GE Power

Products & Solutions for Research & Test Systems

GE's Power Conversion Business

gepowerconversion.com

Challenge & Value

Reliable Technology Validation

Customized and Turnkey Solutions

Maximum Test Scenario Flexibility

Mechanical stress – for example that realized by a wind load unit – can produce bending forces at different angles and to varying degrees. By testing control and protection systems, or single components under external conditions, we can measure the influences on load-carrying parts such as main bearings, yawing systems and gearboxes.

We provide adaptable, robust and dynamic test systems for efficient and reliable equipment operations based on:

- Reliable and proven product motors and drives, combined with automation and controls
- System solutions that may include mechanical structure and additional electrical balance of plant products
- Equipment installation services

Shorter R&D cycles

Engineering and Consulting Expertise

Life cycle and Grid Simulation

Electrical malfunctions and equipment protection systems have historically led to unforeseen excessive loading of mechanical components, reducing their expected and calculated life cycle. It's therefore essential to simulate worst-case conditions to design a reliable product.

GE is your partner for customized test system solutions including:

- Feasibility and design studies
- Consulting, planning and contracting
- System engineering to meet customer specifications

Optimized Testing Economics

Project Life Cycle Services

Helping to Lower Development Cost

The substantial cost of installations means that customers can't wait for critical equipment, substructures and components to prove themselves in service. Cars, turbines, compressors and other technology must be fully tested and validated before they are deployed.

To manage the timing, execution and performance of services for critical assets, we provide customized support, upgrades and life extensions. This includes:

- Project management services and maintenance programs – from component level up to the broader electrical system
- Standard packages and customized solutions
- Remote diagnostics
- Technical support and training maintenance
- Upgrade or replacement of GE Power Conversion's legacy and other OEM equipment

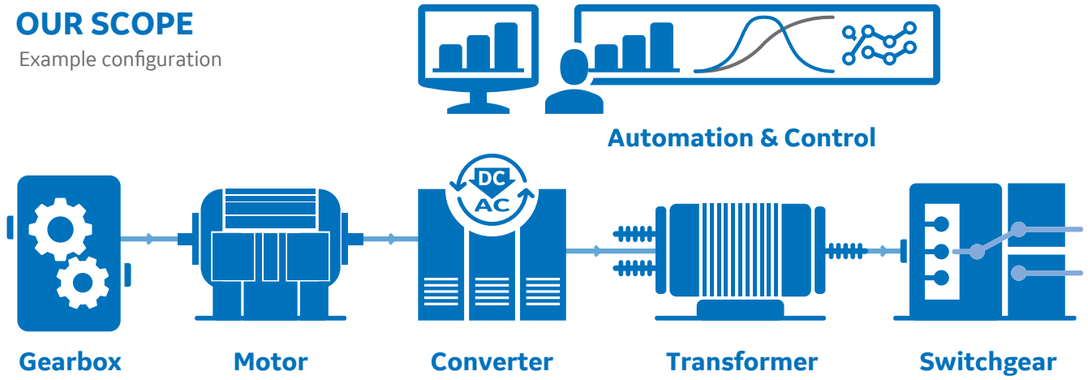
Research, Development and Test Systems Solutions

Robust product testing of critical equipment is the foundation for quality and reliability. It means manufacturers of critical equipment and research centers for industries such as renewables, power generation, oil and gas, automotive, marine or aerospace need to stay ahead of the game. For example, simulating years of wear and exposure in months can lead to shorter development times.

GE provides adaptable, robust and dynamic test systems for efficient and reliable equipment operations across these industries. Our customized and turnkey solutions, combined with engineering and consulting expertise and project life cycle services, help to improve the performance of your products.

OUR SCOPE

Example configuration



Adaptable, Robust and Dynamic Testing

- Easy-to-adjust test set-up
- Modular test bench software
- Standard interfaces
- Robust and durable mechanical and electrical set-up
- Allows for highly dynamic processes testing including quick load charges and fast response times

Typical Test Conditions

- Load simulation
- Grid emulation
- FRT – LV/HV
- Environment simulation
- Fatigue testing
- Customized testing

Technical Range

- Speed: 5 to 50,000 rpm
- Power: 150 kW to 100 MW
- Torque: 100 Nm to 18 MNm
- Control and measurement cycle time: <2 ms
- Hardware in the loop (HIL)

Critical Equipment Testing Solutions

Automotive Test Systems

The automotive testing industry requires high performance, with highly innovative software features as a key to success. GE provides automotive testing solutions for combustion, drive line, electric & hybrid vehicles. The automotive industry in changing rapidly and forcing us to constantly deal with new challenges. The demand for electric vehicles is increasing worldwide while at the same time new testing capabilities are needed and customers are asking for cars with more custom design options – while for the coming years conventional drive trains will be in demand.

Advances in battery storage technology are constant. However, battery testing is inconsistent across all markets. Manufacturers are using different chemistries, formats, and processes. System integrators are developing systems that may be useful for one application, but inefficient for another. Flexible test benches are necessary to accommodate high testing accuracy of prototypes, pre-series and constantly changing products or partial systems to ensure long-term investment protection.

Based on our experience and know-how, and given the hardware and software available, we have developed systems, which can be easily combined with GE drives to provide high performance testing in the automotive industry for electric or hybrid vehicles and battery emulation. GE provides innovative software modules, e.g. the patented 300Hz ETPS engine torque pulsation simulation system which is an embedded feature of the drive software specifically for this industry segment.

Wind Tunnel Testing Solutions

Wind tunnel testing plays a major role in the development of high-speed vehicles – not just around their aerodynamic form but also to ensure cooling air is effectively directed into the vehicle. GE's services cover all electrical equipment including drives, automation and visualization solutions. We have supplied systems to a variety of institutes and universities, as well as the National Aeronautics and Space Administration (NASA).

Renewables Testing Solutions

Wind turbines and solar farms are increasingly contributing to meeting the world's energy demand. Such systems work often under extreme conditions and in remote places. Yet they're expected to provide maximum reliability and minimum lifetime costs without compromising performance – sustainably delivering power to the grid under varying environmental influences. Product life cycle testing and grid emulation are key for testing renewable power generation systems. GE offers consulting expertise, test systems and services that meet these requirements using a range of drives, electrical machines, test and simulation software.

Test Benches for Compressors, Turbines, Generators and Gearboxes

GE delivers turnkey solutions, on-demand adaptable drive technology and energy-efficient solutions with high accuracy and speed. To help ensure the highest reliability, we develop and test units under worst-case conditions. Our offering covers the complete drive system from medium voltage down to the motor shaft. Our mechanical construction expertise, combined with design and engineering, results in the manufacture of powerful testing solutions, from turbines and combustion engines to power trains and vibration simulation.

Research, Development and Test Systems Product Portfolio

Power Electronics

Offering high power density, reliability, availability and scalability.

Models
- LV8 Series
- ProTX Series
- MV6 Series
- MV7 Series

Technical Capabilities
- Output power: 0.25 to 120 MW
- Output voltage: Up to 13.8 kV
- Output frequency: Up to 1,200 Hz
- Input frequency: 50 or 60 Hz +/-5%
- Variable-speed systems for main, major and auxiliary drives
- HV/LV power supply

Electric Motors

Reliable and efficient rotating machine technology.

Models
- Induction motors
- Synchronous motors
- High-speed motors
- PM motors

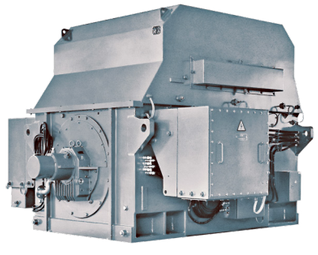
Technical Capabilities
- Speed: 40 to 30,000 rpm
- Power: 1 to 30 MW
- Voltage: Up to 13.8 kV

Generators

Operate effectively and reliably in challenging applications.

Models
- 2-Pole turbo generators (gearless)
- 4-Pole synchronous gas and steam turbine (alpha) – laminated or solid rotors

Technical Capabilities
- Speed: 2–22 pole range
- Power: 2,500–80,000 kVA
- Voltage: Up to 22 kV
- Frequency: 50 or 60 Hz
- Hazardous Area: Zone 1 or 2 and Div 1 or 2



Extended Systems

Test and simulation software, as well as services including electrical and mechanical infrastructure.

Systems
Systems scope may comprise:
- Automation and control
- Test and simulation software
- Electrical plant balance
- Mechanical structure
- Power supply

Energy Systems
- Battery testing
- Battery simulation
- Power electronic and inverter testing

Technical Capabilities
- Load simulation
- Grid emulation
- FRT – LV/HV
- Environment simulation
- Fatigue testing
- Customized testing

Automation and Control

Maximize System Availability and Process Uptime
The controls executing across our automation and drive systems platform are built using a mature suite of reliable and secure automation components assembled into modular, flexible and scalable automation solutions. Our solutions use modern interfaces like OPC-UA, IEC 61850 and web technologies to facilitate integration with customers' existing OT/IT infrastructures.

Key Components
- HPCi: High-performance system controller for process control and automation
- PECe/PECeLite: Drive controllers with associated power interfaces (PIBs) and specialist control libraries
- P80-Pilot: Engineering toolbox and its associated system engineering tools
- Visor: Remote monitoring and diagnostics system to provide safe and secure remote service capability and connection to Predix for remote analytics

e-House

GE's integrated e-house solutions combine electrification, motion and control systems with GE's engineering expertise, offering optimized solutions for power supply and control across intensive industrial and test applications.

Key Components
- Modular control building with protection, control, metering and communications panels
- Switchboard
- Power transformers
- MV/LV switchgear and transformers
- Integrated SCADA system
- Monitoring and diagnostic systems for transformers, motors and breakers
- Motor control center
- UPS and battery systems
- HVAC
- Lighting

Turnkey Solution
- Multi-level, multi room
- 100% continuous welded panels
- Automatic fire detection and suppression system
- Fire and smoke dampers
- Reports for structural, seismic, air conditioning, illumination and fire
- Installation guidelines
- MV/LV Cables
- Cable routing and laying

E-Charging Challenge

The World is Changing

The reduction of CO_2 emissions is a main global objective. The world watches out for carbon dioxide (CO_2) emissions and faster solutions provided by the industry to create respective infrastructures.

While the European Automobile Manufacturers Association is “concerned about the extremely aggressive CO_2 reduction targets and the imposition of sales quotas for battery electric vehicles”, we need to prepare for a faster, reliable and sustainable change of standards.

Consumers as well as enterprises (as fleet owners) cannot be forced to buy electric vehicles, without the necessary infrastructure or incentives in place.

Industry Challenges

Today’s electric vehicle (EV) market is highly subsidized and requires government support to compete in the automotive industry. EVs are however, becoming more viable and competitive due to the increasing pressure from society on cutting emissions and advancing sustainable solutions, lowering costs and the growing availability of charging infrastructure, especially in cities. It is expected that within the next 10 years long range battery electric vehicles can reach cost parity with internal combustion engine vehicles and thereby become the rational end-user choice. In order to achieve the EU target of zero emission vehicles by 2050, it is expected that all new car sales by 2035 need to come from these sources.

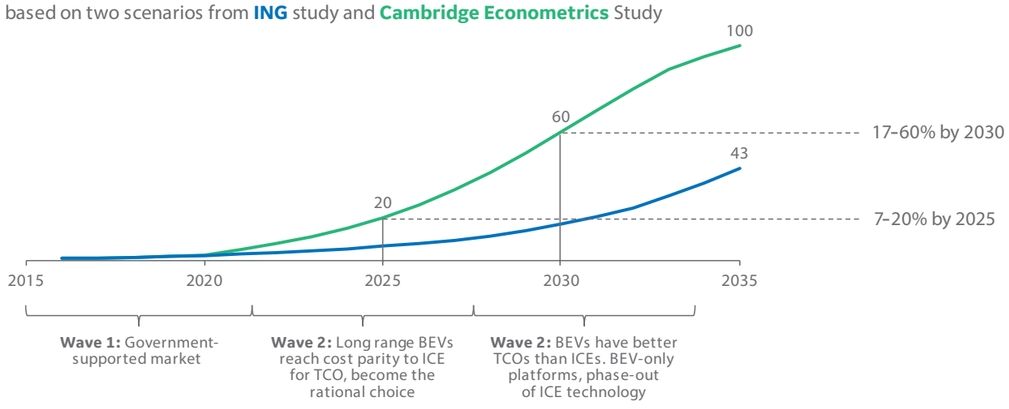
Energy providers are expected to cope with the higher power demand emerging from these new technologies. A key challenge is the optimization and balancing of the grid through the electric vehicle charging infrastructure, which includes collecting and processing real-time data.

To transfer this megatrend to corporate fleets such as the heavy good or load-carrying vehicle industry and its players, we need to provide not only high power density, but also a flexible and smart charging solution.

GE can play a key role in establishing a solid interface in the triangle of automotive industry, energy industries and the growing demand of corporate fleets by providing a turnkey solution for the end-user.

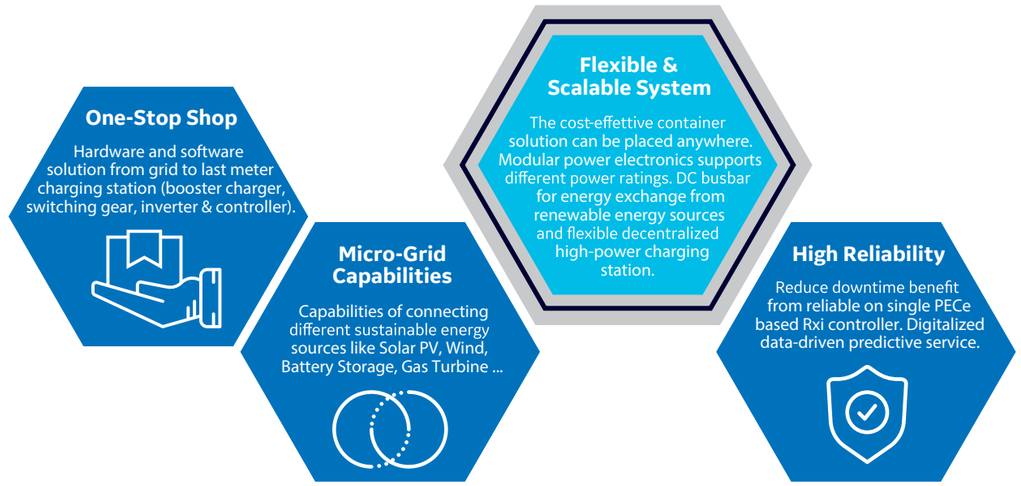
BEV (and Other ZEV) Will Fully Replace ICEs by 2035–2050

The graph shows the assumed ZEV share of new vehicle sales until 2050 in Europe – based on two scenarios from **ING** study and **Cambridge Econometrics** Study



BEV = Battery Electric Vehicle, ZEV = Zero Emission Vehicle, thus including BEV but also fuel cell electric vehicles, ICE = Internal Combustion Engine Vehicle, TCO = Total Cost of Ownership – Source: Study ‘Fuelling Europe’s Future’ – by Cambridge Econometrics & Element Energy; ING Economics Department • July 2017

E-Charging Today and Tomorrow



The GE Value – Solution Overview

GE’s flexibility across the complete portfolio allows our customers to select products and systems that meet their specific requirements, while maintaining the key benefits of standardization and pre-engineering processes.

The Solution – From Standardized Solutions to a Flexible and Reactive Approach

GE has a proven track record, expertise and resources to meet specific customer needs with a portfolio of technology, products and services across the commonly used power supply methods and grid operations. Cost-effective system design, highest energy output, efficient connection to the grid and long-term reliable operation are key to our customers’ success.

Our core offering is a containerized converter solution, or an installation directly in the customer’s electrical switch room, that enables a centralized connection of multiple charging stations for electric vehicles. Potential end-user cases could be, but are not limited to company workplaces, vehicle fleets, real estate owners and public entities to help increase attractiveness by providing customers with fleet management solutions and innovative services that fulfill their aspiration for a sustainable development.

At the same time this solution can be utilized as an energy management system that integrates a large variety of local sustainable energy sources such as batteries, Solar PV, Wind or even gas turbines.

At last this solution enables a smart grid interaction by collecting and processing real-time data and in turn providing insights to optimize and balance the grid through the electric vehicle charging infrastructure.

E-Charging Solution

Connecting Fleets to Wire

Charging station management and fleet management solutions provide facility owners real-time monitoring and control on all levels of their assets. From grid load, energy storage usage to electric vehicles' data are all visualized, available to facility owners or operators even remotely.

HIGH LEVEL CONTROL MONITORING

ASSET PERFORMANCE MANAGEMENT (APM)

Thanks to the optional built-in and smartly controlled alternative energy sources, such as solar, wind, bio gas buffered with battery, GE's ultra-fast charging solutions could provide end customer charging solution in the most economical way.

BATTERY ENERGY STORAGE

GAS TURBINE

PHOTOVOLTAIC

WIND

Grid load overview with the balancing capability is provided in the software solution.

GRID CONNECTION

SWITCHGEAR

TRANSFORMER

GE's ultra-fast charging offering is a containerized converter solution or an installation directly in the customer's electrical switch room.

LV8 PLATFORM

ENERGY MANAGEMENT CONTROLLER

AC DC

DC DC

The charging points are compatible with a variety of charger standards and available for a large amount of level 3 DC fast charging solutions. Both AC and DC transmission solutions enable either centralized or decentralized approaches.

For more information on GE Power Conversion's Research & Test System Solutions, please contact your local sales representative.

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