few avenues for NPT infrastructure and we may well be limited to one port, or one railhead, which could lead to monopoly power in the NPT chain and a lack of value for money. As such it is too early to have a view on whether such markets should be economically regulated. As such the Authority's believe that strong strategic direction is required from the Government to incentivise the development of CO2 hubs such as rail heads and ports. Action needs to happen now such that the necessary infrastructure is established in a timely manner ahead of the transition period and at the appropriate scale. This is further discussed in the response to Q8. Government has set out three 'lenses' of NPT delivery archetypes specifically: Store Led, Capture Led and Intermediary Led. The Authority's view is that an Intermediary led model is preferred and agrees with the Government that such a party could facilitate the connection between the capture project and the T&SCo. Dedicated intermediaries are likely to have greater technical proficiency in managing the logistics and operational complexities of CO2 transport particularly for rail and shipping (such complexities are outside the core competencies of the Authority). In addition, such intermediaries are likely to drive economies of scale through the aggregation of multiple sources of CO2 which could deliver a value for money solution. The risk for Government is that the NPT market will be caught in a paradox. Emitters may not commit to CCS because NPT costs are too high or uncertain (as discussed in Q11, Q14 and Q19) but the cost reductions from financing large assets

		developed through aggregated CO2 sources will not occur without emitters committing to carbon capture. Without strategic leadership and interventions from Government projects in the pipeline are at severe risk of being shelved. From an operational flexibility perspective, the Authority does not agree with the Government's view that NPT users could be necessarily be reactive to the T&S networks by delivering CO2 when the network is under-utilised. The Authority would prefer secure, medium to long-term costs of transport and storage rather than depending on the nearly immediate and unplanned trading method suggested in the call for evidence through a dynamic and responsive set of charging structures (i.e. merchant market with spot pricing). Given the Authority's role as a public entity and the regulations guiding our budgeting process including the Local Government Finance Act 1992 and the Local Government Act 2003, the Authority is required to set an annual balanced budget. As such the Authority would prefer fixed prices throughout medium to long-term contract durations to avoid any potential price shocks. This is discussed further in the response to Question 15.
	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?*	Summary points: • The Authority's ERF plant is in a densely populated area of London. Significant challenges are associated with pipeline systems navigating through densely populated areas including wayleave costs and H&S risks. An NPT solution would reduce a number of those pipeline-related risks. • A significant concentration of emitters is prevalent both north of the Authority's site and along the Thames Estuary and Medway region. • Conclusively, the EfW sector and densely populated areas such as London will particularly benefit from NPT solutions which help to unlock CCUS. Response: The Authority recognises that the Government may need to adopt a regional or sectoral approach to effectively develop the NPT market. It is essential that this targeted approach does not disadvantage regions that may be less suitable for NPT or CO2 pipelines due to the dispersed nature of emitter sites. Ensuring equitable support and resources for these regions is crucial to fostering a comprehensive and inclusive strategy for CO2 transportation and storage. **Regions** Densely populated regions like London and its surrounding areas would greatly benefit from NPT options due to the major difficulties of installing CO2 pipelines in urban environments. As part of its pre-feasibility studies, the Authority has identified other emitters within the East Coast area that in theory could share the infrastructure for CO2 transport. A significant number of emitters are prevalent both north of the Authority's site and along the Thames Estuary and Medway region. The accumulated emissions for the East Anglia / Bacton area were in the region of 1.7Mtpa and in the Thames Estuary / Medway area 6.3Mtpa consisting mainly of EfW, biomass and CCGT plants. However, emitters are not located in very close proximity and the challenges associated with pipeline systems navigating through densely populated areas or regions are significant. By considering NPT options, matters such as policy, regulatory, and legal hurdles, which necessitate careful planning and strategic decision-making may be reduced. In addition, for a pipeline solution the wayleave costs and the H&S risks associated with the transport of dense CO2 via densely populated areas are primary concerns and may also be mitigated through NPT.

		Sectors - Energy from Waste Government is clear that carbon capture is the only net zero compliant technology for residual waste management facilities such as EfW plants. EfW operators have a very limited range of alternative options to achieve largescale reductions in CO2 emissions from their facilities. Waste pre-sorting (i.e. extracting fossil-based materials prior to incineration) is not currently a viable option for largescale decarbonisation waste. This is because the material typically extracted is of very low quality and markets currently do not exist for such materials. The Authority is the statutory waste Authority responsible for waste treatment and disposal in North London and is the second largest waste Authority in the UK. The Authority is currently constructing a new Energy Recovery Facility (ERF). The ERF will be a long-term public asset which will process a quarter of London's household waste for 25+ years (the existing EfW plant is over 50 years old). Most local authorities in the UK outsource the waste disposal to the private sector by service contracts or via Design, Build and Operate (DBO) contracts. These contracts are ultimately time bound (typically 25 years) and usually the asset reverts to the local authority. Once such contracts expire private companies are free to disengage from their obligations and can essentially 'walk away'. NLWA is in a unique position compared to other local authorities or EfW operators in being fully 'vertically integrated' for the disposal of waste owning the infrastructure and operating the ERF plant. The ERF is also located on a protected waste site which means under the London Plan it is a designated area reserved for waste management activities and are safeguarded through planning policies to ensure they remain available for waste management purposes. The Authority cannot change its 'fuel' and waste arisings need to be managed, therefore the CO2 will still exist and have a global warming impact. The disposal costs for waste ultimately fall on local authorities. Whilst local authorities make extensive efforts to move waste up the waste hierarchy their options are limited and subject to significant diminishing returns. This makes waste different to other sectors where there may be an option to divest from the CO2 creating activity. As such the Authority cannot 'walk away' owing to its obligations and status as waste disposal authority. Given that no other technology is available to substantially reduce emissions from such facilities, the Climate Change Committee (CCC) recognised that EfW operators will have to deploy CCS. As such, pursuing the installation of a CCS project at the Authority's under-construction ERF is both essential and in line with plans at similar plants across the UK. EfW facilities are typically dispersed but associated with densely populated areas and therefore present significant challenges for transportation modes, NPT may improve the outlook for such projects. In light of the above, the EfW sector and densely populated areas such as London will particularly benefit from NPT solutions which help to unlock CCUS.
NPT value chain data – project data	*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*	The Authority conducted a feasibility study to explore the indicative costs associated with a range of CO2 export scenarios. The scenarios examined the capex and opex associated with a number of different routes and modes including pipeline, road, rail, barge and shipping. A number of different intermediate transport nodes were selected to inform potential multi-model scenarios. These intermediate nodes represent potential locations in the London and surrounding region which could support a multi-modal solution for the Authority. The separate template presents the costs of five NPT scenarios examined as part of the transport routes and modes study: 1. Trucks to Bacton terminal, Norfolk (single mode)

	future, and the minimum viable project.	2. Pipeline to a port terminal in the Thames area and shipping to North Sea (multimodal) 3. Trucks to the Thames area and shipping to North Sea (multimodal) 4. Barges via the River Lead Navigation canal adjacent the Edmonton EcoPark to a port terminal in the Thames area and shipping to North Sea (multimodal) 5. Pipeline to a railhead depot, train to Teesside area and shipping to North Sea (multimodal) The aim for selecting those scenarios was to present to DESNZ a wide range of different transport modes and associated costs. The study results are at an early stage (AACE class 5) and will be refined in coming months as the Authority narrows down the potential options as part of ongoing pre-FEED studies. Please refer to the separate template for more information in terms of the technical and operational considerations, the contractual strategy and the associated costs.
	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.	Please refer to the separate template
	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	**Summary points:** • For a number of EfW businesses including the Authority's, transporting CO_2 is far removed from their core business objective. • It is currently assumed that NPT options (for example lorries, rail, maritime ships or barges) and associated infrastructure will be outsourced to third parties via long-term services contracts. This approach is preferred to outright purchase, as the project initial CapEx is reduced, and the approach transfers risk of ownership/maintenance to the lease owner.

	arrangements. Please include when equipment is to be shared between multiple entities or for sole use.	• From the Authority's perspective, intermediary led option is the preferred one as it allows the development and operation of large-scale intermodal facilities by third parties which will drive economies of scale and reduce costs. However, the development of mechanisms to manage cross-chain liability issues (such as leaks and CO2 specifications) across the network chain will be required in a multi-modal CO_2 transport network. **Lease** The Authority's main legal duty is to manage and dispose of waste collected by the seven north London boroughs (Barnet, Camden, Enfield, Hackney, Haringey, Islington, and Waltham Forest). It does not have the legal authority or interest in developing, owning, or operating its own CO2 transport modes particularly for those beyond its core competencies such as pipelines, rail and shipping for example . It is currently assumed that NPT options (for example lorries, rail, maritime ships or barges) and associated infrastructure will be outsourced to third parties via long-term services contracts. Equipment/infrastructure outside the Authority's site boundary would be contracted and could therefore be shared with other emitters by the operators of such infrastructure. This approach is preferred to outright purchase, as the project initial CapEx is reduced, and the approach transfers risk of ownership/maintenance to the lease owner. From a cost perspective, we do not foresee a major difference between a leasing or ownership approach as the transport service provider would transfer the capex cost to the emitter, plus a profit. Government has set out three 'lenses' of NPT delivery archetypes: **Store Led:** store holds responsibility for collection of CO2. The key drawback of this option is that it could have monopolistic characteristics and therefore may require regulated. In addition, it would not necessarily provide flexibility as not all CCUS clusters would develop infrastructure for all transport modes. It's unclear how the Government could enforce the development of NPT facilities in the CCUS clusters. **Capture Led:** capture project carries responsibility for delivering CO2 to the store. The key drawback of this option is that it does not promote economies of scale as each emitter will have to develop its own value chain. In addition, the development of multiple NPT solutions by several projects in the same area could embed unnecessary cost into the system. **Intermediary Led:** utilises third parties separate from users and T&SCos to provide NPT solutions. The intermediary led scenario would be a preferred option on the basis that it would include the development and operation of the intermodal facilities by third parties which will handle the transport and intermediate storage of several CO2 emitters and drive economies of scale and reduced costs. However, the development of mechanisms to manage cross-chain liability issues (such as leaks and CO2 specifications) across the network chain will be required in a multi-modal CO_2 transport network. The Government will need to develop a bilateral agreement template that a user will have to enter into with third parties/hauliers to ensure that all users are offered the same terms subject to the inclusion of the various user-specific information. The bilateral agreements will also govern the custody of the CO2 including liability for risk of loss and or need for venting if transport/stores are unavailable and formally document the user's and haulier's rights and obligations. The CO2 parameters (specifications and quantity) in a form of a

		certificate will have to be contemplated by a schedule in the bilateral agreement to manage the complexity of cross-chain liability issues. In our view, a strong strategic direction is required from the Government to support the development of the NPT market and CO2 hubs such as rail heads and ports. There are high barriers to market entry and market forces alone are not sufficient to address the complexities and challenges inherent in developing this first-of-its-kind market. The shipping industry poses unique challenges. Given that CO2 transport is a niche and relatively small market, it is uncertain how the shipping sector would respond and if it could respond competitively. Road transport, while more flexible, raises questions about scalability and environmental impact unless mitigated by low or zero carbon technologies. In December 2023 the Department for Transport set an ambitious target to grow rail freight by at least 75 per cent by 2050. However, network capacity is a known issue as well as underinvestment not helped by the cancellation of HS2 which could have freed up capacity for more freight trains. These challenges underscores the need for proactive Government intervention and support to ensure the successful establishment and growth of the NPT market. Such intervention could be mandated through bodies such as Network Rail, Great British Rail or National Highways. This will need to be accompanied by lifting any barriers from a planning perspective for the faster deployment of NPT value chains. A techno-economic assessment of the available NPT (rail, port, waterways, road) infrastructure across the UK is recommended to be conducted which would indicate where the government could intervene in support of the development of strategic NPT infrastructure. The regulatory and delivery environment could be explored as well as the capacity of existing infrastructure to determine if it conducive to new capacity being provide. Such a study could identify key hubs, corridors and NPT integration points across different transport modes. This could support efforts to deliver value for money, drive the costs down and reach as many emitters as possible. Government could explore opportunities to encourage and/or require new transport hubs (such as ports or rail heads) to be carbon capture ready i.e. ensuring sufficient capacity for CO2 intermediary storage and loading stations. In the context of the climate crisis and net zero such interventions could help deliver the necessary transport networks required to deliver the Governments CCS ambitions.

	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).*	One of the longest lead times would be the construction of: - CO2 marine vessels - the intermediate storage facilities (e.g. jetties, tank farms, conditioning stations, loading stations) - rail heads - non-fossil fuel truck infrastructure (charging stations, hydrogen stations etc)
	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.*	Please refer to the separate template
NPT Value Chain Data - Costs	11. *Could the costs associated with the full NPT value chain prevent investment and deployment of NPT solutions? If so, why?*	**Summary points:** • For CCS investments to be financially viable, their costs must be less than the expenses incurred from the ETS or other similar charges. DESNZ forecasts for UK carbon prices up to 2050 indicate that it is challenging for dispersed emitters to consider CCS investments worthwhile, as choosing not to adopt CCS and instead paying ETS liabilities is more financially attractive. • Unless further efficiencies are delivered across the CCS value chain or governmental support is provided, the carbon price under the UK ETS needs to be upwards of £133/t for the Authority to be financially equal between pursuing CCS or buying carbon allowances under the UK ETS. • The first developers of NPT solutions will face the same 'first mover' challenges as those of the of the CCUS plants and transport networks forming the initial clusters. • Strategic involvement from Government needs to happen now, rather than waiting for the market transition phase, to secure the vision of a self-sustaining vision market. **Yes – overall cost of NPT value chain compared to ETS liabilities** The application of the UK ETS to waste facilities represents a significant new burden on the Authority's finances and hence the finances of the constituent boroughs, regardless of whether they decide to do CCS or not.

Any CCS value chain investment must have an overall cost lower compared to the ETS liabilities, or similarly applicable levies, to become financially attractive. With DESNZ's current forecast of UK traded carbon prices till 2050, it becomes extremely difficult for dispersed emitters to justify any CCS investment with the 'do-nothing' scenario (do not develop CCS, pay ETS liabilities) being more financially attractive.

As part of its pre-feasibility studies, the Authority has identified that the breakeven point when comparing the different transport options to the 'Do Nothing' option is at least £133/t assuming monetisation of Negative Emissions (i.e. carbon from non fossil-fuel sources) be progressed. Therefore, unless further efficiencies are delivered across the CCS value chain or governmental support is provided, the carbon price under the UK ETS needs to be £133/t for NLWA to be financially equal between pursuing CCS or buying carbon allowances under the UK ETS. Under the DESNZ forecast, this level is not set to be reached until 2037.

It is clear from the analysis conducted to date, that the Authority is suffering a cost penalty through being a dispersed emitter. This cost penalty depends on the NPT route chosen, but in all cases results in a significant increase in transport costs as a proportion of overall costs. Our initial analysis of both capital costs and levelized cost per tonne of CO_2 shows that total capex for the selected scenarios could range from between £249 million up to £308 million.

High-level analysis of the scenarios mentioned in our response to Q6:

Capital Investment	Truck To Bacton	Pipeline to Thames	Truck to Thames	Barges to Thames	Train to Teeside
	£m	£m	£m	£m	£m
Plant / other Capex	174.6	174.6	174.6	174.6	173.5
Transport Capex	74.1	133.2	74.1	79.3	84.7
TOTAL Capex	**248.7**	**307.8**	**248.7**	**253.9**	**258.1**
Transport as a % of total	30%	43%	30%	31%	33%

Levelised Cost (£/t of CO_2)	Truck To Bacton	Pipeline to Thames	Truck to Thames	Barges to Thames	Train to Teeside
	£/t	£/t	£/t	£/t	£/t
TOTAL	**129.8**	**123.8**	**120.0**	**127.4**	**122.6**
Transport as a % of total	47%	42%	42%	48%	43%

The levelised costs could range from between £120 per tonne of CO2 up to £129 per tonne of CO2. The analysis shows that for an NPT solution transport costs significantly increase the overall cost. In levelized cost terms, transport could represent over 40% of the overall cost. These levelized costs also exclude allowance and contingency estimates, which could increase them by 25%-40%.

To mitigate this risk the Authority has conducted a study of mapping transport routes and energy intensive industries (CO2 emitters) across a wide area between the Edmonton EcoPark site and the industrial clusters or other relevant staging points, terminals, or projects at coastal locations. This enabled the identification of emitters that the Authority could engage and potentially collaborate with along each short-listed transport route option. Only a limited number of opportunities have been

		identified owing to the regional profile in an urban environment and limited numbers of closely located emitters. Nonetheless. a regional aggregation of several CO2 emission sources that share the infrastructure for capture and transport of CO2 emissions could help to reduce the costs for emitters such as the Authority. The first developers of NPT solutions will face the same 'first mover' challenges as those of the CCUS plants and transport networks forming the initial clusters. These might include more substantial initial capital investments with increased levels of risk, a restrictive number of users, and challenges connected to establishing a market in its infancy (First Of A Kind, FOAK). Due to an immature market and lack of governmental support, the level of uncertainty and risk would be high. There might be a tendency for potential project developers to delay investments until FOAK projects have been proven, to gain advantages such as knowledge acquisition, cost reduction, or enhancements in efficiency. Therefore, Government's expectations for a competitive and self-sufficient market by 2035 would not materialise. Government funding and intervention is necessary to help resolve significant financial, commercial and coordination challenges. This necessitates careful planning and strategic decision-making and reflects the approach Government is taking with the cluster programme. Without the involvement of the government as soon as possible, it is highly unlikely that emitters and/or private companies will align their investment choices to establish an NPT network of appropriate scale and flexibility for the expected future demand in a timely manner necessary to reach the goal of net-zero emissions by the year 2050.
	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.	**NPT solution more economically viable** As part of its pre-feasibility studies, the Authority has considered several routes and transport modes including the pipeline export via the Thames area. Two multi model scenarios specific to the Thames area were examined where CO2 is exported either via truck or pipeline to a port located along the Thames and then further transported via ship to a store. In this like-for-like scenario, the levelised cost per tonne of CO2 for the pipeline option was slightly higher at £52 compared to £50 for road transport along the same route. These costs exclude any retrofit costs for the ERF, T&S costs and contingency and allowance budget. An NPT scenario could be more cost effective than pipeline noting that wayleave, leasing or purchase costs for laying a pipeline were not considered. As part of the CAPEX assessment, the AACE International (Association for the Advancement of Cost Engineering) methodology has been applied. The level of allowance and contingency applied to this study is in line with AACE methodology for class 5 cost estimates which is the applicable class for this project. The AACE suggests that the allowance and contingency for class 5 should be between 25-40%. That would be equivalent to an additional cost of approx. £20 per tonne of CO2 to the abovementioned levelised costs. However, under the scenario the Authority is assumed to be the sole user of the pipeline as there are no other emitters in the area. In addition, the pipeline costs were levelized over the lifetime of the pipeline assumed to be 25 years. Although pipelines typically have longer lifespans, a shorter lifetime was assumed for financing purposes, considering the Authority as the sole operator. The economies of scale normally achieved using a pipeline are not achieved as the Authority would be the sole user of the infrastructure. In this example road transport is likely to be more economic (when considering levelised costs) or at least comparative to pipeline given the complexities involved in laying a pipeline in a dense urban environment. However, in comparison to other multi model options pipeline could still be more economic. For example, rail and barge scenarios were more expensive than a pipeline

		scenario across north London. The key reasons being that although a pipeline is capex intensive, it is much less expensive on a yearly basis for operation and maintenance as opposed to barge and train solutions. Therefore, over the lifetime of the project, the operation and maintenance costs contribute substantially more to the levelised costs compared to the capex costs. **Piped solution unlikely to be technically viable** From a technical perspective, a piped solution inside the London Metropolitan Area could be as much as three times more expensive than a piped solution through rural areas due to the number of underground services present within London's area, the increased cost for road and/or pavement restoration and lengthier construction programmes to comply with local planning permission requirements. In addition, whilst pipelines are an established technology, there is significant uncertainty in estimating the likely lifecycle costs of pipelines, given the significant level of permissions, wayleaves and H&S requirements. From a H&S perspective, Health and Safety Executive (HSE), Ref. (Guidance on conveying carbon dioxide in pipelines in connection with carbon capture and storage projects, 2023) and (Pipeline design codes and standards for use in UK CO2 Storage and Sequestration projects, 2023), lists the applicable standards and guidelines for CO2 transportation in the UK which include BS-PD-8010 Part 1. This standard provides the design factors to be considered for each location class (LC1, LC2 and LC3) and at specific locations. These design factors are applied to the design calculations to ensure that the wall thickness of the pipeline selected is more conservative than theoretically required, minimising the risk of failure. LC3 is applicable in "Central areas of towns and cities with a high population and building density, multi-storey buildings, dense traffic, and numerous underground services". If a location is determined as LC3, it is recommended to be avoided due to potential grave consequences in case of failure. If required to cross a LC3, a specific safety and risk analysis must be performed, and risk mitigations such as increased safety factors for pipeline design, fracture arrestors, escape routes and venting equipment, should decrease them to acceptable levels.
	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*	Please refer to the separate template

	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 Data - Financing	*14. What are the main financing risks with a disaggregated chain, and how do these differ to the full chain piped approach?*	Summary points: • Disaggregated chain increases risk that financing does not flow due to uncertainty; and risk that assets which are financed are done so ad-hoc and inefficiently (e.g. capture-led archetype, with each emitter financing small assets) • Assumption that disaggregated chain is viable may not be true of all geographies, e.g. London with few large emitters and NPT challenges may be a market failure. We would urge intervention to ensure the market gets off the ground in challenging areas. Whilst the NLWA is in the process of investing £1.2bn in waste management assets at the Edmonton EcoPark, it is likely to only invest in carbon capture assets on its own site rather than NPT (remote) assets, given that its core responsibility is the treatment and disposal of waste from its constituent boroughs. That said, the greatest challenge NLWA can foresee for investors is lack of certainty about CO2 throughput volumes. Investors would require that sufficient CO2 throughput was guaranteed and contracted for a sufficiently long period of time before committing investment. Without such guarantees it is likely that smaller NPT assets are financed, as only a certain level of throughput could be guaranteed. This would inhibit cost savings, as larger assets would give greater economies of scale. The main difference between the disaggregated chain and the full chain piped approach is one of uncertainty on transport and storage, both of cost and availability. In order for NLWA to take a decision to invest in CCS, a business case would have to be made on the basis of likely costs. If NLWA were able to take advantage of an existing pipeline, some certainty would be available about the costs of transport and storage, enough to enable the business case to be completed. However, in a disaggregated chain scenario, it is not clear that enough certainty would be available, at least until the chain is established and has been operating long enough for cost data to become available. Our cost analysis to date indicates a wide range of costs for NPT and those costs can be challengingly high. For this reason, NLWA believe intervention is needed by government to ensure that the disaggregated chain is successfully started, such that it is available to the Authority and the costs are known before the Authority makes its investment decision. Otherwise, the financial risks inherent in a disaggregated chain may prevent that investment being made. This is especially true of certain geographic areas such as London, with few large emitters and challenges such as urban density making CO2 pipeline transport difficult and expensive. Even if NPT could be a success in some areas, certain geographies will still require intervention.

	15. What are the main financing risks associated with operational flexibility, and how do these differ to the full chain piped approach?	Summary points: • Operational flexibility increases uncertainty, which increases investment risk. • From a public sector emitter perspective, some certainty about CO2 storage costs will be required for budgetary purposes. Therefore, even if operational flexibility existed, emitters such as the Authority may not see significant benefits. From the Authority's perspective, it is not likely to provide finance for infrastructure that is remote from its own site. However, investment in on-site infrastructure may be less attractive with operational flexibility in the NPT value chain. This is because the Authority would be better placed to invest in carbon capture infrastructure if it had more certainty about long-term costs of transport and disposal. If such costs were highly variable in an operational flexibility scenario, the Authority's investment decision to proceed with carbon capture would be more difficult. In the London context, the Authority is concerned that operational flexibility would not assist the Authority in making an investment decision – although it may bring a future price benefit, it would not be able to take that into account at decision-making time. In some aspects, even if operational flexibility existed, the Authority would need to forgo some of the potential benefit in order to have greater budgetary certainty, e.g. by letting medium to long term contracts for transport and storage. Given its role as a public entity and the regulations guiding our budgeting process including the Local Government Finance Act 1992 and the Local Government Act 2003, the Authority is required to set an annual balanced budget. As such the Authority would prefer fixed prices throughout medium to long-term contract durations to avoid any potential price shocks. To some extent, our concern is not so much that there will be too much operational flexibility but rather the reverse – that in London there will be few avenues for NPT infrastructure and we may well be limited to one port, or one railhead, which leads to monopoly power in the NPT chain and a lack of value for money.
	16. Which archetype do you think would be most attractive to investors? Why?	Capture-led archetypes may lead to capture specific infrastructure which will not enable economies of scale, but investors in capture facilities may be more willing to invest. Store and Intermediary led investors will be reluctant to invest without surety about the flow of CO2, but if the investments were made, they are likely to be for larger, more cost-efficient infrastructure. Therefore, intermediary-led investment is likely to lead to the most cost-competitive assets but this is unlikely to happen in a timely fashion unless government intervention ensures that the market is successful as investors require certainty regarding CO2 flow.
	17. What types of financing are best placed to deliver NPT value chains?	Very large corporate entities might choose to commit balance sheet finance if they are sufficiently confident about the overall strategy, the impact of the UK ETS and the amount of CO2 that flow through NPT infrastructure. More risk-averse methods of financing, such as bank finance, will only follow once there is certainty about the throughput. The danger from a government perspective is that the NPT market will be in a "chicken and egg" situation, where emitters do not commit to CCS because NPT is too expensive, but the cheap financing of large assets (which would drive savings) will not happen as emitters are not committing to CCS.

CCUS Policy Landscape – TRI Model	*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?*	It is not possible to answer this question definitively without knowing what forms of NPT options will become technically and financially viable. Regardless of whether some or all operators are licensed there is a pressing need for a stronger strategic lead from the government on T&S if CCS is to be viable across as large a part of the country as possible. This could involve ensuring that pipeline routes are developed in areas that are not currently planned so that remaining distances required to be covered by NPT within the UK are minimised. NPT solutions (and emitter projects that would be entirely dependent on them) face essentially the same risks as pipeline projects in terms of whether the assets/infrastructure will exist at all as well as whether they will continue to be available over the lifetime of the project. They are similarly exposed to risks of changes to the costs paid if those costs sit with the project rather than are passed straight through as in the current waste ICC business model. It might eventually be the case that these risks are substantially mitigated by the availability of several viable solutions within a reasonable distance of the emitter but this will not be the case initially or in the UK as a whole, and such a widespread provision of options may well reflect an economically sub-optimal outcome with multiple, uncoordinated facilities with limited interoperability, leading to stranded assets and potentially reduced confidence in the market. Economic licensing is one way of addressing these challenges, but it is not the only way – and the government may prefer to avoid trying to manage finding the 'right' charging structure for a given NPT solution or potentially setting up a barrier to entry by preventing anyone to provide an NPT solution unless they have first obtained a licence from Ofgem. Whichever route is chosen, strong strategic direction is required from government – the precise form in which that is delivered is a secondary issue.
	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.	The risks of NPT are very different depending where in the value chain an entity sits. For Stores and Intermediaries, the risks are primarily CO2 throughput related, ensuring that there is sufficient throughput to justify investment and ensure profitability. For Emitters, the risks relate to cost (financial risk), certainty of CO2 storage and availability of NPT at an affordable price. For both parties there is interface risk, including the transfer of liability for the CO2 as it makes its way along the NPT route, including the technical risks around CO2 quality. Though none of these risks are insurmountable, the issue is that in a "first of a kind" situation, the number of risks present a barrier to entry that might prevent investment in CCS in a NPT scenario. The timeline factor makes these risks difficult to manage commercially, as Emitters will require their risks to be manageable before committing to carbon capture, but Intermediaries and Stores may not be able to offer manageable risks without commitments from the Emitters on throughput. Therefore, without government intervention, the NPT market may struggle to establish. In addition, there may be tensions about who takes the risks, especially for Intermediaries. From an emitter's perspective, it would require a clean interface when handing CO2 over to an intermediary, either at the site boundary or a proximate node (railhead / port). The Emitter would want the Intermediary to take full responsibility for the CO2 from that point onwards. However, the Intermediary might see the financial / reputational risk from CO2 leakage to be too high and therefore try and push risk back to the emitter, at least until the point where the CO2 is stored. Finally, in areas such as London where there may be few viable NPT routes, Intermediaries may have monopoly power in dictating risk transfer, which may make the price / interface risks unpalatable to the Emitters and stall investment in CCS. These questions are very material to the Authority's ability to develop an investable business case, so a delay in resolving them at either national or local level will at best lead to delays in project delivery and at worst to projects being abandoned. This further highlights the need for a prompt and clear strategic intervention from government to enable both emitters and potential providers of transport and storage solutions to move forward with confidence.

CCUS Policy Landscape – CCS Network Code	20. *Please provide details on how you believe that the CCS Network Code would need to be updated to facilitate NPT.*	We support the way in which the Network Code has been developed, by focussing on the needs of initial projects and leaving placeholders for areas where further development is likely to be needed later. Those needs will become clear as the industry develops, although there will continue to be a need for strong strategic direction from the government. We note and agree with the proposals in the recent consultation on the Network Code to ensure that NPT solution providers are able to access existing networks on a reasonable basis.
CCUS Policy Landscape – Capture Business Models	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.*	The comments below relate solely to the waste ICC BM. The costs of carbon capture at the Edmonton EcoPark site are not inherently more expensive than comparable sites elsewhere. As a dispersed emitter, the NLCCP is unlikely to benefit from economies of scale. The project could also be entirely dependent on NPT solutions to remove the captured CO2 from the site. Taken together, this means the cost of CCS could be higher than for a pipeline based solution as part of a wider industrial cluster. The BM would need to be able to cover those additional costs through either or both of a higher strike price or via transport and storage payments within the business model. Assuming the above is addressed then two issues would remain of concern that would materially affect the viability of the project: 1) The requirement to pay back money to the counterparty when carbon prices are high. We note that the minded to position for the generic ICC is not to require this for the initial 10 year period (a position known as 'asymmetric payments'. The risk of having to pay back money at times of high carbon prices is very challenging to manage in the context of an ERF project. The NLCCP business case would reflect the value of avoided UK ETS payments but would not have any additional revenue to pass on to the counterparty in the scenario that carbon prices were high. We therefore recommend that the minded to position on repayments for the generic ICC is also adopted for the waste ICC 2) Related to the above, the current BM position is that emitters may not get income from negative emissions (ie from capture and storage of biogenic carbon). The current policy is that the position may change in time, but if so only to a position where only 10% of that income is retained by the emitter. Around 50% of the CO2 captured would be biogenic, so this is very material. We therefore recommend that this uncertainty is resolved as soon as possible so that the potential benefits of retaining 10% of negative emissions income can be built into the NLCCP business case

	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)?	Consistency is desirable, if for no other reason than it is helpful when considering development and engagement with multiple related policies. It is not essential, however, if there are good reasons for different applications taking different approaches. Since an emitter will only be entering into its own contract, it matters far more that this is sufficient to enable investment and that the contractual obligations on both sides are clear.
CCUS Policy Landscape – Future Allocation Processes	*23. If NPT solutions are assessed against pipeline solutions, would this raise any concerns?*	**Yes -** To be able to accurately compare NPT vs PT solutions the following aspects should be considered: - The assumed lifetime of the various solutions should be on the same basis to avoid misleading results. Pipelines tend to have large lifetimes spanning more than 50 years. On the other end of the spectrum trucks tend to have a typical lifetime of a decade. Hence, assuming a 25-year operational period, the capex cost for a truck must be multiplied by 2.5 times and the opex cost to be extended to the same lifetime period to be able to compare against a 25-year pipeline. - The full lifecycle costs of a transport solution should be considered including any indirect investment. For a pipeline solution for instance, the wayleave costs should be taken into account. For a barge or marine vessel solution, upgrading existing infrastructure (locks, port terminals) to be able to accurately compare the different options.
	24. If government is to allow all archetypes of NPT, how should an assessment of an NPT value chain be considered to allow comparisons?	**Cost effectiveness, flexibility, fugitive emissions, equitable lifetime** The key parameters for the assessment of NPT vs PT solutions should be: - From an economic perspective with the aim of achieving cost-effectiveness. - The ability to operate flexibly: Non-Pipelined Transport (NPT) solutions offer operational adaptability for the operator because, unlike in piped Transport and Storage (T&S) networks, there is no physical connection between the carbon capture site and the storage facility. This flexibility could lead to enhanced system resilience and better utilization of the T&S network. However, from a public sector emitter and contractual perspective, long-term contract and cost certainty is a key driver. See response to Q15 on financing risks associated with operational flexibility - The anticipated fugitive emissions throughout the supply chain. In comparison with pipeline transport, it is more common for the NPT supply chain to experience transportation-related emissions and unintentional CO2 leakage.
CCUS Policy Landscape – Cross-Border CO2	*25. NA*	
	26. NA	
	27. NA	
	28. NA	

CCUS Policy Landscape - Storage	*29. NA*	
	30. NA	
Wider Deployment Considerations – other regulatory concerns	*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)?*	This response seeks to outline those regulations that are seen as key to the deployment of NPT value chains and in doing so, seeks to understand whether any beneficial amendments could be made. In terms of whether any of the regulatory frameworks outline below require amendment, considering the early stages of NPT development, currently there are no 'lessons to learn' given that CCS facilities that have been approved or are in the system have generally not utilised NPT. In respect of land use planning, there are several legislations and associated regulations which must be taken cognisance of when seeking to establish NPT solutions. **For road,** whilst no separate land use planning permissions are required for a proposed development to utilise the existing public highway, it is recognised that all planning applications for CCS facilities, where road transportation of captured carbon is proposed, would be expected to be accompanied by a full Transport Assessment (TA). Such TAs consider the extent to which the existing highway network could accommodate any projected increases in traffic on the surrounding network. Where it is concluded that a proposed development can only be made acceptable with highways mitigation works, are further 'consents' required. Should any TA conclude that the existing highway network could accommodate any projected increases in traffic, then no further consents would be required. Construction of new highways or amendments to existing highways (and their associated junctions) are covered by the Highways Act 1980. Specifically, section 278 of that act, allows developers to enter into a legal agreement with the relevant local authority (the Highways Authority) to make permanent alterations or improvements to a public highway, as part of any planning approval. When entering into a Section 278 agreement, dependent upon length of public highway affected and or the location of any improvements along that route, there may be a need to consult with and seek approval from numerous Highways Authorities. There may also be a need to consult National Highways, where the strategic road network (major A roads and motorways) is affected. **For rail**, like road, there is no separate planning consent required to utilise an existing rail facility. However, as with road, where any TA concludes that extensions or improvements to that facility are needed to allow captured carbon to pass through the infrastructure, then further consents may be required. Notwithstanding this, railway undertakers have significant permitted development rights under the Town and Country Planning (General Permitted Development) Order 2015 i.e. development on railway land is allowed for development by railway undertakers on their operational land, required in connection with the movement of traffic by rail without the need for planning permission. However, in certain cases, such as work which is particularly intrusive, planning permission may be needed from the Local Planning Authority. Moreover, for more substantial rail development, the Planning Act 2008 (section 25) sets out the definition for those railway projects that would be regarded as Nationally Significant Infrastructure Projects and for which, a Development Consent Order would need to be sought from central Government. **For barges/ shipping**, like road and rail, there is no separate planning consent required to utilise an existing harbour or wharf. However, as with road and rail, where any TA concludes that extensions or improvements to that facility are needed to allow captured carbon to pass through the infrastructure, then further consents may be required. Notwithstanding this, development on operational land by statutory undertakers or their lessees in respect of dock, pier, harbour, water transport, or canal or inland navigation undertakings has the benefit of wide permitted development rights under the Town and Country

		Planning (General Permitted Development) Order 2015. Where development sits outside permitted development parameters, the Harbours Act 1964 allows for Harbour Empowerment Orders (Section 16) or Harbour Revision Orders (Section 14) to be created. The former allows for the authorisation for the construction, operation and maintenance of new harbour facilities, whilst the latter are used to extend or amend existing statutory powers to the extent that it is desirable to do so in the interests of securing the improvement, maintenance or management of the harbour in an efficient or economical manner. Where more substantial works are required however, Development Consent Order permissions are obtained under the Planning Act 2008.
	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?	**Not in principle** All the non-pipeline transport modes (trucks, rail, marine vessels and barges) can move bulk quantities of CO2 safely and efficiently with cargos such as liquid CO2 covered by the 'Dangerous Goods' regulations which permits such commodity to be carried by these transport modes. Ensuring NPT projects can receive their permits and comply with health and safety and environmental regulations in a timely manner will be critical to the development of the NPT CCUS market.
	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?	NA

	34. What do you see as the biggest regulatory barriers to the growth of cross-border CO2 T&S networks?	NA
Wider Deployment Considerations - delivery	*35. What are your views on the best approach to creating interoperable CCUS networks?*	**Common codes for technical standards eg CO2 quality and conditioning, transport interfaces, plus legislative compliance** The potentially high variability of impurities in CO2 phase in a pipeline and NPT network may lead to a sudden phase change of the CO2 fluid (gas, liquid, dense liquid or supercritical) within the CO2 network and could typically occur in points of CO2 aggregation as well as pipeline elements. This phase change may result in damage to equipment or infrastructure. It is advisable to harmonise and establish the various requirements for CO2 specifications in terms of shipping, liquefaction, and onshore storage to maintain compatibility and uniformity across CCS initiatives. A comprehensive European CO2 transportation network that includes all forms of transit—such as pipelines, road, rail, inland waterways, and seagoing vessels—necessitates standardized regulations for permissible CO2 impurities.
	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?	**Continue to develop harmonised Heads of Terms for CCS Network Code, considering the most stringent requirements (be it storage or transport modes) as the base case.** The Heads of Terms of the CCS Network Code define the CO2 specifications as general (Annexure A) and specific for each individual T&S Network which are currently set out for the two most advanced CCUS clusters: Northern Endurance Partnership (East Coast Cluster) (Annexure B) and HyNet (Annexure C). The CO2 specifications from the two clusters are almost identical with minor deviations. In developing the code further, the UK standards and specifications should be cognizant of European (and potentially broader) codes governing other projects. For example, the Northern Lights project has more stringent CO2 specifications than the UK clusters which would likely influence carbon capture plant design codes or increase requirements for conditioning CO2 at points of entry to European systems.
	37. NA	

	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?	A widespread adoption of NPT capabilities across multiple CCUS clusters would be necessary. Each CCUS cluster should develop the necessary infrastructure to accept as many transport modes as possible (temporary storage, loading/unloading equipment and transport node infrastructure (e.g. jetty) to unlock CCUS for capture projects outside the CCUS industrial clusters.
	39. NA	
	40. NA	
	41. NA	
Wider deployment considerations – further comments	*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.	