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Via email: ggr-call-for-evidence@beis.gov.uk

Greenhous Gas Removals Team
Department for Business, Energy and Industrial Strategy
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Response to UK Government – Call for Evidence: Greenhouse Gas Removals

Dear Sirs,

UKPIA represents the eight main oil refining and marketing companies operating in the UK. The UKPIA member companies – BP, Essar, Esso Petroleum, PetroIneos, Phillips 66, Shell, Total and Valero – are together responsible for the sourcing and supply of product meeting over 85% of UK inland demand, accounting for a third of total primary UK energy[1].

The refining and downstream oil sector currently lies at the heart of the UK economy. It provides a secure supply of affordable energy for road and rail transport, aviation and marine applications, as well as for commercial and domestic heating. It also supplies feedstocks for the petrochemicals sector, along with specialised non-energy products such as lubricants, bitumen for use in road surfacing, and graphite for use in electric vehicle batteries and as electrodes in steel and aluminium manufacture.

The sector, therefore, has an opportunity to be at the heart of an orderly and just transition to a Net-Zero economy. By reinventing itself, using its extensive resources to decarbonise its activities and products, the sector has an important role also in future supply of new energy carriers and technologies such as hydrogen, energy storage and carbon capture, utilisation and storage. This opportunity extends also to greenhouse gas removals (GGR), where companies such as bp, ExxonMobil and Shell are already investing in nature-based solutions such as forestry and wetlands and engineered GGR technologies such as DACCS.

[1] BEIS Digest of UK Energy Statistics (DUKES) 2019 Tables 3.2-3.4.

UKPIA welcomes the opportunity to respond to the call-for evidence to strengthen the evidence base on GGRs and on the role of government in providing incentives for development and deployment of GGR technologies in the UK over the medium- and longer-term. Our responses to the questions posed in the consultation document are given in Attachment 1.

Yours faithfully,

Dr Andrew Roberts
Director – Downstream Policy

cc:

	Michael Duggan	BEIS
	Simon Stoddart	BEIS
	Mike Mackay	BEIS

Attachment 1

UKPIA Response to Call for Evidence: Greenhouse Gas Removals

1. Do you give permission for your evidence to be shared with third party contractors for the purpose of analysis?

Yes.

2. Do you agree that some greenhouse gas removal methods will be required to achieve the UK's net zero target by 2050? What are your views on the suitability and mix of different technologies in supporting the delivery of net zero?

UKPIA believe that a wide variety of greenhouse gas removal (GGR) methods will be required to achieve the UK net-zero target by 2050 and continue thereafter.

To manage uncertainties around the performance and reliability of different GGR methods, a diverse mix of engineering and nature-based technologies will be required. Nature-based methods in particular may be susceptible to seasonal weather variation and changes in climatic conditions, whilst integrated engineering-based removals may be dependent on the level of activity present in the sector producing the CO_2 captured.

3. In relation to the GGRs listed in Figure1 (except afforestation, habitat restoration and wood in construction), is there new evidence that you can submit in relation to any of the following:

i. technology readiness levels

UKPIA has no new evidence to submit in relation in response to this question.

ii. scale-up potential (in the UK and/or globally)

The scale-up potential for GGR technologies in the UK (and for that matter globally) remains uncertain but is undoubtedly significant. Modelling carried out by Concawe, the technical body for the European refining sector, has shown that a wide range of technologies[2] [3] will be required to decarbonise liquid fuels required for difficult to decarbonise sectors such as aviation and to continue manufacture of non-energy products currently obtained from crude oil such as bitumen, chemical feedstocks, lubricants and synthetic graphite, which is increasingly important for high performance lithium-ion batteries used in electric vehicles.

Concawe have also developed a Low Carbon Pathway[4] based on the European Commission "Clean Planet for All" 1.5°C scenario[5,6]. This shows that, in

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[2] Concawe Report No. 8/19 "CO_2 Reduction technologies. Opportunities within the EU refining system (2030/2050)." (Available at https://www.concawe.eu/wp-content/uploads/Rpt_19-8.pdf.)

[3] Concawe Report No. 9/19 "Refinery 2050: Conceptual Assessment". Available at https://www.concawe.eu/wp-content/uploads/Rpt_19-9-1.pdf and https://www.concawe.eu/wp-content/uploads/Rpt_19-9A.pdf.

[4] FuelsEurope "Clean Fuels for All: EU Refining Industry Proposes a Potential Pathway to Climate Neutrality by 2050" (2020). Available at https://www.fuelseurope.eu/wp-content/uploads/FuelsEurope-Clean-Fuels-for-All-Final.pdf.

[5] EC Communication COM/2018/773 "A Clean Planet for all. A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy" (available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0773).

[6] EC Report "In-depth analysis in support on the COM(2018) 773: A Clean Planet for all - A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy" (available at https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf).

combination with electrification and hydrogen, road transport can reach Net-Zero emissions and aviation and marine transport can achieve a 50% reduction in GHG emissions by 2050.

Drawing from the Concawe studies, UKPIA sought to provide an illustrative pathway for the UK refining and downstream oil sector in its report "Transition Transformation and Innovation" (UKPIA TTI Report), published in October 2020[7,8]. The six UK refineries currently represent around 12% of European refining capacity. Progressive decarbonisation of refinery processes and substitution of crude oil with biomass feedstocks, together with implementation of limited e-fuel production using captured refinery CO_2, shows the potential for a significant reduction in emissions both from production and use of liquid fuels, although residual emissions will require CCUS (with some potential for BECCS) and other GGR measures. Key details from this pathway, identifying the potential for GGR to mitigate against remaining emissions from refining and use of products (including transport emissions) are given in Table 1.

Table 1. Feedstocks, production and emissions from illustrative pathway

	2020	2050
Feedstocks, mt/year		
Crude oil	58.9	2.43
Bioethanol	0.60	0.07
Lipids	1.52	6.45
Biomass	0.00	8.40
Captured CO_2	0.00	8.19
Production, mt/year		
Petrol and petrochemical feedstocks	23.2	1.34
Jet fuel and middle distillates	27.7	7.82
Emissions, mt/year		
Refinery site – total[1]	11.6	1.44
Product use (transport fuel, combustion)[1]	153	20.5
CO_2 used for e-fuels[1]	0.00	-2.59
CCUS and GGR[1]	0.00	-19.3

Note 1. Includes emissions derived from biomass and waste-derived feedstocks.

There are clearly many different potential pathways to Net-Zero, with progress determined by many factors, including biomass availability, development of circular economy and availability of waste feedstocks, availability of green and blue hydrogen and renewable electricity and the capacity and utilisation of CCUS transport and storage facilities, which have finite capacity.

[7] UKPIA "Transition, Transformation and Innovation: Our role in the Net-Zero Challenge" (2020). Available at https://www.ukpia.com/media/2501/ukpia-transition-transformation-and-innovation-report.pdf.
[8] The illustrative pathway is based on case LBE from Concawe Report No. 9/19.

iii. costs per tonne of CO_2 removed, including any additional information about cost savings per tonne for removals "in bulk" (where possible, please provide evidence for cost breakdowns across the various elements e.g. capture costs, transport and storage costs)

Concawe recently published an overview of carbon capture technologies in its report "Technology Scouting – Carbon Capture From Today's to Novel Technologies"[9]. This considers various techno-economic factors such as carbon capture efficiency/rates, purity, cost of CO_2 capture levelised cost of electricity and risks and barriers to assess the near-term and emerging carbon capture technologies.

iv. constraints to deployment;

See response to Question 3 iii.

v. ability to verify removals, taking into account considerations of permanence of removal (i.e., how accurately can you measure the amount of CO_2 removed and stored by this method);

UKPIA has no response to this question.

vi. lifecycle emissions for these methods in the UK (please specify any assumptions as part of this calculation, for example the carbon intensity of the electricity being used. If you are assuming a lower carbon intensity than the modern grid, why?);

UKPIA has no new evidence to submit in relation in response to this question.

vii. wider environmental impacts and risks.

UKPIA has no new evidence to submit in relation in response to this question.

4. Is there any evidence you would like to submit in relation to other nascent GGR methods not outlined in Figure 1? If so, please provide a clear description of the method and the evidence available in respect to the categories listed above, including deployment potential in the UK. If evidence is not available, please outline why and when it might become available.

UKPIA has no new evidence to submit in relation in response to this question.

5. What do you consider to be the main barriers to the development and deployment of GGRs?

UKPIA is currently focussed on the potential for refinery CCUS and hydrogen production and supply and has not considered at length the development and deployment of GGR technologies for mitigation of residual refinery and transport emissions. However, the five main barriers identified in Chapter 2 of the consultation document are clearly significant and mirror many of those found for deployment of industrial CCUS and development of blue hydrogen production and supply at scale.

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[9] Concawe Report No. 8/20 "Technology Scouting - Carbon Capture: From Today's to Novel Technologies". Available at https://www.concawe.eu/wp-content/uploads/Rpt_20-18.pdf.

6. What principles would you like to see included in a framework for incentivisation of greenhouse gas removals?

In addition to the six principles identified in Chapter 2 of the consultation document, UKPIA believe sustainability to be important as many of the resources used by GGR technologies are themselves finite resources. Use of a system-based approach to decarbonisation, including potential use of GGRs is strongly supported.

7. What specific policy mechanisms could the government consider to incentivise (a) innovation and (b) initial deployment? Could any of the policy options outlined above be designed in a way that stimulates investment in innovation, including pilots and demonstrators for less mature technologies?

The policy mechanisms required to provide incentives for innovation and deployment of GGR technologies will depend on the nature of the technology, scale of GGR and level of investment required to support the planned deployment. Comments on specific policy options identified in the consultation document are as follows:

Tax incentives. Tax incentives, such as the 45Q scheme in the USA, have proved successful in bringing forward large-scale CCUS projects. The 45Q scheme in particular provides a stable and predictable value for captured carbon and has the advantage that it is not subject to the same potential volatility of carbon markets or carbon trading mechanisms. At the same time, the value is high enough to be able to support investment in CCUS in a variety of energy-intensive industry sectors[10].

The design of such tax incentive schemes is important to provide certainty for long-term projects, whose commercial viability may be dependent on the support provided. They may therefore require long term policy commitments to mitigate against political risk and changes in policy resulting from potential changes in government.

As set out in the UKPIA TTI Report[7], a major transformation in the refining and downstream oil sector will be required to deliver Net-Zero, with significant investment over a sustained period, at a time when demand for petrol and diesel will decline and competitiveness come under threat due to over-capacity and low levels of utilisation. In this situation, incentives such as tax credits may be insufficient to provide support for CCUS and GGR when earnings before interest and tax (EBIT) are depressed.

Obligations. Fuel suppliers have been obligated under The Renewable Transport Fuel Obligation (RTFO) to blend renewable fuel components into petrol and diesel/gas oil or to pay a buy out fee. To date, there has been no significant buy-out from the RTFO, as it has been cheaper to supply biofuels or purchase renewable Transport Fuel Certificates (RTFCs) than pay the buy-out price (increased from 30p/litre to 50p/litre from 1st January 2021). The fuels market is highly competitive and since all suppliers have been obligated, the additional costs incurred by fuel suppliers in meeting their obligations are likely to have been passed on to consumers.[11]

Although the RTFO has supported incorporation of renewable components in transport fuels, it would be difficult to manage an obligation placed on fuel wholesalers to compensate for a percentage of the CO_2 content of the fuel they sell in the UK, due to

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[10] Global CCS Institute, The US Section 45Q Tax Credit for Carbon Oxide Sequestration: An Update". Available at https://www.globalccsinstitute.com/wp-content/uploads/2020/04/45Q_Brief_in_template_LLB.pdf.

[11] Department for Transport Consultation "Increasing the Renewable Transport Fuel Obligation buy-out price to ensure continued greenhouse gas savings" - see https://www.gov.uk/government/consultations/increasing-the-renewable-transport-fuel-obligation-buy-out-price-for-biofuels-suppliers/increasing-the-renewable-transport-fuel-obligation-buy-out-price-to-ensure-continued-greenhouse-gas-savings.

the complexity of fuel supply operations and difficulty in determination of CO_2 content at the point of delivery. (See also response to Question 27.)

Payments and Service Contracts. UKPIA note that contracts-for-difference (CfD) business models are currently under development by BEIS for industrial CCUS and hydrogen production. Similar mechanisms are likely to prove suitable for GGR using engineered large-scale GGR projects, where the technologies are similar and where the same project risks are likely to be encountered. However, cross-policy impacts must be considered carefully, for example, on carbon leakage protection (allocation of free allowances) under the UK Emissions Trading Scheme (ETS), to avoid adverse impacts on competitiveness.

Cap and trade. In principle, UKPIA believe negative emission certificates could be considered by a broad range of GGR technologies as part of a revised UK ETS, but this should not be considered if this compromises potential linkage of the UK ETS to the EU ETS or other emissions trading schemes.

Voluntary Private Sector Action. UKPIA member companies such as bp, ExxonMobil and Shell are already investing in nature-based solutions such as forestry and wetlands and engineered GGR technologies such as DACCS, to offset emissions from their activities and to deliver against corporate net-zero and sustainability objectives.

UKPIA agree there is a potential role for government in supporting more companies to make similar commitments in the UK by promoting voluntary offset markets, with the potential to use offsets in meeting compliance obligations under emission trading and other policies. However, we believe the need for robust monitoring, reporting and verification of emissions (including negative emissions) should also be addressed through global initiatives to ensure greater consistency and accountability in corporate reporting and to avoid multiple reporting requirements, imposing unnecessary administrative burden and potential conflicts in corporate reporting requirements.

8. How could government best contribute to establishing optimum market conditions for GGRs to be developed and deployed at a large scale?

As mentioned in the response to Question 5, at this stage in the energy transition, UKPIA is focussed on the potential for refinery CCUS and hydrogen production and supply and the business models required to support large scale deployment of these technologies. Early success with such projects, in particular CCUS, would provide insights into the optimum market conditions for development and deployment of large scale GGR projects.

9. How might the role of government change over time to bring GGR technologies to market and encourage their deployment up to 2050?

For GGR technologies at lower levels of technology readiness, the role of government and policy mechanisms required to provide incentives for continued development and initial deployment may well be different. Grant funding may be most appropriate for development early-stage technologies (e.g. TRL 3-6), with joint government/industry funding for later-stage demonstration and first-of-a-kind projects (e.g. TRL 7-8), where the BEIS Energy Innovation Programme competition-based approach has brought forward a number of promising projects. At later stages and deployment at scale, some of the policy options considered in the consultation document, in particular CfDs, may be more appropriate. (See also response to Question 7).

10. Which factors should be considered when assessing the suitability of different policy options for businesses?

UKPIA believe a wide variety of factors should be considered when assessing the suitability of different policy options to provide support for business investment in GGRs. These include (in no particular order of priority):

- Cost-effectiveness e.g. cost/tCO_2e removed
- Sustainability of the business model
- Risk levels and risk mitigation (technological, financial and political)
- Resource utilisation and alternative use (potential for disruption of circular economy)
- Environmental impacts and sustainability
- Energy intensity compared to alternative options

11. Are there any existing business models in other sectors – such as power, industry, transport or land use – that could complement new schemes to incentivise GGRs?

See response to Question 7 regarding CfDs.

12. Are price instruments or quantity instruments likely to be more effective in encouraging and sustaining deployment of GGRs? Or will a combination be required?

The choice between price and quantity instrument or a combination of the two will depend on the type of GGR technology under consideration and the scale of deployment – see also response to Question 7.

13. How far should a policy framework aspire to be technology-neutral between different GGR options?

Although UKPIA has been a strong supporter of technology-neutrality in the development of other decarbonisation policies, there is a case for targeted policy support for GGR technologies with lower TRLs to bring these closer to commercial and technical realisation.

14. Could wider support for GGRs have any unintended effects on the development and commercialisation of technologies in other sectors, and how could this be mitigated?

See response to Question 7. UKPIA has particular concerns regarding the proposed forfeit of free allowances under the CfD business model currently under consideration for support of industrial CCUS, which has the potential to undermine carbon leakage protection afforded through the allocation of free allowances under the ETS.

15. Are there any international examples that have proved effective at incentivising GGRs? Why were they effective, and are there any barriers to taking similar action in the UK? Are there examples of international approaches that have not worked well?

UKPIA has no knowledge of examples of policy measures from other countries that have proved effective in providing incentives for GGR, except for those identified in the consultation document (in particular the 45Q scheme in the USA.

16. Should the government introduce a tax credit, and if so, how should this be designed? Should it be provided only for specific GGR technologies or a broad range of methods? Would multiple, specific rates be effective at incentivising as much investment as possible?

Some of the disadvantages associated with tax credits have already been identified in our response to Question 7, although these are more specific to medium- to large-scale investment in engineered GGR technologies. Tax credits may be more appropriate for small-to medium-scale land- and nature-based projects in the UK, for example, biochar, enhanced weathering, afforestation, habitat restoration and soil carbon sequestration.

Although the focus of the consultation is to identify ways in which government can support investment in GGR, there is also a need for development of sustainable business models for land- and nature-based technologies, perhaps through combination of tax incentives with support for development of a robust and transparent offset market.

17. Should participants from specific sectors with historical carbon emissions be eligible to apply for the credit or should the credit be economy-wide?

UKPIA believe eligibility for tax credits should be economy-wide but targeted at specific GGR technologies as outlined in the response to Question 16.

18. If the government were to introduce a GGR obligation scheme, which businesses and emitting sectors could this cover? How could such a scheme be designed to minimise competitiveness impacts and regressive passed-through costs (e.g. to consumers and bill-payers)?

UKPIA does not support use of an obligation scheme for GGR – see response to Question 7.

19. What other regulatory approaches could government explore to incentivise GGR deployment?

UKPIA has a strong preference for support mechanisms rather than use of regulatory approaches to bring forward investment in GGR.

20. What are the merits and risks of introducing payment schemes for GGRs, potentially involving up-front grants or payments for each tonne of CO_2 stored? Which GGRs would be suitable for a payment scheme?

As observed in the response to Question 7, contracts-for-difference (CfD) business models are currently under development by BEIS for industrial CCUS and hydrogen production. Similar mechanisms are likely to prove suitable for GGR using engineered large-scale GGR projects, but simpler payment or contract schemes may also be suitable for land- and nature-based GGR technologies.

21. Could a contract scheme be effective in incentivising GGRs such as DACCS and BECCS? What would be the main challenges and limitations of such a mechanism, and how could it be designed to maximise its effectiveness?

Again, as mentioned in the response to Question 7, contracts-for-difference (CfD) business models are currently under development by BEIS for industrial CCUS and hydrogen production. Similar mechanisms are likely to prove suitable for GGR using DACCS and BECCS, where the technologies are similar and where the same project risks are likely to be encountered. However, a number of additional challenges and limitations are likely to be found, including policy sustainability (who pays?), competition for biomass from alternative uses and use of finite storage capacity.

22. What could a cap-and-trade scheme for negative emissions look like, and which sectors would you propose to be included in such a market?

In principle, UKPIA believe negative emission certificates covering GGR delivered by a broad range of technologies as part of a revised UK ETS. However, for practical reasons, the sectors eligible for use of such certificates may be limited initially to those currently covered by the UK ETS. If the scope of the ETS is expanded to cover for example, road transport and space heating, use of the certificates by energy suppliers to these sectors to cover energy use would require careful consideration.

23. The costs of different GGR technologies vary significantly. How could a cap-and-trade system address these differences? How could a cap-and-trade system be used to incentivise initial investment in any future emerging GGR technologies over a long-term trajectory?

In view of the varying cost/tCO_2e captured for different GGR technologies, it is difficult to see how allocation of negative emissions certificates alone could provide an incentive for investment across a wide range of GGR technologies. Rather, this approach could be used to offset the cost to government for payment and service contract schemes tailored to specific GGR technologies, as the certificates would have a value to emitters covered by the cap-and-trade scheme (more specifically, the UK ETS).

24. What role can government play in encouraging more companies to make voluntary commitments to invest in GGR technologies in the UK? To what extent can this support innovation in, and deployment of, these technologies?

UKPIA is unclear what role government can play in encouraging more companies to make voluntary commitments to invest in GGR technologies in the UK, or what this could achieve in supporting innovation and deployment of these technologies. The companies that have made such voluntary commitments have made strategic decisions to do so, demonstrating their commitment to the energy transition and Net-Zero.

25. What are your views on the government's intention to coordinate deployment of GGR technologies such as DACCS and BECCS in line with our stated CCUS ambitions, and how could we best do this?

See response to Question 8.

26. What principles would you wish to see in any accreditation scheme for negative emissions? How should the government regulate this? Any evidence relating to best practice of existing negative emissions MRV is welcomed.

As a matter of principle, monitoring, reporting, verification and accreditation (MRVA) activities for negative emissions must be robust. The EU and UK ETS provide examples of where robust regulation has been implemented, although negative emissions introduce greater complexity. Carbon accounting and verification of claimed carbon savings for low carbon products is of increasing importance but is also becoming extremely complex.

This has been recognised in early steps taken in decarbonisation of refining activities, in particular with the introduction of biogenic and waste-derived feedstocks, substituting crude oil. Such alternative feedstocks can be co-processed with crude oil through the whole of the refining process or co-processed with intermediate products through specific refinery units. Molecules originating in these feedstocks are likely to be found in most product streams and internal fuels used in the refinery. Quantification of the proportion of "renewable" molecules present in the finished products is likely to prove nigh on impossible, with mass balance or averaging methods the only options available.

Despite these difficulties, CCUS applied to refinery emissions from combustion of refinery fuel gas containing components of biogenic origin will result in a proportion of negative emissions. For example, where lipids are co-processed with crude oil to produce propane and hydrocarbons indistinguishable from diesel or gas oil produced from crude oil, if the propane produced is used for combustion and the emissions captured, this results in negative emissions. In this case the negative emissions can be quantified on a mass balance basis, but carbon accounting for product streams likely to be dependent on averaging methods.

27. What are the most significant barriers to developing a robust monitoring, reporting and verification system for GGRs?

Issues with carbon accounting have already been briefly explained in the response to Question 26, but there are further challenges in monitoring and quantifying CO_2 stream flow rates seen in refining applications such as fluid catalytic cracking units (FCCs)[12]. Similar measurement challenges are likely to be found for other CO_2 streams.

[12] Concawe Report No. 10/04 "Guidance document for application of the EU Commission's guidelines for monitoring and reporting of GHG emissions", (2004). Available at https://www.concawe.eu/wp-content/uploads/2017/01/rpt_04-10-2004-02155-01-e.pdf.