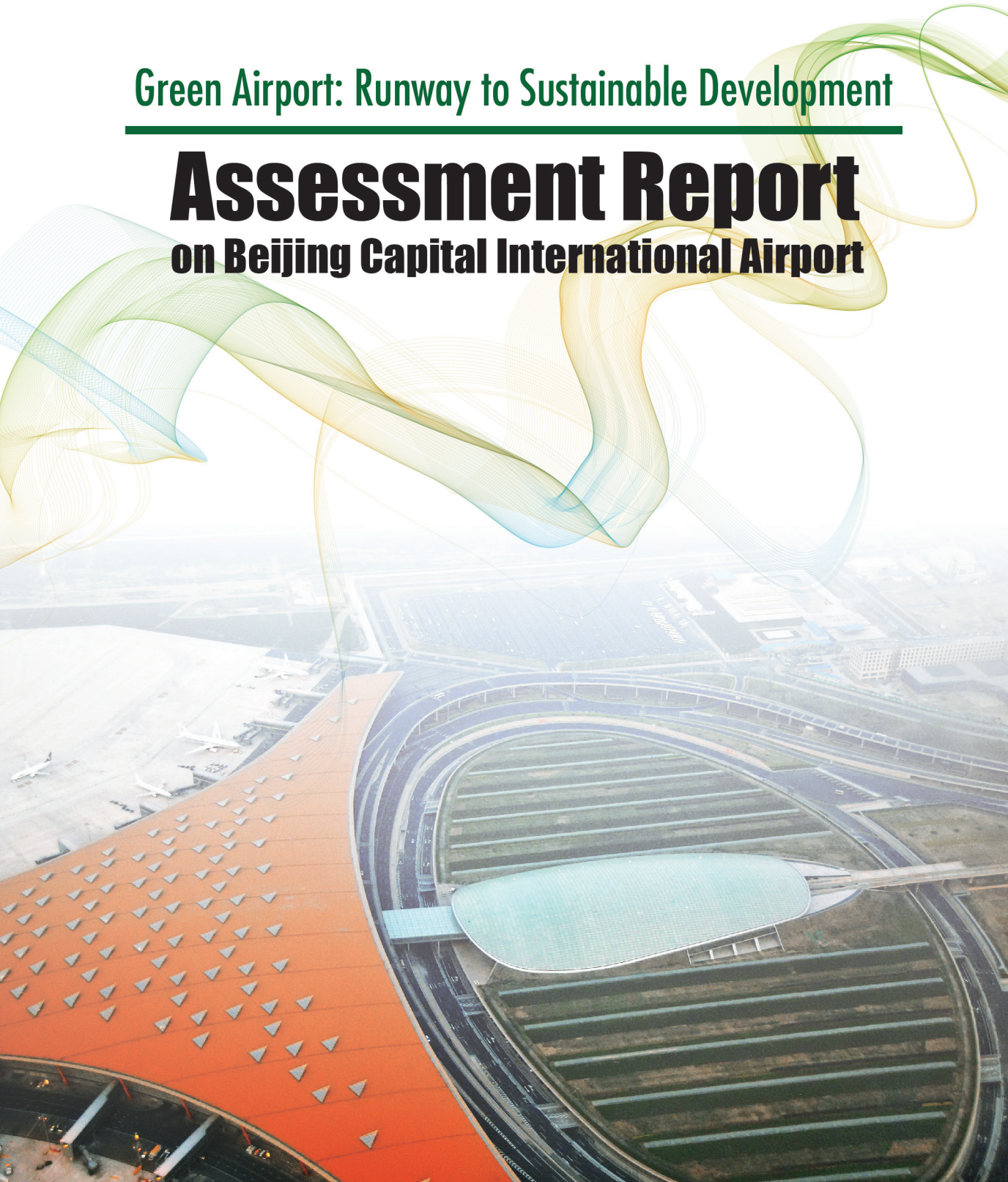
UN environment

Green Airport: Runway to Sustainable Development

Assessment Report

on Beijing Capital International Airport



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Citation

United Nations Environment Programme (2017). *Green Airport: Runway to Sustainable Development.* An Assessment Report on Beijing Capital International Airport. Nairobi.

Job No: DTI/2142/GE

Table of Contents

Acknowledgments

The report is produced under the guidance of Sheng Fulai, Senior Economist of the United Nations Environment Programme (UN Environment) and Wu Jiang, Dean of the UN Environment-Tongji Institute of Environment for Sustainable Development (IESD). Contributors include: Li Fengting, Wang Xin, Zhang Jing, Tan Hongwei, Guo Ru, Li Kaiguo, Mao Dongxing, Niu Dongjie, Wang Hongtao, Jia Qian, Wang Ying, Gu Yifan, Liu Zhaohui, Shi Yu, Zhu Qiang. Zhang Jing supported management of the content and development of the report.

The contributors would like to acknowledge the support and advice from: Chen Hao, Arab Hoballah, Jiang Nanqing, Li Zhaoying, Solange Montillaud-Joyel, Steven Stone, Zhang Shigang. Appreciation also goes to Lei Yu of the Chinese Academy for Environmental Planning, Liu Wujun of the Shanghai Airport Authority, and Hu Jing of the Shanghai Academy of Environmental Science who have reviewed and commented on the drafts of this report. Special thanks are due to Rong Rong, Gu Beibei, Chang Yan, Zhang Huiting and Ma Hui for their organization and coordination, Mark Grassi for editing, and to Jiang Dahe,Jia Qian,Sun Jie and Wang Zidi for their translation.

Finally, this report would not have been possible without the full cooperation and support from colleagues at the Beijing Capital International Airport: Han Zhiliang, Zhang Wei, Gao Lijia, Deng Xianshan, Luo Liang, Yang Jian, Yu Yong, Wang Zidong, Gao Meng chen, among many others, who have provided access to data and information and facilitated arrangements for interviews and discussions.

Executive Summary

Modern aviation industry's rapid development, including that in China, has contributed to economic expansion locally and worldwide. Airports are at the core of this development by providing the infrastructure for air transport, thereby contributing to the generation of goods, services and jobs, as well as connecting local economies to global markets.

The aviation industry's growth, however, also entails pressure on natural resources and the environment, as reflected in its contribution to greenhouse gas emissions. In this context, Beijing Capital International Airport is among several embracing the concept of becoming 'green' or 'sustainable'. While this concept does not have an internationally accepted definition, it is strongly aligned with the major strands of sustainable development – economic, social, environmental and, increasingly, governance.

Beijing Capital International Airport has shown strong commitment towards ensuring that its growth in air, cargo and passenger traffic is balanced with improved performance in this regard.

The airport has contributed up to 9.7% of Beijing's economic output and employed up to 6% of the city's working population directly and indirectly. It has furthermore brought broader positive impacts on investments, trade, and tourism to the local economy.

Parallel to its economic performance, the airport has invested in the health and professional development of its staff, leading to it being named among the top 30 employers in Beijing in 2016. Further progress could be achieved by ensuring that its recruitment procedure becomes more encouraging for women applicants. The airport provides wastewater treatment and solid waste management for neighbouring communities. It is also taking noise complaints seriously and has launched a project whereby technologies will be developed to reduce noise levels.

In terms of environmental performance, Beijing Capital International Airport has shown increased energy efficiency and reduced carbon emissions per unit of operation, even as its business keeps growing. Use of gasoline and diesel by airport vehicles declined 45% and 49% respectively between 2010 and 2016 for example, while overall carbon emissions were cut by almost 16% between 2014 and 2016. Performance in terms of indoor air quality and wastewater treatment is fully up to national standards, while efforts to encourage recycling among passengers are innovative and commendable. Further milestones could be achieved by ensuring that a greater share of electricity is sourced from renewable energy, that waste volume is reduced and energy is recovered from incineration.

Departments involved in the day-to-day running of the airport are seen to work together closely to improve flight punctuality and the efficiency of ground transport for example – with implications for energy consumption, carbon emissions, and air quality. The airport has also set up a Science and Technology Management Committee to conduct research on issues such as rapid transit and smart airport decision-making systems. One area where further efforts from multiple stakeholders are required in this regard is improving public transport between the city center and airport. Meanwhile, relevant products are being procured in favour of projects to introduce LED lighting and switch from gas to electricity. Preliminary efforts to conduct environmentally-selective procurement provide a sound basis for adopting a full-fledged green procurement policy. Linking financial management to the growing green bond market could lay the grounds for further positive highlights in its next green airport assessment.

Chapter 1.
Introduction

This chapter provides the background and contour of this report. It starts with an introduction to the development of global and Chinese aviation industry and airports, and places the “green airport” concept in that context. It then presents the basic information on Beijing Capital International Airport (hereafter Beijing Airport), on which this report focuses. Finally, the chapter ends with a roadmap to help readers navigate the rest of the report.

1.1 Global Aviation Industry and Airports

Modern aviation industry's rapid development has contributed to economic expansion worldwide. According to the International Air Transport Association, this industry provides over 60 million jobs, transports cargo worth US$18.6 billion daily, and accounts for 1/3 of the global trade by value[1]. Global airline passengers exceed 3.7 billion annually[1], largely travelling between Asia, Europe and North America - accounting for over 80% of the global market in 2014[2]. The industry has kept growing at a high rate, fueled by the growth in emerging economies and the global economy's gradual recovery. The International Civil Aviation Organization estimates that, by 2030, the number of airline passengers worldwide will exceed 6.4 billion[2].

Airports are at the core of the aviation industry. They provide the infrastructure for air transport and play an important role in facilitating cooperation among different entities. Apart from managing runways and providing aviation- and non-aviation-related services to passengers, airports are also responsible for transport control, provision and maintenance for aircrafts, and cargo transport, among other functions. These activities involve airline companies, other airport-based businesses, and government agencies. Airports serve as a platform where different agents can coordinate to move towards a common vision, as well as multiple destinations.

For the hosting city, airports not only contribute to economic output and job creation, but also connect the surrounding areas to the world economy. Almost every large city now has at least one airport, which is like a "business card", providing visitors with their first impression of the city. At the same time, an airport is also a bridge connecting the hosting city to the world, enhancing accessibility and providing an impetus for urban development.

While the aviation industry is growing, natural resource and environmental constraints are also increasing. Take carbon emission as an example: IPCC estimated that 2% of total anthropogenic CO_2 emissions were emitted by aircrafts in a special report on Aviation and the Global Atmosphere[3]. In 2009, at the United Nations Climate Change Conference in Copenhagen (known as "the Copenhagen Summit"), International Air Transport Association announced a goal for the aviation industry to reduce half of the carbon emissions by 2050 compared to a 2005 baseline[1]. The delivery of this commitment requires collective efforts of airports, airline companies, and all the components of the aviation supply chain.

1.2 Chinese Aviation Industry and Airports

China's aviation industry has been growing rapidly in conjunction with the country's urbanization, the rate of which increased from 20% in the 1980s' to 57% in 2016[4], amounting to an increase of 500 million urban residents over this period. This rate is estimated to reach 60% by 2020[5]. Rapid urbanization has expanded demand for leisure services, resulting in growing demand for air travel. In 2016, there were 218 civil airports in China (excluding Hong Kong, Macao and Taiwan) servicing 1 billion passengers for the first time (26.2% of which was accounted for by hub airports in Beijing, Shanghai and Guangzhou, which also handled 49.6% of total air cargo in China)[6]. In terms of total civil aviation turnover, China's ranking among International Civil Aviation Organization member states rose from 37th in 1978 to 2nd in 2005, and it has remained in that position ever since[7-8].

1.3 Beijing Capital International Airport

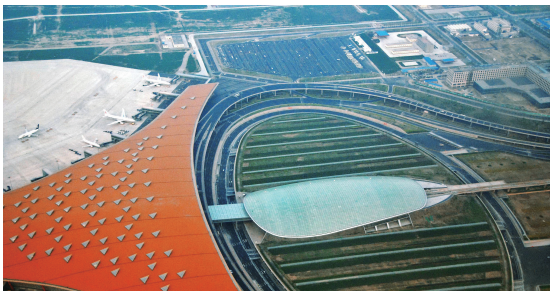


Fig. 1.1 Aerial view of Beijing Airport

Beijing Airport is geographically important by virtue of being located in the Chinese capital, which has a population of 21.73 million[9]. As China's major center for political affairs, cultural activities, international exchanges, and innovation, Beijing generates huge demand for domestic and international air services. Fig. 1.1 shows the aerial view of Beijing Airport. Fig. 1.2 shows Beijing Airport's development over the years. Fig. 1.3 shows the airport as a hub connecting Asia, Europe and America.

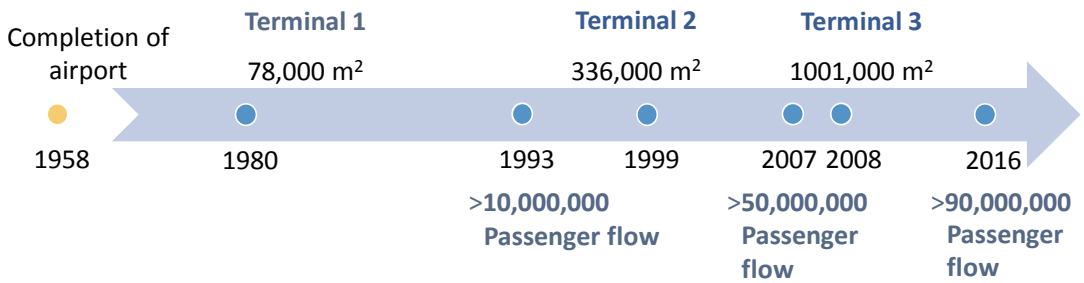


Fig. 1.2 Beijing Airport's development over the years

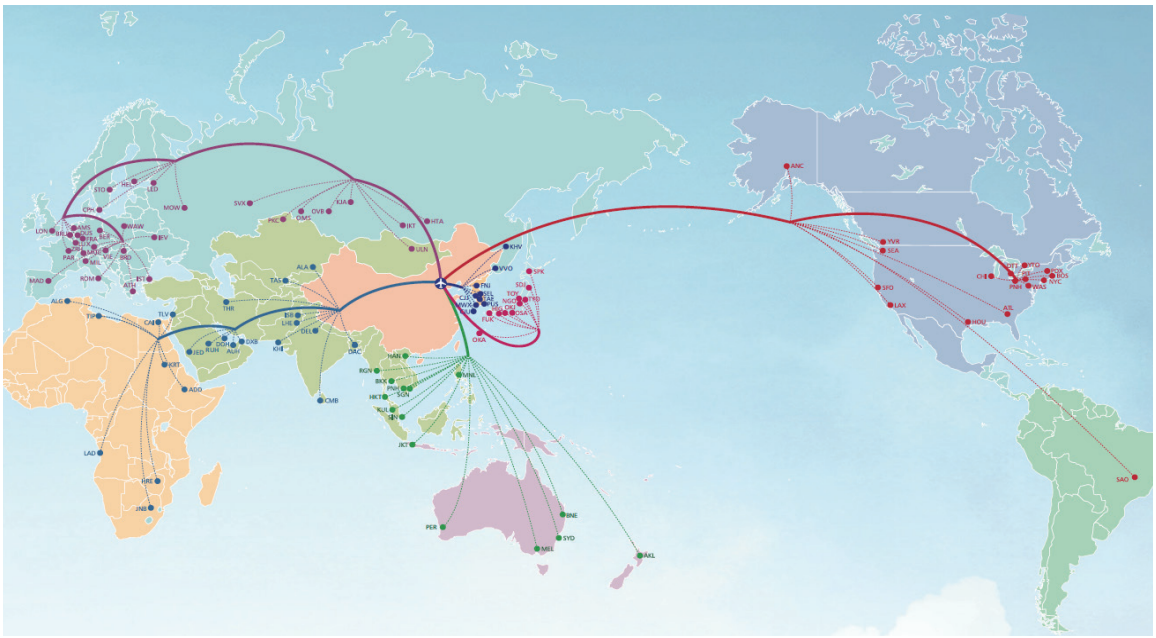


Fig. 1.3 Beijing Airport connects the city to the world
Source: Corporate social responsibility report of Beijing Airport Co., Ltd.[11]

Beijing Airport is also China's largest and busiest international airport. In 2016, the airport moved 94.39 million passengers and handled 606,000 aircrafts, more than any of the other 217 airports in China.[6] Its passenger handling capacity is ranked as second in the world after Hartsfield-Jackson Atlanta International Airport (Atlanta Airport) in the United States. In terms of cargo handling capacity, Beijing Airport is second in China at 1.94 million tons, after Shanghai Pudong International Airport (Pudong Airport)[6].

With an increasing capacity, Beijing Airport has set itself the goal of "building a green gateway to China by mobilizing multiple actors". It is a representative of existing Chinese airports that have systematically pursued the green airport concept, taking steps in areas such as improving service quality, saving energy, and monitoring and managing noises. During China's 12th Five-Year Plan period (2011-2015), Beijing Airport set becoming a green airport as its development goal, seeking to achieve breakthroughs in energy saving and green transport. During the 13th Five-Year Plan period (2016-2020), the airport aims to make specific plans for implementing green airport concept.

1.4 The "Green Airport" Concept

Although there is no universally accepted definition of the "green airport" term, a number of airports and related industries have taken initiatives based on the concept of sustainable development. This has moved the idea of "green airport" (or "sustainable airport") from focusing on isolated issues of energy consumption, greenhouse gas emissions, and noise reduction towards the systemic consideration of an airport's overall operation and management. The Green Airport Initiative launched by the Clean Airport Partnership in the United States, for example, provides guidance for American airports to pursue balanced development and reduce environment impacts.

As another example, Chicago Aviation Administration has produced a Sustainable Airport Manual for O'Hare International Airport (Chicago Airport), covering planning, design, construction, airport management, operations and stakeholder involvement[11]. Since 2007, the Chicago Aviation Administration and American Association of Airport Executives have hosted the annual "Airports Going Green Conferences", attracting participants from around the world.

Other than Chicago, Atlanta Airport has also produced a Sustainable Management Plan, focusing on raising resource efficiency, reducing environmental impacts, strengthening stakeholder participation, and specifying sustainable development goals[12]. Munich Airport, Frankfurt Airport , Los Angeles International Airport, Hong Kong International Airport, Incheon Airport, Narita Airport, among many others, have also made efforts to promote sustainable airports.

Even though no universally accepted standard exists for evaluating airports from a sustainable development or broadly defined "green" perspective, there are existing resources that can be drawn upon. Green architecture standards, such as Leadership in Energy & Environment Design, for example, can be useful when it comes to the greening of terminal buildings. Broader evaluation systems cover economic viability, operational efficiency, natural resource conservation, social responsibility.

The latter has been proposed by the Airports Council International North America and endorsed by Sustainable Aviation Guidance Alliance in its Sustainable Aviation Resource Guide[13].

The application of these frameworks, however, needs to take into account different types of airports in different localities facing different challenges. New and existing airports, for example, have different "green airport" objectives and pathways. This is shown by their different degrees of flexibility in adopting renewable energy technologies for example. Existing airports face the challenge of their carbon legacy locked in decades ago.

In China, efforts are underway to promote the green airport concept. In the early 21st century, Beijing Airport, Pudong Airport and other Chinese airports tried to reduce their environmental impacts through technological and management interventions. Beijing Airport's Terminal 2, for example, has applied central air conditioning system and automatic light sensing equipment, Terminal 3 has adopted natural lighting and ventilation, and aircraft movement areas have installed a noise monitoring and control system[14]. Pudong Airport, as another example, has put the Combined Cooling Heating and Power system in place[14].

In 2007, Civil Aviation Administration of China launched the Kunming Green Airport Demonstration Project, anchoring the concept of green airport to the principles of "saving natural resources, protecting environmental quality, using clean technologies, and providing good services to passengers". These principles have attracted attention from other Chinese airports. Beijing Airport, for example, has started to integrate the green airport concept into its development plans and other airports have also launched projects with "green" elements.

In 2015, Civil Aviation Administration of China released the Guideline for Green Airport Planning, largely based on the green airport principles developed for the new Kunming Airport. It describes green airport as "an airport system that provides a safe, healthy, efficient and comfortable space for work and activity; a space that promotes a coordinated relationship between human and nature, development and the environment, airport construction and nature conservation, and economic growth and social development, in a manner that saves natural resources and reduces environmental impacts"[15].

1.5 Guide to the report

This report has six chapters. Chapter 1 outlines the development of the aviation industry and airports globally as well as in China, including a profile of Beijing Airport, which is the focus of this report. It then places the concept of "green airport" in that context. The chapter also helps navigate the readers through the rest of the report.

Chapters 2-5 assesses Beijing Airport's economic, social, environmental and governance performance, respectively, based on a select number of indicators. The decision to cover these four dimensions reflects a broad appreciation of how the green airport concept is aligned with the concept of sustainable development. Given the growing recognition of governance in sustainable development discourse, this dimension is also covered in the assessment. It should be noted, however, that the boundaries of these dimensions are not always clear cut. Some issues could easily be reflected in more than one dimension. For example, the airport's provision of waste management services to local communities could be assessed under either social or environmental dimensions.

Ideally, when assessing an airport from a "green" or sustainable development perspective, a fully integrated approach should be taken that considers links among the various dimensions. An airport's profitability alone, for example, is not necessarily synonymous with its sustainability; its impacts on the environment should be costed and deducted from its profits. Similarly, pollution in the airport affects employees' health, which can in turn reduce productivity. Due to the analytical and data constraints that currently exist, however, this report assesses these dimensions distinctively with the hope that readers will bear this caveat in mind and read different chapters with an integrated perspective.

Chapter 6 concludes the assessment and puts forwarded suggestions to Beijing Airport for furthering its green airport effort.

Chapter 2.
Economic Performance

This chapter assesses Beijing Airport's economic performance from two perspectives: 1) the airport's internal economic performance including operating efficiency, labor productivity and land-use efficiency; 2) the airport's contribution to Beijing's economic output, employment, investment, trade, and tourism.

2.1 Internal Economic Performance

2.1.1 Operating efficiency

With its rapid development as a hub airport and the expansion of its non-aviation businesses, Beijing Airport has achieved sound profitability and business growth. Beijing Capital International Airport Company Limited (Beijing Airport Co., Ltd.) manages the airport, including its aviation operations and a number of ancillary businesses. According to the company's annual reports[16-22], revenue from aviation and non-aviation businesses increased at an annual average of 7.1% during 2010-2016, and the return on equity increased from 4.4% in 2010 to 9.2% in 2016. The share of non-aviation revenue grew from 38.4% in 2010 to 44.6% in 2016 (Fig. 2.1). The development of non-aviation businesses not only contributes to a wider range of airport services, but also offsets the airport's investment and operating costs. Fig. 2.2 shows a corner of commercial area in Terminal 2.

Fig. 2.1 Beijing Airport's revenues and composition
Source: Annual reports of Beijing Airport Co., Ltd.[16-22]

As its business expands, Beijing Airport's operating costs keep rising, though at a rate lower than the growth of its revenue. According to the company's annual reports[16-22], Beijing Airport's operating costs increased at an annual average of 5.8%. Among these, during 2010-2016 expenses on utilities and power grew at a lower level of 2.1%, despite electricity prices increasing in 2012 and the new demand for water and electricity consumption sparked by the opening of Terminal 3D in 2013. This is thanks to the airport's efforts in energy and water conservation, which will be elaborated in subsequent chapters.

Beijing Airport's sound financial position is also facilitated by its access to capital markets. In 2016, it issued short-term bonds amounting to RMB2.5 billion to improve the company's financing structure[22]. In future, the company may wish to consider issuing green bonds to fund its green airport efforts. Additionally, the company may also want to consider investing some of its liquid assets – worth billions of RMB in green bonds to support the green transformation of society at large.

Fig. 2.2 A corner of commercial area in Terminal 3

2.1.2 Land-use efficiency and labor productivity

As Fig. 2.3 shows, since 2010, Beijing Airport's passenger handling capacity per unit of land has been increasing. Compared with a few large airports in the United States, Beijing Airport is second after Atlanta Airport in terms of land-use efficiency, and is ahead of Chicago Airport and John F. Kennedy International Airport (Kennedy Airport). In connection to cargo handling, Beijing Airport uses land more efficiently than Atlanta Airport (and Kennedy Airport after 2012). Beijing Airport only has three runways, yet in 2016, each runway serviced more than 550 flights daily - a demonstration of effective management. Beijing Airport's labor productivity (covering the company's employees only, not the airport's entire labour force) has also followed an upward trend.

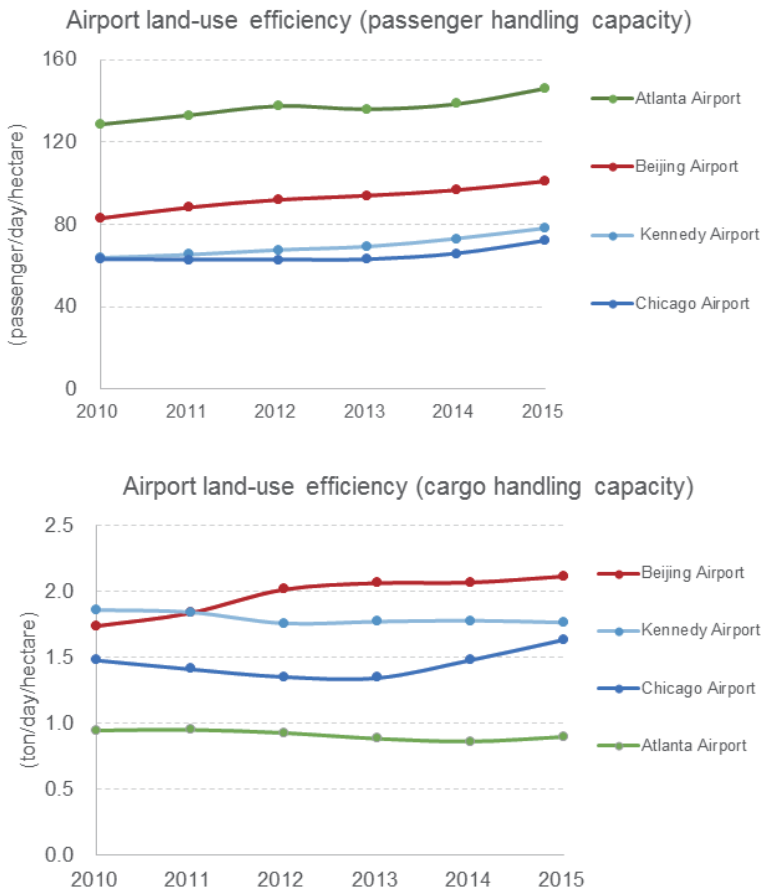


Fig. 2.3 Passenger and cargo handling capactiy per unit of land of Beijing Airport and selected airports
Source: Beijing Airport land area from Beijing Airport website. Land area of other airports from their respective website[23-25]. Business data from the Wind database[26].

Table 2.1 Beijing Airport's labor productivity

	2010	2011	2012	2013	2014	2015	2016
Passenger (passenger/day/staff)	111	134	135	137	140	150	159
Freight volume (ton/day/staff)	2.3	2.8	3.0	3.0	3.0	3.2	3.2
Aircraft movement (times/day/staff)	0.8	0.9	0.9	0.9	0.9	1.0	1.0

Source: Annual reports of Beijing Airport Co., Ltd.[16-22]

2.2 Contribution to Beijing's Economy

2.2.1 Output and employment

Beijing Airport's business development has been grown in line with Beijing's Gross Domestic Product (GDP). During 2010-2016, Beijing Airport's passenger handling capacity grew at the same pace as Beijing's GDP growth rate, as shown in Fig. 2.4. A 2014 study on "Beijing Airport's Regional Economic Impact" shows that, between 2010 to 2012, Beijing Airport's total economic contribution remained at about RMB130 billion, accounting for 7-10% of Beijing's GDP over the same period[27]. This includes direct and indirect contributions, and the latter including upstream and downstream industries, spending by passengers and employees along the aviation service chain, as well as the air cargo related industries. As far as Beijing Airport's contribution to municipal and national fiscal revenues is concerned, in 2016, Beijing Airport made RMB595 million in taxes, three times that paid in 2010 (RMB197 million)[16,22].

Fig. 2.4 The Beijing Airport's passenger flow and Beijing GDP
Source: Beijing 2000-2015 GDP data from Beijing Statistical Yearbook 2016[28], Beijing 2016 GDP data from the Wind database[26].

Beijing Airport has also contributed to job creation in Beijing. According to its annual report, the company employed 1,623 people in 2016[22]. In Shunyi District where Beijing Airport is located, 63,126 people were employed in the aviation-related industry[29]. According to the China National Bureau of Statistics, the country's aviation industry employed 553,358 employees in 2015. Of these 70,708 or 12.8% were in Beijing[26]. Another source shows that in 2012 Beijing Airport provided jobs for 664,100 people[27], or 6% of the hosting city's working population[28].

2.2.2 Investment, trade and tourism

Beijing Airport contributes to Beijing's accessibility, including by improving the local and neighboring transport networks (see Fig. 2.5), facilitating the city's overall development. The airport connects Beijing to 279 cities in

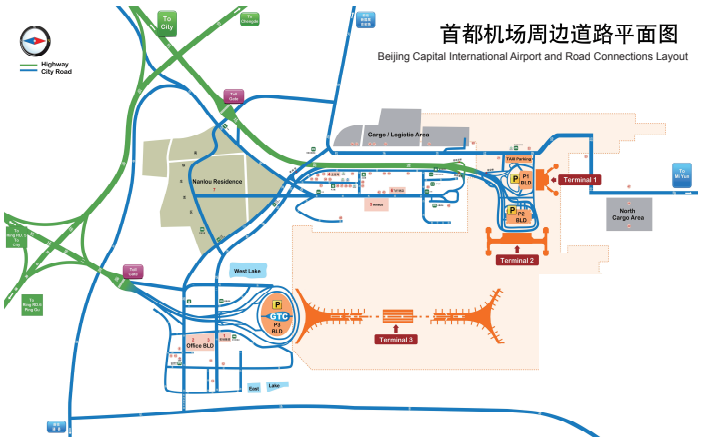


Fig. 2.5 Beijing Airport and road connections layout

65 countries, more than Atlanta Airport and many other airports in Asia including Inchon Airport, Hongkong Airport, Pudong Airport and Hongqiao Airport. Beijing Airport thus plays a major role in helping Beijing attract foreign investments, promoting trade and tourism, as well as in raising the city's international visibility.

In 2016, foreign direct investment in Beijing exceeded US$13 billion (about RMB85 billion), twice as much as in 2010[28]. In the hosting Shunyi District, foreign investment in 2015 amounted to US$521.1 million, much higher than that of the other four new development zones in Beijing[29]. Beijing Airport is also at the center of Beijing's port system - there are four other ports in Beijing – and, as such, plays a major role in Beijing's international trade. In 2016, the total volume of imports and exports was 58.71 million tons, 97.9% of which was accounted for by Beijing Airport[30].

Another beneficiary of Beijing Airport's presence is Linkong Economic Zone, one of the six emerging and high-end industrial zones in Beijing. The area within 10km around the airport is host to the Tianzhu Free Trade Zone, the New International Exhibition Center, and other commercial establishments. Linkong's assets increased from RMB483.11 billion in 2010 to RMB794.09 billion in 2015,[29] with an annual average growth of 10.4%. On average, during the same period, its annual revenue grew by 5.6% and annual profits by 9.3%[29].

The development of tourism in Beijing can also be attributed to the airport. During 2010-2015, the number of tourists arriving in the city grew at an annual average of 8.2%, reaching 270 million in 2015[28]. In 2016, 24.25 million tourists passed through customs at the Beijing Airport[30], of which 4.2 million were inbound, bringing Beijing US$4.61 billion in foreign exchange revenue[28]. The 72-hour visa-free transit policy introduced on 1 January 2013 has led to Beijing Airport bringing even more tourists to the city. According to the data provided by the Department of Planning and Development, by June 2017, the airport had received 189,520 passengers benefiting this policy, which the authorities are contemplating extending to 144 hours[30].

Chapter 3.
Social Performance

This chapter assesses Beijing Airport's performance covering: 1) airport services, including passenger services, safety, flight punctuality, and ground transport, 2) labour relations, and 3) social responsibility - including noise management, charitable activities and information disclosure. Some of these aspects such as ground transport and community services also include environmental issues. These include the electric transport used between terminal buildings and the provision of solid waste management for local communities.

3.1 Airport Services

3.1.1 Passenger services

Beijing Airport has a management system that prioritizes passenger satisfaction (see Fig. 3.1). The system starts with surveys and analyses to understand passengers' needs, collect best practices, consider industry standards for domestic and international civil aviation and other service industries. The goal is to formulate and implement a system of service standards for the airport. The Airport Service Quality Survey drawn up by the Airports Council International is used to evaluate passengers' satisfaction level, the results of which serve to guide improvements.

On the basis of this management system, Beijing Airport has taken measures to improve the quality of its services. Examples include establishing the Passenger Service Promotion Committee (Box 3.1), the training of service personnel, improving facilities, enhancing the travelers' feedback system, analyzing and addressing the particular issues of luggage transfer, and setting up a Wi-Fi connection and transit service. Beijing Airport's service management system and standard have received recognition within the Chinese aviation industry. In 2011, for example, Beijing Airport was tasked by Civil Aviation Administration of China to draft the Service Quality Standard for Civil Transport Airport (MH/T5104-2013), so that it can be applied nationwide[31].

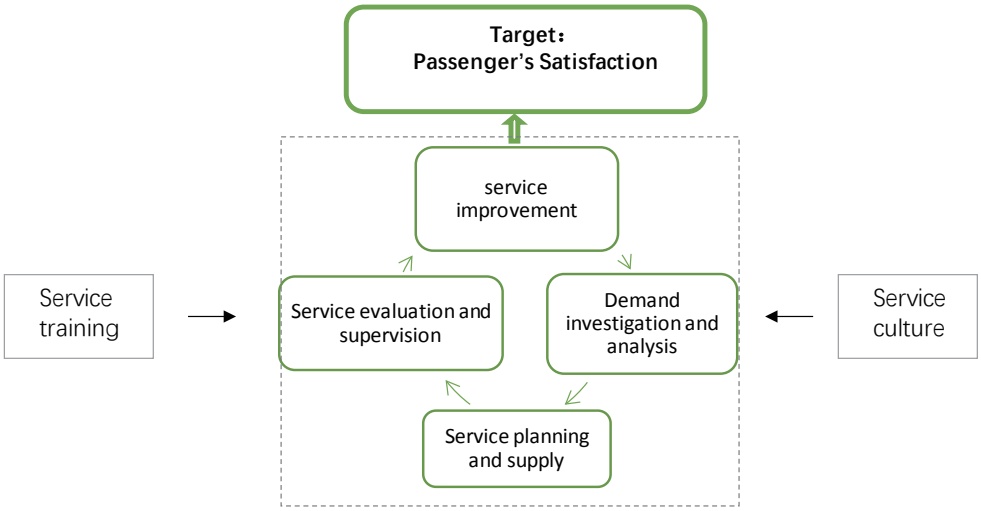


Fig. 3.1 Management system for passenger satisfaction
Source: Department of Service Quality of Beijing Airport

Box 3.1 Good practice: Passenger Service Promotion Committee

A good passenger experience requires cooperation among every component of the service chain. A passenger's travel experience includes ticketing, transport to and from the airport, security checks, boarding, and so on. Each component corresponds to different service providers. The quality of communication among each service providers affects passenger's satisfaction.

Beijing Airport has taken the initiative to set up a platform for cooperation among hundreds of service providers. In 2004, it launched the "Passenger Service Promotion Committee" as a way of creating a coordinated value chain oriented towards passengers' needs. In 2008, the Passenger Service Promotion Committee played an important role in moving a number of airline companies to the newly built Terminal 3 for servicing the passengers in connection to the Beijing Olympic Games. This line of thinking – transcending organizational boundaries – was also used more generally. In 2008, for example, to reinforce aviation safety during the Olympic Games, Beijing Airport set up the Safety Management Committee that comprised of relevant agents with respective safety management and supervision responsibilities. In addition, together with the air traffic control authority and airline companies, in 2009 Beijing Airport established the Operation Management Coordination Committee to coordinate air and ground services. Similar committees are now required in other domestic airports. Foreign airports such as Singapore Changyi Airport and Munich Airport have also been inspired to follow the Passenger Service Promotion Committee model.

Fig. 3.2 Interior environment of terminals

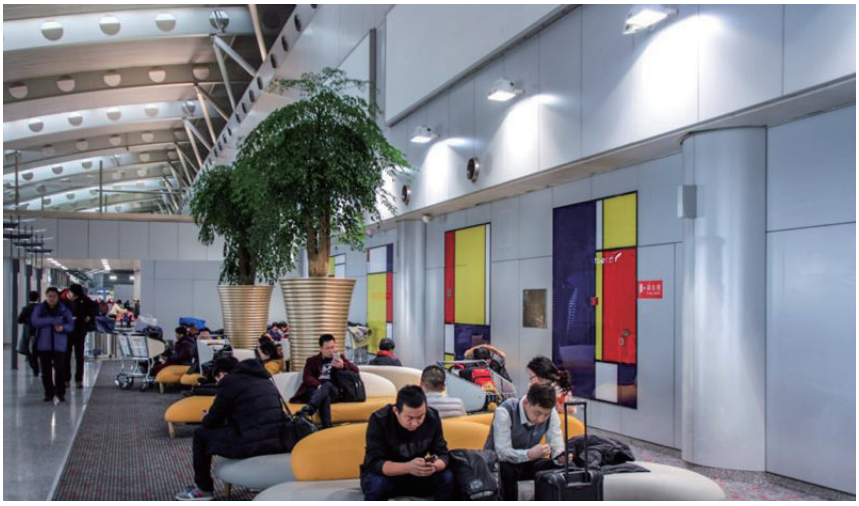


Fig. 3.3 Beyond first/business-class service zones in terminals

Beijing Airport's management system has generated encouraging results. The airport's Airport Service Quality rating moved from 4.90 in 2013 to 4.98 out of 5 in 2016. In 2016, ratings for all the sub-items under the Airport Service Quality exceeded 4.6, with an average improvement of 2.3% between 2013-2016. Accordingly, in 2016, Airports Council International awarded Beijing Airport with third prize in the categories of Best Airports in the Asia-Pacific Region, and Best Airports with the capacity of handing more than 40 million passengers annually. Fig. 3.2 and Fig. 3.3 shows interior environment of terminals and the beyond first/business-class service zones.

Table 3.1 Results of Airport Service Quality survey (2013-2016)

	2013		2014		2015		2016	
	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank
Overall satisfaction	4.90	3	4.93	3	4.96	7	4.98	6
Ground transportation to/from the airport	4.66	7	4.72	8	4.68	17	4.73	17
Parking facility	4.53	9	4.65	6	4.69	9	4.73	11
Parking facilities, value for money	4.39	8	4.51	9	4.53	13	4.65	12
Availability of baggage carts / trolleys	4.87	1	4.88	2	4.91	5	4.93	5
Waiting time in check-in queue / line	4.80	3	4.85	2	4.86	5	4.87	6
Efficiency of check-in staff	4.87	2	4.88	2	4.90	3	4.91	6
Courtesy, helpfulness of check-in staff	4.88	2	4.88	2	4.90	3	4.92	5
Waiting time at passport / personal ID control	4.83	3	4.82	6	4.85	6	4.86	7
Courtesy, helpfulness of inspection staff	4.86	2	4.85	4	4.89	3	4.91	5
Courtesy, helpfulness of security staff	4.88	1	4.88	2	4.91	3	4.93	4
Thoroughness of the security inspection	4.91	1	4.91	2	4.93	3	4.95	3
Waiting time at security inspection	4.81	2	4.81	4	4.85	5	4.87	7
Feeling of being safe and secure	4.90	2	4.89	4	4.93	4	4.94	5
Signage	4.79	2	4.82	3	4.84	8	4.86	8
Flight information screens	4.82	2	4.83	3	4.85	5	4.89	7
Walking distance inside the terminal	4.50	20	4.48	30	4.59	23	4.67	17
Ease of making connections with other flights	4.70	3	4.61	11	4.65	14	4.70	17
Courtesy, helpfulness of airport staff	4.90	2	4.92	2	4.93	4	4.94	6
Restaurant/dining facilities	4.56	4	4.51	8	4.67	8	4.76	9
Restaurant facilities, value for money	4.29	6	4.30	10	4.44	14	4.61	12
Availability of bank / ATM / money exchange	4.66	2	4.66	7	4.78	8	4.86	5
Shopping facilities	4.65	4	4.67	6	4.80	5	4.84	6
Shopping facilities, value for money	4.41	4	4.41	7	4.63	7	4.75	6
Internet access/Wi-Fi	4.43	12	4.43	17	4.55	18	4.67	19
Business / Executive lounges	4.74	4	4.76	8	4.85	7	4.89	5
Availability of washrooms / toilets	4.88	2	4.89	3	4.92	6	4.95	3
Cleanliness of washrooms / toilets	4.87	2	4.88	3	4.90	6	4.95	3
Comfort of waiting / gate areas	4.82	2	4.82	3	4.83	9	4.90	8
Cleanliness of the terminal	4.91	2	4.92	4	4.94	7	4.97	3
Ambience of the airport	4.88	2	4.90	3	4.91	8	4.96	3
Arrivals passport and visa inspection	4.77	4	4.72	9	4.81	10	4.81	12
Speed of baggage delivery service	4.53	11	4.44	19	4.53	19	4.65	19
Custom inspection	4.75	3	4.71	7	4.79	8	4.78	11

Source: Department of Service Quality of Beijing Airport

Beijing Airport also attends to travelers with special needs such as those who are physically challenged, pregnant or the elderly. The airport has installed washrooms, elevators and parking areas for the disabled, as well as sidewalks for the blind and nursing rooms. There are also battery-powered vehicles and volunteers to assist those in need. As of 2017, there are 10, 14, and 33 slots in parking areas P1, P2, and P3 respectively. The airport also has 104 nursing rooms (Fig. 3.4) and 124 family washrooms accessible that can be accessed by disabled people (according to the data provided by Department of Planning and Development of Beijing Airport in May 2017). These facilities are all located at the departure and arrival areas, as required under industrial standards.

3.1.2 Safety

Beijing Airport has taken innovative measures to ensure safety in all its operations. Some 128 airport entities have signed security protocols with the airport as a pre-requisite for getting their lease contracts[32]. Airport regulators are required to sign a paper committing them to airport safety. In 2013, Beijing Airport launched a “safety grid” model, which “grids” individuals with the responsibility for highly[33] specific safety items as in operating the navigation light. By 2016, 8,982 safety grids had been established, covering 508 responsibilities[34]. In 2016, Beijing Airport put forward a “safety responsibility jigsaw” as a way of distinguishing responsibilities among relevant parties[34].

The issue of safety includes not only operational safety, e.g. safety on airport roads, airport aprons - where airplanes are parked, refueled, unloaded, loaded and boarded - and air-field clearance zones, but also to aviation safety, fire protection and information security.

Fig. 3.4 Nursing rooms in the airport

Beijing Airport has taken a number of measures to ensure airport safety. In addition, Beijing Airport has set up a laboratory to develop a strategy for preventing birds from crashing into airplanes. It has also provided aid to disabled birds, saving 53 of them during the 2016 migrating season[34]. In terms of stakeholder engagement, the airport has been communicating with the government of its hosting district Shunyi to regulate the height of its buildings. At the same time, the airport’s staff visit neighboring communities to raise awareness of the importance of air clearance. Fig. 3.5 and 3.6 show staff and participants in the community campaigns on safety measures and airfield clearance.

Fig. 3.5 Campaign on airfield birds control and safe airport
Source: Corporate social responsibility report of Beijing Airport Co., Ltd.[34]

Fig. 3.6 Campaign on airfield clearance in the community
Source: Corporate social responsibility report of Beijing Airport Co., Ltd.[34]

Fig. 3.7 Staff firefighting games
Source:Corporate social responsibility report of Beijing Airport Co., Ltd.[34]

Internally, Beijing Airport conducts training for all airport staff to raise their awareness of safety and improve their ability to implement safety measures. It has invited safety experts from Civil Aviation Administration of China to give lectures on safety issues. In 2016, it invested RMB700,000 on safety training for more than 2,000 people that lasted over 47,000 hours[34].

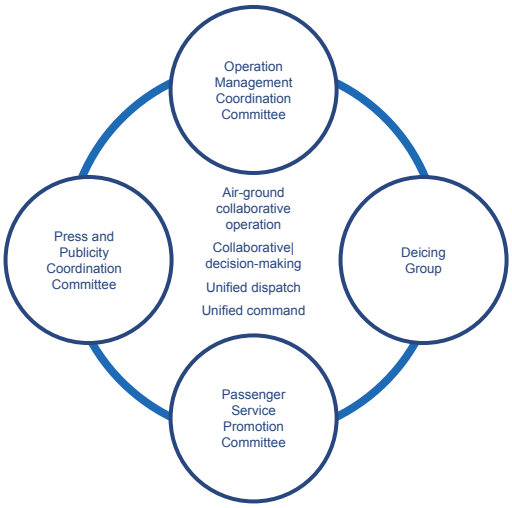
Concerning emergency response, Beijing Airport has improved its ability to mobilize resources and coordinate different departments through training and emergency drills. In addition, it organized firefighting games in 2016, which enabled airport staff to better master firefighting skills (Fig. 3.7).

3.1.3 Flight punctuality

Beijing Airport has been trying to reduce flight delays and provide support for passengers affected by delayed flights. The challenge is that Beijing Airport's aprons (or "ramps" as they are known in the United States) and airspace resources are already operating at full capacity or even beyond. This affects flight punctuality, which is made worse under icy and snowy weather conditions, according to the data from Beijng Airport, the on-schedule rate of Beijing Airport during 2010-2016 is 78.15% on average, while the highest level reached 82.31% in 2010 and the lowest was 73.54% in 2013. The punctuality of flights is important for the competitiveness of Beijing Airport. To reduce flight delays, Beijing Airport involved the Operation Management Coordination Committee in order to analyze and address the problem, improve the coordination and efficiency of using ground and airspace resources, and increase the preparedness for special weather conditions (Box 3.2).

Box 3.2 Good practice: enhancing safety in icy and snowy weather

1. Coordinated multi-party response



Beijing Airport's committees and working groups respond to icy and snowy weather as follows:

Operation Management Coordination Committee: based on the deicing capacity as informed by the Deicing Group, make the flight queuing schedule.

Deicing Group: based on the deicing needs informed by Operation Management Coordination Committee, centralize the deployment of the deicing capacity.

Passenger Service Promotion Committee: based on the flight queuing scheduling, mobilizing various services.

Press and Publicity Coordination Committee: based on Operation Management Coordination Committee's decisions, release flight cancellation information in a timely manner.

Box 3.2 Good practice: enhancing safety in icy and snowy weather

2. Engine running deicing

In 2015, Beijing Airport switched to the model of deicing in designated sites while an aircraft's engine is running in low gear (Fig. 3.8). This model does not require the aircraft to switch off the engine while being deiced and switch on when deicing is completed, thereby reducing the possibility of the aircraft getting re-iced and consequent delays. To prevent deicing fluid from polluting the soil and groundwater, Beijing Airport has set up a system to recycle the fluid for other industrial applications such as windshield washer fluid.

Fig. 3.8 Engine running deicing
Source: Corporate social responsibility report of Beijing Airport Co., Ltd.[35]

3.1.4 Transport services

Transport services in an airport cover: 1) external transport; 2) connection between internal and external transport; and 3) internal transport. This section assesses the quality of the transport services by focusing on operating efficiency as well as the use of electric mobility and charging stations in different segments of airport transport.

External transport

Public transport takes a long time to get to or from Beijing Airport. The direct distance from downtown Beijing (Tiananmen Square) to Beijing Airport is 24.5km, which takes 70 minutes by rail (including the time for a luggage-unfriendly 500-meter transfer at Dongzhimen Station where a new ticket is required), compared to 50 minutes by car or taxi. In comparison, the direct distance from London Heathrow International Airport to downtown (Trafalgar Square) is 25 km, which takes 40 minutes by car and 35 minutes by rail (Fig. 3.9). Compared with 10 other international airports, Beijing Airport had the largest passenger flow in 2015 but the smallest share of public transport to and from the airport (see Table 3.2).

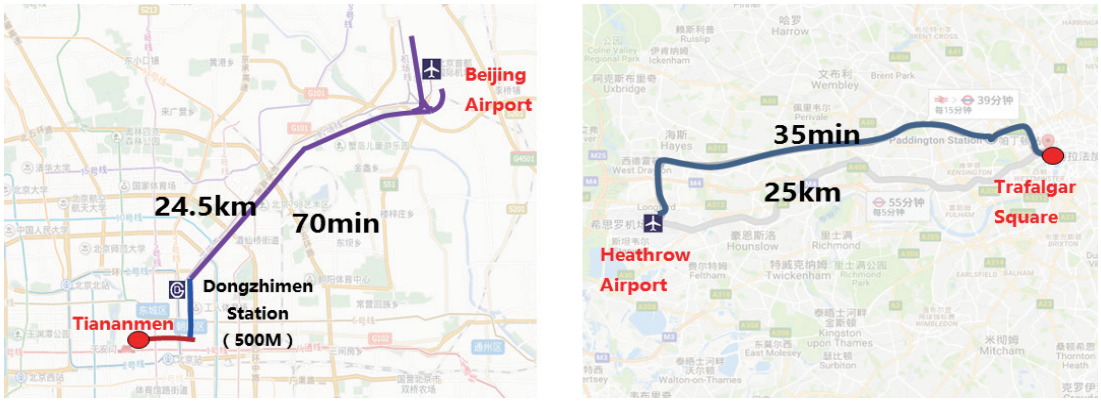


Fig. 3.9 Distance and time from downtown to Beijing Airport and Heathrow Airport by public tranport
Source: edited Google map

Table 3.2 Share of ground transport modes at select international and domestic airports

Airport name	Rail(%)	Bus(%)	Car(%)	Taxi(%)	Other(%)	Passenger flow (10,000)
Beijing Airport	13	14	42	31	0	8993.9
Tokyo Haneda Airport[36]	50	20	15	15	0	7531.7
Heathrow Airport[37]	28	13	34	27	1	7498.9
Hongkong Airport[38]	25	46	8	13	8	6828.3
Aeroport Charles de Gaulle[39]	32	13	27	25	3	6576.7
Frankfurt airport[39]	28	5	45	21	1	6103.2
Shanghai Pudong Airport[40]	19	24	33	22	2	6005.3
Amsterdam Airport[39]	39	5	41	15	1	5828.5
Incheon Airport[41]	30	35	29	6	0	4551.0
Shanghai Hongqiao Airport[42]	35	8	15	34	8	3982.0
Toyko Narita Airport[41]	39	42	11	2	6	3559.5

Source: Data on Beijing Airport from Department of Public Area Management of Beijing Airport; data on other airports from peer reviewed paper or research publications[36-42].

Connection between internal and external transport

Beijing Airport has 10 parking areas. According to the data provided by the Department of Public Area Management of Beijing Airport in September 2017, the airport upgraded its parking system with automatic plate recognition in 2015, meaning that drivers are no longer forced to stop and get a ticket. It also introduced mobile payment in 2016 through Alipay and in 2017 through WeChat. In 2017, a smart parking system was also piloted in the West Parking Lot to reduce the time required to search for a vacant space. These improvements in service quality also generate economic and environmental benefits. The automatic plate recognition system saves nearly RMB400,000 per year in paper ticket cost avoided. The mobile electronic payment saves more than RMB3 million per year in avoided labour cost, as payments are now handled electronically. Fig. 3.10 shows the entrance/exit of the parking lot.

Fig. 3.10 Entrance/exit of Beijing Airport parking lot

Parking rates at Beijing Airport are reasonable, when the ratio between parking rates and average GDP in the cities hosting major airports is taken into account (Fig. 3.11). Given Beijing Airport's higher share of cars in transport to and from the airport as compared to other airports, however, higher rates at Beijing Airport could help encourage greater use of public transport.

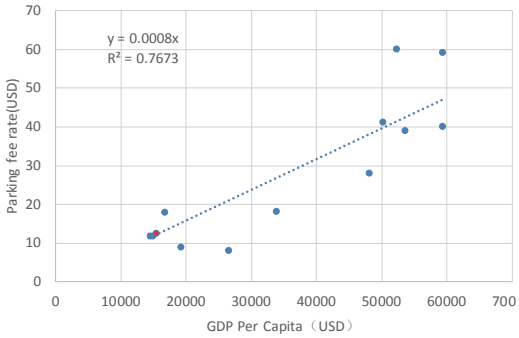


Fig. 3.11 Parking rate of Beijing Airport and Beijing's GDP per capita

Beijing Airport's taxi waiting system has been improved from a straight line of taxis streaming to load a small number of passengers one-by-one, to multiple oblique parking positions taking on a larger number of passengers simultaneously. On average, about 22,000 taxis flow through the airport every day (Fig. 3.12). An on-site survey showed that the average time for a passenger waits for a taxi is now 10-15 minutes compared to 25 minutes previously. The queuing time for taxi drivers at the airport is consequently reduced, based on on-site surveys, although no quantitative analysis has been conducted due to the lack of baseline data.

Fig. 3.12 Beijing Airport taxi waiting area

Table 3.3 GDP per capita and parking rates

City	Per Capita GDP (USD)	Short-term Rates (USD/hour)	Long-term Rates (USD/day)
Tokyo[43]	59,400	2.6	40
London[44]	59,352	11	59
Paris[45]	53,617	7.5	72
Amsterdam[46]	52,249	11	60
Singapore[47]	50,123	1.7	41
Frankfurt[48]	48,061	4.9	28
Hongkong[49]	33,800	2.8	18
Inchon[50]	26,552	2.1	7.9
Shanghai[51]	15,346	0.74	12.6
Beijing[52]	14,885	0.74	11.8
Guangzhou[53]	19,175	0.74	8.9
Hangzhou[54]	16,648	1.48	17.8
Xiamen[55]	14,500	0.89	11.8

Source: Official websites of selected airports[43-55]

Internal Transport

In an effort to improve the air quality in the airport, in 2014, Beijing Airport and Beijing Electricity Bureau installed an electric vehicle charging system in the airport. This includes 4 stations of 450KW DC serving airport shuttle buses, 25 stations of 37.5KW DC and 25 stations of 7KW AC for non-airport vehicles. In the airfield, there are two large charging centers with 36 charging stations. Fig. 3.13 shows the new energy vehicles and charging stations.

Fig. 3.13 New energy vehicles and charing stations of Beijing Airport

Fig. 3.14 Electric shuttle buses in Beijing Airport

The installation of charging stations has spurred an increase in the use of electric vehicles. In 2015, for example, the airport started converting eight diesel-based inter-terminal buses into electric-based ones, in a gas-to-electricity project initiated by the Chinese aviation authorities (see Box 3.4). The airport has 20 inter-terminal buses, ten of which are already electric (Fig. 3.14), with the other ten to be converted over time. When all such buses are converted, the airport will be able to reduce 864kg of CO, 720kg of hydrocarbons, and 144kg of NO_x per year. There are 3,679 vehicles on the airfield, 46 of which are now powered by electricity.

Box 3.4 Good practice: from gas to electric mobility

In recent years Beijing Airport has been piloting a "gas to electric mobility" project targeting special-purpose vehicles in the airfield. It approaches the project by limiting the access of non-electric vehicles, installing the required infrastructure, and implementing enabling policies. Of the airport's 4,000 vehicles, more than 60% are special-purpose. Beijing Airport aims to convert at least 10% of them and 20% of the general-purpose vehicles into electric ones by 2020.

In 2014, taking the Asia Pacific Economic Cooperation (APEC) conference in Beijing as an opportunity, the airport purchased 17 electric buses for inter-terminal passenger transport. At the same time, the airport's high-capacity electric vehicle charging station – the first of its kind in China – entered into service for both airport and non-airport vehicles. In addition, Beijing Airport has built 50 lower capacity charging stations serving electric vehicles used by airport employees.

Source: UN Environment, 2015[56].

Beijing Airport, however, still lacks an Automated People Mover (APM) system between terminals. It uses inter-terminal buses, which are more time consuming. In comparison, the APM at the Charles de Gaulle Airport connects three terminals as well as two parking areas and a railway station while Pudong Airport is developing an APM system to link the terminals.

Staff commuting within the airport's public areas relies on cars and buses provided for free, yet non-motorized modes of transport are lacking. At the same time, however, transport times inside the airport are improving, thereby reducing the need to exit the airport to access another area. In the end of 2015, the airport built a tunnel under the east and west runways, contributing to energy saving and pollution reduction.

3.2 Labour relations

In 2014 and 2015, Beijing Airport was recognized being one of the 100 best employers by Peking University and Zhaopin.com[35,57]. In 2016, it was among the 30 best employers in Beijing[34]. This recognition reflects Beijing Airport's professional handling of labour relations. It has set up a system of Occupation Health and Safety, whereby over 100 employers benefit from an evaluation of and guidance on their physical and psychological well-being and social relations. During the period 2011-2016, 9-10% of the airport's expenditure was spent on salaries and benefits[17-22]. The salary system is based on an integrated consideration of post, skill, and performance in alignment with the company's overall performance. In 2016, all airport staff were covered by a complete set of insurance policies, including a pension. In addition to national holidays, employees are also entitled to paid annual leave.

The airport also invests in its staff's career development. According to the data provided by the Department of Human Resources of Beijing Airport in October 2017, it spent RMB5.57 million on staff training, an increase of 26.8% compared to the previous year, with every employee receiving 42 hours of training on average. Training covers the thematic areas of safety, service provision, English language, post-specific skills and general management at various levels. In addition, Beijing Airport implements a programme of "management trainees" who are placed in different departments to understand the entire system's operation before potentially moving onto managerial positions.

Efforts, however, need to be made to improve gender equity in recruitment. In 2016, women accounted for 30.4% of the airport's 1,623 employees[34], particularly under-represented in the firefighting and airfield management departments. Moving forward, Beijing Airport should consider encouraging women to apply for airport jobs and giving priority to women candidates where they are equally qualified for positions as men. According to the Department of Human Resources of Beijing Airport, the gender ratio among middle to high level managers in 2017 is 2:1, which means a relative fair career development path under the current gender ratio of the whole company.

3.3 Social responsibility

This section assesses three aspects of Beijing Airport's social responsibility: 1) noise control; 2) social services; and 3) information disclosure.

3.3.1 Noise management

Beijing Airport has an automatic noise monitoring and information management system. By the end of 2016, there were 20 fixed monitoring stations located on the ends of three runways in six directions in addition to a mobile monitoring station . Fig. 3.15 shows the locations of the monitoring stations. Related data and detailed analysis are published in quarterly and annual reports. In response to public complaints about airport noise, Beijing Airport deploys the mobile monitoring station and shares related reports. It also reports to the CAAC and Beijing Municipal Government on the analysis of noises from different aircrafts. In addition, Beijing Airport engages a third party to monitor airport noise and publishes the results on its website on a quarterly basis.

The airport has a noise complaints management mechanism in place. Under the mechanism, a weekly meeting is held with neighboring communities to hear complains and provide responses (see Fig. 3.16). In 2015, 10 cases were received, all of which were processed in accordance with the established procedure, contributing to reduced tension between the airport and the local communities. In 2016, only one complaint was lodged.

Although noise levels have increased in line with the number of passengers and flights, the number of residents in highly affected areas has not changed much, which to some extent reflects the achievements of noise control. For example, there were over 90 million passengers using Beijing Airport in 2016 compared to the 70 million in 2010. Yet, the number of households and residents located within the area where the "weighted equivalent continuous perceived noise level" or WECPNL exceeded 85dB had not changed, and those in the area of 80~85dB decreased only slightly. Beijing Airport's project to sound-proof windows for local residents in the area of 75~85dB is expected to improve the situation further. Other noise reduction measures are presented below.

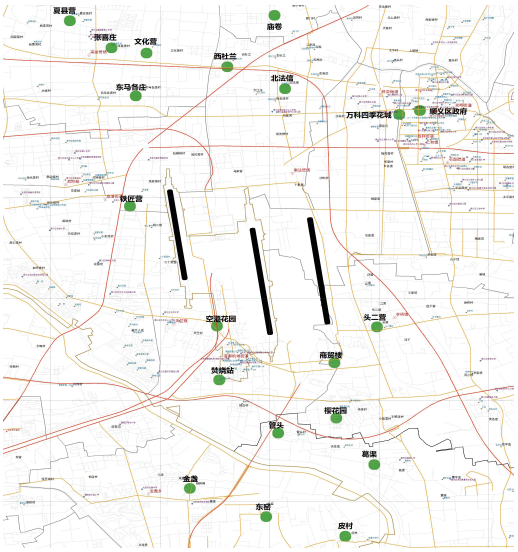


Fig. 3.15 Locations of noise monitoring stations

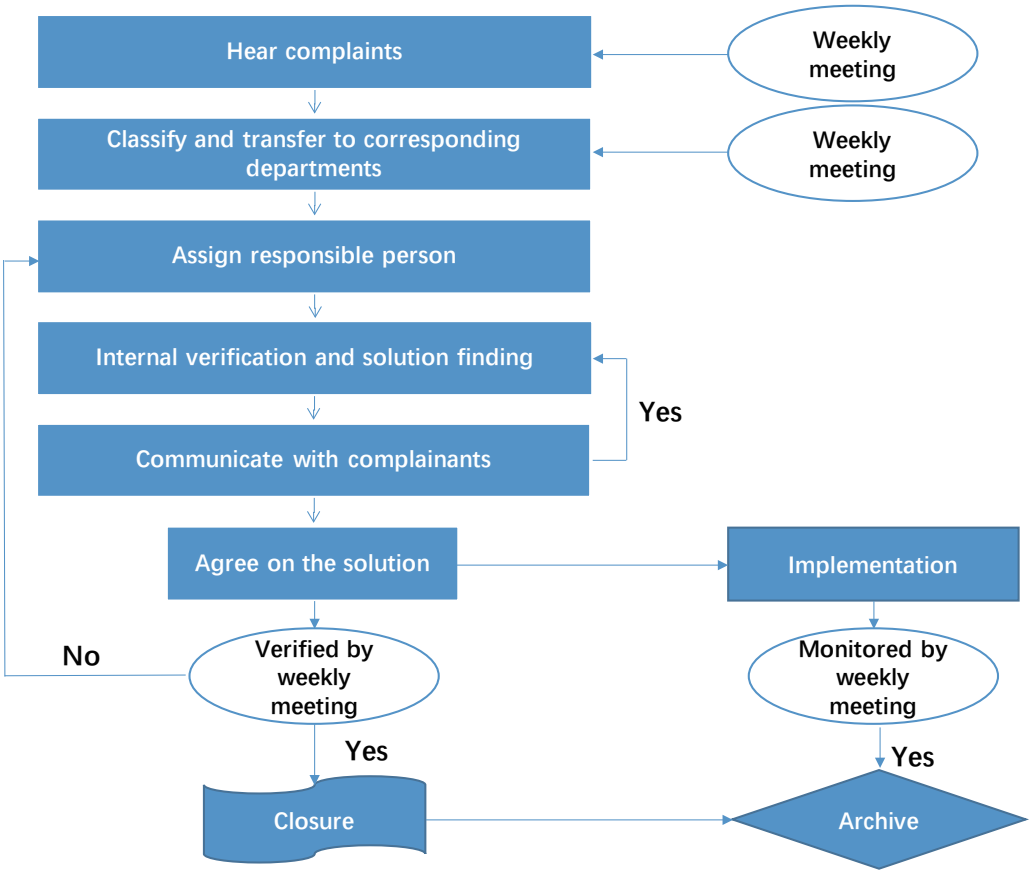


Fig. 3.16 Noise complaints management mechanism

Investigating noise impacts
In 2012, Beijing Airport started investigating the noise impacts in areas where noise level exceeded 75dB. It conducted a household survey in the Yinhua Community where the noise level was over 80dB. Alternative property of equivalent value was offered in exchange for the ownership of this community's property. It also conducted a survey in a further nine communities where the noise level was below 75dB and offered to install sound-proof windows.

Regulating runway operation hours
In 2011, Beijing Airport started closing the south end of the East Runway between 23:00 to 5:30, as it is closest to residential areas.

Researching optimal flight paths
In 2012, Beijing Airport completed two projects: 1) "reducing wake vortex separations" (the distance between landing aircrafts), and 2) "independent operation of three runways". The two projects have helped to reduce the average waiting time of aircrafts in the air before landing as well as the number of night flights.

Upgrading aircrafts and proposing noise tax
Beijing Airport has already phased out obsolete aircraft models and urged airline companies to replace some of the models that create more noises. For example, in 2011, Beijing Airport worked with Air Hong Kong to replace the latter's Boeing 727 for flight AHK768/769 with Air Bus 300, which is quieter. In 2012, it submitted a proposal to Civil Aviation Administration of China on imposing noise-related fees or taxes.

Developing noise reduction technology
In 2016, Beijing Airport launched a project to develop technologies for reducing aircraft noise. It has included aviation noise reduction in Beijing Airport 13th Five-Year Plan for Science and Technology Development Plan (2016-2020).

3.3.2 Social services

Beijing Airport has been deploying its human resources and infrastructure for social services. It has been providing wastewater treatment and solid waste management to neighboring communities for years. In addition, it has shared share knowledge on aviation, airfield clearance, firefighting, etiquette and nature conservation with youth, passengers and the local residents (see Box 3.5). In August 2015, Beijing Airport set up the Youth Volunteer Association, which has since conducted a number of awareness raising activities covering airport services and procedures, flight punctuality and weather conditions, among other areas.

Box 3.5 Good practice: green exhibition at the airport

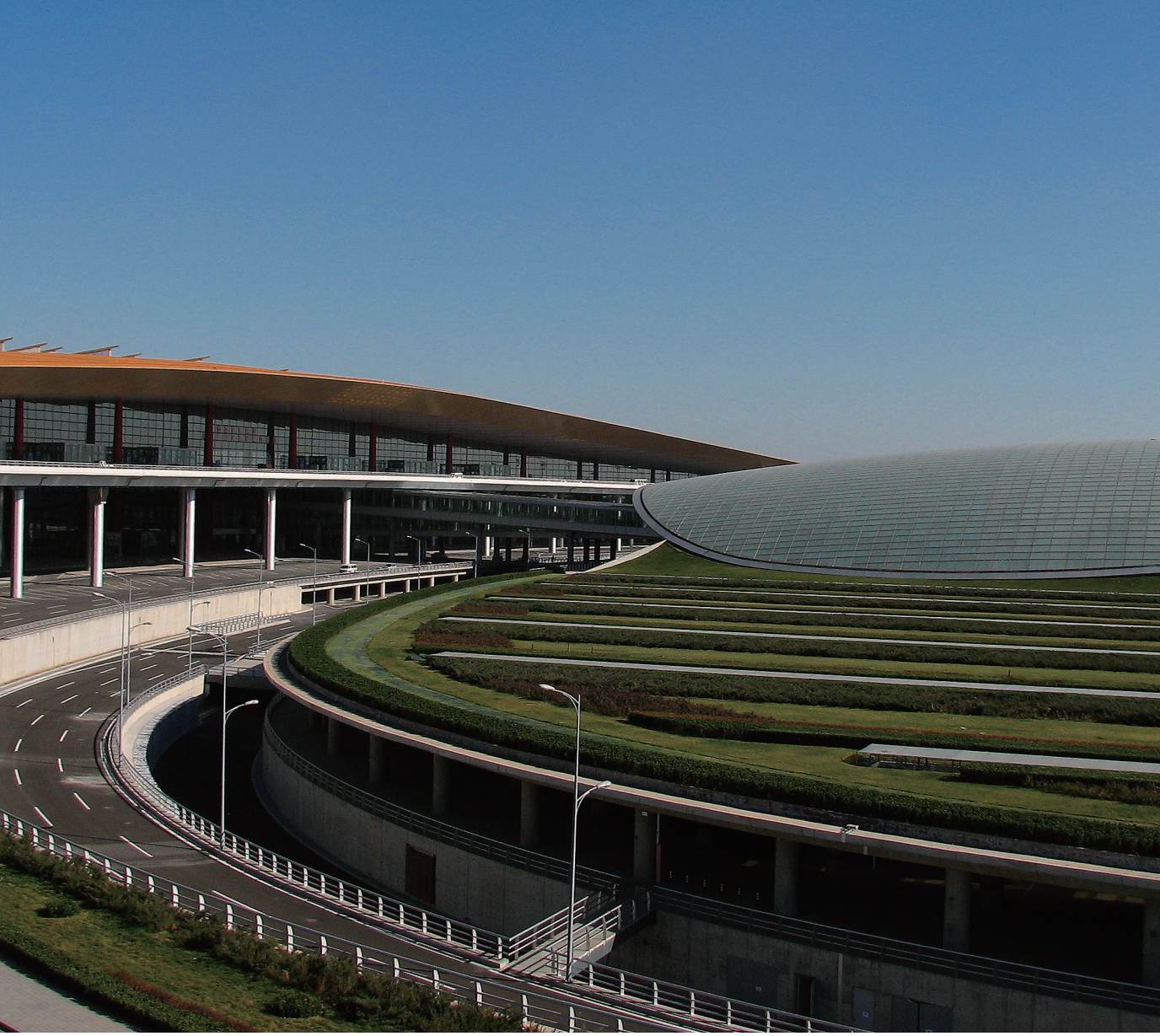
The United Nations Environment Programme and Beijing Airport have organized several exhibitions at the airport to raise passengers' environmental awareness. In 2011 and 2013, for example, the exhibitions included "Chinese Children's Paintings on Environmental Protection' and "Wild and Rare Wildlife", respectively. In September 2016, the "Wild for Life" International Photo Exhibition was held in Terminal 3 in support of the global effort to fight the illegal wildlife trade. The airport put up 60 exhibition boards and over 400 LED screens with visuals on the challenge.

Source: Corporate social responsibility report of Beijing Airport Co., Ltd.[34]

Fig. 3.17 "Wild for Life" International Photo Exhibition

3.3.3 Information disclosure

Beijing Airport discloses its information through its website, Corporate social responsibility reports, and annual reports. The website provides information on flights, port entry and exit, airport transport, passenger services, and airport businesses. A mobile application also provides information in real-time. In addition, the airport also makes announcements via its official blog and WeChat account, while its annual report provides the company's financial status. Its corporate social responsibility report, starting from 2011, discloses information on corporate management, safety, services, environment protection, labour relations, and social responsibility.



Chapter 4.
Environmental Performance

This chapter assesses Beijing Airport's efforts on the environmental front. It covers five aspects: 1) energy; 2) carbon emissions, 3) air quality, 4) water use, and 5) solid waste.

4.1 Energy

An importance guidance for Beijing Airport's energy management comes from the 13th Five-Year Plan for the Development of China's Civil Aviation[58]. This requires all Chinese airports to use energy and other natural resources efficiently in their construction and operation, have operating environments that favour energy saving and promote a greener civil aircraft manufacturing industry, all leading towards reduced carbon emissions. More specific guidance comes from the 13th Five-Year Plan on Energy Saving and Emission Reduction in Civil Aviation[59]. This requires that the industry's five-year average energy consumption and carbon emissions per unit of cargo transported be reduced by more than 4% by 2020. Energy consumption per passenger handled must meanwhile be reduced by more than 15% compared to the previous five-year period.

4.1.1 Aircraft movement areas

As shown in Fig. 4.1, Beijing Airport's energy saving efforts in its aircraft movement areas are reflected in three aspects: 1) using the Ground Bridge Loaded Power Unit (Fig. 4.2) instead of the Auxiliary Power Unit, 2) regulating high-mask lighting, and 3) switching to electric vehicles, which are already covered in Chapter 3 and will not be discussed further here.

From Auxiliary Power Unit to Ground Bridge Loaded Power Unit

Auxiliary Power Unit is an onboard equipment fueled by aviation kerosene. It is used to power aircrafts on the ground in preparation for take-off, but uses a large amount of aviation fuel, making it the most expensive form of power supply. For airline companies, the use of Auxiliary Power Unit increases the consumption of aviation fuel and the cost of equipment maintenance. For airports, the use of Auxiliary Power Unit produces air pollution and noise. In contrast, Ground Bridge Loaded Power Unit not only increases energy efficiency, but also reduces the emission of sulfur dioxide and nitrogen oxides.

The aircraft movement areas at all three terminals of Beijing Airport are now deploying Ground Bridge Loaded Power Unit at varying extents. All contact stands at Terminal 3 are equipped with Ground Bridge Loaded Power Unit (Box 4.1). The procurement of 65 Ground Bridge Loaded Power Units and associated 61 air conditioners for Terminal 1 and 2 is underway as this report goes to print and installation is planned for completion in 2020. Ground power supply and related air conditioners for 139 remote stands are furthermore being planned.

Fig. 4.2 Efficient Ground Bridge Loaded Power Units replaces Auxiliary Power Units

Fig. 4.1 Energy saving highlights in the aircraft movement areas

Box 4.1 Good practice: Ground Bridge Loaded Power Unit

87 contact stands at Terminal 3 are equipped with 91 Ground Bridge Loaded Power Units and 94 associated air conditioners. Between January and April 2017, Ground Bridge Loaded Power Unit was used 323 times on average, a utilization rate of 90%. In 2016, Ground Bridge Loaded Power Unit was connected to aircrafts 106,930 times, saving aviation fuel by some 47,924.1 tons and reducing the emission of pollutants by 858,675.6 kg (including approximately 25,928.62 kg of HC, 479,566.6 kg of CO, and 353,180.31 kg of NO_x).

Regulating high-mask lighting

In aircraft movement areas, Beijing Airport has sought to adjust high-mask lighting in line with flight information to save energy. There are 246 high-mask lamps in aircraft movement areas. In 2015, Beijing Airport started converting 141 of them into a new system, which puts these lamps on an energy-saving mode between 1AM to 7AM. Previously, the lamps were connected to power through a single cable, allowing them to be turned on or off with a single switch. Since 2016, all the lamps have been connected with two separate cables to avoid having to keep all the lights on or off at the same time (Fig. 4.3).

4.1.2 Terminal buildings

Beijing Airport has sought to save energy in its terminal buildings through: 1) building design, 2) Building Energy Management System, 3) LED lighting, 4) energy-saving lighting and air conditioning, and 5) electrical vehicle (covered under Chapter 3), as shown in Fig. 4.4. An innovative approach is shown by its use of Energy Performance Contracting with Beijing Capital Airport Power & Energy Co., Ltd. in deploying energy-saving technologies.

Building design

Notably, the suspended curtain walls and the cornices around the Terminal 3 building help reduce the offsetting effect of solar radiation on indoor air conditioning. In addition, the southeast side of Terminal 3 lets in natural light, which can be blocked if the sun is too strong to minimize the impact on air conditioning. The skylight is estimated to cut the amount of energy used related to lighting by about 20%.

Building Energy Management System

Beijing Airport was the first Chinese airport to introduce the Building Energy Management System in 2013, contributing to reduced energy consumption in its terminals in successive years even while the flow of passengers has kept rising. The system includes a platform for online data monitoring and analysis, which supports the detailed management of energy consumption in terminal buildings. The system was initially deployed in parts of Terminal 3C, with a view to being rolled out to the rest of Terminal 3 in 2017-2018. Based on the principle of data collection, diagnosis and fine-tuning on a daily basis, the system has led to an increase in both energy efficiency and comfort for passengers.

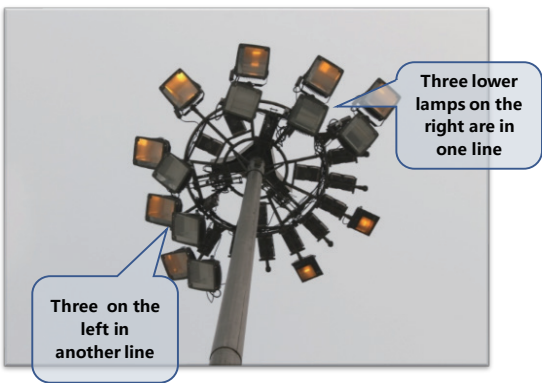


Fig. 4.3 Regulating high-mask lighting in aircraft movement areas

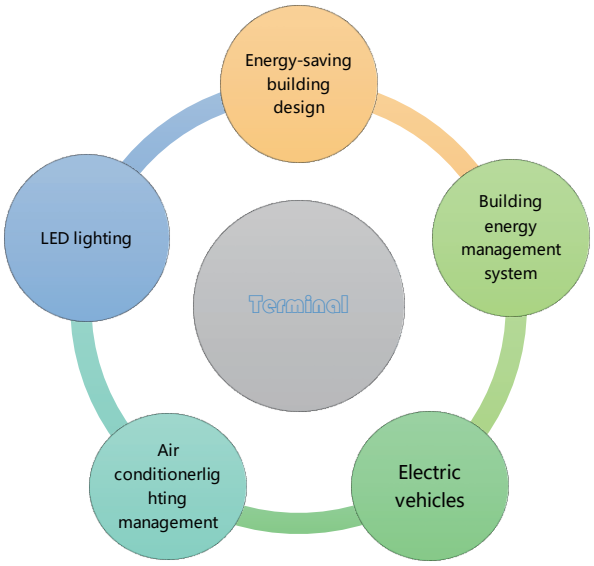


Fig. 4.4 Energy saving highlights in the terminal

For example, in the four-month “heating-provided season” of 2013/2014, the average temperature was kept at the comfortable level of 20°C, while electricity consumption was reduced by 6.4% and heat consumption by 28.9% over the previous season. Even with taking into account how 2013/2014 was a relatively mild winter, heat consumption was still down by 5.7% over an equivalent number of heating-provided days, saving energy worth of RMB7 million. Beijing Airport has thus ensured a comfortable indoor environment while promoting energy-saving measures. Beijing Airport Contracted Energy Management System requires that "during the operation period, temperature inside terminal buildings should remain in the ranges of 22-26°C for summer and fall, and 18-22°C for winter and spring."

Another example is the measurement of energy consumption at a disaggregate level, which has been implemented in some areas of the airport and will be rolled out further in near future. In 2017, Beijing Airport plans to apply such measurement to Terminal 1, Terminal 2 and public areas (the latter of heat consumption) and prepare aircraft movement areas for the same (Phase I). In 2018, it will apply the disaggregate measurement to electricity consumption in public areas. In 2019, Terminal 3 will be covered, and 2020, jet bridges and Ground Bridge Loaded Power Units at Terminal 3.

LED lighting

As shown in Fig. 4.5, since 2014, Beijing Airport has added 375 LED lamps for supplementary lighting over the check-in and immigration counters. In VIP areas, a panel of LED lamps over 2300 meters long has been installed, with lighting regulated based on use, thereby contributing to an annual electricity saving of 630,000 kWh[35]. In 2015, the installation of LED lamps under 70W at Terminal 1 and 2 avoided RMB6.9 million worth of electricity cost. According to the data provided by the Department of Terminal Management in August 2016, Beijing Airport applied LED lamps with sensors to the boarding-gate side of the 69 boarding bridges at Terminal 3. This allows for lighting to be regulated needed, saving 900,000 kWh of electricity – an efficiency improvement of at least 90% - and RMB1.15 million in electricity cost each year.

Lighting management

Beijing Airport has developed an energy-saving lighting model for its terminals, taking into account the functions of different terminal areas as well as weather conditions in conjunction with post-flight management. First, Beijing Airport has applied partial lighting (50%) and full lighting (100%) to the waiting areas and the arrival halls. In other areas, there are lightings even more precisely controlled. Second, it tailors its lighting control to changes in daylight, adjusted 24 times a year (see Table 4.1 for an illustration). Third, it concentrates stands for aircrafts so as to be able to close the lighting for blocks of vacant ones (Fig. 4.6), saving 100,000 kWh of electricity each year at Terminal 3 and avoiding RMB120,000 in electricity costs. This last measure is particularly important for newly built airports that are not yet operating in full capacity and should be considered at the design stage. In total, these measures are estimated to save the terminal 9.583 kWh of electricity, a reduction of 40% per year.

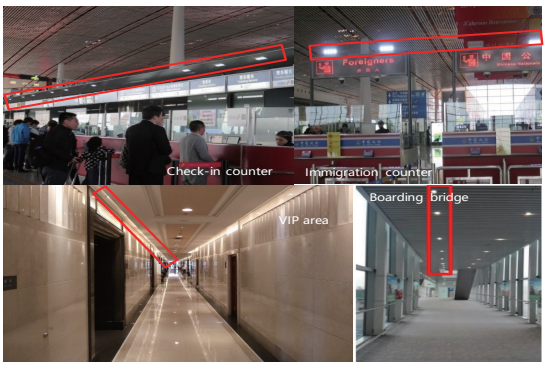


Fig. 4.5 LED lighting

Fig. 4.6 Saving lighting energy in blocks of vacant stands

Table 4.1 Daylight and lighting control

Date	Jan 1	Jan 2	Jan 15	Jan 16	Jan 30	Jan 31
Dawn	7:04	7:05	7:03	7:03	6:54	6:53
Sun rise	7:34	7:35	7:33	7:33	7:24	7:23
Sun set	16:56	16:56	17:09	17:10	17:27	17:28
Nightfall	17:26	17:26	17:39	17:40	17:57	17:58
Day length	9 hours & 21 minutes	9 hours & 22 minutes	9 hours & 36 minutes	9 hours & 38 minutes	10 hours & 3 minutes	10 hours & 5 minutes

4.1.3 Public areas

Beijing Airport has installed LEDs for landside areas (areas that are not accessible by aircrafts). In 2014, the parking area at Terminal 3 received 25,000 LED lamps, saving more than 20% of electricity per year. In 2015, the parking area at Terminal 2 was equipped with 14,500 LED lamps and a smart lighting system, saving more than 25% of electricity per year. As far as landside high-mask LEDs are concerned, electricity saving is estimated at 790,000 kWh/year (more than 50%), worth RMB940,000. LEDs for street and tunnel lighting is expected to save 680,000 kWh of electricity per year – a saving of at least 50% - worth RMB810,000 in avoided costs.

In 2016, Beijing Airport completed a solar power project for its ground transport center (i.e. parking area at Terminal 3, see Fig. 4.7). The total installed capacity is 430kW with an annual electricity output of 420,000 kWh. As Beijing Airport has constructed different terminals in several stages based on existing facilities, it faces constraints in deploying solar energy technologies. At present, solar power makes up 0.04% of the airport's total energy consumption. Beijing Airport plans to install solar power systems for Parking lot 1 and the parking areas for staff.

Fig. 4.7 Solar power project at ground transport center

4.1.4 Energy performance in summary

At the aggregate level, from 2015 to 2016, there was a slight reduction (2.3%) in the airport's energy consumption (Fig. 4.8). Terminals, which occupy 1,420,000 m^2 of floor space, accounted for the largest share of energy use, mostly for heating, cooling and electric power, as shown in the 2015 energy flow chart (Fig. 4.9).

Beijing Airport consumes grid electricity, gasoline, diesel, natural gas, outsourced heating and a limited amount of solar powered electricity, with electricity and outsourced heating being the dominant sources of energy. In recent years, use of natural gas, gasoline, and diesel has decreased from 0.7% of the total energy share in 2010 to less than 0.001% in 2016. The share of renewable energy, at 0.16%, however, is negligible at present and represents an area for further innovation.

At the operation level, from 2015 to 2016 the airport reduced its energy consumption per unit of passengers, cargo and aircrafts handled, by 6.9%, 5.0% and 4.9% respectively. This took place even as business volume rose.

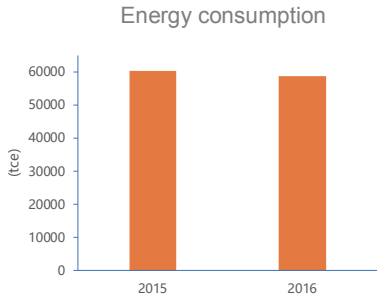


Fig. 4.8 Energy consumption of Beijing Airport (2015-2016)
Source: Department of Planning and Development of Beijing Airport.
Note: Energy consumption covers electricity, heating and cooling. The measured data of heating and cooling are only available for the year 2015 and 2016. Data on electricity are available for a period of 2013-2016. To ensure data consistency and accuracy, the total energy consumption shown in Fig. 4.8 is calculated for the year of 2015 and 2016.

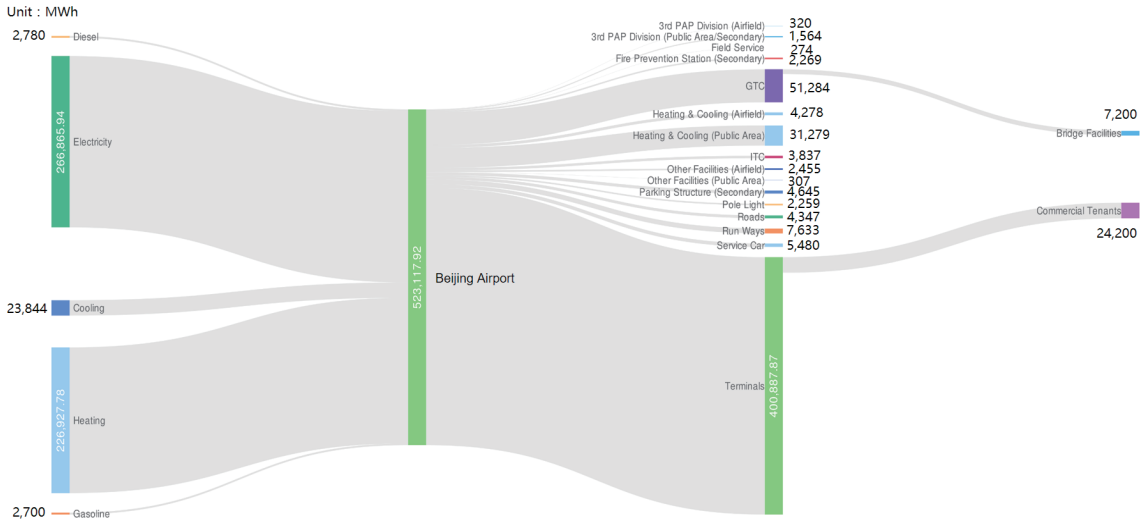


Fig. 4.9 Energy flow diagram of Beijing Airport in 2015
Source: 2015 carbon verification report of Beijing Airport Carbon Accreditation report on Beijing Airport (2015)

If we measure the energy performance in the terminal buildings, from 2013 to 2016 the annual electricity consumption stayed relatively consistent at between 22,400-23,400 MWh (Fig. 4.10). Table 4.2 shows the energy consumption - electricity and overall energy consumption, respectively - per square meter and passengers handled. The annual electricity and overall energy consumption per unit of passengers handled came down over this period and moved closer to the levels required by the industrial standard[60]. Annual overall energy consumption per unit of square meters is lower than that required by the industrial standard, but in terms of electricity consumption remained higher.

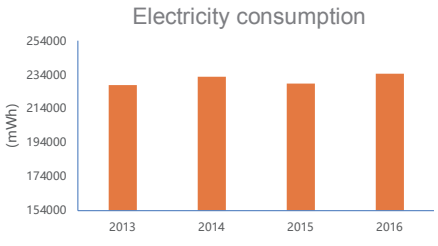


Fig. 4.10 Electricity consumption of terminal buildings (2013-2016)

Table 4.2 Energy intensity at terminals

	Electricity consumption (kWh/m^2)		Electricity consumption (kWh/passenger)		Overall energy consumption (kg coal equivalent/ passenger)		Overall energy consumption (kg coal equivalent/m^2)	
Year	Value	Standard	Value	Standard	Value	Standard	Value	Standard
2013	163.70	140	2.72	1.75	——	——	——	——
2014	167.15	140	2.70	1.75	——	——	——	——
2015	160.85	140	2.54	1.75	0.55	0.50	34.61	40
2016	164.98	140	2.48	1.75	0.52	0.50	34.42	40

Note: "——" indicates data missing, please refer to the note of Fig. 4.8.

4.2 Carbon emissions

Beijing Airport has taken a number of steps in recent years to mitigate its carbon footprint. It has developed a multi-stakeholder carbon management system and taken part in Beijing's pilot carbon trading programme (see Fig. 4.11). In addition, it has participated in the Airport Council International's Airport Carbon Accreditation programme, which has four progressive levels: 1) mapping, 2) reduction, 3) optimization, and 4) neutrality. For 2016-2017, Beijing Airport has been accredited with the level of mapping and for 2017-2018, reduction, meaning the airport's carbon mitigation efforts have been internationally recognised.

Box 4.2 Good practice: carbon management

In 2016, Beijing Airport involved all major parties of the airport in compiling its "Carbon Emission Management Regulations" in response to a related directive issues by the Beijing Municipal Government. In that year, it started taking inventories of carbon, with two documents internally audited: 1) list of major sources of carbon emissions; and 2) carbon accounts.

Also in 2016, Beijing Airport achieved a surplus of 15,000 tons of carbon quotas in Beijing's carbon trading market. The roof garden of the parking building near T3 is covered with 10 daylighting bands totaling 6763 m^2 in size, which is expected to offset 364.7 tons of CO_2 annually.

Fig. 4.11 Airport Carbon Accreditation

Beijing Airport's carbon performance may be assessed by focusing on three areas: 1) total carbon emissions and decoupling of emissions from airport operations; 2) carbon intensity; and 3) carbon sequestration.

In 2016, the airport's total emissions amounted to 228,565.7 tons, a reduction of 50,940.7 tons or 15.9% from the 2014 levels (Fig. 4.12). Direct emissions, mainly from vehicles were 1,247.2 tons (0.5%), whereas indirect emission mainly from outsourced electricity, heating, steam and cooling accounting for 227,318.6 tons (99.5%). Comparing Beijing Airport's total carbon emissions to the three indicators of major airport operations over the same period (volumes of passengers, cargo, and flights), reveals the state of "absolute decoupling" between carbon emissions and business growth.

Between 2014-2016, Beijing Airport's carbon intensity – which is measured in emissions per unit of passengers, cargo and aircrafts handled - also declined (Fig. 4.13), especially in 2016. The performance was between that of Munich and Frankfurt airports, showing how Beijing Airport's held its own among high international achievers.

Beijing Airport has been increasing its carbon sequestration capacity by planting trees on the ground and roof. According to the afforestation plan provided by the airport in November 2016, the total forested area is 0.39 km^2, absorbing 2,523.3 tons of CO_2 or 6.45 kg CO_2/m^2 per year.

4.3 Air quality

The Chinese government has placed a strong emphasis on controlling air pollution. In 2013, the Beijing Municipal Government issued a clean air action plan for 2013-2017,[64]encouraging the use of clean energy and synergistic reduction of multiple pollutants. In 2014, Beijing's municipal legislation on air pollution prevention requires the phasing out of obsolete vehicles and rapid installation of infrastructure for new and clean energy vehicles.

The national law on pollution prevention[65] includes a specific reference to the reduction of air pollution from civil aircrafts. In 2015, this law was revised calling for measures to be taken in the design, production and use of aircrafts. At industry level, in 2016, the 13th Five-Year Plan for the Development of the Chinese Civil Aviation Industry proposed greening the civil aviation manufacturing industry with specific fuel consumption targets (tons/km).

In response to these policy initiatives, Beijing Airport has adopted various measures to reduce both air pollution and GHG emissions mainly from aircrafts and vehicles. Major measures include the switch from APU to GPU, the deployment of electric vehicles and coordinated operation of the CDM and A-CDM systems, which reduced the average taxiing time by 1.6 minutes in 2013-2014. This led to reduced fuel consumption and a 40% decline in the number of aircrafts where on-board waiting exceeded one hour[57]. The underpass between Terminal 2 and Terminal 3 has reduced inter-terminal commuting by about 13 minutes on average, contributing to reduced air pollution.

According to the data provided by the Department of Planning and Development of Beijing Airport. The major sources of air pollution at Beijing Airport include aircrafts, vehicles, and boilers. Pollutants from aircrafts include NO_x, CnHm, and CO emitted from the different segments of aircraft movement. These pollutants are also found in the exhausts from vehicle operations. As for boilers, they mainly discharge NO_x and CO. Of these sources, the one which Beijing Airport has greater direct control over is the use of airport vehicles; their gasoline and diesel consumption had declined between 2010 and 2016 by 45% and 49%, respectively (Fig. 4.14), contributing to reduced emission of related pollutants.
The type of air quality Beijing Airport has greatest direct control over is that found indoors. Judging from the concentrations of NO_2, NO, CO, and CO_2 as monitored at 38 check points in 2016, the airport's air quality meets the related regulatory standards. In October 2016, Beijing Airport monitored formaldehyde, ammonia, benzene, total volatile organic compounds, and radon at 48 check points (offices and lounges) and found that air quality met the civil construction requirements.

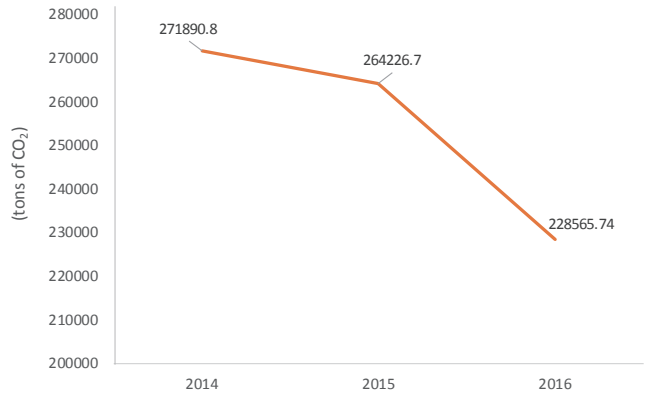
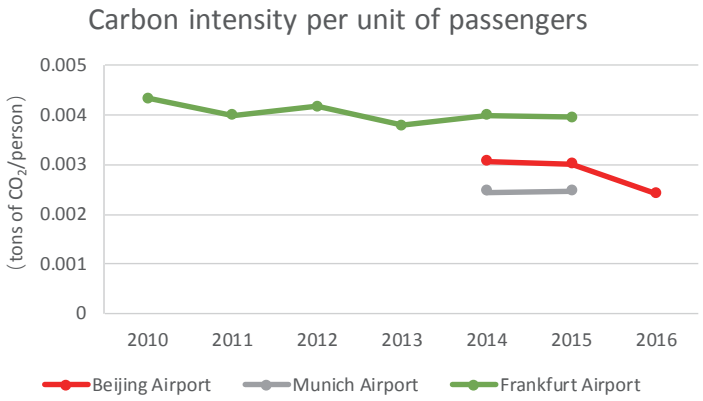
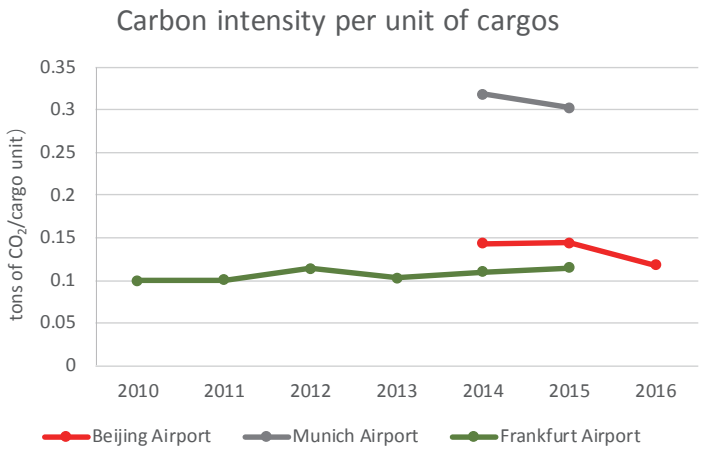


Fig. 4.12 Carbon emission of Beijing Airport (2014-2016)





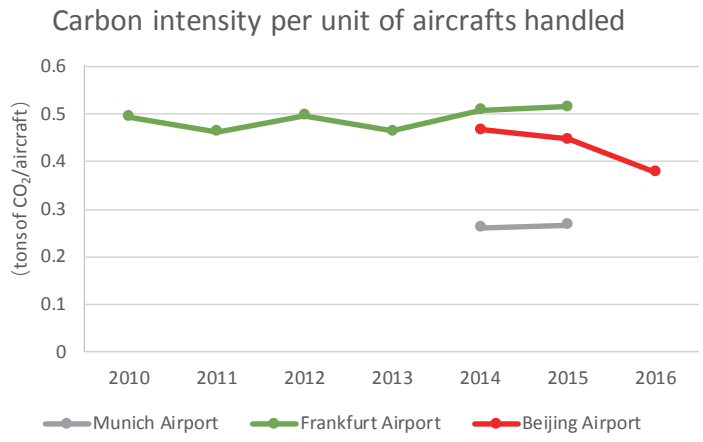


Fig. 4.13 Beijing Airport's carbon intensity per unit of passengers, cargo and aircrafts handled (2010-2016)
Source: data on Beijing Airport from Airport carbon Accreditation report on Beijing Airport (2014, 2015), 2016 carbon verification report of Beijing Airport; data on Frankfurt and Munich Airport from their Corporate social responsibility reports[61-63].

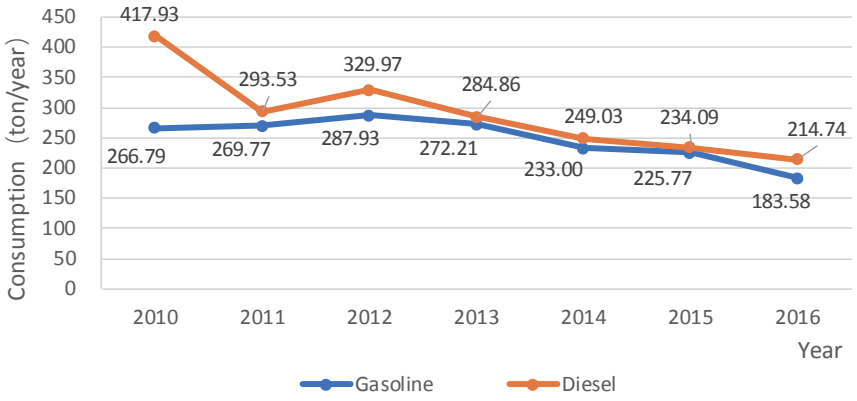


Fig. 4.14 Gasoline and diesel consumption of Beijing Airport
Source: Department of Planning and Development of Beijing Airport.

4.4 Water use

Beijing Airport's water management is assessed in three dimensions: 1) water efficiency; 2) water environment; and 3) wastewater treatment.

4.4.1 Water efficiency

Beijing Airport's hosting city Beijing faces a serious water shortage[113], with per capita water availability measured at 95.15 m^3 in 2014 - 1/20 of the nation's average, as measured in 2014. In 2015, the government enacted an action plan on the prevention and control of water pollution as a way of saving water, giving a strong impetus to Beijing Airport's effort to raise water efficiency in airport operations. Beijing Airport's maximum daily water use currently stands at 90,000 tons and discharge at 63,500 tons, covering water uses in public areas (offices, gardens, and staff living quarters), aircraft movement areas (vehicles, runways, and aircrafts), and terminals (passengers, shops, and restaurants).

In response to the water shortage in the city, Beijing Airport has focused on raising the efficiency of its water consumption and has made important progress in this regard. As shown in Fig. 4.15, the airport's per capita water consumption declined from 23.75L in 2012 to 21.24L in 2015, a reduction of 10.6%. Table 4.3 shows a comparison of per capital water consumption at select international airports.

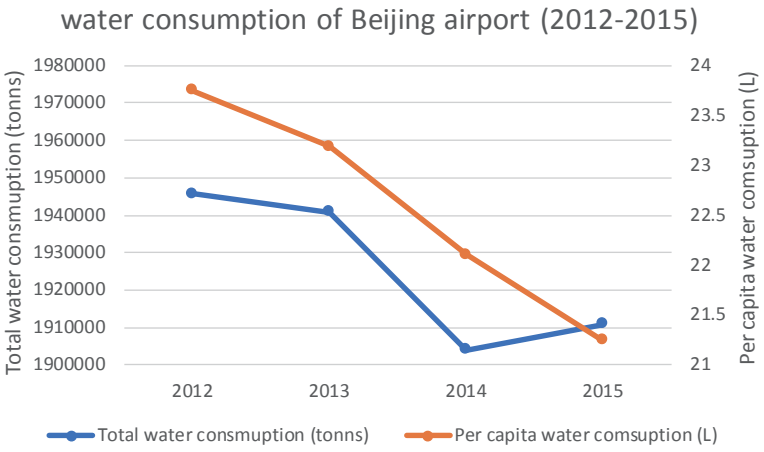


Fig. 4.15 Water consumption of Beijing Airport (2012-2015)
Source: Department of Planning and Development of Beijing Airport.

Table 4.3. Per capital water consumption at selected international airports

Airport	Atlanta Airport[66]	Heathrow Airport[67]	Manchester Airport[68]	Lisbon Airport[68]
Per capital water consumption (L)	28	30	50	43
Airport	**Frankfurt Airport[68]**	**Madrid Airport[68]**	**Amsterdam Airport[68]**	**Beijing Airport**
Per capital water consumption (L)	22	24	27	21

In 2016, Beijing Airport added rainwater and reclaimed water to its water supply so as to reduce the pressure on municipal water. According to the data provided by the Department of Planning and Development of Beijing Airport in June 2016:

1) A water purification station on the eastern side of the airport was capable of reclaiming 10,000 tons of wastewater per day whereas a station on the western side reclaimed 200,000 tons in 2016.
2) The airport used 224,000 tons of the rainwater it collected for watering the gardens.
3) Reclaimed water and rainwater collected together accounted for 17.2% of the airport's total water consumption, saving RMB2.63 million from reduced use of municipal water.
4) Other measures to prevent leakage, switch to water-saving appliances, and raise awareness of water conservation (as shown in Fig. 4.16) saved 3,300 tons of water and approximately RMB20,000.

Fig. 4.16 Save water sticker

4.4.2 Water environment

The airport's main waterscape is the West Lake, which was completed in 2007 as part of the Terminal 3 construction project and with its main function being water regulation. It is used as a water storage for firefighting, flood control, soil and water conservation, and plant watering. The lake has an area of 70,000 m^2 and storage capacity of 180,000 m^3. Each year, the lake collects 98,000 m^3 of rainwater from the aircraft movement areas (Fig. 4.17). It has also become a tourist attraction.

The lake is, however, susceptible to contamination stemming from upstream wastewater discharge, oil pollution from aircraft movement areas, and the spread of algae and microorganisms, especially in spring when precipitation is low but temperatures rise. This tends to bring total phosphorous, nitrogen and chemical oxygen demand close to threshold levels. In response, Beijing Airport can close the flood gate, turn on the aerator, spray chemicals, release fish fries, dredge, and open the flood gate when the water level is high in flood season. Beijing Airport also plans to give the lake a comprehensive clean in 2018.

Fig. 4.17 Location of the West Lake

4.4.3 Wastewater treatment

Airports can produce a large amount of wastewater, including 1) domestic sewage from terminals, business areas, living quarters, restaurants, and hotels, 2) industrial effluent from airplane food processing, mechanical operations, and oil tank cleaning, and 3) used water from washing vehicles and aircrafts, as well as rainwater carrying traces of oil from the airfield.

Beijing Airport has built two wastewater purification stations on the eastern and western sides of the airport, respectively (East Station and West Station) following both municipal and national standards. The West Station's designed capacity is 20,000 tons per day, although in practice it has handled up to 28,000 tons per day. In contrast, the East Station – which is equipped with more advanced technologies - has a designed capacity of 80,000 tons per day, but is significantly underutilized. This discrepancy between the two stations remains to be addressed.

Thanks to these two stations, however, Beijing Airport's wastewater discharge level stays low. In 2016, the West Station treated 8.4 million tons of wastewater and reduced more than 2,300 tons of chemical oxygen demand and 240 tons of ammonia nitrogen whereas the East Station treated 4.6 million tons of wastewater. In total, the two stations handled 13 million tons of wastewater in full compliance with the government's quality standards. Apart from treating wastewater from airport operations, Beijing Airport has also provided support to some neighboring communities, which is discussed in Chapter 3.

4.5 Solid waste

An airport's solid waste may be found on the airside and ground service area. The former includes leftover flight meals and waste brought by passengers on board whereas the latter comes from terminals, aprons, living quarters, restaurants, hotels, airport construction and expansion, and sludge from wastewater treatment plants. In terms of toxicity, solid waste can also be divided into general and hazardous waste. Fig. 4.18 shows the classification of an airport's solid waste.

The Chinese government has national policies covering various aspects of waste management with specific targets. By 2020, for example, 95% of the municipal waste should be treated and 35% of recycled[69]. Meanwhile,13% of urban construction waste must be re-used[70], and 60% -90% of urban sludge safely disposed, depending on different administrative levels and thus the capabilities of cities[71]. There are also requirements for the management and re-use of hazardous waste.

In the context of the government's overall waste management policy, Beijing Airport has focused its efforts on three areas: 1) airside waste, 2) waste from ground service areas, and 3) hazardous waste (mainly from the airside including waste via flights from epidemic areas).

General and hazardous waste results from airside activities. Recyclable items such as plastics account for more than 20-30% of the general waste. Beijing Airport sterilizes the general waste before taking it to the airport's solid waste transfer station, where more than 20% of

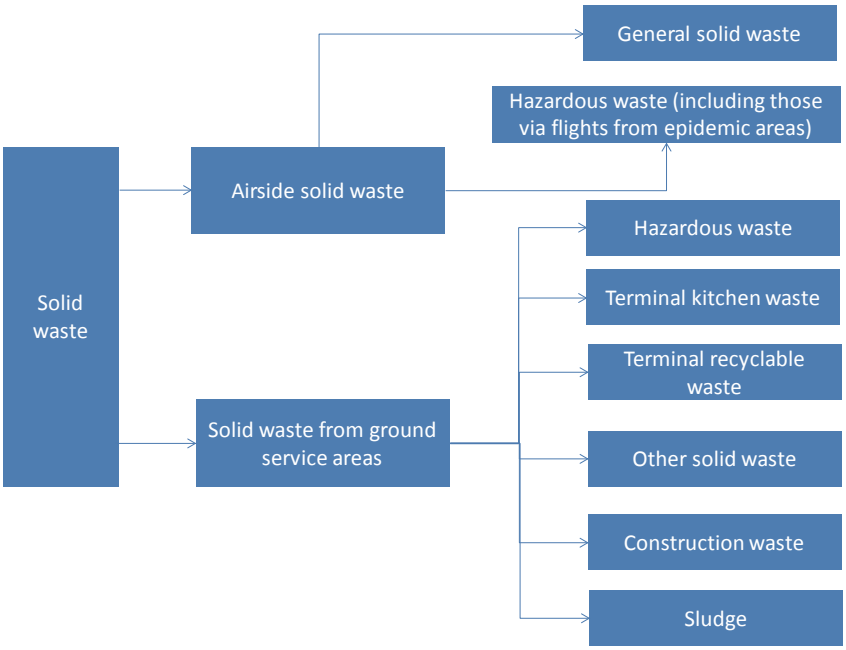


Fig. 4.18 Classification of airport's solid waste

the recyclable waste is sorted (in comparison with 35%, the national target for 2016-2020. In 2016, 2,000 tons of airside solid waste was sorted and transferred to the recycling facility. The rest of the waste is combined at the transfer station with the general solid waste from the ground service areas and delivered together to a qualified treatment facility for incineration. Since 2013, Beijing Airport has collected and transferred between 8,200-9,350 tons of solid waste from the airside each year, gradually increasing overtime.[33-35, 57]

Concerning the handling of hazardous waste, starting from 2017 Beijing Airport will outsource the handling of waste from epidemic areas to a third party, whereas previously it replied on its internal incineration facilities. The remaining of hazardous waste, whether from the airside or ground service areas - such as cartridges, mercury-containing lamps, and lead batteries - is collected by Beijing Airport and given to a third party facility for disposal. In 2016, the airport's hazardous waste handled by the external facility included 6.23 tons of mercury-containing lamps and 25.03 tons of lead batteries[34].

In response to the serious levels of in-flight food waste, Beijing Airport has intensified efforts to promote sustainable consumption. On 4 June 2015, Beijing Airport and the United Nations Environment Programme signed an agreement to cooperate on environmental protection, green airport operations and corporate sustainable development. The two parties also celebrated "World Environment Day 2015 - Seven Billion People's Dream: One Planet, Consume with Care". In the subsequent five months, Beijing Airport deployed 400 TV sets, 80 posters and 64 LED screens near the boarding gates of all three terminals, calling for "sustainable production and consumption"[35].

Waste from ground service areas, including waste from terminals and restaurants therein, is not separated. It is collected from different areas, delivered to the airport's waste transfer station and combined before being sent to the waste disposal company for incineration. Since 2013, the amount of waste from ground service areas has been growing, with an average of 28000 tons handled each year. [33-35, 57]

In Terminal 1 and Terminal 2, Beijing Airport has placed 513 sets of garbage bins that allow for waste separation between aluminums, plastics, papers, and non-recyclables. These bins are themselves made from 1896 recycled milk boxes that are safe from corrosion, moisture, fire, and statics. They can be further recycled when broken. In T3, Beijing Airport introduced six new "Smart PET Recyclers" in 2013, which draw attention from passengers. These recyclers are managed by an external company and can identify, accept, and place empty bottles and reward users with electric transfer of credits to their mobile phone accounts (0.05 or 0.10 RMB per bottle recycled). More such recyclers will be rolled out over time. In addition to these efforts, Beijing Airport has been promoting the recycling of waste papers and office materials since 2013.

Other waste form ground service areas include construction waste such as existing asphalt pavement, which becomes waste after a new pavement is installed, and sludge. Beijing Airport stores all old pavement materials onsite for use to solidify the soil foundation of future construction projects. In April 2017 for example, a major overhaul in the middle of the central runway covered 200,000 m^2, generating old pavement materials of least 50,000 m^3, which were kept for re-use. Since 2014, Beijing Airport has generated an annual average of 5,000-6,800 tons of sludge. In 2014, all the sludge generated was transferred to a third party for disposal. In 2015-2016, thanks to technological improvement, about 5,000 tons or 80% of the sludge generated was reused by the cement industry each year.

Chapter 5.
Governance

This chapter assesses Beijing Airport's governance, which underlies its efforts to become a green airport. It covers: 1) the airport management, 2) technological innovation, 3) procurement, and 4) partnership. Some aspects of governance, such as the various inter-departmental coordination committees are covered under Chapter 3 in the context of improving passenger services and will not be discussed further.

5.1 Management

Beijing Airport's management structure is shown in Fig. 5.1. The work on becoming a green airport is coordinated by the Department of Planning and Development of Beijing Airport, which is responsible for formulating the overall strategy and monitoring its implementation by different departments. The Legal Department provides legal advice on Beijing Airport's green development strategy. Other departments and management centers are involved at implementation level.

In the early stages of efforts to become a green airport pursuit, Beijing Airport focused on energy conservation and emission/noise reduction. Overtime, it has expanded the green airport practice to cover green transport and use of reclaimed water. Its achievements have been recognized by international institutions as in the case of ISO certifications (ISO14001 for environmental management in 2004 and ISO50001 for energy management in 2014) and Airport Carbon Accreditation in 2016 and 2017.

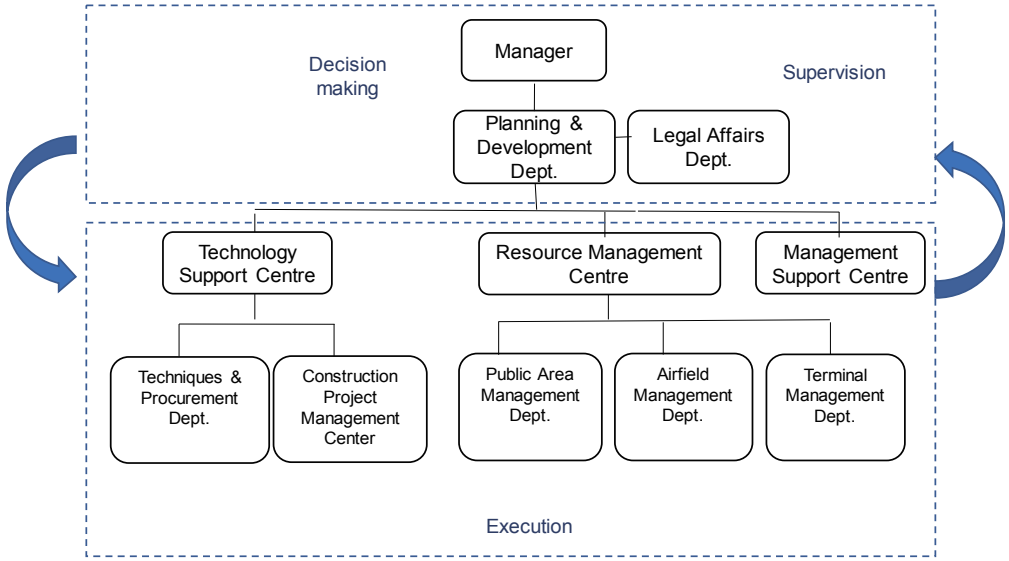


Fig. 5.1 Management structure of Beijing Airport

Box 5.1 Wi-Fi network for contact and remote stands

An airport's digital operation requires high speed, stable and real-time transmission of data throughout the airport. Until recently, however, Beijing Airport had no dedicated Wi-Fi network that could cover the entire area of contact and remove stands. Instead, it had to rely on the inefficient manual collection of data and high-cost yet unstable signals from satellites. In October 2016, Beijing Airport's technical team succeeded in connecting ground-based and on-board Wi-Fi networks, which now cover 136 contact stands at all three terminals and most of the remove stands at Terminal 3, contributing to increased operational efficiency.

Source: Department of Planning and Development of Beijing Airport

Box 5.2 Private cloud computing

With the development of information technology, there is an increasing number of independent information systems. In the case of Beijing Airport, 100 exist each with their own hardware-supporting platforms, which cause resource waste. The lack of unified standards also put these systems' maintenance and stability at risk.

In 2013, Beijing Airport started research on a unified "private cloud" platform to serve a new generation of large-scale hub airports. It has already developed the technology, which is expected to save half of the maintenance cost (saving RMB400,000 each year) and 120,000 kWh electricity each year while making data reading and writing speed 16 times faster. Migration from the old systems to the new cloud platform has been carried out safely and now covers nearly 40 servers and 17 different systems.

Source: Department of Planning and Development of Beijing Airport

5.2 Technological Innovation

Beijing Airport considers technological innovation as a major tool for becoming a green airport. In 2011, it set up a Science and Technology Management Committee focusing on airport operation, safety and services. Since 2011, it has succeeded in receiving funding from the civil aviation authorities each year. These are matched with its own RMB2-11 million to conduct research on rapid transit systems in large hub airports and smart airport decision-making systems for example. Its pursuit of becoming a smart airport is demonstrated by its development of a Wi-Fi network for contact and remote stands (Box 5.1) and "private cloud" computing in the airport (Box 5.2).

5.3 Procurement

Beijing Airport has started procuring environmentally friendly products to support its projects on LED lamps and "gas-to-electricity". In addition, the airport has started purchasing green brands of deicing fluid, snow dissolving agent, and hand sanitizer as well as recycled toilet paper for use at its administration building. Some of its bidding documents for goods and services have included environmental requirements. In addition, Beijing Airport has set up a "supplier evaluation system" (Table 5.1), which can potentially serve as a basis for identifying suppliers of green products and contributing to the green transformation of the aviation supply chain.

Table 5.1 Supplier evaluation system

★★★★★	★★★★☆	★★★☆☆	★★☆☆☆
>95	90-95	60-90	<60
Contract can be renewed for two years	Contract can be renewed for one year	Contract cannot be renewed but eligible for bidding	Unqualified supplier (contract cannot be renewed within one year, ineligible for bidding)

5.4 Partnership

Airport operation involves not only Beijing Airport itself, but also airline companies and government agencies, among others. As it moves towards becoming a green airport, Beijing Airport has been engaging a diverse range of stakeholders through, for example: 1) the platform for exchange and cooperation with airline companies and other entities operating on the airport's premises, 2) the agreements with airport businesses on safety issues, 3) the dynamic management of suppliers (i.e. retention is based on performance evaluation), and 4) a partnership with the United Nations Environment Programme. In addition, Beijing Airport has established cooperative relationships with over 30 sister airports in other countries, which can help spread the green airport concept.

Table 5.2 shows the airport's major stakeholders, their focal areas and issues that need to be addressed collaboratively. One particular area where government support is essential, for example, is the airport's external public transport system, which needs to be improved. This table, however, is not exhaustive. The customs authorities at the airport, for instance, is a key partner in combating the smuggling of endangered wildlife. According to the data provided by Beijing Airport customs, in 2016, it seized 2,300 pieces of endangered wildlife and related products in 128 cases.

Table 5.2 Cooperation areas of Beijing Airport and partners

Partners	Green airport cooperation	
	Current cooperation areas	To be strengthened
Government & regulatory bodies	All aspects of airport operation	Public transportation
Airlines & other resident entities	Airport security, aviation service	Decision making, implementation and supervision
Airport businesses	Service diversification	Agreements on environment & social responsibility
Suppliers	Supplier chain management	List of green suppliers, database of green goods and services
Passengers	Services	Waste separation, reduction of food waste
Staff	Staff benefits, career development	Training in sustainable development, accountability
Communities & society	Noise control, community services, publicity & education	Active noise reduction measures.
Airports	Business development	Best practices of green airport
International organizations	Environmental awareness raising	Development strategy, technological support, development evaluation

Chapter 6.
Conclusions and Recommendations

The Chinese aviation industry has experienced tremendous growth since the 1980s when China started its “open door” policy. Beijing Airport, being located in the Chinese capital, has played a major role in that growth and contributed to Beijing’s economic development. It brings in investors, traders, and tourists, contributing to the hosting city’s economic output and jobs.

As awareness of human pressure on the natural environment grows, Beijing Airport, together with other airports in China and beyond, has embraced the concept of a green or sustainable airport and put this into practice. Although the volumes of passengers, and aircrafts handled have increased many times in the past decades, Beijing Airport's environmental performance is generally encouraging. This is reflected, for example, in major indicators of energy efficiency, carbon emission, indoor air quality, water management, and solid waste treatment. At the same time, Beijing Airport has attended to the well-being of passengers, its staff, as well as neighboring communities whose complaints about noise are handled professionally and whose wastewater and solid waste disposal is taken care of by Beijing Airport. These achievements are inseparable from Beijing Airport's governance, which has ensured that the aim of becoming a green airport is taken on across departments and which has placed a strong emphasis on technological innovation and partnership with a diverse range of stakeholders.

Moving forward, Beijing Airport and its partners may want to consider making improvements in the following areas:

First, Beijing Airport can explore the feasibility of tapping into the growing green bond market to finance its green airport projects such as the installation of the Automated People Mover (APM) system to replace the less efficient inter-terminal buses. It can also assess the potential for investing some of its liquid assets in green bonds, contributing to green transformation at societal level.

Second, it can work with Beijing Municipal Government - specifically the transport department and metro service - to identify options for integrating the airport's light rail with the city's metro system. This is especially relevant at the connecting stations, where separate ticketing could at least be avoided. At the same time, it should raise parking fees to discourage the use of private cars.

Third, it can work with new energy companies and electric utilities to source electricity from renewable energy sources. The effort to convert gas-based vehicles to electric ones and install the associated charging infrastructure is commendable. It contributes to improved air quality. Yet electric vehicles will only contribute to reduced carbon emissions if they are powered by renewable energy, whose share in the airport's total energy consumption should increase.

Fourth, there is a need to reduce the volume of solid waste from both airside and ground service areas. The share of the recyclable waste that is separated should be increased from the current level of 20% to the national target of 35% for 2016-2020, or even higher. A lot of the waste still goes to incinerators without being able to serve society further. Even if there is no other option than incineration, Beijing Airport may still work with partners to seek energy recovery from incineration.

Last but not least, the proportion of women in Beijing Airport's labour force needs to be increased. There are few if any airport jobs that only men can perform. In its recruitment policy and practice, Beijing Airport may assign particular importance to the hiring of women, which is a major indicator of an employer's social responsibility.

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