



# Advanced Sorting Facilities

The key to effective and efficient recycling  
and waste management in Hong Kong



German Industry  
and Commerce Ltd.  
德國工商會有限公司



# A White Paper

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German Industry and Commerce Ltd.  
19/F, COFCO Tower, 262 Gloucester Road, Causeway Bay  
Hong Kong

T: +852 2526 5481  
info@hongkong.ahk.de  
www.hongkong.ahk.de

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Written by: Nigel Mattravers and Edwin Lau

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Under the 'Econet' brand, GIC together with its AHK sister offices in Greater China promotes green technology and service solutions from Germany in the Hong Kong and Mainland markets.

## Abstract

This white paper explores the critical role of advanced sorting facilities in achieving effective and efficient recycling and waste management in the dynamic city of Hong Kong. With its dense population and limited land resources, Hong Kong faces significant challenges in handling its waste stream while striving to achieve sustainable practices. The paper underlines the need for advanced sorting facilities as a cornerstone of a comprehensive waste management strategy.

The white paper highlights the current state of recycling and waste management in Hong Kong, shedding light on the existing challenges and inefficiencies. It stresses the importance of adopting advanced sorting technologies to enhance the sorting process, improve recycling rates, and minimise waste sent to landfills. The implementation of automated sorting systems, optical sorting technology, and innovative waste segregation techniques is explored as key components of advanced sorting facilities.

Furthermore, the white paper showcases successful case studies from other cities around the world

that have implemented advanced sorting facilities, drawing valuable lessons and insights. It examines the positive environmental, economic, and social impacts of such facilities, including reduced landfill waste, increased resource recovery, job creation, and improved public awareness of recycling practices.

Additionally, the white paper addresses the critical factors for the successful implementation of advanced sorting facilities in Hong Kong. It highlights the importance of stakeholder collaboration, policy support, public education, and adequate infrastructure investment. The integration of digital technologies, data analytics, and intelligent waste management systems is also discussed to optimise the efficiency and effectiveness of sorting facilities.

Ultimately, this white paper advocates for the prioritisation and investment in advanced sorting facilities as a crucial step towards achieving Hong Kong's waste management goals. It emphasises the potential for a more sustainable future through increased recycling rates, reduced environmental impact, and the creation of a circular economy.

*Keywords: advanced sorting facilities, recycling, waste management, sustainability, Hong Kong, sorting technologies, resource recovery, landfill diversion, stakeholder collaboration, circular economy.*



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Photo courtesy of ALBA Group

## Introduction

Waste is a global problem, and despite best endeavours, it continues to grow. Landfills have potential to be hazardous and are running out of capacity. Other solutions, such as energy from waste, are very expensive to build and operate if they are to be environmentally acceptable. At the same time, there is increasing recognition that valuable resources are being wasted by being buried or burnt rather than being recovered. The current disposal solutions are a major contributor to carbon emissions and hence global warming.

Many developed countries, in particular in Europe, have for many years adopted the use of mechanical sorting or material recycling facilities

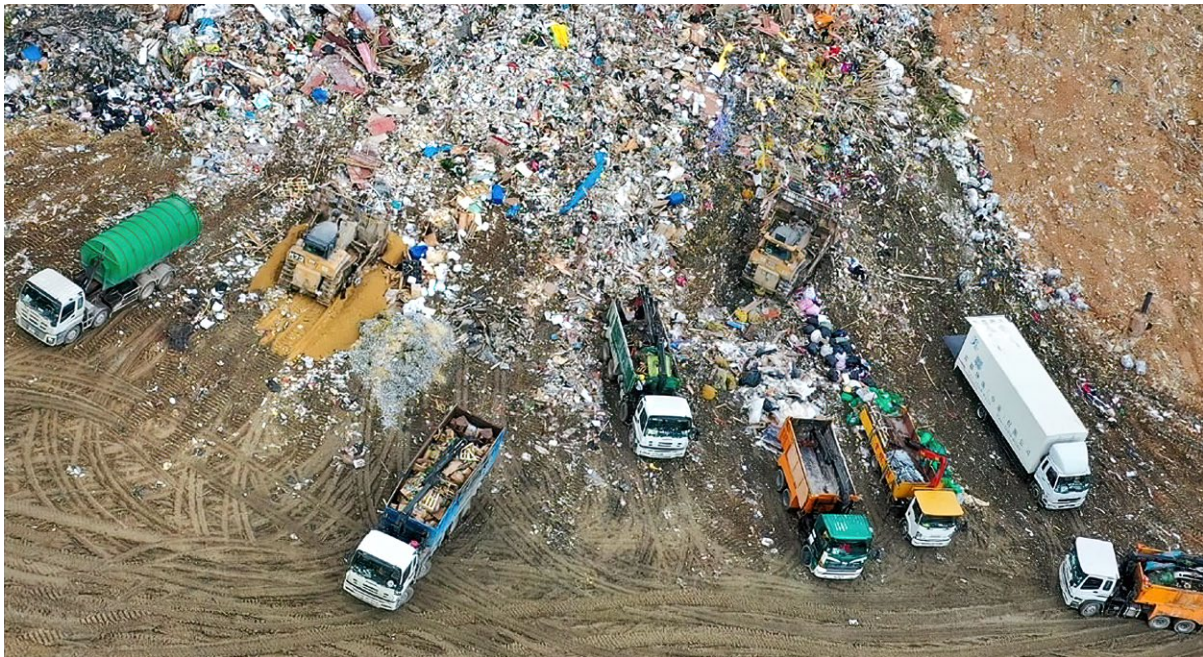
(MRF) to address these challenges. They are seen as vital elements to move towards a more circular economy. Hong Kong, however, has not yet adopted the use of mechanical sorting facilities and continues to depend on low-level separation and sorting, with the bulk of the waste going to landfills, and in the future, very expensive, inefficient mass-burn energy-from-waste (EfW) facilities.

This paper aims to show that sorting facilities are not only possible, but essential to help manage Hong Kong's waste problem, and to meet the challenges of the National 14<sup>th</sup> Five-Year plan with respect to a circular economy.



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Landfill Operations in Hong Kong

## The Problem for Hong Kong

Hong Kong is a city with a population of 7.41 million living on a total land area of 1,114.35 square kilometres. While country parks and special areas account for about 40% of Hong Kong's land area, the population density is 6,800 per square kilometre.

According to the Environmental Protection Department, the total amount of solid waste disposed of in landfills was 5.67 million tonnes in 2021. The average daily amount was 15,533 tonnes per day (tpd), which is an increase of 5.4% compared to 2020. Municipal solid waste includes household waste, and commercial and industrial (C&I) waste. In 2021, the amount of MSW disposed of was 11,358 tpd (4.15 million tonnes), an increase of 5.1% from the previous year.

The rate of municipal solid waste disposal also increased from 1.44 kg/person/day in 2020 to 1.53 kg/person/day in 2021. The main component of municipal solid waste is household waste, which accounted for 2.55 million tonnes in 2021.

The COVID-19 pandemic particularly fuelled the trend toward more delivery services, and the use of plastic containers and peripherals. Food waste also accounts for 30% of the MSW. Plastic waste (21%) and paper waste (20%) follow behind, and both have increased sharply.

The trend shows that as there is more waste per capita, the city's waste crisis will worsen unless effective action is taken. The city relies heavily on landfills, which are obviously limited in space to dispose of Hong Kong's increasing garbage. The environmental impact of unsorted waste and unmindful disposal is devastating. Waste that does not end up in landfills, ends up in the sea or in nature.

Waste incineration plants (EfW) could be one of the solutions to this crisis. However, on the one hand, these plants burn waste that could be turned to valuable resources. On the other hand, they convert waste into ash and other forms of pollutants that require disposal. The incineration of waste is hardly contributing to the carbon neutrality efforts that the city has committed to in becoming carbon neutral by 2050.

Waste should be avoided in the first place, but recycling of the remaining waste is an essential part of the solution for the city's waste crisis, and can contribute to the government's carbon reduction strategy. Hong Kong's capacity to consume raw materials or recycled materials for local production is relatively limited. In 2021, 1.8 million tonnes of waste in total were recovered for recycling, which accounts for only 31% of the total waste produced. Among the recovered materials, ferrous metals (42.7%) and paper (32.8%) accounted for the largest share.

According to recent research from the European waste management sector, sorting mixed waste before thermal treatment, such as incineration, could save up to a quarter of emissions. To achieve this in Hong Kong, using mixed waste sorting systems is essential to remove recyclable materials before incineration. A ban on incineration and disposal of recyclable materials could also provide an incentive for such systems and for better environmental protection.

Looking at the data, it becomes evident that Hong Kong is producing too much, discarding too much, and recycling too little. The city relies heavily on landfills, while treatment or recycling facilities are still in the development phase.

## The Need for MRFs and How They Could Work in Hong Kong

The development and use of mechanical sorting of mixed waste have been the backbone of municipal solid waste management in Europe and North America for more than two decades. It has been long recognised in those places that in order to reduce the amount of waste going to potentially polluting landfills, materials that have value should be considered as a resource and should be recovered from the waste stream. This move to sort waste has been driven to a large extent by legislation to reduce volumes of waste going to landfills and setting recycling targets. As a result, modern mechanical separation or recycling facilities (MRFs) have evolved.

Using advanced MRFs, many elements of the waste stream can be recovered, which may include:

- **Metals – both ferrous and non-ferrous**
- **Paper in its various forms – cardboard, newsprint, mixed, cartons**
- **Glass – which can be separated by colour if required**
- **Plastic films**
- **Hard plastic – bottles, pots, and containers which can be further separated by type**
- **Organic material – depending on the waste stream, this may be treated further by composting or digestion if appropriate**
- **Removal of hazardous items – such as batteries, e-waste**

Dependent on the waste stream, the remaining output comprises of small mixed materials that are difficult to recover, and can go to landfills or potentially be used as a clean high-energy fuel, secondary recovered fuel (SRF) for EfW facilities. The separated waste fractions form a supply of clean material that can be taken by recyclers and re-processors to bring these resources back into the economy, with subsequent environmental and carbon reduction benefits. It is clear that manual sorting of waste is unattractive, has limited capacity and cannot manage to separate the modern mixed waste streams. Over the years, the technology for separation has advanced significantly and can include combinations of:

- **Sorting drums (trommels)**
- **Magnets and eddy current separators (for non-ferrous materials)**
- **Ballistic separators**
- **Air separators**
- **Optical sorters**
- **Compactors and balers**



A MRF in action

Photo courtesy of ALBA Group



# Sorting of lightweight packaging – Flow Chart

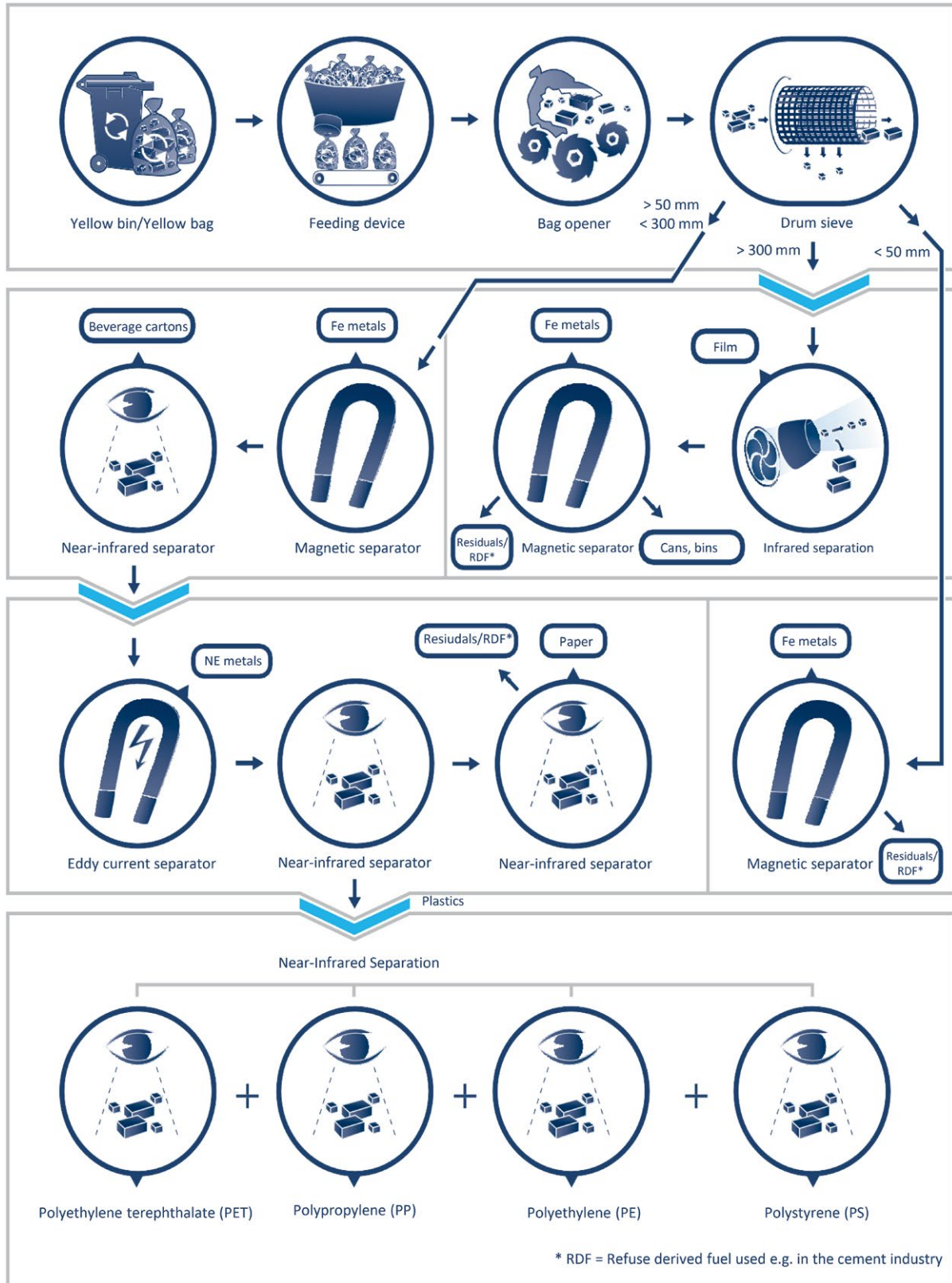




Photo courtesy of ALBA Group

### A trommel forms an early stage of the sorting process

There is also a lot of work being done with the development of the use of AI technology and robotics in the sorting process.

MRFs have been developed to process different feedstocks and end markets. Some deal with single-stream, unsorted waste (also known as dirty

MRFs); others handle source-separated waste, where the organic waste has been separately collected; others are optimised to provide high energy, clean fuels for EfW plants or cement production. By using the sorting facilities to prepare 'green fuels' then, the size and cost of the EfW facilities can be reduced, and their efficiency increased.



Photo courtesy of Van Dyk Recycling Solutions

### A 30t/h single stream MRF is being developed in Regina, Canada





## How can MRFs work in Hong Kong?

As the first section of this paper has set out, Hong Kong has a chronic waste problem. The landfills have limited capacity, even with the extensions to North East New Territories (NENT) and West New Territories (WENT) Landfills. The planned EfWs being built or in planning are very expensive, and it makes no sense to try and incinerate non-combustible materials and those that have an intrinsic value to the economy. At the same time, the existing recycling industry needs more quality feedstock. The Hong Kong SAR government has also expressed its desire for innovative re-industrialisation and a commitment to carbon reduction; a revitalised, hi-tech recycling industry would support these aims.

Sadly, opportunities to construct MRFs in existing or newly constructed urban areas have been lost. The Hong Kong SAR government does, however, have ambitious plans for the Northern Metropolis, Lantau Tomorrow Vision and extensions to Tseung Kwan O, amongst others. For these developments, the government has 'green ambitions', and the sorting of waste using advanced technology would seem to help achieve the sustainability goals that have been set. As the planning for these areas is still being developed, this would seem to be a great opportunity to incorporate sorting facilities as part of the green living and industrial plans for these areas. It is noted that there are plans for new, old-style refuse transfer stations to serve these developments; perhaps these could be developed as MRFs instead.

There have been repeated statements that there is no land available for these MRFs, but this may not necessarily be the case.

Modern MRFs can be compact and built-in multistorey developments, as has been shown in Singapore. Specialists in the design of MRFs consider multistorey facilities are the optimum layout as the materials move downwards under gravity. They have not been commonly used, however, because in most countries they are uneconomical, as land is cheaper and the construction cost unwarranted.

MRFs can also be built underground. Again not normally considered in most countries, but Hong Kong has, and is planning, underground refuse transfer stations in caverns.

MRFs could be readily placed in operational landfills. This would make sense as the supply routes are already in place, and the distance to the disposal point for rejected materials is minimal. Yet, previous proposals to collocate MRFs at landfills in Hong Kong were rejected for planning reasons.

MRFs optimised for 'green fuel' production can be constructed adjacent to the projected EfWs. The fuel can be delivered directly to the plant. Land can be made available because as the EfW is using a higher energy fuel than for the equivalent mass burn design, it will have a smaller footprint both for the plant itself and the land required for ash handling and treatment.

## MRFs and the Circular Economy

Although the desire to move towards a circular economy is not expressly stated in any Hong Kong SAR government targets, unlike the Mainland, there are ambitions for:

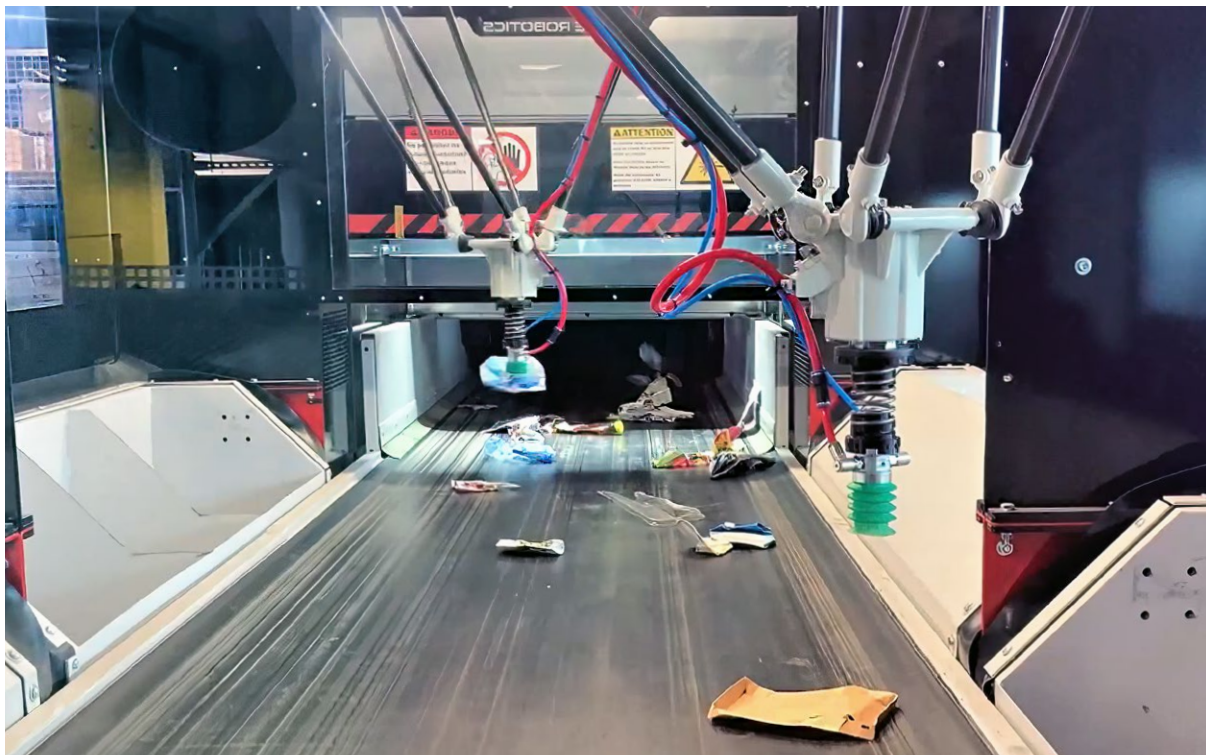
- **Reindustrialisation**
- **Innovation**
- **Carbon reduction**

Advanced sorting facilities will help achieve these ambitions.

The production of good quality feedstock for further processing or remanufacturing will enable the current industry to invest in further advanced processing facilities using hi-tech equipment as a new advanced industry. These facilities will benefit from innovative solutions, including digital

technology, AI and robotics. Robotics allow for more precise recognition and identification of different materials through recognition technology. It should be noted that German companies are particularly advanced in their development of robotics for this application.

It has long been recognised that recovery of materials for recycling and reprocessing has significant carbon savings, in the fact that the demand for energy and water in the extraction process is negated. An example in Hong Kong is the WEEE-PARK, which saves approximately 80,000 tonnes of carbon emissions each year. Thus the recovery of materials for reuse and reprocessing from the MRF operations will have a significant carbon reduction benefit for Hong Kong.



Robotics in action in a sorting facility

Photo courtesy of Waste Robotics





A MRF in action

## Conclusion

The concept and use of advanced waste sorting facilities, or MRFs, is widespread throughout developed countries across the globe. In fact, in some countries in Europe, including Germany, all waste must be sorted before any further disposal can be considered, and only 5% of all municipal solid waste goes to landfills. As a result of this widespread use, the technologies around these facilities are well-proven but continuing to develop.

Hong Kong, on the other hand, relies on large landfills, which have a limited useful life and will rely on very expensive and inefficient EfW plants to manage its increasing waste growth. At the same time, existing recycling businesses in Hong Kong are struggling for good quality feedstock and are reluctant to invest in new technologies.

The strategic use of MRFs in Hong Kong will help address these problems of waste disposal and, at the same time, meet the SAR government's ambitions for reindustrialisation, innovation and carbon reduction. This will be an important step in helping Hong Kong move towards carbon neutrality by 2050.

Now is an excellent time for Hong Kong to introduce the use of MRFs with strategic planning being developed for Lantau Tomorrow, the Northern Metropolis and Tseung Kwan O extensions. The much-cited issue of land availability can be addressed through thoughtful design of the facilities, including the development of vertical processing, installation in caverns or integration within new urban developments.

German industry is well placed to assist Hong Kong in the development of sorting facilities as part of the SAR's waste management strategy. Our many years of experience in development and operations, technical know-how and innovation, coupled with a local presence, will be a great benefit to the SAR as it addresses its multiple ambitions for waste management and the move towards a circular economy.

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19/F, COFCO Tower  
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