Bombardier Transportation
A leader on rail technology and innovation-
The Eco$^4$ case

4a Jornada Nacional de Innovación y competitividad
October 11th, 2012

Dipl. Ing. Uwe Georg Fischer
## Content

**Bombardier Transportation**

- Bombardier Mexico
- Bombardier Eco4
- Bombardier Primove
Bombardier Transportation
Facts & Figures

- A global leader in the rail sector
- Broadest product portfolio
- ECO4 technologies for more sustainable mobility
- Worldwide installed base of more than 100,000 vehicles
- Revenues $9.8 bn US
- Order backlog $31.9 bn US
- Global headquarters in Berlin, Germany

Die Weltliga der Zughersteller

<table>
<thead>
<tr>
<th>Company</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bombardier</td>
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<tr>
<td>Alstom</td>
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<td>CSR</td>
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<tr>
<td>CNR</td>
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<td>Siemens</td>
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<td>GE</td>
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<td>Kawasaki</td>
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<td>CAF</td>
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<td>EMD</td>
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<tr>
<td>TMH</td>
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</tbody>
</table>

Alle Angaben in Millionen Euro Umsatz, nur Neufahrzeuge, ohne After Sales
Quelle: Ergebnisse MultiClient Studie MC Hersteller 2009/2010

ECO4 is a trademark of Bombardier Inc. or its subsidiaries.

¹ for fiscal year ended December 31, 2011
## Our Products and Solutions
### The Broadest Portfolio in the Rail Industry

<table>
<thead>
<tr>
<th>Rail Vehicles</th>
<th>Transportation Systems</th>
<th>Services</th>
<th>Rail Control Solutions</th>
<th>Propulsion &amp; Controls</th>
<th>Bogies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light rail vehicles</td>
<td>Monorail systems</td>
<td>Fleet management</td>
<td>Integrated control systems</td>
<td>Traction converters</td>
<td>Portfolio to match entire range of rail vehicles</td>
</tr>
<tr>
<td>Metros</td>
<td>APM systems</td>
<td>Operations &amp; maintenance</td>
<td>Automatic train protection and operation</td>
<td>Auxiliary converters</td>
<td>Full scope of service over the lifetime of a bogie</td>
</tr>
<tr>
<td>Commuter trains</td>
<td>Light rail systems</td>
<td>Material solutions</td>
<td>Interlocking systems</td>
<td>Traction drives</td>
<td></td>
</tr>
<tr>
<td>Regional trains</td>
<td>ART systems</td>
<td>Vehicle refurbishment</td>
<td>Wayside equipment</td>
<td>Control and communication</td>
<td></td>
</tr>
<tr>
<td>Intercity trains</td>
<td>Metro systems</td>
<td>Component reengineering</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>High speed trains</td>
<td>Intercity systems</td>
<td></td>
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</tr>
<tr>
<td>Locomotives</td>
<td>Transit Security</td>
<td></td>
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</tbody>
</table>

- Bogies: Portfolio to match entire range of rail vehicles
- Full scope of service over the lifetime of a bogie
# Content

- Bombardier Transportation
- Bombardier Mexico
- Bombardier Eco4
- Bombardier Primove
BT Mexico

- BT Mexico is a strong supplier in rail solutions worldwide

- Examples of “Hecho en Mexico”
  - Toronto
  - Beijing
  - Kuala Lumpur
  - Vancouver
BT Mexico

- BT Mexico is the only rolling stock producer in Mexico with a full scope capability
  - Design
  - Production
  - Testing
  - Project management

- Examples of “Hecho en Sahagun”
  - Mexico City
  - Monterrey
  - Guadalajara
Content

Bombardier Transportation
Bombardier Mexico
Bombardier Eco4
Bombardier Primove
Bombardier Sustainable product
The Climate is Right for Trains

Megatrends – Overview

- Climate change
- Urbanization and population growth
- Congestion
- Oil scarcity and price of energy
- Aging of societies
The Climate is Right for Trains
Megatrends – Climate Change

Challenge
CO₂ emissions are a contributing factor to climate change

Solution
Rail has lower CO₂ emissions than other modes of motorized transport

CO₂ Emission of Transportation Sector (Europe)

- Road: 26.4%
- Others: 72%
- Rail: 1.6%

Source: 2005 CO₂ emission figures in EU-27, EC 2007 and UIC Energy/CO₂ database
The Climate is Right for Trains
Megatrends – Urbanization and Population Growth

Challenge
Increasing demand for passenger transportation, esp. in urban areas

Solution
Rail provides capacity for projected urban population growth

Population Growth¹

<table>
<thead>
<tr>
<th>Year</th>
<th>Rural [billion]</th>
<th>Urban [billion]</th>
<th>Total population [billion]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>4.1</td>
<td>8.0</td>
<td>12.1</td>
</tr>
<tr>
<td>2000</td>
<td>6.1</td>
<td>8.0</td>
<td>14.1</td>
</tr>
<tr>
<td>2025</td>
<td></td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td></td>
<td></td>
<td>19.2</td>
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</tbody>
</table>

The Climate is Right for Trains
Megatrends – Congestion

Challenge
Congestion wastes time, energy, money and creates pollution

Solution
Rail uses considerably less land and carries high number of passengers

Number of people transported per hour in urban environment¹

<table>
<thead>
<tr>
<th></th>
<th>Car</th>
<th>Bus</th>
<th>Tram</th>
<th>Metro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>2,100</td>
<td>9,000</td>
<td>22,000</td>
<td>50,000</td>
</tr>
</tbody>
</table>

¹ Number of people crossing a 3 to 5 metre-wide space in an hour in an urban environment
Source: International Association of Public Transport (UITP)
You must hand back this leasing object without any damage!
eco⁴ - The new Formula for Total Train Performance from Bombardier Transportation

eco⁴ is a suite of solutions, services, products and technologies, offering the best in class environmental performance.

eco⁴ balances Energy, Efficiency, Economy, Ecology with convincing and reliable solutions, services and products.

eco⁴ offers our customers added value to their trains and services and delivers on the promise of Total Train Performance.

Welcome to the World of eco⁴.
eco⁴ - A Strong Portfolio of Technologies and Solutions

- EcoSilent Optimised Sound Design
- PRIMOVE Contactless and Catenary-Free Operation
- MITRAC Hybrid
- MITRAC Energy Saver
- AeroEfficient Optimised Train Shaping
- EBI Drive 50 Driver Assistance System

Energy
Efficiency
Economy
Ecology
Bombardier offers more than 120 eco4 applications within its product portfolio.

Customers have gained 1.7 Billion kilometers of experience with eco4 (more than 4400 times the distance of earth and moon).
## Content

<table>
<thead>
<tr>
<th>Section</th>
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<tbody>
<tr>
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<td>Bombardier Eco4</td>
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<tr>
<td>Bombardier Primove</td>
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</tbody>
</table>
The BOMBARDIER PRIMOVE solution is a game-changing technology that enables the wireless charging of electric vehicles. Based on inductive power transfer, the PRIMOVE system liberates e-mobility from the constraints of cables, wires and plugs – making urban transport more flexible and convenient than ever before.

The innovative PRIMOVE system provides a contactless power source for all types of electric transport – from light rail and bus networks to commercial vehicles and cars.
The Inductive Principle

Based on the principle of inductive power transfer, PRIMOVE technology allows energy to be transmitted without contact between components buried underground and receiving equipment installed beneath the vehicle. The principle functions as follows: an electric conductor creates a magnetic field, which generates an electric current in another conductor placed within that field. When applied in conjunction with the PRIMOVE system, this electric current generates energy that is then used to propel vehicles forward in a clean, efficient way.

Electric current in a primary coil (winding) creates a magnetic field, which induces current in a secondary coil.

This power transfer occurs even if there is a gap in the iron core, enabling the process to be contactless.

If the primary coil is extended in a loop, the secondary coil can receive power anywhere along this loop.
PRIMOVE
Catenary-free Energy Supply for Vehicles

Features

- Unique concept - driving with contact-less power supply, yet same performance
- Cables in the ground provide the necessary energy – only energized when needed
- Pick-up coils underneath vehicle turns magnetic field below into electric current
- Easily be coupled with the Mitrac Energy Saver for full energy saving potentials
- Proven on a light rail vehicle at the Bombardier site in Bautzen

Pilot applications: Bautzen Test Track, Stadtwerke Augsburg (LRV) and Flanders Drive (Bus)

Unique Benefits

- Invisible and contactless power supply
- No wear of high voltage pick-up components, lowers service & maintenance costs
- Reliable performance in all weather and ground conditions
## PRIMOVE

**Catenary-Free Energy Supply for Vehicles**

### Augsburg, Germany
Demonstrating safe high power inductive charging for trams

- In September 2010, Bombardier Transportation installed the contactless and catenary-free PRIMOVE system for the trams of Line 3 in Augsburg
- The pilot project is being co-funded by the German Federal Ministry for Transport, Building and Urban Development (BMVBS)
- Realized in cooperation with the Augsburg Transport Authority (Stadtwerke Augsburg Verkehrs-GmbH)
- Demonstrating reliable operation under the real conditions of daily operation in an urban environment

### Braunschweig, Germany
Taking the primove concept to the road

- Bombardier’s first PRIMOVE bus project for passenger operation in the city of Braunschweig, Germany
- Marking a significant leap forward in bringing clean e-mobility solutions to urban areas.
- A 12 km section of the bus network is turned into an eco-friendly electric route which is served by PRIMOVE equipped buses
- The German Federal Ministry of Transport, Building and Urban Development is granting Bombardier and its project partners, a funding to the project
- The project is guarded scientifically by the Technical University of Braunschweig,

### Mannheim, Germany
A state-of-the-art e-mobility hub

- Committed to innovation and the continued development of PRIMOVE technology, Bombardier has opened a dedicated e-mobility-facility there
- This Centre of Excellence supports partnerships, projects and opportunities in the fast-moving electric mobility sector
- It has a complete power lab test set-up for all kinds of applications
- Different vehicles including buses and minivans have been acquired to ensure that testing at the facility is conducted independently and in a real-life setting
THE CLIMATE IS RIGHT FOR TRAINS

We have the Solutions

eco

The new Formula for Total Train Performance from Bombardier Transportation