

# Turning biomass into value

Power generation equipment for biomass-fueled plants

siemens.com/biomass

# An age-old fuel put to new use

#### **Energy generated from biomass**

Providing a future-proof source of electricity and contributing to lower CO<sub>2</sub> 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  $\rm CO_2$  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 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 CO<sub>2</sub> 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 byproducts need no additional processing and further strengthen the financial feasibility of the biomass plant.

#### As a leader in the field, Siemens 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.



#### 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.

#### 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

Input / cost of biomass

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



MW(th)

## 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.

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

#### 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.



# Get the power right

### Power equipment for your needs

Siemens 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 steam turbines typical for biomass applications



Learn more: www.siemens.com/steamturbines

#### Siemens generators typical for biomass applications



#### Additional suitable products



Industrial and aeroderivative gas turbines up to 66 MW



		370		
180				
200	300	400	500	600 MVA

Generators up to 370 MVA



Gas engines up to 2 MW

# More than the sum of the parts

### Partnering with the best

To gain a comprehensive overview of each specific project, Siemens 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 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, you gain access to several leading boiler producers. Siemens 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 Siemens.

### Service and remote monitoring

Extending to servicing timed to coincide with boiler intervals, Siemens offers a range of services pioneering tailor-made digital services that enable new maintenance models to help customers achieve neverbefore-possible performance outcomes. We also offer the remote process control of your plant.

Furthermore, Siemens' extensive experience monitoring several thousand connected rotating equipment worldwide has shown

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.



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



# A range of benefits

#### Major advantages of Siemens steam turbines

The result of decades of experience in supplying, installing, and servicing equipment in biomass plants, Siemens steam turbines are exceptionally well suited to pure power and heat generation.

#### Efficiency is key

With their leading efficiency profile and minimal outages, our turbines maximize the amount of electricity generated while further reducing a plant's lifetime emissions footprint. This enhanced efficiency is due to several special features.

Siemens turbines operate more effectively with the improved blade and seal concept. Double casing solutions, with a geared high pressure and immediate pressure turbine also contribute to the overall plant efficiency. In these cases losses in the steam path and sealing are significantly minimized.

#### Reliability

Drawing on a century of experience, all our turbines guarantee a long life cycle. Their low outage rates are due to the proven design and technology, including tried-andtested root clamps and maintenance-free bolts.

#### Tailored to your needs

Built to meet your specific demands, our turbines are available in both single and

multi-stage designs. They are also supplied with proven single or multiple controlled and uncontrolled extraction systems, with up to seven extraction planes for one casing possible.

All our steam turbines are designed with a customized steam path, which is calculated individually for every project. Thus, we get out the maximum for our customers.

#### Flexible operations

permit any load regime.

An additional contribution to higher efficiency is the revised steam path realized by specialized steam inlets which ensure high temperatures with short heat-up times, along with competitive solutions for lower parameters.

With all turbines designed to accommodate customizable features, we are confident of helping you find a configuration that achieves the optimum balance between highest efficiency and lowest cost.

The highly volatile heating values involved in a biomass plant require flexible operation, which is ensured by our customized turbine configurations in single and multi-casing solutions. The inner casing allows a three-step elongation according to required blade path length, while faster and unlimited load changes over entire life time





>70 units

Africa

>5 units



#### 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: SS 9 Power output:

#### 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 turboset produces more electricity than the previous solution, while using the same amount of fuels.

Steam turbine: Steam turbine: 2 Power output:

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 to

fuel, 12,10 and 14,300 tons of pellets from the lignin



Asia-Pacific

>75 units





สร้างคุณก่า สร้าง

straw p.a and distil

Products: Per year,



Siemens steam turbines

Latin America

>40 units

18

ST-800	Inlet pressure:	85 bar / 1,305 psi
0 MW	Inlet temperature:	540 °C / 1,004 °F

ST-300	Inlet pressure:	68 bar / 986 psi
6 MW	Inlet temperature:	505 °C / 941 °F

#### Denmark, energy surplus brings down costs

33.000 tons of straw p.a., Fermentation and distillation	Siemens Solution:	Power distribution, control systems and process instruments
Per year, 5,300 tons of fuel, 12,100 tons of cattle feed from the C5 molasses		

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