Efficiency: More value to your facility

Siemens steam turbine portfolio
Steam turbines from 10 kW to 1,900 MW

siemens.com/steamturbines
With over a century of experience and continuous development in steam turbine technology, Siemens has stayed at the forefront of development and is a prime partner for your business. With a fleet of more than 60,000 steam turbines worldwide, Siemens is a reliable and experienced partner.

Siemens Steam Turbines are an essential piece of turbo-machinery to many power plants worldwide. They are applied either as a generator drive or a mechanical drive for pumps and compressors. The modular design concept of all steam turbines ensures high flexibility, availability and a reduction of time-to-market.

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Steam turbines overview

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<th>Output (MW)</th>
<th>10</th>
<th>100</th>
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<tr>
<td>SST-9000</td>
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<tr>
<td>SST-150</td>
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## Steam Turbines Overview

### Output (kW)

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*Note: The output kW values are approximate and may vary depending on specific configurations.*
Siemens offers a comprehensive range of steam turbine products in the power output range from 90 to 1,900 MW. These are used in conventional fossil-fired steam power plants as well as in nuclear and combined cycle power plants. With more than 8,000 steam turbines in service worldwide we provide proven technology, adapted to the specific local conditions.
**SST-3000 Utility steam turbine package**

Flexible steam turbine for applications in single-shaft and multi-shaft combined cycle configurations

In our Siemens Steam Turbine portfolio, we offer with the SST-3000 series steam turbine a compact arrangement, that features a two-cylinder design with an axial exhaust for use in combined cycle power plants. Steam turbines of SST-3000 series are exceptionally compact machines for use in combined cycle power plants.

**Ribatejo, Portugal**

The Ribatejo power plant was one of the most technologically advanced combined cycle power plants at the time of construction. In operation: unit1: 02/2004, unit2: 10/2004, unit3: 03/2006

Net plant output: 3 × 390 MW

Steam turbine output: 3 × 142 MW

Scope of supply: 3 × SGT5-4000F, 3 × SST5-3000, 3 × SGen5-2000H

Main steam conditions: 125 bar / 1,813 psi, 565 °C / 1,049 °F

Reheat steam conditions: 555 °C / 1,031 °F

**Ribatejo, Portugal**
Utility steam turbine package

Powerful and reliable – thanks to proven design for high efficiency

The SST-4000 series is our specialized turbine for non-reheat, combined cycle applications. With the specialized design of the blade path, the entire power range from 100 to 380 MW can be covered with the highest reliability and availability. Almost 40 turbines of this type are already in operation or in the commissioning stage, with a total installed capacity of approximately 7,200 MW.

The SST-4000 series consists of an intermediate-pressure and a low-pressure turbine. The installation is either high or low level arrangement with down, double-side or single-side exhaust. The turbine is able to provide process steam e.g. for industries or sea water desalination and can provide industrial heating.

Thanks to its systematically modular design, the SST-4000 series can easily be adapted to the individual operating conditions and thermal cycle design of the plant. Its fast installation, thanks to prefabricated, tested modules delivered ready for connection, is of additional advantage.

Al Ezzel, Bahrain

The power plant makes an important contribution towards meeting the country’s growing power demand in an economic and environmentally compatible manner.

Customer: Al Ezzel Power Company
Plant type: SCC5-2000E multi shaft 2 x 1
Power output: 2 x 475 MW (power plant)

Suitable for operations in condensation and back-pressure mode
Proven designs for highly efficient, continuous operation
Low space requirement due to compact design, low investment costs
Short start-up times
Widening of suitable reaction type
Long service intervals lead to low maintenance costs and high availability

Suitable for high pressure or low pressure arrangement
Suitable for operations in condensation and back-pressure mode
Proven designs for highly efficient, continuous operation
Low space requirement due to compact design, low investment costs
Short start-up times
Blading of variable-reaction type
Long service intervals lead to low maintenance costs and high availability

SST-4000

Power output: 100 up to 380 MW
Frequency: 50 or 60 Hz

Main steam conditions
Inlet pressure up to 105 bar / 1,523 psi
Inlet temperature up to 565° C / 1,049° F

Last stage blade length
50 Hz 80 cm to 115 cm / 31 inches to 45 inches
60 Hz 76 cm to 95 cm / 30 inches to 38 inches

Customer:
Al Ezzel Power Company
Plant type: SCC5-2000E multi shaft 2 x 1
Power output: 2 x 475 MW (power plant)
A steam turbine with short start-up times and variable start-up modes to ensure grid stability

Siemens Steam Turbines of the SST-5000 series are operated in combined cycle power plants (CCPP) and in coal-fired steam power plants (SPP). The SST-5000 steam turbine combined with an SGT-8000H gas turbine, achieves a world record efficiency of 61.5 percent in combined cycle applications.

Lausward “Fortuna”, Germany

The combined cycle power plant set three world records: in the acceptance test a maximum electrical net output of 603.8 MW was achieved and the net energy conversion efficiency was around 61.5 percent.

- overall plant efficiency considering thermal extraction was above 85%
- 300 MW thermal power extraction through one steam turbine train

Plant type: SGT-8000H 1S (single shaft)
Power output: 604 MW
Efficiency: 61.5%

The SST-5000 is suitable for supercritical and ultra-supercritical steam power plants. Due to its higher pressure and temperature ratings, power plant efficiency increases to more than 46 percent and overall performance is improved. In steam power plants the SST-5000 consists of a combined high pressure/intermediate pressure turbine, and one or two low pressure turbines with down exhaust, single sided or double sided exhaust. It is installed in a low- or high-level arrangement. Various extractions (up to 9 stages) contribute to an optimized plant efficiency.
Combined stop & control valve
Valve connection below the horizontal flange of the HP-IP turbine for easy maintenance.

High-pressure / intermediate-pressure turbine
Combined HP turbine with circular inner and outer casing for minimal thermal deflection and minimal clearances for high efficiency.

Low-pressure turbine
Inner and outer casing of the double flow turbine are mechanically decoupled. That allows minimal radial clearances resulting in maximum efficiency. The condenser is installed either below, on one side or on both sides of the low-pressure turbine.

Single crossover pipe
Crossover pipe designed to minimize losses, reduces plant complexity and minimizes footprint.

Combined HI turbine with circular inner and outer casing for minimal thermal deflection and minimal clearances for high efficiency.

Bearing
Single bearing arrangement between HP-IP and LP turbine cylinders for simple alignment and stable operation.

SST-5000
Reduced lifecycle costs with the SST-6000 steam turbine

Siemens Steam Turbines of the SST-6000 series are widely operated in steam power plants with a power output up to 1,200 MW and an efficiency up to more than 46 percent. Turbine trains of the SST-6000 series consist of a high-pressure turbine, an intermediate-pressure turbine, and up to three low-pressure turbines for 50 and 60 Hz.

The SST-6000 is installed in a high-level arrangement with down exhaust. Various extractions (up to 10 stages) are available for feed water preheating, process steam, and district heating.

The globally installed capacity of the SST-6000 all over the world is more than 100,000 MW.

Eemshaven, Netherlands

Thanks to its highly efficient power plant process the Eemshaven steam power plant consumes less hard coal compared to the average of coal-fired power plants. This leads to a reduction in CO₂ emissions of 2.5 million metric tons per year.

Power output: 2 × 800 MW
Efficiency: 46.2 %
Main Steam: 275 bar/597 °C (3,989 psi/1,107 °F)
Reheat Steam: 609 °C/1,130 °F
Commissioning: 2014
Intermediate-pressure turbine

- Double-flow intermediate-pressure turbine
  - Circular inner and outer casing for minimum thermal deformation and minimum clearances for high efficiency
  - Shipped to site fully assembled for smooth erection and start

High-pressure turbine

- Barrel type HP turbine, no half joint flange connection
- Single-flow high-pressure turbine with circular inner and outer casing, optimum thermal loading and small clearances.

Bearing

- Fixed bearing
  - Single, fixed bearing arrangement between HP and IP turbine cylinders for simple alignment and stable operation. Fixed bearing pedestals on foundation crossbeams.

Crossover pipe

- Single crossover pipe
  - Large diameter pipe to minimize losses and to reduce plant complexity and steam turbine footprint.

Low-pressure turbines

- Double-flow low-pressure turbines
  - Inner and outer casing are mechanically decoupled preventing displacement and deformation of the inner casing. That allows minimal radial clearances resulting in maximum efficiency.
  - The outer casing is directly welded on the condenser underneath the low pressure turbine casing.

Valve

- Combined stop & control valve
  - For easy opening of steam turbine casing valves are connected to the lower part of the outer casing via bolt connection.
SST-9000
Utility steam turbine package

Leading technology for efficient, flexible and reliable power generation

The SST-9000 is a highly reliable steam turbine for applications in the conventional-islands of advanced pressurized water reactors in nuclear power plants, with a power output up to 1,900 MW.

The half-speed SST-9000 features a double-flow saturated steam high-pressure (HP) turbine and up to three double-flow low-pressure (LP) turbines with shrunk-on disk rotors.

Shrunk-on disk design features proven technology: eliminating stress-corrosion cracking and replacement of the low-pressure rotors or disks during the design lifetime.

Yang Jiang, China (Unit 1–6)
Nuclear Power Plant

Customer:
China Nuclear Power

Scope of supply:
Unit 1: LP rotors and HP valves
Unit 1-6: Turbine Engineering and Instrumentation & Control Systems

Commercial operation:
Unit 1 since May 2014

Power output: 1,103 MW (as built)
Grid Frequency: 50 Hz
Turbine Frequency: 25 Hz

Yang Jiang, China
As a market leader for industrial steam turbines, we offer a comprehensive range of reliable and versatile steam turbines for the power output range from 2 to 250 MW. Our industrial steam turbines are designed for easy constructability, fast start-up and economical operation.
Steam turbine with efficient and compact arrangement

The SST-150 is a single-casing steam turbine, providing geared drive to a 1,500 or 1,800 rpm generator. The turbine is packaged in a skid-mounted design (can also be with separate oil system). This is a very compact arrangement which provides high efficiency in power generation and mechanical drive applications. The pre-engineered turboset enables early planning of the turbine building layout, saving time for the customer.

The SST-150 is a steam turbine with impulse blading, developed to meet the most demanding customer requirements for cost-efficient power generation and mechanical drive applications. The turbine is used for both backpressure and condensing applications with internally controlled extraction and scope for several bleeds. Both back pressure and condensing turbines are available with upward or downward exhaust. The exhaust flange can be equipped with top or bottom exhaust.

Roi Et, Thailand: Turboset for the Bua Sommai Electricity biomass power plant.

SST-150

Industrial steam turbine

- Back pressure or condensing steam
- Customized steam path
- Single controlled extraction
- Highly predefined design
- Pre-engineered turbine
- Shop assembly

**Typical applications**

- Mechanical drive
- Combined-cycle power plants
- Cogeneration (Combined Heat and Power and district heating)
- Waste incineration plants and biomass power plants
- Waste heat recovery
- Captive power plants for pulp and paper mills, steelworks, mines, and for the sugar, textile, chemical and petrochemical industries

**Roi Et, Bangkok, Thailand**

The 9.9 MW electrical capacity power plant is based on mostly rice husk and a smaller fraction of wood chips (up to 10%) as fuel. The power plant was erected by Bua Sommai Electricity Generating Co., Ltd. (Buasommai) located in Roi Et, Thailand. Out of the gross generation capacity of 9.9 MW, a total of 8 MW is fed into the national electricity grid.

Steam turbine: SST-150

Power output: 3.0 MW

Generator drive

**Steam turbine:** SST-150

**Power output:** up to 20 MW

**Speed:** up to 13,000 rpm

**Inlet pressure:** up to 130 bar (1,965 psi)

**Inlet temperature:** up to 505° C (940° F)

**Exhaust steam parameters:**
- Back pressure: up to 18 bar (265 psi)
- Condensing: up to 0.25 bar (3.6 psi)

**Steam extraction:**
- Controlled (up to 4): 16 bar (230 psi), 350° C (660° F)
- Uncontrolled: 25 bar (365 psi)
The Siemens SST-200 Siemens industrial steam turbine product line is based on the reaction blade technology. The turbine series follows a modular product philosophy, ensuring a high level of performance and reliability. The ability to combine standardized casing modules enable optimal design flexibility. This allows the turbine series to achieve high performance in combination with an optimal cost position.

Each steam path is customized for optimal fit to the specific thermal cycle requirements providing high efficiency over the entire operating range.

The inlet and exhaust sections are configured to cover different plant configuration needs and are used in condensing configurations as well as in back pressure applications.

With this flexible approach the SST-200 covers the range of both industrial mechanical drive and industrial power generation applications.

The product design closely follows API 612 requirements.

Tamoil, Switzerland
2 turbines producing an average 5 MW each in mechanical drive application

Steam turbine: 2 × SST-200
Power output: 5 MW each
Mechanical drive

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**Typical applications**

- Generator and mechanical drive
- Chemical and petrochemical industry, such as Ethylene plants, Ammonia and fertilizer plants, Methanol plants
- Sugar mills
- Biomass plants
- Metals & mining
- Energy from waste plants

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**Technical data**

- **Power output**: up to 20 MW
- **Speed**: up to 14,600 rpm
- **Inlet pressure**: up to 120 bar (a) / 1,740 psi
- **Inlet temperature**: up to 540 °C / 1,004 °F
- **Exhaust steam parameters**
  - Water-Cooled Condenser: 0.05–0.15 bar (a)
  - Air-Cooled Condenser: 0.15–0.50 bar (a)
  - Backpressure Turbines: 2–20 bara
- **Steam extraction**
  - Controlled (up to 4): up to 16 bar (230 psi) / up to 350° C / 560° F
  - Uncontrolled: 60 bar (870 psi)
The SST-300 is an optimal solution for a wide range of applications due to the implementation of the best technology combined with over 20 years of experience. In the last decade alone, this turbine has been installed in over 500 industrial and power applications by customers all over the world.

The flexible configuration of the SST-300 enables it to be used in diverse applications such as waste-to-energy, chemical processing, pulp and paper, cement and many more.

### Typical applications
- Biomass plants
- Chemical and petrochemical industry
- Cement industry
- Combined cycle power plants and combined heat and power plants
- Concentrated solar power plants
- District heating
- Waste-to-energy plants (waste incineration)
- Pulp and paper mills
- Sugar industry
- Steel works and mines

| SST-300 Power output up to 45 MW |
|-------------------|-----------------|-----------------|-----------------|-----------------|
| Speed | up to 12,000 rpm |
| turbine inlet parameters | inlet pressure 140 bar / 2,030 psi |
| inlet temperature 540 °C / 1,004 °F |
| Exhaust steam parameters | exhaust back pressure up to 16 bar / 232 psi |
| Condensing up to 0.3 bar / 4.4 psi |
| Additional extractions (up to 2) single or double, adaptive stage, nozzle control, throttle control |
| Pressure up to 25 bar / 362 psi |
| Temperature 400 °C / 752 °F |
| Uncontrolled extractions (up to 6) |
| Pressure up to 60 bar / 870 psi |

**Waste-to-energy plant, Lincoln/UK**

In operation since 2014, the Lincolnshire Waste-to-Energy facility 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.

- Power output: 25.15 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)

**Industrial steam turbine**

All components and auxiliaries including the lube oil system are mounted on a common base frame or skid.

- Short erection time at site due to a "plug and play" system.
- Fast, easy and flexible layout planning.

Waste-to-energy plant, Lincoln/UK
Valve arrangement
Internal valve arrangements (or adaptive stages) control the steam flow and maintain constant process steam extraction pressures over a wide flow range.

Base frame
SST-300 turbines are delivered as packaged units with simple or integrated base frame. The oil tank is inside the base frame. Only a minimal number of external connections, which are clearly defined according to standards, ensure fast and easy installation.

Exhaust
Equipped with upward, downward or axial exhaust orientation.

Turbine Casing
The nearly symmetrical casing allows short start-up times and quick load changes.

Reaction Blading
The rotor is fitted with resonance-proof fully shrouded blading. The last stage is free standing with damping wires (condensing steam turbine)
SST-400
Industrial steam turbine

The SST-400 is a single casing steam turbine, providing geared or direct drive to 50 and 60 Hz generators, or to compressors and pumps. The symmetrical casing with horizontal joint flange enables the SST-400 to accept short start-up times and rapid load changes. The modular package design allows a wide variety of configurations to satisfy the customer’s individual needs in the most economical way. The utilization of selected proven components assures high reliability and easy maintenance.

The SST-400 can be equipped with upward, downward or axial exhaust to fit with the selected installation. The turbine skirt can be combined with standardized gearbox/oil units and generators to a turboset, according to the customer’s needs.

Waste-to-energy plant, Mallorca/Spain

Tourism drives the local development and welfare of the Mediterranean island. The significant increase in Island guests causes the population to vary between about 1 million in winter and 6 million in summer. This poses a challenging task for the proper disposal of daily waste. The EfW plant in Palma de Mallorca has a capacity of about 430,000 t per year. Mallorca reached zero landfill waste.

Power output: 38 MW (steam turbine)
Speed: 4,500 rpm
Inlet temperature: 397 °C / 746 °F
Inlet pressure: 50 bar / 725 psi

Waste-to-energy plant, Mallorca/Spain

| Typical applications |
|---------------------|------------------|
| • Power generation industrial power plants |
| • Biomass & waste |
| • District heating |
| • Combined cycle power plants |
| • Mechanical drive |
| • Waste heat recovery |

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<thead>
<tr>
<th>Key notes</th>
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<td>Power output</td>
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Fast and early layout planning
Short delivery time
Compact design minimizes space requirements of installation
Easy access to mechanical components facilitate maintenance
SST-500

Double exhaust flow steam turbine

The SST-500 is a single casing, double exhaust flow steam turbine, which can be used as an entire drive or as the low-pressure module of a multiple casing turboset, directly driven or geared. This turbine, with its capacity to operate over a wide range of speed and power, is ideal for large steam volume flows.

Steam flows into the turbine via two tangential inlets to equalize thermal loading and blade stress. Emergency stop valves and control valves are installed in the steam inlet pipes. The steam flows tangentially into the inner casing and then axially to both exhausts. The customized design of the steam path allows exact adjustment to surpass general physical limitations of the last stage blades. Double-end drive is available, if required, e.g. for booster pump drive.

Booster pump drive, Shanghai/China

Customer: Shanghai Municipal Electric Power Co
Project: The coal-fired Wai Gao Qiao power station consists of eight generating units, including four 300 MW sub-critical, two 900 MW supercritical and two 1,000 MW ultra-supercritical units
Application: Booster pump drive
Power output: 19.4 MW (steam turbine)
Speed: 5,912 rpm
Inlet temperature: 343 °C / 649 °F
Inlet pressure: 11.1 bar / 160.9 psi

Typical applications
- Pump drive (e.g. feedwater pump for large boilers)
- Generator drive
- Compressor drive
- Chemical industry
- Steel works
- Waste to energy, e.g. waste incinerators
- Waste heat from chemical processes
**SST-600**

**Flexible condensing or back-pressure steam turbine**

**Generator drive in various packages**

We deliver a standard steam turbine generator set including the SST-600 (with or without gearbox), a generator, oil system, piping and instrumentation and the control system. The standard package can be extended to include a condenser, condensing plant or pre-heating system. The SST-600 with its reliable and flexible design is available with axial or radial exhaust.

**Mechanical drive**

The SST-600 is also an efficient and economic mechanical drive. Since the 1970s, hundreds of projects have been successfully implemented all over the world using the SST-600 to directly drive everything from the smallest boiler feedwater pump just as reliably as the largest compressor even in the most complex processes. The SST-600 complies with regulations including the API standard.

**Biomass district heating plant, Västergötland / Sweden**

The district heating plant, operated by Mölndal Energie (supply 91 MWth thermal power and 23 MWe electricity). It has been in operation since 2009 and uses wood as fuel. Siemens delivered the complete turbine (SST-600 and generator).

**Power output**: 23 MW

- **Live steam temperature**: 519°C/966°F
- **Live steam pressure**: 127 bar / 1,840 psi
- **Exhaust steam pressure**: 0.5 bar / 7.3 psi
- **Speed**: 5,000 rpm

**Generator drive**

- **Power output**: up to 200 MW
- **Speed**: 1,500 to 18,000 rpm

**Live steam parameters**

- **Inlet pressure**: up to 165 bar / up to 2,393 psi
- **Inlet temperature**: up to 565°C / 1,050°F

**Exhaust steam parameters**

- **Back pressure**: up to 80 bar / 1,160 psi
- **Condensing**: up to 1.0 bar / 15 psi
- **District heating**: up to 3.0 bar / 43 psi

**Controlled extractions**

- **Pressure, ext. valve**: up to 72 bar / 1,044 psi
- **Pressure, int. valve**: up to 45 bar / 665 psi
- **Temperature**: up to 480°C / 895°F

**Uncontrolled extractions**

- **Pressure, ext. valve**: up to 85 bar / 1,233 psi
- **Pressure, int. valve**: up to 60 bar / 870 psi

- **Outstanding efficiency**
- **Fast start-up times**
- **Highest reliability**
- **Economic installation and operation**
- **Flexibility for complex, industrial processes**

**Typical applications**

- Chemical and petrochemical industry
- Pulp and paper mills
- Steel works
- Mines
- Power plants
- Seawater desalination plants
- Biomass and Waste-to-energy plants (waste incineration)
The possibility of applying up to 3 balancing pistons minimizes thrust and allows smaller axial bearings. Thanks to improved journal bearings, less oil and a smaller oil tank are needed.

The symmetrical design of the upper and lower halves avoids material concentrations and ensures improved thermal behavior and an improved start-up time.

A wide range of exhaust sizes and types is available for back-pressure and condensing applications. The improved cylindrical high pressure blades and tapered intermediate pressure blades allow longer airfoils and contribute to the overall high efficiency.

The improved sealing system allows more sealing strips per blade row at both moving and stationary blades.
SST-800
Steam turbine with center steam admission

Generators drive in various packages
The SST-800 is a single casing steam turbine with center steam admission and suicide steam flow inner casing, designed for a direct coupled generator or mechanical drive. The power output with dual casing solution is up to 250 MW.

The highly customized turbine provides for an outstanding efficiency, fast start-up times and high reliability and availability. It supports all requirements for economical installation and operation in combination with highest flexibility for complex industrial processes. A double or even multicasing solution can also be provided.

The SST-800 steam turbine can be used for both condensing and back-pressure applications. It is built up from pre-designed modules combined into a single unit for optimum matching of the required parameters. Turbine auxiliary systems are also designed as pre-engineered modules covering the complete range of turbine sizes.

The SST-800 turbine is equipped with impulse control stage and reaction blading fixed in blade carriers. Furthermore the turbine is offered with throttle controlled inlets. The turbine can be arranged on a foundation or as a package (including oil system and on a dear frame). The SST-800 steam turbine design is in accordance with DIN or API standards.

Steam Turbines for Pulp & Paper Industry SST-800, Klabin/Brazil
Two Siemens SST-800 steam turbines are supplying electricity and process steam to a pulp factory in Brazil. The SST-800 has a capacity of 190 megawatts (MW), making it among the largest steam turbines in use in the pulp and paper industry worldwide.

Steam Turbine for the pulp plant Klabin, Brazil

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>up to 250 MW</td>
</tr>
<tr>
<td>Speed</td>
<td>3,000 to 3,600 rpm</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>up to 165 bar / up to 2,393 psi</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>up to 565 °C / up to 1,050 °F</td>
</tr>
<tr>
<td>Exhaust pressure</td>
<td>up to 72 bar / 1,044 psi</td>
</tr>
<tr>
<td>Controlled extractions (up to 2)</td>
<td>up to 65 bar / 942 psi</td>
</tr>
<tr>
<td>Uncontrolled extractions (up to 7)</td>
<td>various pressure levels</td>
</tr>
</tbody>
</table>

Steam Turbine for the pulp plant Klabin, Brazil

Typical applications
- Combined cycle power plants (CCPP)
- Combined heat and power plants (CHP)
- Oil & Gas industries
- Industrial power plants (e.g. captive power plants in chemical and petrochemical industries, manufacturing industries, paper mills, mines, metal and cement plants, waste heat recovery)
- District heating plants
- Biomass plants and waste-to-energy plants (WtE)
- Concentrated solar power plants (CSP)
Center steam admission
- The reverse flow adjusts the thrust and relieves the bearings of large steam turbines

Bearings
- Simplified maintenance due to horizontal casing split or independently accessible bearings

Steam path
- Highly customized section with up to 3 internally or externally controlled extractions and up to 7 uncontrolled extractions

Exhaust section
- Axial or downward connection for condensing, upward or downward connection for back pressure is provided

Casing
- The steam turbine casing is based on a combined housing concept featuring a cast steel and welded design. The material mix ensures high availability and reduced delivery times.
Economical dual casing steam turbine for reheat applications

The SST-700/900 is a standard turbine solution with short delivery time due to its fixed pre-engineered design. Prefabricated modules enable a short manufacturing period, cost-efficient material supply and a fast ex-works delivery. The straight flow turbine solution with power output of up to 250 MW consists of a geared high-pressure steam turbine (backpressure), an intermediate/low-pressure steam turbine (condensing), both driving a generator installed in between. The dual casing reheat turbine configuration with inner casing is a competitive and optimized product for combined cycle power plants and concentrated solar power plants.

Parabolic trough technology in Morocco

On February 4, 2016, the King of Morocco Mohammed VI inaugurated the Noor I unit of Ouarzazate Solar Power Station. This is the first of four phased Noor projects at Ouarzazate site which are expected to provide a total electrical generating capacity of 580 megawatts, making it the largest complex of its kind in the world. Siemens is supplying three turbine-generator sets for the power station.

Steam turbine SST-700/900
Power output: 180 MW
Inlet steam temperature: 380°C / 716°F
Inlet steam pressure: 168 bar(a) / 2,437 psi
Exhaust pressure: 0.06 bar(a) / 0.87 psi

Fast load changes
Short start up times
Increased efficiency
Increased life cycle
Low level arrangement
Reheat application

Steam turbine SST-900 for the CSP-plant NOOR III, Morocco

Typical applications

- Combined cycle power plants
- Concentrated solarthermal power plants
- Biomass-fired power plants
With the D-R steam turbine portfolio Siemens has the most comprehensive range of API turbines available on the market, including:

• Standard single stage turbines for pump, fan & small compressor drives according to API 611 General Purpose (GP) standard
• Standard and engineered single stage turbines as generator drives for waste heat recovery applications
• Engineered single stage turbines for applications according to API 611 (General Purpose — GP) or API 612 (Special Purpose — SP) standards
• Standard multistage turbines for larger pumps, fans & compressors to API 611 or API 612 standards, or for power generation
• Engineered Multi-Stage Turbines according to API 612 for main compressor drives or power generation
• Turbines for geothermal plants
• Turbines for expansion of ORC and process fluids

As required either bare ST drivers to OEMs, or complete packages including gears, lube oil systems and controls are supplied

Benefits:

• Highest levels of quality & reliability for the most critical services in the business
• All units factory tested in accordance with API and customer requirements
• Units with modular designs, but engineered to order, according to customer project specifications & standards and local environmental requirements

Dresser-Rand — A Siemens Business
D-R SST 350/500/700

Standard single stage steam turbine

• Rugged, versatile design
• Woodward TG Oil Relay NEMA Class A constant speed governor or electronic governor
• Horizontally split casing with centerline support
• Overspeed mechanical trip valve, separated from governor valve
• Carbon ring or labyrinth sealing glands
• Built-in, removable steam strainer
• API style blanket lagging/insulation (API applications)
• Oil ring lubricated with forced pressure lubrication or circulating oil cooling options
• Rolling element or Tiltpad thrust bearings
• Broad range of controls and accessories available
• WORTHINGTON heritage (D-R SST 350/500)

Typical applications
• Refineries
• Petrochemical plants
• Food processing
• Steel industry
• Pulp & Paper
• Institutional
• Process waste heat recovery
• Replacement of steam pressure reduction valve
• Feed water pumps
• Process pump drives
• Cooling water pumps
• Fans
• Compressors
• Generators

Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>2,460 kW / 3,500 HP</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤ 12,000 rpm</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 63 bar(a) / 914 psi</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>≤ 482°C / 900°F</td>
</tr>
<tr>
<td>Back pressure</td>
<td>21 bar(a) / 315 psi</td>
</tr>
<tr>
<td>Type of wheel/blades</td>
<td>Curtis/Diaphragm</td>
</tr>
<tr>
<td>API compliant</td>
<td>API 611 and API 612</td>
</tr>
<tr>
<td>Bearings</td>
<td>Sleeve</td>
</tr>
</tbody>
</table>
Rugged, versatile design
Radially split casing with centerline support
Woodward TG Oil Relay NEMA Class A constant speed governor
API 611 compliant, positive seating, mechanical overspeed trip valve
Separate double seated governor valve

Built-in removable steam strainer
Removable carbon ring sealing glands
API style blanket lagging/insulation (API applications)
Oil ring lubricated
Broad range of controls and accessories available
COPPUS heritage

Separate double seated governor valve
Built-in removable steam strainer
Removable carbon ring sealing glands
API style blanket lagging/insulation (API applications)
Grease lubricated with circulating oil options
Broad range of controls and accessories available
COPPUS heritage

Typical applications
- Refineries
- Petrochemical and chemical plants
- Food processing
- Institutional
- Process pump drives
- Lube oil pumps

Technical Data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
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</thead>
<tbody>
<tr>
<td>Power (kW)</td>
<td>745 kW / 1,000 HP</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤ 4,300 to 6,000 rpm</td>
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<tr>
<td>Inlet steam temperature</td>
<td>≤ 440°C / 824°F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 47 bar(a) / 682 psi</td>
</tr>
<tr>
<td>Back pressure</td>
<td>≤ 12 bar(a) / 174 psi</td>
</tr>
</tbody>
</table>

Type of wheel/Blades: Curtis / Impulse
API 611 compliant: Yes
Bearings: Ball bearing (Journal & Thrust)
D-R RLH

Standard single stage steam turbine

Typical applications
- Refineries
- Petrochemical plants
- Food processing
- Institutional
- Process waste heat recovery
- Replacement of steam pressure reduction valve
- Process pump drives
- Feed water pumps
- Lube oil pumps

D-R RLH-15
- Rugged, versatile design
- Woodward TG Oil Relay NEMA Class A constant speed governor or electronic governor
- Horizontally split casing with centerline support
- API 611 compliant, positive seating, mechanical overspeed trip valve
- Separate double seated governor valve
- Built-in removable steam strainer
- Carbon ring sealing glands
- API style blanket lagging/insulation (API applications)
- Carbon ring sealing glands
- Oil ring lubricated with forced pressure lubrication or circulating of cooling options
- Broad range of controls and accessories available
- COPPUS heritage

Technical Data
- Power output: 1,865 kW / 2,500 HP
- Turbine speed: ≤ 6,000 rpm
- Inlet steam temperature: ≤ 482°C / 900°F
- Inlet steam pressure: ≤ 63 bar(a) / 914 psi
- Back pressure: ≤ 21 bar(a) / 300 psi
- Type of wheel/blade: Curtis/Impulse
- API 611 compliant: Yes
- Bearings: Ball and sleeve bearing designs

D-R RLH-15/24
- Horizontally split casing with centerline support
- Woodward TG Oil Relay NEMA Class A constant speed governor or electronic governor
- API 611 compliant, positive seating, mechanical overspeed trip valve
- Separate double seated governor valve
- Built-in removable steam strainer
- Carbon ring sealing glands
- API style blanket lagging/insulation (API applications)
- Oil ring lubricated with pressure or circulating oil cooling options
- Ball or Tilting thrust bearings
- Broad range of controls and accessories available
- COPPUS heritage

Typical applications
- Refineries
- Petrochemical plants
- Sugar mills
- Food processing
- Institutional
- Pulp & Paper
- Process pump drives
- Cooling water pumps
- Fans
- Compressors
- Generators
D-R 2TA

Single stage steam turbine

Typical applications
- Pumps and fans
- Compressors

- Horizontally split casings
- Between bearing design
- Multi-Valve or Single Valve Inlet
- Solid or built-up rotor
- Carbon ring or labyrinth glands
- API 611 & 612 compliance
- Electronic governor
- Electronic overspeed trip
- Trip and throttle valves (option w/o exerciser)

Technical Data

<table>
<thead>
<tr>
<th>D-R 2TA</th>
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</thead>
<tbody>
<tr>
<td>Power output</td>
<td>3,640 kW / 4,880 HP</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>&lt; 12,500 rpm</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>&lt; 530 °C / 986 °F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 104 bar(a) / 1,515 psi</td>
</tr>
<tr>
<td>Back pressure [bar]</td>
<td>&lt; 33 bar(a) / 480 psi</td>
</tr>
<tr>
<td>Type of wheel blades</td>
<td>Curtis/Rateau impulse</td>
</tr>
<tr>
<td>API 611 compliant</td>
<td>Yes</td>
</tr>
<tr>
<td>Bearings</td>
<td>Tilting pad</td>
</tr>
</tbody>
</table>

Power output 3,640 kW / 4,880 HP
Turbine speed < 12,500 rpm
Inlet steam temperature < 530 °C / 986 °F
Inlet steam pressure ≤ 104 bar(a) / 1,515 psi
Back pressure [bar] < 33 bar(a) / 480 psi
Type of wheel blades Curtis/Rateau impulse
API 611 compliant Yes
Bearings Tilting pad
**Technical Data**

**D-R AVTTW / GTW**
- Power output: 4,500 kW / 6,000 HP
- Turbine speed: ≤ 14,500 rpm
- Inlet steam temperature: ≤ 550°C / ≤ 1,022°F
- Inlet steam pressure: ≤ 125 bar(a) / ≤ 1,813 psi
- Back pressure: ≤ 40 bar(a) / ≤ 590 psi
- Type of wheel / blades: Curtis / Rateau Impulse
- API 611 compliant: Yes (with comments)
- Bearings: Tilting-pad sleeve

**D-R C**
- Direct drive or Integral Gear operation
- Overhung design
- Multi Valve or Single Valve inlet
- Marine Classification approval
- Auto/Quick start ability

**Technical Data**

**D-R AVTTW / GTW**
- Power output: 2,500 kW / 3,250 HP
- Turbine speed: ≤ 8,500 rpm
- Inlet steam temperature: ≤ 520°C / 986°F
- Inlet steam pressure: ≤ 120 bar(a) / 1,740 psi
- Back-pressure: 21 bar(a) / 315 psi
- Condensing pressure vacuum
- Type of wheel / blades: Curtis / Rateau Impulse
- API 611 & 612 compliance with exception
- Bearings: Tilting-pad sleeve

**Typical applications**
- Waste Energy
- Biomass Plants
- Marine Applications
- Chemical Industries
- Paper / Sugar Mills
D-R GAF / U

Standard multi-stage steam turbine

D-R GAF
• Condensing or back pressure steam turbine
• Horizontal casing split
• Between bearings
• Max. 6 stages
• Single valve inlet
• API 611 or 612 design

D-R U
• Unique above-centerline casing split allows removing the cover without disturbing the steam sealing areas, coupling and steam connections
• Condensing or back pressure
• Low cost applications
• Single valve inlet
• Up to 10 stages

Typical applications
• API mechanical drive (e.g. pump fans)
• Turbogenerator sets

Technical Data

<table>
<thead>
<tr>
<th>D-R GAF</th>
<th>D-R U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>3,500 kW / 4,690 HP</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤ 6,000 rpm</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>≤ 440 °C / 825 °F</td>
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<tr>
<td>Inlet steam pressure</td>
<td>≤ 49 bar(a) / 715 psi</td>
</tr>
<tr>
<td>Back pressure</td>
<td>≤ 6 bar(a) / 87 psi</td>
</tr>
</tbody>
</table>

Type of Blading

<table>
<thead>
<tr>
<th>D-R GAF</th>
<th>D-R U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impulse</td>
<td>Impulse</td>
</tr>
</tbody>
</table>

API 611 & 612 compliance

<table>
<thead>
<tr>
<th>D-R GAF</th>
<th>D-R U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Bearings

<table>
<thead>
<tr>
<th>D-R GAF</th>
<th>D-R U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tilting sleeve</td>
<td>Tilting sleeve</td>
</tr>
</tbody>
</table>
**D-R R/RS**

Standard multi-stage steam turbines

- Single valve or multivalve inlets
- Multiple uncontrolled bleeds
- Dual-acting, hydrodynamic, Tiltpad thrust bearing
- Spherically seated or Tiltpad-type journal bearings
- Interchangeable parts
- Standard assemblies and components
- API and non-API options
- Condensing or back pressure
- Up to 15 stages

**Technical Data**

<table>
<thead>
<tr>
<th>Specification</th>
<th>D-R R/RS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>25,000 kW / 33,500 HP</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤ 15,000 rpm</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>≤ 482°C /900°F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 63 bar (g) / 915 psi</td>
</tr>
<tr>
<td>Back pressure</td>
<td>≤ 29 bar (g) / 421 psi</td>
</tr>
<tr>
<td>Condensing pressure</td>
<td>vacuum</td>
</tr>
<tr>
<td>Type of Blading</td>
<td>Impulse</td>
</tr>
<tr>
<td>API 611 &amp; 612 compliance</td>
<td>Yes</td>
</tr>
<tr>
<td>Bearings</td>
<td>Tiltpad or sleeve</td>
</tr>
<tr>
<td>Bleedings/Extractions</td>
<td>1 or multiple</td>
</tr>
<tr>
<td>Pressure capability increases above 900 psig at reduced temperature</td>
<td></td>
</tr>
</tbody>
</table>

**D-R K**

Standard multi-stage steam turbine

- Condensing or back pressure
- Low cost applications
- Single valve inlet
- For wide range of speeds throughout continuous operation

**Technical Data**

<table>
<thead>
<tr>
<th>Specification</th>
<th>D-R K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>4,850 kW / 6,500 HP</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤ 10,000 rpm</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>≤ 389°C /750°F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 27.5 bar (a) / 415 psi</td>
</tr>
<tr>
<td>Back pressure</td>
<td>≤ 5 bar (a) / 75 psi</td>
</tr>
<tr>
<td>Condensing pressure</td>
<td>vacuum</td>
</tr>
<tr>
<td>Type of Blading</td>
<td>Impulse</td>
</tr>
<tr>
<td>API 611 &amp; 612 compliance</td>
<td>No</td>
</tr>
<tr>
<td>Bearings</td>
<td>Tiltpad, Sleeve</td>
</tr>
<tr>
<td>Pressure capability increases above 900 psig at reduced temperature</td>
<td></td>
</tr>
</tbody>
</table>

**Typical applications**

- API 611/612 compressor, fan and pump drives
- Turbo-generator sets, oil & gas and industrial
- Condensing or back pressure
- Interchangeable parts
- Standard assemblies and components
- API and non-API options
- Single valve inlet
- For wide range of speeds throughout continuous operation

**Typical applications – K**

- Non-API mechanical drive (e.g. pump fans)
- Air conditioning chiller / compressor drives
- Small, low pressure turbogenerator sets

**Power output**

D-R R/RS

Power output: 25,000 kW / 33,500 HP
Turbine speed: ≤ 15,000 rpm
Inlet steam temperature: ≤ 482°C / 900°F
Inlet steam pressure: ≤ 63 bar (g) / 915 psi
Back pressure: ≤ 29 bar (g) / 421 psi
Condensing pressure: vacuum
Type of Blading: Impulse
API 611 & 612 compliance: Yes
Bearings: Tiltpad or sleeve
Bleedings/Extractions: 1 or multiple
Pressure capability increases above 900 psig at reduced temperature.

D-R K

Power output: 4,850 kW / 6,500 HP
Turbine speed: ≤ 10,000 rpm
Inlet steam temperature: ≤ 389°C / 750°F
Inlet steam pressure: ≤ 27.5 bar (a) / 415 psi
Back pressure: ≤ 5 bar (a) / 75 psi
Condensing pressure: vacuum
Type of Blading: Impulse
API 611 & 612 compliance: No
Bearings: Tiltpad, Sleeve
Pressure capability increases above 900 psig at reduced temperature.
Custom engineered multi-stage ST’s

**Engineered Mechanical Drive (EMD)**
- Controlled/uncontrolled extractions
- Double end drive

**Engineered Turbine Generator (ETG)**
- Single/double uncontrolled extraction
- Multiple uncontrolled extractions/bleeds
- Induction

**Technical Data**

**EMD**

- **Power output**: 80 MW
- **Turbine speed**: ≤ 17,000
- **Inlet steam temperature**: ≤ 565°C / 1,049°F
- **Inlet steam pressure**: ≤ 139 bar(a) / 2,016 psi
- **Exhaust back pressure vacuum**: None
- **Type of Blading**: Impulse/Reaction
- **API 611 & 612 compliance**: Yes
- **Bearing constellation**: Tiltpad
- **Bleedings/Extractions**: Yes

**ETG**

- **Power output**: 100 MW
- **Turbine speed**: ≤ 17,000
- **Inlet steam temperature**: ≤ 565°C / 1,049°F
- **Inlet steam pressure**: ≤ 139 bar(a) / 2,016 psi
- **Exhaust back pressure vacuum**: None
- **Type of Blading**: Impulse/Reaction
- **API 612 compliance**: Yes
- **Bearing constellation**: Tiltpad
- **Bleedings/Extractions**: Yes

**Typical applications**
- Refinery
- Petrochemical
- Fertilizer
- Feed pump drives

**Typical applications**
- Power generation
- Combined cycle
- Petrochemical
- Fertilizer
**D-R B Standard multi-stage steam turbine**

- Low cost design for high efficiency
- Multivalve inlets
- Multiple uncontrolled bleeds
- External controlled induction
- Double shaft end
- Suitable for Tandem

**D-R B Tandem**

- Multivalve inlets
- Multiple uncontrolled bleeds
- Single automatic controlled extraction/induction
- Max. extraction pressure 40 bar

**Typical applications**

- Turbogenerator sets
- Mechanical drives

**Technical Data**

<table>
<thead>
<tr>
<th></th>
<th>D-R B</th>
<th>D-R B Tandem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Power output</td>
<td>11 MW</td>
<td>12,5 MW</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤6,500 rpm</td>
<td>8,800</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤65 bar(a) / 942 psi</td>
<td>≤121 bar(a) / 1,750 psi</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>≤500°C / 932°F</td>
<td>≤530°C / 986°F</td>
</tr>
<tr>
<td>Back pressure</td>
<td>≤13 bar(a) / 189 psi</td>
<td>≤13 bar(a) / 189 psi</td>
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<tr>
<td>Condensing pressure</td>
<td>vacuum</td>
<td>vacuum</td>
</tr>
<tr>
<td>Type of wheel blades</td>
<td>Impulse</td>
<td>Impulse</td>
</tr>
<tr>
<td>API 611 compliant</td>
<td>with exceptions</td>
<td>No</td>
</tr>
<tr>
<td>Bearings</td>
<td>Multiple</td>
<td>Multiple / 1</td>
</tr>
<tr>
<td>Rearings</td>
<td>Tilting or sleeve</td>
<td>Tilting or sleeve</td>
</tr>
</tbody>
</table>

**D-R B Tandem**

- Multivalve inlets
- Multiple uncontrolled bleeds
- Single automatic controlled extraction/induction
- Max. extraction pressure 40 bar
Our steam turbines meet customer requirements for economic installation and operation as well as providing excellent flexibility for complex processes. Worldwide, hundreds of successfully installed generator drives for power generation or mechanical drives for compressors, blowers and pumps are in operation and reliably provide power.
Lünen is the cleanest and most efficient hard-coal-fired power plant in Europe. It provides electricity for around 1.5 million households. It also supplies the city of Lünen with district heating. Using leading-edge Siemens technology makes it possible to save up to a million tons of CO2 every year.

- Power output: 812 MW
- Efficiency: 46%
- Commercial operation: 2013

In 2009, Waigaoqiao III was “Asian Power Plant of the Year” and got an “Asian Power Award”.

- Power output: 2 × 1,000 MW
- Efficiency: 45%
- Commercial operation: 2008

Yuhuan was China’s most advanced coal-fired power plant and got the “Asian Power Award”.

- Power output: 4 × 1,000 MW
- Efficiency: 45%
- Commercial operation: 2007
Reference examples Combined Cycle Power Plants

Combined cycle power plant Dangjin III South Korea
Siemens turbines are making Dangjin III the most efficient combined cycle power plant currently operating in Asia.

- Power output: 400 MW
- Efficiency: 60%
- Commercial operation: 2013

Combined cycle power plant for the mining industry Diamantina, Australia
Two Power Islands each performing at well in excess of 51 % efficiency. The plant provides a total capacity of 242 MW to supply environmentally friendly and local mines and to people living in the region.

- Power output: 242 MW
- Commercial operation: 2014

Combined cycle power plant Panda Sherman Power Project, Texas, USA
The Panda Sherman Power Project utilizes the latest, most advanced emissions control technology, making it one of the cleanest, natural gas-fueled power plants in the United States. The 758 MW combined cycle generating facility can supply the energy needs of up to 750,000 homes.

- Plant type: SGT-800 gas turbine
- Power Output: 758 MW

Combined cycle power plant for the mining industry Diamantina, Australia
Two Power Islands each performing at well in excess of 51 % efficiency. The plant provides a total capacity of 242 MW to supply environmentally friendly and local mines and to people living in the region.

- Power output: 242 MW
- Commercial operation: 2014

Power block for combined cycle power plant Nhon Trach 2, Vietnam
The power plant reaches an efficiency of over 57 percent and has very low nitrogen oxide emissions. It entered commercial operation after just 28.5 months.

- Power output: 760 MW
- Efficiency: 57 %
- Commercial operation: 2011
Reference examples  Biomass and Waste-to-energy

Igelsta Södertalje, Sweden

**SST-800: Biomass District Heating Plant**

- Sweden’s largest biomass plant
- Inaugurated in March 2010
- The plant uses a biomass fuel mix consisting of about 90% renewable fuels like forest refuse, wood chips, tree bark, and 10% non-recyclable waste paper and plastic.
- It produces 200 MW heat and 85 MW electricity, the equivalent of heating 50,000 households and generating electricity for 100,000 residences.

**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 30%.
- It uses薪 and wood chips, tree bark, and 10% non-recyclable waste paper and plastic.
- It produces 210 MW heat and 90 MW electricity, the equivalent of heating 50,000 households and generating electricity for 100,000 residences.

**Biomass Power Plant Simmering Vienna, Austria**

- Simmering biomass power plant, owned by the Viennese utility Wien Energie, is exclusively fed with fresh wood from the forest.
- Producing 23.4 MW electricity in summer and 15.06 MW plus 37 MW for district heating in winter, the plant reduces Vienna’s CO₂ emissions by 144,000 tons per annum. In operation with heat extraction, total efficiency is 83%.

**SST-300 North Hykeham Lincoln, UK**

- We would definitely recommend Siemens. First because we would work again with them, they have provided a machine that is hard to make and hard to integrate into such a kind of plant, and they have been successful with this project. Tupolov Gavrilko. Project Manager at CNIM

**Afval Energie Bedrijf (AEB, Waste and Energy Company Amsterdam)**

- Power output: 90 MW
- Inlet pressure: 85 bar / 1,250 psi
- Inlet temperature: 540 °C / 1,000 °F

**Biomass Power Plant Simmering Vienna, Austria**

- Steam turbine: SST-400, Reheat
- Power output: 23.4 MW
- Inlet pressure: 120 bar / 1,740 psi
- Inlet temperature: 520 °C / 968 °F
- Fuel: Fresh wood

**Afval Energie Bedrijf (AEB, Waste and Energy Company Amsterdam)**

- Steam turbine: SST-800, Reheat
- Power output: 210 MW
- Inlet pressure: 125 bar / 1,813 psi
- Inlet temperature: 440 °C / 824 °F
- Fuel: Municipal solid waste

**Customer: CNIM**
**Operator: FCC Environment**
### Reference examples: Concentrated solar plants

**ANDASOL 1 + 2, Granada, Spain**
The two CSP plants are located in the Granada area, each covering a field of 1.95 km² of which the mirror field size is about 510,000 m². Both Andasol plants have a thermal storage system using molten salt to absorb part of the heat produced in the solar field during the day. This process almost doubles the number of operational hours per year at the solar thermal power plant. Andasol I went online in 2008 and Andasol II in 2009.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam turbine</td>
<td>Siemens SST-700</td>
</tr>
<tr>
<td>Power output</td>
<td>2 x 50 MW(e)</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>100 bar / 1,450 psi</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>377 °C / 711 °F</td>
</tr>
</tbody>
</table>

**IVANPAH SOLAR POWER COMPLEX, California, USA**
BrightSource Energy, a privately owned energy company, developed the Ivanpah solar energy generating system in California’s Mojave Desert. It consists of three separate plants using tower technology and provides approximately 400 MW electricity to the US Southern California Edison. The whole complex generates enough electricity to power more than 140,000 homes.

**IVANPAH SOLAR POWER TOWER (Water/Direct Steam)**
3 plants, 392 MW(e) in total

<table>
<thead>
<tr>
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<tr>
<td>Steam turbine</td>
<td>Siemens SST-900</td>
</tr>
<tr>
<td>Power output</td>
<td>3 x 123 MW(e)</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>160 bar / 2,321 psi</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>540 °C / 1,004 °F</td>
</tr>
</tbody>
</table>

**PUERTO ERRADO 1 (PE1), Calasparra, Spain**
The PE1 Linear Fresnel demonstration plant, developed by Novatec Biosol AG, commenced selling power to the Spanish grid in March 2009. The 1.4 MW plant, located in Calasparra in the region of Murcia, Spain, has two rows of receivers, each with a length of 860 m, providing direct steam to the steam turbine. Each receiver uses 16 parallel lines of mirrors with a total surface of 18,662 m². A Ruth heat storage system, which utilizes hot water and saturated steam, is used for steam buffering.

**Linear Fresnel (Water/Direct Steam)**
1.4 MW(e)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
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<tbody>
<tr>
<td>Steam turbine</td>
<td>Siemens SST-120</td>
</tr>
<tr>
<td>Power output</td>
<td>1.4 MW(e)</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>55 bar / 798 psi</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>270 °C / 518 °F (saturated steam)</td>
</tr>
</tbody>
</table>

**NOOR/Ouarzazate, Morocco**
On February 4, 2016, the King of Morocco, Mohammed VI, dedicated the Noor I unit of Ouarzazate Solar Power Station. This is the first of four phased Noor projects at Ouarzazate site which are expected to provide a total electrical generating capacity of 580 megawatts, making it the largest complex of its kind in the world. Siemens is supplying three turbine-generator sets for the power station.

**Steam turbine: SST-700 / 900**

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<thead>
<tr>
<th>Parameter</th>
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</tr>
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<tbody>
<tr>
<td>Power output</td>
<td>160 MW</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>380 °C / 716 °F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>168 bar(a) / 2,437 psi</td>
</tr>
<tr>
<td>Exhaust pressure</td>
<td>0.66 bar(a) / 9.87 psi</td>
</tr>
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**Linear Fresnel (Water/Direct Steam)**
1.4 MW(e)

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</table>
Khanh Hoa (Cam Ranh), Sugar Plant, Vietnam

The Khanh Hoa Sugar Plant is located in the Cam Lam District in central coastal Khanh Hoa Province. It handles roughly 3,000 tons of sugarcane per day.

Technology: SST-300
Complete: 1999
Power output: 25 MW
Speed: 7,161 rpm
Inlet steam pressure: ≤46 bar(a)/667 psi
Inlet steam temperature: ≤450 °C/842 °F
Exhaust pressure: 2.5 bar(a)/36.3 psi

Mitr Phol, Sugar Plant, Thailand

In 1946 Mitr Phol sugar business was initially established in Ratchaburi province as a small family business producing and trading condensed syrup to sugar mills. Meanwhile, it expanded to an internationally integrated enterprise acting in China, Laos, Australia and other countries.

Technology: SST-300
Complete: 2010
Power output: 26 MW
Switchable bleed for deaerator

Grupo Delta Suroenergia / Brazil

The efficiency of the SST-600 steam turbine convinced the customer Grupo Delta Suroenergia. Siemens installed the biggest steam turbine in the sugar-ethanol sector with an output of 73.5 MW. It is also the first turbine in Brazil to waive the use of gears with direct drive for the generator.

Technology: SST-600
Complete: 2013
Power output: 73.5 MW
Inlet steam temperature: 520 °C
Inlet steam pressure: 67 bar(a)
Exhaust: radial downward
Length: 8.5 m
Weight: 130 t

Simbhaoli Sugar, Sugar Plant, India

Simbhaoli Sugars is a technology company with a business mix that spans specialty sugars, quality liquor, technology consultancy, co-generated power, extra neutral alcohol (ENA), ethanol and bio-mannure. As India’s largest integrated sugar refinery, the company has pioneered path-breaking innovations in sugar refining (Defeco Remelt Phosphotation and Ion Exchange technology), high value, niche products (specialty sugars) and clean energy (ethanol).

Technology: SST-300
Complete: 2013
Power output: 18 MW
Speed: 6,900 rpm
Inlet steam pressure: 86 ata
Inlet steam temperature: 510 °C/950 °F
Exhaust steam pressure: 0.1 ata
**Steam Turbines for Pulp & Paper Industry SST-800, Hainan Island / China**

Siemens Industrial Technologies was appointed as general contractor for the entire electrical engineering, while Siemens Energy won the order for the Hainan Pulp & Paper’s power plant.

**Technology** 2 × SST-800

**Complete** 2004

**Power output:** 120 MW (each)

**Inlet steam temperature:** 475 °C / 887 °F

**Inlet steam pressure:** 80.5 bar / 1,167.5 psi

**Speed:** 3,000 rpm

**Extraction steam pressure:** 6.5 bar / 94.3 psi

**Exhaust steam pressure:** 0.13 bar / 1.88 psi

**Steam Turbines for Pulp & Paper Industry SST-800, Klabin / Brazil**

Two Siemens SST-800 steam turbines are supplying electricity and process steam to a pulp factory in Brazil. The SST-800 has a capacity of 190 megawatts (MW), making it among the largest steam turbines in use in the pulp and paper industry worldwide.

**Power output:** 190 MW

**Speed:** 3,600 rpm

**Inlet steam pressure:** 100 bar / 1,450 psi

**Inlet steam temperature:** 498 °C / 928 °F

**Extraction pressure:** 10 bar / 145 psi

**Exhaust pressure:** 5.4 bar / 78.3 psi

**Steam Turbines for Pulp & Paper Industry SST-300, UPM Caledonian, Scotland / United Kingdom**

UPM’s mill is responsible for a third of all industrial and commercial electricity consumed across Ayrshire. With huge amounts of electricity and heat required to drive processes in the pulp and paper industry, UPM was keen to explore ways of reducing its energy costs while improving site competitiveness.

Siemens custom designed its SST-300 steam turbine to meet UPM’s specific requirements at the plant and also provided the control systems. The plant incorporating Siemens technologies has enabled the mill to meet all its steam requirements involved in the production of coated papers – and in particular, drying of the paper.

**Technology** SST-300

**Power output:** 27 MW

**Speed:** 6,800 rpm

**Inlet steam pressure:** 90 bar / 1,305 psi
Kuwait is forging ahead with a new refinery project costing 4 billion Kuwaiti dinars (Dh49.7bn) despite the oil price slump, Kuwaiti officials said. The construction of Al Zour refinery is part of plans to boost refining capacity to 1.4 million barrels per day (bpd) by 2019 from 940,000 bpd at present.

**Scope of Supply:**
- 57 SSTs for process and water pump drives
- Variety of models to meet power and steam condition
- 2018 expected completion

**Morning Star Packing, 24 Single Stage Steam Turbines**
California, USA

Application: Mechanical drive for feed water pumps, boiler fans, hydraulics, generators, slurry pumps, fire systems.

The tomato processing window in the US is May through October. Six months of non-stop production requires rugged, reliable equipment which in the reputation the KLH24 has earned over the years.

**Scope of Supply:**
- 24 Single Stage Turbines
- KLH24
- 2014

**KNPC New Refinery Single Stage, Mechanical Drive steam turbines**
Kuwait

Kuwait is forging ahead with a new refinery project costing 4 billion Kuwaiti dinars (Kd49.7bn) despite the oil price slump, Kuwaiti officials said.

The construction of Al Zour refinery is part of plans to boost refining capacity to 1.4 million barrels per day (bpd). The project is expected to be completed by 2019.

**Scope of Supply:**
- 24 Single Stage Turbines
- RLHB 24
- 2014

**Steam Turbine Applied as a Gas Expander Emergency Shut Down Drive**
Approximately 95 world wide

Dresser Rand supplied special expander turbines which operate only when a power outage or other mechanical fault causes tripping of the process compressor and/or the main motor drive. When a "kill cycle" is initiated, reactor gases are routed from the compressor discharge to the turbine inlet (the turbine exhausts to a flare while steam turbine and drives the compressor train through an SSS clutch at reduced speed and load for 10 minutes or less). This is adequate time for the process to be prepared by a "kill gas" which is injected into the reactor vessel thus preventing "solidification" which would require personnel with jackhammers to enter and clean the reactor vessel at a cost of millions in lost production.
### Performance data overview

<table>
<thead>
<tr>
<th>Steam turbine type</th>
<th>Output SPP MW</th>
<th>Output CCPP MW</th>
<th>Net efficiency SPP %</th>
<th>Net efficiency CCPP %</th>
<th>Gross head</th>
<th>Export pressure bar / psi</th>
<th>NPSHr</th>
<th>NPSHa</th>
<th>Turbine inlet pressure bar / psi</th>
<th>Turbine inlet temp °C / °F</th>
<th>Turbine reheat temp °C / °F</th>
<th>Electrical speed rpm</th>
<th>Rotational speed rpm</th>
<th>Controlled extraction bar / psi</th>
<th>Controlled extraction temp °C / °F</th>
<th>Uncontrolled extraction bar / psi</th>
<th>Uncontrolled extraction temp °C / °F</th>
<th>Exhaust Pressure (back) bar / psi</th>
<th>Exhaust Pressure (cond.) bar / psi</th>
<th>Exhaust Pressure (distr) bar / psi</th>
<th>Last stage blade length (cm / inches)</th>
<th>Last stage blade length (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SST-9000</td>
<td>1,000–1,900</td>
<td></td>
<td></td>
<td></td>
<td>87.5</td>
<td>961 / 1,420</td>
<td>330</td>
<td>650</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>120</td>
<td>250 / 3,513</td>
<td>107 / 1,858</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
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<td></td>
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</tr>
<tr>
<td>SST-6000</td>
<td>500–1,200</td>
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<td></td>
<td></td>
<td>85.6</td>
<td>880 / 1,292</td>
<td>250</td>
<td>640</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>100</td>
<td>560 / 836</td>
<td>107 / 1,858</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
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<tr>
<td>SST-5000</td>
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<td></td>
<td>85.6</td>
<td>775 / 1,178</td>
<td>250</td>
<td>620</td>
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<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>3,000–3,600</td>
<td>50</td>
<td>330 / 492</td>
<td>107 / 1,858</td>
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<td>3,000–3,600</td>
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<td>SST-4000</td>
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<td>85.6</td>
<td>675 / 996</td>
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<td>600</td>
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<td>30</td>
<td>170 / 2,470</td>
<td>107 / 1,858</td>
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<tr>
<td>SST-3000</td>
<td>90–250</td>
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<td></td>
<td>85.6</td>
<td>575 / 864</td>
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<td>600</td>
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<td>3,000–3,600</td>
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<td>15</td>
<td>130 / 1,981</td>
<td>107 / 1,858</td>
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</tr>
<tr>
<td>SST-700 / 900</td>
<td>≤ 250</td>
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<td></td>
<td>85.6</td>
<td>475 / 692</td>
<td>250</td>
<td>600</td>
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<td>5</td>
<td>60 / 870</td>
<td>107 / 1,858</td>
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<td>SST-800</td>
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<td>375 / 540</td>
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<td>4</td>
<td>75 / 1,090</td>
<td>107 / 1,858</td>
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<tr>
<td>SST-600</td>
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<td>85.6</td>
<td>275 / 393</td>
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<td>SST-500</td>
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<td>175 / 251</td>
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<td>2</td>
<td>55 / 815</td>
<td>107 / 1,858</td>
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<tr>
<td>SST-400</td>
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<td>85.6</td>
<td>75 / 109</td>
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<td>25 / 365</td>
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## Performance data overview

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<th>Steam turbine type</th>
<th>Power output (kW)</th>
<th>Inlet Pressure</th>
<th>Inlet Temperature</th>
<th>Rotational Speed</th>
<th>Uncontrolled exhaust</th>
<th>Exhaust Pressure</th>
<th>Bearings Type of wheel / blades</th>
<th>API 611 compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-RA CL/CLA/CLCA</td>
<td>1,000 (HP)</td>
<td>47.6/692</td>
<td>6,030 – 6,000</td>
<td>12,174</td>
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<td>Impeller</td>
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<td>yes</td>
</tr>
<tr>
<td>D-RA CT16 / CT18</td>
<td>2,500 (HP)</td>
<td>63.9/915</td>
<td>488/880</td>
<td>8,200</td>
<td>21 / 308</td>
<td>Impeller</td>
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<td>yes</td>
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<tr>
<td>D-RA SST 150/250 / 350</td>
<td>3,000 (HP)</td>
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<td>482/880</td>
<td>12,200</td>
<td>271 / 395</td>
<td>Impeller</td>
<td>yes</td>
<td>yes</td>
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<td>D-RA CTN</td>
<td>3,500 (HP)</td>
<td>138.1/1,015</td>
<td>530/886</td>
<td>13,340</td>
<td>53 / 752</td>
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<td>6,000 (HP)</td>
<td>120.1/1,611</td>
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<td>402 / 608</td>
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<td>D-RC</td>
<td>5,000 – 2,000</td>
<td>1,211 / 755</td>
<td>520 / 886</td>
<td>9,500</td>
<td>271 / 395</td>
<td>Vacuum</td>
<td>Impeller</td>
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<td>D-RC AF</td>
<td>8,500 – 4,000</td>
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<td>46 / 587</td>
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<td>D-RC C3</td>
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<td>961 / 1,394</td>
<td>504 / 883</td>
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<td>15 / 219</td>
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<td>D-RC BL3</td>
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<td>631 / 915</td>
<td>482 / 880</td>
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<tr>
<td>D-RE</td>
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<td>50,000 – 150,000</td>
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<td>8,300</td>
<td>15 / 218</td>
<td>Vacuum</td>
<td>Impeller</td>
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E-mail: support.energy@siemens.com

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