ENVIRONMENTAL PERFORMANCE

- Initiatives in Planning and Construction of New Housing Estates
- Initiatives in Existing Housing Estates
- Initiatives in Office at Work
- Case Study – Environmental Excellence from Planning to Operation – Lam Tin Estate

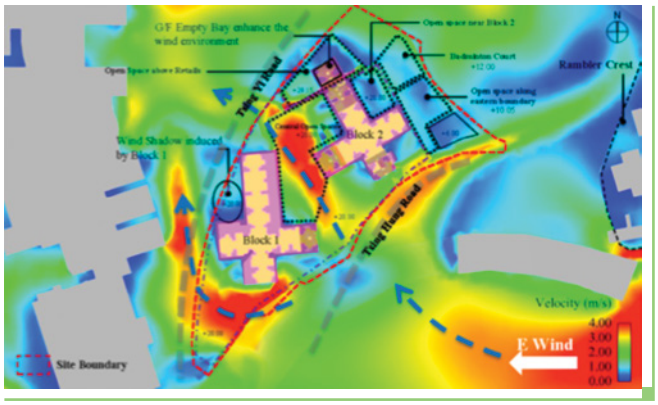
The Hong Kong Housing Authority (HA) is committed to offering public housing estates that are of high quality and sustainable environmental performance. We actively enhance different aspects including energy efficiency, resource conservation, air quality and greening in our estates and offices.

Initiatives in Planning and Construction of New Housing Estates

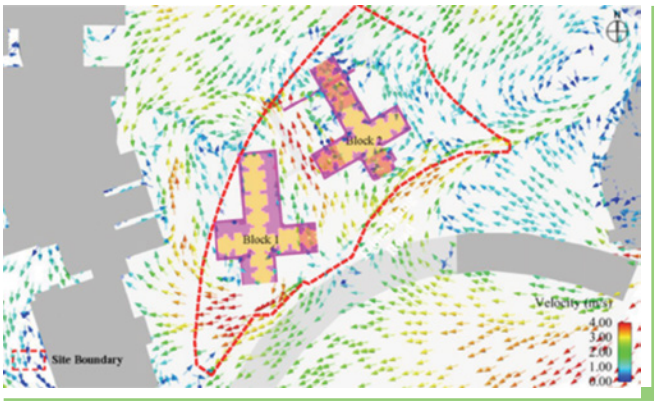
Green Design and Construction

Conducting Micro-climate Studies

We conduct micro-climate studies during the site planning and design stages by applying computer simulations generated from local climatic conditions-calibrated software. Taking wind pattern, natural ventilation, pollutant dispersion, natural daylight, solar heat gain and numerous other environmental factors into account, the study provides us with more comprehensive insights of the environmental impact of the projects on the surrounding area. During the year, such micro-climate studies were carried out in 37 on-going public housing projects, together with 25 projects that underwent Air Ventilation Assessment to create a better wind environment, facilitate natural ventilation and use of daylight, and reduce solar heat gain in housing blocks and external areas.



▲ Air Ventilation Assessment



▲ Micro-climate studies with computer simulations

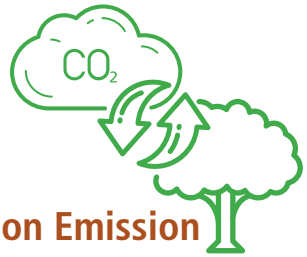
Leveraging the distinctive characteristics of individual sites, we have included passive designs in our projects to enhance environmental performance and we will continue to adopt other green design elements in our development projects.

▲ Examples of passive designs in our projects: light atrium (left); wind tunnel (upper right); corridor utilising natural light (lower right)

Adopting Low Carbon Building Design

Echoing the Government's target of reducing greenhouse gas (GHG) emission intensity by 65% - 70% by 2030 using 2005 as the base year as outlined in Hong Kong's Climate Action Plan 2030+, we have adopted green building strategies during the design and construction stages to curb GHG emissions in our public housing projects.

Since 2011, in order to benchmark the GHG emission level across our projects, we have deployed Carbon Emission Estimation (CEE) at the planning and design stage of all new development projects. CEE predicts the amount of GHG emissions of a public housing block throughout its lifecycle in the form of carbon dioxide equivalent. During the year, 14 projects underwent CEE at the design stage. We will continue to implement CEE in all projects at the design stage. The level of GHG emissions of each block was benchmarked against that of the standard block of New Harmony 1 Option 6 and Kai Ching Estate. We estimate that an average of around 14% GHG emissions reduction has been achieved since implementation, compared with the construction floor area-based baseline data of New Harmony 1 Option 6 block.



Carbon Emission Estimation

Amount of CO_2 saved equivalent to **86,000 trees** planted

Utilising Green Materials and Products

In order to reduce the use of cement and promote the adoption of recycled materials, we have specified the mandatory use of Ground Granular Blast Furnace Slag (GGBS) in all our new projects to replace part of cement for precast facades and staircases. In addition, we have studied the application of GGBS in producing precast beams, precast refuse chutes and precast planks of semi-precast slabs. We will also continue to use synthetic macro-fibre reinforcement in on-grade slabs in new projects, where appropriate.

Besides concrete, we continue to conserve resources by adopting sustainable materials and resource-efficient installations. For example, we use timber from certified sustainable origins for door manufacturing. We have extended the Chain of Custody (COC) certification for timber from sustainable sources to doorset manufacturers and suppliers who should produce a Certificate of Registration issued by an independent certification body for compliance with the COC standard. Other examples include the Water Efficiency Labelling Scheme (WELS) registered plumbing fixtures, two-level lighting, grid-connected photovoltaic systems, etc. To adhere to the specified flow rate restrictions, we closely monitor the performance of mixer tap products. By consulting the Water Supplies Department on the results of the latest flow rate tests, we keep our specification in our Specification Library up-to-date.

We apply Building Environmental Assessment Method Plus (BEAM Plus) specification clauses for all new work projects, apart from the aforementioned measures. To reduce the environmental footprint of our housing blocks, we specify the use of the following materials in our contract:

- pulverised fuel ash (PFA) as cement replacement material in structural concrete with mass concrete pouring;
- recycled rock-fill in earthworks and recycled sub-base materials in roadworks;
- recycled rock cores retrieved at ground investigation work for landscape and associated external work;
- GGBS as replacement material for part of cement in concrete for the manufacturing of precast façades and precast staircases in domestic blocks;

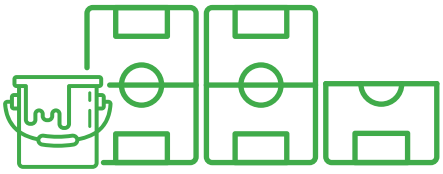
- recycled concrete paving blocks with recycled glass aggregates and replacement of concrete paving blocks for new building and civil engineering contracts;
- marine mud excavated at site stabilised by cement treatment as useful backfilling material;
- timber from sustainable sources for temporary works; and
- modular hoarding using bolt-and-nut connections for re-use in projects.

During the year under review, we registered seven new projects with the Hong Kong Green Building Council (HKGBC) for assessment and rating under the BEAM Plus assessment scheme.

To enhance the quality of building materials and components, we have implemented product certification for eleven types of building materials and services as a means of effective upstream control. We are preparing to implement certification for paint products in 2017/18.

Use of Recycled Material

5,720 tonnes GGBS used, equivalent to **380** trucks



Plastering

2,860,000m² of plaster saved, equivalent to **446** standard football pitches

As part of our continuous effort, we explore the incorporation of more green elements into the new project and maintenance work specifications. We have promulgated the mandatory use of B5 bio-diesel as fuel for all non-road-based construction machinery on site after consultation with the Hong Kong Construction Association and contractors. In the first quarter of 2017, we documented the Highways Department's revised specification on the use of recycled glass cullets as aggregates for precast concrete paving blocks in our General Specification for maintenance work. We conducted a trial of using manufactured sand for screeding works to verify their application for architectural finishing work at one of our projects in end of 2017.

▲ Use of recycled glass cullet as aggregates for precast concrete paving blocks (top and bottom)

We emphasise green procurement to make our projects more environmentally friendly. We explored the integration of HKGBC Green Building Product Labelling Scheme, Construction Industry Council (CIC) Carbon Labelling Scheme and our product certification scheme during the year. In addition, HKGBC agreed to include product certification into their Consultant Study for BEAM Plus NB Major Revision. In terms of the environmental labelling schemes, we will prepare and implement new specification clauses for their coordinated implementation. We will also monitor the development of the HKGBC Green Product Accreditation & Standards Scheme, and update our guide specifying green materials and products for maintenance and improvement work, as appropriate.

Other than building materials, we inject green elements into the specifications for general goods and services whenever possible. During the year, we reviewed the purchases of general goods and services, including IT equipment, in collaboration with the respective users to adopt the relevant recommendations from the Environmental Protection Department.

Environmentally Friendly Construction Practices

We mandate our construction contractors to practice green building methods which exceed the statutory requirements. Throughout the project construction phase, we ask our contractors to follow the requirements on different aspects, including site formation, demolition, foundation, superstructure building and civil engineering works, to enhance their environmental performance. For example:

- submitting and implementing environmental management plans;
- implementing ISO 9001 Quality Management System (QMS) and ISO 14001 Environmental Management System (EMS);
- requiring Building (New Works Category) and Piling Contractors to be certified ISO 50001 Energy Management System (EnMS);
- prohibiting the use of incandescent light bulbs for temporary lighting on site;
- using generators with Quality Powered Mechanical Equipment (QPME) labels;
- installing water recycling facilities;
- limiting vehicle speed on site;
- practicing hard paved construction;
- adopting precast concrete components;
- using single board hoarding;
- offering solar hot water heaters in workers' shower areas;
- providing food waste composting facilities in remote sites with canteens or catering services;
- greening on site;
- using electric vehicles (EVs) as contract cars within a specified round-trip distance; and
- recovering undamaged timber pallets for locally manufactured pavers for reuse or recycling.

The Building Information Modelling (BIM) is adopted in all disciplines and aspects of planning, design and construction of new projects. As at March 2017, more than 45 projects were using the technology at various stages. We also performed a total of 17 site potential and feasibility studies using Geographic Information System (GIS). For the construction material delivery and waste generated from our construction sites, we utilise radio-frequency identification (RFID) for tracking.

In addition, we seek to apply innovative means which include the 5D BIM and structural soil used in Anderson Road Sites A and B Phases 1 and 2 (On Tai Estate). The former takes into account time and cost in the traditional BIM, facilitating project management. In terms of structural soil, it not only allows us to comply with the load-bearing requirements but also fosters the root growth of vegetation. The installation has been tested in laboratories with different mixes of soil, and we have piloted it in the Anderson Road project with two trees planted in structural soil.

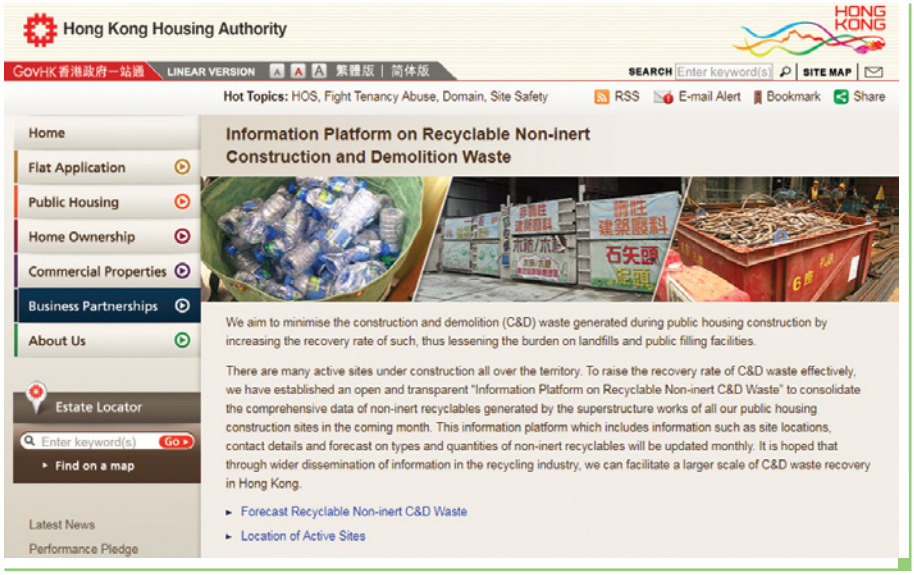
▲ RFID for tracking delivery of building components and construction waste from construction sites

While adopting different innovative and environmentally friendly practices in our housing projects, we have developed standards for their application. We have used precast segmental roof water tanks of standardised design in suitable new projects. We have issued an instruction on "Implementation of Precast Construction at Roof of Domestic Block" in January 2018. We also continue to explore wider use of precast concrete components, including volumetric precast balconies.

▲ Precast segmental roof water tanks

▲ Volumetric precast balconies

To provide monthly information on the non-inert, recyclable construction and demolition materials generated in construction sites which are available to be collected and thus facilitate construction waste recycling, we have launched a database "Information Platform on Recyclable Non-inert Construction and Demolition Waste" for our recyclers' reference. It can be accessed on the HA website.



▲ Information database on construction waste recycling

Modular Design/ Precasting & Prefabrication

Cost **40%** less than private sector

Timber Saving from Use of Large Panel Formwork & Precast Elements

20,000 tonnes of timber saved, equivalent to **1,300** trucks

Handling Method	Amount Handled in New Works Projects in 2016/17 (tonnes)
Hazardous waste	
Recycled	14.5
Landfill	4.3
Non-hazardous waste	
Recycled	16,998.6
Public fill	453,589.9
Landfill	631,333.0

Transfer of C&D Materials for Reuse

2,800 trucks of C&D materials in HA sites were re-used

Construction Waste

30% less than private sector

GIS for Site Potential and Feasibility Studies

3D GIS now plays a major role in the planning and design of our estates, especially at feasibility stage. Our Architects and Planners will make more use of GIS to assist them in understanding their site and its surrounding area in a 3D environment. As we have already obtained 3D spatial data for the whole of Hong Kong from Lands Department, including 3D terrain, buildings and infrastructure, we were able to carry out visual assessment of our estates, such as ridgeline analysis, vantage point analysis, shadow analysis in site potential and feasibility studies.

Green Building Recognition

We incorporate environmentally friendly features into our projects wherever practicable, and require all projects to readily achieve the "Gold" rating standard in the HKGBC's BEAM Plus.

The Fat Tseung Street West Development, which is scheduled to be completed in 2020, was awarded the highest platinum rating in the BEAM Plus Neighbourhood Pilot-testing Project, with the project forming part of a vibrant community after other public housing developments in the area of Cheung Sha Wan are built. More information about the social performance of this development project is available in the case study in the Social Performance section.

BEAM Assessed Projects

7 projects registered and
9 projects assessed by BEAM Plus

Our dedication to promoting a sustainable built environment for our housing development projects has been recognised by the HKGBC and Professional Green Building Council. We received the highest honour in the Green Building Leadership category of the Green Building Awards 2016 – a biennial prestigious industry award for building-related projects and organisations with outstanding performance and contributions in sustainability.

▲ Green Building Leadership category under the Green Building Awards 2016

Green Recognition

In the Green Building Awards 2016, our Hung Fuk Estate Public Rental Housing Development at Hung Shui Kiu Area 13 won the Grand Award in the New Buildings Category (Completed Projects – Residential Building). We were also awarded the Merit Award in the Research and Planning Category for "Concrete Innovation – Application Research for Carbon Footprint Reduction" and "Research and Development of Second Generation Acoustic Balcony". Please refer to our List of Awards and Community Recognitions for full details on our achievements.

Resource Conservation

Holistic Energy Management

Recognising the importance of an effective Energy Management System (EnMS) for improving energy performance, we have implemented EnMS in accordance with the ISO 50001 EnMS standard for our projects since 2011. Using the system, we can estimate the communal energy consumption of the completed and occupied buildings during the design stage, which allows us to identify and implement energy efficiency enhancement measures. During the year, we have applied the energy estimation approach to 14 new public housing developments.

As a means of extending our environmental commitment, we continue to require our contractors applying for admission to the HA Lists of Building (New Works Category) and Piling Contractors to be ISO 50001-certified. We also closely monitor their energy performance by collecting energy consumption data and conducting analysis.

Energy Consumption by Construction Contractors (April 2016 – March 2017)	Gigajoule (GJ)	%
Diesel consumption for construction activities	626,816	84.6
Diesel consumption for transportation of construction waste	64,808	8.7
Electricity consumption for construction activities	42,643	5.8
Gasoline consumption for contract cars	6,720	0.9
Total	**740,986**	**100**

Renewable Energy

We strive to apply renewable energy technology in our housing developments as we are at the forefront of incorporating green features into projects. New blocks are equipped with grid-connected photovoltaic (PV) systems where appropriate to generate at least 1.5% of electricity consumed in communal areas. A total of 16 estates have been equipped with PV systems since March 2009. We also install one to two solar-powered lights in all new projects to promote the use of renewable energy and education purpose.

▲ PV panels

Promoting Electric Vehicles

In support of the Government's policy to promote the use of electric vehicles (EVs), we include EV charging facilities for private cars in the design of the covered car parks in all the new estates. As at the end of the year, we have provided private car parking spaces with EV charging facilities in seven new development projects. To incentivise the use of EVs, we offer up to two hours of free parking for EV users during charging. We also specify the provision of EVs as contract cars in our housing projects.

▲ EV charging facilities (left and right)

Energy Efficiency in Buildings

We have aligned our design of new projects with the "Guidelines on the Design and Construction Requirements for Energy Efficiency of Residential Buildings" (the Guidelines) by the Buildings Department in 2014, and will continue to improve energy efficiency and natural ventilation by designing the housing blocks according to the Guidelines. We are also in compliance with the Building Energy Codes issued by the Electrical and Mechanical Services Department (EMSD).

Since August 2015, 51 energy certificates have been obtained under the Energy Efficiency Registration Scheme for Buildings from the EMSD, illustrating our commitment to satisfying the energy efficiency requirements in various building installations.

On the other hand, we have prepared a list of application criteria and guidelines on air-conditioning systems, based on the evaluation results of three pilot systems in Yau Lai Shopping Centre, Choi Tak Shopping Centre and Domain. These facilitate the implementation of hybrid ventilation systems in suitable projects which reduce the energy use in air-conditioning and mechanical ventilation systems.

▲ Hybrid ventilation system

▲ Choi Tak Shopping Centre

▲ Yau Lai Shopping Centre

For new lift installations, we have specified the use of regenerative power for lift motors of 18kW or above and energy-efficient gearless lift drives. We have completed the data collection and analysis for the lift system at Kai Ching Estate and Tak Long Estate, and the performance review was finalised and the result was satisfactory. In some of our projects, we have adopted permanent magnet synchronous motors (PMSM) to reduce the lifts' energy consumption. To further enhance the energy performance, we are considering expanding the adoption of regenerative power for lifts with motor rating from the current "18 kW or above" to "8 kW or above".

Since early 2016, we have adopted LED bulkhead lights as the standard lighting in communal areas of our housing blocks for all new projects under design. Two-level lighting control systems have also been deployed to meet the illumination requirements stipulated for barrier-free access in new residential projects; and to maintain energy efficient usage by adopting motion sensors and on-demand switches with timer controls to improve energy use.

▲ PMSM for lift installation

▲ LED bulkhead lights

▲ Two-level lighting control system: before (left) and after (right)

Other measures to reduce energy consumption have been explored. Our new projects generally fulfil the mandatory requirements on Residential Thermal Transfer Values promulgated in the Building Department's Practice Note.

Smart Meter

In all new housing blocks, we implement smart meter monitoring systems with monthly energy consumption information shown at the main entrance lobbies. Peer comparison data of communal and tenants' consumption of electricity, gas and fresh water has been made available to raise environmental awareness among tenants. New standard specifications have been prepared for implementation.

▲ Display of the smart meter monitoring system at main entrance lobby

Water Conservation

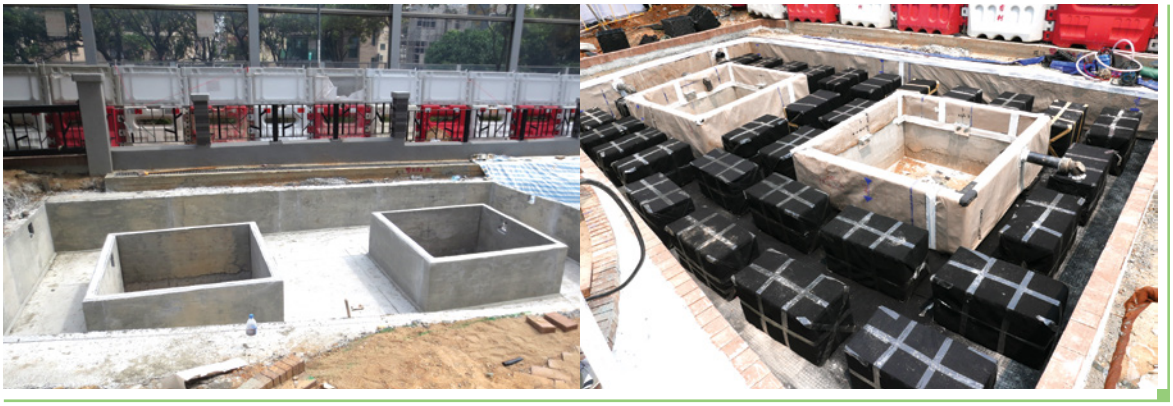
We have carried out a variety of water-saving initiatives in our new projects to conserve water. For example, we have implemented a Zero Irrigation System (ZIS), which makes use of Sustainable Urban Drainage System and Sub-irrigation Planting System, to reduce irrigation water consumption in suitable housing estates. At Hung Fuk Estate, we have tested the adoption of ZIS alongside a Rainwater Harvesting System and Root Zone Irrigation for better irrigation water management. ZIS in new public housing projects was proven to be effective and will be adopted in other new projects.

Twin Tank

534,000 litres of water saved for **14,300** new households

Zero Irrigation System Planter

21 projects with in-situ ZIS planter provision are under construction. Anticipated **4,906,330** litres of water will be saved annually



▲ ZIS: preparation (left) and implementation (right)

In addition, we have made use of integrated water-sensitive urban design to gather rainwater at high elevations and on vegetated slopes in Shui Chuen O Estate. The rainwater is subsequently treated by bio-retention, stored and used for watering plants.

▲ Plumbing fixtures registered under WELS

▲ ZIS: completion

As for housing flat fixtures, we have promoted the adoption of 6-litre single or dual flush water-closet suites, plumbing fixtures registered under WELS of the Water Supplies Department and other water-efficient installations.

For our new development projects, a total of 1,064,660 cubic metres of water were consumed during the year, with 69,905 cubic metres recycled.

Mitigating Environmental Impacts

Estate Ecology

We meticulously maintain the ecological value in the proximity of all our applicable housing projects through practicing balanced environmental planning and design principles. Balanced ecological planning and design principles have been applied in suitable projects and we conduct briefing and debriefing sessions and site visits for contractors. At Long Shin Estate, a plantation improvement study for the revitalisation of the existing vegetation on the slopes has been conducted jointly with the University of Hong Kong, and native saplings have been planted on site. We continue to monitor their growth. Apart from collaborating with the Development Bureau to preserve and manage trees, we are also developing guidelines and clauses which will engage our contractors through regular liaison channels.

▲ Plantation improvement study at Long Shin Estate

Our green design guidelines underpin our emphasis on greenery in our housing projects. We target at having no less than 20% of the new estate area allocated for greening and 30% for sites over two hectares. The tree planting ratio is set to be one tree or more for every 15 flats. We will closely follow up on the cost effectiveness of the greening work.

At Hung Fuk Estate, we have experimented with sustainable gardening by recycling felled trees and turning them into compost. The results have been used to develop the selection criteria for composting machines and the optimal mix of wood and garden waste for compost production. Recycling trees as mulch for landscaping work will be conducted in other appropriate projects in the future.

Trees are felled

Felled trees are cut and shredded into wood chips

Wood chips are used as bulking agent to mix with food/garden waste and decomposed into soil conditioner

During the year, we continued to engage our tenants to green four new housing estates through the Action Seedling programme. To further promote tenant participation, we have designated planting areas in development projects for the residents to take part in gardening and planting for leisure and education.

Action Seedling programme (left and bottom)

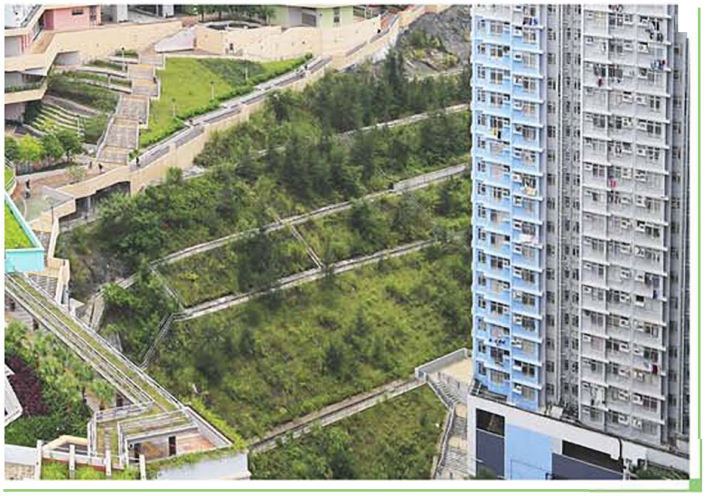
Trees

1,592 trees planted

Slope Greening

28 slopes

To offer an aesthetically appealing environment for our residents, we actively adopt hydroseeding, planting and other measures in newly formed slopes. Green treatment has been carried out in four projects with formed slopes, including Shui Chuen O Estate, So Uk Estate Phase 1, Po Heung Estate and Ching Chun Court.



Green treatment to slopes at Shui Chuen O Estate

Noise Control

A range of noise mitigation measures have been deployed to minimise noise impact on our developments. Depending on the site-specific characteristics, acoustic windows, acoustic balconies, architectural fins, noise barriers and other noise-lessening methods have been adopted to improve the living experience of our tenants.

Noise Mitigation Measures
(Including barrier, fin, acoustic window and/or balcony etc.)
11 projects adopted

The design of the second generation acoustic balconies which feature a sliding screen in front of the balcony door, noise absorptive material in the balcony wall and ceiling, and inclined panels along the parapet has been completed. Further mitigating the impact of traffic noise, the acoustic balconies will be included in new projects where necessary.

▲ Second generation acoustic balcony

▲ Vertical noise barrier

Air Quality Management

We have adopted the Development Bureau's implementation plan to phase out the use of four types of Exempted Non-Road Machinery for our contracts with estimated value greater than $200 million which can only be waived with the contractor's justifiable substantiation. The foundation contractors have agreed to add filters to their plants and machines to reduce air pollution.

The application of bio-filtration systems has been studied in various housing estates for air pollutant reduction in car parks and roads. At Cheung Sha Wan Estate, the study has yielded encouraging results.

▲ Bio-filtration system at Cheung Sha Wan Estate

Asbestos Abatement

During the year, we completed asbestos removal work for existing buildings at new Public Housing Development Sites at Queen's Hill and Fo Tan.

Risk Assessment

A risk assessment following the guidelines of the International Standard ISO 31000 has been carried out on about 2,300 building materials used in architectural, building services, structural, civil engineering, geotechnical engineering and landscaping works. We have evaluated the risk assessment results and are developing corresponding risk treatment measures. The first batch of risk treatment measures for architectural components was rolled out in January 2017.

WSBE17 Hong Kong

With our different environmental initiatives in public housing development, we are eager to exchange green ideas with both the local and international building sector. Between 5 and 8 June 2017, we took part in the World Sustainable Built Environment Conference 2017 (WSBE17) Hong Kong jointly organised by the CIC and HKGBC.

▲ Ms Ada Fung, Deputy Director of Housing (Development and Construction), presenting at the conference

▲ Mr Lawrence Chung, Assistant Director of Housing (Project), speaking at the event

The event was part of the 2015-2017 Cycle of the reputed Sustainable Built Environment (SBE) Conference Series and was regarded as the "Olympics" for the green building industry in the world, with attendance of around 1,800 green building advocates, policy-makers, academia and industry practitioners from 57 countries and regions.

We contributed to the highly influential conference by sharing our sustainability experiences and achievements in six presentations, establishing and manning an exhibition booth to promote our green initiatives, arranging guided green-building technical visits to Hung Fuk Estate and Wah Ha Estate, which are our award-winning housing estates, and providing our stories about community engagement, studies and housing projects in the Hong Kong 2017 Report.

▲ Green-building technical visits to Hung Fuk Estate (top) and Wah Ha Estate (bottom)

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Initiatives in Existing Housing Estates

Environmentally Responsible Management and Maintenance

ISO 14001 Environmental Management System (EMS)

We have incorporated EMS which is in accordance with the internationally recognised ISO 14001 standard into our housing estate management since 2010. In 2011 and 2013, ISO 14001 certifications for maintenance and property management were obtained, respectively, by all our PRH estates. An annual internal audit for maintaining ISO 14001 was completed in March 2017.

We continue to implement ISO 14001 together with ISO 9001 in the planning, design, project management, contract administration of planned Maintenance and Improvement (M&I) works to maintain continual improvement in our environmental performance. The ISO 19011 Auditing Management System is still in use for M&I works.

Energy Conservation and Carbon Management

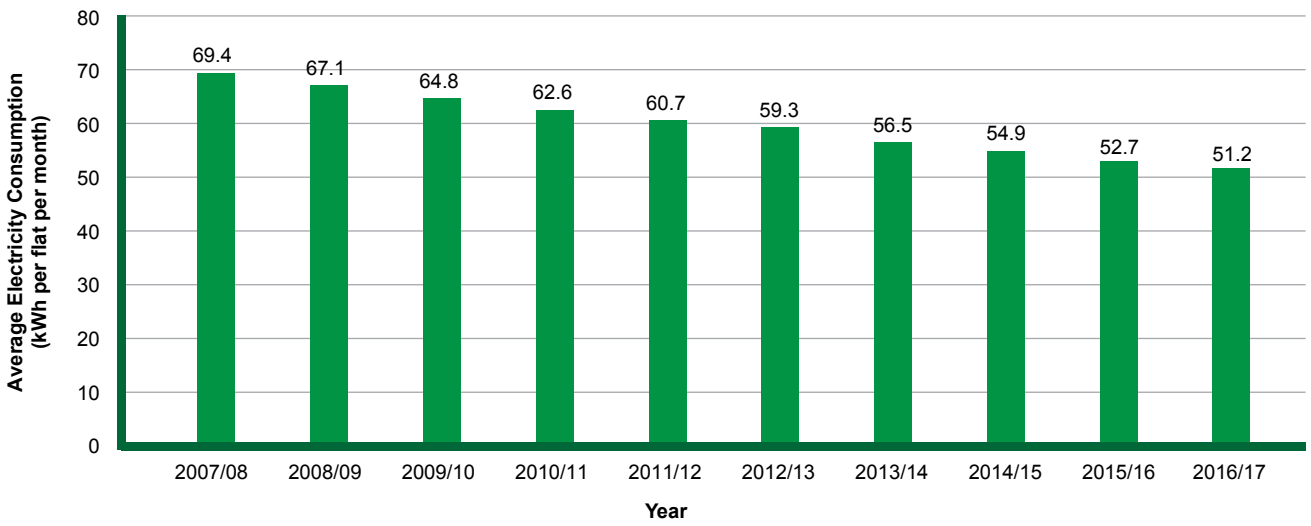
ISO 50001 Energy Management System (EnMS)

We continue to maintain the EnMS in all existing PRH estates since the award of the fully extended certification of ISO 50001 EnMS in April 2015. Nevertheless, as the 3-year validity period commenced upon the initial certification at Kwai Shing West Estate was expired in June 2016, a large scale re-certification audit was therefore required and accomplished in April 2016 and our certification for all existing PRH estates was renewed with another 3-year validity period (i.e. up to June 2019).

Overall Energy Consumption

Resulting from the effective use of EnMS, electricity consumption in the estates' communal areas in 2016/17 was 51.2 kWh per flat per month. This represents a 3.0% decrease compared to the consumption in 2015/16.

Electricity Consumption in the Public Areas of Estates



Adoption of Energy and Carbon Reduction Measures

Apart from close monitoring and periodic reviews of the energy consumption on our premises, we have deployed a wide range of energy reduction measures. One hundred and seven old lifts were replaced in 2016/17 under our Lift Modernisation Programme (LMP). Compared with the old models, the new ones can generally save more than 30% of energy consumption. Meanwhile, we provide standard EV charging facilities for monthly EV parking in existing car parks when technically feasible and on an as-needed basis. At present, 21 standard charging facilities have been installed in eight car parks. EV users can also enjoy up to two hours of free parking during charging.

We continue to manage our carbon footprint by monitoring and benchmarking the emissions of 14 typical housing block types representing the majority PRH block types in a carbon audit. With the fourth carbon audit report completed, against the baseline data in 2011/12, the overall carbon emissions of the 14 blocks in 2015/16 decreased, ranging from 1.61% to 28.42%. The findings from the carbon audit shed light on the applicable carbon reduction measures.

In addition to the above, we have put in place other energy-saving measures. For instance, the indoor temperature of the public area in our shopping centres with central air-conditioning is regulated between 24 - 26°C in summer. Some of the lightings are switched off during non-peak hours. We have also set timers for advertising panels and decorative lightings, and install oil-free chillers. Over the years, we have participated in the Government's Energy Saving Charter to show our commitment to reducing energy use.

Noise Control

As our operation may emit noise which creates nuisance for the residents and neighbours, we adhere to the statutory requirements with suitable measures to mitigate the impact. No noise abatement notice from the Government has been received since 2005/06.

Waste Management

We have launched the Source Separation of Domestic Waste Programme in all our housing estates to encourage the community to reduce waste generation and promote waste separation at source. Various video broadcasts and promotional activities have been conducted to arouse the residents' interest and encourage their involvement. Recyclable collection counters have also been set up in all housing estates to incentivise the residents with cash or household groceries in exchange for waste recycling. During the year, we collected about 26,652 tonnes of waste paper, 1,362 tonnes of plastic bottles, 1,339 tonnes of aluminium cans and 901 tonnes of used clothes for recycling in our estates.

Waste Type	Quantity of Waste Collected for Recycling (tonnes)							
	2009 /10	2010 /11	2011 /12	2012 /13	2013 /14	2014 /15	2015 /16	2016 /17
Paper	17,935	21,376	23,849	27,589	29,394	27,127	26,690	26,652
Plastic Bottles	1,218	1,427	1,584	1,929	1,812	1,983	2,223	1,362
Aluminium Cans	520	865	1,054	1,133	1,359	1,362	1,353	1,339
Used Clothes	775	844	945	998	1,053	896	867	901

We support the restaurant, supermarket and market stall tenants in practicing food waste management, including donating surplus food to non-government organisations (NGOs).

With the collaboration between NGOs or other government departments, we provide venues in our shopping centres free of charge to help carry out their waste reduction and environmental activities. For Lai See Reuse and Recycling Programme 2017, a total of 13 HA's shopping centres took part to distribute reusable red packet envelopes and collect used envelopes.

With the waste reduction initiatives, in 2016/17, the average domestic waste production of our residents was 0.55 kg per person per day. On the other hand, with our measures to reduce water wastage in our estate management, the water consumption of the common areas of the housing estates was 1,827,096 cubic metres.

▲ Lai See Reuse and Recycling Programme 2017 (left and right)

Greening and Tree Management

Greening

We continue to enhance the living environment of our housing estates through greening. A number of works have been carried out, including replacing chunam surfaces with hydroseeding for 10 slopes at nine estates and greening the rooftop of Kwai Shing West Estate, which was welcomed by the residents. We also introduced different plants which matched the local conditions when improving the landscape. A total of 20 estates have undergone landscape improvement work. To promote residents' awareness and participation in the greening of housing estates, community garden programmes were organised in 10 estates.

▲ Landscaping Improvement Programme at Hoi Lai Estate

▲ Community Garden Programme at Shum Lee Estate

Strengthening Tree Management

A new Enterprise Tree Management System (ETrMS) has been developed and deployed for effective tree risk assessment and management of over 102,000 trees on the premises of around 200 housing estates within the territory. The ETrMS serves as a database which allows us to systematically monitor the work on tree management and risk assessment via web and mobile applications. After each assessment, the findings will be saved in a comprehensive Geographic Information System (GIS). By logging the ETrMS for on-site inspection, it assists us to identify trees requiring special care immediately. Ad-hoc risk assessment and maintenance are also carried out when necessary.

▲ ETrMS as a database on tree management and risk assessment (left and right)

▲ Refresher and training courses for ETAs (left and right)

We have recruited Estate Tree Ambassadors (ETAs) in our estates to support our work on tree management and preservation. As at March 2017, 710 people were engaged as ETAs. We organised three refresher and training courses during the year to equip them with the latest knowledge.

We organise meetings with the Development Bureau regularly to update our tree preservation and management guidelines and clauses in contracts for good practice. In addition, the public can access our mini-website for general information and the characteristics of tree species commonly found in our housing estates.

▲ Mini-website with information on common tree species

Asbestos Abatement

While asbestos can be found in some of our old housing blocks and buildings, the substance poses little to no threat to human health if left intact and undisturbed. We carry out inspections twice a year to keep track of the condition of the asbestos-containing materials in our housing estates and ensure they stay in good condition. For emergency repair of underground asbestos cement water-mains, a registered contractor specialising in asbestos handling has been appointed.

Organising Green Activities

To raise the environmental awareness of the residents in our housing estates, we have partnered with local green groups to plan and execute the "Green Delight in Estates" (GDE) – a long-term estate-wide environmental education programme – since 2005. Around 22,000 residents and students have been trained as Green Estate Ambassadors to promote green messages to other residents to build a green and healthy living environment for the community.

During the year, we concluded GDE Phase 9 and commenced GDE Phase 10. Themed "Waste Reduction Begins with Waste Audit", echoing the Government's current waste management policy, a range of in-depth environmental education activities have been organised for residents in 33 estates to raise our residents' awareness of waste reduction and recycling, and encourage them to conserve resources in their daily routine. "Household Waste Audit" was the highlighted campaign for all the public housing estates. We also extended the educational programme to five shopping centres for product waste reduction, such as food waste, and to commercial tenants and residents. In the past nine phases, plastic bottle recycling campaigns, plastic bag reduction, waste separation promotion schemes, green living carnivals, talks and workshops on waste reduction, green visits, exchange of second-hand goods, quizzes and other occasions were arranged.

▲ Launching ceremony of GDE Phase 10

In collaboration with our Estate Management Advisory Committee (EMAC), we have arranged a wide variety of programmes for residents to help them to participate in our environmental work. During the year, we organised tree planting days in 10 estates and greening activities for residents in 20 estates.

Tree Planting Days at Wo Che Estate

◀ Green Fun Day under GDE

To encourage our shop tenants to implement green measures for the improvement of the overall environmental performance, we have signed up the retail facilities in 20 shopping centres or estates to join the Hong Kong Green Shop Alliance.

▲ Hong Kong Green Shop Alliance

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Initiatives in Office at Work

Implementation of Environmental Management System

Our Corporate Services Division was certified with ISO 14001 EMS since December 2013 on the property management at the HA Headquarters (HAHQ). The same certification and ISO 9001 QMS standards were awarded to the Independent Checking Unit (ICU) in May 2014. Being the first regulatory body to receive the qualifications in relation to building control in Hong Kong marks an important point in the commitment to excellence in monitoring and management. The preparation for upgrading the QEMS of ICU to ISO 9001:2015 and ISO 14001:2015 standards and extending the scope to include two building control teams, the Mandatory Building Inspection Scheme Team and the Minor Works Team, was in progress and targeted for certification by end of 2017.

To comprehensively improve the offices' environmental performance, environmental audits are carried out. We conducted and completed environmental audits at a total of 282 sites in 2016. In the last Green Manager Report, our resource consumptions, including paper, envelope and electricity, have declined steadily, and the amount of waste paper collected has been on the rise. In addition, we provided our staff with EMS and environmental audit training for better implementation of the management approach.

Energy Saving and Carbon Management

Apart from the aforementioned EMS and environmental audits, we endeavour to reduce our energy consumption and GHG emissions at work by organising different initiatives. For instance, over the years, we have controlled the use of refrigerants, adopted motion sensors for lighting, optimised chiller system control, changed the operating hours of lifts, escalators and air-conditioning equipment.

Using the electricity consumption in 2013/14 as baseline, we target at reducing our electricity consumption by 5% from 2015/16 to 2019/20, in order to align with the Government's latest electricity saving target. Hence, we aimed to reduce consumption by 2% in 2016/17 compared to 2013/14. During the year, our office premises consumed 34,850,777 kWh of electricity. Compared with the baseline data in 2013/14, consumption decreased by 5.4%.

A carbon audit has been conducted since 2008/09 for HAHQ Block 3 and Lok Fu Customer Service Centre, and the 8th carbon audit report covering period from 1 August 2015 to 31 July 2016 for the venues has been finalised to monitor our GHG emissions (see the table below for the annual results). With our carbon management programme, the amount of emissions in our offices has remained steady in the past few years. We will continue to implement any necessary improvement measures identified through such audits.

Properties	GHG Emission Intensity (Tonnes of CO_2 equivalent/m^2)							
	2008 /09	2009 /10	2010 /11	2011 /12	2012 /13	2013 /14	2014 /15	2015 /16
Block 3 of HAHQ	0.170	0.146	0.122	0.110	0.110	0.126	0.120	0.117
Lok Fu Customer Service Centre	0.171	0.168	0.224	0.167	0.161	0.162	0.157	0.150

Waste Management

To reduce the amount of solid waste produced by our office operation, multiple waste management initiatives have been implemented in our offices. During the year, we consumed 134,477 reams of paper which represents a 1.8% decrease from the baseline data in 2013/14. It exceeded the endorsed target for 2016/17 (i.e. 1% lower than the paper consumption in 2013/14).

The amount of waste paper collection per staff in 2016/17 was 81.6 kg, which was well beyond the collection target of 21.6 kg per staff.

To further reduce the environmental impact of paper use, all our publicity materials are required to be printed with environmentally friendly paper.

Defective mercury-containing lamps are the major hazardous materials at HA Headquarters. To dispose of them responsibly and protect the environment, all the lamps collected undergo special waste treatment.

Waste Type	Amount Handled by HAHQ in 2016/17 (tonnes)
Hazardous waste	
Recycled	3.7
Landfill	0.0
Non-hazardous waste	
Recycled	185.0
Landfill	163.8

Water Conservation

We constantly monitor the water consumption at HAHQ through conducting regular inspections to prevent pipe breakage and leakage and providing water conservation tips to our staff. To demonstrate our commitment to protecting our water resources, while no government-wide water saving target is present at the moment, we have set our own which is to achieve a further 2% reduction in consumption in 2016/17 compared with that in 2015/16. During the year, the premises used 11,316 cubic metres of water – a 26.0% reduction compared with the consumption in 2007/08.

Green Culture and Activities

We foster the green culture in our offices with multimedia platforms. The HA Environmental Corporate Video, which highlights our environmental programmes and activities, is available on the HA/HD website, social media channels and e-Learning Portal, and is played at the induction course for all new staff. In addition, during the year, we organised 22 seminars to improve our staff's understanding of environmental issues. We arranged green display panels at HAHQ and Lung Cheung Office Block during the year to showcase our latest environmental work.

▲ HA Environmental Corporate Video

Our offices have implemented a number of green measures regarding waste minimisation, waste recovery for recycling and reuse, and energy conservation. Apart from ordinary green office practices, including paper-saving measures, recycling of printer cartridges and toners, energy-saving initiatives, the HA has organised routine Office Security cum Energy Conservation Check every day after office hour to ensure the lighting and office machines are switched off. To facilitate behavioural change, we also put in efforts on staff participation and publicity.

An "Environmental Collection and Recycling Campaign" was co-organised with the Community Recycling Coop of Industrial Relations Institute, a non-profit making charitable organisation in June 2016 to raise our staff's environmental awareness and help the needy. With the full support from our staff, more than 4.8 tonnes of reusable items were collected, including electrical appliances, clothes, shoes, handbags, books, stationery, toys, kitchenware, bedding and sports items, decorations, etc.

▲ Environmental Collection and Recycling Campaign at HAHQ (left), Lung Cheung Office Block (middle), and HKHA Customer Service Centre (right)

Our staff are also encouraged to participate in other environmental activities organised by external parties. In 2016/17, about 110 staff and their family members took part in the Hong Kong Tree Planting Day. We also participated in Eco Expo Asia 2016 and the Community Chest's Green Day to showcase our green performance and disseminate green messages to the community.

▲ Hong Kong Tree Planting Day (left and right)

In recognition of our outstanding performance in green purchasing and green management, we were commended with Platinum Awards in the categories of Green Purchasewi$e (Large Corporation) and Green Management (Corporate); Corporate Green Governance Award (Corporate Vision and Stakeholder Engagement) and Outstanding Sustained Performance 7 Years+ Recognition under Hong Kong Green Awards 2016.

Green Manager Scheme

The HA has actively supported the Government-wide Green Manager Scheme launched by the Environmental Protection Department. Same as other bureaux and departments, we have appointed Green Manager and Green Executives to promote environmental protection principles in the offices, and monitor the HA's environmental performance and effectiveness of the measures.

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Case Study

Environmental Excellence from Planning to Operation – Lam Tin Estate

As a staunch advocate of environmental sustainability, we put considerable thought and effort, at the planning and design stage of our housing estates, into how to enhance the quality of life of our tenants and the long-term environmental sustainability of each project. Situated on a hillside of east Kowloon between Kwun Tong and Lei Yue Mun, the award-winning Lam Tin Estate presents one of the best examples of how we achieve environmental excellence.

Present-day Lam Tin Estate

Communal area

Open space

Community play area

Lam Tin Estate was initially built in 1966 in the form of 24-storey slab blocks, with 4,200 domestic flats accommodating about 13,000 residents. As time passed, the living environment could no longer satisfy the local needs, so a comprehensive redevelopment project was carried out between 1992 and 2009 in 11 phases to improve the quality of the community. In terms of the environment, poor natural ventilation, lighting and lack of open space were prioritised.

Instead of tackling the issues individually, we adopted a holistic approach with innovative measures to create a healthy and green environment for residents. For instance, at the planning and design stage, we conducted micro-climate studies using computer simulations to derive the best redevelopment option which takes the local wind environment, sun path and heat distribution into account. The cruciform block design was adopted for the general enhancement of ventilation, daylight and thermal comfort. The redeveloped areas now house about 13,400 domestic flats with 38,000 residents. Estates completed in the earlier phases were given different estate names; and Phases 7 and 8 were combined and retained the old name Lam Tin Estate.

Apart from block design, we leveraged greenery to reduce the urban heat island effect. By planting about 20,000 plants and shrubs and installing vertical green walls and a green roof on the pedestrian covered walkway, the greening ratio of Lam Tin Estate was improved to 26%. To save water for irrigation, an automatic irrigation system with rainwater sensors has been installed on the aforementioned green roof, and the irrigation volume can be adjusted automatically according to the weather conditions.

To reduce the Estate's reliance on electricity generated from non-renewable sources, we installed grid-connected PV modules on the rooftops of the domestic blocks and on the roof of the pedestrian covered walkway that are able to provide around 32,000 kWh of electricity annually, accounting for around 2.6% of electricity demand. The lighting systems are equipped with timers and photo-electric sensors to adjust to the illumination angle and duration of daylight, and thus reduce unnecessary energy demand. In addition, we made use of the environmental facade to reduce solar heat gain, further curbing energy consumption.

Covered walkway with green roof

Pledge of Go Green in Lam Tin

Before the completion of the redevelopment, we engaged the residents, schools and organisations in the vicinity to participate in the Action Seedling campaign, where the participants were given seedlings to nurture and transplant into flowerbeds.

While the presence of the hardware directs Lam Tin Estate to a greener path, the involvement of the local community takes the Estate further on the journey to sustainability. To this, a number of green elements have been incorporated into the daily management at Lam Tin Estate. For example, the management team actively promotes green messages on notice boards and electronic display panels, and distributes pamphlets with Green Living Tips to new tenants. Some of our security guards also act as Green Ambassadors to share environmental messages with the residents.

Waste reduction initiative at Lam Tin Estate

Community activity in Lam Tin Esate

Community garden at Lam Tin Estate

We also organise carnivals, workshops, fun fairs and other publicity campaigns to enhance the residents' environmental awareness and encourage them to practice green living in their daily lives. As for green education, the Estate's community farm is available for them to plant fruit and vegetables. In addition, various environmental training events, visits, seminars and workshops for management staff, tenants and contractors were arranged.

For waste reduction, the yard waste collected in Lam Tin Estate is recycled as compost for on-site gardening, with around 40 kilograms produced every month. The Estate also has over 160 collection points to collect recyclables.

With the impressive environmental performance at Lam Tin Estate, in 2012, the redevelopment of the Estate received the Grand Award in the Hong Kong Residential (Multiple Building) Category of the Quality Excellence Award. The Estate received the Gold Award for Property Management (Residential) in the 2016 Hong Kong Awards for Environmental Excellence (HKAEE). It is also certified with ISO 14001 EMS and ISO 50001 EnMS certifications, and awarded "Best Performing Estate - Kowloon East Region" in the 2015 and 2016 Public Housing Waste Reduction Campaign.

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