CHP and the new energy world – a winning combination

Pikunic: adopting distributed energy technologies can significantly reduce emissions and make a positive impact on the economy at the same time

The uptake of combined heat and power (CHP) has been relatively limited to date. Recently, however, coupled with advances in new technologies like fuel cells and storage, its value proposition is rapidly becoming more attractive. **David Appleyard**

The inherent efficiency of combined heat and power (CHP) allows operators to wring every last drop of useful energy from their fuel. Despite this, CHP uptake has been relatively limited to date. Now though, increased demand for energy efficiency in commerce and industry and the growth of distributed power systems is boosting the case for CHP. Coupled with advances in new technologies like fuel cells and storage, the value proposition for CHP is rapidly becoming more attractive.

According to a recent report from Wiseguy Reports MRC, the global combined heat and power market accounted for some $640 billion in 2017. With an anticipated growth rate of 5 per cent over the forecast period, this figure is expected to reach more than $996 billion by 2026. Government programmes and incentives for clean energy and increased use of natural gas to generate power are some of the factors driving market growth, the report notes.

Similarly, the market for micro CHP systems is also expected to see rapid expansion.

Emerging demand for continuous and reliable power supply from residential and commercial establishments is a key driver pushing the 2-10 kW micro CHP market, finds Global Market Insights, Inc. in its latest analysis. It concludes that by 2024 this market alone could cross $13 billion, up from $2 billion in 2017.

Again, pointing to climate change concerns, increased demand for energy security and government policy as major factors propelling micro CHP market growth, Global Market Insights cites zero interest rate loans, tax rebates, and financial assistance among the available incentives introduced by regulators to promote the adoption of these systems. "Favourable government measures to enhance the deployment of green technologies along with strict government norms pertaining to carbon emissions will further augment the industry dynamics," the report concludes.

An example comes from the UK, where in April this year Triple Point Heat Networks Investment Management, was appointed as delivery partner for the UK government's Heat Networks Investment Project (HNIP). Over the next three years the programme aims to deliver £320 million of government support to individual projects across England and Wales as part of the HNIP main scheme. In addition, the programme is looking to leverage around £1 billion of private and other capital in order to provide "much needed scale to the market".

The UK has set out legally binding targets to reduce greenhouse gas emissions by at least 80 per cent by 2050 from 1990 levels, and by 57 per cent over the 2028-2032 period. In the Clean Growth Strategy, the government set out three illustrative pathways for meeting the 2050 target, each including a significant role for heat networks, for instance providing 17 per cent of heat demand in homes and up to 24 per cent of heat demand in the non-industrial business and public sector buildings. Of course, not all heat networks use CHP, but they do nonetheless represent a significant potential market.

More broadly, mega trends like increasing urbanisation and the clean energy transition – manifesting as a widely distributed energy generation system increasingly dominated by variable output renewables like wind and solar – are key long-term drivers for CHP.

While the benefits of expanding heat networks and CHP capacity are well proven, there are nonetheless further measures required to maximise on the potential for CHP. For example, research by the UK's Energy Technologies Institute (ETI) shows that nearly half of the UK's heat demand could be met by heat networks, which, they say, should therefore play a much larger part, especially in higher density buildings.

However, as Rebecca Sweeney, Programme Manager at the ETI, comments: "To make this a reality we see a need for operational frameworks to be developed by the UK central and devolved governments to support the demonstration, knowledge transfer and skills development in the heat sector."

In Germany every town with a population of over 80 000 has at least one heat network. In the UK, heat networks currently only provide two per cent of space and water heating," notes Sweeney.

The ETI has now developed eight route maps that could reduce the capital cost for infrastructure in heat networks by 30-40 per cent, it claims. Finding that it is possible to reduce the capital costs needed to deploy heat networks at scale, the ETI says that the cost of the UK's low carbon transition could be cut by £3 billion if such a programme were adopted.

Alongside the largely positive market and policy developments technology is also playing its part in building an economic case for CHP.

For example, new analysis from Centrica shows that new energy technology could meet more than half of the UK's 2030 20 per cent carbon reduction targets for the healthcare, industry and hospitality sectors. The three sectors collectively represent some 27 per cent of total UK emissions.

In its 'Powering Sustainability' report, released in October, Centrica highlights the opportunity for distributed energy technologies such as storage, on-site generation and energy efficiency to deliver an 11 per cent saving across these sectors.

The report's estimates suggest that the deployment of distributed energy solutions in just 50 per cent of organisations across the three could achieve annual savings of 9 million tonnes of CO_2 equivalent. According to Centrica, for example, the National Health Service is targeting a 64 per cent reduction in emissions from 1990 levels by 2030. The assumed technology split to achieve these cumulative savings from 2017 to 2030 sees more than 90 per cent of the gains derived from energy efficiency measures including CHP. A similar figure is reported for industry and again Centrica points to CHP as a key enabling technology in achieving their 11 per cent emissions reduction target.

The report highlights biogas CHP – combining the efficiency benefits of CHP with a carbon-neutral fuel supply – a technology of particular interest to food and drink manufacturers and agri-businesses with access to organic food waste. Attractive economic returns are possible with ready markets for power and potentially heat too, whilst also offsetting carbon emissions.

Commenting on the analysis, Jorge Pikunic, Managing Director of Centrica Business Solutions, said: "This report shows how by adopting distributed energy technologies, we can significantly reduce emissions and make a positive impact to the economy at the same time."

At the core of many CHP systems lies a reciprocating engine running on gas or liquid fuels. Robust and reliable, such systems are a well proven solution in many applications. Now though, more conventional CHP systems are being coupled with emerging technologies like fuel cells or storage capacity and advanced controls to gain still more carbon savings whilst maximising individual asset value.

An example of this kind of hybrid development is currently under construction in Lempäälä, in southwestern Finland. Energy company Lempäälän Energia is leading the development of the LEMENE smart grid project, which will supply approximately 50 businesses in the industrial district of Marjamäki as well as street lighting. In all, the Marjamäki industrial area covers about 300 hectares along one of the country's busiest highways near Tampere.

Powered by a 4 MW solar photovoltaic array, an 8.1 MW biogas-fuelled engine and a battery to even out temporary fluctuations in energy production, it will feature a fuel cell-based CHP system too.

Two Convion C50 fuel cell systems, each featuring 24 fuel cell stacks from manufacturer Elcogen, will supply an additional 116 kWe. The Solid Oxide Fuel Cell (SOFC) stack operates at 650°C and produces 3 kW DC – fuelled by hydrogen derived from reformed natural gas.

Featuring a combination of low-carbon energy generation, storage and smart controls to provide a self-sufficient district energy solution, the LEMENE system will operate mainly as part of the public electrical grid but can also operate as a supporting reserve system for the public grid, or independently off-grid as required.

Lempäälä Energia CEO Toni Laakso explains: "The LEMENE smart grid will feature a variety of smart technologies that will respond to changing electric demand, enabled by automation solutions adapted to the microgrid. An important part of the project is to secure energy availability as renewable energy production varies."

Lempäälän Energia Ltd has also signed an agreement with Siemens AG for the supply of an intelligent medium-voltage network, network automation system and electricity storage system.

The smart grid project has been earmarked by the Finnish Ministry of Economic Affairs and Employment (MEAE) as a key development in helping the country achieve its national decarbonisation targets for 2030 and is one of 11 key energy projects to get a share of €39.7 million in MEAE investment. LEMENE received €4.97 million.

Fuel cell system integrator Convion CEO Erkko Fontell commented: "The project is a unique example of a future power solution, where requirements for energy efficiency, power security and sustainability are met."

These three goals are well suited to the inherent capabilities of CHP, whatever the core technology. With growing recognition among policy makers, falling costs, new financing opportunities and a growing range of complimentary distributed energy and power technologies now available, it would seem that combined heat and power is at last ready to take its rightful place among the clean energy technologies of the future.