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**

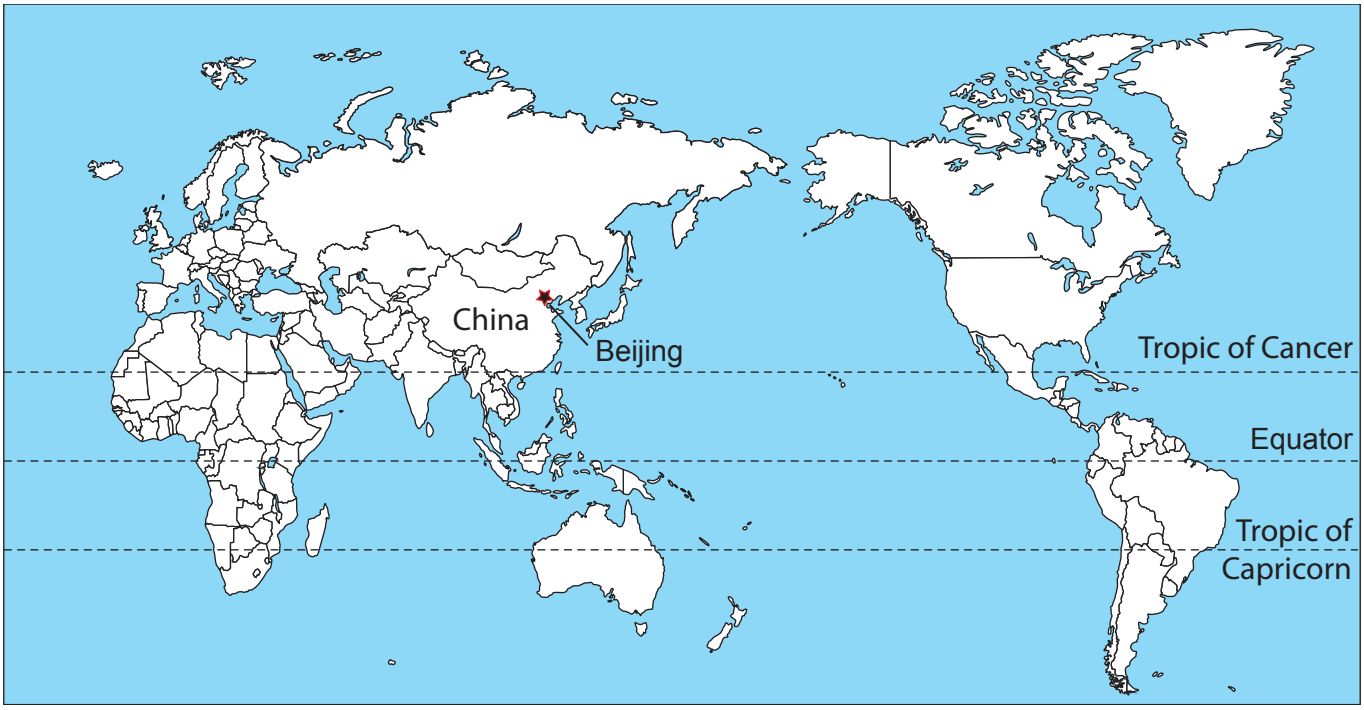


**Figure 1(b): Topographical map of region around Beijing city**

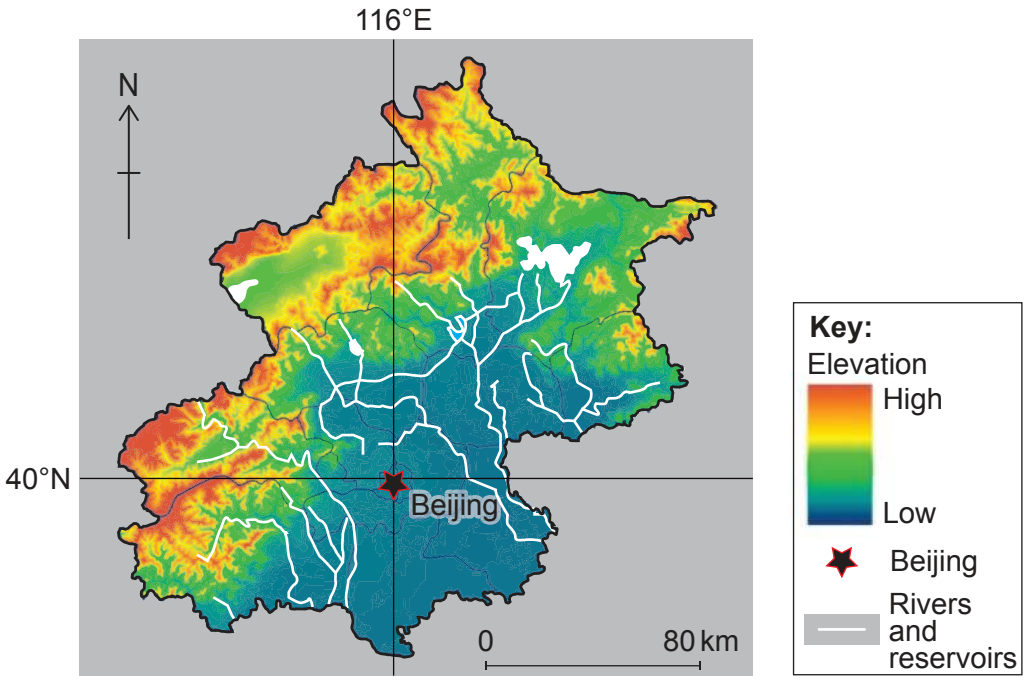

**Figure 2: Fact file on Beijing**

- 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**

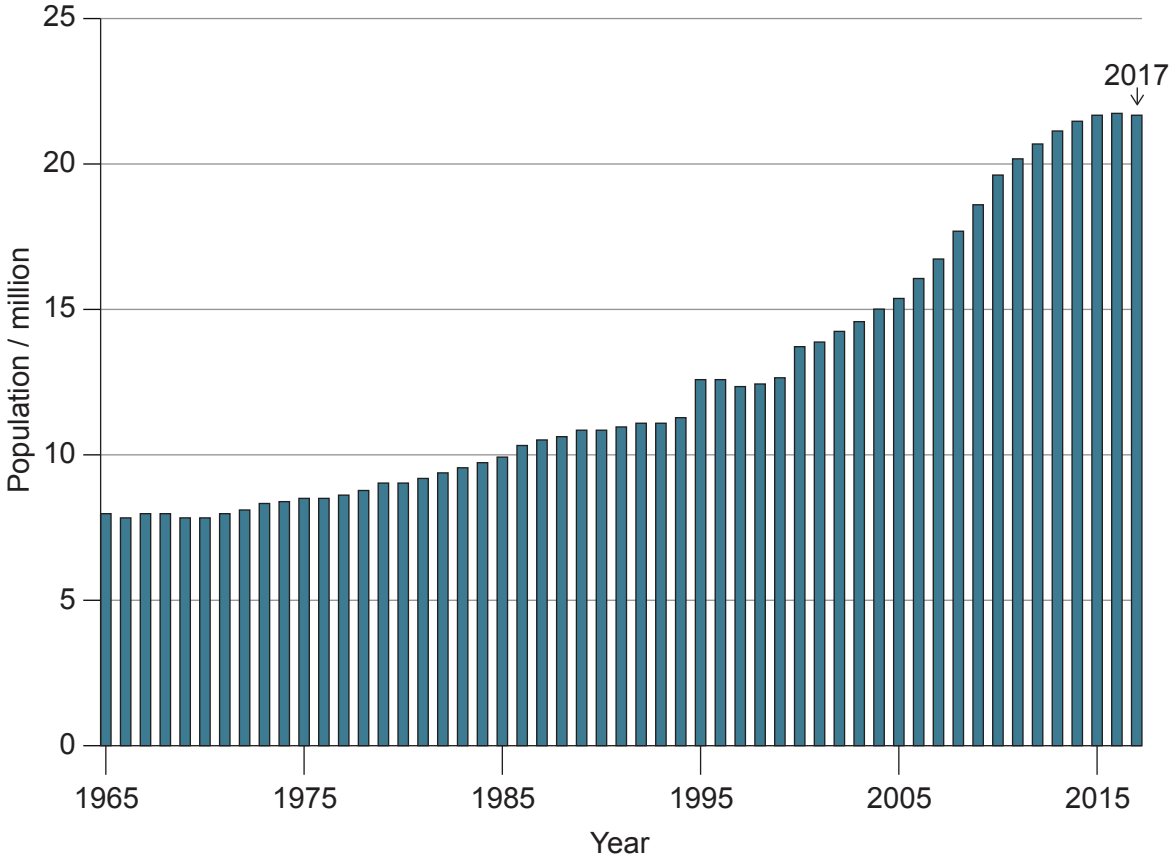

**Figure 3(c): Age–gender pyramids for China for 1950, 2015 and projected pyramids for 2050**

**Figure 4: Climate of Beijing**

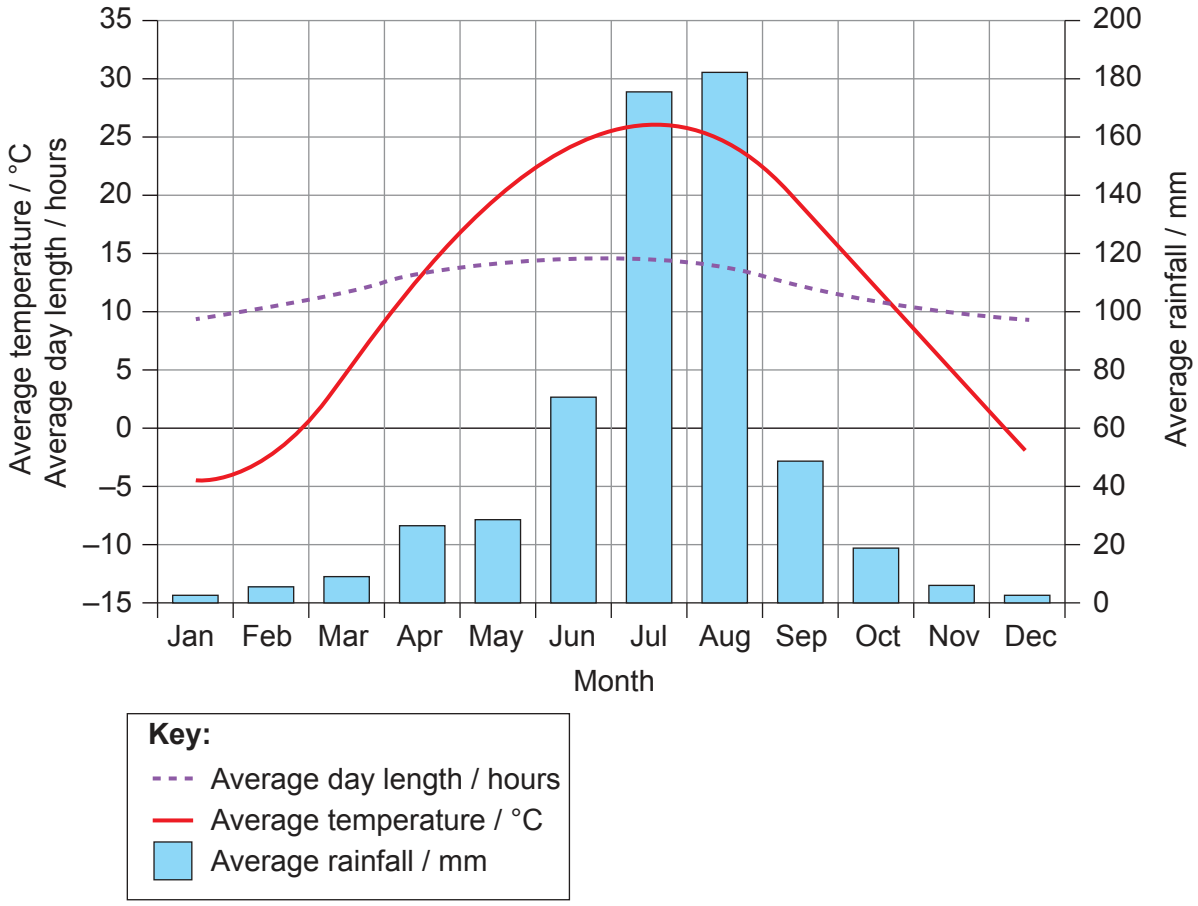

**Figure 5: Recorded electricity consumption for Beijing, 2008–2019**

| 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**

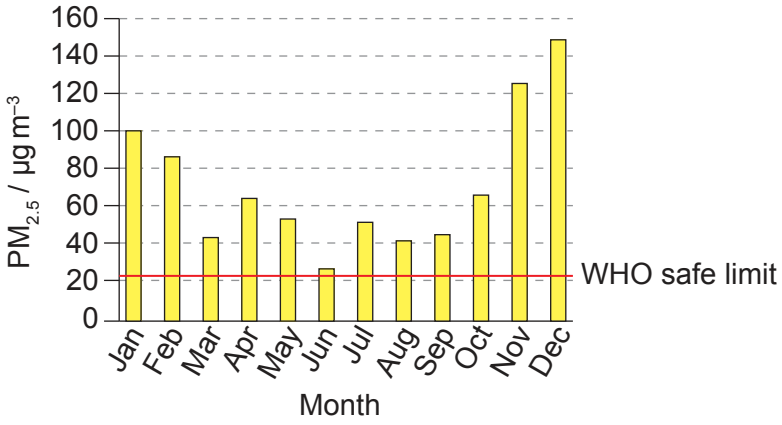


**Figure 6(d): Average monthly tropospheric ozone levels in Beijing, 2014–2016**

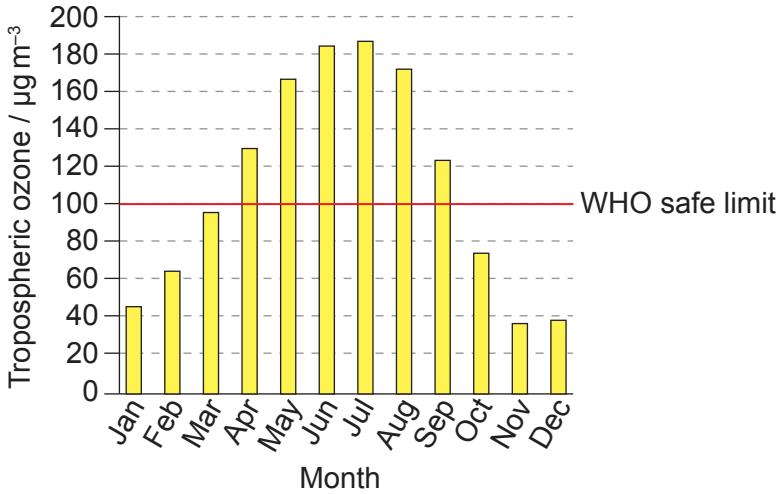

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**Figure 6(e): Annual average concentrations of air pollutants in Beijing, 1998–2017**

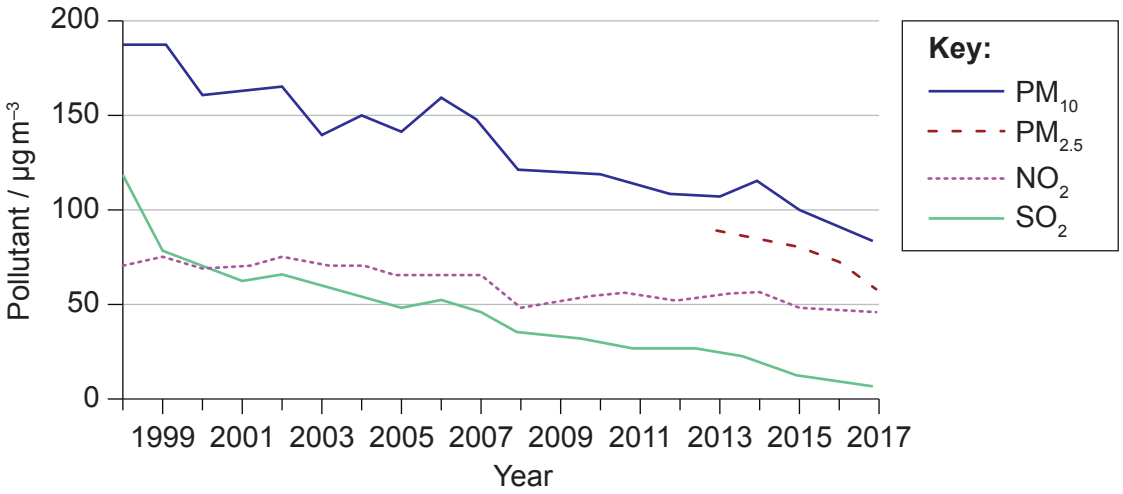


**Figure 7: Transport in Beijing, 1999–2017**

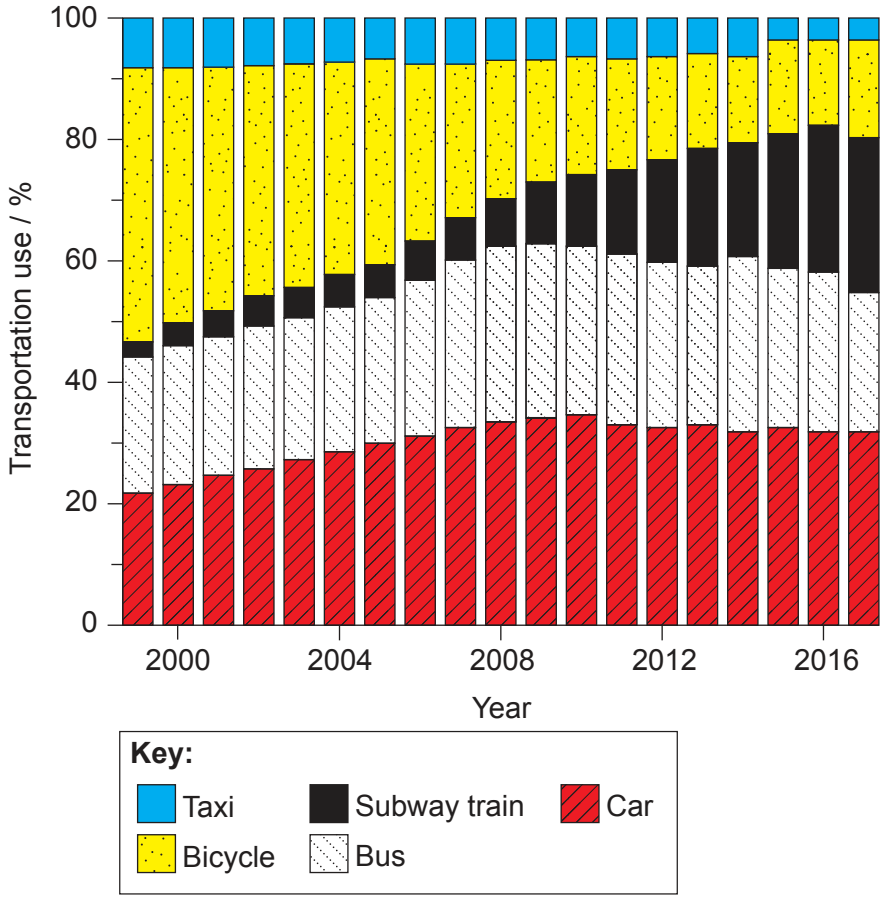


**Figure 8: Examples of greening the city of Beijing**

[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**

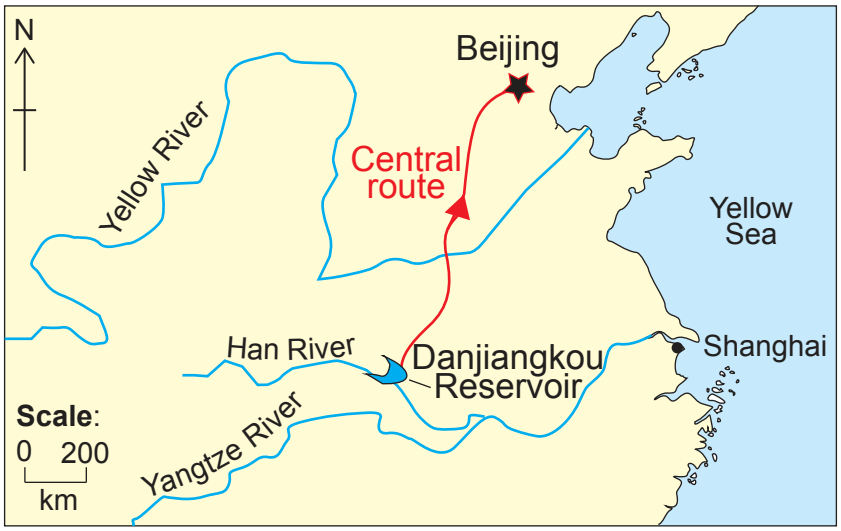


**Figure 9(c): Fact file on water pollution in Beijing**

- 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**

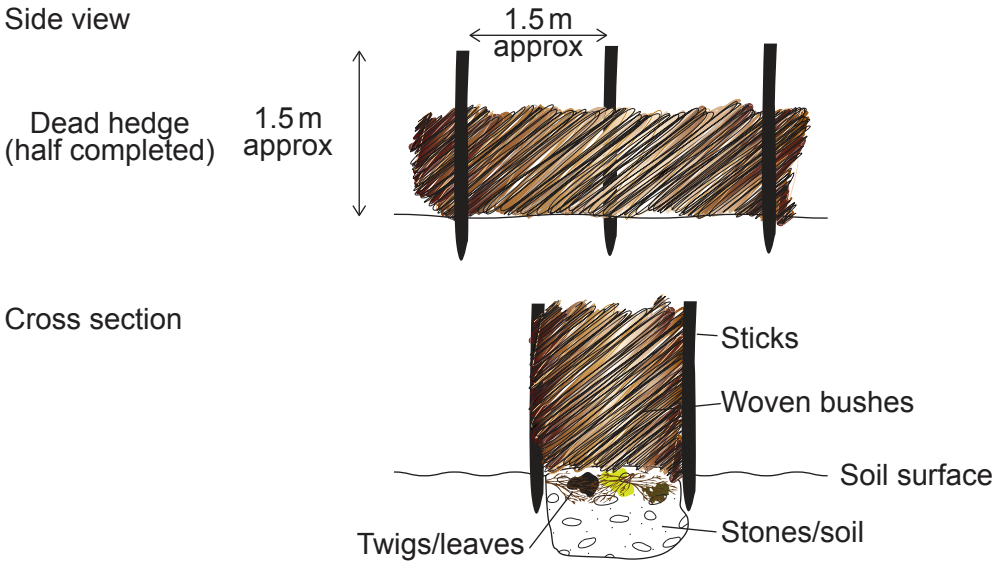
- In 2018, of the 9.29 million tonnes of household waste collected, about 40 % went to landfill and 46 % to incineration.
- Beijing is building incinerators with the aim of no waste going to landfill by 2035.
- Waste to energy incinerators are used to generate electricity.
- In 2020 new regulations included:
  - 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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estivillml / iStock.

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].