St. Dympna's Hospital, Carlow

What is CHP?

Combined heat and power (CHP), also known as "cogeneration", is the simultaneous generation of electricity and useful heat from the same item of plant. As a form of energy, electricity is more expensive than heat. In most CHP installations, the emphasis is on producing electricity to displace some of the power that would be otherwise bought from the electricity grid. At the same time, the heat produced from the plant is used to replace or supplement heat provided from a conventional boiler system.

CHP systems range from large scale, several MWe output, to the small microturbine variety, less than 150kWe output. These small scale microturbines have a gas turbine engine and recouperator, electrical generator, electrical system, exhaust gas heat exchanger and supervision and control system.

The benefits of CHP when compared to importing electricity and using boilers to generate heat include: savings on total energy costs for the user, improved efficiency of overall primary energy use, reduced overall CO_2 emissions, and independence & security of power supply.

In the unit installed at St. Dympna's, the exhaust gas heat recovery system is used to boost the temperature of the cold water feed to the hospital's domestic hot water system providing significant savings on domestic hot water costs. The CHP's final exhaust is then vented to the atmosphere. Because the microturbine uses a clean burning process, these exhaust gases have low emissions and are oil free.

St. Dympna's Hospital

Run by the South Eastern Health Board, St. Dympna's Hospital is a 115 bed psychiatric hospital based in Carlow town, providing a variety of clinical services and community based services throughout Carlow county. The wide range of services include: acute and long stay care, out-patient services, addiction counselling, community hostel and day care facilities.

The Background

Prior to the installation of the CHP, the hospital's primary heat load was serviced by two 2250kW gas-fired boilers feeding a Low Pressure Hot Water (LPHW) System. The LPHW system indirectly heated the hospital's domestic hot water system. The site's electrical demand was serviced by a low voltage supply.

In June 2002, St Dympna's commissioned a comprehensive review of energy costs at the hospital. Its brief was to address three main energy-related issues:

- *Rising energy costs*
  National grid electricity prices increased by 13% in 2002, exposing the hospital to an increased annual cost of over €10,000. Additional rises in electricity costs expected in 2002 subsequently materialised, further adding to expenditure.

- *Thermal energy efficiency*
  As with all hospitals, St. Dympna's has a large and consistent heat demand. This provides opportunities for increased energy efficiency through additional heat recovery on-site.

- *Carbon Tax*
  The hospital's reliance on national grid electricity produced by fossil fuels could potentially expose St. Dympna's to significant costs following the implementation of the EU emissions trading directive in respect of electricity from 2005 onwards.

Having identified the main areas of concern and cost, a high-efficiency, low-emissions microturbine CHP generator was chosen as the best technology to deliver significant energy cost savings.

The Project

With a clear idea of the size and type of on-site generator required, The South Eastern Health Board selected a 110kWe Turbec microturbine – supplied, installed and commissioned by F4energy Ltd, an Irish energy supply company.

The microturbine has the following features:
- additional exhaust heat recovery,
- 110kW electrical output with 30% electrical efficiency,
- 183kW thermal output, it achieves 50% thermal efficiency.

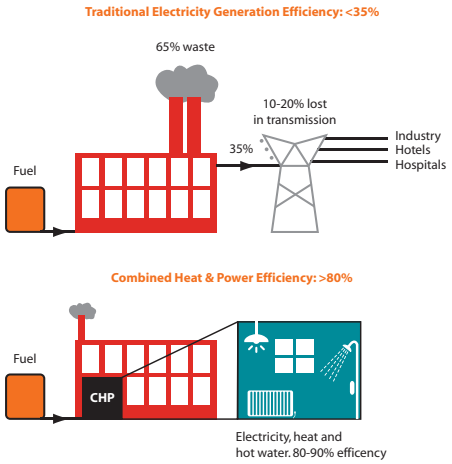
However, with additional exhaust heat recovery, the performance of the microturbine is boosted to an overall efficiency of 88%.

An internal heat bypass is an integral part of the package thus ensuring optimum electrical output year round and it also has the facility to operate in load-follow mode. These features allow the unit to supply some of the hospital's varying electrical load 365 days a year, independent of the site's thermal load.

Importantly for a hospital, the 110kWe Turbec microturbine is low noise (70dBA), utilising a zero vibration generator with internal heat bypass.

Why Combined Heat and Power?

Whenever electricity is generated using a thermal fuel input, heat is given off in the process. Producers using conventional power stations in Ireland typically waste this heat to the atmosphere or cooling water. Combined



CHP Plant with Heat Exchange Unit

heat and power generation however, captures both the heat and electricity from power generation.

By using CHP, generation can be up to 90% efficient – resulting in substantial energy cost savings mainly by way of the on-site production of electricity.

St. Dympna's Hospital CHP – Technical Data

Type	*110kWe Turbec microturbine*
Electrical Power	*110kW (30%)*
Heat Output	*183kW (50%)*
Fuel Input	*367kW*

Installation and Maintenance

The unit is supplied as a turnkey installation and can be commissioned in a matter of days depending on access to heating distribution system and electrical distribution boards.

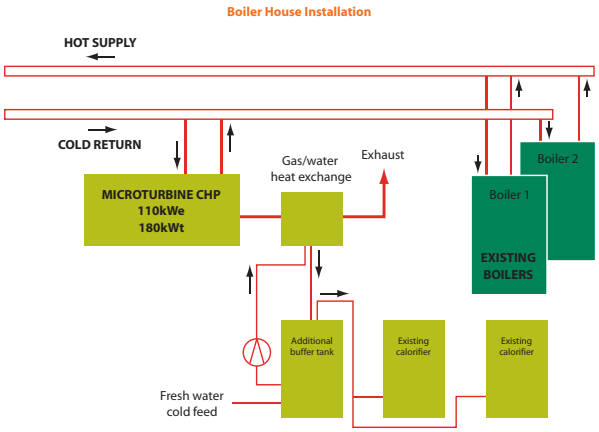
The 110kWe Turbec microturbine requires only one service per year. This means maintenance costs are exceptionally low and the microturbine is actively working for more than 98% of the time.

Control and supervision is completely automatic and needs no attendance of personnel in normal use. In case of critical distortion, the system automatically shuts down and records the fault code to the Power Module Controller (PMC). The PMC is used to start, stop and supervise the CHP unit. All monitoring and control functions are remotely accessible and operated.

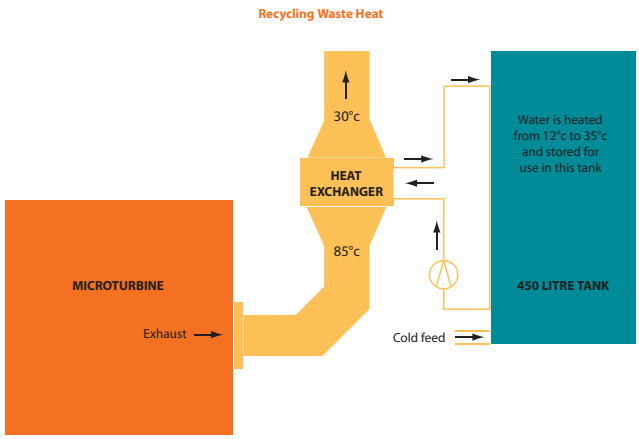
Better Costs, Better Environment

By using fossil fuels more efficiently and also through using natural gas as the primary source of energy, CHP reduces the environmental impact associated with heat and power production considerably. In an Irish context the CHP system can reduce carbon dioxide emissions by as much as 75% for each kWh of electricity produced on site. CHP also reduces the emission of sulphur and nitrogen oxides which contribute to acid rain and helps to preserve fossil fuel resources.

Schematic of St. Dympna's Microturbine CHP Engine



Additional Heat Recovery



Energy Savings Delivered

After the CHP had been fully operational for several months, the hospital undertook a review of electricity and heating costs to evaluate the project benefits based on the annual energy costs, pre and post CHP installation.

Using current (2003) national grid gas and electricity prices and benchmarked against previous consumption data for the hospital, it is estimated that the microturbine CHP installation will deliver savings of €64,000 per annum.

Payback Analysis

Capital purchase price	€135,000
Net annual savings (incl. maintenance costs)	€64,000
Simple Payback Return	*2.1 years*

After the initial installation, it will take a little over 2 years for the CHP to recover its costs. For each of the 10 years of the microturbine's guaranteed lifecycle, it will continue to deliver substantial savings, requiring very few man-hours to maintain.

Conclusions

The benefits, both financial and environmental, gained from St. Dympna's installation of a CHP microturbine are considerable. It is currently delivering annual savings of €64,000 and prevents 400 tonnes of carbon dioxide being released into the atmosphere each year.

The initial costs of purchase and installation will be recouped in just over 2 years. Therefore, with an expected operational lifespan of at least ten years, the savings will accumulate and provide capital for investment in other energy saving initiatives in St. Dympna's Hospital.

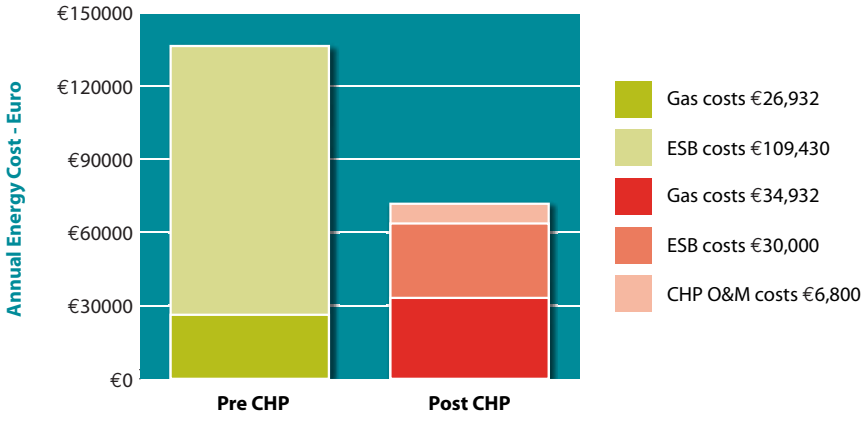
The advantages obtained by St. Dympna's Hospital from installing their microturbine are ones that can be enjoyed by the vast majority of commercial, office or residential developments. From both a commercial and an environmental standpoint the benefits are significant.

Source Text

Aidan McDonnell,

Design Team

Project Manager:
Donal Deering,
Chief Assistant Technical Services Officer,
South Eastern Health Board.



sei SUSTAINABLE ENERGY IRELAND

Glasnevin
Dublin 9
Ireland
t +353 1 8369080
f +353 1 8372848
e info@sei.ie
w www.sei.ie

Sustainable Energy Ireland is funded by the Irish Government under the National Development Plan 2000-2006 with programmes part financed by the European Union

NDP NATIONAL DEVELOPMENT PLAN

Designed by Huguenot