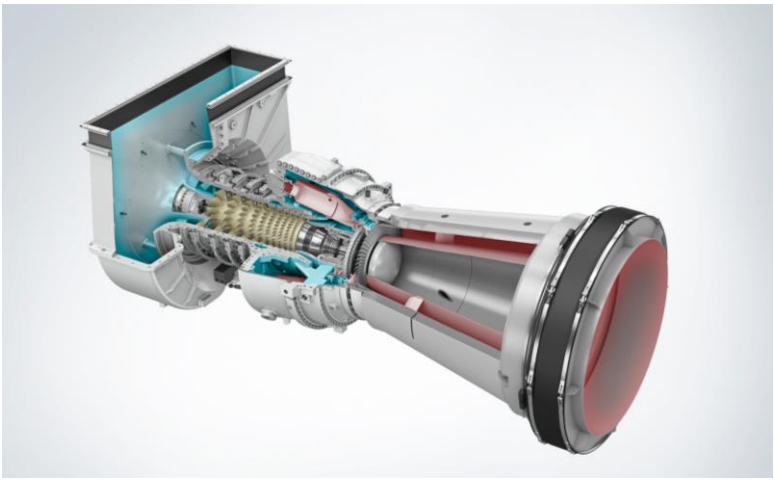
Siemens Energy SGT-100

Light Industrial Engines
February 2021



Courtesy of Siemens Energy

Quick Specs (power generation):

Power Class:	5.05 – 5.4 MW(e)
Thermal Efficiency:	30.2 – 31%
Heat rate (@ISO):	11,914 kJ/kWh - 11,613 kJ/kWh

Program Briefing

The SGT-100 (previously known as the Typhoon) is a single- or twin-shaft light industrial gas turbine suitable for industrial power generation, particularly in cogeneration or combined heat and power applications or mechanical drive.

The generator set package is compact, providing a small footprint and a high power-to-weight ratio. The single-shaft configuration provides excellent load acceptance and rejection characteristics. In mechanical drive applications, the SGT-100 is employed on offshore platforms and Floating Production Storage and Offloading (FPSO) vessels. In addition, it has Lloyd's certification for marine propulsion for FPSOs.

The SGT-100 competes engines such as the General Electric NovaLT5, Solar Taurus, and the company's own aeroderivative Industrial 501-K (was R-R).

Siemens reports that more than 420 units have been sold with approximately 25 million hours of operating time with 99% overall fleet reliability. The lead package has tallied more than 180,000 hours.

We predict the production of 145 of the gas turbines over the next ten years, valued at $406 million.

Manufacturer

Siemens Energy AG
Otto-Hahn-Ring 6
81739 Munich, Germany
Tel: +49 (89) 630 00
website: www.siemens-energy.com

Technical Description

Components

Intake

Variable inlet guide vane and stators.

Compressor

10-stage axial flow transonic compressor. Pressure ratio of 15.6:1 for power generation and 14.9:1 for mechanical drive.

Combustor

Six reverse-flow tubular combustion chambers. Conventional combustion system option with two retractable high energy igniters and

Summary Forecast

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Units Produced	16	16	15	15	15	14	14	14	13	13	145
Value (2021 $ Millions)	44.8	44.8	42.0	42.0	42.0	39.2	39.2	39.2	36.4	36.4	406.0

cross lighting between chambers. Dry Low Emissions (DLE) system option with a single high energy ignitor in each chamber. There is a steam Injection option for power augmentation. Fuel containing up to 100 percent hydrogen can be used with a diffusion burner.

Turbine

Two-stage overhung transonic turbine. The first stage is air-cooled. There are axial and radial exhaust system options.

For mechanical drive applications, the twin-shaft design has a single compressor turbine stage and a two-stage free power turbine.

Fuel System

Dual fuel capability: natural gas or liquid fuel (other fuels capability on request). Automatic changeover from primary to secondary fuel at any load.

Specifications

Electric Power Generation

	5.1 MW SGT-100	*5.4 MW SGT-100*
Power output:	5.1 MW(e)	5.4 MW(e)
Frequency:	50/60 Hz	50/60 Hz
Gross efficiency:	30.2%	31%
Heat rate:	11,914 kJ/kWh	11,613 kJ/kWh
Turbine speed:	17,384 rpm	17,384 rpm
Pressure ratio:	14:1	15.6:1
Exhaust flow:	19.5 kg/s	20.6 kg/s
Exhaust temperature:	545°C (1,013°F)	531°C (988°F)
NOx Emissions:	≤ 15 ppmvd	≤ 15 ppmvd

Package dimensions (both versions)

Approximate weight:	61,325 kg (135,198 lb)
Length:	11 m (39.1 ft)
Width:	2.9 m (9.4 ft)
Height:	3.6 m (11.8 ft)

Mechanical Drive

	SGT-100	*Package dimensions*	
Power output:	5.7 MW	Approximate weight:	47,227 kg (104,117 lb)
Gross efficiency:	33.2%	Length:	6.1 m (20 ft)
Heat rate:	10,832 kJ/kWh	Width:	2.9 m (9.4 ft)
Turbine speed:	6,500 - 13,000 rpm	Height:	3.6 m (11.0 ft)
Pressure ratio:	14.9:1		
Exhaust flow:	19.7 kg/s		
Exhaust temperature:	543°C (1,009°F)		
NOx Emissions:	≤ 25 ppmvd		

Note: Natural gas, liquid fuel, dual fuel; other fuels on request; automatic changeover from primary to secondary fuel at any load. NO_x emissions at 15% O_2 on fuel gas (with DLE).

Marketing Data

Costs

Our estimated retail value for the Siemens SGT-100 gas turbine alone is approximately $2.8 million.

Recent Sales

July 2004—OXXO S.A. in Ecuador orders one 5.25-MW Typhoon gas turbine generating set to be used by Petrolindustrial Filial de Petro- Ecuador at the Libertad refinery. The turbine will operate on liquid fuel. Delivery of the unit to the site is scheduled for December 2004.

July 2004—Four Typhoon 4.922 MW (6,600 bhp) gas-turbine-driven pump sets will upgrade an existing crude oil pipeline in the Middle East. They were scheduled for delivery by May 2005.

January 2005—Siemens Power Generation received an order from Engineering form the Petroleum Process Industry (ENPPI) in Egypt for a 4.7-MW SGT-100 genset. The machine is to be installed at a facility operated by Burullus Gas Co. and will provide electrical power for the Sapphire field onshore processing terminal, 50 km east of Alexandria.

March 2006—MOL Natural Gas Storage of Budapest, Hungary, ordered three compressor trains, each comprising a two-shaft SGT-100 and a direct-driven compressor. Equipment delivery autumn 2006.

January 2017—As part of a large order for 12 compressor trains to be operated at the Mohr C2+ hydrocarbon recovery plant in Iran, four of the compressor trains will be driven by SGT-100 gas turbines.

May 2020—Turkmengaz, Turkmenistan's national gas company, ordered an unspecified number of SGT-100 and SGT-300 turbines for mobile compressor stations to modernize its Lebapgazçykaryş natural gas processing facility located in eastern Turkmenistan.

Program Overview

Background

Initial Development

Ruston Gas Turbines Ltd. in the United Kingdom announced the initial details about the development of a pair new-generation gas turbines—the RH (later renamed Hurricane) and the RM (later the Typhoon)—in May 1989. They would be in the 1.5-2 MW and 3.5-4.5 MW classes, respectively. Design goals were to produce compact, lightweight machines with higher efficiency and lower operating costs.

By early 1989, three Typhoons were under test. In the middle of 1990, the fist machines entered service in the UK and Spain.

More than 230 Typhoons had been put into operation by early 1999, with more than four million operating hours having been accumulated. By the summer of that year, it was announced that more than 260 units had been sold.

From Alstom to Siemens

In the spring of 2000, Alstom acquired full ownership of the Typhoon program. After three years, Alstom sold its small and medium-sized gas turbine, and industrial steam turbine businesses to Siemens. Along with the deal went the Typhoon. In November 2004, Siemens announced that it had completed the integration of its new gas turbine business (Demag Delaval and Westinghouse units had also been acquired) into its own. Subsequent to this, the company announced that it was unifying its product nomenclature whereby the Typhoon became the SGT-100. Packaged engines are designated SGT-PAC 100.

MRO

Services

Siemens offers a comprehensive services program including Long Term Programs (LTP), overhaul service, field service, spare parts, service exchange, remote diagnostic service, and modernization and upgrades.

Axial Blade Attachment

The first stage rotor blades can be axially removed for quick and easy in-situ changeout, maximizing availability.

Easy Combustor Maintenance

Combustion pressure casings split for easy access to the combustion hardware.

Wood Group Expansion

In August 2013, Wood Group expanded its gas turbine service to maintain, repair and overhaul SGT 100 (Typhoon) gas turbines, among others. Wood Group added new test capability at its Aberdeen facility, featuring control systems that enable the turbines to be tested at full operating load.

Current Developments

Biodiesel Tests

In 2010 it was reported in the Journal of Engineering for Gas Turbines and Power, that atmospheric and high-pressure rig tests were conducted by Siemens to investigate the feasibility of using biodiesel as an alternative fuel to power industrial gas turbines in the SGT-100.

At the same conditions, tests were also carried out for mineral diesel to provide reference information to evaluate biodiesel as an alternative fuel. In atmospheric pressure rig tests, the likelihood of the machine lighting was identified based on the measured probability of the ignition of a single combustor. Lean ignition and extinction limits at various air temperatures were also investigated with different air assist pressures.

The ignition test results reveal that reliable ignition can be achieved with biodiesel across a range of air mass flow rates and air fuel ratios (AFRs). In high pressure rig tests, emissions and combustion dynamics were measured for various combustor air inlet pressures, temperatures, combustor wall pressure drops, and flame temperatures.

These high-pressure rig results show that biodiesel produced less NOx than mineral diesel. The test results indicated that the Siemens DLE combustion system could be adapted to use biodiesel as an alternative fuel without major modification.

Siemens Energy Formed

In June 2020, Siemens AG spun off its Oil and Power business and combined it with Siemens Gamesa Renewable Energy to form a new company, Siemens Energy AG. Initially Siemens AG has 34.1 percent of the shares in the company and the Siemens Employees Trust owns 9.9 percent, with the remaining 55 percent distributed to existing Siemens shareholders. Share began trading in Germany on September 28, 2020.

Program Status

Siemens reports that more than 420 units have been sold with approximately 25 million hours of operating time. The lead package has tallied more than 120,000 hours.

Recent information on the Siemens Energy website upped these figures to over 800 units, 38 million hours with the lead package at 180,000 hours. We believe these new figures include the now discontinued SGT-200.

Teal Group Evaluation

We expect to see a small bump up in production in 2021/2022 as demand recovers from Covid-19 related disruptions. For the longer term, however, we expect a slow decline in demand. Somewhere along the line we could see either the SGT-100 or SGT-A05 being discontinued as they both occupy similar power bands. For now, we are assuming both stay in production through our forecast period given their differences in markets and applications. With that in mind, we are expecting production of 145 SGT-100 gas turbines over the next 10 years, valued at approximately $406 million.

Production Forecast

Units	Through 2020*	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Power Generation												
SGT-100/Typhoon	359	15	15	14	14	14	13	13	13	12	12	494
Mechanical Drive												
SGT-100/Typhoon	89	1	1	1	1	1	1	1	1	1	1	99
Total	**448**	**16**	**16**	**15**	**15**	**15**	**14**	**14**	**14**	**13**	**13**	**593**

**estimated total and breakdown*

Value (2021 $Millions)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Power Generation											
SGT-100	42.0	42.0	39.2	39.2	39.2	36.4	36.4	36.4	33.6	33.6	378.0
Mechanical Drive											
SGT-100	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	28.0
Total	**44.8**	**44.8**	**42.0**	**42.0**	**42.0**	**39.2**	**39.2**	**39.2**	**36.4**	**36.4**	**406.0**