Diploma Programme
Programme du diplôme
Programa del Diploma

Environmental systems and societies
Standard level
Paper 1 – resource booklet

30 April 2026

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

1 hour

Instructions to students

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

2226 – 4626

16 pages

Figure 1(a): World Map showing location of Chile

Figure 1(b): Maps of South America and Chile showing principle features

Figure 1(c): Fact File on Chile

Population: 20 213 000 (2025 est.)	50 % of the population lives in or near the capital city of Santiago in the central valley.
Major exports: copper and related products, fruit and wine, fish, lumber and related products	Major imports: petroleum, fuel, clothing, vehicles and appliances
Economic activities are concentrated by region, except for tourism which takes place in many parts of the country. • Northern (Atacama) desert: mining • Central valley: agriculture (including viticulture), financial services	• Central mountains: forestry • Southern coast: aquaculture, fishing, fish processing
Chile is around 4300 km in length and has more than 92 000 km of roads and railways.	The average elevation in Chile is 1871 m and 80 % of land is the Andes mountains.

Figure 2(a): Simplified cross-section of Chile (west to east) at approximately 43°S

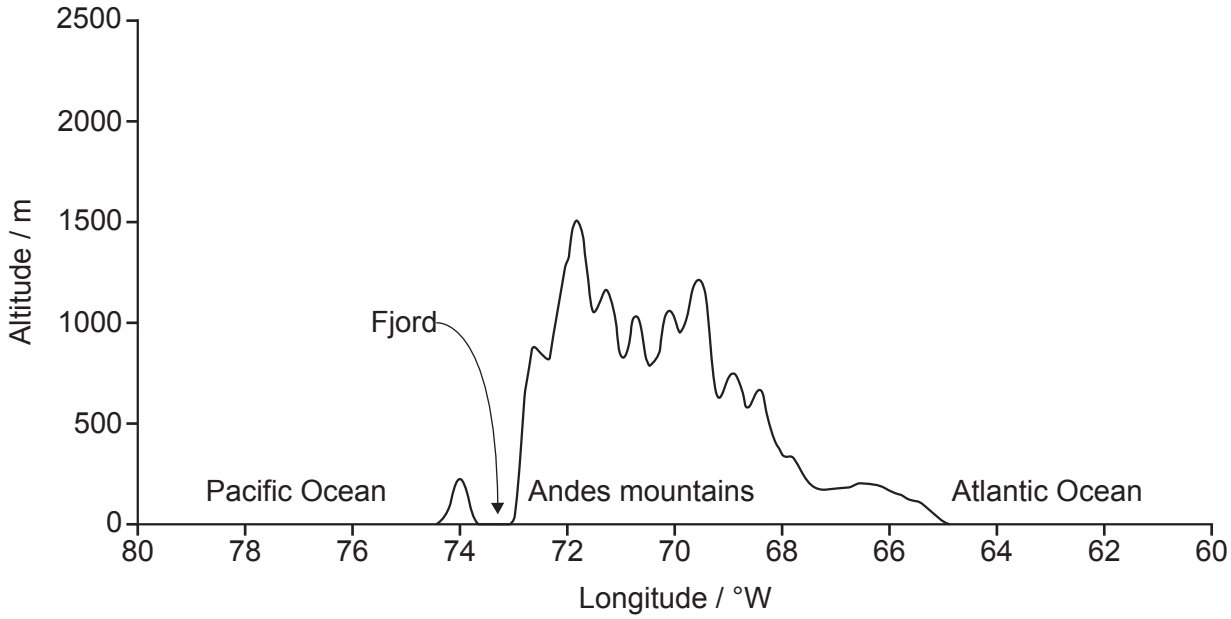

Figure 2(b): Image of Andes mountains

Figure 2(c): Images of Antofagasta (northern Chile) and Punta Arenas (southern Chile)

Figure 2(d): Climate data for Antofagasta (northern Chile) and Punta Arenas (southern Chile)

	Antofagasta	**Punta Arenas**
Dominant vegetation/biome	Desert at both sea level and high altitude	Cold temperate forest and tundra
Average annual temperature	15.8 °C	5.3 °C
Average annual precipitation	148 mm	951 mm
Average annual windspeed	4–6 m/s	>10 m/s
Average daily sunshine (cloud-free)	7–9 hours	4–8 hours

Figure 2(e): Humboldt Current and prevailing westerly winds

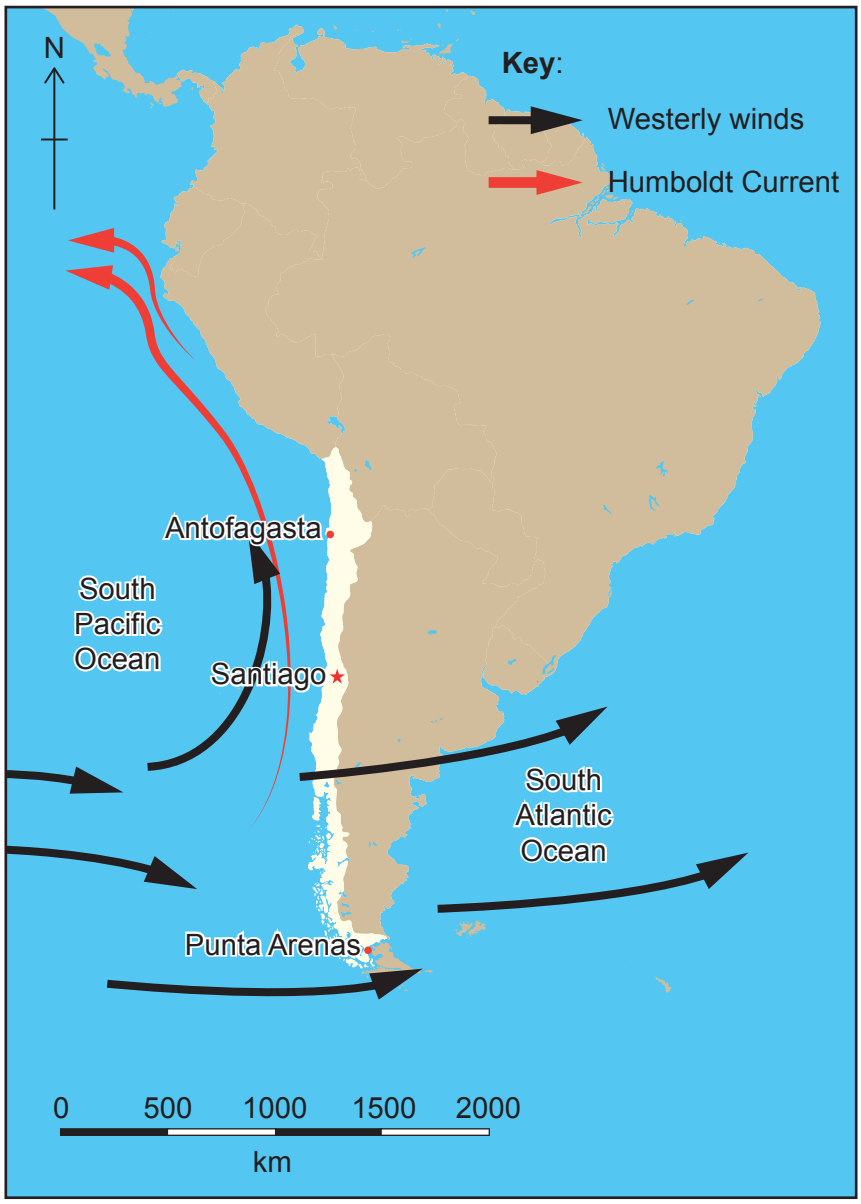

Figure 2(f): Fact file on Humboldt Current

- The current originates in the far south of the Pacific Ocean, where it splits from the Antarctic Circumpolar Current.
- The current, the prevailing westerly trade winds and the Earth's rotation combine to pull abundant rich nutrients from the deep ocean to the surface along the coast of Chile.
- As the current flows north, the marine air is cooled, limiting evaporation.
- Climate change and the effects of El Niño/La Niña can disrupt the current's flow, speed, direction and depth.

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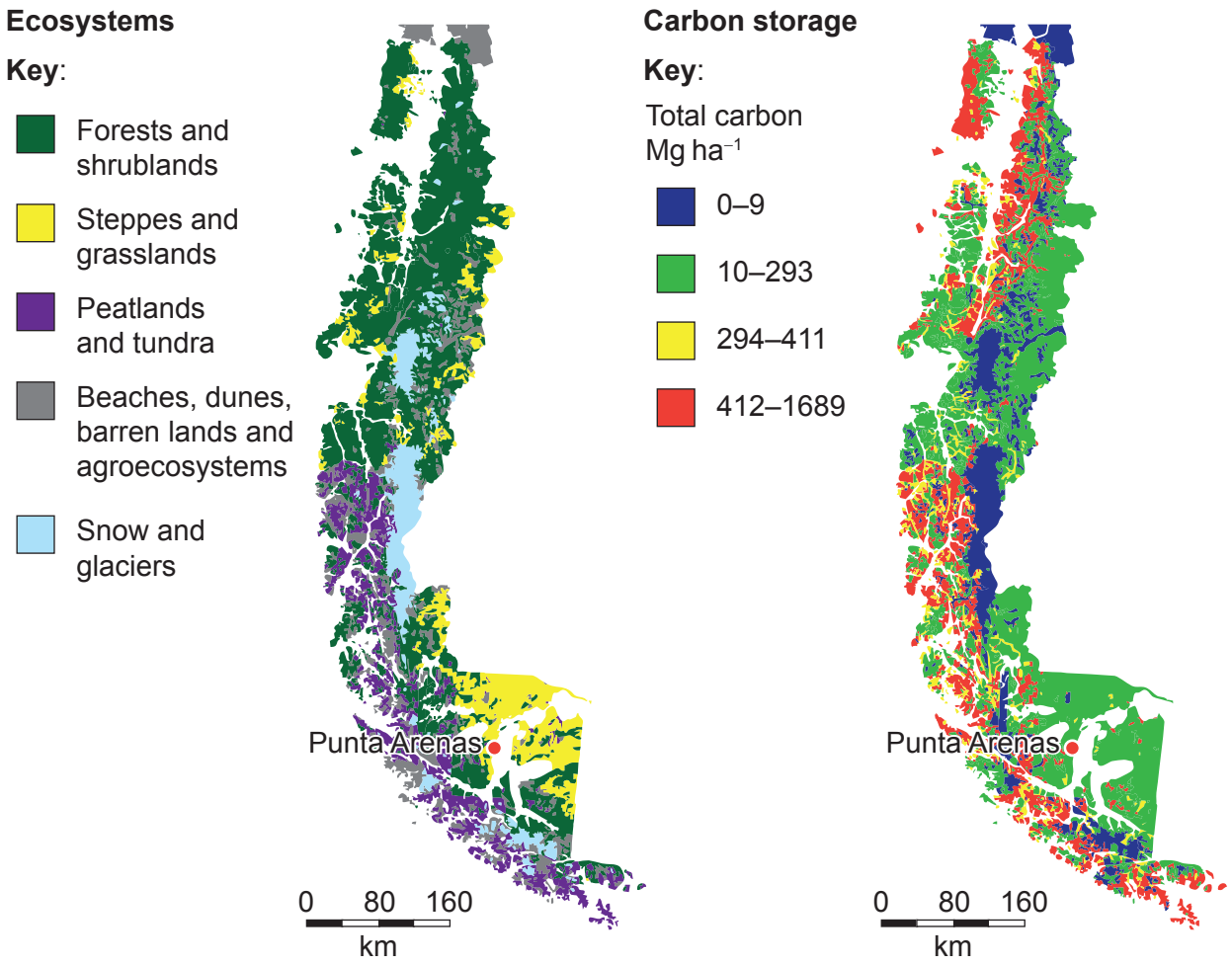
Figure 2(g): Ecosystems and carbon storage in southern Chile



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Turn over

Figure 2(h): Image of forestry industry in southern Chile

Figure 2(i): Fact file on forestry in Chile

- Traditional forestry involves the removal of native trees and vegetation, followed by the planting of economically useful species of trees which are later harvested.
- Sustainable forestry practices include selective harvesting of large trees, replanting of native trees from clear-cut areas and/or conservation of native seedlings (young trees).
- In 2010, southern Chile had 4.26 million hectares of tree cover, covering 32 % of its land area.
- By 2023, only 577 hectares had been lost to logging in this part of Chile.

Figure 3(a): Animals and plants of the high Andes ecosystems

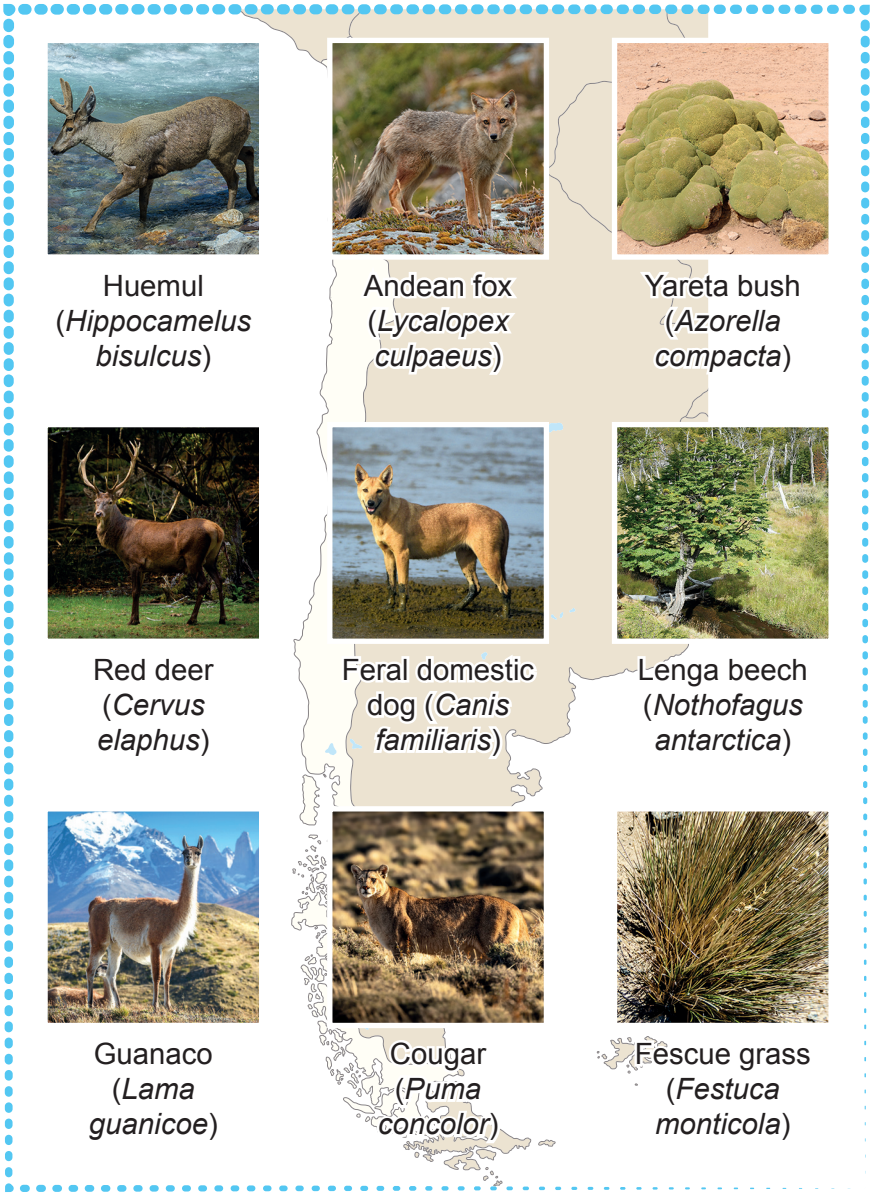

Figure 3(b): Comparison of Andes herbivores

Huemul (*Hippocamelus bisulcus*)	**Red deer (*Cervus elaphus*)**
IUCN category: endangered (EN)	IUCN category: least concern (LC)
Endemic to mountains and high steppe of Argentina and Chile, at the base of glaciers	Imported as livestock to the central valley in the 1920s; escaped (feral) deer are now living at all altitudes
Diet consists of leaves and flowers of herbs and plants, and buds of the beech tree in winter. Does not eat grasses.	Extensive diet of all available grasses, leaves, flowers and tree buds
Predators (adult): cougar/puma Predators (young): fox, feral domestic dog	Predators (adult): cougar/puma, human Predators (young): fox, feral domestic dog
Adult male mass: 70 kg	Adult male mass: 300 kg

Figure 3(c): Fact file on huemul

- The huemul's IUCN category is endangered (EN).
- Approximately 1500 huemul are left in Chile (as well as several hundred in Argentina); they are found in small, fragmented populations.
- Huemul are protected under the Memorandum of Understanding on conservation (2010), signed by Chile and Argentina.
- Threats to the huemul include both ecosystem degradation and direct species stress.
- Climate change models suggest a decrease in traditional habitat of approximately 60 % for huemul compared to a 37 % reduction for most other species studied.
- Other models predict new suitable areas of habitat will be created, some of which are situated near towns, cities and other areas populated by humans (such as cattle ranches and forestry plantations).

Figure 3(d): Distribution of huemul (historic and present)

Figure 3(e): Fact file on Chile's national parks and reserves

- Chile has 42 national parks, 46 national reserves, 4 marine parks and 18 natural monuments managed by the government.
- Chile has another 138 protected areas managed by individual landowners, NGOs and local communities.
- 21 % of Chile's terrestrial and inland waters and 41 % of its marine area is protected.
- Since 2018, the government has been working with private foundations and individuals to expand the national park system, rewilding millions of acres of previously developed land to establish five new parks.
- National reserves are administered by the National Forest Corporation and the Ministry of Agriculture, who allow some commercial activities such as forestry and fishing.

Figure 3(f): UN Sustainable Development Goal 15

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Figure 4(a): Aquaculture and fishing in the southern Chile region

- Chile is the world's second largest producer of farmed salmon.
- Aquaculture and fishing occur within the Kawésqar National Reserve (KNR), which is bordered by the Kawésqar National Park (KNP) and the Francisco Coloane Marine Park (FCMP).
- As of 2021, there were 58 fishing operations in the KNR, with another 176 operations awaiting approval.
- The salmon aquaculture industry employs over 70 000 people and is a source of significant tax contribution for the government.
- There was a large-scale salmon virus outbreak in aquaculture locations in central Chile between 2008 and 2010, resulting in the industry moving to the fjords of southern Chile.
- The sheltered fjord locations offer protection from damaging ocean waves and currents but also limit circulation of water between the islands and the fjords.
- The Chilean Fisheries Service reported in 2019 that many of the demersal fisheries (harvesting of wild fish that live on or near the sea floor) in southern Chile are overexploited.
- Ecotourists visit FCMP to view humpback, sei and minke whales as well as Magellanic penguins, sea lions, dolphins and albatrosses.

Figure 4(b): Map showing location of aquaculture activity in the Kawésqar National Reserve (KNR)

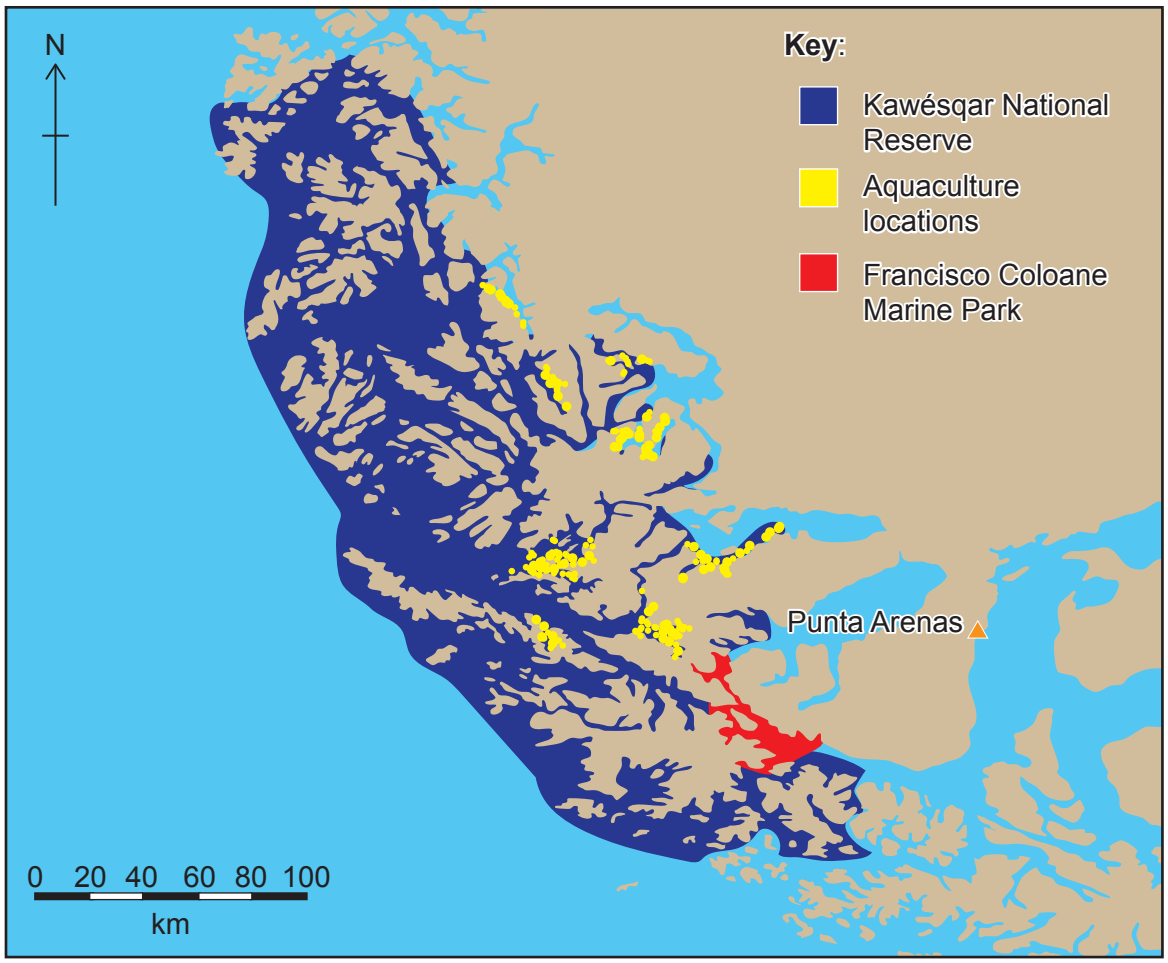

Figure 5(a): Ice loss on identified World Heritage glaciers from 2000 to 2020, as a percentage of glacier area

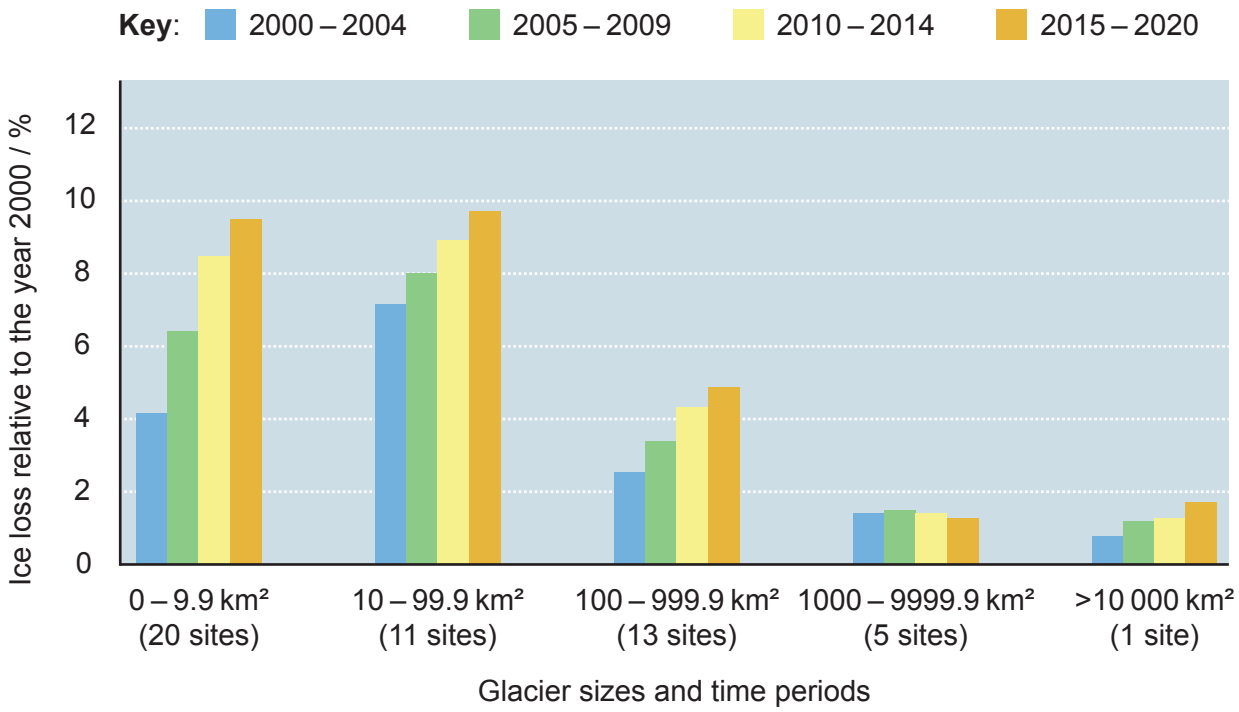

Figure 5(b): Image of glacier foreland

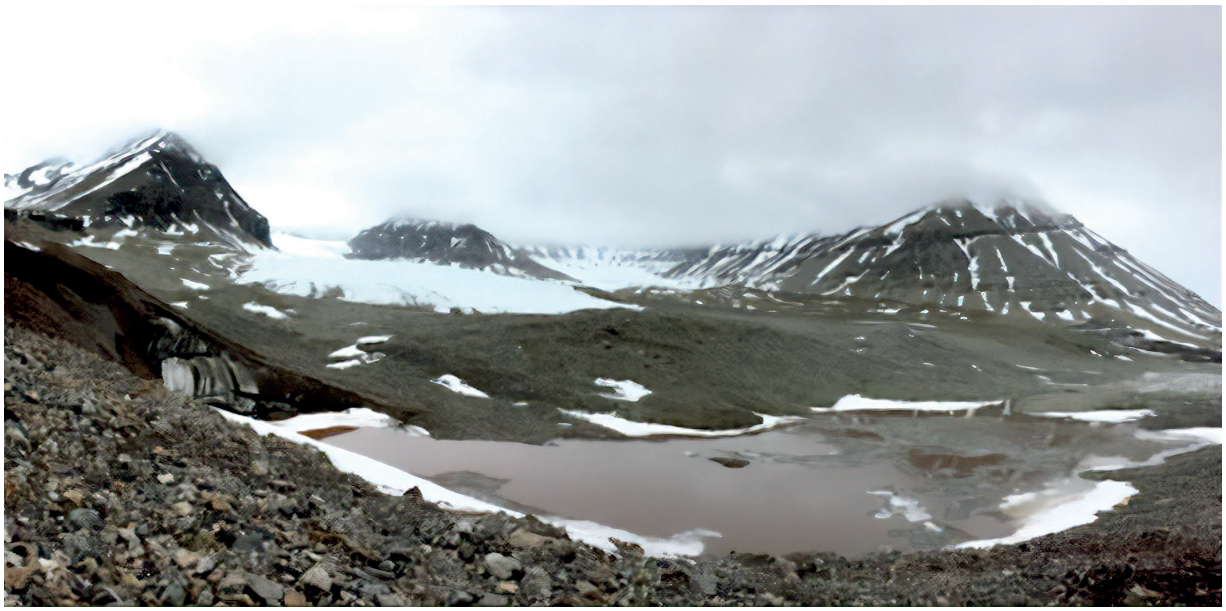

Figure 5(c): Fact file on glacier retreat in Chile

- 70 % of the population of Chile relies on glaciers for their freshwater needs.
- Meltwater from the glacier delivers nutrients to lakes, rivers and oceans, supporting all ecosystems found at lower altitudes.
- Meltwater is also used for hydroelectricity production, crop irrigation and reservoirs to support urban development.
- Areas that become ice-free (glacier foreland) will consist of bare rock, sand and gravel.
- Climate change has increased the rate of glacier retreat and melting, resulting in:
  - meltwater and sedimentary material held in glaciers being added rapidly and unpredictably to glacial lakes and river systems
  - freshwater store (ice) decreasing
  - rapid exposure of newly released, unstable, rocky material and clay.
- In 2023, Chile's National Forest Corporation permanently closed a popular hiking route due to the instability of the local glacier and surrounding mountainside.

Figure 6(a): Electricity production by source in Chile (2000–2023)

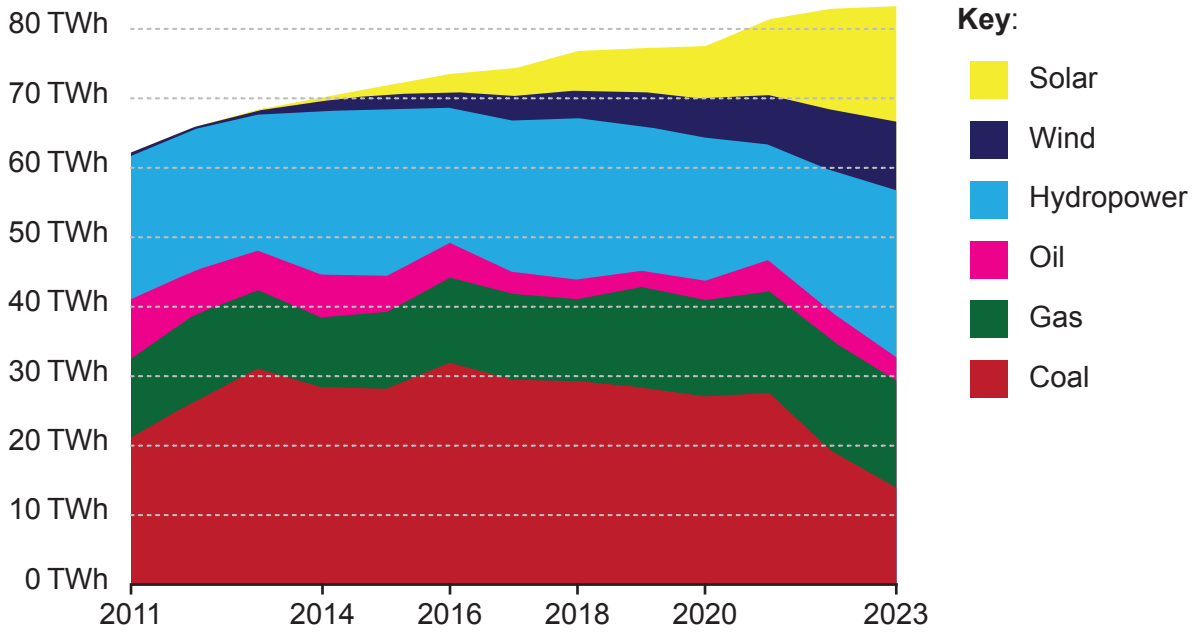

Figure 6(b): Fact file on energy and climate action in Chile

- In 2013, regulations were introduced offering financial incentives for forest owners to preserve existing forests or create new forests.
- In 2017, a carbon tax was introduced, with plans to increase the amount of this tax over time.
- A 2022 study indicated that 91 % of Chileans believed climate change should be treated as a government priority.
- In 2022, the government established the Framework Law on Climate Change, which targets 70 % of all energy sources to be renewable by 2030 and for the country to be carbon neutral by 2050.
- At COP28, Chile and Germany launched a club of governments to help developing nations invest in decarbonizing industries.
- Policies are established that direct funds generated from copper and lithium mining to developing green hydrogen capacity as an energy source.
- Government subsidies are available for the purchase of electric taxis and for installation of charging points at residences.
- Following decades of environmental protest at local and national levels, coal-powered electrical plants signed a voluntary binding agreement to gradually close all plants by 2040.

Figure 6(c): CO_2 emissions by sector in Chile (2021)

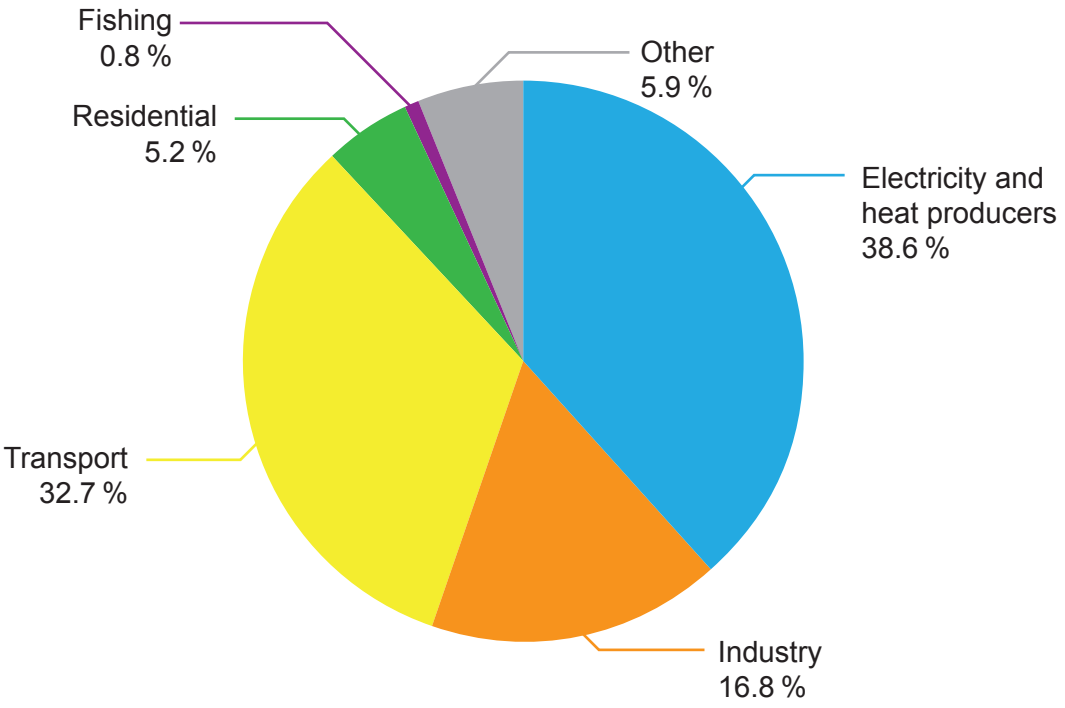

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Figure 2(b): Leamus, 2022. *Stunning glaciers and waterfalls along the Beagle Channel, a strait in the Tierra del Fuego Archipelago, on the southern tip of South America between Chile and Argentina*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/stunning-glaciers-and-waterfalls-along-the-beagle-royalty-free-image/1379434863 [Accessed 31 July 2025]. Source adapted.

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Figure 4(b): Friedlander AM, Ballesteros E, Goodell W, Hüne M, Muñoz A, Salinas-de-León P, et al. (2021) Marine communities of the newly created Kawésqar National Reserve, Chile: From glaciers to the Pacific Ocean. *PLoS ONE* 16(4): e0249413. https://doi.org/10.1371/journal.pone.0249413. Open access article, licensed under CC BY 4.0 https://creativecommons.org/licenses/by/4.0/. Source adapted.

Figure 5(a): UNESCO and IUCN 2022. World heritage glaciers: sentinels of climate change. https://unesdoc.unesco.org/ark:/48223/pf0000383551. DOI: 10.3929/ethz-b-000578916. Open access, licensed under CC-BY-SA 3.0 IGO https://creativecommons.org/licenses/by-sa/3.0/igo/deed.en. Source adapted.

Figure 5(b): Wietrzyk-Pełka P, Rola K, Szymański W, Węgrzyn MH. Organic carbon accumulation in the glacier forelands with regard to variability of environmental conditions in different ecogenesis stages of High Arctic ecosystems. *Sci Total Environ*. 2020 May 15;717:135151. doi: 10.1016/j.scitotenv.2019.135151. Epub 2019 Nov 21. PMID: 31839323. Source adapted.

Figure 6(a): Hannah Ritchie and Pablo Rosado (2025) - “Energy” Published online at OurWorldinData.org. Retrieved from: 'https://ourworldindata.org/profile/energy/chile' [Online Resource]. Data source: Ember (2026); Energy Institute - Statistical Review of World Energy (2025). Licensed under CC BY 4.0 https://creativecommons.org/licenses/by/4.0/. Source adapted.

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