

EcoActive Technologies

ECO4 Technologies – Leading the way in total train performance



As a global innovator, Bombardier is at the forefront in developing customer-oriented trains and equipment that enhance total train performance – worldwide.

Bombardier's pioneering *ECO4* portfolio, introduced in 2008, has rapidly become recognised for its market-leading contribution to cost-effective, efficient, economic and sustainable mobility. Its modular product base is continuously evolving and already includes 15 innovative technologies.

BOMBARDIER ECO4** technologies have already convinced train operators around the world to adopt their

game-changing approach to performance optimisation. *ECO4* products are aligned to train operators' requirements for overall efficiency, energy saving and cost-effectiveness hence providing an approach that is performance based, as well as environmentally driven.

ECO4 is both a product portfolio and a roadmap for action, based on the knowledge that rail is both environmentally and economically better for our world.

The Climate is Right for Trains

eco⁴ BOMBARDIER

Energy
Efficiency
Economy
Ecology

The new formula for
Total Train Performance
from Bombardier Transportation

*eco*⁴



ECO4 – The success story continues

Transportation drives the world's economy – promoting global productivity, creating jobs and facilitating social development. To ensure that growth in rail transportation is achieved sustainably and without detriment to the environment, Bombardier has developed the ground-breaking portfolio of *ECO4* solutions.

Based on the four cornerstones of Energy, Efficiency, Economy and Ecology, *ECO4* technologies are providing overall energy savings of up to 50 per cent. They represent a unique and market-leading combination of new and proven products that deliver improvements in total train performance and, at the same time, help reduce energy consumption and minimise carbon footprints.

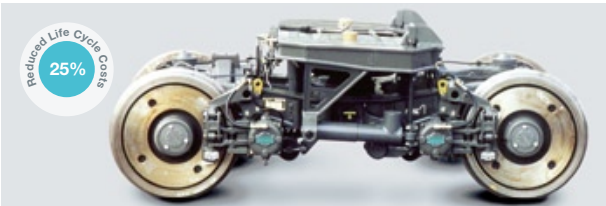
As part of *ECO4*, energy efficiency is built into our products right from the design phase. This means incorporating total lifecycle considerations into our research and development programmes. Bombardier has determined how each sub-system impacts upon the overall efficiency of a train. The solutions range from lighter weight, lower maintenance bogies with reduced wheel and track wear to intelligent, comfort-driven interior climate control; and from optimised aerodynamic performance of very high speed trains to catenary-free tram operation.

Many of these and other *ECO4* technologies were developed in close cooperation with rail operators, in order to enable perfect functionality in a wide variety of technical environments. *ECO4* solutions are already incorporated in latest rail projects worldwide, from our ALP-45DP locomotives and our latest *BOMBARDIER* ZEFIRO** very high speed train to Bombardier's high capacity vehicles *OMNEO** and *TWINDEXX** or the *BOMBARDIER* MOVIA** metro for Singapore.

Today, a total of fifteen *ECO4* products, including five industry-first technologies, in approximately 120 applications, are paving the way for a new era in rail technology with unprecedented reductions in costs and emissions.

Rail represents the future of transportation. Our *ECO4* products will continue to deliver even greater advances in total train performance. Together they are the fastest way to save the planet.





Reduced Life Cycle Costs
25%

FLEXX Eco Bogie

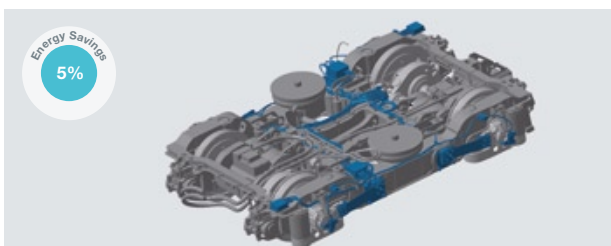
BOMBARDIER FLEXX** Eco bogie is an exciting product within the Bombardier bogie portfolio which enables significant reductions in energy consumption and noise emissions. Characterised by an extremely compact and low weight design, the *FLEXX* Eco bogie creates a massive 30 per cent reduction in total bogie mass and unsprung mass. With almost 1,000 units in operation worldwide, the reliability and operational benefits of the *FLEXX* Eco bogie have been proven. The excellent stability properties make it ideal not just for commuter and regional applications but also for high speed.



Energy Savings
15%

EBI Drive 50 Driver Assistance System

BOMBARDIER EBI** Drive 50 Driver Assistance System is a smart software tool assisting train drivers with recommendations for velocity and acceleration/ deceleration, thereby minimising the energy needed to run a train punctually. Smoother operation also results in reduced wear on wheel sets, engines, brakes and tracks.



Energy Savings
5%

FLEXX Tronic Technology

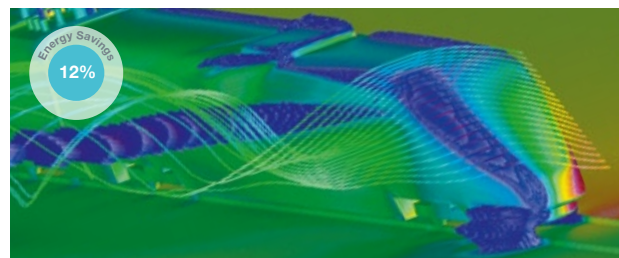
BOMBARDIER FLEXX** Tronic technology uses active, multi-functional elements to automatically adapt to changing operating conditions, such as high speed, tight curves and different track parameters. *FLEXX* Tronic technology is driven by integrated, model-based controllers. They stabilise the bogie at 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.



Energy Savings
20%

EnerGstor Wayside Energy Storage

The new *BOMBARDIER* EnerGstor** wayside energy storage system is based on supercapacitor technology, which captures and stores potentially wasted braking energy and recycles it back into the system. Providing both economic and environmental benefits, the solution is compatible with any electric transit system, regardless of the type or manufacturer. The modular system complements regenerative braking by storing excess energy released from braking trains, then releases it when nearby trains need to draw power. This can reduce the network energy consumption by up to 20 per cent.



Energy Savings
12%

AeroEfficient Optimised Train Shaping

Bombardier is committed to improving 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 realised 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 Aided Engineering tools to optimise 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 travelling time.



MITRAC Energy Saver

*BOMBARDIER** *MITRAC** Energy Saver is based on proven, highly reliable technology. The innovative double layer ultracapacitors store the energy released each time a 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.



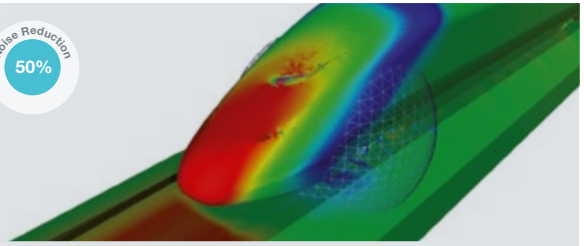
MITRAC Permanent Magnet Motor

The *BOMBARDIER** *MITRAC** Permanent Magnet Motor saves energy by improving overall vehicle performance as well as increasing energy efficiency at reduced volume and weight. This results in lower operating costs and a reduced environmental impact. Equipped with the *MITRAC* Permanent Magnet Motors from the *ECO4* concept the “Gröna Tåget”, based on a *BOMBARDIER** *REGINA** Train, set a new Swedish speed record at 303 km/h on a track originally designed for 160 km/h.



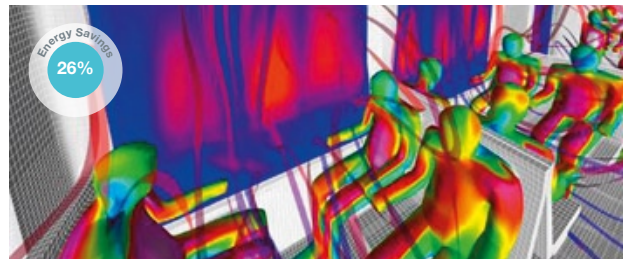
EnerGplan Simulation Tool

The *BOMBARDIER** *EnerGplan** tool simulates and optimises the design of power distribution and energy consumption for a complete transportation system, creating energy savings of up to 20 per cent to reduce operating costs. It is a highly flexible, graphical simulation tool that can conduct an overall analysis of virtually any transit system of any complexity to determine the optimal mode of operation.



EcoSilent Optimised Sound Design

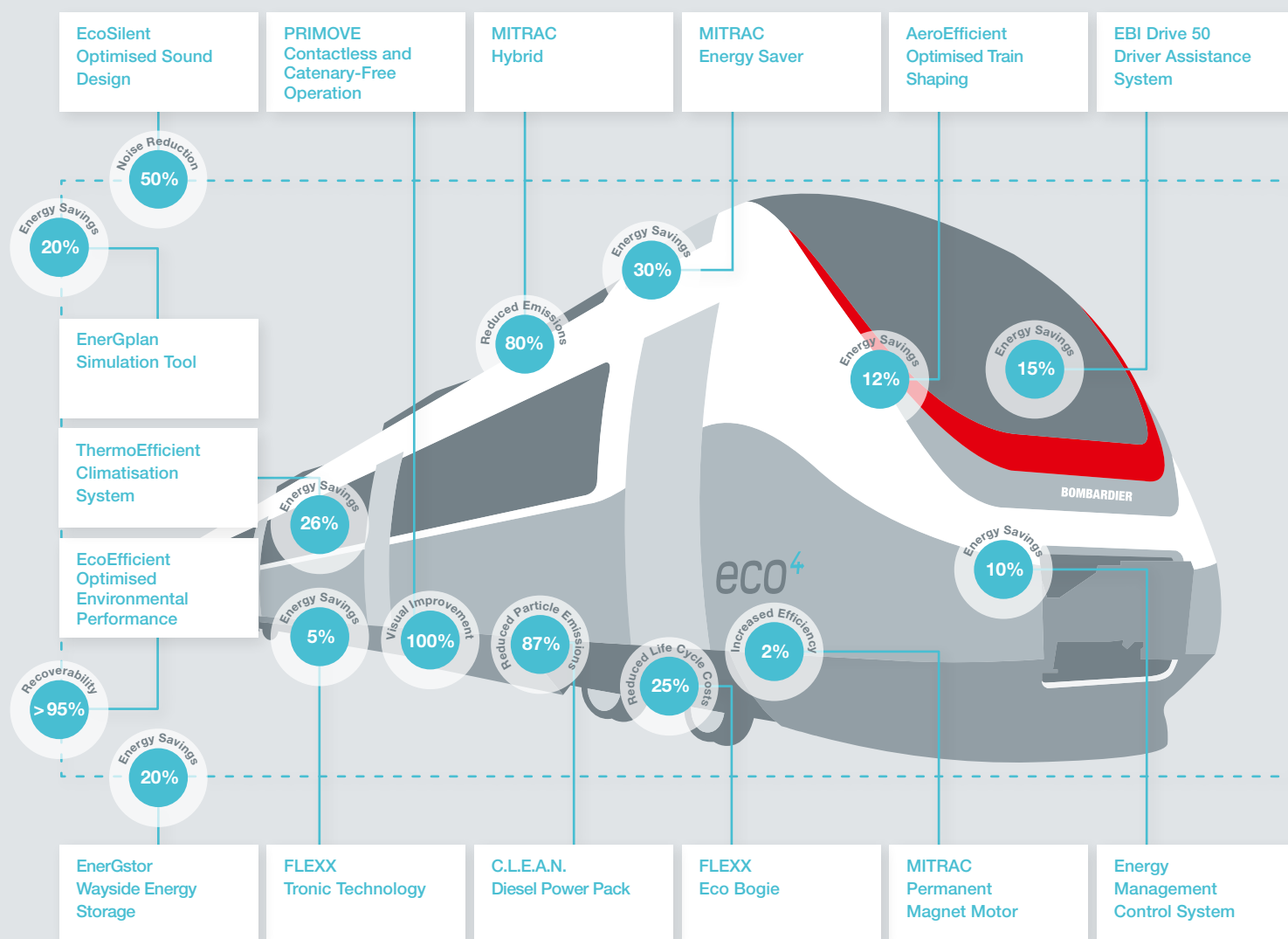
EcoSilent is a holistic approach to sound optimisation, which addresses both the reduction of exterior noise whilst harmonising interior sound to ensure comfort for passengers. Low external noise emissions are ensured through optimised wheel and bogie designs, whilst sound emanating from electrical equipment and cooling systems is also minimised. For the interior, Bombardier tackles the complex issue of creating a balanced acoustic environment by the use of a 'sound studio' concept in which a selection of design elements such as integrated absorbents, resonators, reflectors and intelligent material is fine-tuned and ensures all-round audio comfort for passengers.



ThermoEfficient Climatisation System

ThermoEfficient Climatisation System is an intelligent, low energy interior climate system designed to save both energy and costs for all rail vehicles, whilst maximising comfort for passengers. 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 expelled air. The systems can reduce the energy consumption by up to 24 or 26 per cent, respectively.

Our ECO4 technologies can create energy savings of up to 50%¹



¹ Compared to current products



Energy Management Control System

Bombardier's 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 visualisation tools based on methods proven in the *BOMBARDIER* ORBITA** system.



PRIMOVE Contactless and Catenary-Free Operation

The innovative *BOMBARDIER* PRIMOVE** system is the only solution to provide continuous catenary-free operation of trams based on contactless inductive power transfer. The electric supply components are hidden under the vehicle and beneath the track thus eliminating the need for unsightly overhead wires and poles, as well as reducing wear on parts and ensuring safe operation for all weather and ground conditions. When combined with the *MITRAC* Energy Saver, the power supply of the tram system can be further optimised to achieve energy savings of up to 30 per cent.



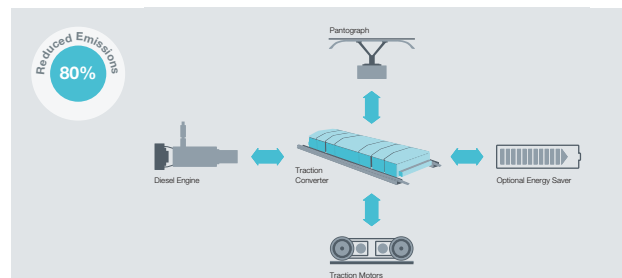
C.L.E.A.N Diesel Power Pack

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 commenced operation in Germany and Sweden in 2009.



EcoEfficient Optimised Environmental Performance

The integration of environmental sustainability into product development is elemental at Bombardier Transportation, where it has a core function in designing state of the art rail transportation equipment. The Bombardier Transportation Design for Environment (DfE) Centre of Competence, together with our entire DfE expert network, acts as a catalyst by providing the essential tools, expertise and central coordination in projects worldwide.



MITRAC Hybrid

BOMBARDIER 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 utilising both electric and diesel power sources. This results in minimal use of fossil fuels with an up to 80 per cent reduction in 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.

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Learn more about our commitment to sustainable mobility on:

www.theclimateisrightfortrains.com

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