

# EcoActive Technologies

## ECO4 – Now, More than Ever, the Climate is Right for Trains

Global climate change, diminishing natural resources and rising energy costs all present major concerns for our industry and our planet. Bombardier Transportation, in upholding its responsibility to the environment, highlights sustainability, along with cost and reliability, as one of its highest priorities.

As an industry leader, Bombardier Transportation pioneered “The Climate is Right for Trains” concept. Now, we are going even further with **BOMBARDIER\* ECO4\***, a combination of new and proven products that help reduce energy consumption and minimize carbon footprints and – at the same time – delivering improvements in Total Train Performance.

### Overview of Bombardier Transportation’s industry-leading ECO4 Technologies

<p><b>EcoActive Technologies</b></p> <p>PRIMOVE Catenary-Free Operation</p> <p>A world premiere: catenary power transfer for urban rail vehicles</p> <p>Light Rail Vehicles</p>	<p><b>EcoActive Technologies</b></p> <p>CLEAN Diesel Power Pack</p> <p>Maximum efficiency</p> <p>Passenger Vehicles</p>	<p><b>EcoActive Technologies</b></p> <p>AeroEfficient Optimized Train Shaping</p> <p>The Climate is Right for Trains</p> <p>Heavy and High-Speed Trains</p>	<p><b>EcoActive Technologies</b></p> <p>FLEXX Tronic Technology</p> <p>Tronic</p> <p>Boogie</p>	<p><b>EcoActive Technologies</b></p> <p>EBI Drive 50 Driver assistance system</p> <p>The Climate is Right for Trains</p> <p>Train Control Systems</p>	<p><b>EcoActive Technologies</b></p> <p>Energy Management Control System</p> <p>Knowledge and Expertise to Boost Profitability</p> <p>Services</p>
<p><b>EcoActive Technologies</b></p> <p>ThermoEfficient Climatization System</p> <p>The Climate is Right for Trains</p> <p>Passenger Vehicles</p>	<p><b>EcoActive Technologies</b></p> <p>MITRAC Energy Saver</p> <p>Energy savings and power supply optimization</p> <p>Propulsion &amp; Control</p>	<p><b>EcoActive Technologies</b></p> <p>EnerGplan Simulation Tool</p> <p>The Station</p> <p>Simulation Systems</p>	<p><b>EcoActive Technologies</b></p> <p>MITRAC Hybrid The Dual Power Propulsion Chain</p> <p>Propulsion &amp; Control</p>	<p><b>EcoActive Technologies</b></p> <p>MITRAC Permanent Magnet Motor</p> <p>Propulsion &amp; Control</p>	<p><b>EcoActive Technologies</b></p> <p>FLEXX Eco Bogie</p> <p>Boogie</p>

# ◁ Committed to Sustainable Mobility ▷

*ECO4* is one of Bombardier's major initiatives to leave future generations with an environment primarily unspoiled by our industrial activities and products. To ensure its success, energy efficiency is built into our products right from the design phase. This means incorporating total lifecycle considerations into our product research and development programmes.

With sustainable mobility at the heart of our design, engineering and operating philosophy, we create innovative products that add value for our customers and enhance the reputation of rail transportation.

Demonstrating our commitment to sustainability, in 2003, we became the first vehicle manufacturer to sign the International Union of Public Transport's (UITP) Sustainability Charter. In 2007, Bombardier Inc. was recognized for its achievements in the environmental arena, as it joined the world's top 10 per cent of companies on the Dow Jones Sustainability Index.

To ensure that we are minimizing our environmental impacts in real terms we customize our management systems and operations, setting challenging targets that help us continuously improve our performance in this area. Over 90 per cent of our sites are externally certified to ISO 14001 and OHSAS 18001 standards, which provide the foundation for legal compliance and continuous environmental performance improvement. With our sites subject to independent checks every three years, we not only verify our progress through third-party endorsement, we also ensure a healthy and safe workplace for our employees.

Working to protect the environment through product and corporate responsibility is not only a commitment to our employees and towards society, but also creates competitive advantages for our customers, the rail operators.

Bombardier Transportation – by making a difference today, we are helping to create a better world for tomorrow.



Energy  
Efficiency  
Economy  
Ecology

The new formula for  
Total Train Performance  
from Bombardier Transportation

*eco*<sup>4</sup>



# ECO4 – The New Formula for Econ

Bombardier's *ECO4* suite of solutions, services, products and technologies addresses the most pressing concerns facing rail transit operators today. It offers the best-in-class environmental performance by combining the four "E" cornerstones of sustainable mobility: energy, efficiency, economy and ecology.

Our modular portfolio of innovative *ECO4* technologies covers a wide spectrum of performance requirements and offers specific benefits for train operators. Implementing our *ECO4* technologies can create an overall energy saving of up to 50 per cent. Solutions range from planning energy efficiency of new transportation systems and new aerodynamically enhanced train designs to optimizing the energy consumption of an existing fleet.

## Optimizing fleet and operational performance

When planning a transportation system, customers face the challenge of selecting the appropriate technology and mode of operation that will provide peak performance, lowest operating costs and the smallest environmental footprint while minimizing energy consumption.

**BOMBARDIER\* EnerGplan\*** is our latest tool that simulates and optimizes the design of power distribution and energy consumption for a complete transport system, creating energy savings of up to 20 per cent.

In addition to enhancing overall systems, Bombardier can help improve the aerodynamic performance of rail vehicles. Energy savings of up to 8 per cent for regional and 15 per cent for high speed trains can be realized by reducing the aerodynamic drag by 25 per cent using **AeroEfficient Optimised Train Shaping**. This uniquely comprehensive and forward-looking approach uses state-of-the-art Computer Added Engineering tools to optimize the design of the vehicle. It takes into consideration low drag as well as maximum stability. Therefore, as it allows increased acceleration, it not only saves energy, but also reduces traveling time.

As well as improving the performance of new systems and trains, we enhance existing fleets with our **BOMBARDIER\* EBI\* Drive 50 Driver Assistance System**. Saving traction energy of up to 15 per cent and reducing maintenance costs, the *EBI Drive 50* is a smart software tool assisting train drivers with recommendations for velocity and acceleration/deceleration, thereby minimizing the energy needed to run a train punctually. Smoother operation also results in reduced wear on wheel sets, engines, brakes and tracks.

## Industry-leading advances for environmental excellence

As one of the most fascinating, new, eco-active technologies of the *ECO4* product family, the **BOMBARDIER\* MITRAC\* Energy Saver** is based on proven, highly reliable technology. The innovative double layer ultracapacitors store the energy released each time a



EnerGplan Simulation Tool



MITRAC Energy Saver



EBI Drive 50 Driver Assistance System

# omic Sustainability >

vehicle brakes and reuse it during acceleration or operation. Applied to a light rail vehicle the system has – during several years of testing – been proven to save up to 30 per cent of energy. It also enables catenary-free operation for limited distances. For diesel multiple units the *MITRAC* Energy Saver reduces emissions as well as costs. Alternatively, the technology can also be used as a performance booster by adding extra power during acceleration.

For distances of varying length, the new and unique ***BOMBARDIER\* PRIMOVE\**** system has been developed. It uses the *MITRAC* Energy Saver and allows catenary-free operation of *BOMBARDIER\* FLEXITY\** trams in all surroundings as well as on underground lines – particularly beneficial in historic city areas or protected environments as it eliminates the need for overhead wires and poles. One of its outstanding features is the safe and contactless power transfer. The electric supply components are invisible and hidden under the vehicle and beneath the track, thus ensuring operation in all weather and ground conditions.

The ***MITRAC Hybrid technology*** enables one vehicle to operate equally efficiently on both electrified and non-electrified tracks due to a common propulsion chain that is capable of utilizing both electric and diesel power sources. This results in minimal use of fossil fuels with an up to 80 per cent reduction of air pollution as well as low emissions. Operators also gain economic benefits based on 40 per cent reduced fuel consumption. In addition, the versatile

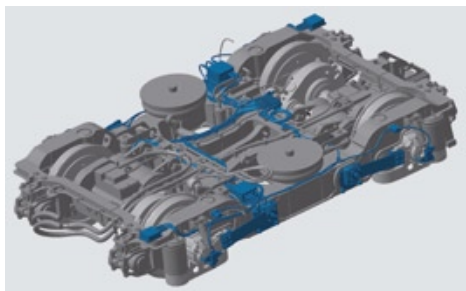
dual mode vehicle can seamlessly cross the network, drawing power from any source, thereby ensuring flexible allocation of the fleet.

## Creating a lasting impact with technologies for the future

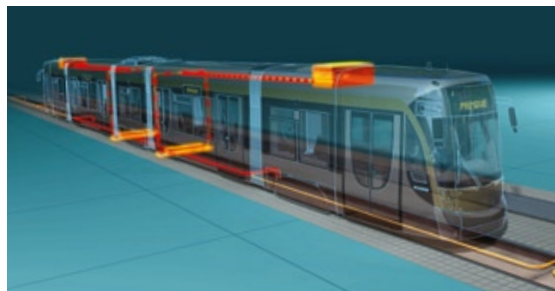
As part of the C.L.E.A.N. (Catalyst based Low Emission Application) research project, Bombardier Transportation has developed the lowest emission propulsion system for diesel-driven vehicles in the 500 kw class, the new **C.L.E.A.N. Diesel Power Pack**. This technology conforms with the EU emissions guidelines Stage III-B that come into effect in 2012. The innovative product is thus years ahead of the legal requirements and will start operation in Germany and Sweden in 2009.

Bombardier has developed the ***MITRAC Permanent Magnet Motor***, which saves energy by improving overall vehicle optimization as well as increasing energy efficiency at reduced volume and weight. This results in lower operating costs and a reduced environmental impact. Recently, we tested the *MITRAC* Permanent Magnet Motor in Sweden: Two of our Permanent Magnet Motors replaced four forced air-cooled induction motors in the *BOMBARDIER\* REGINA\** as part of the Gröna Tåget (“Green Train”) project.

The energy used for climate control within a rail vehicle can be higher than 30 per cent, but is often wasted as it does not adapt its performance to variables such as passenger occupancy. Therefore, to ensure comfort of passengers



FLEXX Tronic Technology

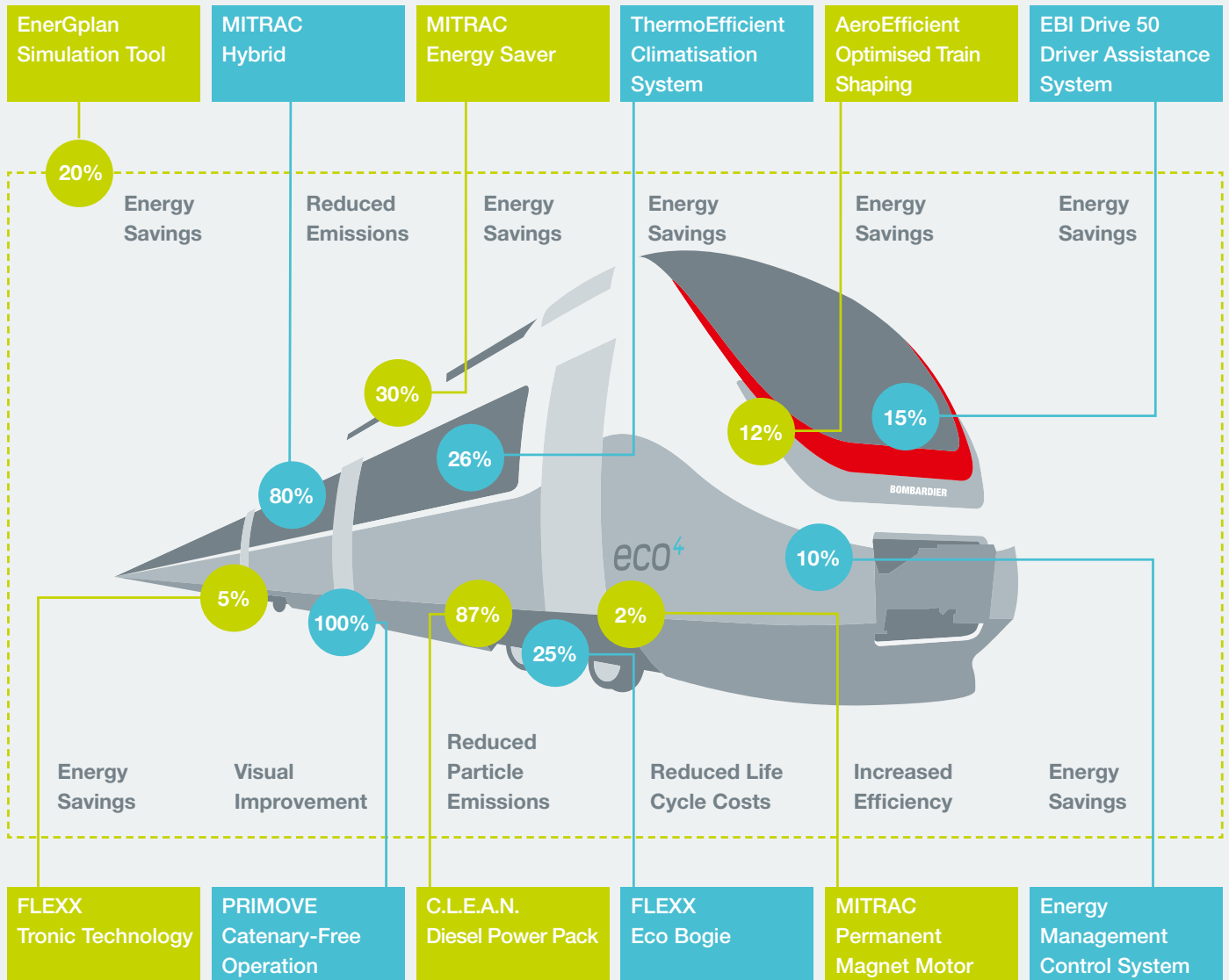


PRIMOVE Catenary-Free Operation

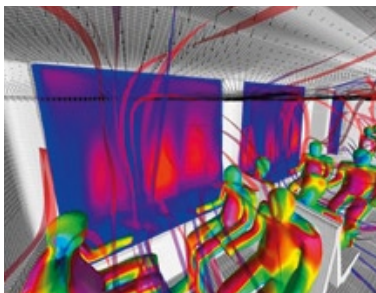


MITRAC Permanent Magnet Motor

Our new ECO4 Technologies can create Energy Savings of up to 50%<sup>1</sup>



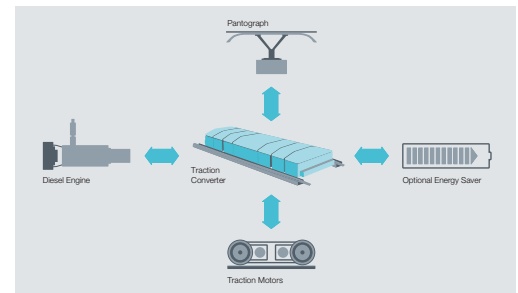
<sup>1</sup> Compared to current products



ThermoEfficient Climatisation System



FLEXX Eco Bogie



MITRAC Hybrid Technology

whilst saving energy, we have developed the **ThermoEfficient Climatisation System** – an intelligent, low-energy interior climate system designed to save both energy and costs for all rail vehicles. ThermoEfficient uses a combination of two systems; a variable fresh-air rate system that uses sensory information to calculate passenger occupancy and adapt the rate accordingly; and one that uses heat exchangers to pre-heat or pre-cool the fresh air by reusing up to 80 per cent of the energy contained in the exhausted air. The systems can reduce the energy consumption by up to 24 or 26 per cent, respectively.

To enable operators to monitor and manage their fleet's energy usage, the **Bombardier Energy Management Control System** provides an affordable fleet energy management solution that integrates energy awareness, efficiency and carbon control into an operator's business. The system uses data gathered from the trains, combined with flexible and intuitive visualization tools based on methods proven in the *BOMBARDIER\* ORBITA\** system.

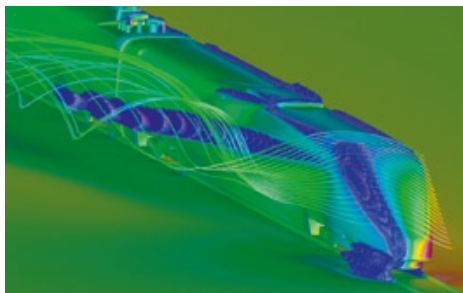
### Bogie designs that reduce energy consumption and maintenance costs

The **BOMBARDIER\* FLEXX\* Eco bogie** design is an exciting product within the Bombardier bogie portfolio which enables significant reductions in energy consumption and noise emissions. Characterized by an extremely compact and low weight design, *FLEXX Eco* creates a massive 30 per cent reduction in total bogie mass and

unsprung mass. With almost 1,000 units in operation worldwide, the reliability and operational benefits of the *FLEXX Eco* have been proven. The excellent stability properties make it ideal not just for commuter and regional applications but also for high speed.

Another innovative development within the Bombardier bogie family is the **FLEXX Tronic technology** which uses active, multi-functional elements to automatically adapt to changing operating conditions, such as high speed, tight curves and different track parameters. *FLEXX Tronic* is driven by integrated, model-based controllers. They stabilize the bogie at high speed and steer the wheelsets in curves. This brings significant benefits in terms of reduced wheel and rail wear – leading to considerably extended maintenance and exchange intervals – together with a reduction in vehicle mass, vibration and noise.

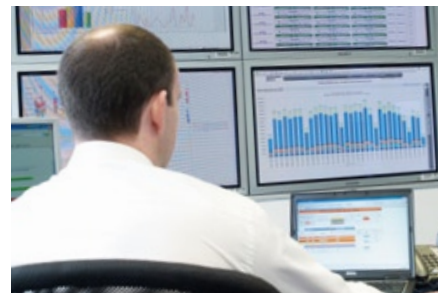
Many of our *ECO4* products were developed in close cooperation with Bombardier Transportation customers to enable perfect functionality in a wide variety of technical environments. The *ECO4* product line reflects a unique dynamic process in the rail industry and will continue to evolve and become more diversified in future.



AeroEfficient Optimised Train Shaping



C.L.E.A.N. Diesel Power Pack



Energy Management Control System

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Learn more about our commitment to sustainable mobility on:  
[www.theclimateisrightfortrains.com](http://www.theclimateisrightfortrains.com)

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