

Published by
Siemens AG 2018

Power and Gas Division
Steam Turbines
Freyeslebenstrasse 1
91058 Erlangen, Germany

For more information, please contact
our Customer Support Center.

Phone: +49 180 524 70 00
Fax: +49 180 524 24 71
(Charges depending on provider)
E-mail: support.energy@siemens.com

Article-No: PGSU-B10015-00-7600
Printed in Germany
Dispo 34808
BR 0318.10 BB.11116 V2

Subject to changes and errors. The information given in this document only contains general descriptions and / or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

The powerful
potential
of sugarcane
Turning biomass into profit

A taste of independence

Get the most out of your fuel

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.

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.



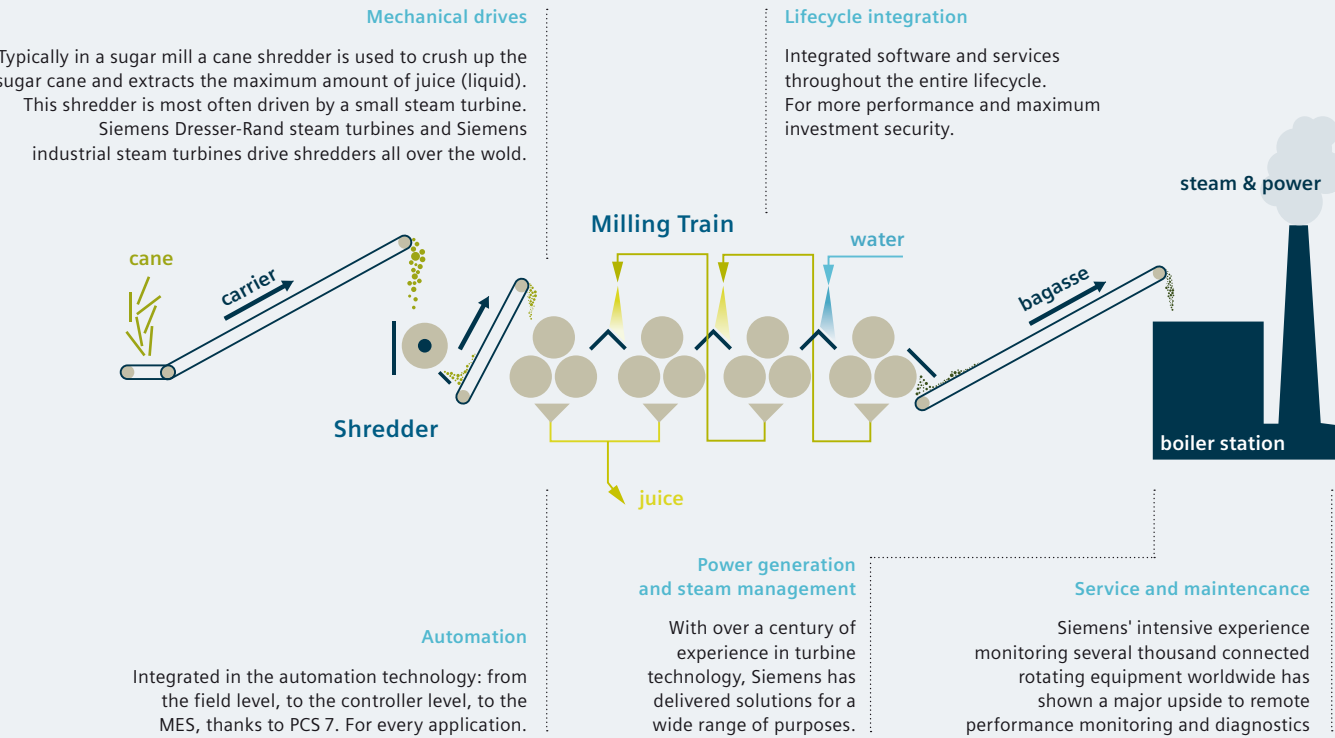
Bagasse is the residual fiber left over from the sugarcane extraction process. Instead of treating it as waste, sugar mills can repurpose it to produce heat and electricity, in turn boosting independence and profit without creating more greenhouse gases.

Boost 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.

Bagasse as fuel

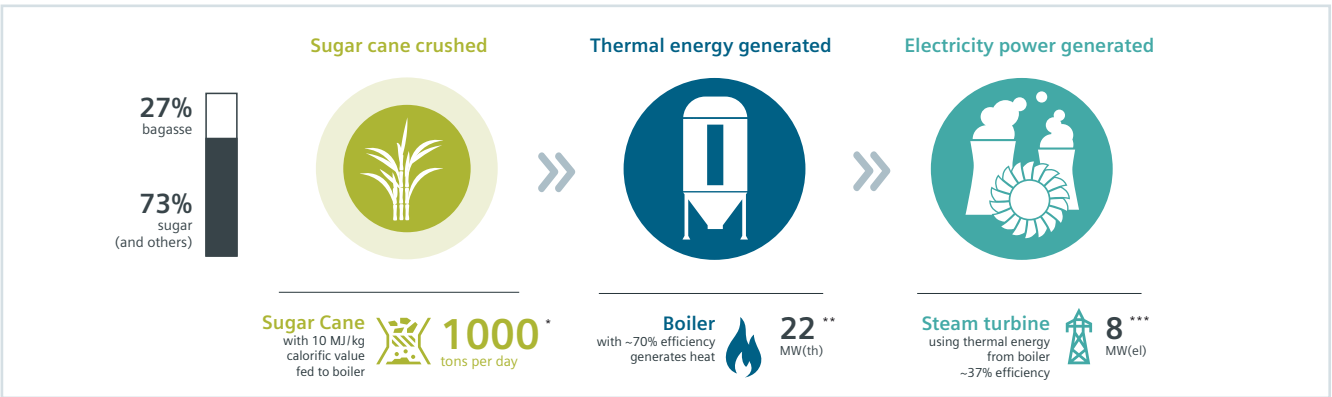


Steam conditioning

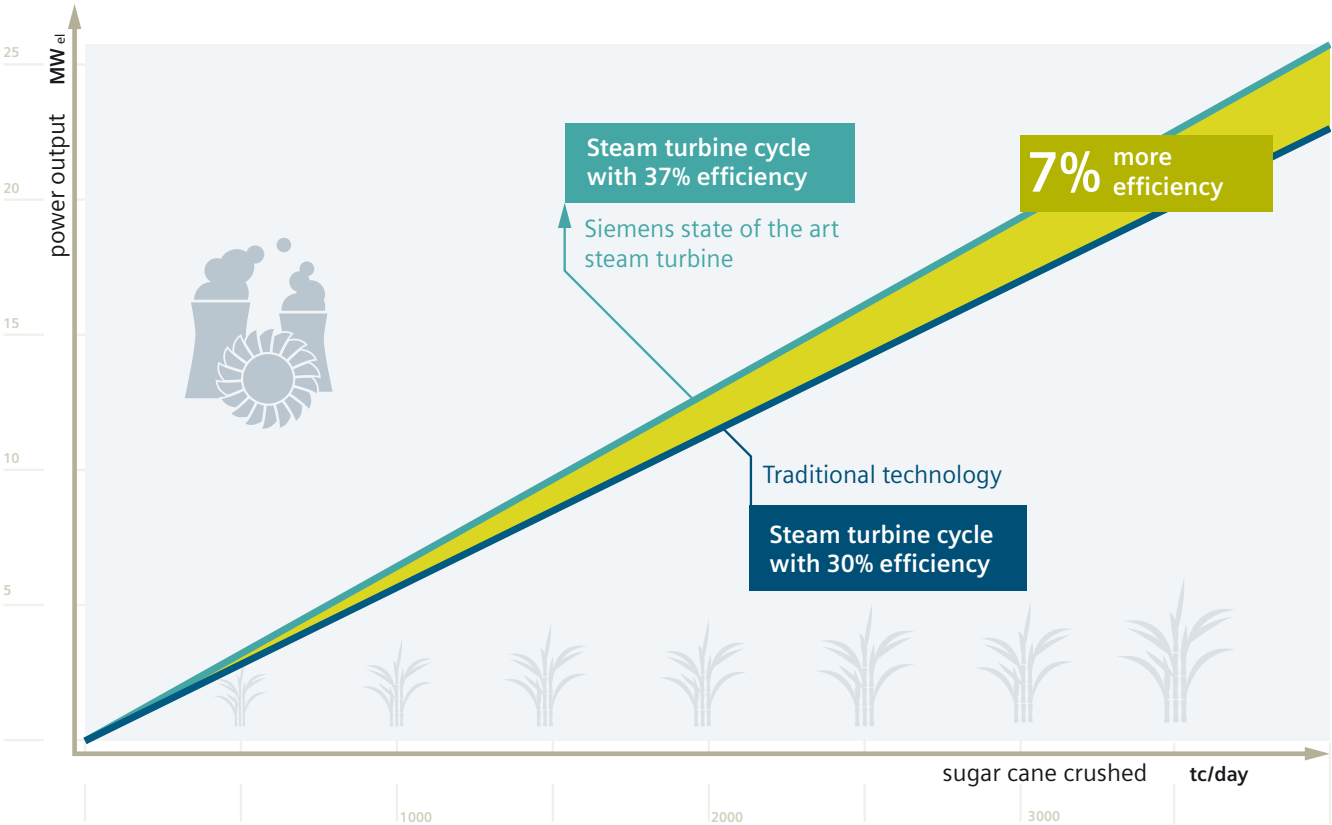
In a sugar mill most amount of steam is consumed by the vacuum pans. As market leader in the area of industrial steam turbines, we know the importance of a flexible and customized turbine design. That's why we provide steam turbines with various uncontrolled and controlled extraction options adapted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

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.



* annual average crashed ton
** gross heating value of bagasse
*** Considering pure-condensing cycle for comparison purpose



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.

Small sugar mills

up to

8 MW

1,000

tons of sugarcane crushed per day (tcd)

Medium-size sugar mills

up to

49 MW

6,000

tons of sugarcane crushed per day (tcd)

Large sugar mills

up to

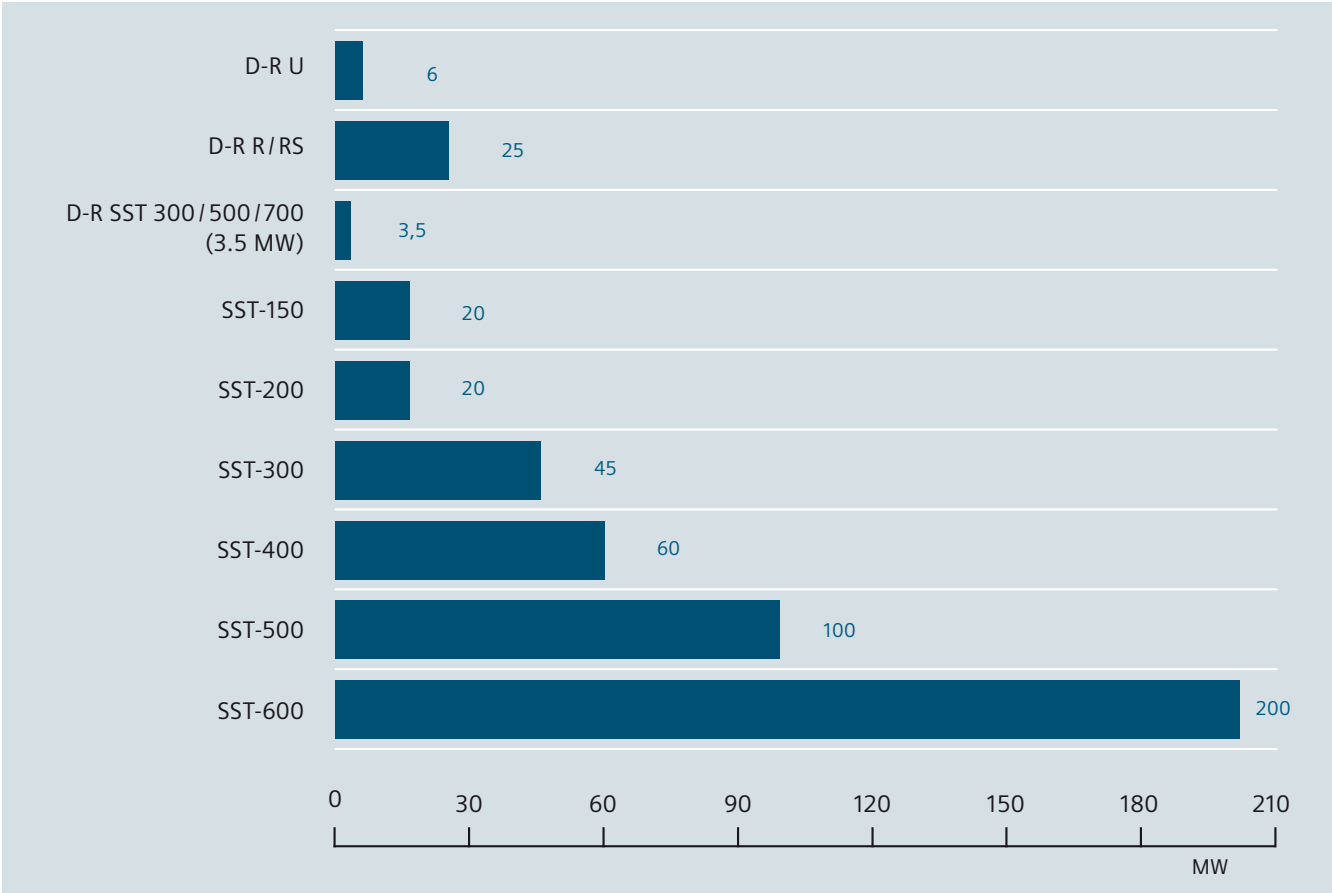
162 MW

20,000

tons of sugarcane crushed per day (tcd)

Aproximate values only. Actual output depends on e.g. calorific value of sugar cane, technology used, e.g. condensing cycle.

Power output in MW of our steam turbines



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

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.

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.

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.



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.

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



Each step of the sugar production process must run smoothly. Siemens has a proven portfolio of steam turbines, from small to large, so you can choose a precise solution for your plant.

Generators made with generations of expertise

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.

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.

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.

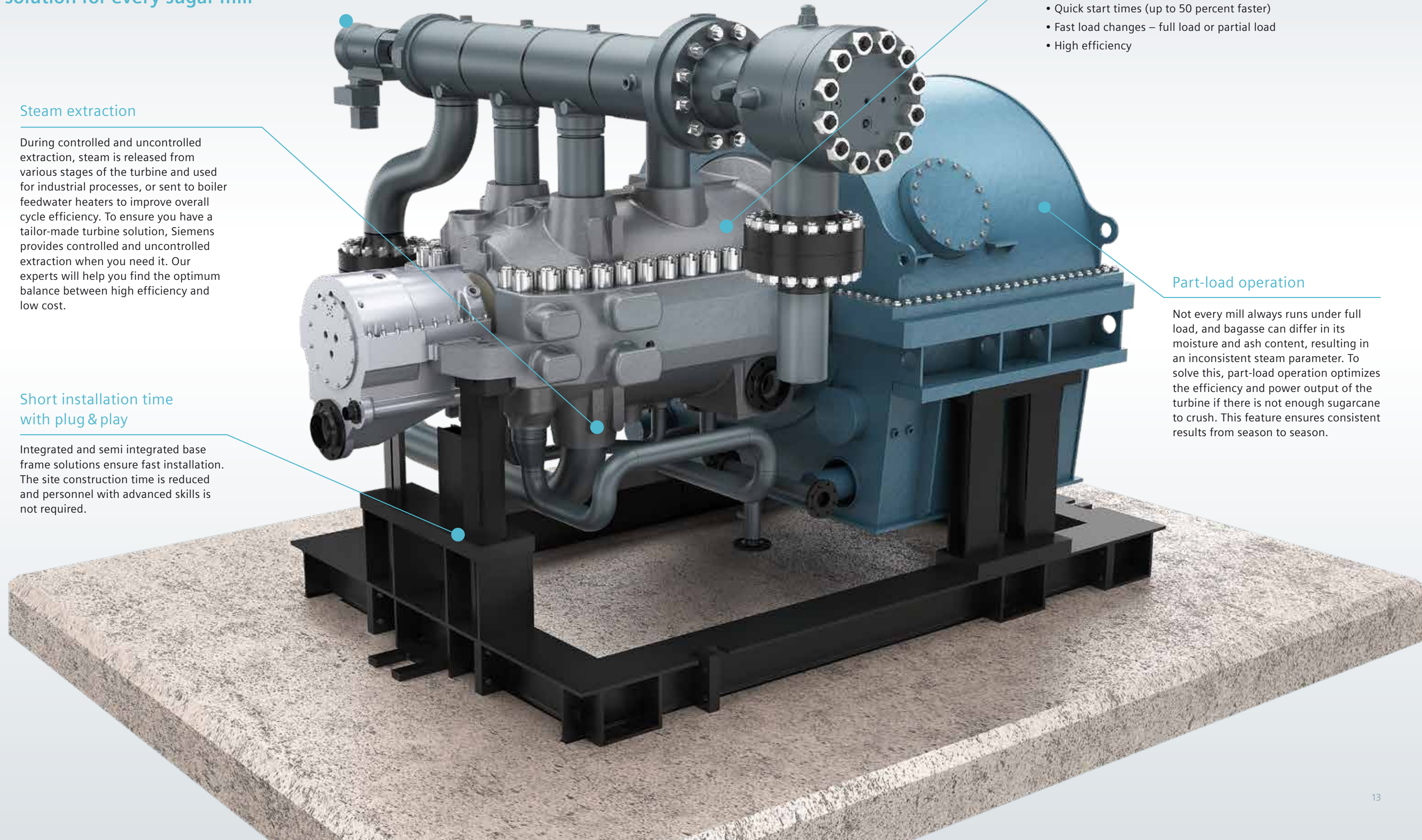
Homogeneous geometrical casing design

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.



Global expertise, local solutions

Our latest references at a glance

1. Sucrierie de Wonji Shoa, Ethiopia
2. Simbhaoli Sugar Ltd., India
3. Shivratna Udyog Pvt. Ltd., India
4. Shree Krishna Khandsari, India
5. Gammon India Ltd., India
6. NSL Sugar Ltd., India
7. Ponni Sugars, India
8. Mitr Phol, Thailand
9. Khanh Hoa (Cam Ranh), Vietnam

1



Becoming self-sufficient Sucrierie de Wonji Shoa Ethiopia

Year: 2013
Steam turbine: SST-300
Power output: 31.5 MW
Inlet steam pressure: 62 bar(a) / 899 psi
Inlet steam temperature: 515 °C / 959 °F

At Sucrierie 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.

2



Powering innovation Illovo Sugar South Africa

Year: 2015
Steam turbine: 3 x D-R RS
Power output: 2 x 1.8 MW / 1 x 2,6 MW
Two of the three delivered steam turbines are operated as shredder drives.

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 outgrowers 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.

3



Looking for a partner Shivratna Udyog Pvt. Ltd. India

Year: 2015
Steam turbine: SST-300
Power output: 12 MW
Speed: 8,300 rpm
Inlet steam pressure: 72 bar(a)
Inlet steam temperature: 510 °C / 950 °F
Exhaust steam pressure: 3 bar(a)
Capacity: 2,500 tcd

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.

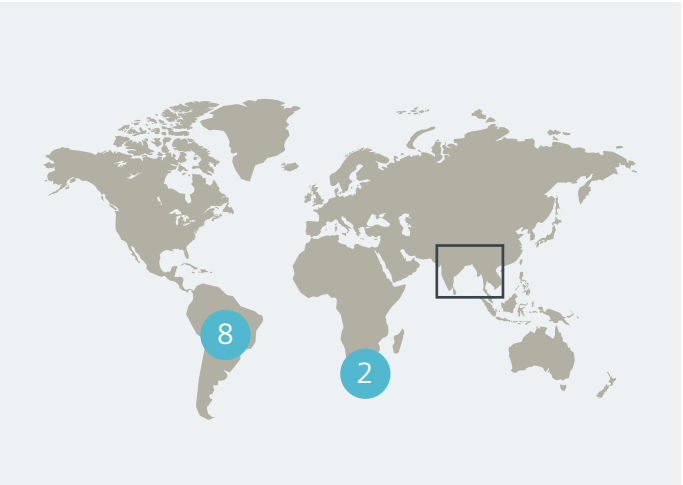
The SST-300 – a success story around the world

22.4 million*
operating hours

11,800 MW*
fleet experience in all regions

100*
SST-300s installed in sugar mills in
Southeast Asia, Africa, and Latin America

*as of 2015





4

Improving efficiency
Semboro Sugar Factory
Indonesia

Year: 2016
Steam turbine: SST-300 (back pressure)
Power output: 7 MW
Inlet steam: 18 bar(a)/325°C
Back pressure: 2.5 bar(a)
Capacity: 3,000 tcd

The Semboro Sugar Factory is located 35 km west of Jember, Indonesia and started production in 1921 with 2103 hectares of sugar cane fields.
"We are pleased to thank Siemens (...) for their exceptional efforts to complete our project 1×7 MW BP STG set at Semboro, Indonesia. The STG set is running well and we also recommend you to other customers for installation of such STG set," says Norman Arifin, Technical Manager Semboro Sugar Factory.



5

Upping the power
Gammon India Ltd A/c.
Pravara Renewable
Energy Ltd.
India

Year: 2012
Steam turbine: SST-300
Power output: 30 MW
Speed: 6,800 rpm
Inlet steam pressure: 107 bar(a)
Inlet steam temperature: 535 °C/995 °F
Exhaust steam pressure: 0.11 bar(a)
Capacity: 5,000 tcd

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.



6

There on time
NSL Sugar Ltd.
India

Year: 2010
Steam turbine: SST-300
Power output: 35 MW
Speed: 6,800 rpm
Inlet steam pressure: 106 bar(a)
Inlet steam temperature: 535 °C/995 °F
Exhaust steam pressure: 0.1 bar(a)
Capacity: 7,500 tcd

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."



7

Fuelling world firsts
Ponni Sugars
India

Year: 2010
Steam turbine: SST-300
Power output: 19 MW
Speed: 6,800 rpm
Inlet steam pressure: 111 bar(a)
Inlet steam temperature: 520 °C/968 °F
Exhaust steam pressure: 0.1 bar(a)
Capacity: 2,500 tcd

This sugar mill has a special place in history: it was the first to successfully produce newsprint from sugarcane bagasse. It continues to pioneer firsts in the industry, such as using alternative fuel in its boilers. In 2010, the plant chose Siemens to deliver an SST-300 turbine, which today generates 19 MW of power – enough to keep the innovations coming.



8

Biggest steam turbine on the sugar market
Grupo Delta Sucroenergia
Brazil

Year: 2016
Steam turbine: SST-600
Power output: 73.5 MW
Inlet steam pressure: 67 bar(a)
Inlet steam temperature: 520°C

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.



9

Future-proof production
Khanh Hoa (Cam Ranh)
Vietnam

Year: 1999
Steam turbine: SST-300
Power output: 25 MW
Speed: 7,161 rpm
Inlet steam press.: ≤ 46 bar(a)/667 psi
Inlet steam temp.: ≤ 450 °C/842 °F
Exhaust pressure: 2.5 bar(a)/36.3 psi
Capacity: 3,000 tcd

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.



“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”

Arnut Yospanya, Managing Director – Bio Power Business, Mitr Phol Group.

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.

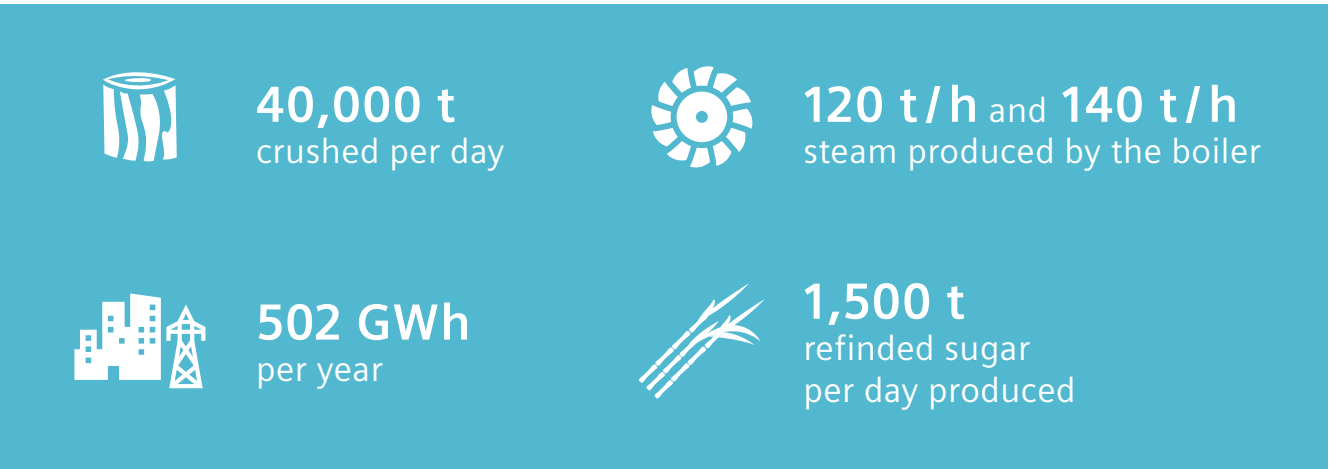
Mitr Phol has signed an agreement with the Electricity Generating Authority of Thailand (EGAT) to sell its excess power. To consistently produce electricity, they need reliable and high-performance steam turbines and generators.

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.

Key facts Phu Khieo I and II



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-300 (backpressure): 18 MW (2015)
- SST-400 (backpressure): 27 MW (2015)
- SST-400: 30 MW (2017)
- SST-300 (backpressure): 26 MW (2017)

