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GE's HYDROGEN TRACK RECORD: **120+ Units** running on hydrogen blend | **8.5M+** operating hours | Pathway toward **100%** hydrogen capacity by the end of the decade | **50 Years** of hydrogen experience

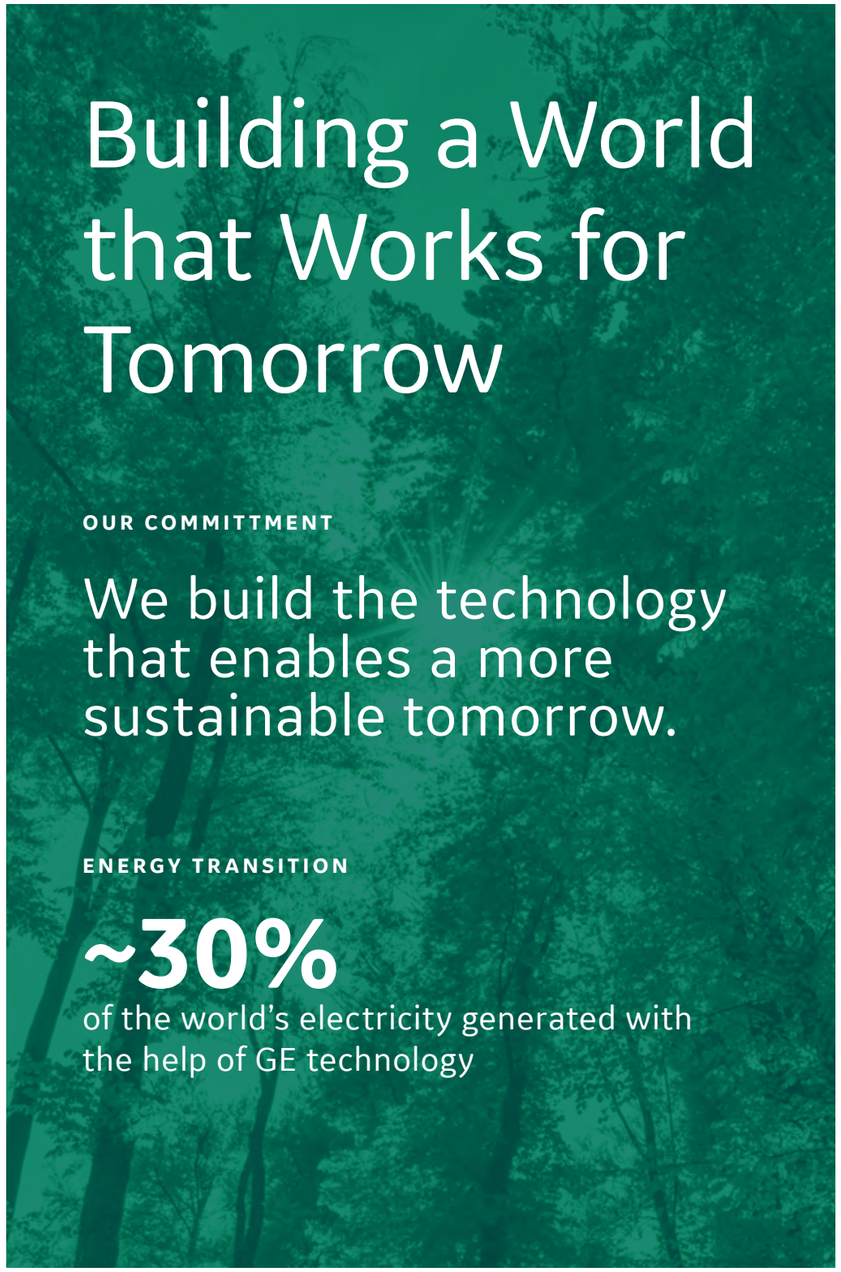
THE ENERGY TRANSITION

The International Energy Agency (IEA) expects global energy consumption will grow by 75% between a 2021 and 2050. Electricity generation contributes around 40% of man made global CO_2 emissions, and this will need to be drastically reduced to achieve the Paris Agreement goal of keeping the rise in global temperatures to well below 2°C.

With this challenge becoming clear, global regulators and industry experts are starting to paint a picture of what the future energy mix will need to look like. While fossil fuels and natural gas will still need to play a role to support the transition, there will be huge growth in the clean energy and renewables sector as well as in the use of decarbonization† technologies.

In its 2022 World Energy Outlook the IEA notes: "The world is in a critical decade for delivering a more secure, sustainable, and affordable energy system – the potential for faster progress is enormous if strong action is taken immediately. Investments in clean electricity and electrification, along with expanded and modernized grids, offer clear and costeffective opportunities to cut emissions more rapidly while bringing electricity costs down from their current highs."

As a company whose equipment helps generate "~30%" of the world's electricity, GE has a responsibility to lead the industry's decarbonization efforts and help meet the rising global demand for affordable, reliable, and sustainable electricity, especially for the more than 750 million people without access.



† Decarbonization as used herein is intended to mean the reduction of carbon emissions on a kilogram per megawatt hour basis.

Beyond providing technology the world needs today, GE is equally focused on the important role of building the breakthrough technologies the world will need in the future, including the use of low- and zero-carbon fuels such as hydrogen for recent and existing gas plants and carbon capture, utilization, and sequestration (CCUS) systems. For example, we are working to help construct and update power plants in the U.S., Australia, and China to run on blends of hydrogen and natural gas and we are systems Front-End Engineering Design (FEED) studies for CCUS solutions in the U.S. and U.K. to significantly reduce CO_2 emissions from power generation.

GE's gas turbines will remain essential to decarbonization by enabling the rapid transition of baseload generation away from coal-fired technologies. They also will be a key enabler to increasing renewables by helping to ensure overall system reliability as renewable power generation grows in many segments. We expect gas generation will continue to play a key role as a destination technology in the energy transition through the breakthrough technologies of pre-combustion hydrogen fuel use and post-combustion CCUS.

More work needs to be done to reduce the cost of hydrogen and CCUS technologies to accelerate their deployment. These technologies have the potential to significantly enable near-zero-carbon power generation, and some governments are offering incentives to foster adoption.

The energy transition remains the greatest uncertainty for the power sector today. While the sense of urgency to address climate change has never been higher, the pace and scale of investments must increase significantly to aim to meet decarbonization goals.

A POWERFUL COMBINATION – RENEWABLES PLUS GAS-FIRED POWER

GE believes that accelerated and strategic deployment of renewables and gas power can change the trajectory for climate change, enabling substantive reductions in emissions quickly, while in parallel continuing to advance the technologies for low- or near zero-carbon power generation.

Viewed separately, renewables and gas generation technologies have merits and challenges in addressing climate change, and optimum solutions will differ regionally. Such solutions will depend upon factors such as the current level of reliable access to electricity, fuel availability and security, land use constraints, renewable resource availability, and the emphasis a particular region is placing on climate change. Together, their complementary nature offers tremendous potential to address climate change with the speed and scale the world requires. GE as a company is uniquely positioned to play a role through its scale, breadth, and technological depth.

GE's HYDROGEN TRACK RECORD: **120+ Units** running on hydrogen blend | **8.5M+** operating hours | Pathway toward **100%** hydrogen capacity by the end of the decade | **50 Years** of hydrogen experience

A mix of generation sources is the most effective way to provide system reliability and energy security. The world is better served by accelerating renewables deployment, running existing gas plants more, and adding newer gas capacity as the industry reduces coal generation. GE believes in and promotes additional renewables capacity, augmented where needed with natural gas generation to provide system flexibility and dependable capacity, as the most effective near-term action to decarbonize the energy sector.

On a global scale, replacing coal with a combination of variable renewables and batteries plus dispatchable gas yields greater carbon reduction than renewables alone (see figure adjacent).

POTENTIAL FOR REDUCING COAL EMISSIONS BY USING RENEWABLES PLUS GAS POWER

CO_2 REDUCTION POTENTIAL

COAL → WIND + SOLAR PV = **25–45%**

Reduces 100% of the carbon 25–45% of the time
coal must run when wind and sun are not available based on average capacity factors

COAL → COMBINED CYCLE GAS = **50–60%**

Reduces 50–60% of the carbon 100% of the time
gas runs baseload and the coal plant can be shut down

COAL → WIND + SOLAR PV + COMBINED CYCLE GAS = **62–78%**

Renewables reduce 100% of the carbon 25–45% of the time
and gas reduces 50–60% of the carbon the rest of the time.

COAL → WIND + SOLAR PV + BATTERY + COMBINED CYCLE GAS = **68–80%**

Renewables plus 4-hr batteries reduce 100% of the carbon 35–50% of the time
and gas reduces 50–60% of the carbon the rest of the time

Replacing baseload coal with a combination of renewables and gas yields the quickest carbon reduction at scale.
Note that CAPEX and required land are not addressed in the above analysis.

	WIND, SOLAR & STORAGE	GAS POWER
FUEL	Limitless, free fuel that is variable	Flexible, dispatchable power whenever needed, utilizing abundant and affordable natural gas or LNG
CO_2	Carbon-free generation	Less than half the CO_2 of coal generation with a pathway to future conversion to low or near-zero carbon with hydrogen and Carbon Capture and Sequestration (CCS)
COST	Competitive Levelized Cost of Electricity (LCOE) with no lifecycle uncertainty (mostly CAPEX)	Competitive LCOE with lowest CAPEX, providing affordable, dependable capacity
DISPATCH	Dispatched first in merit order… extremely low variable cost	Most affordable dispatchable technology… fills supply/demand gap
PEAKING	Battery storage economical for short duration peaking needs (<8 hour, intraday shifting)	Gas economical for longer-duration peaking needs (day-to-day and weather-related extended periods)
CAPACITY FACTORS	25% – 55% capacity factors based on resources (wind and solar often complementary)	Capable of >90% capacity factors when needed, runs less based on variable costs and renewables
LAND	Utilizes abundant land with good renewable resources (multi-purpose land use); Offshore wind is not constrained	Very small physical footprint for dense urban areas with space constraints
HYBRID SOLUTIONS	Extends renewable energy to align with peak demand	Target carbon-free spinning reserve peaking plants using onsite battery storage

Natural gas-fired power generation is flexible and dispatchable. Plants can go online quickly, adjust power output level, and turn down to a very low output level to balance supply and demand as needed. They can provide more power or less as supply and demand for electricity varies throughout the day, over the course of a week or month, and seasonally, whenever required. This flexibility is especially important to maintain grid stability as more non-dispatchable wind and solar resources are deployed. Because electricity supply and demand must always be in balance, renewables require dispatchable backup power such as natural gas power plants or batteries to help ensure system reliability.

With less than 50% of the CO_2 emissions of coal, gas can provide affordable baseload power in developing, high-growth regions and then transition to economic and complementary cyclic or peaking power as needed to accommodate future renewables growth. Land is an increasingly scarce global resource that is subject to competing pressures from agriculture, human settlement, and energy development. Renewable sources such as wind and solar PV are less power dense than natural gas power, meaning that they require more land per unit of installed generating capacity or unit of electricity produced.

A key element of decarbonization of the power sector will be to help ensure the entire system, including generating assets, the grid, and loads, are integrated efficiently to improve electricity generation and thereby reduce carbon emissions. This is where GE digital technologies can play an important role.

System operators will need to integrate and enhance dispatch of all assets after factoring in wind and solar resources days or weeks ahead, while considering the actual cost of each generation source, including maintenance costs. Gas power plant component life is largely dictated by thermal consumption of parts, whereas wind components are driven more by mechanical wear, solar plants by output degradation, and battery systems on the number of charge/discharge cycles. All of these factors can be improved digitally to help ensure the lowest carbon/least cost generation solution is achieved in real time.

INNOVATING BREAKTHROUGH TECHNOLOGIES

The achievement of deep decarbonization goals over the coming decades is likely to depend in part on technologies that are still being developed and have yet to be deployed or widely adopted. Together with our partners, we are working on hydrogen as a fuel, carbon capture and sequestration, superconducting generators for wind turbines with no rare earth materials, advanced nuclear power, and additive manufacturing. GE's history of innovation has prepared us to support the global energy transition in ways that are as equitable as they are efficient.

DLN Evo: Newer F-Class Pre-mixed Combustion Technology

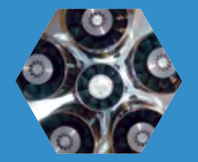
In development, available for order in 2024, delivery in 2026

The Evo combustion system is based on fielded HA technologies and experience: Advanced mixer, axial fuel staging (AFS), and unibody construction.

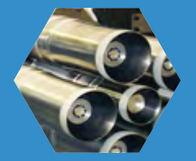
BENEFIT FROM:

TURNDOWN IMPROVEMENT
>50% over DLN2.6+
- As low as 10% GT load
- As low as 20% CC load

FUEL FLEXIBILITY
- Up to 80% vol hydrogen



NOx EMISSIONS
- 9 ppm with natural gas
- 15 ppm with natural gas/hydrogen blend



EXPANDS OPERABILITY SPACE OVER DLN2.6+

FULLY COMPATIBLE/RETROFITTABLE WITH ALL EXISTING 9F GAS TURBINES

GE's HYDROGEN TRACK RECORD: **120+ Units** running on hydrogen blend | **8.5M+** operating hours | Pathway toward **100%** hydrogen capacity by the end of the decade | **50 Years** of hydrogen experience

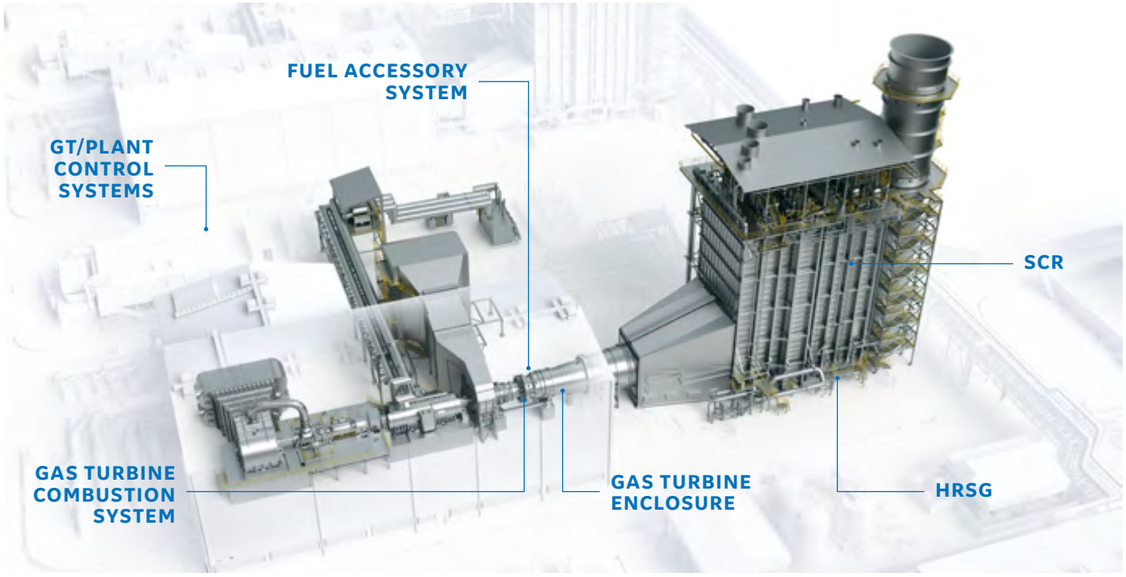
GE is investing today in innovation to decarbonize gas turbines in the future. Decarbonizing a gas turbine requires the supply of a low-carbon fuel (e.g., hydrogen) and/or the capturing of carbon from the exhaust for transport offsite. GE is investing in both decarbonization pathways to aim to ensure we have multiple solutions for the world to fulfill carbon reduction commitments.

We have more than 120 gas turbines worldwide using hydrogen and associated fuels for power generation, with more than 8.5 million operating hours in aggregate. Our HA gas turbines with DLN technology can already operate with up to 50% hydrogen/natural gas mix Work is under way to extend the capability to 100% hydrogen in these machines by the end of the decade.

GE has more experience burning hydrogen than any other OEM, dating back to the 1970s. We understand the unique challenges of using hydrogen as a gas turbine fuel. GE leads in hydrogen combustion capability today and will continue to expand capability for increasing blends with a goal of 100% hydrogen capable products by 2030. Each gas turbine model has specific capability for burning hydrogen, dictated primarily by the combustion system. Some are capable of burning 100% today.

Low and zero carbon energy, such as lost cost wind power, will play a major role in the supply of green hydrogen, which ultimately could rival renewable energy demand for power applications. Our Renewable, Grid, and Power Conversion businesses have the domain expertise to develop solutions to help ensure efficient use of renewable power and electrolyzer assets.

Potential Hydrogen Impact on Newer and Existing Power Plants



HYDROGEN CAPABILITIES IN GAS POWER PLANTS

Existing gas power plants can be retrofitted to burn higher volumes of hydrogen than originally contemplated. These upgrades can be scheduled with planned outages to decrease the time the plant is not generating power, and for new units these capabilities can be part of the initial plant configuration or phased in over time as hydrogen becomes available.

In addition to differences in the combustion properties of hydrogen and natural gas, it's important to consider the impact to all gas turbine systems, as well as the overall balance of plant. In a power plant with one or more hydrogen-fueled turbines, changes may be needed to the fuel accessories, bottoming cycle components, and plant safety systems.

Because hydrogen is more flammable than natural gas, critical aspects are considered to help ensure the safe operation of a gas turbine with a natural gas/hydrogen fuel blend. For example, the gas turbine enclosure and ventilation system must be configured to help ensure the concentration of hydrogen is maintained outside of its upper and lower explosive limits. Furthermore, hazardous gas and flame detection systems configured for typical hydrocarbon fuels may need to be supplemented with systems capable of detecting hydrogen. There are other changes and upgrades that must be considered if you're thinking about safely running your power plant on a hydrogen blend.

Newer gas turbine power plants could be "hydrogen enabled," meaning that they are configured to operate on natural gas when they enter commercial operation with provisions put into place to allow hydrogen fuel upgrades more easily in the future. A hydrogen-enabled power plant might require modifications to the plant's configuration that are easier to implement during construction than in the future when the plant is fully operational. Examples include different physical layouts (to allow for the addition of hydrogen fuel systems) and upgrades to safety systems.

Hydrogen Enabled Power Plants

HRSG/SCR	COMBUSTION SYSTEM	FUEL ACCESSORY SYSTEM	GAS TURBINE ENCLOSURE	CONTROL SYSTEMS
Hydrogen flame temps may increase NOx emissions, depending on the percentage of hydrogen in the fuel, selected combustion system and site operating conditions. A larger or more efficient SCR may be required†. HRSG duct burner upgrades may be required for safe/reliable operation.	Based on significant differences in methane and hydrogen flame speeds, combustion upgrades with defined flame speed ranges configured for hydrogen may be required. Combustor configuration changes may be needed to operate with high concentrations of hydrogen.	For higher hydrogen concentrations, all piping and fuel accessories must be configured to handle larger volumes of fuel. Hydrogen molecules, which are smaller than molecules of hydrocarbon fuels, have a higher propensity for leakage, requiring better sealing and leakage detection. Welded piping and flanges may be required.	Based on reduced instrument sensitivity newer hazardous gas detection may be required for lower luminosity flames. Installation of sensors and instrumentation specifically configured for hydrogen. Fire protection and ventilation is required to help ensure the hydrogen concentration is within acceptible operating range.	Combustion dynamics (acoustics) differences while burning hydrogen warrant a change in gas turbine controls, startup and shutdown sequences. Emissions controls may be required to stay within allowable NOx limits.

The magnitude of potential plant modifications is a function of the amount of hydrogen in the fuel.

† May also depend on existing permits, local regulations.

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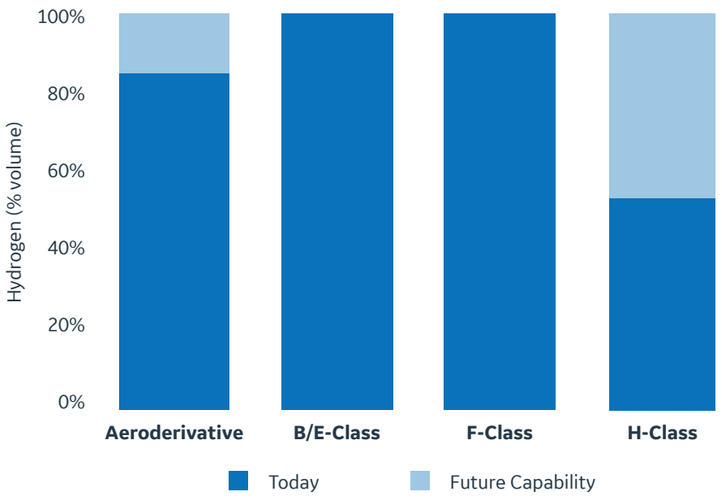
Hydrogen Enabled Power Plants



Hydrogen (% volume, actual hydrogen levels may vary based on gas turbine model, combustion model, combustion system, and overall fuel composition)

CARBON CAPTURE

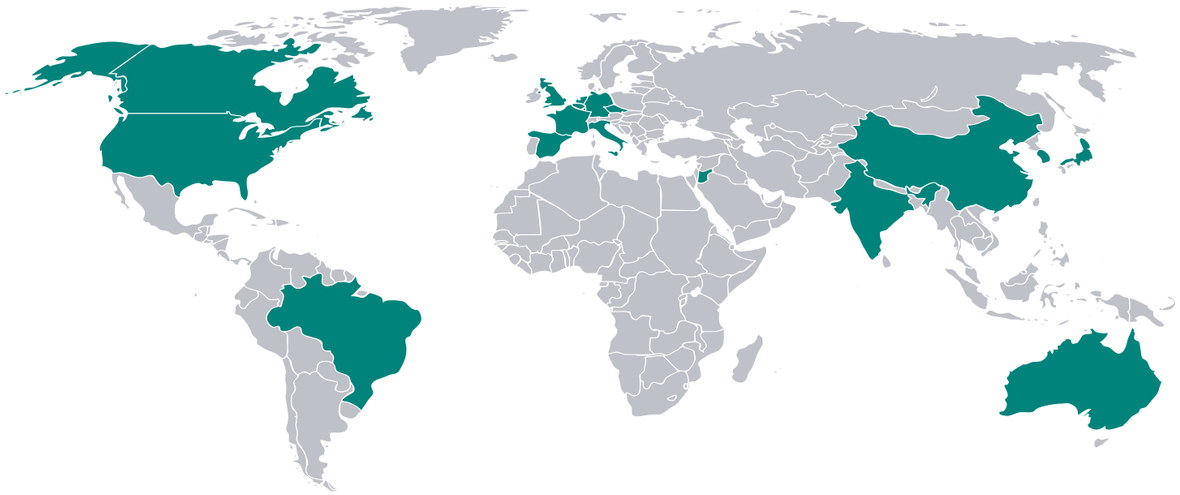
CCUS is the process of capturing CO_2 formed by fuel combustion in a power plant or industrial facility , and either re-utilizing it or storing it so that it can't enter the atmosphere.

GE is participating in multiple FEED studies to integrate carbon capture technology into a flexible gas combined cycle plant. Significant reductions in capital costs, operating costs, and physical space are under development, with the potential to improve carbon capture economics. In addition to investing in the improvement of the technology, GE continues to educate and inform policymakers to help ensure sensible regulations on CCS are prioritized as part of good decarbonization planning.

Similar to introducing hydrogen to a plant, CCUS can be applied to both newer and existing gas power plants. CO_2 can be extracted from power generation and industrial sites in the post-combustion phase,or even directly from the air. Once it's been captured, the CO_2 is compressed and then transported either by ships or pipelines. The US, for example, has about 5,000 miles of CO_2 pipelines today. Finally, the CO_2 can be stored safely far underground, or the CO_2 can be reused to produce synthetic fuels, chemicals, and building materials. Most of the captured CO_2 will be permanently sequestered.

Retrofitting existing plants helps de-risk future carbon regulations that impact the decision to build a gas-fired power plant today. Furthermore, retrofits can significantly extend the lifetime of operating assets, extending economic viability and deferring costly decommissioning expenses. According to the IEA's 2022 Net Zero by 2050 Scenario, more than 60 GW of coal- and gas-fired power plants operate with CCUS by 2030, and this rises to more than 330 GW by 2050.

Hydrogen Experience



GE's experience with hydrogen includes more than 120 turbines and over 8.5 million operating hours.

GE's Carbon Capture Product Offerings

Decarbonize at lowest overall cost while maintaining availability and reliability

STEAM INTEGRATION

- Utilizing GE's HRSG results in lower capital costs
- HRSG produces reliable steam for capture plant
- GE fine tunes steam path and steam turbine controls to reduce costs

+ LOWER CAPEX
+ EFFICIENCY

ENHANCED CO_2 INTENSITY

- Employing GE's GT combustion capabilities to increase CO_2 concentrations
- Increased CO_2 concentration helps reduce the size of the capture plant
- GE manages the risk of elevating the CO_2 in our GTs

+ LOWER CAPEX
+ LESS RISK EXPOSURE

ADVANCED CONTROLS

- Extending predictive model-based controls into the CCS plant
- Advanced simulation of integrated NGCC and CCS improves commissioning time and training
- GE manages the risk of GT and ST operability as well as CCS (e.g. grid, response, fast ramp, etc.)

+ RELIABILITY

MAINTAIN FUNCTIONALITY

- Building upon proven GT modifications to improve functionality
- Recover MW to compensate for CCS operation

+ RELIABILITY
+ OUTPUT
+ OPERABILITY
+ EFFICIENCY

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Not every combined-cycle power plant will be a good candidate for CCUS retrofitting due to factors such as available land, access to geologic storage formations, and lack of strong policies or incentives.

More funding of R&D can help reduce costs, improve efficiency, and accelerate deployment, leading to a more reliable grid. Governments must establish policies which recognize the important role of CCUS in the power generation sector and also accelerates the deployment of the technology

GE is improving carbon capture economics through our thermal integration, controls integration and operability, hardware integration, and strategic upgrades. We are committed to working with various technology providers and EPCs to provide pre- and post-combustion decarbonization technologies in a turnkey or phased approach, thereby allowing you to pace your decarbonization journey to help meet your needs.

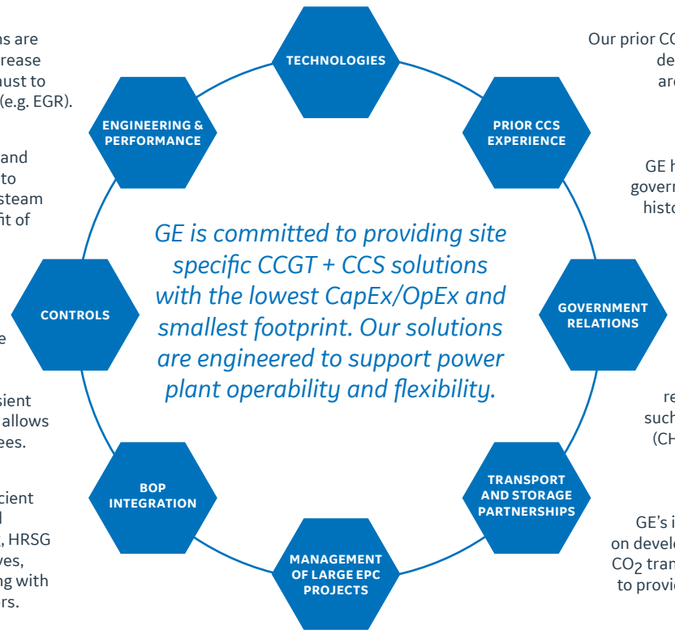
Integrating CCS with Combined Cycle

GT and plant engineering teams are focused on technologies to increase CO_2 and reduce O_2 in the exhaust to improve overall CapEx & OpEx(e.g. EGR).

GT, ST and plant configuration and performance expertise allows to evaluate the best location for steam extraction and potential benefit of GT enhancements to increase output and reduce impact to power plant heat rate.

GE's Controls team can provide one system to control GT/ST/ HRSG/BOP/CCS allowing for optimal steady state and transient operation. Integrated controls allows GE to offer total plant guarantees.

BOP team has expertise in efficient plant layout plus electrical and mechanical integration (piping, HRSG ductwork/damper, control valves, attemperators) by collaborating with EPC partners and tech providers.



Our prior CCS experience includes 13 CCS demonstration projects, located around the globe, engineered by GE's Steam Power team.

GE has multiple teams focused on government relations. GE has a long history of US DOE funding awards. Our Government Affairs team monitors emerging federal and state regulations.

GE has global experience with management of large EPC projects including those requiring significant integration such as combined heat and power (CHP) and integrated gasification combined cycle (IGCC).

GE's infrastructure team is focused on developing relationships to support CO_2 transport and storage allowing us to provide a complete CO_2 solution to our customers.

GE's Pre-Feasibility Study for Carbon Capture and Storage

GE will use a proprietary heat balance tool along with internal guidelines and standards to develop the following:

- Estimated performance and emissions (with/without carbon capture)
- High level information on the Carbon Capture and Storage (CCS) facility
  - — Estimated site-specific land requirements
  - — Typical process flow diagram
- Discussion of major modifications required to existing combined cycle power plant
- Preliminary thoughts on CO_2 transportation and storage
- High level schedule for a CCS project from first discussions through commercial operation
- Indicative CapEx and OpEx for adding CCS to the existing combined cycle power plant
- Suggested next steps

GE's CCS Front-End Engineering Design (FEED) Study Phase I

PRIOR TO STUDY:

Mutually agree on baseline performance, configurations to study (for example: EGR, Future H_2 in GT), and on approx. 10 individual cases for assessment (for example: Baseline at x% load and xo F ambient; Baseline with x% EGR; Baseline with x% H_2)

STUDY PART I:

GE and selected amine provider will assess the individual cases which includes:

- Preliminary heat balance
- Preliminary process flow diagram plus layout and list for major CCS equipment
- Preliminary layout and written description for any BOP that needs to be resized to support CCS (air cooler, for example)
- Written description of expected mechanical interfaces between NGCC/BOP and CCS
- Preliminary controls/controls integration philosophy for normal operation, start up, shut down, and upset conditions
- Preliminary discussion of technical risks

GE will develop techno-economic analysis (TEA) for the individual cases

- Performance (including efficiency, power consumption, flue gas and CO_2 flow rate)
- CapEx & OpEx

STUDY PART II:

- GE will assess approx. 5 combined cases which includes:
  - — Update any documents developed during assessment of the individual cases
- GE will develop techno-economic analysis (TEA) for the combined cases
- GE will provide a written report including findings, recommendations, and conclusions

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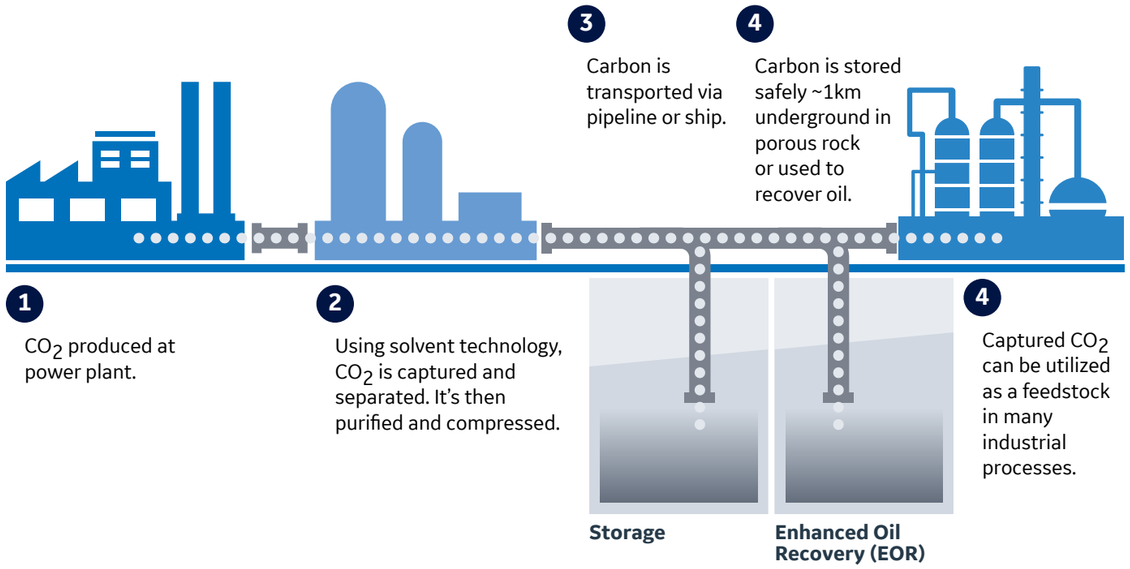
There are misconceptions of not enough capacity deep below the surface of the earth to house a meaningful amount of carbon and that potential storage reservoirs that do exist are far away and hard to access. According to third-party studies, hundreds of years of suitable storage reservoirs are available at today's global CO_2 emissions rates.

An additional public misconception is that carbon sequestration is unsafe, and there are fears that the carbon may not stay underground. While risks exist, they can be mitigated through proper regulation, monitoring, maintenance, and implementation of current tools. The same non-porous geologic structures that trapped hydrocarbons such as oil and gas for hundreds of millions of years are ideal for permanently trapping CO_2.

It's important to note that adding a carbon capture system to a gas plant would roughly double its capital cost and its footprint. Heat is needed for the carbon capture process, and GE's integration expertise is focused on providing site-specific solutions to reduce this impact.

Carbon capture using liquid amine solvents is a mature technology. Ample experience exists with capture, utilization, and storage. NGCC with post-combustion CO_2 capture plant impacts can be improved with robust integration of power plant and capture technologies.

GE is available TODAY to provide support as you continue to investigate decarbonization for your site.



"Cutting Carbon" Podcast

One of the most dynamic and informative conversations taking place on climate change is GE's "Cutting Carbon" podcast, in which co-hosts Dr. Jeffrey Goldmeer and Brian Gutknecht talk through the factors at play today as well as the journey ahead. The award-winning podcast sits on iHeartRadio's list of top podcasts in the "climate" category and has reached ~90,000 downloads.

We launched the podcast in 2020, with our first five seasons focusing on climate change and the basics of decarbonization, the pathways to decarbonize gas, complementary technologies contributing to the energy transition, how regions around the world are driving decarbonization, and decarbonization efforts outside the power industry.

In December 2022, we launched season six to take a deep dive into the critical role infrastructure plays in supporting and sustaining innovative decarbonization technologies With a roster of special guests, we highlight the role of Independent System Operators, digital lessons learned from Australia's grid operator, AEMO, pumped hydro storage, transportation of carbon after it is captured, the water-energy nexus, and how the public and private sectors can work together to support decarbonization R&D.

GAS POWER PATH TO DECARBONIZATION

APPALACHIA

GE Gas Power along with an alliance of six energy and manufacturing companies aims to establish a low-carbon and hydrogen industrial hub in northern Appalachia, USA with a goal to help decarbonize the industrial region.

TALLAWARRA B POWER STATION

Australia's first dual-fuel capable natural gas/hydrogen power plant at Tallawarra B Power Station will be powered by the hydrogen-ready 9F in peaking capacity to stabilize the grid and decrease carbon emissions footprint.

US DEPARTMENT OF ENERGY

The US Department of Energy awards funding to a GE-led project for integrating technologies to aim to capture ~95% of the carbon dioxide emissions generated at the 7F James M. Barry Electric Generating Plant.

GUANGDONG

Expected to burn up to 10% by volume of hydrogen blended with natural gas, the 9HA.01's at Guangdong Huizhou combined cycle power plant will be GE's first hydrogen-blended natural gas fueled facility in mainland China.

UNIPER

Grain power station has commenced its hydrogen plant readiness assessment which will include the scope required for operating the GT26 upgrade on up to 40% hydrogen while maintaining plant economics and reliability.

LONGRIDGE

The first GE H-Class power plant in the world utilizing hydrogen, Longe Ridge Energy Terminal successfully demonstrated the initial use of 5% hydrogen in its 7HA gas turbine via GE's H2 Integrated Fuel Blending System.

UAE MOU

Emirates Global Aluminum signs a MOU with GE to develop a roadmap to reduce gas turbine operation greenhouse gas emissions by exploring hydrogen fuel as well as carbon capture, utilization and storage solutions.

US DEPARTMENT OF ENERGY

The US Department of Energy awards funding to GE to focus on the study of highly reactive hydrogen fuels including testing gas turbine components with natural gas-hydrogen fuel mixtures up to 100% hydrogen.

SHARM EL SHEIK

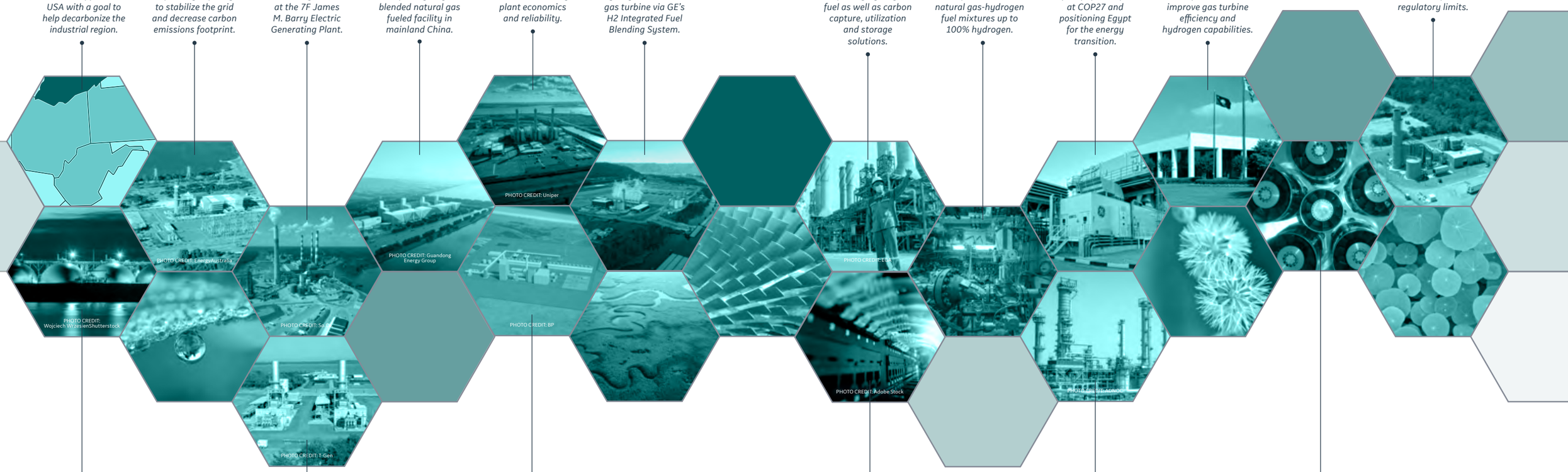
The LM6000 installed at Sharm El Sheikh Power Plant was successfully adapted to run on hydrogen-blended fuel in < 5 months, culminating in a proof of concept at COP27 and positioning Egypt for the energy transition.

US DEPARTMENT OF ENERGY

GE awarded ARPA-E OPEN 2021 program funding which will be used for "lifted-flame" combustion and modernizing casting methods supporting the potential to improve gas turbine efficiency and hydrogen capabilities.

NYPA

Brentwood Power Station's LM6000 runs on hydrogen fuel blends where CO2 rates were reduced by ~14% at 35% hydrogen and nitrogen oxides, carbon monoxide, and ammonia levels were also kept below regulatory limits.



SHELL COLLABORATION

GE collaborates with Shell to develop potential lower-carbon solutions for B&E-Class gas turbines, aiming to reduce the carbon intensity of Shell's LNG supply projects around the world by accelerating 100% hydrogen solutions.

CHANNEL ISLAND POWER

The trailer-mounted TM2500 for Channel Island Power Station will support grid firming as well as the Australian Government's commitment to building a hydrogen industry and the Roadmap to Renewables energy policy.

TEESSIDE

Technip Energies and GE are selected to develop a FEED study for the development of the proposed Teesside 860 MW highly efficient 9HA power plant and amine-based carbon capture facility.

ZERO LAB

GE joins other founding members Google and ClearPath for Princeton's ZERO lab coalition which aims to help leaders from diverse parts of the energy sector accelerate novel clean energy technologies.

ADNOC

A joint cooperation between ADNOC and GE supporting the Net Zero by 2050 strategic initiative will explore hydrogen fuels, evaluate ammonia, and introduce integrating carbon capture solutions at their power generation facilities.

US DEPARTMENT OF ENERGY

Advanced Mixed Mode Combustor for Hydrogen F-Class Retrofit receives US DOE funding for further development and testing of breakthrough technologies to burn higher levels of hydrogen in GE's largest installed base.

GE BELIEVES THAT ACCESS TO RELIABLE, AFFORDABLE AND SUSTAINABLE ENERGY IS ESSENTIAL FOR ALL PEOPLE GLOBALLY. AS THE DEMAND FOR ENERGY GROWS, GE IS COMMITTED TO PURSUING TECHNOLOGICAL INNOVATIONS TO SUPPORT DECARBONIZATION AND INCREASED RELIABILITY AND ACCESSIBILITY.

GE HAS A LONG HISTORY OF WORKING COLLABORATIVELY ACROSS THE ENERGY INDUSTRY TO ACHIEVE REAL AND LONG-STANDING POSITIVE OUTCOMES FOR OUR CUSTOMERS, THE INDUSTRIES WE SERVE AND OUR PLANET.

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A DIGITAL TRANSFORMATION WITH LIVE OUTAGE

Live Outage, the latest evolution of GE's outage services, is a weatherproof, touchscreen-based, digitized platform that replaces our traditional paper-based approach. This platform, part of our continuous improvement efforts, reduces the risk of mistakes and rework while speeding up the outage process, so you can reduce outage durations.

Live Outage was piloted for select gas turbines during the 2021 Fall outage season. Through the first half of 2022, Live Outage was implemented on 41 outages with 48 more outages expected by the end of the year. Live Outage will be rolled out on 9F outages in the first quarter of 2023. Our goal is to scale it to all GE technologies in the coming years.

The system is cloud-based and secure. Protecting outage data in the cloud was a critical development pillar.

Live Outage provides you access to outage related information: real-time schedule status, customer-related stop work events, suggested improvements, and approved data sheets.

Live Outage isn't connected to the customer's HMI or the operating system of the power plant, but it can help GE understand the quality and safety failures that occur during an outage. Fewer outage related failures will improve plant startup and running reliability.

The tool allows us to know the person who performed a specific task, the time of day an event occurred, and the specific step in the work method when something occurred. Armed with better information, we increase our ability to help prevent mistakes and rework from happening in the future.

This newer approach includes 14 hardened, weatherproof tablets and two large kiosks at each site. This hardware allows access to stored drawings, videos, and step-by-step checklists for the crew performing the outage. Immediate feedback and updates are available online.

Before Live Outage, outage execution relied on paper procedures and drawings found in the outage trailer or on the Field Engineer's laptop. Now, this information is fully digitized, enabling real-time access and progress tracking.

The Live Outage platform brings Lean techniques to our onsite execution teams by creating an integrated and scaled standard work practice, simplifying the complexity of the tasks at hand, and improving the safety, quality, and efficiency of the outage process.

CUSTOMER STORY: BORN FROM LEAN – LIVE OUTAGE

Four 7FA.03 gas turbines operating as peakers for a customer providing electricity to nearly 7 million residents went back online after a complex hot gas path (HGP) outage **6 days faster** than traditional methods all with the help of Live Outage.

THE FUTURE OF POWER AROUND THE WORLD

TECO BIG BEND

Tampa Electric Company's Big Bend power station replaces existing 50-year-old coal-fired units with two 7HA.02 gas turbines, nearly halving CO_2 emissions and increasing plant efficiency to greater than 60%.

OSTROLEKA

Ostroleka C power plant powered by a 9HA.02 gas turbine will play a strategic role in supporting the acceleration of renewable energy growth by enhancing the reliability and stability of the energy grid.

GUANGMING

Powered by three 9HA.01's the Guangming power plant is expected to help deliver up to 2 gigawatts of electricity to portions of a province with a population of ~126 million just in time to support coal-fired power retirement.

NHON TRACH

The 9HA.02's at Nhon Trach 3&4 are expected to provide over 1.6 gigawatts of electricity for three large industrial areas and contribute to the commitment to achieving net zero carbon emissions by 2050.

MELAKA

The commercial operation of the 2.2 gigawatt Alor Gajah, Malacca 9HA.02 power plant marks the start of the largest combined cycle power plant in Malaysia, supporting ~10% of the country's current power demand.

INDECK NILES

Indeck Niles Energy Center, built for generating resources after decommissioning of less efficient coal-fired plants, reaches commercial operation with two 7HA.02's helping to deliver ~1.1 gigawatts of electricity.

BANG PAKONG

In response to a government commitment to retire less efficient power plants, the 9HA.02 Bang PaKong power plant has replaced 1.4 gigawatts of older technology and reduced the overall carbon footprint of the plant.

MANILDRA

The arrival of the LM2500 gas turbines at Shaolhaven Starches site will help transition the energy supply from existing coal-fired boilers to natural gas-fueled operations, reducing CO_2 emissions by up to 40%.

TAIWAN

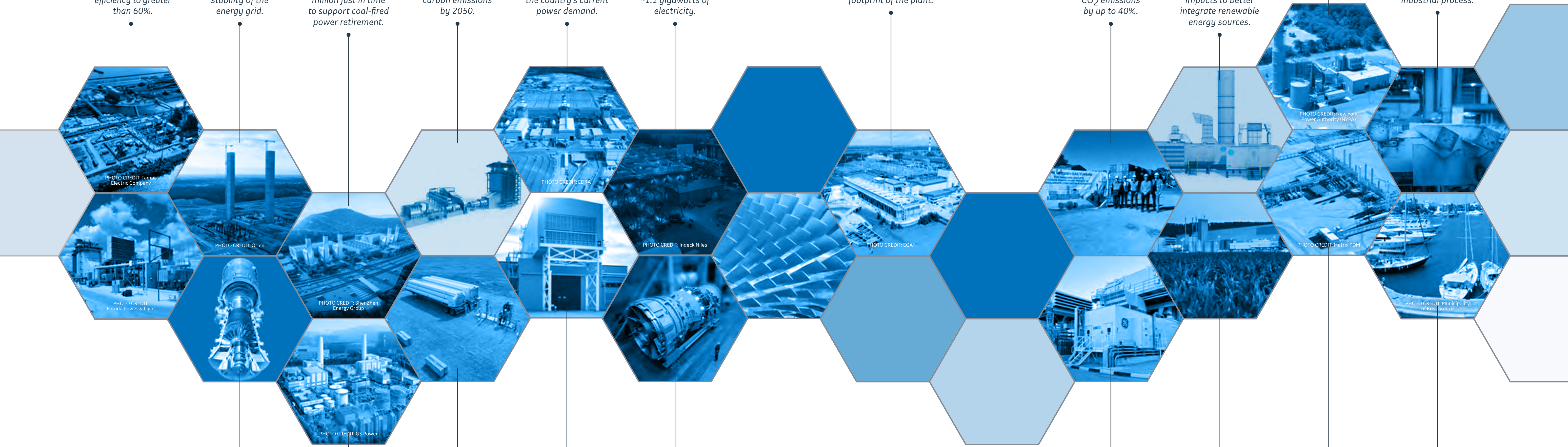
Tung Hsiao Renewal Project's LM2500XPRESS gas turbines are capable of starting in 5 minutes or less, performing daily starts and stops without maintenance impacts to better integrate renewable energy sources.

NYPA

The LM6000 fueled by blends of 5% to 40% hydrogen at the Brentwood Power Station demonstrated CO_2 emission rates during a pilot project were reduced by ~14% at 35% volume hydrogen, cofiring.

ALGOMA

Algoma Steel's energy transformation program to be supported by two LM6000 gas turbines, bringing more efficient, more flexible, and lower-carbon power for their industrial process.



DANIA BEACH

One of the most fuel-efficient plants in operation, Dania Beach Energy Center with around-the-clock power to enable America's largest solar expansion is powered by the 7HA.03, GE's most efficient and flexible 60 Hz gas turbine.

AZULAO

The 7HA.02 for Azulao power plant will help deliver highly efficient and reliable reserve power to help stabilize the grid, support the energy transition, and enhance renewable energy growth in Brazil.

ANYANG

The Combined Heat and Power of Anyang District Heating Plant benefits from highly efficient and advanced 7HA.02 technology which is capable of reaching more than 93% efficiency in district heating mode.

LONG RIDGE

The successful demonstration of 5% hydrogen-blended fuel in Long Ridge's 7HA.02, signifies the first time a GE H-class gas turbine utilized hydrogen in a commercially operating power plant worldwide.

GREENVILLE TEST STAND

The 7HA.03 was subjected to nearly 500 hours of turbine validation facility testing utilizing thousands of sensors to gather gigabytes of data, all to test the engine's durability, maximum efficiency and power.

MAGNOLIA

Once it is in commercial operation in 2025 the Magnolia plant powered by the 7HA.03 gas turbine is expected to be the most efficient plant in the MISO South system, supporting ongoing energy transition.

SHARM EL SHEIKH

The Sharm El Sheikh LM6000 hydrogen demonstration performed during Energy Day at COP27 was successfully executed in less than five months from the signing of the strategic cooperation agreement.

SWISS GOVERNMENT

Demonstrating the crucial role TM2500's can help deliver in emergency situations, the Swiss Federal Office of Energy is renting eight trailer mounted units to help meet electricity demand during the winter season.

WEST TEXAS

Two LM2500EXPRESS aeroderivative gas turbines expected to be in commercial operation near year's end will help the West Texas Gas North Permian Midstream plant process gas.

TERNA SA

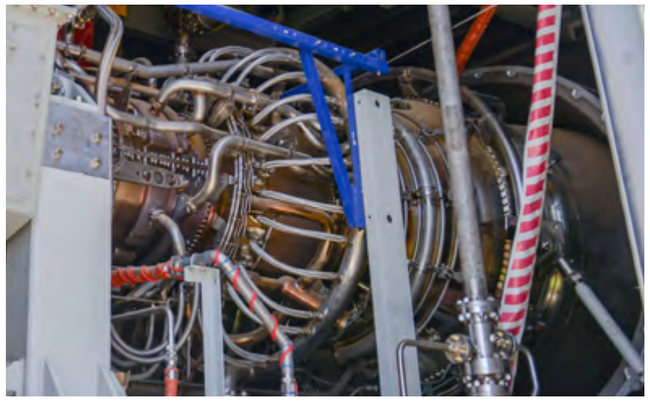
Greece, in need of emergency fast power to support peak demand during summer months orders a TM2500 with immediate shipment availability and begins operation within 100 days of the order.

GAS TURBINE LEASING PROGRAM

GE'S AERODERIVATIVE GAS TURBINE LEASE POOL PROGRAM IS ENGINEERED TO REDUCE OVERALL LIFE-CYCLE COSTS AND PROVIDE A LOW-COST METHOD FOR MAINTAINING UNIT AVAILABILITY.

Aeroderivative gas turbine leasing is an alternative to, or supplementary to, possessing spare engines. We have the largest LM fleet, more than 120 engines, ready to be deployed when the need arises. As a program member, you pay reduced annual fees and usage rates. You benefit from guaranteed asset availability and spare engine support without major investment.

You can lease gas turbines from GE when your own turbine is at a depot for repair or when it cannot be repaired on site within a reasonable amount of time. Formal lease agreements containing the specific terms and conditions of the lease are executed prior to leasing an engine. Lease assets are provided under member or non-member lease agreement concepts.



A member lease agreement is a minimum three-year contract in which you pay an annual membership fee and a usage fee by fired hour whenever a lease asset goes into service at your facility.

Availability for non-member usage is not guaranteed. A onetime fee and a weekly usage fee apply to non-members.

BRINGING OEM VALUE TO YOUR AERODERIVATIVE SERVICE NEEDS

When it comes to servicing your GE aeroderivative gas turbine, no one knows it better than we do. With more than 40 years and 150 million hours of proven LM engine operating experience, GE helps deliver the OEM value you need to get your unit back up and running as fast as possible. Our experts know all of the LM applications and understand the impacts of different operating conditions on our units.

As the OEM, we are the only ones with a full knowledge of your unit's configuration parameters, operating stresses, and acceptance criteria. And we use world-class analyses tools based on modern aviation engineering practices and backed by indispensable world-wide fleet input. All of this enables our team to quickly and effectively evaluate your problem and provide timely root cause analysis. And, when we offer upgrades to your LM aeroderivative equipment, you can breathe easy knowing all improvements are based on our known engine configurations.

What's more, our parts supply chain for repairs is the same as that for our newer units. It is continuously monitored to help meet our high-quality standards.

IMPROVE OUR ABILITY TO SUPPORT YOU

Ask your service provider if all replacement parts will be manufactured by GE and if we will be authorizing all component repairs, control modifications, and upgrades performed. We license our authorized service providers (ASPs) to help ensure they have full knowledge of GE's instruction manuals. Because our manuals do not cover installation needs and operating conditions related to non-OEM materials, we recommend that you use only approved OEM replacement parts and substantiated OEM repairs for our LM engines.

UNAPPROVED PARTS & REPAIRS PUT YOUR TURBINE AT RISK

Many turbine parts—like hot section flow components—operate at high energy. And, because there is a minimum margin engineered into these critical parts—even seemingly small changes can result in significant direct and indirect consequences. GE has a limited knowledge of non-OEM materials and cannot fully analyze their potential impact on adjacent parts, such as disks and thermal shields.

The use of unapproved parts and repairs on OEM hardware may negatively impact GE's ability to provide technical, maintenance, or warranty support to the engine or engine package systems, parts, or assemblies. As such, non-OEM materials and unapproved repairs on OEM material may significantly impact commercial conditions for future service from GE.

Here's a real-world case study that shows the difficulties that can result from the use of non-OEM materials in your GE aeroderivative gas turbine:

PROBLEM	DETAILS	IMPACT/RESOLUTION
CUSTOMER WITH AN UNAPPROVED HOT SECTION EXPERIENCED STALLS SHORTLY AFTER INSTALLATION	• 3 stalls experienced over a 4-week period • Each stall occurrence resulted in 2–3 days of downtime and repairs, including inspection and post-stall checklist • GE's technical team was engaged, but support was limited by uncertainties around system issues with non-OEM parts and their impact on stall margins	• Customer operated below full power for more than 10 weeks and experienced at least 3 outages while GE's investigation was slowed by unknowns related to non-OEM parts • Vibration issues were finally resolved after the customer made the decision to replace the non-GE hot section with GE parts from their spares, without a shop visit

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PARTNERING WITH GE: LONG-TERM SERVICE OFFERINGS AND MULTI-YEAR AGREEMENTS

GET THE MOST OUT OF YOUR AERODERIVATIVE GAS PLANT ASSETS WHILE BALANCING PERFORMANCE AND RISK AND BENEFITING FROM FLEXIBLE BILLING ARRANGEMENTS AND PREDICTABLE COSTS.

Business environments are constantly transforming, but you need consistent outcomes. By partnering with us for long-term service agreements (LTSAs) and multi-year service agreements (MYAs), you'll be able to realize the full potential of your aeroderivative gas plant.

Aeroderivative gas plant operations and daily maintenance go through GE's Operation & Maintenance (O&M) support team. That means access to 10,000 experts providing planned and unplanned O&M support with OEM-quality gas turbine parts, repairs, and service.

We offer a wide range of guarantees on both a plant and turbine basis, including:

- Unplanned events
- Outage duration
- Availability and reliability
- Emissions assurances
- Maintenance performance guarantees

BENEFITS:

Companies that have taken advantage of GE's LTSAs have seen significant performance and operational excellence results, including an availability advantage up to 0.74% and a reliability advantage up to 0.38%. This equates to 2.5 days of additional asset availability.

With over 1 million installed MW in more than 120 countries, our MYAs are available wherever you need them to provide the right partnership in a dynamic world. We have MYAs in place with aeroderivative gas plants around the world, including more than 80 in Latin America, 160 in Asia/Australia, 174 in the Middle East/ Africa, 285 in Europe, and 370 in North America.

A power plant LTSA such as a contractual service agreement (CSA) or a multi-year maintenance program (MMP) gives you better access to technology that will keep your aeroderivative gas plant relevant in the future. As the world's largest supplier of gas turbine technology, with the world's largest installed base, we're ready to help you meet the challenges of tomorrow today.

Our CSA for aeroderivative gas plants and turbines is engineered to address your challenges. Let us take care of the planned and unplanned maintenance of your key plant equipment. With a power plant CSA, GE shares your business risk and is devoted to helping you achieve your business goals.

Do you need streamlined access to quality parts and services, such as rotor repair and balancing, with predictable cost from the OEM? MMP is a long-term power plant service agreement that gives you the flexibility to determine your maintenance scope while relying on GE to help deliver high-quality gas turbine parts and services at preferential conditions, reducing administrative efforts and simplifying planning.

With our customizable O&M power plant services options, we can take your aeroderivative gas plant to the next level. Whether you're seeking advisory services to enhance your own operation or are looking for a full-service operator to perform all the daily activities associated with operating your site, we can create an operational partnership and planned aeroderivative gas plant maintenance contract with solutions to help meet your business goals.

By combining an O&M partnership with our CSA or MMP programs, you'll be able to increase your aeroderivative gas plant's productivity, enhance your profitability, and maintain the flexibility to adapt your operation over time as your organizational needs and goals evolve. Best of all, you'll be able to take advantage of long-term financial predictability.

7HA.02 AGP+C1 UPGRADE

YOUR PLANT WILL RUN MORE EFFICIENTLY WITH OUR 7HA.02 AGP+C1 UPGRADE, WHICH WILL ALSO INCREASE YOUR ASSET UTILIZATION AND YOUR PLANT'S AVAILABILITY.

The AGP+C1 upgrade offers higher firing temperatures, resulting in more exhaust energy, and the ability to make your combined cycle megawatts more efficiently. Maximum flexibility for baseload and peak power demands and industry-leading service intervals for minimum downtime make improved merit order a benefit of the upgrade.

We updated the combustor's Axial Fuel Staging (AFS) configuration for better NOx control. The combustor also features enhanced cooling for durability, additional turbulators for more effective heat transfer, and improved thermal barrier coating (TBC).

For turbine stages 1-4, upgrades to the blades include enhanced reduced-conductivity (Low K) thermal barrier coatings and improved cooling. The nozzles now feature a cooled configuration for part-life longevity, enhanced Low K thermal barrier coating, a larger throat area, improved cooling, and up-to-date circumferential seals. The shrouds have a newer cooling hole pattern, preferred material, and minor flow path changes for better clearance.

Finally, electronic heating blankets were added to improve clearance in the compressor and turbine sections.

BENEFITS:

Greater output and improved heat rate

@ ISO, Baseload	Output (MW)	Heat Rate (BTU/kWh)
1x1 Combined Cycle	Up to +9.6%	Up to -0.53%
2x1 Combined Cycle	Up to +9.6%	Up to -0.53%

@85F, Baseload	Output (MW)	Heat Rate (BTU/kWh)
1x1 Combined Cycle	Up to +7.2%	Up to -0.67%
2x1 Combined Cycle	Up to +7.2%	Up to -0.67%

Better availability
32,000 hours service interval

7HA/9HA PARK MODE

A 15% PARK MODE ENABLES PLANT OPERATORS TO LOWER FUEL BURN AND SHUTDOWN/START COSTS DURING PERIODS OF LOW DEMAND WHILE PROVIDING A FASTER RAMP TO FULL LOAD.

HA gas turbine products offer a low-load, low-emission operating point for both single-shaft (SS) and multi-shaft (MS) arrangements. This load point is available for steady-state, extended operation, and occurs with the gas turbine synchronized to the grid, while the steam turbine can either be uncoupled (clutch disengaged) or engaged.

The plant can operate at its lowest fuel consumption with low emissions, enabling it to avoid the expense and effort needed for shutdown and restart during brief periods of low electricity demand and price. In addition, normal GT ramp rates (8.33%/Min) remain available during park mode, allowing the plant to be flexible and responsive.

Maintenance intervals and parts lives can be extended through avoidance of shutdown and subsequent restart. Start emissions reach maximum levels during the transient period from initial startup to MECL. For plants with annual limits on overall mass of emission, avoidance of starts by sustained operation in stand-by or response modes can lower annual emissions significantly.

Emission levels during Park Mode will be lower than 25 ppm NOx (corrected to 15% O_2) and 80 ppm CO from the GT and similar to normal base loaded operation.

7HA/9HA WET COMPRESSION (WC)

THE WET COMPRESSION SYSTEM ENABLES UP TO A 10% POWER INCREASE WHILE OPERATING ON GAS FUEL, WHICH IS ESPECIALLY USEFUL IN HOT OR TROPICAL CLIMATES.

Now that gas turbine plants are increasingly required to take a load-following role, wet compression can be vital if it is properly controlled—equating to higher revenue, reduced fuel costs, and lower maintenance costs.

WC is a power augmentation system used to enhance output at baseload, particularly during summer peaking operation. The system operates in combination with an inlet evaporative cooler to improve mass flow into the turbine and maintain inlet humidity conditions regardless of ambient conditions, helping to ensure repeatable intercooling results.

There are no limits as to the number of hours that a WC system can be operated. However, as with evaporative cooling, wet compression cannot be run at ambient temperatures below 59°F due to the potential for icing.

The key components in the WC system are:

- high-pressure pumping skid, which includes the high-pressure water pumps, filters, valves, flowmeter, and instrumentation
- spray nozzle grid mounted inside the inlet duct
- water delivery interconnect piping between the pump skid and spray nozzle grid
- gutters and a false floor on the inlet plenum
- drain system (part of pump skid and plenum drain arrangement)
- controls in accordance with engineering standards

Benefits of Wet Compression:

- Increased GT or CC output during Hot Day Operation
- Reduced compressor discharge temperature and maintenance factoring for rotor life.

9F ADVANCED GAS PATH

Increase output, efficiency and availability while extending your 9F gas turbine assets with GE's Advanced Gas Path (AGP). You benefit from increased revenue, lower fuel consumption and reduced maintenance costs.

GE's 9F AGP portfolio is a collection of evolved hot gas path upgrades that aim to deliver industry-leading performance and operational flexibility. Based on data-driven insights from a rapidly growing 9F AGP installed base, the solution blends hardware innovations with GE's advanced OpFlex* software. It was adapted from proven GE 7F AGP upgrade technology and improved upon by incorporating GE's latest HA gas turbine technical innovations.

Complemented by total plant and digital solutions, our AGP solution incorporates some of the industry's most versatile technology, enabling greater operational flexibility while also providing improved turndown and reducing fuel consumption and CO_2 emissions. All three stages of buckets, nozzles, and shrouds have been reengineered as part of a systemic approach in which each component complements its counterparts for enhanced overall performance.

AGP is also setting current standards in performance. By combining engineering innovations, materials advancements, and proven model-based control software, AGP enables you to benefit from dramatic output and efficiency improvements while extending maintenance intervals and maintaining low emissions.

BENEFITS:

- **Reliable.** Improve reliability by incorporating fleet experience
- **Proven.** F-class cycle conditions, materials, cooling and sealing technologies
- **Retrofittable.** Engineered as a system for upgrades of installed base and new units
- **Improve performance.** For better efficiency and more power
- **Low life cycle costs.** Extended hours and starts intervals, with extended life parts

9F ROBUST EXHAUST FRAME

REDUCE YOUR O&M COSTS AND DOWNTIME WITH A ROBUST EXHAUST FRAME UPGRADE.

Bringing the advantage of OEM data and product expertise, the robust exhaust frame upgrade evolves operational flexibility and boosts reliability.

Backed with GE's extensive fleet experience, this upgrade features advanced exhaust frame technology, tested and proven in our 7F.05 and 7HA/9HA gas turbines. The robust exhaust frame solution modernizes gas turbine exhaust systems to match today's demanding industry, adding the flexibility needed to manage the increased cyclical peak demands that future energy operators will require.

The mission-built robust exhaust frame addresses exhaust liner degradation from more frequent plant cycling. Using HA technology to protect 9F units during turndown and peaking helps reduce the cost and downtime linked to exhaust liner degradation from cyclic thermal stress.

Your 9F plant can gain significant availability and reliability through the reduction of unplanned outage risk, and it will benefit from shortened outage time with reduced scope of repairs.

The robust exhaust frame is a key hardware enabler for future enhanced turndown solutions. The upgrade is a true step forward in the evolution of your 9F gas plant, helping to ensure the flexibility to respond to changing demands on plant operations.

BENEFITS:

Increased flexibility. The robust exhaust frame adds flexibility to withstand cyclic operations and future operational demands.

Improved reliability and availability. Reduced unplanned outage risk—and shorter outage times—increase the reliability and availability of your plant.

Reduced O&M costs. The mission-built robust exhaust frame addresses costly exhaust liner degradation from more frequent plant cycling.

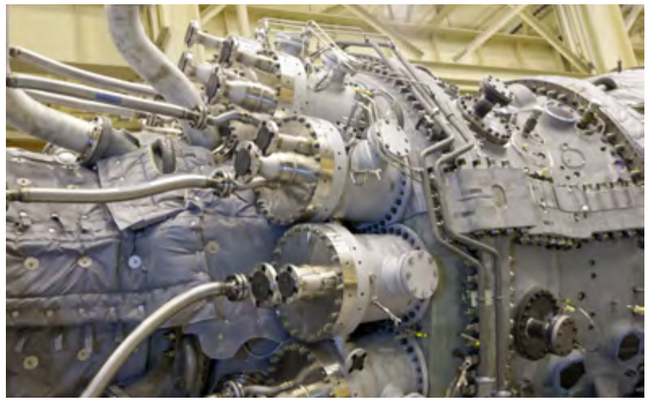
7F ADVANCED GAS PATH TECH CONVERSION

Our 7F advanced gas path upgrades help deliver more efficient, reliable power output while providing the flexibility needed to adapt to a changing energy mix and transition to relatively cleaner energy. Take advantage of your next planned advanced gas path (AGP) repair by utilizing AGP Tech Conversion technology to move your hardware to the next level, reducing CAPEX and adding value to your existing inventory.

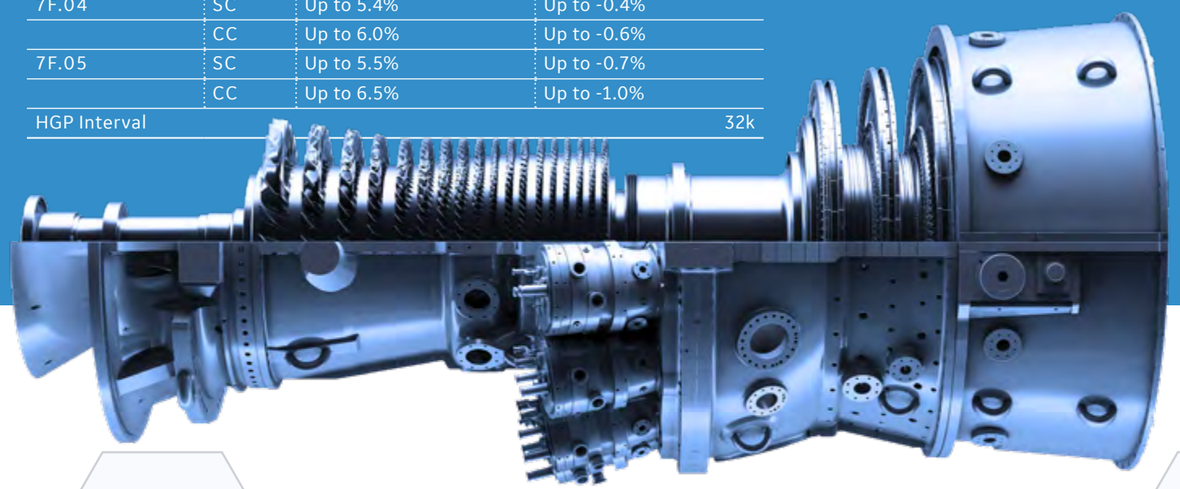
During a planned repair cycle of your 7F.04 unit, we can convert your existing standard AGP to an AGP Tech configuration by applying modifications and improved coatings for better output and reliability. When combined with current Tech S2B and S3B, the final configuration will be compatible with existing AGP Tech hardware.

Your 7F.05 gas turbine can also help better deliver high-level performance with an AGP Tech Conversion. Along with the DLN2.6+, Stage 2 and 3 buckets must be replaced with newer components. Other hardware can be converted during a planned repair cycle, including the Stage 1 shroud, Stage 1 bucket, and Stage 1, 2 and 3 nozzles.

More accessible than ever, AGP technology is evolving to push the boundaries of performance through upgraded coatings, improved TBC, improved cooling and sealing technology, upgraded material for higher creep strength, and the next evolution of AGP architecture.



		Output	Heat Rate
7F.04	SC	Up to 5.4%	Up to -0.4%
	CC	Up to 6.0%	Up to -0.6%
7F.05	SC	Up to 5.5%	Up to -0.7%
	CC	Up to 6.5%	Up to -1.0%
HGP Interval			32k



7F AXIAL FUEL STAGING

Today's power plants are being dispatched for greater cyclic operation to allow for increasing renewable energy use, exposing operators to higher maintenance costs from more frequent starts. Adding flexibility to mature technology can help you avoid many of the cost impacts of cycling.

If your 7F gas turbine already has the DLN2.6+ combustor and your plant runs on Mark* Ve or VIe controls, you can install the Axial Fuel Staging (AFS) upgrade for even greater flexibility and turndown.

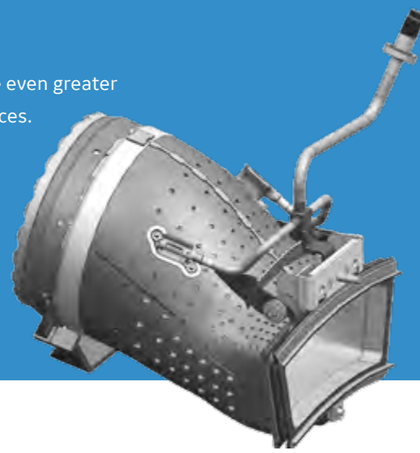
Axially staging combustion in two zones allows one combustor to have enhanced performance at both baseload and minimum turndown. During low-load operation, the percentage split in the staged fuel system can be reduced or turned off, thereby keeping the overall combustion system in emissions compliance over a wide range of firing temperatures. The AFS premixers are circumferentially distributed, and the exits of the injectors are flush with the transition-piece inner wall. The AFS fuel system doesn't require any mechanical joints inside the engine. All fuel piping joints are located outside the compressor discharge casing for increased durability.

Our DLN combustion system helps reduce emissions with faster startup than ever before. With the AFS upgrade, you also gain the advantage of improved capacity, minimum fuel burn, and reduced O&M part/outage costs. Plus, you can realize reduced renewable curtailment and increased access to ancillary services.

BENEFITS:

With the AFS upgrade added to your DLN 2.6+ combustion system, you can realize even greater turndown, reduced renewable curtailment, and increased access to ancillary services.

- **Turndown.** Turndown from 40% to 26% in NOx/CO compliance
- **Maintains Fuel Flexibility.** +/- 15% MWI, 7-12% ethane/propane, 5-10% hydrogen
- **Emissions Range.** <9 ppm NOx, <9 ppm CO
- **Maintenance.** 32000 FFH, 1250 FFS
- **Fuel Burn.** Up to 25% reduction in minimum fuel burn



GT24 MXL2 UPGRADE

The GT24MXL2 upgrade features completely reengineered turbine blading and an optional compressor upgrade for increased efficiency and extended component life.

The upgrade, which is operating successfully in multiple units worldwide, offers the possibility of operating in two different modes. Depending upon specific requirements, the unit may be operated in an extended life (XL) mode or in an increased power (M) mode. Either mode can be selected on demand and while online. This flexibility allows electricity costs to be continuously improved.

The MXL2 upgrade focuses on a newly developed Low Pressure Turbine (LPT), which offers an increased firing temperature. Maintenance costs will be reduced through longer intervals resulting in decreased inspections and increased availability.

We have built upon proven technology with an improved airfoil profile, an enhanced components count, reduced losses through shroud improvements, increased flow path due to an increased outer diameter, reduced thickness on the trailing edge (pressure side bleed), and improved internal cooling schemes.

With the improved airfoil, 3D airfoil profiling was applied for higher aerodynamic efficiency. To support the increased turbine inlet temperature in M mode, thermal barrier protection was enhanced. The vane part count in the LPT vane rows 1 and 2 was reduced, so less cooled air is required internally. An improved shroud layout of LPT blades and vanes leads to a reduction in over-tip leakages. Spot-accurate heights of vanes and blades makes for tighter compressor clearances and higher performance.

BENEFITS:†

Choosing the upgrade in M mode offers you increased performance of up to 17 MW in combined cycle. Selecting the XL mode for extended life adds up to 8000 hours between service intervals.

†All values based on rating GT24 2006 configuration

GT26 HE UPGRADE

The HE upgrade for our GT26 gas turbine fleet marks an innovation breakthrough. The result is an agile F-class gas turbine with a significant and proven step change in efficiency that brings the GT26 closer to the H-class performance.

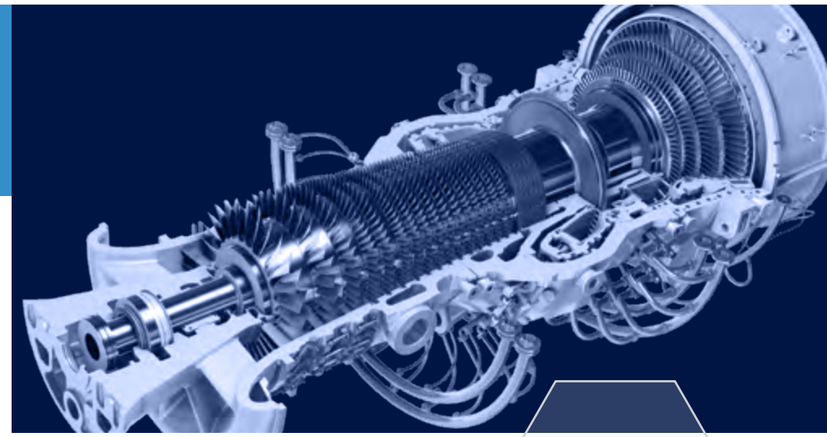
Unique features include advanced manufactured parts that aim to deliver high performance and reduced cooling requirements. The 3D-Aero profile compressor configuration provides higher baseload and part load performance.

Through advanced upgrades across the compressor, combustor and turbine sections, the GT26 HE builds on GE's latest proven technology to provide an unprecedented performance and inspection interval increase . Using the same cooling technology as our record-breaking H-class technology, this offering is ready to protect your plant's merit order in an increasingly competitive environment. With growing installation of higher efficiency gas turbines and renewables, existing plants must work even harder to remain competitive.

BENEFITS:

- Up to an additional 1% part load combined cycle (CC) efficiency, so you can compete and win in the renewables space.
- Substantially reduced fuel costs and improved dispatchability with more than a 2% CC baseload efficiency increase.
- Increased maintenance inspection intervals and generation days available with up to 32,000-hour C-inspection intervals while removing the EOH limit. The HE inspection interval concept provides up to 44,000 corresponding equivalent operating hours compared with the traditional EOH concept, resulting in up to 2 years worth of additional operation for balanced cycling operating profiles.
- Increased revenue opportunities during peak demand with an additional 15 MW to 55 MW plant output.
- Reduced CO_2 emissions up to 5%.

The GT26 HE upgrade brings a blend of innovations in material science, aerodynamics and combustion dynamics. The current LP turbine incorporates H-class cooling technology and durability improvements including robust coatings and GT26 specific lessons learned out of the GE´s serviced fleet. The upgrade uses a 22-stage compressor with 3D-Aero blades, as well as advanced manufacturing in SEV combustor lances and burners.

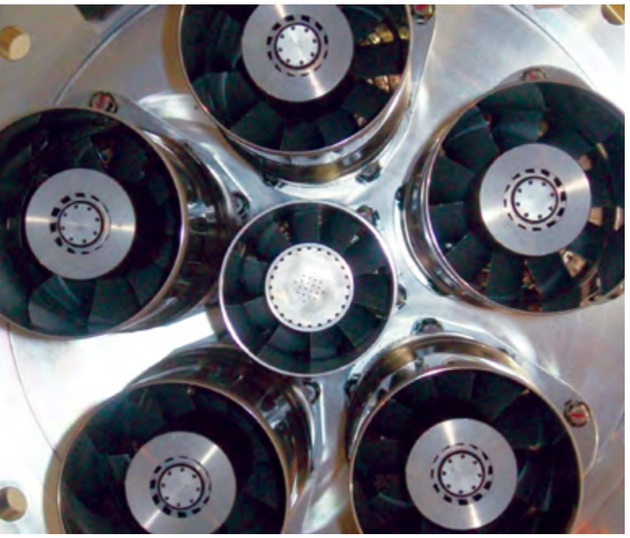


9E DLN1+ COMBUSTION UPGRADE SOLUTION

Increase the value of your assets and plant operation with the Dry Low NOx (DLN)1+ combustion upgrade solution for GE's 9E gas turbines. This advanced technology extends combustion inspection intervals to up to 32,000 hours or 1,300 starts when operating on natural gas. With the DLN1+ solution, you can stay online longer than ever, reducing maintenance costs and emissions while providing broader operational flexibility and extended asset life.

In addition, when combining the capability of DLN1+ technology with GE's Advanced Gas Path (AGP) solution, you can reap even greater rewards. These two technologies together can extend and align your gas path and combustion maintenance intervals, providing up to nearly four years of continuous operation between inspections.

DLN1+ technology translates to lower NOx emissions, down to as low as 5 ppm without the use of water, steam, or ammonia; broader fuel flexibility for increased levels of ethane, propane, butane, and hydrogen; fuel cost savings from lower emissions-compliant turndown to as low as 35% load; lower CO emission levels; and additional revenue opportunities.



With component wear as a leading contributor to combustion repair costs, we engineered advanced technology combustion parts that help reduce system degradation. Built on proven combustion technology and data-driven insights from more than 43 million hours of operation, the DLN1+ solution helps deliver for our customers with advanced features including enhanced thermal barrier coatings (TBC), stronger contact surfaces, and reduced clearances. These advances result in lower emissions and more durable, long-lasting combustion components.

The primary fuel nozzle's newer bolted configuration provides tighter fuel control, as well as improved assembly and maintainability. The flangeless configuration of the secondary fuel nozzle reduces leak potential. The liner and flow sleeve feature reengineered center and aft sleeves, which reduce creep and bulging and other enhancements that provide tighter air control, reduced seal temperatures, uniform loading, and reduced wear and wear variation. The current transition piece helps deliver improved creep and strength characteristics. A newer alloy material for the inner male and female cross-fire tubes enables better heat resistance and less oxidation.

The DLN1+ combustion system features fuel flexibility, enabling operation on natural gas as well as a wide spectrum of other gases, including hydrogen, ethane, propane, olefins, butane, ethylene, and propylene, allowing you to take advantage of formerly wasted industrial off-gases. If you have backup fuel requirements, the DLN1+ also provides dual-fuel capability, achieving less than 25 ppm NOx on distillate oil with water injection. As the original equipment manufacturer dedicated to continually improving combustion technology, no one knows your 9E gas turbine better than GE. We can reduce NOx and CO system emission levels to conform to your site's specific ambient conditions, load range, and emission requirements with minimal impact to performance.

With the DLN1+ combustion system, OpFlex options such as AutoTune, Low-NOx Variable Peak, AutoRecover, and Fast Start increase operational flexibility. Real-time data monitoring allows the enhanced control system to improve emissions across ambient and load range, and the system lowers costs by eliminating seasonal tuning.

Advanced, wear-resistant materials and coatings increase inspection intervals. Proven, patented sealing technology utilized from our F-Class fleet improves performance and lengthens maintenance intervals.

The newer configuration is compatible with existing DLN1 fuel delivery systems and end covers. The enhanced hot gas temperature profile exists with limited impact on performance or hot gas path component life. DLN1+ is compatible with Mark* V, Ve, and VIe control systems.

BENEFITS:

- Sub-5 ppm (10 mg/Nm3) NOx emissions across large load and ambient temperature range of 0°F to 120°F
- Single-digit CO emissions on natural gas at baseload
- Eliminated or reduced need for costly and complicated SCR systems
- Eliminated water use and costs for steam/water injection for NOx control when operating on natural gas
- Decreased operational disruption when installed during routine hot gas path, combustion, or major inspection
- Customized low NOx and CO emissions solution for specific loads and ambient range

9E ADVANCED GAS PATH XPAND

The 9E Advanced Gas Path (AGP) XPAND upgrade builds upon 9E.03 AGP technical improvements and fleet experience to bring you enhanced durability and performance.

High-temperature alloys help allow for maintenance inspection intervals of 32,000 FFH/900 FS. Advanced metal seals reduce leakages between components, in turn reducing losses. In stages 1-3, advanced metal seals for nozzles and shrouds are among the 9E AGP XPAND improvements. The blades in stages 1 and 2 feature the high-temperature alloy R108, and the upgrade includes improved dovetail sealing for the stage 1 blade.

BENEFITS:

Additional features allow the 9E AGP XPAND to help deliver improved output and exhaust energy, with SC output increased by up to 2.4% and SC exhaust energy improved by up to 2.1% for combined heat and power (CHP) or combined cycle (CC) performance.

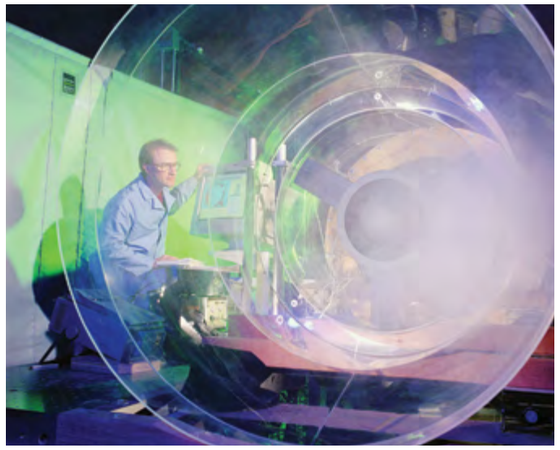
9E ROBUST DIFFUSER

GE's commitment to excellence and efficiency resulted in changes to the 9E Robust Diffuser. For you, that means improved durability and reliability.

Analytical methods and validation testing proved that turning vanes are not required to maintain flow uniformity or to direct the flow radially. So, we removed the existing turning vanes, gussets, and poles and added six poles/supports to the lower half of the diffuser.

The result is reduced stress and strain on the diffuser while output and heat rate performance remain as strong as ever, with no impact on downstream components or on emissions. Through the reduced mechanical load, maintenance costs to repair hardware are reduced.

Installation of a newer diffuser can be performed during scheduled hot gas path or major inspections.



9E ENHANCED COMPRESSOR PACKAGE

Based on extensive fleet experience, GE has developed an array of enhancements for 9E compressors aimed at responding to all known fleet events and improving the operating stress margins of certain components.

The full suite of options to monitor and improve reliability starts with dimensional changes to the R1 compressor blade, the IGV, and the aft stub shaft impeller.

The newer R1 blade features a machined undercut and a squealer tip. Increased thickness near the blade's base and minor thickness changes along the span of the airfoil improve the root fillet radius. The changes result in a blade with better tolerance for corrosion and erosion. The undercut feature eliminates the risk of fretting-induced cracking through the platform. The blade is engineered for in-field replacement and does not require unstacking the rotor or wheel tipping in the factory. Compressor performance is maintained.

The IGV was modified with an undercut to mitigate the risk of cracks near the bushings. Replacement of the IGV can be performed on site.

Enhanced geometry in the current aft shaft impeller reduces stress at the impeller corner radius. The impeller may be converted to the enhanced configuration at a GE qualified repair shop or replaced with a newer component.

Current stator vane ring segments for stage 1 feature an upgrade from carbon steel to stainless steel, which provides better resistance to corrosion and oxide buildup between the vane and ring and the ring/casing interface. The package includes shorter ring segments, 12 per set in a shimless configuration, that are easier to remove during maintenance and are a direct replacement for the existing ring segments. The airfoils are fully shot peened.

Enhanced compressor package provides either an option to improve performance or an option for enhanced corrosion resistance.

Performance option has all rotor blades and stator vanes featured with improved surface finish and GTD-450 material. These include IGVs and R4-R7 blades and S3-S7 vanes (formerly of SS-403). This upgrade results in better compressor efficiency and performance, low dust accumulation, and lower degradation.

In the enhanced corrosion resistance package the first seven stages of the compressor are coated with GECC-1, a slurry coating with a ceramic top layer. GECC-1 provides improved erosion and corrosion resistance with minimal impact to compressor performance. Previously, only rotor blades 4-7 and stator vanes 3-7 were coated with GECC-1.

Bear in mind that performing timely and accurate maintenance of the inlet system and compressor is critical to the overall gas turbine reliability and that utilizing predictive tools such as Blade Health Monitoring can protect the gas turbine against costly failures and reduce downtime.

Blade Health Monitoring is a non-contact system that uses sensors installed over airfoils to provide real-time assessment of R1-R3 and early identification of a shift in blade response. The system protects the gas turbine against costly failures through early detection of cracks, with real-time local screen plots, trending calculations, and spectrum graphs. The system has a high sensitivity to frequency shift.

7E DRY LOW NOx COMBUSTION UPGRADE

Increase the value of your 7E or 7EA gas turbine through the use of a dry low NOx (DLN) combustion upgrade. With hardware and controls modifications for extended turndown or peak fire, you can be emissions-compliant with enhanced flexibility.

This enhancement builds upon our experience and expertise in combustion technology aimed at reducing NOx emission levels. An upgraded DLN combustion system enables you to comply with local regulations requiring reduced NOx and CO emissions without impacting gas turbine performance. We can improve the NOx and CO system emissions levels to conform to your specific site ambient conditions, load range, and emission requirements. The newer DLN1+ system can be installed during a combustion inspection, a hot gas path inspection, or a major inspection, and it carries with it a combustion inspection interval of 32,000 hours or 1,300 starts (based on natural gas operation).

Adding the Axial Fuel Staging (AFS) option introduces emissions-compliant, low part load operation, enabling operators to keep their assets online at times of low electrical demand and react immediately when demand increases.

You can count on NOx/CO-compliant turndown to 35% of baseload with inlet bleed heating—up to 25% improvement from previous limits. Expect an improved baseload performance and emissions: an 85% reduction in CO emissions combined with heat rate and output improvements of up to 0.25% and 0.4% with no impact on exhaust energy. The upgrade helps deliver an increase in part load simple cycle efficiency, with more than a 2% reduction in heat rate at 70% gas turbine load.

In peak-fire configuration, the upgrade increases simple cycle output by up to 8% by peak firing up to 100°F, with no impact on NOx emissions or turndown, and with CO levels 70% lower than at baseload.

See improved potential for revenue from growing NOx credit trading. Maintenance costs will fall in conjunction with the increased reliability that comes with a combustion inspection interval of 1,300 starts. Expenses for water usage and steam/water injection for NOx control are eliminated with the upgrade, which also eliminates or reduces the need for costly and complex SCR systems, along with associated ammonia slippage, water usage, and heat rate impacts.

BENEFITS:

- **25%** improved NOx/CO-compliant turndown
- **85%** reduced CO emissions from heat rate improvements
- **8%** increased simple cycle output by peak firing (up to 100°F)

Configuration	Interval (FFH/FFS)	NOx Level (ppm)
DLN1	12000/450	15 or 25
DLN1 LN	24000/600	9
DLN1+ LN	32000/1300	9, 15, or 25
DLN1+ ULN	32000/1300	3.5

7E CAPACITY PERFORMANCE PACKAGE

GE's 7E Capacity Performance Package (CPP) enables customers to produce up to 8% more output without increasing NOx or CO production. 7E CPP is backed by GE's Axial Fuel Staging (AFS) and Corrected Parameter Control (CPC) software platform.

AFS technology introduces gas fuel into the head end of the transition piece through a newer fuel circuit. A current wrapper system is deployed with nimonic transition pieces. CPC enhances the existing static turbine control with an all load temperature reference which is updated as ambient conditions change. This enables better control of unit exhaust temperature and emissions.

In addition to these combustion enhancements CCP also introduces GE's OpFlex Start Assurance package. This software includes simpler start permissives and conducts pre-start system checks on major systems to help ensure your turbine is ready to start when the plant is dispatched. Additionally, an HMI start-up sequence display is included to show the progress of the start-up.

These upgrades are applicable to GE DLN 1 and DLN 1+ configurations and require a Mark*VIe control system.

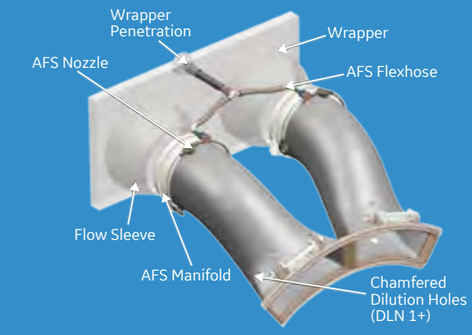
BENEFITS:

Increased revenue generation. Up to 8% greater output.

Equivalent NOx emissions.

Improved start-up reliability. Ready when you are.

In addition to the performance benefits, the installation of the Capacity Performance Package can be performed during a combustion inspection.



7E ADVANCED SECONDARY FUEL NOZZLES

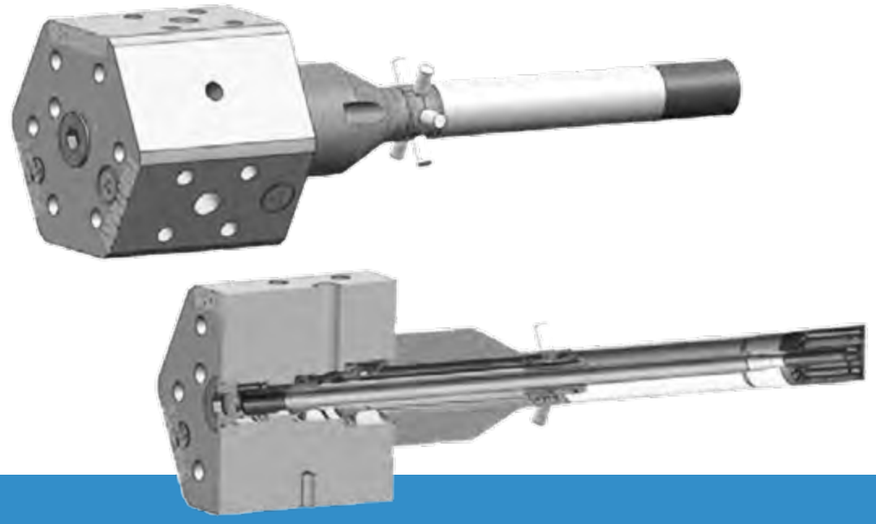
The 7E advanced secondary fuel nozzle's newly engineered configuration premixes air and fuel in DLN1/1+ gas only systems. With lower emissions, more MW, and better reliability, our 3D-printed fuel nozzle upgrade creates real customer value.

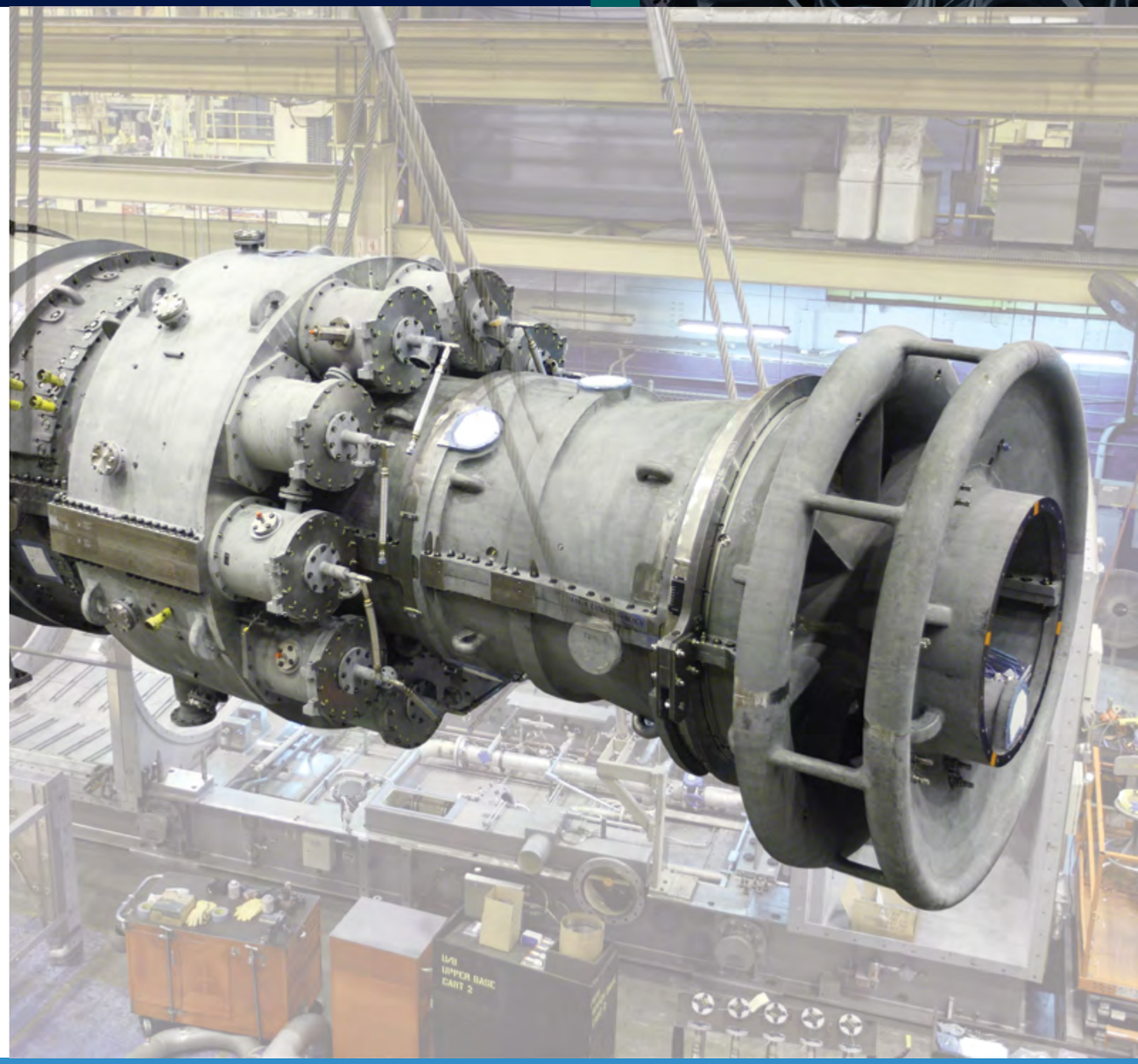
The same hardware solution can give you low turndown today and peak MW as your future needs change.

The 7E advanced secondary fuel nozzle provides a rapid, cost-effective energy boost for power generators. The reengineered secondary fuel nozzle lowers NOx, allowing increased emissions-compliant megawatts by increasing the unit firing temperature, with no hardware tuning. That simple shift can yield as much as $250,000 annually, with an improved power rating. These outcomes were tested and proven in the field as of July 2021.

Operators can expect rapid returns with the 7E advanced secondary fuel nozzle—and quick installation as well. Some upgrades require waiting for an outage or scheduling one specifically. This nozzle upgrade is easy to install with no extended outage needed. Installation can be completed in as little as 48 hours.

Additive manufacturing was used to create the premixing features. The flangeless configuration is compatible with DLN1 and DLN1+ systems.





BENEFITS:

- **Up to 37%** lower NOx emissions
- **Up to +55°F** emissions-compliant peak fire
- **6 – 8%** greater emission-compliant turndown
- **As Low As -20°F** ambient NOx compliance range

6F.03 GAS TURBINE ADVANCED GAS PATH (AGP)

INCREASE OUTPUT, EFFICIENCY, AND AVAILABILITY WHILE REDUCING FUEL CONSUMPTION AND EXTENDING YOUR GAS TURBINE ASSETS WITH OUR ADVANCED GAS PATH (AGP) UPGRADE FOR 6F.03 GAS TURBINES.

With a significant reengineering of hot gas path (HGP) components, the latest 6F AGP combines advanced materials, improved coatings, and our latest OpFlex software, which builds upon the hundreds of 7F and 9F AGPs already in successful operation. The reengineering considered your need to reduce O&M costs while keeping plants flexible for a dynamic industry.

Combined with the latest 6F DLN2.6+ combustion system, this upgrade helps deliver reduced annual baseload fuel costs and longer times between HGP inspections. Our AGP-Lite solution also includes an option to modify existing hardware, which allows you to get the same benefits without needing to dispose of assets.

AGP TECHNICAL OVERVIEW

- High temperature alloys with advanced coatings
  - — Extended maintenance intervals
- Advanced air-cooling manufacturing techniques enabling internal and film cooling
  - — Reduced cooling flows for improved efficiency
- Advanced metal seals to reduce leakages between components
  - — Reduced cooling flows for improved efficiency
- Tighter clearances with abradable coatings and honeycomb seals
  - — Reduced tip leakages for improved efficiency
- Three-dimensional first-stage airfoil configuration
  - — Improved efficiency
- Fleet experience-based configuration enhancements
  - — Improved reliability and repairability

BENEFITS:

Enhanced performance. The upgrade improves simple cycle and combined cycle MW output by up to 8.2% and 8.0%, respectively, through increased Tfire capability and reduced HGP clearances. Exhaust energy increases by up to 4.5%.

Greater efficiency. Reduce baseload fuel consumption per MWh by improving full-load simple cycle and combined cycle heat rate up to 1.8% and 1.6%, respectively. Enjoy higher efficiency across full and part load operations thanks to better seals to reduce leakages, improved air-cooling techniques for reduced cooling flows, and 3D Stage 1 airfoil configuration.

Better availability. Improved coating and materials result in up to 32,000 FFH and 1,350 FFS HGP intervals.

Bottom line boost. Experience increased revenue potential from energy and steam generation. Save fuel with up to 1% efficiency improvement in simple and combined cycle. Decrease O&M costs and increase uptime with longer CI/HGPI intervals.

Premier parts. All nine HGP capital components are replaced, with an option to improve performance even further with a DLN2.6+ combustor. Higher temperature alloys with TBC coating are used.

Emissions compliance. Increase your range of emissions-compliant loads with improved turndown, lower emissions, and better fuel flexibility when paired with a DLN2.6+ combustor

6F.03 DLN2.6+ UPGRADE

In the past, gas plants were engineered to provide efficient baseload power, but today, with the dramatic growth of weather-dependent solar and wind capacity, gas plants must provide critical renewable-balancing grid support, making flexibility a priority. Dry Low NOx (DLN) combustor systems not only provide this flexibility but also help meet increasingly demanding emissions regulations. To remain competitive, F-class plant owners and operators must change operating profiles to go beyond their plant's original configuration and find innovative ways to remain profitable.

Building on a rich heritage of combustion leadership, the DLN2.6+ system can improve turbine flexibility, help deliver industry-leading low emissions, and extend your outage intervals. A key feature of the fuel nozzles is the premixed pilots that stabilize the main flames. This creates robust operability at all loads and enables the system to achieve the lowest NOx emissions for GE's F-Class gas turbines. The NOx performance allows for sizeable increases in firing temperature and output with no increase in emissions over the previous DLN combustion systems. Originally introduced in 2005 on 9F gas turbines, the DLN2.6+ is now an established upgrade for all F-Class gas turbines.

BENEFITS:

Improved capacity, minimum fuel burn, and reduced O&M part/outage costs.

Core Benefits	• Fuel flexibility improvements • Outage interval extension • Emissions reduction • Enhanced load range
Emissions Range	• Up to 15ppm NOx
Availability and Maintenance Cost	• Up to 32,000 factored fired hours (FFH) • Up to 1,350 factored fired starts (FFS)
Operational Flexibility (exact figures may vary by model)	Extend turndown to as low as 38% of baseload
Fuel Flexibility	Broad fuel flexibility with up to 30% Modified Wobbe Index (MWI), 25% ethane/propane, 20% hydrogen, and a wide range of distillate fuels
Add-ons	• Accelerate start times with OpFlex Fast Start, Variable Load Path, ST Agility, or ST Warming Blankets • Add maintenance-neutral peaking with Dispatch Optimizer • Improve operability when combined with OpFlex controls software including AutoTune and Cold Day Performance • Eliminate costly diluent injection or selective catalytic reduction (SCR) systems • Enhance Advanced Gas Path (AGP) and compressor upgrade performance and operability

6B GAS TURBINE ADVANCED GAS PATH UPGRADE

The 6B AGP upgrade allows you to remain competitive as it builds on the rugged reliability the fleet has demonstrated for more than 40 years. The upgrade, which utilizes E-, F-, and H-class developments to increase firing temperature, enables higher output (by up to 16%, depending on the plant's configuration) and exhaust energy (2%-9%), lowers fuel consumption, and increases maintenance inspection intervals. The 6B AGP upgrade improves heat rate by up to 5%, depending on the plant's configuration.

When packaged with 6B Advanced Extendor combustion technology, the AGP upgrade allows for synchronized combustion and hot gas path inspection intervals up to 32,000 FFH.

The upgrade includes nine current hot gas path (HGP) capitals. Highlights also include laminate sealings and sealing geometry reengineering for improved heat rate, advanced blade tip shroud configurations for improved cooling and sealing efficiencies, and cooling airflow changes for improved efficiency and component life.

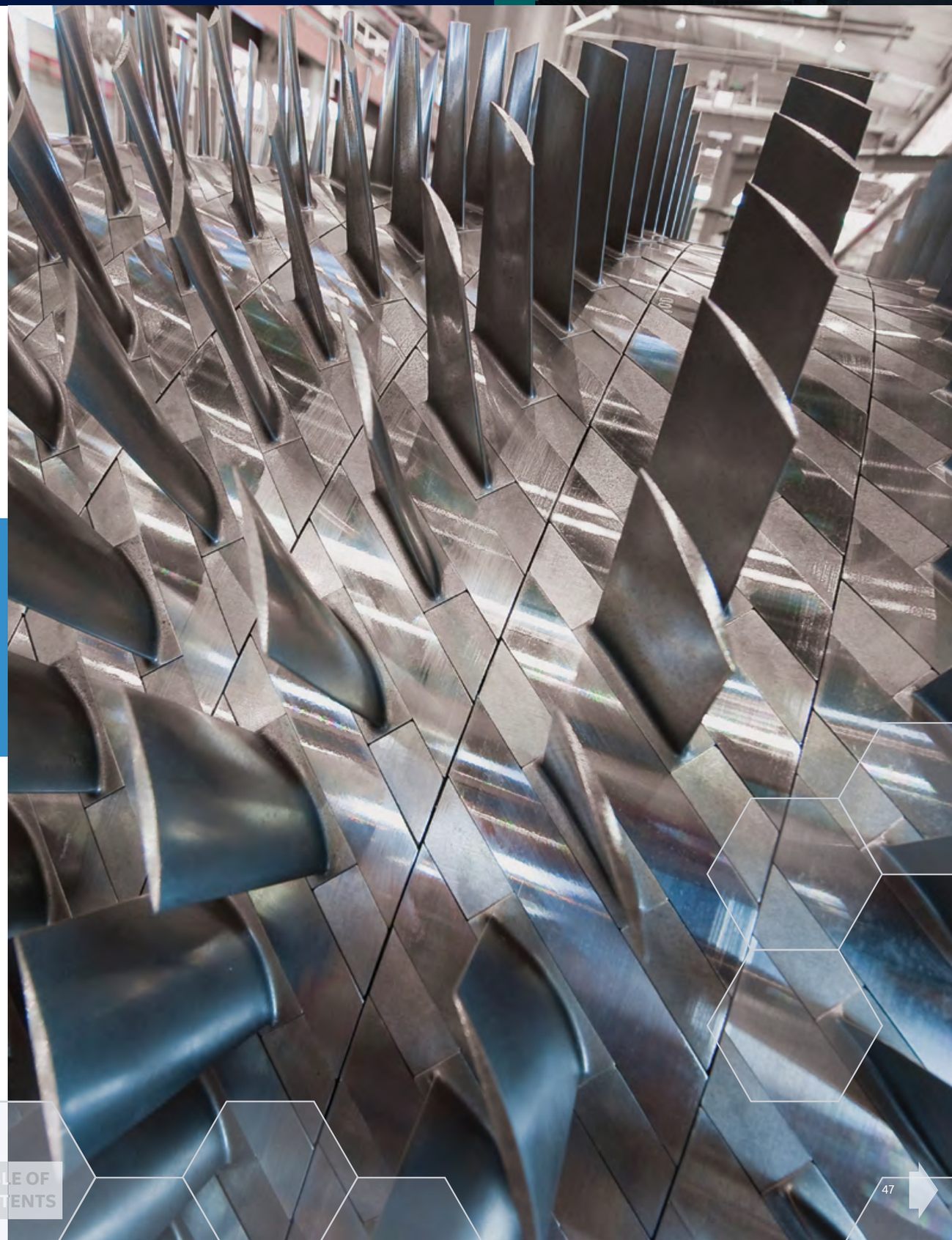
The upgrade is applicable to PG6541 or newer models with Mark* VI or newer control system and is compatible with a wide range of fuels including high hydrogen applications.

BENEFITS:

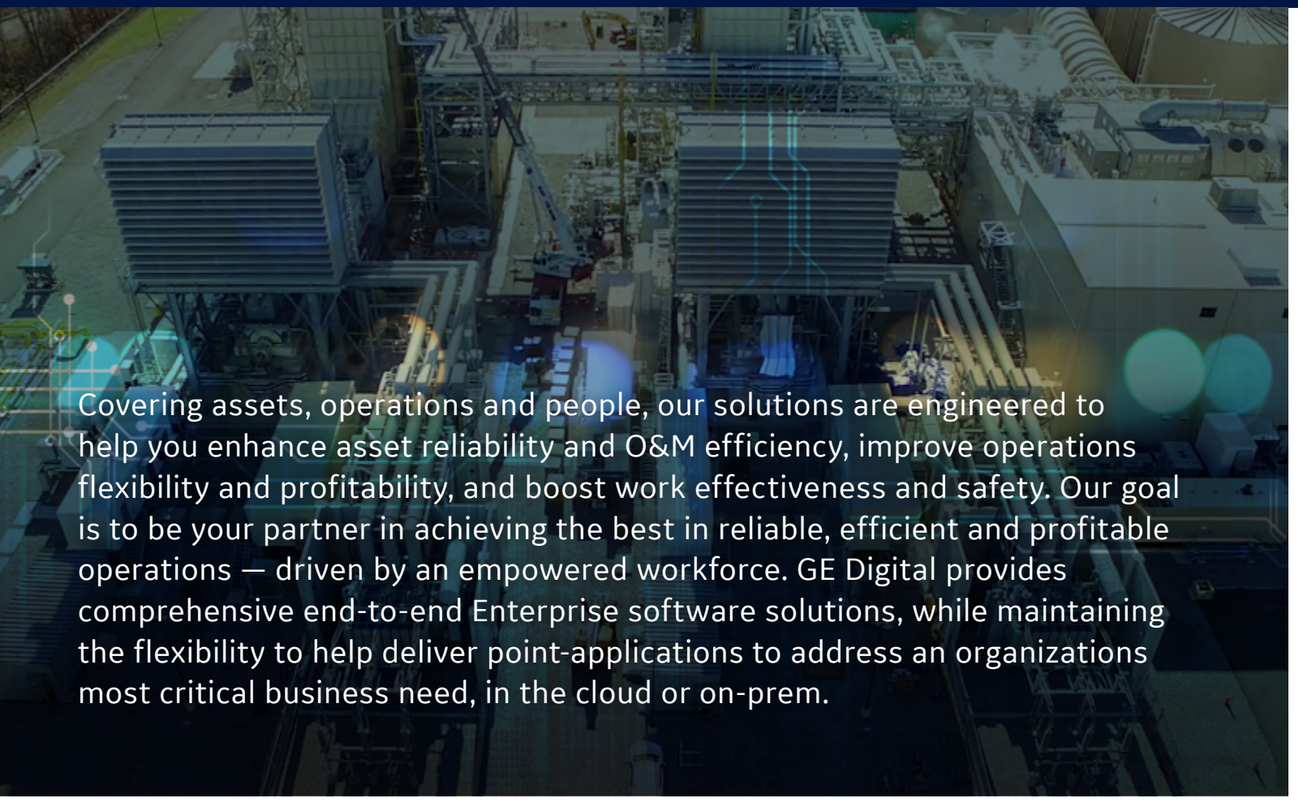
Enhanced performance. The upgrade improves MW output by up to 16% through increased Tfire capability and reduced HGP clearances. Exhaust energy increases by up to 9%.

Better availability. Improved coating and materials result in up to 32,000 FFH and 1,200 FFS HGP intervals.

Bottom line boost. Experience increased revenue potential from energy and steam generation, same fuel efficiency improvement in simple and combined cycle, and decrease O&M costs and increase uptime with longer CI/HGPI intervals.



Digital Solutions



Covering assets, operations and people, our solutions are engineered to help you enhance asset reliability and O&M efficiency, improve operations flexibility and profitability, and boost work effectiveness and safety. Our goal is to be your partner in achieving the best in reliable, efficient and profitable operations — driven by an empowered workforce. GE Digital provides comprehensive end-to-end Enterprise software solutions, while maintaining the flexibility to help deliver point-applications to address an organizations most critical business need, in the cloud or on-prem.

Industrial Data Diagnostics enables customers to unlock hidden savings in your maintenance & reliability program, benchmark performance, and help ensure trusted data drives business metrics with greater confidence.

Industrial Data Diagnostics is a cloud application that provides process and CMMA/EAM asset data quality analysis, identifies areas of good data versus what needs improvement, industry benchmarking, and helps continuously deliver actionable recommendations to operation & maintenance program data that is easily scaled throughout the enterprise. The software includes asset and process analytics, holistic dashboards, and reporting automatically.

ASSET PERFORMANCE MANAGEMENT (APM)

Asset Performance Management helps improve equipment reliability and O&M efficiency across the plant and fleet. Featuring built-in GE industry expertise, advanced analytics and work process automation, APM is the backbone of accelerating the energy transition.

GE's APM solution includes:

Health: Gain a unified view from anywhere, remote or on-site, of your critical assets' health. Our Health Application is focused on helping provide digital & mobile-first worker solutions for individual sites and entire fleets. The newest solution we offer is Rounds Pro, featuring a flexible mobile app with comprehensive capabilities for supervisors, engineers, and O&M managers. Rounds Pro easily integrates with the rest of GE Digital solutions. This allows an organization greater control of asset data to make critical decisions fast.

Reliability: Avoid surprises from your assets with real-time issue identification and next-best-action guidance. SmartSignal: Improve your asset data with predictive analytics and proactively prevent unplanned downtime and failures. Over 340+ Digital Twin Blueprints that provide out-of-the-box analytics to your assets that matter the most. Our Blueprints are expertly built, embedded with AI/ML and Similarity Based Models, to help organizations predict & diagnose potential criticalities. These models easily integrate with APM applications for a comprehensive view of your assets.

Integrity: Enhance your overall Mechanical Integrity (MI) program by calculating risk and remaining useful life of fixed assets. The solution offering includes an integrated set of tools and work-processes to profile asset degradation mechanisms and containment threats and further generate improved inspection strategies targeted at mitigating these risks.

Strategy: For many asset-intensive businesses, their current asset management strategies are not under control, nor are they aligned to achieve the highest profitability at the lowest risk and cost. Our solution offering enhances and prioritizes the overall asset strategy investment allocation based on asset criticality, risk and operating context. Furthermore, the asset management strategy can be improved and adjusted over time based on data and information to establish a sustainable, closed-loop continuous improvement cycle.

Safety: The solution offering can identify and mitigate process safety hazards, manage critical safety instrumentation, and manage equipment and process changes that can increase safety risk. In addition to being compliant to the global Process Safety Management standards, the solution fully integrates safety lifecycle management initiatives with corporate asset hierarchy and EAM system integration, resulting in higher asset availability and lower catastrophic incident probability.

OPERATIONS PERFORMANCE MANAGEMENT

Power Plants operating in dynamic conditions need advanced solutions to provide system stability, flexibility, and operational efficiency to help meet their mission goals. OPM solutions improve the plant to save fuel, reduce emissions and help meet commitments.

Performance Intelligence (PI): To answer where is the problem coming from, what is it and when do I need to fix it, Performance Intelligence improves plant efficiency with thermal performance data, analysis and advice. Current features include strategic business decision support with What-If and Economic Advisory features and Carbon Analytics. For a holistic, end-to-end solutions, PI with Reliability integrates into one dashboard. Now available both In Cloud and On Prem.

PERFORMANCE INTELLIGENCE & RELIABILITY

Production Planning: For deregulated industries, increase margins and manage risk through capacity prediction, fuel nomination and decision support. For regulated industries, reduce costs by understanding generation uncertainty and fuel needs. **Production Planning for Renewables** will join the suite for both deregulated or regulated uses. Proven solution to increase revenue and reduce risk.

PERFORMANCE OPTIMIZATION SOLUTIONS

Autonomous Tuning: to help meet operator inefficiencies, and emission requirements while also gaining flexibility, Autonomous Tuning saves fuel and reduces emissions in a closed-lopped system. By utilizing equipment models and AI/ML, achieving optimal flame temperatures and fuel splits for gas turbines is now possible.

Capacity Dispatch Optimizer and Capacity Trader: Improves GE F-Class gas turbine energy production during peak demand for increased plant dispatch by operating at Cold Part Load and "banking" hours that can be used for peak fire application without incurring costly maintenance adders or adversely impacting the maintenance interval.

Duct Burner Optimizer: Automates and enhances the dispatch of duct burners using AI-enabled predictions of near-term demand. Improves flexibility of plant operations and reduces fuel consumption.

Remote Operations - Command Center: Helps deliver a 360 view of operations, fleet, and assets using a centralized secure solution to rapidly configure industrial applications to connect, aggregate, and visualize data into a single view. Improves operations, cross functional collaboration, and data collection – from anywhere, on any device.

ACCELERATORS

GE Digital Accelerators are pre-configured health monitors, predictive analytics, asset maintenance strategies, and business process workflows. Engineered to expedite customer's implementation and expanded use of GE Digital's APM solutions.

The Accelerators are built utilizing energy subject matter expertise from GE Digital's innovative architects and technology partners.

Simply use pre-built data templates to quickly accelerate an intelligent maintenance reliability program, embed prioritized actionable information into daily work, and scale the power of APM across the enterprise.

3D VISUALIZATION (V-SUITE STARTER)

Through GE Digital's partnership with Visionaize, APM Integrity applications such as Risk-based Inspection (RBI), Inspection Management & Thickness Monitoring now include enhanced 3D visualization capabilities for critical fixed assets in the plant.

"V-Suite Starter" provides data driven visualizations of key APM attributes by color coding the 3D model to filter out the noise and focus on what matters most. Quickly access and contextualize risk, corrosion & thickness data on the schematic of an asset itself improves workforce productivity and time to resolution.

While the solution is fully productized for use with the APM Mechanical Integrity solution, customers can further extend the use across APM solutions such as Health & Reliability through services led integration.

NON-OPTICAL FLAME DETECTOR FOR 9F, 7F, AND 6F† GAS TURBINES

Faulty flame scanners and leaky water-cooling circuits can bring operations to a halt. GE's Non-optical Flame Detector (NOFD) software keeps a close and safe watch on combustion operations, helping you avoid unnecessary downtime and eliminating a significant source of maintenance expenses.

NOFD software gathers information from existing turbine instrumentation to monitor flame status as effectively as flame scanners but without the maintenance associated with those sensors. Instead of relying on visuals to read light waves, NOFD is a Mark* VIe algorithm using existing instrumentation to determine the flame state. Deploying NOFD software is a prime example of modernizing the right assets in an aging plant.

NOFD is available in two options, Base and Extended. Installation and can be as quick as a software update, in one to two days.

The Base option includes NOFD software and HMI screen changes, with associated drawing updates. The existing FDs remain installed but are used only for monitoring. With the Extended option, you receive the Base benefits plus removal of the optical FDs and decommissioning of associated accessory systems and wiring, such as the water-cooling circuit in the gas turbine compartment.

With NOFD software, detection time is faster than required to help maintain rigorous safety standards, and testing shows the system to be more than 99.9% accurate. There is no dependence on gas turbine/combustion hardware or on fuel quality. (NOFD is not allowed for H_2 content above 10% by volume.)

Traditional flame detectors (FD) sit close to the turbine, where high temperatures dictate the need for complex water-cooling circuits, requiring regular maintenance and creating potential for extensive damage due to leaks. GE's NOFD software eliminates the FD, thus eliminating the risk associated with FD failure, and where applicable removes the associated water-cooling circuits, which reduces O&M costs.

NOFD uses redundant sensors to detect the safety-critical events of global loss of flame and ignition, monitoring compressor discharge pressure, turbine shaft speed, exhaust temperature, and combustion dynamics. Each is monitored separately for a dynamic response signature indicating a global flame on/off event.

† Excluding 6F.01

ACTIVE POINT HMI

As the OEM of your existing HMI, we know your equipment. GE offers modern HMI solutions that are kept updated and will be supported for years to come.

Based on CIMPLICITY* 11 (GE's latest user interface software), our ActivePoint* HMI integrates seamlessly into Microsoft Windows server architecture and can be implemented on both traditional and virtual operation, saving time and money through less maintenance and more efficient operations.

With ActivePoint HMI, you will experience faster performance, a modern and user-friendly interface, and protection into the future.

ActivePoint HMI helps deliver real-time, plant-wide data in substantially less time than it takes for your current HMI to load, with a 50% average decrease in point loading time (contingent on system configuration).

With simpler and more intuitive graphics and navigation, along with the ability to add improved alarms and alerts, this interface makes it easier to detect and act on issues, demonstrating a usability improvement of up to 21%.

ActivePoint HMI's modular configuration will allow you to invest in upgrades over time, helping to ensure your operations are always current.

OPFLEX FAST RAMP FOR F-CLASS GAS TURBINES

With the influx of renewable energy into today's power grids and the resulting rise in ancillary services, a plant's ability to provide emissions-compliant firming capacity by rapidly responding to simultaneous changes in supply and load can lead to increased revenue and dispatch for the generator and a more stable grid for the system operator.

Our OpFlex Fast Ramp product provides the ability to offer more Megawatts into ancillary services such as regulation up and down service and spinning reserve while maintaining the F-class gas turbine's world-class standard for reliability and efficiency in both simple cycle and combined cycle.

OpFlex Fast Ramp requires OpFlex Enhanced Transient Stability (ETS) as a prerequisite. ETS and the robust underlying Model-Based Control platform provide the needed transient handling capability to manage unit operation while ramping up and down in load at increased rates.

When combined with turndown products which expand the emissions compliant turbine operating range, Fast Ramp enables this expanded load range to be traversed in less time, further increasing the amount of megawatts that can be offered into these ancillary services.

Fast ramping is available on both current and existing F-class gas turbines.

With OpFlex Fast Ramp, the maximum gas turbine ramp rate increases to at least double the nominal (from ±8.3%/minute to ±16.6%/minute) while maintaining low emissions. Higher rates are possible, as a field test showed a threefold increase to more than ±50 MW per minute. Users select their rates, which are variable and in MW increments from ~0 to the maximum.

OpFlex Fast Ramp may be used in emissions-compliant Dry Low NOx combustion modes, from minimum emissions compliant load to baseload.

OPFLEX SLIDING FUEL PRESSURE CONTROL

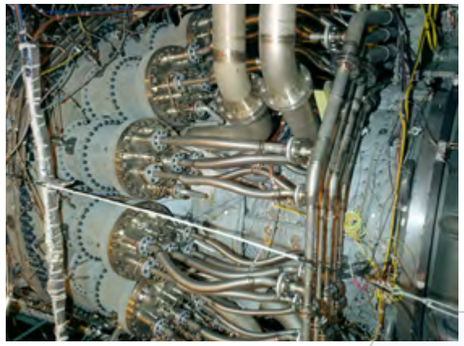
OpFlex Sliding Fuel Pressure Control significantly reduces the gas fuel supply pressure requirement in most operating conditions for GE heavy-duty gas turbines with DLN combustors. A minimum gas fuel supply pressure is required to provide the motive force for the fuel to overcome losses due to strainers, valves, piping and fuel nozzles, and to maintain sonic/choked fuel flow entering the DLN combustion system fuel nozzles to help ensure accurate fuel split control under all potential operating conditions. Traditionally, this pressure was set based on a fixed, worst case condition (ambient, load).

OpFlex Sliding Fuel Pressure Control utilizes closed loop control to increase tolerance to operating condition variation (ambient temperature, pressure, and gas turbine load) and improve fuel flow capability with the available gas fuel supply, in particular allowing the unit to operate with significantly lower gas fuel supply pressures in most conditions. In addition, protective actions in the event of low gas fuel pressure are further redefined to increase load capability and reduce operator interaction (e.g., protective load runbacks are replaced with a load limiter function), and improved flexibility is provided to customize conditions for automatic transfers to liquid fuel, if so equipped.

Operational benefits include improving load capability for the actual fuel supply pressure at any given condition, and reduction in the probability of upsets, such as protective load runbacks and combustion trouble, which may impact turbine operation.

OPFLEX COLD DAY PERFORMANCE

Increase output and capacity in cold weather and magnify output increase from inlet conditioning systems with OpFlex Cold Day Performance for 6F, 7F, and 9F gas turbines.



The OpFlex F-Class Cold Day Performance solution was specifically developed to increase unit output and improve heat rate at compressor inlet temperatures of less than 59°F (15°C). Cold Day Performance increases F-class gas turbine capacity and exhaust energy, a particularly beneficial feature for combined cycle operations. Historically, the F-Class required reduced firing temperatures below 59°F (15°C) to remedy higher emissions and dynamics levels caused by limited combustor operability in colder inlet temperatures. The OpFlex platform removes this restriction and provides unsuppressed baseload firing temperatures during colder inlet temperatures, while maintaining low emissions and dynamics levels.

Simple-cycle users can expect increased output of up to 5 MW. For units with inlet chillers, Cold Day Performance helps deliver up to 1.5 MW of incremental output at typical chiller operating conditions, about 50°F (10°C).

BASELINE SECURITY CENTER

Once a day, the energy sector faces a cyberattack that has never been seen before. Of surveyed CEOs, 49% say that becoming a victim of a cyberattack is now a case of "when," not "if." Of all cyberattacks in operational technology (OT), 46% go undetected.

To guard against cyberattacks and help ensure the continuous availability of critical OT infrastructure, power generators must implement and sustain a growing number of vital security controls. Because cyberthreats evolve rapidly, systems need to be tuned, monitored, and managed on on a continuous basis. Many struggle to keep pace with the ongoing demands.

Baseline Security Center offers a more appealing alternative by providing comprehensive security capabilities in a single, pre-integrated platform, enabling your organization to establish robust, defense-in-depth controls in plant environments.

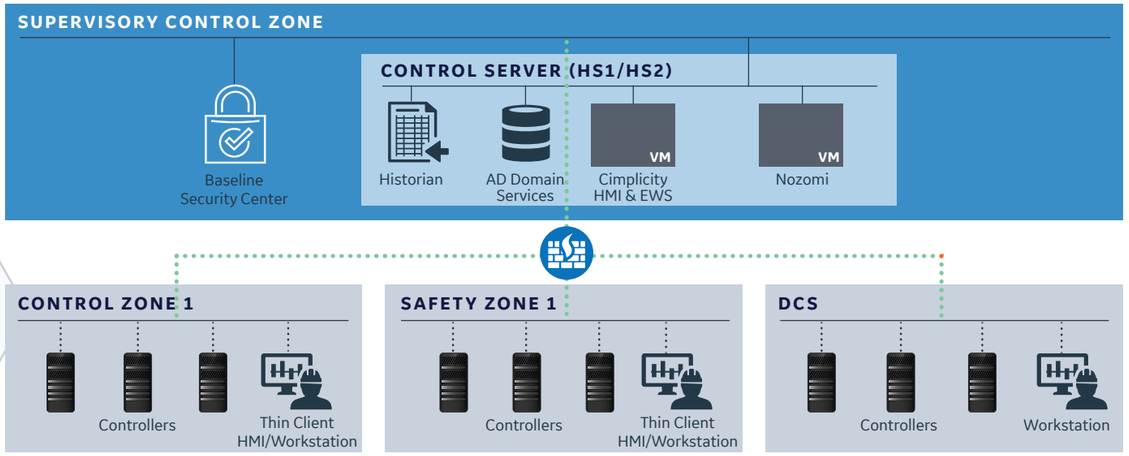
Baseline Security Center collects, correlates, and forwards security logs and events, and it presents this information to plant personnel in a highly usable format. The solution offers identity and password management, backup mechanisms, anti-virus technologies, and log management platforms.

The range of features includes a hardware appliance and operations console, a hardened server and thin-client console, an optional, hardened firewall, secure-by-design configuration, and global regulatory certifications and hardware support.

By working with us, you benefit from our procuring, testing, integrating, and deploying of disparate solutions independently.

Baseline Security Center supports integration with a range of operating systems, including various versions of Linux, Windows, and UNIX, and provides enhanced plant control created for OT environments, including close alignments with GE and third-party equipment. Advanced automation is used for patch deployments, configuration policy enforcement, and configuration file backup. A modular approach enables teams to start small and expand over time, helping address near- and long-term needs.

Baseline Security Center centralizes the management of patches, anti-malware, backup and recovery, and user identities. With Baseline Security Center, you gain insights into your OT environment and security posture. You can quickly establish comprehensive security mechanisms that mitigate the risk of cyberattacks and failed compliance audits. Baseline Security Center helps your team ensure that the security controls implemented are aligned with your operational goals and supports the implementation of maintenance and governance processes that help protect your most critical assets.



POWER PATCH VALIDATION

The Power Patch Validation Program offers comprehensive patch management services, covering all GE assets managed by Baseline Security Center.

This program offers testing and validation of anti-virus and host intrusion detection signature updates as well as operating system patches. These patches are provided via a convenient, secure web portal in complete, scripted packages that are easy to deploy. Featuring cumulative updates, these packages help ensure that you're current with the latest releases. Plus, using the Baseline Security Center appliance, you can establish automated, centrally managed deployment of patches.

It's vital to quickly apply patches and fixes when vulnerabilities are identified. However, for resource-constrained operations teams, patch validation, testing, and deployment efforts can present challenges. Staying on top of vulnerabilities and available patches can be complex and difficult. For internal teams, it can be hard to verify which vulnerabilities affect specific environments and how interdependent systems are affected. Finally, applying patches can be very labor intensive. Teams need to dedicate significant time and effort to staying abreast of vulnerabilities and patches; downloading, installing, and testing the patches; and deploying newer code into production.

GE's SOLUTION:

As part of the program, we will test and validate antivirus and host intrusion detection signature updates as well as operating system patches. First, we'll verify whether these newer releases apply to your environment, and based on that, we'll establish a list of candidates for testing. We then test applicable updates in controlled, representative lab environments that offer safeguards against intrusion and tampering. Through this testing, we determine whether updates adversely affect the functional operation of the control system, related interfaces, or system communications. Based on our findings, we can exclude any updates that may introduce performance or availability issues. If a given patch is excluded, we provide documentation to support this exclusion.

With this program, you can more consistently and comprehensively comply with a number of government and industry cybersecurity standards.

The Patch Validation program is available as a stand-alone offering. In addition, your organization can deploy these patches using Baseline Security Center, which brings centralized management to the deployment process, reducing the need to run patch deployment tools locally on each system being patched. By harnessing these combined offerings, your team can enjoy even greater speed and efficiency gains.

SOLUTION BENEFITS

Put the Patch Validation Program to work for your organization and you can realize the following benefits:

REDUCE CYBER RISK EXPOSURE

This program helps your team more quickly and consistently apply patches and other mitigation tactics, so you can more effectively safeguard your environment and adhere to cyber security best practices.

ENHANCE COMPLIANCE

With this program, you can more consistently and comprehensively comply with a number of government and industry cyber security standards, including North American Electric Reliability Corporation Critical Infrastructure Protection (NERC CIP), Nuclear Energy Institute (NEI) 08-09, and ISA 99/IEC 62443.

IMPROVE SYSTEM AVAILABILITY

By employing the program's validated, pre-packaged updates, your organization can avoid the potential risks of implementing patches that can have a negative impact on production environments.

BOOST OPERATIONAL EFFICIENCY

By harnessing these services, your internal teams can reduce the time they spend on laborious efforts like patch testing. Plus, they can deploy tested and validated patches that have been proven to run in a similar environment—and to reduce the trial, error, and remediation efforts associated with implementing untested patches.

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GUARDIAN† CYBERSECURITY SOLUTION

Quickly respond to cyberattacks and operational disruptions in control networks with the Guardian cybersecurity solution. Guardian rapidly detects cyberthreats and process anomalies, providing unprecedented operational visibility and enhanced resiliency.

Guardian offers leading capabilities that help power generators improve reliability, safety, cybersecurity, and operational efficiency in industrial control system (ICS) environments. Once deployed, Guardian automatically discovers operational technology (OT) network topologies and connected devices. The solution develops security and process profiles and monitors systems in real time to detect unexpected changes.

Guardian features automatic discovery of industrial assets and visibility into their vulnerabilities and cybersecurity risks. The solution offers multifaceted capabilities for detecting ICS threats, employing behavioral analysis and artificial intelligence-powered risk assessment, and easy integration with existing IT and OT infrastructure. Continual monitoring of ICS networks and processes results in superior incident capture. Enterprise-class scalability exists when Guardian is deployed with the complementary Central Management Console.

With Guardian, you improve system and process awareness with a visualization interface that shows all assets and links, including built-in and customizable dashboards, detailed reports, and ad hoc querying capabilities. Using passive, non-intrusive deployment, Guardian connects to network devices via SPAN or mirror ports.

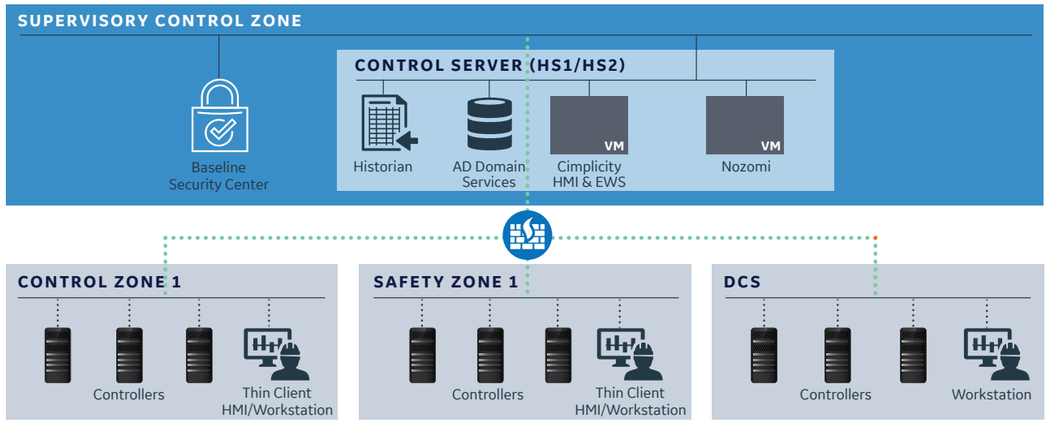
The solution triggers automated alerts when it detects anomalies, and changes and offers views that make it easy to drill down on asset information. Plus, Guardian switches from learning of threats to protection mode automatically. Once in protection mode, you'll be alerted to any changes in your environment.

Guardian uses information from OT ThreatFeed, a subscription service that includes rules, signatures, and other indicators to detect newer and emerging threats. With this ICS security solution, your team can detect malware, ransomware, and other malicious software, zero-day attacks, complex threats and attacks, man-in-the-middle attacks, brute-force and distributed denial-of-service attacks, and other unauthorized behavior.

Guardian offers built-in integration with:

- Firewalls from such vendors as Cisco, Check Point, Fortinet, Palo Alto Networks, and more
- User authentication directories, including Active Directory and LDAP
- Ticketing systems, including ServiceNow for case management
- Endpoint security tools, including antivirus and host intrusion detection systems
- SIEMs, including HPE ArcSight, IBM QRadar, LogRhythm, and Splunk

SAMPLE DEPLOYMENT ARCHITECTURE



†Trademark of Nozomi Networks, Inc.

ADVANCED STEAM PATH UPGRADE

Today's combined-cycle plant operators are facing critical component wear and tear due to equipment age and increasing cyclic duty. As a result, plant output and efficiency are on the decline and unplanned emergent work is becoming more common. GE's Advanced Steam Path (ASP) upgrade can change that, improving capacity, power output, efficiency, availability, reliability, and lifetime extension.

The upgrade includes a newer, larger diameter three-piece welded rotor with 10-Cr material in the center section, singlet* diaphragms in the high-pressure (HP) and intermediate-pressure (IP) sections, HP reaction blading, IP impulse blading, integral cover blades, a modern N_2 packing head configuration made of 9-Cr material with reduced axial loading and improved clearances, and enhanced sealing features including HP tip and root J-seals, N_2 packing head brush seals, and IP tip brush seals. Plus, the current steam path is engineered to fit within the existing shell.

Further benefits include improved reliability of the steam turbine by addressing outstanding TILs. The upgrade brings with it not only better performance through the modern steam path configuration but also an opportunity to size the steam path to accommodate higher steam flow from any GT uprate. The clock is set back to zero on rotor fatigue and rupture damage.

The economics of an upgrade compare favorably with the cost of a newer plant, and lead time is much shorter. Our services range from technical direction to complete turnkey installation (typically achieved within a scheduled outage period). Return on investment can be as little as three years, and performance guarantees are provided.

The typical post-ASP upgrade regular maintenance interval is 100,000 hours, which is very likely to be longer than the original, thus saving costs and increasing availability.

With rising fuel prices and increasingly stringent environmental regulations, the improved thermal performance of a steam turbine can be biased toward reducing input rather than raising output. The appropriate balance between fuel savings and power increase can be tailored to help meet customer requirements, with up to a 10% steam turbine cycle efficiency gain.

GE's expertise enables us to offer ASP upgrades for all types of steam turbine from any manufacturer, and we uniquely can cover both impulse and reaction steam turbine technologies—irrespective of the original blading technology—to get the best results for you.

GE is at the forefront of steam turbine technology development in the areas of steam path, frame architecture, components, and material development. As a leader in upgrade components, we focus on tailored solutions through a holistic approach with cutting-edge mechanical, aerodynamic, thermodynamic, materials, and manufacturing technologies.

While our innovative and flexible concepts can be customized to help meet your requirements, the proven features used can be developed quickly and precisely. For non-GE equipment, onsite interface measurements are taken before configuration is finalized. When implementing our ASP upgrades, we work with you to reduce changes to your operating procedures.

Blade engineering is continually evolving through advanced Computational Fluid Dynamics (CFD) techniques, with the most promising solutions validated in model turbine tests.

The routine use of three-dimensional (3D) blading has allowed many traditional efficiency limitations to be overcome. With 3D blading, the blade profile and shape are improved to reduce aerodynamic loss. This has allowed for aft-loaded profiles, which increase velocity distribution and reduce secondary flow losses at the hub and tip. For stationary blades, end losses are reduced with the controlled flow configuration, which enlarges the throat area of the central section by twisting the leading edge.

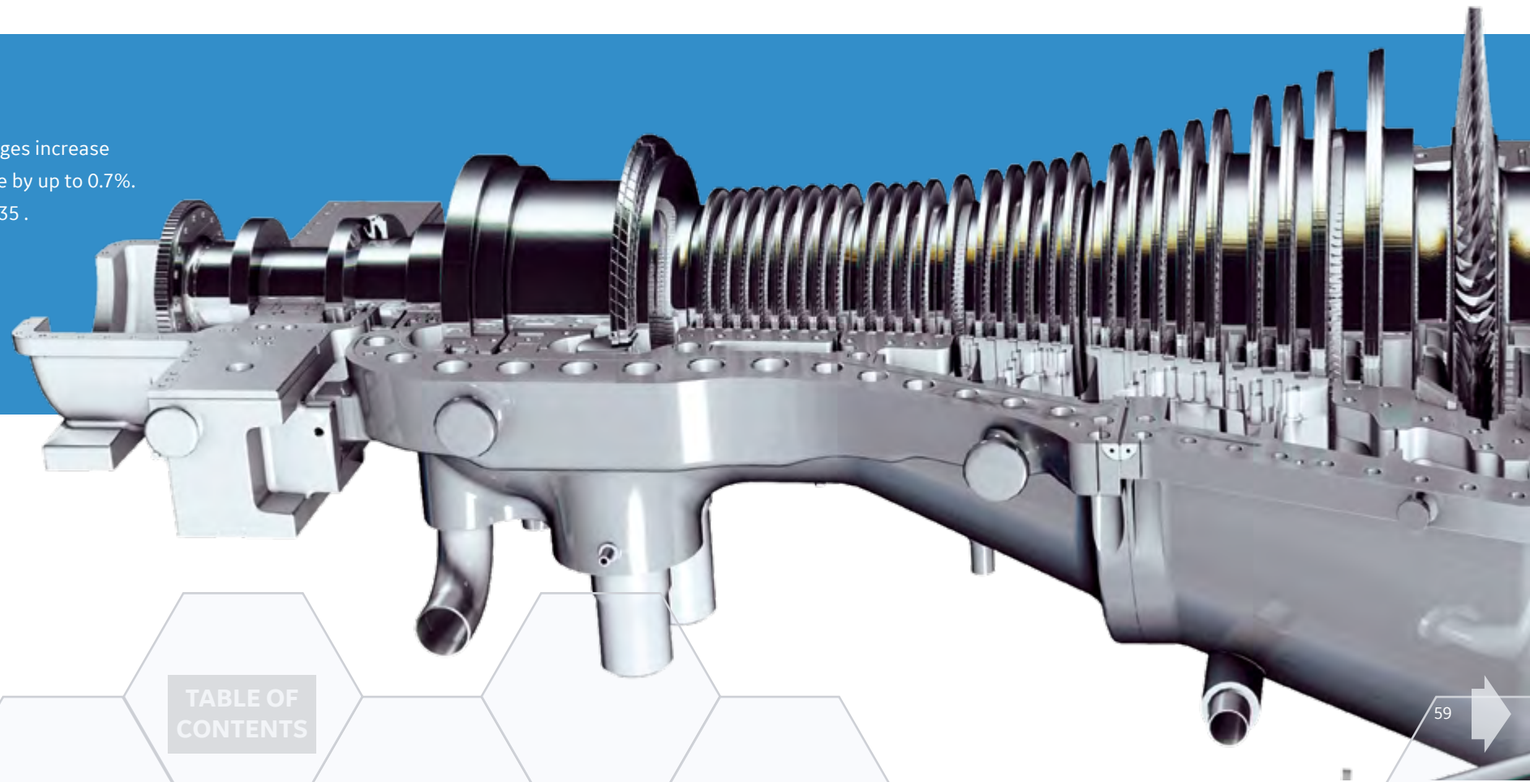
Advances in modeling and analysis also provide greater understanding of stresses and vibration, resulting in resilient components with high operational flexibility. Modern manufacturing capabilities not only allow for better aerodynamics but also enable features such as integral shrouds and snubbers, which improve the stiffness of blade packets.

BENEFITS:

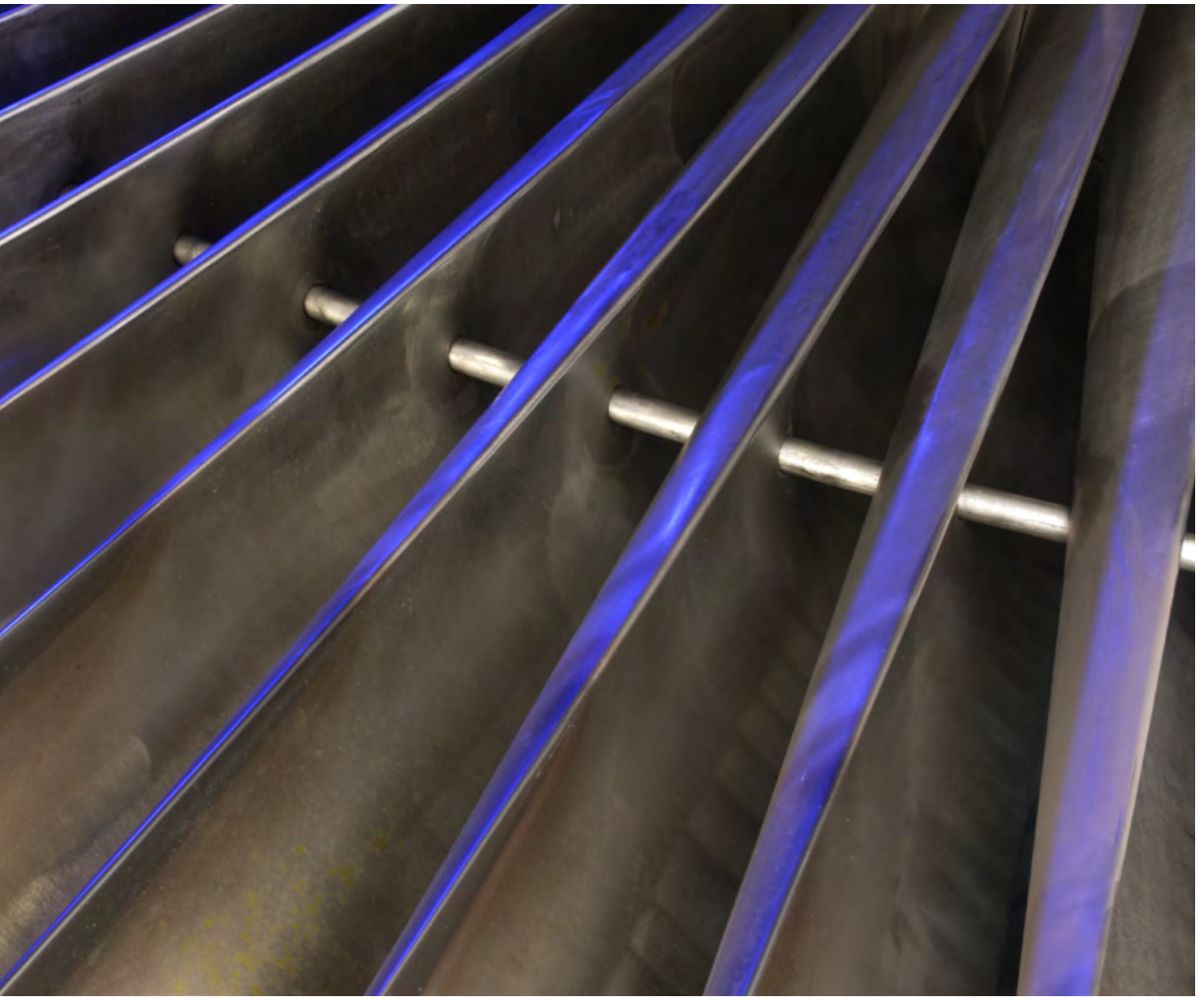
With the ASP upgrade, you can expect up to a 20-day reduction in outage duration and lower risks of unplanned outages and major emergent repairs during planned outages. You can count on increased steam turbine output, thanks to improved technology and the recovery of aging losses. The upgrade helps deliver an improved combined cycle heat rate and enables combined cycle plant upgrades that increase steam flow.

In addition to addressing rotor bow, the changes increase ST MW output by up to 2.2% and CC heat rate by up to 0.7%. Outage days are estimated to be fewer than 35 .

ASP, coupled with our Opflex Agility solution, can help improve startup times up to 56%.



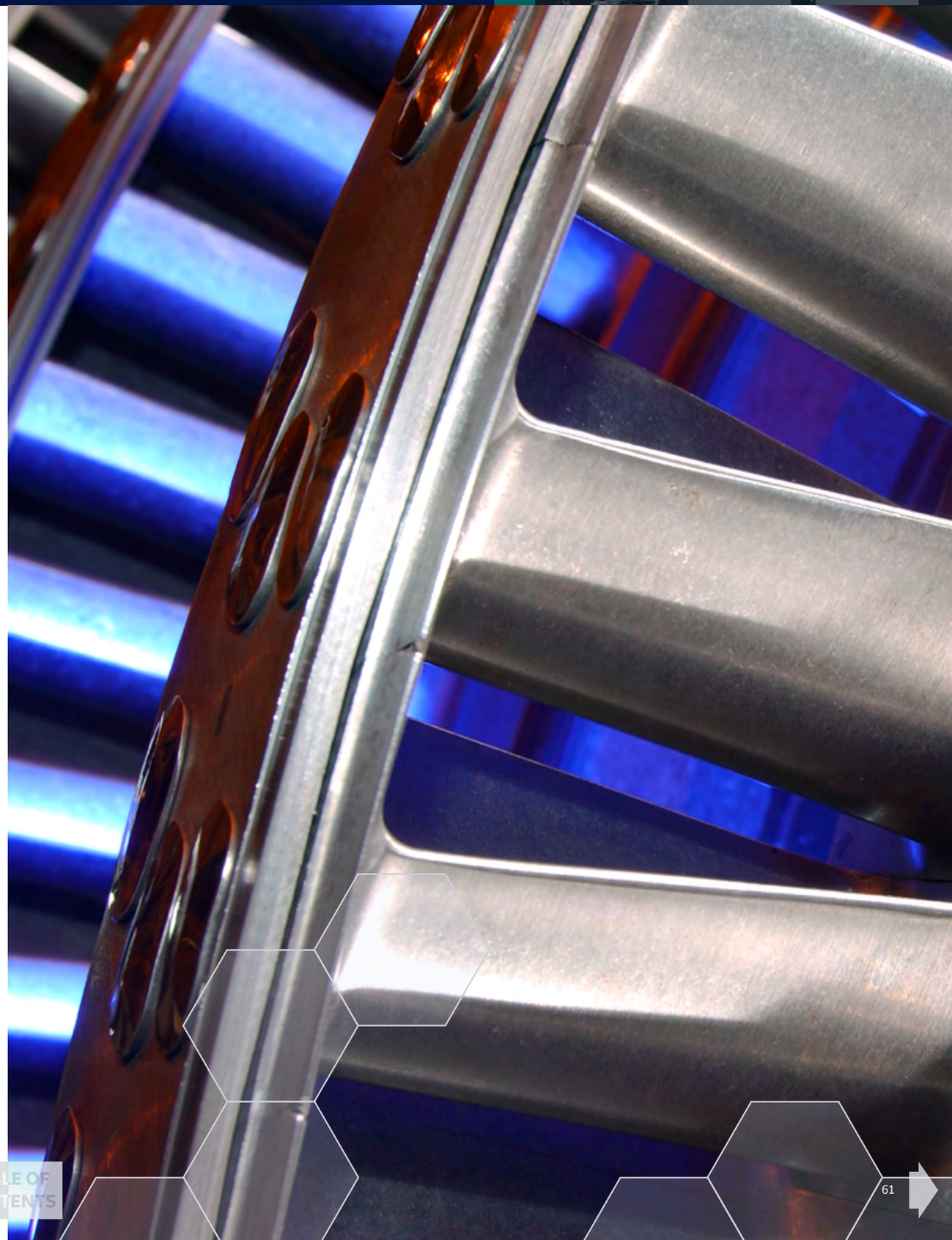
HIGH PRESSURE STEAM TURBINE



Experience advanced bottoming cycle by integrating a High Pressure Steam Turbine into your plant as a turnkey offer or through GE's Engineered Equipment Package.

This upgrade, which utilizes Once Through Heat Recovery Steam Generator (HRSG) technology, unlocks advanced steam cycle enhancement of up to 185 bar main steam pressure.

With GE's high pressure steam turbine a site is able to achieve excellent plant efficiency at the lowest CAPEX.



HRSG PRESSURE PARTS REPLACEMENT

As your Heat Recovery Steam Generator (HRSG) ages, it may be time to consider pressure parts replacement to help ensure unit reliability, save on O&M costs, and extend the lifetime of your plant.

The typical engineering life of HRSG pressure parts is 25-30 years. Operating the HRSG outside of the original specification—especially in a cycling gas turbine operation—can result in accelerated lifetime consumption, which typically leads to an increased risk of forced outage and higher costs.

As an OEM with a global workshop network, GE can offer replace-in-kind or tailor-made pressure parts for any HRSG specification, including Alstom and Doosan. no matter how vast the scope is and how complex the installation might be, we have a solution to streamline the cycle and enhance your unit's availability quickly, safely, and with high quality.

A pressure parts replacement includes the engineering and procurement of the current pressure parts, their installation, an optional site hydrotest, in-kind or upgraded material and/or geometry, and the use of FAC-resistant material. The scope of the replacement is based on site needs and may include the replacement of headers, harps, or complete modules. Front-end, multi-row headers can be reengineered to improve their lifetime under cycling conditions.

Because we installed the original unit, GE has in-depth knowledge of every piece of equipment in your HRSG. Not all HRSGs are the same, but we have detailed drawings of every type, which will save you additional time and money with no need to "reverse engineer" your equipment.

BENEFITS:

With a pressure parts replacement, we will replace all the internal equipment in your HRSG, resulting in restored reliability up to 98.5%, reduced O&M costs of up to $100,000 per year vs. repairs, a reduced risk of forced outage of up to 90%, and up to 25 years of extended life.

ONCE THROUGH HRSG TECHNOLOGY

GE's Once Through (OT) HRSG technology is a key enabler in advanced water-steam cycles, providing higher combined cycle efficiency with high cyclic capability.

Proven with more than 2.5 million operating hours, Once Through technology offers superior part load performance due to the ability to vary feedwater flow resulting in increased combined cycle efficiency. Furthermore, it can operate at higher HP steam pressures, resulting in increased combined cycle efficiency at base load.

Our water treatment solution with Once Through HRSG requires a small polisher (3%) for make-up water in lieu of a typical 50% condensate polisher required by others, inherently decreasing total plant cost. Because there is no continuous blowdown as on drum type HRSGs, GE's OT has a smaller water footprint, with less energy loss.

HIGHLY MODULARIZED HRSG AND POWER ISLAND SUB SYSTEMS

Our full suite of transportable auxiliary modules allows for faster construction, fewer site risks, and reduced total installed costs.

Through plant modularization, factory-assembled HRSG auxiliary modules and power island sub systems, site construction costs and the duration of construction are reduced.

Factory testing of some of these modules leads to fewer non-conformance reports, with lower site environment, health, and safety risks.

Technical Training

TECHNICAL TRAINING

GE's customer training solutions are constructed to develop your team's expertise, provided through a variety of flexible methods, throughout your plant's lifecycle.

Our pool of more than 50 GE expert instructors shares insights based on a thorough knowledge of OEM engineering, installation, operation, and maintenance, using the latest highly effective training tools and techniques:

Site-Specific Courses
Our portfolio of over 200 high value Site-Specific courses is built using site-specific manuals, configurations, drawings, and software (as available) to help meet your specific needs, and to develop your team's expertise. They are provided either at your site or at one of our Gas Power global learning centers in the language of your choice, and on a schedule that works for you. Courses may contain a mix of classroom learning, site walkdowns, and hands-on training.

Open Enrollment Courses
Provided via Distance Learning or in one of our Global Gas Power Leaning Centers.

With technology-specific content, our Open Enrollment training offers a comprehensive selection of more than 75 English language courses for small staff or new team member training, or to expand the skills of select employees. Courses offer a mix of learning techniques and may contain walkdowns and/or hands-on training.

Online Courses
A cost-effective solution for a broad range of employees, our 25-plus self-paced Online English language courses let you train your personnel anytime, anywhere, and at their own pace. Each course ranges in duration from one to several hours and can be started and stopped at the student's discretion.

Training Simulators
GE offers a variety of training simulator solutions to help meet your needs—whether you require an onsite simulator tailored to your equipment or remote access to a technology-specific simulator. These simulators are effective, convenient, and comprehensive, while posing no operational risk to GE's OEM equipment.

Multi-Year Training Agreements
Our long-term flexible training agreement is our highest value offering, which allows you to simplify your budgeting and planning efforts. This agreement entitles you to a fixed number of annual training days for GE's Site-Specific and/or Open Enrollment courses, unlimited use of all our available Online courses, plus exclusive access to our Technology-Specific Simulator. We work with you throughout your plant's lifecycle to help you select the training solutions that best aim to meet your evolving needs.

www.geenergytechnicaltraining.com

Comprehensive Flexible Training Solutions to Help Meet Your Total Plant Needs

Controls | Gas Turbines | Steam Turbines | Generators | HRSGs

SPECIFICATIONS

HEAVY DUTY GAS TURBINES

		50/60 Hz (Geared)			50 Hz			
		6B.03	6F.01	6F.03	9E.03	9E.04	GT13E2-190	GT13E2-210
SC PLANT PERFORMANCE	SC Net Output (MW)	45	57	88	132	147	195	210
	SC Net Heat Rate (Btu/kWh, LHV)	10,216	8,975	9,277	9,960	9,238	8,872	8,980
	SC Net Heat Rate (kJ/kWh, LHV)	10,779	9,469	9,788	10,508	9,747	9,361	9,474
	SC Net Efficiency (%, LHV)	33.4%	38.0%	36.8%	34.3%	36.9%	38.5%	38.0%
GAS TURBINE PARAMETERS	Compression Pressure Ratio (X:1)	12.8	22.3	16.4	13.1	13.2	17.6	18.2
	Exhaust Temperature (°F)	1,041	1,136	1,151	1,022	1,016	956	959
	Exhaust Temperature (°C)	561	613	622	550	547	513	515
	Exhaust Mass Flow (lb/s)	319.9	295.9	482.4	929.3	925.1	1,248.4	1,370.4
	Exhaust Mass Flow (kg/s)	145.1	134.2	218.8	421.5	419.6	566.3	621.6
	GT Turndown Minimum Load (%)	30%	40%	35%	35%	35%	20%	30%
	GT Ramp Rate (MW/min)[1]	20	12	22	50	29	12/24	14/36
	NOx (ppmvd) at Baseload (@15%O_2)	4	25	15	25	15	15	15
	CO (ppm) at Min Turndown w/o Abatement	25	9	9	5	25	25	25
	Startup Time, Conventional/ Peaking (Min)[2]	12/10	23/10	13/10	30/10	30/10	25/15	25/15
1X CC PLANT PERFORMANCE	CC Net Output (MW)	70	84	135	205	218	280	305
	CC Net Heat Rate (Btu/kWh, LHV)	6,578	5,980	5,998	6,421	6,203	6,172	6,189
	CC Net Heat Rate (kJ/kWh, LHV)	6,940	6,309	6,328	6,775	6,545	6,512	6,530
	CC Net Efficiency (%)	51.9%	57.1%	56.9%	53.1%	55.0%	55.3%	55.1%
	Plant Turndown Minimum Load (%)	41%	39%	44%	45%	46%	28%	40%
	Ramp Rate (MW/min)[1]	20	12	7	50	29	12	14
	Startup Time (RR Hot, Minutes)[3]	30	30	45	38	38	30	30
	Bottoming Cycle Type	2PNRH	3PRH	3PRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	STF-A100	STF-A100	STF-A200	STF-A200	STF-A200	STF-A200	STF-A200
2X CC PLANT PERFORMANCE	CC Net Output (MW)	141	170	272	412	439	563	613
	CC Net Heat Rate (Btu/kWh, LHV)	6,515	5,932	5,944	6,372	6,166	6,137	6,153
	CC Net Heat Rate (kJ/kWh, LHV)	6,874	6,259	6,271	6,723	6,505	6,475	6,492
	CC Net Efficiency (%, LHV)	52.4%	57.5%	57.4%	53.5%	55.3%	55.6%	55.5%
	Plant Turndown Minimum Load (%)	20%	19%	21%	22%	22%	14%	19%
	Ramp Rate (MW/min)[1]	40	24	13	100	58	24	28
	Startup Time (RR Hot, Minutes)[3]	30	30	35	38	38	30	30
	Bottoming Cycle Type	2PNRH	3PNRH	3PNRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	STF-A200	STF-A200	STF-A200	STF-D200	STF-D200	STF-D200	STF-D200

		50 Hz			60 Hz					
		9F.04	9HA.01	9HA.02	7E.03	7F.04	7F.05	7HA.01	7HA.02	7HA.03
SC PLANT PERFORMANCE	SC Net Output (MW)	288	448	571	90	201	239	290	384	430
	SC Net Heat Rate (Btu/kWh, LHV)	8,810	7,960	7,740	10,107	8,873	8,871	8,120	8,009	7,884
	SC Net Heat Rate (kJ/kWh, LHV)	9,295	8,398	8,166	10,664	9,362	9,359	8,567	8,450	8,318
	SC Net Efficiency (%, LHV)	38.7%	42.9%	44.0%	33.8%	38.5%	38.5%	42.0%	42.6%	43.3%
GAS TURBINE PARAMETERS	Compression Pressure Ratio (X:1)	16.9	22.8	23.8	12.7	17.0	18.8	21.6	23.1	23.7
	Exhaust Temperature (°F)	1,150	1,199	1,184	1,018	1,158	1,205	1,158	1,202	1,217
	Exhaust Temperature (°C)	621	648	640	588	626	652	626	650	658
	Exhaust Mass Flow (lb/s)	1,459.0	1,869.0	2,292.5	644.0	1,028.6	1,163.9	1,293.7	1,609.4	1,718.0
	Exhaust Mass Flow (kg/s)	661.8	847.8	1,039.9	292.1	466.6	527.9	586.8	730.0	779.3
	GT Turndown Minimum Load (%)	35%	25%	25%	35%	49%	43%	25%	25%	25%
	GT Ramp Rate (MW/min)[1]	23	65	88	40	30	40	55	60	75
	NOx (ppmvd) at Baseload (@15%O_2)	15	25	25	4	9	12	25	25	25
	CO (ppm) at Min Turndown w/o Abatement	24	9	9	25	9	9	9	9	9
	Startup Time, Conventional/ Peaking (Min)[2]	23/20	23/	23/	23/10	21/11	21/11	21/10	21/10	21/10
1X CC PLANT PERFORMANCE	CC Net Output (MW)	443	680	838	140	309	379	438	573	640
	CC Net Heat Rate (Btu/kWh, LHV)	5,666	5,356	5,320	6,514	5,716	5,667	5,481	5,381	5,342
	CC Net Heat Rate (kJ/kWh, LHV)	5,978	5,651	5,613	6,873	6,031	5,979	5,783	5,677	5,636
	CC Net Efficiency (%)	60.2%	63.7%	64.1%	52.4%	59.7%	60.2%	62.3%	63.4%	63.9%
	Plant Turndown Minimum Load (%)	48%	33%	33%	45%	58%	46%	33%	33%	33%
	Ramp Rate (MW/min)[1]	22	65	88	40	30	40	55	60	75
	Startup Time (RR Hot, Minutes)[3]	30	<30	<30	35	28	25	<30	<30	<30
	Bottoming Cycle Type	3PRH	3PRH	3PRH	2PNRH	3PRH	3PRH	3PRH	3PRH	3PRH
	ST Configuration (Type)	STF-D650	STF-D650	STF-D650	STF-A200	STF-D650	STF-D650	STF-D650	STF-D650	STF-D650
2X CC PLANT PERFORMANCE	CC Net Output (MW)	889	1,363	1,680	283	622	762	880	1,148	1,282
	CC Net Heat Rate (Btu/kWh, LHV)	5,649	5,345	5,306	6,454	5,675	5,640	5,453	5,365	5,331
	CC Net Heat Rate (kJ/kWh, LHV)	5,960	5,639	5,598	6,809	5,987	5,951	5,753	5,660	5,625
	CC Net Efficiency (%, LHV)	60.4%	63.8%	64.3%	52.9%	60.1%	60.5%	62.6%	63.6%	>64.0%
	Plant Turndown Minimum Load (%)	22%	15%	15%	22%	27%	22%	15%	15%	15%
	Ramp Rate (MW/min)[1]	44	130	176	80	60	80	110	120	150
	Startup Time (RR Hot, Minutes)[3]	39	<30	<30	35	28	25	<30	<30	<30
	Bottoming Cycle Type	3PRH	3PRH	3PRH	2PNRH	3PRH	3PRH	3PRH	3PRH	3PRH
	ST Configuration (Type)	STF-D650	STF-D650	STF-D650	STF-D200	STF-D650	STF-D650	STF-D600	STF-D600	STF-D650

[1] Ramp rates are Fast Ramp via AGC.

[2] Start times recognize purge credit. Turning gear to full speed, full load and synchronized to grid. Peaking maintenance factors may apply depending on the operating profile.

[3] Start times are based on rapid response technologies in hot start conditions with purge credit recognized. Simultaneous start sequence of gas turbine may apply depending on exact project configurations.

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
All performance figures based on once through condenser with 1.2" Hga condenser pressure. 2PNRH = Two pressure, non-reheat; 3PRH = Three pressure, reheat.

AERODERIVATIVE GAS TURBINES†

		TM2500		LM2500 DLE		LM2500+ DLE		LM2500+G4 SAC	
	Frequency	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
SC PLANT PERFORMANCE	SC Net Output (MW)	34.6	37.0	22.2	22.9	30.5	31.4	34.4	37.2
	SC Net Heat Rate (Btu/kWh, LHV)	9,784	9,333	9,920	9,557	9,356	8,959	9,819	9,286
	SC Net Heat Rate (kJ/kWh, LHV)	10,323	9,847	10,466	10,083	9,871	9,452	10,360	9,797
	SC Net Efficiency (%, LHV)	34.9%	36.6%	34.4%	35.7%	36.5%	38.1%	34.8%	36.7%
GAS TURBINE PARAMETERS	Compression Pressure Ratio (X:1)	26.2	26.3	19.2	19.1	25.0	24.5	26.2	26.3
	Exhaust Temperature (°F)	978	962	1,033	1,012	998	975	978	962
	Exhaust Temperature (°C)	526	517	556	545	537	524	526	517
	Exhaust Mass Flow (lb/s)	214.8	214.8	151.8	151.2	197.9	194.7	214.8	214.8
	Exhaust Mass Flow (kg/s)	97.4	97.4	68.8	68.6	89.8	88.3	97.4	97.4
	GT Turndown Minimum Load (%)	—	—	—	—	—	—	—	—
	NOx (ppmvd) at Baseload (@15%O_2)	25	25	24	24	25	25	25	25
	CO (ppm) (@15%O2)[1]	54	56	25	25	25	25	54	56
	Startup Time, Conventional/Peaking (Min)	—	—	—	—	—	—	—	—
1X CC PLANT PERFORMANCE	CC Net Output (MW)	49.3	51.2	33.3	33.5	44.2	44.0	49.1	51.3
	CC Net Heat Rate (Btu/kWh, LHV)	6,883	6,745	6,577	6,507	6,440	6,355	6,885	6,726
	CC Net Heat Rate (kJ/kWh, LHV)	7,241	7,116	6,939	6,866	6,794	6,705	7,264	7,096
	CC Net Efficiency (%)	49.7%	50.6%	51.9%	52.4%	53.0%	53.7%	49.6%	50.7%
	Plant Turndown – Minimum Load (%)	—	—	—	—	—	—	—	—
	Ramp Rate (MW/min)	—	—	—	—	—	—	—	—
	Startup Time (RR Hot, Minutes)	—	—	—	—	—	—	—	—
	Bottoming Cycle Type	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing
2X CC PLANT PERFORMANCE	CC Net Output (MW)	99.3	103.3	67.2	67.7	89.2	88.9	99.0	103.5
	CC Net Heat Rate (Btu/kWh, LHV)	6,807	6,687	6,525	6,445	6,385	6,300	6,829	6,674
	CC Net Heat Rate (kJ/kWh, LHV)	7,181	7,055	6,884	6,800	6,737	6,647	7,205	7,041
	CC Net Efficiency (%, LHV)	50.1%	51.0%	52.3%	52.9%	53.4%	54.2%	50.0%	51.1%
	Plant Turndown – Minimum Load (%)	—	—	—	—	—	—	—	—
	Ramp Rate (MW/min)	—	—	—	—	—	—	—	—
	Startup Time (RR Hot, Minutes)	—	—	—	—	—	—	—	—
	Bottoming Cycle Type	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing

LM2500+G4 DLE		LM2500XPRESS+G4 UPT DLE		LM2500XPRESS+G5 UPT DLE		LM6000 PC	LM6000 PC SPRINT	LM6000 PG	LM6000 PG SPRINT
50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
33.0	34.1	33.9	34.3	36.3	37.1	46.6	51.1	56.1	57.3
9,291	8,827	8,861	8,861	8,805	8,673	8,533	8,576	8,718	8,812
9,803	9,313	9,349	9,349	9,290	9,150	9,003	9,048	9,198	9,297
36.7%	38.7%	38.5%	38.5%	38.8%	39.3%	40.0%	39.8%	39.1%	38.7%
25.5	25.0	25.0	24.9	25.6	25.8	31.4	32.7	34.9	35.2
1,023	994	996	989	1,026	1,018	831	846	892	895
550	534	535	532	552	548	444	452	478	480
206.7	203.2	202.4	201.9	206.1	207.6	290.3	299.8	317.7	319.4
93.7	92.2	91.8	91.6	93.5	94.2	131.7	136.0	144.1	144.9
—	—	—	—	—	—	—	—	—	—
25	25	25	25	25	25	25	25	25	25
25	25	25	25	25	25	89	89	59	59
—	—	—	—	—	—	—	—	—	—
48.0	48.0	47.8	47.9	51.4	52.0	60.4	66.6	73.9	75.5
6,354	6,254	6,240	6,213	6,151	6,120	6,561	6,598	6,577	6,611
6,704	6,598	6,583	6,555	6,490	6,457	6,922	6,961	6,939	6,975
53.7%	54.6%	54.7%	54.9%	55.5%	55.8%	52.0%	51.7%	51.9%	51.6%
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	30	30	30	30
—	—	—	—	—	—	—	—	—	—
2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing
96.9	96.7	96.4	96.6	103.7	105.0	121.4	133.8	148.7	152.1
6,301	6,206	6,190	6,163	6,102	XXXX	6,523	6,566	6,532	6,563
6,648	6,548	6,531	6,503	6,438	6,400	6,882	6,927	6,892	6,924
54.2%	55.0%	55.1%	55.4%	55.9%	56.3%	52.3%	52.0%	52.2%	52.0%
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	30	30	30	30
—	—	—	—	—	—	—	—	—	—
2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing

[1] At baseload/minimum turndown without abatement

NOTE: Gas turbine ratings are at the generator terminals; 15˚C (59˚F), 60% relative humidity; unity power factor, natural gas, inlet, and exhaust losses excluded. Plant ratings are on a net plant basis; 15˚C (59˚F), 60% relative humidity; 0.8 power factor, natural gas, inlet, and exhaust losses included. Actual performance will vary with project-specific conditions and fuel. 2PNRH = Two pressure, non-reheat.

† Aeroderivative simple and combined performance numbers for 2022 have been updated to reflect best available information for each engine model and its operating auxiliary loads, and sourced equipment/sub-system performance, consistent with the requirements and needs of most customers.

AERODERIVATIVE GAS TURBINES (cont.)†

		LM6000 PF	LM6000 PF SPRINT	LM6000 PF+	LM6000 PF+ SPRINT	LM9000	
	Frequency	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50 Hz	60 Hz
SC PLANT PERFORMANCE	SC Net Output (MW)	44.7	50.1	54.3	57.2	72.2	72.7
	SC Net Heat Rate (Btu/kWh, LHV)	8,248	8,244	8,304	8,368	8,046	7,980
	SC Net Heat Rate (kJ/kWh, LHV)	8,702	8,698	8,761	8,829	8,489	8,419
	SC Net Efficiency (%, LHV)	41.4%	41.4%	41.1%	40.8%	42.4%	42.8%
GAS TURBINE PARAMETERS	Compression Pressure Ratio (X:1)	31.1	33.0	34.3	35.9	36.1	35.8
	Exhaust Temperature (°F)	864	864	918	908	845	849
	Exhaust Temperature (°C)	462	462	492	487	452	454
	Exhaust Mass Flow (lb/s)	280.7	295.5	311.1	324.8	434.7	430.2
	Exhaust Mass Flow (kg/s)	127.3	134.0	141.1	147.3	197.2	195.1
	GT Turndown Minimum Load (%)	—	—	—	—	—	—
	NOx (ppmvd) at Baseload (@15%O_2)	25	25	25	25	—	—
	CO (ppm) (@15%O2)[1]	25	25	25	25	—	—
	Startup Time, Conventional/Peaking (Min)	—	—	—	—	—	—
1X CC PLANT PERFORMANCE	CC Net Output (MW)	58.8	65.2	72.3	75.7	93.4	93.8
	CC Net Heat Rate (Btu/kWh, LHV)	6,238	6,297	6,179	6,276	6,189	6,154
	CC Net Heat Rate (kJ/kWh, LHV)	6,581	6,644	6,519	6,621	6,530	6,493
	CC Net Efficiency (%)	54.7%	54.2%	55.2%	54.4%	55.1%	55.4%
	Plant Turndown – Minimum Load (%)	—	—	—	—	—	—
	Ramp Rate (MW/min)	30	30	30	30	—	—
	Startup Time (RR Hot, Minutes)	—	—	—	—	—	—
	Bottoming Cycle Type	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing
2X CC PLANT PERFORMANCE	CC Net Output (MW)	118.3	131.1	145.6	152.5	188.0	188.7
	CC Net Heat Rate (Btu/kWh, LHV)	6,199	6,267	6,136	6,230	6,153	6,154
	CC Net Heat Rate (kJ/kWh, LHV)	6,540	6,612	6,473	6,573	6,492	6,493
	CC Net Efficiency (%, LHV)	55.1%	54.4%	55.6%	54.8%	55.5%	55.4%
	Plant Turndown – Minimum Load (%)	—	—	—	—	—	—
	Ramp Rate (MW/min)	30	30	30	30	—	—
	Startup Time (RR Hot, Minutes)	—	—	—	—	—	—
	Bottoming Cycle Type	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing

LMS100 PA+		LMS100 PB+	
50 Hz	60 Hz	50 Hz	60 Hz
112.9	115.8	106.5	107.5
7,935	7,773	8,017	7,977
8,372	8,201	8,458	8,416
43.0%	43.9%	42.6%	42.8%
44.6	44.5	44.4	44.2
786	777	789	785
419	414	420	419
516.2	514.5	507.3	506.4
234.1	233.4	230.1	229.7
—	—	—	—
25	25	22	22
11	10	187	187
—	—	—	—
134.5	137.1	127.6	128.2
6,636	6,567	6,550	6,548
7,001	6,929	6,911	6,909
51.4%	52.0%	52.1%	52.1%
—	—	—	—
—	—	—	—
—	—	—	—
2PNRH	2PNRH	2PNRH	2PNRH
Condensing	Condensing	Condensing	Condensing
269.9	275.0	256.2	257.3
6,617	6,550	6,527	6,526
6,981	6,910	6,886	6,885
51.6%	52.1%	52.3%	52.3%
—	—	—	—
—	—	—	—
—	—	—	—
2PNRH	2PNRH	2PNRH	2PNRH
Condensing	Condensing	Condensing	Condensing

[1] At baseload/minimum turndown without abatement

NOTE: Gas turbine ratings are at the generator terminals; 15°C (59°F), 60% relative humidity; unity power factor, natural gas, inlet, and exhaust losses excluded. Plant ratings are on a net plant basis; 15°C (59°F), 60% relative humidity; 0.8 power factor, natural gas, inlet, and exhaust losses included. Actual performance will vary with project-specific conditions and fuel. 2PNRH = Two pressure, non-reheat.

† Aeroderivative simple and combined performance numbers for 2022 have been updated to reflect best available information for each engine model and its operating auxiliary loads, and sourced equipment/sub-system performance, consistent with the requirements and needs of most customers.

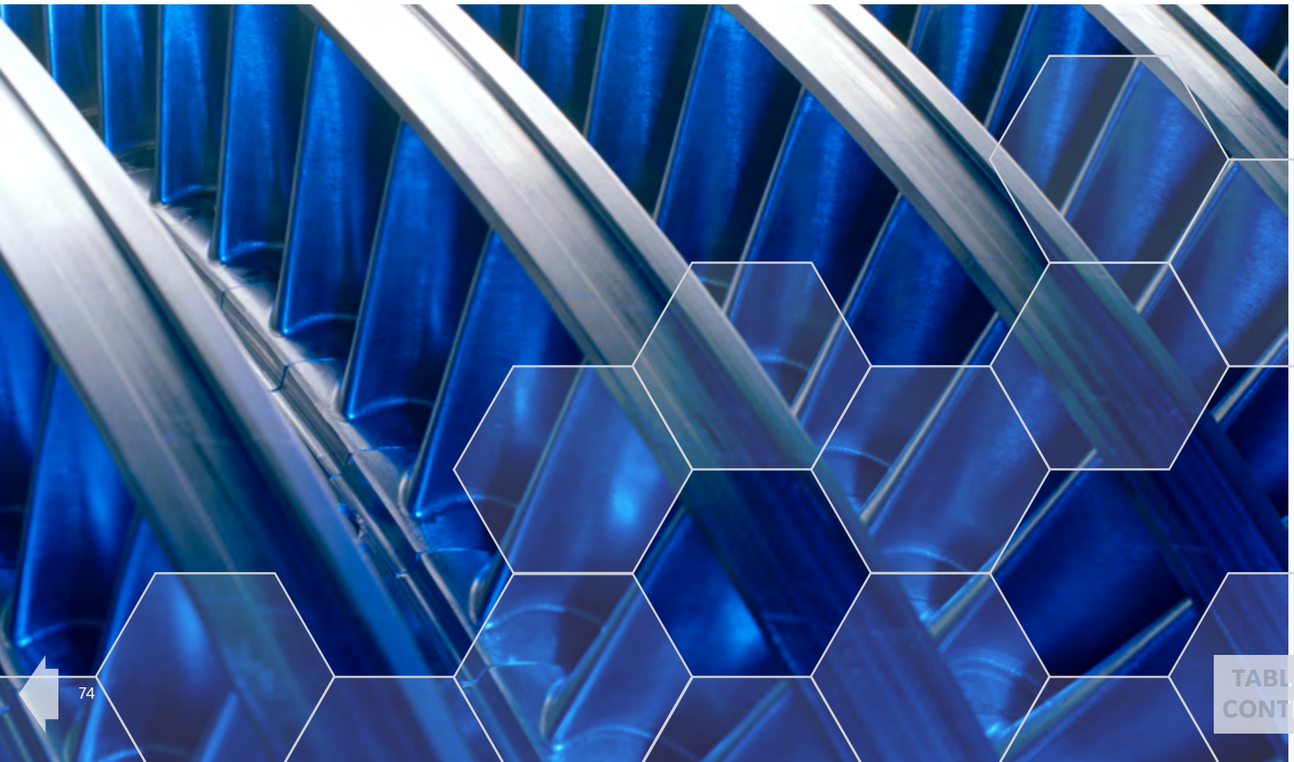
STEAM TURBINES

600 Series

	STF-A650	STF-D600	STF-D650
MAIN STEAM PRESSURE	Up to 2680psi (185bar) Up to 1112°F (600°C)	Up to 2680psi (185bar) Up to 1112°F (600°C)	Up to 2680psi (185bar) Up to 1112°F (600°C)
REHEAT STEAM TEMPERATURE	Up to 1112°F (600°C)	Up to 1112°F (600°C)	Up to 1112°F (600°C)
FREQUENCY	50 Hz and 60 Hz	50 Hz and 60 Hz	50 Hz and 60 Hz
OUTPUT	85 – 300 MW	180 – 700 MW	150 – 700 MW

200 Series

	STF-D200	STF-A200
MAIN STEAM PRESSURE	Up to 2030psi (140bar) Up to 1050°F (565°C)	Up to 2030psi (140bar) Up to 1050°F (565°C)
REHEAT STEAM TEMPERATURE	N/A	N/A
FREQUENCY	50 Hz and 60 Hz	50 Hz and 60 Hz
OUTPUT	150 – 340 MW	70 – 220 MW



GENERATORS

OUTPUT >	30 – 320 MW			240 – 605 MW			530 – 920 MW		
GAS TURBINES >	LM/TM2500;LM6000;LMS100; B/E/F-CLASS			F/H-CLASS			H-CLASS		
STEAM TURBINES >	O&G; IST; A200; D200			A200; D200; A650; D650; D600			A650/D650		
	Model	**MVA**	**Freq**	**Model**	**MVA**	**Freq**	**Model**	**MVA**	**Freq**
	A35	105/145	50/60	H35	285	60	W84	790	60
	A39	200	50/60	H53	355/405	50/60	W86	975/875	50/60
	A63	350	60	H65	450/545	50/60	W88	1090	50
	A70	260	60	H78	740	50			
	A72	235	50	H84	625/710	50/60			
	A74	295	50						
	A78	390	50						

AIR COOLED	50 Hz	60 Hz
Power Factor	0.8	0.85
MVA	390	350
Efficiency	Up to 98.9%	Up to 98.8%
Terminal Voltage	Up to 21 kV	Up to 19 kV
Reliability†	99.84%	99.84%

† Average Air-Cooled

HYDROGEN COOLED	50 Hz	60 Hz
Power Factor	0.8	0.85
MVA	740	710
Efficiency	Up to 99.0%	Up to 99.02%
Terminal Voltage	Up to 23 kV	Up to 26 kV
Reliability†	99.86%	99.86%

† Average Hydrogen-Cooled

WATER COOLED	50 Hz	60 Hz
Power Factor	0.8	0.85
MVA	Up to 1090	Up to 875
Efficiency	Up to 99.08%	Up to 98.98%
Terminal Voltage	Up to 24 kV	Up to 25 kV

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