Diploma Programme
Programme du diplôme
Programa del Diploma

Environmental systems and societies
Standard level
Paper 1 – resource booklet

5 May 2023

Zone A morning | **Zone B** afternoon | **Zone C** afternoon

1 hour

Instructions to candidates

- Do not open this booklet until instructed to do so.
- This booklet contains all the resources to answer paper 1.

2223 – 6302

14 pages

2223–6302

Figure 1(a): Map showing location of Beijing in China

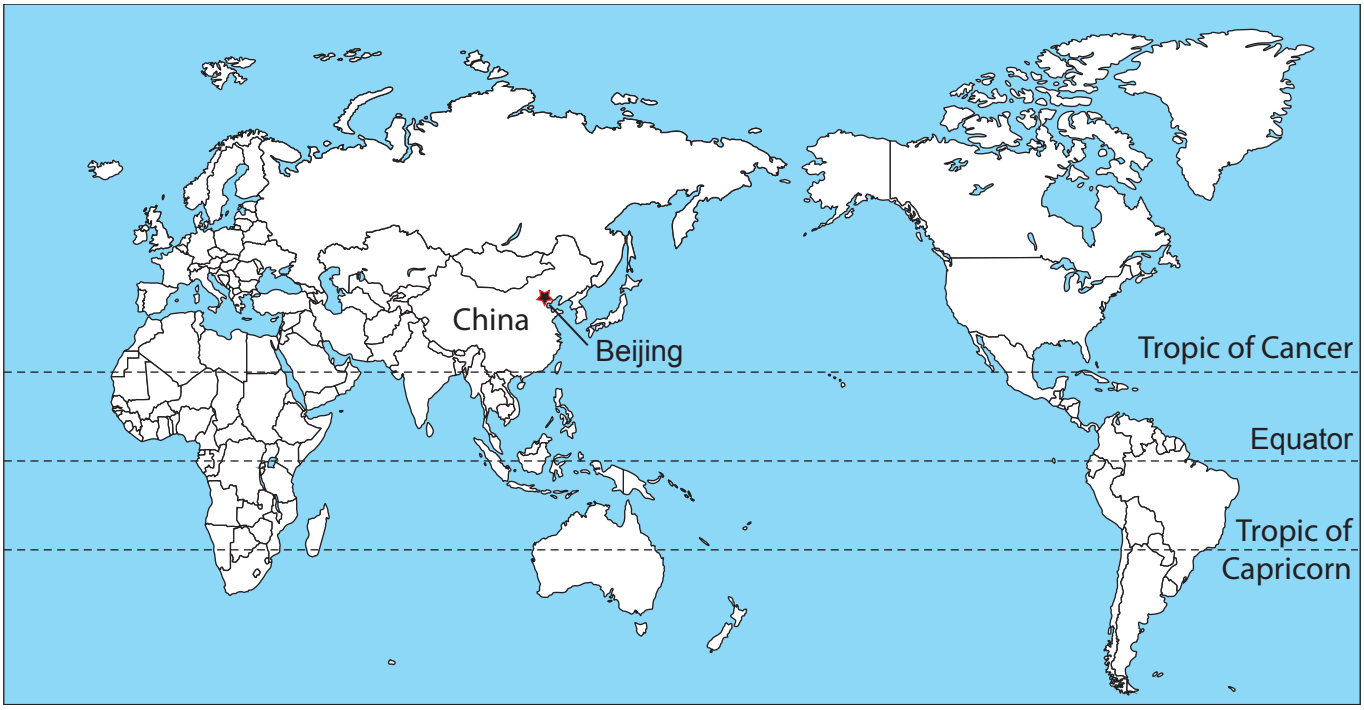

Figure 1(b): Topographical map of region around Beijing city

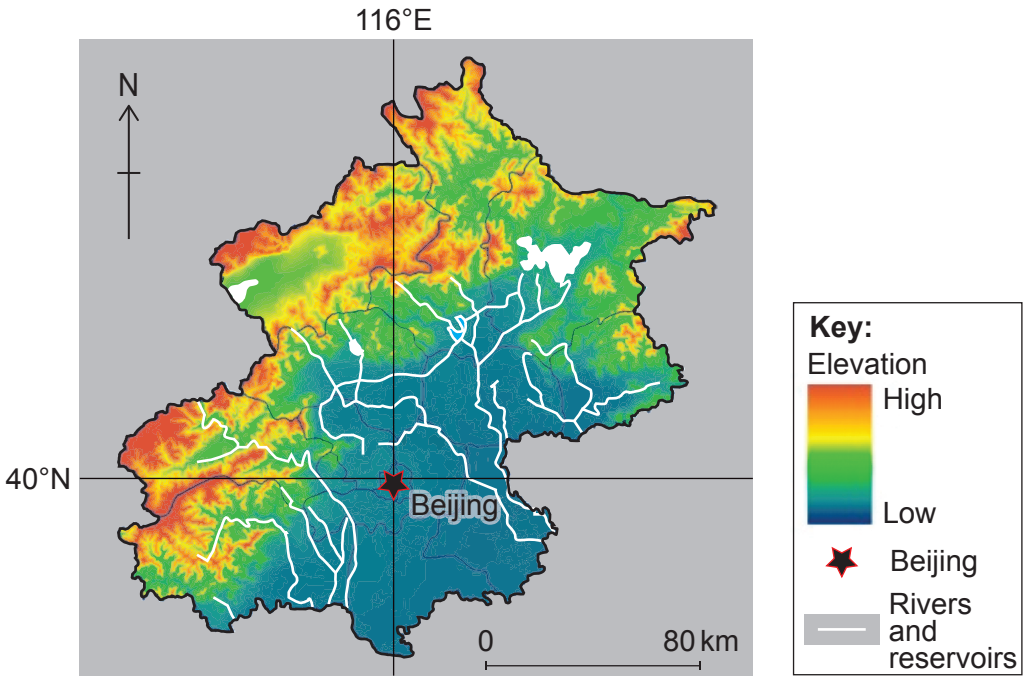

Figure 2: Fact file on Beijing

- The capital city of China, covering an area of 16 808 km^2.
- The second largest city in China after Shanghai.
- One of the oldest cities in the world; Beijing dates back over 3000 years.
- Seven UNESCO world heritage sites are located close to the capital and attract many tourists (*eg* Forbidden City, Great Wall of China).

Figure 3(a): Fact file on Beijing population

- In 2019, the population of Beijing was about 20.04 million.
- In 2018, life expectancy in Beijing was 81.2 years compared to 76.4 years for China.
- In 2017, governmental policies were implemented to restrict the future Beijing population to 23 million, for example by:
    - discouraging migration into the city
    - encouraging relocation of people to areas outside of the city
    - relocating factories to areas outside Beijing.

Figure 3(b): Population of Beijing, 1965–2017

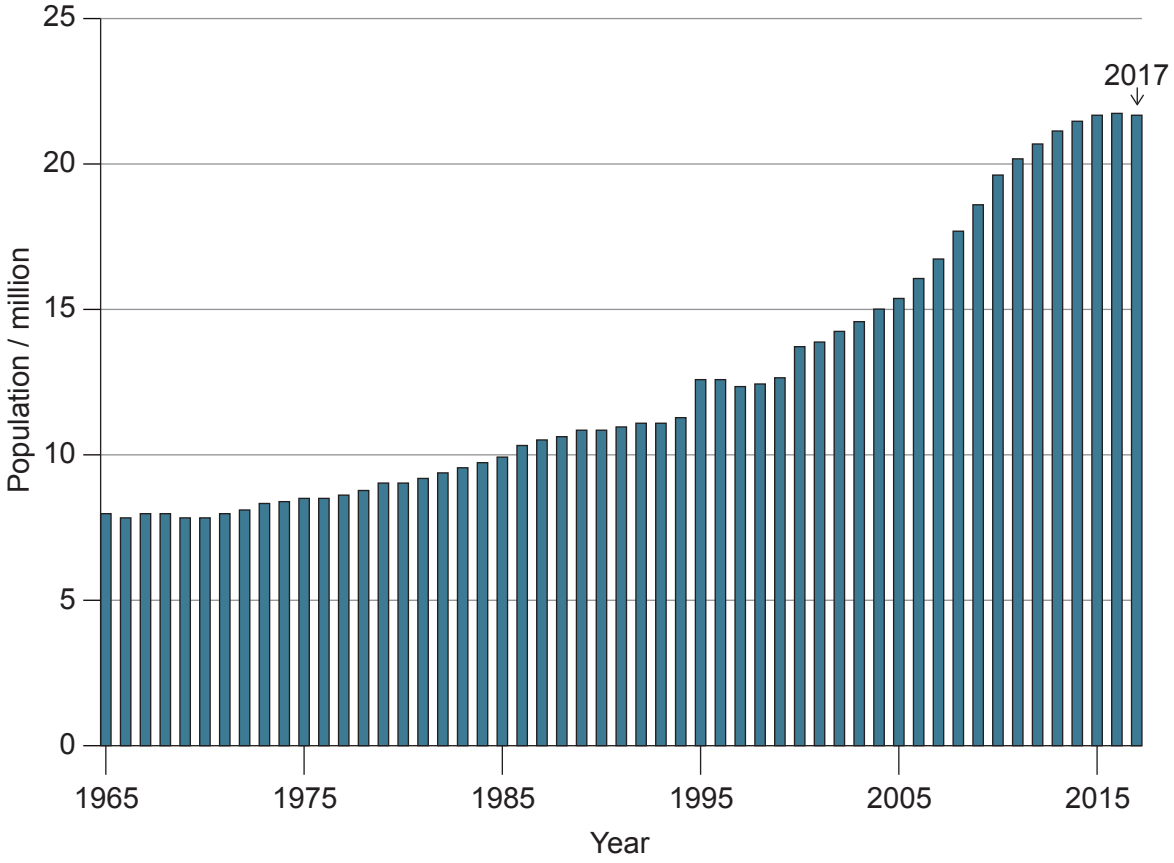

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Figure 3(c): Age–gender pyramids for China for 1950, 2015 and projected pyramids for 2050

Figure 4: Climate of Beijing

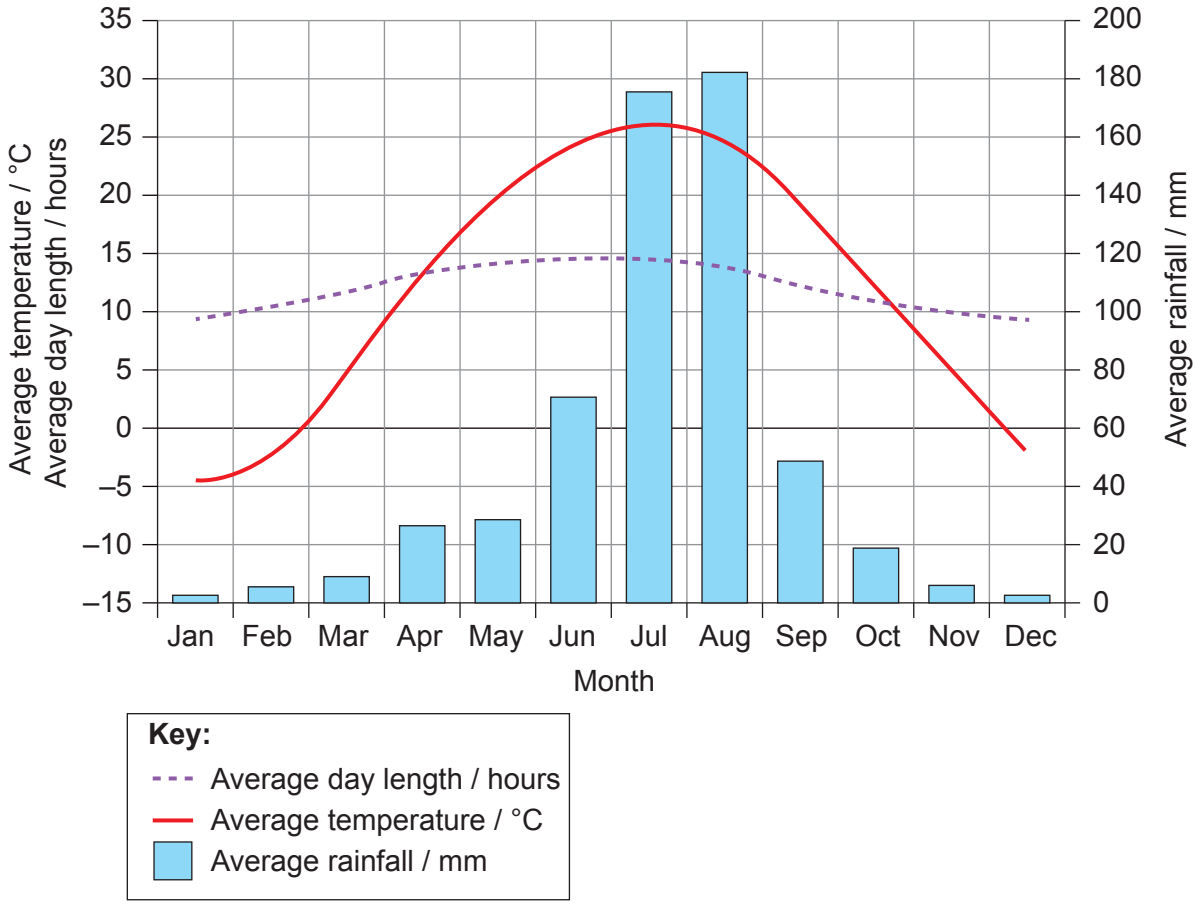


Figure 5: Recorded electricity consumption for Beijing, 2008–2019

Year	Recorded electricity consumption (kWh bn)
2019	117.020
2018	114.351
2017	107.002
2016	101.998
2015	94.982
2014	92.884
2013	90.655
2012	90.954
2011	84.893
2010	82.794
2009	76.016
2008	71.195

Figure 6(a): Fact file on air pollution management in Beijing

- In 2018, the *Beijing Clean Air Action Plan* included:
  - limiting car ownership by using quotas of 100 000 new car purchases each year
  - a reduction in coal consumption from 30 million tonnes in 2005 to 4 million tonnes
  - creation of forested areas and green spaces, *eg* 5 urban forests, 21 green spaces, 10 leisure parks and 100 km of greenways.
- Beijing has the potential to reach net zero carbon emissions by 2050.

Figure 6(b): Fact file on particulate matter

- Small particles such as dust, soot, smoke suspended in the air.
- Commonly categorized by particle size, such as $PM_{2.5}$ and PM_{10}.
- If inhaled, $PM_{2.5}$ and PM_{10} are small enough to enter the lungs and cause health impacts including coughing, asthma attacks, bronchitis, heart attacks and cancer.
- The World Health Organization (WHO) estimates that nearly one million people in China die annually from exposure to $PM_{2.5}$ and PM_{10}.

Figure 6(c): Average monthly $PM_{2.5}$ levels in Beijing, 2015

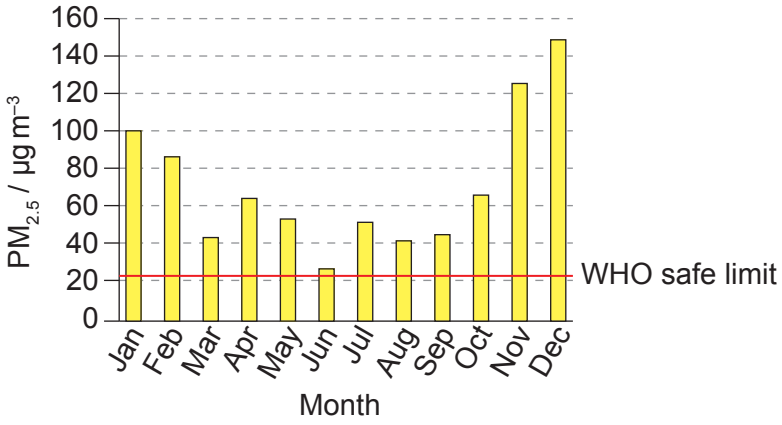


Figure 6(d): Average monthly tropospheric ozone levels in Beijing, 2014–2016

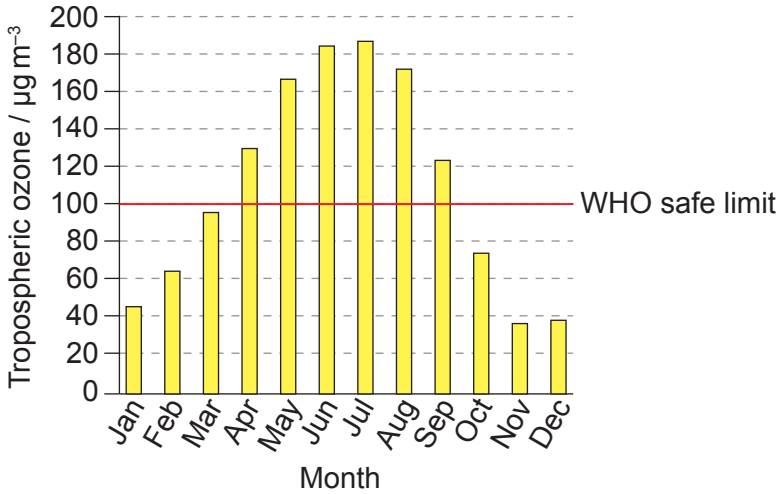


Figure 6(e): Annual average concentrations of air pollutants in Beijing, 1998–2017

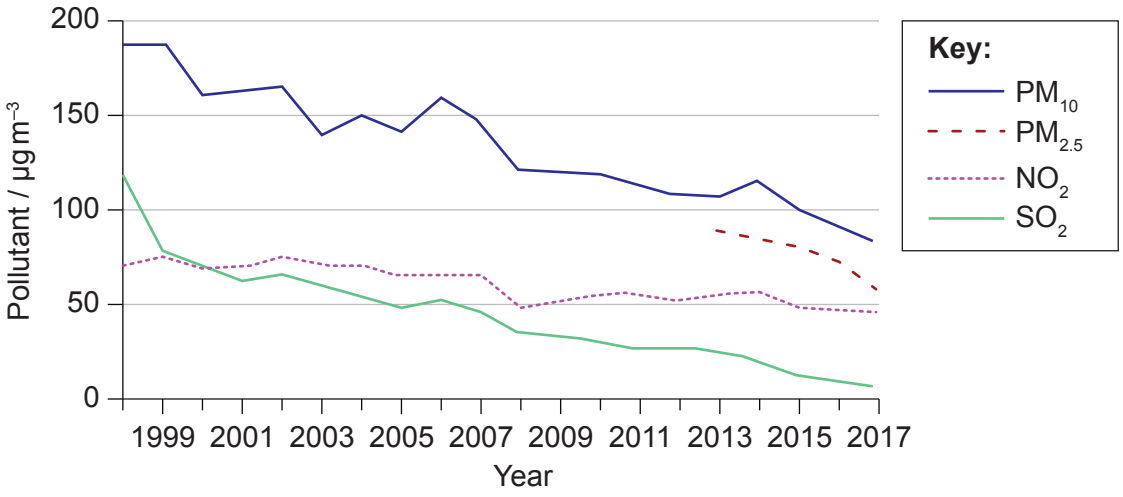


Figure 7: Transport in Beijing, 1999–2017

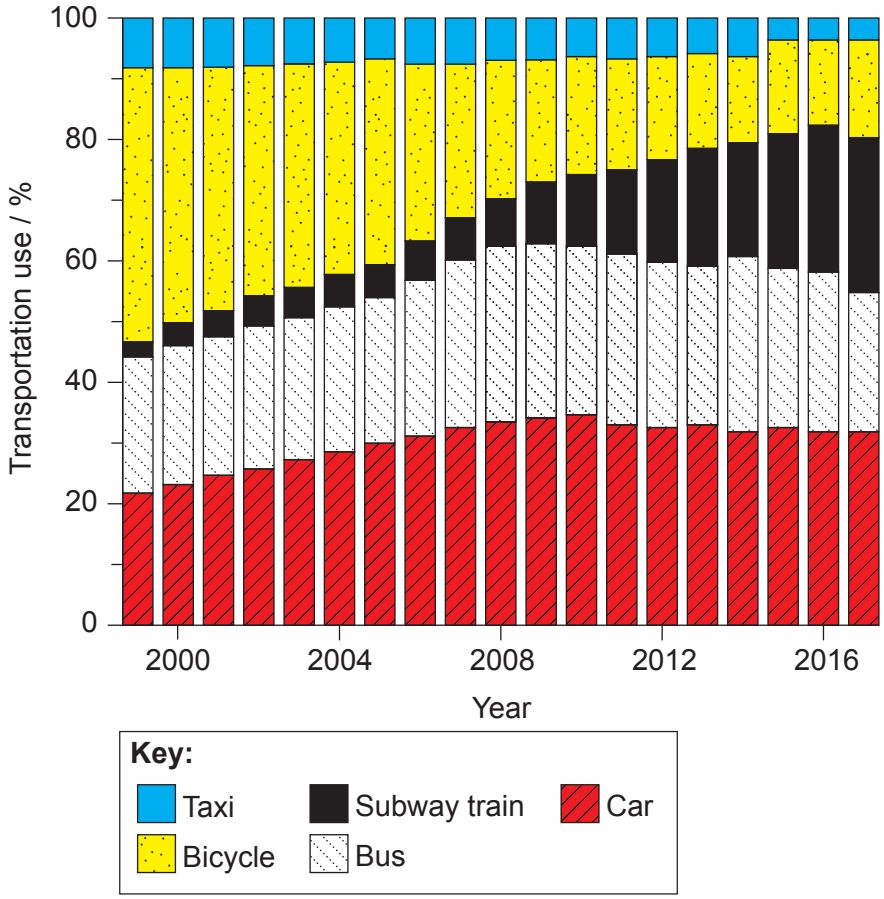


Figure 8: Examples of greening the city of Beijing

[Source: Wenbin / iStock]

[Source: estivillml / iStock]

[Source: wenpu wang / iStock]

Figure 9(a): Fact file on water resources in Beijing

- Beijing is a water scarce city.
- Water use per person has decreased but because of growth in population the overall water demand has increased.
- By 2020 about 70 % of Beijing's water was supplied from the South–North Water Diversion Project. This involved the:
  - major expansion of the Danjiangkou dam and reservoir
  - transfer of water via canal and pipelines more than 1200 km from the Danjiangkou reservoir in Central China to Beijing in the north
  - generation of hydroelectric power and provision of flood control.

Figure 9(b): Central route of the South–North Water Diversion Project

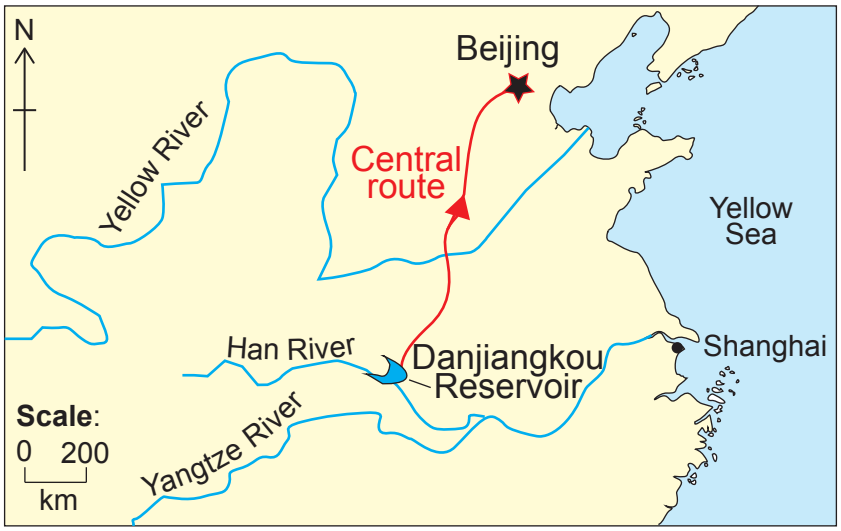


Figure 9(c): Fact file on water pollution in Beijing

- In 2015, China's state council issued the *Water Pollution Prevention and Control Action Plan* to improve the quality of the water environment by:
  - setting stricter standards
  - increasing water monitoring
  - improving enforcement of environmental laws.
- In 2018, 40 % of surface water in Beijing was too polluted to use.

Figure 9(d): Pollutants in wastewater discharged into Beijing rivers, 2011–2015

Pollutant	Unit	2011	2012	2013	2014	2015
Nitrate	kt	32.80	32.60	31.30	37.10	32.90
Phosphate	kt	4.50	4.40	4.00	4.80	4.40
Lead	kg	186.18	215.91	201.00	41.21	3.57
Arsenic	kg	28.09	21.34	15.11	8.00	11.04
Mercury	kg	1.72	0.49	0.64	0.10	0.33
Cadmium	kg	12.44	17.90	17.45	0.58	0.70
Chromium	kg	508.68	460.10	438.05	266.65	93.59

Figure 10: Fact file on solid domestic waste in Beijing

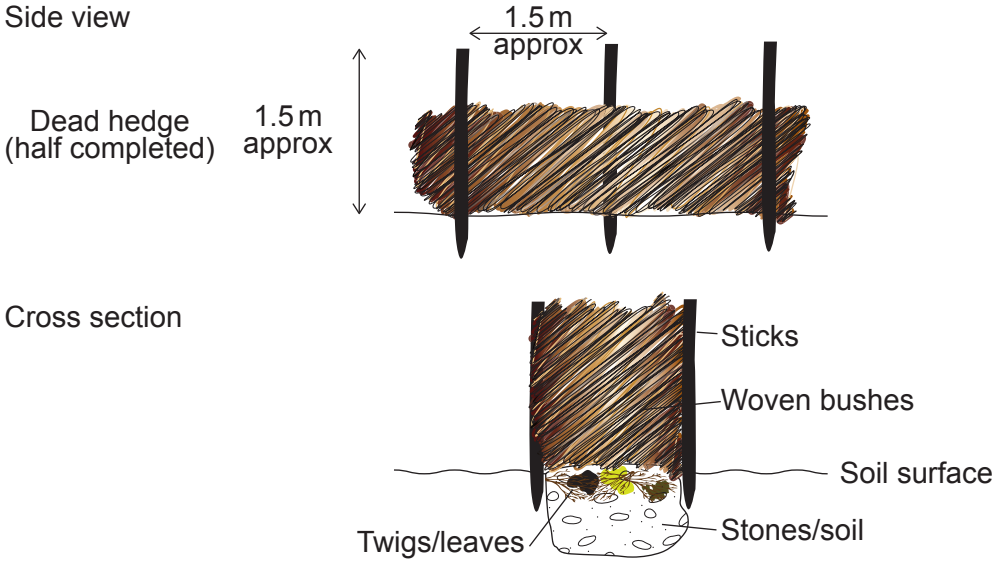
- In 2018, of the 9.29 million tonnes of household waste collected, about 40 % went to landfill and 46 % to incineration.
- Beijing is building incinerators with the aim of no waste going to landfill by 2035.
- Waste to energy incinerators are used to generate electricity.
- In 2020 new regulations included:
  - compulsory sorting of household waste
  - stopping use of free plastic bags by supermarkets
  - reducing waste at source, *eg* encouraging paperless offices and reducing use of disposable cups.

Figure 11(a): Fact file on conservation in Beijing

- Beijing Zoo maintains an active breeding program that recently produced over 1000 surviving offspring of nearly 100 species in one year, including the critically endangered Northern white-cheeked gibbon and Guizhou snub-nosed monkey. Other reproduced species include the giant panda.
- The Beijing Gardening and Greening Bureau plans to plant at least one “dead hedge” in each of the city’s parks.

Figure 11(b): Construction of a dead hedge

A dead hedge is made from materials left over from pruning, clearing or forestry activities, and provides a habitat for small mammals and reptiles.



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References:

Figure 3 (b) Qiuyu, R., 2018. *Beijing's Population: Better-Educated, Fewer Migrants, and Facing an Aging Crisis*. [online] Available at: https://www.caixinglobal.com/2018-12-11/beijings-population-better-educated-fewer-migrants-and-facing-an-aging-crisis-101358166.html [Accessed 11 August 2020]. Source adapted.

Figure 3(c) CHINA-POPULATION/PYRAMID C / RNGS Reuters [Source adapted].

Figure 6(c) Quane, L., 2017. *Helping employees cope with air pollution in Beijing*. [online] Available at: https://www.eca-international.com/insights/articles/january-2017/air-pollution-in-beijing [Accessed 31 October 2019]. Source adapted.

Figure 6(d) Talhelm, T. (Smart Air), 2018. *Ozone Levels Rising Across China*. https://smartairfilters.com Clean air blog, [blog] 11 June. Available at: https://smartairfilters.com/en/blog/analysis-shows-ozone-levels-rising-across-china/ [Accessed 31 October 2019]. Source adapted.

Figure 6(e) UN Environment (2019). *A Review of 20 Years' Air Pollution Control in Beijing*. United Nations Environment Programme, Nairobi, Kenya. Figure1: Changes in annual average concentrations of air pollutants in Beijing, 1998–2017. Source: Former Beijing Municipal Environmental Protection Bureau.

Figure 7 UN Environment 2019. *A Review of 20 Years' Air Pollution Control in Beijing*. United Nations Environment Programme, Nairobi, Kenya. Figure 4.4 Modes of Transportation in Beijing, 1998–2017 Source: Beijing Transportation Research Center.

Figure 8 Wenbin / iStock.

A bird's view of the green roof of Beijing University of Chinese Medicine. Image by Luo Xiaoguang. https://wiki.ubc.ca/File:A_bird%E2%80%99s_view_of_the_green_roof_of_Beijing_University_of_Chinese_Medicine.jpg. Under copyright and licensed under the Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0). https://creativecommons.org/licenses/by-sa/4.0/. (Image cropped).

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wenpu wang / iStock.

Figure 9(d) Jia, X., Varbanov, P.S., Walmsley, T. and Yan, Y., 2017. Water Pollution Impact Assessment of Beijing from 2011 to 2015: Implication for Degradation Reduction. *Chemical Engineering Transactions*, 61 (2017) pp.1525–1530. Available through: *Chemical Engineering Transactions* journal website https://www.cetjournal.it/index.php/cet/issue/view/vol61 [Accessed 14 August 2020].