

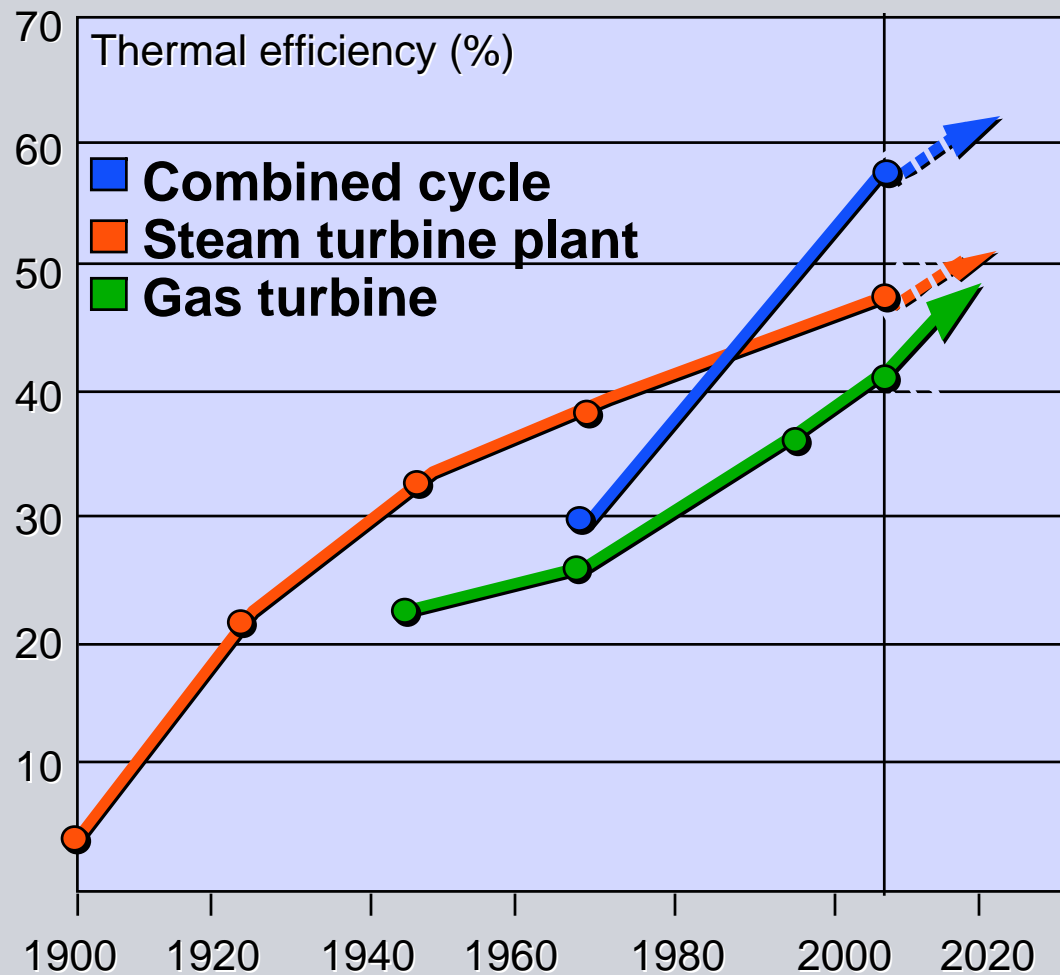


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Siemens Industrial Turbomachinery, Inc.

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Technology Trend in Favor of Cogeneration



Typical Industries Suitable for Cogeneration

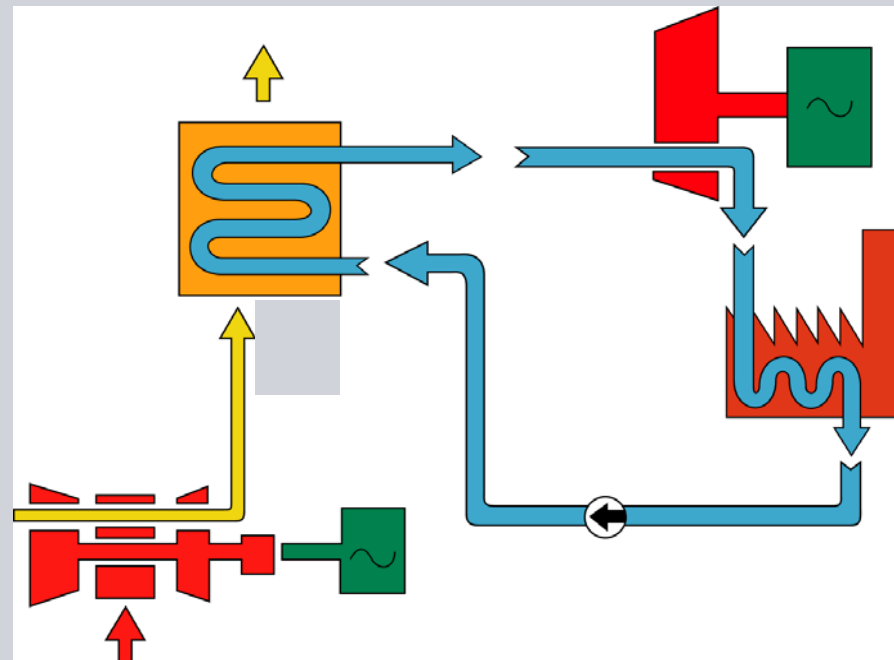
Cogeneration Solutions for

Industries

- Chemicals and Petrochemicals
- Pulp & paper
- Food & beverage
- Sugar
- Automotive
- Metalworking
- Mining
- Cement
- Wood processing
- Textiles

Power producers

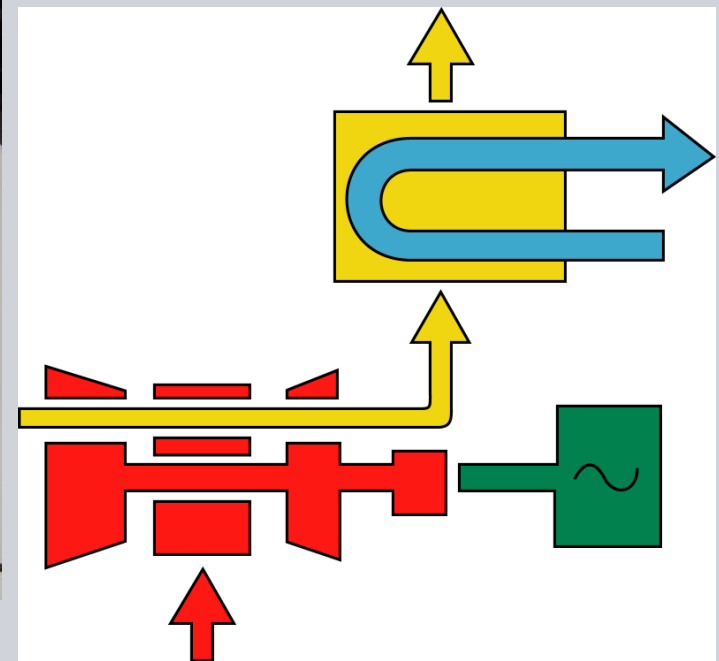
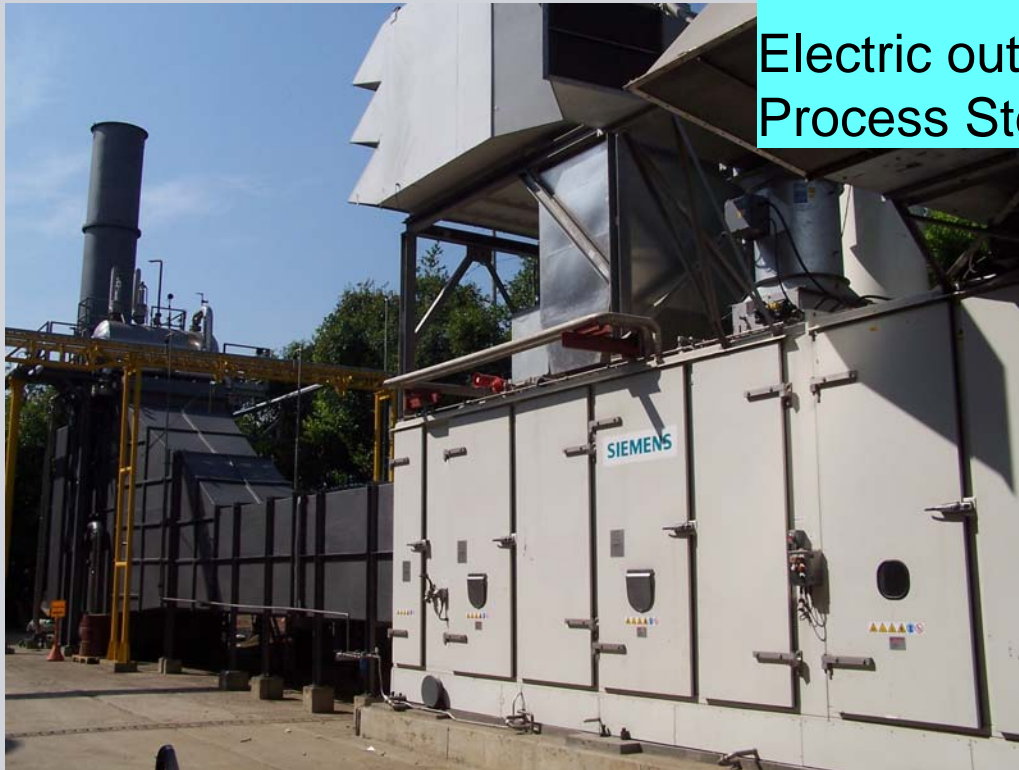
- Utilities
- IPP's
- Municipal CHP



Typical Industrial Cogeneration Plant

SIEMENS SGT-300 gas turbine with Heat Recovery Steam Generator, producing power and process steam for a Paper Mill

Electric output 7.9 MW
Process Steam 22t/h



Siemens Offering

- To meet the growth of 1500 MW of CHP in New Jersey, supporting different industries is key.
- Power requirements may range from < 1.0 MW to 100+ MW at sites.
- Siemens strives to supply full scope offerings with a broad range of Gas and Steam Turbine products to ensure an optimum efficient solution.
- Siemens has several operating companies located in New Jersey: SE&A, SBT, PTD.

***Siemens Solutions support
the New Jersey CHP Goal of 1500 MW***

Siemens Commitment to New Jersey

- To focus our Aftermarket activities, Siemens recently allocated \$12 MM to develop and expand our Trenton facility.
- Siemens views the Northeastern US as center of Power Gen and CHP activities for the United States.
- Trenton, as the headquarters for the Industrial Power Generation Service group in the US & Canada, has over 280 employees throughout the US and roughly \$150M turnover business.

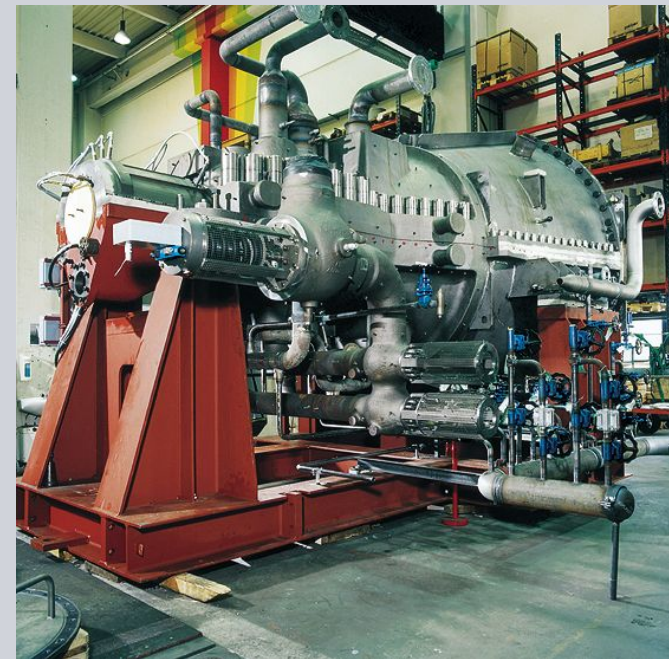


Siemens Local Support of New Jersey Economy

Steam Turbine Experience

Since 1998 in North America:

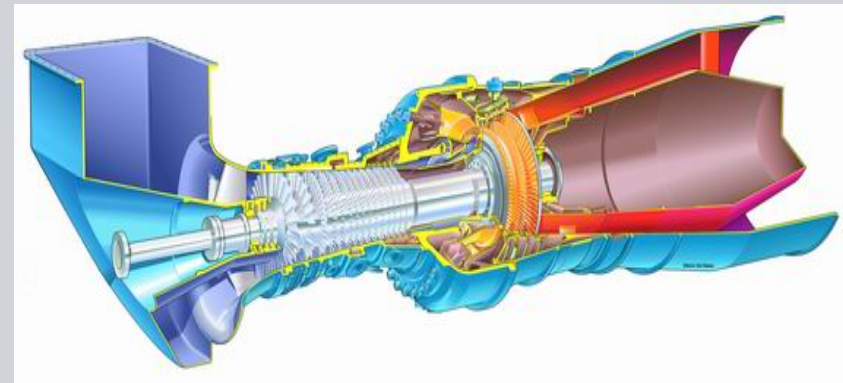
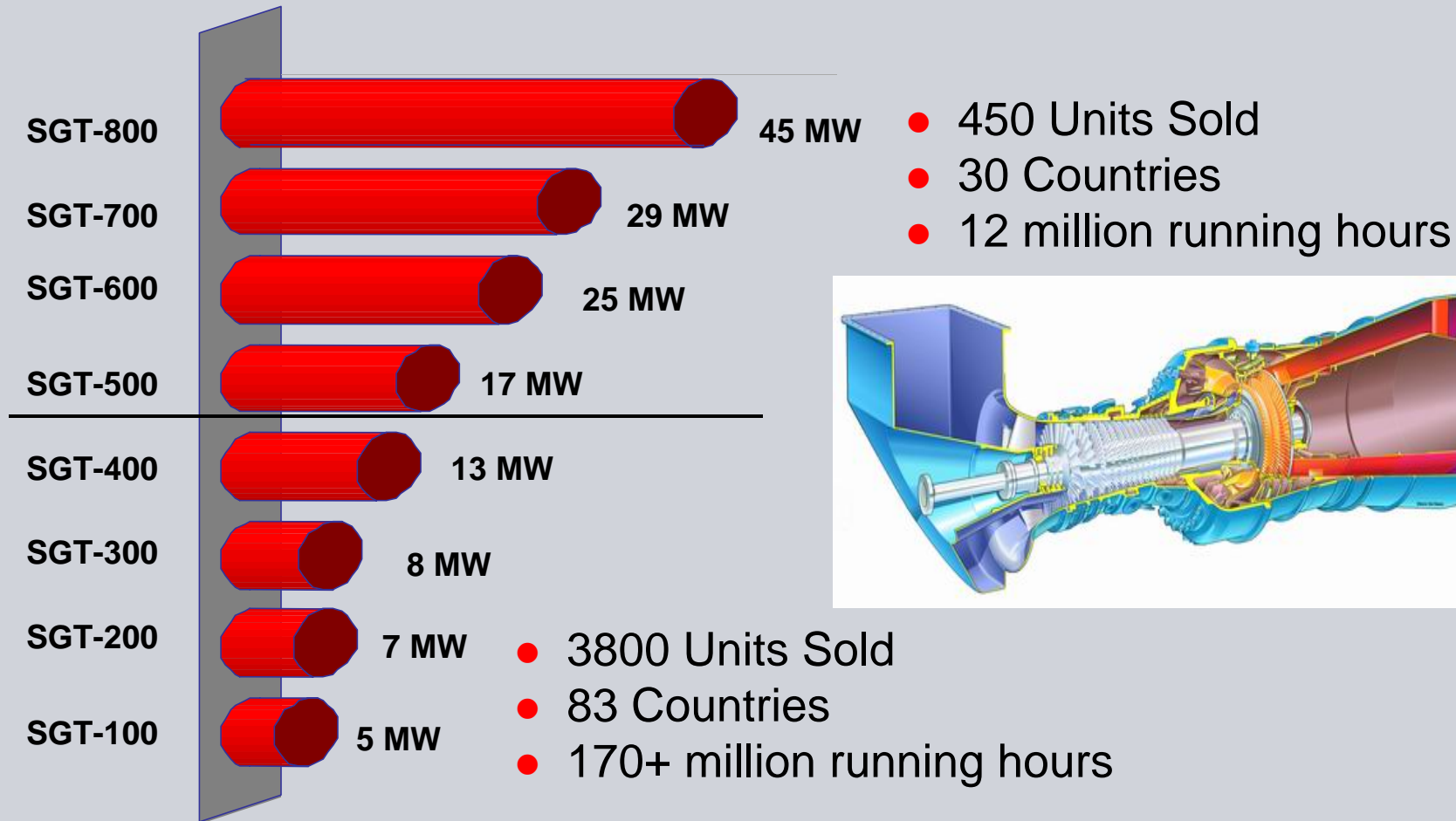
- 66 units ranging from 6.9 MW to 157 MW
- Total installed power of 4000 MW



Installed in:

- Industrial Applications
- IPP's
- Utilities

Industrial Gas Turbine Range



SGT 500 - 800 Manufactured and Packaged in Finspong, Sweden circa 1950

SGT 100 - 400 Manufactured In Lincoln, UK circa 1946, Packaged in Houston, TX circa 2001

Every industrial power plant has to be optimized for the end-user profile

SIEMENS



Utilities



Process Industry



Manufacturing Industry

Demand profiles include:

- Power and heat requirement
- Efficiency in part load, base load, peak load
- Total efficiency (power and heat)
- Peak load, min load operation (heat and power)
- Flexible relation of heat and power generation
- Load variations / load rejection
- Start-up time and power ramp-up
- Emissions (NO_x, CO₂, etc.)

Cogeneration Benefits

Reduced Energy Cost

Higher fuel utilization and efficiencies gives energy savings

Improved Electric Reliability

Less instantaneous and prolonged outages plus better power quality

Improved Environmental Quality

Lower “green house gases” and NOx emissions

Determining Cogen Potential - Financial Attractiveness -

Electrical and Thermal Load Coincidence

The more electricity a facility needs at the same time it needs thermal energy, the more attractive the savings and payback associated with cogen become. A good match will give higher fuel efficiency and quicker payback

Cost Difference Between Electricity and Natural Gas

The higher the difference between the cost of buying electricity power from the grid and the cost of natural gas, the more attractive the savings and payback associated with cogen become. For a favorable payback, the spark spread should be at least \$12 per MMBtu or USD 0.03 per kWh

Long Hours of Operation

Cogen plants generally operate when production cost of electricity is lower than the purchase cost and when the facility is in need of process heat. This time should be minimum 3000 hours annually but preferable more than 6000 hours

Electricity Power Reliability and Quality

When power reliability/stability is an issue, cogen may make more sense.

Cogeneration Barriers

Uncertainties

- Electric restructuring creates uncertainty in electricity pricing and reliability plus a “wait and see” attitude
- Gas price volatility creates uncertainty in savings and a fear of the unpredictable
- Electricity utility position – Ambivalent at best – Hostile at worse

Costs and Paybacks

- High first cost discourage investment despite energy cost savings
- Under estimated cogen value as avoidance of electric outages and reduced overall emissions
- Unfavorable utility tariffs – Standby charges – Backup rates – Exit fees

Installation Issues

- Permitting process sometimes may be long, cumbersome and costly
- Grid interconnect – Inconsistent standards – complex process – unpredictable / high costs

Total Cost of Ownership

- Capital costs are a very small part of the total cost of ownership proposition and should be only part of the decision criteria.
- The focus should be on the lifecycle operation and the need to optimize efficiency of the whole plant.
- Siemens has the ability to assist with a lifecycle analysis using various evaluation tools.
- Siemens turbines are designed for maximizing overall plant efficiency—not just simple cycle efficiency.



***By designing turbines that optimize CHP / CC performance,
Siemens supports higher efficiency systems.***

Energy Policy / Incentives

- A lack of long term stable energy policy / incentives and fuel pricing has been an obstacle to CHP growth.
- Many European markets for CHP have gone through 'boom and bust' cycles as different administrations have changed policies and deliberated different technologies to fulfill the energy needs. Renewables also take a high profile.
- Many states have adopted their own incentive programs. A National policy is also now being recognized.



Energy Policies are starting to reflect the Importance of Efficient System by offering Incentives for CHP.

Siemens Support of CHP

- As a manufacturer, the instability in policy means it is difficult to focus our considerable R&D spend to satisfy changing market dynamics.
- Developing a new Turbine takes approximately 5 - 7 years. We want to ensure that the machines developed fit the requirements of the market and the incentives sent forward, maximizing power generation while also optimizing overall CHP efficiency.
- In 2006, Siemens spent 6% of Annual Sales (approximately 5.7 MM Euro) on R&D. We are the world leader in R&D outlay for Electronics and Electrical Engineering industries.

Siemens: a World Leader in Innovation

Cogeneration Case Study

Plant Assumptions - Reference Case -

Buying electricity power from an external supplier
Producing process steam in house with gas fired boiler

Technical Requirements

Average power demand (equal to SGT-400 output)	12.9 MW
Average steam demand (saturated 25.5 t/h 12 bara)	16.7 MW _{th}
Base load operation annual	8,760 hours

Economical Assumptions

Average electricity purchase price	6.5 cent/kWh
Average gas fuel purchase price	7.0 USD/MMBtu
Escalation rate per year	3 %

SGT-400 Cogeneration Data - Cogen Case -

Generating process steam & power in a cogeneration facility

Cogen Plant Technical Data

Electric output	12.9 MW
Process steam output	16.7 MW _{th}
(saturated 25.5 t/h 12 bara)	
Annual operation hours	8,400

Economical Assumptions

Average electricity purchase price
6.5 cent/kWh

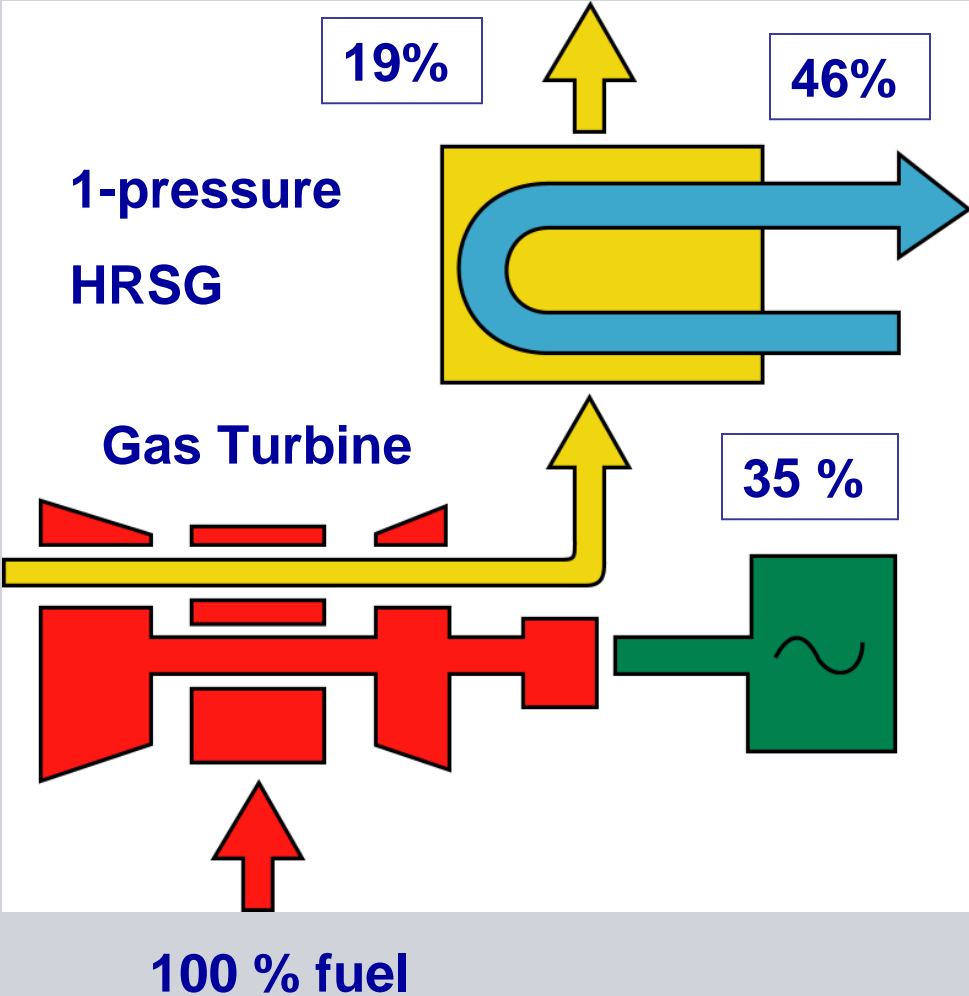
Average gas fuel purchase price
7.0 USD/MMBtu

Estimated investment cost \$ 8,800,000

Interest rate 10%

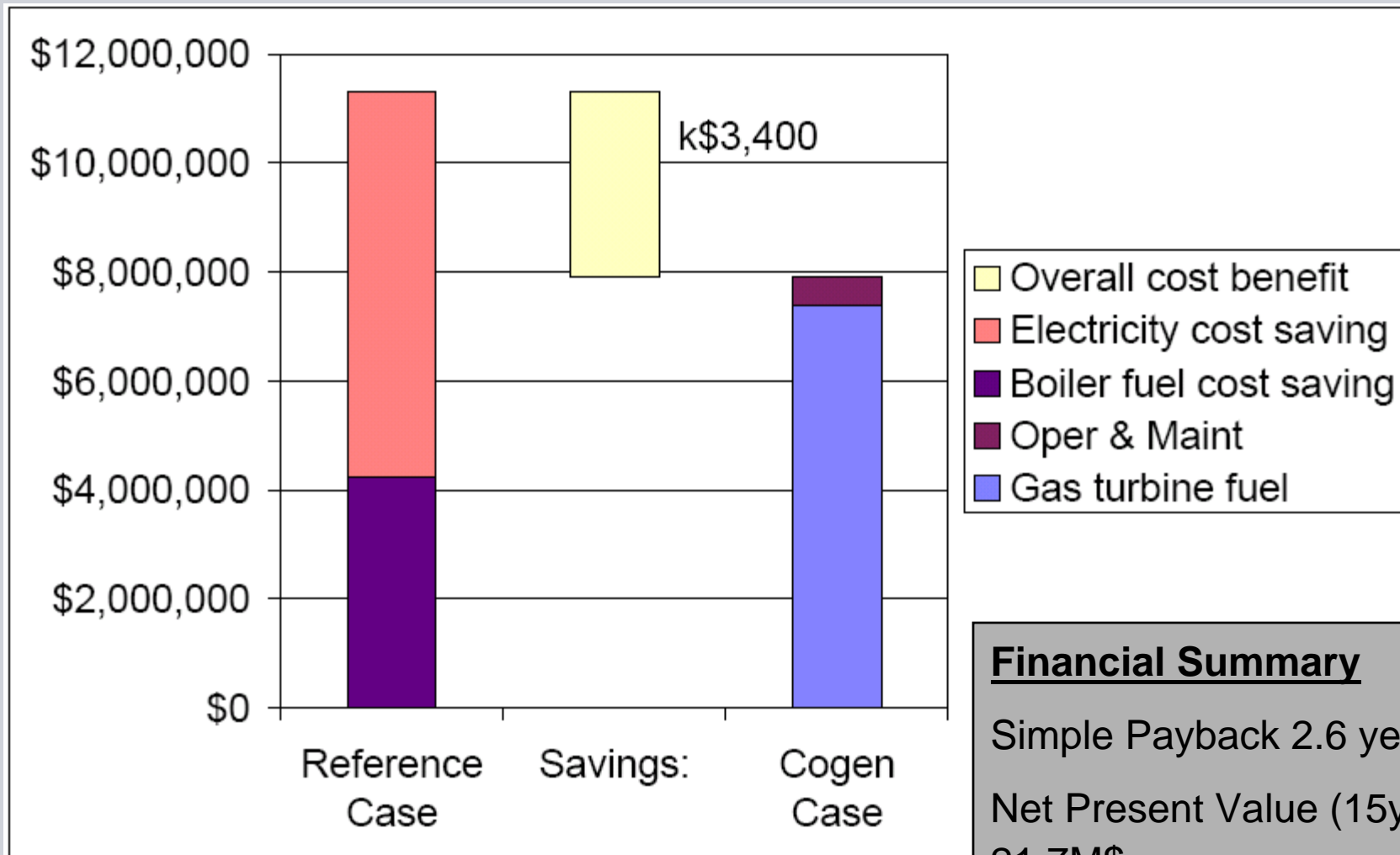
Operation and maintenance cost
5.5 USD/MWh

SGT-400 Cogeneration Performance



Pgt	12.99	MW
Pst	0	MW
Paux	0.03	MW
Pnet	12.96	MW
Heat duty	16.81	MJ/s
Qfired	36.62	MJ/s
Alfa	0.77	---
Net electrical efficiency	35.4	%
Net total efficiency	81.4	%

Annual Savings



Financial Summary

Simple Payback 2.6 years

Net Present Value (15y)

21.7M\$

Industrial Cogeneration Summary

Energy intensive industrial users have begun to build integrated cogeneration solutions, sized after their facility demand.

- Some industries focus on reliable power supply only by installing reciprocate peaking units, which is only a partial solution, missing the cogeneration benefit.
- Process energy intensive industries are upgrading their energy plants with cogeneration solutions to benefit from higher fuel utilization factor.
- Beside demand for high reliability, spark spread between the price of electricity and natural gas are justifying investment in industrial cogeneration solutions
- In the future, participating in CO₂ emissions trading will further improve the economical benefits with cogeneration and decrease industries energy cost.

Driving Profitability

In an Industrial setting, electricity and heat drive the processes. Those costs drive profitability, which is certain vital elements need to be reliable and cost effective.

Siemens can help drive profitability by:

- **Being industry leaders in reducing environmental impact**
- **Maintaining process consistency with reliable heat and power**
- **Maximizing return while reliably meeting the power needs**
- **Generating all energy at a low and predictable cost**

Siemens: a Reliable Partner to Improve your Profitability

Any questions?

Thank You !

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