Presented by:

The Role of Power Electronics in Distributed and Cogeneration (DCG) A Critical Look at North America and Europe

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Background

- **Darnell Group is a publishing and market research company that focuses exclusively on the Power Electronics industry.**
- **The Forecasts and Material provided in this presentation stem from the second update of the Distributed and Cogeneration Power Electronics Report.**

Methodology

- Forecasts are derived using a multi-step process.
- Initial forecast is of the Worldwide DCG market and the driving factors.
- Primary forecast is of the power electronic components.
- Interviews, current publications, existing data bases.
- The regions covered are North America, Europe and Asia.

Distributed and Cogeneration

- **Produces both Electricity & Heat from a single fuel.**
- **Facilities located at or near the consumer.**
- **Lessens reliance on the Electricity Grid.**
- **Operated independently, both in parallel or as backup.**
- **Increased Efficiency**

Distributed and Cogeneration Technologies

- Established Technologies
  - Wind Turbines
  - Photovoltaics
  - Gensets
  - Gas Turbines
- Emerging Technologies
  - Micro Turbines
  - Fuel Cells
  - Variable Speed Generators

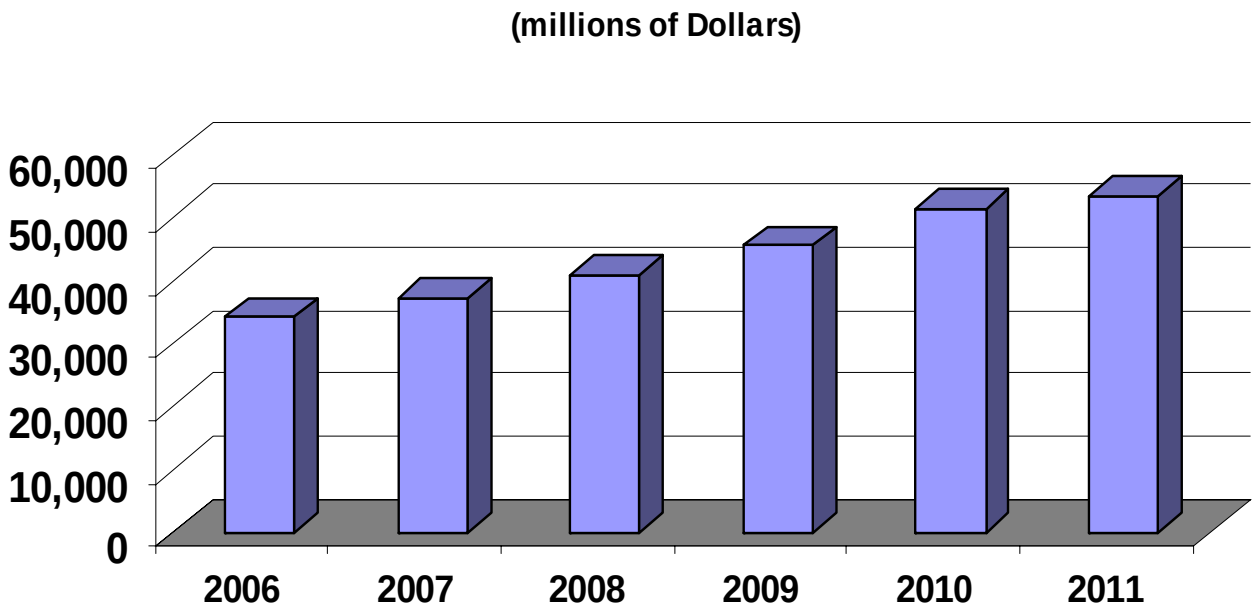
Market Dynamics Differ in Various Regions

- **In North America, DCG relieves pressure from Volatile power prices and ensures power reliability.**
- **In Europe, DCG is promoted because it provides environment-friendly energy and reduces greenhouse gases.**
- **In Asia, DCG contributes to the alleviation of power shortages and helps both mature and emerging nations manage their energy needs.**

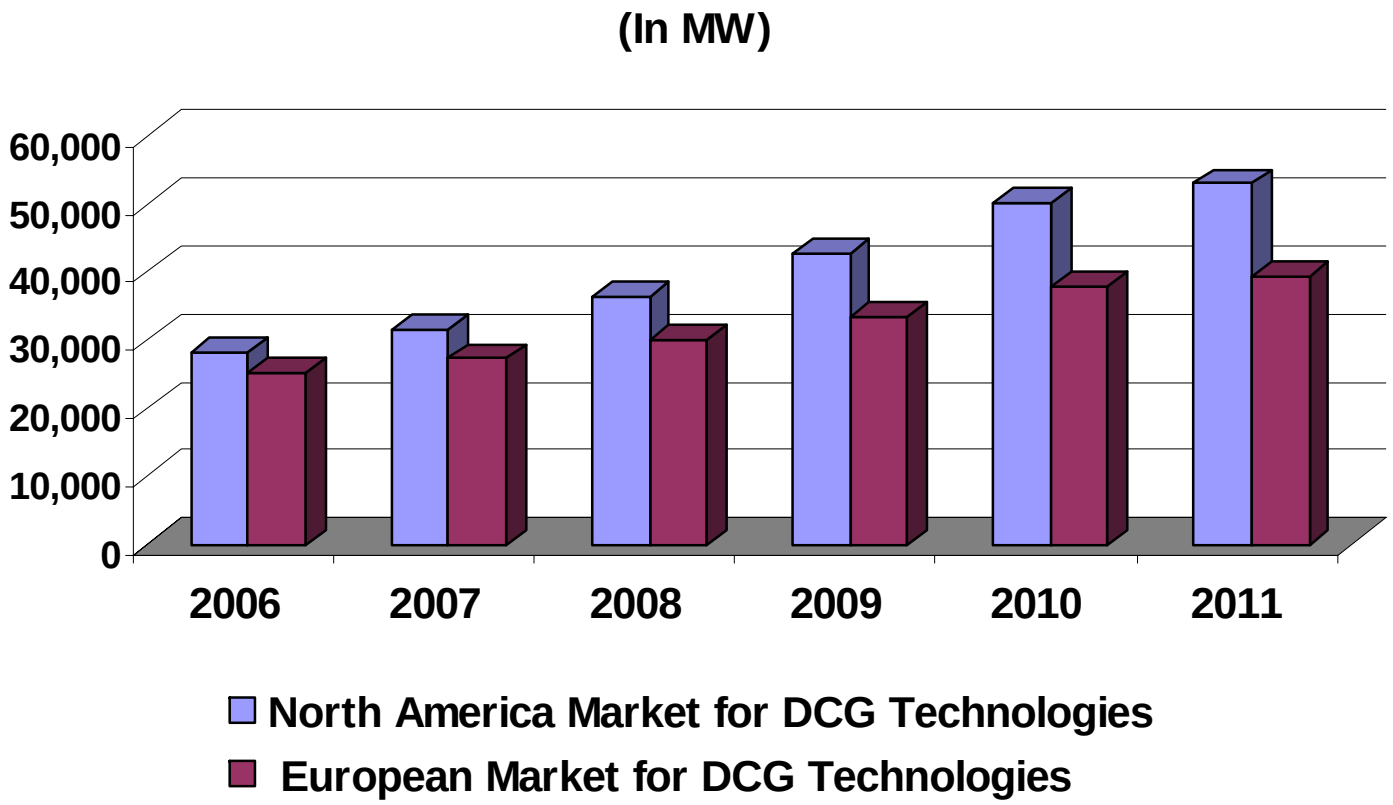
Worldwide DCG Technology Forecast

- The worldwide economic rebound provided the DCG market with momentum in 2006.
- The combined DCG Technologies are projected to grow at a 9.3% CAGR.
- From $34.3 billion in 2006 to $53.5 billion in 2011.
- This top level view hides the applications and technologies that drive the market.
- North America vs. Europe.

Worldwide DCG Technology Forecast



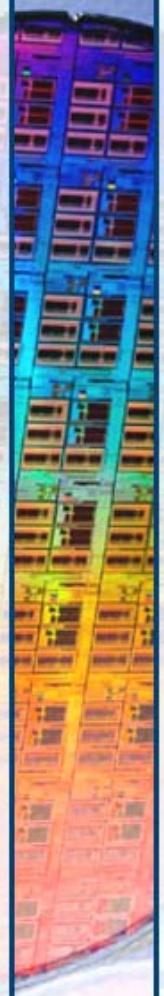
North America vs. Europe (MW)



DCG Power Electronics Components covered in the Forecast

- Inverters
- Variable Frequency Converters
- Static Transfer Switches
- AC-DC Power Supplies
- DC-DC Converters
- Other Category (battery chargers, controllers, electricity meters, protective relays, etc.)

Worldwide Power Electronics (DCG) Market Outlook



- **Regardless of application or technology employed, Power Electronics is expected to be the key element in the growth of commercial DCG systems.**
- **Power Electronics devices can be applied in place of traditional power devices such as switches, capacitors and condensers and can perform several of these functions with a single device.**
- **Necessary to the Digital Economy.**

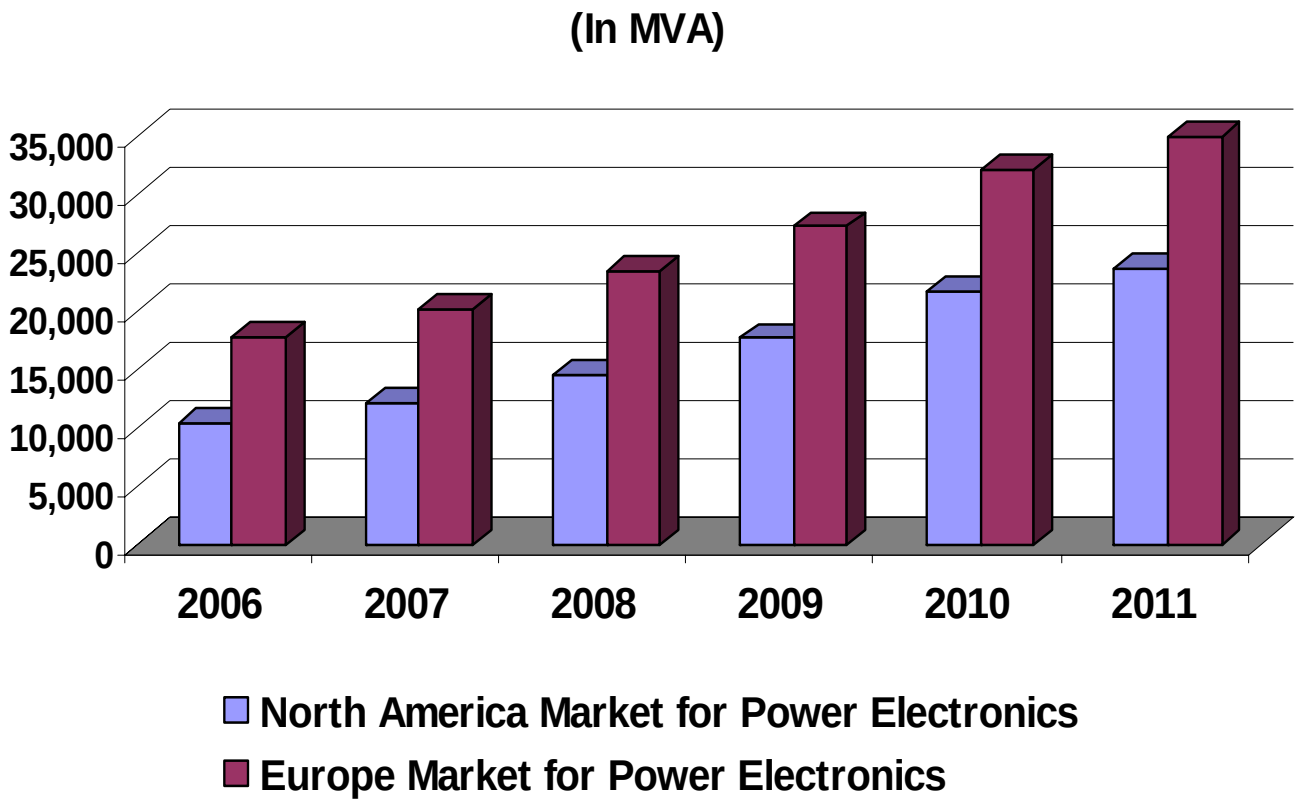
Worldwide Power Electronics (DCG) Market Outlook

- In traditional DCG applications, Power Electronics make up less than 5% of the system cost.
- In newer DCG applications, Power electronics account for 20-30% of the total system cost and growing.
- The technology development in Power Electronics will further drive the DCG penetration into the electricity market.

Power Electronics Growth In North America

- The North American market for Power Electronics is projected to grow at a 17.9% CAGR.
- From 10,377 MVA in 2006 to 23,649 in 2011.
- Growth in Industrial applications using little Power Electronics…Gas Turbines, Gensets.
- Power Grid interconnection an important factor.

Comparison of Power Electronics for DCG



Power Electronics Growth In Europe

- The European market for Power Electronics is projected to grow at a 14.5% CAGR.
- From 17,674 MVA in 2006 to 34,838 in 2011
- Region favors Alternative sources like Wind Power & Photovoltaics.
- Germany & Denmark are leading producers
- Adherence to Kyoto Protocol.

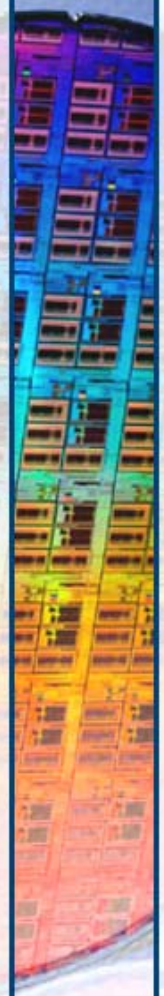
The Market for Power Electronics in Emerging DCG Technologies

- **Photovoltaics, Micro Turbines and Fuel Cells are expected to grow at faster rates.**
- **Growth includes both DCG Technologies & Power Electronics.**

Challenges Facing DCG in Both Regions

- Revise & improve existing regulation so that DCG can be integrated into the utility grid.
- Market penetration depends on how well manufacturers of DCG systems do in meeting product pricing and performance targets.
- Maintenance costs can be significant.
- Some emerging technologies are still emerging.

Factors Driving the Power Conversion Market In both Regions



- The need for interconnection to the existing power grid.
- Improving the reliability of the power supply, reducing the cost of electricity and lowering the emissions of air pollutants.
- Power Electronics technology lowers the cost of DCG systems.
- The production of DCG Power Electronics is both profitable and environmentally friendly.

Summary

- Energy needs, new technology and innovative financing tools have created new opportunities for DCG & its Power Electronics Components.
- Power Electronic interfaces introduce new control issues and possibilities.
- A growing percentage of DCG systems are using Power Electronics to improve efficiency.
- North American emphasis on traditional DCG technologies.
- European emphasis on alternative forms of DCG technologies.