

Prismo®

- Next-Generation AGT Achieving Carbon Neutrality Based on Half a Century of Proven Automated Transport Technology -



TARO TASHIRO*1 TOMOCHIKA YAMAGUCHI*2
RYU INOMATA*3 YUTO IHARA*4

On May 19, 2025, Mitsubishi Heavy Industries, Ltd. launched its new brand, Prismo®, developed based on its proven fully automated and driverless (GoA4) guideway transit system. The company will manufacture vehicles with enhanced environmental performance through energy management systems utilizing onboard storage batteries at Mihara Machinery Works in Hiroshima, which operates on 100% solar power. It will also promote resource-saving infrastructure. Accordingly, Prismo contributes to global efforts toward carbon neutrality by integrating energy-efficient vehicle design with resource-saving infrastructure.

1. AGT development at Mitsubishi Heavy Industries, Ltd.

1.1 History of track-based transport business (Table 1)

Mitsubishi Heavy Industries, Ltd. (hereinafter referred to as MHI) began its track-based transport business in earnest with the manufacture of steam locomotives (Table 1-(1)), and in 1971, commenced the development of AGT ^{Note 1)}, which is characterized by driverless running (Table 1-(2)).

Since 1981, MHI has been involved in the construction of domestic AGT systems (Table 1-(3)) and began its international expansion starting with Hong Kong International Airport in 1998, establishing an extensive track record in Southeast Asia, the United States, the Middle East, and other regions. Furthermore, MHI has built a strong reputation in full turnkey projects for track-based transport, completing the Taiwan High Speed Rail in 2007, which was the first export of Shinkansen technology, and the Dubai Metro in 2009, which is the world's longest driverless system.

Since developing the MAT system, the prototype of the AGT, in 1971, MHI has accumulated a proven track record in system integration, including the manufacturing of AGT vehicles for numerous projects. Through these projects, MHI has gathered expertise by incorporating Operation & Maintenance (O&M) experience and customer feedback, while systematically advancing technologies for subsystems such as vehicles, power supply, control, and communications as a system integrator. Leveraging this experience, core technologies, and research findings, MHI developed and launched Prismo®, the next-generation AGT in 2025 (Table 1-(4)).

Note 1: AGT is the abbreviation for Automated Guideway Transit. In Japan, it is commonly known as "Shin-Kotsu System" (New Transit System) and is designed specifically for medium-capacity transport in urban areas. Like other track-based transport systems, it is controlled and secured by railway signaling systems. Its key features include over 40 years of proven performance in GoA4 (fully automated and driverless) running, the ability to handle steep gradients and quiet running through the use of rubber tires, and the ability to navigate tight curves with compact vehicles. While fundamentally designed for driverless running, some lines are operated with a single driver (driver-only operation) due to local regulations and other factors.

*1 Engineering Manager, Mobility Engineering Department, Plants & Infrastructure Systems

*2 Senior Manager, Mobility Services Engineering Department, Plants & Infrastructure Systems

*3 Mobility Business Department, Plants & Infrastructure Systems

*4 Visiting Associate Professor, Advanced Collaborative Research Organization for Smart Society, Waseda University

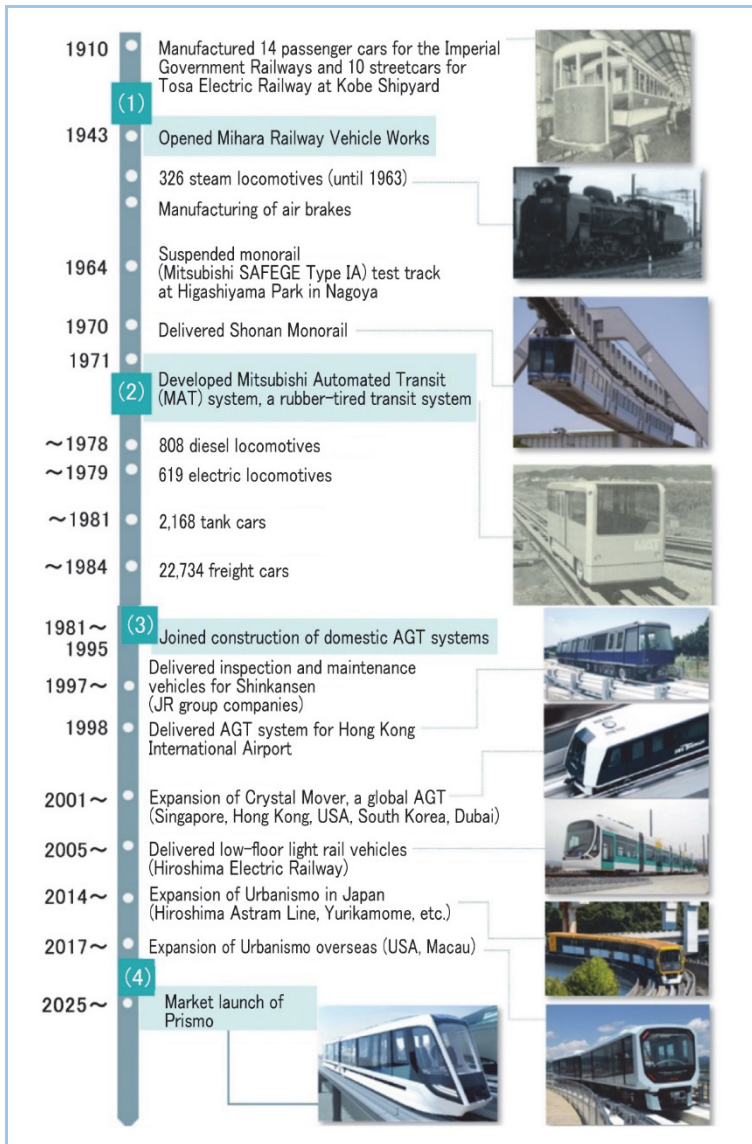


Table 1 History of MHI's track-based transport business

1.2 Key features of MHI's AGT vehicles

MHI's AGT vehicles have the following features:

(1) Light weight

The aluminum double-skin body structure, which optimizes onboard control wiring routes, together with an Ethernet-based control system that reduces signal cabling and the proactive use of lightweight components, reduces the vehicle weight and thereby enables a higher passenger capacity (Figure 1).

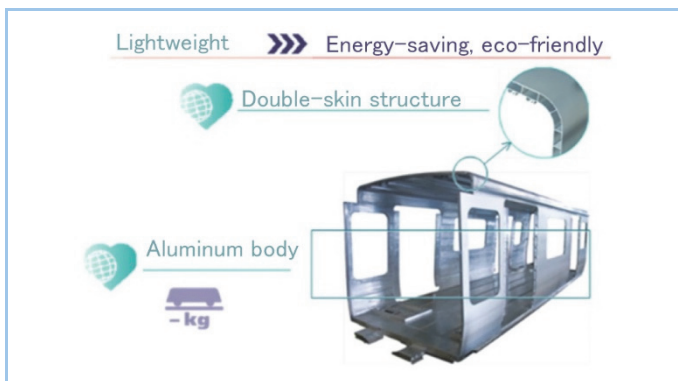


Figure 1 Light-weight vehicle body

(2) Smooth-moving bogies

AGTs often navigate tight spaces between buildings in urban areas and airport terminals. MHI's proprietary steering bogies enable smooth running in such situations (**Figure 2**).

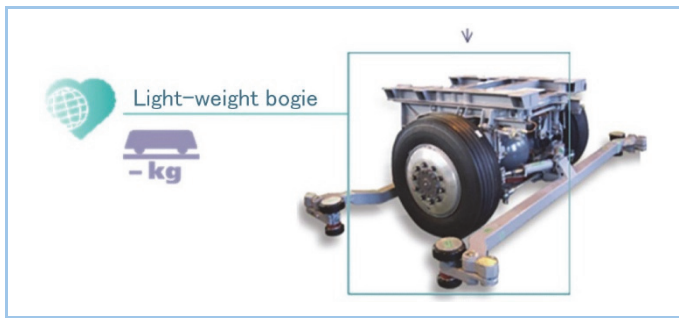


Figure 2 Smooth-moving bogies

(3) In-house developed components with dedicated designs

Waste reduction is achieved through the adoption of in-house developed oil-free scroll compressors for air brakes, which are designed with a focus on environmental performance and ease of maintenance (**Figure 3**).

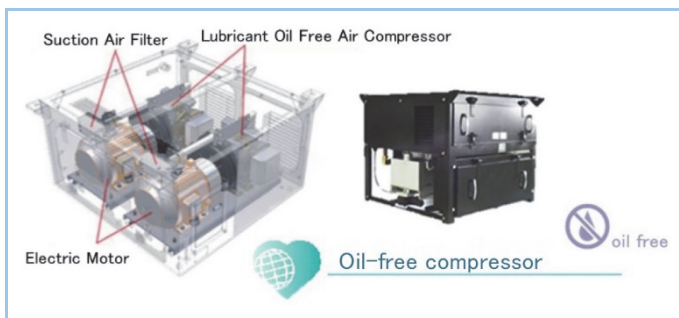


Figure 3 Components with dedicated designs

2. Prismo

2.1 Branding

Prismo, a new brand featuring a center-guideway system and onboard energy storage, has joined MHI's AGT product portfolio, the Crystal Mover family, alongside the existing side-guideway brand Urbanismo® (**Figure 4**).



Figure 4 Next-generation AGT Prismo

2.2 Features of Prismo

(1) Improved energy efficiency

The onboard energy storage utilizes a newly developed high-performance capacitor that can be rapidly charged while stopped at a station and provides sufficient power to travel 2 km, which is equivalent to the standard distance between AGT stations. By efficiently storing and utilizing regenerative energy during deceleration with less waste, the system achieves an approximately 10% reduction in energy consumption and CO₂ emissions compared to conventional AGT systems. Power supply during travel between stations is no longer required,

allowing passengers to be safely delivered to the next station even in case of a power outage (**Figure 5**). Furthermore, the capacitor offers a longer service life even with repeated rapid charging and lighter weight, compared to general storage batteries. Additionally, real-time monitoring of the state of charge enables efficient energy management across the entire AGT system (**Figure 6**).

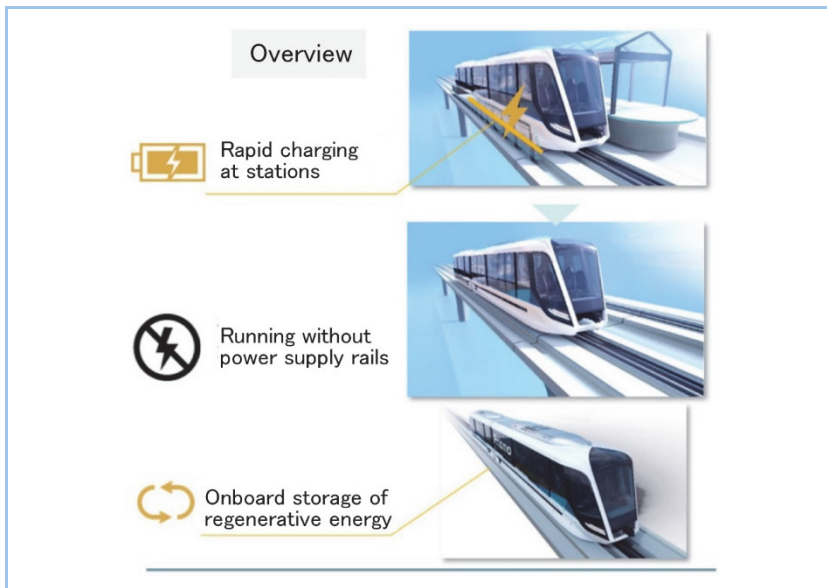


Figure 5 Prismo's power supply system

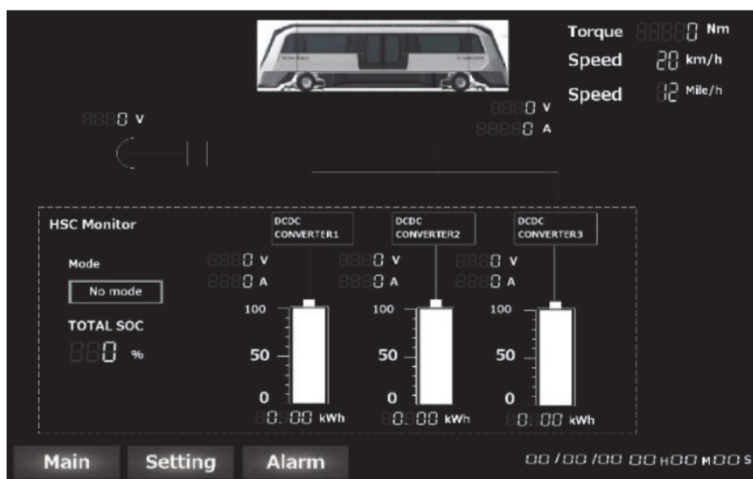


Figure 6 Vehicle monitoring screen example

(2) Reduction in infrastructure volume

By eliminating the need for power supply rails between stations and adopting a center-guideway system instead of side-guideway rails (**Figure 7**), the space for trackside structures is removed. This allows for a reduction in construction volume and a narrower track structure width compared to the conventional system.

(3) Labor-saving maintenance

The omission of power supply rails between stations not only reduces the maintenance workload for inspection and replacement but also lowers the risk of operational disruptions, such as short circuits caused by foreign objects adhering to the rails.

(4) Urban adaptability

While inheriting the 10% climbing capability of the existing Urbanismo, Prismo realizes a turning radius of R22, even smaller than the previous R30, due to the center-guideway system. The quietness inherent in running on rubber tires has been further enhanced by eliminating friction noise from power supply rails during running.

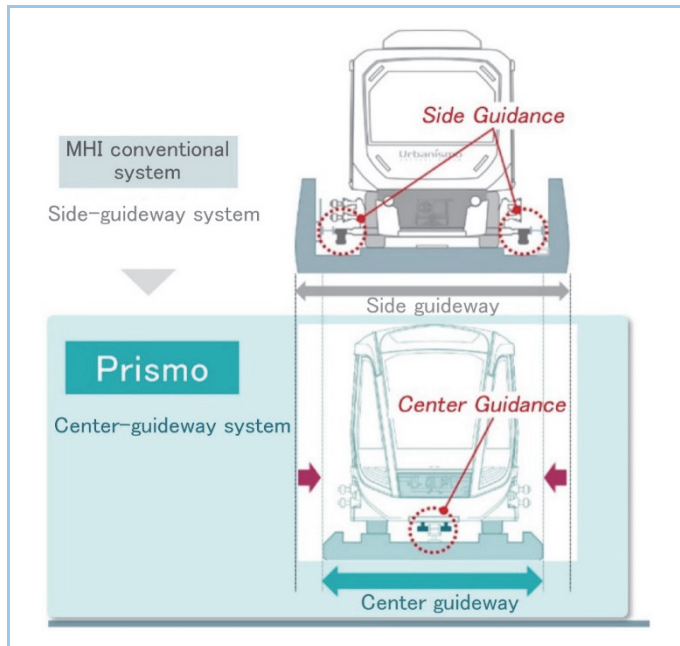


Figure 7 Guideway for Prismo

3. Contribution to carbon neutrality

Compared to conventional vehicles, Prismo enables reductions in CO₂ emissions through the use of renewable energy during vehicle manufacturing, the reduction of resource inputs during infrastructure construction due to the elimination of the power supply rail, and the effective utilization of regenerative energy during running. This chapter evaluates the life-cycle CO₂ (LC-CO₂) emissions across the entire lifecycle of Prismo, from manufacturing and running to disposal, to demonstrate its contribution to carbon neutrality.

3.1 CO₂ emissions during vehicle manufacturing

By utilizing solar power systems installed at MHI's Mihara Machinery Works, where vehicle manufacturing is conducted, CO₂ emissions from energy use decreased by 86.3%, leading to an overall 37.9% reduction in CO₂ emissions during the vehicle manufacturing process (Figure 8).

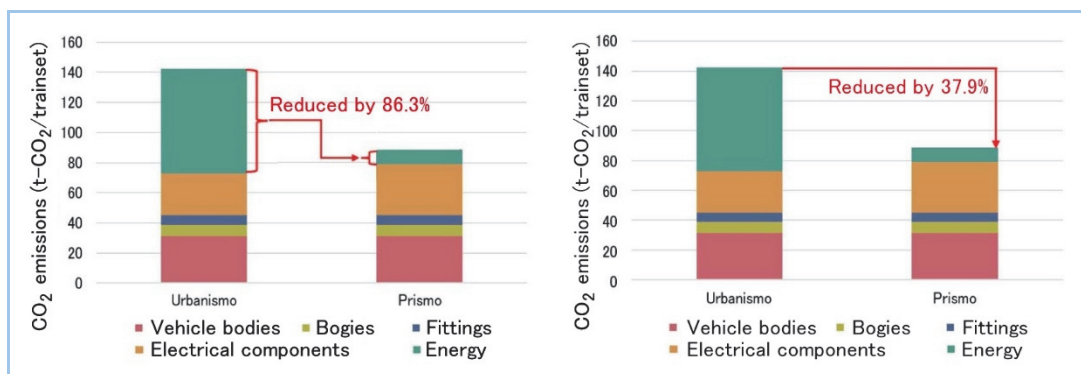


Figure 8 Comparison of CO₂ emissions during vehicle manufacturing

3.2 CO₂ emissions during infrastructure construction

CO₂ emissions during infrastructure construction were evaluated by categorizing them into tracks, power lines, station platform screen doors, signaling, and communication equipment. Prismo reduces the resource inputs for track construction by utilizing a single center-guideway for guidance during travel. Furthermore, by leveraging the aforementioned onboard energy storage to achieve the elimination of the power supply rail through charging at each station stop, the installation of the power supply rail between stations is no longer required. As a result, CO₂ emissions during infrastructure construction were reduced by 46.6% (Figure 9).

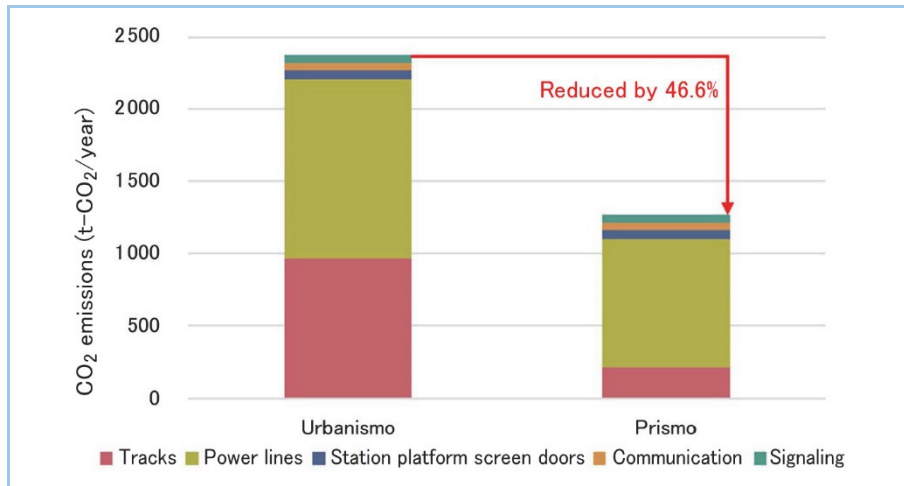


Figure 9 Comparison of CO₂ emissions during infrastructure construction

3.3 CO₂ emissions during running

The onboard energy storage enables more efficient recovery of regenerative energy compared to conventional vehicles, improving energy consumption from 2.17 kWh/km for conventional vehicles to 1.97 kWh/km for Prismo. As a result, it was found that CO₂ emissions during running can be reduced by 9.4% for an airport AGT system in the United States with an annual mileage of 132,000 km (Table 2, Figure 10).

Table 2 Reduction amount and reduction rate by life cycle phase

	Manufacturing	Running	Maintenance	Final disposal
Reduction amount	1,569.1t -CO ₂	4,751.34 t-CO ₂	38.4 t-CO ₂	73.1 t-CO ₂
Reduction rate	43.6%	9.4%	6.1%	55.6%

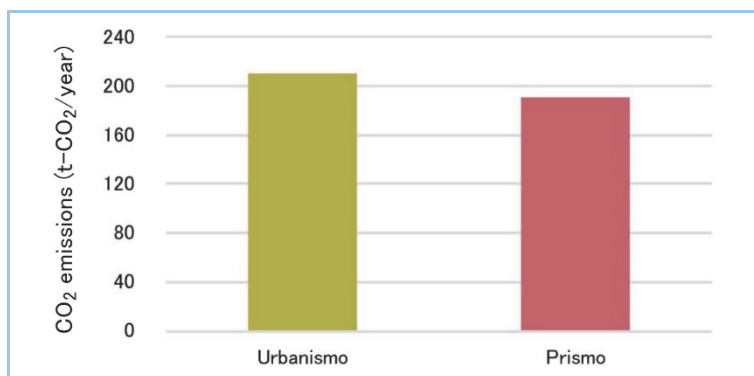


Figure 10 Comparison of CO₂ emissions during running

3.4 Evaluation of life cycle CO₂ reduction effects

Figure 11 shows the LC-CO₂ evaluation for Prismo over a 30-year operation period. In addition to the manufacturing and running mentioned above, the LC-CO₂ assessment considers CO₂ emissions from maintenance and final disposal over the 30 years of operation.

As shown in Table 2, CO₂ emissions for Prismo, similar to Urbanismo, are highest during running, where the energy-saving effects of utilizing regenerative energy contribute significantly to the reduction amount. On the other hand, the reduction rate is higher during the manufacturing and final disposal phases due to the substantial decrease in resource inputs. To further reduce CO₂ emissions in the future, it will be necessary to proactively utilize renewable energy for power during running.

Furthermore, to achieve carbon neutrality, reducing CO₂ emissions per passenger is as important as reducing the vehicle's emissions. The CO₂ emission rate of Prismo at full capacity is 7.66 g-CO₂ per passenger-kilometer. This is approximately 10% of that of a passenger car under the same conditions⁽¹⁾. By combining the efficiency of the vehicle itself with the effect of carrying a large number of passengers simultaneously, Prismo can contribute significantly to carbon neutrality.

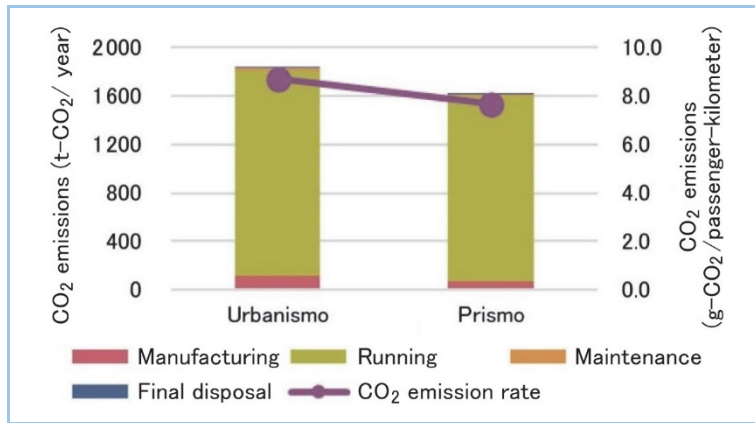


Figure 11 Comparison of CO₂ emissions based on LC-CO₂

4. Mihara Test Tracks

Japan's first comprehensive transportation system test facility, which began operation within MHI's Wadaoki Plant in 2014, features AGT test tracks. This facility is utilized as a demonstration site for developing new technologies for Prismo (Figure 12).

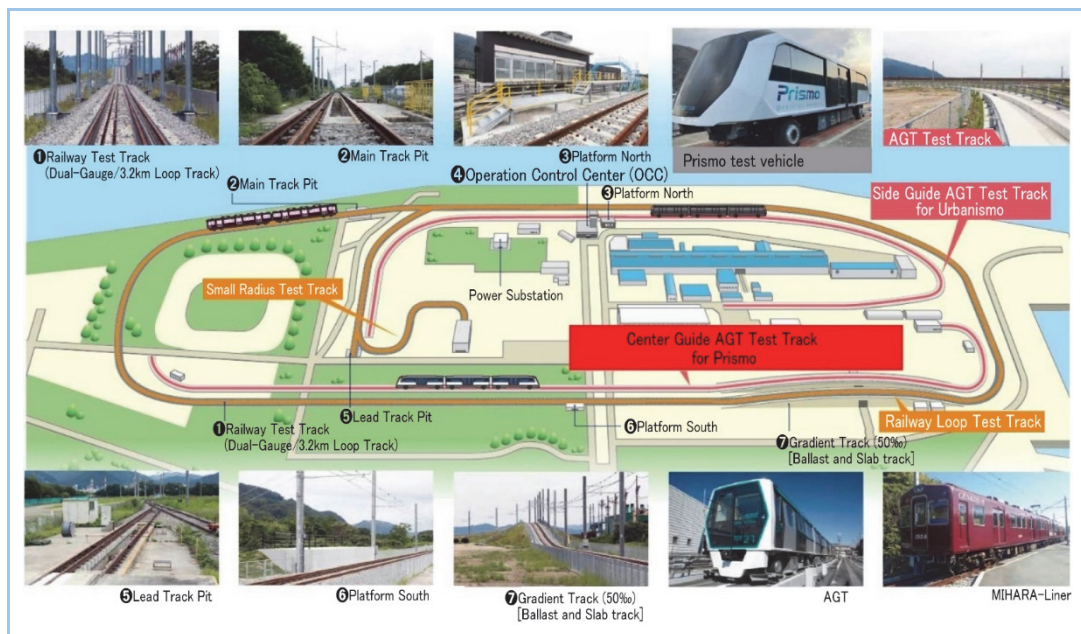


Figure 12 Comprehensive transportation system test facility (Wadaoki Plant)

The AGT test tracks include a side-guideway test track for Urbanismo and a center-guideway test track for Prismo. These tracks enable comprehensive testing of vehicle performance and noise/vibration on curves, as well as various evaluations of signaling, communications, power supply, and operation management.

- (1) System verification
 - Data acquisition for standard compliance, certification, and evaluation of vehicles and signaling systems
 - RAMS (IEC 62278) and EMC (IEC 62236) compliance, durability testing, and integration testing of combined subsystems
- (2) On-site condition reproduction testing
 - Preliminary testing and event reproduction testing as requested for new routes
 - Environmental compatibility testing, including noise, vibration, and EMC
- (3) Training and demonstration

Operational and maintenance training tailored to customer requirements for new system installations in various regions, including emerging markets, as well as preliminary training in preparation for on-site commissioning.

- Demonstrations of railway systems

Solar panels are installed at the Wadaoki Plant (**Figure 13**), providing 100% of the electricity required for both the comprehensive transportation system test facility and the vehicle manufacturing plant.

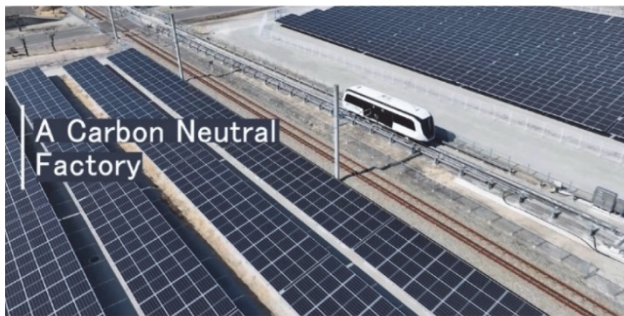


Figure 13 Solar panels and Prismo test vehicle (Wadaoki Plant)

5. Smart maintenance

MHI provides not only system delivery but also Operation and Maintenance (O&M) services after the start of commercial operations worldwide, and high-quality O&M will be provided similarly for Prismo. The O&M services for AGT systems began in Hong Kong in 1998 and have since expanded to North America, Southeast Asia, and the Middle East. The abundant experience cultivated through these O&M services maintains high safety and reliability. In addition to the maintenance labor savings achieved by eliminating power supply rails, Prismo will advance maintenance by leveraging functions that monitor vehicle condition and capacitor state of charge. Specifically, improving inspection quality by automating as many inspection items as possible while also extending periodic maintenance intervals is planned to further enhance product value (**Figure 14**).

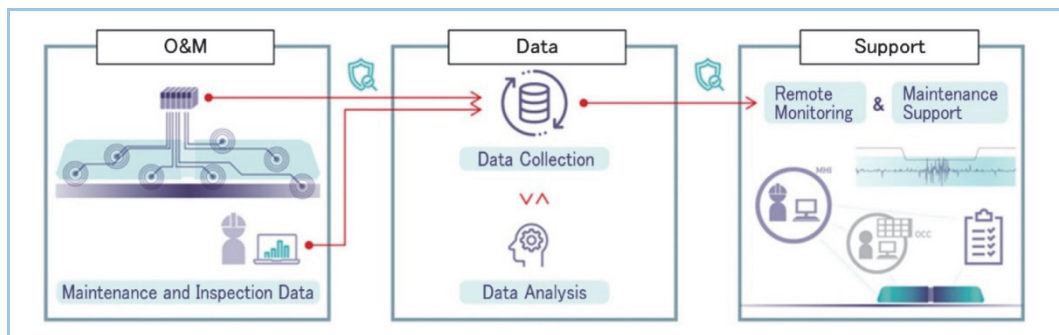


Figure 14 Smart maintenance related to vehicles

5.1 Optimization through condition monitoring

In addition to periodic maintenance, monitoring the wear and degradation status of vehicle components as part of condition monitoring enables not only the optimization of part replacement frequency but also proactive action before issues occur, thereby preventing decreases in availability.

5.2 Labor savings through DX

By replacing visual inspections with AI-based image diagnostics, leveraging sensor-based measurements for anomaly detection, and substituting wear and dimensional measurement with sensor-based data, maintenance can be performed with fewer personnel than conventional methods, without relying on the skills of experienced technicians.

5.3 Efficiency improvement through data-driven approaches

The transition from paper and handwritten records to digital historical data using mobile terminals, combined with the accumulation, analysis, and evaluation of long-term data, such as wear and dimensional measurement data from sensors and part replacement records, enables the determination of optimal maintenance and timing for equipment replacement. This allows for planned part replacement and the optimization of spare parts inventory.

6. Future outlook

Prismo was developed with a primary focus on overseas airports and emerging cities where demand for new routes is high. Consequently, it was designed with standard specifications for international markets, featuring a larger vehicle size than the specifications for the Japanese market and a transport capacity of approximately 100 passengers per car.

However, following the announcement of Prismo in 2025, MHI has received more inquiries and requests for information than anticipated from various local governments, operators, and think tanks, revealing a clear demand for new domestic route projects as well.

Common feedback from these stakeholders indicates high expectations for Prismo's aforementioned key features: the reduction in construction volume and maintenance workload through the elimination of the power supply rail and the adoption of the center-guideway system, environmental performance that meets decarbonization needs, and operational continuity free from power supply rails-related disruptions. Furthermore, MHI's proven track record of high availability in driverless operation (GoA4) since joining the construction of domestic AGT systems in 1981 has received renewed appreciation.

It is highly significant that such features of Prismo meet urban transport needs and have attracted strong interest. Currently, MHI is conducting adaptability verifications for specific domestic and international projects, and plans to continuously improve Prismo in collaboration with stakeholders through preliminary verification of alignment conditions and operational scenarios at the Mihara Test Tracks, as well as by validating the effectiveness of smart maintenance technologies in practical operations.

Through these efforts, Prismo will mature into a next-generation public transport system contributing to carbon neutrality. MHI will continue to engage with stakeholders and pursue further improvements to ensure Prismo becomes a long-lasting and valued presence both domestically and internationally.

Prismo® and Urbanismo® are registered trademarks of Mitsubishi Heavy Industries, Ltd. in Japan.

References

- (1) U.S. Department of Transportation Federal Transit Administration, Public Transportation's Role in Responding to Climate Change, 2010