



# Connecting For Success...

ELECTRIC POWER DAYS 2017

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# New Markets for Caterpillar Gas Products

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# Agenda

- Gas Market trends and drivers
- EP Gas Applications
- Focus on new Applications Technologies
- EP Gas Product Portfolio

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# Gas Market trends and drivers

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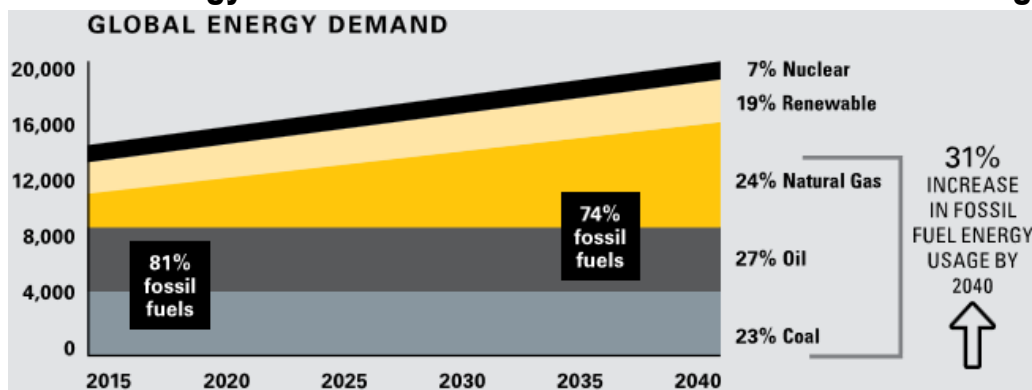
# Key factors which will drive the electrical power gas sector

 <b>Rise of Gas</b>	<ul style="list-style-type: none"><li>• Natural Gas will become world's most important source for electricity generation</li></ul>
 <b>New Technologies</b>	<ul style="list-style-type: none"><li>• Improving economics of distributed energy technologies</li><li>• Improving economics of utility scale renewable through hybrid integration</li></ul>
 <b>Digital Revolution</b>	<ul style="list-style-type: none"><li>• Change in how companies create value for their customers towards a comprehensive digitalized approach to optimizing operations</li></ul>
 <b>Gas Standby &amp; Mission Critical Application</b>	<ul style="list-style-type: none"><li>• Increasing penetration of natural gas gensets as an economically viable alternative for the Dynamic Start Load applications for mission critical customers such as data centers</li></ul>
 <b>Geo Political Issues</b>	<ul style="list-style-type: none"><li>• Political disturbance/ Instabilities in global economies such as Brexit affects the regional growth strategies. Additionally, reliance on incentives alone to make sales, makes it challenging to compete on a sustainable basis</li></ul>
 <b>Remote Locations</b>	<ul style="list-style-type: none"><li>• Distributed generation is offering alternative ways to serve increasing demand in remote locations—example rural Africa</li></ul>
 <b>Increasing costs of traditional Power</b>	<ul style="list-style-type: none"><li>• Rising costs of traditional electricity supply, including transmission and distribution charges requires to support investment in infrastructures</li></ul>
 <b>Product Compliance - Emissions</b>	<ul style="list-style-type: none"><li>• Continuous political and regulatory support to emission reduction and energy efficiency</li></ul>

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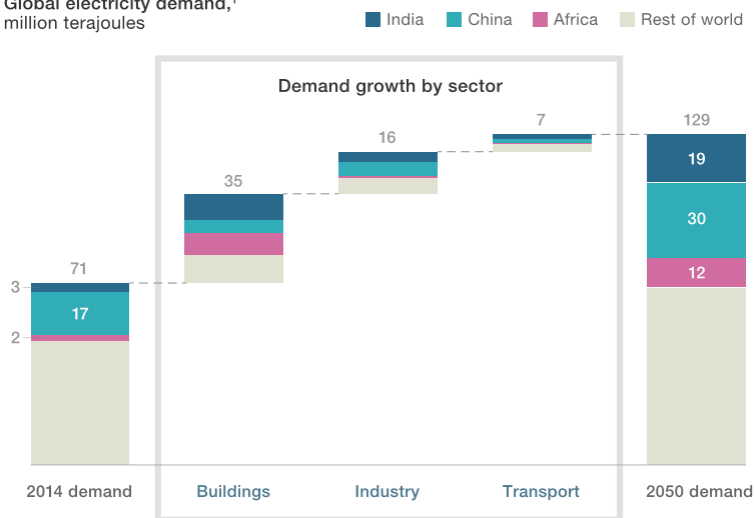
# Global Energy Demand and Rise of Gas

Global energy demand drives increase of Natural Gas fuel usage



## Global demand of electrical power will be doubled by 2050

Global electricity demand,<sup>1</sup> million terajoules



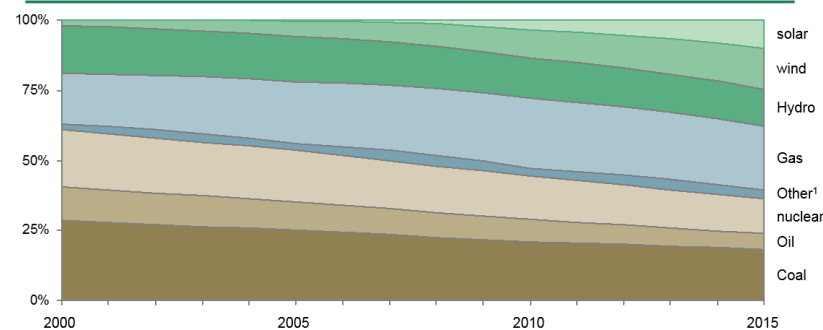
<sup>1</sup>Figures are rounded; 2050 data are projected.

## Mega Trends

- Rise of gas – Greener fossil fuel
- Increase costs of traditional power needs
- Emissions
- Support growth of Renewables
- New technologies (i.e.: Gas Genset runs like Diesel)
- Waste to Power
- Governmental subsidies
- Product Compliance
- Geo political issues

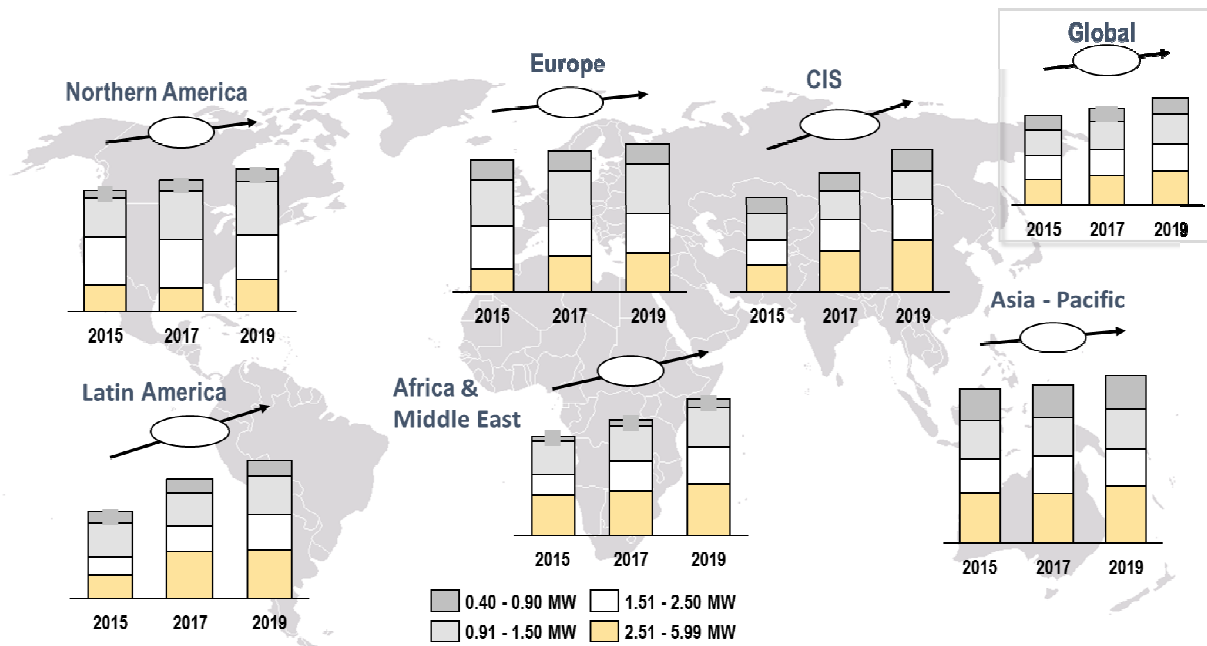
## The transition already started in Europe – Gas remains strong

Share of electrical generation capacity (centralized and distributed) in Europe





# Global Gas Genset Market by Regions – a good business to be in



## Key drivers

- Global Gas Market Growth – big opportunities in decentralized power generation
- New Markets / Applications requires new products
- Potential at every level
- Increasing share of load Increasing share of Load management, Stand-by, CHP and CCHP

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# EP Gas Applications







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# Applications Overview

	Combined Heat and Power (CHP)	Electrical Power	Biogas	Landfill	Stand-by and Mission Critical	Others
						
<b>Products</b>	<ul style="list-style-type: none"> <li>• CG</li> <li>• G3500</li> </ul>	<ul style="list-style-type: none"> <li>• G3500</li> <li>• CG</li> </ul>	<ul style="list-style-type: none"> <li>• CG</li> </ul>	<ul style="list-style-type: none"> <li>• G3500</li> <li>• CG</li> </ul>	<ul style="list-style-type: none"> <li>• G3400</li> <li>• G3500</li> </ul>	<ul style="list-style-type: none"> <li>• CG</li> <li>• G3500</li> </ul>
<b>Customer types</b>	<ul style="list-style-type: none"> <li>• Utilities</li> <li>• District heating</li> <li>• Industrial</li> <li>• Hospitals</li> <li>• Airports</li> <li>• Greenhouses</li> </ul>	<ul style="list-style-type: none"> <li>• Energy services</li> <li>• IPP</li> <li>• Utilities</li> <li>• Industrial</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture</li> <li>• Food industry</li> <li>• Sewage</li> <li>• Waste Water Treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Landfills</li> <li>• Utilities</li> </ul>	<ul style="list-style-type: none"> <li>• Industrial</li> <li>• Hospitals</li> <li>• Airports</li> <li>• IT companies</li> <li>• E-commerce</li> <li>• Banking</li> </ul>	<ul style="list-style-type: none"> <li>• Mining</li> <li>• Oil &amp; Gas</li> <li>• Waste</li> <li>• Industrial</li> </ul>
<b>Key buying criteria</b>	<ul style="list-style-type: none"> <li>• TCO</li> <li>• Total efficiency</li> </ul>	<ul style="list-style-type: none"> <li>• TCO</li> <li>• Electrical efficiency</li> </ul>	<ul style="list-style-type: none"> <li>• TCO</li> <li>• Biogas</li> </ul>	<ul style="list-style-type: none"> <li>• TCO</li> <li>• Landfill gas</li> </ul>	<ul style="list-style-type: none"> <li>• “Runs like Diesel”</li> <li>• First Cost (Stand-by)</li> </ul>	<ul style="list-style-type: none"> <li>• Fuel flexibility</li> </ul>

## CHP — Natural Gas Applications with critical heat use

OpEx — Operational Expenses (Fuel Gas, Maintenance, Lube Oil) are more important than genset purchasing price

CapEx — Capital Expenses are more critical to the customer than operational expenses

## Electrical Power — Natural Gas Applications with primary use of power

OpEx — Operational Expenses (Fuel Gas, Maintenance, Lube Oil) are more important than genset purchasing price

CapEx — Capital Expenses are more critical to the customer than operational expenses

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# Focus on new Applications Technologies

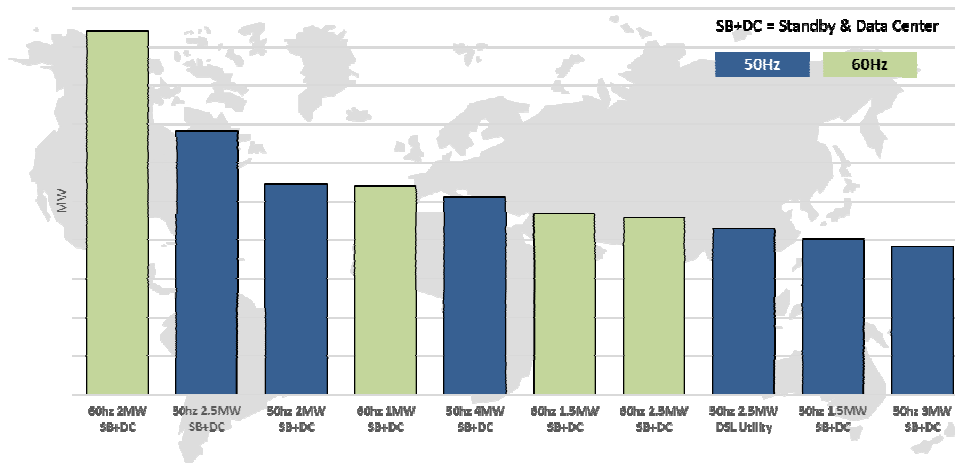
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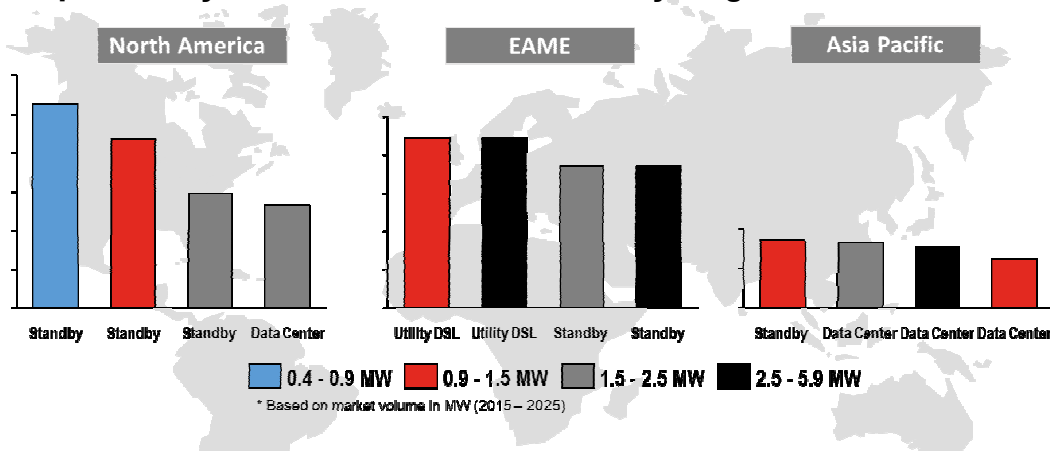
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# Stand-by & Data Center a growing Opportunity

## Global demand of Stand-by & Data Center Applications



## Top Standby and Data Center Markets by Region



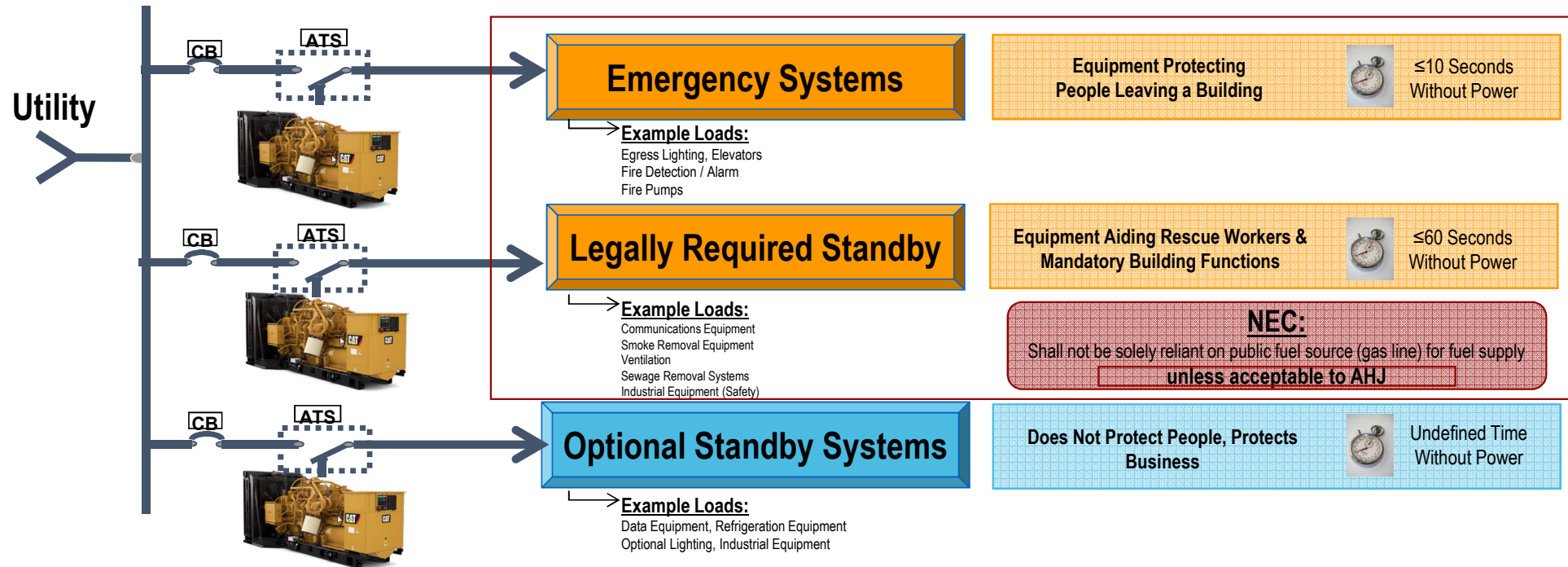
## More than Stand-by

- Stand-by & Data Center growth rate is higher than the overall market
- Majority of the growth from gensets 1.5 MW to 6MW

Backup power in event of power outage for:

- Office Buildings/Complexes
- Industrial Facilities
- Data Centers
- Retail Complexes
- Schools
- Government Buildings

# Emergency Power Supply Gensets “NFPA110”



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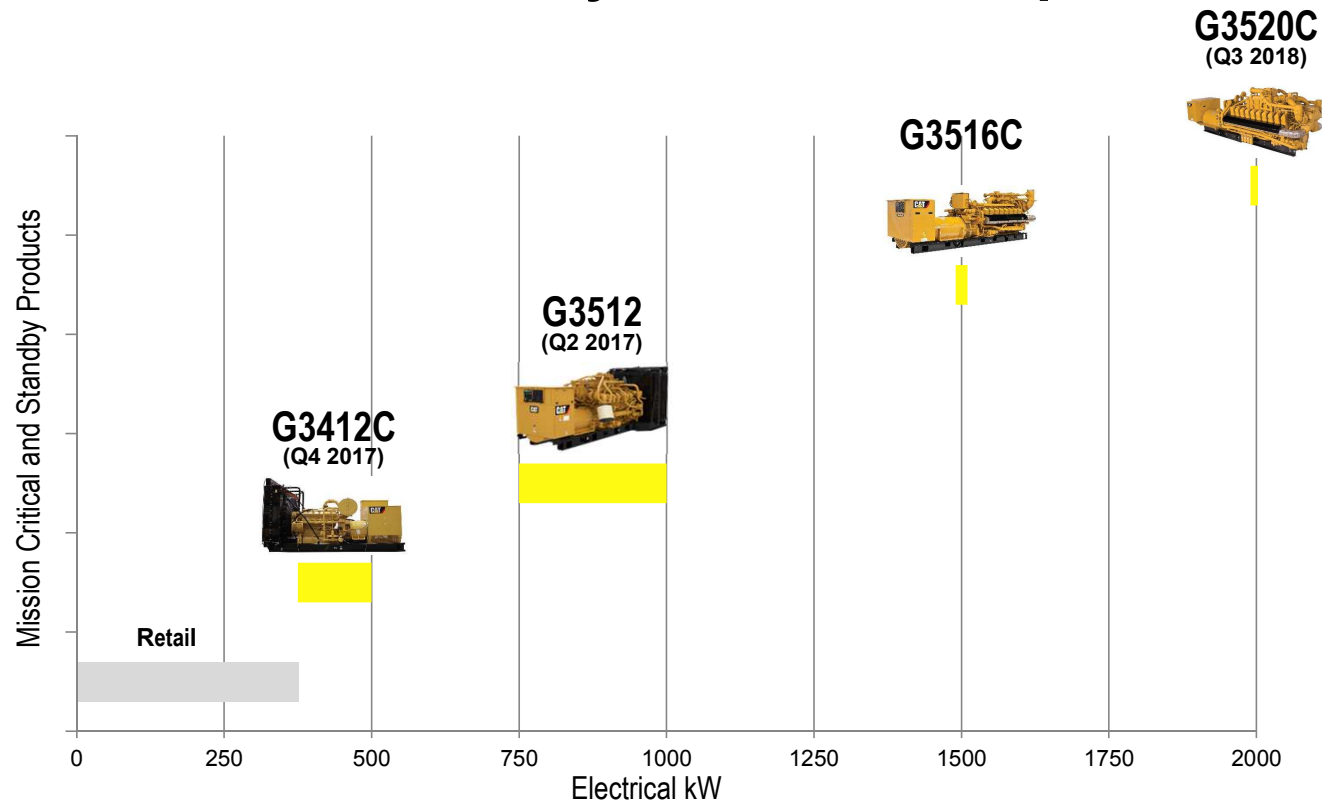
# Growing Interest from Datacenter Owners/Operators

- Primary Driver is “Green” Image & Carbon Footprint
- Energy Management
  - Many Enterprises data centers hire energy traders to better understand demand response market
- Natural Gas Capex is comparable with Tier 4 Diesel
  - Opex of Gas is  $\frac{1}{4}$  of Diesel (Diesel fuel \$2.5/gal, Natural Gas \$4/MMBTU)
- Primary usage is still Load Management / Standby
  - Most units will experience < 500 Operation hours / year



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# Current Gas Stand-by Product Lineup



## Key Fulfillments

- Gas Genset runs like Diesel
- Ready to Accept Loads 6.5s
- Load Step Increase 40% (ISO 8528 G2)
- 100% Block Load Capable
- EPA Certification
- UL 2200 Listing
- NFPA110 Type 10

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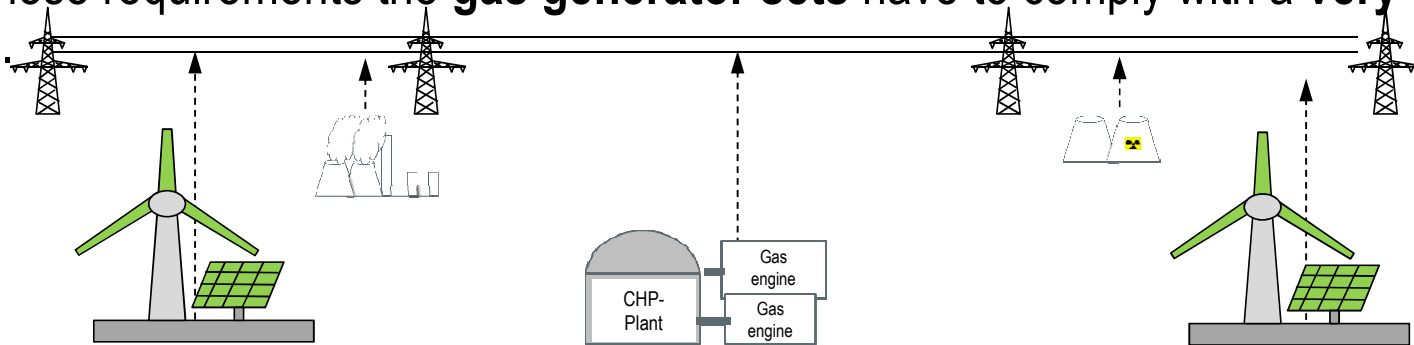


# Fast Ramp-Up - Flexible and Fast Power Supply

The **demand of power reserve** is part of the growing and positive trend of **STOR** aggregation (Short Term Operating Reserve).

This requires creating **virtual power stations** by pooling gas generation plants capable of offsetting site demands to practice load-reduction in times of critical need on the national grid.

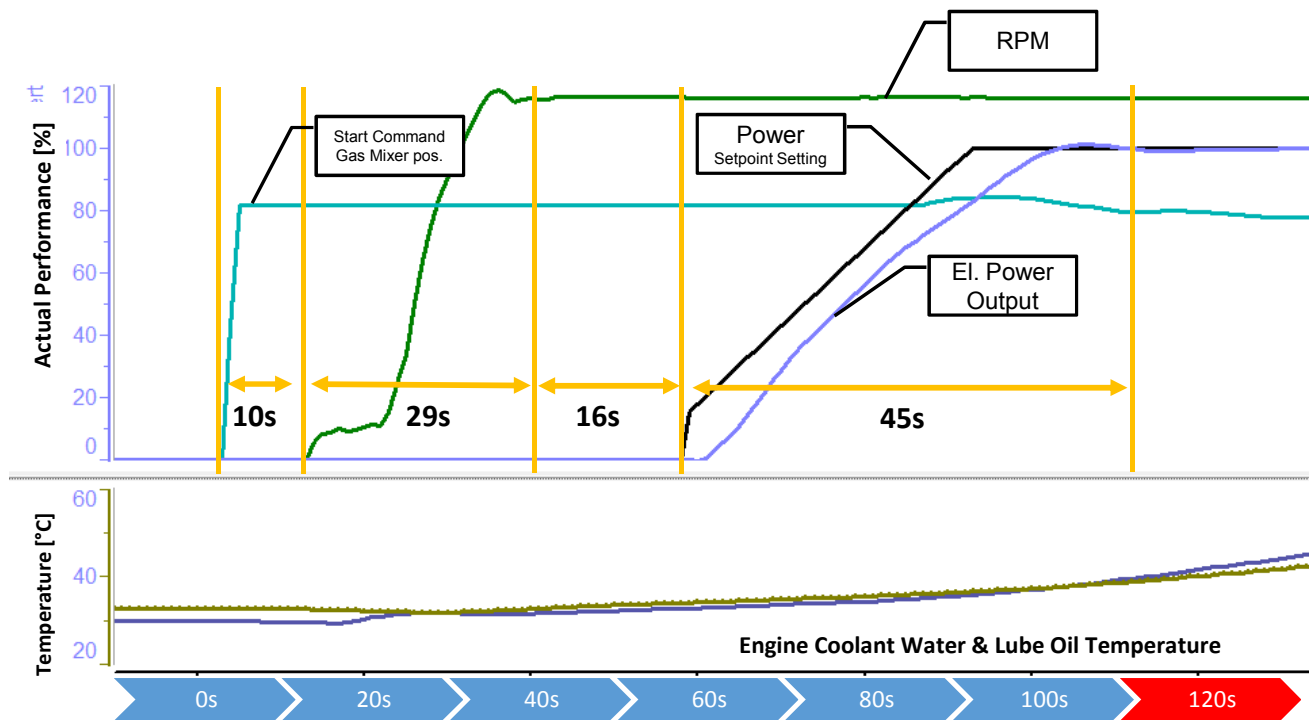
According to these requirements the **gas generator sets** have to comply with a **very short ramp-up time**.



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# Fast Ramp-Up with optimized CG170-20 series

- The genset reached 100% Load parallel to Grid (2.0MWe) in 100 Seconds after Start signal
- Coolant Water as well as Lube Oil Temperature were not preheated



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# Digital revolution of energy assets

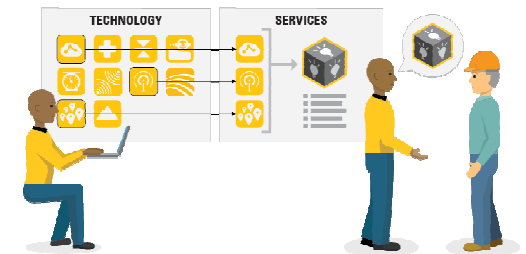
## Improving productivity and efficiency



### Think Smart and Start Now with Cat Connect

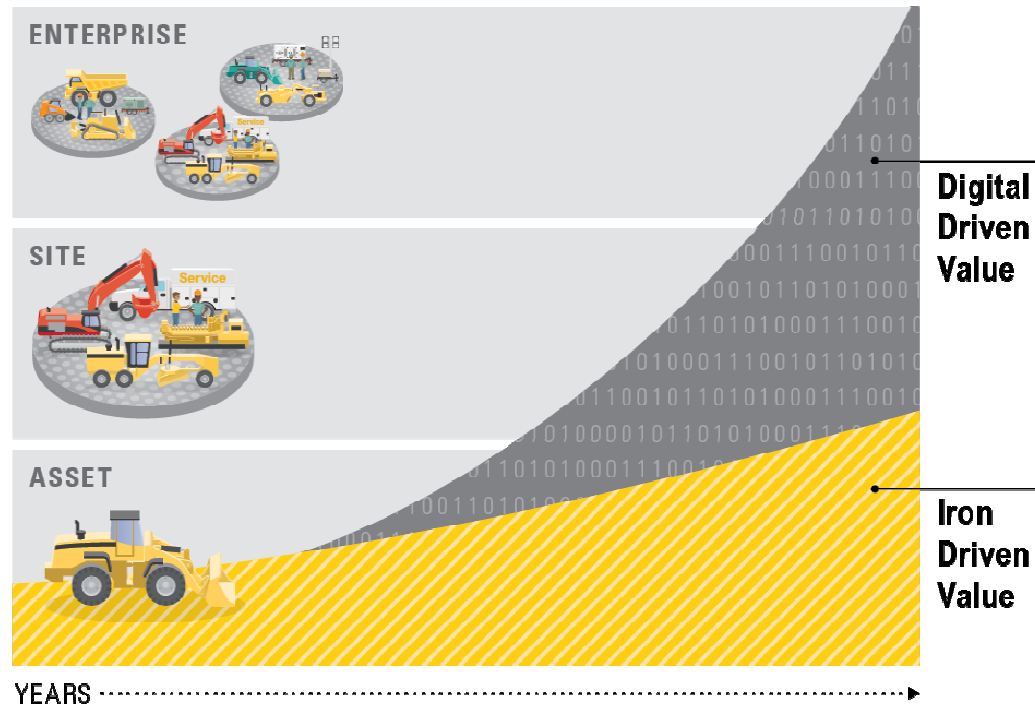
- “Internet of Things” - New product and management options
- Data collection and exchange
- Power Industry value chain - from generation to customer relationship management
- Cat Connect is the Platform and Solution
- Not only product provider becoming service provider

Source: McKinsey&Company



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# The value of digital is growing at a greater rate than the growth in iron value



## Key Trends

- **Data is the new oil** – it will become immensely valuable to our customers because of the way it can improve job site performance.
- **It's also what we need to grow our business** - future profits depend on successfully providing services based on data.

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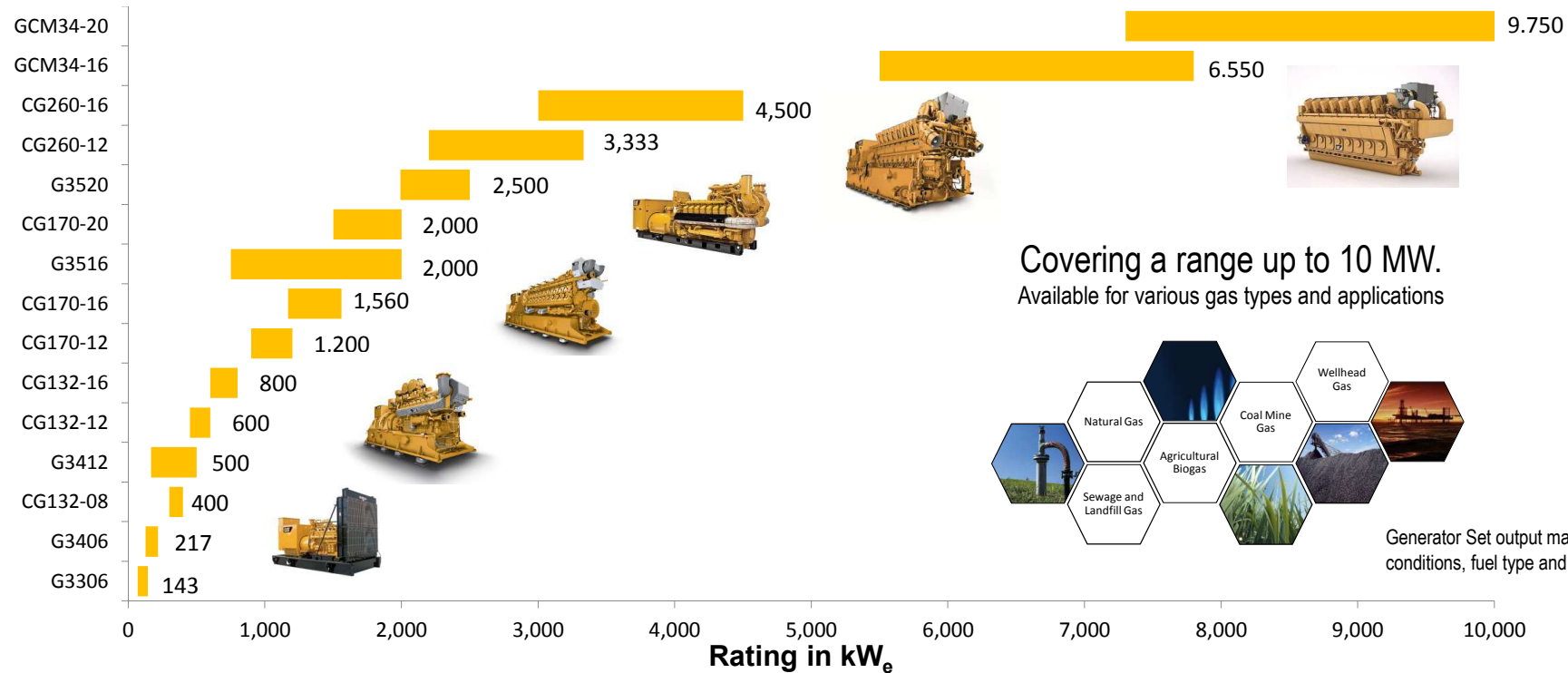
# EP Gas Product Portfolio

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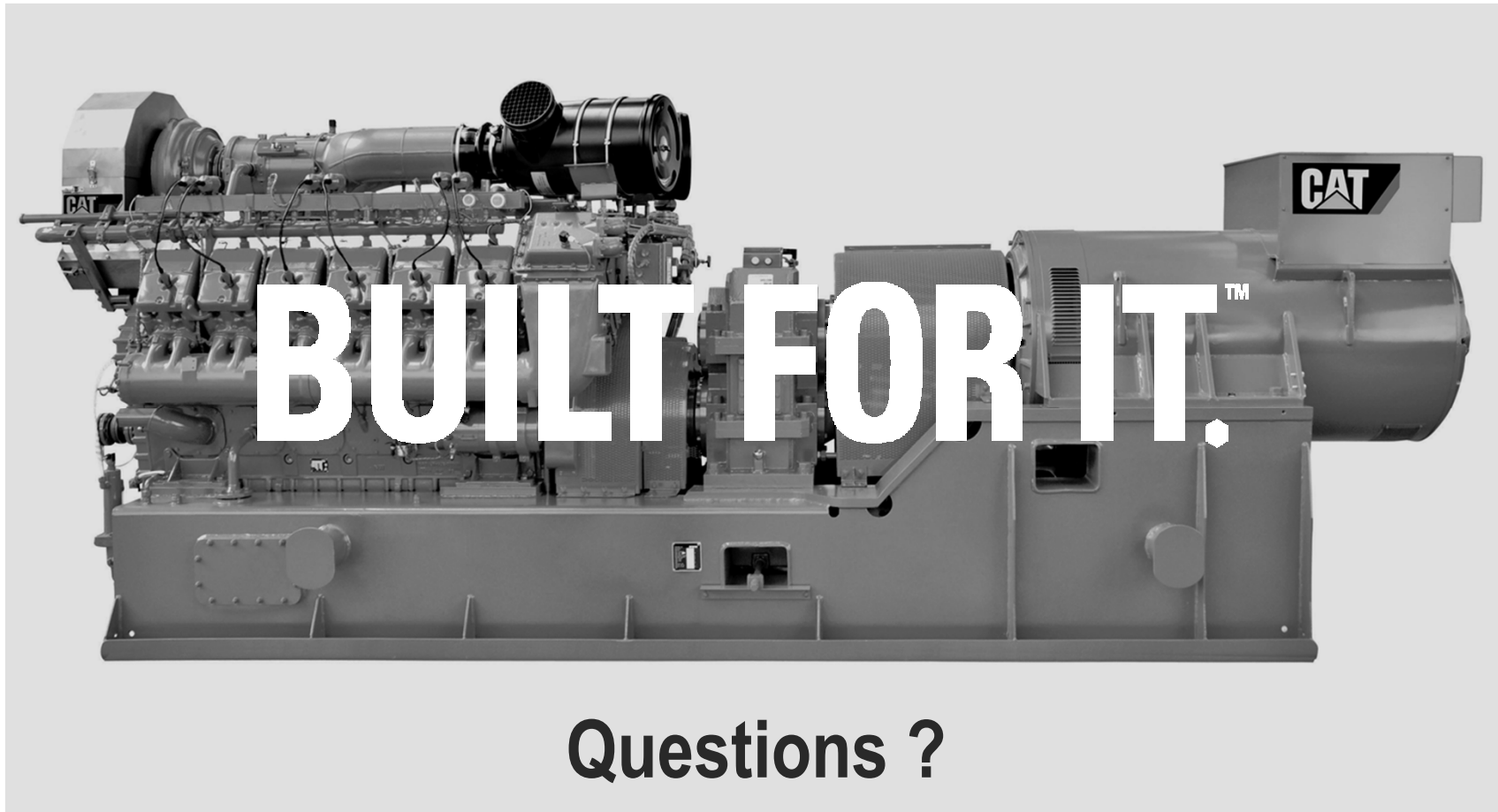
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# One Unified Product Portfolio of the Cat® Gas Engines



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