Energy from Waste

Steamturbines for Waste-to-Energy Plants

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Not only in times of increasing urbanization and population or of the growing industrialization of countries becomes waste treatment more and more demanding. Each year thousands of acres of land are lost to landfills. The methane produced from decomposing waste is a potent greenhouse gas. And the costs associated with using a landfill are rising as cities and counties truck their waste ever farther away.

Reasons like these, and others, are causing municipalities to re-evaluate the benefits of energy-from-waste facilities. Some municipalities are considering new facilities and others are looking at expanding the ones they have.

Additionally, more and more governments establish subsidiaries for an ecological friendly waste treatment. Energy from Waste (EfW) is often viewed as primarily a waste management solution rather than a valuable energy resource. Consequently, its full potential has not always been realized. Still, worldwide more than 2,200 EfW plants with an overall capacity of about 255 million tons per year are installed.

The heart of virtually every EfW plant is a steam turbine generating electrical power out of the heat from the combustion of waste. An efficient and reliable steam turbine is the key to harnessing energy from waste and provides many benefits.
Environmental Benefits
EfW plants are part of the environmental portfolio and contribute significantly towards reducing carbon emissions and meeting renewable energy targets. They have a very good sustainability and greenhouse gas saving characteristics, as they make further use of materials that have already been discarded. Waste seen as source for energy saves the limited fossil fuel resources for the production of sustainable energy.

Sustainability
Waste is produced by mankind. Re-cycling and waste avoidance are still the major ways of waste reduction. The beyond that existing community refuse can be a valuable energy source. One kilogram of waste has a calorific value of around 10,000 KJ and can ideally replace about 0.25 liters of high-grade fuel oil.

Efficiency
The plant makes use of up to 75% of the calorific value of the fuel, since all of the steam produced during incineration is utilized. The high usage factor is also a result of the most advanced techniques in thermal waste disposal. An even higher investment in the power generating technology employing the latest design of steam turbines can result in up to 4% more output compared to the well-proven standard design.

Reliability
EfW plant use waste incineration as a valuable source of fuel. Thus, they help to reduce the dependency on energy imports. When used for electricity generation, these technologies have a steady and controllable output, sometimes referred to as providing “base load” power.

Ludwigslust Thermal Waste Treatment Plant
Ludwigslust, Germany
In operation since 2006, the thermal waste treatment plant has a capacity of 50,000 t/a. The plant delivers heat of 9,600 kJ/a treating the waste of 50,000 citizens. Operator RWE runs the plant non-stop in five shifts for 24 hours a day.

Steam Turbine: SST-110
Power output: 3.5 MW
Total plant capacity: 50,000 t/a
**GÄRSTAD PLANT,**
**Linköping, Sweden**

At the Gärstad waste incineration plant, operated by Tekniska Verken, a total of 420,000 tons of sorted waste per year is incinerated for energy recovery. The heat of the waste incineration is used for district heating in Linköping and other local communities. Since 2011, two SST-110 steam turbines are used to produce electricity in addition. Both, electricity and district heat are sold via the energy exchange market, and power and heat loads can be balanced to run the plant always with maximum profitability.

**Steam turbine:** 2x SST-110  
**El. power output:** up to 11.5 MWe  
**Heat capacity:** 65 – 83 MWth  

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**District Heating and Cooling**

District heating and cooling using a cogeneration system is one of the most efficient applications of a power plant. Usually a plant generates thermal energy at a centralized location and distributes steam to a larger number of buildings for space and water heating. District heating plants can provide higher efficiencies and better pollution control than stand-alone solutions. The process is normally governed by the total heat load and electrical energy is supplied as an additional benefit.

Whether a cogeneration application is for a district energy system, a heating or cooling system, or any other application, Siemens expertise ensures that your project will maintain optimal performance in markets with demand fluctuation. Any Siemens steam turbine can also feature extraction customization as required. The Siemens engineering staff is expert at designing turbines which can maximize output and plant value for seasonal load and demand variations.
Whichever turbine is used in your EfW plant, a Siemens steam turbine will ensure high plant performance. These flexible machines can even optimize electric output in plants which have steam parameters affected by inconsistent feedstock moisture content. This is possible by integrating industry-leading steam cycle technology.

**Siemens Steam Turbines**
The Siemens industrial steam turbine portfolio can be used with any waste-fired steam boiler to generate power from 75 kWa up to any size. The Siemens experts will assist in selecting the optimum turbine that meets all application requirements while at the same time it minimizes the investment costs.

The Siemens steam turbine portfolio is characterized by efficiency and durability. Turbine generator sets have been deployed in EfW plants in the past decade with an outstanding record of applicability and reliability. Siemens can also supply your steam turbine with auxiliary equipment such as generator, a condenser system, monitoring and control systems and power transmission and distribution equipment.

**Leading Technology**
Siemens turbines are available for back-pressure or condensing operation in a single or multi-stage design. They can also be equipped with single or multiple controlled (pass-out) and uncontrolled extractions (bleeds) to satisfy particular process or district heating as well as cooling requirements. Additionally, Siemens offers turbine-generator packages with a reheat feature, further optimizing plant performance and efficiency.

**Afval Energie Bedrijf Amsterdam, Netherlands**
Afval Energie Bedrijf (AEB; Waste and Energy Company Amsterdam) burns 1.7 million tonnes of waste per year and has recently increased its energy generation efficiency from 22% to 31%. This 8% increase resulted from installing a new SST-700 with a steam reheat system. AEB not only generates power from Amsterdam’s municipal waste, but also recovers and sells materials from the waste stream such as metals and gypsum.

**Steam turbine:** SST-700, Reheat  
**Power output:** 74 MW  
**Inlet pressure:** 125 bar/1,813 psi  
**Inlet temperature:** 440 °C/824 °F  
**Fuel:** Municipal solid waste  
**Capacity:** 1.5 Mio + 850,000 t, each line with 93.6 MWth
Turbines with reheat can improve overall plant efficiency by up to 3%, further mitigating the release of harmful emissions by burning less fuel. Each turbine, along with its customized features, is built to meet specific demands.

**Standardized and pre-designed Steam Turbines**
Siemens offers a comprehensive range of pre-designed steam turbines up to 12 MW. These innovative but economical machines have a simple modular design which facilitates optimization of performance for the required application. For optimal configuration, we have different but fully compatible design series to draw upon, enabling us to match your needs as exactly as possible.

- Pre-designed and modular design
- Innovative product design
- High flexibility
- High availability, short delivery time,
- Economic installation and operation

**Customized Steam Turbines**
Our industrial steam turbines up to 250 MW meet customer requirements for economic installation and operation as well as providing excellent flexibility for complex industrial processes.

- Versatile, reliable and proven steam turbines
- Maximum flexibility with predefined components
- Customized turbine configuration
- Single and multi-casing solutions
- Flexible casing concepts
- Predefined components, modular design
- Controlled and uncontrolled extractions

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**Lincolnshire’s Energy from Waste Facility, Lincoln, UK**
This new facility (in operation since 2014), commissioned by Lincolnshire County Council, built by CNIM and operated by FCC Environment Ltd, provides a safe, sustainable and affordable waste treatment solution to dispose of household waste, with a useful and profitable by-product – electricity. It burns 150,000 t of waste a year and has an electrical power output of 15.25 MW and a heat power of 10 MW.

- **Steam turbine:** SST-300
- **Power output:** 15.25 MW
- **Speed:** 5,300 rpm
- **Live steam pressure:** 58 bar / 841 psi
- **Live steam temperature:** 397°C / 746°F
- **Exhaust steam pressure:** 0.07 bar / 1 psi
Reheat Improves Efficiency
Integrating a steam reheat system into an EfW plant is one of the best ways to increase overall plant performance. With the Siemens reheat turbine package, live steam is run through a high pressure (HP) turbine, sent back to the steam generator to increase steam temperature, then run through a low pressure (LP) turbine. Raising the temperature of steam that is going from a high to a low pressure turbine allows for greater output using the same amount of fuel. Geared single-casing reheat solutions up to 60 MW are also available in the Siemens portfolio.

Scheme of a EfW plant: 1 waste treatment, 2 boiler, 3 water steam circle, 4 steam turbine and generator, 5 flue gas treatment, 6 emission control
Siemens steam turbines
The complete product portfolio

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*Steam turbines typically used for WtE plants