Powertrain Strategies for the 21st Century: Revolution and Evolution

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Agenda

- BorgWarner Company Background
- Forecasts and Technology Trends
- Advanced Components for Fuel Economy
- Outlook
BorgWarner at a Glance

- **2014 Sales:** $8.3 Billion ($9B unconsolidated)
- **Employees:** 22,000
- **Operations:** 58 Locations
  19 Countries
- **Products:** Engine, Transmission and Driveline systems
- **Market Drivers:** Fuel Economy, Emissions, Performance
Customer and Geographic Diversity

2015 Sales Outlook*

- VW/Audi: 11%
- Daimler: 6%
- Ford: 4%
- Renault: 3%
- BMW: 3%
- Fiat: 2%
- PSA: 1%
- GM: 1%
- Commercial Vehicles: 2%
- Other: 11%

- Hyundai/Kia: 6%
- Toyota: 4%
- Nissan: 1%
- Honda: 1%
- China: 13%
- Other: 5%

- Ford: 8%
- Chrysler: 5%
- GM: 3%
- Asian OEMs: 2%
- Commercial Vehicles: 4%
- Other: 5%

*NSK-Warner included
** NSK-Warner excluded

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Corporate Advanced Engineering - Functions

**Core Functions**
Activities which support the goals of BUs and BW Corporate, but are not tied to a specific product or technology offering.

**BU Support**
Demonstrating advanced BU technologies which require system integration for maximum benefit. Internal resource for sim. & controls work.

**New Product Development**
Development of new market leading products/technologies that do not currently fit into an existing BU.

**System Engineering Projects**
Investigating new operating regimes and system configurations to identify product and technology trends which cross BU boundaries.
Diversification: Many solutions will be required for the future

- Strategy used to mitigate risk
- A way to deal with uncertainty

Risk & Uncertainty

Source: 2014 EPA Trends Report
Hybrid and Electric Vehicle Segments

INCREASING ELECTRIFICATION

Internal Combustion Engine (ICE) + Electrification

- ENHANCED ICE
  - Stop/Start
  - BMW 328i
  - % of Total LV: 2020 ~47%, 2025 ~50%

- HYBRID ELECTRIC “HEV”
  - Mild HEV Parallel
  - Buick Regal eAssist
  - % of Total LV: 2020 ~2%, 2025 ~9%
  - Full HEV Parallel/Series
  - Toyota Prius
  - % of Total LV: 2020 ~5%, 2025 ~6%

- ELECTRIC DRIVE
  - Range Extended Electric Vehicle
  - GM Chevy Volt
  - % of Total LV: 2020 ~1%, 2025 ~2%
  - Battery Electric Vehicle
  - Nissan Leaf
  - % of Total LV: 2020 ~47%, 2025 ~50%

Electric Motor + ICE

- Electric Motor Only

Source: IHS Automotive, BorgWarner forecasts (January 2015)
I.C. Engines will continue through 2025

What technology will be in the IC Engine of the future?

Source: BorgWarner forecasts, IHS Automotive (January 2015)
Powertrain Trends

Electrification  Stop/Start  48 Volts  Thermal Management  Downsizing and boosting

Downspeeding  Light-weighting  Cost Reduction  Fuel Diversification  Emissions Reduction
Fuel Economy Driving Component Growth

**LV Transmissions**

- Manual Transmissions
  - DCT (11%)*
  - Step ATs (1%)*
  - CVT (7%)*
  - AMTs and EVTs (13%)*

- Non-Turbocharged
  - (13%)* Gasoline (3%)* Diesel

- 2015E: 89.6
- 2020E: 103.8

**LV Turbocharged Systems**

- 2015E: 89.6
- 2020E: 103.8

Global light vehicle industry volumes; units in millions (January 2015)

* CAGRs are shown in parentheses

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2025 / 2030 Technology Projections

Boosting

- Turbo-charging
  - 2025: 25.0
  - 2030: 29.9

- Multiturbo
  - 2025: 2.5
  - 2030: 4.3

- eBOOSTER
  - 2025: 0.6
  - 2030: 2.3

- eTURBO
  - 2025: 0.0
  - 2030: 0.3

Source: BorgWarner forecasts, Schlegel & Partners
2025 / 2030 Technology Projections

Cooled EGR (Gasoline) 12.3
Dual Loop (Diesel) 4.3
HP-EGR (Diesel) 5.1
Dedicated EGR (Gasoline) 1.1

Source: BorgWarner forecasts, Schlegel & Partners
Expanding Component Set for Fuel Economy

- Timing chain
- Fans/fan drive
- Solenoid
- Friction
- Transfer case
- Turbocharger
- Diesel cold start
- Timing system
- EGR cooler
- Control module
- Clutch module
- AWD coupling
- FXD
- VCT
- ePhaser
- Variable valvetrain
- Exhaust heat recovery system
- Eco-Launch™ solenoid valve
- Wet clutch for manual transmissions
- Permanently Engaged Starter
- eBOOSTER® turbocharger
- eBOOOSTER® turbocharger
- ePhaser
- Cabin heater for EVs
- EcoFlash® high frequency ignition

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What will the Future Hold for the I.C. Engine?

1. There is an exciting future for the IC Engine
2. All eggs won't be in one basket, a diverse range of strategies will be used
3. Joint effort from OEMs, Suppliers, and Governments working together
Thank You For Your Attention

Our Vision
A Clean, Energy-Efficient World

Our Mission
Deliver Innovative Powertrain Solutions that Improve Fuel Economy, Emissions & Performance

Fuel Economy  Emissions  Performance