

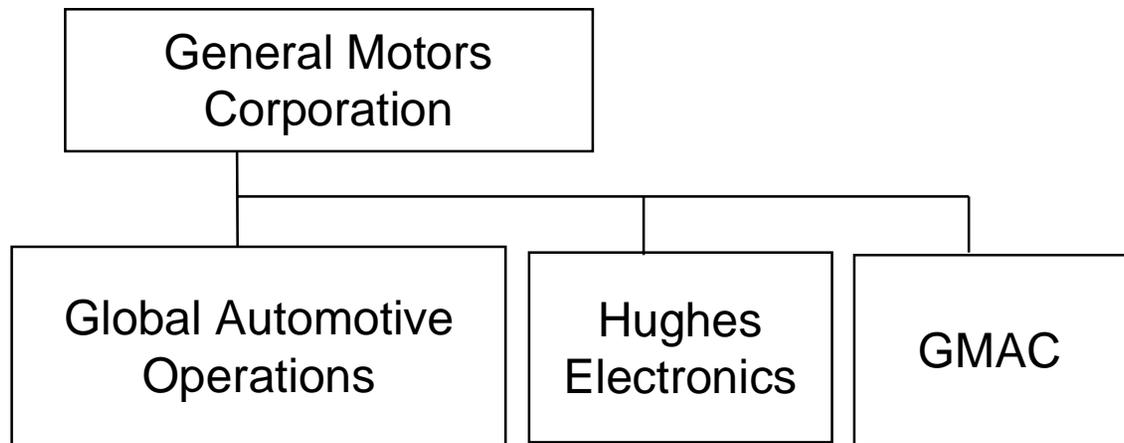
# DELPHI

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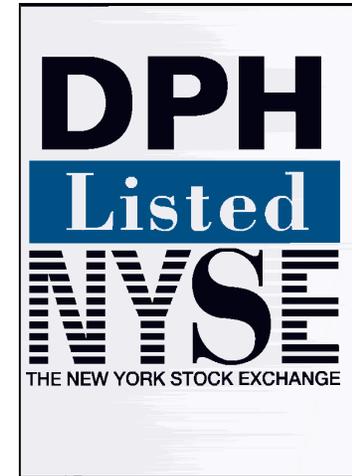
Automotive Systems



# The Evolution of Delphi



**Spin-Off**  
**May 28, 1999**



- 1900s: 90 years + of history as the in-house supplier to GM
- 1988: ACG Worldwide Group structure created
- 1994: ACG Worldwide established as separate business sector
- 1995: ACG Worldwide became Delphi Automotive Systems
- 1998: Delphi incorporated as a subsidiary
- 1999: Delphi Initial Public Offering; "DPH" on NYSE
- 1999: Delphi becomes a totally independent company

# Mission

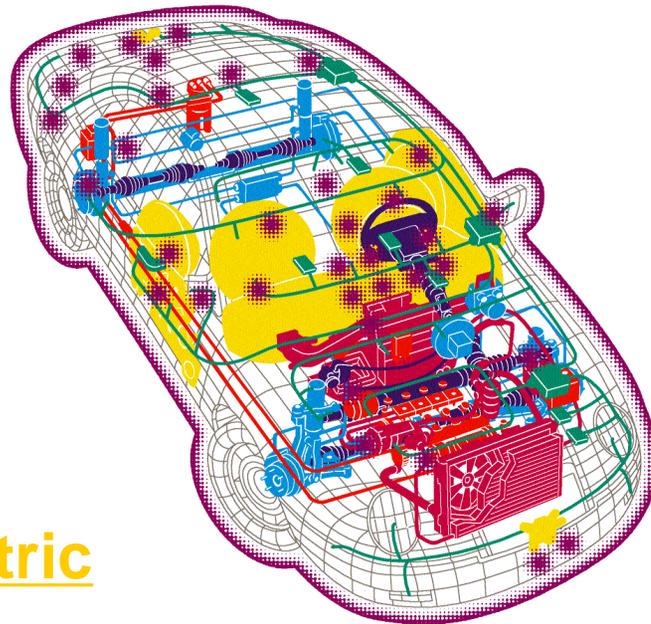


- Global Automotive Systems Supplier With Component Excellence
- Passionate Pursuit of Customer Satisfaction Through Technology, Quality, Cost, Responsiveness and Attitude
- Grow Revenue Across a Diversified Customer Base
- Increase Stakeholder Value Through Revenue Growth and Superior Returns
- Create an Environment Where Every Employee Can Contribute and Excel

**Energy & Engine  
Management  
Systems**

**Delco  
Electronics  
Systems**

**Packard Electric  
Systems**



**Chassis Systems**

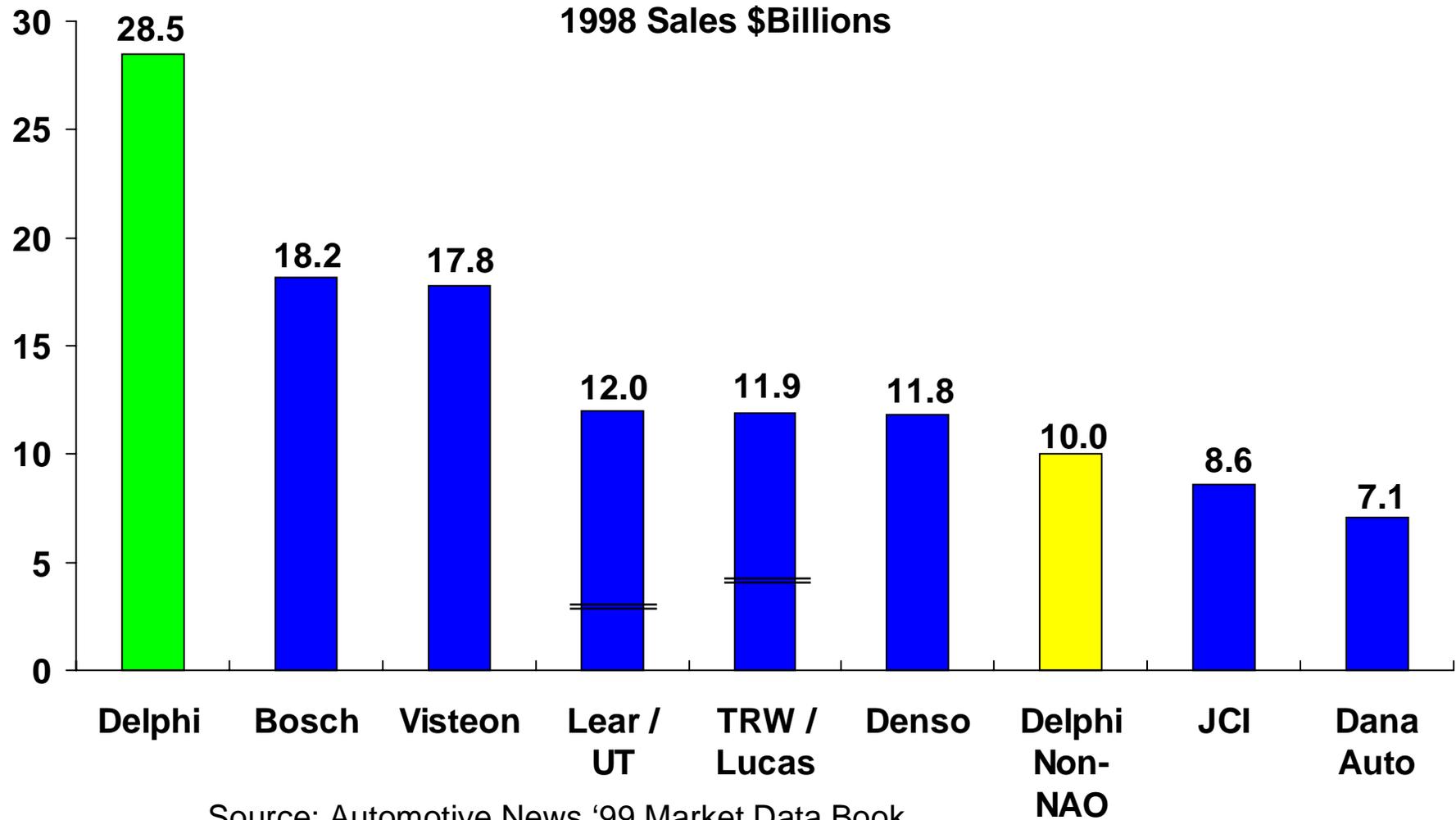
**Saginaw Steering  
Systems**

**Interior & Lighting  
Systems**

**Harrison Thermal Systems**

# Comparison To Major Competitors

**DELPHI**  
Automotive Systems



Source: Automotive News '99 Market Data Book

# Major Customers



# Delphi Automotive Systems

## Core Competencies

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- Chassis System Design and Integration
- Mechatronics-Electromechanical Integration
- Friction Management
- Fluid Power Management
- Value Enhancing Processing
- Energy Conversion
- Energy Storage
- Sensing & Actuation
- Exhaust & EVAP Emissions
- Fuel Delivery & Combustion Control

*Delphi and BMW Announce Development of  
Fuel Cell  
Auxiliary Power Unit.*

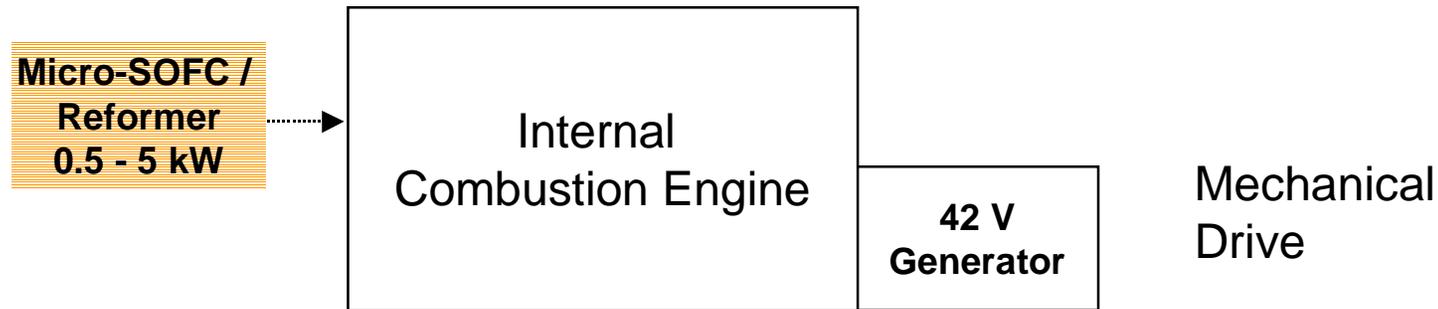
For Release: April 26, 1999

*MUNICH, Germany /PRNewswire/ --*

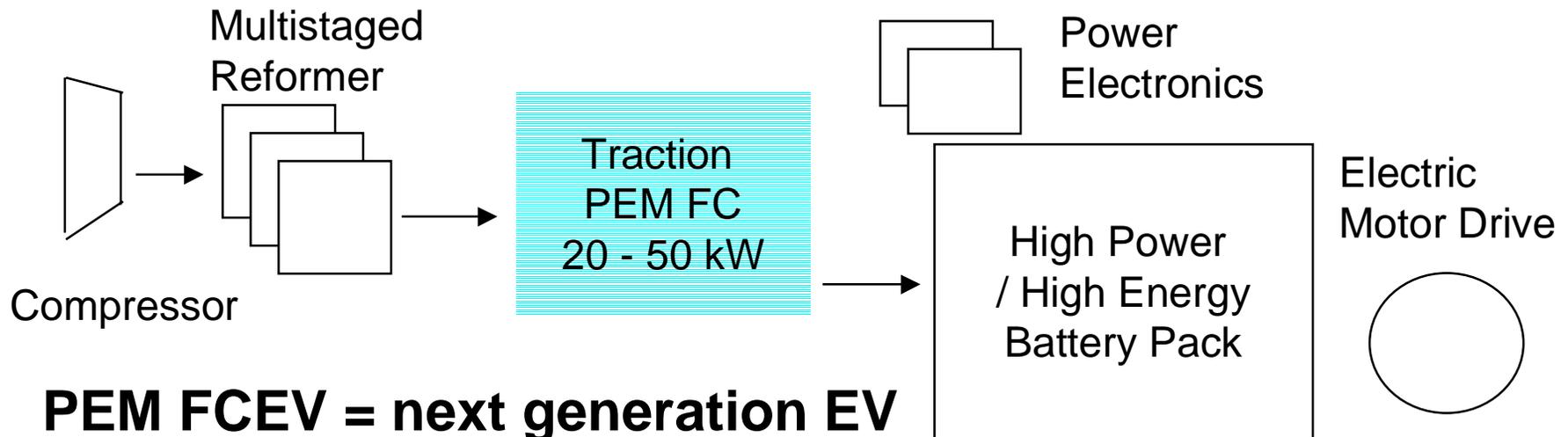
Delphi Automotive Systems (NYSE: DPH) and BMW announced today that they have signed a development agreement to produce vehicles that use a solid-oxide fuel cell as an auxiliary power unit and that have the potential of being clean, high-power-generation vehicles. Under the development agreement, BMW and Delphi are jointly developing a fuel cell system that will be used as an auxiliary power unit for gasoline engines. This will allow BMW to offer more features more efficiently with the potential to reduce the emissions of an internal combustion engine.

# Competing visions: Improve ICE or replace it?

**DELPHI**  
Automotive Systems

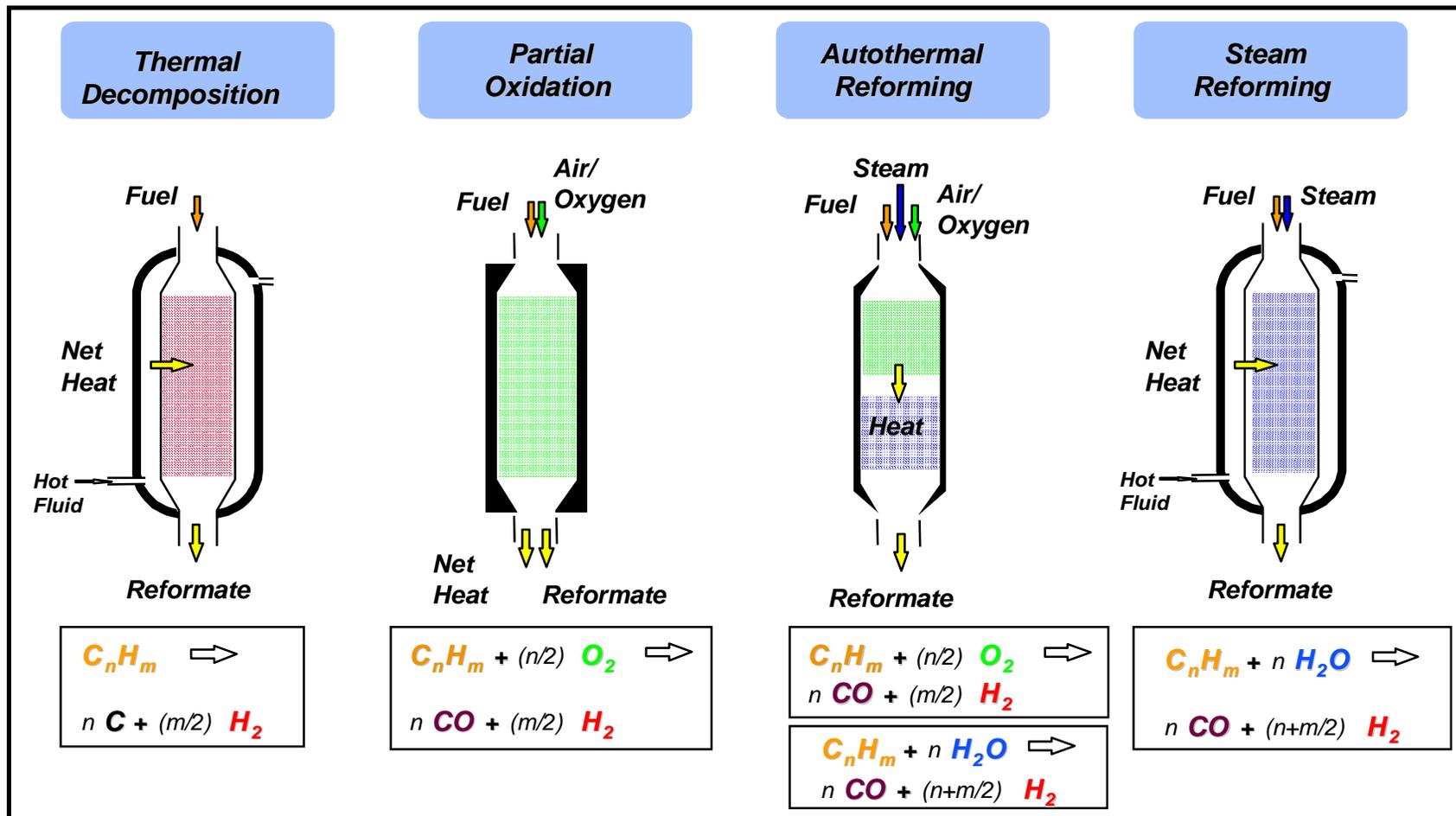


**SOFC APU = high efficiency electricity +  
future vision for integration with ICE**



**PEM FCEV = next generation EV  
(with smaller battery pack)**

# Reforming Methods



# Technical Challenges



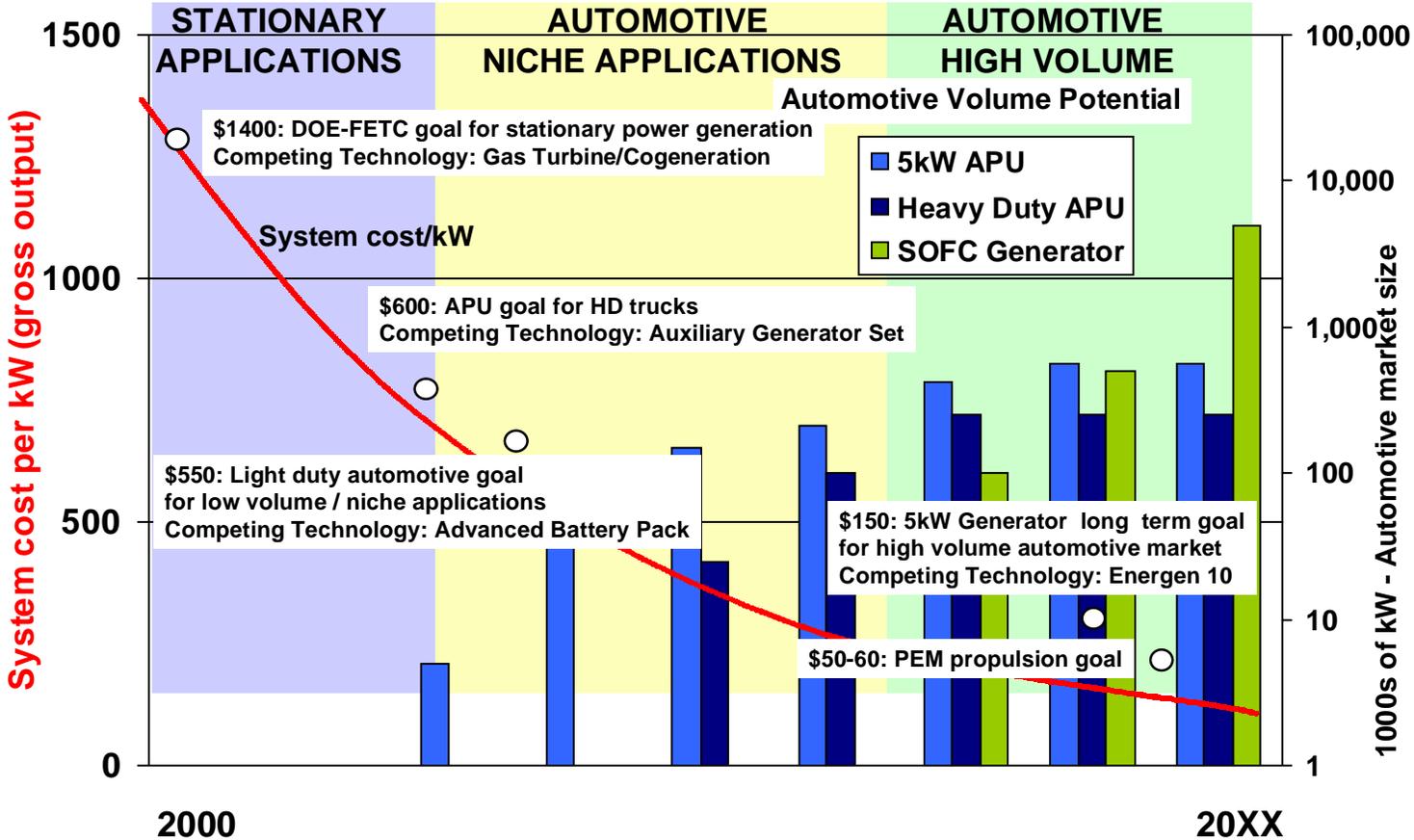
**SOFC has many challenges to be viable as an automotive technology:**

- (1) Cost**
- (2) Robustness (especially Thermal Cycling)**
- (3) Anode oxidation sensitivity**
- (4) Low Fuel Utilization**
- (5) Thermal Management (high temperature insulation)**
- (6) System integration (many new technologies)**

**But:**

- SOFC is an attractive automotive fuel cell technology**
- It has other future mechanizations which support the trend to nearly-zero toxic emissions and much reduced CO2 emissions**

# Cost imperatives by market segment



### Further development to achieve cost targets:

- **Internal Reforming**
  - simplification of thermal management, elimination of various balance of plant issues
- **Thermal Control Subsystem**
  - integration (internal reforming, adiabatic wall) and simplification
- **Waste Energy Recovery Subsystem**
  - simplification, possibly elimination
- **Materials**
  - potential to reduce stack material costs up to 80%
  - potential to use metal interconnects
- **System operating temperature**
  - lower system operating temperature leads to less expensive materials in balance of plant subsystems

**Delphi is interested in leveraging multiple applications  
(i.e. military, stationary, portable power and automotive)  
in the interest of accelerating technology development.**

## – Fuel Cell Design and Manufacturing objectives

- Operating Temperature: 750 to 800 °C
- Current Density (stack): 0.5 to 0.7 A/cm<sup>2</sup>
- Power Density (stack) 1.75 kW/L
- Normal Operating Voltage (cell) 0.7 to 0.8 V
- Stack Cross Section (cell) 15 x 15 cm
- Production Cost (stack) \$200 / kW

## **SUBSYSTEMS / BALANCE OF PLANT**

- validation and optimization of stack / reformer in automotive mechanization
- innovation of low cost, high performance high temperature heat exchangers
- cost effective and standardized electrochemical hardware
- robust low cost, high temperature sensors and actuators
- low cost, high performance insulation

## **MANUFACTURING - processes for high volume production**

- integration: optimize total system for fewer and lower cost components
- reliable low-cost processing
- alternative seal designs
- simple, compact internal reformer