

GE Power

# Advanced Gas Path

Bringing  
Power FlexEfficiency\*  
to installed assets.

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1010100100101001101  
0011010010011100001010

# TABLE OF CONTENTS

01011100100101  
0101000010110001  
101001010100001  
01110010101010  
00101001001101  
00101100110100  
11011011100101  
00101001100110  
00101001100101  
01001101010011  
00110001100001  
00011100101010  
00101101001001  
00100101011100  
10010101001001  
01001100101001  
10101100100101  
10100010101110  
00100110100101  
10010100110110  
11100101001010  
01100110001010  
01100101010011  
01010011001100  
01100001000111  
00101010001011  
01001001001001  
01011100100101  
01001001010011  
00101001101011  
00100101101000  
1010111001001  
01010100010110  
01101001010100  
01011100101010  
10001010010011  
01001011001101  
00110110111001  
01000101001000  
01000101001000



# GE's Power FlexEfficiency



## Blending hardware with software to drive better performance, and value

In an information-driven world, knowing how to turn knowledge into power can be the greatest advantage of all. At GE, we're dedicating more time, in more ways than ever to share and gain knowledge from our customers. Then together, we're taking a hard look at their options, and co-creating the solutions that best position our customers to achieve their desired outcomes.

An expanding suite of data analytics tools enables GE to mine more than 100 million hours of real-world operating data from the world's largest gas turbine fleet. Every day, this information is analyzed, extracting the systems-level insights needed to unleash higher performance. This knowledge is then applied to the development of solutions that marry hardware advancements with software solutions, enabling our customers to break through barriers that could otherwise hold them back.

That's GE's Power FlexEfficiency.



# GE's Advanced Gas Path

## Powering Greater Output and Efficiency

GE's Advanced Gas Path (AGP) is a great example of Power FlexEfficiency at work, setting new standards in performance. By combining design innovations, materials advancements, and proven model-based control software, the Advanced Gas Path enables GE gas turbine customers to benefit from dramatic output and efficiency improvements, while extending maintenance intervals and maintaining low emissions. It's the kind of solutions-driven thinking that's helping GE customers meet the world's energy demands.

### IMPROVES CAPACITY

- Up to 6% increase in output<sup>†</sup>
- Meets growing power demand

### INCREASES EFFICIENCY

- Up to 2% fuel efficiency improvement<sup>†</sup>
- Reduces fuel costs

### EXPANDS FLEXIBILITY<sup>††</sup>

- Up to 30% reduced start-up time
- Up to additional 3% increase in peak power capacity
- Turndown to as low as 35%
- Emissions as low as 9 ppm (20 mg/Nm<sup>3</sup>) NO<sub>x</sub>

### EXTENDS AVAILABILITY

- Increases availability up to .5%
- Extends maintenance intervals up to 32,000 hours<sup>†</sup> (up to 30%)
- Expands life-cycle value with up to 96,000-hour part life (up to three maintenance intervals)

<sup>†</sup>Applicable to GE F-class heavy duty gas turbines only. Performance varies depending on frame type and configuration.

<sup>††</sup>Requires addition of OpFlex Suite and/or Dry Low NO<sub>x</sub> solutions.



Only GE Can Harness...

# Data and analytics from the world's largest gas turbine fleet

Upgrades like the Advanced Gas Path are far more than just machined parts. These solutions tap into thermodynamic design breakthroughs and industrial-strength software technology that expand performance and enable more dynamic operational control. From there, we analyze an extraordinary amount of operational data—**more than 30,000 hours a day** culled from assets in use at customer sites around the globe. Then, we talk to customers—a lot—to learn what they need to operate effectively in a changing world. Using advanced analytics, GE experts translate all that accumulated information into the knowledge, and inspiration, needed to design tailored solutions that zero in on the needs of a specific customer operating profile.



GE's Global Research Centers (GRCs) are world-renowned for technological innovation, and a vast resource of knowledge for our product development experts. Scientists and researchers there focus on disciplines including aero-thermal systems, sensing technologies, applied materials, and software analytics—providing an array of technological building blocks that are critical advances in gas turbine design.

At GE, our knowledge—and resources—run deep. Our engineers work throughout the vast GE network, sharing processes and technologies to help make our gas turbines run cleaner, smarter, and more efficiently. The Advanced Gas Path, for example, was made possible in part due to advances in model-based controls from aviation, new sealing technologies developed for industrial applications and design innovations leveraged from across GE.

To complement GE's robust portfolio of technology resources is a collective dedication to excellence. Our cultural mindset is sharply focused on listening to our customers, customizing solutions that speak to their needs, and consistently executing on our service commitments. The GE team brings a partnership approach in collaborating with our customers, from the inception of a project to supporting their total life cycle maintenance and operational needs.

## GE'S UNPARALLELED EXPERTISE AND RESOURCES



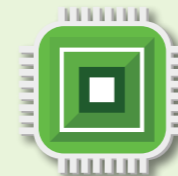
**130 years**

of thermal engineering experience



**>100 million**

hours of operating data



**A Silicon-Valley**

based software center of excellence



**2,000**

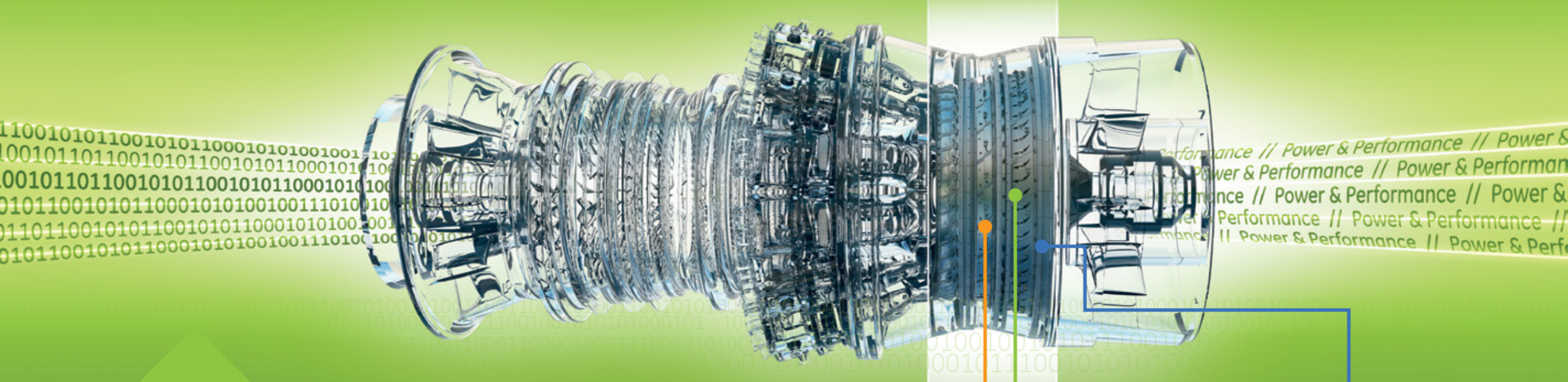
thermal engineers



**\$5.7 billion**

annual GE R&D investment

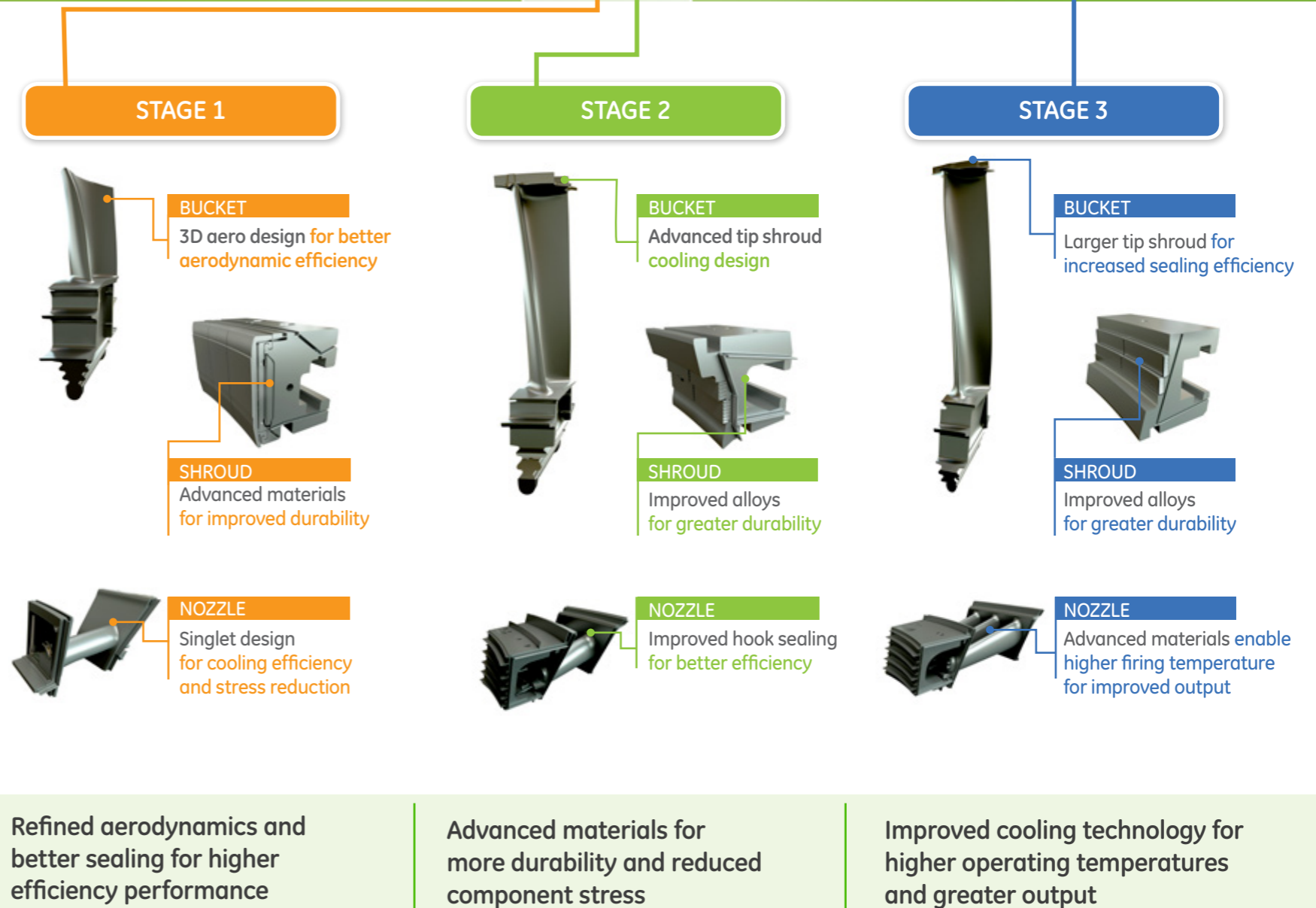




## System Advancements... and Data-Driven Insights

# That Transform Knowledge into Power

GE's Power FlexEfficiency Advanced Gas Path solution incorporates some of the industry's most versatile technology, allowing plants to deliver increased output with improved cost efficiency, while maintaining a low emissions footprint. We have redesigned all three stages of buckets, nozzles, and shrouds as part of a systemic approach in which each component complements its counterparts for enhanced overall performance.





# Bringing Power FlexEfficiency to your existing assets

The Advanced Gas Path is just one of many solutions GE has developed to help customers extract more value from their existing assets.

Hardware upgrades, software packages, or customized combinations of both are available for all major gas turbine components to help customers achieve their desired outcomes. That's GE's Power FlexEfficiency.

**Dry Low NO<sub>x</sub> (DLN) combustion technology** broadens operational flexibility by lowering emissions, delivering fuel flexibility, and extending maintenance intervals.

**The OpFlex\* suite** expands operational flexibility with a platform of customized advanced controls that provide unprecedented control across critical gas turbine operating modes.

**Valpak solutions** bring customized hardware and software upgrades together in cost-effective packages designed to address site-specific needs.

A **Flange-to-Flange upgrade** can produce significant performance improvements in output and fuel efficiency while restarting the clock on asset life.

**GE's Multi-Year Agreements (MYAs)** provide customers with some of the most comprehensive guarantees available to keep their assets operating at peak performance. MYAs are backed by the financial strength and the technical edge GE has developed over 130 years of maintaining power generation systems around the globe.



# A World of Difference

GE's Power FlexEfficiency Advanced Gas Path solution has qualified for the company's ecomagination portfolio by **delivering proven, industry-leading upgrade performance to customers** with existing GE heavy duty gas turbines. AGP technology enables greater operational flexibility driven by increased output, efficiency, and availability, while also reducing fuel consumption and CO<sub>2</sub> emissions. Ecomagination is GE's commitment to imagine and build innovative solutions to today's environmental challenges while driving economic growth.†

A GE customer operating a combined-cycle plant powered by a 7F gas turbine with AGP technology, and generating a net output of 525.2 MW, can reduce its CO<sub>2</sub> emissions by 11,400 tons per year. This reduction equates to the annual CO<sub>2</sub> emissions of approximately 2,200 cars on U.S. roads. Under these same operating conditions, the site could also realize an annual fuel savings of more than \$790,000 at a natural gas price of \$3.75 per MMBtu.

† Applicable to select GE heavy duty gas turbine frames.



## Personal commitment to quality

Every day at GE, employees across the company make a personal commitment to own quality. This means doing the job right the first time, on-time, every time. This personal commitment to quality is what enables us to provide the best possible products and services to our customers.

**Quality is not just a GE priority. Quality is a value, an integral part of our culture.**

To learn more about this offering, contact your GE Sales representative or visit [powergen.gepower.com](http://powergen.gepower.com).

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