WÄRTSILÄ

Flexible power generation combined with heat recovery

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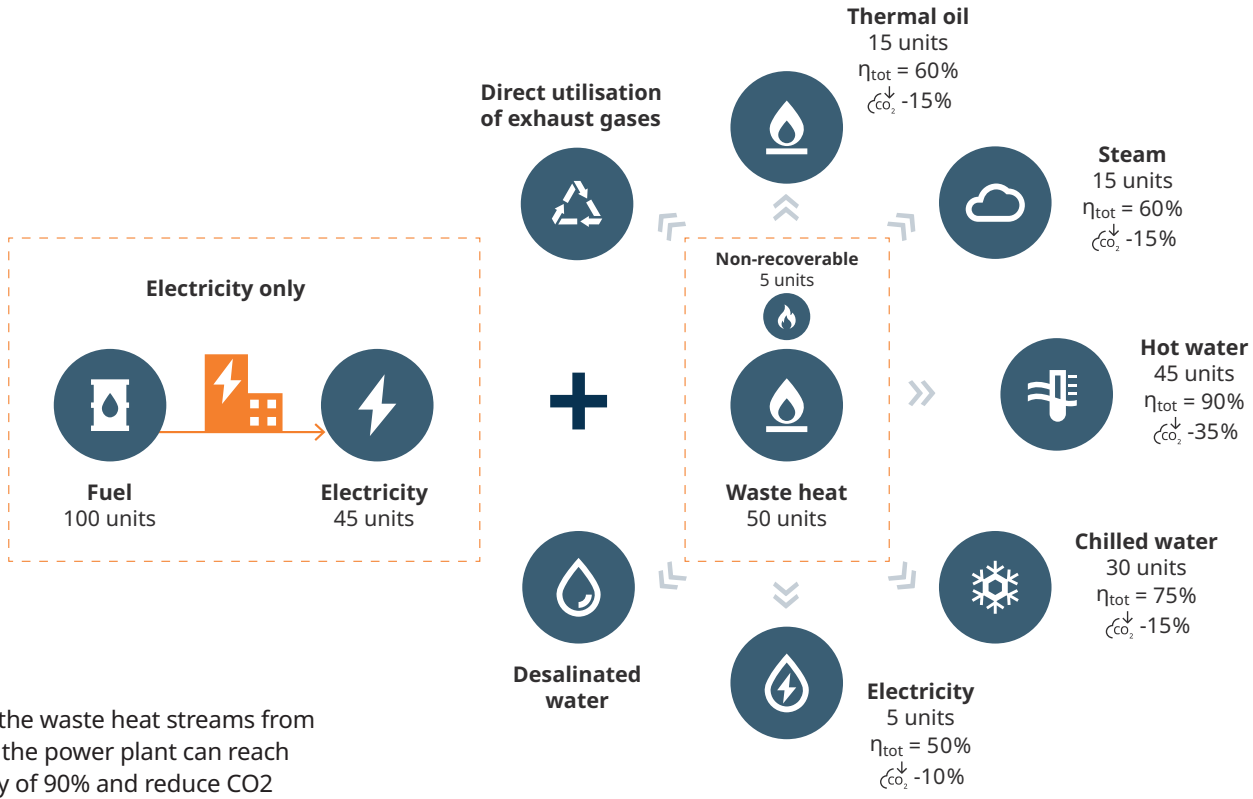
Utilising waste heat to reach considerable fuel savings and CO_2 reductions

Wärtsilä combustion engines are known for their high electrical efficiency, reliability, and flexibility. However, many power producers are still under pressure to further reduce carbon emissions and to increase their power plant profitability.

This is made possible by utilising the waste heat streams from engines to achieve considerable fuel savings compared to separate production of heat and power. At the same time, to provide electricity without interruptions, high-renewable power systems require flexible and cost efficient resources to ensure reliable energy.

Read more about Wärtsilä Flexicycle™ solution.



By utilising the waste heat streams from the engine, the power plant can reach an efficiency of 90% and reduce CO2 emissions by 35% compared to electric power only.

Wärtsilä's combined heat and power (CHP), district cooling and power (DCAP), and trigeneration plants use fuel in the most efficient way and help to reduce carbon emission levels. The heat recovery products can be hot water, steam, thermal oil, chilled water or even a combination of these. In some cases, also desalinated water or direct utilisation of exhaust gases might be an alternative. For customers without any need of heating or cooling, Flexicycle™ solution - a combined cycle concept - might be appealing to boost the plant output and efficiency.

Features

- Distributed electrical and thermal power production close to the consumers reducing transmission losses and distribution times.
- High efficiency compared to power or heat alone solutions.
- Flexible operation with multiple units and fast start and ramp rates.
- Flexibility can be further improved with heat storage.
- Multi-unit design allows to maintain eminent efficiency over a wide load range and enables on-site maintenance without production downtime.
- Lifecycle solutions ensures optimal efficiency and performance of the plant throughout its lifetime.
- Typical plant sizes: 6-200 MWe.

Benefits

- Cost efficient operation with small CO2 footprint.
- Quickly reacts on electricity price variations and to changes in power, heating, and cooling demands.
- Reliable power available at all times.

Heat recovery power plant concept

With Wärtsilä's distributed engine power plant solutions, power, heat, and cooling can be generated closer to consumers, which significantly reduces the transmission and distribution losses of electricity and heat. Powered by reciprocating internal combustion engines, Wärtsilä heat recovery plants offer lower fuel consumption, exceptional operational flexibility and uncompromised performance wherever power, heat and/or cooling are required.

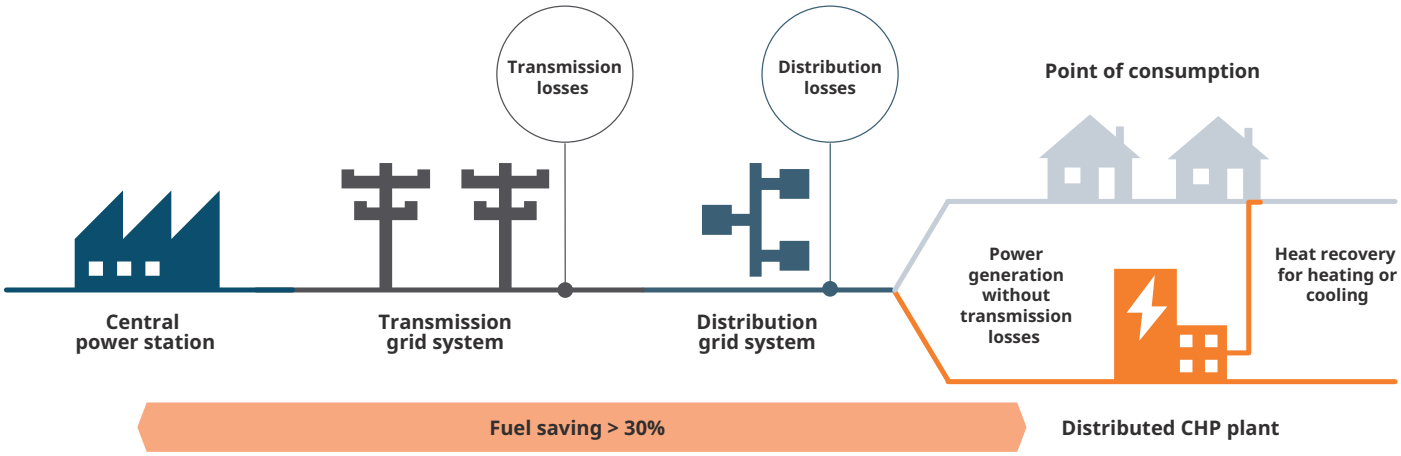
The heat recovery system is tailored for each customer's specific need. The design is typically done as "add-on" solution ensuring both optimised heat production and effective engine cooling. Heat recovery does not affect the electrical output or the electrical efficiency of the engine. With Wärtsilä Lifecycle solutions the efficiency and performance of the plant is retained at a high level throughout its lifetime. Our power plants are capable of running on various liquid, gaseous and biofuels.

If there are space limitations, the heat recovery power plant can be built on two floors, which allows a small and compact footprint of the plant. The generating set and auxiliaries are on the first floor and the ventilation, exhaust gas heat recovery, and emission reduction equipment on the second floor.

Outstanding load following capabilities

Wärtsilä's modular plant concept with multi-unit installation provide high plant efficiency at any load: at times of low demand, some of the generating sets can be turned off, while the plant continues to run at peak efficiency with as many units running as required. This also allows for maintenance of a unit while the plant is producing power. When load requirement increases, the plant can quickly ramp-up: the medium bore engine plant will reach 100% electrical output in only 2 minutes, which makes it a perfect complement to power production from wind and solar sources.

Generating electrical and thermal power close to the consumers will reduce the transmission and distribution losses with a reduction in fuel consumption of more than 30% as a result.


Transmission losses
Distribution losses
Point of consumption
Central power station
Transmission grid system
Distribution grid system
Power generation without transmission losses
Heat recovery for heating or cooling
Fuel saving > 30%
Distributed CHP plant

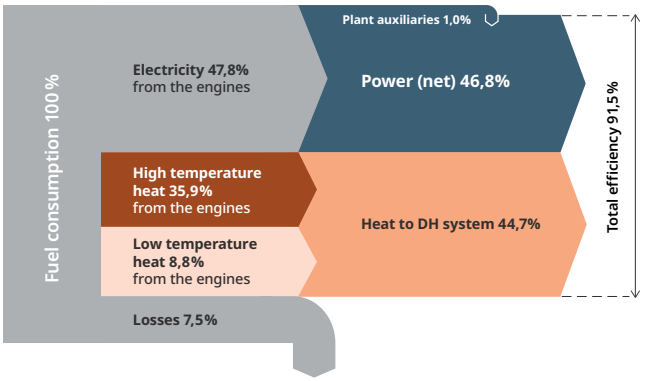
Combined heat and power solutions

The Wärtsilä CHP plant is a thrifty solution where total efficiency can exceed 90%. The most common heat products are hot water or steam, which makes it perfect for both industrial and district heating purposes.

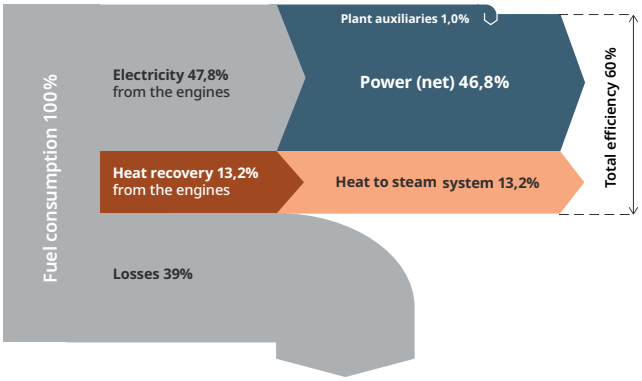
A distributed combined heat and power plant increases reliability in the supply of energy. As the energy production is local and close to the point of consumption, it ensures quick response to changes in capacity or temperature in the industrial process or the district heating network.

The automation system not only controls all the internal processes in the Wärtsilä CHP plant but is also carefully integrated with all necessary signals and connections to the external systems, thereby guaranteeing a fully compatible plant.

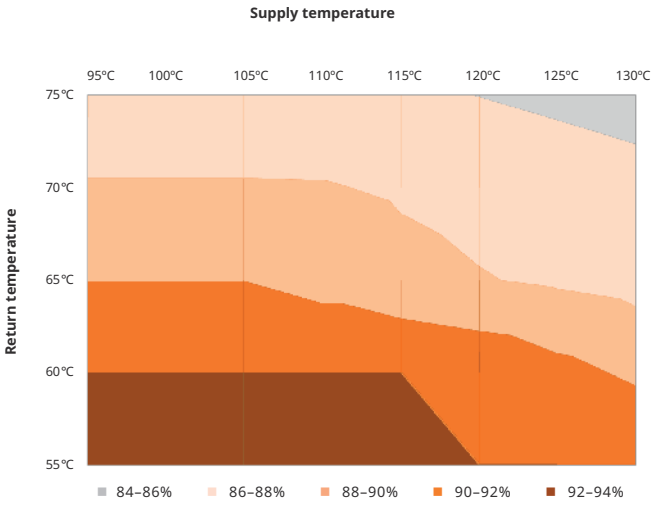
For industrial applications (e.g. textile industry, food processing, refineries, etc.) process steam can be generated with engine exhaust energy, with or without additional hot water recovery from the engine cooling circuits. Should the electricity grid be subject to failures, Wärtsilä engines with lifecycle solutions guarantee a reliable supply of energy at all times.



When the waste heat streams are used for hot water generation, over 90% of the fuel's energy input can be recovered as electrical and thermal power.



In steam generation, major part of heat is recovered from engine exhaust gas streams.



Typical total plant efficiency as a function of the district heating supply and return temperature.

Selected references

Dynamic district heating solutions

The increasing amount of renewable energy creates fluctuations in the electricity market price. In Wärtsilä's Dynamic District Heating (DDH) concept electricity is generated during the profitable peak demand hours while simultaneously fulfilling the mission of heat generation.

Plant configuration

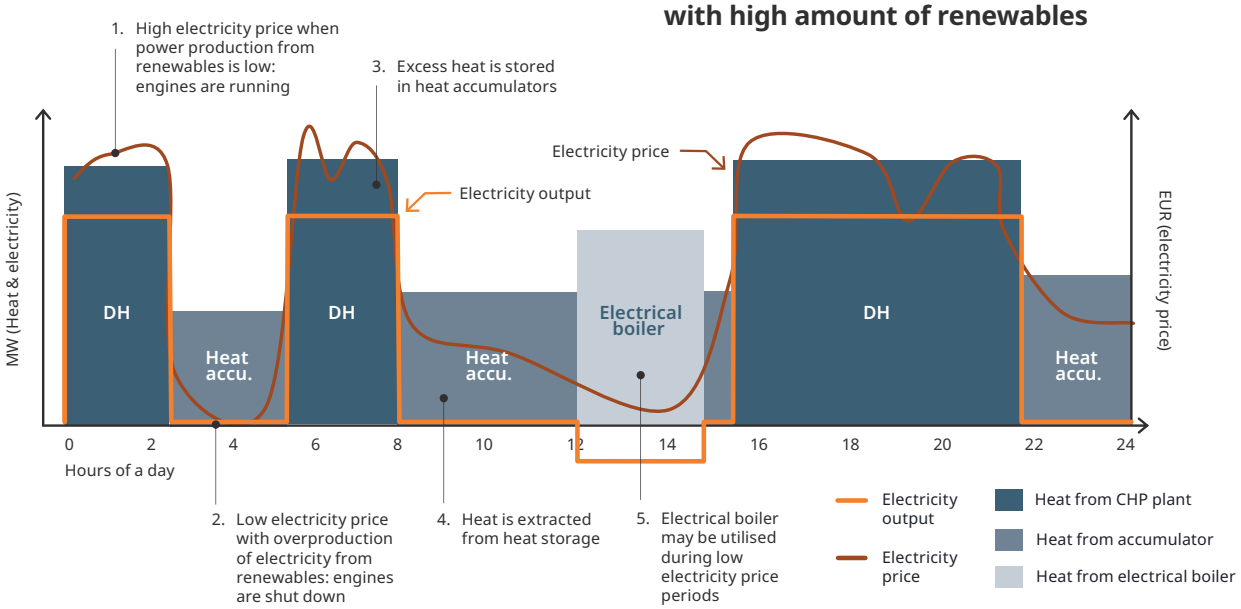
A Wärtsilä DDH power plant is a multi-unit CHP plant that includes the engines, boilers and hot water circulation pump modules. DDH plants are capable of high efficiency and flexible operation over a broad range of plant loads and are thus able to respond to the demand for heat, and to fluctuations in the price of electricity. This flexibility can be further enhanced with thermal storage of the produced heat.

Thermal storage

In a DDH plant, the generated thermal energy can be stored in thermal storage tanks, also known as heat storage tanks, in order to decouple heat supply from electricity supply.

With a Wärtsilä DDH power plant and thermal storage, the variations in power prices and heat demand can be utilised to maximise the value of the heat and power generation. This is achieved by operating the engines during these peak hours and feeding the heat produced into the district heating network or to the thermal storage tank. With a thermal storage tank tightly integrated into the Wärtsilä DDH power plant, the benefits can be utilised completely.

Operating DDH in an energy system with high amount of renewables



In DDH plants, engines are producing electrical and thermal power when the electricity prices are high. Excess heat can be stored and used during periods, when engines are shut down.

Such benefits include

- The heat output from the engine and thermal storage will substitute other investments in heat generating capacity.
- The power plant's power output will be at maximum load during periods when energy prices are high.
- The combination of engine and hot water accumulator will decrease the operation of heat only boilers.
- Eventually the value of the generated power may be boosted by selling the capacity on the balancing market.

By combining the efficiency and flexibility of Wärtsilä engine technology with a tailored and optimised CHP process, a DDH plant can efficiently operate in electricity markets anywhere.

District cooling solutions

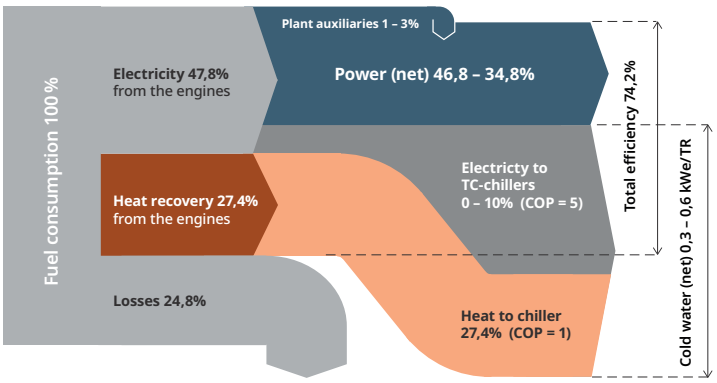
Cooling generation is essential for hotter climates where summer temperatures are high and demand of heat is scarce. Still, even in hot climates both electric power and cooling consumption are dependent on seasonal and daily demand variations that can vary a lot when ambient temperatures can reach 50 °C in the summer. Therefore, fluctuations in electrical power consumption are also considerable. Cogeneration plants have to follow the load accordingly.

The Wärtsilä District Cooling and Power (DCAP) system has been developed for hot climates, where no heat is required, but only power and chilled water for district cooling and air conditioning is needed. DCAP solutions utilises absorption chillers to recover the heat energy from the engines, and can be designed for up to 50 000 TR. In the most cost-efficient solutions, electric driven chillers and/or chilled water storage cover the demand peaks. This minimises the total investment cost of the chiller capacity.

The plant can provide both the required electricity and cooling even during the hottest time of the year. When the engines feed electricity to the grid, all available waste heat is used efficiently for cooling. In case the chilled water cannot be utilised right away, the plant is able to run in pure electricity mode or charge the chilled water storage so that no capacity is wasted.

DCAP reduces primary fuel usage by one third

Fuel savings of more than 30% can be achieved in comparison to conventional centralised power plants producing electricity to the grid and operate electrically driven compressor cooling plants installed on rooftops.



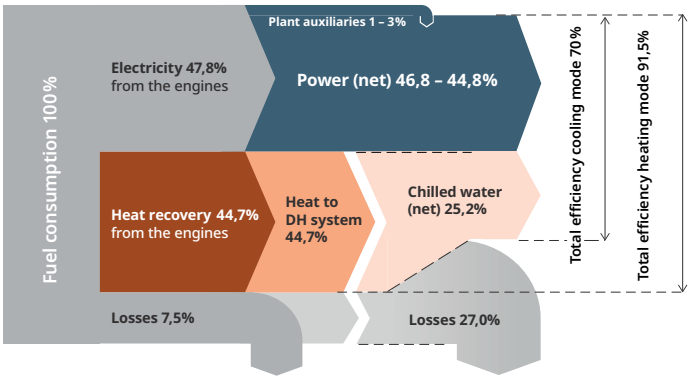
In district cooling, part of the generated electricity can be used for extending the chilling capacity.

Trigeneration solutions

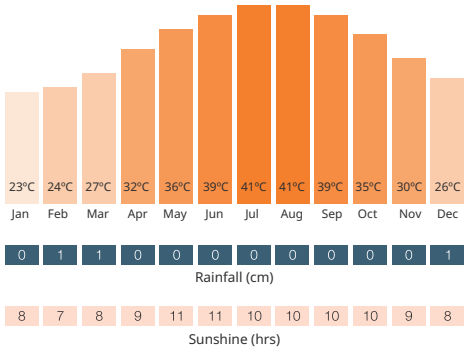
Many industrial facilities and public buildings, such as airports, hospitals, shopping malls and large factories, have both heating and cooling needs. These can be efficiently met by a trigeneration plant.

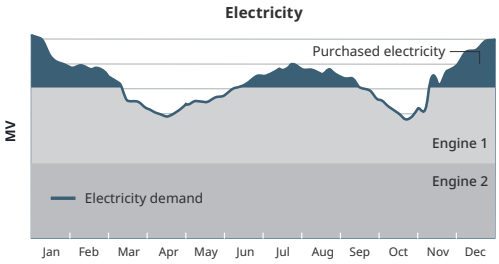
In trigeneration power plants, Wärtsilä can deliver three valuable products for the customer: electricity, heating and cooling – all this from just one power plant. This is possible without compromising the high reliability and superb flexibility of the Wärtsilä power plants. To maximise the total efficiency of a trigeneration plant, its location should ideally be close to the consumers.

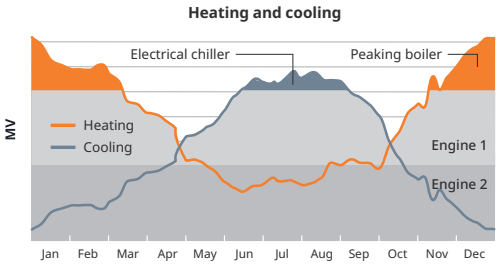
While generating electric power, a substantial amount of cooling energy can be generated from the exhaust gas and engine waste heat by applying absorption chiller technology. When the cooling demand decreases, engine waste heat is typically captured to cover the heat demand. However, different variations of utilisation of excess heat are possible. Wärtsilä designs its trigeneration plants to optimally meet the demand for both power, cooling and heating.



In trigeneration high total efficiencies can be reached both in cooling and heating mode.







Case: Typical variation curves for a two engine trigeneration plant supplying electricity, heat and chilled water according to customer needs. Heat from the engines is utilized for heating during the winter period, and as an energy source for chillers during the summer. Thus, the plant's heat recovery is efficiently used throughout the entire year.

Wärtsilä leads the transition towards a 100% renewable energy future. We help our customers to decarbonise by developing market-leading technologies.

These cover future-fuel enabled balancing power plants, hybrid solutions, and energy storage and optimisation technology, including the GEMS energy management platform. Wärtsilä Energy's lifecycle services are designed to increase efficiency, promote reliability and guarantee operational performance. Our portfolio comprises 76 GW of power plant capacity and more than 110 energy storage systems delivered to 180 countries around the world.

www.wartsila.com/energy

Wärtsilä is a global leader in innovative technologies and lifecycle solutions for the marine and energy markets. We emphasise innovation in sustainable technology and services to help our customers continuously improve their environmental and economic performance.