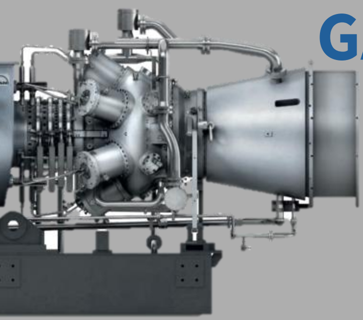
GAS TURBINE VS. GAS ENGINE

CHP APPLICATIONS

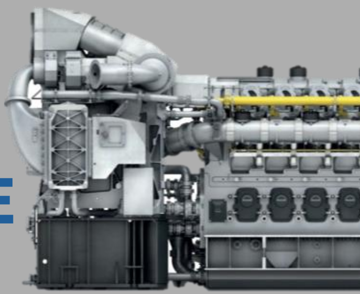
METISPOWER



GAS TURBINE
(MPG Product Family)

VS.

GAS ENGINE
(High-speed Series)



	Feature	Gas Turbine	Gas Engine
Exhaust	Temperature (°F)	**Very High** (~900–1050°F / 480–560°C) 0 – 1100	**High** (~710–800°F / 380–430°C) 0 – 1100
	Oxygen	**High** 14-16%	**Low** ~9%
Heat Rejection	Exhaust	**Concentrated** Almost all waste heat is in the high-temperature exhaust stream.	**Distributed** Waste heat is split between the exhaust and the engine's cooling systems.
	Casing	**Negligible** No Heat rejection from casing	**Significant** A large amount of low-grade heat is rejected as hot water (~200–230°F / 93–110°C).
Supplemental Firing	Configuration	**Inline** Simple, efficient burner placed directly in the exhaust duct.	**Parallel** Requires a separate burner with its own fresh air supply because the exhaust has too little oxygen to support combustion.
	Fresh Air Fan	**Not Required**	**Required**
Overall Efficiency		**Higher** due to the highly efficient use of supplemental fuel.	**Lower** due to the thermodynamic penalty of operating a separate burner system with fresh air.
System Complexity		Simpler and more compact heat recovery design.	More complex and costly, potentially requiring elaborate ducting or multiple HRSGs.
Ideal Thermal Application		Best for producing large amounts of high and medium-pressure steam.	Best for applications needing hot water or low-pressure steam.

Thermal Efficiency

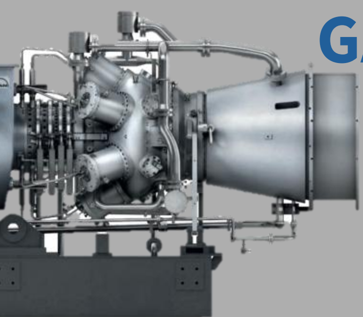
The selection of the ideal Combined Heat and Power (CHP) technology is critically dependent on a facility's specific steam and power requirements. This analysis reveals the distinct operational advantages of Gas Engines and Gas Turbines by comparing their thermal efficiency across a range of steam-to-power outputs. The sharp change in slope for each technology indicates the activation of supplemental firing (e.g., a duct burner) to meet higher steam demands.

Key Findings:

Hot Water or Low Steam Demand: Before supplemental firing, the **Gas Engine** shows superior thermal efficiency due to its highly optimized heat recovery design.

Medium-to-High Steam Demand: After supplemental firing begins, the **Gas Turbine's** efficiency rises steeply and ultimately surpasses the Engine's. The turbine's oxygen-rich exhaust makes it exceptionally well-suited for efficient duct firing.

Operational Crossover: A distinct crossover point exists where the two technologies have equal efficiency. This highlights that the optimal choice is dependent on the facility's specific operational needs.



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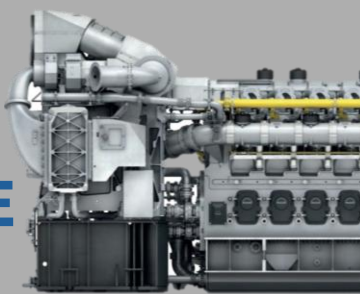
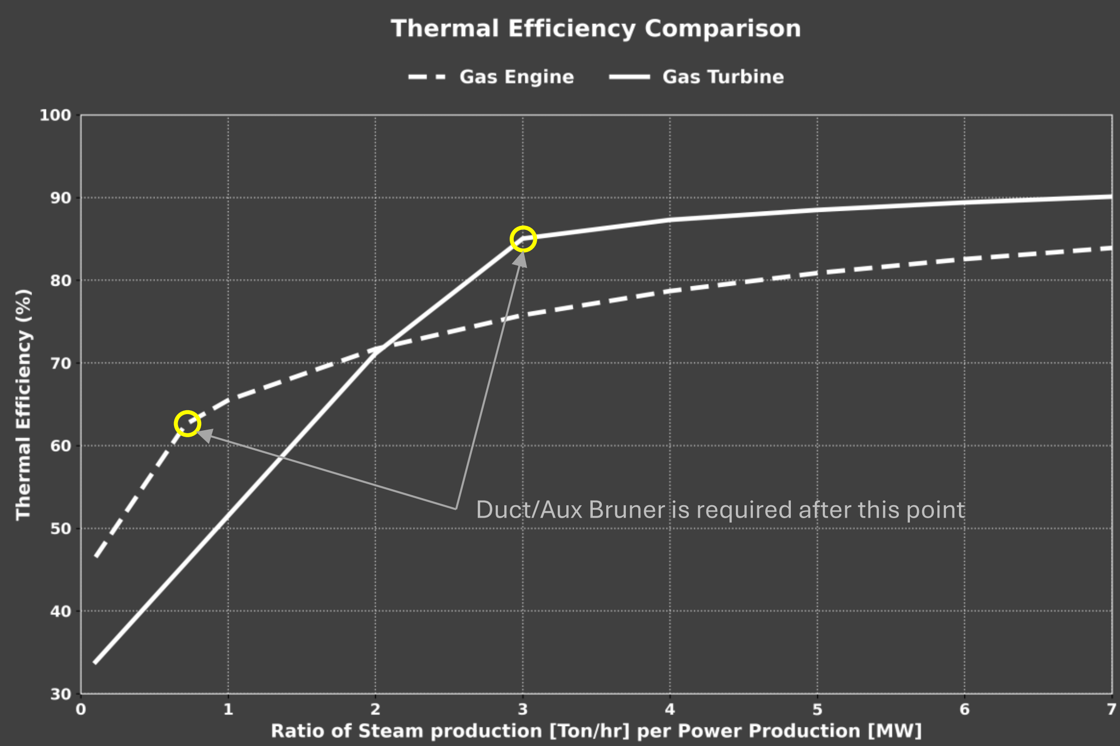
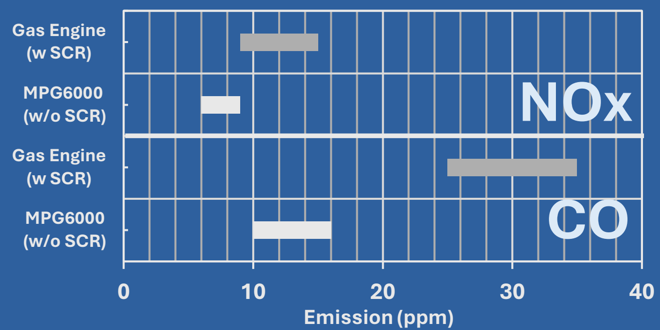




Production Saturated Steam @ 220PSIG, 80% Return Steam Water@212°F, Make-up Water Temperature 60°F, Pinch Temperature 36°F

Emissions

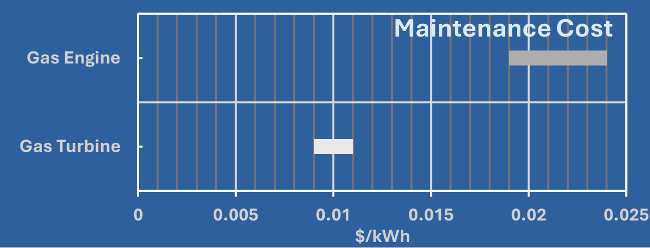
Gas turbines offer considerably lower emission levels compared to gas engines. MPG product family's emission levels are as low as <9 ppm NOx and <16 ppm CO without requiring any after-treatment. In comparison, gas engines typically need an after-treatment system (SCR) consuming ammonia to achieve levels of <15 ppm NOx and <35 ppm CO. This advantage allows for higher installation capacity with less CapEx and eliminates the need for SCR systems.



Maintenance Cost

With less than half of the maintenance cost compared to gas engines, gas turbines can provide a substantial reduction in OpEx. Also, the downtime for major overhaul for gas turbine (MPG products) can be as low as 48 hours compared to close to 30 days for a gas engine.

Overhaul	Minor	Major
Gas Turbine	8000 hrs	40,000 to 50,000 hrs
Gas Engine	2000 hrs	40,000 to 60,000 hrs



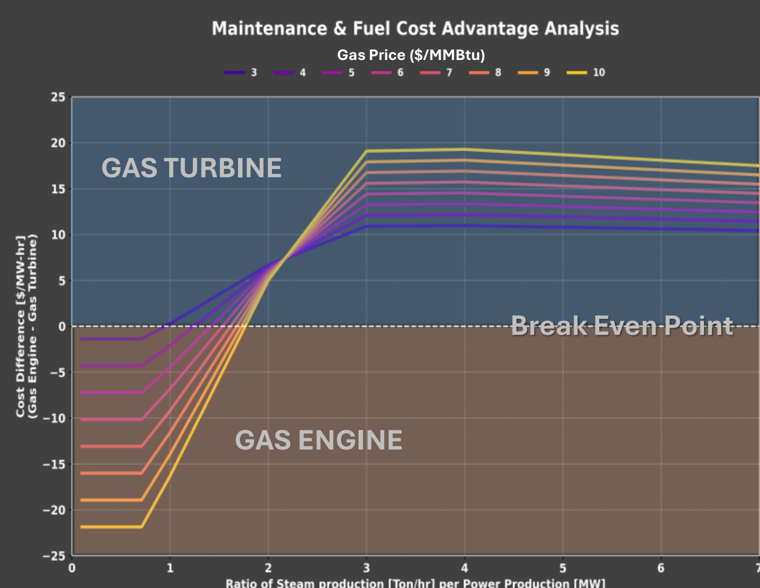
Cost Advantage Analysis

This chart provides a direct financial comparison between Gas Engine and Gas Turbine CHP systems. The vertical axis represents the operating cost difference (Engine - Turbine), where a negative value indicates a cost advantage for the Gas Engine, and a positive value favors the Gas Turbine.

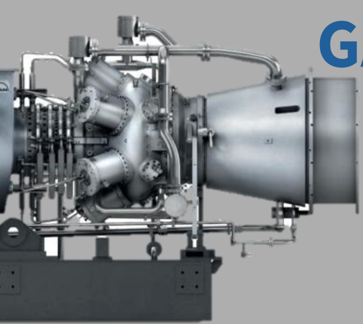
Key Findings:

1.Fuel Price Dictates the Break-even Point: The economic crossover point is highly sensitive to the price of natural gas. As fuel costs increase (from darker to lighter lines), the operational range where the Gas Turbine is the more cost-effective choice expands significantly.

2.Advantage is Determined by Steam-to-Power Ratio: The chart reveals a clear operational dichotomy. While Gas Engines consistently hold a cost advantage in applications with low steam production requirements, the financial advantage shifts decisively to the Gas Turbine as steam demand increases. This advantage is not static; it amplifies at higher ratios. To illustrate, consider a facility where gas costs $7/MMBtu. If this facility has a high steam demand (a ratio of 5), the chart shows the Gas Turbine offers an operational cost saving of nearly $15 per MWh.



Conclusion: This analysis underscores the importance of selecting a CHP technology based on a facility's specific steam-to-power profile and local energy pricing to maximize financial returns.



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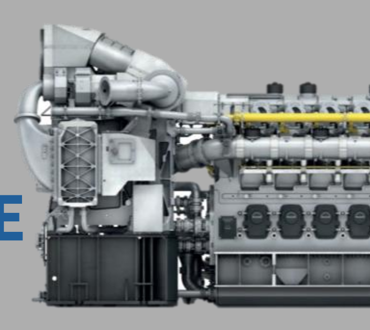

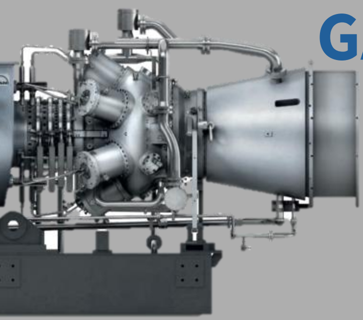

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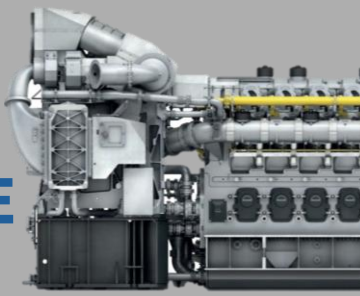

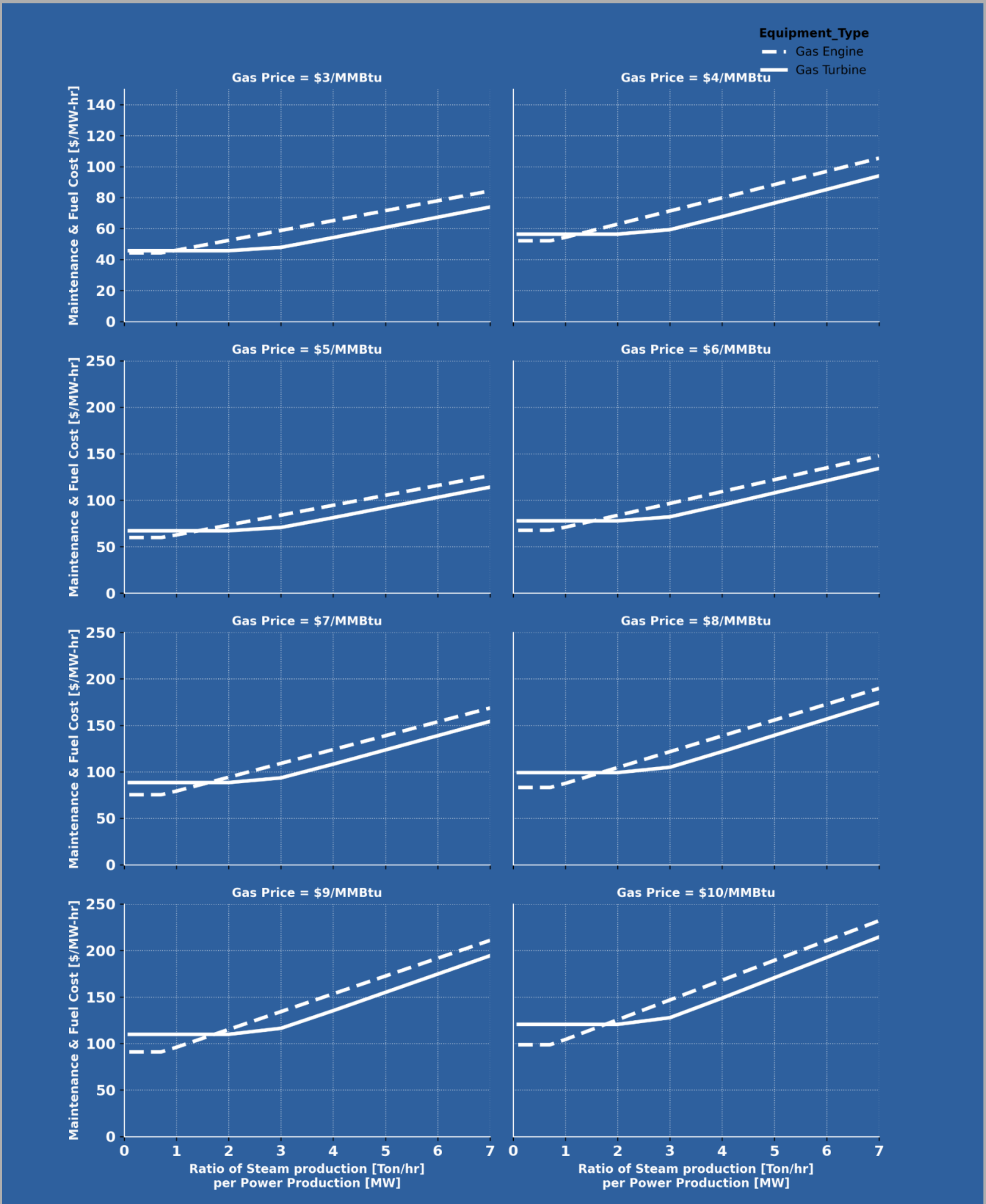

METIS POWER

POWERING WHAT'S NEXT...

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