1BTR 5NC

Executive Summary

First Biennial Transparency Report and Fifth National Communication to the UNFCCC

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Gobierno de Chile
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Ministerio del Medio Ambiente
Gobierno de Chile

Organización de las Naciones Unidas para la Alimentación y la Agricultura

gef

Photo: Nicolás Smith D.

Executive Summary

1. NATIONAL CIRCUMSTANCES

1.1. Geographic and social profile

Chile, a tricontinental country with territory in South America, Oceania and Antarctica, has a surface area of 2,006,096 km², which is organized into 16 regions, 54 provinces and 346 districts. Of its total area, 755,915 km² corresponds to South America and the rest to its Oceania and Antarctica territories.

Chilean geography and morphology are organized into four longitudinal zones: the Coastal Plains, which connect the Pacific Ocean with the Coastal Range; the Central Valley, or Intermediate Depression, which is home to most of the population and agricultural activity in the central zone; and the Andes Mountains, the most dominant feature of the country with peaks such as Llullaillaco (6,739 m.a.s.l.) and Monte San Valentín (4,058 m.a.s.l.). Chile's geographic and bioclimatic diversity influences land use, with grasslands and scrublands (40.15%) and native forests (19.37%), standing out in the south. Although only 1.07% of the territory is urban or industrial, these areas are steadily growing.

At the social level, Chile recognizes ten indigenous ethnic groups, with the Mapuche ethnic group predominating (77.8%). The immigrant population has grown in recent years, reaching 1.6 million in 2022, equivalent to 9.25% of the total population, concentrated mainly in the Metropolitan Region and coming from countries such as the Bolivarian Republic of Venezuela, Peru and Colombia.

The Chilean education system covers pre-school, primary, secondary and higher education levels, with more than 3.5 million students and a gender balance. Most of the enrolment is concentrated in subsidized private and municipal establishments, although rural education faces access challenges. Pre-school education, led by the state-funded preschool education system JUNJI[1] and the private non-profit organization Fundación Integra, promotes inclusion with programmes adapted to ethnic and penitentiary contexts. In higher education, women make up a higher proportion of students while students from indigenous communities are also represented, especially in universities. In addition, the country encourages scientific and technological research through the Ministry of Science, Technology, Knowledge and Innovation, focused on issues such as climate change.

Chile faces health challenges related to environmental pollution. Air pollution, mainly from PM2.5 generated by wood burning and industrial processes, affects respiratory and cardiovascular health. Water pollution, caused by pesticides, heavy metals and industrial waste, compromises water quality and public health, while soil is impacted by hazardous waste. Climate change has led to the expansion of vector-borne diseases, such as the *Aedes aegypti* mosquito, which transmits dengue, prompting the implementation of preventive measures. Air quality and water resource management are priorities, supported by monitoring and control programmes.

Finally, Chile integrates a gender approach into its climate policies, recognizing that gender inequalities increase vulnerabilities to climate change. The Ministry of Women and Gender Equality, together with the Fourth National Equality Plan 2018-2030, works to eradicate gender violence and include intersectional perspectives in rural and migratory contexts. These policies seek to ensure that climate action is inclusive, equitable and effective, while promoting sustainable development with social and gender justice.

[1] The National Board of Early Childhood Education (acronym in spanish, JUNJI) is a public institution in Chile responsible for overseeing nurseries and preschools across the country.

1.2. Climate profile

Chile is a climatically diverse country due to atmospheric, orographic and oceanographic factors, such as the Humboldt Current, the Southeast Pacific Subtropical Anticyclone and the Polar Front. The country is divided into five natural regions: the Norte Grande (desert), the Norte Chico (semi-arid), the Central Zone (temperate Mediterranean), the Southern Zone (rainy and cloudy) and the Austral Zone (cold and rainy). Phenomena such as the El Niño-Southern Oscillation (ENSO) affect rainfall and temperatures, with El Niño increasing rainfall in the south-central region and La Niña generating cold winters. Temperatures vary between 8.6 °C in the south and 18 °C in the north, while rainfall is scarce in the north and abundant in the south.

Chile is home to four macrobioclimates that influence its biodiversity and vegetation.

1. The tropical climate in the north combines warm temperatures and summer rains, with vegetation adapted to humid areas.
2. The Mediterranean climate in the central area is characterized by winter rains and summer droughts, with a transition from xerophytes to humid forests.
3. The temperate climate, the largest, extends from the southern limit of the Mediterranean climate zone to the southern tip of the country, with abundant rains that support forests and peat bogs, while its xeric variant is home to steppes and grasslands.
4. The boreal climate in the Magellanic archipelagos combines cold and high humidity, with peat bogs, deciduous forests and grasslands predominating.

These macrobioclimates, shaped by the climate and relief of the land, support a unique biodiversity in Chilean territory.

1.3. Economic profile

Chile has an open and stable economic model, with a strong historical dependence on mining. The Chilean economy showed a rapid recovery after the COVID-19 pandemic, driven by pro-cyclical fiscal policies and pension fund withdrawals equivalent to 35% of GDP. However, this generated imbalances such as high inflation, fiscal and current account deficits, along with risks of recession. In 2022, the government implemented fiscal consolidation, reducing public spending by 23% and applying restrictive monetary policies that managed to reduce inflation, stabilize debt and improve the current account, moving towards more sustainable economic growth. By 2023, mining continued to be the main pillar of the economy, representing 55.5% of exports, with copper as the key product. However, public debt increased steadily, reaching 39.4% of GDP in December 2023. Imports were dominated by intermediate goods, which accounted for 54% of the total in 2023, showing the country's dependence on inputs to maintain its productive activity.

1.4. Sectoral vision

Energy

Chile is moving towards the decarbonisation of its energy matrix with an increase in Non-Conventional Renewable Energies (NCRE) projects. Although hydro and thermal sources persist, the country's goal of carbon neutrality by 2050 has reduced the use of fossil fuels. Energy consumption is led by the industrial/mining (37.3%), transport (34.1%) and commercial/residential (23.9%) sectors, with an annual growth trend of 2.2%. Dependence on hydrocarbons has decreased thanks to energy efficiency policies and clean technologies.

Agriculture and forestry

The forestry and agricultural sector reached exports of USD 18.91 billion in 2022, led by exports of fresh fruit (31%) and wood pulp (17%). Since 2007, the land area used for agriculture has fallen by 12%, but the area under fruit production has grown by 16%. The forestry sector covers 11.7 million ha, mostly native forest, while the livestock industry contracted. Agricultural employment is concentrated in the central regions of the country.

Fishing and aquaculture

Fishing and aquaculture have recovered their pre-pandemic levels, with landings dominated by artisanal and industrial fishing (88.1%) and salmonid exports representing 75.4% of the total value (USD 8.98 billion in 2023). Problems such as red tide affect the coastal economy, although Chile has implemented prevention and monitoring programmes.

Mining

Mining is key to the Chilean economy, accounting for 11.9% of GDP in 2023, with copper as the main product. Other notable minerals include iodine (73% global), lithium (23.1%) and molybdenum (16.9%). The mining industry directly employs 339 014 workers, with growth of 5.8% compared to 2022, and 11% female participation.

Transport

Transport is a crucial sector for the economy, with advanced land, sea and air infrastructure. In 2023, rail and sea freight decreased, while air and passenger transport recovered. Despite the challenges Chile faces to achieve carbon neutrality by 2050, it is promoting electromobility, with 6,812 electric vehicles in circulation in 2023, which is an important but insufficient advance towards the national zero-emission goals.

1.5. Legal, political and institutional frameworks

Chile's institutional framework on climate change is broad and decentralized. The Ministry of the Environment (MMA) leads national policies, supported by the Interministerial Technical Team on Climate Change (ETICC) and the Regional Committees on Climate Change (CORECC). The Framework Law on Climate Change (LMCC), enacted in 2022, establishes binding objectives, including carbon neutrality and climate resilience by 2050 at the latest. It also defines planning instruments, such as Regional Climate Change Action Plans (PARCC) and Sectoral Mitigation and Adaptation Plans.

In terms of participation and governance, participatory mechanisms are promoted that include local communities, the private sector and citizens. These processes are essential to guarantee a fair transition towards a low-carbon economy.

1.5.1 International commitments

Since joining the United Nations Framework Convention on Climate Change (UNFCCC) in 1994, Chile has developed a proactive State policy on climate matters, ratifying the Kyoto Protocol in 2005, the Doha Amendment in 2015 and the Paris Agreement in 2017, while committing to contribute to the effort to limit global warming. Chile participates in key conventions such as the Convention on Biological Diversity (CBD), the United Nations Convention to Combat Desertification (UNCCD), the Convention on Wetlands (Ramsar) and the Escazú Agreement, which promotes sustainability and disaster risk reduction. Through the MMA, Chile updated its Nationally Determined Contribution (NDC) in 2020 and strengthened its climate targets in 2022, with a new update process scheduled for 2025. Regarding transparency obligations,

the country has submitted four National Communications and five Biennial Update Reports (BURs) between 2014 and 2022, showing progress in mitigation and emissions reduction. However, Decision 14/CMA.1 adopted at COP 26 in Glasgow (2021) established the obligation to submit Biennial Transparency Reports (BTRs), replacing BURs as of 2024.

Photo: Ana Guerrero

1.5.2 National, subnational and sectoral climate change policies

Chile demonstrates a strong climate commitment with a solid institutional framework and innovative policies. The LMCC, enacted in 2022, establishes the goal of carbon neutrality by 2050 and guidelines for mitigation, adaptation, equity and citizen participation. This includes instruments such as the Long-Term Climate Strategy (LTS), mandatory sectoral and regional plans, and the National Climate Change Action Report (RANCC), which monitors progress in this area.

In terms of climate planning, the LMCC requires sectoral plans in key areas (biodiversity, water, energy, health, infrastructure) updated every five years, as well as Strategic Water Management Plans and Regional and Communal Climate Action Plans adapted to local contexts.

Chile also prioritizes information and financing mechanisms, including the National System for Citizen Participation and Access to Information on Climate Change and (SNAICC, in spanish), the National GHG Inventory System, the Climate Risk Atlas (ARClim, in spanish) and a Voluntary Certification System to reduce emissions in the private sector. At the financial level, it has a Climate Change Financial Strategy aligned with the LTS and the NDC, which is focused on green finance and climate resilient investments.

Finally, other national policies complement climate action, such as the Law that establishes the National System for Prevention and Response to Disasters (SINAPRED), which integrates disaster risk management with climate change adaptation criteria, and the National Territorial Planning Policy (PNOT), which recognizes the critical importance of addressing climate challenges in the territory.

1.6. Institutional framework for climate governance

Chile's climate institutions have been strengthened by the LMCC, creating a multi-level and multi-sector governance system. The MMA leads climate action, coordinating the LTS and the NDC, and promoting environmental education and citizen participation. The MMA's Climate Change Division oversees actions related to mitigation, adaptation and climate finance. The Environmental Assessment Service (SEA) assesses the climate impacts of projects and policies. Inter-institutional coordination is key, with the Council of Ministers for Sustainability and Climate Change assessing the coherence of instruments, while the CORECCs - chaired by the Regional Governments - facilitate regional plans adapted to local realities. Several ministries, such as the Ministry of Finance, the Ministry of Energy, the Ministry of Agriculture and the Ministry of Housing and Urban Planning (MINVU), address specific areas of climate action. In addition, agencies such as the National Disaster Prevention and Response Service (SENAPRED) and municipalities implement local plans. Chile's climate framework promotes comprehensive governance to address climate change and advance toward climate resilience and carbon neutrality by 2050.

1.7. NDC monitoring and reporting

The MMA leads the preparation, review and update of Chile's NDC, in coordination with sectoral ministries, integrating mitigation and adaptation goals and financial guidelines aligned with the LTS. The NDC includes Greenhouse Gas (GHG) indicators, synergies between mitigation and adaptation, and an MRV system for the annual monitoring of commitments. The process includes citizen participation, review by Congress and approval by supreme decree. Its implementation is supported by sectoral and territorial plans, together with a financial strategy that ensures transparency, equity and alignment with the standards of the Paris Agreement.

2. GREENHOUSE GAS INVENTORY

2.1. General context

The National Greenhouse Gases Inventory (INGEI, in Spanish) consist of an exhaustive numerical list of the estimate of each of the anthropogenic GHGs emitted or absorbed into the atmosphere in a certain area over a specific period, generally corresponding to a calendar year. The INGEIs aim to determine the magnitude of national GHG emissions and absorptions, which are directly attributable to human activity, in order to demonstrate their implications for climate change.

According to international agreements, developing countries, such as Chile, must submit their INGEI to the UNFCCC as part of their National Communications and Biennial Transparency Reports.

In response to the country's commitments regarding reporting and presentation of its INGEI to the United Nations, the Climate Change Division of the MMA has designed, implemented and maintained Chile's National Greenhouse Gas Inventory System (SNICHILE, in spanish) since 2012. This system will be made official once the SNAICC Regulations, established in Title V, Article 27 of the LMCC, are approved. This contains the institutional, legal and procedural measures for the biennial update of Chile's INGEI, with the objective of guaranteeing the sustainability of the preparation of the INGEI in the country and maintaining the coherence of the reported GHG flows and the quality of the results.

2.2. National trend of greenhouse gases in Chile

In 2022, GHGs were quantified at the following levels: the CO_2 balance was estimated at 26,837 kilotonnes (kt); CH_4 emissions reached 585 kt, and N_2O emissions totalled 21 kt. In the case of fluorinated gases, HFC emissions were estimated at 5,527 kt CO_2eq, PFC emissions reached 0.5 kt CO_2eq and SF6 emissions were estimated at 156 ktCO_2eq. Chile's total emissions and removals in 2022, in terms of CO_2 eq, were 54,370 kt. These results translate into growth of 253% since 1990 and 10.7% since 2020. Regarding the participation of each sector in the 2022 GHG balance in absolute terms, the Energy sector represented 50.6%, followed by the Land Use and Land use, land-use change, and forestry sector (LULUCF, 33.8%), the agriculture sector (5.5%), the waste sector (5.3%), and finally the Industrial Processes and Product Use sector (IPPU, 4.9%). Figure 1 shows the temporal evolution of each of the sectors proposed by the UNFCCC for the preparation of inventories.

For its part, the country's total GHG emissions in 2022, that is, the sum of all categories without considering the LULUCF sector, were estimated at 111,049 ktCO_2eq, increasing by 135% since 1990 and by 7.1% since 2020. It is important to mention that in 2020 a decrease can be observed compared to the last years of the series, which is mainly explained by the low activity during the COVID-19 pandemic. Regarding the participation of each sector in the country's total GHG emissions in 2022, the energy sector represented 76.4%, followed by the agriculture sector (8.3%), the waste sector (8.0%) and finally the IPPU sector (7.3%). This shows that the energy sector is the most important sector, both in terms of the GHG balance and total emissions. An expanded summary of these results can be seen in Chapter 2 of this report, and more detailed results can be found in **Chile's National GHG Inventory Document, 1990-2022 series.**

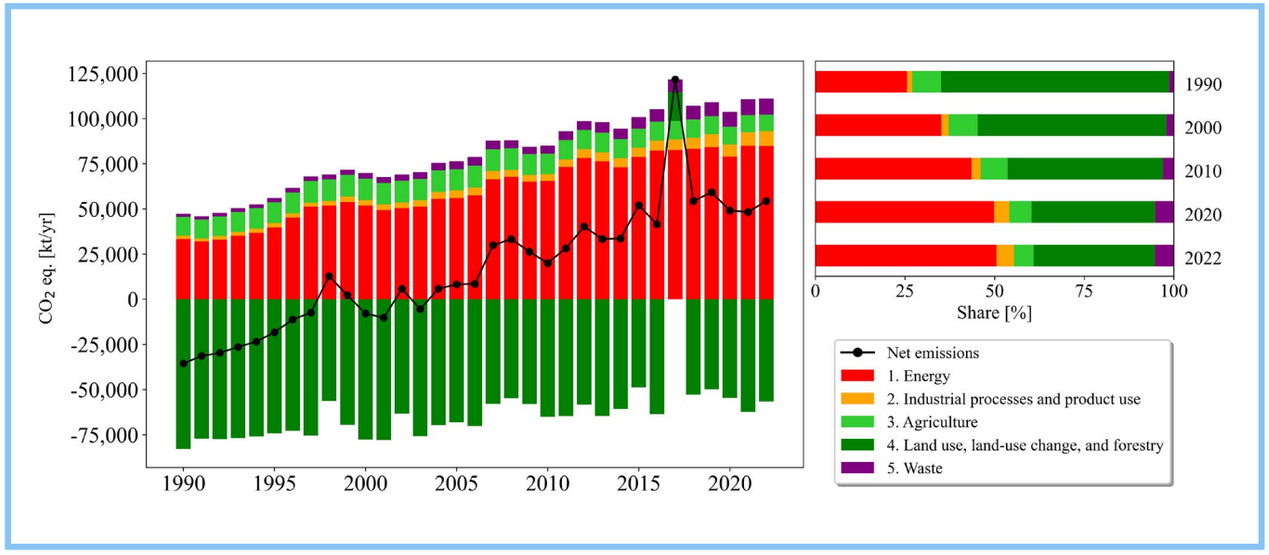

Figure 1. Chile's INGEI: GHG emissions and removals by sector, 1990-2022 series (the balance between emissions and removals is shown with a black line).

2.2.1 Greenhouse gas intensity indicators

One of the most widely used indicators to compare GHG emissions and removals between countries is based on their population. In this regard, Chile defines two indicators: the GHG balance per capita, that is, the annual GHG balance divided by the total population, and second, the emissions per capita, following the same methodology as the previous indicator.

In 2022, the GHG balance indicator was 2.74 tCO_2eq per capita, increasing by 202% since 1990 and by 8.6% since 2020. On the other hand, the indicator of total emissions per capita (excluding the LULUCF sector) was 5.60 tCO_2eq per capita, increasing by 55% since 1990 and 5.1% compared to 2020 (Figure 2). The trend of this indicator shows a disconnection between per capita emissions and population growth. During the last years of the series, the emissions shows very small variations, while the population shows a significant increase.

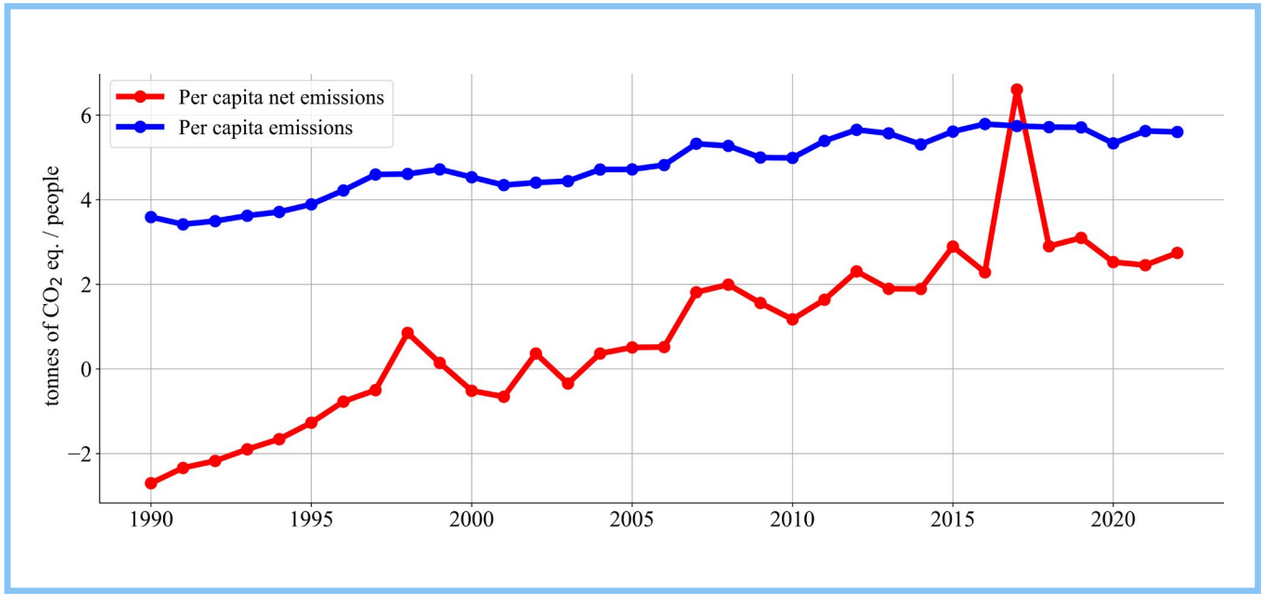

Figure 2. Chile's INGEI: per capita GHG balance and per capita emissions, 1990–2022 series.

2.2.2 Regional inventories

Due to Chile's size, the different political regions of the country differ in aspects ranging from climate to economic and social aspects. These differences translate into important factors that influence local and regional greenhouse gas emissions. To better characterize local differences, the MMA prepares regional GHG inventories.

In Chile, historic GHG emissions are determined, firstly, by the level of fossil fuel consumption in electricity generation processes and, secondly, by absorptions generated on forest growth and through other types of land use. This explains why the regions of Antofagasta, Valparaíso and Biobío have a higher level of emissions, due to the presence of power plants and why Chile's absorptions, accounted for in the LULUCF sector, occur mostly in the south of the country, where there is a lower population density and greater vegetation cover. Additionally, the Metropolitan Region is also among the regions with the highest emissions, where high population density is the main cause of GHG emissions, related to both land transportation and waste disposal and treatment. These results can be seen in Figure 3.

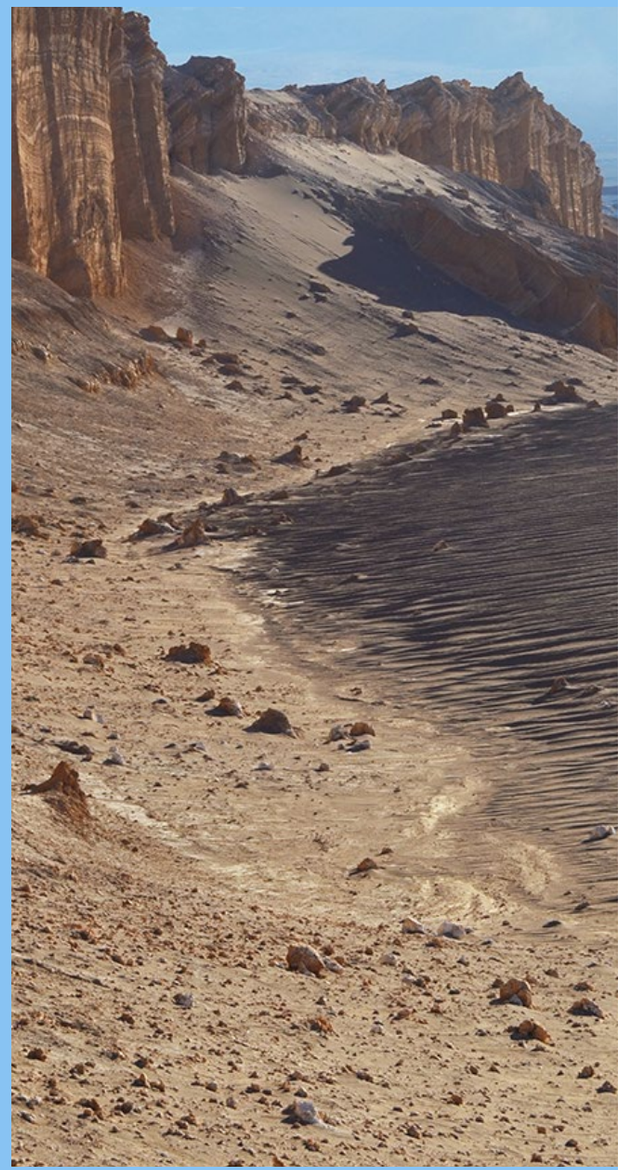

Photo: Micaela Jara Forray

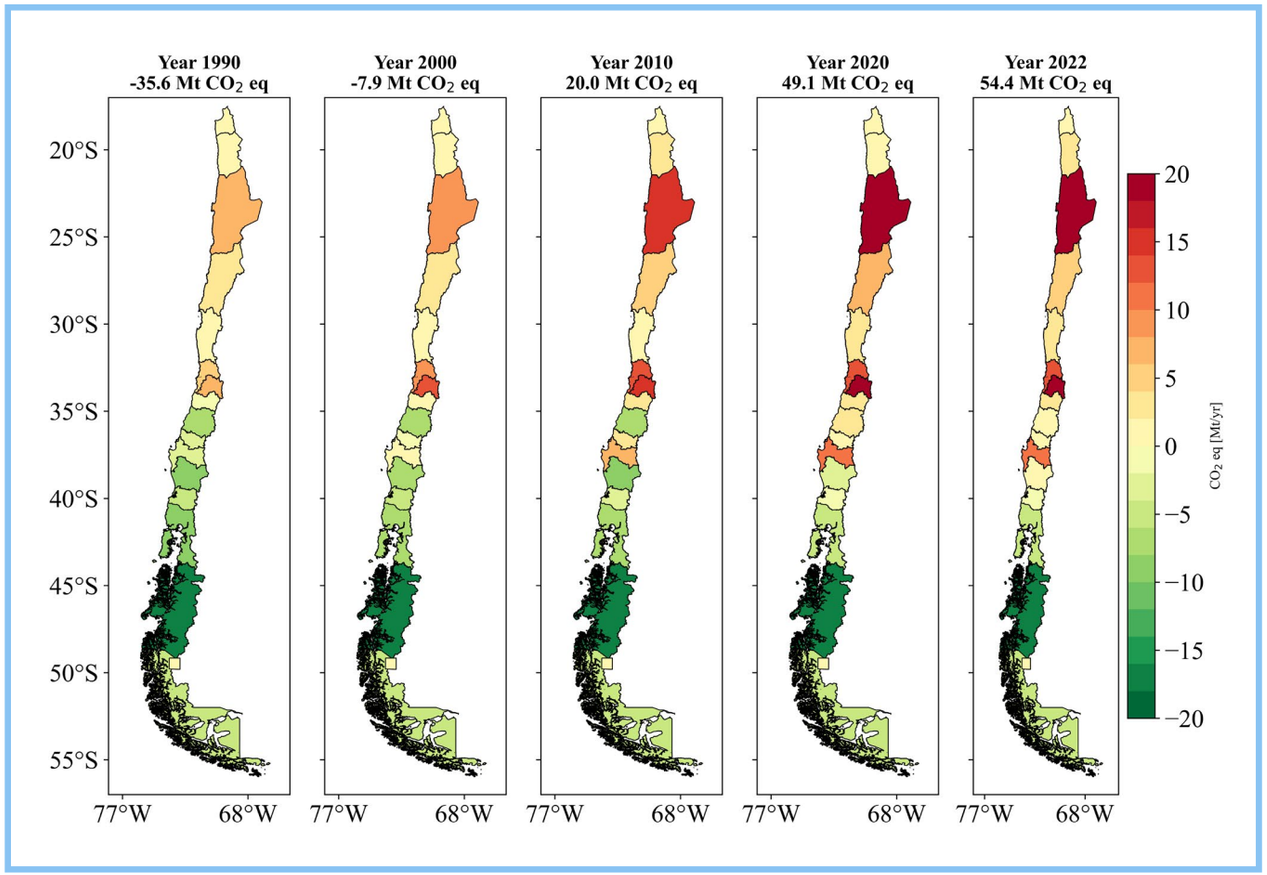

Figure 3. Annual GHG emissions balance by political region of Chile expressed in CO2 eq for the years 1990, 2000, 2010, 2020 and 2022.

2.3. National black carbon inventory

Chile's NDC recognizes the importance of Short-Lived Climate Forcers (SLCF), particularly black carbon (BC). Because of this, Chile is committed to reducing BC emissions by at least 25% by 2030 compared to 2016 levels.

The fifth BC inventory (INCN, in Spanish) provides evidence of the main sources of this pollutant throughout Chile and its regions, through a methodology in part capable of showing progress in emissions mitigation (in some categories), in line with the INGEI. The INCN covers the 1990–2022 series and shares the structure of the categories defined by the INGEI of Chile. In 2022, total BC emissions reached 24.9 kt, which represented an increase of 64% since 1990, and an increase of 5.9 % compared to 2020. These results can be seen in Figure 4.

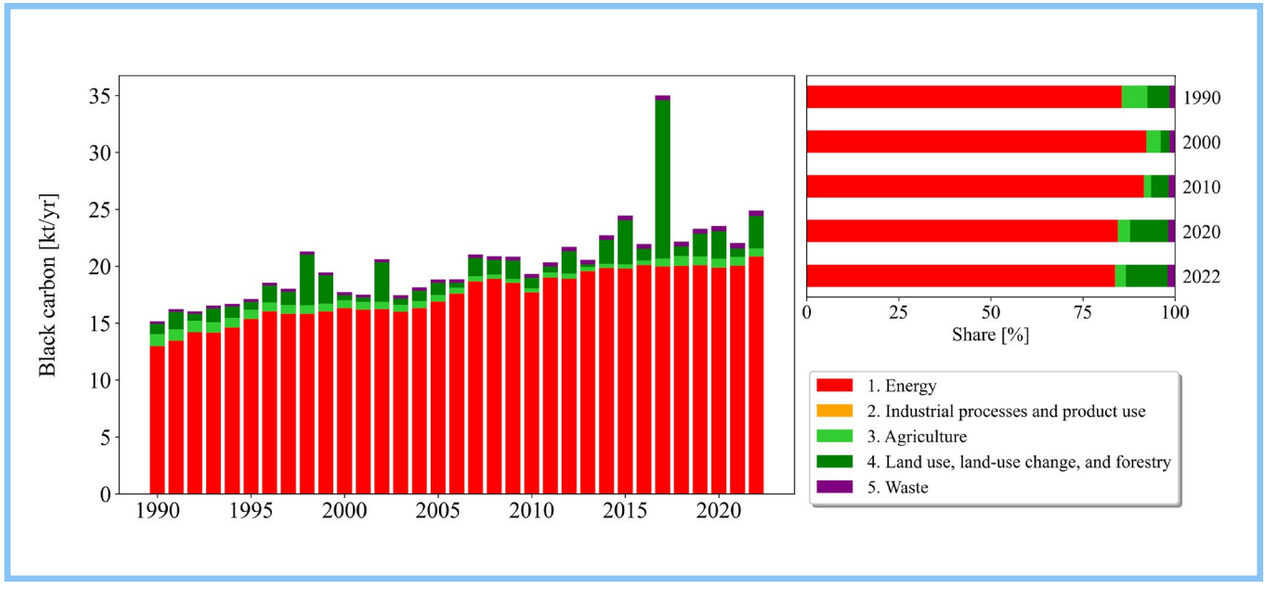

Figure 4. Chile's INCN: BC emissions, 1990–2022 series.

Photo: Micaela Jara Forray

3. INFORMATION NEEDED TO TRACK PROGRESS IN IMPLEMENTING AND ACHIEVING ITS NDC UNDER ARTICLE 4 OF THE PARIS AGREEMENT

3.1. National circumstances and institutional arrangements for mitigation

Chile has made progress in climate mitigation driven by international commitments, political will and the urgency of climate change. Highlights include the development of its NDC in 2020, as well as the LTS and LMCC, which establish a long-term sectoral vision and make NDC commitments mandatory. In 2022, Chile strengthened its NDC in response to the Glasgow Climate Pact of COP26, laying the foundations for a more ambitious update in 2025.

Regarding the LMCC, it defines instruments, institutional arrangements and structures to achieve national and international climate goals, including carbon neutrality by 2050, making NDC commitments binding and granting new responsibilities to sectoral authorities. Through the LTS, it assigns emissions budgets and sectoral goals, implemented through Sectoral Mitigation Plans (PSM) with horizons to 2030 and, in their updates, with horizons to 2040 and 2050. These plans, in development since 2023, will be finalized in 2024, with intersectoral measures that require coordination between authorities.

The climate change management instruments considered in the LMCC that are most relevant to the mitigation issues presented in Chapter 3 are: the **Long-Term Climate Strategy** (art. 5), the **NDC** (art. 7), the **Sectoral Climate Change Mitigation Plans** (art. 8), the **Regional Climate Change Action Plans** (art. 11), the **Communal Climate Change Action Plans** (art. 12), the **Emission Standards and compensation system** (art. 14 and art. 15), the **Mechanisms of Article 6 of the Paris Agreement** (art. 15), the **National Greenhouse Gas Inventory System** (art. 28), the **National Greenhouse Gas Prospective System** (art. 29), the **Voluntary Certification System for Greenhouse Gases and Water Use** (art. 30) and the **National Climate Change Action Report** (art. 10).

3.2. Description of a Party's Nationally Determined Contribution under Article 4 of the Paris Agreement, including any updates

This BTR reports on the progress made in the mitigation goals proposed by the country regarding the reduction of GHG emissions, the reduction of total emissions of black carbon and methane, as well as goals associated with the LULUCF component.

Chile's 2020 NDC is based on a comprehensive approach that encompasses, in addition to the mitigation and adaptation components, three key components: 1) an integration component, which covers actions with an impact on both mitigation and adaptation; 2) a social pillar focused on the just transition and sustainable development, and 3) a component focused on the means of implementation.

Chile has defined two specific contributions related to mitigation; their content and association with the Sustainable Development Goals (SDGs) are presented below.

Photo: Nicolás Smith D.

Table 1. GHG mitigation target.

CONTRIBUTION	SDGs
M1) Chile commits to a GHG emissions budget that will not exceed 1 100 $MtCO_2eq$ between 2020 and 2030, with a maximum GHG emissions (*peak*) in 2025, and reaching total GHG emissions of 95 $MtCO_2eq$ in 2030.	7 AFFORDABLE AND CLEAN ENERGY; 8 DECENT WORK AND ECONOMIC GROWTH; 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Source: NDC (Government of Chile, 2020).

Table 2. Contribution to the reduction of black carbon emissions.

CONTRIBUTION	SDGs
M2) A reduction of at least 25% in total black carbon emissions by 2030 compared to 2016. This commitment will be implemented mainly through national policies related to air quality. In addition, it will be monitored through ongoing and periodic work on improving black carbon inventory information.	3 GOOD HEALTH AND WELL-BEING; 11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION

Source: NDC (Government of Chile, 2020).

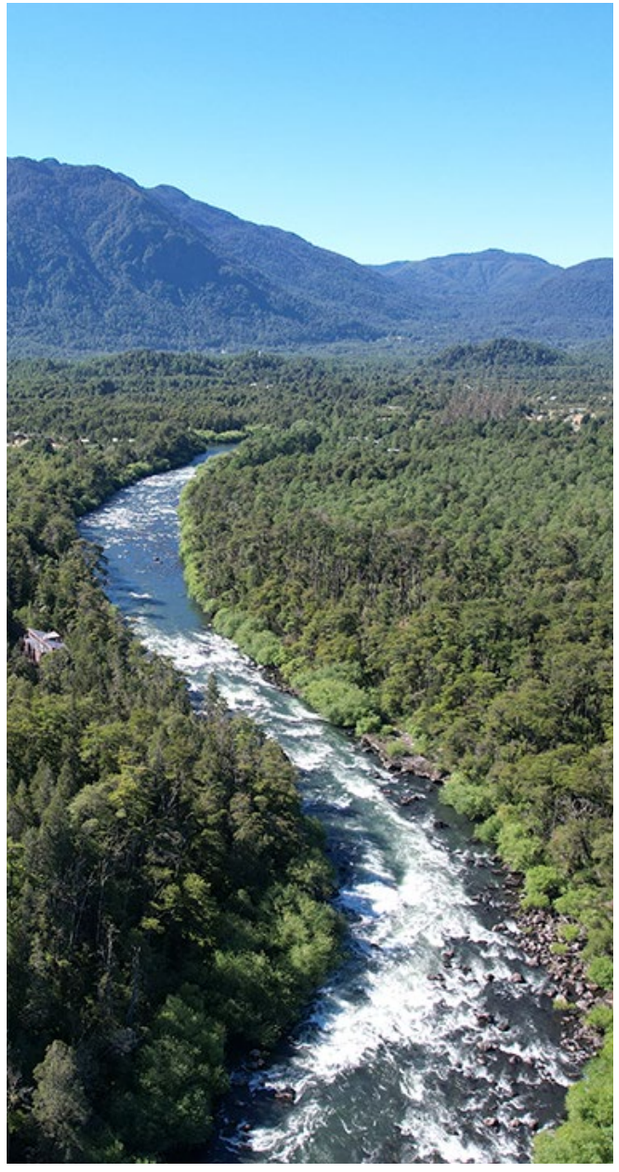

Photo: Tomás Gómez

3.3. Information needed to monitor progress in the implementation and fulfilment of NDCs under Article 4 of the Paris Agreement

Below is a summary of the progress of the NDC monitoring indicators in relation to art. 4 of the Paris Agreement.

Table 3. Summary of progress on the 2020 NDC monitoring indicators in relation to art. 4 of the Paris Agreement.

Goal		Indicator	Progress
M1	‧ Chile commits to a GHG emissions budget that will not exceed 1 100 $MtCO_2eq$ between 2020 and 2030 ‧ Maximum emissions in 2025 ‧ Reach a level of GHG emissions of 95 $MtCO_2eq$ in 2030	Cumulative emissions (3 years, 2020-2022) (*)	325.4 Mt of CO_2eq (29.6% of the 2020-2030 budget)
		Peak year of emissions (*)	111,049 kt of CO_2eq in 2022
		% of emissions from the last year reported compared to the expected level for 2030 (*)	2022 emissions were 117% of 95 $MtCO_2eq$
M2	‧ Reduction of at least 25% of total black carbon emissions by 2030, compared to 2016	%age of emissions from the last year reported compared to the level of 2016 (**)	2022 emissions were 104% of 2016 level
I4	‧ Sustainable management and recovery of native forests (200 000 ha by 2030) ‧ Associated GHG captures (around 0.9 - 1.2 $MtCO_2eq$/year by 2030)	% of managed native forest area	23% progress between 2020 and 2023 compared to the total expected
		% of absorption achieved by the managed area of native forest	7.7% between 2020 and 2023 compared to the total expected
I5	‧ Afforestation of 200 000 ha in total (of which 100 000 ha with permanent forest cover, with at least 70 000 ha of native species) ‧ Associated GHG captures (around 0.3 - 3.4 $MtCO_2eq$/year by 2030) ‧ Recovery and afforestation will be carried out on soils that are preferably suitable for forestry and/or in priority conservation areas	% of forested area	6.3% progress between 2020 and 2023 compared to the total expected
		% of absorption achieved by forested	3.5% between 2020 and 2023 compared to the total expected
Methane	‧ Reverse upward trend by 2025*	Trend in methane emissions (peak)	Last reported year is recorded as the highest (568.7 $ktCH_4$ in 2022)

(*) Does not include the LULUCF sector; (**) Include only the Energy sector.

3.4. Mitigation policies and measures, actions and plans, including those with mitigation co-benefits from adaptation actions and economic diversification plans, related to the implementation and fulfilment of a NDC under Article 4 of the Paris Agreement

Chapter 3 details the monitoring of actions, policies and measures to implement the NDC, in accordance with the Modalities, Procedures and Guidelines (MPGs) of the Enhanced Transparency Framework. It includes policies and measures in the design, planning, approval and implementation stages to reduce GHG emissions at the sectoral level. The report includes estimates of emissions reductions achieved and projected, presented in the Common Tabular Format No. 5 (CTF), with the methodology explained in *Annex 1 of Chapter 3.*

At the national level, the LMCC establishes that the national budget committed in the NDC must be distributed among seven ministries, which, in turn, must develop sectoral plans to ensure they do not exceed their assigned quota. Below are the progress details for each sectoral ministry.

3.4.1 Ministry of Energy

Chile's Ministry of Energy has implemented various mitigation measures to reduce GHG emissions and achieve the goals set out in the LTS and NDC. These actions include promoting the National Energy Policy 2050 and the Energy Agenda 2022-2026, with key initiatives such as the Green Hydrogen Action Plan, which promotes the sustainable development of this industry, the National Electromobility Strategy to promote clean transport, and the implementation of the National Energy Efficiency Plan to optimize the use of energy in strategic sectors. In addition, work is being done on the flexibility of the electrical system, the promotion

of emerging technologies such as geothermal energy, and the Energy Efficiency Law, which encourages responsible energy consumption.

The Sectoral Plan for Climate Change Mitigation and Adaptation of the Energy Sector is essential to achieve carbon neutrality by 2050 and improve the country's climate resilience. The plan includes short-term goals for 2030, aligned with the Paris Agreement and Chile's NDC, with the aim of achieving the decarbonization of the economy. Its strategic vision is based on four main pillars:

1. Productive conversion
2. Resilient and enabling infrastructure
3. Transitional fuels
4. Financing for decarbonization

Despite progress in reducing emissions and saving energy, challenges remain in implementing intersectoral measures and strengthening monitoring and reporting systems. These initiatives reflect the Ministry of Energy's commitment to Chile's climate commitments and to mitigating climate change globally.

3.4.2 Ministry of Transport and Telecommunications

The Ministry of Transport and Telecommunications leads the development of the transport sector, which is one of the main sources of GHG emissions and contributes significantly to local pollution. Promoting accessible, inclusive and sustainable mobility is essential to address the global climate crisis, mitigate its local impacts and facilitate adaptation to climate change.

The Sectoral Plan for Climate Change Mitigation and Adaptation for the transport sector defines strategic guidelines to address the impacts of the climate crisis in the sector, promoting a new mobility approach based on the use of low-emission technologies, the expansion of active mobility and efficient transport alternatives, the strengthening of intersectoral alliances, and the promotion of adaptive policies and disaster risk management. This approach seeks not only to mitigate the effects of climate change, but also to strengthen the resilience of the transport sector.

Other initiatives implemented by the Ministry include the creation of a National Urban Mobility Programme for climate change mitigation and adaptation and the Moving Chile project, through which chargers for electric vehicles were installed in 12 cities and more than 170 public transport operators were trained. Since 2014, the Green Tax on New Motor Vehicles seeks to reduce pollution. In addition, the State-owned railways company *Empresa de Ferrocarriles del Estado (EFE)* is committed to achieving carbon neutrality by 2035. In terms of infrastructure, 2 266 km of cycle paths have been built and initiatives related to green hydrogen and cargo vehicles are being developed.

3.4.3 Ministry of Mining

The mission of the Ministry of Mining is to design and evaluate public policies to promote the development of the mining sector, fostering innovation, productivity and sustainability, and leading initiatives to reduce greenhouse gas emissions.

The National Mining Policy 2050 establishes goals to achieve sustainable mining, including reducing emissions from large-scale mining by 50% by 2030 and achieving carbon neutrality by 2040, in addition to objectives in energy efficiency and adaptation to climate change.

Various initiatives have been implemented to move towards more sustainable mining. These include the study and regulation of the use of green hydrogen, the training of energy managers at the State-owned mining company Empresa Nacional de Minería (Enami) and the annual measurement of GHG emissions from the sector, led by the Chilean Copper Commission (Cochilco). The State-owned copper mining company Codelco has been a benchmark in decarbonization, with plans to achieve 100% renewable electricity supply by 2030 and the implementation of the largest fleet of electric buses in Chile. A carbon footprint calculator has also been developed for mining suppliers. Work is also underway on the Sectoral Plan for Climate Change Mitigation and Adaptation in the mining sector, and the Policy for the Promotion of Small-Scale Mining, which seeks to incorporate sustainability strategies in this area.

3.4.4 Ministry of Health

The Ministry of Health leads health policies in Chile, including health and environmental surveillance, infrastructure and equipment management, and technical regulations. In terms of GHG mitigation, it has developed the Sectoral Mitigation Plan, together with the MMA, which mainly addresses methane emissions from the waste sector.

The plan includes five key measures: the valorisation of organic waste through composting; the capture and valorisation of biogas in landfills, potentially reducing emissions by 91% of the plan total reductions; recycling of paper and cardboard; reduction of food waste, and the measurement of carbon footprint, together with energy efficiency programmes in hospitals. These actions add up to a mitigation potential of 6.21 Mt CO_2eq for 2020–2030.

Additionally, the plan considers strengthening health infrastructure with a focus on equity and energy efficiency. It also incorporates food safety to reduce waste in line with the National Health Strategy.

3.4.5 Ministry of Housing and Urban Planning

The Ministry of Housing and Urban Planning (MINVU) promotes various initiatives to mitigate climate change at the level of homes, neighbourhoods and cities, considering the high population concentration and its environmental impacts. Among the most notable means of implementation is the National Sustainable Construction Strategy, which sets goals to incorporate environmental criteria into buildings by 2050. In addition, the residential insulation subsidy programme has benefited more than 236 000 homes, while reducing emissions and improving thermal insulation. In terms of regulations, article 4.1.10 of the General Law on Urbanism and Construction (OGUC) establishes standards for new homes.

MINVU also promotes sustainable mobility through the Cycle Path Plan, which totals 236 km of bike lanes. In addition, the I Love My Neighbourhood *(Quiero Mi Barrio)* programme incorporates tree planting and waste management, while the Valorisation of Organic Waste in Urban Parks programme reduces emissions through composting.

3.4.6 Ministry of Agriculture

The Ministry of Agriculture (MINAGRI) leads the development of the forestry and agricultural sector in Chile, promoting sustainable practices and the conservation and restoration of ecosystems. The sector is key to mitigating climate change due to its unique capacity to both emit and remove CO_2 from the atmosphere. MINAGRI, together with institutions such as the Office of Agricultural Studies and Policies (ODEPA), the Forestry Institute (INFOR) and the National Forest Corporation (CONAF), updates emissions inventories and carries out actions aligned with the NDC, the LTS and the carbon neutrality framework, focusing on the management of native forests, afforestation and reduction of degradation.

Through the Sectoral Mitigation Plan, measures such as biodigesters, fertilizer efficiency and low-emission agricultural production are established. Additionally, Chile updated its forest reference levels (FREL/FRL), expanding its geographic scope and improving data accuracy, while strengthening the REDD+ approach for the protection of native forests and the reduction of emissions.

Highlights include Chile's National Strategy on Climate Change and Vegetation Resources (ENCCRV), led by CONAF under the REDD+ approach, which seeks to reduce social, environmental and economic vulnerability caused by climate change, desertification and land degradation. This strategy establishes activities and measures focused on forest restoration, forest fires prevention, conservation and management, including institutional management, environmental education and research.

3.4.7 Ministry of Public Works

The Ministry of Public Works (MOP) has strengthened its climate governance, with the creation of the Sustainable Infrastructure Division and the Department of Climate Change and Circular Economy (DCCyEC), which are leading the process to update the Sectoral Plan for Climate Change Mitigation and Adaptation (PSMA).

The Ministry carries out actions that contribute to the reduction of GHG emissions, such as the implementation of Sustainable Building Certification in public projects, waste management in projects with a focus on reduction and recycling, and the use of renewable energy. In addition, it promotes the circular economy through the recycling of materials used in pavements and estimates the carbon footprint of each of its projects.

3.5. Projections of greenhouse gas emissions and removals, as applicable

This subchapter updates the sectoral emissions projections considered in Chile's fifth BUR, integrating preliminary results of scenarios developed for the NDC update in 2025. Although the NDC update contemplates various scenarios to meet Chile's carbon neutrality goal by 2050, only two scenarios are considered here: "without measures" and "with measures". The "without measures" scenario assumes the absence of additional mitigation efforts, while the "with measures" scenario includes actions aligned with the 2020-2030 Sectoral Mitigation Plans and projects the efforts necessary to achieve carbon neutrality, according to the LMCC.

Photo: Bryan Contreras

The figure below presents a comparison of both scenarios. On the left is the scenario "without measures", which continues the trend of increasing net emissions, and on the right is the scenario "with measures", where the carbon neutrality objective is achieved by 2050.

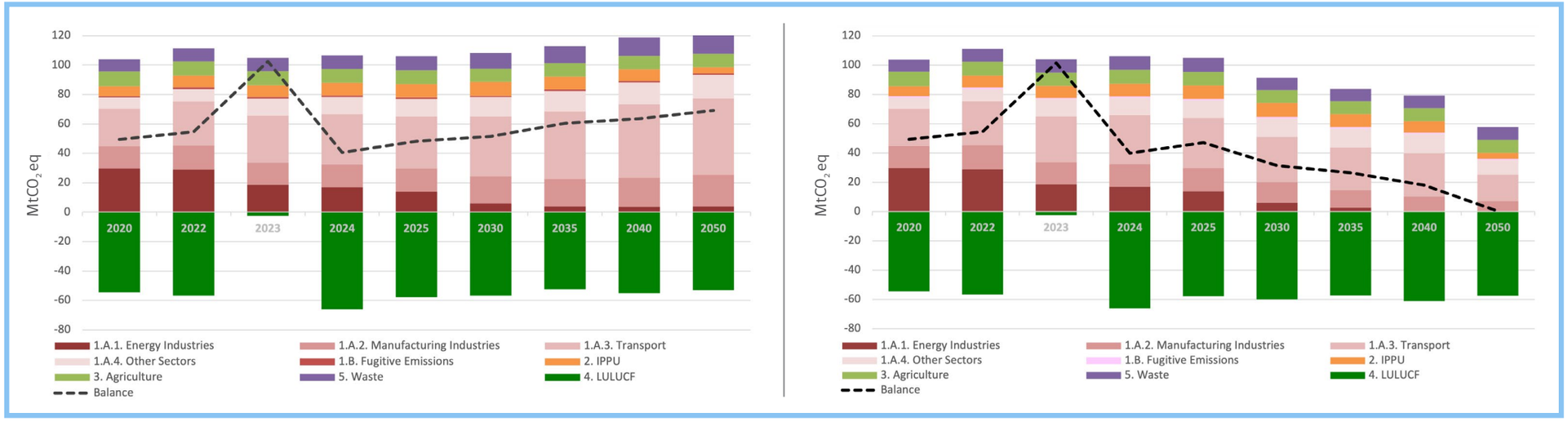

Figure 5. Emissions scenario comparison: scenario without measures (left) and scenario with measures (right).
Source: Prepared by the author, MMA.

3.6. Other information

This subchapter contains relevant information regarding climate change mitigation, which, although additional to the Modalities, Procedures and Guidelines of the Enhanced Transparency Framework, complies with the traceability of information reported by the country in the 5th BUR. Below is a summary of the contents of each item.

3.6.1 Mitigation efforts of other public institutions

At the national level, various public institutions have developed their own mitigation actions and measures, which complement the efforts by the seven sectoral authorities in this area. Although these institutions are not required to prepare Sectoral Mitigation Plans, their work is crucial to meeting the mitigation goals at the national level. The entities included in this section are the MMA, through its Office of Legislative Implementation and Circular Economy, the Air Quality Division and the Ozone Unit of the Climate Change Division; Chile's Production Development Corporation (CORFO); the Ministry of Social Development and Family; the Ministry of National Assets, and the Ministry of Defence.

Also included is the report on Intersectoral efforts to reduce GHG emissions from international shipping. Additionally, an effort has been made to describe some of the mitigation measures in detail, which is presented in *Annex 1 of Chapter 3*.

3.6.2 Regional mitigation efforts

The formation and ongoing operation of the CORECCs, as well as the development of the first five PARCCs, demonstrate the progress of a multi-level coordination and governance process involving the main actors and objectives established in national public policies and management instruments at the subnational level. As for the rest of the regions, since they are still in the early stages of developing their PARCCs, they are in the stage of intersectoral discussion and definition of measures that seek to reduce GHG emissions or increase carbon capture. Although the areas addressed vary according to the realities of each region, sustainable mobility has been prioritized in all of them.

3.6.3 Local mitigation efforts

Chile recognizes the importance of all territories acting to reduce emissions and increase their climate resilience, in line with national objectives for 2050. Cooperation between regional governments and municipalities, as well as adapting to local realities, will be key to achieving these goals. Advances in mitigation at the local level include national initiatives such as the HuellaChile programme, the Comuna Energética programme and projects managed by associations of municipalities, as well as local actions promoted by municipalities and international collaborative networks.

3.6.4 Public-private mitigation efforts

This section describes various public-private initiatives that contribute to GHG mitigation, highlighting the participation of private organizations in collaboration with the public sector.

The **Sustainability and Climate Change Agency (ASCC)** has signed 216 Clean Production Agreements (CPAs) with 9 521 companies and 16 131 facilities. Since 2020, 1 974 new facilities have been added and, as of 2024, 90 CPAs covering 3 249 facilities are active. The CPAs, recognized as Chile's first Nationally Appropriate Mitigation Action (NAMA) in 2012, have reported annual emissions reductions since 2016. For 2020-2030, a total reduction of 2 270 000 tCO_2e is projected, in line with Chile's NDC commitments.

As of April 2024, the **MMA's HuellaChile programme** has registered the participation of 1 781 organizations and issued 1 630 certificates, including certificates for quantification, reduction, neutralization, and management of GHGs. Since the promulgation of the LMCC in 2022, the number of organizations reporting to the programme has increased.

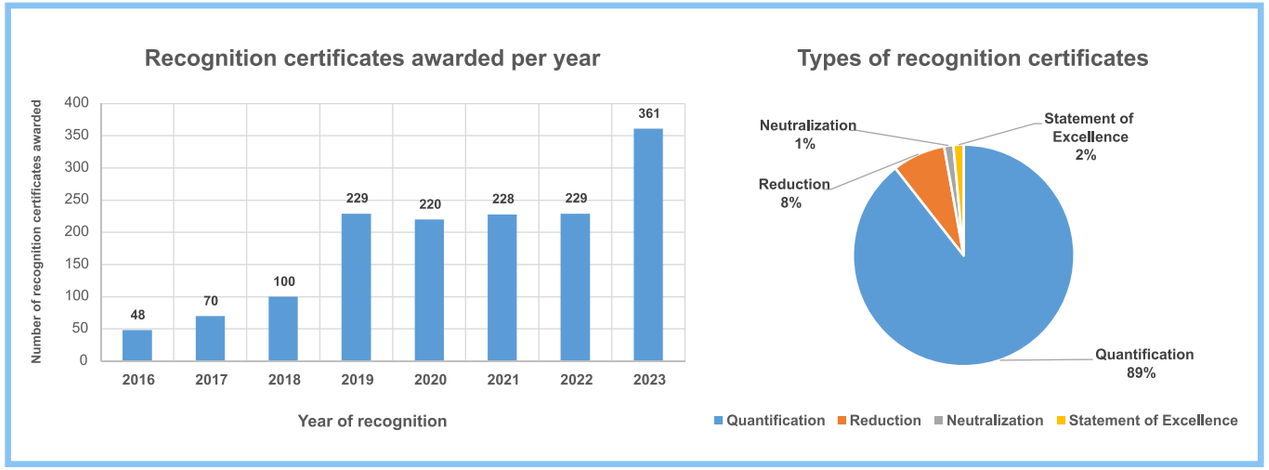

Figure 6. Certificates awarded by the HuellaChile programme, 2016-2023.
Source: Prepared by the Ministry of the Environment.

Additionally, the private sector also promotes mitigation initiatives, which are registered on platforms such as the Non-state Actor Zone for Climate Action (NAZCA), the Climate Ambition Alliance, and Race to Zero, among other initiatives.

3.6.5 Applying carbon pricing to address environmental externalities

In this section of Chapter 3, progress is reported in several key areas. Initiatives related to the Green Tax and the Compensation System are addressed, as well as emission standards that seek to regulate greenhouse gas emissions. Carbon market mechanisms under the UNFCCC are also included, such as the Clean Development Mechanism of the Kyoto Protocol and the Paris Agreement Crediting Mechanism, in addition to the carbon market mechanisms of Article 6.2 of the Paris Agreement. Moreover, the Partnership for Market Implementation (PMI) and initiatives linked to tax modernization are presented, focused on improving fiscal and economic frameworks to address climate change. Finally, instruments associated with the social cost of carbon are addressed, which allow the valorisation of CO_2 emissions to promote emissions reduction.

3.7. Monitoring, reporting and verification (MRV) related to mitigation

To date, there have been various efforts and developments of MRV systems in the country related to mitigation, which have been designed in stages prior to the creation of the Framework Law on Climate Change (LMCC) and therefore are not linked to the monitoring of the Climate Change Management Instruments (IGCC) indicated by the law. This poses the challenge of establishing a national system to monitor the IGCC in climate change mitigation. Section 3.7.6 addresses general definitions of MRV systems in mitigation, their level of progress (detailed in Annex 2), and the MRV system of the mitigation measures included in the Sectoral Mitigation Plan, concluding with the Inclusive Forum on Carbon Mitigation Approaches (IFCMA) Initiative and a pilot case in Chile.

3.8. Flexibility

Chapter 3 includes a subchapter on the guiding principle of MPD flexibility optional to developing country parties, which Chile is needing in the light of our capacities from flexibility for provisions 85 and 102.

Photo: Tomás Gómez

4. VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE

4.1. Impacts, risks and vulnerabilities

4.1.1 Current and projected climate trends and hazards

Significant changes in the climate have been observed in Chile in recent decades. The year 2023 was the warmest on record since 1961, marking 13 consecutive years of warmth and 17 years of dry conditions. Seven of the 10 warmest years occurred in the last decade. The extreme drought of 2019 and 2021 with deficits of -36.6 and -42.9%, respectively, decreased in 2023 to -11%.

4.1.1.1 Land historical trends

The **average annual temperature in Chile has shown a significant increase**, from 12.4 °C (1961-1990) to 13.0 °C (2009-2023), an overall of 0.15 °C per decade and more pronounced than the last reporting period. Of all the country's monitoring stations, 98% show positive differences between both periods, with the largest temperature increases recorded between the Atacama and Ñuble regions. The average **annual accumulated precipitation has decreased** from 675.3 mm to 536.4 mm (4%/decade), with downward trends in practically the entire continental territory, with the largest reductions observed in the Valparaíso, Metropolitan and Maule regions (up to -55%). Only in the northern regions are slight increases recorded (+6%/decade). In parallel, the **altitude of the 0 °C isotherm has risen** by 41-64 m/decade (2000-2023), with the greatest increase in the central and southern areas. This trend has affected snow accumulation, accelerated glacier loss and intensified summer droughts and intense rainfall resulting in floods, avalanches and landslides.

4.1.1.2 Land future projections

Chile has climate hazard projections available in ARClim, updated in 2023 based on the CMIP-6 initiative of the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6). Accordingly, the following projections are based on the SSP5-8.5 scenario, reflecting a development pathway of high GHG emissions. An increase in the average annual temperature is anticipated throughout the country by 2035-2065 (Figure 7A), although with different intensity depending on latitude, altitude and proximity to the ocean. According to the projections, greater increases are anticipated in the northern Andes mountain range (+2.10 to +2.35 °C) and smaller increases in the southern (+1.1 to +1.67 °C) and extreme southern areas (+0.74 to +1.27 °C), maintaining the trend towards greater increases in the Andean foothills and Andes mountains. Global warming will intensify evapotranspiration, extreme heat events and glacier retreat, affecting ecosystems, water resources and productive systems, while also increasing the presence of vector-borne diseases.

In terms of **annual accumulated precipitation, the projected changes from 2035 to 2065 show different patterns** (Figure 7B). In the north, increases of up to 57% are projected in the Atacama Desert and slight reductions in the Andes and on the Arica coast. In the central zone, large decreases in precipitation are projected (-12 to -30%), compromising water and food security in agricultural and highly populated regions. The southern areas will see reductions of 8 to 11.9%, and in the far south the variations range between -7.9 and +7%.

A **reduction in annual accumulated snow is projected between 2035 and 2065** (Figure 7C) in almost the entire Andes mountain range, due to the combination of increasing temperatures, reduced precipitation and the rise of the 0 °C isotherm. This decrease could reach 100% in the Andean foothills and southern fjords and smaller reductions in high sectors of the Andes and the extreme south, which, comparatively, represent the loss of large volumes of snow. This trend contributes to the loss of glaciers and intensifies summer droughts that threaten the availability of water for human consumption, agriculture and ecosystems.

Photo: Micaela Jara Forray

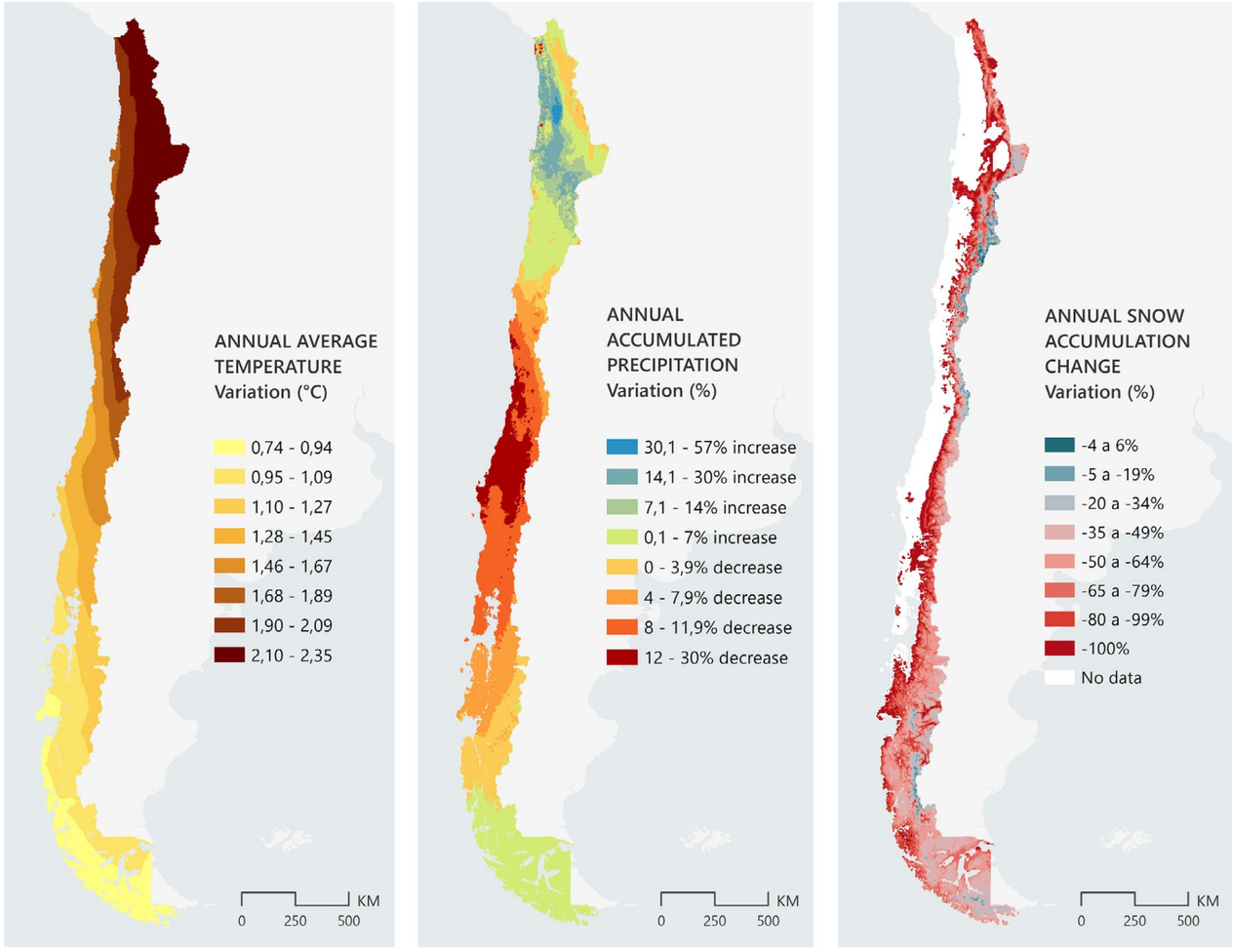

Figure 7. Projected changes in mean annual temperature (A), annual accumulated precipitation (B), and annual accumulated snow (C), for the period 2035–2065 with respect to 1980–2010, under the SSP5-8.5 scenario.

Source: Prepared based on the Threat Explorer, ARClim (2023).

4.1.1.3 Extreme weather events and climate-related hazards: trends and projections

Projections for 2035–2065 show a significant increase in the frequency of **heat waves with temperatures above 30 °C** for three or more consecutive days in almost the entire country, excluding the Magallanes and Chilean Antarctic Region (A). The most critical increases are projected in the Pampa and Altiplano in the north and in the central valley between the Valparaíso and Ñuble Regions, with episodes that could extend to between 10 and 80 consecutive days above 30 °C in addition to those currently recorded.

Meanwhile, the **frequency of droughts** (B) is projected to present varied patterns throughout the country. While this frequency is expected to be similar or tend to decrease slightly in the northern and southern areas, increases are anticipated in the northern Cordillera and Aysén Region. The central and central-southern areas of the country, which are key for agriculture and are highly populated, will be the most affected, with increases in the frequency of droughts of between 15 and 27%.

An increase in **maximum daily rainfall** (C) is projected in much of the country, with extreme variations concentrated in the Andes mountain range, between the Atacama and Metropolitan Regions, where historical values could double, thereby increasing the risk of flooding. The southern region could register increases of up to 20%, while rainfall in the Pampa and the Andes north of Antofagasta is projected to increase between 11 and 60%. In contrast, a decrease is expected on the coast, in the coastal mountain range and in the valleys between the Atacama and Biobío Regions.

4.1.1.4 Oceanic Trends and Projections

The **mean sea level** in Chile shows regional variations, with increases of 0.38 cm/year in San Antonio and decreases of -0.40 cm/year in Puerto Montt, influenced by tectonic processes associated with the seismic cycle, while in the central zone upward trends predominate.

Between 1980 and 2015, **wave height** increased 0.1-0.4 meters (10-20 %), especially in the south, and changed direction due to the displacement of the South Pacific anticyclone. Projections for 2026-2045 indicate slight increases in wave height towards the south (>50°S), while mid-latitudes (35°S-45°S) could experience slight reductions due to changes in wind patterns. These changes impact coastal settlements, fishing and tourism.

Sea surface temperature shows cooling in the north, stability in the central area of the country and warming in the south of the country. By the end of the century, increases of up to 2.31 °C are projected, alternating atmospheric and oceanic circulation, with critical implications for marine ecosystems and biodiversity and activities such as artisanal fishing and aquaculture.

4.1.2 Observed and potential impacts of climate change

Since 2010, Chile is facing a **megadrought**, with a 30% rainfall deficit between the Coquimbo and Araucanía Regions, which has reduced water levels in reservoirs, increased snowmelt, and affected water quality and quantity, thereby reducing the supply of water for drinking, agriculture, mining and hydroelectric generation, while increasing biodiversity and ecosystem loss. More severe **heat waves** have increased energy demand, caused health problems, accelerated glacial melting and generated water stress in flora and fauna. Combined with the megadrought, heat waves have intensified the conditions for large-scale and extensive forest fires. The accelerated **glaciers retreat** in the last 30 years has compromised water supply for human consumption, agriculture, mining and energy and altered biodiversity and essential ecosystem services. In the central area, glaciers are a critical source of fresh water and sustain river flows during dry periods, and their loss threatens water security. In addition, their retreat has generated risks of landslides and disrupted tourist activities. The **increase in frequency and intensity of storm surges** is eroding the coasts, damaging infrastructure, limiting economic activities such as tourism, fishing and port operations, and affecting habitats and biodiversity on beaches and coastal ecosystems.

In sectoral terms, climate change impacts Chile's **water resources**, threatening urban and rural water security, while accelerating desertification, loss of wetlands and glacial retreat. Sectors such as **agriculture, mining, tourism and health** face economic and social losses due to water scarcity, increased costs and risks. **Biodiversity** is severely affected, with risks to native species, fishery resources and the expansion of invasive species.

Extreme events such as intense rainfall, droughts, floods and landslides damage **infrastructure** such as roads, bridges and buildings, especially affecting transport systems and ports due to rising sea levels. The **forestry, agriculture and livestock sector** suffers from crop losses, high costs and vulnerability of small-scale farmers, rural women and Indigenous Peoples. By 2100, a decrease in agricultural GDP of up to 5% per year is projected.

The **energy** sector is vulnerable, with impacts on hydroelectric, solar and wind power generation due to water scarcity and climate change. Electricity demand could increase by up to 4.3% by 2060, while in **mining** water shortages and heat waves reduce productivity and increase risks of flooding and landslides.

In **cities**, extreme events affect housing, infrastructure and health, increasing respiratory and cardiovascular diseases, especially in vulnerable communities. **Coastal areas** face erosion, changes in temperature and salinity, storm surges and loss of marine productivity, impacting **fisheries, aquaculture and tourism**. The loss of snow and water compromises high mountain and coastal tourism, thereby reducing local income and biodiversity.

4.1.3 Approaches, methodologies, tools, uncertainties and challenges

Chile has a network of nearly 1 000 meteorological, fluviometric, glaciological and water quality **monitoring stations** led by the Meteorological Directorate of Chile (DMC) and the General Directorate of Water (DGA) to collect key data to analyse climate trends and monitor meteorological phenomena. The DMC **Climate Services Platform** offers access to data and products such as the drought monitor and, since 2017, the DMC has published annual **Climate Evolution Reports** based on indices recommended by the World Meteorological Organization. The MMA **Climate Risk Atlas (ARClim)** combines public and scientific data into climate hazard and risk maps, aiming to support the development of public policies and adaptation initiatives. It consists of three main components including a **climate hazard explorer, risk maps for 12 sectors and species maps.**

4.2. Adaptation priorities and barriers

4.2.1 National priorities and progress towards these priorities

Chile has identified 12 **priority sectors for adaptation**: biodiversity, water resources, infrastructure, health, energy, fisheries and aquaculture, cities, forestry, agriculture, transport, tourism, mining and coastal zones, which must develop or update Sectoral Adaptation Plans. All these sectors recognize water management as a critical priority, given Chile's vulnerability to droughts and extreme weather events, which is addressed through the Adaptation Plan for Water Resources, the NDC, the LTS and the Strategic Plans for Water Resource Management.

The **priorities established in the Climate Change Management Instruments** in Chile include several key commitments and objectives. The **2020 NDC** establishes eight commitments in terms of adaptation and focuses on updating studies on vulnerability and risks, strengthening adaptive capacity, and integrating adaptation and mitigation, especially through circular economy, reforestation and landscape restoration. The **2021 LTS** defines 46 long-term objectives, highlighting sectoral governance, scientific knowledge, water security, and risk reduction, with adaptation goals in productive and territorial sectors. The National Adaptation Plan incorporates a differentiated vulnerabilities approach considering gender and intersectionality and prioritizes the resilience and knowledge of vulnerable groups. On the other hand, the **Climate Change Financial Strategy (EFCC)** focuses on prioritizing adaptation measures based on their maturity and attractiveness, promoting a transition to cleaner technologies through effective coordination.

4.2.2 Adaptation challenges and gaps and barriers to adaptation

Climate change adaptation in Chile faces **cross-cutting gaps** such as a lack of resilient infrastructure, adequate land use planning, and deficiencies in technical capacities and human resources, which limit the effective implementation of policies. There are also difficulties in coordination, insufficient financing, and a lack of tools to measure resilience, as well as gaps in oversight and monitoring. Difficulties in accessing funds and a lack of coherence between national and local policies hinder decision-making. However, **enabling factors** include specialized units, institutional collaboration, current legislation, and progress in local governance.

4.3. Adaptation strategies, policies, plans, goals and actions to integrate adaptation into national policies and strategies

4.3.1 Actions related to global adaptation goal

For the 2025 NDC update, Chile will align its adaptation commitments with the goals of the United Arab Emirates Framework for Global Climate Resilience (2023), prioritizing the water, agriculture and food security, health, biodiversity, infrastructure and human settlements sectors. Regarding the adaptation cycle of the framework, Chile commits to strategies and policies to strengthen resilience, assess risk, reduce vulnerability and improve the capacity to adapt to climate change and strengthen monitoring, evaluation and learning. Progress has been made in commitments regarding the implementation of the adaptation policy cycle supported by the LMCC, although challenges persist in early warning systems. Significant gaps are identified in technologies and infrastructure, which require investments that have so far not been financially sustainable with the available resources.

4.3.2 Objectives, measures, goals, initiatives, efforts, plans and other actions to build resilience

The **LTS** establishes long-term adaptation objectives and goals through the National Climate Change Adaptation Plan (PNACC). These instruments provide the guidelines for sectoral, regional and communal plans. This policy framework allows for effective coordination between different levels of governance, ensuring coherence between mitigation and adaptation policies.

Specifically, the PNACC is Chile's main instrument for addressing climate change from an adaptation perspective. In addition, it strengthens the integration of adaptation in public policies, encourages public-private cooperation and promotes innovation and climate financing, strengthening a robust system of evaluation and continuous improvement.

Photo: Bryan Contreras

The main progress and approaches of the **Sectoral Plans for Adaptation to Climate Change** are highlighted below.

	Sector	Main approaches and advances
Previous plans, currently being updated	Forestry, agriculture and livestock	The update of the 2013 plan has evolved towards greater specificity, prioritising integrated water resource management, agro-environmental sustainability and agro-climatic risk management, moving away from a general focus on competitiveness.
	Biodiversity	The update of the 2014 plan has integrated nature-based solutions (NbS) as a main axis, emphasizing public-private collaboration and ecosystem restoration as adaptation mechanisms.
	Health	The update of the 2016 plan has adopted a preventive approach, including measures such as epidemiological surveillance, vector monitoring and response plans for extreme events, reflecting a more comprehensive approach to the relationship between public health and climate change.
	Fishing and aquaculture	The update of the 2015 plan maintains the same objectives but incorporates lines of action that describe adaptation measures at the territorial level and the strengthening of the ecosystem approach in fisheries management.
	Infrastructure	The update of the 2017 plan broadens the focus to climate resilience, sustainability in public works, gender inclusion and integrated climate change management, moving beyond the previous emphasis on methodologies and monitoring.
	Energy	The 2024 version updates the guidelines of the 2018 plan, focusing on energy resilience by segment (electricity and fuels), energy demand management and energy security for vulnerable groups.
	Cities	The update maintains the strategic axes of the 2018 plan, but with more of a focus on specific actions such as waste management, environmental education and urban resilience through sustainable infrastructure.
	Tourism	The updated plan incorporates a comprehensive approach to diversify tourism offerings, restore key resources and strengthen institutional coordination, thereby expanding on the objectives of the 2019 plan.
New plans in development	Water resources	Climate risk reduction, institutional strengthening and access to financing are prioritized, with a focus on water governance and adaptation.
	Mining	The guidelines emphasize water security, resilient planning of operations and the use of nature-based solutions, promoting sustainability in a key sector for the national economy.
	Coastal zone	A clear operational delimitation is proposed, as well as the integration of climate concepts in territorial management and the strengthening of the protected areas system, together with broad social participation and technical strengthening.
	Transportation	The objectives include sectoral governance, continuous risk monitoring, implementation of nature-based solutions and climate disaster management, reflecting a preventive and comprehensive approach.

Regional Climate Change Adaptation Plans (PARCC) in Chile allow regional governments to connect national policies with local priorities. As of August 2024, four regions have approved PARCCs, ten are in development, and two are in preliminary phases. These plans include concrete measures in key sectors, such as biodiversity conservation, water management, agricultural resilience, resilient infrastructure, and citizen participation. Cross-cutting approaches identified include increasing protected areas, wetland conservation, reforestation, agroecological practices, and resilient urban planning with nature-based solutions.

Strategic Management Plans for Water Resources in Basins (PERHC) are key instruments for sustainable water management to address climate change. Currently, these plans are being developed in nine river basins, with the participation of key stakeholders, through Strategic Roundtables for Water Resources (MERH).

Sectoral Adaptation Plans in Chile incorporate **Disaster Risk Management,** ensuring synergy between climate change adaptation and risk reduction. These plans adopt risk prevention and mitigation approaches, promoting effective governance in the affected territories. This approach coordinates the provisions of the LMCC and the SENAPRED Law, strengthening the country's response capacity to climate and disaster challenges

Chile has **other relevant policies and strategies for adaptation to climate change**, such as the National Water Resources Strategy 2012-2025, the Strategic Management Plans for Water Resources in Basins (PERHC), the National Biodiversity Strategy 2017-2030, the National Strategy on Climate Change and Vegetation Resources (ENCCRV), the National Strategy on Forests and Climate Change (ENBCC), the National Policy for Disaster Risk Reduction (PNRRD), the National Territorial Planning Policy (PNOT),

the National Rural Development Policy 2020-2030, the National Strategy for Food Security and Sovereignty, and the National Organic Waste Strategy 2040. These strategies and policies have been taken into account in the design of climate change management instruments to ensure the coherence and effectiveness of adaptation action.

4.3.3 Gender perspective and indigenous, traditional and local knowledge in adaptation strategies, policies, plans, goals and actions

Integrating a gender perspective into climate change adaptation policies has been essential to ensure inclusive and equitable responses. The PNACC, aligned with the LMCC and the LTS, includes a gender approach to reduce inequalities and promote climate justice.

Indigenous and local knowledge is valued in sectoral plans, such as Forestry, agriculture and livestock and Fishing and aquaculture, while PNACC included measures aiming to strengthen the resilience of women, older people, people with disabilities, youth and indigenous peoples. Citizen participation is key in planning processes.

4.3.4 Adaptation actions and/or economic diversification plans that lead to mitigation co-benefits

The country has implemented climate change adaptation measures that seek synergies with greenhouse gas (GHG) mitigation measures, promoting climate resilience and progress towards carbon neutrality, while maximizing environmental and social benefits. Examples of synergies include the infrastructure sector, with the promotion of non-conventional renewable energy, energy efficiency and carbon footprint management in public infrastructure, which reduces energy demand and the use of fossil fuels, while improving climate resilience. In the energy sector, climate considerations are integrated into policies and regulations, promoting a transition towards more sustainable and resilient energy sources.

4.3.5 Nature-based solutions (NbS) to climate change adaptation

The LMCC defines Nature-based solutions (NbS) as actions to sustainably manage ecosystems, addressing challenges such as climate change, food and water security, and disaster risk, while promoting benefits for biodiversity and sustainable development. The LMCC strengthens Chile's international commitments and integrates NbS into climate change management instruments. Specifically, the LTS prioritizes NbS due to their capacity to reduce emissions, capture carbon, and generate ecosystem benefits.

The PNACC establishes "Guidelines for the incorporation of NbS" that prioritize equity, inclusion, and cost-benefit assessment in their implementation. In addition, the study "Nature-Based Solutions for Chile" identifies NbS with high potential to reduce GHG and promote co-benefits. Relevant projects include the Baquedano Wetland Park, the restoration of watersheds in the Maule Region and the conservation of wetlands in the Atacama Region, which improve both water resilience and capture carbon. In the forestry and agriculture sectors, relevant initiatives include hydrological restoration in the Coquimbo Region and the recovery of wetlands in the Tarapacá Region. Despite progress, challenges persist, including the lack of systematization of projects and centralization of information.

4.3.6 Stakeholder involvement, including subnational, community-level and private sector plans, priorities, actions and programmes

The private sector in Chile is taking steps to improve its climate resilience, reduce risks and take advantage of opportunities in the face of climate change. Examples include updating climate models to assess mining risks, water tanks to increase water autonomy in Santiago, research on the impact of heat on health, desalination plants for mining activities, and ecological restoration and biological corridor programmes.

NGOs promote ecological restoration and community resilience initiatives, such as the restoration of urban green spaces and high Andean wetlands.

Academia develops interdisciplinary research that provides data and tools to improve public policies and adaptation strategies, covering areas such as water management, ecosystem services modelling and ecosystem degradation.

4.4. Progress on the implementation of adaptation measures

By integrating new approaches and strengthening climate governance at the national and territorial levels, the country has made progress in implementing its adaptation commitments. However, challenges persist in the execution of measures and in the consolidation of monitoring and evaluation systems. The ongoing update of the plans seeks to address these gaps, ensure effective climate action anda align efforts with international commitments.

Photo: Bryan Contreras

4.4.1 *Progress in the implementation of Sectoral Adaptation Plans*

Chile has shown significant progress in the implementation of climate change adaptation through the PNACC and sectoral plans. The PNACC achieved 83% progress in its implementation and began its update process in 2022. Meanwhile, the ministries and undersecretariats in charge of sectoral plans reported specific progress in the measures established in their areas:

- **Forestry, agriculture and livestock sector (2013)** achieved 84% progress, including key measures such as strengthening local capacities and promoting sustainable agricultural practices;
- **Biodiversity (2014)** reached 81% progress in its 50 measures, with notable achievements such as the national biodiversity monitoring network and the use of wetlands as indicators of watershed health;
- **Fisheries and aquaculture (2015)**, with 80% progress, this plan strengthened climate management in fisheries and aquaculture through research projects and tools such as Climate Risk Maps (ARClim);
- **Health (2016)** achieved 63% progress, with key measures including the creation of a climate coordination unit and predictive studies of vector-borne diseases;
- **Infrastructure (2017)** reached a 78% progress, focused on preparing public works for climate change, integrating climate change into ministerial planning and monitoring coastal works;
- **Energy (2018)**, with 68% progress, this plan strengthened energy resilience through efficiency programmes and analysis of the climate impact on energy demand;
- **Cities (2018)** achieved 96% progress with significant measures such as incorporating climate change into urban planning regulations and promoting green infrastructure;
- **Tourism (2019)**, the plan reached 45% progress, with achievements such as training on resilient practices.

Most sectoral plans have shown a positive evolution in their implementation, although those launched more recently have shown less progress. The 2024 updates to these plans seek to enhance adaptation, overcome barriers, optimize planning and strengthen sectoral coordination to address climate change challenges more comprehensively.

4.4.2 *Implementation of adaptation actions identified in the adaptation component of the NDCs*

Chile has made significant progress in its NDC 2020 adaptation commitments, in alignment with the LMCC:

- **Climate change instruments:** progress has been made in the development of new plans and the update existing ones, including 16 regional and 12 sectoral plans.
- **Vulnerability and risk assessment:** the ARClim platform and studies on the costs of inaction and loss and damage have strengthened the scientific basis for decision-making, integrating gender and intersectional approaches.
- **Monitoring and evaluation:** indicators systems are being strengthened with resilience indices and methodologies to measure progress and results in adaptation goals.
- **Involvement of non-governmental actors:** in 2024, the creation of a registry of adaptation actions by non-governmental actors began, promoting public-private cooperation.

- **Water resources and risk management:** the implementation of the National Policy for Disaster Risk Reduction 2019–2030 and specific plans, such as the plan to address heat waves, help to strengthen resilience to climate threats.

4.4.3 Coordination activities and changes in regulations, policies and planning

Chile has developed institutional arrangements to integrate climate change into its policies and improve climate governance, including:

- **New units and committees:** institutions such as the Ministry of Public Works (MOP), the Ministry of Mining, the Ministry of Health, the National Disaster Prevention and Response Service (SENAPRED), the National Geology and Mining Service (SERNAGEOMIN), the MOP's General Water Directorate (DGA), and the Roads and Urban Transport Programme (SECTRA) of the Ministry of Transport and Telecommunications have created units dedicated to climate adaptation, promoting advances in infrastructure, public health, transportation and water resources and the integration of adaptation in disaster risk management.

- **Strengthening of the CORECC:** these regional committees have improved territorial and intersectoral coordination, allowing the planning of adaptive measures that respond to regional priorities. Notable progress includes greater investment in climate education and better coordination with the Ministry of Housing and Urban Planning in urban development projects.

4.5. Monitoring and evaluation of adaptation actions and processes

The LMCC establishes procedures for monitoring and evaluation (M&E) of climate change adaptation. All adaptation instruments must include MRV indicatorsthe implementation of which is overseen by the MMA.

Furthermore, the National System for Access to Information and Citizen Participation includes a Climate Adaptation Platform, which centralizes information to support policies and evaluate adaptation measures. In addition, Chile is moving towards its NDC 2025 commitment by developing an M&E system with process and outcome indicators applicable to all adaptation instruments.

As part of the PNACC, Chile is developing an M&E system, through a publicly accessible digital platform, to consolidate and standardize information on the implementation of measures, facilitating progress evaluation and reporting to the UNFCCC. The PNACC 2024 prioritizes the development of resilience and adaptation capacity indicators, as well as improving the monitoring of climate change integration into the Environmental Impact Assessment System (SEIA) and the Strategic Environmental Assessment (EAE). These indicators will enable the annual tracking of actions and the fulfilment of adaptation objectives by 2050, with a focus on reducing vulnerabilities and risks.

Among the advances to date are the MMA's studies, such as the "Development of national indicators" (2021–2022), which recalculated ARClim risks and proposed governance for an Adaptation Indicator System. In addition, in 2024, a public registry of adaptation actions was created to disseminate good practices.

Photo: Nicolás Smith D.

4.6. Information related to averting, minimizing and addressing loss and damage associated with climate change impacts

4.6.1 Observed and potential impacts

A MMA study commissioned by the Economic Commission for Latin America and the Caribbean (ECLAC, 2023) highlighted that inaction on climate change under the RCP8.5 scenario could generate significant annual losses by 2050, estimated at USD 4.12 billion, affecting key sectors such as mining (USD 1.65 billion) and biodiversity (USD 1.3 billion). Another MMA study proposed a roadmap to improve the quantification of loss and damage (L&D) through tools such as remote sensing and GIS, and assessed the impacts on infrastructure, housing, services, productive sectors and population due to extreme events that occurred between 2008 and 2023 (Figure 8).

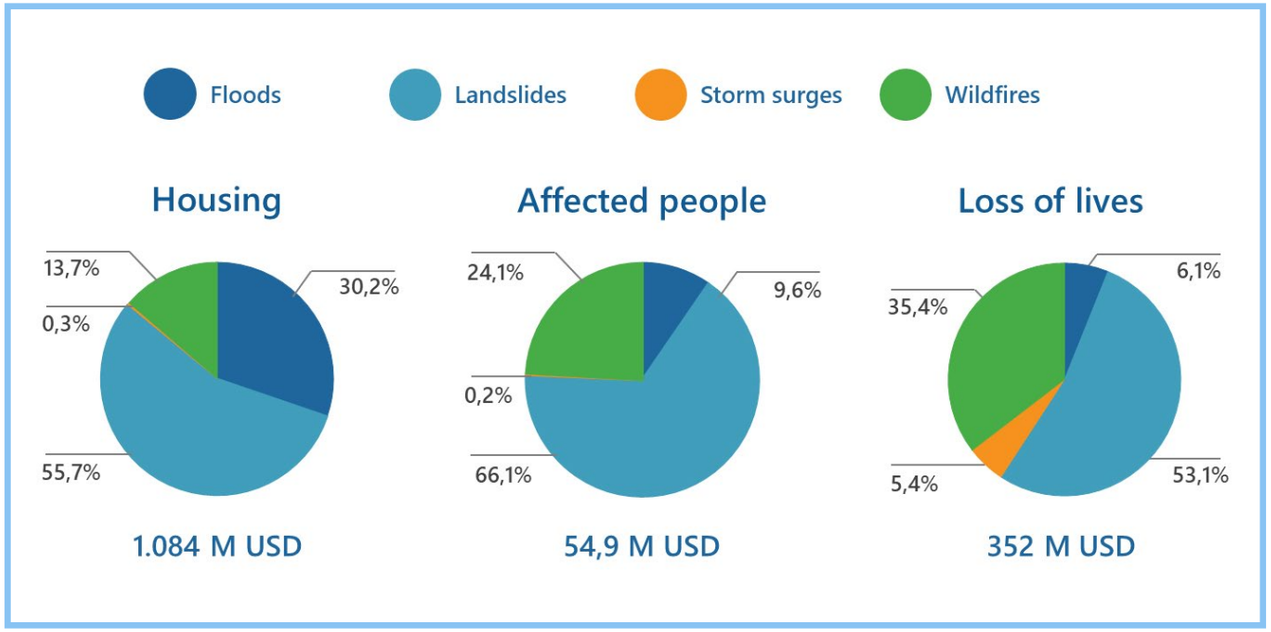

Figure 8. Summary of economic damage caused by extreme events between 2008 and 2023 (March).
Source: (MMA-DEUMAN, 2023a).

Based on participatory processes carried out in workshops with the involvement of municipalities, academia, NGOs and civil society organizations, **specific L&D were identified in each macrozone of the country:**

- **Northern macrozone:** storm surges affecting coastal infrastructure and marine biodiversity;
- **Central macrozone:** losses in agricultural productivity and biodiversity; social conflicts associated with adaptation to climate change;
- **Southern macrozone:** impacts on infrastructure, water systems and biodiversity; loss of human settlements and lives;
- **Austral macrozone:** damage to ecosystem resilience and tourism productivity; losses in marine biodiversity and water systems due to glacial retreat.

Among the **opportunities and gaps to evaluate L&D**, the lack of homogeneous criteria for data collection was detected, along with the need to have real-time monitoring and evaluation systems, with tools to measure non-economic impacts, and centralized platforms to integrate data from multiple institutions. The need to improve management and governance was also identified, strengthening coordination between central, regional and local levels, and connecting international mechanisms to access financing and technical assistance. Finally, greater participation by the private sector is required to redirect investments towards adaptation and loss and damage management.

4.7. Cooperation, good practices, experience and lessons learned

Chile has prioritized knowledge and resources exchange, including experiences, best practices and lessons learned at both the national and international levels, as a key part of its strategy for climate change adaptation.

4.7.1 Experiences that contribute to international cooperation

Chile contributes to international cooperation in climate adaptation, through initiatives such as **ENANDES**, led by the DMC and financed by the Adaptation Fund. This initiative aims to strengthen climate services in the Andean region through forecasts, tools such as the AgroPhotovoltaic Calculator, drought indices, and early warning systems in Argentina and Bolivia. Additionally, **AdaptaClima** stands out as a regional project focused on the coastal cities of Antofagasta, Taltal (Chile) and Esmeralda (Ecuador) seeking to mitigate risks of floods and landslides. . The project is implemented by the Development Bank of Latin America and the Caribbean (CAF), and financed by the Adaptation Fund.

4.7.2 Good practices and lessons learned

Chile has shared some of the best practices and lessons learned in relation to its National Climate Change Adaptation Plan (PNACC) and the incorporation of cross-cutting guidelines and frameworks for the inclusion of adaptation into public policies at different territorial levels.

Moreover, the implementation of adaptation projects has helped identify good practices related to various topics, such as: (1) climate change and resilience of small-scale agriculture; (2) adaptation capacity in the fishing and aquaculture sector, which identified success factors and potential barriers influencing the sector's sustainable development; and (3) water access gaps in vulnerable regions, which involved developing networks of collaboration and promoting participatory water management that could be replicated in other territories.

Additionally, SENAPRED has implemented a pilot project, based on the Global Methodology for Infrastructure Resilience, to design more resilient infrastructure in the face of climate disasters.

4.8. Other information related to climate change impacts and adaptation

4.8.1 Participatory processes

Chile guarantees citizen participation in public management through Law 20,500, which recognizes the right of people to be involved in state policies and decisions. Notable examples include Early Citizen Participation, promoted by the MMA, which facilitates input collection through tools such as surveys, public-private roundtables and citizen assemblies, both in person and virtually. Under the LMCC framework, the Territorial Conmmittees promote participation in regional climate action plans, integrating specific local issues into mitigation and adaptation strategies.

4.8.2 Transboundary climate risks

Transboundary climate risks require international cooperation due to their shared nature. In Chile, shared water resources in Andean river basins highlight the importance of "hydro-diplomacy" to manage conflicts and promote sustainable water use. Climate change also affects marine ecosystems, intensifying tensions in fishing and aquaculture due to species displacement and overexploitation, especially with Peru. In addition, the *Aedes aegypti* mosquito, a vector of dengue, threatens to expand in Chile, which is working with the Pan American Health Organization (PAHO) and the World Health Organization (WHO) on prevention and control strategies.

Photo: Nicolás Smith D.

5. SUPPORT RECEIVED AND PROVIDED BY CHILE TO MEET NEEDS RELATED TO CLIMATE CHANGE

Chapter 5 provides information on Chile's specific needs in terms of climate change management, including the identification of existing barriers and gaps. It also highlights the international support received during the last two years and the contributions Chile has provided to other countries.

The information provided is the result of the sectoral reporting process, with the ETICC being the main informant. This information is structured in two parts: 1) needs, barriers and gaps in the public and private sectors, and 2) support for climate action; these categories are analysed according to their scope and dimensions.

The methodology used for the collection and analysis of information on the "*needs*" of the public sector was carried out through: an analysis of the documentation for the reporting of needs; the design of a method for capturing primary information; training and empowerment of relevant actors; the collection of primary information; the reception and validation of the primary information reported, and, finally, the consolidation of information for the analysis. For the private sector, a methodology based on interviews with key business owners was used.

Based on the above, a total of 118 needs were identified, which are distributed as follows.

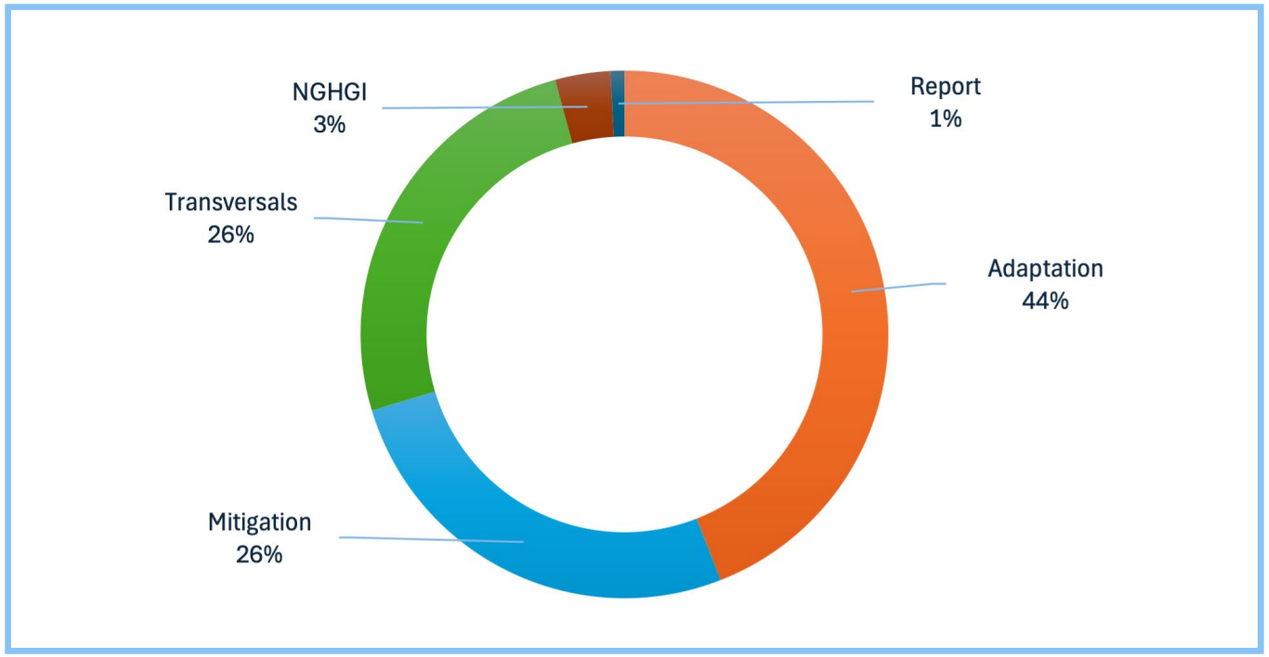

Figure 9. Distribution of needs by area.
Source: Prepared by the MMA.

In addition, the distribution of needs is detailed according to their main support dimension, where the majority (59%) refer to capacity development, 30% represent the implementation of specific plans, projects and technologies, which are grouped in the category of financial support, 10% are related to the promotion of development and technology transfer actions, and 1% are related to support for transparency.

Also, the chapter presents relevant information regarding possible solutions and implementation barriers related to the needs of the public sector, which are analysed in detail according to the area of action and the support dimension. For example:

- In the Reporting area, it is noted that challenges persist in the Support for Transparency dimension, in particular regarding the allocation of permanent resources (USD 500,000 annually) for the preparation of the reports established under the Enhanced Transparency Framework of the Paris Agreement.

- In the National Greenhouse Gases Inventory (INGEI) area, the needs identified are related to the generation of methodologies, the collection of information and the implementation of studies for the measurement of the carbon footprint in different sectors. The greatest barrier identified is the availability of financing and the position of the country as a recipient of international funds, as well as technological limitations; therefore, to meet these needs an investment of approximately USD 140 000 is required (two-year period).

- In the Mitigation area, urgent needs are identified, mainly in relation to capacity building and technical assistance (especially for the energy, transportation and infrastructure sectors).

    - Under the Financial Support dimension, this document shows that the financing available for the execution of these initiatives is the most important barrier, in addition to technical barriers in terms of the level of training of the professionals in charge of implementing the projects and the technological capabilities available. The document also refers to sociocultural barriers, referring to the capacity of citizens to accept and integrate new methods into their daily lives. The resources needed for this dimension total approximately USD 378 million.
    - In terms of the Capacity Building dimension, it is evident that the needs are primarily related to the generation of specific studies (information gathering, design, implementation) and the strengthening of technical capacities of the services through training and development in human resources. Financial support is the main barrier to carrying out these actions, as well as the existing capacities of the teams to undertake high-level technical studies. It is identified that the investment needed in this area totals USD 7.7 million.
    - For the Technology Development and Transfer dimension, it is noted that the needs are related to the increase in knowledge regarding green hydrogen, with the main transversal barriers being those of financing and the capacities of the teams tasked with implementing and managing the new technologies. The investment required to address the needs in this area totals USD 5.9 million.

- In the Adaptation area, an important milestone is the update of the PNACC. The update of this instrument will provide sectoral, regional and communal plans with guidelines for the preparation of local plans, providing minimum standards for the sectors to ensure their implementation. This reflects the challenge of updating sectoral plans by incorporating new knowledge related to impacts, vulnerabilities and lessons learned.

    - In the Financial Support dimension, there is a need to implement the measures included in the sectoral adaptation plans, as well as specific programmes, while improving the country's monitoring networks and developing online tools. The biggest gap is financing, as well as limitations in terms of available capacities. The amount needed to address this need totals USD 593 million.
    - In terms of the Capacity Building dimension, there is a need for information gathering, the development of action methodologies and guidelines, the generation of technical studies and the identification of enabling conditions for the implementation of plans and projects, as well as the training and hiring of technical support within the services, and the generation of alliances between relevant actors for the development of enabling conditions. Here, the main barriers are once again related to the available financial support, as well as the lack of available capacities and technologies for the implementation of the measures. The total investment needed is USD 258 million.
    - In the Technology Development and Transfer dimension, the needs presented in the document refer to the further study of geothermal energy generation, the strengthening of energy security, and the implementation of machine learning processes in the forestry and agricultural sector. Meanwhile, barriers associated with financing, governance, and sociocultural factors are in the process of being removed. The required investment in this dimension is USD 352,000.

- Regarding Cross-cutting needs, this category highlights the need to address the gaps identified in the available studies by implementing projects on the ground.

    - In the Financial Support dimension, financing would be needed for the implementation of programmes, projects and plans. An estimated investment of USD 83 million is required.
    - In terms of the Capacity Building dimension, it is evident that most of the needs refer to the generation of spaces for technical assistance, training and hiring of professionals. Also, there is a need for the development of technical guidelines and studies and the identification of enabling conditions. The main barrier identified is the limited availability of financing, followed by a lack of adequate gover-

nance. The amount needed to address these needs is estimated at approximately USD 3.2 million

- Regarding the Technology Development and Transfer dimension, the country's main needs are related to the development of capacities for the adoption of existing technologies. The main barrier is access to financing, with the amount required to address these needs estimated at USD 370,000.

Therefore, this chapter confirms that access to financing is the main barrier to meeting the needs regarding climate action in all areas and dimensions of the public sector.

Regarding the prioritization of the needs expressed in the public sector, it is noted that the promotion of capacity development is highlighted as a transversal need.

In terms of the support needs of the private sector, it is highlighted that this sector has played a significant role in the investment and implementation of innovative measures to mitigate climate change. However, the area of adaptation is an emerging topic that is only recently being studied and incorporated into the sector.

The document explains that, based on a study recently conducted for the private sector and various interviews, the gaps and needs in terms of the required support were confirmed, including: the limited understanding of adaptation to climate change, the poor implementation of measures related to adaptation, the limited use of financial instruments, the difficulty of accessing financing, the need to intensify efforts to generate synergies between companies and/or conglomerates, and how Chilean technology faces various barriers to market entry.

Regarding Support for Climate Action in Chile, the chapter refers to the international support received and provided by Chile for activities related to climate change. This information was classified into two categories: support received in the period 2022-2024 and support provided for activities related to climate change.

Regarding the support received, for the period 2022-2024, the document shows that Chile received a total of USD 68,880,192 in international support for the development of projects and activities related to climate change, distributed across the dimensions of Financial Support, Capacity Building, and Technology Development and Transfer. This includes support provided for the development of the Fifth National Communication and the First Biennial Transparency Report, as well as for the strengthening and updating of Chile's NDC, which totalled USD3,239,755.

In addition, the chapter highlights the international support received by Chile, as a developing country, for activities related to climate change from different organizations and institutions. This includes information regarding the contributions received by Chile through direct cash transfers to develop specific activities or programmes on the national climate agenda. During the reporting period, 2022-2024, donor institutions contributed a total of USD 63,776,956 to address needs in the Financial Support dimension, a total of USD 963,495 in the Capacity Building dimension, and USD 800,076 in the Technology Development and Transfer dimension.

Photo: Bryan Contreras

6. OTHER RELEVANT INFORMATION

6.1. Introduction

Article 3 of the LMCC defines the Means of Implementation as any "action, measure or process in the institutional or regulatory field for the development and transfer of technology, the creation and strengthening of capacities and financing, among others, that are required for the implementation of actions for climate change mitigation and adaptation"; and, the article 6 provides a description of the Means of Implementation of the LTS, including: a) development and transfer of technology; b) creation and strengthening of capacities, and c) financial guidelines. In this context, this chapter presents the country's progress regarding these three means of implementation, which are linked with the following strategies: i) development and transfer of technology for climate change; ii) development of capacities and climate empowerment, and iii) climate finance.

6.2. Technology Development and Transfer

Since 2018, the Ministry of Science, Technology, Knowledge and Innovation has promoted, facilitating the formation of human capital and democratising knowledge. Its structure includes an Undersecretariat, Regional Secretariats and the National Agency for Research and Development (ANID), focusing on reducing territorial, disciplinary and gender inequalities, while strengthening capacities in R&D&I at the national and regional levels. Although it does not have a specialized unit on climate change, the ministry has developed strategies and technical teams to assume responsibilities in this area, such as the technical secretariat of the Scientific Committee and the Science and Technology Repository. In 2021, it presented the Technology Transfer Strategy for Climate Change, aligned with the LMCC and linked to national climate goals.

The National Policy on Science, Technology, Knowledge and Innovation (CTCI) 2023-2026 promotes sustainable development in the face of the environmental crisis and social challenges. Its main axes are: engagement with civil society, capacity development and strengthening of the ecosystem. It focuses on actions such as promoting climate resilience, carbon neutrality and strengthening sustainability research.

During 2024, five key gaps were identified in the CTCI system that must be closed to address the climate crisis: 1) data and technology governance for integrated approaches; 2) the science-policy and science-society interface for informed actions; 3) human capacities specialized in interdisciplinary approaches; 4) knowledge and infrastructure on climate change, biodiversity and pollution; and 5) technical monitoring of Climate Change Management Instruments (IGCC). In addition, 79 sub-gaps were detected that require urgent and coordinated actions (UNTEC *et al.*, 2024).

6.2.1 Technology development and transfer strategy for climate change (EDTTCC)

The EDTTCC seeks to strengthen technology transfer to achieve sustainable, resilient and carbon-neutral development by 2050, which is aligned with the commitments of Chile's NDC 2020. Its objectives include identifying and prioritizing sectors that emit or capture GHG and are affected by climate change, based on the National Inventories of GHG (INGEI) and agreed national criteria. The strategy proposes creating Technology Action Plans (PAT) through the Technology Needs Assessment (TNA), including the elimination of institutional, regulatory and economic barriers. In addition, it promotes cooperation between the public and private sectors and international organizations to coordinate initiatives and incorporates research guidelines and systematization of climate data to inform policies at all levels. The EDTTCC also highlights the creation of an enabling framework to overcome barriers in the development of technologies and the implementation of PAT, prioritizing key sectors.

During the period 2020-2025, a project was submitted to the Green Climate Fund (GCF) to carry out TNA and PAT in three sectors, in addition to creating a Climate Technology Inventory and research centres. Chile's Agency for Sustainability and Climate Change (ASCC), as a Designated National Entity, facilitated TNA in adaptation (forestry, agriculture and water resources sectors) and mitigation (energy and waste).

6.2.2 Experiences in technological development to address climate change in cooperation with the private sector

This section presents some specific technological development initiatives on climate change, developed by the Production Development Corporation (CORFO) and the Energy Sustainability Agency (AgenciaSE). In this regard, the creation of the Sustainable Productive Development programme (DPS) in 2023 marked a key milestone by addressing challenges such as fair decarbonization, climate resilience, and productive diversification.

CORFO promotes mitigation and adaptation to climate change through programmes such as **Transforma Cambio Climático** (energy, water resources, sustainable construction), **Territorio Circular** (circular economy) and **Transforma Turismo** (energy efficiency and zero-emission management). It has financed key research centres such as the Chilean Institute of Clean Technologies in Antofagasta and the Electromobility Centre. During the period 2020-2024, it supported more than 600 projects in adaptation, mitigation and the circular economy, strengthening climate innovation and resilience.

AgenciaSE has implemented various initiatives to promote energy efficiency and renewable energy in Chile, including photovoltaic and thermal conditioning projects in public buildings and schools, as well as the GEF District Heating programme and the Giro Limpio programme to certify sustainable transport companies. The agency supports the transition to clean technologies through its Electromobility and Green Hydrogen Accelerator programmes. It has also installed photovoltaic systems in homes and improved energy access in rural kindergartens. AgenciaSE's Comuna Energética programme promotes sustainable projects in 108 districts of the country, and the agency also provides energy education and supports the industry through energy efficiency and renewable energy programmes. In addition, it recognizes leading organizations in emissions reduction and certifies energy savings.

6.2.3 *Scientific Advisory Committee on Climate Change*

The Scientific Advisory Committee on Climate Change ensures that Chilean policies are aligned with international commitments, such as the Paris Agreement, and support long-term objectives in mitigation and adaptation. The current committee, formed in 2024, brings together experts in critical areas such as marine ecosystems, public health, water governance and energy efficiency. During the reporting period, several publications have been generated, such as the Preliminary Report on the Long-Term Climate Strategy, and on specific topics such as: desalination, ventilation, nature-based solutions, energy transformation, water security, oceans and opportunities for a resilient reactivation.

6.2.4 *National Agency for Research and Development and Research Related to Climate Change*

The National Agency for Research and Development (ANID) administers programmes focused on: Human Capital, which finances national and international postgraduate scholarships; Research Centres, which promote institutions such as Basal Centres, the Fund for Research Centres in Priority Areas (Fondap) and Millennium Nuclei; Networks, Strategy and Knowledge, which promote collaboration between science, industry and the State; Research Projects, which finance initiatives such as the National Science and Technology Development Fund's (Fondecyt) Research Initiation project, and Applied Research, with programmes such as the Fund for the Promotion of Scientific and Technological Development (Fondef), which are aimed at promoting innovation in productive and social sectors. In addition, ANID executes other relevant programmes such as the National Fund for Research and Development in Health (Fonis), the Associative Research Programme (PIA) and Explora, which seek to strengthen scientific production and technology transfer in various areas.

Since 2010, ANID has shown sustained growth in projects related to climate change, both in quantity and financing, highlighting years such as 2023, with 106 projects awarded.

Between 2021 and 2023, 980 projects linked to climate change were awarded, covering research on topics such as forest fires, adaptation to climate change in arid zones, and CO_2 bioconversion. These initiatives demonstrate ANID's commitment to applied science, generating innovative solutions and critical knowledge to face climate challenges in Chile and strengthen adaptation and mitigation.

Several research centres have been supported by ANID through programmes such as Centres of Scientific Excellence and Regional and Associative Research Programmes. These centres focus on areas linked to climate change and sustainability, addressing topics such as climate science, marine ecosystems, arid zones, applied ecology, geothermal energy, sustainable aquaculture, renewable energy, urban development, and oceanography, among others.

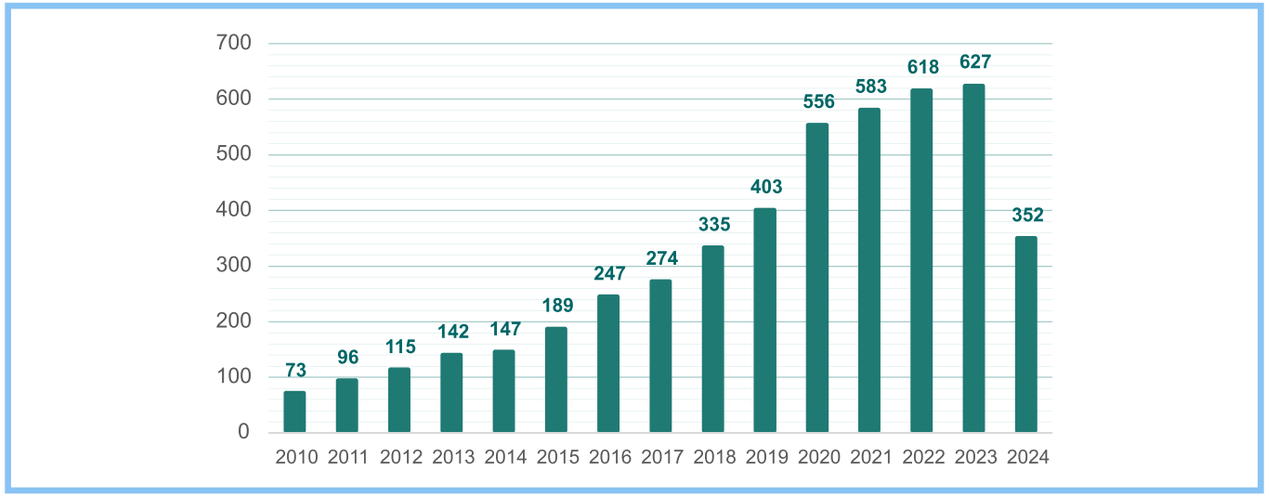

Figure 10. Temporal evolution of the number of publications.
Source: Data shared by MinCiencia.

In addition, Chile's Public Technological and Research Institutes strengthen the national infrastructure and support scientific and technological research, with a focus on innovation and economic and environmental development. These include the Energy Sustainability Agency, the Natural Resources Information Centre (CIREN), Conecta Logística, Fundación Chile, the Fisheries Development Institute (IFOP), the Chilean Military Geographic Institute (IGM), the Chilean Antarctic Institute (INACH), the Forestry Institute (INFOR), the National Hydraulic Institute (INH), the Agricultural Research Institute (INIA), the National Standards Institute (INN), the Public Health Institute (ISP), and the Institute for Disaster Resilience (ITREND). Other key bodies include the Aerophotogrammetry Service (SAF), the National Geology and Mining Service (SERNAGEOMIN), and the Chilean Navy's Hydrographic and Oceanographic Service (SHOA).

6.3. Capacity building and strengthening

The LMCC establishes that the LTS must include objectives, goals and indicators that strengthen the capacities necessary to face climate change. In this regard, on 16 January 2024, Resolution No. 35 of the MMA was published, which approves the Climate Empowerment and Capacity Development Strategy, based on the vision "that Chile has a society and institutions capable of responding to the challenges of climate change, with an informed, sensitized and proactive citizenry that will contribute to the development of public policies and will contribute from their personal and organizational area to the changes necessary to achieve carbon neutrality and resilience of the country no later than 2050". The strategy proposes guidelines and lines of action grouped into five components: a) research and science; b) capacity building and strengthening; c) citizen education to address climate change; d) cooperation and exchange of experiences, and e) access to information and citizen participation.

These components include guidelines and lines of action to guide the development of climate change management instruments and their implementation by organizations in the public and private sectors, as well as by academia and civil society organizations. The strategy establishes the Coordinating Committee for Climate Empowerment Action (CCAEC), which is responsible for the development, implementation and monitoring of the Climate Empowerment Strategy, in collaboration with the Ministry of Education, the Ministry of Science, Technology, Knowledge and Innovation, the Ministry of Labour and Social Security, and the MMA. This component aims to generate skills for the labour market and promote the development of capacities in organizations, both public and private, as well as in civil society, to advance towards carbon neutrality and climate resilience.

It should be noted that the research and science component was discussed in the previous section of this chapter. The progress reported in the other four components is summarized below.

6.3.1 Capacity building and strengthening

Some initiatives that have contributed to the implementation of this component are the study "Projection of the need for human capital in the context of the implementation of the Framework Law on Climate Change in Chile" and CORFO's Training Programmes for Competitiveness (PFC), through courses in horticultural adaptation, GHG management, and Circular Economy, among other initiatives. In addition, this component has sought to strengthen capacities at the national, regional and subregional levels, through a programme supported by the European Union's EUROCLIMA+ initiative and the German Agency for International Cooperation's (GIZ), and the creation of a diploma in subnational climate actions with the support of FAO and the GCF. There is also the regional training initiative of the Undersecretary for Regional and Administrative Development (SUBDERE), Academia SUBDERE, which includes programmes on climate change, energy management, sustainable development and circular economy. Additionally, the "Methodological guidelines for the preparation of a communal action plan on climate change", developed by the United Nations Development Programme (UNDP) and the MMA, and the "Guidelines for climate action in municipalities and regional governments: towards carbon-neutral and resilient territories", developed by the Inter-American Development Bank (IDB) and the MMA, have been made available.

Another initiative of the MMA is the Municipal Environmental Certification System (SCAM), which is a voluntary system that allows municipalities to become certified in environmental management. As of March 2024, 70% of the country's municipalities are part of the programme. In addition, the MMA promotes an accreditation programme for public institutions and private entities to incorporate good environmental practices in the administration of the institution's physical facilities, called the Green Office (*Oficina Verde*). Currently, the programme has 81 participating institutions, of which 67 are public institutions and 14 are private entities.

6.3.2 Citizen education to address climate change

This component aims to raise awareness and educate children, youth and adults about climate change at both the formal and informal levels, while promoting the identification and implementation of transformative solutions to address the climate emergency, with an intercultural, intergenerational and gender approach. This section presents the progress made by the Ministry of Education (MINEDUC) and some initiatives led by the MMA, such as the National System of Environmental Certification of Educational Establishments (SNCAE), the Adriana Hoffman Environmental Training Academy, community environmental education initiatives, the Environmental Education Repository and the Environmental Protection Fund.

It is important to mention that the MINEDUC has played a key role in climate action, participating in high-level technical-political bodies and forming an internal committee that coordinates common guidelines. In this regard, it has been working on the development of the Comprehensive Education Framework for Sustainability and Climate Change (MEISC), which integrates legal obligations, international commitments and principles such as those of the Escazú Agreement to strengthen environmental education, inclusion, equity and quality of learning. This framework, which is still in the final phase of publication, is comprised of four main axes: institutional management, capacity development, transformation of learning spaces and territorial linkage. In addition, initiatives such as the Escazú Agreement Implementation Plan, the EDS 2030 Programme and the Comprehensive School Safety Plan (PISE) reinforce the commitment of education institutions to sustainability.

Furthermore, the incorporation of climate change into the school curriculum, including the updating of content and learning objectives for secondary education, contributes to forming more informed and resilient citizens. The MINEDUC has promoted the survey on the status of Education for Sustainable Development, the creation of a Sustainability Education website that systematizes resources and pedagogical guidelines, and a curricular update process in 2024, which seeks to strengthen environmental education from early childhood to higher education. In this regard, the Chilean educational system is moving towards a comprehensive education approach capable of facing the triple planetary crisis (climate change, biodiversity loss and pollution) and building a fair, sustainable and inclusive society.

Some results of the MMA initiatives include the certification of schools and high schools, integrating the environmental dimension in curricular areas, internal management and connection with the environment, with more than 2,300 establishments certified in 2024 through the SNCAE system. In addition, the MMA's Adriana Hoffmann Environmental Training Academy has provided e-learning courses for teachers, citizens and public officials, addressing issues of climate change, water and gender equity, while strengthening capacities in environmental education. Community environmental education promotes actions in territories and communities, highlighting the work of environmental advocates (*Forjadores Ambientales*) and the development of methodological guidelines for citizen participation in climate change. The MMA Environmental Education Repository brings together more than 250 pedagogical resources, supporting teachers, citizens and public officials with information on various topics, including climate change.

Finally, the Environmental Protection Fund (FPA) finances citizen initiatives for environmental protection, with an emphasis on climate change mitigation and adaptation, sustainable projects for indigenous peoples and innovative uses of extra-budgetary resources, thereby contributing to education, sustainability and climate action at the local level.

6.3.3 Cooperation and exchange of experiences

This component promotes cooperation and the exchange of knowledge and experiences to facilitate climate action at the international, national, regional and local levels. In this framework, the Local Youth Conference (LCOY) is a key space for Chilean youth to present proposals and demands, which are reflected in the National Youth Declaration on Climate Change. Since 2021, various versions of the LCOY have been held, incorporating themes such as climate empowerment, loss and damage, the just transition and environmental justice. The resulting declarations have influenced advances such as the ratification of the Escazú Agreement, the approval of the Framework Law on Climate Change and the modification of the Water Code. Although substantial changes are not yet observed in response to all youth demands, there are signs of progress in terms of governance, environmental rights and the transition towards more just and sustainable societies. The latest declaration (2023) integrates territorial, intersectional and fair approaches, strengthening the role of youth in the construction of climate public policies.

6.3.4 Access to information and citizen participation

This component seeks to strengthen access to climate information and citizen participation to improve decisions and actions related to climate change, thereby ensuring their legitimacy and effectiveness. It facilitates the analysis and use of data in line with the Escazú Agreement, promotes representative and safe citizen participation, and mainstreams the gender perspective in all climate policies and plans. The goal is to reduce gender gaps and highlight the role of women as a climate solution, while promoting greater inclusion of vulnerable territories and groups in climate governance.

In this regard, the MMA developed the National System for Access to Information and Citizen Participation on Climate Change (SNAICC), which includes six sub-systems to make information transparent and easily accessible while promoting citizen participation. During 2023, progress was made on the regulations and the development of technical requirements for its implementation. In addition, the MMA web portal was updated to integrate key climate information and improve interaction with citizens. A sustained increase in requests for information and hearings related to climate change has been observed.

The MMA has led participatory processes related to climate management instruments, promoting open, inclusive and representative citizen consultations. These processes guarantee the right of citizens to participate in the formulation of policies, plans

and regulations related to climate change, following the provisions of the Framework Law on Climate Change and the General Environmental Bases Law. Between 2020 and 2024, 39 national and regional consultation processes were carried out, including workshops, working groups and digital platforms to ensure early participation and the collection of observations.

The procedure for developing the climate management instruments includes various stages, such as early participation, receipt of background information and formal public consultation, with an emphasis on accessibility for vulnerable groups. Examples of these processes are the Long-Term Climate Strategy and the update of the Nationally Determined Contribution (NDC). It is worth mentioning that, during 2024, the sectoral mitigation and/or adaptation plans implemented the processes of receiving information and public consultations.

In 2023, CORFO carried out a national survey to identify the needs and actions of Chilean companies in the face of climate change. Of the total number surveyed, 50.9% have taken adaptation measures in the last seven years, with higher %ages in the Ñuble and Coquimbo Regions (60%) and lower in the Antofagasta and Metropolitan Regions (39.8 and 44.8%, respectively). The oldest companies, founded before 2000, have adopted the most measures, while the newest companies have done so to a lesser extent. Of the companies that implemented measures, 46.4% have faced difficulties, mainly due to high costs (34.2%), lack of financing (31.2%) and knowledge (16%). Those that did not take measures pointed out the lack of financing (35.3%), lack of knowledge (29.5%) and other priorities (23.4%) as barriers. To facilitate adaptation, 34.1% consider financial advice to be key, followed by training (11.2%) and technological demonstrations (10.9%).

In addition, the National Youth Institute (INJUV) conducted a Youth and Climate Crisis Survey in January 2024, interviewing 1,513 young people between 15 and 29 years old. It reveals that 91% believe that climate change negatively affects the quality of life, generating feelings such as worry (21%) and sadness (18%). Of those who do not want to have children, 67% indicate that this decision is influenced by the climate crisis. In addition, 88% of young people are interested in the subject and 70% show a willingness to participate in environmental actions. Social networks, especially Instagram, are the main source of climate information (60%), and 68% identify human activity as the main cause of climate change. The study also highlights that women, especially those from lower-middle-class backgrounds, experience higher levels of emotional distress and that 20% have faced mockery for their environmental opinions or actions.

6.3.5 Gender and climate change

Since 2018, Chile has made progress in incorporating the gender perspective in climate change management. The LMCC promotes equity and climate justice, balanced participation and gender criteria in sectoral plans and governance. The LTS establishes goals for 2030 and 2040 to reduce gender gaps in climate management instruments, integrating gender-responsive actions and promoting equity in participation and policy design.

Between 2020 and 2024, work has continued with the **Gender and Climate Change Roundtable**, applying the "Checklist for the integration of Gender in Climate Change public policy instruments" and providing recommendations to the leading institutions of various public policy instruments, including: the Update of the National Climate Change Adaptation Plan; the Update of the Adaptation Plan for the forestry and agricultural sector; the National Landscape Restoration Plan 2021-2030; the National Organic Waste Strategy Chile 2040; the Just Transition Strategy for Decarbonization; the Long-Term Climate Strategy; the four Regional Climate Change Action Plans (Atacama, O'Higgins, Los Ríos and Los Lagos); the update of the Climate Change Adaptation Plan for the Biodiversity Sector; the Transport Adaptation and Mitigation Plan; the Mining Adaptation and Mitigation Plan, and the Water Resources Adaptation Plan.

In addition, projects such as Gender and Climate Change have trained more than 400 people, in addition to generating information on the relationship between gender and climate change. At the international level, Chile organized the Regional Meeting on Climate Change and Gender Equality, promoting regional networks and good practices in Latin America and the Caribbean. Joint work with countries such as Uruguay, Mexico and Canada has allowed for the exchange of experiences and the strengthening of inclusive and gender-transformative solutions.

6.4. Financial guidelines

Chile has promoted a series of actions aimed at promoting financing for climate action at the national and international level, including the Climate Change Financial Strategy, which seeks to align the efforts of the public and private sectors to mitigate its impacts and adapt to its effects, while promoting carbon-neutral and resilient development.

In recent years, Chile has seen considerable growth in green finance, driven by collaborative development between the public and private sectors. For example, the Sovereign Green Bonds (SGB) established in 2019 are financial instruments designed and managed by the Ministry of Finance, which seek to channel investments towards projects that promote sustainable development, such as clean transport, energy efficiency, renewable energy, water management and green buildings (Ministry of Finance, 2019). In addition, in 2022, Chile became the first country to issue Sustainability-Linked Bonds (SLB), with the aim of reducing greenhouse gas emissions and promoting clean energy.

The Ministry of Finance is the public institution responsible for the climate financing component of the UNFCCC, and the Budget Directorate (DIPRES) of the Ministry of Finance is the technical body in charge of ensuring the efficient use of public resources to meet these objectives. These, together with the MMA and the Ministry of Social Development and Family (MDSYF), must draft the climate investment report, which will be part of the National Climate Change Action Report. The first climate investment report was published in September 2023 and contains the analysis and results for 2022 of the identification of climate change-linked investment. This first report analysed a total of 3,075 investment projects, of which 416 were projects with a climate spending component; total expenditure reached 258.89 billion Chilean pesos, representing 13.7% of the total investment in these initiatives.

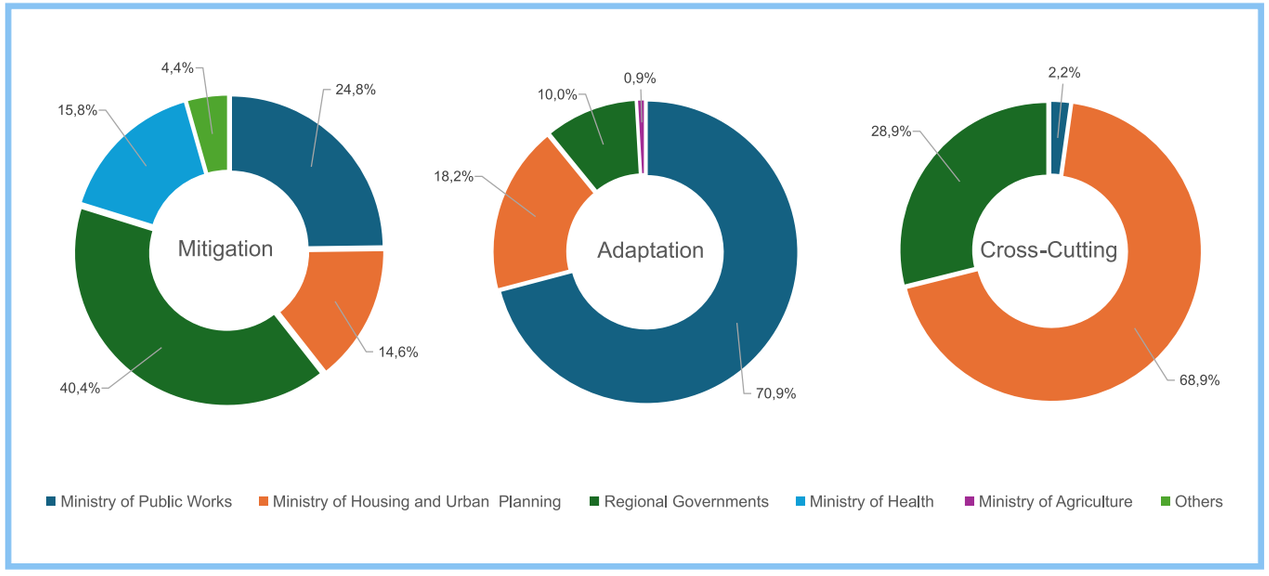

Figure 11. Spending executed in 2022 investment projects with a climate component by category and ministry, in %ages.
Source: DIPRES, 2023.

Meanwhile, since 2022, the Finance Ministry has led the development of the document "Structure of the Classification System or Taxonomy of Environmentally Sustainable Economic Activities for Chile", the objective of which is to present the framework for the construction of a national taxonomy.

Regarding climate change and decentralization, in 2021 the need to generate a support process focused on different aspects of climate financing led to the creation of the Communal and Regional Climate Action and Financing Group (GAFICCOR). In coordination with this group, methodological guidelines have been developed for the financing of measures under the Regional Climate Change Action Plans (PARCC) and for the use of the financing registry, which are essential instruments to facilitate the planning and financing of climate measures. Additionally, in 2023, the MMA implemented a Climate Laboratory to promote the design of local climate projects within the framework of the relevant climate transformations of the territory.

Finally, to advance the implementation of NbS projects, an investment and financing plan for projects and initiatives at the territorial level was developed with the support of UNDP and guidance from the MMA. In this regard, 18 types of NbS were identified, organized into five approaches or groups of solutions.

7. MONITORING AND STRENGTHENING THE INTEGRATION COMPONENT OF THE NDC

This chapter highlights Chile's progress and challenges in integrating climate change mitigation and adaptation actions. This approach, aligned with the Paris Agreement, responds to the need to address environmental and social problems jointly, while optimizing resources and generating greater impact. Chile's NDC includes a pioneering integration component, which contains commitments that contribute in a comprehensive manner to addressing both the causes and the effects of climate change. These commitments are associated with key areas such as the circular economy, forests, peatlands, oceans and protected areas.

Regarding the progress of these commitments by 2024, Chile has met 100% of the goals established to advance the promotion of the circular economy. In terms of forests, Chile has made three commitments, each with a different degree of progress. Regarding sustainable management and the recovery of 200,000 ha of native forests, also reported in the mitigation chapter, progress of 23% is reported. Meanwhile, regarding the country's commitment to reforest 200,000 ha, progress has reached 6.3%. In the case of the commitment to reduce emissions from the forestry sector due to degradation and deforestation of native forests, Chile's progress is presented in the technical report of the REDD+ results included in this BTR as a Technical Annex. In terms of peatlands, Chile has reported 50% progress towards its commitment to identify peatlands and wetlands for the creation of an inventory by 2025. However, it has made no progress towards its commitment related to the development of standardized metrics to assess the mitigation and adaptation capacity of this ecosystem. With respect to oceans, a delay is reported in meeting the 2025 goals, specifically those related to the implementation of management plans in marine protected areas. It is worth mentioning that several of these areas have plans that have already been approved. So far there has been no progress towards either of these commitments. Finally, regarding protected areas, there has been progress towards the 2030 goals, both in terms of the increase in the surface area of terrestrial and aquatic-continental ecosystems under official protection, as well as in terms of the coverage of the implemented management plans.

Photo: Micaela Jara Forray

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