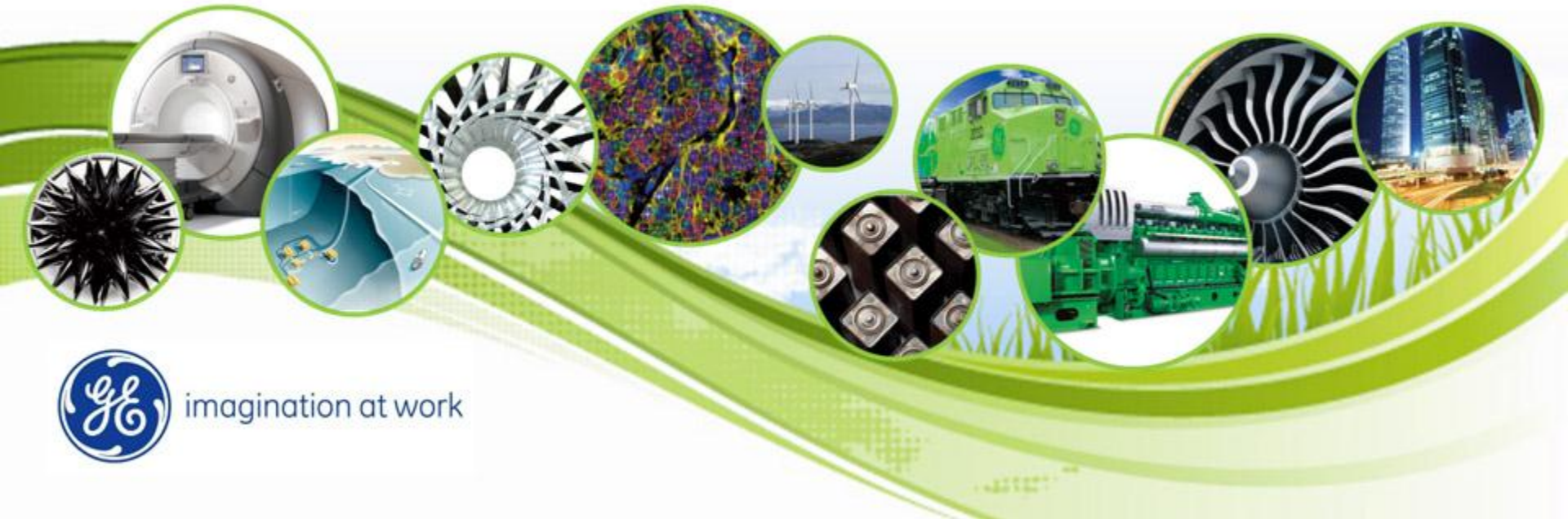


# SiC Applications in High Power

## NIST/DoE Workshop

Rajib Datta, GE Global research  
4/16/2014



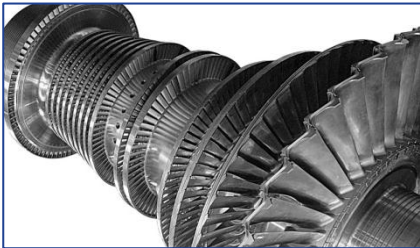
imagination at work

# Our business units

## Energy Management



Oil & Gas



Power & Water



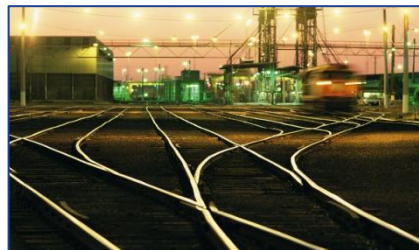
## Healthcare



Aviation



Transportation



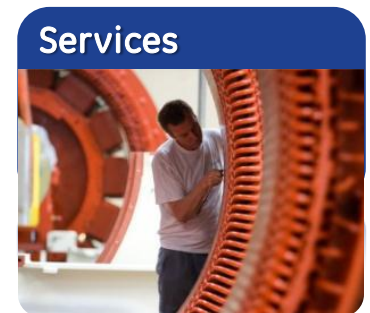
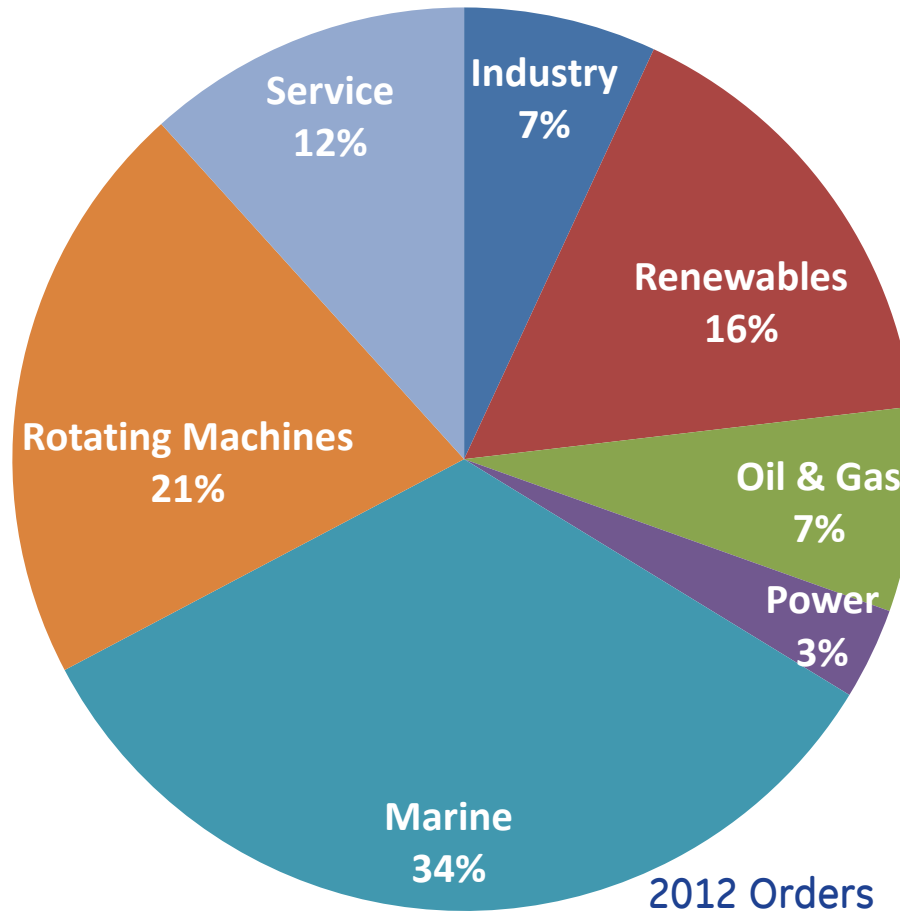
## Capital



Home & Business Solutions



# Broad Industries Served



Providing power conversion solutions  
across the world's energy infrastructure

# Application Examples

## Electricity into motion



- Compressors
- Propellers
- Rolling mills
- Pumps

## Motion into electricity

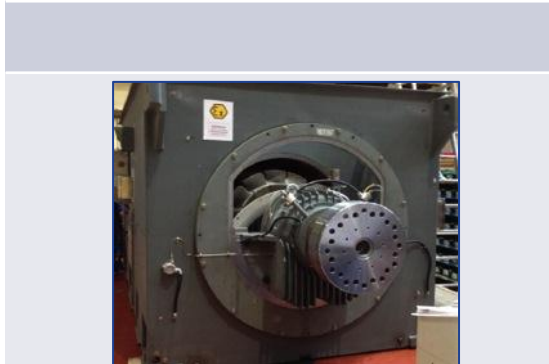


- Wind turbines
- Turbogenerators
- Hydropower
- Wet renewables

## Electricity into electricity



- Wind/solar PV
- Railway substations
- Pulse power supply
- Soft starters



Transforming energy to optimize customer process is our mission

# Motor Technology Portfolio



High Torque  
Up to 20 MW  
Below 400 rpm



Induction  
Conventional Speed  
Up to 80 MW



Synchronous  
Up to 100 MW



Explosion-Proof  
Up to 6 MW



Marinized  
Up to 18 MW



Induction  
High Speed  
Up to 18,000 rpm

# High Power Drive Technology

Grid side

Motor side

Diode or Active  
Front End technology

High power factor  
No pollution on grid

Addressing diverse  
grid environment



Scalable  
Inverter

Powering  
all types of motors



Isolated  
grid



Remote  
area



High speed  
solutions



Long distance  
application

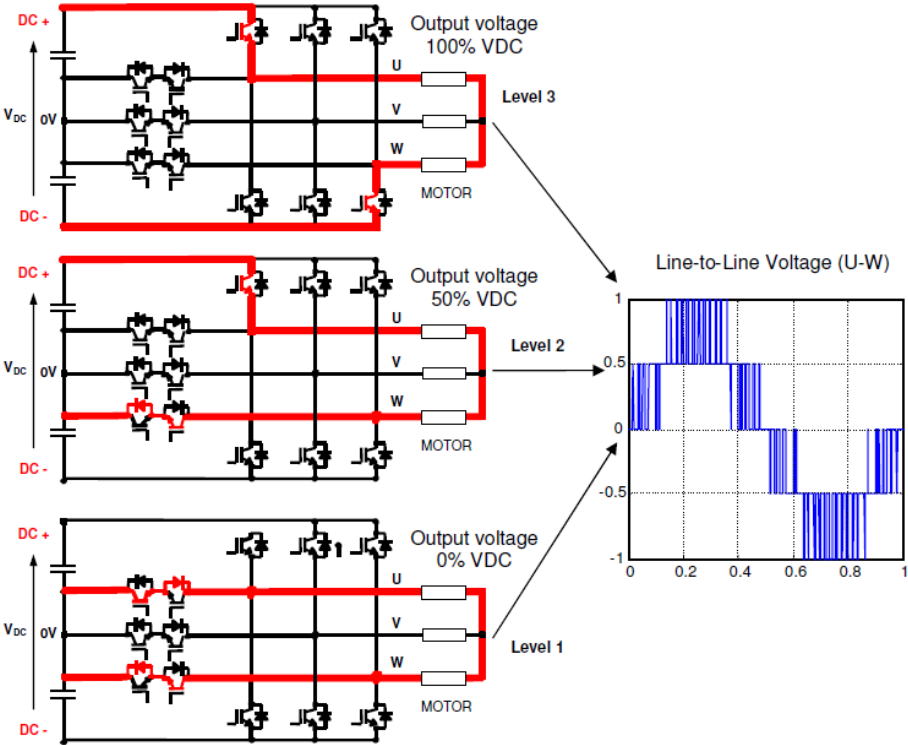
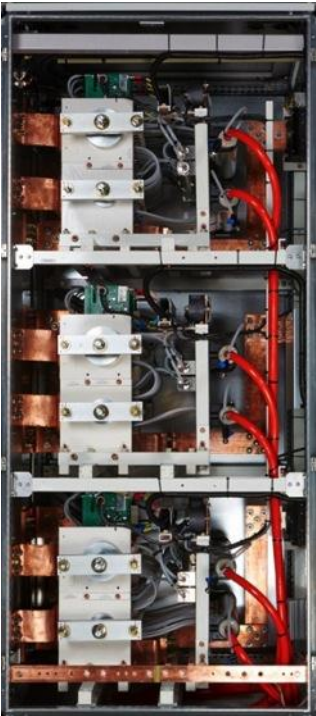
Proven across all business segments

# Neutral Point Piloted Converter

IGBT stack for phase U

IGBT stack for phase V

IGBT stack for phase W



## GE's MV Experience

- Proven Technology: first medium-voltage drive installed in 1975
- Installed Base >1000 units; Accumulated Operating Time\* >1,000,000 hours

# MV7000 Range Scalability & Modularity

Inverter circuit					
<b>Output voltage</b>	<b>3.3kV ac</b>	<b>5.5kV ac</b>	<b>6.6kV ac</b>	<b>8.2kV ac</b>	<b>9.9kV ac</b>
IGBT ST750	5MW	7MW	9MW	11MW	13MW
	MV7305	MV7607	MV7609	MV7811	MV7913
IGBT ST1500	10MW	15MW	18MW	21MW	27MW
	MV7310	MV7615	MV7618	MV7821	MV7927
IGBT ST2100	10MW				
	MV7311 MV7312 MV7315				

**Power scalability is achieved by voltage increase 3,3 up to 13,8kV**



# MV7618 line-up

## ■ A look inside



# Integrated Compressor Line (ICL)



Direct-drive high-speed Induction Motor / Permanent Magnet motor

High fundamental frequency capability of MV drive using novel multi-level converter technology

*Can high switching frequency capability of SiC simplify converter topology?*

# Integrated drive system configuration

**DYNAMIC RETARDING ASSEMBLY**  
*Dissipates Heat Generated in Retarding*



**Control Group**  
*Directs Engine & Controls Power Circuit*



**ALTERNATOR**  
*Generates Electrical Power*



**Need for high power density, high temp, harsh environment operation**



**Motorized Wheels**  
*Propel & Retard Vehicle*

# Enabling New Solutions with SiC

## High-speed Medium Voltage Drives

Simpler 2L or 3L topologies using high switching frequency of SiC devices can provide simpler solution

## “Transformer-less” Medium Voltage Drives

MV drives typically require a large transformer at the input for voltage scaling and isolation

Possible to significantly reduce drive footprint and potential cost by using high frequency transformer (from 60Hz to 60 kHz)

## Integrated Motor-Drive

Integration of power electronics with machines at low and medium power

Substantially increase power density, particularly in mobile applications

High temperature capability of SiC can be effectively used to minimize cooling loops