Unite the Union response to the Department for Business, Energy & Industrial Strategy's' consultation - Business Models for Engineered Greenhouse Gas Removals

1. Introduction

1.1. This submission is made by Unite, the UK's largest trade union with over one million members across all sectors of the economy, including;- energy and utilities; chemicals, pharmaceuticals, process and textiles; food, drink and agriculture; manufacturing industries like aerospace and automotive; financial services; over a quarter of a million members in all modes of transport; the construction industry; information technology; service industries; all public services including health; local government and the not for profit sector. Unite also organises in the community, enabling those who are not in employment to be part of our union.

1.2. Of particular relevance to this submission, Unite represents 35,000 energy and utility workers; members in our Chemicals, Pharmaceuticals and Processing, sectors who will be impacted by these decisions. In this response we aim to respond to the desperate need to extract Greenhouse Gasses (GHG's) from our atmosphere at a higher rate than we are pumping them to reverse the tide of pollution that is causing Global Warming. Sadly these industrial processes are needed now to compliment those efforts to capture and store GHG's using nature based solutions. Sadly, in the very near future, given the continued growth of emissions worldwide, nature based solutions will not be enough to capture and permanently lock away GHG's, so we can reach a balance and start to undo the damage man has done to the earth's climate.

1.3. An accurate assessment of anthropogenic carbon dioxide (CO_2) emissions and their redistribution between the atmosphere, ocean, and terrestrial biosphere as the climate changes is critical to better understand the global carbon cycle, which in turn supports and helps develop climate mitigation policies and project the future concentrations and their impact on the climate, sea levels and how change will impact life as we know it. Comparisons from multiple approaches and observations shows:

- a persistent large uncertainty in the estimate of land-use changes emissions,
- a low agreement between the different methods on the magnitude of the land CO_2 variations in the northern extra-tropics, and
- a discrepancy between the different methods on the strength of the ocean GHG absorption over the last decade.

1.4. In short the scientific understanding of the volumes of GHG emissions could be out by up to 1 Giga-tonne CO_2 per year[1]. For the most part the World Metrological Organization relies on the national emissions reported to the United Nations under the United Nations Framework Convention on Climate Change (UNFCCC) as well as scientific evidence gathered from teams of scientists conducting studies across the planet. Through a thorough sequence of analysis and re-analysis, the team have reduced the overall error of these emissions estimates to +5%; in the case cited here for 2015 was 9.9+0.5 GtC yr^{-1}.[2] According to the Intergovernmental Panel on Climate Change (IPCC) Each 1000 $GtCO_2$ of cumulative CO_2 emissions is assessed to likely cause a 0.27°C to 0.63°C increase in global surface temperature with a best estimate of 0.45°C[3]. The most recent estimates of the volume of carbon the world can afford to emit to limit and still stay below 1.5°C of planetary warming above pre industrial levels, as defined by the Paris Accord, may be as little as 300 $GtCO_2$ released from the beginning of 2020 (83% chance of staying below 1.5°C[4]) There is an outside chance (17% chance of staying below 1.5°C) if 900 $GtCO_2$ but obviously the more GHG's emitted the less likely it is that the climate will stabilise below 1.5°C of warming. At the rate the UK is

[1] See the article from the Esrt System Science Data website html

[2] Statement from the World Metrological Organisation html

[3] In the literature, units of °C per 1000 PgC (petagrams of carbon) are used, and the AR6 reports the TCRE likely range as 1.0°C to 2.3°C per 1000 PgC in the underlying report, with a best estimate of 1.65°C html page 28 Para D.1.1 line 2.

[4] See Page 29 D1.2 table html

emitting CO_2 this would mean that we would exceed our equal share of this lower limited budget at some point in 2024 at the current rate of emissions.

1.5. The IPCC has made it clear that whilst nature based solution might sequester enough CO_2 in the very long term, in the short term these measures will not lock away the majority of the GHG's it absorbs for more than a couple of hundred years at best. If not properly managed the plant based options will rot creating a greater problem in the form of Methane (CH_4) as opposed to CO_2 concentrations in the atmosphere. The IPCC has therefore suggested that without an industrial approach to GHG capture and storage the trajectory is such that a wholescale change in the world's production of these gasses is very unlikely to limit global warming below 1.5°C.

1.6. In 2005 the WMO and other scientific bodies warned that above 1.5°C it was possible that the planet itself would unlock its vast stores of greenhouse gasses, driving the climate to concentration levels not seen for billions of years. The warming that would result would be irreversible and eventually kill all life on this planet. What is for certain if warming exceeded a 2°C level of warming, such a scenario was going to happen for sure.

1.7. In the interim as the planet warms, storms are going to become more violent, deserts will expand, crops will fail and the monsoon series of protracted droughts followed by sudden downpours and flooding may make large regions of the world uninhabitable. The surface area of the planet would also shrink as ice caps and glaciers melted to drive up sea levels causing many global capitals, including London to sink under the waves.

1.8. In short, Unite believes, the sooner there is an industry to capture and store carbon under the ground at a scale to combat and exceed the industry that is extracting it, the better.

2. Consultation Questions

Question 1: Do you agree that the Government should develop a GGR business model to enable a diverse portfolio of GGR technologies to deploy at scale in the next decade?

2.1. Unite believes that there should always be a mixed bag approach so that the government does not place all their eggs into a basket of measures which do not live up to expectations and predictions. Unite would however hope that deployment will happen far sooner given the UK will by 2024 be utilising some other nation's carbon budget if the goal is to stay below 1.5°C. If the IPCC projections are correct it means that if this industry is not operational by 2032, the planet will need to run the risk of exceeding 2°C of warming, hoping that the scientific community has gotten their sums wrong.

2.2. Unite would further argue that there needs to be a clear and present pathway to encourage individuals to leave highly polluting industries for more sustainable ones. A pathway that protects their standard of living, utilises their skill set, wherever possible, or provides training, if that is not possible, to ensure that the industry is populated with engineers who can ensure the maximum amount of carbon is captures and sequestrated in the minimum time. This provision of a just transition pathway for workers will ensure they are encouraged to work hard once they are made fully aware of the stakes and not simply picked up from the streets after their work activities are no longer needed.

2.3. Unite would further argue that such a transition pathway would avoid the need for that government to spend billions in benefits to them, their families and the community which dies once the main generator of income in the region is taken away. This is a lesson which should have been learned following the closure of the UK coal and tin mining industries.

Question 2: To support a portfolio approach to GGR deployment, do you agree that Government policy for incentivising negative emissions should be technology-neutral as far as possible?

2.4. Unite agrees that the financial incentive needs to be, as far as is possible, technology-neutral with the financial reward based on the results in terms of kilogrammes of CO_2 or an equivalent amount of GHG (kgCO2e) captured and stored. The moral incentive on the other hand is one which should need no incentive.

2.5. The premise of a financial incentive requires such payments to be greater per kgCO2e than the value of the Carbon could attract as a feedstock used for the creation of synthetic fuels. If not the market may decide that the value of carbon, in being a keystone ingredient in the creation of drop-in synthetic fuels, will favour a fuel replacement, than a permanently underground storage option. Morally at least an equilibrium should be maintained between sequestration and synthetic fuel creation.

2.6. Following that rational it would follow that the taxpayer would need to provide an ever increasing amount of tax payer funding into a public enterprise in order support the idea that the market knows best.

2.7. Unite cannot see any reason why a ratio approach could not be used as a carrot, rather than having the business underwritten by the tax payer. The current stick approach to punish businesses for their carbon emissions, works and if they can save money by paying for the sequestration of carbon instead of a carbon credit, it would seem to be a reasonable exchange. Of course this means that the price of a tonne of carbon credits has to be high enough to encourage such an exchange to start flourishing. Currently the permission to emit carbon is traded on the basis of a diminishing supply of carbon credits resulting in a path to Net Zero. If the aim is Net Zero slowly reducing the availability of credits to zero is the way to go, to force business investment into Carbon Capture, Utilisation and Storage (CCUS).

2.8. Unite is convinced that for such an industry to flourish it has to be under central government control so there is one and only one objective determining all business decisions, the safe return of the planet to one where the climate is in balance. Having the primary objective of making profits for shareholders leads to the wrong decision paths being taken.

Question 3: Do you agree with the Government's principles for policy design?

2.9. Whilst man has been injecting CO_2 into the ground since the 1970's, the primary purpose then was the enhanced recovery of oil and gas as in the Century Plant project in Texas, United States that has been operational since 2010 storing up to 8.4 million tonnes per annum (mtpa) of CO_2. Instead the purpose today is the salvation of a habitable climate for future generations. There is a vibrant, influential and extremely wealthy oil and gas industry today which wants to be the company that is industrially devoted to selling that last barrel of oil or therm of gas. Sadly there is no such CCUS industry today injecting Carbon back into the ground, at least not in the UK. There are pilot projects such as or the Longship - Northern Lights project in Norway which pumps liquid CO_2 from industrial capture facilities into long term storage in the Utsira formation under the North Sea. Since 1996 Norway has been injecting up to 1 mtpa of CO_2 and selling long term storage space to tanker loads of the gas.

2.10. Unite, therefore, agrees that the risks associated with the creation of a new technology based industry is too significantly important and feels that as such we cannot leave it to the markets to decide. Such investment into all our futures requires a minimum of government control. Seed funding and assistance in developing the infrastructure, will be needed whichever route is followed to turn theory into industrial practice. Once established such funding can and should be reclaimed especially if the government feels that life on this planet and the possible prevention of an environmental and ecological disaster is so trivial that they can outsource this critical endeavour.

2.11. Unite is concerned as companies come and go in decades, whilst these facilities need to be operational for centuries to undo the damage caused and maintain the atmospheric mixture in balance if we continue capturing and releasing CO_2. The operation of such facilities would appear to be a role for governments around the world to manage rather than leaving it to private operators and the risks that they may go bankrupt leaving vital infrastructure to sit idle.

2.12. Whilst it may be initially cheaper to capture and store GHG's elsewhere in the world, by funding international CCUS projects, doing so would ultimately result in the financial development of that region and their progression toward the creation of carbon credits and synthetic fuels, which could undercut and eventually starve out the UK supply chains. At that stage, those nations could start charging a premium for exports of sustainable fuels to the UK and the charge a premium for the storage of GHG's undermining our domestic economy.

2.13. One only has to look at the relative cost of steel, aluminium etc. to discover that international imports are now cheaper than domestic production and it is only the quality of the produce that is keeping some industrial practices still operational in the UK. Unite therefore welcomes the news that the governments intends to stick with UK CCUS technologies.

2.14. Since the understanding and harnessing of fire, humans have known that burning something creates CO_2 so it will never be the case that a nation could be deigned the supply of the materials to create synthetic fuels. The problem is the provenance of the Carbon supplies to ensure it has not derived from fossil fuels but has been captured and will be reducing the levels of GHG's in the atmosphere.

Question 4: Do you agree with our overall approach to introduce a contract-based business model for GGRs to provide revenue support for negative emissions?

2.15. As stated time and again Unite would argue that leaving the fate of the planet in the hands of private companies is a recipe for disaster. Unite believes that, if we are not going to see the Government pass on the responsibility for our climate and all life to a company, whose business model is focused on making money for shareholders rather than saving lives, then a contract based model would offer minimal guarantees. Contracts are only enforceable if the company is still in existence to enforce them against.

2.16. The decision to use a similar model to that of the water industry will end in tears where moneys are syphoned off the business often by taking out loans, and the infrastructure is left to rot. When the Water industry was privatised it had land purchased to create reservoirs, no debts and a system free of fatbergs and major flooding incidents. Today we have an industry where:- due to the lack of proper maintenance as staffing levels have been cut to the bone, we have fat build ups and blockages; human waste is simply dumped into rivers and the sea because the investment is not there to build enough treatment works, damaging our tourism industry and reputation around the world; Flooding as we do not have enough drainage capacity, droughts as we do not have enough fresh water reserves; and a water industry over 360 billion in cumulative debts. It is also strange that if you add up the cumulative dividends to water industry shareholders over the years this also equates to £60 billion.

2.17. Unite would argue that the government has a responsibility to protect its citizens and should be leading by example. Clearly it believes that it can outsource this obligation to a foreign state or to a UK business which could collapse. It believes that businesses and people do not deserve the protection of government who can find so many billions of taxpayer's money into reducing energy bills instead of obtaining those billions from windfall taxation from those who have received an unexpected windfall and could therefore afford to pay.

2.18. If the government truly believes that the future of life and limb can be trusted to an outsourced company whose focus is on profits, then a contract based business model is the least of a bad set of options left open. Unite would still however believe that this premise is a mistake.

Question 5: What is your preferred contract scheme of those outlined in the consultation? Please provide arguments to support your view.

2.19. Unites preferred contract scheme is one based on the existing UK Emissions Trading Scheme (ETS) model but where the Government manages and operates a major carbon capture and storage industry which allows private businesses to inject their captured carbon for a reward in carbon credits in a similar way to the Negative Emissions Guarantee idea.

2.20. If the government is in control of the dispersal of carbon credits it can limit their supply and can adjust the market to favour a total reduction in carbon in the atmosphere.

2.21. Whilst the Woodland Carbon Guarantee scheme would help in the development of woodland there is no guarantee that such woodland will not combust due to droughts, high temperatures and someone's accidently discarded lit cigarette. Should this happen all the trapped carbon will escape. Depending on soil conditions, the access to water, weather conditions and tree variety, a tree will absorb a different volume of carbon, so there is also no guarantee that enough carbon will be stored. Similarly should the woodland in decades to come become mismanaged these trees can die, collapse and rot creating methane, a gas that is far worse than CO_2 when it comes to global warming. With all nature based solutions have a similar problem in that they can lock carbon away for a short duration (a couple of hundred years at best) before it is released during natures carbon cycle. Thus the government is currently providing land owners a guaranteed up-front payment (in the form of carbon credits) per hectare when there is no guarantee that the woodland will absorb that volume of carbon permanently.

2.22. Consequently either nature based solutions need to be managed and closely monitored in perpetuity to stop the release of methane and ensure the carbon is locked away or the carbon is released from its nature based solution into a permanent industrial scale carbon storage solution like the combustion of wood pellets in a facility connected to a CCUS pipeline or the methane release it trapped and passed through a methane pyrolysis process to create hydrogen and solid black carbon.

2.23. There are a number of ways to permanently lock away Carbon permanently on an industrial scale whilst the use of nature based solutions requires a very long term to convert captured carbon into a permanent storage. The benefit of nature based solutions are that they can be deployed at scale now to draw as much carbon out of the atmosphere allowing time for these industrial processes to become established. Unite would therefore support the growth of nature based solutions but only as a stopgap until the industry becomes established.

Question 6: When might it be feasible to introduce an auction mechanism for GGR contracts, and what criteria should the Government consider when developing its allocation process?

2.24. Unite believes that rather than reinvent the wheel there is a UK ETS mechanism already established that would simply need revising to allow for the flow of carbon credits issued by the government on behalf of a supplier of a carbon storage solution. The government should consider the duration of the carbon storage and the need for carbon credits to be purchased by an insurance body if the nature based solution is hit by a fire or similar natural disaster which unlocks the carbon. Given the additional cost of insurance some industrial and some nature based solutions may become significantly more expensive but the volume of credits should not change if we are to limit the volume of carbon. Accordingly, the Government would need to provide a supplementary scheme that can be repaid when the carbon becomes permanently stored.

2.25. Unite would caution the government once more that the "market will decide", "survival of the fittest" way of approaching the development of a GHG removal industry when so much is at stake. Unite strongly suggests that the state should invest in the purchase of a CCUS pipe network to collect captured CO_2 from industry for delivery to industries like horticulture, that requires a higher atmospheric mix of CO_2 to produce more food, to the synthetic fuel industry and to permanent sequestration options.

Question 7: How can the Government most effectively reward innovation and cost reduction in early GGR contracts?

2.26. Unite believes that the best solution is early government investment into the creation of a GHG removal pipeline to aid in their commissioning, given the public good that can be derived from the creation of these industries. Unite then favours rewards in the form of UK ETS carbon credits and an initial guaranteed price for generated carbon credits together with a higher strike price to encourage private investment into carbon reduction methodologies. Unite would, however, suggest a standing charge for the use and maintenance of the CCUS pipeline. Given it is during the transport process that the industrial CCUS is most venerable it needs to be a governmentally secured asset.

Question 8: If the Government pursues a Negative Emissions Contract for Difference, what is the most appropriate basis for setting the reference price for initial contracts? Please provide arguments to support your view.

2.27. Given the past experiences of the operation of contracts for difference Unite would more heavily police the health and safety of the workforce, who the contracts are with and the need to ensure investment into the UK economy rather that the economies of other nations, pension funds or large value shareholdings.

Question 9: What mechanism could the Government introduce to ensure that project developers achieve the highest possible sales price for negative emissions credits on the market?

2.28. As highlighted by all of the potential methods to incentivise developers, everyone has its faults. The best option as stressed is public ownership where the government controls the availability of carbon credits and rewards industry for the capture and permanent storage of carbon over those who are only locking away the carbon for short durations. Unite believes the floor price is the best option listed as it only guarantees that the operator will receive an amount for a set level of production guaranteeing that that volume will be worth a minimum of a set price. Should the operator become able to sell the carbon credit for more, they make more profit. If they produce more than the amount covered by the price guarantee they can obtain the extra from the carbon trading for the additional credits but will only receive market rates for the carbon.

2.29. Unite believes that there needs to be an operator of last resort and that operator should be the government.

Question 10: What do you think is the most appropriate option for setting the length of GGR contracts? Please explain your rationale.

2.30. Unite believes that the initial danger period is the duration until 2050 when we hopefully will reach parity between emissions and carbon sequestrated. From that point forward the task is to store more GHG than is released. In an ideal world Unite would like to see Net Zero achieved far sooner especially as we have the technical solutions and know what must be done. Unite would therefore like to see Net Zero achieved by 2035. As a consequence Unite would suggest that the validity of a carbon credit be up to the time when we achieve Net Zero.

2.31. Once net zero has been achieved all outstanding credits should be purchased at marginally more than market rate by the government as a reward. From that point forward the carbon trading market will be awash with credits as more carbon is sequestrated than emitted. At this point the aim of the government is to ensure carbon matching between carbon credit creation and release and purchasing credits so that the net impact is the return to a climate closer to preindustrial levels in order to reduce the impacts of the altered weather conditions, to make life more habitable once more. At this point carbon

sequestration credits should be treated like currency in that they should never leave their minimum value, retained at a set value which increases with inflation providing some certainty of reward. The treasuries books can be balanced by becoming the only place where carbon release credits can be obtained and credits sold at an ever increasing cost. This should therefore encourage industry to maximise their own carbon capture and disposal facilities to avoid having to rely on the government's scheme.

Question 11: Would it be desirable to include a review mechanism in early GGR contracts? If no, please outline your reasons. If yes, please give your views on how a review mechanism might be designed.

2.32. Unite would hope the government should be reviewing the performance of the mechanism at very frequent intervals to ensure that the value of credits for release and credits for capture are in balance ensuring that there are always fewer credits for release than there are for capture. This could be achieved through a central register of all trading in carbon credits.

Question 12: Should the Government allow project developers to combine negative emissions support under a GGR business model with other support mechanisms for co-products? Please provide arguments to support your view on whether this could be an effective route to supporting multi-product GGR projects.

2.33. Unite would suggest that the industry will initially require as much financial assistance as possible to construct the infrastructure and therefore should be allowed to combine support for the co-production of secondary products such as heat, electricity, hydrogen and black carbon. Some processes like methane pyrolysis produce both hydrogen and black carbon and given the potential future demand for Silver Carbon (AgC) solid state batteries[5], the production of black carbon alone should provide enough financial support. As hydrogen free of contamination will also be in high demand, Unite would suggest that this process, which uses less energy than steam methyl reformation, could be self-sustaining. Processes that simply capture the carbon for injection into a pipeline may require a greater level of financial support.

Question 13: Do you believe that capital support instruments are necessary to complement GGR business models? If so, please outline your reasons and your preferred type of capex support mechanism.

2.34. Unite believes that state investment in this industry should at more than match private investment into this industry so that it can be established and the state retains some level of control in this critical endeavour to preserve the safety of its citizens. State involvement should also make borrowing cheaper than from the financial markets. In addition given the need for a CCUS pipeline network to be established the government needs to guarantee that it is free from leaks and fit for purpose to carry CO_2 to where it can be utilised or permanently stored.

Question 14: What other issues should the Government consider when progressing work on the design of a GGR business model? Please focus your response on issues that are not directly considered through this consultation.

2.35. Unite would highlight the lack of any measures for a Just Transition of workers as agreed by the UK when they signed up to the Katowice agreement in 2019 to take "*into account the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities*"[6], . The Government instigated the creation of the support for Just Transition internationally at COP 26 in Glasgow in November 2021[7] and along with its partners recently announced it is helping the South African Coal miners establish a Just Transition pathway[8] so why can't the UK apply this to its own citizens?

5 Press statement from Samsung html

6 See line 11 on page 21 html. See also the UNFCCC Technical paper html

7 COP26 statement html

8 Governments Joint statement on a just energy transition html

2.36. Nowhere in the consultation has there been any suggestion of public ownership of any of the infrastructure to turn GHG capture and storage either through nature based solutions or industrially. This industry is one which will need to be operational for hundreds of years, through financial crisis and times of plenty, in order to correct what generations have done whilst exploiting the earth's mineral resources without regard for the damage it could cause. Throughout there needs to be the stability of ownership and control that only a national government can provide. This has to be true of the most vulnerable part of the process transferring the captured CO_2 from where it was captured to where it will be stored or utilised. It is also this pipeline network which will ensure that every factory has a pathway to transport this gaseous waste product in the most environmentally sustainable fashion. Unite would urge the government to strongly consider the need for the government to own and operate this network or at the very least be the operator of last resort for the pipeline and any infrastructure that is extracting CO_2 from the atmosphere or preventing release. In this way the government has the certainty that the most abundant greenhouse gas is contained for generations to come.

Question 15: What do you believe is the most appropriate market framework for supporting initial GGR projects over the next decade, and how might this framework evolve over time? In your answer, please consider the market options outlined in Section 3, indicating which option or combination of options would be preferable to achieve our objectives.

2.37. As highlighted in 1.44 above Unite believes the most appropriate model is public ownership of the infrastructure to ensure long-term stability. When considering the market options Unite would suggest the Greenhouse Gas Removal (GGR) Obligation scheme model noting that it would create a market demand for negative emissions credits, that such a scheme would be very difficult to implement in the early years of deployment and would not directly guarantee the supply of negative emissions credits to meet demand. If married to the existing Carbon trading scheme, however, the government could control the number of credits available to the market and purchase any excess to ensure a path towards net zero.

2.38. Unite would of course applaud the voluntary removal of GHG's from the atmosphere over and above any financial reward, conducted on the basis of the right thing to do morally. Unite is, however, sceptical about the honesty of companies when it comes to declaring actual emissions. One only has to remember the scandal around the emissions from diesel vehicles where software was installed in vehicles to manipulate air pollution testing resulting in numerous legal claims against the perpetrators.

Question 16: What steps should the Government take to stimulate voluntary corporate demand for negative emissions credits?

2.39. Unite would hope that there was already a moral duty and public interest obligation to drive a voluntary corporate demand to purchase negative emission credits particularly from organisations which fly executives around the world for meetings. If linked to any stimulation or financial reward it can then no longer be said to be voluntary.

2.40. If the government wishes to seek investment into negative emission certificates the link should be made with the existing carbon trading market. It would appear to Unite that the government would be re-inventing the wheel to do otherwise.

2.41. Unite believes that the private individual or company may also wish to offset their emissions for things that at are hard to calculate without access to the data such as the offsetting of emissions released by some form of transport. Whilst the impact of surface transport emissions are reasonably easy to calculate based on fuel consumption the same is not true of aviation.

2.42. Whilst the total carbon impact can be calculated from the weight of fuel consumed on its journey, the impact of non-carbon based aviation emissions is depend on where the aircraft was flying at the time, and the time of day. Factors like the altitude, weather conditions will all have a bearing on the volume of non CO2 emissions determining if these emissions have a positive or negative impact increasing or reducing the total footprint of the flight in terms of global warming[9]. Consequently, calculating the non-CO_2 impact of civil aviation is a significant task but since aircraft heights, speeds, throttle positions, time of day, weather conditions, passenger/cargo loadings are all tracked and logged and are available to any organisation with the funds, it is possible to calculate retrospectively the equivalent Carbon footprint. But as none of the carbon calculators on the market currently provide such a detailed analysis, a voluntary contribution is the only way a private individual can offset their footprint. Corporations, on the other hand, can afford the subscriptions to these services that collate this information and can therefore assess the total footprint of their executives and any air cargo and therefore these could be incorporated into the organisations wider secondary footprint calculations.

Question 17: To maximise voluntary private investment in negative emissions credits, would it be preferable for the Government to (i) establish a regulated market for engineered GGRs or (ii) directly endorse voluntary carbon market bodies that meet high integrity and verification standards? Please outline your view of the main benefits and challenges of each approach.

2.43. Unite would again question the voluntary nature of the private investment if there is to be some stimulation or reward beyond the moral duty aspect.

2.44. As stated Unite believes that engineered GGR credits should be tradable on the UK ETS and similar carbon markets already established and should be obligatory in nature, along the lines of the polluter pays principle. These could also be available to the private individual if they wish to offset their emissions.

Question 18: Would it be desirable for the Government to establish a regulated market for engineered GGRs to allow for future integration with the UK ETS and/or provide the foundation for a GGR obligation scheme? If so, how could this be achieved?

2.45. Unite would strongly suggest at least until the establishment of Net Zero, that engineered GGR's should be incorporated into the UK ETS. As previously stated providing more negative carbon credits than are needed would have the perverse effect of encouraging the burning of fossil fuels. This should not prevent the use of such credits in other ETS markets until they themselves reach net zero.

Question 19: Do you agree with the government's immediate priority for MRV, including a review of standards that could underpin business model support for initial GGR projects? Please share any views or suggestions that could help to inform our approach.

2.46. Unite would strongly agree that there is need for monitoring, reporting and verification (MRV) of engineered GGRs to ensure there is a total security about its long term storage. As highlighted in the section in the consultation, nature based solutions do not offer anything like the permanence offered by engineered GGR's. Unite agrees that Direct Air Carbon Capture and Storage (DACCS) and Bioenergy with Carbon Capture and Storage (BECCS) are currently the front runners in the race to store carbon but would caution that BECCS option also causes the release of other GHG's beyond CO_2 but has the advantage of creating badly needed Electrical supplies to ensure the UK's energy security.

[9] The release of particulates can cause cloud formation which can either shield the planet from the suns radiation or act as a blanket trapping the warmth in. Similarly the release of NOX can either reduce the concentration of methane in the atmosphere or create Ozone dependant on the altitude flown. See html

2.47. To make BECCS work there needs to be enough land to grow the woodland, process it into pellets, transport it to the power station and then capture the released carbon, producing carbon at each stage and adding a vulnerability should the governments of the nations where these trees are felled, decide to use this resource themselves. Whilst it is true that "*More CO_2 can be sequestered synergistically in the products or wood energy and landscape together than in the unharvested landscape. Harvesting sustainably at an optimum stand age will sequester more carbon in the combined products, wood energy, and forest than harvesting sustainably at other ages*"[10] the area needed to supply trees to Drax is considerable. Drax consumes over 7 million tonnes of wood pellets each year requiring 14 million tonnes of green wood harvested. The UK only currently harvests 11 million tonnes of wood. With the last of Drax's remaining furnaces turning from Coal to wood pellets, this disparity is only going to get greater and cannot be matched even in the next 30 to 40 years whilst new woodland is established. Further there is evidence that the emissions from the US source of wood pellets were responsible for between 13 & 16 million tonnes of CO_2 emissions in 2019[11] as opposed to being carbon neutral as claimed. As a consequence these emissions from the harvesting of trees, processing and transportation as well as the rotting of the pellets needs to be accounted for in the calculations to reflect their true tally of negative carbon emissions.

2.48. If the United States forestry industry was compelled to remove and dispose of tree stumps, turning them to pellets, rather than leaving them in the ground to rot, this would significantly reduce this footprint of BECCS at Drax using wood pellets. Sadly this is outside of UK governmental control but not outside the influence of Drax or the UK's influence with US regulators.

2.49. Burning wood also releases sulphur oxides (SOx), and nitrogen oxides (NOx) together with other regulated elements and compounds, such as mercury and hydrochloric acid are measurable in the emissions but at levels much below accepted maximums per kilo. At the volumes of use of this biomass at Drax these secondary emissions may also be a concern.

2.50. Given this one facility provides 6% of the UK's energy supply and could if provided with the CCUS pipeline and CO_2 separation and extraction facilities could exceed current UK targets for phase 1 of its removals engineered GGR rollout proposals on its own the benefits outweigh the negatives, but still need to be accounted for.

2.51. Similarly if reliant on just an electrical supply to extract CO_2 from the atmosphere, the use of DACCS has a major stumbling block in its way and that is the generation of enough electricity to power enough plants to make a difference. It would be nonsensical and self-defeating to burn fossil fuels to generate the electrical supply needed and given the estimates of power consumption to tonne of CO_2 captured and stored, the generational capacity required would exceed that of the UK total generational capacity to reach net zero. The principle issue is the amount of energy required to heat the carbon capture medium to 100°C in order to release the CO_2 If, however, waste heat from industrial processes and energy generation was utilised, the only power needed would be the pumps to force the air through the capture medium and the pumps to inject the CO_2 into the CCUS pipeline.

2.52. Given the concentration of CO_2 in sea water can be higher[12] than that in air, given the sea's role in the carbon cycle and carbon storage, it is can be more efficient to simply drive off the CO_2 from the sea water than extract it from the air, doing so would also reduce the acidity of the salt water returning it to natural

[10] CHADWICK DEARING OLIVER, NEDAL T. NASSAR, BRUCE R. LIPPKE, and JAMES B. McCARTER, 2014. Carbon, Fossil Fuel, and Biodiversity Mitigation with Wood and Forests. html

[11] See the Chatham house paper html

[12] Results suggest that if the air above the surface layer is above 17°C the seawater CO2 content relative to the air increases fairly rapidly with temperature, at about +4 ppmv per °C html

concentration levels possibly saving offshore reef formations, shelled creatures from having their shells dissolved and preserving the limestone of the reefs themselves from dissolving releasing more CO_2.

2.53. The natural location for such a sea water processing facility or a DACCS would therefore be collocated with a nuclear plant, given the proximity to its cooling water intakes, availability of waste heat and the short distances from power generation therefore minimising losses in power transmission. Should such a nuclear plant also invest into Pink hydrogen[13] energy storage, any excess hydrogen and captured CO_2 could be used in the manufacture of synthetic crude for refining into a drop in fossil fuel replacement in any kind of vehicle.

Question 20: Beyond ensuring the legitimacy of initial projects, what is the appropriate role for the government in developing a robust and enduring framework for negative emissions MRV, compared to the role of other bodies such as those outlined in Figure 1?

2.54. CORSIA is an international emissions trading scheme for the civil aviation industry which has been a long time arriving and still does not have all the signatories of all nations or participation of all of those nations airlines as signatories. The IPCC Guidelines are just that guidance, they do not physically monitor anything just suggest the methodology of calculation. Therefore there is not a single intergovernmental panel which monitors any emissions beyond the aviation industry save for the UN reporting guidelines for each nations total emissions. Whilst there are a number of NGO's and private voluntary organisations these do not have the same reporting obligations to the UNFCCC as agreed under the Paris Agreement signed at COP 21 in Paris[14]. As such the Government already has an obligation to monitor carbon emissions and by extension the volume of emissions captured and stored. Unite would further highlight that to ensure the integrity of the storage system, the government needs to ensure that the volume of gas captured is injected into a CCS storage facility or utilised by industry. For this reason Unite would suggest that the Government needs to closely monitor and evaluate the performance of the capture transfer and storage of the CO_2.

Question 21: Do you agree with our proposed principles for negative emissions legitimacy?

2.55. Unite agrees with the principles for negative emissions legitimacy[15] but would suggest that the scope be expanded to include CO_2 extracted from sea water as the relative concentrations of CO_2 can be many ppmv higher especially if the sea water is warmed as is found in the outflow from a nuclear power station.

Question 22: Are there specific policy requirements for DACCS projects that the Government should take into consideration? Please provide arguments to support your view.

2.56. Unite would strongly suggest that any DACCS facility be collocated with a power station or industrial process which produces vast amounts of waste heat. Doing so would reduce any electrical power consumption requirements. Alternatively such facilities need to be able to tap into geothermal heat sources to access a free supply of heat, radiating from the earth's mantle. Doing so should significantly reduce the price per tonne of CO2 stored from the £318 per tonne quoted.

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13 Pink hydrogen is generated through electrolysis powered by nuclear energy. Nuclear-produced hydrogen can also be referred to as purple hydrogen or red hydrogen. This can be stored and released through a bank of hydrogen fuel cells to regenerate electricity to fill gaps in the grid supply, caused by less predictable sources of energy such as wind, solar, wave and similar renewables or variability in the volume of demand. html

14 See the clauses under Enhanced Transparency Framework (ETF) and Guidance for operationalizing the modalities, procedures and guidelines for the enhanced transparency framework referred to in Article 13 of the Paris Agreement html

15 As found on Page 57 of the consultation html

2.57. Unite would disagree with the assumption that DACCS does not have any co-production opportunities. Whilst a DACCS facility if viewed in isolation may not produce anything it can and should be used as stated above to use a waste industrial product adding co-production to that facility.

2.58. If the captured CO_2 is combined with a supply of green hydrogen to produce sustainable crude, via the Fischer Tropsch (FT)[16] process, for refining into a sustainable aviation fuel (SAF). Currently SAF is the only solution which can mitigate all of the aviation industries CO_2 emissions and significantly reduce its secondary induced cloud cover emissions. Whilst hydrogen and battery storage aircraft are still on the drawing board and will not see commercial service until 2035 at the earliest, SAF can be used today if it were available in the volumes needed. SAF does not require any changes in equipment and can in fact provide better fuel economy, further reducing aviation's impact on our climate[17]. Therefore converting the captured CO_2 to SAF would currently have a greater impact than injecting it into a CCS storage facility.

2.59. Whilst this is also true of a BECCS facility, in truth the biomass is better converted directly by the FT process rather than first converting the biomass to CO_2

2.60. Of course creating a DACCS and SAF production industry will not only create more jobs but provide a future for many existing careers in refineries and the chemical processing industry, removing their dependence on crude oil, providing the UK with a far better energy security profile than we have today allowing us to export both our technology and any excess sustainable fuel derivatives that are produced in excess of those needed for our domestic and international flights and eventually all forms of transport and machinery that currently uses fossil fuels.

Question 23: Do you have views on the applicability of the GGR business model to BECCS projects that are not eligible for the Industrial Carbon Capture or Power BECCS business models?

2.61. Unite would argue that once adjustments are made for the feedstock and transport emissions to Drax, all captured carbon should generate negative carbon credits. Equally, if there are any other BECCS projects that such projects are treated in a similar fashion. It should not matter if the net result is a net tonne[18] of CO_2 stored via BECCS, via DACCS or a nature based solution if that solution offers a very large degree of permanence, it is still a tonne of CO_2 that is not in the atmosphere, and hence should be treated in the same way. Equally, however, if a tonne of CO_2 stored escapes from a pipeline, storage facility or nature based solution then these would need to be offset against any claims of volumes captured. As it is during the transition of captured CO_2 and the leakage from stores that there is the greatest risk of escape, Unite believes that the pipeline assets should be under public ownership to maximise the spread and scope of carbon capture. Industrial processes that create CO_2 could then pay for the connection to the network and for the tonnage taken away rather than the situation where there is an open market where there is no guarantee that the captured CO_2 will not be dumped rather than injected into a salt aquifer disused well etc.

Question 24: Do you have views on the applicability of the GGR business model to novel technologies excluding DACCS and BECCS? Please outline any specific policy requirements or other considerations we should take into account.

2.62. Unite would support the development of carbon negative concrete and cement as well as the removal of CO_2 from sea water[19]. Obviously close monitoring is needed to evaluate the potential and permanence of every new technological development in the field of carbon removal with negative carbon credits

16 See the Science Direct overview html

17 See the Air BP page on SAF html

18 Once all emissions from the supply of biomass and transport are accounted for.

19 See earlier para

awarded accordingly. Unite would highlight that given the area required for forestry management, if Drax only used waste wood and waste sawdust, it is unlikely that there would be many duplications of their form of BECCS.

3. Conclusion

3.1. Unite believes that the government has failed to appreciate the duration of operation of GGR technologies, how environmentally critical they are. The proposals as outlined in this consultation further entrenches the private market and profit into decarbonisation technologies. Regardless of the model finally adopted private companies will be inoculated from risk by tax payer funding. Unite believes that if this is the case there needs to be a high degree of governmental controls in place to ensure the company does not syphon off public funds into shareholder pockets. Unite believes at the very least that the security and integrity of the CCS pipeline needs to be under state ownership and control to ensure that carbon captured is injected into a permanent storage facility and that it does not escape en-route. As the government is taking on board most of the risk involved in creating the market around GGR technologies, why wouldn't there be scope for a public stake in this industry where companies pay into the public purse for the development and use of GGR plants

3.2. The consultation references creation of "thousands of jobs", yet where is the plan and pathway for workers currently engaged in high polluting industries. Unite believes that there is a clear need to ensure a Just Transition of the workforce from their established roles into what the ILO defines as "*decent work opportunities and leaving no one behind*"[20]. Unite therefore calls on the government to live up to the agreements signed at COP 25 in Katowice re supporting a Just Transition. Unite would argue that a full evaluation needs to occur to establish where the workers for such an industry are derived from, what skills they can bring with them and therefore what training is required. It cannot be assumed that the workers will just appear. It is also far more damaging to the economy to allow an industry to fail in any community.

3.3. As seen following the closure of the coal fields the whole economy of that area was adversely impacted requiring significant governmental support to enable the workers and the economy to recover. It is far better for the workers and UK plc to ensure that workers simply transfer from one industry to the next.

3.4. It is also statistically better for a company to have a single voice to deal with, rather than numerous individuals raising the same or similar grievances. Nowhere in this consultation does it mention recognition or the organisation of the workforce, the role of trade unions role in the development of jobs, nothing concerning conditions the workers are expected to work in, their health and safety. There is nothing on the requirement for collective bargaining or ensuring that the development of the sector does not result in a race to the bottom on employment rights. The conditions, workers were and are being subjected to such a working environment, during the roll out of the government's contracts for difference, in the offshore wind industry, that their lives were and are being put at risk. This has caused several deaths and personal injuries, during their race to complete the project to the company's unrealistic time frame. Unite therefore calls for rights of access for trade unions to be enshrined, along with respect and adherence to collective agreements to be feature of the development of the GGR industry to stop this happening again and give the workforce a voice to raise concerns.

3.5. Unite would further argue that negative credits should form part of the UK ETS so that each years governmental awards of additional credits are eventually matched with the volume of carbon released thus achieving on paper at least a form of net zero. As not every tonne of CO2 released is covered by the UK ETS, however, some way will still have to go to achieve actual net zero and eventually a carbon

[20] See the International Labour Organisation definition of Just Transition html

negative society where the UK will start to undo the damage caused to the environment by the industrial revolution.

3.6. The UK was home to the beginnings of the industrial revolution which instigated an industry devoted to extracting carbon from the ground for combustion in our factories in order to create wealth. We owe it to the world to become an example of the way to correctly follow the international agreements signed at successive UNFCCC climate change talks and put our money where our mouth is to create a GGR industry that will be the envy of the world.

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