Consultation response

Clean Air Strategy 2018

Department for Environment
Food & Rural Affairs

Energy Systems Catapult welcome the wide-reaching approach to tackling air pollution as set out in the consultation document 'Clean Air Strategy 2018'.

Energy Systems Catapult carries out expert and independent 'whole systems' analysis of the UK's transition to a low carbon future and we advise key stakeholders including the Department for Business, Energy and Industrial Strategy (BEIS) and the Committee on Climate Change (CCC).

We welcome the emphasis in the proposed strategy on realising opportunities to mitigate climate change and reduce air pollution together. The synergies between these two objectives should be fully reflected in the design of policies and incentives in energy production, transport, and agriculture. Our response highlights evidence relating to two specific potential opportunities to simultaneously reduce greenhouse gas (GHG) emissions and improve air quality.

- **Clean synthesis gas (syngas)** derived from biomass and waste is suitable for use across multiple vectors such as power generation, heat, and production of chemicals, hydrogen and fuel. In addition, the increased efficiencies (only available at smaller scales <15 MWe) in combusting clean syngas compared to conventional incineration of waste not only results in reduced GHG emissions per unit energy, but there is also an associated reduction in air pollution because of the syngas cleaning process which capture particulates before combustion.[1]
- The development and commercialisation of **Carbon, Capture and Storage (CCS)** can provide opportunities on two levels to simultaneously reduce GHG emissions and air pollution:
    1. Direct removal of pollutants: the CCS process also removes and treats non-CO_2 components.
    2. Substitution of fuels: CCS derived hydrogen for hydrogen fuel cell trains and heavy goods vehicles (HGVs) could substitute the use of diesel and therefore lowers the release of pollutants.

We provide further details of the technical, scientific, and economic evidence which underpin these observations in our response to specific consultation questions. Much of this draws on the body of evidence created by ten years of investment in knowledge building activities by the Energy Technologies Institute (ETI) in collaboration with a wide range of commercial and academic partners. Further details and advice relating to all underlying evidence can be provided by staff of either Energy Systems Catapult or the ETI.

Yours faithfully,

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RESPONSES TO CONSULTATION QUESTIONS

Q7. What do you think of the package of actions put forward in the clean growth and innovation chapter? Please provide evidence in support of your answer if possible.

1. We welcome the proposal for a cross-departmental review into the role of biomass in future policy for low carbon electricity and heat, focusing on the air quality impacts. We would draw attention to the evidence from the ETI's bioenergy programme and whole system analysis of the high value of biomass-based energy for UK decarbonisation, particularly in combination with carbon capture and storage technology (which can also reduce air quality impacts). The extremely high potential value of sustainable biomass for decarbonisation is set out in a range of documents published by the ETI.

2. We are doubtful of the case to make coal to biomass conversions ineligible for contract for difference, because they can play an important role in enabling the build-up of sustainable biomass supply chains in relevant areas and the demonstration of Bioenergy and Carbon, Capture and Storage (BECCS) technologies. Support for biomass conversions could simply be made conditional on the adoption of best practices to ensure air pollution targets are met.

3. We support the proposal to consult on excluding biomass from the RHI if installed in urban areas that are on the gas grid. Biomass boilers have the greatest potential to reduce carbon emissions if replacing coal or oil. The emissions savings relative to gas is much lower. However, there should be an exception for biomass boilers used for district heating, provided that they are able to demonstrate an appropriate approach to mitigating air pollution. Particulates from biomass boilers can be minimised by automating the boiler operation, sizing it correctly, and installing a hot water tank as storage for peak times (this allows the boilers to operate at a more even rate which produces lower levels of pollutants than frequent ramping up and down or switching on/off). In addition, owners must use the correct fuel and ensure the boiler is regularly serviced. There is also an opportunity for technical innovation, e.g. filters[2], as well as improvements installer/user knowledge.

Q10. In your view, are the priorities identified for innovation funding the right ones?

4. We believe that there is an extremely strong case to increase innovation funding directed towards the development of:
   - Clean synthesis gas (syngas) technologies, and
   - Carbon capture and storage technolgoes (CCS).

5. Both of these technologies can deliver both air quality and decarbonisation benefits and should therefore feature in the BEIS/UKRI priorities for clean air innovation (in addition to their decarbonisation potential).

6. Clean syngas via gasification can utilise both biomass and waste resources. It also provides a pathway to the medium-term development of technologies capable of developing clean energy (e.g. hydrogen produced through biomass gasification) for multiple applications across power, industry, heat, and transport.

7. Compared with other technologies, especially at smaller scales, clean syngas permits the use of higher efficiency generating processes such as engines and gas turbines. There is also innovation headroom to increase efficiencies further. At the current innovation level, the extra financing required for larger scale gasification plants with syngas cleaning has been shown to be difficult to acquire and/or service.[3] Clean syngas derived from biomass and waste has uses across multiple vectors:
   - to generate power in an engine or gas turbine with heat as a by-product that may be used to deliver heating via district heating.
   - to make hydrogen or jet fuel (and a number of other fuels and chemicals) through chemical and/or biological process.

   In addition, clean syngas derived from biomass has near zero particulate matter emissions as the particulates are filtered out during the cleaning process. There is also opportunity to half the NOx emissions during combustion for a given output by increasing the hydrogen content of the syngas

mixture to the same level as methane.[4] Finally, the gasification has the potential for integration with CCS through pre-combustion capture, which yield added benefits as discussed in the general points up front. The ETI and Kew Tech-funded Sustainable Energy Centre (SEC) are constructing a plant to demonstrate syngas cleaning technology at a commercial scale and will generate electricity via syngas combustion in an engine.[5]

8. CCS also has a potential role in improving air quality in two areas, in addition to its decarbonisation benefits.

   Direct removal of pollutants:

   In addition to emitting CO_2, combusting fossil fuels produce contaminants that vary depending on the fuel used. Generally, light fossil feedstocks such as natural gas will produce fewer and less pollutants and heavier feedstocks such as diesel, fuel oil, coal or waste that produce SO_2, NOx, PM, and NMVOC. CCS removes not only CO_2, but reduces other pollutants, thereby reducing air pollution.[6]

   For example, combustion of natural gas in unabated gas fired power stations (CCGTs) is limited by NOx, CO and VOC emissions. It is possible to fit NOx reduction equipment in CCGTs, and this is practiced in key markets around the world, but not generally in the UK. One common technical solution is to add ammonia (which is also a pollutant) to the hot flue gas, which converts the NOx to N_2 over a catalyst. The application is demanding, because increasingly CCGTs are constantly changing load, making potential slippage of ammonia or NOx a managed issue. A current design (2016) of CCGTs with CCS[7,8] for the UK, which will operate at steadier, higher loads, removes NOx before CO_2 capture (this is effective in reducing degradation of the amines used in the CO_2 capture process). Additionally, an acid wash is fitted to reduce light amine emissions to values where they are negligible when compared to amine emissions from other sectors, for example, agriculture. Further, useful quantities of heat can be extracted from the CCS plant for use in district heating. Since this comes from an abated plant, this heat is clean when compared to heat from a gas fired combined heat and power (CHP) plant and heat from burning waste. This is just one example of how CCS provides an opportunity, if understood at the beginning of projects, to improve air quality 'at scale'.

   Combustion of heavier fossil feedstocks creates bigger problems than natural gas in both the energy generation and industrial sectors. Large emission sources in industry, such as steel, chemical and cement can also be cleaned using technology developed for CCS. In the solid fuel energy generation market, as coal becomes retired as a fuel, the largest energy from waste plants become potential candidates for CCS.

   Substitution of Fuels with Hydrogen:

   Combusting heavier fossil fuels, biomass and waste produces air pollution containing a number of pollutants depending on the fuel content. Hydrogen produced from natural gas with CCS (and appropriate environmental devices), could be used in the latest hydrogen fuel cell vehicles and to decarbonise the gas grid[9], producing only water as a 'waste' product at the point of use. Not only resulting in a reduction of CO_2 emissions, but reducing other negative externalities from diesel (e.g. PM and NO_2) in trains[10] and HGV[11], improving air quality 'hot spots' in conurbations such as trunk routes and train stations. A large CCS facility, improving air quality at scale, and distributing clean fuels for smaller users, is therefore an enabling technology and piece of infrastructure for reducing air pollution.

   As promoted by H21 Leeds project, hydrogen could also be used in smaller natural gas burners, including domestically, but NO_2 emissions will need to be addressed.[12]

Q11. What do you think of the package of actions put forward in the transport chapter? Please provide evidence in support of your answer if possible.

9. We suggest that for maritime the introduction of in-port power supplies allowing ships to turn off their on-board diesel generators, which enables a reduction in GHG emissions through fuel savings, but also importantly reducing the amount of pollutants emitted in ports.[13]

Q16. What do you think of the package of actions put forward in the farm chapter? Please provide evidence in support of your answer if possible.

10. Reducing air pollution emissions from farms should align with the broader opportunities available in both the Industrial and Clean Growth Strategies. The synergies between practices that address both GHG emissions and air quality need to be better understood across the farming sector to enable the development of best available practices. The design of incentives under the new agriculture policy (replacing farm support under the Common Agricultural Policy) should take account of the value of both climate change and air quality benefits for practices which deliver both.

Q18. Should future anaerobic digestion (AD) supported by government schemes be required to use best practice low emissions spreading techniques through certification? If not, what other short-term strategies to reduce ammonia emissions from AD should be implemented? Please provide any evidence you have to support your suggestions.

11. We agree with the proposal to require future anaerobic digestion (AD) plants to spread digestate in accordance with best available techniques is sensible. However, if the new rules on spreading only apply to digestate (but not slurries and manures) and require investment in new spreading equipment, then we are concerned this could make the business case for new AD plants on farms uneconomic. If so, this could have an overall negative impact on air quality and GHGs because farmers choose instead to dispose of slurries/manures directly (and not necessarily according to best practice).

12. Biomass crops should not be purposely grown for use in anaerobic digestion, because they are likely to struggle to meet GHG thresholds, due to large cultivation emissions and assumed 3% methane slip in biogas production and upgrading ('conversion emissions').[14] However, there are other more efficient crops that could instead be grown for energy, for example, Miscanthus and Short Rotation Coppice Willow.[15]

Q27. Are there gaps in the powers available to local government for tackling air problems? If so, what are they?

13. While the Clean Air Strategy does have some suggestions and actions on how local authorities can improve air quality, it is lacking the detail and defined timelines required from central government to enact them. More broadly, there is a gap in the powers that local authorities (LA) have for tacking air quality issues, which fundamentally is the result of a lack of framework for LAs to work within to develop their own clean air strategies.

    LAs will also require funding to carry out initiatives to improve air quality such as the replacement of high emitting public transport (e.g. local buses, waste collection vehicles) with cleaner alternatives.

    In addition, LAs will require new powers to restrict the introduction of sources of pollution such as biomass CHP, biomass boilers and wood-burning stoves. For larger installations, this could be done through the planning process. Cleaner, low-carbon alternatives to fossil-fuels for heating can be identified by Local Area Energy Planning (LAEP).[16] Energy Systems Catapult has been working with Bury Council with their LAEP, which restricts the development of biomass boilers due to the potential detrimental impact on air quality. Bury has also seen improvements in air quality from the low carbon transition, which sees emissions being cut from burning gas across the entire town, the air quality benefits of which are estimated to have a value of £10m-£16m.[17]

References.

1 ETI (2017). Targeting new and cleaner uses for wastes and biomass using gasification [online].

2 Supergen Bioenergy [online].

3 ETI (2017). Targeting new and cleaner uses for wastes and biomass using gasification [online].

4 GE Power Systems. IGCC Gas Turbines for Refinery Applications [online].

5 For more information on the ETI's demonstration project visit waste gasification project page and Kew's website.

6 European Environmental Agency (2011). Carbon capture and storage could also impact air pollution [online]

7 ETI (2017). Final Project Report: Thermal Power with CCS [online].

8 Shell (2016). Peterhead CCC Project [online].

9 For example, see Keele University's HyDeploy project and Cadent's Liverpool-Manchester Hydrogen Clusters project.

10 Alstom (2017). Alstom's hydrogen train Coradia iLint first successful run at 80 km/h [online].

11 Toyota (2017). Toyota's Heavy-Duty Fuel Cell Truck Finally Hits the Road [online].

12 Leeds City Gate (2017). H21 [online].

13 Ricardo Energy & Environment (2018). Study of ship emissions whilst at berth in the UK [online].

14 ETI (2015). Bioenergy: Delivering greenhouse gas emissions savings through UK bioenergy value changes [online].

15 ETI (2015). Bioenergy: Delivering greenhouse gas emissions savings through UK bioenergy value changes [online].

16 For more information: Energy Systems Catapult (2018). Local area energy planning – driving clean growth [online] and, ETI. EnergyPath Network™ [online].

17 Energy Systems Catapult (2018). Local Area Energy Planning: Policy and Commercial Insights for Energy System Transformation for Bury Council.