



## Summary

Papermaking is a continuous, energy intensive process which uses electricity to power the paper machine (equipment such as drive motors, pumps and compressors) and heat (essentially steam or hot air) to dry the paper from a water content of more than 99% down to 6-7% in a few seconds.

This need for both heat and power means that combined heat & power technology (CHP) is a good fit for the sector. In the UK, 77% of paper is made at sites using either gas or biomass fuelled CHP, which delivers major energy and carbon savings compared to the alternative of grid-supplied electricity and stand-alone boilers.

Grid-supplied electricity is from a mix of sources and increasingly includes significant quantities of low-carbon renewables. However, marginal grid generation is still dominated by fossil fuel (gas or coal), with sector CHP plant displacing marginal sources of grid supply (which are almost always closed or open cycle gas turbines, plus some coal). CHP power does not displace low carbon sources or even grid average carbon electricity. Additionally on-site generation avoids transmission losses associated with grid supplied power.

The joint BEIS/Paper Sector 2050 Decarbonisation Plan identified CHP as one of the key technologies to help deliver the plan, either powered by gas or biomass, and it was expected that Government support would be offered to further roll-out CHP across the sector and support the replacement of older CHP plant reaching the end of its operational life.

## Combined Heat & Power

CPI continues to argue that industrial CHP fired by natural gas has a realistic role to play in decarbonising the UK in the short to medium term to cover the gap before alternative technologies develop and become cost effective.

A brand new, state-of-the art gas-fired CHP can deliver significant carbon savings versus grid gas CCGT (which, together with OCGT, will be the marginal generation technology for some years to come). It follows that until gas is phased out of the generating mix completely, the use of high-efficiency gas-fired CHP at an industrial site (plus avoided transmission losses) will save carbon compared with the alternative of installing heat-only boilers and purchasing electricity from the grid.

The Government decision not to provide further incentives to invest in such plant, and indeed to consider the further withdraw of some policies that have benefited the technology in recent years, is misguided and should be reviewed. CHP technology remains BAT and economic alternatives are not currently available for most sites – the choice for many is between an expensive energy supply and an even more expensive one. Indeed driving industry to replace gas-CHP with grid supplied electricity will actually increase carbon emissions while the grid marginal fuel of generation remains gas.

There's also a risk that papermaking company decision makers – nearly all headquartered outside the UK – decide to stop investing in their local assets and reduce or cease UK manufacturing because of the high costs of energy in this country compared to the cost elsewhere. CHP remains an obvious way to reduce this risk. Additionally, the EU (unlike the UK and irrespective of the current supply issues) has accepted that gas still has a role to play in supporting the energy transition, with this policy divergence having serious implications for UK industry.

## Decarbonising the electricity supply

Government policy assumes that the UK grid-electricity will continue on its rapid decarbonisation pathway. Now that coal has been largely removed from the generation mix, natural gas is the major fossil fuel used to produce electricity. The Committee on Climate Change assumes that unabated gas generation will no longer be needed after 2035. At some point before this, depending on how quickly natural gas generation is phased out, co-generating heat and electricity from natural gas will no longer produce electricity with a lower carbon content than that sourced from the grid.

The expectation is that, provided appropriate policies that increase the price of higher carbon fuels are put in place, sites currently using gas-CHP will be driven by economics to swap from auto-generation to grid-supplied electricity and separate heat boilers.

Three issues arise:

1. Can the UK generate or import the increased quantities of electricity required to electrify industry, at the same time as other sectors such as transport and domestic heating are also being driven to electrify?
2. Can grid connections be reinforced sufficiently to get this electricity to industrial users?
3. UK manufacturing industry already suffers from the most expensive grid-supplied electricity in Europe, and while Government has taken some actions, there's no sign that this position is about to fundamentally change.

Can sites operate on grid supplied electricity and manage the operational cost to stay competitive?

The important issues to consider are:

1. How rapid will grid decarbonisation be?
2. Even if the average grid carbon factor rapidly falls, what is the marginal generation technology going to be?
3. If bio-methane and renewable hydrogen are blended into natural gas (say at up to 20%) in the near and medium future, this will reduce the carbon intensity of natural gas in direct proportion and will push back the point in time at which average CHP generation becomes less carbon-efficient than marginal grid supply. New CHP plant can (and is) be designed for this new feedstock.
4. Can a UK paper mill move from CHP to grid electricity without reducing competitiveness to such a low level that future investment in the site is curtailed or stopped altogether?

5. CHP provides a huge benefit to the electricity network in that the system does not have to have the capacity that would otherwise be needed if CHP did not exist. If industrial CHP is allowed to wither and die earlier than necessary, electricity network capacity will have to be enhanced at (typically) huge cost.
6. CHP provides a further significant benefit in that excess electricity can be spilled into the grid locally thus (a) reducing the total requirement for power generated at distance, (b) further reducing the required capacity of the network and (c) avoiding transmission losses.

The two UK mills making virgin pulp already use UK sourced forest residues and wood-based wastes to power modern biomass fired CHP; with these low-grade and otherwise waste materials being generally acknowledged to be eminently suitable for high-efficiency energy generation using CHP. Two other sites also include biomass-based wastes in their CHP input fuel. There's a general acceptance that such use should continue to be supported where suitable feedstock is available.

For other sites (where the production feedstock is predominantly recycled fibre and biomass-based materials are not readily available) gas-fired CHP is still acknowledged as Best Available Technology (BAT) by the UK regulatory agencies and in the live sector technical BREF.

## Annex – CHP Carbon Savings:

CHP is a proven way of increasing energy efficiency at a consumer site which uses both heat and electricity. Because of this, it will also deliver carbon savings compared with use of the same input fuel to (a) provide heat in boilers and (b) generate electricity centrally and distribute it to the site.

CPI holds data sourced from the CHPQA on the operation of CHP installations at UK paper mills. Numerical analysis (copy on request) shows the carbon savings that electricity generation using gas-fired CHP plant delivers versus that generated in CCGT power stations. And this will remain the situation until gas is no longer the marginal fuel of production.\*

1. Current paper sector average gas-fired CHP fleet vs grid supplied CCGT electricity:
  - Carbon content of CHP electricity = 284 gCO<sub>2</sub>e/kWh (assuming heat is delivered at 81% gross efficiency)
  - Carbon content of CCGT electricity = 352 gCO<sub>2</sub>e/kWh (assuming 55% gross efficiency and after transmission losses)

**The CHP option delivers a 19% carbon saving.**

2. Newest paper sector gas-fired CHP plant vs grid supplied CCGT electricity:
  - Carbon content of CHP electricity = 221 gCO<sub>2</sub>e/kWh
  - Carbon content of CCGT electricity = 352 gCO<sub>2</sub>e/kWh (assuming 55% gross efficiency and after transmission losses)

**The CHP option delivers a 37% carbon saving.**

In 2021, gas-fired CHP in the paper sector generated 1,250 GWh of electricity. This saved 85,000 tCO<sub>2</sub>e compared with sourcing this electricity from the grid assuming that it had been generated in a CCGT. In fact, there was 111,400 GWh of gas-generated electricity produced in 2020 – 90 times the quantity generated in the paper sector. Since gas is currently the effective marginal generation fuel these carbon saving delivered by sector CHP can be regarded as genuine and not theoretical.

For current investment, new gas-fired CHP will still deliver significant savings versus gas CCGT (and even more versus gas OCGT) and these will be the marginal generation technologies for some years to come.

Until gas is phased out of the generating mix completely, high-efficiency gas-fired CHP will still save carbon.

\*In 2021 642.1TWh was used to provide/generate electricity in the UK (all sources including import). Of this, 252.8TWh was natural gas – around 40% of the total.

Source – BEIS Digest of UK Energy Statistics C5.  
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Technical justification is available upon request. Contact [sfreeman@paper.org.uk](mailto:sfreeman@paper.org.uk).