Federal Reserve Automotive Symposium
June 4, 2009
Agenda

2:00 Welcome & Overview
Dave Shemmans, CEO Ricardo plc
Dean Harlow, President, North America

2:10 Strategic Consulting
Andy Chien, President, Strategic Consulting

2:25 Fuel Economy Overview
Sandy Stojkovski, Director

2:40 Vehicle Electrification
Rod Beazley, Director

2:55 Questions

3:00 Facility Tour
Three facility tour groups
Welcome
Dave Shemmans
CEO
Ricardo plc
Ricardo is an Eco-innovation Technology Company Offering:
- Product Engineering/R&D
- Software
- Management Consulting

Global Client Base

<table>
<thead>
<tr>
<th>Clean Energy</th>
<th>Financial Firms</th>
<th>Oil Companies and Utilities</th>
<th>Governmental Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTDA, QinetiQ, Infinia, AFS Trinity Power Corporation</td>
<td>Greenbriar Equity Group, Berkshire Partners, 3i, Rothschild</td>
<td>bp, ExxonMobil, Duke Energy, British Gas</td>
<td>IE, D'Ib New &amp; Renewable Energy Programme, CARB, California Air Resources Board</td>
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<tr>
<th>Automotive</th>
<th>On/Off Highway</th>
<th>Suppliers and Aftermarket</th>
<th>Defense Sector</th>
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<tr>
<td>BMW, Toyota, Honda, GM, Ford</td>
<td>John Deere, Caterpillar, Paccar, Freightliner</td>
<td>Delphi, Eaton, Honeywell</td>
<td>TACOM, UK MoD, Army, BAE Systems, Pinzgauer</td>
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The Ricardo Advantage

Ricardo Product Areas

- Vehicle Engineering
- Hybrid Systems
- Diesel and Gasoline Engines
- Driveline Systems
- Controls and Electronics
- Advanced Technology
- Clean Energy

Ricardo is on the leading edge of new technologies……

- Rapid Prototypes
- Efficient Power
- Advanced Hybrid Systems and Battery Technology

…… adapting to real world needs……

- 5.7L HEMI® Engine
- Bugatti Veyron Transmission

…… and looking towards the future.

- Unmanned Vehicles
- Vehicle To Grid

RICARDO
Automotive Has Collapsed Overnight, But Still Profitable

Prior FY Order Intake

Order Intake to Date

Margins & Mix

Volume

Costs

= $ Profitability Maintained
Key Business Drivers are Strong

Strategy ➔ Go Where the Money Is

Government Stimulus

- $40B in DOE funding
- Oil Independence
- 1M PHEV’s by 2015
- Fuel diversity
- Bio-fuels like ethanol
- Clean Energy

CAFE/CO2 Regulations

- CAFE standards - 35% FE improvement required
- Accelerates growth of alternative propulsion
- Vehicle Electrification - hybrid version of every model
- $2B advanced battery pack market by 2011
- Vehicle to Grid
- Off-Hwy regulations

Global Climate Change

- Military fuel reduction agenda
- #2 priority for ground fleet
- State legislation - Renewable Portfolio Standards
- Efficiency issues exploding in adjacent markets
- Autos still 90%+ gas
- Downsizing, DI, turbo’s, VVT, DCT’s
- Fuel price spikes

Source: Ricardo is in the Sweet Spot
Emerging Strategic Issues That Will Help Shape the North American Auto Industry

Andy Chien
President and Managing Director – RSC North America
On top of the macro-economic slowdown, the auto industry faces additional disruptors that will reshape the industry

**Economic Volatility**
- Nearly unprecedented volatility in exchange rates, factor inputs (steel, copper, precious metals) and energy impacting both costs and revenues

**Product Mix Uncertainty**
- Rapidly shifting consumer preferences and evolving federal and state level regulations leading to historic levels of product uncertainty

**Sector "Ecosystem" Damage**
- Automotive value chain (supply chain, distribution) severely disrupted by downturn and restricted capital flows; may constrain recovery

**Disruptive Technologies**
- Green (CO2, tailpipe emissions), and energy security legislation driving accelerated adoption of disruptive technologies
Emerging issues

Automakers need to be formulate a response to these future issues

- Critical Supplier Viability
  - Operational improvement support to assist critical suppliers with a particular focus on "chokepoint" suppliers with few viable alternatives due to technology or product capabilities

- Portfolio Optimization
  - Portfolio and technology diversification strategies to reduce risk associated with uncertain energy prices, consumer preferences, changing regulatory environment

- Scalable Energy Optimized Vehicle PD Process/Practices
  - Reinventing the Product Development (PD) process to facilitate the development and production of energy optimized vehicles

- Product Development Cycle Time Reduction
  - Dramatic product cycle time reductions to better match development times with future market volatility
A fundamental disconnect exists between development and market cycle times, adding additional risk to the enormous cost of new vehicle development.

**Current Automotive Development is a High Investment, Long Lead Activity**

- Average program cost
  - MY Update (~5% of content): <$10M
  - Mid-Cycle Enhancement/Minor Upgrade (~20%): $100M to $150M
  - Major Upgrade (~50%): $150M to $250M
  - New Vehicle (~90%): $500M to $1B

- Average Development time
  - Model Year Update: 9 to 12 months
  - Mid-Cycle Enhancement/Minor Upgrade: 12 to 18 months
  - Major Upgrade: 18 to 24 months
  - New Vehicle: 36 to 60 months

Direct cost of poorly developed vehicles are enormous: $24B in industry warranty costs, 10.8 M vehicles recalled in 2008

**Shifts in Market Drivers Can Occur in Far Less Time**

During the 54 month Gen III Prius development cycle, oil prices/barrel went from $40 to $140, and back to $36!

Source: Warranty Week, Autoloan Daily, Japan Times, EIA, Ricardo Analysis
As automakers regroup and seek competitive advantage, cycle time reduction needs to be aggressively addressed.

New Product Development ("V-Model") Cycle Time Reduction Levers

- Evolutionary Development: Singles/ Doubles vs. Home Runs/Grand Slams
- Resource front loading: Build the blueprint and execute to it
- Requirements Optimization: Eliminate waste from over/under specification
- Earlier Supplier Integration: Pre-selection and early co-development
- Commonality: Reuse vs continual Re-invention
- Technology Portfolio Development: Bookshelf production ready technology
Total Vehicle Fuel Economy

Sandy Stojkovski
Director
Hybrid and Electric Vehicles are Completely Electrifying the Vehicle
Batteries are Key to the Electric Vehicle Solution

- Complete, outsourced battery pack design and integration
- Seamless extension of customer’s battery system development
- Evaluation in our Battery System Development Center
A new generation of electronic technology is required to help meet these challenges

- Recent advances in Electronics technology provides increased information
  - GPS / Map systems for navigation, Long and Short range radar, RDS/TMC Traffic info, Telematics information…
- These systems can be used to improve Environmental Performance:
  - Reduction of Fuel Consumption, CO₂ emissions and Pollutant emissions via better powertrain control
  - The more flexible the future powertrain, the bigger the potential gain..
- They can also provide information for improved Safety…
  - Warnings for Proximity, Lane Departure, Adverse Conditions, Approaching Hazard; Inputs to Stability Control / Active Chassis programs
  - Possible future source of information for Safe Driving Enforcement and Automated Accident Avoidance
- Congestion can be reduced by better traffic management & reducing accidents.
Ethanol Boosted Direct Injection Engine
“EBDI”

Rod Beazley
Director
Ricardo Ethanol Boosted Direct Injection (EBDI®)
Research Engine

Environment

Reduce CO$_2$ Emissions
Future Engine Challenges - Drivers of Change

**FUEL**
- Diesel vs gas cost differential
- Variability / Volatility of fuel costs
- Availability of alternative fuels

**Technology Advancement**
- Emissions driven aftertreatment complexity
- Gasoline / SI efficiency advancement
- Waste heat recovery

**Emissions Legislation**
- Tier 4
- Retrofit emissions
- 2010
- CO₂ legislation

**Increasing Customer Demands**
- Cost reduction
- Reduced cost of ownership
- Increasing engine output

- Diesel vs gas cost differential
- Variability / Volatility of fuel costs
- Availability of alternative fuels
Downsizing = “Doing More With Less”

Ethanol Boosted Direct Injection (EBDI®)

Fuel economy improvement solutions for multiple applications:
- Passenger cars
- Truck and medium duty vehicles
- Off-road applications: Agricultural and Construction

A scaleable SI engine technology package

EBDI = EXTREME Downsizing

3.3. Spark ignited engine running on E85 ethanol with performance of 6.7L Diesel engine
Fully flexible powertrain optimized for operation on standard pump gasoline to E85

Unprecedented Spark-ignited Performance

Vastly Reduced CO₂ Emission

300 Nm available across 3,600 rpm range

EBDI E85 - Target
6,000lb Gas Engine
8,500lb Diesel Engine
6,000lb Diesel Engine
EBDI® – Regulated Cycle CO₂ Reduction

- Initial simulation performed on 8,000 lb truck shows excellent results for the EBDI® concept
- Further improvement potential with final drive ratio adjustment