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Question 7 - Greenhouse gas removal

The contribution that GGR can make to off-set remaining emissions depends upon the availability of sustainable renewable biomass and the rate at which GGR technologies are developed and deployed. Costs will reduce with improvement in the available technologies and with scale of deployment. Any GGR potential will be reduced with delay in the development and commercialisation of GGR technologies whether BECCS or DAC.

To illustrate this Biomass combustion with CCS technology for power and heat is highlighted with the assumption that commercial deployment at scale of advanced BECCS technologies is targeted in the UK commencing in the 2030's.

1st generation commercial BECCS combustion projects could be realised by the mid-2020's based on oxy-combustion or post combustion capture technologies that are currently available taking into account the likely project development period and the need for access to CO2 transportation and storage infrastructure. Efficiencies percentages (LHV) will be in the low 30's and capture rates around 90%.

2nd generation technologies, in particular pressurised oxy-combustion, are however emerging that would have higher efficiencies and higher capture rates (>99%) and are ready for initial commercialisation. If the development and demonstration of these technologies is supported during the 2020's, then it is possible for them to be commercially available by the start of the 2030's providing a much more attractive biomass "best use" proposition and a more efficient delivery of GGR both in the UK and internationally.

Assuming a requirement for 45mtCO2/y by 2050 2nd generation Oxy-combustion BECCS could deliver this quantity with a capacity of 9GWe (gross) and co-generation of up to 9.7GW of thermal energy. Assuming deployment over a 20-year period from 2030 – 2050 this would be the equivalent of 450MWe (gross) capacity addition per year. For a similar output 1st generation oxy-combustion technology would deliver around 41mtCO2/y GGR due to lower capture rates, representing less GGR per ton of biomass consumed.

Any delay in the development of BECCS technology will significantly reduce the potential of GGR to contribute to the achievement of carbon reduction targets and the timing of reaching a net zero emissions economy.

Question 8 - Technology and innovation

It is arguable that tighter long-term emissions targets for the UK cannot be achieved without targeted innovative policies aimed at the development, commercialisation and deployment at scale of innovative technologies to reduce or remove emissions.

Tighter targets will likely mean an earlier and more accelerated deployment of GGR technologies than has hitherto been assumed. Policies should be targeted at the development/commercialisation of these new technologies including shared investment risk as well as in developing the commercial and business models required to accelerate large scale deployment. The focus should be on technologies that support the "best use" of limited domestic and global supplies of sustainable biomass.

Technologies that should be supported include BECCS with power and heat generation including higher efficiency combustion-based technologies with capture rates of 99% or higher. Priority should be given to applications that focus on maximising the useable energy including through CHP generation.

Biomass gasification for the production of aviation fuel represents another promising area. Of interest is the specific production of Kerosene from synthesis gas either via improved more selective FT catalysts or via the Methanol to kerosene (MtK) route. With the generally low price of oil there is little appetite in the petrochemical sector to invest R&D funds into improved FT or MtK catalysts without government support.

http://www.lbst.de/news/2016_docs/161005_uba_hintergrund_ptl_barrierrefrei.pdf

The development programmes for advanced CCS technologies will typically have a development timeline of between 5 – 10 years to full commercialisation depending upon the current status of the technology. Many 2nd generation technologies are ready for pilot demonstration and in some cases commercialisation. For advanced power BECCS technology a view on the development programme required for 2nd generation oxy-combustion technology has been provided under question 7.

In addition to the need to develop advanced technologies the commercial and business model environment needs to be developed in parallel to allow deployment of the first projects in the mid to late 2020's and to establish the basis of widescale roll-out into the 2030's.

BECCS technology would benefit from all of the measures required for the deployment of CCS in general including the respective business models and public sector backing of specific risks that the private sector is unable to bear at an acceptable price.

In addition, BECCS will also require that the value associated with negative emissions is recognised and appropriately remunerated as a public good bringing wider value to the economy as it decarbonises across all sectors.

Question 10 - Policy

Though the focus of carbon capture and storage projects has tended to be on the capture plant, with the "polluter" responsible for the development of the full CCS chain, arguably CCS is mostly a CO2 storage challenge. More focus is required at the storage end of the pipe.

The quantity of CO2 reduction required in order to meet decarbonisation targets means that it is essential that a well-conceived CO2 transport and infrastructure (T&S Infrastructure) emerges in the UK and within Europe. With the well documented lack of private sector appetite to develop such T&S Infrastructure there is a key role for the public sector to play in both the planning logic of the T&S Infrastructure and in bearing risks that the private sector is unwilling to take or to price at acceptable levels of affordability.

In order to meet tightening targets, or a net-zero target, it is imperative that new and innovative publicly backed business models and commercial structures are developed and implemented such that affordable and investable T&S infrastructure becomes available for CO2 sources to access by the mid 2020's.

BECCS will undoubtedly play a key role in achieving the overall carbon emissions reduction targets in the UK. In this respect, the development of commercial models with secure revenue streams that reward GGR services as a public good providing significant value to the economy and creating elbow room for hard to decarbonise sectors like aviation, is of high importance. If the first BECCS demonstration projects are to come on stream in the 2nd half of the 2020's then the development of these models needs to commence without delay bearing in mind the project development cycle.

In addition, Government Policy should be directed towards the development of technology across all CCUS areas including the building of the skills and capabilities required to support a major expansion of the industry in the UK over the coming decades.

Until confidence in the CCUS industry grows it will be important that the public sector shares in the risks of technology and CCUS project development, through grant funding and other financial incentives including tax incentives and loan guarantees, etc.

Question 11 - Costs, risks and opportunities

One of the major risks associated with the tightening of UK targets in both absolute terms and timing is the ability of the supply chain to deliver the required projects. In its report "Clean Air – Clean Industry-Clean Growth published by Summit Power the economic and societal benefits of a CCUS programme of investment along the east Coast of the UK was evaluated commencing in the early 2020's based on a demand for CCS derived from CCC projections (central scenario). The full capacity of the East coast investments reached 75mtCO2/y by 2050.

https://industriamundum.com/210-2/

As a part of this study the impact of delaying the start of deployment of CCUS until the early 2030's was evaluated making clear the significant reduction in the benefits that CCUS could bring to the UK economy by 2050 resulting from delay.

During the evaluation it was considered that a 25-year deployment of CCUS capacity coming on-stream between 2025 and 2050 would be challenging in terms of delivery especially in the later periods. Between 2045 and 2050 the modelling required 28mtCO2/y of additional capacity to come on-stream. Compression of this timescale to 15-years to accommodate a delay in commencing CCUS deployment was considered unrealistic.

This is an area that needs a detailed evaluation taking into account capacity constraints and the potential for overheating of the supply and construction industry not only in the UK but across Europe and more widely as the similar decarbonisation programs are implemented. The results could have negative impacts on competitive pricing, schedules (delays) quality and safety.

Tightening of the UK targets would add to the pressure probably pushing back the date by which a zero emissions / targeted reduction could be achieved.

Question 14 - Work plan

The ability of the market to design, engineer, manufacture, construct and commission the required CCUS capacity could be the single biggest influence on the timing of the achievement of the UK carbon emission goals.