



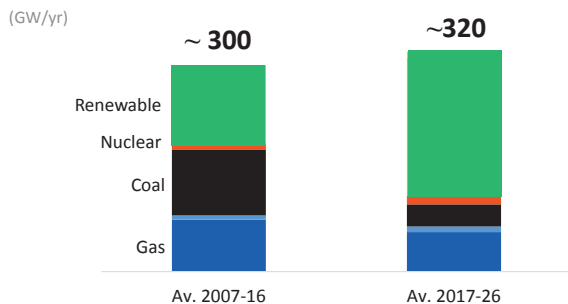
Soluzioni innovative progettate per supportare la trasformazione del settore energetico

Dora Adamo – Industrial Marketing Leader

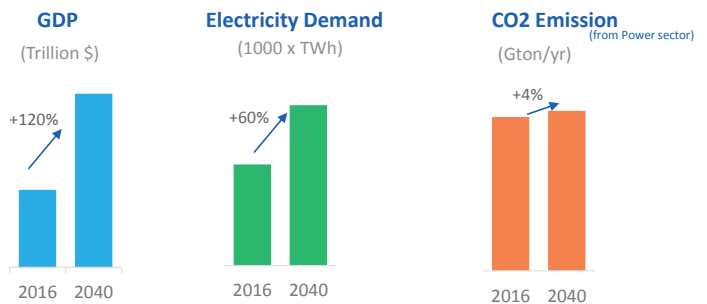
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New Era in the power market ... renewables and gas dominant

New Unit Power Gen



Global Indicators



- **Clean energy transition** ... shift away from coal, gas-fired capacity overtakes coal by 2030, renewables adds @60% 2026
- **New Era for power gen** ... outdated infrastructure, policy changes, decentralized power, digitalization
- **LCOE parity** to be achieved by 2025 in largest economies (U.S, China and India)

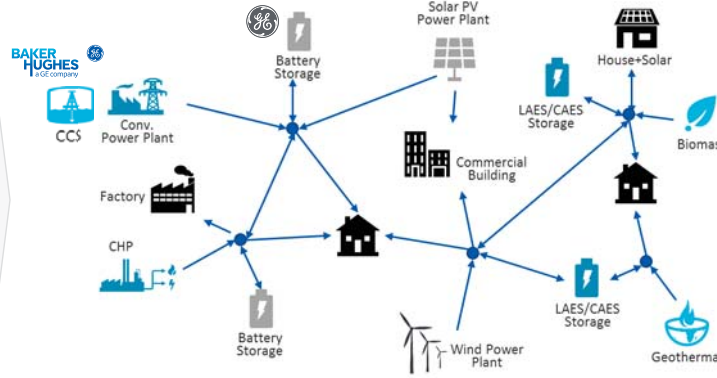
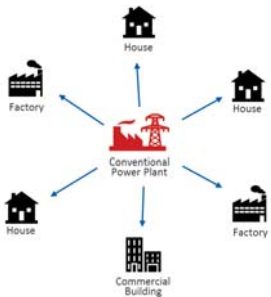
- **Economic growth decoupling from energy demand** ... Structural transformation of industry... decrease in global energy intensity
- **Energy efficiency** ... Policies, prices and technologies drive improvements ... Regulations covering only 31% of final energy consumption
- **Greenhouse gas emissions** ... power sector 40% of global CO2 emissions ... power mix shift, carbon price and energy efficiency driving CO2 reduction



New Era in the power market ... smaller, flexible, decentralized

To Clean, Local power

From Centralized power



- **Power generation ... BHGE leadership position ...** proven gas turbine <20MW and Steam Turbine technology
- **Energy recovery ...** ORC, super critical CO2 to convert heat to power and pressure let down
- **Energy Storage ...** BHGE's to support the growth of renewable energy ... LSES
- **Low Carbon and heat efficiency ...** CCS with proven Chilled Ammonia Process to capture CO2



New business models, ad hoc financials solutions... capex to opex

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Digitization, power integration, increase efficiency and productivity enhancement



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NOVA LT... A new generation of gas turbines ideal for CHP

Latest technology from BHGE

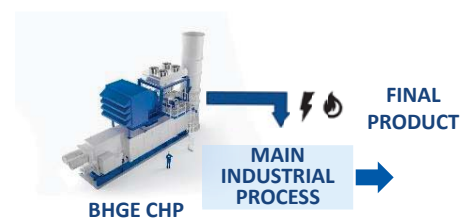


Power output	5/12/16 MW
CHP Efficiency	Up to 85%
Steam Production (10 bar/a dry)	15/23/30 t/hr
MTBM	48,000 hours
NOx emission	15 ppm
DLN turndown	50%

Challenge & Solution

- Balance MWe/MWth
- Cut Capex
- Better Economics
- Plug into the grid
- Comply with stricter emissions

CHP plant combining heat and power production with no electricity from the grid



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Energy Recovery

Waste Heat Recovery ... ORegent™



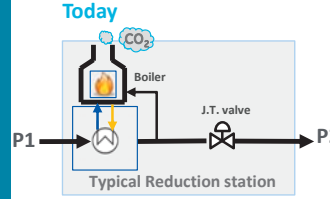
- Best in class ORC efficiency ... Up to 24%
- Best fit for waste heat $T \geq 400^\circ\text{C}$
- C5 working fluid, optimized for GT exhaust
- 17 MW Two Stage Turbo Expander
- No reliability impact to existing plant, independent system

Benefits

- ✓ Waterless system
- ✓ Unmanned operations ... negligible OPEX
- ✓ Increasing overall plant efficiency up to 13%
- ✓ CO2 footprint reduction ... 60.000Ton CO₂/yr saved by single train

S#1 COD in 2015 ... #6 plants in execution

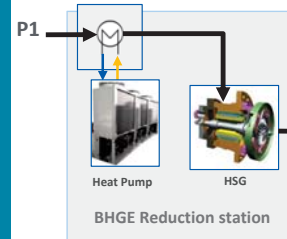
Waste Pressure Recovery ... HIPER



Global environmental impact

- ✗ ~ 0.5% of the gas transported is burned to reach End-Users
- ✗ ~ CO₂ emitted: #50x40MW GTs/yr
- ✗ ~ 30TWh/Y wasted pressure energy

BHGE solutions



Benefits

- ✓ Fuel gas saving thru Heat Pump
- ✓ CO₂ free solution
- ✓ Electricity selling
- ✓ Efficiency incentives
- ✓ Modular design & Integrated unit

300 Kw system Serial N° 1 COD by 2Q18

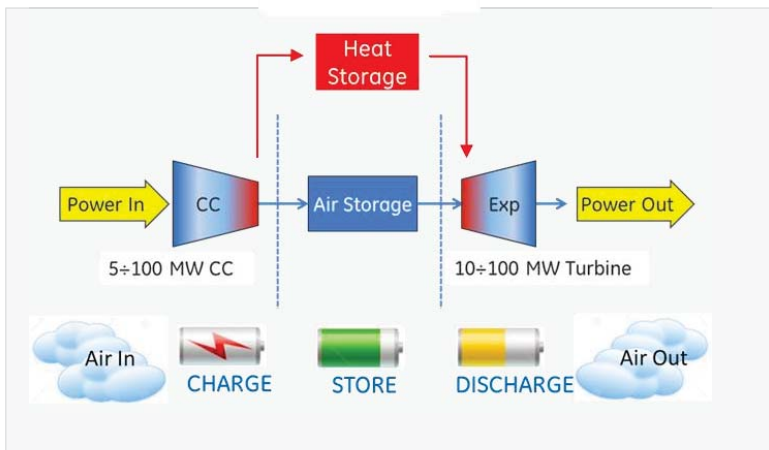


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Large Scale Mechanical Energy Storage

Zero CO2 emissions, Thermal storage through pressurized hot water



Adiabatic-CAES



- Storage thru compressed air
- Larger capacity ... GWhs

Adiabatic-LAES



- Storage thru liquified air
- No geographical limitations
- Capacity increase w/ minimal cost

0% CO2 emissions

Up to 100MW by train

Best fit for Storage >4hours

20 years+ lifetime



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Carbon Capture - Chilled Ammonia Process

TECHNOLOGY PRINCIPLE

- Ammonium carbonate solution reacts with the CO₂ in the flue gas to form ammonium bicarbonate
- Raising the temperature reverses this reaction, CO₂ is released and the solution is recycled

Successfully demonstrated
Technology Centre Mongstad,

Mongstad refinery

- Operational flexibility over wide range of fuels and SO_x contents
- No issues with aerosol or trace pollutant emissions
- Valuable experiences collected regarding plant operation
- 2.6 GJ/t for RFCC fluegas
- 3.0 GJ/t for gasturbine fluegas

85% CO₂ capture efficiency

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