

RENEWABLE.
DEPENDABLE.
SUSTAINABLE.

MTU GAS ENERGY SOLUTIONS:
ENERGY YOU CAN COUNT ON

INTERSTATE
PowerSystems



A Rolls-Royce
solution



Wisconsin Distributed Resources Collaborative

Friday, July 24th, 2020

INTERSTATE PowerSystems

Clay Hardenburger

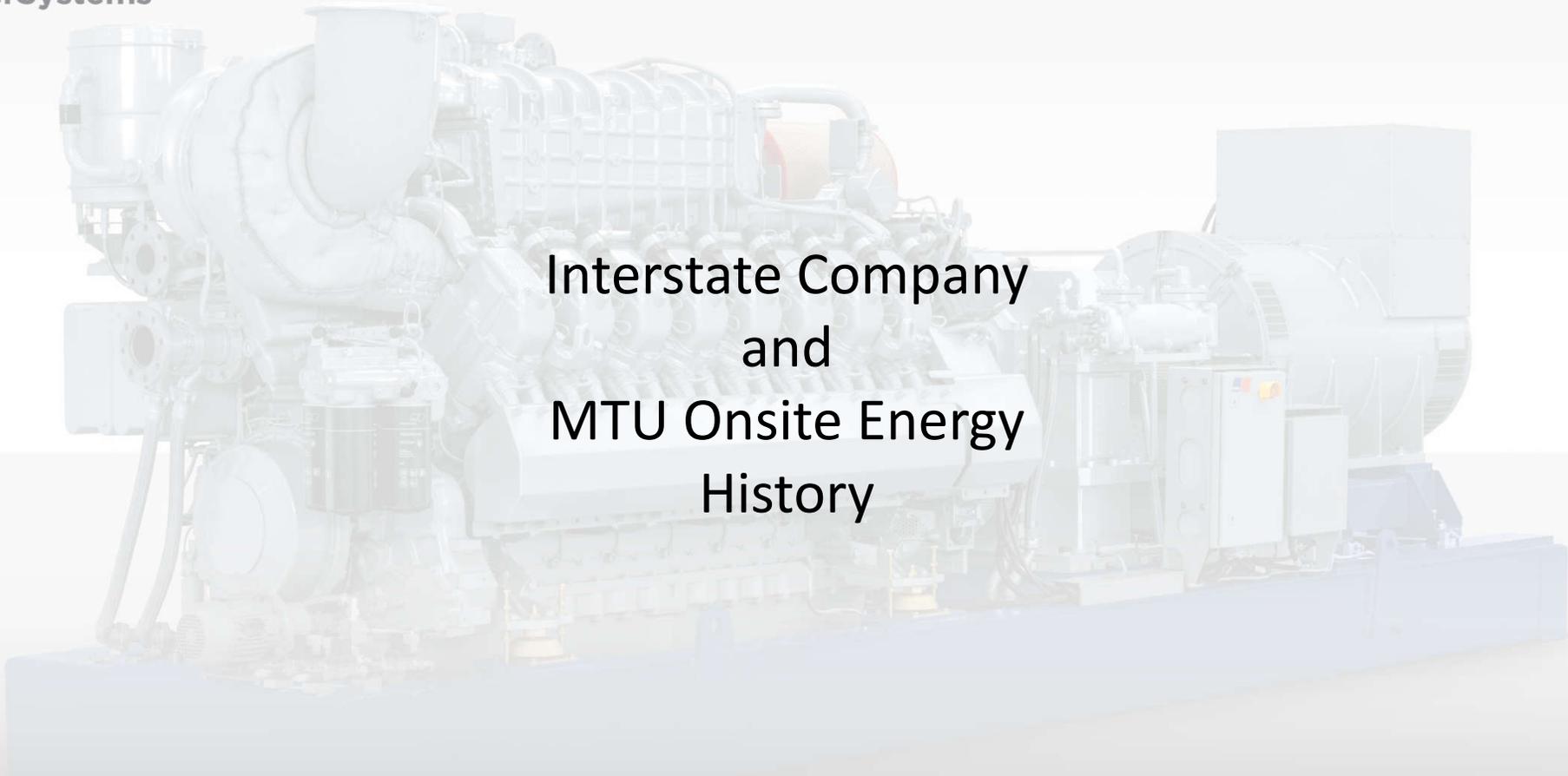
Business Development Manager

PRIDE IN SERVICE

OUTLINE

1. Interstate Company and MTU History
2. Reciprocating Internal Combustion Engine (RICE) Technology Comparison
3. MTU Gas Generator Set Systems
4. Microgrid Systems
5. MTU Control Systems
6. Maintenance and Lifecycle Costs
7. Questions

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Interstate Company
and
MTU Onsite Energy
History

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INTERSTATE
COMPANIES, INC.



PRIDE IN SERVICE

ROLLS-ROYCE POWER SYSTEMS AG

MTU GLOBAL



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RICE Technology Comparison

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RICE TECHNOLOGY VERSE COMBUSTION TURBINES

- Low heat rate
- Low fuel pressure
- No water consumption
- Limited de-rate due to
 - Temperature
 - Elevation
 - Partial load
- Short start cycle time
- Unlimited starts



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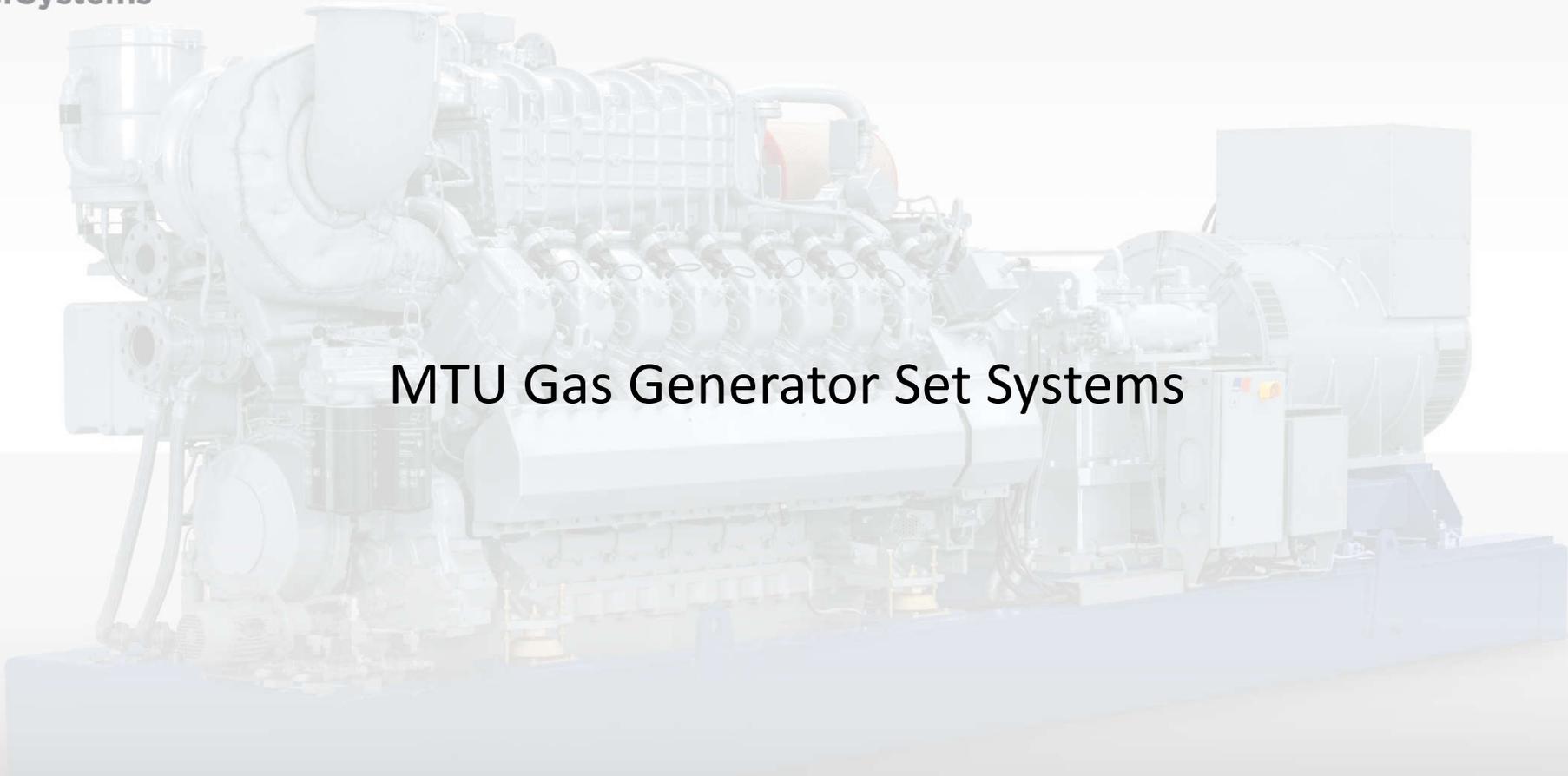
RICE GAS TECHNOLOGY VERSE DIESEL

- Fuel cost
- Emissions
- Equalized capital costs
- Extended outage operation
- Hybrid generation systems
- Alternative fuel sources
 - Biogas
 - Synthetic gas
 - Hydrogen
- Cogeneration systems
- Trigeneration systems
- Medium speed platforms



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MTU Gas Generator Set Systems

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HIGH SPEED DIESEL SYSTEMS (>1000 RPM)

	Open Power Unit	Enclosure / Container	Benefits
MTU 4000 DS 12/16/20 Cylinders 1,125kWe - 3,250kWe			<ul style="list-style-type: none">▪ Outstanding derating behavior▪ High load acceptance▪ Wide range of predefined scope of supply▪ High flexibility for challenging customized solutions▪ Low emissions
MTU 2000 DS 12/16/18 Cylinders 624kWe - 1,250kWe			
MTU 0080 - 1600 DS up to 12 Cylinders 27kWe - 600kWe			

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CONTINUOUS GAS SYSTEMS

Energy Storage



MTU Energy Pack

High Speed Gas Systems

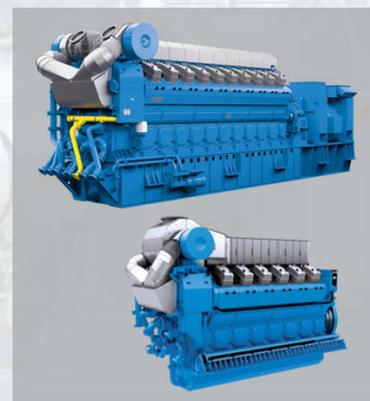
(>1000 rpm)



MTU 400 GS
MTU 4000 GS

Medium Speed Gas, Diesel, HFO Systems

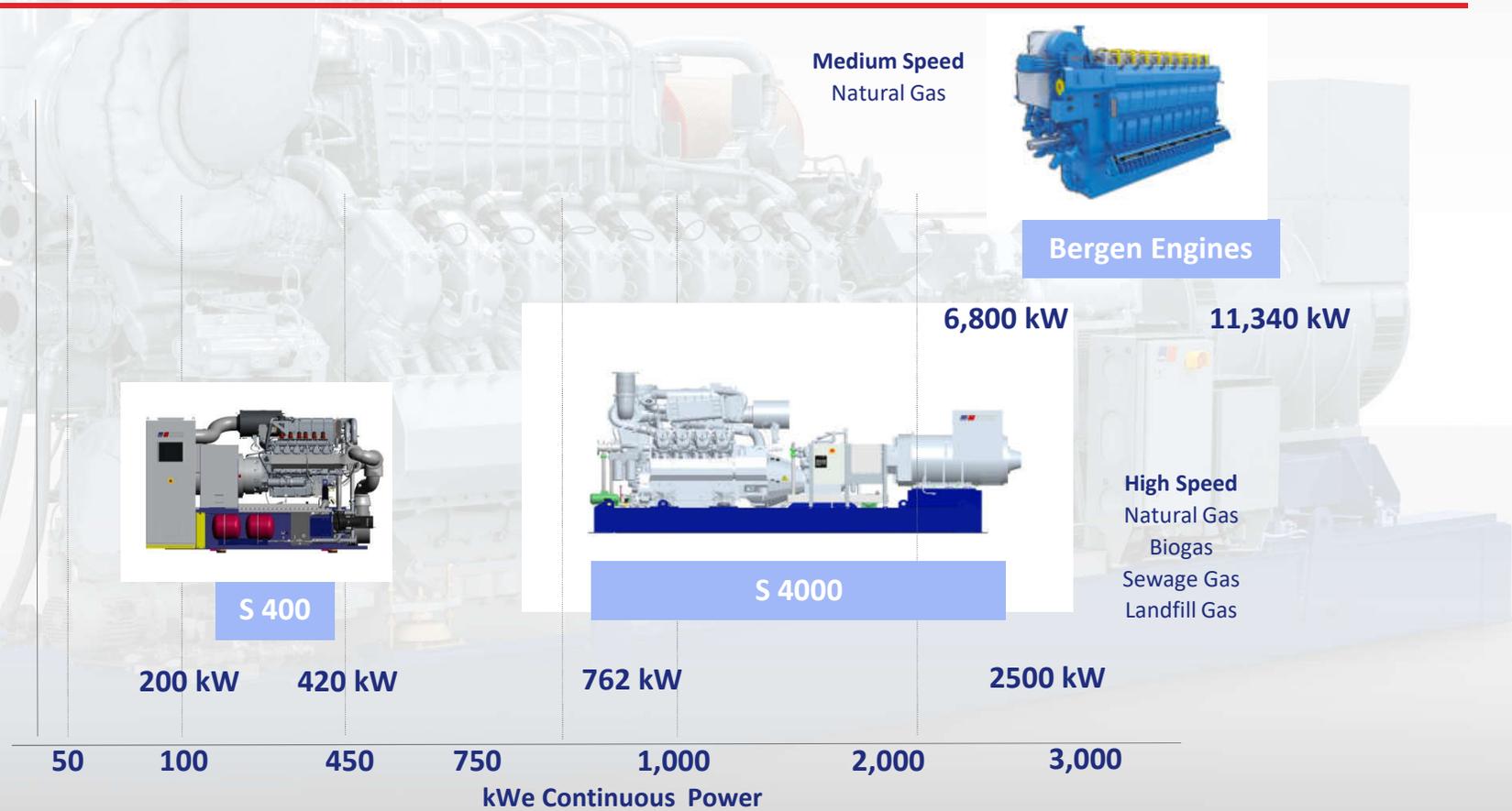
(<1000 rpm)



B35:40 (Gas)
B36:45 (Gas)

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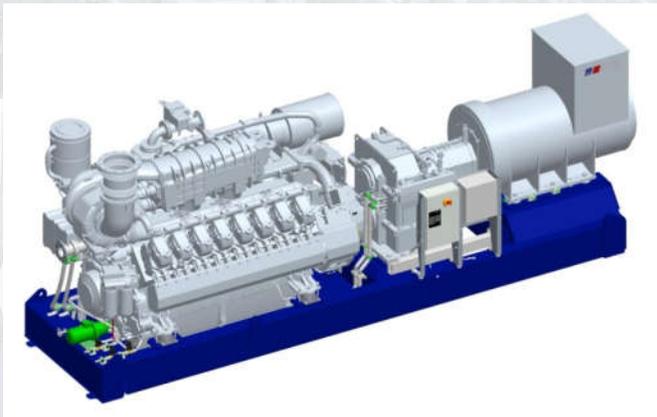
GAS PORTFOLIO



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SERIES 4000 PRODUCT SPECIFICATIONS

MTU Series 4000
natural gas / biogas



Actual technical features (L32/33/L64FNER)

Cylinder Arrangement	8V, 12V, 16V, 20V
Bore/Stroke	170 / 210 mm
Power Range	770 – 2500 kWe 60Hz
Speed	1500 rpm (60 Hz via gearbox)
Combustion	lean mixture 1-stage turbocharger 2-stage intercooler pre-chamber sparkplugs
Electrical Efficiency	up to 43.3% 60hz
NOx Emission	0.5 – 1.0 g/bhp-hr

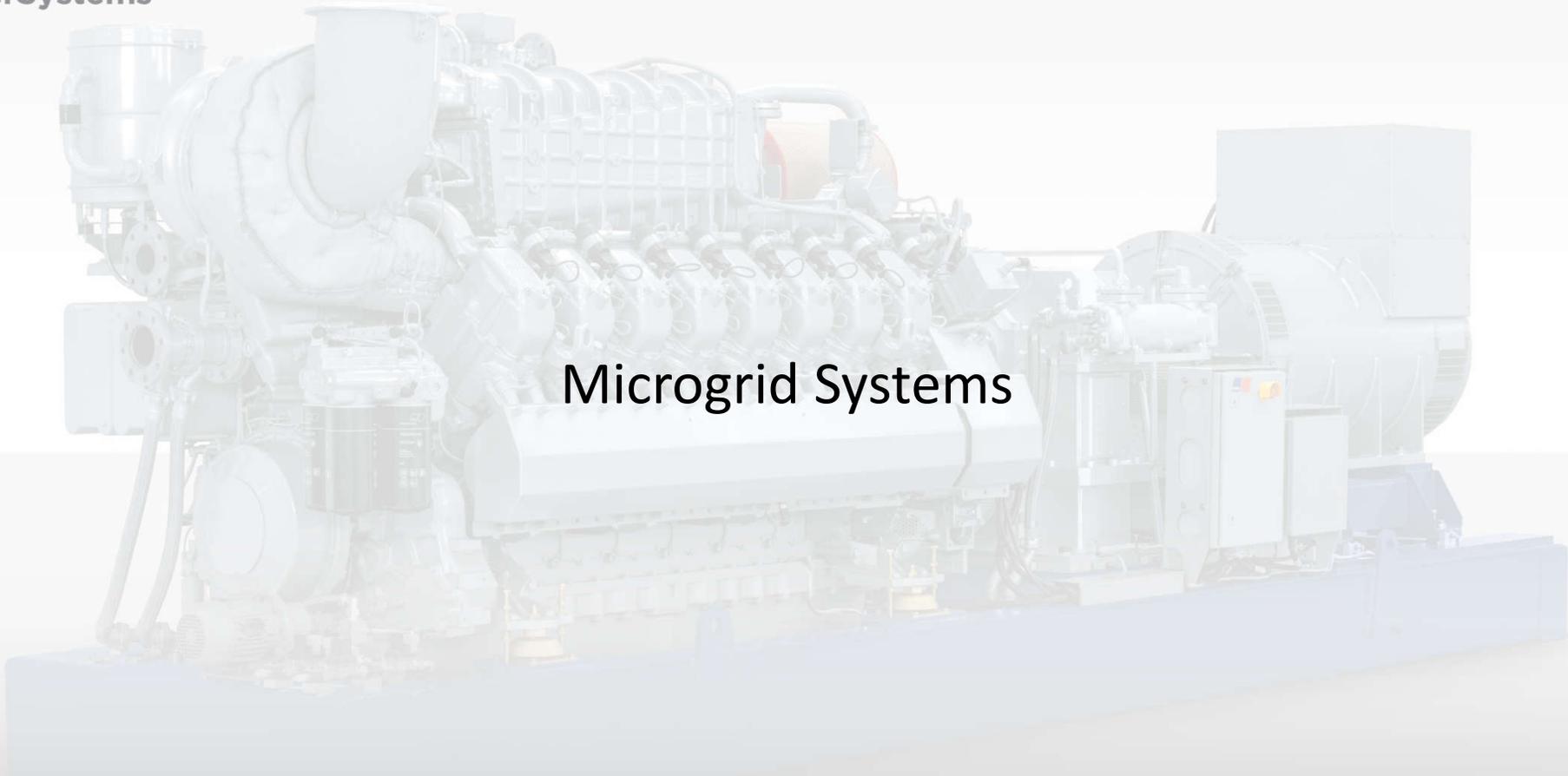
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MTU SERIES 4000 L64 FNER SPECIFICATIONS

1.0 g/bhp-hr NOx	8V4000 L64 FNER	12V4000 L64 FNER	16V4000 L64 FNER	20V4000 L64 FNER
LT Temperature	136°F	136°F	136°F	136°F
Compression Ratio	12.5	12.5	12.5	12.5
Electrical Output (ekW)	1000	1500	2000	2500
Electrical Efficiency (%)	42.9	43.7	43.3	43.3
Total Efficiency (%)	89.7	89.8	90.0	90.1
MN	80	80	80	80

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PowerSystems

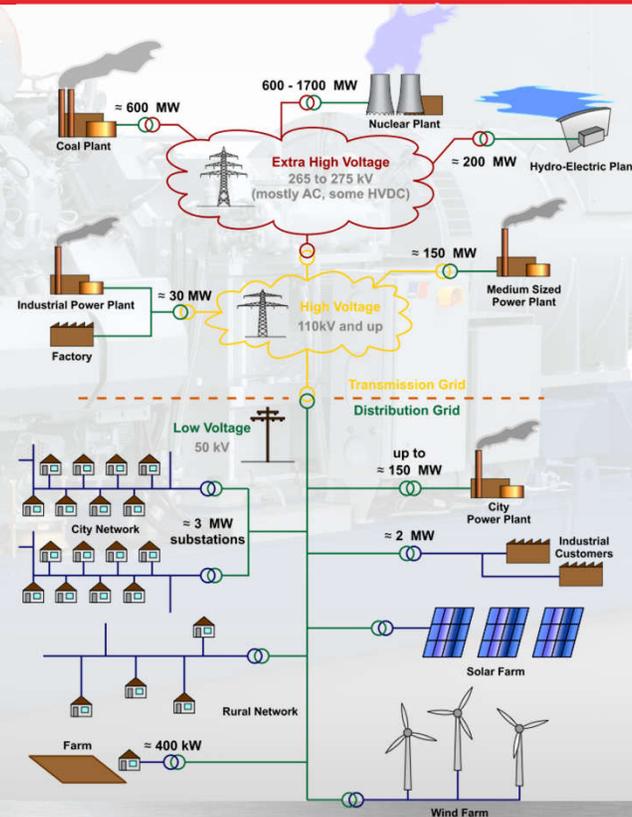


Microgrid Systems

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MICROGRID ADVANTAGES

- Improved generation efficiency
 - T & D losses (8 to 15%)
- Reduced carbon emissions
- Distributed generation
 - Energy resiliency
 - Sustainability
- Renewable energy integration
 - Wind (25 to 45% capacity factor)
 - Solar (13 to 19% capacity factor)
 - Biogas (95% + capacity factor)
- Local generation assets
- District heating and cooling systems
- Electric vehicle charging stations



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MTU ENERGYPACK

Dimensions (L x W x H) 12.2 x 2.4 x 5.2 (incl. HVAC, excl. safety ladder, excl. 10ft transformer container)

Weight 27,700 kg (excl. transformer container)

Fire suppression system

Transformer

Rated voltage / voltage range Customer specific

Inverter

Peak power 2,515 kW (DC) / 2,475 kVA (AC)

Rated frequency 50 / 60Hz

Double floor

Air conditioning

Ambient temperature -20°C up to +40°C

Installation altitude 1,000 m above sea level

Control Cabinet

Supported communication interfaces Profibus DP / Profinet
Modbus / Modbus TCP
Ethernet UDP

Control and monitoring (via external interface) Yes (Touchscreen, SoC LED on container wall)

Battery Racks

Nominal capacity range (dependent of C-rate) 700 – 1260 kWh

Current range 1,560 – 2,808 A

Battery cell chemistry NMC (lithium-nickel-manganese-cobalt)

Battery efficiency (round-trip) 92.5% (2C at BoL)

C-rate 2C

DC-voltage range 750 – 992 V (DC)

Specified cycles (at 2C at 80% DoD at 25°C) 3,600

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MTU MICROGRID VALIDATION CENTER



MTU microgrid validation center:

- Full flexibility regarding integration of renewables (solar, wind etc.)
- Highly flexible testing capability
- Real load simulation
- Capable of going fully off-grid
- Self sustaining
- Advanced integrated MTU automation system



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MTU ENERGYPACK CONTROLS

Energy Shifting



- Managing / shifting energy
- Optimize energy system, physical and economical

Power Quality & Frequency Stabilization



- Maintaining power quality and frequency deviations
- Increase reliability of grid operation

Integration of Renewables



- Increasing & optimizing renewable energy utilization

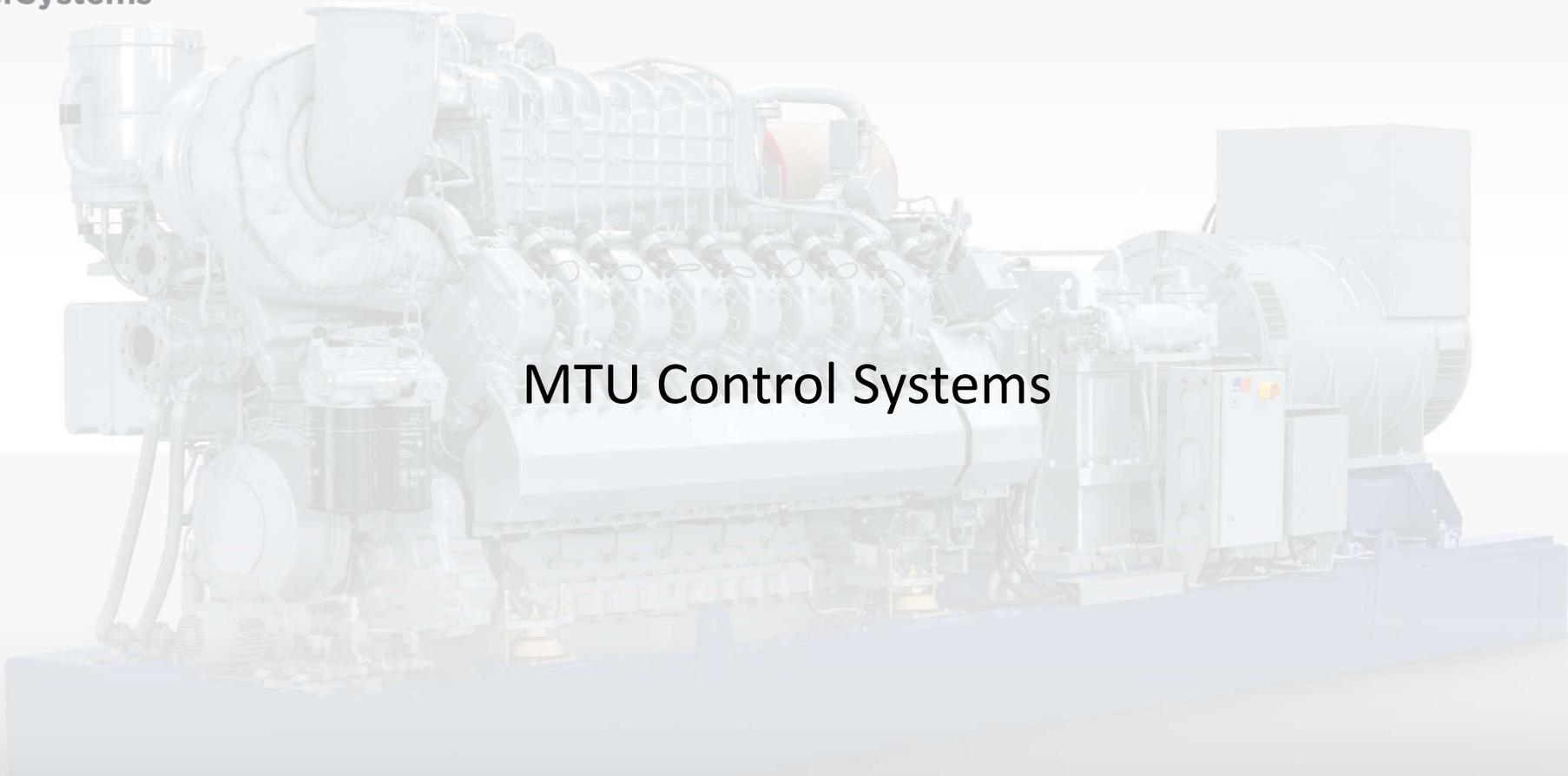
Backup Power



- Covering time until backup generation is synchronized

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MTU Control Systems

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MTU FACTORY CONTROL SYSTEMS

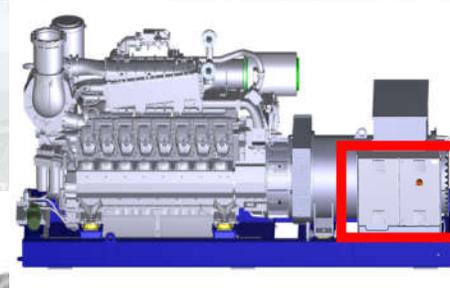
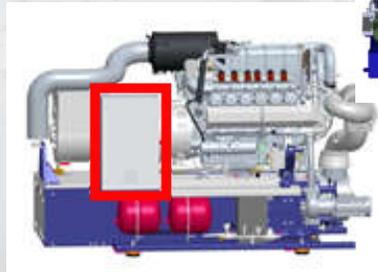
MMC + MIP

MTU Module Control

MTU Interface Panel

CHP System controller

Genset controller (includes Synchronization)



PRIDE IN SERVICE

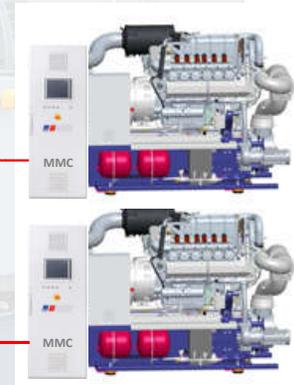
MASTER CONTROL SYSTEM (MCS)

MCS Characteristics:

- Add-on as complete plant control system
- Start/Stop selection of the generator sets to meet facility needs for heat and power
- Complete functionality for island operation
- Series 400 engines can be operated together with Series 4000 engines
- MCS is equipped for control up to 30 generator sets
- Large touchscreen with custom screens for facility control functions
- Data logging

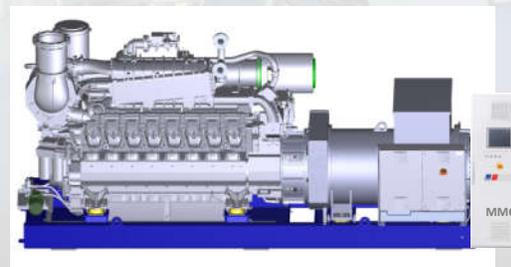


MCS



MMC

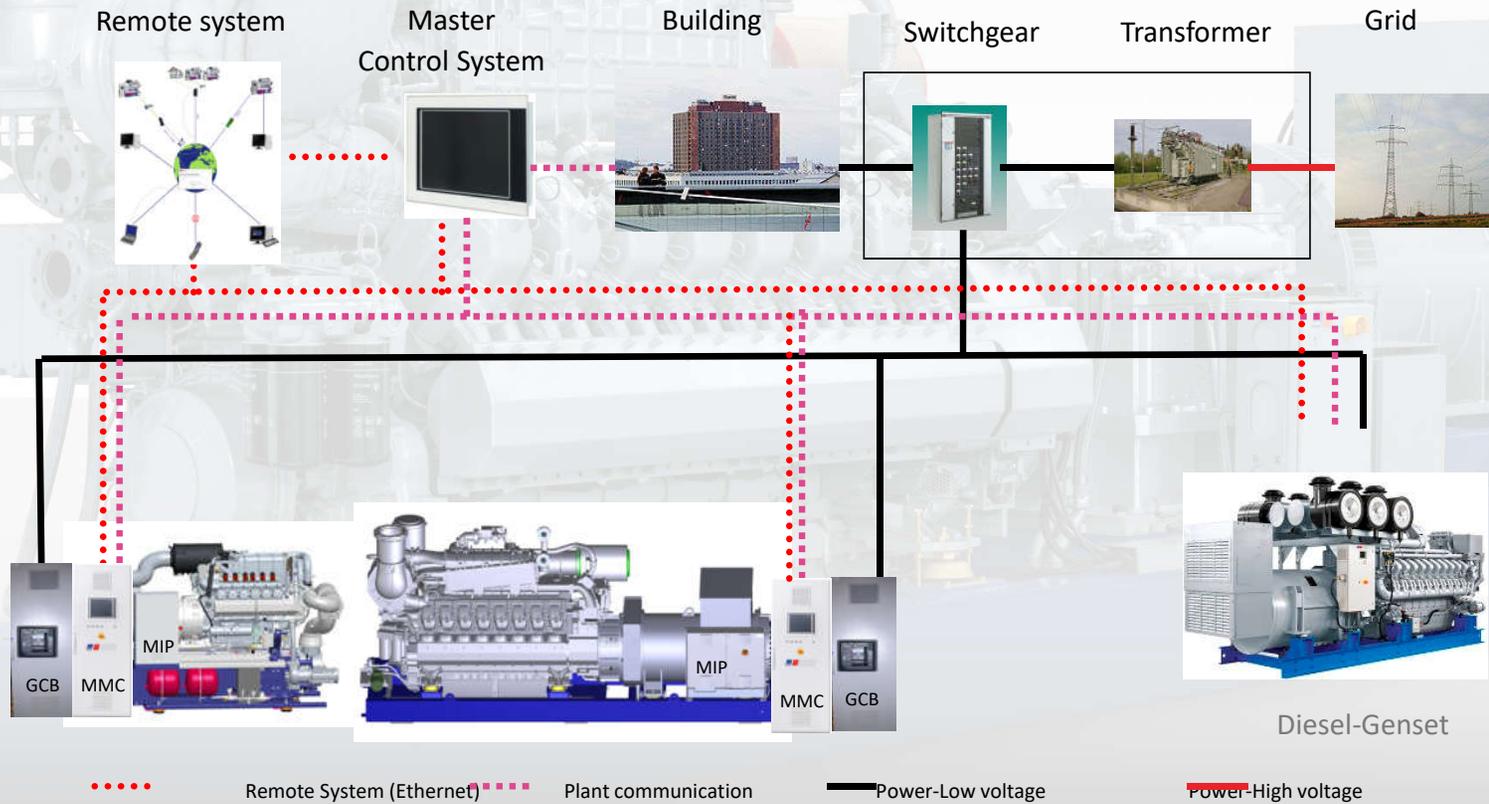
MMC



MMC

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INTEGRATED PLANT CONTROL SYSTEM



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MTU REMOTE MONITORING SYSTEMS

Improved Maintenance Schedule

- 1 common maintenance schedule for L64 FNER
- Improved serviceability: MS50202/05
- Harmonized service intervals i. e.:
 - TBO cylinder heads 63k → USP
 - 3k Operating hours as basis interval
 - Very low lube oil consumption
 - Reduced LCC costs

Ready for DIGITAL



MTU Go! Manage

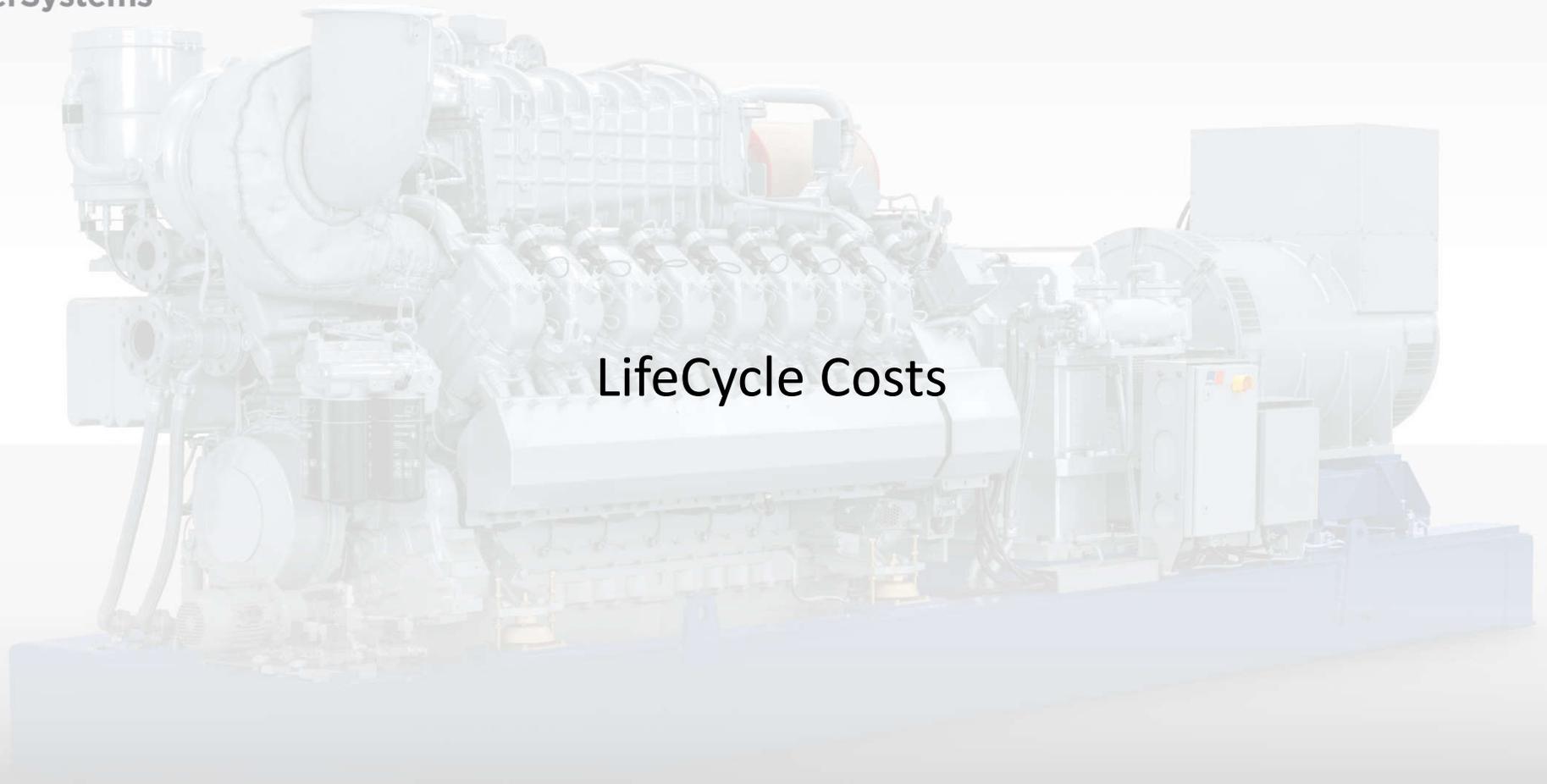
Dashboard with fleet, system & engine view to monitor asset information and live systems data for owners and plant managers.

MTU Go! Act



The mobile app is designed to support on-site operators.

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LifeCycle Costs

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LIFECYCLE MAINTENANCE PERIODS

NATURAL GAS



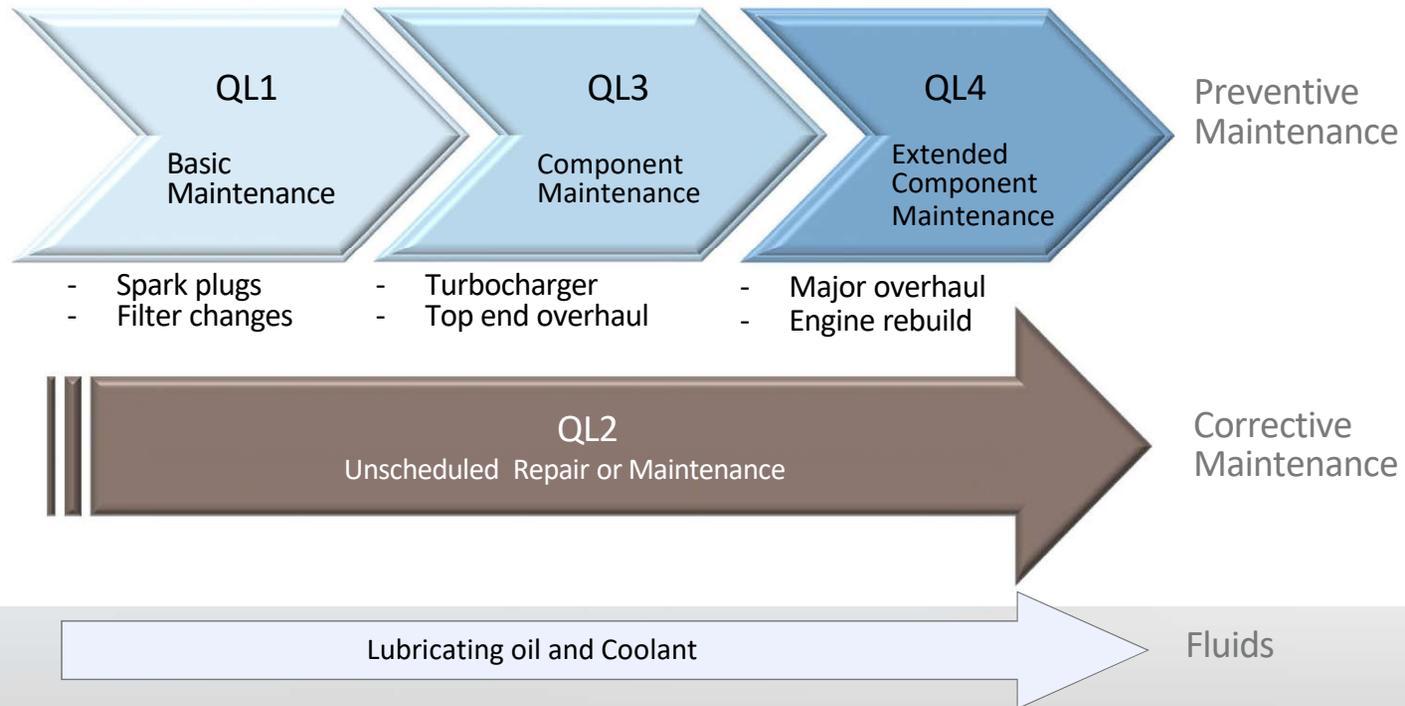
(55 mph x 8760 hrs/yr = 481,800 miles/yr)

How many cars would you own for just one year of 24/7/365 continuous operation???

- Manufacturer Recommended 8 year Cycle
- Based on 16V4000 L64 FNER
- Based on Natural Gas Fuel Source
- Based on 8000 hrs Annual Operation
- 3,000 hrs – Engine Oil Change with External Tank
- 3,000 hrs – Spark Plug Change
- 3,000 hrs – Air Filter Change
- 6,000 hrs – Gearbox Oil Change
- 9,000 hrs – Replace Fuel Gas Filter
- 21,000 hrs – Turbocharger Overhaul
- 21,000 hrs – Replace Cylinder Pack
- 21,000 hrs – Replace Drive Coupling Element
- 24,000 hrs – Coolant Change
- 24,000 hrs – Replace NSCR Catalyst Elements
- 31,500 hrs – Replace Alternator Bearings
- 32,000 hrs – Replace SCR Catalyst Elements
- 63,000 hrs – Cylinder Head Overhaul
- 63,000 hrs – Replace Camshaft System
- 63,000 hrs – Alternator Overhaul
- 63,000 hrs – Gearbox Overhaul

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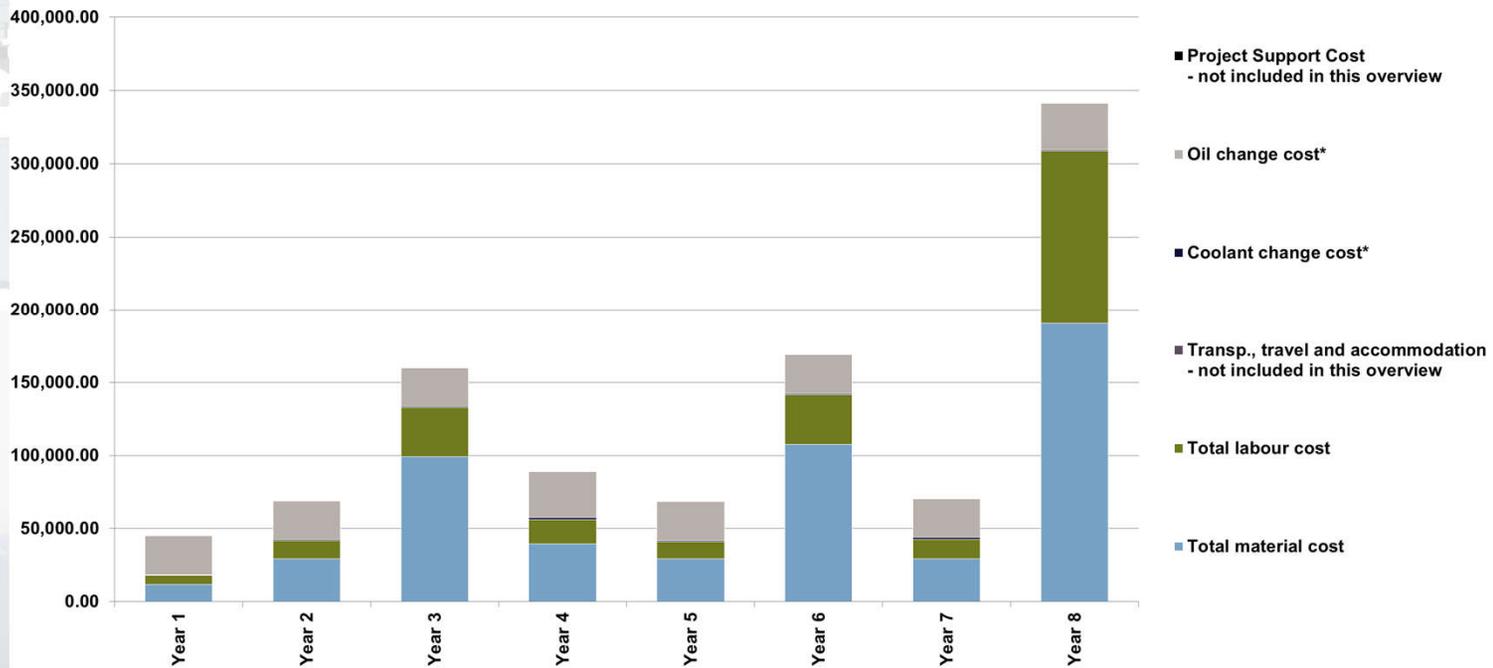
LIFECYCLE MAINTENANCE CONCEPT



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LIFECYCLE CALCULATION OUTPUTS

Total cost of ownership per engine - Overview by year



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ANY FURTHER QUESTIONS?



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“Pride in Service”

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