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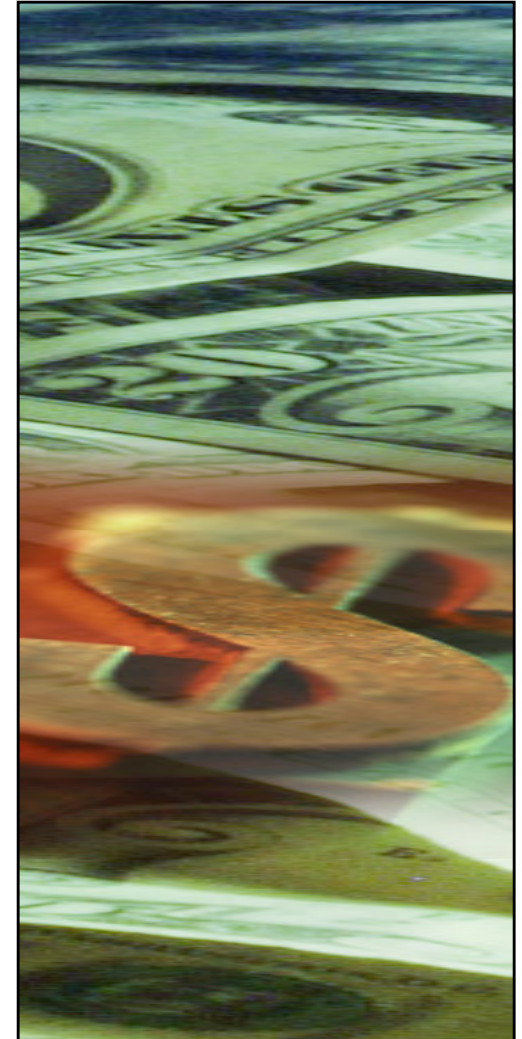
# Lithium-ion Batteries *and the Rest of the Story*



Jeff DeLaune  
September 20, 2010

# Johnson Controls – Overview

- Vision: A more comfortable, safe and sustainable world
- Automotive Experience, Power Solutions, Building Energy
- Headquartered in Milwaukee since 1885
- 140,000 employees in more than 1,300 locations serving customers in 125 countries



# The Lithium-ion Battery Value Chain

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1. Battery R&D
2. Battery Manufacturing
3. Battery Systems
4. Channel to Market
5. Battery Charging
6. Battery Charger Control

# Battery Technology

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- Johnson Controls has battery Technology Research Centers in Plymouth, Milwaukee, Hannover, Monterrey, Sorocaba and Shanghai
- The new Johnson Controls-Saft 58,000-square-foot Battery Technology Center in Milwaukee, Wisconsin, is the largest and most sophisticated automotive battery research and development, engineering and validation facility in the United States, including cell design, system engineering, manufacturing, prototype assembly, testing and integration.



# Johnson Controls Battery Manufacturing

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- Johnson Controls has a long history of manufacturing batteries and supplying them to the automotive industry
- Johnson Controls is the leading supplier of lead acid batteries for virtually every type of passenger car, light truck or utility vehicle as well as the leading independent supplier of hybrid systems.
- Thirty battery manufacturing plants supply more than one third of the world's lead-acid batteries to major automakers and aftermarket retailers



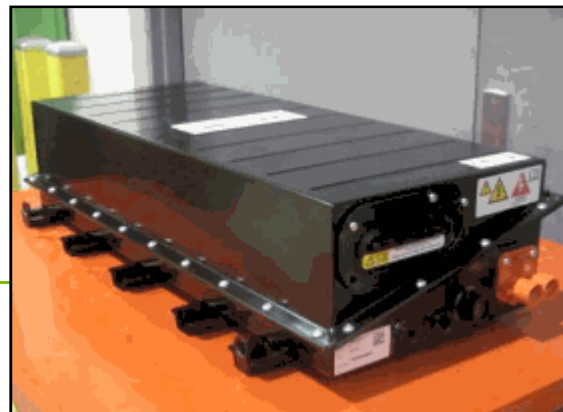
# Lithium-ion Batteries

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Johnson Controls developed a joint venture with Saft Advanced Power Solutions for the purpose of developing, manufacturing and selling NiMH and lithium-ion batteries for hybrid electric vehicles (HEVs) and electric vehicles (EVs) globally.

The company opened the world's first lithium-ion manufacturing facility for hybrid electric vehicles in 2008 in Nersac, France

Lithium-ion manufacturing began September 16, 2010 at the new Meadowbrook facility in Holland, Mich. for the Azure Balance Hybrid-Electric Vehicle (HEV) Lithium-Ion battery pack



# Lithium-ion Battery Systems

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Johnson Controls is a full-service supplier capable of executing the entire battery system, from design to manufacturing.

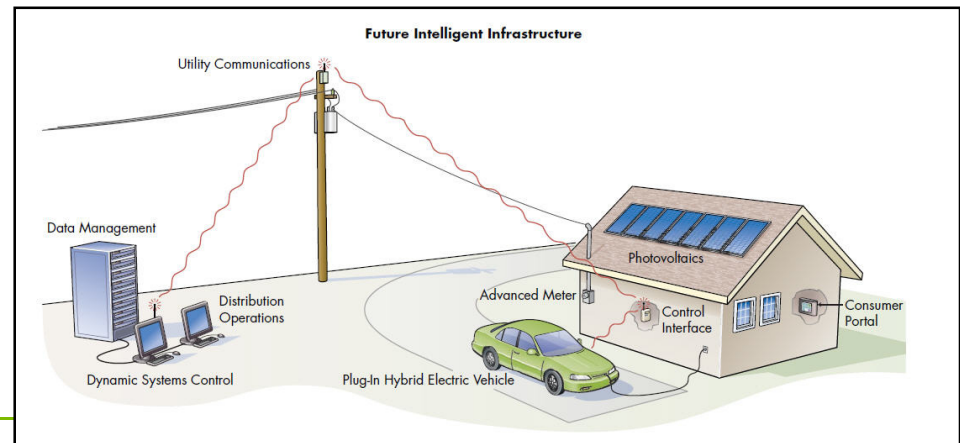
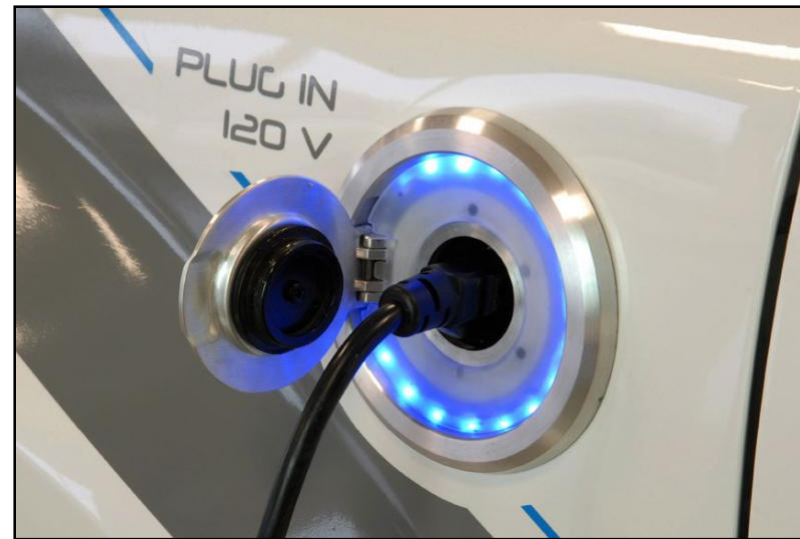
- Mechanical Subsystem
- Electrochemistry/Cell
- Battery Management System Software & Hardware
- Electronics
- Electrical Subsystem
- Thermal Management Subsystems

# Lithium-Ion Battery Production Contracts

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- Daimler Mild Hybrid: Mercedes S-Class SOP 2009 with Li-ion technology.
- BMW Mild Hybrid: 7-Series Li-ion SOP 2010.
- Azure Balance™ Hybrid Electric: Commercial delivery trucks
- Ford Transit Connect Electric Vehicle Lithium-Ion battery pack planned for March 2011

# Battery Charging Infrastructure



# Battery Charging

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- **Level 1 Charging**

- 120V 16A
- Nema 5---20 Outlet
- Bollard, Wall, and Pole mount

- **Level 2 Charging**

- 208/240V 30A
- SAE J1772™ plug
- Bollard, Wall, and Pole mount

- **Level 3 Charging**

- 50 kWh
- DC Charging
- 10 to 15 minutes of charge time

# Level 2 Charging Infrastructure



Who will install it?

# Battery Charging

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Johnson Controls-Saft is supplying the batteries for a demonstration fleet of Ford Escape Hybrids. This fleet is a collaboration between the Electric Power Research Institute (EPRI), Ford, and eight utility partners around the country to test plug-in hybrids and their connectivity and impact on the electric grid.



# Controlling Battery Charging

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## Traditional

- Network Operation
- Utility Interface
  - Billing
  - Dispatch control
- Customer Interface

## Value-Added

- Nominate blocks of PHEV charger Demand Response into MISO day-ahead market. Same for battery discharge.
- Dispatch PHEV charger load to maintain load level at base-load power plants
- Other ?

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**The battery is only part of the story.**

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**Thank you..**