Commercial and financial structuring options for a CO_2 transportation network in Yorkshire and Humber – Executive summary

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Commercial and financial structuring options for a CO_2 transportation network in Yorkshire and Humber

CO2Sense Yorkshire is Yorkshire Forward's business development programme dedicated to helping businesses and other major regional organisations cut their carbon emissions. We have recently taken on the responsibility for a Carbon Capture and Storage (CCS) programme for Yorkshire Forward.

Carbon capture and storage is highlighted in the new UK Low Carbon Transition Plan as a key approach to addressing the energy and climate challenge. In 2008 Yorkshire Forward published A Carbon Capture and Storage Network for Yorkshire and Humber. The main conclusion of this report was that if the region wanted to deploy CCS across all its major industrial CO_2 emitters, linking them into a integrated CO_2 transport network would be more cost-effective than developing standalone 'source to sink' CCS projects.

With a steering group of industrial partners, we have now worked with Ernst & Young to understand the options for the commercial and financial structuring of a business to transport CO_2 across the region at an industrial scale in the near term. Of the options reviewed, and based on certain evaluation criteria, a Government led concession or a Third Party Regulated model appear the preferred options.

Under all options, some form of public sector support would be required to enable development in the absence of a bankable ETS price.

Establishing a viable CO_2 transport network will depend heavily on the co-operation of the companies involved across the CCS chain: emitters, transporter and storage operators. We are confident that the commercial approach identified here is an important step in realising early investment in CCS demonstration in Yorkshire and Humber and would leave us well placed to see the rapid deployment of the technology as the market matures towards 2020.

Dr Stephen Brown

Director, Carbon Capture and Storage

CO2Sense Yorkshire

Yorkshire and Humber is well placed to play a leading role in the development of CCS and CO_2 transportation networks.

CCS in context

Carbon capture and storage (CCS) has the potential to capture up to 90% of the carbon dioxide (CO_2) produced when fossil fuels are utilised, preventing it from entering the atmosphere. This involves stripping out the carbon dioxide from the other gases produced in the generation process, compressing and transporting by pipeline or ship for storage to a suitable site such as former gas and oil fields, in deep saline formations, or injected into declining oil fields to increase the amount of oil recovered.[1]

CCS is one solution that is considered fundamental to providing a global lower carbon future. Fitted to old or new industrial processes and power stations, it would allow current technology to emit less carbon until replacement low carbon processes can come to maturity. Therefore CCS is an essential requirement to combating climate change whilst also maintaining security of resource and energy supply.

Deployment of CCS in the medium and long term is expected to be supported in Europe by the Emissions Trading Scheme (ETS) cap and trade system and an increasing cost of purchasing ETS permits. However, a key barrier to demonstration of the technology today is that the financial cost of purchasing permits is currently considerably lower per tonne than the cost of implementing CCS. In addition, CCS has yet to be demonstrated on a commercial scale as a complete chain, from source to sink. Governments in the UK and overseas are investigating methods to address this market failure and accelerate the commercial deployment of CCS.

Several demonstration support programmes have been announced at the UK and European Commission (EC) levels to bridge this gap in the near term. The objective of these programmes is to demonstrate the whole CCS chain at a commercial scale, which will contribute to cost reductions in CCS in the longer term. It typically takes 5-7 years to construct a conventional coal-fired power station. Therefore CCS projects need to be constructed and operational by 2014 if the technology is to be deployed from 2020. This will allow sufficient time for optimisation of the technology and scale up of the supply chain to realise economies of scale, standardisation and design optimisation before large scale deployment.

Sharing of CO_2 transportation network infrastructure connecting large point sources of CO_2 has the potential to lower the costs of CCS implementation for users and could accelerate deployment. The Yorkshire and Humber region has an established and diverse heavy industry and power generating base. It has one of the largest clusters of CO_2 emitters in the UK and Europe, with around 90mt of CO_2 emissions per annum adjacent to suitable storage sites in the North Sea. Given its favourable geographical positioning, and the clustering and diversity of large scale CO_2 emitters in the region, Yorkshire and Humber is well-placed to play a leading role in the development of CCS and CO_2 transportation networks in the UK.

Purpose of the report

In 2008, Yorkshire Forward commissioned AMEC Plc to explore the potential route, cost and phasing of a network (the Network) which would link the region's principal CO_2 emitters to offshore storage sites, and to compare this to the cost to each emitter of developing a standalone solution (results detailed in 'A Carbon Capture and Storage Network for Yorkshire and Humber' – May 2008[2], the 'Technical Study'). It found that, for every CO_2 emitter, linking into a Network would be more cost-effective than developing a standalone solution.

The Technical Study estimates that the Network, which would have the capacity to transport 60m tonnes of CO_2 per annum, will take approximately four years and cost at least £2bn to construct (2008 values). This estimate excludes pre-construction costs, assumes no re-use of existing pipeline infrastructure and that CO_2 will be transported in dense, rather than gaseous, phase.

Building on the Technical Study, Ernst & Young (EY) have undertaken an evaluation of potential commercial and financial structures for an entity to develop, construct and operate a CO_2 transportation network ('Network'; the activities of the entity are referred to as 'the Project').

[1] Commission Staff Working document SEC(2008) 47 [2] http://www.yorkshire-forward.com/sites/default/files/documents/Carbon%20Capture.pdf

Methodology

The study involved:

1. Interviews with key Project stakeholders to understand their potential role in a future Network, if any, and their commercial requirements and to build a register of key Project risks.

2. Evaluation of seven broad delivery options against stakeholders' requirements as identified in 1 above.

3. An indicative Project risk identification and allocation exercise.

4. Development of a financial model.

5. Quantitative analysis of the options to provide an indicative assessment of the impact of risk allocation on tariff and financing.

The quantitative analysis carried out is not included in this summary.

Financial modelling work relied on capital and operating assumptions provided by AMEC and taken from the 'high case' scenario described in the Technical Study.

Steps 2, 3 and 5 were driven by EY but discussed and agreed with Yorkshire Forward and the Yorkshire Forward CCS Steering Group ('Steering Group'). The Steering Group brings together public and private sector organisations interested in exploring the development of a Network in the region. Its members are:

– Yorkshire Forward – the regional development agency and Chair of the Steering Group

– Air Products Plc (Air Products)

– AMEC Plc (AMEC)

– ConocoPhillips (UK) Ltd (ConocoPhillips)

– Corus UK Ltd (Corus)

– Department of Energy and Climate Change (DECC)

– General Electric Infrastructure (GE)

– National Grid Carbon (National Grid)

– Powerfuel Power Ltd

Limitations

Any evaluation of structuring options should be viewed as indicative at this early stage in the Network's development, in particular because:

– The costs, phasing and timescales for implementation remain uncertain and in flux.

– The viability of the Network is dependent upon many factors beyond its control, such as the availability of CO_2 storage facilities, clarity on Health & Safety regulations relating to the transportation of CO_2, the EU ETS price of carbon and the availability and nature of support for CCS development.

Further technical studies will be required and a more detailed business case will need to be drafted for presentation to possible funders as these issues are resolved.

Benefits of the network's development

There are a number of long term benefits which were identified by the stakeholder group to developing a CO_2 transportation network in Yorkshire and Humber:

– The region's proximity to storage locations and a significant cluster of industrial emitters which could in the long term result in the least cost solution for CO_2 disposal at industrial scale. The Technical Study found that, for every CO_2 emitter, linking into a Network would be more cost-effective than developing a standalone solution.

– The potential to enhance Yorkshire and Humber's reputation for innovation.

– The economic benefit to the Yorkshire and Humber region by keeping and attracting low carbon manufacturing jobs could result in long term and sustainable added economic value creation.

– Its contribution to achieving emission reduction targets, both regionally and nationally.

Sharing of CO_2 transportation network infrastructure connecting large point sources of CO_2 has the potential to lower the costs of CCS implementation for users and could accelerate deployment.

Challenges to the network's development

Following interviews with key project stakeholders, the key challenges to the Network's development were perceived to be (not listed in order of significance):

- Uncertainty over Health & Safety legislation and in particular whether CO_2 can be transported in dense phase. Newcastle University have estimated it would be twenty (20) times more expensive to transport gaseous CO_2 vs. dense (liquid) CO_2 ('Some Technical Aspects of CO_2 Transport for Large Scale CCS', January 2008).

- Lack of clarity around a possible economic regulatory framework for the transportation of CO_2 – some stakeholders interviewed voiced concerns that economic regulation, whether by an independent third party or government body, could be introduced post construction of the Network, impacting investment returns.

- Lack of demand for carbon capture, transportation and storage today given the low current ETS price. It is currently more cost effective per tonne of CO_2 for companies in Europe to emit and purchase ETS allowances than to invest in CCS. This situation is expected to reverse in the medium to long term, stimulating CCS deployment.

- The interdependence between customers, the Network and the storage providers is a defining characteristic of the CCS chain and presents a number of commercial and financial challenges to the Network's development. For example:

  - The Network and storage providers would be impacted by any delays in the installation of capture equipment; the emitter would be impacted by any delays in the construction of the Network or the availability of storage.

  - In the early years of operation at least, the Network would likely be reliant on one or a small number of emitters for revenue. The emitters will be reliant on the Network as the sole provider of transportation services to a limited number of storage providers. The counterparty risk for each participant in the chain is therefore significant.

- Significant risks in the pre-construction phase of the Network's development, such as obtaining planning permissions, consenting, wayleaves and easements along the proposed Network route. Linked to this is the risk of public opposition to the development, which could lead to increases in design costs and delays in completion.

The challenges of developing a commercial scale CO_2 Network are characterised by uncertainties external to the CCS chain and interdependencies and complexities within the CCS chain. Critical to unlocking private sector financing for the Project in the short term will be the involvement of Government in addressing the imbalance of cost and risk experienced by early adopters of CCS. Financial incentive mechanisms will be essential to generate demand while the ETS price remains below the cost of implementing CCS but of equal importance will be the provision of a clear and stable regulatory environment in which investment decisions for the long term can be made with confidence.

Key criteria for network structure

Following interviews with key project stakeholders, it was agreed that the structure of the Network would need to:

- Enable the first phase of the Network to be available for use by 2014 to accommodate the CO_2 emitter with the earliest timeframe for capture.

- Place project risk with the private sector, as far as practicable and affordable (i.e., low level of project risk assumed by Government).

- Deliver a low cost of capital, efficient Network.

- Fit with the Government's current approach to funding energy infrastructure development.

- Provide the potential for the Network to expand efficiently and cost effectively to include other CO_2 emitters as they become carbon capture ready.

Some of the criteria listed above may be of greater importance and carry greater weight than others. Further discussion would be required with stakeholders, and in particular with Government, to understand relative weightings.

Delivery option analysis

A spectrum of delivery options is set out to the right corresponding to different allocations of design (pre-construction) and build, financing and operating risks between the public and private sector.

On the left of the spectrum, the Government alone assumes the design and build, financing and operational risks of the Network. At the other, the private sector assumes these risks. The spectrum is divided into seven widely recognised delivery options, although there are hybrid models, corresponding to different allocations of specific project risks.

The options were evaluated with the Steering Group and the results summarised below.

Indicative table of delivery options

INCREASING PRIVATE SECTOR INVOLVEMENT AND RISK

Delivery option	1	2	3	4	5a & 5b	6	7
Type	Government	Design/build contract	Management contract	Lease contract	Government or emitter led DBFO concession	Third party regulated	Unregulated
RISK CATEGORIES							
Design & build	G	P	G	G	P	P	P
Financing	G	G	G	G/P	P	P	P
Operating	G	G	P	P	P	P	P
Note Residual value risk	G	G	G	G	G/P	P	P

G = Government

P = Private sector

Options 1-4

Options 1-4 require a high level of Government involvement in the development of the Network, in particular that it is financed by the Government.

The advantages and disadvantages of options 1-4 are summarised to the right.

Although it is recognised that these structures may represent viable options for other countries and governments to explore in the development of CO_2 transportation networks, Options 1-4 were excluded from further review in this study as, in the UK, they may not represent the most appropriate allocation of risk between the private and public sector and do not fit with the current favoured method of supporting CCS demonstration.

ADVANTAGES...	DISADVANTAGES...
Is not predicated on EU ETS price as trigger for investment	Potentially undermines EU ETS as a CO_2 pricing mechanism
Could be implemented using simple contractual models and comparatively quickly	Government would carry design, build, finance and operating risk to varying degrees
Represents lower risk for emitters	At odds with current energy framework in the UK
Low cost of capital	Does not fit with the current favoured method of supporting CCS demonstration in the UK (unlock private sector investment through competition and revenue/capital support). The credit crisis and increasing direct government investment to drive policy may, however, result in future possible government ownership of CO_2 pipelines.[3]
May facilitate Network oversizing	Construction cost out-turn may be higher than under a private sector led model
By being centrally involved in the development of the Network, Government would be strongly incentivised to ensure that a viable, long term CO_2 market develops.	Government runs stranded asset risk should demand for CO_2 transportation not materialise, or capture/storage fail. (There is a corresponding advantage to the private sector, in that it would not be required to assume this risk.) May result in an unintentional subsidy of emitters.

[3] The Low Carbon Economy,- Security, Stability and Green Growth; Policy Green Paper No.8

The private sector is likely best placed to manage the risks of the Network's development and operation in the long term but would require significant support from the public sector to stimulate investment in the near term.

Option 5a – Government led DBFO concession

A Government led design, build, finance, operate (DBFO) concession (Option 5a) would require Government to procure the Network on behalf of the emitters and finance it through a payment for services over the period of the concession. Delivery risk would rest with the private sector. The Government would likely introduce a competitive tender process to ensure value for money is received, providing there was a sufficiently large pool of potential suppliers. The Network asset could either revert to Government at the end of the concession period or remain under private ownership.

The Network Entity's payment structure would need to be carefully constructed and would need to take into account any funding emitters may receive for CCS development which may include support for transportation costs. The payment mechanism from Government could be based on availability of the Network, or on CO_2 tonnes transported, and cover a proportion or all of the Network's construction costs, for example. Emitters could be charged based on throughput only, or throughput and an availability charge. A mechanism would need to be put in place to ensure that Government benefits from future increases in the ETS price and is recompensed for the risk it assumes. The payment/charge mechanisms between the parties will depend on the allocation of detailed risks between them and would affect the ability of the Network Entity to finance construction.

ADVANTAGES...	DISADVANTAGES...
Is not predicated on EU ETS price as trigger for investment	Potentially undermines EU ETS as CO_2 pricing mechanism
Private sector assumes design, build, finance and operating risk	Government takes some CO_2 pricing risk away from emitter
Government covenant supports low cost of capital	There is no clear contracting authority in the public sector
May facilitate Network oversizing	Difficult model to implement where projects involve the contractor assuming a high degree of technology risk (as may be the case here).
By being centrally involved in the development of the Network, Government would be strongly incentivised to ensure that a viable, long term CO_2 market develops.	Terms of the payment mechanism would need careful consideration, e.g., if based on availability, would payment still be made if the Network were available but unable to transport CO_2 due to a storage failure? How could the mechanism ensure the Government is rewarded should the ETS price exceed the total cost of CCS?
Process to award a concession typically requires at least two years but this may be quicker than other options (e.g., third party regulated Network).	Government runs stranded asset risk should demand for CO_2 transportation not materialise, or capture/storage fail. (There is a corresponding advantage to the private sector, in that it would not be required to assume this risk.)

Option 5b – Emitter led DBFO concession

An emitter led concession is as 5a above, except that a single emitter or a consortium of emitters (rather than Government) would contract with a private entity to design, build, finance and operate the Network.

For both models 5a and 5b, Network funders may insist on equity investment from emitters to demonstrate support.

ADVANTAGES...	DISADVANTAGES...
Private sector assumes design, build, finance and operating risks.	It would require financial support or a long-term floor price on the EU ETS from Government to unlock investment
As a private sector driven model, it is more akin to the current UK energy sector.	Emitters not part of the consortium could be subject to unfair or cost inefficient charging.
It ensures commitment from emitters.	Emitters have different timeframes for implementation of CCS, different degrees of certainty and different return requirements. Reaching agreement on joint investment could be challenging.
	None of the emitters interviewed considered equity investment in a Network their preferred option.
	May limit expansion potential of the Network.
	Third party funders of the Network Entity are unlikely to accept the long term counterparty risk of the emitter(s)/consortia.
	Procurement of the solution would require a similar timescale to that required under the Government sponsored concession, subject to there being a financial incentive for the private sector to invest.
	As in Option 5a above, the payment mechanism between the contracting entity and the Network would need careful consideration.
	There is a stranded asset risk should demand for CO_2 transportation not materialise, or capture/storage fail.

Option 6: a Network regulated by a third party

A regulated network would be facilitated on the same principles as the existing electricity, gas and water transport networks.

The advantages and disadvantages of this model are summarised to the right.

Given the amount of time required to enact primary legislation, economic regulation of the Network could be undertaken by a private third party. An industry group of emitters, energy users or an independent third party arbitrator, could result in a more rapid development of the Network. An example of such private self-regulation is the UK oil & gas Infrastructure Code of Practice (ICOP), a non-statutory industry code which sets out principles and procedures to allow third-party access to offshore oil and gas infrastructure. Although non-binding, the code sets as a principle that parties 'agree fair and reasonable tariffs and terms, where risks taken are reflected by rewards'. In the case of dispute, the Secretary of State has powers under primary legislation to determine that access be provided and on what terms.

A private, or self-, regulation regime could act as a transitional arrangement until a government appointed regulator can be put in place. Funders would likely consider the powers and authority of a privately regulated asset provide lower security than that of a publicly appointed one.

ADVANTAGES...	DISADVANTAGES...
It provides protection for emitters against the Network's potential natural monopoly in the region.	In the early years of operation at least, the Network is likely to be serving a relatively small number of customers (compared to other utilities networks). This may argue for regulation through contract rather than through a third party.
It would deliver investment without the need for a price on CO_2 as costs could be socialised.	Public sector financial support may be required in the early years of operation, given the small number of customers.
It will allow access to be provided to emitters across the region under commercial contractual terms.	Introducing a regulatory framework for the transportation of CO_2 could delay the Network's development. Would require primary legislation to implement.
It will allow the development of a network which could be financed independently from the CO_2 emitters.	
It would help to create an efficient and cost effective CCS system.	
The cost of financing a regulated entity would be lower, reflecting the lower level of risk.	
A tried and tested regulatory model exists in OFGEM, although primary legislation would be required to implement.	

Option 7: an unregulated Network

Without a bankable ETS price, an unregulated Network would almost certainly fail to attract private investment. It would require an ETS floor price or other incentive mechanism to generate demand and Government may be required to underwrite specific Project risks. The tariff charged to emitters is likely to be higher than under other options.

A key risk to private sector investors would be the threat of the introduction of regulation after initiation of the Project. This may prove so great a risk that investors prefer regulation of the Network from the outset.

Delivery option evaluation summary

In the table below, an indicative rating is awarded to each delivery option depending on their ability to meet the evaluation criteria.

Delivery option	1-4	5a	5b	6	7
Type		DBFO concession – Government led	DBFO concession – Emitter led	Third party regulated	Unregulated
CRITERIA					
Rapidity	Good	Medium	Low	Low	Low
Low Government risk	Low	Medium	Good	Good	Good
Low cost of capital	Medium	Medium	Medium	Good	Low
Fit with Government's current approach to energy infrastructure development	Low	Low	Medium	Good	Good
Allows Network oversizing and expansion	Good	Good	Low	Good	Medium

Key specific risks

Detailed project risks were identified following discussion with project stakeholders, a workshop with the Steering Group and discussion with some members of the Steering Group individually.

The allocation of project risks between parties in the value chain will be central to the ultimate financial and commercial structure of the Network Entity. It will:

- Inform the debt and equity assumptions of the financial model for the Network. The higher the level of risk assumed by the Network, the greater the cost of debt and equity and the lower the quantum of financing the Network will be able to attract.

- Inform the contractual structures between the Network and the emitters.

- Identify potentially non-financeable and uninsurable risks, which Government may be requested to underwrite.

It is important to note that:

- Risks and uncertainties of Network development will be much greater today than they will be in the future, once CCS technology has been demonstrated as a full chain on a commercial scale and as, is expected, the ETS price of CO_2 increases. The risk allocation, together with considerations of financial and commercial structures, was carried out on the basis that the Network will need to be in operation in the near future (i.e., by 2014).

- Allocations and risk sharing arrangements will be subject to negotiations between interested parties. The allocations below are purely indicative but are based on the principle that risks should be carried by those parties best able to manage the risk.

- Given the early stage of development of CCS, there is currently only one known provider of insurance (at the time of writing) to mitigate certain CCS project development risks (product recently launched). References to insurability of risks below are made based on an assumption of those risks which may be covered in the short-medium term. The availability and provisions of any insurance cover would need to be investigated further.

- The likelihood and impact of risks have not been quantified as part of this study.

Key project risks and their potential allocations are summarised here. Risks are not listed in order of potential likelihood or magnitude.

Design and construction cost over-run

Under a DBFO model regulated by concession, it is assumed that the concessionaire would need to carry a greater proportion of the design risks and costs, given its role as concessionaire. The Network would typically assume the cost of construction over-runs. However, some protection may be provided by the concessionaire, depending on contractual terms.

Under a third party regulated model, the regulator would stipulate those design costs that could be assumed within the entity's regulated asset value and that could be socialised among customers. Pre-construction cost over-runs may or may not be included within this. The risk of construction cost over-run would be managed by the Network although the regulator may permit a proportion of over-runs to be socialised.

In an unregulated model, the Network would typically assume all design risk. However, given the size of investment required and the risks and uncertainties involved, it is likely that the private sector would require a significant proportion of design issues to be resolved before financing. A majority of design costs would therefore likely need to be grant or Government funded. AMEC cost estimates do not include design costs but they have indicated these are typically 2.5% of total construction costs (i.e., c.£50m).

The Network would typically assume all build risks, including that of cost over-runs. However, depending on the number and quality of availability contracts signed (see volume and ETS price risk below), the Network may not be able to attract financing for the full proposed pipeline capacity, which includes oversizing. Public funds may be required to fill any funding gap, through a revenue support mechanism or capital injection for example, which would expose the public sector to build risks.

Technology chain risk and obsolescence risk

There was a high degree of confidence in the viability of CCS technology among the stakeholder group interviewed and confidence in the private sector's willingness to assume the revenue risk of at least short-term outages caused by technology failure, a risk which may be insurable.

However, it is assumed that liabilities for long term unplanned outages or catastrophic failure of the Network, the emitter and the storage provider to each other party would be capped in both regulated (Options 5 and 6) and unregulated (Option 7) models. It is likely that a private sector funder of the Network would require some form of recourse to Government in the event of catastrophic failure of emitters' capture equipment or storage facilities, at least in the early stages of operation.

Technology chain risk is likely to be perceived as more significant today by potential funders, when the technology has yet to be demonstrated as a full chain on a commercial scale, than post demonstration.

In both the regulated and unregulated scenarios, the long term risk of technological obsolescence may need to be underwritten by the Government to unlock private sector investment.

Risks will be lower in the future once CCS technology has been demonstrated as a full chain on a commercial scale and the ETS price of CO_2 rises.

EUA liability and environmental damage caused by CO_2 leakage from transportation

It is likely that, from the point CO_2 enters the Network at the agreed technical specification, the Network would be best able to control and manage the risk of leakage. On transfer, the Network would be liable for any environmental damage caused by a CO_2 leakage, as well as for any EUAs the emitters would be obliged to purchase as a result. This risk of leakage is understood to be lower for the Network than for storage providers and insurance may be available to partially mitigate liability. However, private sector funders may require that liability over and above the insurance limit is capped, with the Government providing further protection.

Exposure to unforeseeable changes in legislation or regulation

Additional costs incurred as a result of changes in law or regulations are a significant risk. In both regulated and unregulated scenarios, it is assumed that the Network's liability would be capped and that costs would be passed through to the customer or socialised. This risk is likely to reduce over time, as CCS becomes more established and any regulatory framework is embedded.

Volume and ETS price risk

Under a DBFO concession model, the Network would receive a payment for services from the concessionaire. In a third party regulated model, emitters would be charged a regulated rate based on an allowed return on the Network's efficient investment. The Network would not assume volume or ETS price risk.

An unregulated model, in which the Network assumes volume and ETS price risk with no contracts in place with emitters, is highly unlikely to be viable. Without contracts in place, the Network's construction would be unfinanceable as the pipeline asset will hold little value of itself. Similarly, the emitter is unlikely to take the decision to invest in costly capture equipment without contracts in place for transport and storage.

Emitters could enter into availability ('send or pay') contracts, comprising an availability tariff and a variable charge based on through-put. The availability tariff would be used to recover the Network's construction and financing costs, as well as a profit margin, while the variable charge would cover variable costs of through-put. The number and quality of the contracts would determine the quantum and cost of financing that could be raised. They would need to be put in place before construction could begin, subject to conditions. One of the potential customers interviewed as part of this study is planning to be carbon capture ready by 2014. Others estimate 2016 or 2020. Financing may therefore be limited to the value of the earliest contract, limiting the potential for oversizing of the Network.

Customer counterparty credit risk

Depending on the delivery model adopted, funders may require Government to provide underwriting for customer counterparty risk, given the concentration of customer risk. This may be very high in the initial stages of the Network's operation, when it may have few users.

Indicative range of potential required project returns

The potential required project returns (pre-tax, nominal) will depend on the project's ultimate risk profile and funders' assessment of it.

In a regulated model, where funders will receive a regulated return on their investment, it is possible that required returns could be similar to those of other regulated utilities at around 8%-10%. Under a model regulated by concession, where the counterparty is Government, returns could be expected to be higher, indicatively 10%-13%. Under a concession model, where the counterparty is an emitter led consortium, required returns would be expected to be higher again, given the increased counterparty risk in particular. An unregulated private sector model would likely have the highest return requirement (above 13%, depending on project risk profile) and would therefore likely charge the highest tariff to emitters.

The interdependence between the Network, its customers and the storage providers is a defining characteristic of the CCS chain.

Conclusions

The final risk allocation, delivery model and financing structure of the Network will largely depend on the timing of development:

- The level of technology risk is likely to decrease as CCS becomes more established.

- The ETS price is expected to increase over time, which would generate greater demand for CO_2 transportation and storage and reduce the quantum of any public sector funding/support required.

- Regulatory and legislative uncertainties are likely to reduce over time as experience of CCS grows.

The risk allocation and financing structure, and potentially also the commercial structure of the Network, may need to flex over the life of the asset to take account of:

- The expected reduction in technology chain risk over time.

- Variation in customer counterparty risk as the number of customers using the Network grows or declines.

- Different potential scenarios of sequencing of initial and subsequent customers.

- The potentially reduced need for public sector support over time.

- Increased familiarity of financial institutions with the technology in the medium to long term which may improve financing terms.

To develop the Network in the near term, therefore, risks are higher. This is the early mover disadvantage. This study concludes that the private sector is likely best placed to manage the risks of the Network's development and operation over the long term but would require significant support from the public sector in terms of risk underwriting and support to stimulate investment in the near term, in the absence of a bankable ETS price. Examples of forms of support which could be investigated are the setting of an ETS floor price, a subsidy per tonne of CO_2 stored at the level of the Network or the emitter, or direct grant funding.

The key project risks associated with the development of a CO_2 Network today are (not listed in order of significance or likelihood):

- Design and construction cost over-run risk

- Technology chain risk and obsolescence risk

- EUA liability and environmental damage caused by CO_2 leakage from transportation

- Exposure to unforeseeable changes in legislation or regulation

- Volume and ETS price risks

- Customer counterparty credit risk

These would need to be mitigated, shared or transferred in order to facilitate private sector financing.

In terms of the delivery options short-listed in this study:

- A wholly Government financed solution is not in keeping with the structure of the energy market, nor of the trend in infrastructure development, in the UK. It does not align the key risk categories with those parties best able to manage them.

- DBFO concession model:

  - A DBFO concession with Government as counterparty would require Government financial support to fund the Network and significant Government involvement. However, it would be relatively straight forward to procure.

  - An emitter led DBFO concession is potentially viable, although difficult, and will depend largely on the ability of emitters to reach consensus around governance, tariff structures and respective levels of investment. It could limit the potential for Network oversizing.

- A third party regulated model would likely take the longest of all options to implement but would represent the lowest cost of financing and would better fulfil the requirement for the Network to expand efficiently and cost effectively, for the benefit of a wide range of users in the region.

- An unregulated model would be difficult to finance without mitigation of some of the key Project risks and a bankable ETS price. Returns, and hence the tariff charged to emitters, would need to be much higher and it may not enable Network oversizing without financial support.

Of the options reviewed, a Government led DBFO concession or a third party regulated model appear the preferred options at the current time, if reducing the Project risks to which the Government is exposed, delivering a low cost, efficient Network and facilitating oversizing and expansion are key evaluation criteria. An emitter led DBFO concession may also be feasible but may limit the potential to oversize or expand the Network. It is assumed that some form of public sector support would be required under all these options to enable development in the absence of a bankable ETS price. Careful consideration would need to be given to the detailed workings of these models, the precise nature of the risks assumed by each party at each key stage of the Network's life and the payment mechanisms to be used, particularly given the considerable uncertainties of the Project and its long potential lifespan.

Next steps

In order to advance the implementation of the Project in the short timeframe required:

- Clarity is needed from the HSE as to what form CO_2 can be transported – this has a significant impact on construction and operation costs.

- Yorkshire Forward and the Steering Group need to consult with Government and potential grant funders on the availability of funds to move forward with initial Network FEED studies.

- Government's appetite to support the development of CCS Networks needs to be understood and the timeframes in which support may be provided. In particular, it will be important to understand appetite for:

  - Underwriting of certain key Project risks highlighted above.

  - Implementing mechanisms to support the development of CCS, such as an ETS floor price or subsidy measures.

  - The potential for regulatory oversight of the Network's activities and the scope and direction of any regulation.

- Market soundings need to be conducted with potential private sector investors to test different risk allocations and availability/likely conditions of funding.

- Consideration could be given to alternative funding mechanisms in addition to traditional debt financing.

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A third party regulated model would likely take the longest of all options to implement but would represent the lowest cost of financing and would better fulfil the requirement for the Network to expand efficiently and cost effectively.

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