



Turning biomass into value

Power generation equipment for biomass-fueled plants

[siemens-energy.com/biomass](https://www.siemens-energy.com/biomass)

SIEMENS
ENERGY

An age-old fuel put to new use

Energy generated from biomass

Providing a future-proof source of electricity and contributing to lower CO₂ emissions, power produced from biomass is increasingly economically viable. The interests of operators and investors, on the one hand, and those of utilities and grids, on the other, are becoming more closely aligned. This is because ensuring a stable power supply as well as the financial success of the power plant are common goals.

Understanding the issues



Constant striving toward clean and environmentally-friendly power generation

Maximum efficiency reduces the amount of CO₂ and other – partly toxic – emissions released during biomass incineration.



Challenge for power generation to be economically viable

In the long run, low maintenance and service costs offset the initial costs over the entire lifetime, coupled with the efficient use of the fuel, which further lowers the overall costs.



Continuous availability of base load to the grid

With reliable equipment backed by comprehensive servicing and maintenance options, we are able to optimize the degree of availability and so maximize the amount of revenue from the grid. With our solid understanding of the processes involved, Siemens Energy can support you in ensuring a reliable power supply.



Typical biomass fuels are derived from a wide variety of materials. Some common examples are forestry by-products, agricultural waste, municipal waste, landfill gas, and syngas. In addition, there are many next-generation biomass feedstocks currently in different stages of commercialization. These new fuels impact plant sizes as well as the feedstock supply chain, creating significant opportunities for additional fleet expansion.

Centered on biomass

An integral part of the industry



Green power

Following such initiatives as the Paris climate accord, biomass energy for both industry and electricity providers is a reliable – and sustainable – source of baseload power. It also helps in meeting environmental targets, absorbing more CO₂ than it emits, and efficient equipment used in power generation leads to fewer emissions at the plant site. Biomass is a relatively cheap base load and, depending on the local regulations, surplus electricity produced from it can be fed back to the grid, making it even more economically viable.



Closed-cycle economies

Installing a biomass power plant to burn the on-site waste that occurs as a by-product of industrial processes, such as from pulp, paper and sugar mills or animal biomass, closes the factory input cycle. It also eliminates the need for waste disposal, lowers energy costs and maintains a high availability of the power supply. Incinerating renewables is thus a further step toward sustainability and a closed-cycle economy. These by-products need no additional processing and further strengthen the financial feasibility of the biomass plant.



Investors

The possibility of running a biomass plant on diverse feedstocks adds to its viability while ensuring the availability of the fuel supply. Apart from achieving maximum output with a minimum of life-cycle costs, another decisive economic factor is the need for appropriate frameworks in the country concerned. These regulate such variables as electricity prices, the level of tipping tax, and funding. Finally, many countries are subsidizing biomass-based power generation to make it economically feasible.

As a leader in the field, Siemens Energy supports all these interests with

Flexible, reliable operation

Our steam and gas turbines have been installed in over 200 biomass-fueled plants worldwide with a proven record of applicability and availability.

Lowest lifecycle costs

All our turbines offer a long life cycle thanks to reliable equipment that is backed by our global service.

Professional project development

As a partner, we offer you our full support, from project development right up to technical and commercial operation, dealing with all the parties involved and avoiding any complications.

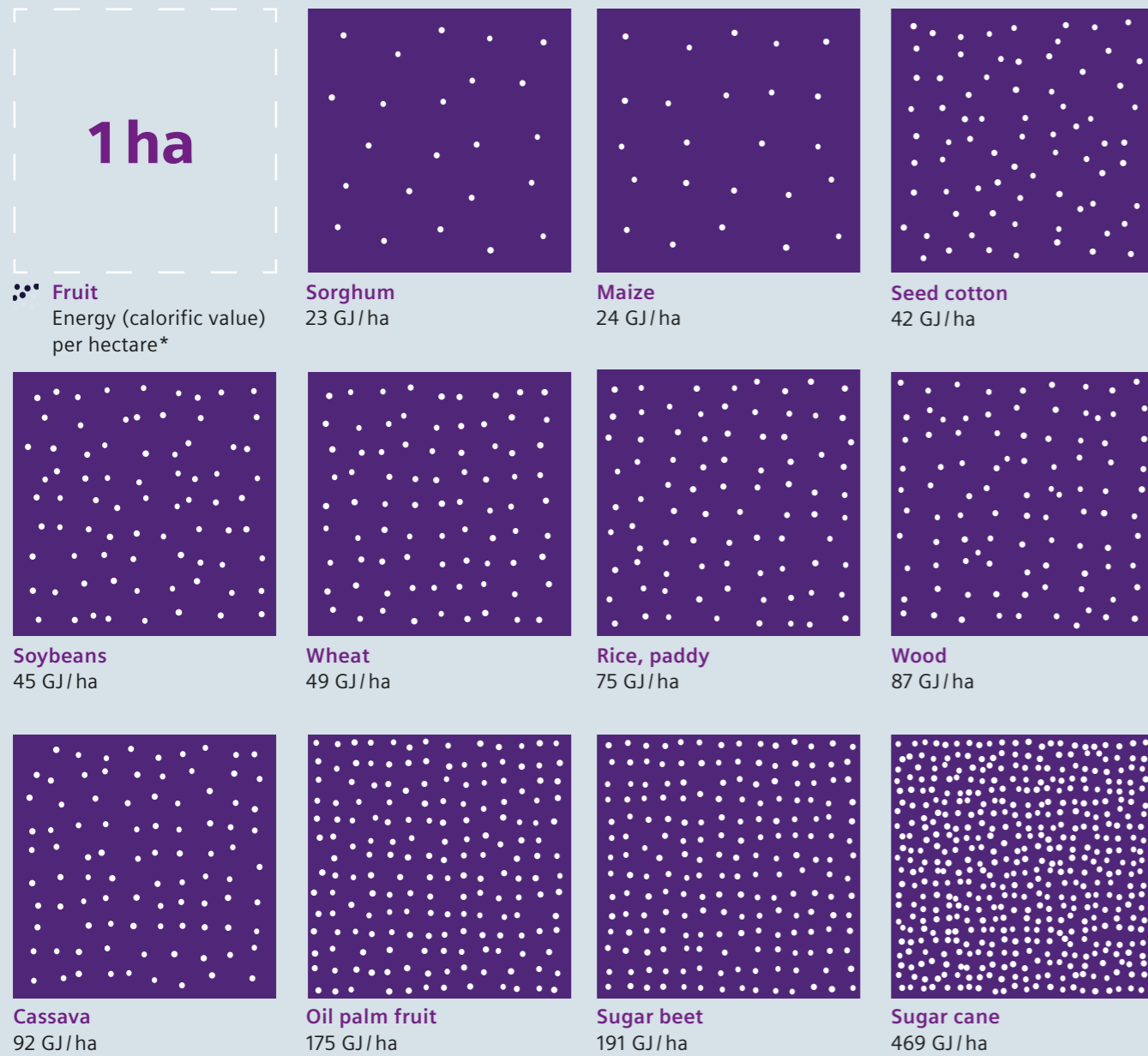
Easier financing

Due to our background and know-how, we can facilitate the financing of your project and even participate with our own financial services (SFS).

The potential of biomass

Fast facts about crops used for biomass

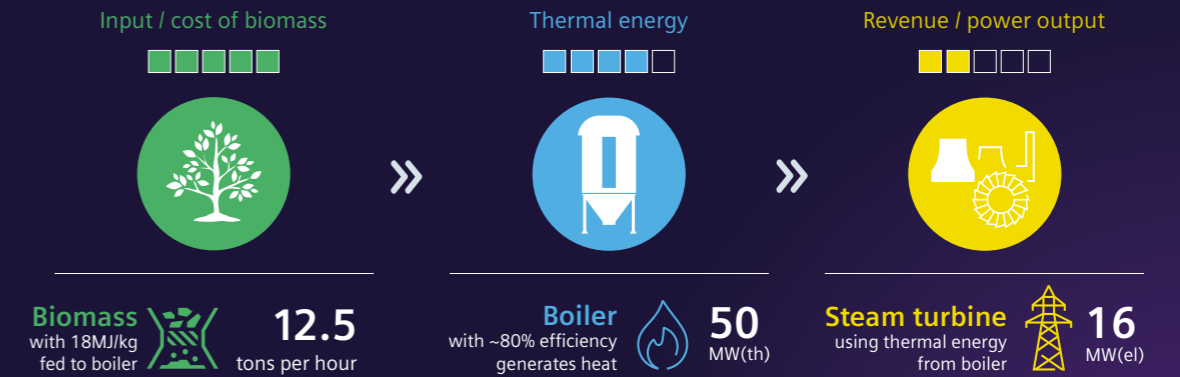
Energy harvested by area



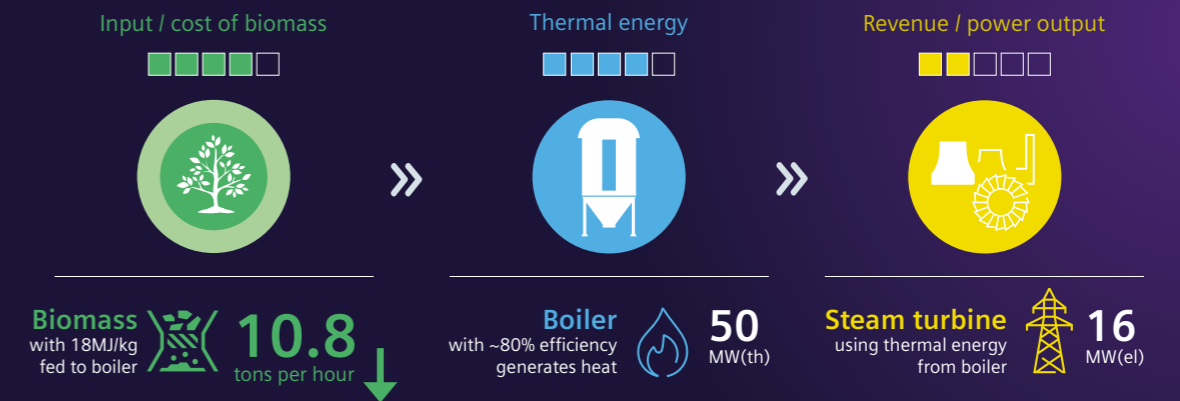
* High deviations exist because of climate, soil and agricultural techniques. Yield ranking is not the same for a single field. Calorific value approx. 20 MJ/Kg, when completely dehydrated. One of the challenges is producing a pre-defined grade of biomass.

Our focus on both fuel costs and revenue

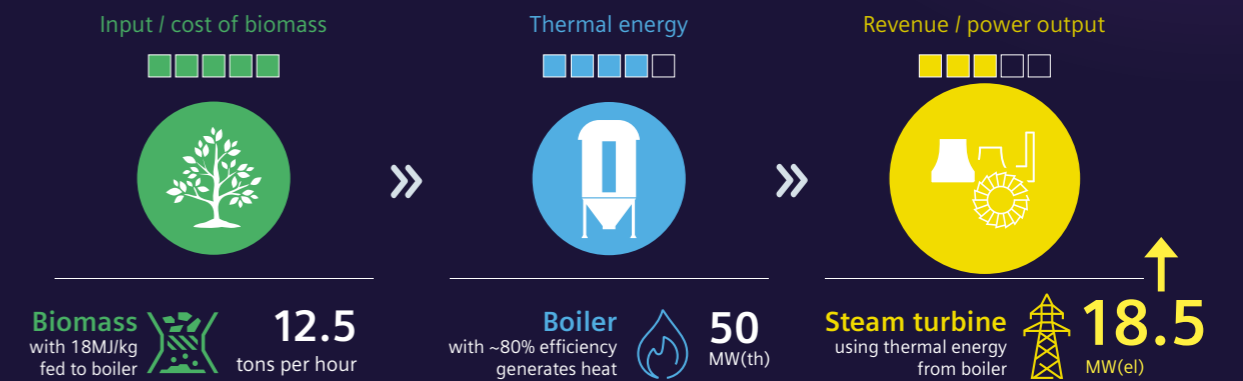
Typical setup in a biomass plant



Option 1: Lowering cost of fuel – use less biomass input but harvest the same amount of power



Option 2: Increase revenue – higher power output by using the the same amount of biomass fuel



A holistic approach

Covering every aspect

With increasingly stringent climate regulations on a national and international scale, electricity providers are increasingly looking to gain from the benefits offered by building new biomass capacity.

However, biomass fuel is highly demanding in terms of the logistics involved, which ultimately impacts on revenue. Due to its composition and seasonal changes, biomass is also subject to varying quality and thus availability. In addition, the planning phase for a biomass power plant requires meticulous coordination, advanced technical expertise, and convincing arguments for governing bodies and societies alike.

biomass plant. Covering all aspects of biomass power plant technology, we provide:

- Project development from beginning to end
- Consulting from an early stage
- Financing (with our own Siemens Financial Services)
- Environmental, health and safety expertise

As an experienced equipment manufacturer, Siemens Energy is thus the partner of choice when it comes to commissioning a new

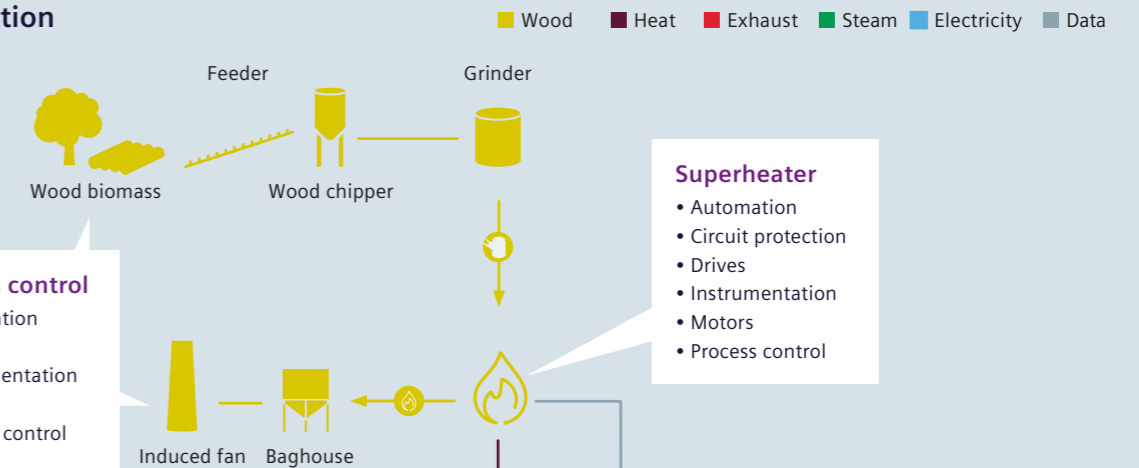
Co-firing – On the way to renewables

Worldwide, combustion is by far the most commonly applied bioenergy technology, either as co-firing or as a 100 percent biomass full-firing.

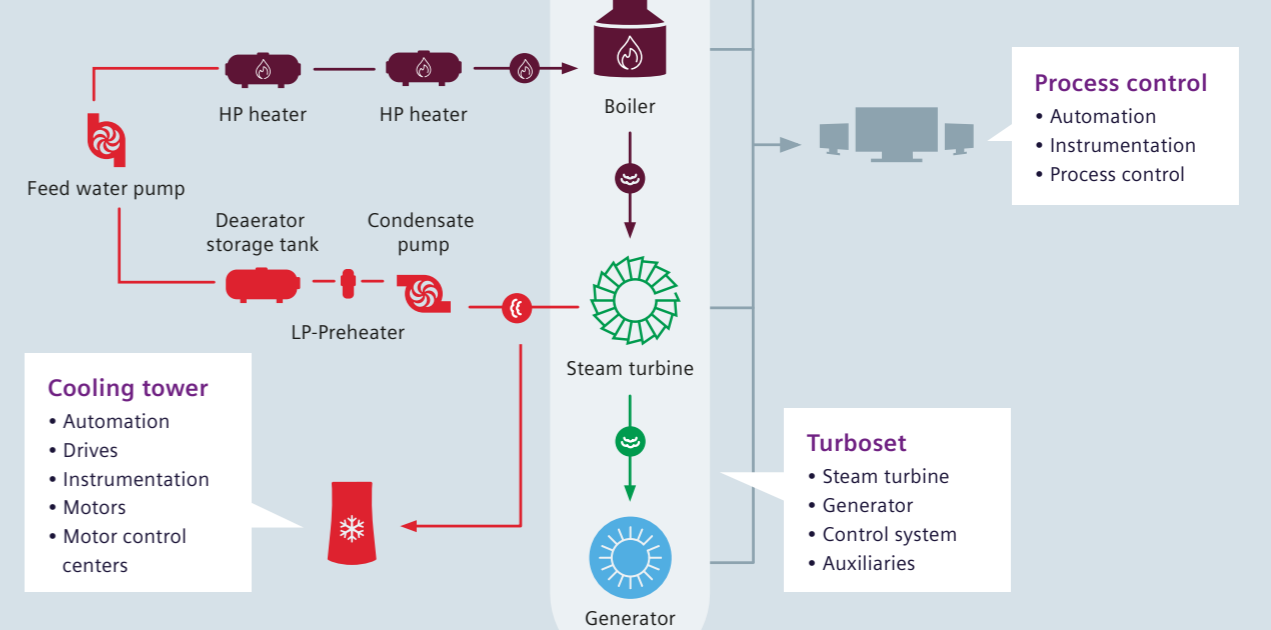
A biomass co-firing business model can help coal utilities to achieve their environmental targets (below 550 gCO₂/ kWh). Because biomass is one of the most capital-efficient transitions from coal to full renewables, it offers one possibility for large utilities to comply with renewable targets while using their existing assets. The implementation in large scale coal power plants with low risk is possible in a short term.

Siemens Energy components for biomass power plants

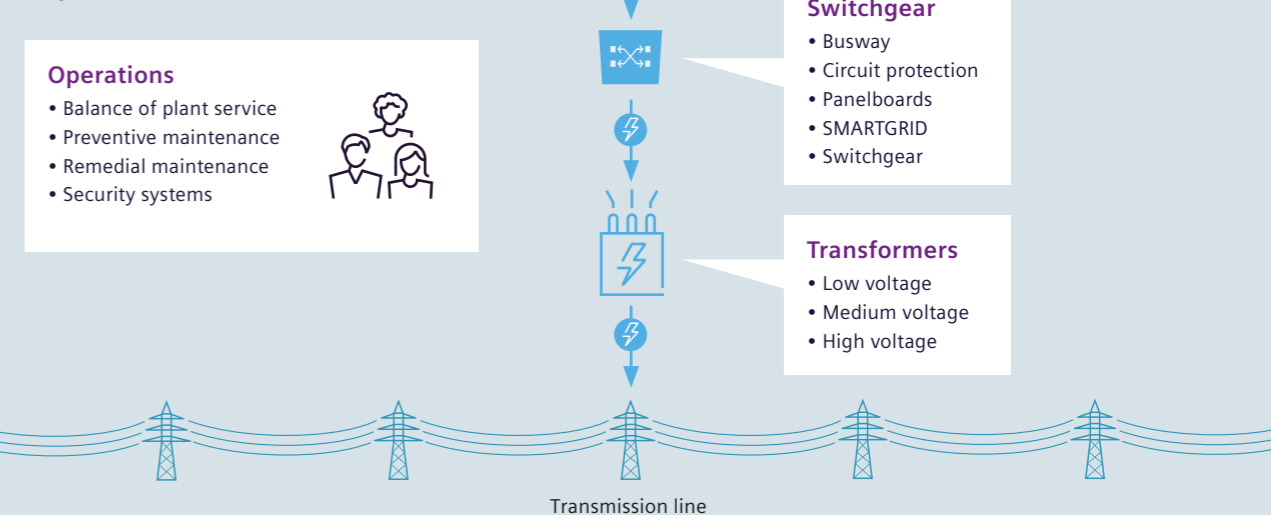
Heat production



Steam production



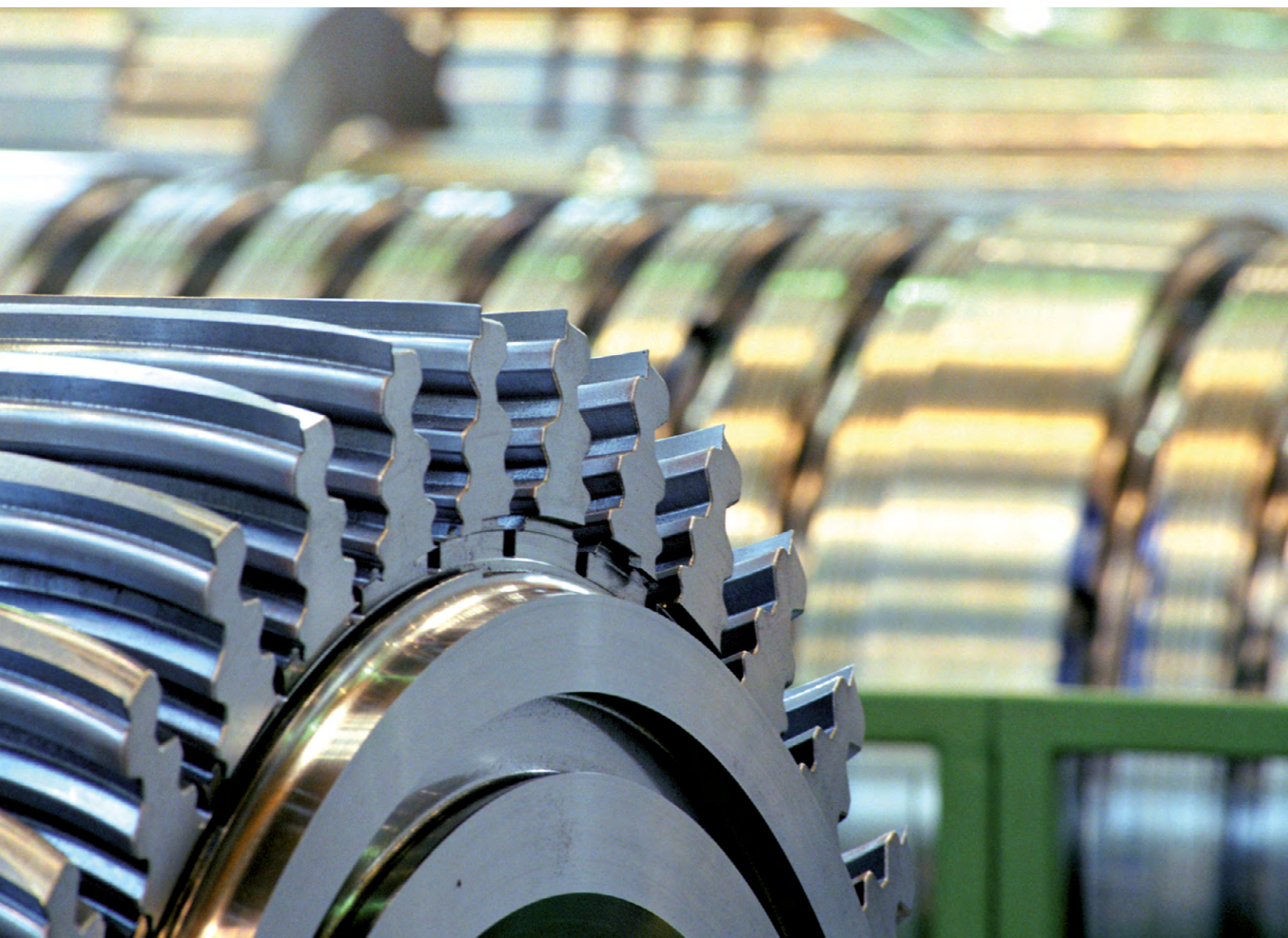
Power production



Get the power right

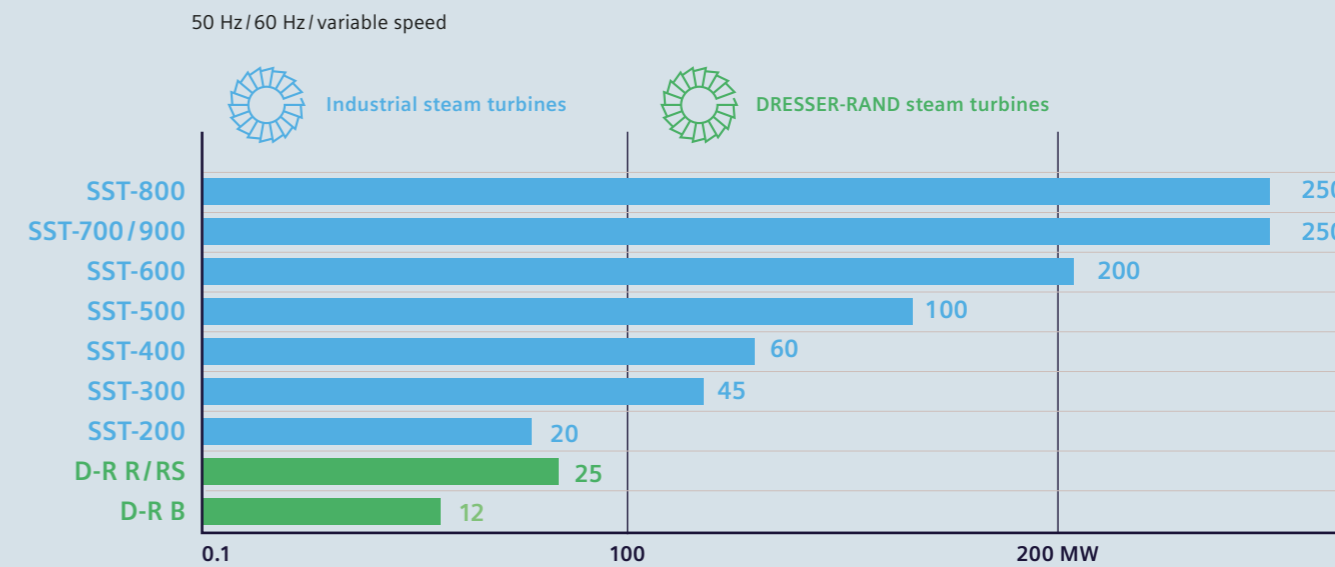
Power equipment for your needs

Siemens Energy has a comprehensive range of products for biomass power applications. Our experts will assist you in selecting the optimum machine that meets all your application requirements while at the same time minimizing the overall investment costs.



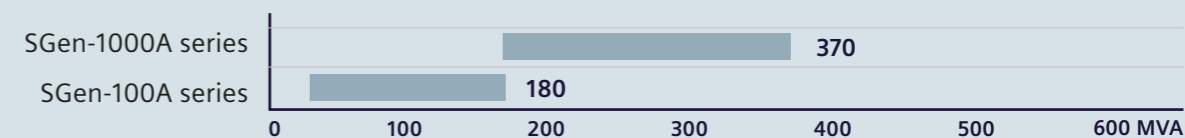
Our portfolio

Siemens Energy steam turbines typical for biomass applications



Learn more: www.siemens-energy.com/steamturbines

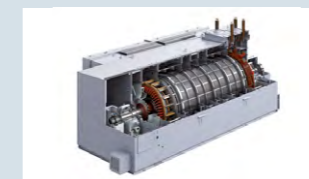
Siemens Energy generators typical for biomass applications



Additional suitable products



Industrial and aero-derivative gas turbines up to 66 MW



Generators up to 370 MVA



Gas engines up to 2 MW

Tickle out the last ounce

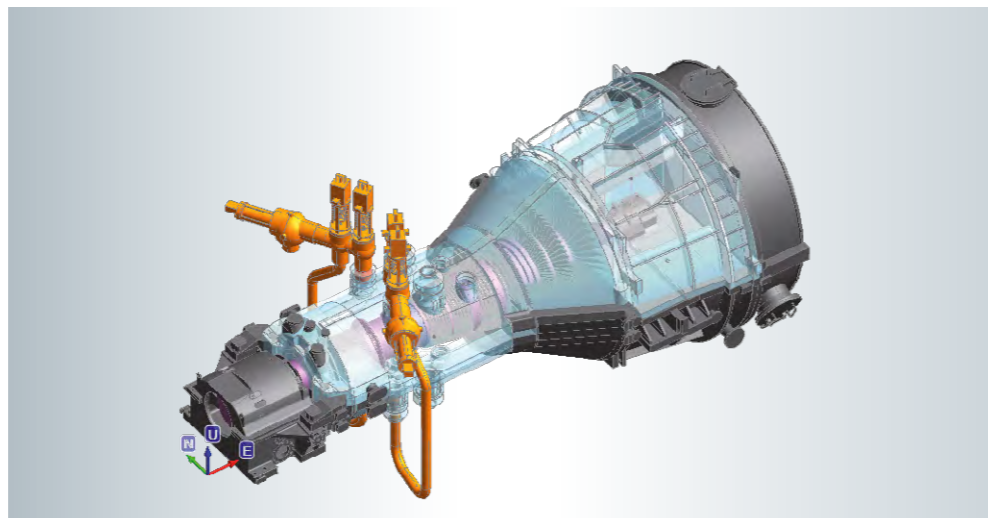
Challenge efficiency

Integrating a steam reheat system into your biomass plant is one of the best ways to increase overall plant performance. With the Siemens Energy reheat turbine package live steam is fed through a high pressure (HP) turbine, returned to the steam generator to increase the steam temperature and then passed through a low pressure (LP) turbine.

Raising the temperature of the steam passing from a high to a low-pressure turbine allows for greater output using the same amount of fuel. Siemens Energy offers single and double-casing reheat solutions. You can also use our reheat solutions for a power output of 10 to 12 MW or below.



Double casing reheat solution SST-700/900



Single casing reheat solution SST-600

Daily restarts

Challenge robust operating conditions

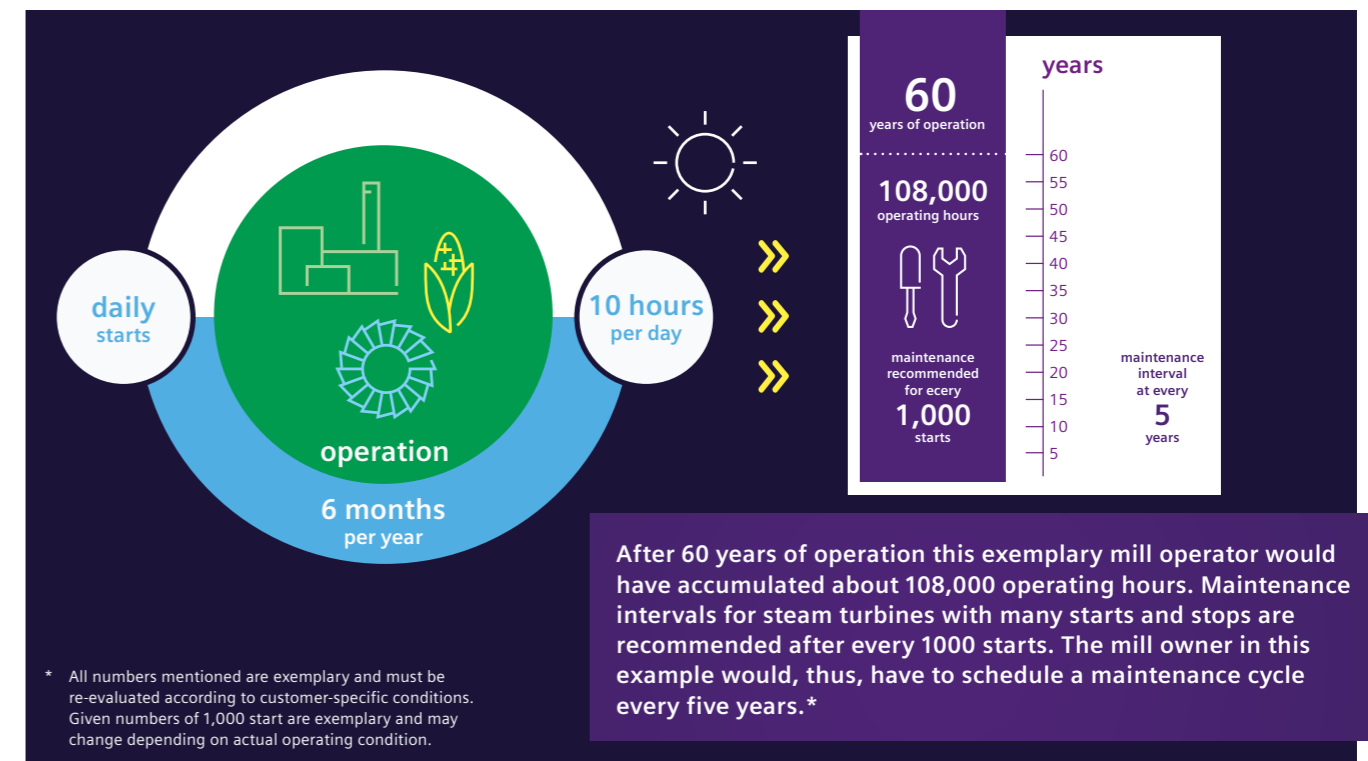
Biomass plants, such as palm oil mills are often operated for the season only and the equipment is shut down during off-season or even after daily operation. All these regimes of operation are tough conditions for the steam turbine.

Compared to a steam turbine, which is evenly driven with the same load in steam power plants, a flexible operation, as is usual in decentralized power generation from renewable energies or in industrial sectors such as palm oil production, reduces the life of a turbine tremendously. However: Siemens Energy steam turbines are designed for 200,000 operating hours.

Long lifecycles

Challenge robust operating conditions

Some mill operators produce only for six months a year, but re-start the power plant equipment on a daily basis and operate it for ten hours



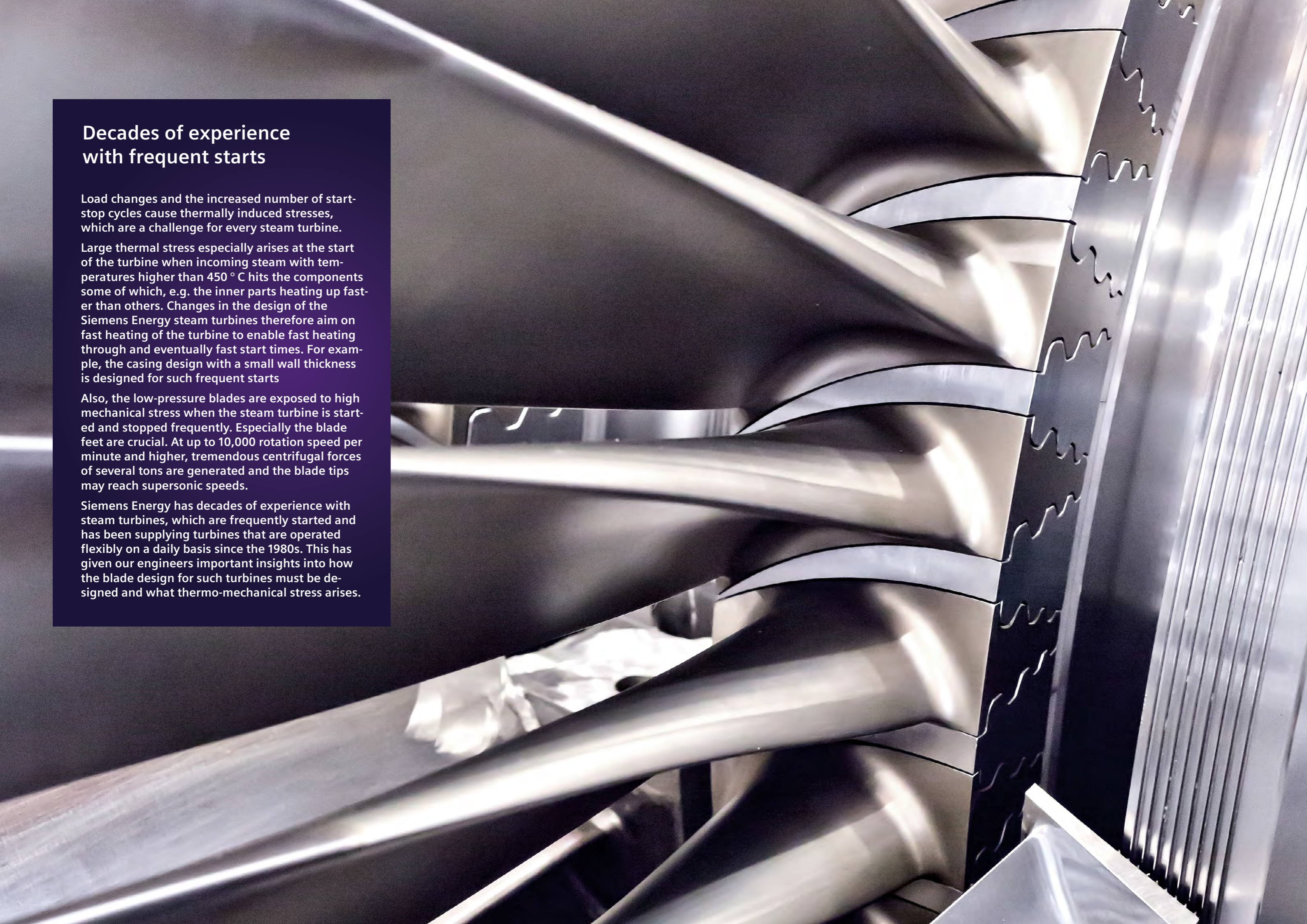
Decades of experience with frequent starts

Load changes and the increased number of start-stop cycles cause thermally induced stresses, which are a challenge for every steam turbine.

Large thermal stress especially arises at the start of the turbine when incoming steam with temperatures higher than 450 ° C hits the components some of which, e.g. the inner parts heating up faster than others. Changes in the design of the Siemens Energy steam turbines therefore aim on fast heating of the turbine to enable fast heating through and eventually fast start times. For example, the casing design with a small wall thickness is designed for such frequent starts

Also, the low-pressure blades are exposed to high mechanical stress when the steam turbine is started and stopped frequently. Especially the blade feet are crucial. At up to 10,000 rotation speed per minute and higher, tremendous centrifugal forces of several tons are generated and the blade tips may reach supersonic speeds.

Siemens Energy has decades of experience with steam turbines, which are frequently started and has been supplying turbines that are operated flexibly on a daily basis since the 1980s. This has given our engineers important insights into how the blade design for such turbines must be designed and what thermo-mechanical stress arises.



More than the sum of the parts

Partnering with the best

To gain a comprehensive overview of each specific project, Siemens Energy offers its expertise in consultancy from an early stage, taking all the relevant factors into account. We are then able to supply the full range of equipment and services necessary, drawing on our trusted and experienced partners as required.

Power plant operation

As the core of the power plant, the control system must be designed to perform all tasks safely, precisely and reliably. And in today's highly competitive markets, increasing output – including maximizing commercial availability – is key. Our proven control systems have been developed to meet the demands for simple, reliable, day-to-day operation as well as for fast reactions in critical situations to ensure your power plant's performance.

Plant equipment

Whichever combustion technology is used in your biomass plant, installing a Siemens Energy turbine ensures the highest possible performance. We can also supply auxiliary equipment such as generators, condenser systems, monitoring and control systems, as well as power transmission equipment.

Our boiler partners

When you choose Siemens Energy, you gain access to several leading boiler producers. Siemens Energy works with several partners to deliver the best fit boiler for each application. To help you understand what is on offer, you might consider one of our partners, Siemens HTT. Siemens HTT creates custom-made heat recovery steam generators (HRSGs), industrial and utility boilers, and related equipment. With over 80 years of experience and

815 HRSGs installed across five continents, Siemens HTT is a leading solutions provider for refineries, the petrochemical industry, and more. Siemens HTT provides various types of steam generators using gaseous, liquid, and solid fuels which include biomass such as sewage sludge and sugarcane residues. By choosing Siemens HTT, you can further enhance your plant and benefit from the specialist support of Energy.

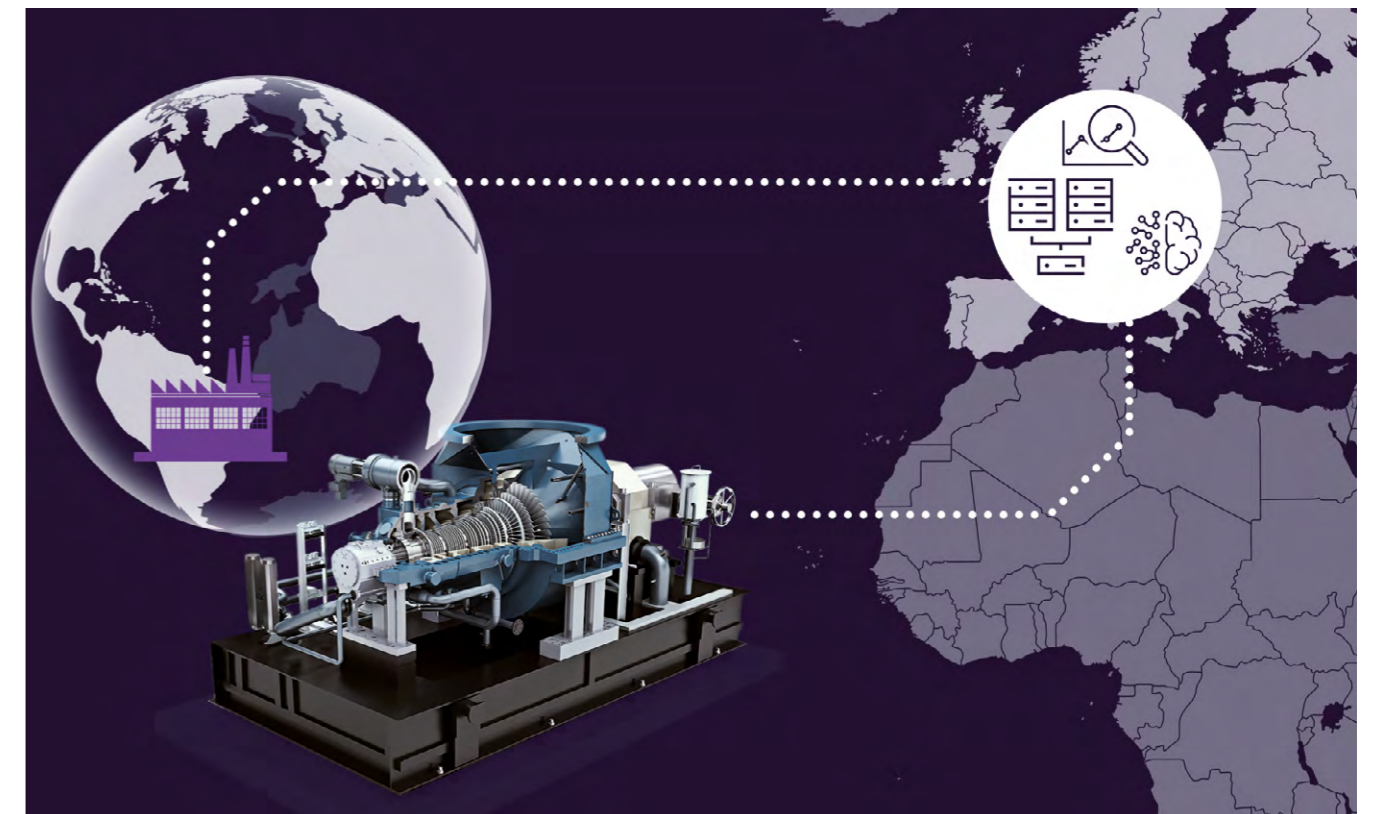
Service and remote monitoring

Extending to servicing timed to coincide with boiler intervals, Siemens Energy offers a range of services pioneering tailor-made digital services that enable new maintenance models to help customers achieve never-before-possible performance outcomes. We also offer the remote process control of your plant.

Furthermore, Siemens Energy's extensive experience monitoring several thousand connected rotating equipment world-

wide has shown a major upside to remote performance monitoring and diagnostics (RDS). By averting trips and resulting forced outages via early detection of potential faults and preventive remediation equipment availability can be increased.

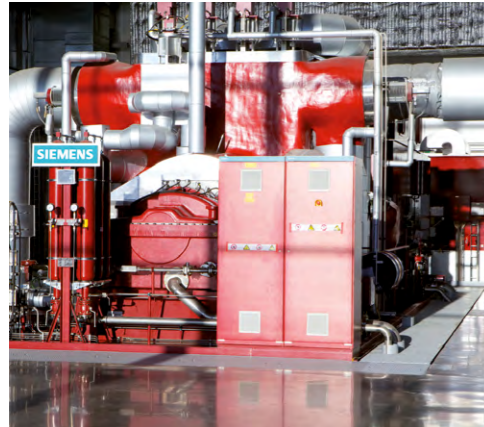
Another benefit is extending the life cycle of components due to more proactive, conditions-based, and predictive maintenance approaches that can potentially save considerable maintenance costs.



Remote performance monitoring and diagnostics (RDS) ensure early detection and predictive maintenance.

The best of references

Some of our success stories



Sweden, district heating for an even cleaner environment

Inaugurated in March 2010, the Igelsta district heating plant uses a biomass fuel mix consisting of about 90% renewable fuels, such as forest refuse, wood chips, tree bark, and 10% non-recyclable waste paper and plastic. The plant generates 200 MW heat and 85 MW electricity, the equivalent of heating 50,000 households and producing electricity for 100,000 homes. The counter-pressure SST-800 steam turbine is a so-called tandem compound turbine with the added advantage of consistently splitting the heat capacity between the two district heaters even if the turboset runs at part load.

Steam turbine: SST-800 **Inlet pressure:** 85 bar / 1,305 psi
Power output: 90 MW **Inlet temperature:** 540 °C / 1,004 °F



Thailand, more energy from biomass waste

Completed in 2015, the high-pressure (backpressure) steam turbine provides a reliable and high-performance electricity supply for the Mitr Phol sugar mill. Following their installation, the Siemens Energy turboset produces more electricity than the previous solution, while using the same amount of fuels.

- Scope of supply:**
- 2 x Steam turbine SST-300
 - Simatic PCS 7 automated process control system
 - Nahmat pan controlF



Denmark, energy surplus brings down costs

The Inbicon Biomass Refinery Kalundborg is one of the first "second generation" biofuels plants to turn straw into bioethanol and pellets. The plant is fully integrated, designed for commercial production with automatic operation 24/7 and a limited staff.

Feedstock:
 33,000 tons of straw p. a., Fermentation and distillation

Products:
 Per year, 5,300 tons of fuel, 12,100 tons of cattle feed from the C5 molasses and 14,300 tons of pellets from the lignin

Scope of supply:
 Power distribution, control systems and process instruments



Indonesia, turn biogas into electricity

The Sei Pelakar palm oil mill in the Jambi Province of Sumatra, Indonesia, owned by PT. Kresna Duta Agroindo, improved its effluent anaerobic treatment system into a new covered biodigester system to capture the biogas produced during the anaerobic digestion process. The mill's capacity is 60 t/h, 285,000 tons of fresh fruit bunch per year. In addition to the crude palm oil extraction, Pelakar mill also processes kernel nuts. The biogas collected could then be used to generate enough power to run the 7.5 t/h kernel crushing plant at the mill, and meet the estate's electricity demands.

Scope of supply:
 2 x containerized biogas gen-sets SGE-36SL, 600 kW-rated



Indonesia, turn biomass waste into power

PT Astra Agro Lestari, owns palm oil mills in the province of Aceh and is one of the largest palm oil plantations owner in Indonesia. It fully commits to the RSPO-rules. Dresser-Rand delivered in 2009 a multi-stage KG 2 steam turbine.

Steam turbine: D-R KG2 **Power output:** 800 kW



Indonesia, sugar mill makes use of biomass waste

CV Sejati owns the sugar mill Kreber-2 in Malang (Province of East Java). In 2012 Dresser-Rand delivered a multi-stage K3 steam turbine, which since then generates 3,000 kW out of bagasse.

Steam turbine: D-R K3 **Power output:** 3,000 kW

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