Appendix 3: Gas Fired Combined Heat and Power (CHP) Advice note for developers in Cambridge and South Cambridgeshire on reducing the impact on Air Quality

Background

1. Combined Heat and Power (CHP) is the co-production of electricity and heat and is considered to be a low carbon technology.

2. Policies 28 and 29 of the Cambridge Local Plan (2018) and policy CC/3 of the South Cambridgeshire Local Plan (2018) are committed to sustainable design and construction with all developments being designed to minimise carbon and other greenhouse gas emissions. Gas fired CHP is a low carbon technology and may be a viable solution for meeting these policy requirements. However despite these benefits, CHP can lead to a localised worsening of air quality as fuel combustion gives rise to air pollutants if not correctly specified, installed and maintained.

3. The city has an Air Quality Management Area (AQMA) for nitrogen dioxide (NO_2) as levels exceed health based standards as agreed with the EU. The AQMA extends across much of the central part of the city[67]. The Air Quality Action Plan (AQAP) 2018 - 2023[68] outlines measures to improve and maintain air quality across the city despite pressures from continued growth. Some of these measures will be delivered via the planning process. Air quality issues within South Cambridgeshire have been linked directly to the volume of traffic that runs through the district, specifically along the A14. The A14 is congested on a regular basis between Bar Hill (to the west of Cambridge) and Milton (to the north north-east of Cambridge). This has resulted in the declaration of an Air Quality Management Area (AQMA) for nitrogen dioxide (NO2) and PM10 along a stretch of the A14 between Bar Hill and Milton.

4. There is no single piece of legislation that covers the installation of CHP systems and their associated emissions. This advice note assumes that the installations discussed fall outside the scope of wider regulatory control such as Part 'A' and 'B' permitted industrial process (>20MW_{th})[69]. The Medium Combustion Plant Directive (MCPD) came into force in 2018. All existing and new plant between 1-50 $MW_{th;}$ will need to be registered and meet set emission limits. Although this is regulated through the Environment Agency impact on air quality will continue to be assessed through the planning process.

[67] www.cambridge.gov.uk/air-pollution
[68] www.cambridge.gov.uk/air-quality-action-plan
[69] www.cambridge.gov.uk/industrial-licences-and-permits

5. As part of the planning process it is important to consider impacts on air quality not only within and near the boundary of the AQMA but also in areas undergoing extensive development. The emissions from CHP should be considered alongside the wider emissions associated with the development such as plant installation, traffic impacts and where relevant the potential for cumulative impact of multiple CHP plants in a small geographical area, which could lead to localised hotspots of poor air quality.

6. This advice note focusses solely on gas fired CHP and therefore assumes that the pollutants of interest are nitrous oxides (NO_x). If fuel sources other than gas are being considered please contact the Environmental Quality & Growth team at Cambridge City Council or the Air Quality Team at South Cambridgeshire District Council [70] as soon as possible to discuss the implications. In these cases installations may fall under other regulatory regimes and other pollutants such as particulate matter (PM) and sulphur dioxide (SO2) may need to be considered.

7. The use of biomass CHP should be very carefully considered due to the potential impact on air quality within the local area. The use of biomass combustion is unlikely to be supported within an AQMA or where it may impact on residents unless it can be clearly demonstrated that there will be no adverse impact on air quality. Consideration will also need to be given to the responsible sourcing of biomass fuel and of the transportation impacts of fuel delivery.

Minimising Emissions

8. It is important to give thought to the design and specification of the system including potential emissions early in the design phase. This will minimise the conflict that gas fired
9. CHP can have with wider air quality issues on the area and help overcome any concerns regarding the health impacts of the proposed development. This advice note has been developed to assist with this process.

10. All CHP installed will meet the following emission standards. This will be secured through a planning condition:
    - Spark ignition engine: less than 150mgNO_x/Nm^3
    - Compression ignition engine: less than 400mgNO_x/Nm^3
    - Gas turbine: less than 50 mg NO_x/Nm^3

[70] Email: egg@cambridge.gov.uk; Tel: 01223 457900, Email: Air.quality@scambs.gov.uk; Tel: 03450 450063

11. Giving thought to the wider environmental impacts of the system early on and ensuring the system is optimised for the proposed use not only helps reduce issues later on, but also helps minimise costs. The retrofitting of abatement equipment at a late stage is likely to be far more costly than giving time and consideration at the planning stage.

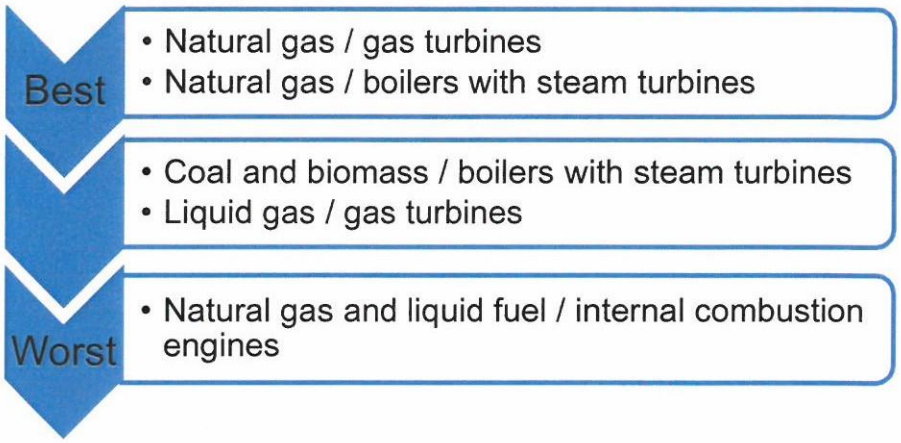
12. The impact on air quality will depend on many factors including emissions, size and type of plant, flue design and dispersion, what it is replacing, whether it represents intensification of site and whether abatement equipment will be installed. The emissions from CHP should be considered alongside other emissions associated with the development including additional plant installation and traffic impacts.

Type and Design of the Plant

13. The plant consists of the prime mover which provides the power for the system, electrical generator and heat recovery equipment (this captures waste heat from the prime mover most often for use as heating and hot water (HHW)). CHP can also include cooling. In this case it is known as combined cooling, heat and power (CCHP) and the design will then include absorption chillers.

14. The type of prime mover has a major impact on the emissions of a system with standards applying to this and not the CHP system as a whole. The two most common prime movers used for gas fired CHP are the internal combustion engine and the gas turbine. Gas turbines produce the lowest emissions and are the most electrically efficient of the two, with modern gas turbines typically incorporating low NO_x burners as standard. They are therefore unlikely to require further abatement features to be in line with emission standards. The combustion engine typically has higher NO_x emissions and should be specified with lean burn technology. Catalytic converters can be installed to reduce NO_x emissions but require further capital outlay. Figure 1 below gives an indicative look at common prime movers and relative NO_x emissions.

Figure 1: Indicative Relative NO_x Emissions Performance of Common CHP Prime mover Technology/Fuel Combinations[71]



15. CHP is typically sized to meet base loads; over-specified systems run less efficiently and produce higher emissions. How the system will deal with variable heat loads is also an important part of the design which again will influence emissions. Will it have a heat store or will peaking plant be used? Where peaking plant is installed, emissions should also be considered; and low NO_x boilers in line with BREEAM should be installed to minimise the emissions of the wider development.[72]

Dispersion of Emissions

16. Consideration should be given at an early stage to the location and the height of the chimney or flue serving the CHP plant. Ideally the chimney should be designed as high as possible to aid dispersion and consideration should be given to the height of surrounding buildings and the impact they may have on dispersion.

17. Under the Clean Air Act (CAA) 1993 details of all new 'furnaces' installed should be submitted to the Local Authority. In some cases a chimney height calculation will need to be completed. For further information visit the Cambridge City Council website at: www.cambridge.gov.uk/chimney-height-approval.

[71] CHP: Air Quality Guidance for Local Authorities; EPUK 2012
[72] Appliances that meet a dry NOx emission rating of 40mg/kWh – BREEAM (www.breea,org)

18. Dispersion modelling may be required for some developments; particularly those within or adjacent to the AQMA or larger developments outside the AQMA. This may form part of an Air Quality Assessment or be standalone depending on the scale and wider air quality impacts of the development over and above those of the CHP installation. Please see both the Air quality in Cambridge: Developer's Guide[73] and 'Land Use Planning and Development Control: Planning for Air Quality'; IAQM 2017 (or as superseded) for further information on when an Air Quality Assessment will be required.

Conclusion

19. It is important to consider the design of the proposed CHP system at an early stage. This should include:
    - Consideration for the type of prime mover and system design to minimise emissions
    - Will further abatement equipment be required to meet emission standards?
    - Has consideration been given to the flue design and dispersion of emissions?
    - Depending on the scale and location of the development will dispersion modelling be required?

20. This information is typically available in the manufacturer's specification and as part of the plant design.

21. The recommended emission standards have been established to minimise the impact of wider development on air quality within the local area. These emissions should be considered alongside other emissions from the development, for example plant and associated traffic. In some cases an Air Quality Assessment may be required; see the Developers Guide for further information.

[73] Available online at: https://www.cambridge.gov.uk/media/3453/air-quality-developers-guide.pdf