

Minimized CO₂ impact with Siemens cogen concepts for decarbonization

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Today- emphasis on minimizing CO₂ emissions

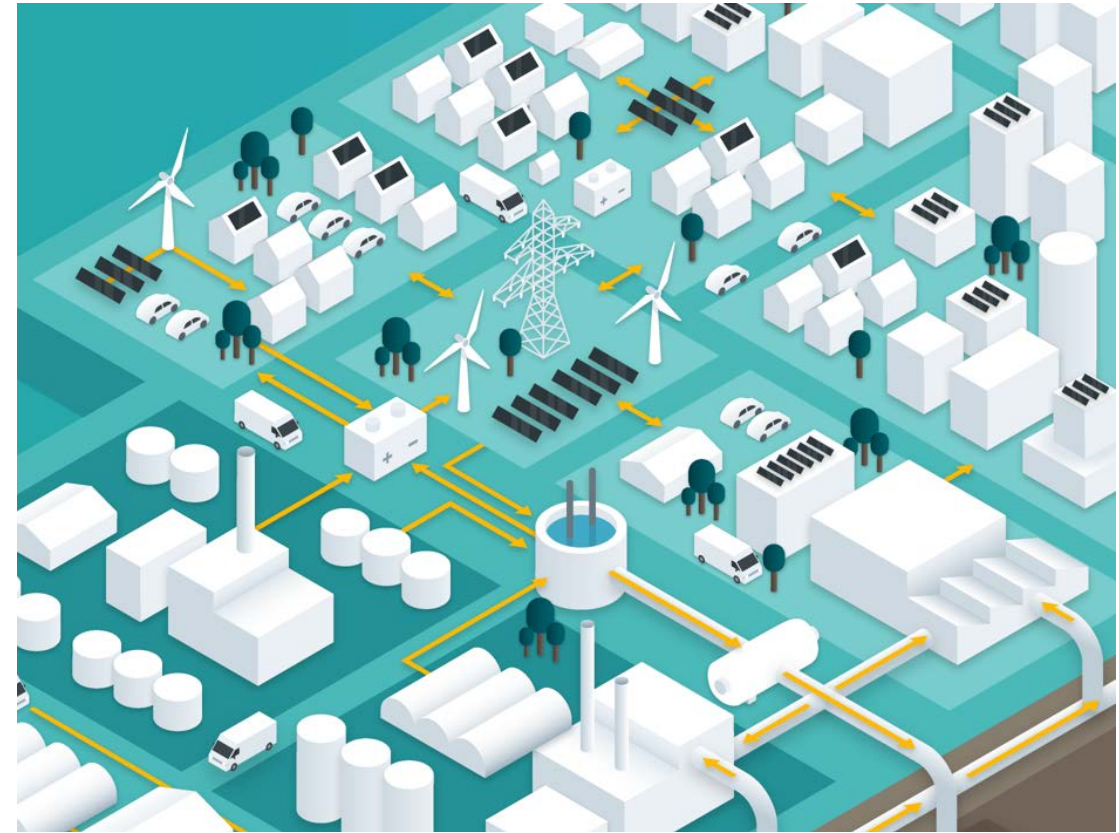
CO₂ and situation today

- Focus on CO₂ emissions => reduce the usage of fossil fuels.
 - Change from coal to gas
 - Optimize efficiency in gas power plants
- The level 250 g/kWh CO₂ is a coming criteria
- EU are discussing levels at 100 g/kWh
- CO₂ release also critical for revenues through subsidies in many countries

Situation today for gas turbine power plants

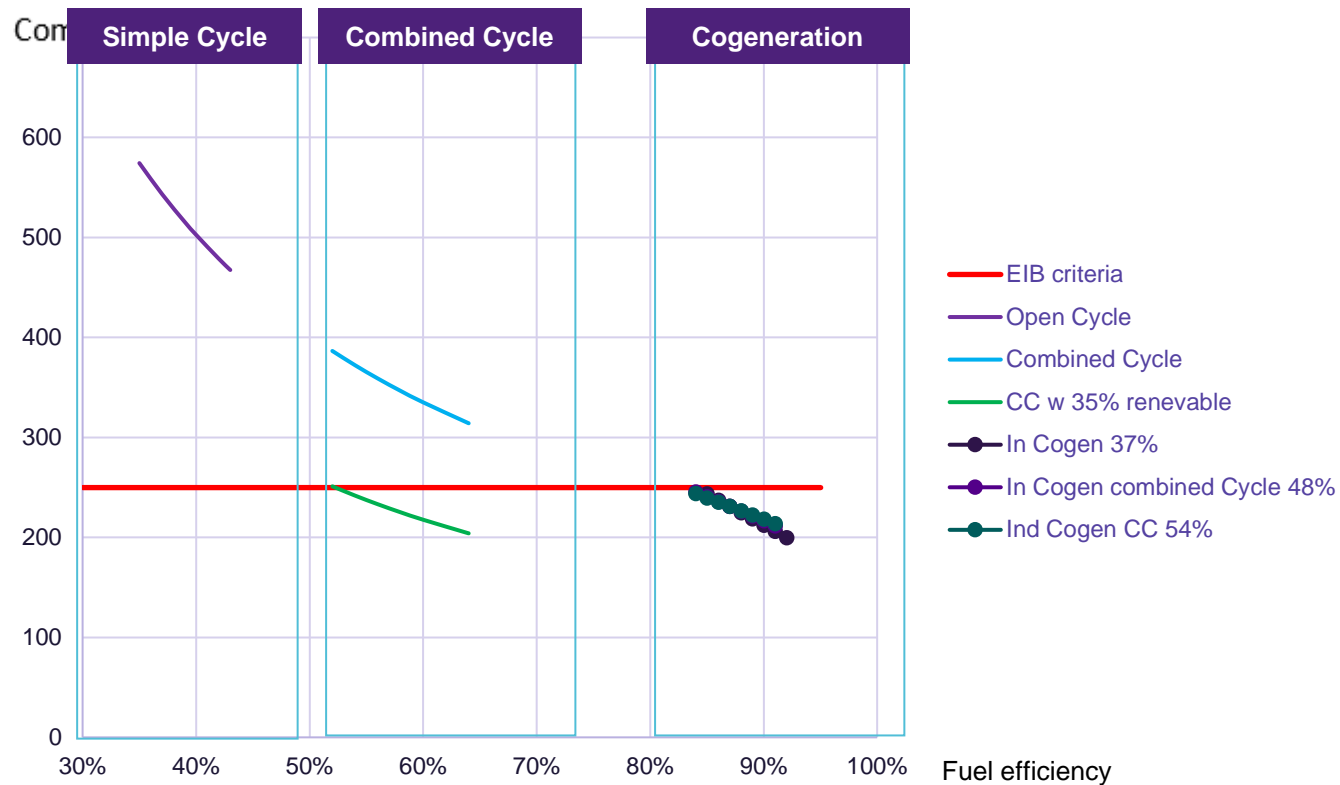
Combine electricity and heat recovery (Cogeneration) is-necessary to respect coming CO₂ limits

- Tools are available for reducing CO₂ emissions
- Siemens have the technical solution to fulfill the requirements for cogen based solutions



Co-Firing renewable fuel and/or utilizing heat in cogeneration are key levers to reduce specific CO₂ emissions below 250 g/kWh

Specific CO₂ Emissions, g/kWh (LHV)



Financing sector require low carbon dioxide footprint from power plants. This is achieved by high fuel efficiency already with Siemens cogeneration plants of adapted design.

In condensing combined cycle plants such good footprint is achieved by replacing more than 35% (energy) of fuel supply with renewable fuel or by incorporating a thermal energy storage.

An open cycle plant would require more than 50% (energy) renewable fuel to achieve this.

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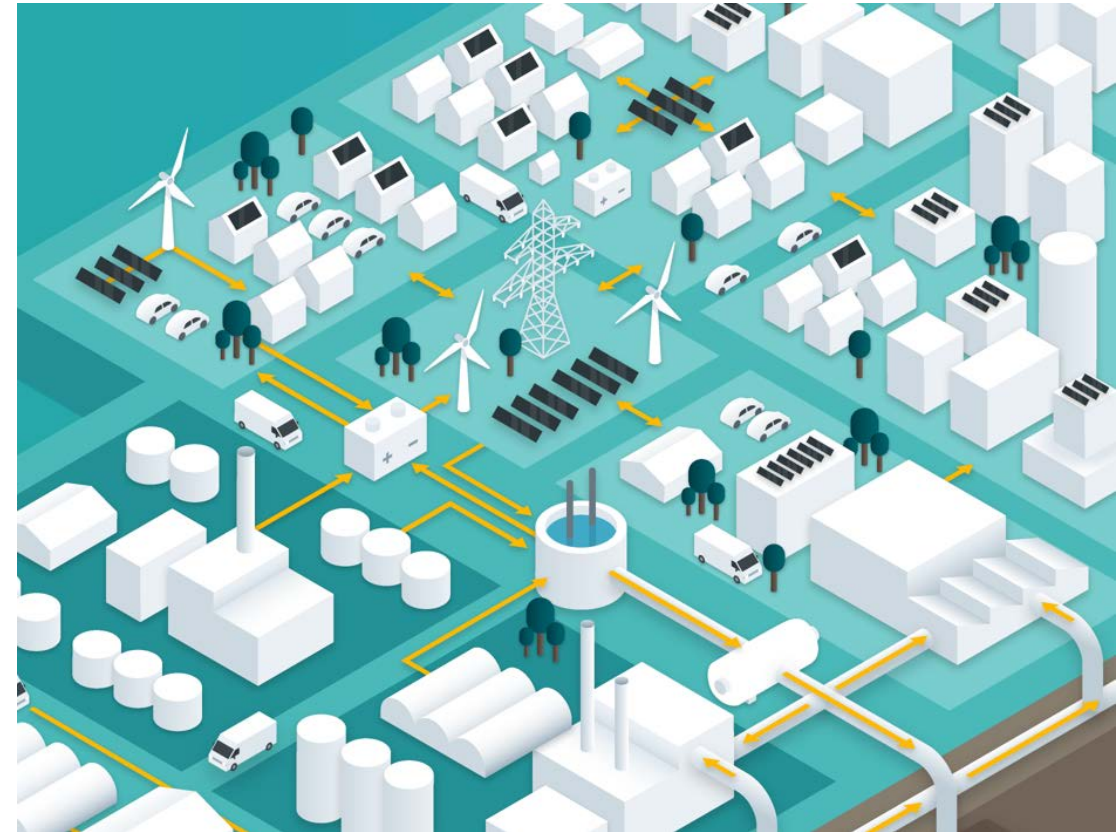
Open cycle cogeneration concepts based on SGT-800

Input conditions

- Low pressure steam supplied, 10 bar slightly superheated
- Typical Eastern European gas used for the comparison
- Air preheating and supplementary firing is also possible for this concept

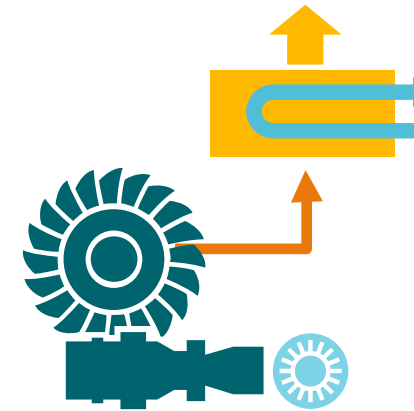
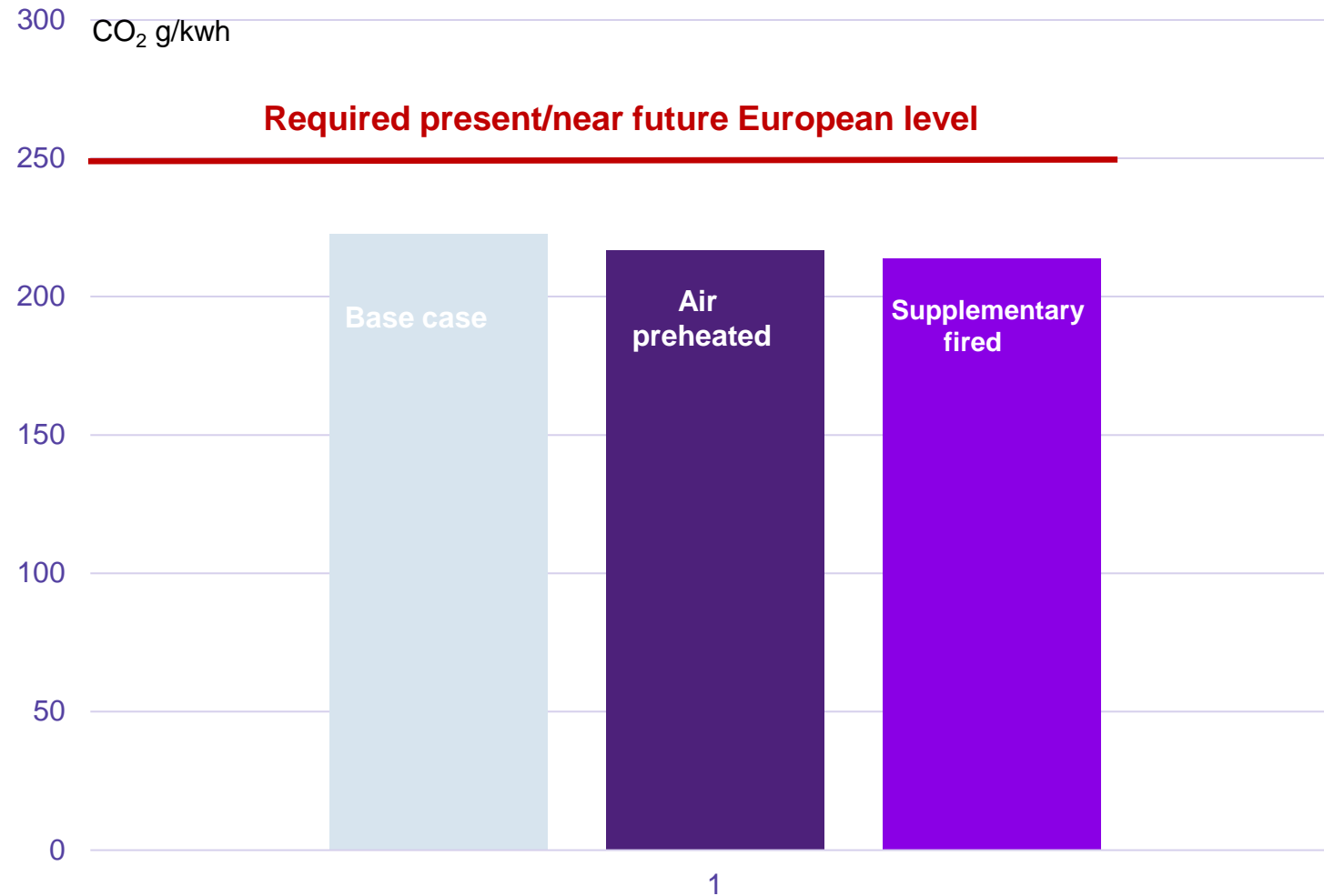
Comments

- Next slide shows SGT-800 based plant.
- Based on a view using heat bonus (total efficiency based) resulting in 250 g/kWh CO₂ emissions,



Open cycle cogeneration concepts based on SGT-800

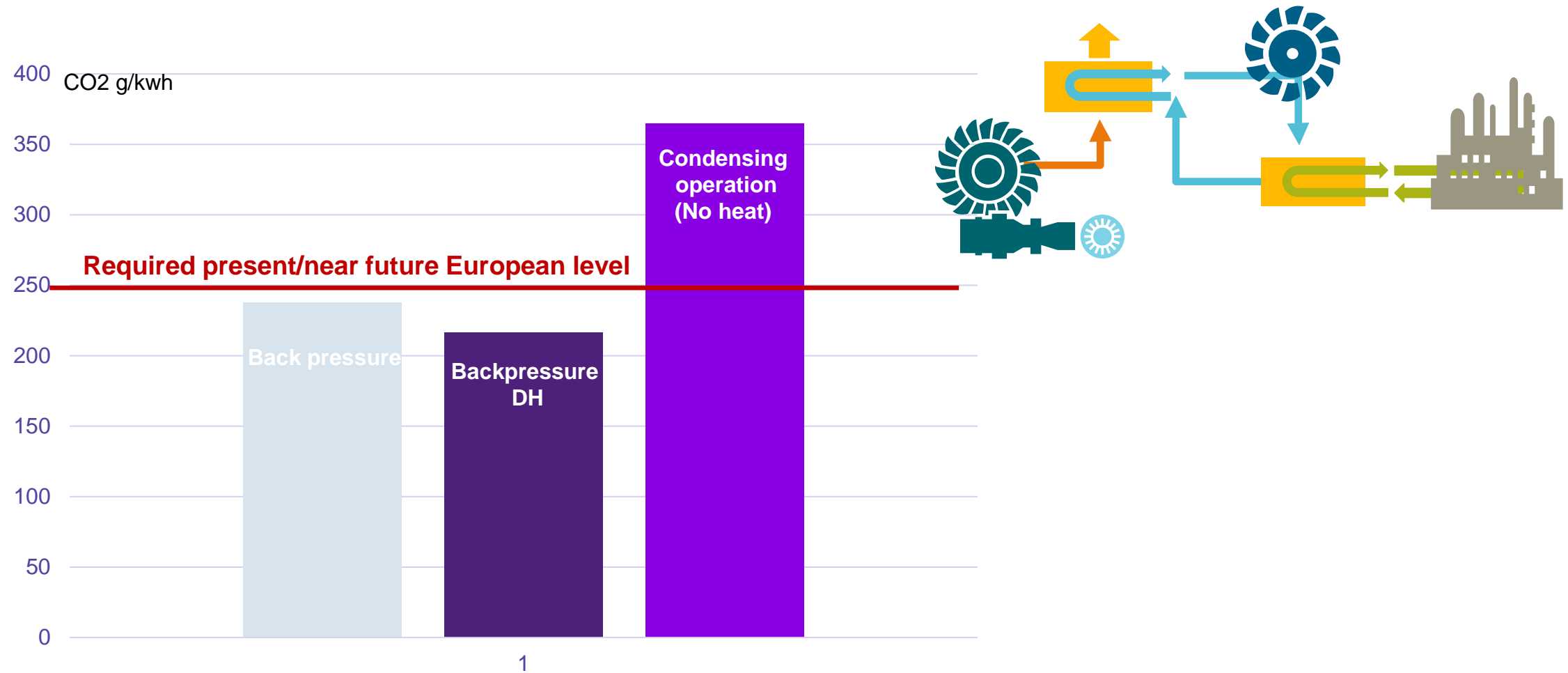
SGT-800 57 MW cogen with LP steam (10 bar)



CONCLUSION:

- SGT-800 complies with the 250 g/kWh requirements with open cycle cogeneration concept
- Operation flexibility is assured by air preheating or supplementary firing

Three different Combined Cycle concepts based on SGT-800



Concepts resulting in a CO2 emission level of 250 g/kWh

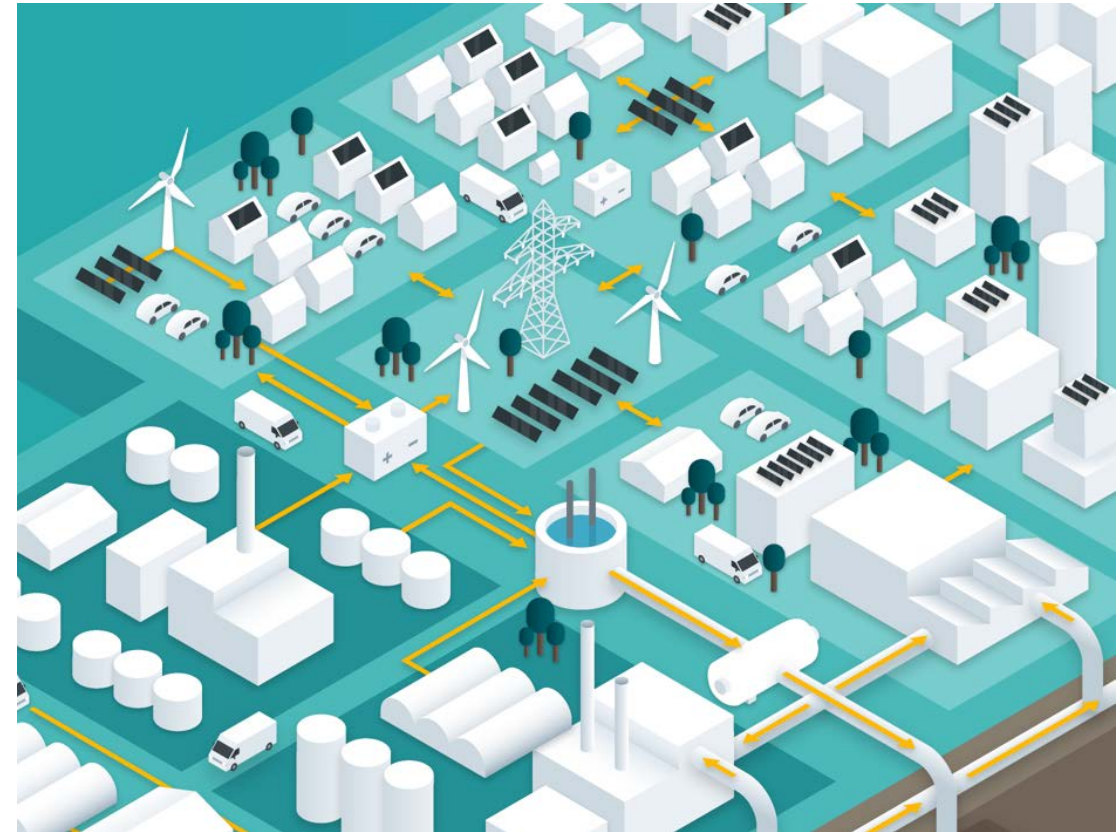
Back pressure for district heating concepts based on SGT-800

Input conditions

- Low pressure steam supplied, 10 bar slightly superheated
- Typical Eastern European gas used for the comparison
- Air preheating and supplementary firing is also possible for this concept

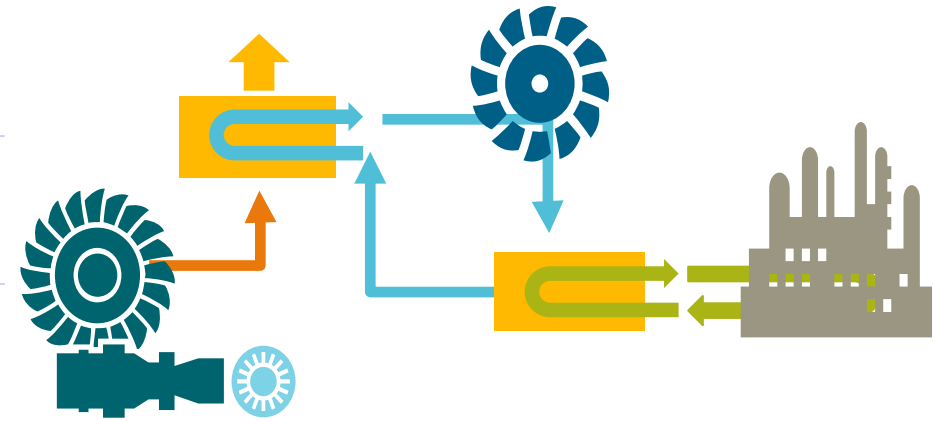
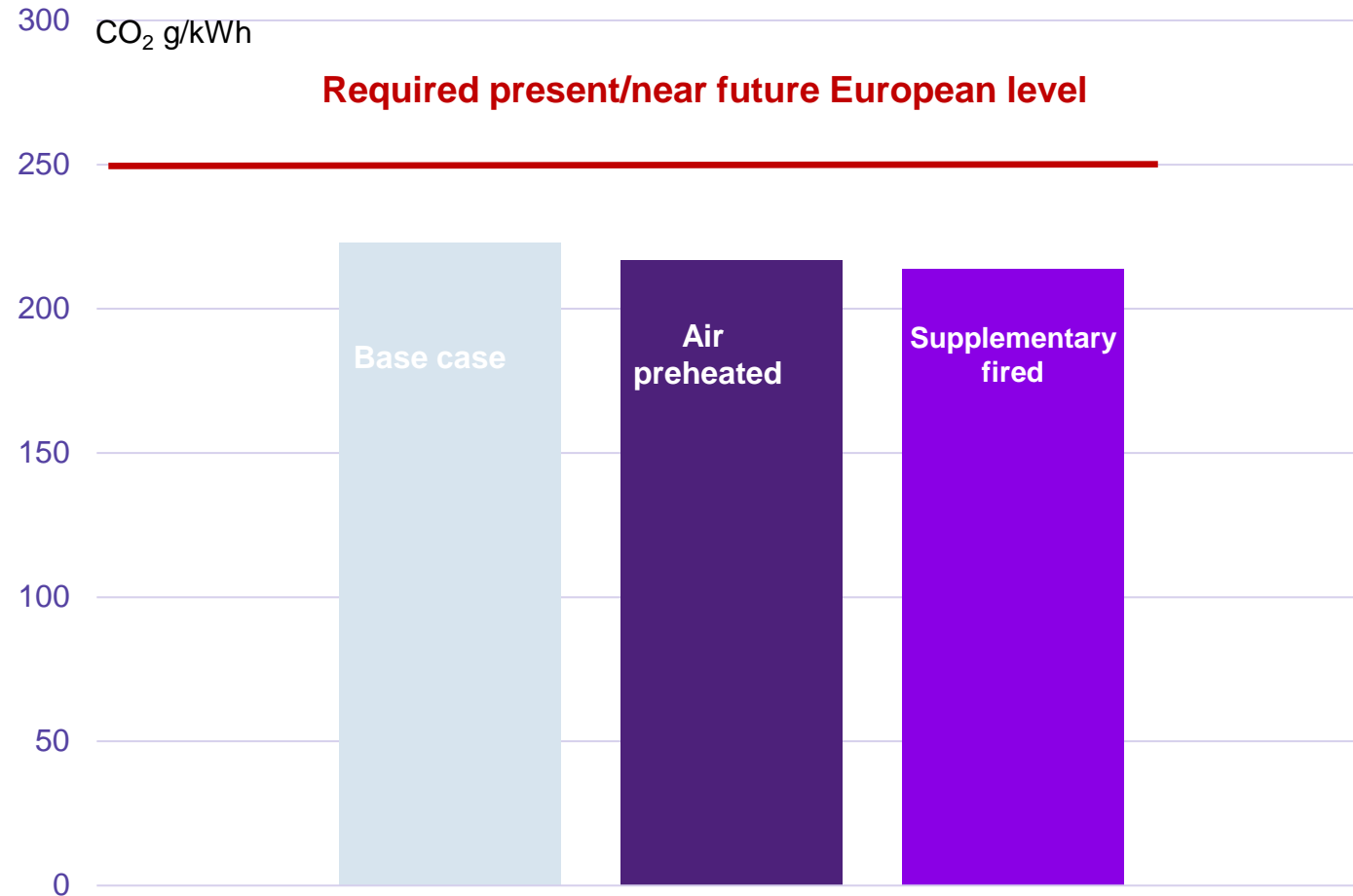
Comments

- Next slide shows SGT-800 based plant.
- Based on a view using heat bonus (total efficiency based) resulting in 250 g/kWh CO2 emissions,



Concepts resulting in a CO2 emission level of 250 g/kWh

Combined cycle concept based on SGT-800 SCC-800 57MW 2x1DH

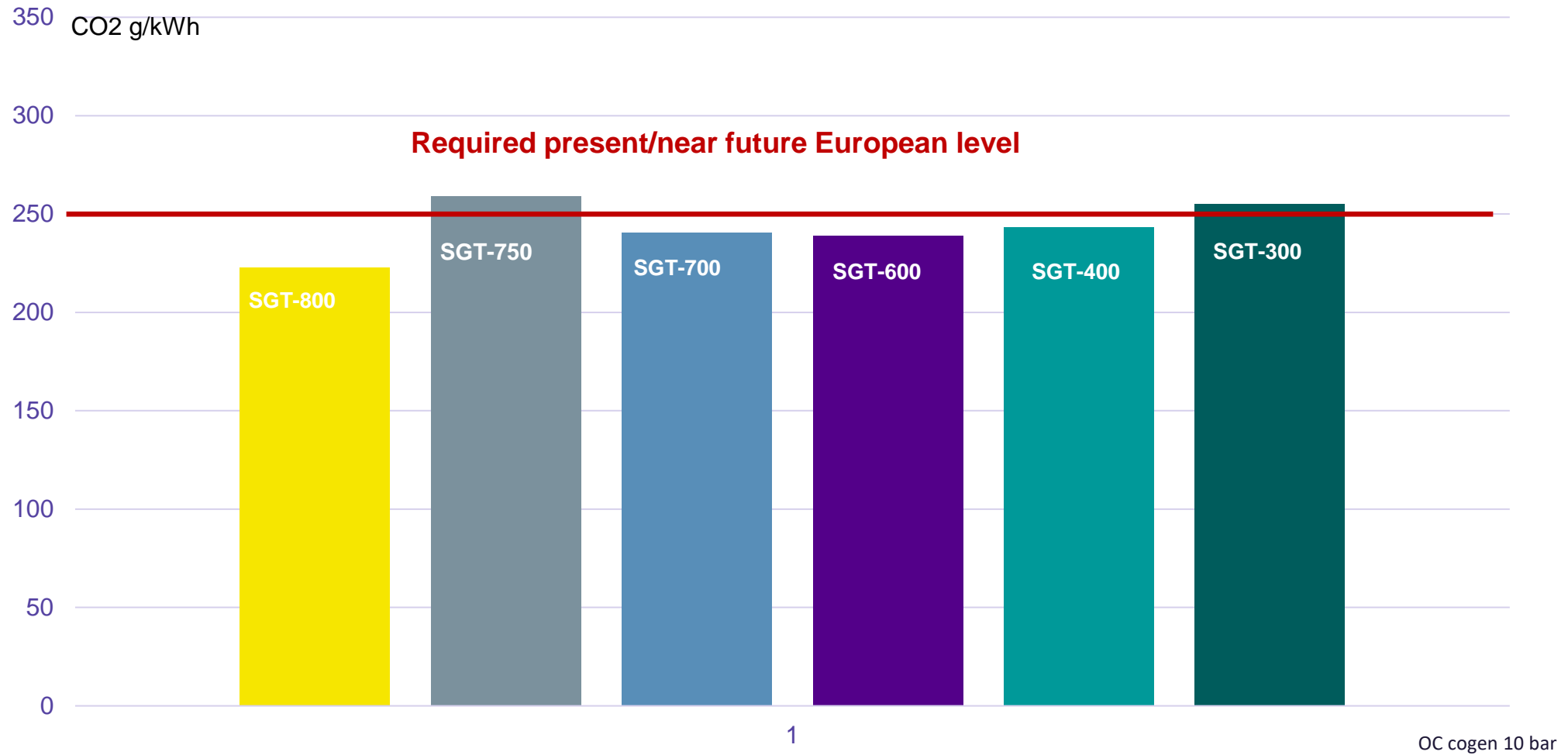


CONCLUSION:

- SGT-800 complies with the 250 g/kWh requirements with CCPP DH concept
- Operation flexibility is assured by air preheating or supplementary firing and/or other flex tools

1
Concepts resulting in a CO₂ emission level of 250 g/kWh

Siemens IGT portfolio



CO₂ emissions and Gas turbine based CHP

Case Study EL-TO Zagreb & Lujan de Cuyo 2 examples of plants under delivery today

- The EL-TO concept with district heating and steam supply will comply with the requirement 250 g/kWh
- Part load operation will only take place part of the time.
- The Lujan de Cuyo project based on the assumptions will be compliant with the requirement 250 g/kWh

EL-TO Zagreb @ full load

Base case CO ₂ g/kWh	227
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Total Efficiency%	90%
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Lujan de Cuyo II @full load

Base case CO ₂ g/kWh	232
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Total efficiency %	88%
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Power-Gen concept compliant with the criteria 250 gr CO₂/kWh

Immediately available

- Mixing with biogas
- Hydrogen from renewable plant, mixing to 60 %

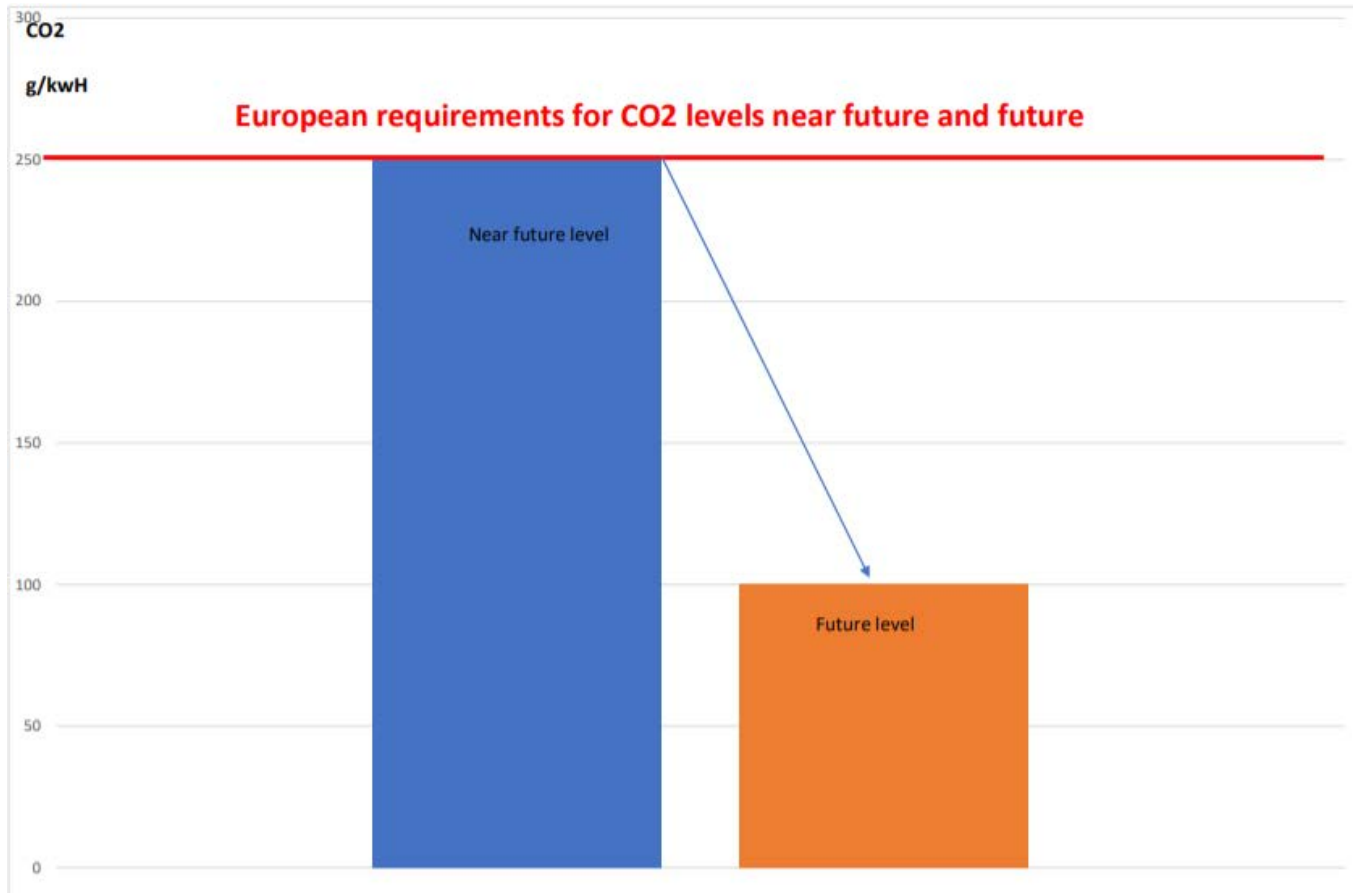
With existing GT technology – concept and plant engineering necessary

- Hybrid with integrated molten salt heat accumulation
- Combined with waste to energy
- Combined with biogas production that supplies biogas to duct burner
- Hybrid with integrated thermal solar power and CCPP

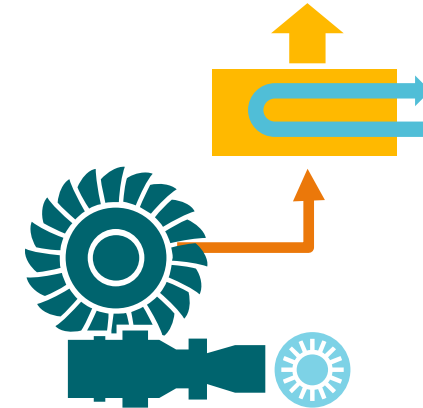
With GT development

- Firing with bio methanol or ethanol
- Hydrogen mix up to <75%
- Firing with ammonia
- Firing with biodiesel

How can we reach 100 g/kWh with e.g. open cycle cogeneration concepts based on SGT-800SGT-800 57 MW cogen with LP steam (10 bar) ?



Concepts resulting in a CO2 emission level of 100 g/kWh



Solution:

- Using high level of renewable fuel, e.g. hydrogen
- Have a cogeneration cycle with high total efficiency, about 87 % (heat bonus)
- **RESULT WITH THESE MEASURES IS:**
 - <100 g/kWh requires about 27 % (energy) of hydrogen (about 56 % volume)

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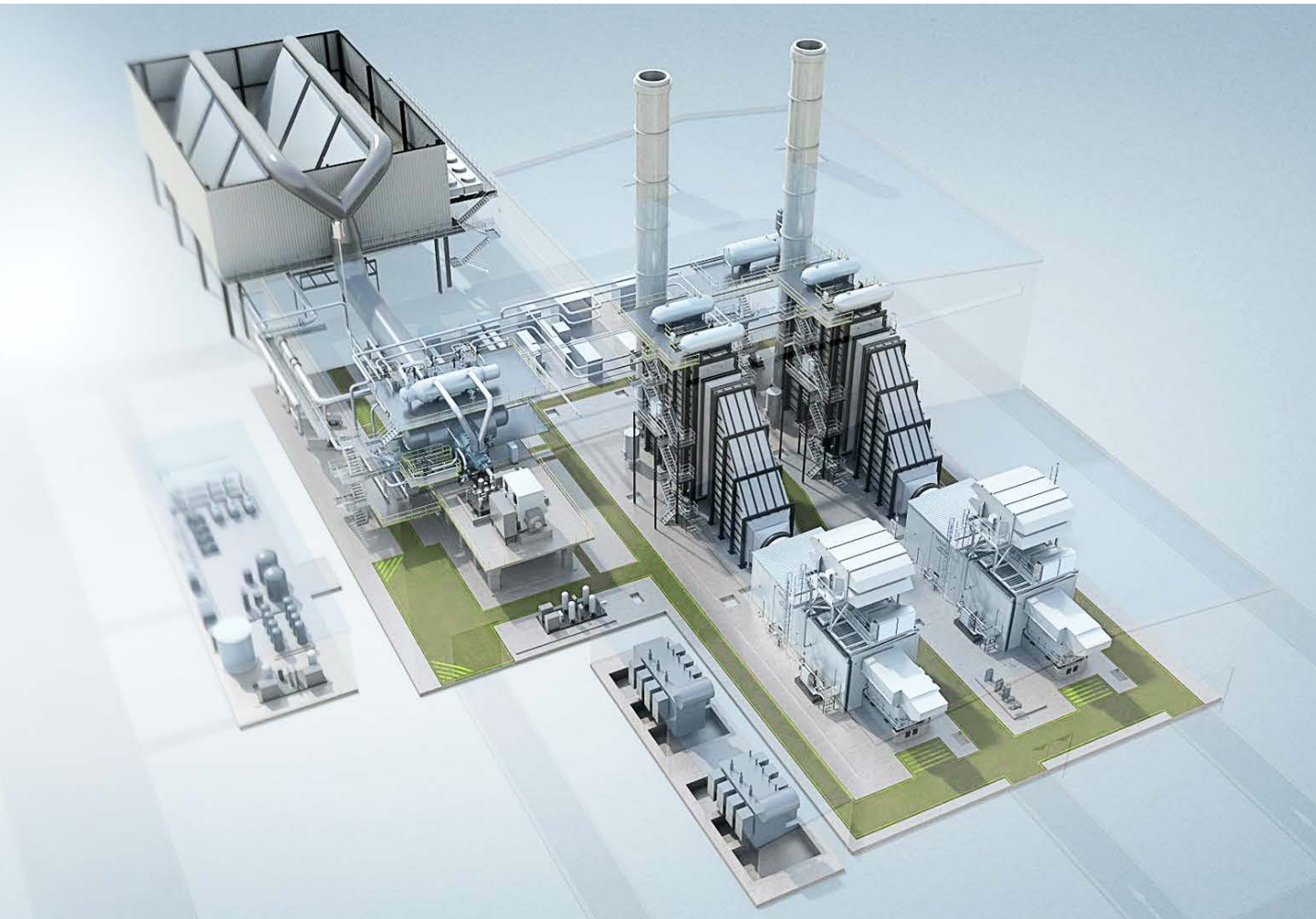
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Customer benefits- decarbonized cogen solutions

Increased power 	OPEX savings 	Improved efficiency 
Increased production and revenue	Cogen subsidies EIB loans at reduced interest rates	Marginal electric efficiency 86% Fuel expenditure reduction
Technology infusion 	Environmentally friendly 	Improved revenue 
State of the art technology and solutions from Siemens	Reduced NOX and CO footprint, with high fuel flexibility	Reduced grid tariff Electric power export to volatile market price



Get in touch with us!

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