

# Investing in India



Bombardier Transportation in India

**BOMBARDIER**

# Committed to India – Foreword from the President



# BOMBARDIER

“Bombardier is poised to bring India to the world stage in rail transportation.”

Benoit Cattin Martel, President and Managing Director  
Bombardier Transportation India

**Bombardier in India is growing from strength to strength. After more than four decades of investing in the country, Bombardier has built up capabilities which cover the complete range of railway vehicle manufacturing, software development and customer service competencies.**

Our most recent achievement is a testament to our manufacturing prowess as Bombardier reached a target of producing one metro car per day at its Savli plant. From this facility in Gujarat, Bombardier has successfully delivered over 80 metro trains to the DMRC in two short years, meeting the tight deadlines for the Commonwealth Games 2010 as well as the expectations of India’s most significant trendsetters in the country’s metro rail industry.

As India embarks on an overhaul and expansion of its passenger and freight transportation network, we look forward to being its key partner in the ever-changing railway scene. Bombardier is the global leader in electric locomotives. Its *BOMBARDIER\* TRAXX\** locomotives are used throughout Europe and are frontrunners in power, flexibility and interoperability, which are vital necessities for

rail operations in India. *TRAXX* platform locomotives provide current and future customers with the advantage of long-term spare parts availability and a high residual value over the locomotive’s lifetime. Bombardier is also the world leader in the development of electric multiple units solutions. The *AGC* trains and the *BOMBARDIER\* SPACIUM\** trains in France, *BOMBARDIER\* TALENT\* 2* trains in Germany, *BOMBARDIER\* REGINA\** trains in Sweden and *BOMBARDIER\* ELECTROSTAR\** trains in the UK are fine examples of our competencies.

We have the capability not only to address the country’s rail industry requirements for the production of metros, electric multiple units and locomotives, advanced IGBT propulsion systems and signalling systems, but also to supply state-of-the-art made-in-India trains to neighbouring markets in the region. As we move forward, our large manufacturing presence in India combined with our local experience, international expertise, and eco-friendly technology means we are poised to bring India to the world stage in rail transportation.

# Our Investment – Competencies and Capabilities in India

**In recent years, Bombardier Transportation has demonstrated its strategic commitment to the Indian market - one of the fastest developing economies of our time - with several major investments, including its largest ever in Asia.**

The significant sum of 33 million euro (Rs 200 crores) has created a state-of-the-art plant in Savli, Gujarat State. The inauguration of this railway vehicle manufacturing site is recognised as being one of the most momentous milestones in the history of Bombardier, and it recently celebrated the manufacture of the 500<sup>th</sup> car.

### Investment in Site and Technology

This wholly-owned plant of a foreign multinational company is the first of its kind in India - with comprehensive capabilities to manufacture complete railway vehicles. This includes bogie and carbody production units, a final assembly area, together with research and development and training centres. The new plant features some of the most advanced equipment including spot welding robots, spot welding jigs, carbody completion and under-frame slave fixtures, coupled with shunting locomotives to move completed trains/cars around the site.

At the same time, we have also upgraded and expanded our existing production centre for propulsion and control and signalling software in Vadodara. Equipped with testing facilities, the site is ISO, OHSAS and IRIS certified, a testimony to the robustness of our internal processes and systems for quality and environmental management; as well as in project management and engineering.

Bombardier has strategically located its manufacturing competencies in Gujarat, ensuring focused quality and control. Railway vehicles that emerge from our sites are assured of strict quarantine checks and follow-up services.

### Investment in People

At Bombardier we believe our people make a difference and are committed to investing in their development. To this end,



all our employees have received comprehensive training in our training centres and/or in our other sites in Europe.

With the construction of the new Savli Site, Bombardier created job opportunities for approximately 700 new employees, who are trained in Europe to meet the high quality standards that Bombardier sets for its production facilities. Furthermore, 3,000 additional employment opportunities have been created within the local supply community.

### Expanding our facilities and physical presence in India

Bombardier has been gradually consolidating its position in India and has various offices and production sites:

- Railway Vehicle Manufacturing Site in Savli, Gujarat
- Propulsion and Control Centre in Vadodara, Gujarat
- Software Development Centre in Vadodara, Gujarat
- Engineering Centre in Hyderabad
- 4 Sales and Marketing offices in New Delhi, Mumbai, Kolkata and Chennai
- Project office in New Delhi
- 4 Depot Offices in New Delhi



# ◁ Bombardier – Partner of Indian Railways ▷

Bombardier's long-standing relationship with Indian Railways began with the award of a contract in 1993 to design and build electric mainline passenger and freight locomotives, combined with a technology transfer agreement for the manufacture of locomotives in India.

The comprehensive technology transfer agreement also enabled similar locomotives to be manufactured at the Chitternanjan Locomotive Works (CLW) in West Bengal. Bombardier's engineers have been instrumental throughout the process - from system engineering to assembly, testing and commissioning of the locomotives. The contract also provided training of Indian Railways' representatives in Switzerland to ensure continuity of quality and maintenance.

Throughout this period, our Bombardier Propulsion and Control Production Centre has been supplying propulsion and control components to Indian Railways. Our production activities are complemented by after-sales service and efficient management, with both on- and off-site training and regular correspondence between our technical experts and railway personnel. These measures have strengthened our understanding of the customer's needs thereby improving reliability and extending product lifespan. This, in turn, has resulted in a tremendous increase in customer satisfaction and confidence in our products.

Bombardier is also instrumental in introducing the latest signalling products to the Indian market, including Audio Frequency, Track Circuits, Axle Counters and Traffic Management Systems. As a testimony to customer confidence in the safety features and attributes of our signalling equipment, our activities in India continue to expand.



WAP 5 locomotive

Continuous efforts are made to provide both the latest and proven technology for the Indian Railways and mass transit projects of India.

# ◁ Locomotives – Where the power is ▷

The two types of locomotives, WAP 5 and WAG 9, designed and built with technology transfer to the Chitternanjan Locomotive Works (CLW) in West Bengal in 1993, pioneered the use of GTO traction and three-phase asynchronous drives in India, thereby establishing Indian Railways as the first railway organisation in Asia operating three-phase drive technology.

## TRAXX Locomotives

The TRAXX locomotive platform features a high level of standardisation and integration at the vehicle, system, and component levels. The TRAXX platform includes single, dual, and multi-system electric locomotives for AC and DC catenary systems, as well as diesel locomotives. Bombardier prides itself on providing locomotives which offer:

- High flexibility of use
- High reliability
- High safety standards

resulting in satisfied customers world-wide.

When it comes to electric locomotives, Bombardier is indisputably the market leader both in terms of engine power and for the number of units sold worldwide. This universally acclaimed product is appreciated by customers for its reliability, powerful performance and low life-cycle cost.

TRAXX platform



Introducing the most powerful locomotives in the world today – IORE KIRUNA

## The Mainstay of the Market

Exceptional reliability, high availability and unbeatable economy – Bombardier's TRAXX platform of locomotives are the mainstay of rail haulage in Europe with over 1,300 of more than 1,500 units ordered to date already moving freight and passengers across the continent. The interoperability, high mileage between maintenance intervals, and exceptionally high operational economy of Bombardier's TRAXX locomotives lead to simplified planning, smooth



TRAXX F140 MS, SBB Cargo, Switzerland

locomotive changeovers, and optimised capacity. Both proven and innovative, Bombardier TRAXX locomotives have been developed to address the challenges and competitive environment of today's railways, now and in the future.

## TRAXX – Impact Zones for Increased Safety

Safety is inherent in all TRAXX locomotives. Since January 2005, all Bombardier TRAXX platform locomotive car bodies meet the latest European interoperability criteria to ensure the highest standards for our customers around the world. To further increase passive safety for the locomotive crew, Bombardier includes energy-absorbing features which ensure the controlled deformation of specific front sections of the locomotive in the event of a front-end collision. In addition to preventing vehicles from overriding and derailling, the easily replaceable parts significantly reduce repair costs.



# Modern Innovation for Developing Cities

To meet the demand for increased passenger capacity in expanding cities, our urban vehicles provide efficient and cost-effective performance in highly populated areas. From large-scale urban transit vehicles to light metro applications, we offer a full range of rail car technologies and systems.



MOVIA Metro, New Delhi, India

## Bombardier's MOVIA trains: Helping cities breathe

The Delhi Metro Rail Corporation (DMRC) has awarded Bombardier contracts to supply 614 state-of-the-art BOMBARDIER\* MOVIA\* high-capacity metro vehicles to combat traffic congestion and to provide effective public transport in New Delhi. With deliveries advantageously scheduled to commence prior to the 2010 Commonwealth Games in New Delhi, the MOVIA metro trains were a cornerstone of the mobility plan successfully implemented by DMRC.

The MOVIA metro train ordered by DMRC is a modern mass transit vehicle, designed for rapid, efficient, and cost-effective performance. The flexible, modular design is equipped with our BOMBARDIER\* FLEXX\* Metro 3000 bogies, an extremely robust and reliable design, specifically adapted by our engineers to suit the existing infrastructure. The light-weight design of the FLEXX Metro bogie enables maximum vehicle capacity utilisation with minimum energy consumption. Primary suspension with elastomeric components guarantees a high level of steering performance with minimal noise emissions and vibrations creating environmental benefits.

The FLEXX bogies portfolio is the most comprehensive one – resulting from 160 years of experience and future-oriented innovations. It covers the entire range of railway vehicles from metros to high speed applications, from trams to heavy haul locomotives. More than 200,000 FLEXX bogies are in operation around the globe every day ensuring safety, reliability and comfort.

## Original, stylish, and fully accessible, MOVIA trains offer value and service second to none.

Bombardier supplies metro cars to operators all over the world, from Stockholm to Mexico City and Bucharest to New York. In the Swedish capital, the three-unit C20/21-Series trains have been gradually replacing their predecessors on the city's oldest lines. For Turkey, Bombardier is currently upgrading the metro lines in Istanbul, Izmir and Ankara. In China, Bombardier is responsible for manufacturing the modern MOVIA metro cars for Shenzhen, Guangzhou and Shanghai. These new trains are transporting the public at speeds and in comfort never experienced before.



1,036 FLEXX Metro 3000 bogies have already been delivered out of Savli factory.

# Propulsion and Control for reliable and safe operations

For decades, our Propulsion and Control Production and Development Centre in India has been supplying converters and electronic devices for train control and communications for three-phase propulsion, circuit breakers and tap changers for Indian Railways. During this time, we have always strived for and delivered optimum reliability and customer satisfaction. With the planned expansion of the site, we will be able to provide a comprehensive propulsion and control product portfolio for Indian Railways and mass transit projects of India.

## Complete Product Portfolio

Based on our wealth of experience, Bombardier Transportation has the expertise and the capability to deliver complete propulsion and train control and management systems, for all types of rolling stock. Our BOMBARDIER\* MITRAC\* portfolio covers the entire range of products and services to ensure safe and reliable operation of your vehicles: transformers, converters, traction motors, gears, auxiliary power supplies, energy storage and complete train control and management systems.

## Proven Reliability – All over the World

Our products and systems have proved their reliability and performance in thousands of vehicles all over the world. As a single partner for the entire range of customers' needs, Bombardier delivers systems which provide simple interfaces and full functional integration.

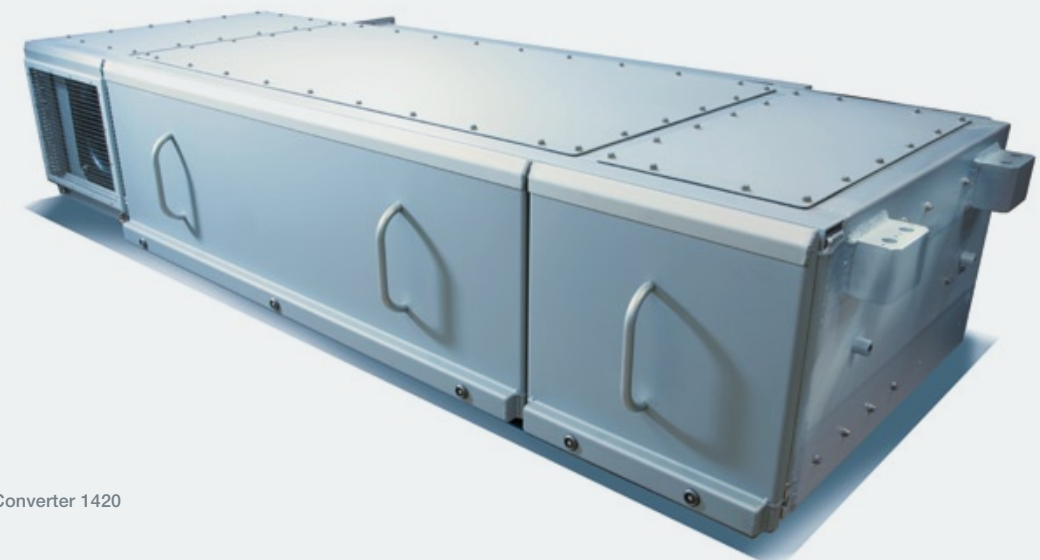
## The MITRAC Energy Saver

The intelligent MITRAC energy saver developed by Bombardier Transportation enables vehicles to save almost

one third of their energy use, and to bridge sections without overhead lines. It works by storing electrical energy generated during braking for reuse during acceleration. Purely electrically driven, it requires considerably less maintenance than mechanical storage systems and is lighter and more compact than conventional batteries. Initial experience in daily operations has proved the reliability of the system.

## MITRAC propulsion systems and products include:

- Drives: The asynchronous, technically mature, reliable and standardised Bombardier MITRAC drives are designed to meet all the challenges of modern global rail transport.
- Bombardier's MITRAC traction converters, with their reliable operation, smooth acceleration and reduced energy consumption provide reduced maintenance and lower life-cycle costs. Their modular design makes them flexibly adaptable to individual customer requirements.
- Built-in and stand-alone auxiliary systems: Minimum maintenance and low energy consumption are also features of the modular and high-performance MITRAC auxiliary converters, designed for all types of railway applications with various line voltages.
- Electronics managing all kinds of communication in a train, as well as controlling the propulsion system. Bombardier MITRAC Train Control and Management System (TCMS) is a high capacity, infrastructure backbone built on open standard IP-technology that allows easy integration of all control and communication requiring functions on-board the train.



MITRAC Traction Converter 1420



# ◁ Rail Control Solutions – A history of success in signalling ▷

With the award of major projects to supply equipment for both mainline and mass transit operations, Bombardier has witnessed a significant growth in its railway signalling business.

In line with the Indian Railway's plan to enhance safety using modern signalling solutions, Bombardier is further consolidating its excellent position in this segment with cutting-edge technologies such as the digital coded audio frequency track circuit, *BOMBARDIER\* EBI\* Track 400*, the implementation of European Train Control Systems (ETCS), high capacity computer-based interlocking systems, *EBI Lock 950*, and digital axle counter, *EBI Track 2000*.

### Our Mainline Portfolio

Bombardier's Rail Control Solutions division first entered the Indian market in 1987 with our relay-based interlocking and in 1992 pioneered the introduction of the first ever jointless audio frequency track circuits, *EBI Track 200 (TI21)*, based on technology developed by Bombardier in the UK. *EBI Track 200* has since been introduced as part of numerous automatic signalling projects for Indian Railways. In 2002, Bombardier delivered the first ever highly sophisticated traffic management system for the Western Railway in India, enabling the management of some of the densest traffic in the world on a real time basis.

Due to the success of this project, Bombardier has been awarded a similar contract by the Central Railway, where phase 1 has been commissioned on a test trial basis. The full system is expected to be commissioned by the end of 2011. Central and Western Railway will then control over 2,500 trains with three minutes headway, spread over 120 km in the Mumbai suburban network which will be capable of handling approximately 5 million passengers per day.



Signalling, *EBI Track 400* track circuit



Signalling, *EBI Link Eurobalise*

### As part of our proven *INTERFLO* solutions for main line transport we provide:

- Specialised technical expertise
- The latest computer-based interlocking systems: ensuring maximum safety and availability by using stand-by interlocking computers
- Effective wayside equipment: providing reliable fixed or variable data to give movement authority information to the cab, and allowing accurate positioning of trains on the track
- Digital axle counter systems for single section and multi-section track suitable for the station area and automatic block applications.

### Our Mass Transit Portfolio

In 2007, Bombardier was awarded the prestigious order for a signalling and train control system for two new lines of the Delhi Metro Rail Corporation. Line 5 of the project was commissioned in April 2010 and Line 6 in October 2010 using our state-of-the-art *BOMBARDIER\* CITYFLO\* 350* mass transit signalling system.

Line 6 was commissioned just before the opening of the prestigious Commonwealth Games, which was used by millions of sports enthusiasts to reach the main venue. The *CITYFLO 350* solution showcases modern technologies such as automatic train protection, automatic train operation, computer-based interlocking (CBI) systems and automatic train supervision (ATS) on the Delhi Metro.

Signalling, *EBI Drive 50*, Driver Assistance System



Signalling Control Room, Traffic Control System

The *CITYFLO* portfolio offers a wide range of solutions for mass transit, from trams to metros and airport people mover systems, all delivering safety, flexibility and performance while reducing costs. From *CITYFLO 150* to *CITYFLO 650*, our systems encompass all requirements from cab signalling to automatic train control (ATC) technology, communication based train control (CBTC) and driverless train operation.

ATC systems offer the possibility of increasingly automatic, cost-effective operation enabling shorter headways and more frequent services. Bombardier's skilled engineers are at the forefront of developing this advanced technology, and can supply a full range of options to suit individual customer needs, such as:

- Semi-automatic train driving with ATC
- Driverless train operation
- Unattended train operation

# Committed to Sustainable Mobility



Bombardier Transportation develops rail technology products with a long-term perspective to ensure sustainable mobility for the 21st century

## ECO4 products – the new formula for Total Train Performance

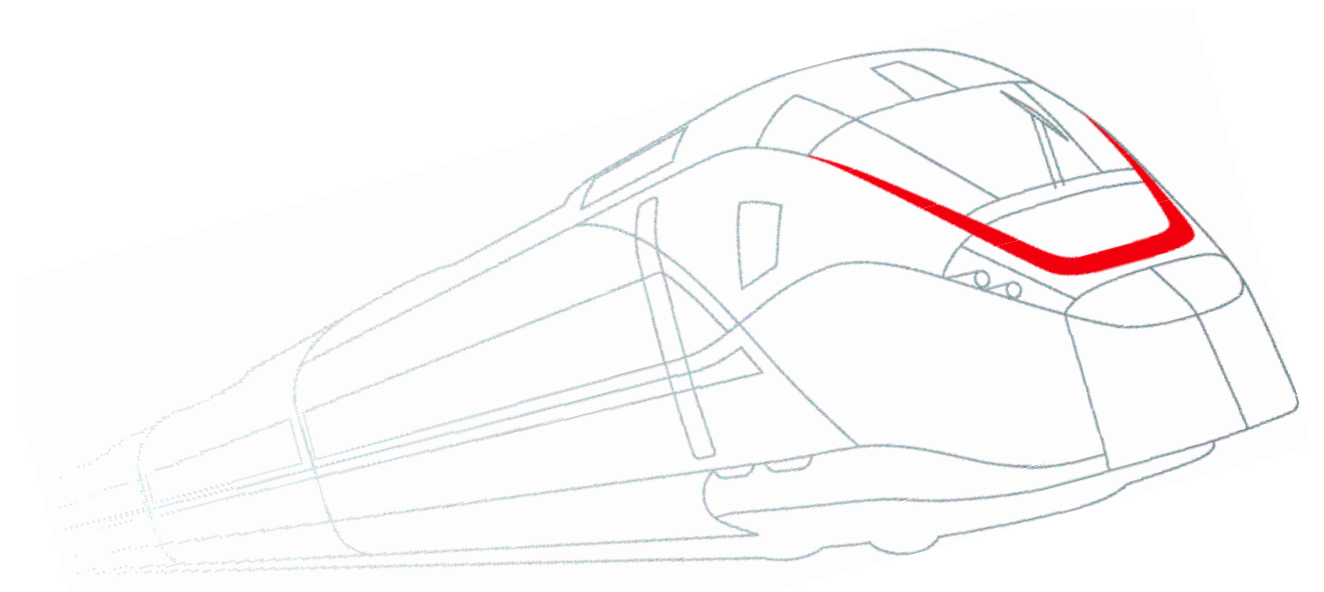
Leading the way towards the future of sustainable mobility, innovative products by Bombardier Transportation are setting new industry standards. *BOMBARDIER\* ECO4\**, with its impressive portfolio of cutting-edge solutions, services, products and technologies, offers the best-in-class environmental and cost-efficient performance. Many of these products are being developed and manufactured in Germany. Balancing the four cornerstones of energy, efficiency, economy and ecology, *ECO4* products offer overall energy savings of up to 50 per cent and cost reductions, thus matching the industry's demand for environmentally-friendly and reliable, yet cost-efficient products. Among the ecoactive products are the *MITRAC* Permanent Magnet Motor, a modern engine technology which enables a significant increase of propulsion chain efficiency; the *EBI Drive 50* driver assistance system, that helps save up to 15 per cent of traction energy by assisting the driver with information on speed and traction force; and the Energy Management Control System, a software which monitors a train's fuel and electric consumption while in service. Other *ECO4* products include AeroEfficient, which reduces the aerodynamic drag by 25 per cent, and the C.L.E.A.N. Diesel Power Pack, the lowest-emission

propulsion system for Diesel Multiple Units (DMUs) in the 660 kW class, which already meets European emission guidelines (stage III-B) for 2012.

## Thermo Efficient energy savings

Trains that operate in extreme temperatures, such as metros, can require up to 30 per cent of the overall power consumption for cabin climatisation. However, this energy usage is often wasted, as performance of the system is not adapted to variables, such as passenger occupancy. An intelligent and flexible climate control system can therefore considerably save both energy and costs. ThermoEfficient uses a combination of two complementary mechanisms: Firstly, a variable fresh air rate system uses information provided by sensors to calculate the passenger occupancy relative to the vehicle mass, adjusting the level of the air conditioning accordingly. The second system uses installed heat exchangers to pre-heat or pre-cool the fresh air using exhaust air. In this way, up to 80 per cent of the energy contained in the exhaust air can be reused. By using the ThermoEfficient systems described, energy consumption can be reduced significantly, by 24 and 26 per cent, respectively.

# Bombardier Transportation The Climate is Right for Trains



**Bombardier Transportation is dedicated to developing, manufacturing and servicing advanced transportation solutions for today's and tomorrow's railways.**

As a global leader in rail technology, Bombardier places environmental sustainability firmly at the top of the agenda. Our products and services combine energy conserving technology with optimal safety, reliability and cost efficiency. They are designed for sustainable mobility throughout their lifecycle.

Our portfolio of rolling stock and services encompasses passenger vehicles for urban and mainline operations, locomotives, bogies, rail control solutions, propulsion and complete transportation systems, as well as vehicle modernization and maintenance.

Over 100,000 vehicles in operation worldwide attest our unique strengths in project management and innovation, design and technology. For decades we have enabled millions of people every day to reach their destinations in comfort and style.

Bombardier is a truly international business, which provides local support. Present in more than 60 countries and with some 35,000 employees worldwide, we strive to be the partner of choice for all the world's rail operators.

Headquartered in Berlin, Germany, Bombardier Transportation is part of Canada based Bombardier Inc. It generates annual revenues in excess of US\$ 9 billion.



Bombardier Transportation has an active set of environmental print guidelines, for further details click onto:

[www.transportation.bombardier.com](http://www.transportation.bombardier.com)

Learn more about our commitment to sustainable mobility on:

[www.theclimateisrightfortrains.com](http://www.theclimateisrightfortrains.com)

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**Bombardier Transportation**

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