

Siemens Energy

Fuel flexible Gas Turbines for grid balancing

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Introduction to gas turbine applications

How gas turbines can provide the grid balancing

Future readiness and green fuel road map with some references

Conclusions

Siemens Energy industrial gas turbine

Power generation applications

Simple cycle

producing power only

35-40%

typical efficiency

Combined heat and power (Co-generation)

using the exhaust heat for process,
heating or cooling

80-90%

typical efficiency

Combined cycle

using the exhaust heat to produce
more power via a steam turbine

55-60%

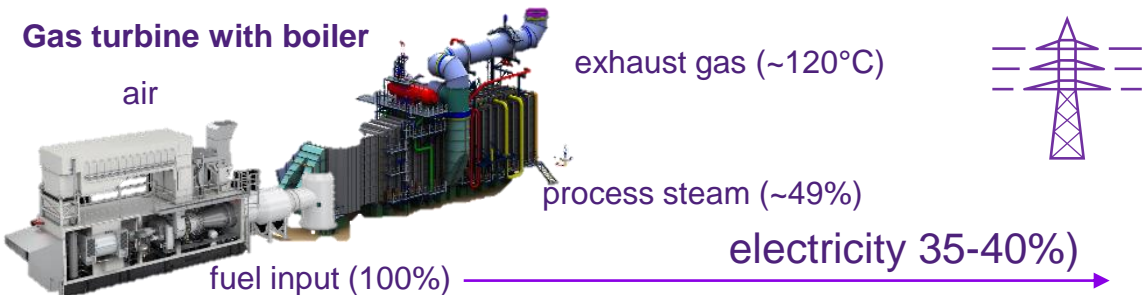
typical efficiency

(Combi-cogen also possible allowing flex between heat and power)

Gas turbine



Gas turbine with boiler



Gas turbine with boiler and steam turbine

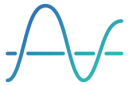


Typical requirements for grid balancing

Important functions of Gas Turbines



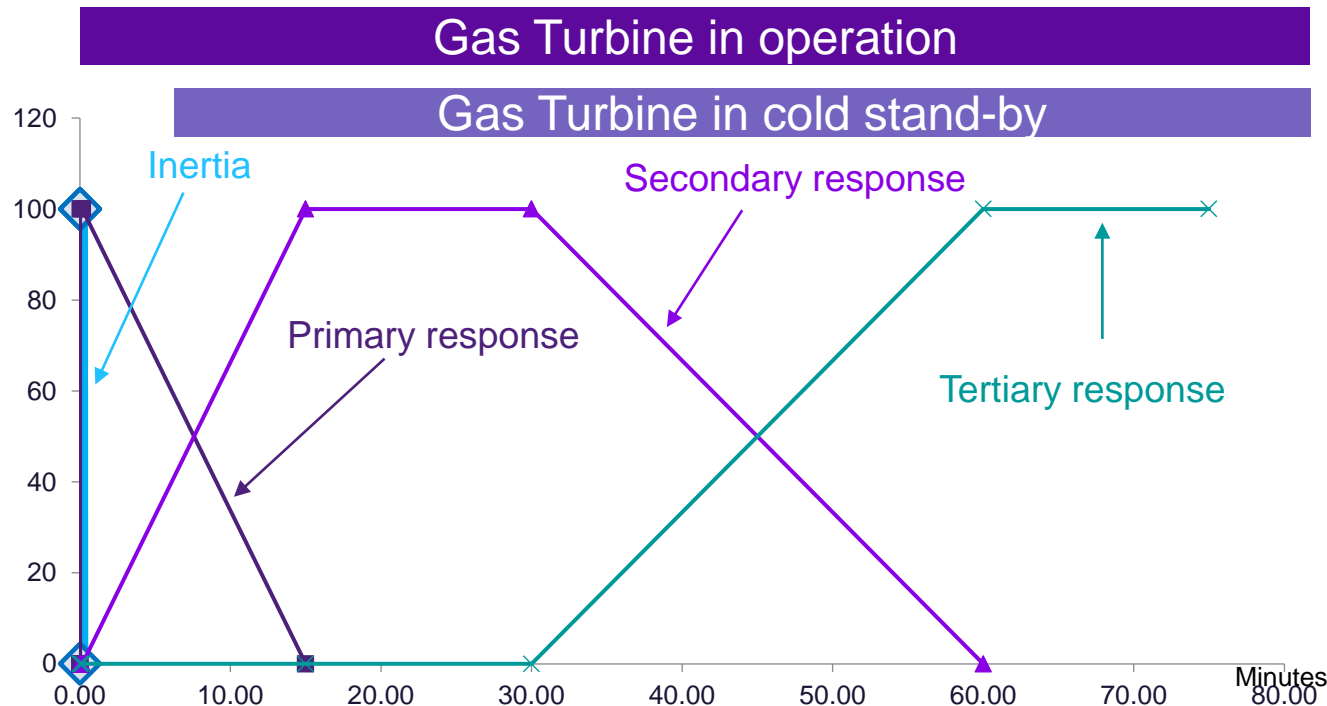
The electric grid only transfers power and does not store or provide energy.



When production and consumption are unbalanced, grid frequency can fluctuate.



Different resources are used to match production with consumption at all time instances.



Ancillary Services Provided by Gas Turbines

•Frequency Regulation:

Quick output adjustments to maintain grid frequency.

•Voltage Support:

•Production or absorption of reactive power to stabilize voltage.

•Load Following & Peaking Power:

Adjusts output to match demand fluctuations and peak periods.

•Spinning & Non-Spinning Reserves:

Standby power for sudden demand spikes or outages.

•Black Start Capability:

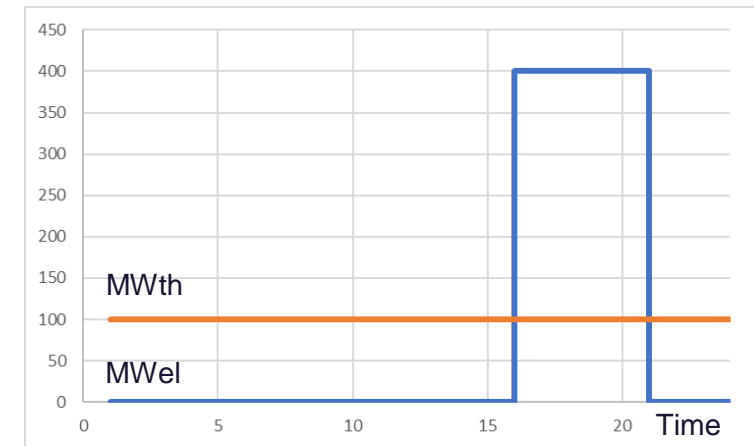
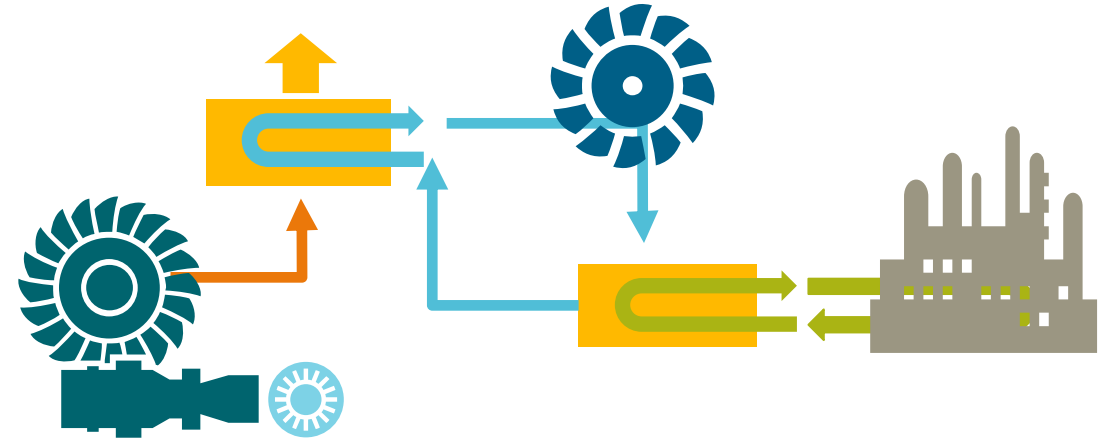
Independent startup to restore power after a blackout.

•Long term power reserve:

Electrification of large amount of stored energy in case of emergency.

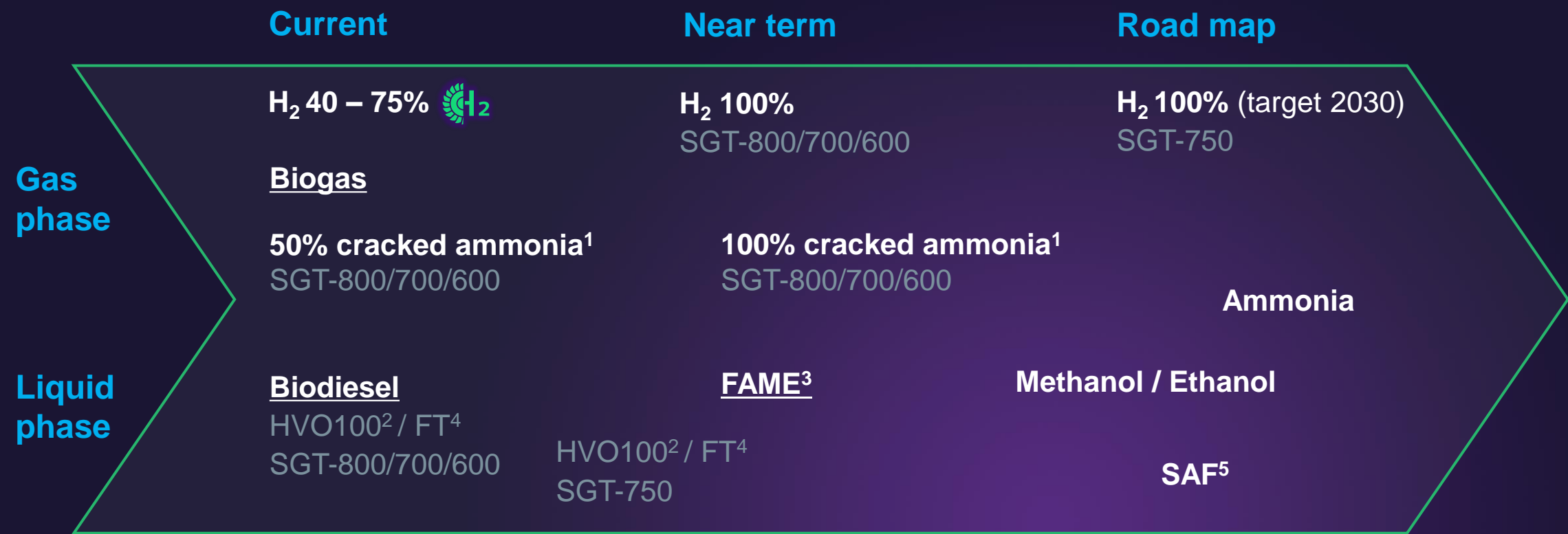
CHP - a large grid balancing potential

- If heat is needed anyway → 85 - 90% marginal electrical efficiency.
- Thermal storage decouples heat and electricity production.
- Low temperature thermal storages are cheap.
- Increased capacity per heat demand makes smaller heat demands still economic for CHP.



Green fuel roadmap - Medium gas turbines with Dry Low Emission

Acceleration through collaboration and partnership



1: Fully cracked (hydrogen/nitrogen mix) SGT-800/700/600
2: HVO = Hydrogenated Vegetable Oil
3: FAME= Fatty Acid Methyl Ester (i.e. RME)
4: Fischer-Tropsch diesel
5: Sustainable Aviation Fuel

Operation on Biogas @Siemens Energy AB test facilities

Biogas ...

... has different gas composition depending on how its is produced and can be very close or identical to natural gas (mostly methane).

... down to Wobbe Index 22 – 25
is currently released for sale.



Rickard Olsson
Head of Finspong test facilities,
Siemens Energy AB



As of April 2020, Siemens Energy in Finspong, Sweden, are mixing in biogas in the gas turbine test facilities with the target to reduce the CO₂ emissions and inspire our customer to change to operation on low-carbon fuels.

The fuel is produced through the decomposition of organic waste in the region and delivered to the facilities as LBG (Liquid BioGas).



[Watch: gas turbines tested on biogas](#)

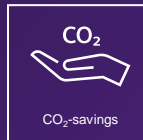
Göteborg Energi and Siemens Energy operate gas turbines on fossil-free liquid biofuel at Rya CHP



CO₂ 100 % fossil free in the near future

PROJECT TYPE

Heat & Green Municipalities



Green Fuel

Customer Challenge/Driver

Transition to 100% renewable district heating by 2025 in Gothenburg, requiring flexible power solutions.



Portfolio Elements

3 x SGT-800 gas turbines in combined cycle for electricity and district heating (total efficiency 92,5%)



Solution

Partnership with Göteborg Energi for fossil-free cogeneration. (i.e., operation on cost-effective green fuels).



Advanced dual fuel gas burners



Verified operation on Hydrotreated Vegetable Oil (HVO) in 2021.



Customer Benefit

- Enhanced fuel flexibility through liquid green fuels for fossil-free power and heat.
- Provides grid balancing and carbon neutral backup in future renewable energy.





Green back up power plant

Customer: Stockholm Exergi AB

Country: Sweden

Commercial operation: 2023

Reference Stockholm Exergi, Sweden

Challenge



Stable electric supply is vital w/ fluctuating renewables and insufficient transmission capability



This requires fast start power to ensure uninterrupted power supply to Stockholm



Stockholm Exergi aims for net zero by 2032

Solution



The new simple cycle gas turbine power plant will provide balancing power to the city of Stockholm



The plant has been validated to operate on bio-diesel enabling fossil free power generation

Technology



- 1 x SGT-800 gas turbine
- PCS 7 control system
- Installation and commissioning

Benefits



Capability to operate on liquid green fuel



Reliable and secure solution with fast start capability



High electrical efficiency and contributing to the net zero goal of Stockholm's

Conclusions

- Gas Turbines are the ideal technology for supporting the stability of electrical grids and capability to operate on biofuels is developed and proven since years.
- For frequency regulation, spinning reserve, voltage control and load following, cost of fuel is critical for economic viability.
- Combined but decoupled heat- and power generation is reducing cost of fuel for these operation modes considerably.

Contact page



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More information

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Our purpose



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