Capabilities on project:
Energy
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Section J

Identifies opportunities and implications for the pipe distribution networks to accommodate gas/liquid biofuels and hydrogen in the future

A gas-fired CHP system currently reduces CO_2 emissions for two reasons: as a result of the higher efficiency of energy use and as a result of fuel switching from coal to gas. Over the next 10 years it is expected that the use of coal in the power station mix will decline and so the CO_2 benefits from gas-fired CHP will also decline over time.

In planning a CHP system it is therefore necessary to consider how the system might develop in the longer term in an era where the electricity system, is decarbonised with nuclear, renewable energy and coal-fired power stations with carbon capture and storage. All of these sources will have a low carbon content and will be expected to be used in preference to gas-fired CCGT power stations which will become the marginal plant in the longer term

At present the average electricity emissions factor is around 520g/kWh with coal-fired marginal plant at around 800g/kWh. At 520g/kWh, heat from a large gas-engine CHP with 37% electrical efficiency has zero CO_2 content but if the longer term marginal plant is older gas-fired CCGT with an electricity emissions factor of 430g/kWh then the heat content would increase to around 90g/kWh. This is still less than half the emissions from gas boilers as shown in Figure J1.

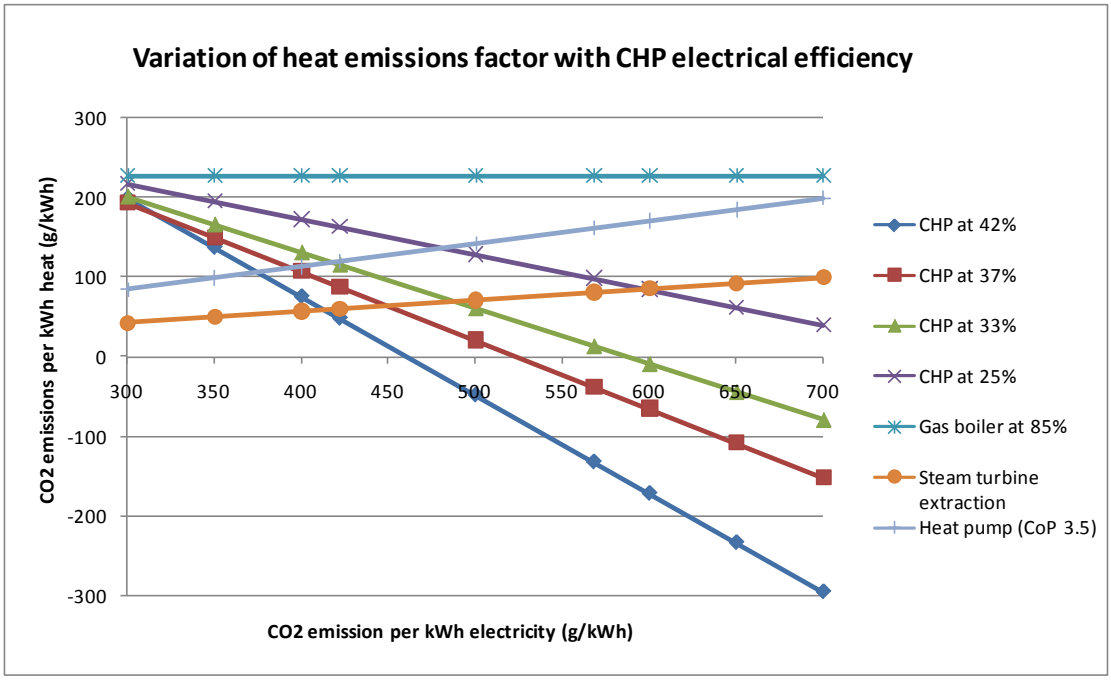

Figure J1 – Variation of heat emissions factor with electricity emissions factor

This heat content is however comparable to heat pumps with a seasonal CoP of 3.5. To maintain its advantage over heat pumps, CHP will either need to improve its electrical efficiency to use an alternative lower carbon source or to extract heat from a steam turbine where the benefit would typically be twice that of a heat pump with an effective CoP of 7.

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Higher electrical efficiency systems can be achieved for larger-scale using CCGT technology so one future option is to grow the scheme to enable all three clusters to be interconnected and CCGT technology could be used.

An alternative approach is to change the fuel used for CHP to improve the CO_2 savings. Lower carbon fuels can be obtained through:

- Production of biomethane from anaerobic digestion of waste
- Production of biomethane from gasification of biomass
- Production of syngas from energy from waste using gasification or pyrolysis

These gas sources can be used in three ways:

- directly in a CHP engine or in the future fuel cells on the same site
- directly in a CHP engine but transporting the biogas by a separate pipeline
- indirectly through injection into the gas grid after treatment and/or methanisation to achieve equivalent natural gas standards.

The latter is generally more likely given that it is difficult to find sites for energy from waste plants close to built up areas where the CHP would be sited and the cost of a dedicated biogas pipeline would be avoided. However in Croydon the waste transfer station is located to the west of the town centre adjacent to the Rolls Royce power plant. There is therefore the potential, subject to space requirements and planning permission, to use an advanced thermal process to obtain energy from waste at this site and to transport heat to the Croydon centre district heating scheme.

An alternative would be install a biogas pipeline from the waste transfer site (or similar remote site) into the town centre to supply each of the local CHP Energy Centres. These new gas pipelines could convey hydrogen rich gas derived from energy from waste pyrolysis. The transport of hydrogen involves some technical issues however. As it is a light gas it is not contained within conventional polyethylene gas pipework and steel pipe would be required. It is possible that a steel heat transmission main could be used for hydrogen in the future, provided suitable sites were available in the town centre for CHP plant.

It is also likely that there will be 20-30 years before the grid is sufficiently decarbonised (i.e. no CCGT left) for gas-fired CHP to have limited benefit compared to other operations such as heat pumps. As a result we recommend that a start is made on a gas-engine based CHP, or the Rolls Royce gas turbine CHP to supply the district heating network whilst investigations continue on the viability of an energy from waste facility at or nearby the waste transfer station. The system as proposed has a number of options for moving towards lower carbon fuels in the future and it will be important that these future opportunities are safeguarded as the scheme is developed.