The powerful potential of sugarcane
Turning biomass into profit
Creating green, CO₂-neutral energy from bagasse requires the highest levels of efficiency. The goal of any plant is to extract as much natural energy as possible, whether that energy is sugar itself or steam and power to be sold to the grid. By choosing and using the right equipment, manufacturers can reap huge financial rewards and feel good about running a sustainable operation that is fit for the future. Cogeneration – the ability to create two forms of energy from a single fuel source – has many benefits, both on a local and global level.

A taste of independence
Get the most out of your fuel

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The benefits of cogeneration

Increase profitability
Take advantage of domestic resources to increase your profits and boost your competitiveness. There are many successful subsidiaries operating around the world.

Renewable and CO₂-neutral
Bagasse is renewable and does not emit greenhouse gases.

Support the national grid
Sell power back to the grid and contribute to the bioenergy targets of your country.

Bagasse is the residual fiber left over from the sugarcane extraction process. Instead of treating it as waste, sugar mills can repurpose it to produce heat and electricity, in turn boosting independence and profit without creating more greenhouse gases.
Steam conditioning

In a sugar mill most amount of steam is consumed by the vacuum pans. As market leader in the area of industrial steam turbines, we know the importance of a flexible and customized turbine design. That’s why we provide steam turbines with various uncontrolled and controlled extraction options adapted to the steam flow in your process. We can offer the number of extractions dictated by the process requirements.

Bagasse as fuel

Mechanical drives
Typically in a sugar mill a cane shredder is used to crush up the sugar cane and extract the maximum amount of juice (liquid). This shredder is most often driven by a small steam turbine. Siemens Dresser-Rand steam turbines and Siemens industrial steam turbines drive shredders all over the world.

Power generation and steam management
With over a century of experience in turbine technology, Siemens has delivered solutions for a wide range of purposes.

Service and maintenance
Siemens’ intensive experience monitoring several thousand connected rotating equipment worldwide has shown a major upside to remote performance monitoring and diagnostics.

Lifecycle integration
Integrated software and services throughout the entire lifecycle. For more performance and maximum investment security.

Booster the efficiency of your business
Flexible solutions for tailored performance

As an experienced equipment manufacturer, Siemens is the partner of choice when it comes to optimizing your mill performance. Covering all aspects of a sugar mill, we provide products along the complete process chain.

Enhanced efficiency with modernized power generation equipment

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.

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The powerful potential of sugarcane

Traditional technology
Siemens state of the art steam turbine

Steam turbine cycle with 37% efficiency
Siemens state of the art steam turbine

7% more efficiency

Traditional technology
Steam turbine cycle with 30% efficiency

Sugar cane crushed
1000 2000 3000 4000 5000 tons/day

Thermal energy generated
Sugar cane with 10 MJ/kg calorific value fed to boiler
1000 tons/day

Electricity power generated
Boiler with ~70% efficiency generates heat
8 MW(el)

Steam turbine using thermal energy from boiler
~37% efficiency

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A surge of power
The right turbine for your plant

With over a century of experience in turbine technology, Siemens has delivered solutions for a wide range of purposes. For the sugar industry, turbines of up to 50 MW are the most relevant. Whether you run a small, medium, or large mill, we have the best-fitting and easily maintainable solution to match your needs.

For most mills, the popular SST-300 is the ideal choice. Turn to the last page of this brochure to learn more.

Your benefits at a glance

- **Minimal inspection required**
  - All Siemens turbines feature a compact design and simple layout. This significantly reduces the cost and time associated with construction, inspection, and maintenance, enabling sugar producers to run a more efficient and independent plant.

- **Proven reliability and availability**
  - Calling on a century of turbine development, all Siemens turbines guarantee a long life cycle of 200,000 hours. High availability is the result of a proven design, comprised of pressure blades with reliable root clamps and maintenance-free bolts. By lowering maintenance costs and being ready to crush whenever necessary, your mill will become more sustainable and profitable.

- **Enhanced efficiency**
  - With their improved blade and seal concept, Siemens steam turbines are highly efficient in operation. Each turbine is characterized by a simple modular construction that provides flexibility and ease during configuration and maintenance, ensuring maximum output in the least time possible. The result is more energy produced and fed into the grid, and thus more profit.

### Power output in MW of our steam turbines

<table>
<thead>
<tr>
<th>Small sugar mills</th>
<th>Medium-size sugar mills</th>
<th>Large sugar mills</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 8 MW</td>
<td>up to 49 MW</td>
<td>up to 162 MW</td>
</tr>
</tbody>
</table>

- **Small sugar mills**
  - 1,000 tons of sugarcane crushed per day (tcd)

- **Medium-size sugar mills**
  - 6,000 tons of sugarcane crushed per day (tcd)

- **Large sugar mills**
  - 20,000 tons of sugarcane crushed per day (tcd)

Approximate values only. Actual output depends on e.g. calorific value of sugar cane, technology used, e.g. condensing cycle.
Siemens: fueling the future of sugar

Tradition meets innovation

Our recipe for success
In today’s sugar industry, increasing competition and the need for higher efficiency means producers are looking for new ways to achieve long-term success. And this is exactly where Siemens comes in. With unparalleled understanding of sugar production, a global footprint, and the most extensive range of products, solutions, and services, we are here to help you succeed. Siemens has been developing solutions for the sugar industry for well over half a century. We are very familiar with the processes and objectives involved, as well as the challenges that producers face. Our work aims to boost output with reduced expenditure and resources, allowing you to acquire greater independence, sustainability, and profit in the future.

Your proven global partner
The wider Siemens world provides 360-degree support for any plant. With an industry-specific portfolio ranging from automation, instrumentation, drive technology and low-voltage switchgear, as well as global services throughout the entire life cycle of the plant, we cover every area of your sugar production to ensure that processes are efficient, coordinated, and centralized. If preferred, we remove the need to deal with third parties and provide everything from under one roof; at the same time we can provide single components only, such as the steam turbine. We are as flexible as you need to be. When you choose Siemens, you have access to many different components, such as boilers and condensers. With a rich history that dates back over a century and new innovations in the making, the Siemens name will be your trusted partner now and in the future.

Siemens offers a comprehensive portfolio of generators for the 25 to 2,235 MVA power range. They achieve efficiency levels of up to 99 percent. The design of our generators benefits from more than 150 years of experience in development. In addition, our specialists service generators from around the world and perform upgrades and repairs – even for components from other manufacturers.

Generators made with generations of expertise

Our boiler partners
When you choose Siemens, you gain access to several leading boiler producers. To help you understand what is on offer, consider one of our partners, Siemens HTT. Siemens HTT creates custom-made heat recovery steam generators (HRSGs), industrial and utility boilers, and related equipment. Siemens HTT provides various types of steam generators using gaseous, liquid, and solid fuels which include biomass such as sewage sludge and sugarcane residues.

What you get when you choose Siemens
• Years of proven experience in the industry
• Specialist support from start to finish
• An all-in-one solution for any plant
• Cost-effective packaging
Siemens SST steam turbines
A solution for every sugar mill

Steam extraction
During controlled and uncontrolled extraction, steam is released from various stages of the turbine and used for industrial processes, or sent to boiler feedwater heaters to improve overall cycle efficiency. To ensure you have a tailor-made turbine solution, Siemens provides controlled and uncontrolled extraction when you need it. Our experts will help you find the optimum balance between high efficiency and low cost.

Short installation time with plug & play
Integrated and semi-integrated base frame solutions ensure fast installation. The site construction time is reduced and personnel with advanced skills is not required.

Homogeneous geometrical casing design
This innovative design approach means Siemens turbines provide distinct benefits.
- Quick start times (up to 50 percent faster)
- Fast load changes – full load or partial load
- High efficiency

Part-load operation
Not every mill always runs under full load, and bagasse can differ in its moisture and ash content, resulting in an inconsistent steam parameter. To solve this, part-load operation optimizes the efficiency and power output of the turbine if there is not enough sugarcane to crush. This feature ensures consistent results from season to season.
Illovo Sugar is Africa’s biggest sugar producer and has extensive agricultural and manufacturing operations in six African countries. The group produces raw and refined sugar for local, regional African, European Union (EU), United States of America (USA) and world markets from sugar cane supplied by its own agricultural operations and independent growers who supply cane to Illovo’s factories. Installed electricity generating capacity, fuelled by renewable resources, annually provides around 90% of the group’s energy requirements.

At Sucrerie de Wonji Shoa, a sugar mill located 100 km east of Addis Ababa in Ethiopia, self-sufficiency is a key objective. After processing sugarcane, the remaining bagasse is used as fuel for the boiler. The mill operates with a capacity of 31.5 MW, which produces enough energy to fully cover the demand for electricity and process steam.

When Shivratna Udyog Pvt. Ltd. started looking for a new steam turbine, quality and reliability were top priorities. “We found Siemens to be always approachable, quality-conscious, safety-conscious, and customer-oriented throughout the execution of the project. We are very much satisfied (...) and would recommend other prospective customers to prefer Siemens over other options,” commented the plant’s general manager.

The powerful potential of sugarcane
NSL Sugar Ltd. (NSL) is one of the most efficient integrated sugar companies in southern India. To help boost this status, the company turned to a Siemens SST-300 steam turbine in 2010. S.C. Gupta, consultant at NSL Sugar Ltd., said: “We are highly satisfied with the support provided by Siemens ... the team completed the project on time, and certain activities were completed ahead of schedule.”

Operating as a subsidiary of Gammon Infrastructure Projects Limited, Pravara Renewable Energy Ltd. owns and operates a bagasse-fueled cogeneration power project that processes roughly 5,000 tcd. By choosing Siemens and installing an SST-300 steam turbine in 2012, the plant now operates at a capacity of 30 MW.

For Grupo Delta Sucroenergia, based in Minas Gerais state, an integrated effort was necessary to show that the Siemens solution was worthwhile. The customer was convinced by the more efficient technology, thanks to the increased size of the machine. Thus the competitive advantage of this turbine was achieved which is the first in the country to waive the use of gears with direct drive for the generator.

Located in the Cam Lam district in the coastal Khanh Hoa province, Khanh Hoa handles roughly 3,000 tcd. In the late 90s the plant was looking for a reliable, high-quality steam turbine solution to power production into the future. Since choosing the SST-300 from Siemens, the plant has not performed a major overhaul or changed any major parts in the past 17 years.
The powerful potential of sugarcane

A Perfect Cycle of Sugar Production

Thailand’s largest sugar producer Mitr Phol teams up with Siemens for intelligent power generation

The family-owned Mitr Phol Group based in Thailand is Asia’s largest sugar and bio-energy producer. Sugar production at Mitr Phol forms a complete cycle: Crushed cane is turned into refined sugar, leftovers are used as fertilizers for the field, and bagasse is used to feed the boilers.

Mitr Phol has signed an agreement with the Electricity Generating Authority of Thailand (EGAT) to sell its excess power. To consistently produce electricity, they need reliable and high-performance steam turbines and generators.

In two of its six sugar mills in Thailand, Mitr Phol runs SST-300 steam turbines. Phu Khieo 1 has been using an 11.4-MW condensing SST-300 since 2007. Phu Khieo 2 started operating its 26-MW backpressure turbine SST-300 after a plant modernization in 2014. In April 2017 the company ordered an SST-400 steam turbine for Phu Luang and an SST-300 steam turbine for Amant Charoen.

The connected boilers produce between 120 and 140 tons of steam per hour. The backpressure turbine is powered by steam at about 70 bar and at a temperature of 510° Celsius. Together the two factories Phu Khieo 1 and 2 crush 40,000 tons sugar per day. The result: 1,500 tons of refined sugar per day and roughly 502 gigawatts of produced electricity per year. In Phu Khieo roughly half of the bagasse is burned during the seasonal production process; the rest is stored to generate power during the off-season, when it’s fed into the grid. In 2011, Phu Khieo won the ASEAN Energy Awards as best biomass power plant at the ASEAN Energy Business Forum Conference in Brunei.

In their Pho Viang plant, Mitr Phol uses the fully automated process control system Simatic PCS 7 from Siemens and the Nahmat pan control decentralized automation system for the sugar crystallization process. By modernizing its equipment, Mitr Phol intends to take a leap into true globalization and to produce high-quality sugar.

With the new Siemens equipment, we’ve achieved a very high level of stability and performance and are able to produce more electricity using the same amount of bagasse”


Key facts Phu Khieo I and II

40,000 t crushed per day

120 t/h and 140 t/h steam produced by the boiler

502 GWh per year

1,500 t refined sugar per day produced

Scope of supply

- SST-300 condensing steam turbine (11.4 MW)
- SST-300 backpressure steam turbine (26 MW)
- Simatic PCS 7 fully automated process control system
- Nahmat pan control decentralized automation system for the sugar crystallization process

Overall Mitr Phol operates seven Siemens steam turbines:

- SST-300: 11.4 MW (2007)
- SST-300: 11.4 MW (2007)
- SST-300 (backpressure): 26 MW (2014)
- SST-400: 30 MW (2017)
- SST-300 (backpressure): 26 MW (2017)