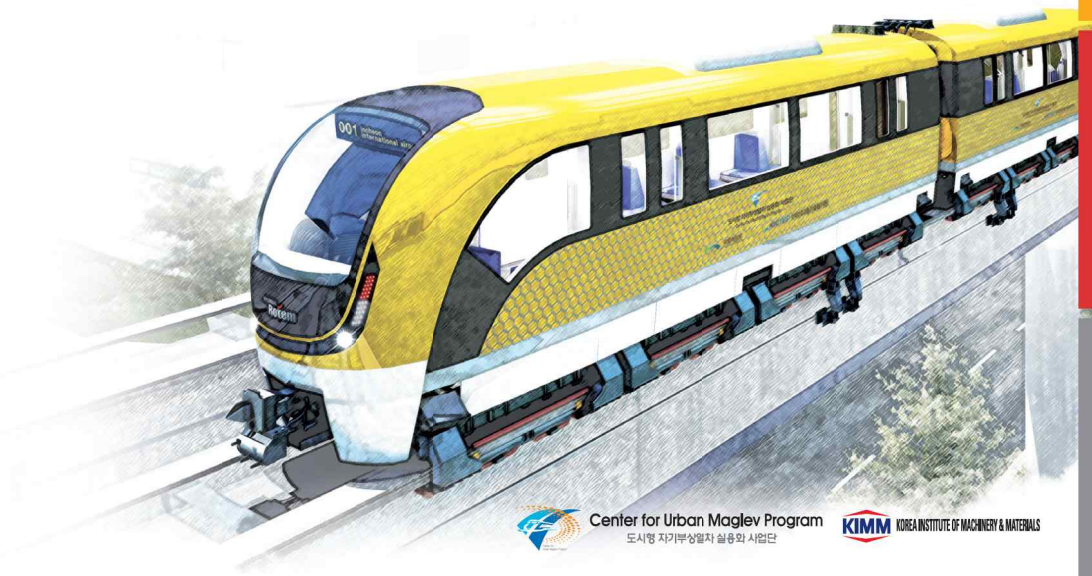
Center for Urban Maglev Program
도시형 자기부상열차 실용화 사업단
KIMM KOREA INSTITUTE OF MACHINERY & MATERIALS

171 Jang-dong, Yuseong-gu, Daejeon, 305-343, Korea
Center for Urban Maglev Program, Korea Institute of Machinery & Materials
TEL +82-42-868-7823, 868-7821 http://www.maglev.re.kr

MLTM
KICTEP
Korea Institute of Construction & Transportation Technology Evaluation and Planning

Urban Maglev Program

도시형 자기부상열차 실용화 사업



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Connecting to your Dream

The longer you stay on a road, the more people you encounter.
The more people you meet, the more dreams you come across.
Dreams for a safer and more comfortable world, and
a greener and happier world.
We all make a journey for the dreams.

In 2013, Korea will become the world's second country to operate the Urban Maglev System with the inauguration of Demonstration Line at the Incheon International Airport.

The Center for Urban Maglev Program will help you make your dreams come true.

CONTENTS

ADVANCE

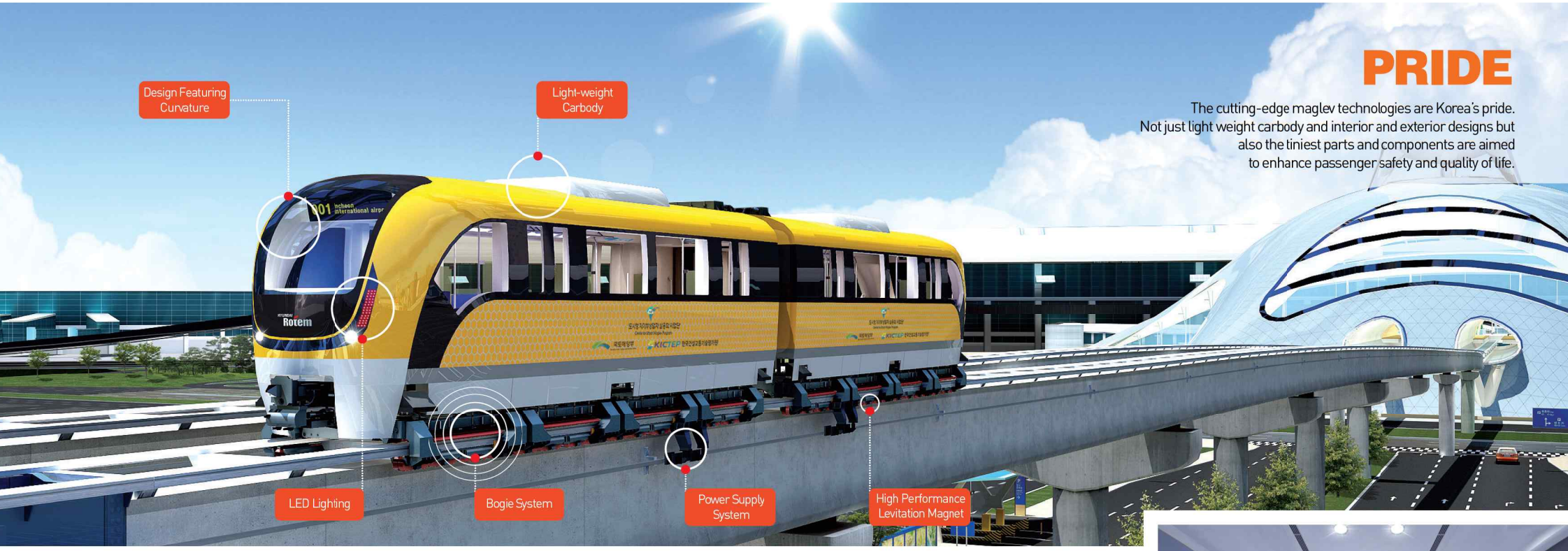
The Urban Maglev System shows us of the future of transportation that we have all dreamed of.
The Center for Urban Maglev Program is building a state-of-the-art system for public transportation with cutting-edge technologies for more pleasant, comfortable and eco-friendly services.

Urban Maglev Vehicle Specifications

- Train configuration : 2 cars per train (standard), more cars can be connected
- Car dimensions : Length 12m / width 2.7m / height 3.45m
- Passenger capacity : 230 persons/train
- Maximum speed : 110km/h
- Operation : ATO/driverless
- Cabin noise : Below 65dBA
- Air gap : 8mm
- Gauge : 1,850mm
- Minimum horizontal curve radius : 50m
- Maximum climbing capability : 7%
- Power supply : DC 1,500V Third Rail System
- Acceleration : 4.0km/h/s
- Deceleration : 4.0km/h/s (in Service), 4.5km/h/s (in Emergency)
- Misted windows for privacy protection (urban areas)

PRIDE

The cutting-edge maglev technologies are Korea's pride.
Not just light weight carbody and interior and exterior designs but also the tiniest parts and components are aimed to enhance passenger safety and quality of life.



Characteristics of Urban Maglev Vehicles

Design Featuring Curvature
– Unique design by incorporating the elegant curvature of traditional celadon which is one of the aspects of Korean traditional beauty, and the honeycomb pattern showing the up-to-the-minute technology.

LED Lighting
– The lighting system is entirely composed of LEDs to save energy.

Light-weight Carbody
– Carbody weight has been reduced with the Single Skin Aluminum Extrusion Technology.

Bogie System
– Advanced steering mechanism provides excellent curve running performance.

High Performance Levitation Magnet
– Long pole levitaton magnet system reduces drag force while providing levitation and running stability.

Brake System
– Electro-hydraulic and pneumatic braking provides excellent braking performance.

Propulsion System
– Optimized control algorithm provides enhanced running performance and environment-friendliness with minimized noise.

Misted Windows
– Window shading function protects the privacy of urban resicents.

Super-light-weight High Quality Seats
– Seat arrangement is customized for airport application.
– Super-light-weight cushions are highly resistant against flame and wear.

Plug-in Type Door
– The door system provides excellent soundproofing and heat insulation performance.

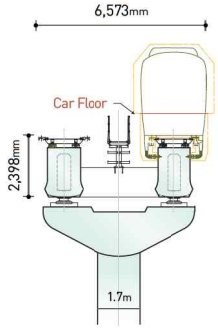
Auxiliary Power System for Emergency Situations
– Stable levitation is maintained for at least 30seconds after power failure.
– The backup battery system is eco-friendly and easy to maintain.

LANDMARK

The slim guideway structure is designed for a perfect harmony with urban landscapes. The low-noise maglev requires no soundproof wall. Its environment-friendly low-vibration system and highly refined designs make the maglev service a main attraction of the urban area where it is offered.

Characteristics of Urban Maglev Guideway Structure

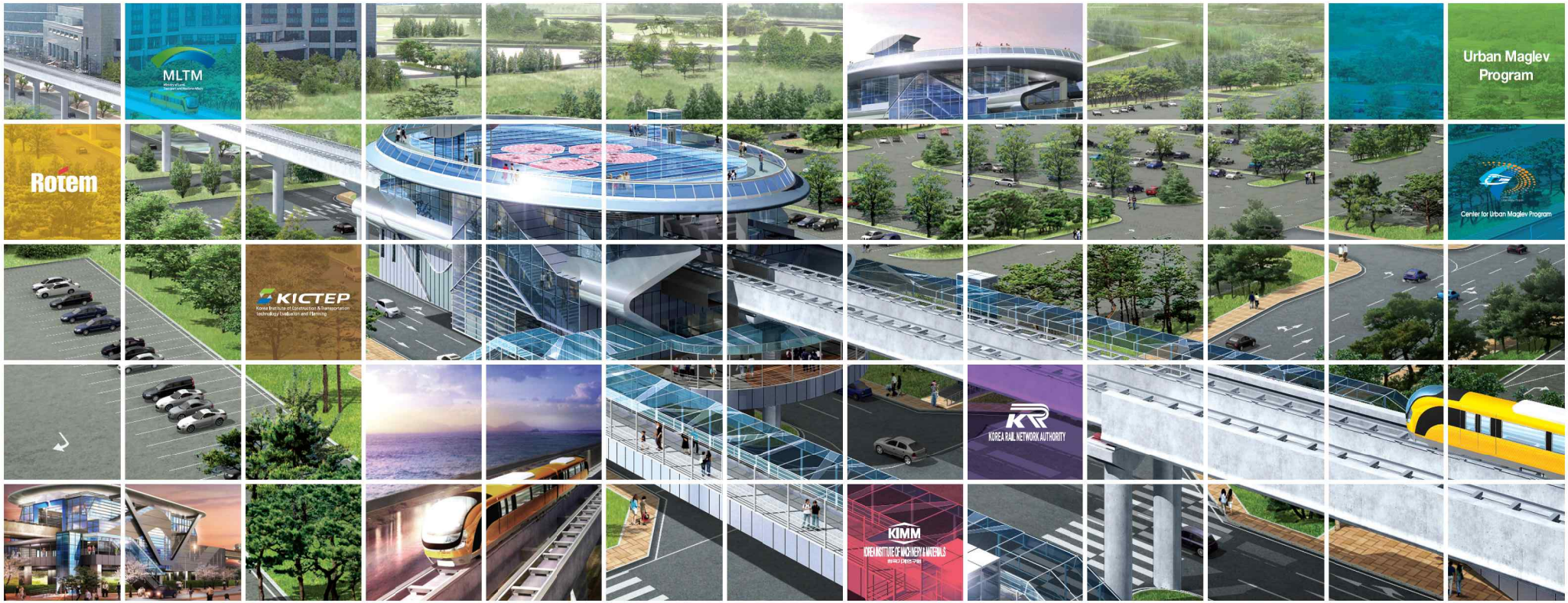
- Construction cost is reduced by girder-type, slab-free structure.
- The catenary lines are installed on the side of the girders to give minimal impact to the aesthetic perspective.
- Negligible noise or vibration during operation disposes of the need for vibration and noise prevention measures such as soundproof walls.
- A notable landmark characterized by a slim structure that harmonizes with the urban landscape.
- Urban maglev, which is advanced and environment-friendly transportation system, will attract the favor of community.



Incheon International Airport Demonstration Line

Features and Construction Cost

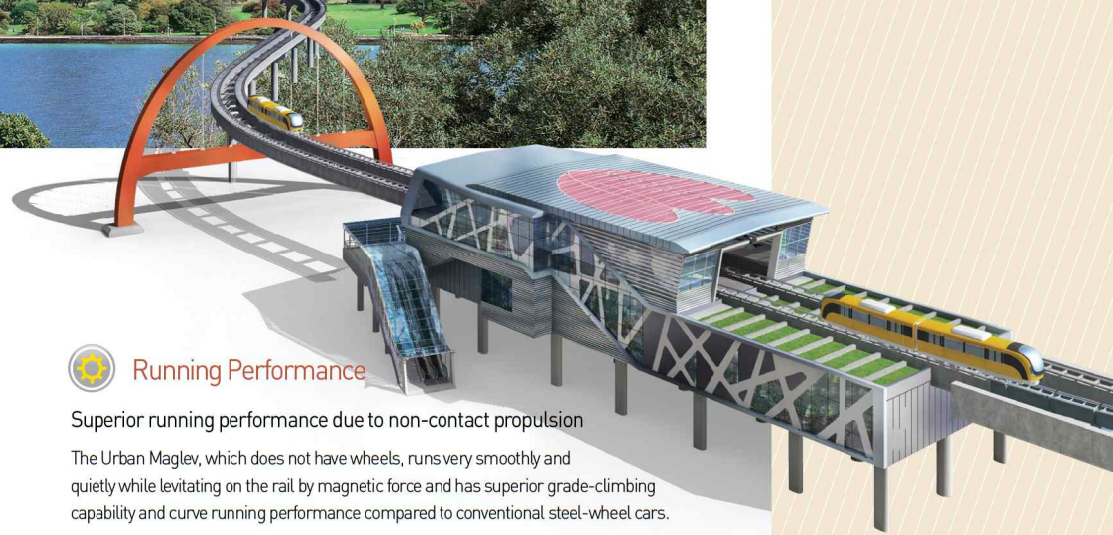
Features	Slabs-free girder only guideway is slim, slender and aesthetically appealing.
Construction Cost	KRW42.7B/km (Estimated design price in 2009)



Maglev trains are not just ordinary trains but wings that help mankind take another leap forward into the future.

Korea's Urban Maglev is a next generation of magnetic levitation system far better than the existing vehicles in comfort, safety and reliability.

The Center for Urban Maglev Program is committed to developing a safer and more comfortable urban transportation system that will enhance the quality of life.



Features of Urban Maglev System

Eco-friendliness

An environment-friendly urban transportation system emitting low noise, low vibration and no pollutants.

The Urban Maglev runs while levitating on the rail, with a cabin noise level of 65dB or less, and without the vibration or pollutants generated by friction between wheel and rail.

Steel Wheel-On-Rail System

Urban Maglev

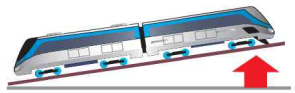
Running Performance

Superior running performance due to non-contact propulsion

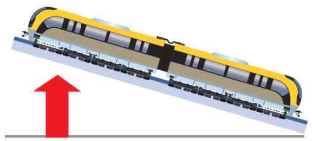
The Urban Maglev, which does not have wheels, runs very smoothly and quietly while levitating on the rail by magnetic force and has superior grade-climbing capability and curve running performance compared to conventional steel-wheel cars.

- Comparison between Urban Maglev and Steel Wheel-On-Rail System

	Steel Wheel-On-Rail System(Subway)	Urban Maglev
Gradeability	Approx. 30/1000	70/1000 or above
Curve Running Performance (min. radius of curvature)	Approx. 150m	50m



Steel Wheel-On-Rail System



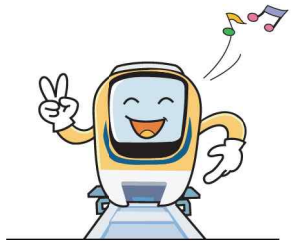
Urban Maglev

Safety

Safe transportation system without the risk of derailment or electromagnetic hazard

The Urban Maglev bogies wrap halfway around the rail, thereby eliminating the risk of derailment or rollover accident.
The electromagnetic field radiation of Urban Maglev to the passengers and environment, in the train, station, track side, etc., is no larger than the level which we experience in everyday life and thus safe for human health.

Steel Wheel-On-Rail System



Urban Maglev

Costs for Construction and Operation

Cost effective construction and operation

Compared with other light rail systems, the Urban Maglev requires similar construction cost and less maintenance and operation cost.

Construction Cost

The construction cost of the Incheon International Airport Demonstration Line is KRW42.7B/km including countermeasures against region specific conditions (poor subsoil, salt injury) and the characteristics of the route. However, in ordinary cities, the cost should not exceed KRW40B/km.

※ Cost of other light rail systems under construction in Korea: KRW40-50B/km

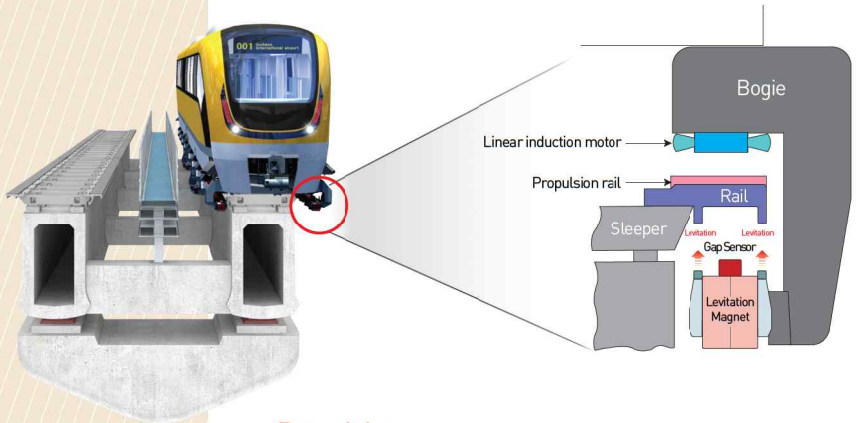
Operational Cost

The Urban Maglev has no consumable parts such as wheels, gears or bearings. Therefore, maintenance and labor costs, which account for about 80% of the total operational costs, can be minimized.
Compared with wheel-based light rail systems, more efficient operation can be implemented at a lower cost.

Technologies of Urban Maglev

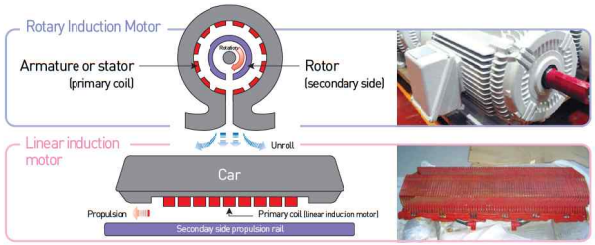
Levitation

When powered, the train's levitation electromagnets generate electromagnetic force to attract the rail, and this force makes the maglev train float over the rail. Gap sensors measure the air gap between the electromagnet and the rail and provide the signal to the levitation controller, which controls the current supply to the magnets to maintain the air gap of 8mm.



Propulsion

The Urban Maglev uses a linear induction motor instead of conventional rotating motors, thus enabling linear motion. The 3-phase AC power supplied to the linear motor induces electric current in the propulsion rail made of aluminum, which generates propulsion force by electromagnetically interacting with the motor current. The train's running speed is controlled by varying the frequency of the input current to the motor.



Worldwide Developments

Germany

- Commenced development in 1969
- High speed type : 450km/h (Electromagnetic Suspension type levitation using conventional electromagnets)
- Application : Shanghai, China (30km, January 2004)

Japan

- Commenced development in 1974
- Medium/Low speed type : 100km/h (Electromagnetic Suspension type levitation using conventional electromagnets)
- Application : Nagoya, Japan (9km, March 2005)

※ **High speed type(MLX)** : Commenced development in 1970, 500km/h and above (Repulsive levitation using superconducting electromagnets)

China

- Commenced development in 2000
- Medium/Low speed type : 100km/h class (Electromagnetic Suspension type levitation using conventional electromagnets)
- Development phase : pilot system under testing

Korea

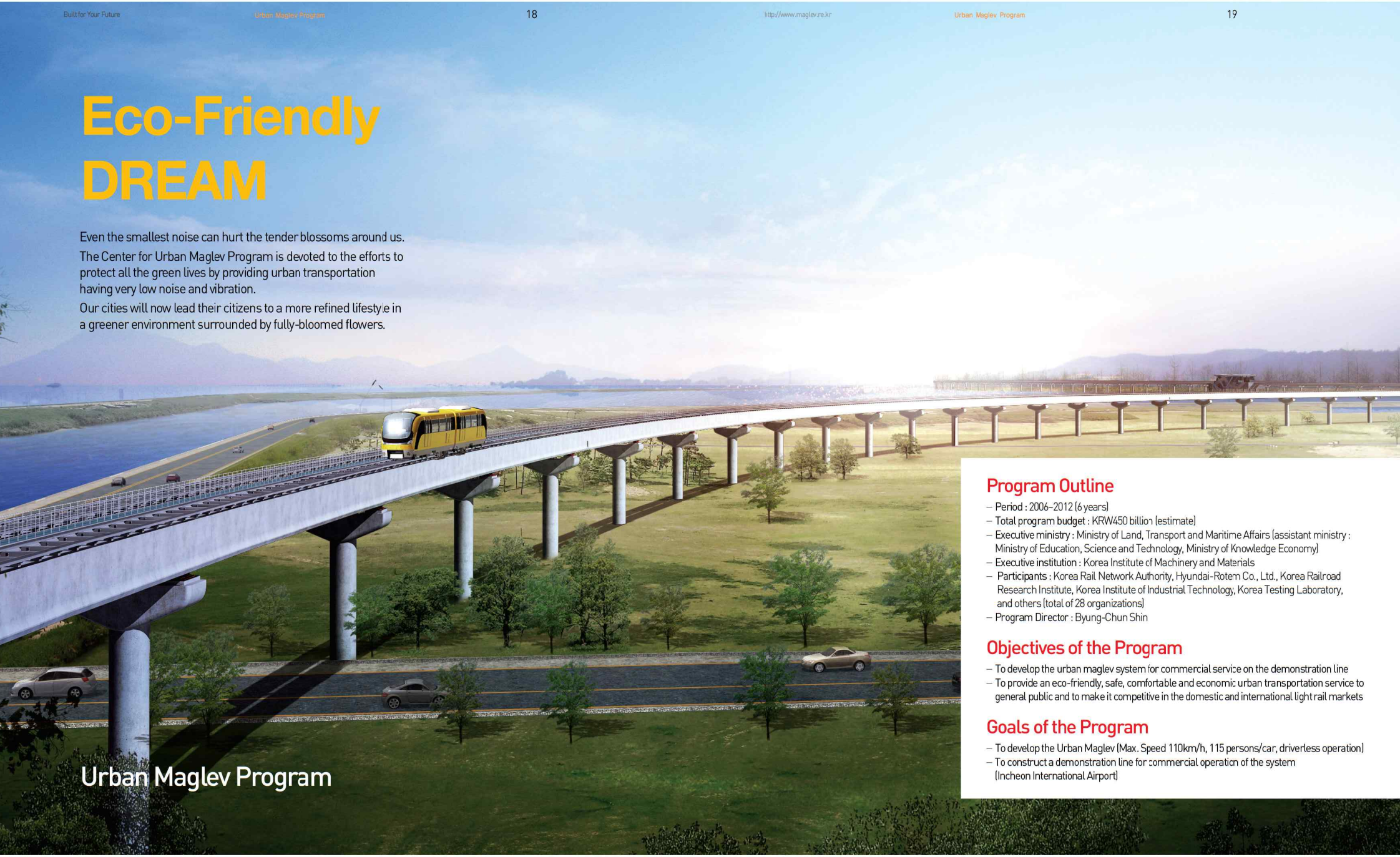
- Commenced development in 1989
- Medium/Low speed type : 110km/h (Electromagnetic Suspension type levitation using conventional electromagnets)

U.S.A

- Commenced development in 1995
- Medium/Low speed type : 100km/h (Repulsive levitation using permanent magnets)
- Development phase

Eco-Friendly DREAM

Even the smallest noise can hurt the tender blossoms around us.
The Center for Urban Maglev Program is devoted to the efforts to protect all the green lives by providing urban transportation having very low noise and vibration.
Our cities will now lead their citizens to a more refined lifestyle in a greener environment surrounded by fully-bloomed flowers.



Urban Maglev Program

Program Outline

- Period : 2006~2012 (6 years)
- Total program budget : KRW450 billion (estimate)
- Executive ministry : Ministry of Land, Transport and Maritime Affairs (assistant ministry : Ministry of Education, Science and Technology, Ministry of Knowledge Economy)
- Executive institution : Korea Institute of Machinery and Materials
- Participants : Korea Rail Network Authority, Hyundai-Rotem Co., Ltd., Korea Railroad Research Institute, Korea Institute of Industrial Technology, Korea Testing Laboratory, and others (total of 28 organizations)
- Program Director : Byung-Chun Shin

Objectives of the Program

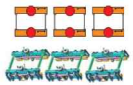
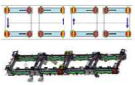
- To develop the urban maglev system for commercial service on the demonstration line
- To provide an eco-friendly, safe, comfortable and economic urban transportation service to general public and to make it competitive in the domestic and international light rail markets

Goals of the Program

- To develop the Urban Maglev (Max. Speed 110km/h, 115 persons/car, driverless operation)
- To construct a demonstration line for commercial operation of the system (Incheon International Airport)

Improvements Achieved by R&D Activities

Improvements of Car Performance

	Existing System at National Science Museum	New System for Incheon International Airport Line	Remarks
Number of Bogies	 3 per car	 4 per car	- Improved curve running performance - Improved anti-vibration performance - Improved ride comfort - Improved levitation stability
Suspension System	2 sets/bogie	4 sets/bogie	
Levitation Air Gap	10mm	8mm	- Power consumption reduced by 36%
Gap Deviation	± 5mm (at 70km/h)	± 3mm (at 110km/h)	- Improved running stability
Levitation Controller	Redundancy not applied	Redundancy applied	- Increased availability
Steering Mechanism	Not applied	Hydraulic cylinder type	
Lateral Displacement Absorption System	Not applied	Sliding Table employed	
Vehicle Weight(Tare)	26.5 tons/car	19 tons/car	- Reduced power consumption

Improved Levitation Stability

System Improvement

– The number of bogies has been increased (3→4bogies/car) and the levitation air gap is reduced (10→8mm).
– Redundancies have been implemented in the levitation controller and electromagnet system.

Improved Components and Algorithm

– The measuring range of the gap sensor has been increased and the control algorithm of the controller has been improved.

Improved Power Supply System

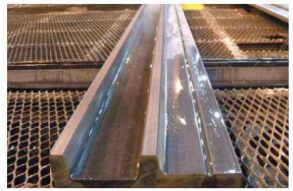
– Independent power supply units have been adopted for each bogey. An emergency backup battery system has been installed.
– The capacity of the power supply system has been increased.

Comparison of Running Performance

– Comparison with the Existing Maglev Systems

Improvement of Guideway Performance

Development of Levitation Rail


Rail production by roll-forming process


Manufacture of curved rails

Development of Articulation Type Turnouts


For left turnout


For center setting


For right turnout

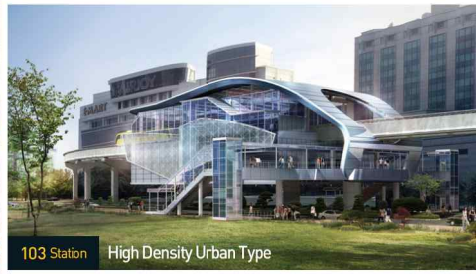
Development of Third Rail System

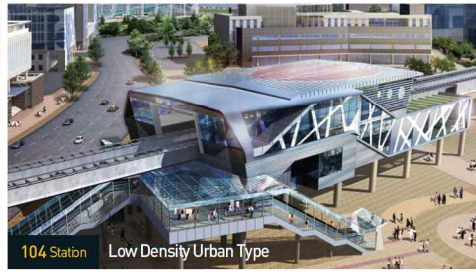
Incheon International Airport Demonstration Line

Outline of Demonstration Line

- Length : Main line (double track)_ L=6.113km and access line_ L=0.380km
- Stations : 6 (island-platform type: 1 / side-platform type: 5)
- Depot : Near the depot of the AREX(Airport Express) Line
  For accommodating and servicing 14 cars (7 trainsets)


102 Station Urban Landmark Type


103 Station High Density Urban Type


104 Station Low Density Urban Type


105 Station Water-side Leisure Type


106 Station Composite Transfer Type