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CHP modelling - DTI convention used for Dukes
Methods based on Value allocation proposed for Green Guide.
A Critique.

The Power industry take the view that its prime product, power, changes to become a waste product if the heat that has to be rejected in power generation is used, as an example, to grow tomatoes. The argument is that since CHP can not operate without a heat load the heat must be the prime product.

This thinking confuses the fact that some CHP units as an example burning a higher cost fuel or being paid a small sum for their power by larger operators may need the value of the heat they use compared to alternative sources of heat to cross subsidise the power production.

This value of heat does not affect its cost or carbon content which is dictated by the marginal fuel burn, which for any specific power cycle tends to zero.

The author questions this view of a change in prime product, and reasons that all thermal power plants by their nature are heat led. The author was taught that the fundamental laws of thermodynamics and physics required heat to be rejected in order to produce power.

All thermal power generation according to these laws thus has to be heat led whether the heat load is a building which is useful or the sea, air or rivers which is wasteful.

The author's view is that all power generation is effectively CHP in some cases the heat is put to use in other cases the heat is wasted.

Originally Dukes statistics method of modelling of CHP by DTI and other organisations adopted a Russian method of analysis based on power as the waste product.
An assumption was made that any heat that was used could be considered as having come from an imaginary boiler.

The waste heat a tomato grower used from cooling towers, was treated as though he was using heat from a boiler at the cooling tower, instead of his own boiler.

The farmer was not burning any fuel in practice, so what should be done with the imaginary fuel he was now using. It was subtracted from the fuel required to produce power!

By using the heat the farmer cleaned up the power. The effect of the allocation means that the fuel burn in the heat sector does not change and the fuel burn in the power sector reduces.

This same fundamental methodology, but in a revised forms, is currently used for Dukes, for CHPQA, for EU calculations and to provide incentives for the use of CHP which in the authors opinion are applied to the incorrect product power, when they should be applied mainly to the heat.

The problem appears to be that those carrying out the analysis confuse value with marginal cost or marginal carbon for the respective products. They reason that if the heat has a value then it must share the fuel burn and carbon burden with the power but that if it has no value then it is carbon free.

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This confusion appears to be present throughout current UK government thinking and is the basis for the analysis proposed for the Green Guide where the following describes the approach to CHP.

"Where the waste heat is used within the same system process, then it is not necessary to consider the carbon emission from the use of the waste heat. All impacts will be included within the process and allocated to the products of the system according to their value. Where the waste heat is used in another process outside the system boundary, then it will be treated as another product of the system, and impact allocated on the basis of the relative value of the products and waste heat (if the heat is given away, then it will attract no impact). A process that a) finds a use for its waste heat or b) is able to sell it will therefore benefit as a) it will reduce the amount of other fuel required and b) the impact will be reduced through allocation. In either case this will encourage the use of waste heat."

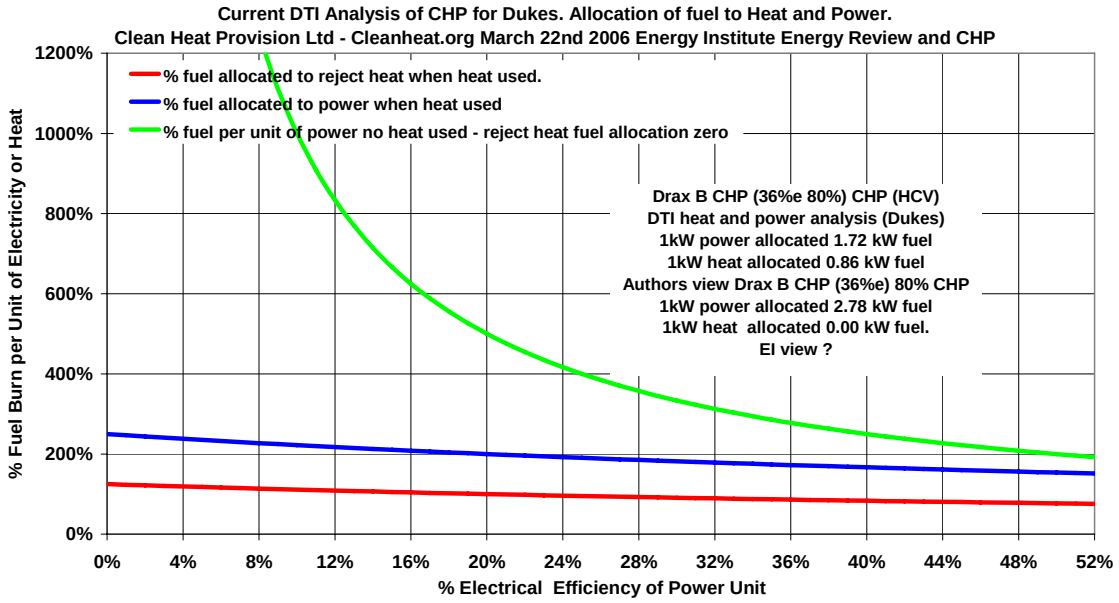
How can a product changes its carbon content just because its value changes?

Does the carbon content of the sun light increase when it provides high value lighting and reduce when it displaces low value heating?

The economic case for use of reject heat from power and its distribution to create competition with locally generated sources depends on the correct economic and statistical signals being given to the respective heat and power sectors.

The example of the tomato farmer is used to illustrate simply the problems with the current methodology. Other aspects associated with analysis of CHP, such as comparisons between power plants and the most economic power plant not necessarily being the most efficient converter of heat to power, are addressed in more detail in the following paper and other papers on the web site. BIEE Academic Conference Paper 2004. "Discussion of defects in current UK and proposed EU conventions for allocation of fuel burn for power and heat rejected in power generation" see http://www.cleanheat.org

This chart shows how fuel burn is currently allocated in Dukes between the two sectors heat and power.



This methodology results in significant cross subsidies from heat to power and signal little benefit to the heat sector to utilise the very large potential of reject heat from power generation to readily meet carbon targets.

The chart signals that waste heat from the cooling towers the tomato grower expected to be carbon free carry a fuel burn of .86 units of fuel per unit of heat.

The cleansing of the power from a low efficiency micro CHP from 6.25 units of fuel per unit of power to 2.8 illustrates the effect of cleaning the power.

The method gives no indication of the fact that using a CHP of around 625kW output linked to any local transformer to secure local heat and power supplies gives double the carbon savings of micro 1 kW CHP.

The method does not allow the fuel burn for heat to be determined when comparing one CHP heat source with other sources of heat, whether CHP, boiler or electric heating, to allow carbon trading to develop in the respective heat and power sectors.

It has been argued that in the case of Dukes and national statistics it does not matter what methods or allocation are used provided the methodology is made clear.

The authors view is that the methods currently used both by DTI and as proposed in the Green Guide will mislead decision takers wishing to understand carbon emissions in the power and heat sector and result in an increase in carbon emissions because incorrect signals of the actual carbon content of the respective products is being signalled.

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