A Culture of Flexibility

A course chartered more than a decade ago...

...a destination realized today.
Siemens has answers –
Four Sectors close to the customer

<table>
<thead>
<tr>
<th>Energy Divisions</th>
<th>Healthcare Divisions</th>
<th>Industry Divisions</th>
<th>Infrastructure &amp; Cities Divisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Power Generation</td>
<td>Imaging &amp; Therapy Systems</td>
<td>Industry Automation</td>
<td>Rail Systems</td>
</tr>
<tr>
<td>Wind Power</td>
<td>Clinical Products</td>
<td>Drive Technologies</td>
<td>Mobility and Logistics</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>Diagnostics</td>
<td>Customer Services</td>
<td>Low and Medium Voltage</td>
</tr>
<tr>
<td>Energy Service</td>
<td>Customer Solutions</td>
<td></td>
<td>Smart Grid</td>
</tr>
<tr>
<td>Power Transmission</td>
<td></td>
<td></td>
<td>Building Technologies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OSRAM 1)</td>
</tr>
</tbody>
</table>

1) In fiscal 2011, Siemens announced its intention to publicly list OSRAM and retain a minority stake as anchor shareholder in OSRAM AG for the long term. Confidential and Proprietary. All Rights Reserved.
Siemens Energy Sector – Organizational structure

Energy Sector
CEO Michael Suess

1) Member of the Managing Board of Siemens AG

1) © Siemens AG, 2013

Confidential and Proprietary. All Rights Reserved.
## Top performance in five Divisions

<table>
<thead>
<tr>
<th>Division</th>
<th>Highlight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Power Generation (E F)</td>
<td>World record 60.75% efficiency for combined cycle power plants</td>
</tr>
<tr>
<td>Wind Power (E W)</td>
<td>New performance dimensions 6 MW for wind turbines</td>
</tr>
<tr>
<td>Oil &amp; Gas (E O)</td>
<td>Deep-sea capable 36 kV seabed power distribution at depths of up to 3,000 m</td>
</tr>
<tr>
<td>Energy Service (E S)</td>
<td>Additional 200 MW through modernization in 2011</td>
</tr>
<tr>
<td>Power Transmission (E T)</td>
<td>World record 800 kV for direct current transmission</td>
</tr>
</tbody>
</table>
Siemens Energy Sector –
Strength through innovative power

Fossil Power

Wind Power

Oil & Gas

Transmission

Flexibility

Cost optimization
and higher efficiency

Secure and reliable
sub-sea grids

Flexible and efficient
Super Grids

© Siemens AG, 2013
Full Scale Validation -
A Proven Record of Maximizing Customer Value

Achievements

- Off-frequency capability
- Sub 9ppm NOx
- Performance & Design Verification
- TBC Validation thru On-line TBC Monitoring
- Fast Starts, Low CO Turndown, Inlet Heating and Icing Studies

Full-load engine testing
First fire April 4, 2009  
Synchronized to grid  June 12, 2009  
Reached Base Load on June 13, 2009

after <1 days of operation  
PAC July 03, 2009

First fire December 20, 2007  
Some site activities were still going on  
Start Testing January 28, 2008  
Synchronized to grid  March 07, 2008  
Reached Base Load on April 24, 2008  
after only 9 days of operation  
Test phase concluded August, 2009

Siemens  
Technology and Quality from the first day
**Industrial Gas Turbines**

State-of-the-art and innovative gas turbines to meet today’s and tomorrow’s energy needs

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Type</th>
<th>Power Output (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Hz or 60 Hz</td>
<td>SGT-100</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>SGT-200</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>SGT-300</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>SGT-400</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>SGT-500</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>SGT-600</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>SGT-700</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>SGT-750</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>SGT-800</td>
<td>47</td>
</tr>
</tbody>
</table>

| 50 Hz     | SGT5-2000E    | 168               |
|           | SGT5-4000F    | 292               |
|           | SGT5-8000H    | 375               |

| 60 Hz     | SGT6-2000E    | 113               |
|           | SGT6-5000F    | 208               |
|           | SGT6-8000H    | 274               |

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Industrial GTs – Steam Raising Capability

*drives CHP efficiency

Notes:
1. Steam values are indicative only. Actual values depend on site configuration.
2. Firing to 1562°F only. Higher firing is available.

- Unfired
- Fired

Steam (lbs/hr) [174 psi saturated]

Power (MWe)
# Steam Turbines – Product Portfolio

## Steam Turbines

<table>
<thead>
<tr>
<th>Type</th>
<th>Power Output (MWₑ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SST-010</td>
<td>0,1</td>
</tr>
<tr>
<td>SST-050</td>
<td>0,75</td>
</tr>
<tr>
<td>SST-060</td>
<td>6</td>
</tr>
<tr>
<td>SST-100</td>
<td>8,5</td>
</tr>
<tr>
<td>SST-110</td>
<td>7</td>
</tr>
<tr>
<td>SST-120</td>
<td>10</td>
</tr>
<tr>
<td>SST-150</td>
<td>20</td>
</tr>
<tr>
<td>SST-200</td>
<td>10</td>
</tr>
<tr>
<td>SST-300</td>
<td>50</td>
</tr>
<tr>
<td>SST-400</td>
<td>65</td>
</tr>
<tr>
<td>SST-500</td>
<td>100</td>
</tr>
<tr>
<td>SST-600</td>
<td>100</td>
</tr>
<tr>
<td>SST-700</td>
<td>175</td>
</tr>
<tr>
<td>SST-800</td>
<td>150</td>
</tr>
<tr>
<td>SST-900</td>
<td>250</td>
</tr>
</tbody>
</table>
# SGT-800

## Flexible operation (SCC-800 2 x1)

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Unfired</th>
<th>DF</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCC-800 1x1</td>
<td>66MW</td>
<td>86 MW</td>
</tr>
<tr>
<td>SCC-800 2x1</td>
<td>130MW</td>
<td>165MW</td>
</tr>
<tr>
<td>SCC-800 3x1</td>
<td>195MW</td>
<td>255MW</td>
</tr>
</tbody>
</table>

### Performance

<table>
<thead>
<tr>
<th>Load</th>
<th>Gas Turbine (kWe)</th>
<th>Steam Turbine (kWe)</th>
<th>Auxiliaries (kWe)</th>
<th>Net total (kWe)</th>
<th>H.R LHV (BTU/kWh)</th>
<th>El. Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1GT 50% Load</td>
<td>22 795</td>
<td>14 030</td>
<td>-1 800</td>
<td>35 027</td>
<td>7 731</td>
<td>44.13</td>
</tr>
<tr>
<td>2GT 75% Load</td>
<td>68 385</td>
<td>36 219</td>
<td>-2 100</td>
<td>102 504</td>
<td>6 736</td>
<td>50.65</td>
</tr>
<tr>
<td>Full GT Load</td>
<td>91 180</td>
<td>76 310</td>
<td>-3 000</td>
<td>164 846</td>
<td>6 978</td>
<td>48.90</td>
</tr>
</tbody>
</table>

- Output: 50 MWe
- Electr. efficiency: 37.5%
- Exhaust Flow: 289.9 lb/s
- Exhaust T: 1,011 F

(© Siemens AG, 2013)
### Utility Scale Gas Turbines

State-of-the-art and innovative gas turbines to meet today’s and tomorrow’s energy needs.

<table>
<thead>
<tr>
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<th>Type</th>
<th>Power Output (MW)</th>
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<td>7</td>
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<td></td>
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<td>292</td>
</tr>
<tr>
<td></td>
<td>SGT5-8000H</td>
<td>375</td>
</tr>
<tr>
<td>60 Hz</td>
<td>SGT6-2000E</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>SGT6-5000F</td>
<td>208</td>
</tr>
<tr>
<td></td>
<td>SGT6-8000H</td>
<td>274</td>
</tr>
</tbody>
</table>

© Siemens AG, 2013
### SGT6-2000E Gas Turbine

- **Fuel**: Natural Gas, Fuel oil / Crude oil
- **GT output SC net**: 112 MW
- **GT efficiency**: >34%
- **Heat Rate**: 10,606 KJ/kWh, 10,052 Btu/kWh
- **Pressure ratio**: 11.8 : 1
- **Emissions**: NOx 9–25 ppm, CO <10 ppm
- **Exhaust Temperature**: 543°C/1009°F
- **Exhaust Mass Flow**: 368 kg/sec (813 lb/sec)
- **Turn down**: 50%

*Conditions are at ISO on Natural Gas, 25ppm Configuration*

Proven, Robust, High-performing
## SCC6–2000E Combined Cycle Power Plant

### Siemens Combined Cycle

<table>
<thead>
<tr>
<th>Multi-Shaft 1x1</th>
<th>SCC6-2000E 1x1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Output (MW)</td>
<td>171</td>
</tr>
<tr>
<td>Net efficiency (%)</td>
<td>51.3</td>
</tr>
<tr>
<td>Net heat rate (KJ/kWh)</td>
<td>7,007</td>
</tr>
<tr>
<td>Net heat rate (Btu/kWh)</td>
<td>6,642</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multi-Shaft 2x1</th>
<th>SCC6-2000E 2x1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Output (MW)</td>
<td>342</td>
</tr>
<tr>
<td>Net efficiency (%)</td>
<td>51.6</td>
</tr>
<tr>
<td>Net heat rate (KJ/kWh)</td>
<td>6,971</td>
</tr>
<tr>
<td>Net heat rate (Btu/kWh)</td>
<td>6,608</td>
</tr>
</tbody>
</table>

*Conditions are at ISO on Natural Gas

*SPA Cogen III, California, 1x1 SGT6-2000E

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Siemens SGT6-5000F Gas Turbine

Product Development Focus

- **Tested and Proven**
  - Berlin Test Facility Since 2002
  - Field tested in service units
  - Combustion Tests

- **Flexible Operation**
  (emissions turndown, start up times, ramp rates)

- **High RAM**
  (Extended parts lives, continuous improvements)

- **Low Environmental Impact**
  (sub 9ppm emissions, reduced start-up emissions)

- **High Performance Across the Operating Range**
  (Shaping power, base and part load performance)
SGT6-5000F Development
Performance Comparison (2x1 CC @ iso)

2x1 CC plant with enhanced F(5) GT can generate over 660MW power output across ambient range from cold day up to 90 F day, without duct firing or other forms of power augmentation, while maintaining better plant efficiency.
SGT6-5000F
What about Elevation?

![Graph showing the relationship between Inlet T [F] and Output MW for F(4) ISO and F(5)ee ISO. The graph shows a downward trend as Inlet T increases.]
SGT6-5000F
What about Elevation?

![Graph showing output (MW) vs. inlet temperature (°F) for different conditions: F(5)ee ISO, F(5)ee 1500 FAS, F(4) ISO.](image)
What about Elevation?

- F(5)ee ISO
- F(5)ee 1500 FAS
- F(4) ISO
- F(4) 1500 FAS

Output, MW vs Inlet T, [F]
SGT6-5000F
What about Elevation?

Output, MW vs. Inlet T, [F]

- F(5)ee 1500 FAS
- F(4) 1500 FAS
What about Elevation?

![Graph showing the relationship between Output, MW and Inlet T, [F] for different scenarios.](image)

**Output, MW**
- F(5)ee ISO
- F(4) ISO
- F(5)ee Cheyenne
- F(4) Cheyenne

**Inlet T, [F]**
- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100

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Plant Options for the SGT6-5000F
Flex-Plant™ 10

The Flex-Plant 10 is the optimum solution for high to intermediate cycling applications.

A small footprint with a lot of flexibility

High MW quickly and reliably – 150MW in 10 min

• Higher efficiency than a simple cycle plant
• Quick start keeps CO emissions low and starting efficiency high
• Ability to use standard SCR Technology to offer low emissions in any operating mode
• Uses much less water than conventional solutions

A great option to partner with renewables.
SGT6-8000H is a Scale of the SGT5-8000H

Harmonized design features allows validation experience to be transferred from 50 to 60 hz products.

**SGT5-8000H**

- **Fuel**: Nat. gas / fuel oil
- **GT output**: 274 MW (375 MW)
- **CC output<sub>net</sub>**: 410 MW (578 MW)
- **GT efficiency**: > 40%
- **CC efficiency<sub>net</sub>**: 60.75%
- **Pressure ratio**: 19.7 : 1
- **Emissions**: NO<sub>x</sub> 9 ppm, CO <10 ppm
- **Exhaust temperature**: 1150 F
- **Turn down**: <50%
- **HRSG/WS-Cycle**: 1100 F / 2470 psia

**SGT6-8000H**

* 12 combustor cans instead of 16
Plant Options for the SGT6-5000F/8000H
SCC6-5000F/8000H 1x1, 2x1, 3x1 Flex-Plant™ 30

Highly flexible fully integrated high efficiency combined cycle

2x1 Flex-Plant™ 30 Features
- 700+ / 825+ MW output
- > 57% / >60% efficiency
- Steam Turbine Start on the Fly 40 minute plant startup
- 300 MW in 10 minutes
- Clean-Ramp™ emissions compliant load following at 75 MW/min
- Low start-up emissions
- Low start-up fuel consumption

Flex-Plant 30

SCC6-5000F - Shown
SCC-8000H - Available

Low Capacity Factor Peaking Duty
Highly Flexible Intermediate Duty
High Efficiency Combined Cycle
Flexible Power Plant Solutions
Continued Success in an Uncertain Market

Key Flex Plant™30 Product Advancements

Recent US Award Highlights:

• PacifiCorp – Lakeside II, 2X1 SCC6-5000F(4) Flex-Plant™ Thermal Island: (CH2MHiIl)
• LS Power – West Deptford, 2XSGT6-5000F(5): (CH2MHiIl)
• LG&E - Cane Run, 2XSGT6-5000F(5)ee, 1XSST-5000: (B&V)
• Panda – Temple I, 2X1 SCC6-5000F(5) Flex-Plant™30 Power Island: (Bechtel)
• Panda – Temple II, 2X1 SCC6-5000F(5) Flex-Plant™30 Power Island: (Bechtel)
• Panda – Sherman, 2X1 SCC6-5000F(5) Flex-Plant™30 Power Island: (Bechtel)
• FPL – Canaveral 3XSGT6-8000H, Equipment – FPL, EPC - Zachry
• FPL – Riviera , 3XSGT6-8000H, , Equipment – FPL, EPC – Zachry
• FPL – Everglades, 3XSGT6-8000H, 1XSST5000, Equipment – FPL, EPC - TBD
Proven Technology: Trans Bay 400MW HVDC Project; Stimulating gas projects, Mid-West Renewables Next?

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Trans Bay Cable Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Pittsburg, CA San Francisco, CA</td>
</tr>
<tr>
<td>Type of Plant</td>
<td>53-mile HVDC PLUS Submarine Cable</td>
</tr>
<tr>
<td>Delivery</td>
<td>400Mw’s in Downtown San Francisco</td>
</tr>
</tbody>
</table>

Marsh Landing
The Siemens SGT6-5000F Gas Turbine
Product update: Commercial Operation

Siemens GRE Project
SGT6-5000F(4) Demonstrations

- Fast Synchronization
- 10 Minute Start-up
- Base load performance
  - Output
  - Efficiency

Fast Sync features incorporated into the Flex-Plant™ Platform
Flexible Solutions
Flex-Plant™ 30: Development Update

Key Flex Plant™30 Product Advancements

Long Island Energy Center: 1x1 SGT6-5000F, CO 3\textsuperscript{rd} QTR 2009
- 100\% Bypass operation
- HRSG / Piping warm up strategy
- Integration of BFP, De-superheaters, Steam Turbine warm up
- Cycle Design
- CO/SCR Catalyst Start Up Efficiency and Emissions Stability
- Two stage kettle boiler
- Heavy Duct Firing (385 MMBTU)
Flexible Solutions
Flex-Plant™ 30: Development Update

Key Flex Plant™ 30 Product Advancements

Lakeside: 2x1 SGT6-5000F, CO 2nd QTR 2008
- 100% Bypass
- HRSG / Piping warm up strategy
- Integration of BFP, De-superheaters, Steam Turbine warm up
- Cycle Design
- Two stage kettle boiler
“This type of technology, where you have both an efficient operation but also a fast response, is a game-changer.” - Energy Commission Chair, Robert B. Weisenmiller

“This is the future for fast-start gas fired combined cycle power plants in the country.” Energy Commission Chair Robert. B. Weisenmiller at the opening ceremony for Lodi Energy Center

“It's a model of national operation flexibility and environmental effectiveness.” - President and CEO of California ISO, Steve Berberich

Thank you!