1 *Trigeneration does not save huge amounts of energy*

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Background

In *Sustainable Energy – without the hot air*, I pointed out that some decentralized technologies, such as micro-combined-heat-and-power, do not actually save much energy. The Carbon Trust's study of micro-combined-heat-and-power reckoned that, at best, this technology's savings were about 12% compared with the standard solution (namely, centralized electricity generation and local gas-fired heating).

I didn't consider *trigeneration*, however. If we deliver not only heat and electricity but also *cooling*, all from a single local facility, does that transform the situation? The answer is, as far as I can tell, **no**. Trigeneration does not save significant energy compared with a standard solution.

Case study

I received data for a real trigeneration system located at the UK's Met Office. The facility takes in **4500 kW** of natural gas [check – HHV or LHV?] and can deliver either

1547 kW of electricity and	1690 kW of heat and	no cooling
	or	
1547 kW of electricity and	290 kW of heat and	1000 kW of cooling

I will focus on the second case, where electricity, heat, and cold are all being delivered. The heat is delivered as 95 °C hot water, and the cooling is delivered (via an absorbtion chiller powered by 95 °C heat from the generator) as 6–12 °C cold water.

Now, these three services could be delivered as follows: our counterfactual imagines replacing a shiny new trigen facility running on gas by equally new standard solutions, powered by exactly the same fuel.

1547 kW of electricity could be delivered from a share of a large centralized powerstation, 48% efficient (including grid losses) which would use **3223 kW** of gas	290 kW of heat could be delivered from a local air-source heat pump with a coefficient of performance of 2.0 powered by **145 kW** of electricity from a central powerstation, 48% efficient (including grid losses) which would use **302 kW** of gas	1000 kW of cooling could be delivered from a local air-conditioner with a coefficient of performance of 2.5 powered by **400 kW** of electricity from a central powerstation, 48% efficient (including grid losses) which would use **833 kW** of gas
		Total: **4358 kW** of gas
	or by a local condensing boiler, 90% efficient, powered by **322 kW** of gas	
		Total: **4378 kW** of gas

These total fuel consumptions can be compared with the **4500 kW** of gas consumed by the trigen facility, which is a *bigger* fuel consumption.

We can conclude that there is no significant energy-saving benefit from building a load of new trigen, compared with building new centralized high-efficiency gas power stations and local heating and cooling systems. It should be noted that the coefficients of performance assumed above for heat pumps and for air-conditioners are very low. Had I assumed higher coefficients of performance, the fuel consumption of the standard solution would have been even lower. Some further advantages of the non-trigeneration solution include (a) that the quantities of electricity, heat, and cold delivered are not constrained to be related to each other at all (whereas the trigen system can produce only a less flexible *range* of ratios of electricity, heat, and cold); and (b) the non-trigeneration solution can use electrical power from any source, including future low-carbon electricity located anywhere on the grid, whereas the trigeneration system would be locked in to gas.

Having said this, there may be reasons for liking trigeneration systems: their capital costs may be lower than those of the standard solution; they don't need to pay grid access charges; and trigeneration systems could continue to run during regional power cuts (as long as the gas doesn't get cut off!).

So, in conclusion, it's possible that trigeneration systems may have benefits, but it is incorrect to claim that they save energy. Nor do trigeneration systems reduce carbon emissions. Indeed, because of lock-in to a particular fuel, the decision to build trigeneration systems may well lock us in

to gas-dependence and thus to long-term carbon emissions that could be avoided if instead we succeed in decarbonizing the electricity grid.

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