



# Powering to a Cleaner Energy Future with Gas

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Scott Strazik, CEO of GE Gas Power

**POWER-GEN INTERNATIONAL | DECEMBER 5, 2018 | ORLANDO, FL**

# Powering to a cleaner energy future with gas

1

Dynamic and changing power market ... but **Gas** will continue to play a **vital role in a cleaner energy future**

2

**Opportunities exist ...** but every market today has its unique catalysts

3

**Technology matters** more than ever





# THE CHANGING ENERGY LANDSCAPE

- **Growing** social preferences toward cleaner energy solutions
  - **Rapidly changing** fuel supply & pricing
  - **Advancing** material sciences impacting the efficiency of many power sources
- **Evolving** views on role of nuclear power
  - **More** distributed and intermittent power
  - **Converging** traditional & emerging, physical & digital, large & small



# GAS WILL PLAY A VITAL ROLE

1

Electricity demand will continue to grow **at over 2% a year** for the foreseeable future ... high growth rates in developing economies

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2

**~700 GWs** of coal and nuclear retiring next ~20 years

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3

**Generation mix** will continue to shift toward substantially more renewables ... **natural gas** is best complement

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4

**Power density matters** ... gas requires 50 to 100 times less space per MWH vs. renewables with storage

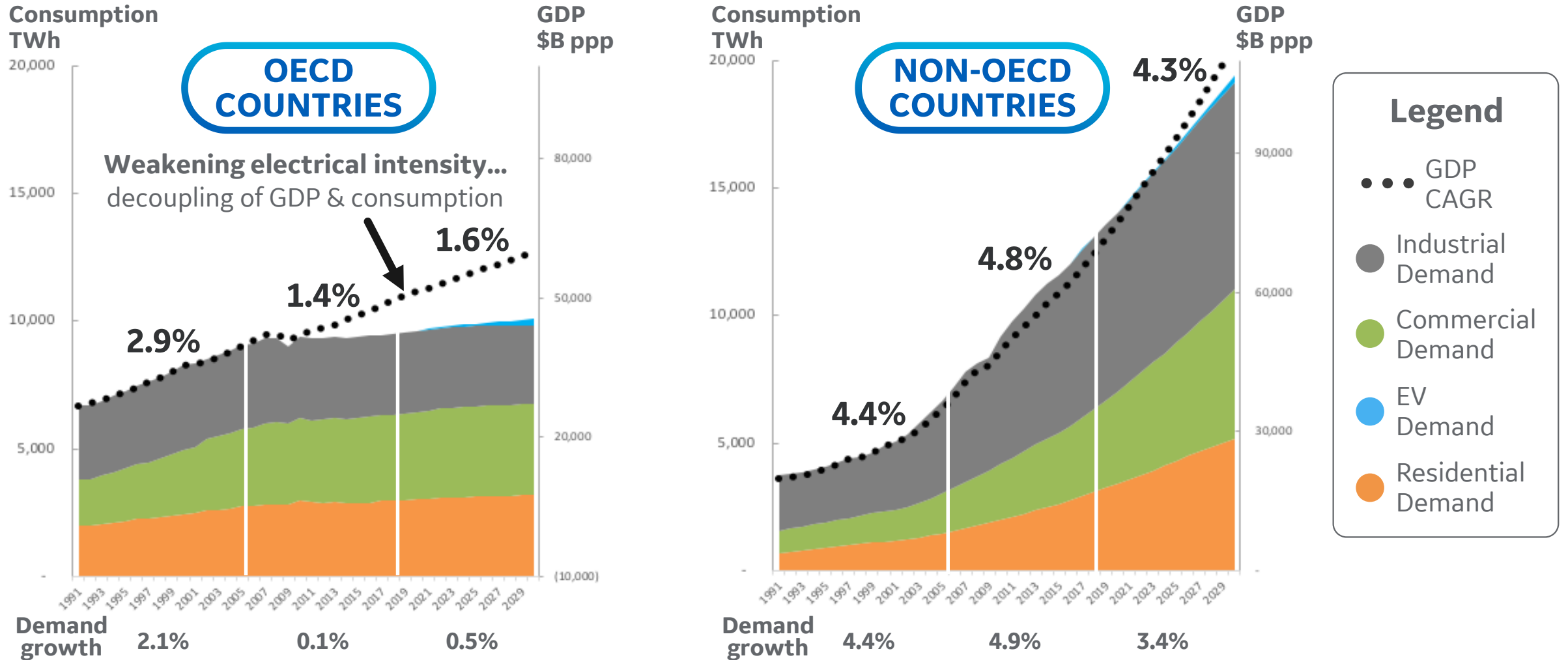
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5

**Shale** drastically altering supply and pricing dynamics of gas ... **92M tons per annum** under construction ... increase capacity by **25% by 2023**



# ELECTRICITY DEMAND GROWS ~2.3%



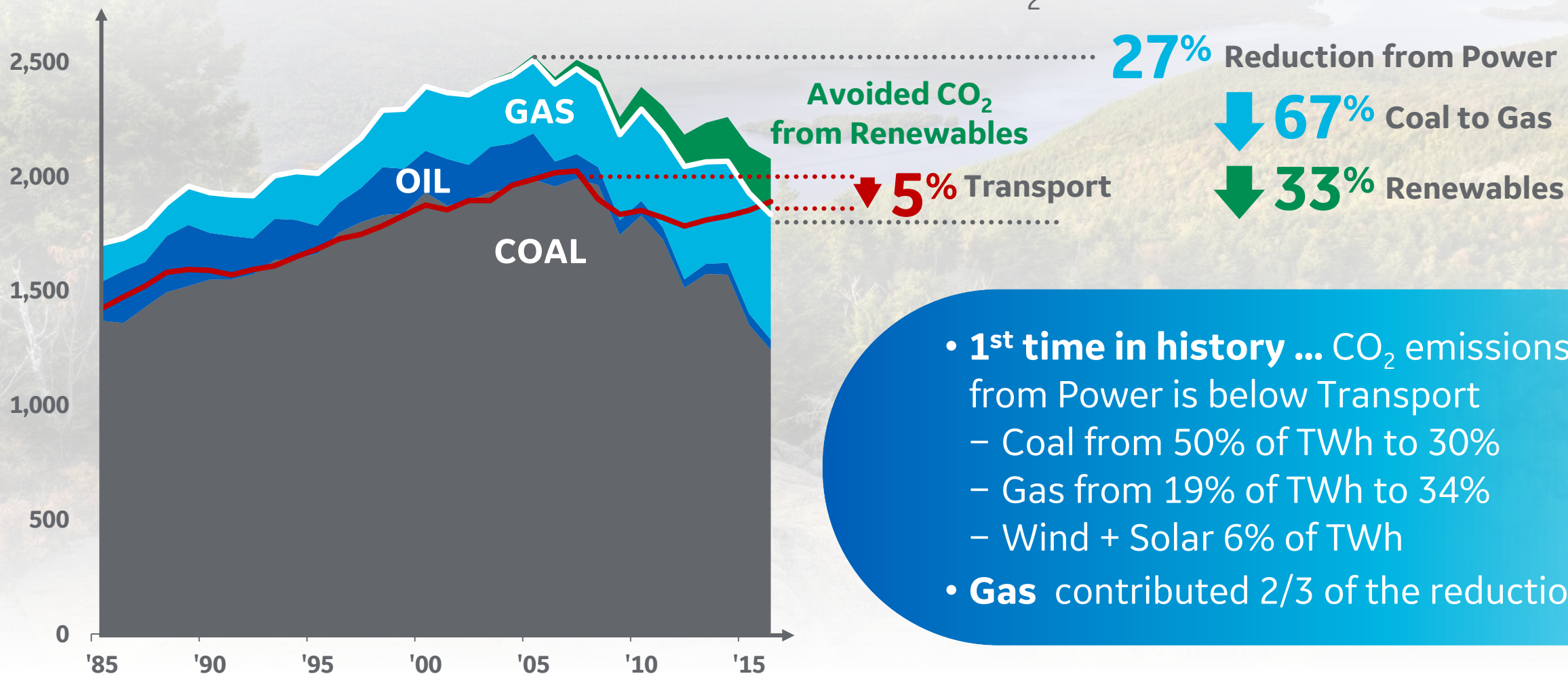
Source: ENERDATA

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# GAS IS CONTRIBUTING TO CO<sub>2</sub> REDUCTIONS

Emissions From the U.S. Electric Power Sector  
Million Metric Tons CO<sub>2</sub>



- **1<sup>st</sup> time in history ...** CO<sub>2</sub> emissions from Power is below Transport
  - Coal from 50% of TWh to 30%
  - Gas from 19% of TWh to 34%
  - Wind + Solar 6% of TWh
- **Gas** contributed 2/3 of the reduction



Source: EIA. Table 12.6 Carbon Dioxide Emissions From Energy Consumption: Electric Power Sector, Table 7.2a Electricity Net Generation: Total (All Sectors), February 2018

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# POWER DENSITY MATTERS

## City density is growing

- **1/4** of global population is in cities of **1M+ people**
- **10%** are in megacities with **10M+ people**

## Cities are electrifying

- NYC plans to electrify all transit busses **by 2040**
- Satisfying this power load with solar PV alone would require **covering 15%** of Manhattan with panels

## Gas is most land-efficient

- Natural gas requires **50-100 times** less space per MWh generated compared to renewables + storage

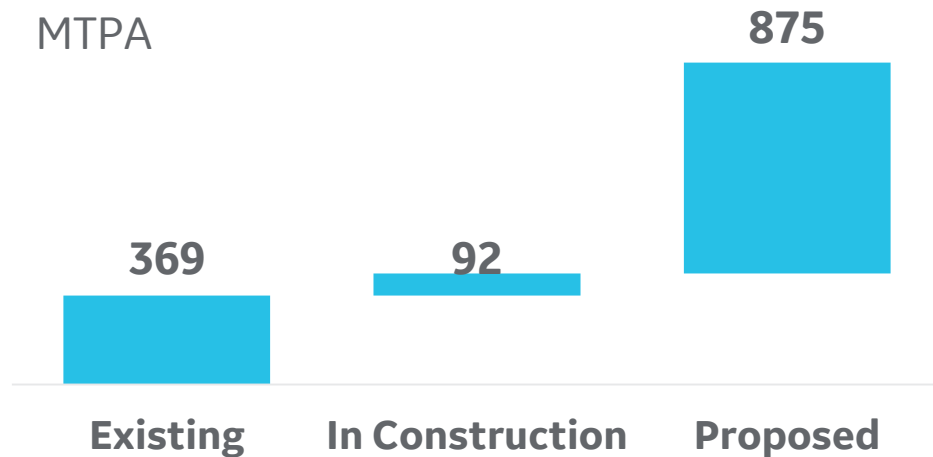
**GAS GENERATION PLAYS A VITAL ROLE IN DENSE URBAN AREAS WHERE SPACE IS A PREMIUM**



# LNG INCREASING ACCESS TO AFFORDABLE GAS

## LIQUEFACTION CAPACITY

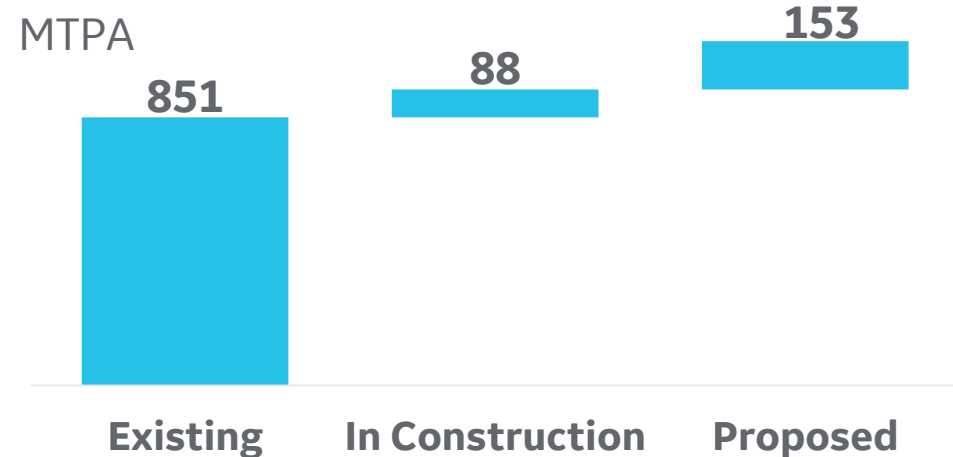
MTPA



- **22 MTPA added in 2017**
- **19** countries with capacity ... **6** countries have **2/3** of the capacity ... Qatar, Australia, Malaysia, Indonesia, Algeria, Nigeria
- **50%** of proposed new capacity in US

## REGASIFICATION CAPACITY

MTPA



- **45 MTPA added in 2017**
- **35** countries with capacity
- In-construction capacity bringing LNG access to **5** additional countries ... Bahrain, Bangladesh, Panama, Philippines, Russia


**LNG ENABLING FUEL SUBSTITUTION IN POWER SECTOR**



Source: International Gas Union 2018 World LNG Report

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Gas is uniquely  
positioned to usher in  
our energy future

## **Dispatchable ...**

THERE WHEN NEEDED

## **Flexible ...**

FAST START AND RAMPING,  
LOW TURN-DOWN

## **Affordable ...**

LOWEST CAPEX TECHNOLOGY,  
GOOD FOR GRID FIRMING

## **Fast to meet urgent needs ...**

SIMPLE CYCLE ON-LINE AS  
FAST AS 90 DAYS



# Opportunities for gas power are **REAL**

## **UNITED STATES** ...

gas continues to gain share  
...~30-40 GWs in next 5 years

## **ITALY** ...

gas to remain the dominant thermal technology with coal capacity phased out by 2025; evaluating new capacity payments to incentivize more gas

## **TAIWAN** ...

eliminating nuclear power by 2025, reducing coal power to 30%; increasing natural gas from 35% to 50%; ~13 GWs of new GTCC expected

## **BRAZIL** ...

expected to add 12GWs of new gas capacity by 2030

## **BANGLADESH** ...

tripling grid power by adding 43 GWs by 2041; aggressive infrastructure plan to ensure supply of imported gas



Source: GE Power Marketing

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# Technology matters ... GE's HA

Continuing to build on  
**\$2B+** investment

**2** WORLD  
RECORDS

**Proven  
technology**

**30+**

UNITS INSTALLED

**220,000**

OPERATING HOURS

**World's largest,  
most efficient  
gas turbine**

**>63%  
net**

COMBINED-CYCLE  
EFFICIENCY

**Industry-leading  
operating  
flexibility**

**<30 min  
start**

**Fastest  
growing fleet**

**83**

UNITS ORDERED

**THERE'S NOTHING LIKE THE HA IN OPERATION TODAY**





# Customers continue to invest in their fleets

## CUSTOMER OUTCOMES

- ✓ **More** efficiency
- ✓ **Better** reliability
- ✓ **Greater** output
- ✓ **Lower** emissions
- ✓ **Increased** availability

Total # of GE  
upgrades sold  
(2012-2017)

~1725

~1110

F-CLASS

~615

NON F-CLASS



# The marketplace is changing TODAY'S APPETITE

## 7F AGP (AMERICAS)

### Product Benefits

6% output, 2% heat rate improvement, 32k interval

### Customer Impact

- **\$3MM** annual value ... more MWs, more hours, capacity payments
- **350+** sold 2014-2018

## 9F AGP (EUROPE, ASIA)

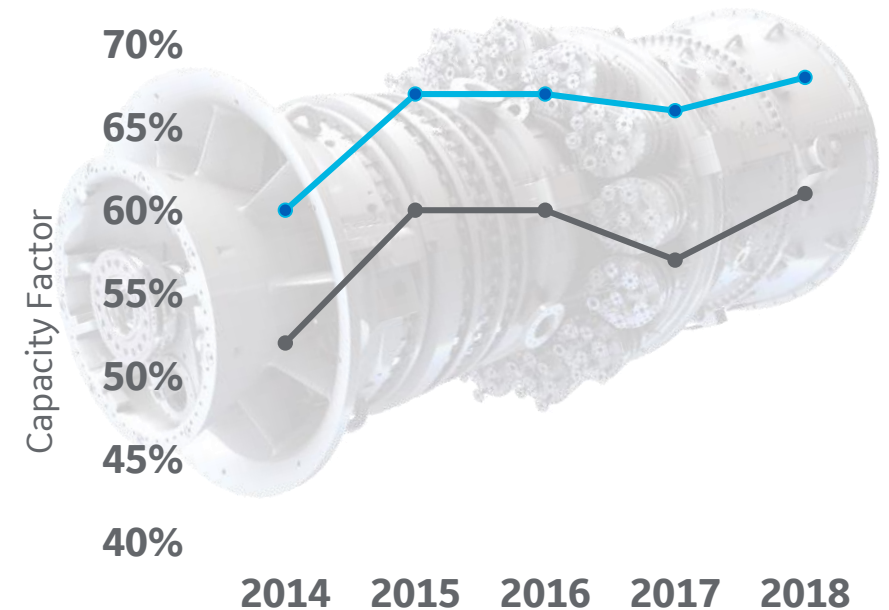
### Product Benefits

8% output, 2% heat rate improvement, 32k interval

### Customer Impact

- **\$5MM** annual value ... lower fuel spend, more MWs
- **60+** sold 2016-2018

## ADVANCED GAS PATH IMPACT ON UTILIZATION



# ... AND TOMORROW'S APPETITE



## 7F DLN2.6+ Flex

**FLEXIBILITY package** ... combines Axial Fuel Staging, DLN2.6+, VLP and AutoTune Mx

### BENEFITS

Improves NO<sub>x</sub>/CO  
compliant  
turndown from  
**40% to 26%**  
GT load

Reduces minimum  
fuel burn  
**up to 25%**

Expands load range  
**~100MW**

Increased energy  
trader access to  
**ancillary  
services**



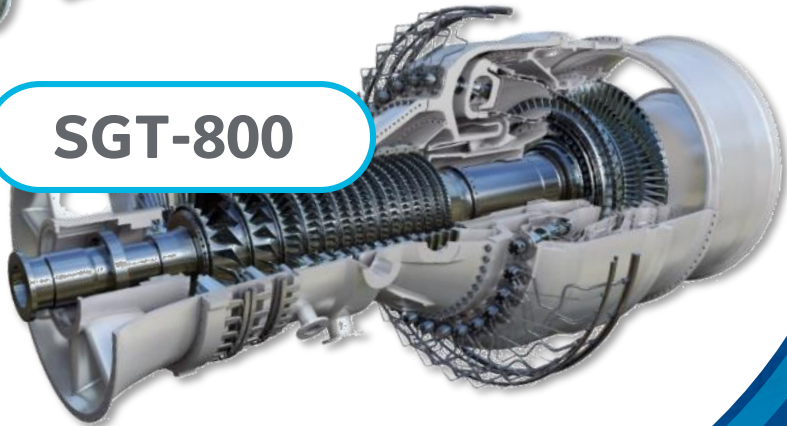


# Competing differently in today's marketplace ... Cross-Fleet

501F/SGT6-5000F



SGT-800



## NATURGY Tuxpan, Mexico



1st full-scope gas turbine/plant upgrade on Mitsubishi 501F gas turbines, steam turbines & generators

**EXTENDED**  
maintenance intervals to  
**32,000 hours**

**INCREASED**  
output  
**9.2%**

**IMPROVED**  
efficiency  
**2.9%**

# Introducing GE Gas Power

**Creates** one stronger, more streamlined gas power business with better outcomes for our customers

**Combines** the talent & technology of new units and services into one unified team

**Gives** power producers the technology, services, knowledge & insights they need to build, operate and maintain gas plants





# Imperatives for tomorrow's marketplace



— **Best technology** in the world

— **Fleet-wide** investments

— **Talented experts committed** to helping our customers win

— **Diverse, strong** and resilient

— **Gritty optimism** in the face of a dynamic marketplace







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