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High efficiency, low emissions, fast start-up capability

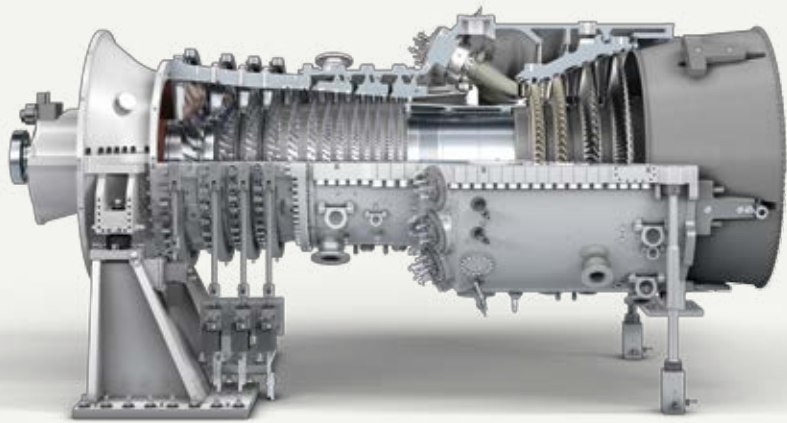
# SGT-8000H gas turbine series – proven in commercial operations

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## SGT-8000H turbine series: Proven, efficient, reliable

The proven Siemens SGT-8000H series is a gas turbine model of top performance and efficiency. Short start-up times, high operational flexibility, and simple plant integration make it the gas turbine of choice for state-of-the-art combined cycle plants. In the Lausward power plant in Düsseldorf, Germany, the SGT5-8000H demonstrated a world record combined cycle efficiency of around 61.5 percent.



SGT5-8000H



SGT6-8000H

## Technical data

### SGT5-8000H gas turbine

Frequency	50 Hz
ISO base power output	400 MW
Efficiency	40%
Exhaust mass flow	869 kg/s / 1,915 lb/s
Exhaust temperature	627 °C / 1,161 °F

#### Physical dimensions

Weight	445 t
Length x Height x Width	12.6 m x 5.5 m x 5.5 m 41 ft x 18 ft x 18 ft

#### Combined cycle plant (single-shaft, 1S)

Net power output	600 MW
Net efficiency	> 60%

#### Combined cycle plant (multi-shaft, 2 x 1)

Net power output	1,200 MW
Net efficiency	> 60%

### SGT6-8000H gas turbine

Frequency	60 Hz
ISO base power output	296 MW
Efficiency	40%
Exhaust mass flow	640 kg/s / 1,410 lb/s
Exhaust temperature	630 °C / 1,166 °F

#### Physical dimensions

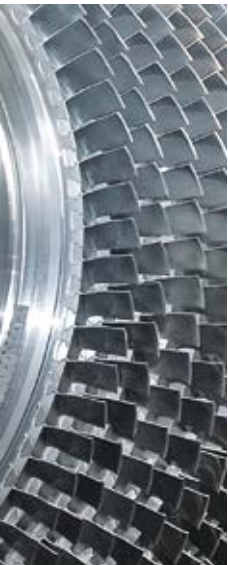
Weight	289 t
Length x Height x Width	10.5 m x 4.3 m x 4.3 m 34 ft x 14 ft x 14 ft

#### Combined cycle plant (single-shaft, 1S)

Net power output	440 MW
Net efficiency	> 60%

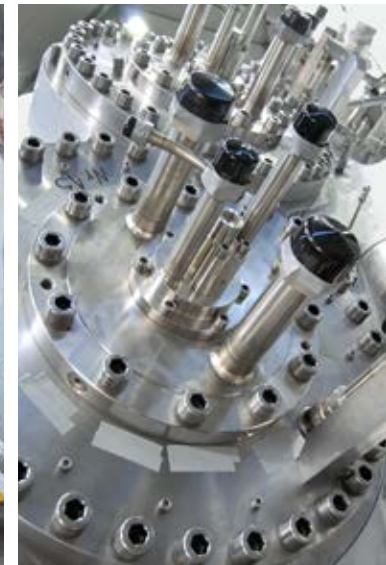
#### Combined cycle plant (multi-shaft, 2 x 1)

Net power output	880 MW
Net efficiency	> 60%



## The Siemens H-class: Proven design, high efficiency

The SGT-8000H design concept is mainly based on proven features of predecessor gas turbines, and was validated by a thorough test program at the Siemens testing facility, as well as an intense prototype testing in the Irsching power plant. In April 2016, 22 Siemens H-class gas turbines were installed worldwide, cumulating a fleet experience of more than 200,000 fired hours.



### Features

- |                 |   |
|-----------------|---|
| • Start time    | Base load within 30min for hot start (combined cycle)   |
| • Low emissions | NO <sub>x</sub> ≤ 25 ppm at 15% O <sub>2</sub> on fuel gas<br>CO ≤ 10 ppm at 15% O <sub>2</sub> on fuel gas |
| • GT design     | Full on-board air cooling   |
| • Maintenance   | Optimized design for short outages  |

### Benefits

- High efficiency (40% SC, > 60% CC)
- Fast start-up capability, high operational flexibility
- Low lifecycle costs
- High reliability and availability
- High serviceability
- Reduced emissions per kWh
- High efficiency and low emission also in part-load operation

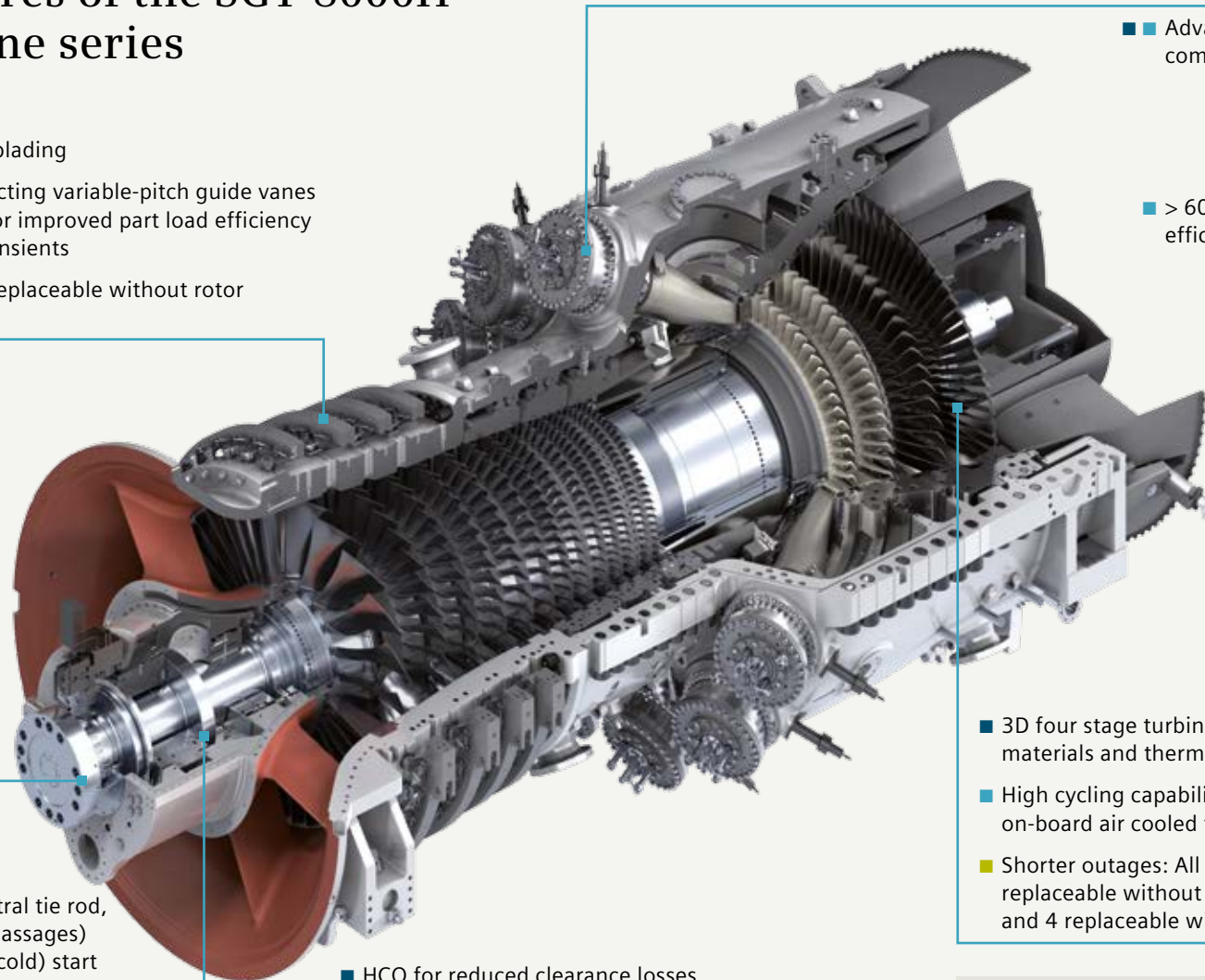
### Outstanding reliability

The SGT-8000H gas turbine series offers outstanding performance and highest flexibility at minimized risk. The rotor design is based on individual discs, spanned to a stiff rotor by a central tie rod. Internal cooling air passages from compressor to turbine section ensure fast thermal response of the rotor in case of high load transients and fast cold starts.

Moderate firing temperatures allow the use of proven materials and provide for high reliability, low maintenance, and excellent availability. The blades and vanes of the SGT-8000H series are based on an evolutionary design approach, combining high efficiency with low outage risk. Hydraulic Clearance Optimization (HCO) reduces clearance losses to increase the gas turbine efficiency. The simple, fail-safe technology is validated for more than 10 years and provides high performance and high operational flexibility at low degradation.

# Key features of the SGT-8000H gas turbine series

- Evolutionary 3D blading
- 4 stages of fast acting variable-pitch guide vanes (VGV) allowing for improved part load efficiency and high load transients
- Rotating blades replaceable without rotor destack or lift



- ■ Advanced can annular combustion system

- ■ > 60% combined cycle efficiency

- Proven rotor design (Hirth serration, central tie rod, internal cooling air passages) for world class fast (cold) start and hot restart capability
- Easy rotor destacking on site: Disc assembly with Hirth serration and central tie rod

- HCO for reduced clearance losses
- Transient protection of clearances for reduced degradation with hydraulic clearance optimization (HCO) active clearance control

- 3D four stage turbine with advanced materials and thermal barrier coating
- High cycling capability due to on-board air cooled turbine section
- Shorter outages: All turbine vanes and blades replaceable without rotor lift; vane 1, blade 1 and 4 replaceable without cover lift

- Performance
- Serviceability
- Flexibility



## Efficient and flexible plant technology

Siemens offers a flexible scope of supply, varying from gas turbine package to extended power train, power island, power block, up to complete turnkey power plants, allowing best fit to customer requirements. All solutions provide optimal balance between capital costs, performance, and operational considerations.



### Single-shaft power plants

The main components of the single-shaft (1S) combined cycle power plant are arranged on one shaft, with a synchronous self-shifting (SSS) clutch between the generator and the steam turbine. This enables a compact footprint and provides high operating flexibility and reliability. The single-shaft plants can also be applied for CHP applications. Despite the space-saving footprint with floor-mounted turbine generator train, it is possible to provide up to a three stage extraction for district heating or process steam.

### Multi-shaft power plants

The SGT-8000H multi-shaft combined cycle power plants can be based on one or two H-class gas turbine packages. The multi-shaft plants are available as Flex-Plant series for optimized operational flexibility.

- SCC6-8000H 1 x 1:  
440 MW, > 60% efficiency
- SCC6-8000H 2 x 1:  
880 MW, > 60% efficiency
- SCC5-8000H 2 x 1:  
1200 MW, > 60% efficiency

### Flexible plant solutions

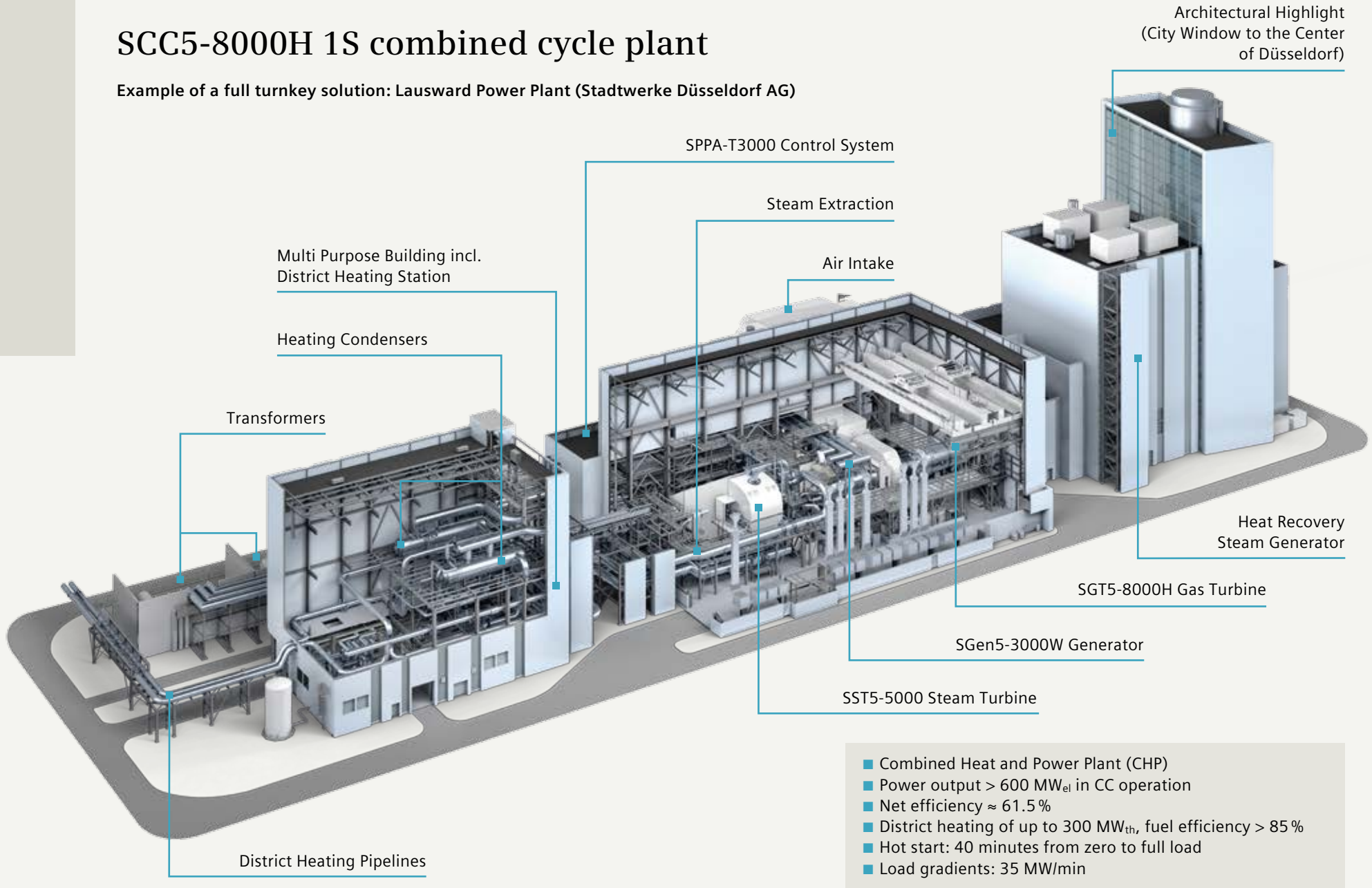
Integrating proven fast-start technology in a high-efficiency, three-pressure reheat combined cycle, Siemens plant technology allows full load in less than half the time required by traditional combined cycle plants. Shorter start-up times reduce the amount of fuel consumed during the start-up of fossil power plants. The gas and steam turbines start, stop, load and unload fast and with reliable predictability. With steam turbine start on the fly, the full combined cycles can be up and running in less than an hour. BENSON® boilers are applied for high steam parameters, high efficiency and outstanding flexibility.

Siemens fast-start technology improves the flexibility of SCC-8000H combined cycle plants:

- Fast start: Gas turbine ramp up to full load at full speed
- Fast load change, up and down: Combined cycle load follows the gas turbine ramp rate
- Expanded power output range: Plant can operate from part loaded simple cycle up to full load combined cycle
- High part load efficiency
- Significant fuel savings
- Low water consumption: Air cooled configurations available which scale footprint down and water usage low
- Low start-up emissions

# SCC5-8000H 1S combined cycle plant

Example of a full turnkey solution: Lausward Power Plant (Stadtwerke Düsseldorf AG)



- Combined Heat and Power Plant (CHP)
- Power output > 600 MW<sub>eI</sub> in CC operation
- Net efficiency ≈ 61.5 %
- District heating of up to 300 MW<sub>th</sub>, fuel efficiency > 85 %
- Hot start: 40 minutes from zero to full load
- Load gradients: 35 MW/min



## World-class service to improve plant performance and profitability

People working at Siemens are passionate about power plants. Their dedication is key to the excellent performance of the power plants we plan, build, service, operate and modernize.



### Outstanding maintainability

In times of widely fluctuating energy prices, market instability, and a highly competitive environment, Siemens remains a consistent and reliable partner. Highly qualified power plant engineers, technicians, and service specialists are at work all over the world keeping our technology running.

The SGT-8000H series is designed for outstanding serviceability. A number of tools and features, such as the combustor handling tool, are designed for efficient maintenance and reduced scheduled down time throughout the lifecycle. All blades are designed to be removable without rotor lift. To make inspection even more comfortable, stage 1 vane as well as stage 1 and 4 blade are removable without cover lift. Optimized outage times mean higher reliability and availability.

### Continuous improvements

Our customized performance enhancement programs help prepare power plants for tomorrow and beyond. Many options for power increase are available e.g. increasing the gas turbine's firing temperature or upgrading the power train including boiler, generator and steam turbine. This is to maximize the benefits of the plant investments. Siemens will continue to develop and implement complex new power plant technologies and solutions to define milestones in advanced technology.

### Every step matters

A service concept is the best way to plan ahead and to support your target achievement. Siemens provides programs to ensure highest power output as well as outstanding plant availability with state-of-the-art service solutions. We offer customized service options based on large service fleet experience including preventive maintenance, scheduled inspections, replacement-part programs, on-site support and much more.



# SGT-8000H gas turbine series: Projects on four continents

To date, Siemens has 78 H-class turbines under contract, with 22 units in commercial operation already. This adds up to a fleet experience of more than 200,000 fired hours globally.

Number of sold units (Status: April 2016)



# SGT-8000H reference examples

Proven performance and reliability



**Cengiz Enerji Samsun, Turkey**  
 SCC5-8000H 1S combined cycle plant  
 1 x SGT5-8000H for a power island installation



**Total power output** 583 MW net

**CC plant efficiency** ~61% net

- Start-up within 30–40 min
- Commercial operation 2 months prior to time schedule

**Düsseldorf, Germany**  
 SCC5-8000H 1S combined cycle plant



**Total power output** 595 MW net

**CC plant efficiency** > 61% net

- CHP plant, district heating 300 MW<sub>th</sub>
- 85% fuel efficiency
- > 61% net efficiency

**Cape Canaveral, FL, USA**  
 3 x SGT6-8000H gas turbines  
 3 x SGT6-8000H gas turbine packages for 3x1 plant



**GT power output** 3 x 274 MW net

**CC plant efficiency** > 60% net

- Commercial operations 5 weeks ahead of schedule
- High operational flexibility
- Short start-up times



**Dangjin 3, South Korea**  
 SCC6-8000H 1S combined cycle plant



**Total power output** 415 MW net

**CC plant efficiency** > 60% net

- First H-class plant for 60 Hz market
- Commercial operation 12 days ahead schedule
- Plant formerly known as Bugok 3

**Andong, South Korea**  
 SCC6-8000H 1S combined cycle plant



**Total power output** 415 MW net

**CC plant efficiency** > 60% net

- Designed for 250 starts per year
- Fast start capability: only 30 min for a hot start
- Fast track project: 24 months

**Ansan, South Korea**  
 SCC6-8000H 2x1 combined cycle plant



**Total power output** 834 MW net

**CC plant efficiency** > 60% net

- Construction period just 24 months
- CHP plant, more than 75% fuel utilization
- NO<sub>x</sub> emissions of 7 ppm, the lowest in Korea

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