Turning waste into power
Sustainable solutions for dealing with growing waste challenges
Around the world, waste generation rates are rising due to rapid population growth and urbanization. Poorly managed waste negatively impacts the entire planet. Waste-to-energy (WTE) plants offer a profitable and environmentally friendly way of properly managing waste. We support our customers’ waste management efforts. As a solution-provider and consulting partner, we want our customers to get the most out of this fuel resource.

Reliable, highly efficient equipment ensures profitable waste-to-energy processes.

Waste – a valuable fuel

Solid waste — our daily routine, page 6

Liquid waste — benefit from decarbonization, page 8

Gaseous waste — tap the potential, page 8
Turning challenges in opportunities

WTE is the best way to efficiently reduce the volume of the garbage. With Siemens products for waste treatment we aim to support a circular economy without landfiling unprocessed waste and, thus, we help to reduce the environmental impact.

How to turn trash into cash

Feeding electricity to the local power grid can be a valuable byproduct and additional source of revenue for WTE facilities. Modern technological solutions enable WTE plant operators to generate thermal power at both high and low temperatures and then distribute this energy for district heating purposes or utilize it for specific thermodynamic processes, e.g. desalination. Operators can also extract and refine multiple types of biofuels from organic waste fractions, and bring these biofuels to market.

Sustainable waste treatment

Siemens advocates for economical cycling in which no raw materials or fuels are lost, rather waste is recycled in a closed-cycle economy. Waste incineration emits harmful NOx gases and other poisonous substances. Reducing such emissions is of utmost importance. You can rely on Siemens as a business partner to offer power generation solutions customized to meet your needs. We consult, plan, engineer and supply all components needed, such as steam and gas turbines as well as electrical generators and auxiliaries – all under one roof. Whether supplying individual components or complete custom-tailored solutions, Siemens can meet its customers’ need. We help plant operators find the best fitting solution, and increase plant efficiency by modernizing their power generation units. Our Financial Services team is happy to consult customers in the entire plant’s planning, financing, and execution.

More than the sum of all parts

Siemens supplies products tailor-fit to customer needs

Siemens provides expert consulting in the conceptual planning phase, helping you select the most appropriate technology that best fits your needs and local conditions. These technologies can be applied to multiple types of waste, from the semi-solid, thickened sludge of effluent treatment plants, to liquid waste like domestic sewage, or gaseous waste such as refinery off-gases.

Customers get state-of-the-art technology of proven quality

WTE plant operators need to be able to handle wastes of changing composition and quantities within very short periods of time. Operationally flexible turbines that pose the best fit for highly volatile calorific values are the right solution for meeting this challenge. Siemens is a strong, reliable business partner offering not only consulting services, but also top-quality technology packaged in a fitting and proven design concept.
Solid waste – our daily routine

Solid waste is part of our daily lives. Household refuse, agricultural waste and woodchips as well as industrial waste are usually in a solid state. Siemens is a reliable business partner offering customized power generation solutions.

Suitable products

Industrial steam turbines

Siemens models most often used in WTE plants: 20 to 200 MW

- SST-600
- SST-400
- SST-300
- SST-200
- D-R B
- D-R R/RS

Steam turbine-generator sets utilize energy most efficiently, and their reliable equipment offers a sustainable business model for plant operators.

Waste treatment

WTE facilities used in municipal solid waste (MSW) treatment convert waste to fuels

- Incineration without adding fuel
  - 1 kg
  - > 1,000 kcal/kg
- Incineration with energy recovery
  - 1 kg
  - > 1,500–1,650 kcal/kg
- Intensified calorific content by producing refuse-derived fuel (RDF)
  - 1 kg
  - > 3,000–3,500 kcal/kg

Reheat improves efficiency

Integrating a steam reheat system into a WTE plant is one of the best ways to increase overall plant performance. In a Siemens reheat turbine package, live steam is fed through a high-pressure (HP) turbine, returned to the steam generator to increase the steam temperature, then routed through a low-pressure (LP) turbine. Raising the temperature of the steam passing from the HP turbine section to the LP section generates greater output using the same amount of fuel. Siemens offers geared single- and double-casing reheat solutions. Plant operators can also use Siemens' reheat solutions for power outputs of 10 to 12 MW, or lower.

Average overall plant efficiency*

- 22–25%
- 29.6%

* Figures based on untreated municipal waste.

Industrial steam turbines

Most often used in WTE plants: 10 MW–200 MW, e.g. SST 300

- SST-600
- SST-400
- SST-300
- SST-200
- D-R B
- D-R R/RS

Generators up to 370 MVA

Most often used in WTE plants:

- SGen-100A / SGen-1000A generator series
- power output > 25 MVA

Powering the future | Turning waste into power
Gaseous and liquid waste – tap the potential

Gasification technology can be used to produce low-carbon fuels from municipal waste. Once compressed into high-pressure gases, Siemens Dresser-Rand DATUM® compressors driven by Siemens steam turbines reduce the plant’s demand for electricity. Other applications include electrical power generation and combined heat and power configurations based on Siemens gas turbines fueled by biogas or syngas. Gas turbines deliver high flexibility and performance when firing these types of fuel, significantly improving plant energy consumption.

Emissions from landfills contribute significantly to the environmental impact of such facilities. Organic components in the waste generate methane gas which, instead of being released to the atmosphere, can be a valuable basis for energy production. Systematic economic use of such gases would also make a valuable contribution to decarbonization.

-75% methane released into the atmosphere

100,000 tons of organic waste (MSW)
1 t/h methane
biogas collection wells

Suitable products

Gas engines
0.19 to 1.3 MW

Industrial and aeroderivative gas turbines
4 to 71 MW

Dresser-Rand compressors
Comprehensive service

Customers partnering with Siemens benefit from condition-based maintenance and service.

Siemens makes certain that service intervals coincide with boiler maintenance intervals to ensure fast plant restart and waste processes after servicing. The company also offers pioneering digital tools for services and for preprocessing systems, as well as equipment for preprocessing waste. Additionally, an advanced power diagnostics center enables operators to efficiently control plant processes.

One reliable business partner to meet any need

Whether individual components or complete solution packages, Siemens delivers everything crucial to WTE plants, all from a single supplier. Moreover, we offer customized components and solutions tailor-fit to the given conditions at the customer’s site.
Modernizing existing WTE plants or building new ones

With increasingly stringent climate regulations on a national and international scale, power producers are increasingly looking to gain from the benefits offered by installing new WTE capacity.

However, fuel from renewables is highly demanding in terms of the logistics involved, which ultimately impacts revenue. In addition, the planning phase for a WTE power plant requires meticulous coordination, advanced technical expertise, and convincing arguments for governmental bodies and society alike.

Partnering with an experienced equipment manufacturer is therefore an important step toward commissioning new plants or modernizing existing facilities.

Early consulting is key

Siemens provides:
- Consulting from an early stage
- Project development from beginning to end
- Financing (with Siemens Financial Service)
- Environmental, health and safety expertise
- Low service and life cycle costs due to long service intervals and high availability
- Continuous research & development

Siemens supports its customers with comprehensive consulting early on in the process to find the solution that best fits their needs. A high level of technical expertise, professional project management and overall development efforts dedicated to WTE projects are part and parcel of the experienced we offer, including financial partnership with Siemens Financial Services.

Making the solution fit the environment

Turbines for the WTE industry must not only meet the specifications governing steam extraction and control, but also operate highly efficiently. With the support of Siemens and the company’s deep understanding of processes and thermodynamic specifications, plant operators are able to meet and master this complex challenge.

With more than 100 years of steam turbine experience under its belt, Siemens offers tailor-made products that can be smoothly integrated into existing system environments – thanks to the high flexible operating modes of these turbines and optimized interfacing between the boiler and steam turbine.

Siemens makes the solution fit the environment, not the other way around.

High efficiency at lowest cost

Siemens offers the best-suited turbines that strike the right balance between high efficiency and low capital expenditure (capex). Reliable power generation units ensure high availability.

The accumulated experienced embodied in Siemens’ products helps reduce overall cost over the turbine’s long service life, thereby maximizing your return on investment.

Siemens has been focusing research and development efforts on building highly efficient steam and gas turbines for over 100 years. Siemens turbines operate up to two percent more effectively compared to conventional designs. An additional contribution to higher efficiency is the revised steam path achieved by specialized steam inlets which ensure high temperatures (up to 565°C) with short heat-up times, along with competitive solutions for lower parameters.

Reliable components

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Reference projects around the world

North America
- USA
  - Hillsborough: Unit power output: 18 MW SST-400
  - Anderson: Unit power output: 20 MW SST-400
  - New Hampshire: Unit power output: 7 MW SST-300

South America
- Total power output: 22.2 MW Gas engines portfolio

Europe
- Germany
  - Germany
    - Knapsack SST-400
      - Unit power output: 34 MW
    - Eberswalde
      - Unit power output: 20 MW
    - Rüdersdorf
      - Unit power output: 35 MW
    - Rostock
      - Unit power output: 22 MW SST-300
    - Mannheim
      - Unit power output: 6 MW SST-400
    - Mainz
      - Unit power output: 20 MW SST-400
    - SST-300
    - Mannheim
      - Unit power output: 9 MW SST-300
  - Total plant power output: 45.1 MW

- Turkey
  - Total power output: 84 MW Gas engine portfolio

- Saudi Arabia
  - Unit power output: 14 MW SST-400
  - Unit power output: 24 MW SST-400

- France
  - France
    - Unit power output: 5 MW SST-400

- Finland
  - Finland
    - Unit power output: 5 MW SST-400

- Spain
  - Palma de Mallorca
    - Unit power output: 38 MW SST-400

- Netherlands
  - Netherlands
    - Unit power output: 35 MW SST-400
    - Unit power output: 34 MW SST-400
    - Middelbourg
      - Unit power output: 350,000 Fuel/year: 128 MW
      - Total plant power output: 128 MW
    - Amsterdam
      - Unit power output: 800,000

- Belgium
  - Belgium
    - Brussels
      - Unit power output: 24 MW SST-300

- Czech Republic
  - Děčín
    - Unit power output: 18 MW SST-400
    - Unit power output: 23 MW SST-400
    - Total plant power output: 3 MW

- Slovakia
  - Bratislava
    - Fuel/year: 80,000 Total plant power output: 3 MW

- Austria
  - Steiermark
    - Unit power output: 18 MW SST-400
    - Unit power output: 14 MW SST-400
    - Total plant power output: 45.1 MW Gas engine portfolio

- China
  - Kaidi IV
    - Unit power output: 31.23 MW SST-400
    - Total power output: 11.5 MW Gas engine portfolio

- India
  - Total power output: 41 MW Gas engine portfolio

- Indonesia
  - Southeast Asia
    - Total power output: 54.3 MW Gas engine portfolio

- South Africa
  - Total power output: 1.5 MW Gas engine portfolio

- Ukraine
  - Unit power output: 8 MW SST-400

- Poland
  - Konin
    - Unit power output: 7 MW SST-300
    - Krakow
      - Unit power output: 17 MW SST-300

- Portugal
  - Total power output: 3 MW Gas engine portfolio

- Indonesia
  - Southeast Asia
    - Total power output: 52.2 MW Gas engine portfolio

- Taiwan
  - Yung-Kais MW Incineration Plant
    - Fuel/year: 219,500

- Thailand
  - Total power output: 107 MW Gas engine portfolio
    - Fuel/year: 219,500

- Singapore
  - Singapore
    - Total power output: 14 MW Gas engine portfolio
    - Fuel/year: 219,500

- United Kingdom
  - Lincolnshire
    - Unit power output: 15 MW SST-300
  - Suffolk
    - Unit power output: 24 MW SST-300
  - Staffordshire
    - Unit power output: 31 MW SST-300
  - Plymouth
    - Unit power output: 28 MW SST-400
  - Twente
    - Unit power output: 25 MW SST-400
  - Castell
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- Sweden
  - Västervik
    - Unit power output: 12 MW SST-400

- Finland
  - Vantaa
    - Unit power output: 55 MW SST-800

- Norway
  - Væring
    - Unit power output: 5 MW SST-400

- Thailand
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    - Fuel/year: 319,500

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Thermal waste treatment powers Lincoln
Lincolnshire’s Energy from Waste Facility, UK
Commissioned by Lincolnshire County Council, built by CNIM and operated by FCC Environmental Ltd., this facility in operation since 2014 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

CO₂ emissions reduced by 40%
UNH Cogeneration Plant, Durham, New Hampshire, USA
The University of Hampshire (UNH) cogeneration plant, fired on landfill gas, supplies 85% of the heat and 75% of the power demand of UNH Durham. By utilizing a Siemens gas turbine with a heat recovery steam generator (HRSG), UNH Durham was able to cut their greenhouse gas emissions by 40%. UNH Cogen was recognized by the US Environmental Protection Agency (EPA) as a "Project of the Year 2010" at their Landfill Methane Outreach Program annual conference.

Gas turbine: SGT-300
Power output: 7.9 MW
Combustion system: Dual-fuel dry low emissions (DLE)
Fuel: Landfill gas, natural gas, distillate fuel

Increased power plant efficiency for extra electricity
Afval Energie Bedrijf Amsterdam, Netherlands
Afval Energie Bedrijf (AEB; Waste and Energy Company Amsterdam) burns 1.7 million metric tons of waste per year and has increased its energy generation efficiency from 22% to 31%. This 8% increase resulted from installing a new Model SST-700 steam turbine 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, with reheat system
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

Capturing methane and making use of biogases
PKS Sei Tapung, Riau province, Samatra, Indonesia
The customer installed a methane recovery and combustion system into an existing anaerobic lagoon wastewater system. The lagoon is covered with high density polyethylene plastic to recover the biogas/methane released from the anaerobic digestion of organic matter within the palm oil mill effluent (POME) that is discharged from palm oil processing.

PKS Sei Tapung exports the electricity generated to PTPN-V for downstream activities (e.g., empty fruit bunches pelleting plant or palm tree trunk plywood plant) that would otherwise use diesel generators to generate electricity. The project activity is estimated to treat approximately 139,160 m³ of POME annually and reduce emissions by approximately 14,854 t CO₂ e.

Two gas engines: SGE-56SM containerized generator set (operating in parallel with an existing diesel generator set), SGE-36SL containerized model.
Power output: 1,500 kW/h