Tremendous Challenges for our Planet and People – Bombardier provides answers

<table>
<thead>
<tr>
<th>Global Warming</th>
<th>Most likely effect of the man-made greenhouse gas concentration(^1)</th>
<th>Bombardier’s electric trains produce zero CO(_2) and no particle emissions (^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Cost Increase</td>
<td>Usage of energy goes up, availability of fossil energy is decreasing</td>
<td>Bombardier technologies allow to reduce the energy demand of a train by 50%</td>
</tr>
<tr>
<td>Urbanization</td>
<td>Continuous growth of our cities - congestion in urban areas</td>
<td>Bombardier products ensure that megacities do not collapse under road traffic</td>
</tr>
<tr>
<td>Demographic Change</td>
<td>Low birth and death rates lead to aging of the population</td>
<td>Bombardier offers attractive designs and comfortable interiors suitable for all ages</td>
</tr>
</tbody>
</table>

1) Intergovernmental Panel on Climate Change (2007)
2) If electricity is produced by zero-emission power plants
The challenges of our world demand a new formula for economic sustainability

- Saving Energy
- Improving Efficiency
- Achieving sound Economic value
- Protecting the Ecology
The challenges of our world demand a new formula for economic sustainability

eco⁴: Bombardier’s new Formula for Total Train Performance

- Energy
- Efficiency
- Economy
- Ecology
eco^4 - the new Formula for Total Train Performance from Bombardier Transportation

eco^4 is a suite of solutions, services, products and technologies, offering the best in class environmental performance

eco^4 balances Energy, Efficiency, Economy, Ecology with convincing and reliable solutions, services and products

eco^4 offers our customers added value to their trains and services and delivers on the promise of Total Train Performance

Welcome to the World of eco^4
eco - a strong portfolio of technologies and solutions
EnerGplan
Predicting and Optimizing the Energy Consumption

Features
- Simulating all energy flows of whole systems
- For metros and people movers
- Enabling the optimization of:
  - drive performance
  - train schedule
  - power supply
  - distribution system
- For complete fleets
- On multiple routes
- Includes energy storage onboard and/or at wayside

Unique Benefits
- Approach for predicting and optimizing the energy consumption
- Max 20% energy saving
Energy Management Control System
Managing Energy Consumption of Locomotives and Trains

Features
- Managing energy consumption of all consumers on-board a vehicle
- **Energy Management - Energy Display** shows the driver actual & average energy consumption compared to fleet average
- **Energy Management - Energy Metering** allows billing and tracking the energy consumption for track operators (new norm!)
- **Energy Management - Smart Stabling** reduces unnecessary auxiliary loads at turnaround, inter-peak and overnight

Benefits
- Increases cost awareness of the driver
- Prepared for future European norm in energy metering
- Reduces energy consumption at standstill
EBI Drive 50
Driver Assistance System: Features

Features

- Most complete solution
- Intelligently combining the goals
  - Punctuality
  - Energy savings
  - Reduced wear
- Generating recommendations to the driver for
  - optimized speed
  - optimized traction force
- Information constantly updated, based on actual position, track information, speed and time compared to time table
- Online Data Transfer to trains allows dynamic, energy minimizing management of the fleet
EBI Drive 50
Driver Assistance System: Layout and Benefits

Unique Benefits
- Minimize energy consumption for given time-table and various system constraints
- Energy savings of up to 15%
AeroEfficient
Optimized Train Shaping

Features
- Energy used through aerodynamic resistance: 35% at 200kph, 50% at 300kph
- Developed in cooperation with Bombardier Aerospace
- Components interact with each other in very complex manner
- Optimization of complete train configuration results in an aerodynamic improvement.
- Bombardier has the most advanced system knowledge to achieve the best results / time

Most advanced Benefits
- Minimizing aerodynamic resistance for a complete train
- Energy savings of max. 12%
ThermoEfficient
Managing the Energy Consumption of HVAC Systems

Features

- Transferring the energy of the exhaust air into the air which is blown into the cabin
- Measuring the number of passengers and supplying the right amount of fresh air
- One heat exchanger per HVAC, 300x300x1200mm (Climate 10,8)

Unique Benefits

- Improved quality of fresh air in train
- Up to 26% energy savings
**FLEXX Tronic**
The Intelligent and Active Bogie

- **FLEXX Tronic** reduces mechanical complexity by active, multi-functional elements to automatically adapt to changing operating conditions
  - High speed
  - Tight curves
  - Different track parameters

- **FLEXX Tronic** is driven by integrated, model-based controllers which
  - stabilize the bogie at high speed and
  - steer the wheelsets in curves

![Energy Saving max 5%](image)
FLEXX Eco
The light weight Bogie

- **FLEXX Eco** reduces direct and indirect energy consumption by
  - Significant reduction in bogie weight and unsprung mass
  - Minimizing aerodynamic drag

- **FLEXX Eco** reduces
  - Cost of bogie maintenance
  - Track wear and risk of rail damage

- **FLEXX Eco** is characterized by in-board bearing design and light weight wheelsets
**FLEXX Eco**

The lightweight Bogie

- Vehicle weight reduced by 10% due to 30% lower bogie weight
- 35% less unsuspended mass

**Comparison Chart:**

- **Conventional**
- **FLEXX Eco**

- Wheelsets
- Frame
- Sec. Suspen.
- Prim. Suspen.
- Brake

Energy Saving

max 5%
MITRAC Permanent Magnet Motor
Very High Power Density

Features
- Design interfaces based on standard Regina motor
- Compatibility with existing systems, approximate same outer dimensions
- Experience from reliable and proven MITRAC induction motor
- Motor reliability / control / protection functionality confirmed

Benefits
- Max tractive effort at 300 km/h 2.65 times than that of comparable induction motor
- Increased vehicle performance and comfort at high speed
- Optimized energy efficiency
- Reduced volume and weight
C.L.E.A.N. Diesel Power Pack
Reducing the Particle Emission and NO\textsubscript{x} Footprint

Features

- First in the market – already 34 units ordered
- Motor system certified Stage III-B, for minimum particle emissions
- Technology based on state of the art automotive technology, adapted to railway conditions
- The most environmentally-friendly Railway Diesel Motor of the World.

Unique Benefits

- Max. 87% particle reduction
- Comply with legal requirements
- Ensure operation of Diesel trains after 2012
- Improve public image
MITRAC Energy Saver
Recuperating Energy

Features
- First in the market
- Storing electrical energy on-board of LRV, Metro and DEMU
- Re-using it, whenever needed
- Reflects four years of customer experience

Benefits
- Up to 30% energy savings for a train
- Reduce transformers along newly built tracks
- Increase traffic volume through higher acceleration
- Eliminate Diesel emission in stations (DEMU)
- Improve public image
### MITRAC Energy Saver

Benefits from using *MITRAC Energy Storage*

| DMU (Diesel Multiple Unit) | 15 - 35% Energy saving  
|                           | similar Emission Savings – e.g. CO₂  
|                           | 20...70% additional power „Booster effect“  
|                           | 30% higher acceleration from 0 to 100 km/h  
| Metro                     | 15 - 30% Energy saving  
|                           | less tunnel heating  
|                           | 25...40% Reduced Power from substations  
|                           | potential infrastructure savings – e.g. less substations  
|                           | Rescue in tunnel  
| LRV (Light Rail Vehicle)  | 15 - 30% Energy saving  
|                           | 30...50% Reduced Power from substations  
|                           | potential infrastructure savings – e.g. less substations  
|                           | Catenary free operation  
|                           | Sold to city of Heidelberg  

*Energy Saving max 30%*
PRIMOVE
Catenary-Free Operation

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 an electric current
- Providing the same performance characteristic as a normal power supply
- Easily be coupled with the Mitrac Energy Saver for full energy saving potentials
- Tested on a light rail vehicle at the Bombardier site in Bautzen

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
eco$^4$ products are tested successfully with customers or are already sold

- Heidelberg
- Mannheim
- East Midland
- SJ
- Veolia
- East Anglia Fleet
- RMV
- LNVG
- Long Island Rail Road (LIRR)
- Green Cargo
- ARRIVA
- Transitio
- National Express
THE CLIMATE IS RIGHT FOR TRAINS

We have the Solutions

The new Formula for Total Train Performance
from Bombardier Transportation