

MENU

[Introduction](#)
[Chairman's Message](#)
[CEO Letter](#)
[Safety](#)
[Customers](#)
[Community](#)


Environment

[Introduction](#)
[Sustainable Resource Use](#)
[Climate Change](#)
[Environmental Protection](#)
[Staff](#)
[Supply Chain](#)
[Financial and Economic Performance](#)
[Corporate Governance](#)
[Building Our Future](#)
[Mainland of China and International Business](#)
[Performance Metrics](#)


ENVIRONMENT

We strive to become one of the most resource-efficient and ecologically sustainable railway and property service companies in the world. This means that we will:

- Increase energy efficiency;
- Use natural resources sustainably; and
- Adapt to climate change.



260

Number of species spotted in Lok Ma Chau wetland



1,355,381 tCO₂

Total GHG emissions

MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

► [Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

INTRODUCTION

We focus our discussion on the railway system given its significant geographical footprint and resource consumption. What we build today may also have a long term impact on the environment. We also include discussion of our property and other businesses especially in relation to resources consumption.

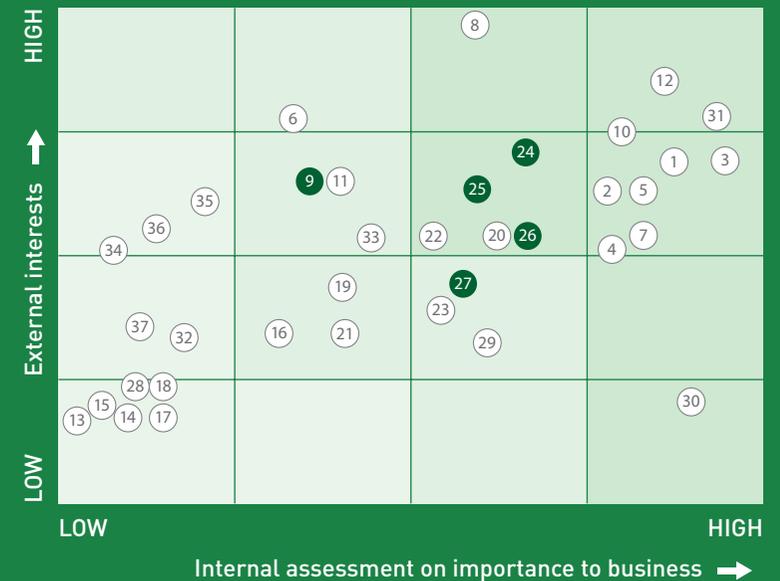
Electrically-powered mass railways are generally acknowledged to be the most environmentally sustainable way to transport the world's growing and urbanising populations. We believe that our most significant contributions to the environment arise from impacts that do not occur as a result of our services. Due to its large capacity, MTR has displaced much road transport with the benefits of cleaner air, less congested roads and makes better use of limited land resources than would otherwise be the case.

In support of this view, the International Association of Public Transport (UITP) and management consultancy Arthur D. Little concluded that Hong Kong has "the most advanced urban system in the world" and ranks first in terms of low carbon transport.

LEARN MORE...

Download a copy of [Future of Urban Mobility 2.0](#) to read more about the findings published by Arthur D. Little and UITP in January 2014, including an updated version of the Urban Mobility Index covering 84 cities.

MATERIALITY ISSUES COVERED IN THIS CHAPTER



- ⑨ Sustainable products & services
- ②④ Prevention of pollution (air, water & waste)
- ②⑤ Sustainable resource use (resource efficiency & water use)
- ②⑥ Climate change
- ②⑦ Biodiversity

MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community

Environment

Introduction

Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

DID YOU KNOW?

How many vehicles does it take to carry the same number of passengers in a MTR train at full capacity?

1 MTR Train



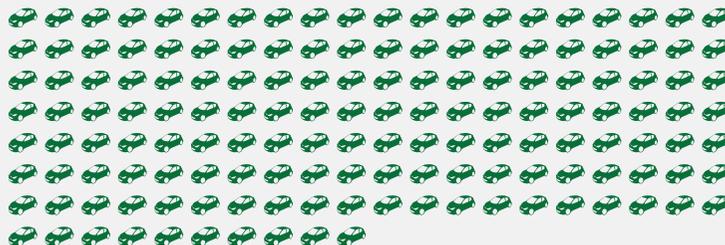
25 Buses



150 Mini-buses



1,500 Cars



Assumptions: 1-2 passenger per car; 16 passengers per minibus; 100 passengers per bus; and 2,500 passengers in 1 train

Management Approach

GUIDING STRUCTURE

Our Commitment and Policies

- Our **Climate Change Statement** – acknowledges that climate change is affecting Hong Kong and other locations where we operate. We are committed to mitigating climate change by providing low carbon transport and lifestyle opportunities for customers and communities, and also to adapting to climate change in order to ensure safe, reliable and efficient delivery of our services in years to come.
- Our **Corporate Biodiversity Policy** commits us to safeguarding ecologically sensitive areas. Under this policy, we have integrated biodiversity considerations into our Environmental Management Systems. An example is our management of the Lok Ma Chau wetland.
- Our **Green Procurement Policy** incorporates principles for responsible management of natural resources.

Managing risk

Risks associated with the environment are subject to regular assessment by our Enterprise Risk Committee. In the case of climate change for example, we distinguish between direct risks that impact service delivery, asset management, staff, and customers, and indirect risks that affect our supply chain, and the communities that we serve.

MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

► [Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Energy efficiency

We have been a signatory of the World Business Council for Sustainable Development (WBCSD) Manifesto for Energy Efficiency in Buildings since October 2012. When it comes to energy efficiency, we strive to go beyond regulatory compliance.

LEARN MORE...

According to the Electrical and Mechanical Services Department, buildings account for about 90% of total energy consumption in Hong Kong. The regulatory framework governing energy efficiency in Hong Kong comprises the [Building Energy Efficiency Ordinance](#) and [Building Energy Code](#).

DID YOU KNOW?

MTR's Inaugural Green Bond Issuance

In 2016, we issued our first ever Green Bond. The issuance of the green bond allows us to tap into a new and fast growing investor base, provides cost effective financing to invest in environmentally friendly service and network enhancement, and supports the development of Hong Kong as a regional green finance hub. Refer to the [Green Bond section](#) for more information.

KEY PROCESSES

Environmental Management Systems

Our Environmental Management Systems (EMS), which are designed and certified to the standard of ISO 14001:2004, support our teams ranging from the Operations, Projects and Property Divisions (through selected MTR managed properties) to estate management to identify environmental impacts and achieve continuous improvement. Our transport operations have achieved the new ISO 14001: 2015 certification; other business units will commence the transition as needed.

LEARN MORE...

[ISO 14001](#) provides a framework that any company or organisation can follow to set up an effective environmental management system, and improve their environmental performance. Amongst other changes, the latest edition issued in 2015, requires environmental management to be more integrated with the organisation's strategy, and focus on life-cycle environmental considerations.

Internal Working Groups

To ensure that we adequately minimise the environmental impact of our businesses, we have set-up relevant environmental working groups across the Company. For example, we have formal and ad hoc working groups on overall environmental management, energy, water, waste and food waste. On the construction of our new railway lines, we have specific environmental teams assigned to manage environmental issues for each line.

Environmental Impact Assessment

We follow a statutory process of Environmental Impact Assessment (EIA) for new projects involving impact avoidance, minimisation and mitigation recommendation. The process also involves public consultation, and expert review when needed. Based on the outcomes of this process, environmental permits issued by the Environmental Protection Department specify conditions that must be complied with throughout the lifespan of our projects, including control and monitoring of environmental impacts relating to noise, water quality, air quality, waste disposal and ecology, to name a few.

Working with Stakeholders on the New Lines

As part of our new railway lines engagement, our Continuous Environmental Improvement Programme (CEIP) provides a platform for knowledge sharing among our construction and environmental staff as well as our consultants, contractors, and relevant government officials.

We also conduct regular engagements with environmental NGOs to update them on the environmental aspects of the construction of the new lines.

MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

SUSTAINABLE RESOURCE USE

In 2016, we purchased over 1,940 GWh from Hong Kong's two electricity providers, representing about 4% of Hong Kong's total energy consumption. Heavy rail accounts for the vast majority, or about 76%, of the electricity that we consume, with our Property Division also representing about 21% of our total electricity consumption. This calculation includes all properties that we own and manage, but only takes account of energy use that we control in those properties (i.e. it does not reflect energy consumed by our tenants).

Electricity consumption (MWh)

	2015	2016
Total	1,954,893	1,948,421
Railway Operations	1,541,108	1,542,581
Heavy Rail (Share of total)	1,486,014 (76%)	1,487,354 (76%)
Light Rail and Bus (Share of total)	55,094 (3%)	55,227 (3%)
Properties (Share of total)	413,785 (21%)	405,840 (21%)

Energy efficiency

Purchased electricity represents our largest non-staff operating cost. Even without taking into account the environmental benefits of consuming less energy, the cost consideration alone provides an important incentive to seek out innovative ways to improve energy efficiency.

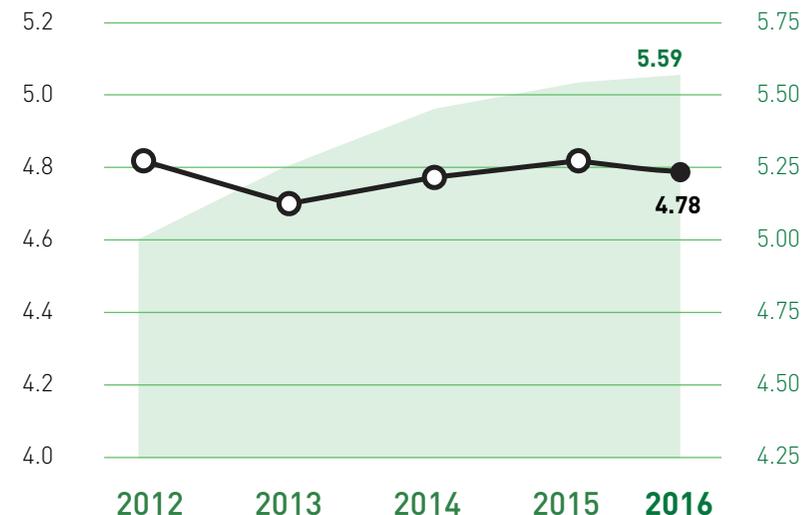
We normalise electricity consumption in two ways in order to evaluate our performance on energy efficiency:

- Electricity use per revenue car km (as illustrated in the chart)
- Electricity use per passenger km on heavy rail operations

ELECTRICITY EFFICIENCY RATIO OF RAIL ASSETS (HONG KONG)

Electricity consumption per revenue car km (KWh/car km)

Passenger trips (weekday average in millions)



By 2020, our target is to reduce by 21% the amount of electricity consumed per passenger-kilometre in our heavy rail network compared with 2008 levels, the first full year after the merger of the rail operations. While patronage in our heavy rail system continued to increase, train frequency has been increased and hence electricity consumption as well. We have now recorded a 16.1% reduction of electricity intensity compared with the baseline from 2008.

For our investment properties, we focus our energy efficiency improvements in older building stocks. In 2013, we set a target to reduce energy use for our investment properties portfolio by 12% by 2023. As of end-2016, we have achieved a reduction of 8% with 2013 as baseline.

MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

▶ [Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Trends in electricity supply

In Hong Kong, our choice of energy suppliers is restricted to two vertically-integrated companies that are regulated by the Government under a Scheme of Control Agreement (SCA) that is valid until 2033. We anticipate that in the coming years the cost of our electricity will rise on account of tariffs being adjusted to reflect developments in energy markets, including the impact of environmental policies.

During 2015, we participated in a consultation exercise organised by the Environment Bureau to consider the future arrangements of the SCA in Hong Kong. We reiterated our views for the Government to continue to find an appropriate balance between the objectives of safety, reliability, affordability, and environmental protection. To reinforce the introduction of renewable energy and demand side management measures, we also suggested that the Government provide more financial support to the private sector beyond tax incentives.

LEARN MORE...

Information about the regulatory framework governing the supply of electricity in Hong Kong is available from the [Environment Bureau](#).

Energy Saving Measures

We have implemented many initiatives to save energy over the years and continue to find new ways to reduce consumption in all areas of our business.

At the procurement phase of our new railway lines, we implement a lifecycle cost assessment with our potential suppliers. This assessment enables us to embed energy saving technologies as early as possible, ensuring energy efficient operations at the onset. Find out more in our [case study on train procurement](#).

In our railway operations, our Energy Management Working Group explores energy efficiency initiatives, including promoting energy conservation amongst staff. At our malls, comprehensive energy saving plans have been established including promotion of energy conservation with staff, tenants, contractors and the public. In 2016, we were awarded for our energy saving efforts with the GREEN PLUS Award in Hong Kong. The GREEN PLUS programme is a collaborative platform that recognises energy efficiency and conservation:

- Railway Operations and The Palazzo received the Grand Award
 - » Prestige Honour Awards for their initiatives; continuing efforts in implementing new energy saving initiatives;
- The Cullinan won the Gold Award in the Property Management (Residential category) and MTR malls received the Joint Energy Saving Award, which recognised the Company's efforts in energy saving.

We are also supportive of Government's initiatives, being amongst the pioneering signatory. These include:

- The Energy Saving Charter – voluntarily setting the average indoor temperatures at MTR Headquarters and common areas of office buildings and shopping malls under our management to 24–26°C during summer months
- Charter for External Lighting – switching off external non-essential lighting after midnight daily

This infographic on the next page brings together our initiatives into a concise summary. Please click on the different parts of the diagram to learn more about what we are doing in each area.

MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives

View by:

✓ STATIONS

✓ TRAINS AND TRACKS

✓ PROPERTIES



MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

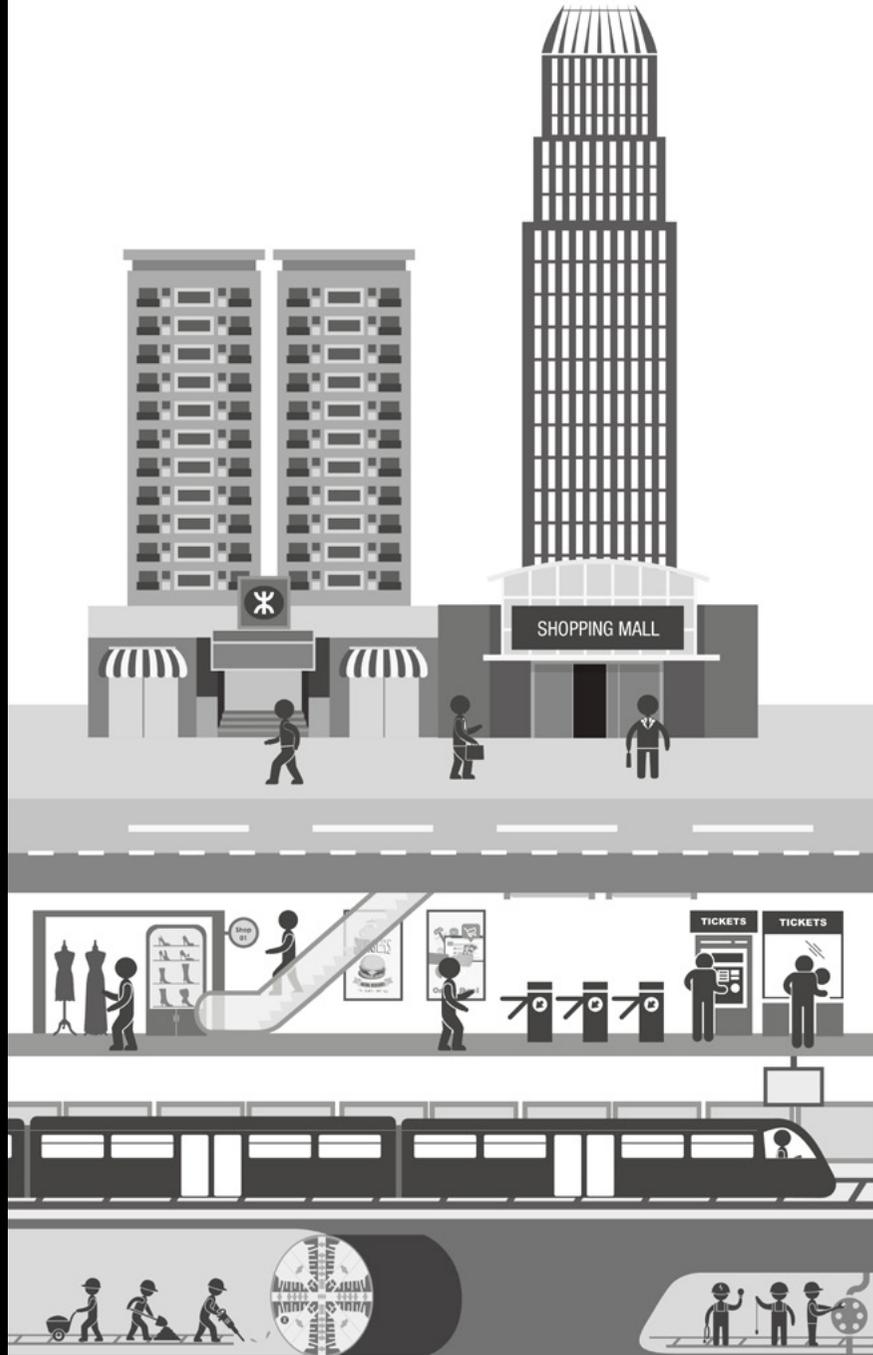
Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

STATIONS

TRAINS AND TRACKS

PROPERTIES

Platform Screen Doors



Winter Full Exhaust Mode



Environmental Control System



Energy-saving Lighting



Escalator Energy Saving Mode



MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

▶ Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

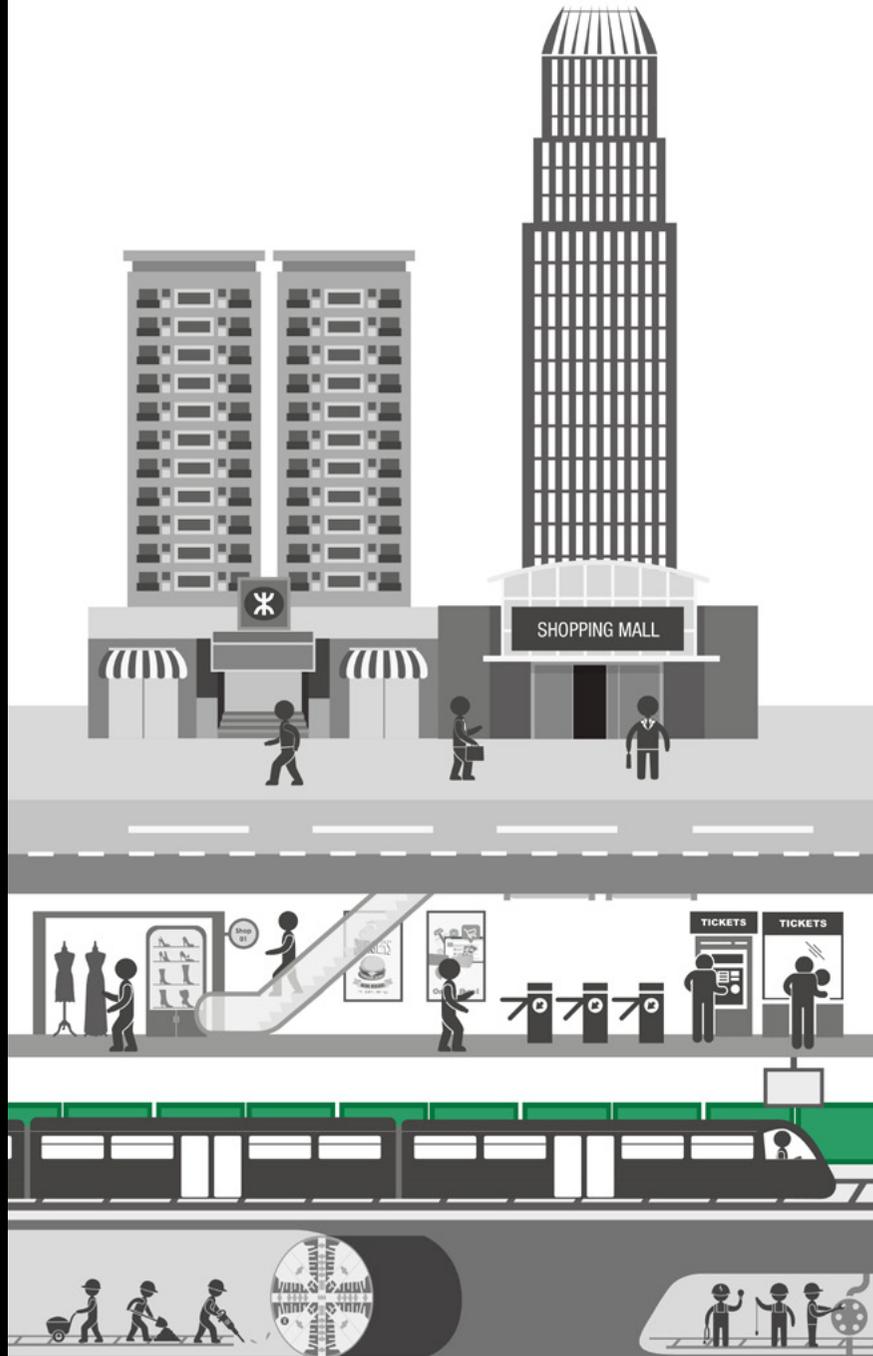
Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

^ STATIONS

✓ TRAINS AND TRACKS

✓ PROPERTIES

Platform Screen Doors



Minimise the cooling volume on platforms and to reduce the piston effect, whereby moving trains pull cooled air from the station into the tunnel and push hot air from the tunnel into the station.

Winter Full Exhaust Mode



Environmental Control System



Energy-saving Lighting



Escalator Energy Saving Mode



MENU

[Introduction](#)
[Chairman's Message](#)
[CEO Letter](#)
[Safety](#)
[Customers](#)
[Community](#)


Environment

[Introduction](#)
[Sustainable Resource Use](#)
[Climate Change](#)
[Environmental Protection](#)
[Staff](#)
[Supply Chain](#)
[Financial and Economic Performance](#)
[Corporate Governance](#)
[Building Our Future](#)
[Mainland of China and International Business](#)
[Performance Metrics](#)

Energy Savings Initiatives



View by:

[^ STATIONS](#)
[v TRAINS AND TRACKS](#)
[v PROPERTIES](#)
[Platform Screen Doors](#)

[Winter Full Exhaust Mode](#)


When the outside temperature is below 22°C, exhaust fans are used to create negative pressure in the station, allowing cool ambient air to be drawn into the station through its entrances to reduce the overall cooling demand.

[Environmental Control System](#)

[Energy-saving Lighting](#)

[Escalator Energy Saving Mode](#)


MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

▶ [Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Energy Savings Initiatives



View by:

∧ STATIONS

✓ TRAINS AND TRACKS

✓ PROPERTIES

Platform Screen Doors



Winter Full Exhaust Mode



Environmental Control System



Variable Frequency Driven (VFD) air handling units are being installed at selected station ventilation systems enabling better energy efficiency. Implementing a life cycle cost assessment, we will also be rolling out our chiller replacement plan in stations from 2017 to 2023, which could reduce our electricity consumption by 30%.

Gradual changes of temperature from station entrances to the concourse and to platforms are designed to reduce overall cooling demand.

Energy-saving Lighting



Escalator Energy Saving Mode



MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

▶ Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

^ STATIONS

✓ TRAINS AND TRACKS

✓ PROPERTIES

Platform Screen Doors



Winter Full Exhaust Mode



Environmental Control System



Energy-saving Lighting



Installation of LED lights in stations, advertising panels, trains, tunnels, and managed properties is on-going. They can achieve energy savings of up to 40% compared to conventional light bulbs, and can last up to 50,000 hours, which is two and a half times longer than conventional bulbs. Our photo-sensor control systems require redundant lights to be switched off automatically on sunny days.

Escalator Energy Saving Mode



MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Energy Savings Initiatives



View by:

[^ STATIONS](#)

[v TRAINS AND TRACKS](#)

[v PROPERTIES](#)

[Platform Screen Doors](#)



[Winter Full Exhaust Mode](#)



[Environmental Control System](#)



[Energy-saving Lighting](#)



[Escalator Energy Saving Mode](#)



Redundant escalators are turned off during non-peak hours.

MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

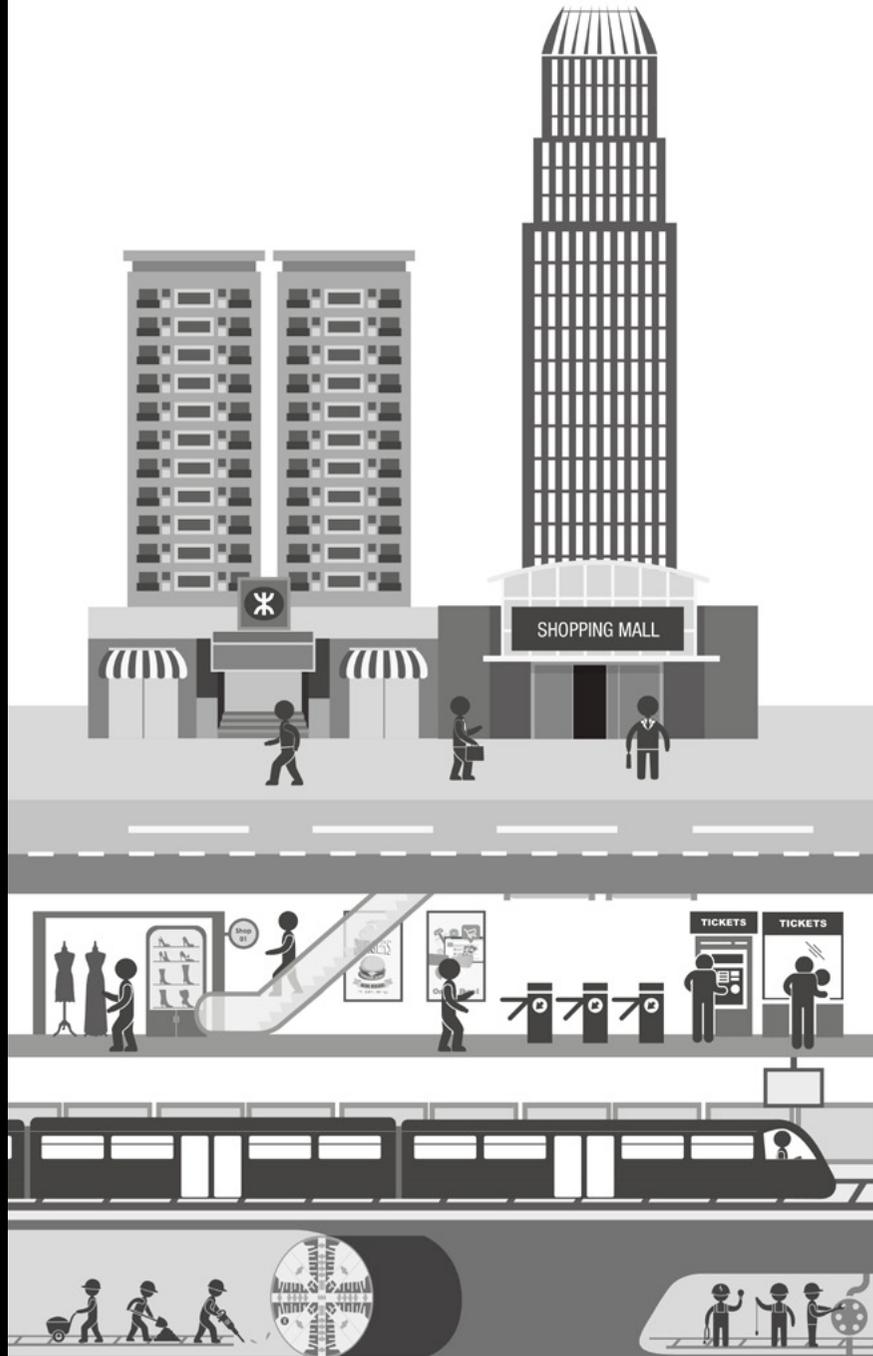
Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

STATIONS

TRAINS AND TRACKS

PROPERTIES

Regenerative Braking

Energy Storage

Train Coasting

Trackside Ventilation Fans

MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

▶ Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

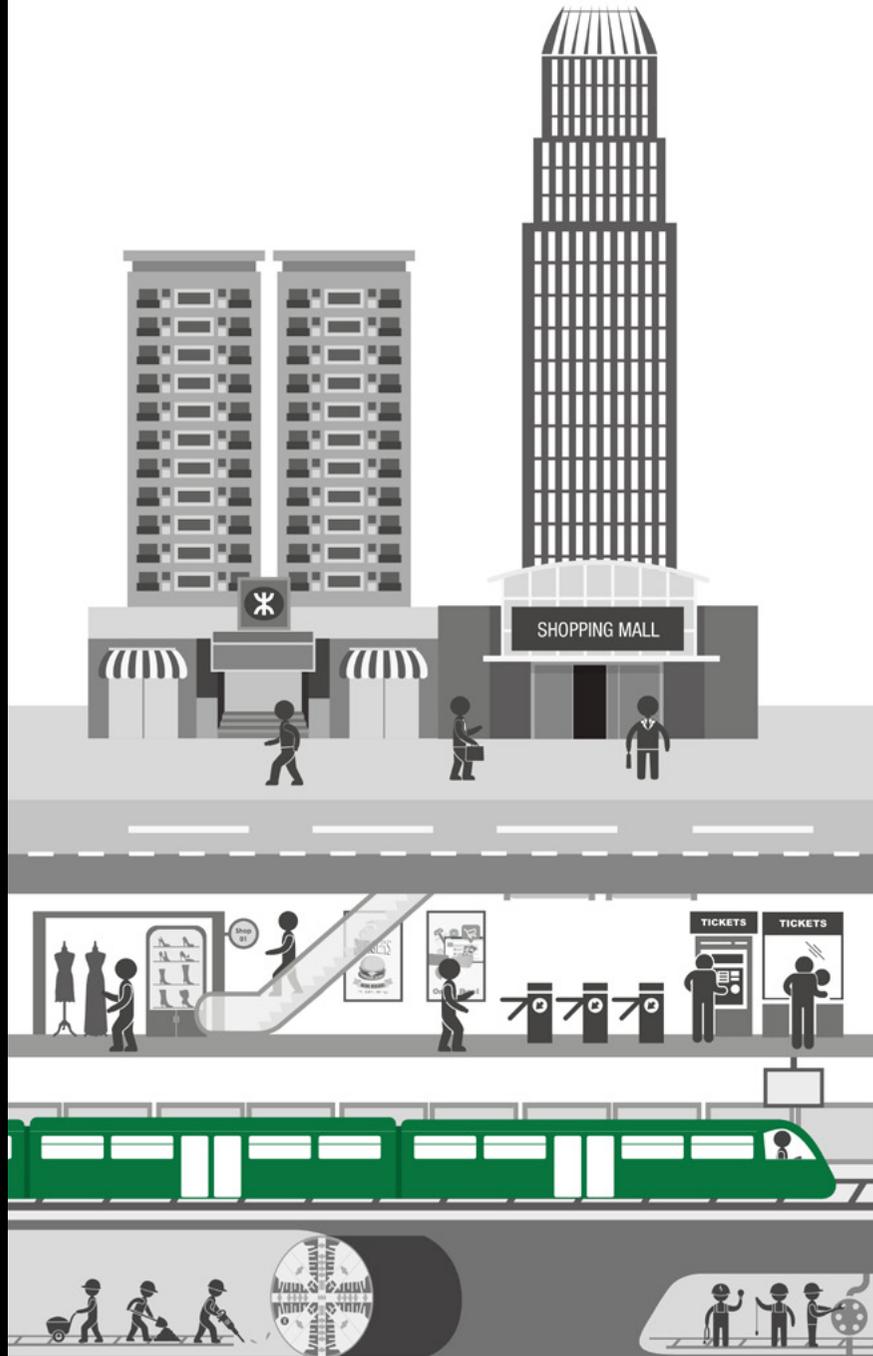
Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

✓ STATIONS

^ TRAINS AND TRACKS

✓ PROPERTIES

Regenerative Braking



We convert kinetic energy from trains when they are braking into electrical energy and feed it back into the power supply network for use by other trains through the overhead power system.

Energy Storage



Train Coasting



Trackside Ventilation Fans



MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

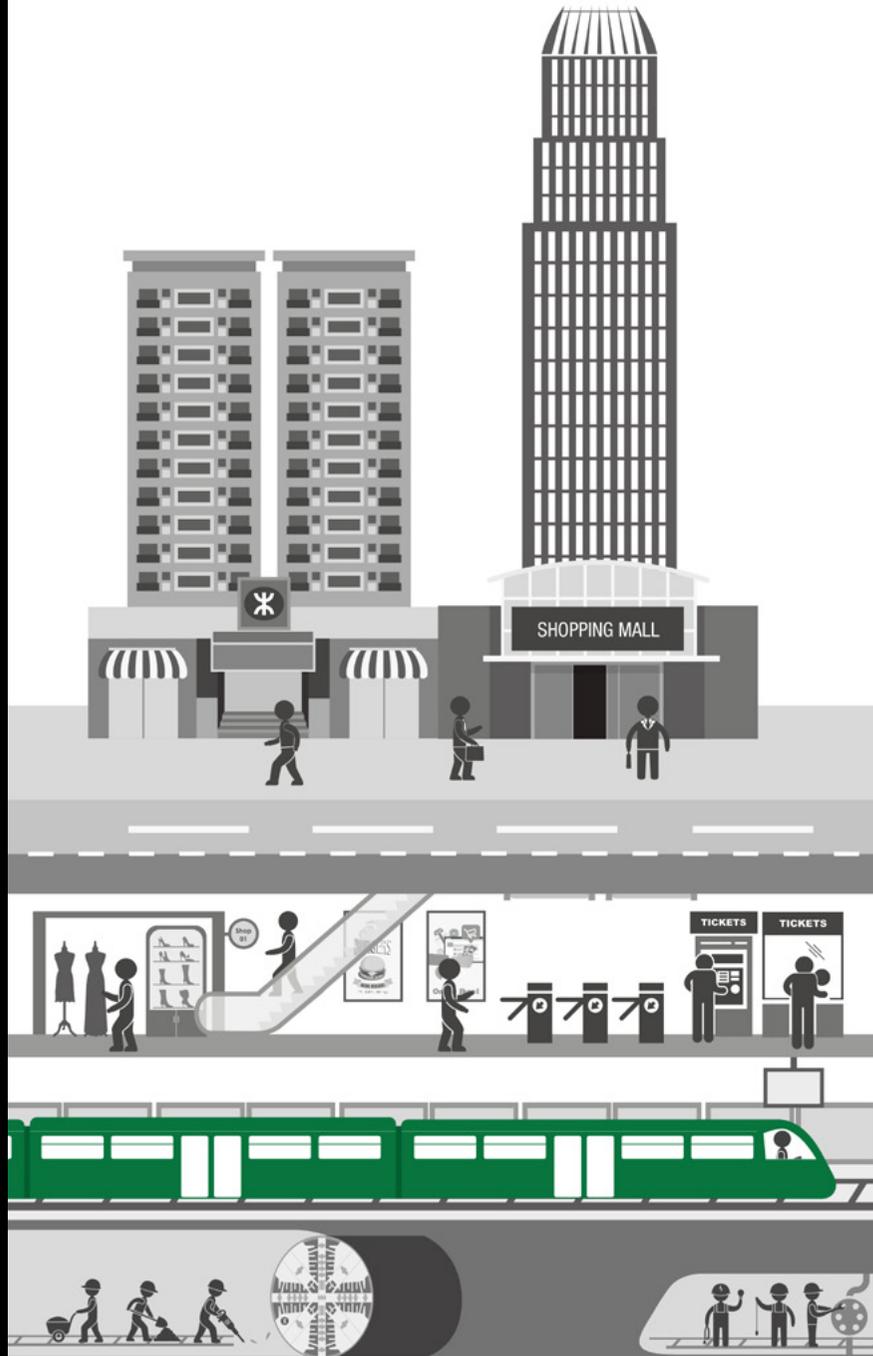
[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Energy Savings Initiatives



View by:

✓ STATIONS

^ TRAINS AND TRACKS

✓ PROPERTIES

Regenerative Braking



Energy Storage



New super-capacitor energy storage devices has been installed in the South Island Line (East). It can better utilise surplus energy produced by train regenerative braking.

Train Coasting



Trackside Ventilation Fans



MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

Staff

[Supply Chain](#)

[Financial and Economic Performance](#)

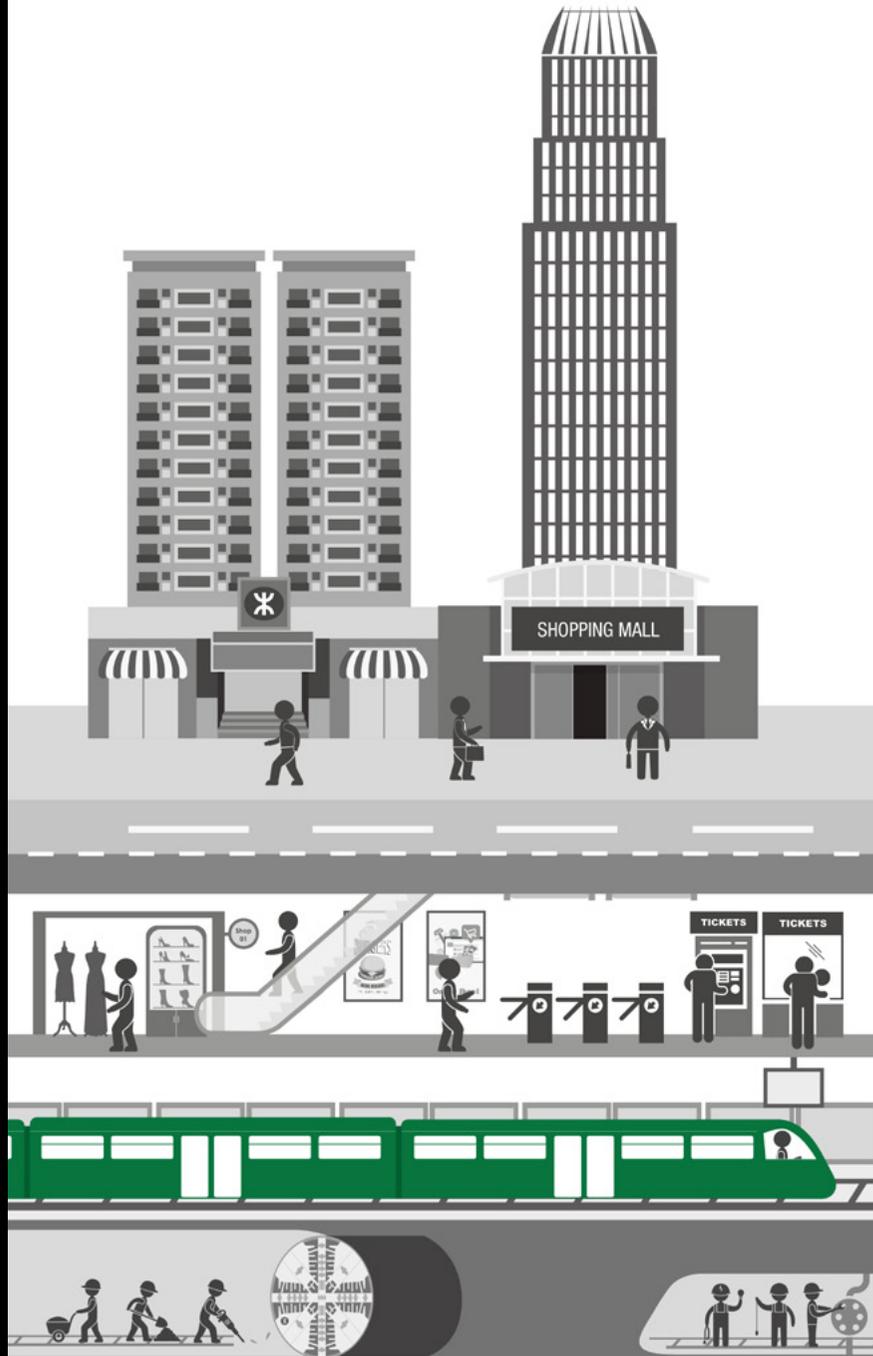
[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Energy Savings Initiatives



View by:

✓ STATIONS

^ TRAINS AND TRACKS

✓ PROPERTIES

Regenerative Braking



Energy Storage



Train Coasting



When trains are going downhill or preparing to slow down for upcoming stations, the driver puts the engine into neutral to save energy.

Trackside Ventilation Fans



MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

▶ [Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

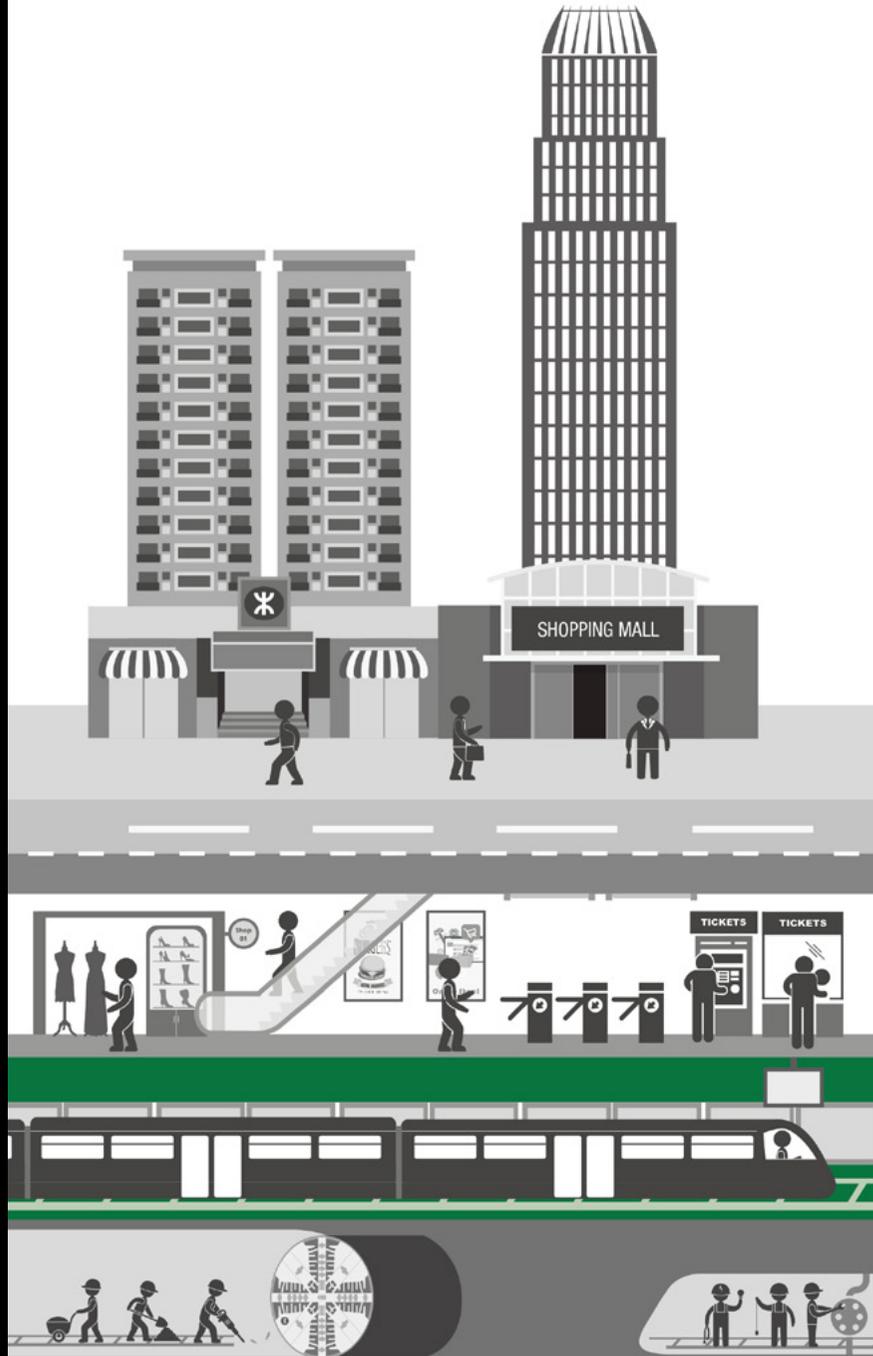
[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Energy Savings Initiatives



View by:

✓ STATIONS

^ TRAINS AND TRACKS

✓ PROPERTIES

Regenerative Braking



Energy Storage



Train Coasting



Trackside Ventilation Fans



Optimised during peak and non-peak hours to maintain trackside temperatures suitable for train operation.

MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

▶ Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

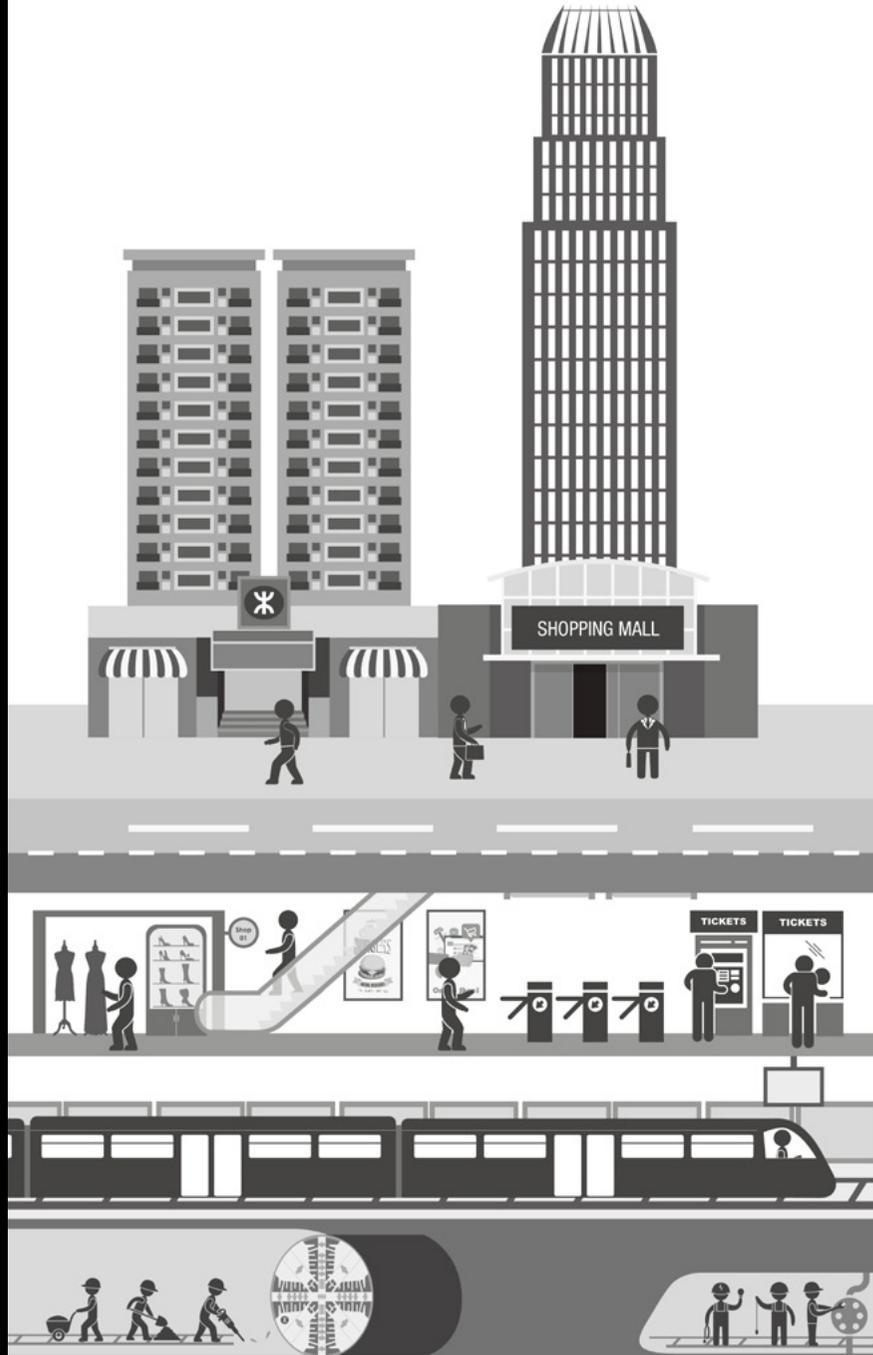
Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

✓ STATIONS

✓ TRAINS AND TRACKS

^ PROPERTIES

Water-cooled air conditioning system with a combination of conventional and oil-free chillers



Air Lock Lobbies and Air Curtains



Adjustment of operating time for energy consumption equipment



Variable Speed Drives



Solar Film



Motion Sensors



Replacement of traditional lamps with LED energy saving lamps



MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

▶ Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

✓ STATIONS

✓ TRAINS AND TRACKS

^ PROPERTIES

Water-cooled air conditioning system with a combination of conventional and oil-free chillers



They are more energy-efficient than traditional air coolers and can save up to 20% in energy use.

Air Lock Lobbies and Air Curtains



Adjustment of operating time for energy consumption equipment



Variable Speed Drives



Solar Film



Motion Sensors



Replacement of traditional lamps with LED energy saving lamps



MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

▶ Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

✓ STATIONS

✓ TRAINS AND TRACKS

^ PROPERTIES

Water-cooled air conditioning system with a combination of conventional and oil-free chillers



Air Lock Lobbies and Air Curtains



Air lock lobbies prevent external hot air from entering and keeping lobbies cool more effectively.

Air curtains are installed to the air-conditioning fresh air unit to enable energy saving.

Adjustment of operating time for energy consumption equipment



Variable Speed Drives



Solar Film



Motion Sensors



Replacement of traditional lamps with LED energy saving lamps



MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Energy Savings Initiatives



View by:

✓ STATIONS

✓ TRAINS AND TRACKS

^ PROPERTIES

Water-cooled air conditioning system with a combination of conventional and oil-free chillers



Air Lock Lobbies and Air Curtains



Adjustment of operating time for energy consumption equipment



Re-adjust the operating time for lighting and chillers at common areas in managed residential estates.

Variable Speed Drives



Solar Film



Motion Sensors



Replacement of traditional lamps with LED energy saving lamps



MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

▶ Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

✓ STATIONS

✓ TRAINS AND TRACKS

^ PROPERTIES

Water-cooled air conditioning system with a combination of conventional and oil-free chillers



Air Lock Lobbies and Air Curtains



Adjustment of operating time for energy consumption equipment



Variable Speed Drives



Installed for air handling units (AHUs) in clubhouse areas and office buildings to save energy in part load conditions.

Solar Film



Motion Sensors



Replacement of traditional lamps with LED energy saving lamps



MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

▶ Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Energy Savings Initiatives



View by:

✓ STATIONS

✓ TRAINS AND TRACKS

^ PROPERTIES

Water-cooled air conditioning system with a combination of conventional and oil-free chillers



Air Lock Lobbies and Air Curtains



Adjustment of operating time for energy consumption equipment



Variable Speed Drives



Solar Film



Applied for large external glass windows in clubhouse areas to reduce solar heat gain.

Motion Sensors



Replacement of traditional lamps with LED energy saving lamps



MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

Staff

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Energy Savings Initiatives



View by:

✓ STATIONS

✓ TRAINS AND TRACKS

^ PROPERTIES

Water-cooled air conditioning system with a combination of conventional and oil-free chillers



Air Lock Lobbies and Air Curtains



Adjustment of operating time for energy consumption equipment



Variable Speed Drives



Solar Film



Motion Sensors



The lighting level is kept at minimum acceptable level in rear staircases to save energy when there is no user.

Replacement of traditional lamps with LED energy saving lamps



MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Energy Savings Initiatives



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Water-cooled air conditioning system with a combination of conventional and oil-free chillers



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Solar Film



Motion Sensors



Replacement of traditional lamps with LED energy saving lamps



Adopt energy efficient LED lightings in driveway uplight, lift lobby spot lights, exit signs, staircase lighting, car park lighting, etc.

MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Green buildings

In 2010, we became the first company involved in property development in Hong Kong to implement voluntary environmental standards in a systematic way with a commitment that our new residential property developments would achieve at minimum the Hong Kong BEAM Plus Gold certification. This is the second highest level in a five-tier system. Where appropriate, we are also implementing BEAM or LEED standards in other properties and railway stations.

As we develop more properties in the coming years, and renovate our existing managed properties, we are planning to install and utilise equipment that will reduce the buildings' environmental impact.

LEARN MORE...

[BEAM Plus](#) is a comprehensive environmental assessment scheme for buildings in Hong Kong recognised by the [Hong Kong Green Building Council](#). The current version for new buildings, BEAM Plus version 1.2, has been available for formal registration since November 2012.

Leadership in Energy and Environmental Design ([LEED](#)) is a set of rating systems developed by the US Green Building Council (USGBC) for the design, construction, operation, and maintenance of green buildings.

Year	Property	Building Standard Awarded
2016	LOHAS Park P6 Site N Residential	BEAM Plus Gold (Provisional Assessment)
2016	LOHAS Park P5 Site G Residential	BEAM Plus Gold (Provisional Assessment)
2016	Tsuen Wan West Station Tsuen Wan 7 Residential	BEAM Platinum
2016	Maritime Square Extension	BEAM Plus Silver (Provisional Assessment)
2016	Austin Site C Residential	BEAM Plus Gold (Final Assessment)
2015	Tsuen Wan West Station Cityside Residential	BEAM Plus Gold (Provisional Assessment)
2015	Tsuen Wan West Station Tsuen Wan 6 Residential	BEAM Plus Gold (Provisional Assessment)
2015	LOHAS Park Site O Residential	BEAM Plus Gold (Provisional Assessment)
2015	Long Ping Station Long Ping North Residential	BEAM Plus Gold (Provisional Assessment)
2014	Tsuen Wan West Station Bayside Residential	BEAM Plus Gold (Provisional Assessment)
2013	Nam Cheong Station Residential	BEAM Plus Gold (Provisional Assessment)
2013	Two IFC	LEED Operations and Maintenance – Gold
2013	University Station Entrance	LEED Core and Shell – Silver
2013	Che Kung Temple Station The Riverpark, Shatin (Residential)	BEAM Platinum
2012	Austin Station Residential Development	BEAM Plus Gold (Provisional Assessment)
2010	West Kowloon Terminus	BEAM Silver

MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

► Sustainable Resource Use

Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Water Consumption

We recognise that consumption and availability of water are important issues for our stakeholders. Hong Kong is dependent on the Dongjiang River basin for up to 80% of its water supply, which is threatened by rapid urbanisation and climate change, among other factors.

All of our water is sourced from the mains supply provided by the Water Supplies Department. The most important uses of water in our railway operations are for cleaning trains, railway infrastructure, and stations. We are using recycled water for toilet flushing in some stations and for train washing in depots.

Water consumption in our Properties

Managed and investment properties account for about 60% of our total water consumption. In recent years, there has been a trend towards greater consumption of water in our properties due to the growing size of our property portfolio and more intensive use of water from landscaping and swimming pools.

Water consumption (m³)

	2015	2016
Total	2,023,116	2,067,096
Railway Operations	870,630	754,541
Cooling Towers in Stations	n/a	187,952
Managed and Investment Properties	1,152,486	1,124,603

We implement measures to conserve water in our managed properties. For example, a grey water recycling system at the LOHAS Park collects and treats up to 440,000 litres of water a day from The Capitol and Le Prestige. The system recycles some of the wastewater for re-use in landscaping and cleaning of outdoor public spaces. Pool covers were used in indoor swimming pools to reduce heat loss and water loss while the swimming pools were not in use at night time during winter.

DID YOU KNOW?

Chiller Replacement Plan – A Balancing Act

The installation of new chillers at Wan Chai Station marked the beginning of our large-scale chiller replacement programme taking place in the next seven years. Starting from the fourth quarter of 2017, a total of 160 chillers in 38 MTR stations and four railway depots will be replaced with more advanced and environmentally friendly systems by 2023.

These new chillers are equipped with variable frequency drive (VFD) inverter technology that can adjust the power capacity based on the actual temperature of the station environment. It will enhance energy efficiency and reach the new Energy Efficiency Grading Standards produced by the Electrical and Mechanical Services Department (EMSD).

In addition, 20 water-cooled chillers will be installed in 6 stations to replace the existing air-cooled chillers to further reduce energy consumption; the downside is that they will inevitably increase fresh water consumption. Water qualities in these chillers needs to be tested and monitored regularly with chemical dosing treatment. Water will be breed-off as needed to maintain hygiene and prevent the spread of infectious diseases. As with many other decisions made, when designing for these new chiller systems, we took these and other factors including energy efficiency, noise level, type of refrigerant used, spare capacity for future expansion, etc., into consideration, and selected the most appropriate chiller type.

MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

Sustainable Resource Use

► Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

CLIMATE CHANGE

Our response to climate change is consistent with the latest recommendations from climate scientists, namely, that adaptation and mitigation are complementary strategies for reducing and managing expected risks.

We fully support the [UITP Declaration on Climate Leadership](#), which is an 11-point declaration outlining the impact of climate change, our responsibility to act, and our commitment to be Climate Leaders.

DID YOU KNOW?

Hong Kong's Climate Action Plan 2030+

On 4 November 2016, the Paris Agreement came into force, succeeding the Kyoto Protocol. The international agreement was adopted by the governments of 195 countries, and set an ambition to keep temperature rise below 2°C, and to make efforts to keep it below 1.5°C with countries to set emission reduction targets.

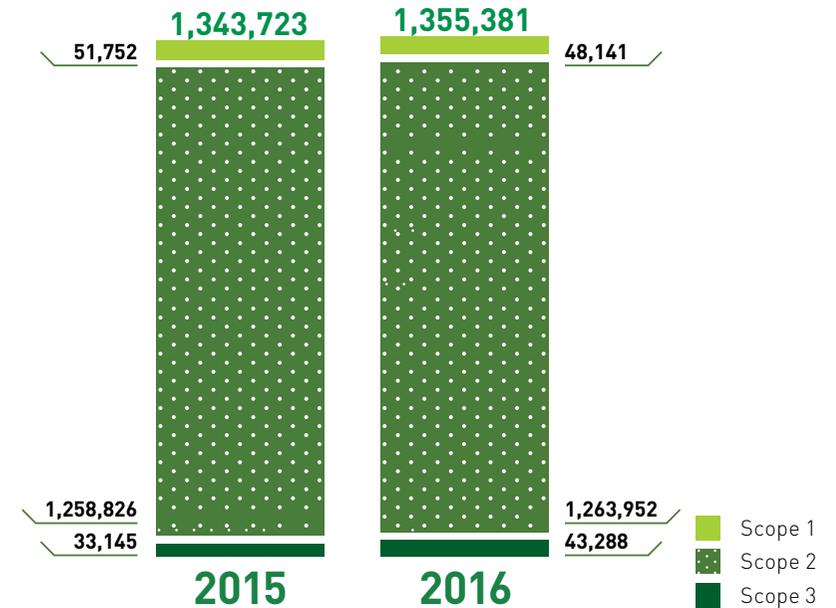
Hong Kong plays a part to help fulfil the obligations that China has under the Paris Agreement. As such, Hong Kong needs to review our climate change efforts every 5 years and align them with the submission timelines under the Paris Agreement. In January 2017, the Hong Kong Government announced its [Climate Action Plan 2030+](#).

The MTR Corporation applauds this milestone. In the past year, we have been supporting the Hong Kong Government's Post-COP 21 engagement sessions, including its discussions with the Hong Kong Building Sector. We will support the Climate Action Plan and promote MTR as an environmentally friendly mode of transport, continue to improve energy efficiency, set targets for our business units and report our progress.

Greenhouse gas emissions

We have been reporting on our Greenhouse Gas (GHG) emissions since 2002. We monitor Scope 1, 2 and 3 GHG emissions in accordance with the [Greenhouse Gas Protocol](#), and also make reference to [guidelines](#) published by the Environmental Protection Department and the Electrical and Mechanical Services Department in Hong Kong as well as other international sources.

GREENHOUSE GAS EMISSIONS (tCO_{2e})



Scope 1 emissions are direct GHG emissions from sources that are owned or controlled by the Company, such as emissions from fossil fuels burned on site.

Scope 2 emissions are indirect GHG emissions resulting from the generation of electricity, heating and cooling, or steam generated off site but purchased by the Company.

Scope 3 emissions include indirect GHG emissions from sources not owned or directly controlled by the Company but related to our activities.

MENU

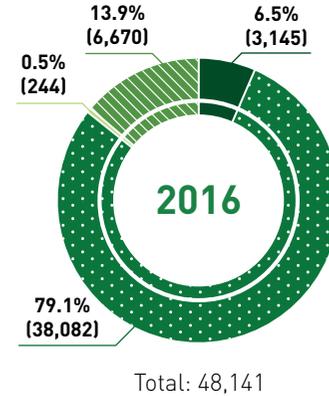
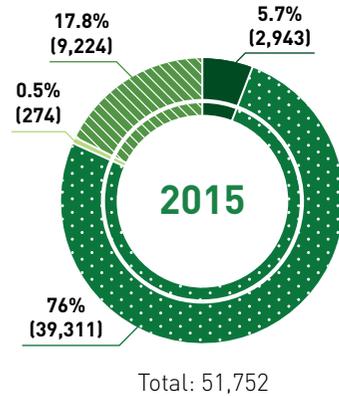
[Introduction](#)
[Chairman's Message](#)
[CEO Letter](#)
[Safety](#)
[Customers](#)
[Community](#)


Environment

[Introduction](#)
[Sustainable Resource Use](#)
[Climate Change](#)
[Environmental Protection](#)
[Staff](#)
[Supply Chain](#)
[Financial and Economic Performance](#)
[Corporate Governance](#)
[Building Our Future](#)
[Mainland of China and International Business](#)
[Performance Metrics](#)

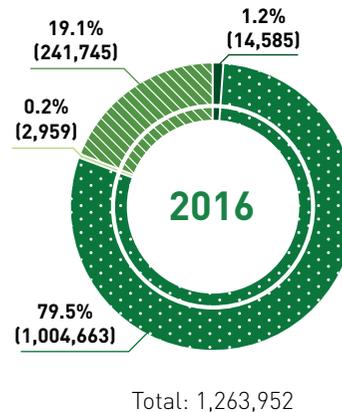
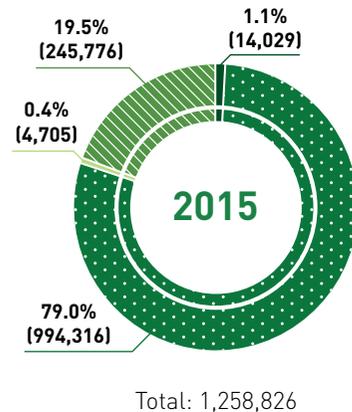
BREAKDOWN OF SCOPE 1 EMISSIONS (tCO₂e)

- Corporate Support Functions and Main Office Buildings
- Transport Operations
- Network Expansion
- Properties & Other Business



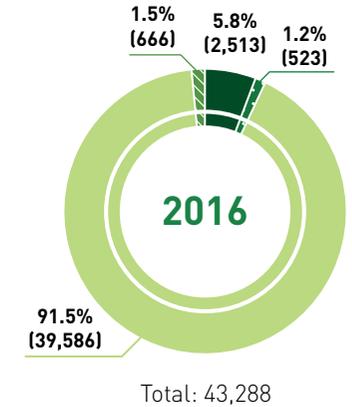
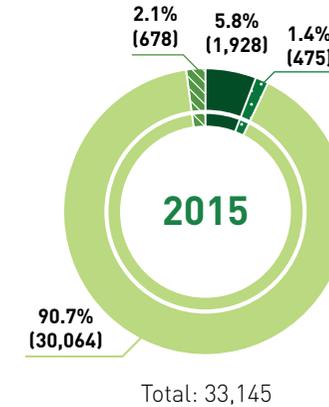
BREAKDOWN OF SCOPE 2 EMISSIONS (tCO₂e)

- Corporate Support Functions and Main Office Buildings
- Transport Operations
- Network Expansion
- Properties & Other Business



BREAKDOWN OF SCOPE 3 EMISSIONS (tCO₂e)

- Corporate Support Functions and Main Office Buildings
- Transport Operations
- Network Expansion
- Properties & Other Business



Climate risks

At the corporate level, the Company's Enterprise Risk Management (ERM) Framework also includes a yearly assessment of climate risks. When reviewing climate-related risks, we make reference to local and international organisations including the UITP and the Hong Kong-based Business Environment Council. Specific direct physical risks or other indirect risks related to climate change that may impact railway operations, property development, investment and management facilities are identified and managed at asset-level by respective departments. Potential regulatory changes are also being closely monitored.

LEARN MORE...

We have participated in the CDP Climate Change Programme each year since 2006. CDP is an organisation based in the United Kingdom, which works with investors and corporations to disclose the GHG emissions of major corporations around the world. It is possible to obtain a copy of the Company's response to the CDP's climate change questionnaire in 2016 from their website.

MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

Sustainable Resource Use

▶ Climate Change

Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

Mitigation

The majority of our GHG emissions are indirect emissions arising from purchased electricity for transport operations, properties and other businesses. This electricity is supplied by two vertically-integrated suppliers and is generated from a mix of coal, natural gas and nuclear power. Since we exercise minimal influence over the source of electricity that we consume, our mitigation efforts focus on energy saving measures.

Lifecycle assessment

It is widely acknowledged that emissions associated with daily operations, such as environmental control systems and lights, account for up to 90% of the total lifecycle GHG emissions from buildings. Our pilot study confirmed that a similarly high proportion of total lifecycle GHG emissions arise during the operational phase of our railway projects, and the overall contribution to climate change from the construction and decommissioning phases of rail projects is relatively minor.

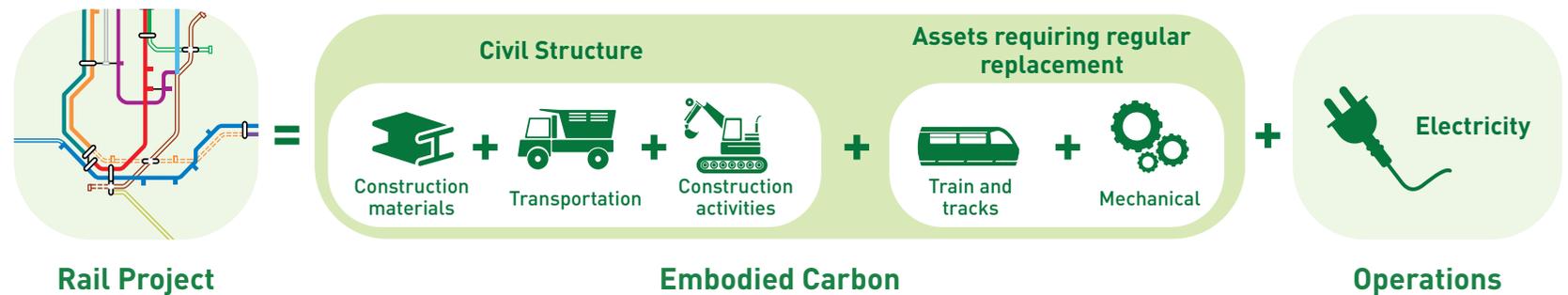
Nevertheless, we continue to explore the possibilities for greener materials. With approval from relevant government department, we have started to use ground granulated blast furnace slag (GGBS) in one of our Shatin-to-Central Link contracts in 2015, a first for private projects in Hong Kong. Compared to conventional cement, GGBS reduces embodied carbon by almost two-thirds.

Asset Replacement

With findings from the project life cycle assessment in mind, when replacing our assets, we emphasise lifecycle costs and take into account capital investment, operational resource use, maintenance, and spare part replacements to achieve an optimal result.

In early-2016, the first of 68 new buses procured to replace our old feeder bus fleet started services. These new buses are of Euro V standard, the latest and most stringent environmental standards at the time of purchase. These buses have increased carrying capacity, are equipped with energy efficient LED lighting, and efficient engines, reducing GHG emissions as well as other pollutants. This is the largest order of new buses, and all buses will commence service by the end of 2017.

SCOPE OF LIFE CYCLE ASSESSMENT



MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

► [Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Adaptation

Research by climate scientists around the world provides increasingly accurate information about the projected impacts of climate change over the next 20 to 100 years. If significant reductions in GHG emissions are not achieved in the short term, significant impacts may be experienced in Hong Kong over the coming decades. We are already responding to potential threats by implementing adaptation strategies to address the direct impacts of climate change on our business.

Heavy rain and flooding

The Hong Kong Observatory provides extensive information about climate change, including projections for Hong Kong's climate in the 21st century. In late-2015, we commissioned a study on risks from extreme weather events across the MTR railway network. Specifically, it includes an identification of stations at-risk to flooding or landslides due to heavy rainfall.

Railway structures are designed and built for a long lifespan. In preparation for the longer term effects of climate change, we regularly review our Design Standard Manual to ensure that new railway projects have appropriate protection for 1:200 year rainfall events. We also inspect and assess our existing railway infrastructure on a regular basis to ensure its robustness in extreme weather events. For instance, we are enhancing or retrofitting flooding protection at all stations with flood boards of increased heights to protect critical equipment.

Extreme weather has the potential to disrupt normal operations. To provide a safe and reliable service to our customers, our Operations Division will inspect slopes close to our stations before rainy seasons to assess and address the risk of landslides. We have developed special procedures and equipment for frontline staff in cases of extreme weather such as stronger typhoons and rainstorms. In 2016, we also launched our Customer Service Typhoon Support Team to assist in incidents during typhoons. Our Property Division has taken further steps to ensure the implementation of procedures, and that there is sufficient manpower and equipment to handle serious flooding situations.

Rising temperatures

Rising temperatures will have a direct impact on Heat, Ventilation and Air-Conditioning (HVAC) systems, leading to increased maintenance requirements and higher operational costs. Extreme heat also presents a direct risk to the well-being of staff and contractors, especially those working on construction sites. We have been implementing heat stress prevention measures and guidelines across all our sites during hot summer months in line with the advice published by the Hong Kong Labour Department.

LEARN MORE...

We published [MTR Typhoon Travelling Tips](#), a guide to promote safe travel for passengers during extreme weather.

MENU

Introduction

Chairman's Message

CEO Letter

Safety

Customers

Community



Environment

Introduction

Sustainable Resource Use

Climate Change

► Environmental Protection

Staff

Supply Chain

Financial and Economic Performance

Corporate Governance

Building Our Future

Mainland of China and International Business

Performance Metrics

ENVIRONMENTAL PROTECTION

Noise

Rail operations

Noise generated by operations of our trains, and maintenance activities on our railway network is a major concern for affected stakeholders. During 2016, our Operations Division received 271 complaints about noise, accounting for 91% of all environment-related complaints received throughout the year.

We conduct regular surveillance on noise levels along our railway and monitor saloon noise inside our trains with reference to an internal benchmark that was established based on feedback from passengers. While our railway is kept in good condition, we are also continually making improvements to mitigate the effects of operational train noise on the community. In 2016, we have retrofitted a noise barrier along the Tung Chung Line for the Housing Authority.

Construction of new lines

When construction is in proximity to a densely populated area, we take extra care to control noise. As such, we have implemented a number of systematic initiatives to ensure consistent application of noise mitigation measures across the construction of new lines. These include:

- The employment of independent acoustic consultants to review and recommend noise mitigation measures
- Provision of a construction noise permit management plan as needed
- Establishment of a permit-to-work system to ensure equipment use meets specifications and users are trained in noise control compliance when working during restricted hours (i.e. Mon-Sat from 1900-0700, and all day Sun and public holidays)

Noise mitigation measures are typically developed through inter-departmental collaboration during the different project stages. This cooperation has enabled us to come up with innovative mitigation measures.

DID YOU KNOW?

Innovative noise mitigation measures on new lines

To minimise noise disturbance in the construction of our new lines, we developed a "mobile sound insulation booth" for the East Rail Line platform strengthening works. These mobile, full noise enclosures can be set up within 15 minutes to reduce noise by 25 dB(A). The flexibility provided by these noise enclosures means we are able to carry out the retrofitting works at night during non-traffic hours without disturbing neighbouring residents, and the platforms can be quickly restored to operational condition every morning.

Our noise mitigation measures are often designed to be aesthetically pleasing as well. The green noise enclosure/barriers around the viaduct section of the South Island Line (East) will be complemented by trees and shrubs planted under the viaducts to help structures blend in with the natural landscape in the area.

MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Air Quality

Monitoring air quality in our trains and stations helps to ensure healthy and comfortable journeys for our passengers, whilst contributing to the wellbeing of our workers. We undertake regular indoor air quality monitoring in our railway system in accordance with the Government's guidance note for railway facilities.

The carbon dioxide levels at our stations and in our trains in 2016 are within 2,500 ppm during peak traffic hours.* During the monitoring periods, no measurements of carbon dioxide levels exceeding the EPD Level One hourly average criteria have been recorded. Air quality of this standard indicates "good air quality of a comfortable railway facility with no health concerns identified," and is defined as Level One Criteria by the Environmental Protection Department (EPD) of Hong Kong's Practice Note for managing air quality in air-conditioned railway facilities.

*Carbon dioxide is selected as a surrogate indicator as suggested in the practice note by the EPD, as its concentration in an indoor environment is a good indicator of the effectiveness of ventilation systems and the adequacy of ventilation. Reference: "[Practice Note for Managing Air Quality in Air-conditioned Public Transport Facilities.](#)"

DID YOU KNOW?

MTR was presented with a "Special Commendation Award" by the Environmental Protection Department for continuous efforts over the years to maintain a good and healthy indoor environment for staff and customers at our offices and properties. The following MTR properties were awarded:

- "Excellent Class": PopCorn, Citylink Plaza, Two ifc, The Cullinan, The Palazzo, Maritime Square, Ocean Walk, Paradise Mall (East Wing), Paradise Mall (West Wing), The Lane and MTR Hung Hom Building
- "Good Class": MTR Headquarters Building, Fo Tan Railway House, MTR Kam Tin Building, all of our 13 shopping malls and 6 managed properties.

Waste

In 2016, we have begun a comprehensive assessment to understand how we can implement effective approaches to waste management across our businesses. We aim to start implementing these approaches in the next year.

Reducing and recycling construction waste

Our new rail projects generate large amounts of construction waste and excavation materials. We adhere to a Government-regulated trip ticket system on all sites in order to keep track of waste and ensure proper disposal, while also continuously explore new ways to reduce waste, and reuse excavation materials on-site and on other projects.

We are able to reuse or recycle about 45% of excavation materials from our network expansion projects and try to reduce marine mud disposal with a new method, called Cement Stabilized Marine Mud (CSMM). It is a cement stabilizing process in which marine sediment is mixed with cement and general material to form CSMM for backfilling. A small portion of excavated marine sediment from Kai Tak area was used for a trial which has been successful, and the CSMM was backfilled to the Shatin to Central Link tunnel area in Kai Tak.

Waste and wastewater from railway operations

We generate a small amount of chemical waste from our railway operations consisting mainly of used batteries and spent lubricating oil. Our heavy rail stations and depots as well as bus depots are all registered with the Environmental Protection Department ("EPD") as chemical waste producers under the Waste Disposal Ordinance (Cap 354) ("WDO"). When any chemical waste requires disposal, the Corporation appoints chemical waste collectors, licensed under WDO, to collect such waste for proper transportation and disposal.

Apart from wastewater from Lok Ma Chau and Lo Wu stations which are equipped with its own sewage treatment plants, all of the water consumed by the Company in Hong Kong is discharged, with appropriate treatment, into the public storm drainage/sewage system, which is maintained by the Drainage Services Department.

MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[▶ Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Influencing our tenants and customers

Every day, millions of customers pass through our stations and the properties we manage, and we collect a wide range of waste generated from them. We encourage recycling by equipping stations in our heavy rail network and shopping malls with recycling bins. We also provide waste recycling bins to separate waste for recycling at all common areas of our managed properties.

We are working to add more recycling bins in selected stations, and in 2016 we rolled-out directional signage to inform customers of the locations of these bins. We continue to work on the robust collection and reporting of our waste data (both recycled and general waste) in preparation for the Government's proposed regulation on waste.

At our managed properties, we join with the Owners' Committees and Incorporated Owners to promote waste separation programmes to residents. Where possible, we liaise with recyclable waste collection contractors and organise green visits for our residents. Through our "Green Train Initiatives" and the provision of special recycling bins in the common areas of our managed properties, we collect used clothes, ink cartridges, and CD discs for recycling or donation to charities. Under the "Glass to Brick" programme, we go one step further to collect and turn waste glass bottles into reusable materials. We also partnered with green organisations appointed by Environmental Campaign Committee on organising "Clean Waste Recyclables" workshops at some of our managed properties.

DID YOU KNOW?

Partnerships to reduce food waste

To contribute to tackling the issue of food waste, MTR joined the Food Wise Hong Kong Campaign as one of its first signatories and as a member of its steering committee to support the Government and other stakeholders. We strive to reduce the environmental impacts of food waste in the following ways:

MTR Malls — Under our self-initiated "MTR Malls Food Waste Reduction Pledge", we work with food and beverage tenants to minimise potential waste at source and to promote food-waste reduction practices in the shopping mall sector. In 2015, we partnered with Food Angel for a pilot programme to collect edible surplus food from our food and beverage tenants in ELEMENTS and Paradise Mall to benefit underprivileged communities in Hong Kong. Meanwhile, MTR Malls received a "Food Angel Thanksgiving 2016" trophy from Bo Charity Foundation, which recognised the Corporation's efforts and contributions in the food recovery programme over the year.

Managed residential estates — Under our "Central Food Waste Recycling for Improving Estate Environment" initiative, we have organised different promotional programmes, such as the festive food donation, seminar on "Cook for Green" to encourage residents to reduce their food waste by either donating to the underprivileged or by utilising the leftover in other dishes. We also have food waste composting machines at some of our managed properties also to convert food waste into compost.

MENU

[Introduction](#)

[Chairman's Message](#)

[CEO Letter](#)

[Safety](#)

[Customers](#)

[Community](#)



Environment

[Introduction](#)

[Sustainable Resource Use](#)

[Climate Change](#)

[▶ Environmental Protection](#)

[Staff](#)

[Supply Chain](#)

[Financial and Economic Performance](#)

[Corporate Governance](#)

[Building Our Future](#)

[Mainland of China and International Business](#)

[Performance Metrics](#)

Ecology

We are committed to protecting the natural environment during the construction of new rail projects and take particular care on sections of the lines that impact natural habitats and areas with high ecological sensitivity. For instance, project teams working on the [Express Rail Link](#) are conducting works to avoid direct impact on the habitats located in the Mai Po Nature Reserve.

Tree Protection

We are committed to enhancing the urban environment by protecting existing trees and introducing new trees according to established guidelines. When planning and constructing new lines, we evaluate the impact of our projects on trees and determine whether they can be preserved in place or need to be transplanted. Where they have to be removed, we undertake compensatory planting of new trees after the project is completed.

Since late 2015, we began to step up measures to reduce the risk of fallen trees affecting train service by increasing large-scale tree survey frequency for over 33,000 trees along the open sections of the railway network from once every four years to once every two years. In addition to the adoption of a more stringent tree coding system, we also developed smart tags for trees along the railway network. Using radio-frequency identification (RFID) technology, information about tree species, height and condition can be retrieved in a simple and quick manner. This enables us to take better care of the trees and maintain safety along the railway network during the typhoon season.

DID YOU KNOW?

We have supported research project on the effects of wood decay on tree species. The research is led by the Tree Management Office of the Development Bureau, the Chinese University of Hong Kong and an arboriculture consultant firm. It is the first to investigate the strength of different tree species in Hong Kong and Southern China. Making use of data collected from trees removed along the Shatin to Central Link enhances our knowledge of trees in Hong Kong, and helps us improve our tree management practices.

Lok Ma Chau (LMC) Wetland

In 2002, the Sheung Shui to Lok Ma Chau Spur Line, part of the East Rail Line, became a Designated Project under the Environmental Impact Assessment Ordinance. The Environmental Impact Assessment (EIA) for this project identified the need for a 32-hectare ecological enhancement area to mitigate impacts from the construction and operation of the spur line on wetland fauna in this ecologically sensitive part of Hong Kong. Located on the eastern side of the Mai Po Inner Deep Bay Ramsar Site in the northwest New Territories, the LMC wetland has been operated since 2007 and helps to maintain biodiversity by providing habitat environments for target species. For the past 14 years, we have been working with a group of environmental professionals on the management of the LMC wetland. This arrangement is the first of its kind and an example of best practice in the region in terms of biodiversity management.

Conservation of migratory birds

The marshes and fishpond areas of the LMC wetland provide important nesting sites for migratory birds. During the 2016 breeding season, for example, 134 pairs of birds representing six different species including Little Grebe (*Tachybaptus ruficollis*) and White-shouldered starling (*Sturnia sinensis*), both of which are believed to have bred in the wetland successfully. Overall, more than 260 species have been spotted in the LMC wetland since 2007, about half of all species ever recorded in Hong Kong. The area also hosts a high number of Black-faced Spoonbills (*Platalea minor*), a globally-threatened species.

We are working to implement measures to improve the wetland habitat for local concern targeted species such as the Pheasant-tailed Jacana (*Hydrophasianus chirurgus*).

Conservation of other species

The EEA also provides various habitats for dragonfly, reptiles, mammals and amphibian species. There have also been regular sightings of the Chinese Soft-shelled Turtle (*Pelodiscus sinensis*), which is a threatened species, and the Eurasian Otter (*Lutra lutra*), which is a near-threatened species.