

Microgeneration: A profitable transition technology to a low carbon future

In the Utility industry there is quite some debate around the pro's and con's of decentralised power generation. Utilities are traditionally biased towards large scale upstream power plants. Nevertheless there might also be a bright future in small scale systems at end-user sites.

The Netherlands has a strong tradition in combined heat & power systems (CHP), based on its extensive gas reserves and gas infrastructure. CHP-systems ideally are "heat driven" in the sense that whenever heat is needed to warm-up industrial or agricultural processes, to heat buildings or to provide warm water, these systems also drive a power generator. Producing power at the same time as using residual heat drives fuel-efficiency of these systems up to over 90%, compared to a mere 40-45% of power-only systems based on natural gas or coal. In the Netherlands medium to large scale CHP-systems constitute around 40% of installed capacity, mainly in agriculture (glass houses), and process industries. Some large scale power plants actually operate as CHP-units by providing hot water for room heating to neighbouring communities.

Can this principle also be applied on the small scale of a private home? The answer is yes! Today small systems are commercially available that produce around 5 kW electrical power, usually enough to supply a fully equipped household. One of such systems is installed in the garage of a private residence in the city of Haarlem, The Netherlands.



This system is supplied by the German company Senertec under the “Dachs” brandname. A similar system is provided by Vaillant subsidiary PowerPlus under the brandname “Ecopower”. The system consists of a one-cylinder motor, powered by natural gas (diesel, or liquified propane is also an option). When running, the system produces 12,5 kW heating energy and 5,5 kW electrical power. The heat is collected in a 700 liter insulated vessel from which the heat is distributed through the house.

The house is a relatively large 6 bedroom home (ca. 275 m² floorspace) across 4 levels. The house was built in 1935, has floor- and roof insulation but no double glazing. Heating requirements in the winter season (Oct-Apr) are substantial, though sustained periods with temperatures below 0° C are rare in the Netherlands. Heating was provided by an ordinary central heating system with a highly efficient natural gas fired boiler (24 kW capacity) that also provides hot water for a bath room. In the summer season (Mai-Sep) the CHP-system is not operated because there is no sustained heat requirement in these months. The existing boiler is used in summer when there is an occasional cold day. In winter the boiler operates as back-up facility should the CHP-system fail or should outside temperatures drop below 0° C for extended periods.

Bearing in mind that the investment for such a CHP-system is substantial (at around € 25k, including installation), what are the benefits of this set-up? The table below shows the results of this actual field test (privately sponsored) that started in Nov. 2006:

I. Situation “As-Was” (avg. 2003-2005), without CHP-system

Commodity	Volume per year	CO ₂ per year	opex. at 2008 prices
Power	10.305 kWh	5.833 kg	€ 2.576
Gas	4.754 m ³	8.462 kg	€ 3.090
Total		14.295 kg	€ 5.666

II. Situation “As-Is” (2008), with CHP-system

Commodity	Volume per year	CO ₂ per year	opex. at 2008 prices
Power	-/- 5.451 kWh	-/- 3.085 kg	-/- € 311
Gas	6.541 m ³	11.643 kg	€ 4.252
Total		8.558 kg	€ 3.940
Annual reduction		40%	30%

The current situation presents a significant saving, both in overall CO₂-emissions and in operational energy expense. The system is producing more power than required in this particular household. The balance is fed back into the public power grid. Compensation for being an environmental hero is poor though. The power supplier is only refunding a non-subsidized wholesale price for the power fed back into the grid (currently around €0,05 per kWh) which is actually lower than the current marginal cost of producing power with the CHP-system (around €0,08 per kWh, which of course still compares favourably to the €0,25 per kWh the regular power supplier is charging).

For private households CHP-systems are currently not subsidized in the Netherlands. The pay-back nevertheless is no more than 15 years, and probably less when energy prices continue their steep climb. The real fun starts when full electrical cars enter the market in 2010. Instead of supplying power back to the grid, this excess power can then be used to charge the car batteries.

This has no additional CO₂ benefit. One uses efficient CHP-power to replace inefficient diesel or gasoline power but since this CHP-power is then no longer used to push inefficient power from the grid the net CO₂-effect is close to zero. The financial benefit is substantial however, adding around € 1.600 a year to the business case of the CHP-system in fuel savings at the pump (at Dutch price levels and in a typical situation where 17.500 annual diesel km's are replaced by electrical power km's). This brings the total saving potential to € 3.090 and a simple pay-back period that moves towards 8 years (the CHP-system is engineered to last 20 years).

Government could improve this business case even further, e.g. by eliminating a double energy-tax that results in this situation (tax is paid on the gas that goes into the CHP-system and is charged again on the power that goes onto the grid to other end-users), crediting households for CO₂-reduction (value at € 30/ton would be € 172 a year) and helping suppliers to pay better feed-in prices for power supplied back to the grid (like we see e.g. in Germany).

There is therefore a bright medium term future for small scale CHP-systems as a transitional technology, able to contribute substantially to greenhouse gas emissions. The technology is there and working. The business case is sound and can improve even more with some sensible government policies that will not break the budget. For Utility companies small scale CHP-systems open-up a new and interesting, high value retail category.