EXECUTIVE SUMMARY

This Second National Communication has been prepared to fulfill Chile's reporting commitments as a Party to the United Nations Framework Convention on Climate Change (UNFCCC). It reports on the national advances made to implement the Convention from February 2000, when the First National Communication was published, through 2010.

In accordance with the guidelines for preparing national communications, this report contains the results of the National Inventory of Greenhouse Gas (GHG) Sources and Sinks, the main advances made in assesing and addressing vulnerability and adaptation to climate change, GHG mitigation measures adopted, and other information deemed relevant at the national level, taking into account the advances in international negotiations made mainly at the Conferences of the Parties held in 2007, 2009 and 2010. Lastly, it outlines some of the country's barriers, gaps and needs that exist in Chile related to national capacities, financing, and technical support that were identified during the preparation of this report.

This report was prepared by the Government of Chile with funding from the Global Environment Facility and support from the Office of the United National Development Program in Chile, which served as the implementing agency for the project for the preparation of the Second National Communication.

1. NATIONAL CIRCUMSTANCES

1.1 COUNTRY CHARACTERISTICS

Territory

Chile is a tri-continental country with territory that extends along the southwest portion of South America and includes Easter Island in Oceania as well as part of Antarctica to the south. The nation's territory also includes the Archipelago of Juan Fernández, the islands of San Félix, San Ambrosio, and Salas y Gómez, as well as the 200-mile Exclusive Economic Zone with its corresponding continental shelf.

Continental Chile is located between 17° 30′ and 56° 30′ Latitude South, while Chile's Antarctic Territory covers the area between 53° and 90° Longitude West and the South Pole. It is bordered by Peru in the north, and Bolivia and Argentina in the east, the South Pole in the south and the Pacific Ocean in the west along 8,000 kilometers of coastline.

In addition to its extensive coastline, the country has three main north-south morphological features: the Andes Mountains in the east, the Coastal Mountains in the west, and the Intermediate Depression, which runs between these two mountain chains but is often interrupted by transversal mountain chains. These chains give the country a rugged and broken topography, with flat areas

accounting for no more than 20% of the entire continental territory. The country's coastal plains, archipelagos and islands are also populated and are host to important economic activities.

Climate

Chile has a multiplicity of climates. In general terms, the country has a temperate climate with some variations caused mainly by differences in latitude and altitude. These variations give rise to desert, tropical, mediterranean, temperate, and polar climates, among others.

The Pacific Ocean has a powerful moderating effect on temperature variations in the coastal zone. Recent studies have shown a shift in historic temperature trends, which have decreased along the coast and over the ocean and increased in the Central Valley and the mountains.

Ecologically, the presence of biomass and specific plant formations in a given zone depends on the existing climate. According to Luebert and Pliscoff, Chile has four macrobioclimate zones: tropical, mediterranean, temperate and antiboreal (Figure 1).

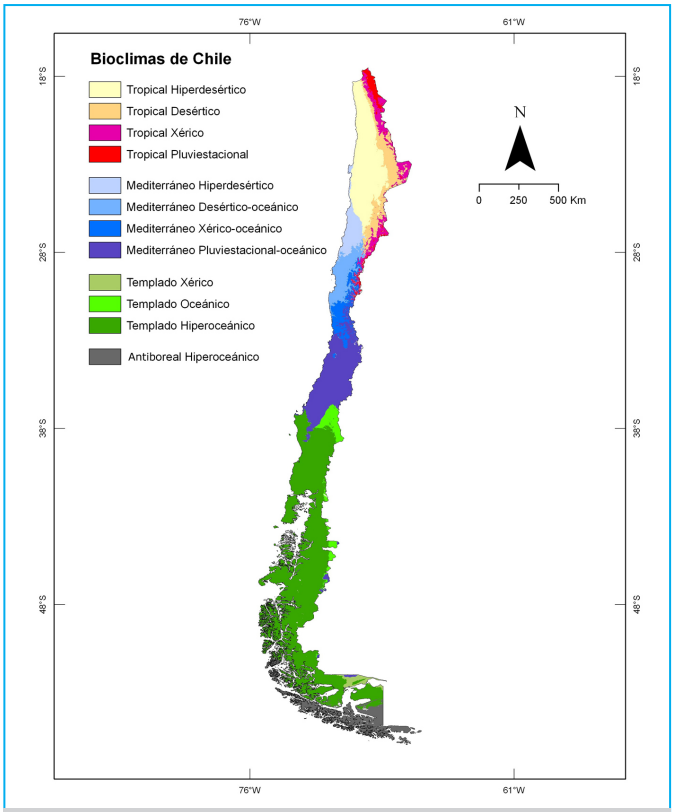


Figure1. Bioclimates of Chile
Source: Luebert and Pliscoff, 2006

Population and social development

Chile's population grew quickly in the 20th Century, but growth has slowed in the past decade and is expected to decelerate even more toward the middle of the 21st Century.

The country's development has improved the quality of life of its inhabitants, and in 2010 Chile ranked 45th globally in the United Nations Human Development Index.

Economy

Since 1990, Chile has experienced rapid economic growth and diversification and increased its reliance on exports. These developments can be explained by the country's stable government, political institutions capable of generating and maintaining consensus on key issues, and effective public policies.

The effects of the country's export-driven development policy can be seen in its balance of trade, which has been positive since 1999 and grew substantially during the 2002–2007 period. Mining accounts for more than 50% of the total value of all goods exported by Chile. Regarding imports, intermediate goods such as fuel predominate, representing 50% of the total value of imports.

Photo: Ministry of the Environment Government of Chile

TABLE 1. Key indicators

Information		Source
Geography		
Total Area (km²)	2,006,096	Military Geographical Institute
Population in 2000	15,397,784	National Statistics Institute
Population in 2010	17,094,275	National Statistics Institute
Projected population in 2050	20,204,779	National Statistics Institute
Rural population (% of the total, 2009)	11%	World Bank
Forested area (2007)	22%	National Forestry Corporation
Human Development		
Human Development Index (2010)	0.783	UNDP
Literacy rate (2008)	99%	World Bank
Life expectancy at birth (2010)	78.8	World Bank
Infant mortality per 1000 live births (2007)	7	World Bank
Potable water coverage (2009)	99.8%	Superintendency of Sanitation Services
Sewerage coverage (2009)	95.6%	Superintendency of Sanitation Services
Public spending on education as a % of GDP (2008)	4.2%	Ministry of Education
Public spending on R&D 2008 (millions 2008 US$)	351.7	Ministry of Economy
Economic Activity		
GDP (PPP) estimated for 2011 (millions of 2011 US$)	276,053	International Monetary Fund
GDP (PPP) per capita estimated for 2011 (US$)	15,866	International Monetary Fund
GDP (PPP) growth in 2009	-0.8%	International Monetary Fund
GDP (PPP) growth in 2010	6.3%	International Monetary Fund
Estimated GDP (PPP) growth in 2011	6 - 7%	Chilean Central Bank
Goods and services exported (% of GDP, 2009)	38%	World Bank
Sectoral Activity		
Renewable energy (% of energy mix in 2009)	29%	Ministry of Energy
Imports of primary energy (% of energy use, 2009)	62%	Ministry of Energy
Consumption of fossil fuel as primary energy (% of total, in 2009)	71%	Ministry of Energy
Water consumption by irrigation (as a % of total national water use)	84.5%	General Directorate of Water

1.2 ENVIRONMENTAL POLICY AND INSTITUTIONAL STRUCTURE

Environmental policy

The country´s comprehensive development strategy includes national policies oriented to foster sustainable development. Chile's Constitution guarantees its citizens the basic right to live in an environment free of pollution and makes the State responsible for safeguarding and preserving nature and the country's environmental heritage.

The country faces numerous environmental challenges, however, such as achieving compliance with primary air quality standards in several of its cities. One especially important issue is agricultural soil degradation. The amount of land affected by water and wind erosion, salinity, contamination, gravel extraction and other activities has increased dramatically, and it is estimated that virtually all of the country's soils display some level of degradation. The absence of effective soil management and soil conservation objectives has led to a major loss of fertility as well as much desertification and flooding.

In regard to water resources, freshwater extraction increased by 160% between 1990 and 2002. The Government of Chile estimates that by 2017, water demand by households, mining and industry will have practically doubled over 1992 levels, and agricultural use will have risen by 20%. Water for irrigation accounts for most of the water consumed in Chile, and major advances are being made to use this water more efficiently, with irrigation improvement programs being a central feature of the country's agrarian policies.

The Ministry of the Environment and the new environmental institutional framework

The year 2010 witnessed the completion of Chile's new environmental institutional structure, a process that began in 2006 and transformed the country's multisectoral model, in which environmental matters were coordinated by the National Environmental Commission (CONAMA), into a more centralized model under the newly created Ministry of the Environment.

Today, the Chilean Ministry of the Environment is the national entity responsible for working with the President of the Republic on the design and application of environmental policies, plans and programs. Also under the purview of the Ministry are all efforts to protect and conserve the country's water, biological diversity, and renewable resources through the promotion of sustainable development and comprehensive environmental policies and regulatory frameworks. One of the Ministry's major areas of responsibility in this context is the development of the country's response to climate change. For the first time the country's legislation includes a government mandate that specifically addresses this issue, affirming that "the Ministry shall be especially responsible for proposing policies and formulating plans, programs and plans of action in the area of climate change" (Art.70, letter h of Law 20.417 of 2010). The Ministry will face major challenges in implementing this mandate on climate change, which is one of five focal areas covered by the country's new environmental institutional framework. To facilitate organizational and administrative aspects, the Office of Climate Change was formally created with its own annual budget and permanent staff to carry out its work.

Institutional structure for climate change in Chile

In 1994, Chile ratified the United Nations' Framework Convention on Climate Change and subscribed to its Kyoto Protocol, convinced that a global response was required to address a phenomenon with such important environmental consequences, particularly for vulnerable nations like Chile.

Recognizing the need to coordinate local efforts and foreign policy on climate change, in 1996 the Government of Chile issued a Supreme Decree establishing the institution that would address this task. The National Advisory Committee on the Global Climate was composed of representatives of the public and academic sectors and its mandate provided for including other institutions and private entities. In 2006, the Committee played a key role in preparing the National Climate Change Strategy, the focal areas of which include adaptation, mitigation, and the promotion and creation of capacities. In 2008, the National Climate Change Action Plan was passed, representing a concrete step toward implementing the National Strategy.

In recognition of the issue's importance, and to strengthen inter-institutional efforts, particularly in the context of international climate change negotiations, in 2009 a presidential instruction led to the creation of the Inter-Ministerial Committee on Climate Change. The members of this Committee include representatives from Chile's Environment, Foreign Affairs, Agriculture, Energy, Economy, Finance, Mining, Public Works, and Transportation and Telecommunications ministries. The Committee also has a Technical Group that meets more frequently to address technical issues and advise the ministerial representatives.

In 2010, in order to broaden the exchange of information and expand the dialogue on climate change between the Government and other stakeholders, two working groups were formed: one public-private, the other public-civil society. These groups were formed to increase stakeholder opportunities for involvement and participation in the process to address climate change in Chile.

National Climate Change Action Plan

In 2008, CONAMA introduced the National Climate Change Action Plan for 2008-2012 as a short-term response to the priorities and objectives of the National Climate Change Strategy. The Action Plan sets out a series of public policy objectives for different public entities with climate change duties and responsibilities. The Plan also serves as guide for industry, the academic sector and non-governmental organizations by setting out the topics that Chilean society as a whole should address in confronting the impacts of climate change. By limiting its implementation period to five years, the Plan is intended as a short-term measure for generating the information needed by the end of the period to prepare longer-term national and sectoral adaptation and mitigation plans. The Action Plan contains some strategic considerations that should be taken into account as Chilean society confronts the challenges of climate change. These can be summarized as follows:

- Climate change as a key issue in Chilean public policy and regulations.

- Adaptation as a foundation for Chile's future development and as an early response to the impacts of climate change.
- Mitigation as a way to improve the quality of growth, reduce overall greenhouse gas emissions and decrease the cost of adaptation.
- Innovation in Chile's financial and business sectors to increase opportunities for investment in mitigation and adaptation projects.
- Assessment of future climate change commitments and their likely effects on international trade for a long-term strategic perspective.
- Development of a basic foundation of climate change-related knowledge to support decision-making. This knowledge will be generated by means of comprehensive research, systematic climate observation, and citizen training, education and awareness-raising.

Sectoral institutional framework

In the decade covered by this National Communication, several changes in the public sector have strengthened climate change-related actions in Chile. Notable among these are the creation of the Ministry of Energy, which was formed to foster the development of a comprehensive energy policy coherent with the objectives of security, quality and competitiveness of the country's energy supply and local and global environmental protection; the creation in 2009 of the Center for Renewable Energy, to serve as a technological antenna for the development of renewable energies in Chile; and in 2005, the launching of the country's National Energy Efficiency Program, later renamed the Chilean Energy Efficiency Agency. This public-private institution has the mission of promoting, strengthening and consolidating the efficient use of energy and coordinating and implementing public-private initiatives in different sectors that consume energy at the national and international levels.

For its part, the Ministry of Agriculture refocused the efforts of some of its agencies toward climate change, and in 2008 the Ministry created the Council on Agriculture and Climate Change, presided by that institution's highest authority. The Council's other members include representatives from the public, private and academic sectors.

A notable development in the area of water resources was the creation in 2008 of the Glaciology and Snow Unit within the Ministry of Public Works' General Directorate of Water. This Unit is intended primarily to establish and implement a national glaciology program that will develop a glacier inventory, study and monitor glaciers in Chile, define present and future responses to climate change in regard to glaciers, and identify adaptation strategies for different climate scenarios.

2. NATIONAL INVENTORY OF GREENHOUSE GAS SOURCES AND SINKS

2.1 GLOBAL CONTEXT

Chile is not a relevant source of greenhouse gases (GHGs). According to international statistics, which consider only national CO_2 emissions from hydrocarbons, Chile accounts for around 0.2% of global GHG emissions, a percentage that has remained stable in recent years. If global emissions from bunker fuels are not accounted, Chile´s contribution in 2008 was 0.26% of emissions from all countries (IEA, 2010) as presented in Figure 2. According to the International Energy Agency (IEA, 2010) Chile ranked 61st in the world for per capita CO_2 emissions in 2008, producing 4.35 tons CO_2 per person, slightly above the global average of 4.23 tons of CO_2 per person. Nevertheless, the country's emissions are growing significantly, mainly as a result of growth in its energy sector.

2.2 METHODOLOGY

The National Inventory of Greenhouse Gas Sources and Sinks (INGEI) presented in this Second National Communication was prepared in accordance with the guidelines for National Communications of the United Nations Framework Convention on Climate Change. It also follows the methodologies proposed by the Intergovernmental Panel on Climate Change (IPCC), as well as the guidelines proposed in the UNFCCC's Decision 17/CP.8, pertinent to non-Annex I countries presenting their second national communication. The revised 1996 IPCC guidelines were used, as well as their 2000 and 2003 codes of good practice. 2000 was the reporting year, and the formats used were those established under the Convention for annual inventory reports. In addition, the country voluntarily decided to include the results of its 2006 emissions inventory to provide a more up-to-date and relevant reflection of national sinks and sources. The 2006 data represents the most recent inventory information available across all sectors. The report also provides a time series of estimated sources and sinks from 1984 to 2006 for all sectors and subsectors.

A summary of GHG sources and sinks in Chile for 2000 and 2006, expressed in CO_2 equivalents (CO_2eq) is presented in Table 2. Meanwhile, Figure 3 represents the global CO_2 equivalent trend for the 1984-2006 period, for the five INGEI sectors, as well as the balance of sources and sinks, which in Chile's case is positive for the entire period analyzed. Figure 4 presents the percentage participation of each INGEI sector in Chile for both CO_2 emission and capture.

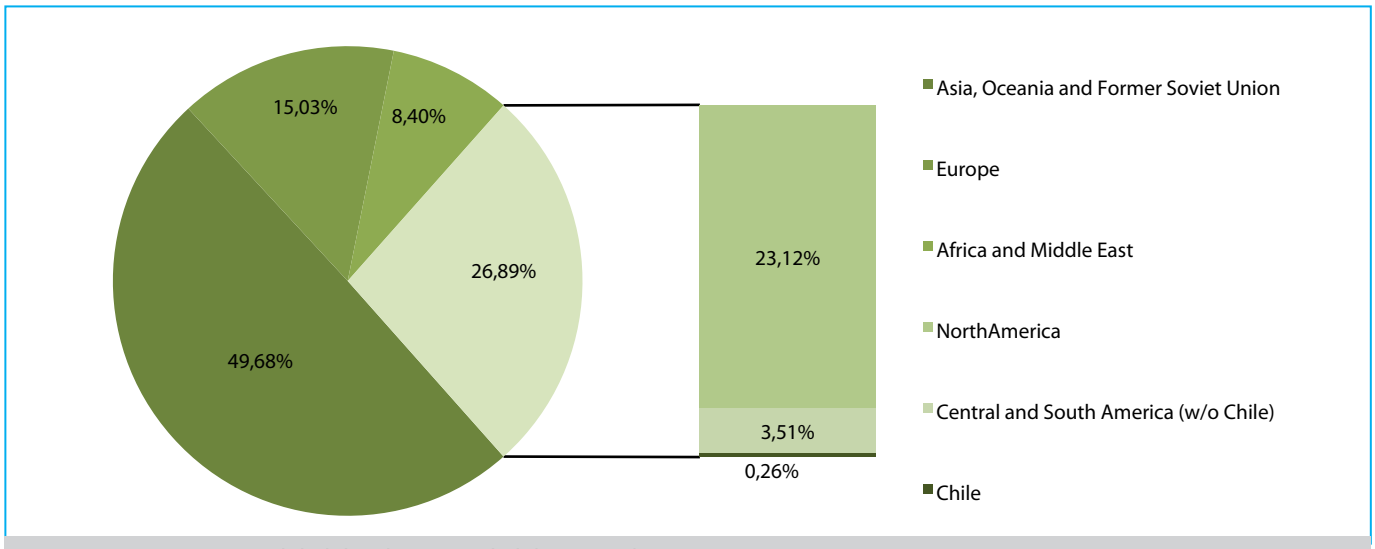


Figure 2. CO_2 emissions global distribution and Chile´s contribution in 2008
Source: Ministry of the Environment, based on IEA, 2010

TABLE 2. GHG sources and sinks in Chile for 2000 and 2006

Sector	Type	2000	2006	Variation
		Gg of CO_2eq	Gg of CO_2eq	%
Energy sector	Source	51,279	57,806	13%
Industrial processes sector	Source	4,447	5,361	21%
Agricultural sector	Source	13,103	13,401	2%
LULUCF	Sources and sinks	-27,446	-19,386	29%
Waste sector	Source	2,028	2,489	23%
National total	**Global balance**	**43,410**	**59,672**	**37%**

Source: Ministry of Environment, 2011

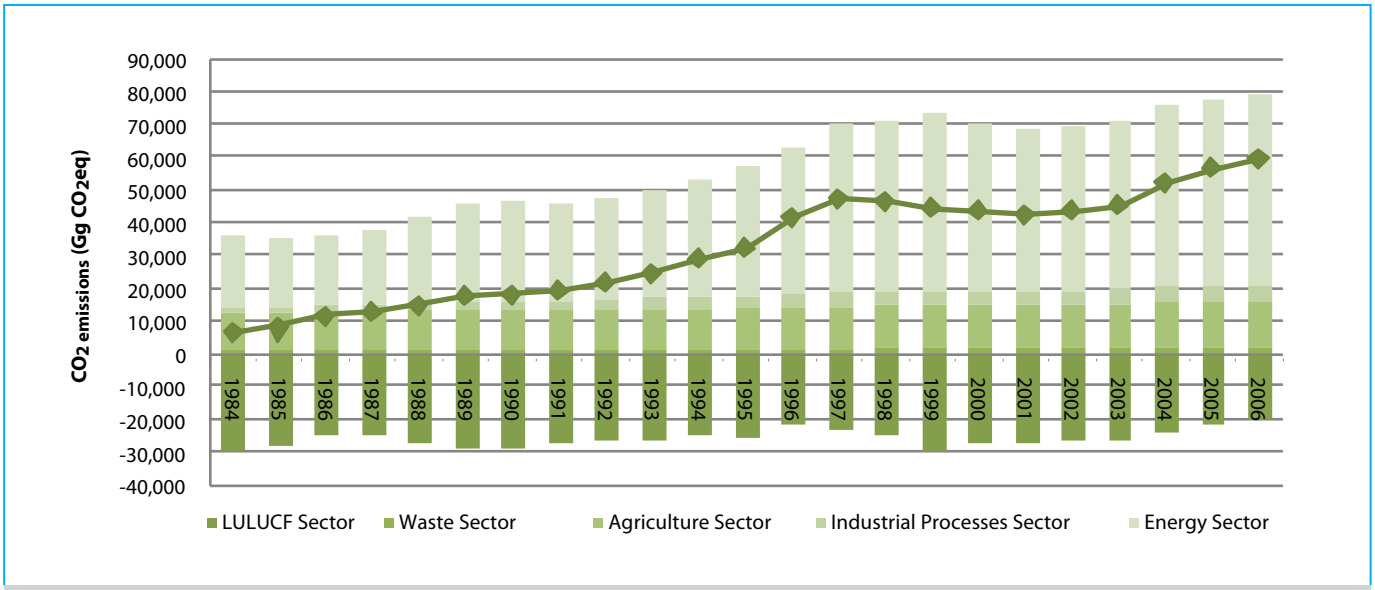


Figure 3. Sectoral contributions and balance of Chile's National GHG Inventory (INGEI), 1984-2006
Source: Ministry of the Environment, 2011

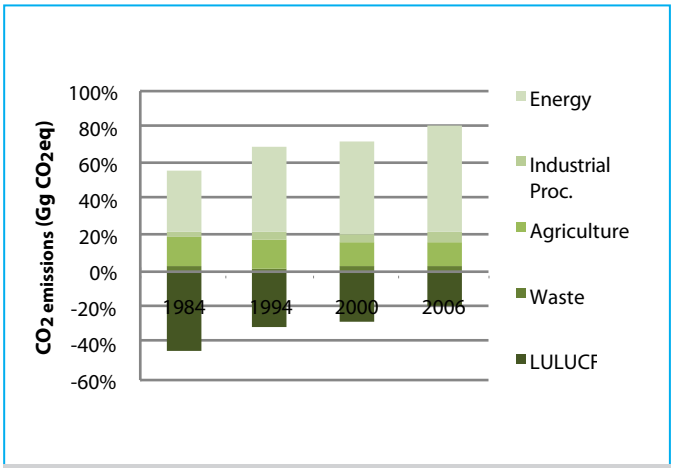


Figure 4. Participation of INGEI sectors in Chile in terms of GHG sources and sinks, in CO_2eq
Source: Ministry of the Environment, 2011

At the sectoral level, the importance of the Land Use, Land Use Change and Forestry sector (LULUCF) for CO_2 capture in Chile is notable, although net capture gradually decreased from 1984 to 2006. In absolute terms, the energy sector is a major source of emissions in the country, and its importance is growing.

In regard to sources and sinks for the three main GHGs in Chile's inventory (carbon dioxide, CO_2; methane, CH_4; and nitrous oxide, N_2O), CO_2 accounts for the greatest release of GHGs. In 2000, this gas accounted for 55% of all net emissions of CO_2eq in the annual inventory, rising to 65% in 2006. For its part, over the same time span (2000–2006), CO_2 capture through natural photosynthetic processes decreased from 29.8 million tons to 22 million tons of CO_2, according to the emissions estimation methods established for the preparation of inventories. This represents a decrease of 26%. After CO_2, CH_4 has the greatest impact on the country's emissions. In 2000, this compound represented 27% of all net releases of CO_2eq in the annual inventory, compared to 21% in 2006. The agricultural sector accounts for most methane released. N_2O represented 18% of all net emissions of CO_2eq in the national inventory in 2000, dropping to 15% of CO_2eq by 2006. The agricultu-

ral sector accounted for most emissions of this gas in both 2000 (88%) and 2006 (87%).

2.3 MEMO ITEMS FOR GHG EMISSIONS

In accordance with the reporting methodology established for Parties GHG emissions under the UNFCCC, some types of emissions do not need to be included in the total reported in national inventories, but can be reported separately from other GHG emissions in a Memo Item. Such emissions of greenhouse gases include those resulting from fuel used for international transport (called bunker fuels) and CO_2 emissions from firewood and biogas burned to generate energy. These are reported in Table 3.

TABLE 3. Memo items: GHG emissions not included within the consolidated totals for 2000 and 2006

Type	2000 (Gg)	2006 (Gg)	Variation %
International Transport	3,068	5,275	72%
Firewood and biogas	16,721	18,563	11%

International transport emissions have increased significantly over time, with those originating from international shipping overtaking those from aviation in recent years. This trend coincides with Chile's increasing participation in the international shipping trade, as most of the country's exports are transported by sea.

3. CHILE'S VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE

3.1 CHILE'S VULNERABILITY TO CLIMATE CHANGE

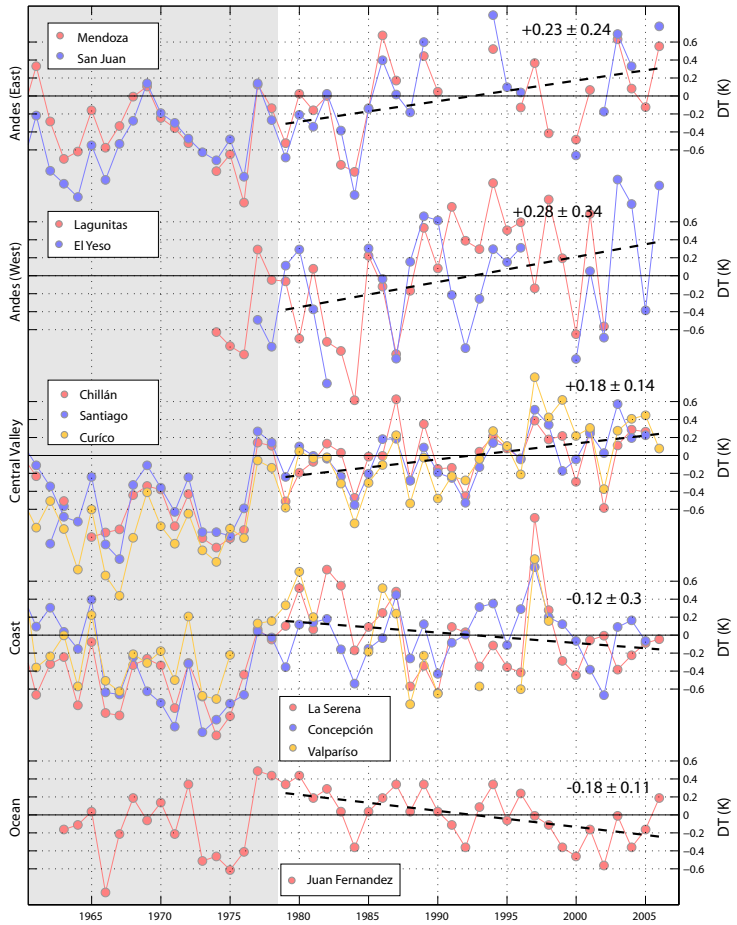
Chile is highly vulnerable to climate change. The country has an extensive low-lying coastline; arid, semi-arid and forest ecosystems; a susceptibility to natural disasters; areas that are susceptible to drought and desertification; urban zones troubled by air pollution; and mountain ecosystems such as those of the Coastal and Andes mountain ranges. Studies conducted in Chile in recent years on the impacts of and vulnerability to climate change confirm the country´s high vulnerability and have added to our knowledge of the phenomenon of climate change and its potential negative effects on our country's plans for sustainable development.

Meteorological/climatic variables

Observed trends

New climate trends are already evident in Chile, as seen in changes in precipitation and temperatures throughout the country. Studies of temperature changes for the period from 1979 to 2006 (Falvey and Garreaud, 2009; Carrasco et al, 2008) report that in the ocean and on the coast temperatures have tended to drop, while those in the Central Valley, and particularly the Andes Mountains—where most of Chile's water resources are stored— have risen (Figure 5).

Photo: Ministry of the Environment Government of Chile



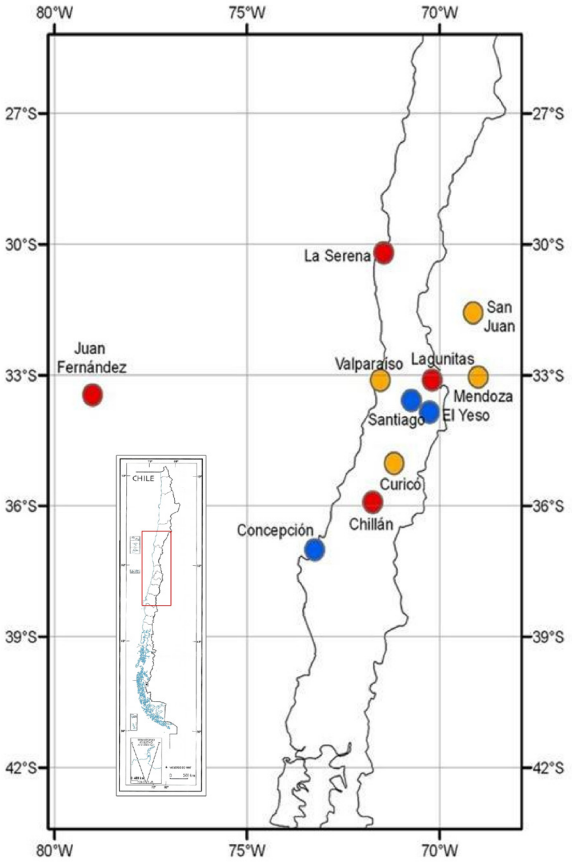


Figure 5. Time series data on temperature anomalies in Central Chile
Source: Falvey and Garreaud, 2009

Projections

To obtain more detailed information on meteorological projections for Chile's territories, in 2006 CONAMA commissioned the University of Chile's Department of Geophysics to conduct a study, entitled "Estudio de la variabilidad climática en Chile para el siglo XXI" (Study of Climatic Variability in Chile for the 21st Century) (U. of Chile, 2006). The study used the PRECIS regional climate assessment model designed by the United Kingdom's Meteorological Office, an instrument that has been widely used in constructing regional climate change scenarios. The exercise considered two of the GHG emission scenarios defined by the IPCC: A2 (severe) and B2 (moderate). The global-scale projections used with the PRECIS model were from the Hadley Centre Coupled Model (HadCM3) global climate model, also developed by the UK Meteorological Office. Modeling of the national scenario considered continental Chile and used a spatial resolution of 25x25 km^2 for the 2071-2100 period. As a way of validating the model, modeling for the 1961-1990 period was also used to contrast the surface climate changes associated with scenarios A2 and B2 with data from recent years. Later, near-term projections were also carried out for the periods 2011-2040 and 2041-2070 under the A2 scenario, once again using the global climate model HadCM3 (ECLAC, 2009).

The projections point to an overall increase in temperature (warming) toward the end of the century in all regions, with greater warming under the A2 scenario. Under this scenario, the mean temperature for continental Chile is projected to rise by 2°C to 4°C over its present level, with greater increases in the Andean regions and lower increases toward the south. Only in southern Chile and under scenario B2 are temperatures projected to rise by less than 1°C (Figure 6). Seasonally, there is more warming in summer, exceeding 5°C in some sectors of the high Andes.

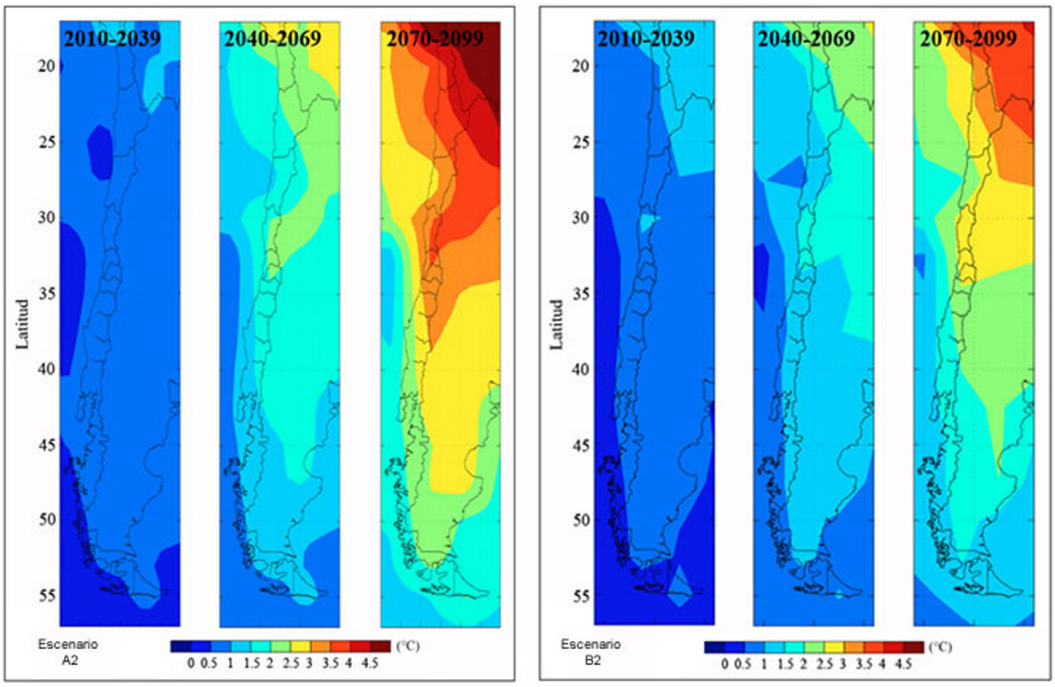


Figure 6. Projected temperature variation for scenarios A2 and B2
Source: ECLAC, 2009

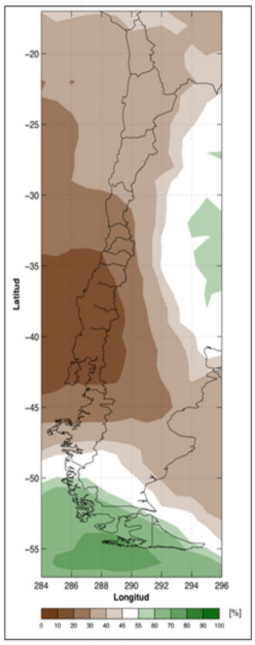


Figure 7. Percentages from models projecting an increase in precipitation in Chile for the 2010–2040 period
Source: ECLAC, 2009

Water resources

In Chile, the availability of water resources is closely tied to the climate, and it is therefore expected that changes in temperature and precipitation predicted by the models used to forecast the continental Chilean climate in the 21st Century will affect these resources, especially under the most severe scenarios (A2).

The expected temperature increases associated with climate change will reduce the mountainous area capable of storing snow over successive years. This occurs as the 0°C isothermal line, or snow line, shifts to higher altitudes, leading to an increase in melt water and river volume during winter months and a reduction in water reserves stored as snow (Carrasco et al, 2005).

Glaciers

Glaciers act as strategic water reserves, as they not only supply water to river basins in summer, but are the single most important source of replenishment for rivers, lakes and groundwater in arid regions and during periods of drought. Chile has the highest continental concentration of glaciers in the Southern Hemisphere. According to an inventory supplied by the Glaciology and Snow Unit of the General Directorate of Water, in 2007 the country's 1,835 glaciers composed a total area of 15,500 km^2. Non-inventoried ice is estimated to cover an additional 4,700 km^2, meaning that the country has more than 20,000 km^2 of ice reserves, 75% of which is found in the Northern and Southern Patagonian Ice Fields located in the Aisén and Magallanes Regions.

Studies conducted on Chile's glaciers indicate that many of them are in retreat. Of 100 glaciers assessed by Rivera et al. in 2000, 87% displayed shrinkage associated with changes in historic patterns of climatic variables. For example, in the last 50 years the Cipreses glacier, which feeds the Cachapoal River basin with its runoff, has been retreating at a rate of 27 meters per year, 3 times as fast as the rate observed since 1860 (Rivera et. al, 2007). It is estimated that increases in temperature and solar radiation in the mountains and decreases in precipitation will continue to shrink the area covered by Andean glaciers; this in turn will continue to impact the availability of water in basins with significant meltwater runoff, mainly those located between the Aconcagua and Cachapoal rivers and some in the north of the country. This effect will become increasingly apparent in summer and fall, when the supply of water from precipitation and melting snow usually falls.

Hydrologic analysis of selected basins

Studies conducted by researchers from the University of Chile and the Catholic University of Chile between 2008 and 2010 used hydrologic models to carry out the first ever quantification of the impacts climate change on water resources in Chile. The research looked at the impacts that predicted changes in temperature, evapotranspiration and precipitation under the A2 scenario of the HadCM3 would have on hydrologic resources eight river basins located along the central valley of Chile, located from the Regions of Coquimbo to La Araucanía. Figure 8 shows the results of this exercise.

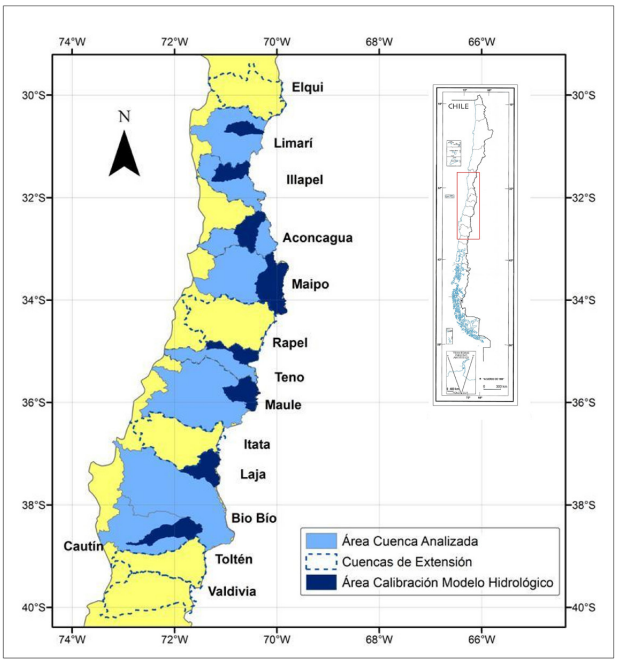


Figure 8. Map of water basins analyzed in Chile, area of calibration for hydrologic models and related basins
Source: University of Chile, Civil Engineering Department, 2010

In general terms, the results of these modeling exercises forecast major impacts from climate change on water resources, with the available water flow decreasing in all river basins. These reductions will be greater in the most northern and southern regions analyzed (the Limarí and Cautín basins) while the rest of the basins show slight reductions in flow levels in the short-term and significant reductions starting in the mid-term. The results also show variations in the timing of increased flow levels produced

Photo: Ministry of the Environment Government of Chile

by melting snows in some river basins, which in some cases would shift from spring and summer to winter months.

Due to the projected changes in availability and seasonal distribution of the water flows, practically all of the river basins analyzed show a major increase in the number of months with hydrologic deficits, based on a comparison of historic and future monthly flow and stress levels. This will greatly affect the availability of water resources by different productive sectors in Chile, with low-flow levels occurring more frequently.

Soil resources

Erosion has a significant effect on soil resources in Chile, and therefore on agricultural productivity. Erosion processes are determined primarily by variables such as precipitation intensity, slope and plant cover. Climate change can affect precipitation and plant cover both directly and indirectly, and may accelerate erosion that already affects much of Chile's agricultural land. A study conducted by experts at the AGRIMED Center of the University of Chile analyzed the impact of climate change on soil resources for the territory between the Valparaíso and Los Lagos Regions. Cross-referencing zones with a high erosion risk with areas that would present a decrease in natural plant cover, the researchers identified the zones that were most vulnerable to severe soil loss. The study concluded that parts of Chile's Central Valley that are highly important for agriculture and forestry could be the most affected by the projected climate change. In irrigated zones, which are generally on flat or very slightly sloped land, soil loss from rainfall erosion is expected to be lower in general.

Agriculture, livestock and forestry sector

The agriculture, livestock and forestry sector is one of the socioeconomic systems that is most dependent on climate. As such, the study of this sector´s vulnerability to the impacts of climate change has been a central concern in Chile recent years. Initial assessments have been focused on determining how this phenomenon will affect the sector's future productivity.

Researchers from the AGRIMED Center of the University of Chile applied the SIMPROC simulation model to evaluate the impact of climate change on irrigated and dry-farmed crops, pastureland and fruit production. The SIMPROC model was calibrated based on current productivity data and then used to analyze the effects of climate anomalies projected under emission scenarios A2 and B2 for two periods, 2046–2065 and 2070–2100, including the impact on water available for irrigation (ECLAC, 2009). The main results, expressed as yields of irrigated and dry-farmed wheat, corn, potatoes, beans and beets sowed at the optimum date as well as impacts on grasslands, fruit and forestry plantations, are presented in Tables 4 to 7.

Photo: Ministry of the Environment Government of Chile

TABLE 4. Projected yields of wheat, corn, potatoes, beans and beets under A2 scenario for the 2070–2100 period

Crop	Irrigated	Dry-farmed
Wheat	• A reduction in yields is expected, mainly in the foothill and coastal zones, where the current potential will drop to levels similar to those of the Central Valley.	• A decrease in yields is expected in northern and central Chile owing to more droughts. On the coast and in the Central Valley, yields will drop by 10 to 20%. • From the foothills of the Biobío Region to the south, in all zones a gradual increase is observed in yields on the order of 30%, reaching 100% in some foothill zones of the Regions of Los Ríos and Los Lagos.
Corn	• A drop in yields of between 10 and 20% is expected throughout the Central Valley in the Regions of Coquimbo to Biobío. • On the coast and in the foothills, yields are expected to rise by up to 50%. • In La Araucanía Region to the south, yields will increase from between 60 and 200% above current levels.	• Yields will continue to be marginal, with productive potential equaling less than four tons per hectare.
Potatoes	• In future scenarios, the northern zone will see 10 to 20% lower yields. • In north-central Chile to the O'Higgins Region, yields will diminish by up to 30%. • Between Talca and Temuco the present situation will continue, but only in the Central Valley, whereas on the coast and in the foothills yields are expected to rise by up to 50%. • Yields will increase by up to 150% from La Araucanía Region southward, and up to 200% in the Los Lagos Region.	• In general, and especially in the central zone, low productivity will continue. Increases are expected on the coast of the Biobío Region, and from the Los Ríos Region to the Aisén Region.
Beans	• Yields of beans will remain stable in future scenarios across the north, central and south-central part of the country. From La Araucanía Region to the south, productivity will increase from 10 to 20%, and up to 100% in the Los Lagos Region. • In general, yields will tend to remain similar—around 4.5 tons per hectare per year—across the central and southern zones of the country.	• Dry-farmed beans will continue to produce the same low yields. However, increases of around 100% are expected on the south-central coast and from Los Ríos Region to Aisén. • In Central Chile, planting dates will remain the same. In some places on the southern coast and foothills zones, however, the planting date will shift from October to September.
Beets	• In the Central Valley, between the Valparaíso and Maule Regions, yields will increase by up to 50% in some districts. • On the coast and in the foothills, yields will drop to levels comparable to the Central Valley. • From the La Araucanía Region to the south, the rise in winter temperatures will potentially increase production.	• Under the current climate scenario, beets grow better in coastal areas, reaching yields of up to 40 tons per hectare. • On the coast between the Maule and La Araucanía Regions, future scenarios show expected yield to decrease by up to 50%. • In the Central Valley and foothills, increases in almost all districts are expected from the Valparaíso Region to the south. • In the La Araucanía and Los Ríos Regions, changes in fall planting dates are expected, which will allow yields to increase in most districts.

Source: ECLAC, 2009

TABLE 5. Grassland productivity for the A2 scenario for the 2070–2100 period

Grassland	• A drop in annual productivity is expected for grasslands between the Coquimbo and Los Lagos Regions, associated with more intense dry periods. • Toward the south, yields will increase by up to 20%. In the far southeastern Andes Mountains, drops in productivity are expected as a result of a reduction in solar radiation of up to 15%. • In the Altiplano zone, grassland productivity will increase over present levels as precipitation increases, as expected under future scenarios. • In the far south, grassland productivity will increase in the western Andes Mountains as a result of higher rainfall, temperatures and solar radiation.

Source: ECLAC, 2009

TABLE 6. Productivity of fruit plantations under the A2 scenario for the 2070–2100 period

Fruit plantations	• Area suitable for fruit growing could spread south to the Regions of La Araucanía, Los Ríos and Los Lagos. • Species that are highly climate-dependent (grapevines, for example) could undergo changes in their organoleptic properties (aroma, flavor, color), and therefore, in their quality. • In general, temperature increases are expected to prolong the life-cycle of some major pests, which could have serious consequences for fruit health. • Projected climatic conditions could lead to the spread of fungal and bacterial diseases. • Climate changes could increase the potential for growing subtropical species (oranges, for example) in almost all regions. • It is highly likely that climatic conditions under the new scenarios will improve the quality of fruit, as temperature increases may decrease acidity. • In the north of Chile, productive potential will increase considerably, especially in the valleys of the Tarapacá Region. • In the Central Andean foothills, climatic conditions will enable an increase in the economically viable fruit growing area.

Source: ECLAC, 2009

TABLE 7. Productivity of forest plantations under the A2 scenario for the 2070–2100 period

Forest plantations	**Pinus radiata (Monterey Pine)** • A considerable deterioration of productive potential is expected in the north-central zone (between the Coquimbo and Metropolitan Regions), becoming less severe toward the south, where it may be moderate or slight in the central zone (Metropolitan, Valparaíso and O'Higgins Regions). The deterioration disappears in the La Araucanía Region, where productive potential will actually improve significantly, with major increases between the Los Ríos Region and the Island of Chiloé.	**Eucalyptus globulus** • A deterioration in productive potential is expected in the Coquimbo Region as a result of decreased precipitation. • Along the central coast, an increase in productive potential is expected due to milder winter temperatures, with a similar expectation for the foothills zone. • From the La Araucanía Region to the south, an increase in productive potential is expected, with notable increases in the Los Ríos and Los Lagos Regions.

Source: ECLAC, 2009

Productive and socioeconomic vulnerability and adaptability of the agriculture, livestock and forestry sector

The productive and socioeconomic vulnerability and adaptability of the agriculture, livestock and forestry sector to climate change were also evaluated in the studies conducted by researchers from Agrimed and the Catholic University. The analyses included intrinsic adaptation by agricultural producers as climate patterns shift. Using the district level as the spatial scale, the following variables were evaluated: changes in land use, changes in net income and changes in labor.

The study concluded that vulnerability to impacts on agricultural productivity is greater in zones with a higher prevalence of annual crops (the valleys of Coquimbo Region, the central valley of Maule Region and southward), while in the Los Ríos and Los Lagos Regions, the greatest vulnerability is due to the lack of irrigation infrastructure. The central regions, where fruit production predominates, are less vulnerable. In terms of social vulnerability, the most affected zones are those that are most intensely agricultural in which the population displays low human development indices, such as the Coquimbo, Maule and La Araucanía Regions. Thirdly, an assessment of economic vulnerability focused mainly on capital invested in supplies and technology, as well as linkages with foreign markets for each subsector. In this case, crops that require more technical management and/or are more profitable are more economically vulnerable, as the potential losses are greater. In this case, results indicate that the effects of climate change on crops grown for export in central Chile and technologically intensive crops could result in a significant economic loss for the country.

Biodiversity

International studies conducted in recent years on the impacts of climate change on biodiversity show that the recent rise in the average global temperature has induced a series of biological and ecological responses in plants and animals. These studies also predict, with a significant degree of certainty, shifts in species distribution ranges and phrenology.

Chile's great range of latitude and altitude leads to a wide variety of environmental conditions that sustain biological diversity. The climatic patterns that result from these two gradients mean that Chile has some areas with the lowest annual rainfall on the planet and others with the highest number of rainy days annually.

Chile's biodiversity hotspots for conservation priorities are zones that concentrate a minimum of 1,500 species of endemic vascular plants and an original habitat that has been significantly degraded by anthropic activity. The two areas of Chile that have been classified as hotspots are the Mediterranean and temperate climate zones and the Chilean Altiplano, as illustrated in Figure 9.

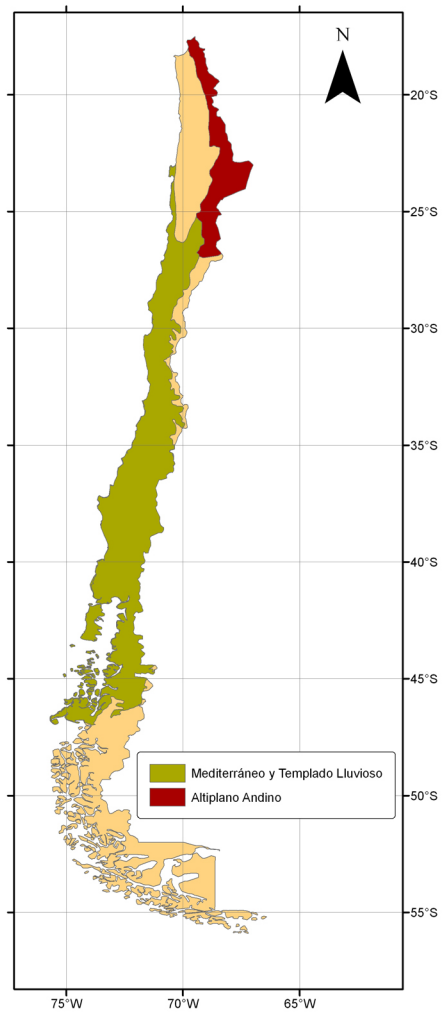


Figure 9. Biodiversity hotspots of Chile
Source: WWF, 2004

A CONAMA-funded study conducted in 2009–2010 by the Institute for Ecology and Biodiversity and the Center for Advanced Studies in Ecology and Biodiversity of the Catholic University assessed the vulnerability of Chile's biodiversity to climate change. Methodologically, the study compared current and expected distribution of species and ecosystems under a climate change scenario to identify possible adaptation measures. Analysis of the way in which species responded to climate change showed that in general, even while most distribution areas will shrink for species with limited dispersion, the number of species that would become extinct is quite small (two species of flora). The greatest variation in vegetation estimated for the end of the century would occur in Chile's central zone, where the ecosystems would undergo greater change. For example, the projection for ecosystems characteristic of Chile's central zone indicate that the area of distribution of inland Mediterranean spiny forest and low desert Andean scrub formations will be considerably reduced. In this context, the Mediterranean hotspot vegetation appears highly vulnerable to the impact of future climate change.

3.2 ADAPTATION TO CLIMATE CHANGE

The Government of Chile is taking concrete steps to promote adaptation to the effects of climate change in different areas such as water resources and the agriculture and livestock sector. The following sections describe some of these measures.

Water resources

In regard to water resources, one notable measure has been the glacier protection and conservation policy passed in February 2009 by the Governing Council (Council of Ministers) of CONAMA. This policy promotes the study and appreciation of Chile's glaciers in the national and international context. To this end, a national registry of glaciers was created and a set of research priorities was defined by the General Directorate of Water of the Chilean Ministry of Pubic Works, which has been systematically implementing a series of initiatives to protect Chile's glaciers since 2008. This policy seeks to establish measures that would preserve and conserve the country's glaciers, in order to ensure the continuity of the natural and productive processes that they sustain and the environmental services they supply. The policy also aims at identifying glacier typologies and conditions for their use and providing for the design of instruments and the institutional mechanisms to implement them.

Agriculture, livestock and forestry sector

The area that has implemented the greatest number of actions for climate change adaptation has been the forestry, agriculture and livestock sector, which has undertaken a series of studies financed by agencies of the Ministry of Agriculture (ODEPA and FIA primarily) and supported by CONAMA, or in some cases by the Ministry of the Environment with its own budget. These studies have generated information about the vulnerability of Chile's agriculture and livestock sector with the goal of enabling the design of concrete measures for the medium and long-term. Spheres of action pertinent to this sector include the use and changeover of crop varieties; improvement and adjustment of current irrigation practices; changes in irrigation systems; sustainable management of groundwater;

tree planting; increasing the availability of water; more efficient and effective fertilization; preparation and application of compost; the use and incorporation of agricultural waste; the controlled use of fire; and the management of herd-irrigation-pasture and livestock infrastructure.

In regard to instruments that support the development and implementation of adaptation measures, while it is true that all instruments that currently exist or have been applied in the recent past in Chile originated to address concerns other than climate change, this does not mean that they are not suitable as adaptation measures for reducing the vulnerability of the agriculture and livestock sector to climate change.

4. MITIGATION OF GREENHOUSE GAS EMISSIONS

4.1 MITIGATION IN CHILE

Chile affirms the need to stabilize global atmospheric concentrations of greenhouse gases (GHGs) at a level that prevents hazardous anthropogenic interference with the planet's climate system by reducing total emissions and protecting and improving GHG sinks and deposits through suitable mitigation measures. The country's contributions to international efforts in this regard are grounded in the principle of common but differentiated responsibilities and are intended to support the aims of the United Nations Framework Convention on Climate Change (UNFCCC) while also generating social and environmental co-benefits within the country.

Although Chile´s emissions are relatively low on a global scale, the country recognizes that due to the rate of economic growth over the last decades, which is expected to continue, emissions are expected to increase at a fast pace. For this reason, the Government has the political will to act to limit the increase in GHG emissions, by adopting nationally financed actions and enhancing the level of mitigation, to the extent that technical and financial support from Annex I countries allows.

In this context, by the year 2020, current emission levels in developing countries must be mitigated through the implementation of nationally appropriate mitigation actions (NAMAs) applied within a framework of sustainable development. These actions should be subject to measurement, reporting and verification processes. Chile will be responsible for implementing unilateral NAMAs and NAMAs supported by Annex I countries through technology transfer, financing and capacity building, which should also be subject to rigorous measurement, reporting and verification processes.

Chile and the Copenhagen Accord

- Chile associated itself with Copenhagen Accord on 29 January 2010.
- On 26 August 2010, Chile presented information for inclusion in Appendix II of the Copenhagen Accord: *Chile will take nationally appropriate mitigation actions to achieve a 20% deviation below the "Business as Usual" emissions growth trajectory by 2020, as projected from year 2007. To accomplish this objective Chile will need a relevant level of international support. Energy efficiency, Renewable energy, and Land Use and Land Use Change and Forestry measures will be the main focus of Chile's nationally appropriate mitigation actions.*

In accordance with its commitments under the Convention, Chile considers it is necessary to take firm and concrete steps toward achieving a lower carbon economy. In this context, the Chilean Government began working in 2010 on several instruments that will provide information for decision-making about mitigation. In the next few years, the Government of Chile will design and implement a strategy for mitigating its emissions.

Some concrete advances that are expected in this area include:

- Strengthening capacities related to the country's emissions inventories through the implementation of a national GHG Inventory Office (more details of this can be found in Chapter 6 of this National Communication);
- Integration of sector-specific efforts to prepare emission projections for the coming years, to establish a Government-sanctioned national baseline that will enable ministries to conduct their emission projection exercises in a complementary fashion and from a common foundation;
- Generation of information to enable Chile to produce NAMAs in the short term, especially in the energy and LULUCF sectors.

Beginning in 2011, the Government of Chile will also embark on an extensive exercise to prepare long-term mitigation scenarios based on a methodology developed and applied in South Africa prior to the 15th Conference of the Parties. This exercise will include inputs from different stakeholders in identifying possible future climate actions and estimating their costs, social implications and barriers to their implementation. The exercise will take two to three years and is expected to generate the best information possible for configuring public policy in this area in the remaining years of the decade.

At present, a variety of sector-specific initiatives are already being organized by different ministries to generate preliminary information about possible mitigation actions in Chile. These analyses do not claim to be exhaustive, but are rather intended to be indicative. In any case, one of the steps in the near future will be to look for a way to prioritize these various options.

4.2 ANALYSIS BY SECTOR

Energy sector

The country's energy policy is founded on the legal and regulatory role carried out by the State through its Ministry of Energy and related agencies, with the private sector taking responsibility for the investments. This arrangement means that the way policies are defined does have an impact on limiting increases in greenhouse gas emissions. The following are some of the main definitions that have been identified by the Administration of President Sebastián Piñera Echenique:

- Increase energy availability to meet the rise in demand related to the average economic growth rate of 6% per year projected up to 2020.
- Increase the security of energy supply in the short, medium and long term, by encouraging energy generation projects that reduce the risks of failure and reinforcing fuel supply to enable the effective and timely response to eventualities and contingencies.
- Promote competitive and sustainable investment in the sector.
- Work toward having 20% of the energy generated in Chile supplied by nonconventional renewable energy sources—our own local and global resources—by 2020.
- Achieve greater energy independence and increase private investment in hydrocarbon exploration and development.
- Improve current regulations governing access to energy resources, in order to increase investment in renewable energies in Chile.
- Conduct further studies and strengthen the institutional framework to enable the future development of any cost-efficient energy source.
- Promote research programs on energy and raise the awareness of younger generations about energy savings and energy efficiency.
- Improve information available about the country's energy resources in order to formulate a policy to promote energy efficiency and energy saving projects.

- Advance in energy efficiency certification and establish energy efficiency standards for residential construction, domestic appliances, lighting and vehicle fleets.

In the decade covered by this National Communication, the Government of Chile has been active in establishing a suitable regulatory framework for mitigating GHG emissions in the energy sector. Notable advances in this area include incentives for the use of non-conventional renewable energies, the Geothermal Law and the 2008 Law on Non-conventional Renewable Energies (NCRE). Others include the tax exemption for solar thermal systems in 2009 and the regulatory framework for the energy efficiency incentive, which includes energy efficiency labeling, home heating regulations, and minimum energy performance standards. Over the same decade, the Government of Chile created several institutions to oversee the implementation of this wide range of instruments.

In regard to Non-conventional Renewable Energy (NCRE), the Government has developed a policy that supports competitive energy generation based on these energy sources by identifying barriers to their introduction and creating lines of action intended to remove those barriers. The barriers themselves include a lack of information, precarious infrastructure, uncertainty about new technologies and difficulties in accessing credit. In cases such as geothermal energy, among others, the barriers are associated with the high cost of exploration. Nevertheless, in four years Chile has doubled its installed capacity of NCRE for electricity generation, which rose from 286 MW (representing 2.4% of total installed capacity) in late 2005 to 600 MW (4% of the total capacity) by the end of 2009, and continues to rise. Furthermore, of the energy projects submitted to the Environmental Impact Assessment System in Chile, between 2004 and the end of 2009, 2000 MW of the total 2,553 MW of NCRE projects were for wind power.

In the area of energy efficiency, Chile has channeled most of its efforts through the National Energy Efficiency Program and the Chilean Energy Efficiency Agency. Since 2009, these programs have enabled the implementation of pre-investment and loan programs that have advanced energy efficiency in the industrial, residential, public and commercial sectors.

The country's energy sector has great potential for mitigating GHG emissions in both generation and consumption. On the other hand, there is uncertainty about the penetration rates of these technologies and about the improvement of technical capacities that will enable these technologies to be taken advantage of in Chile. Some variables that contribute to this uncertainty include the future price of generation and consumption technologies, future international fossil fuel prices, and the rate of national economic growth.

Agriculture, livestock and forestry sector

Chile's forestry, agriculture and livestock sector, is recognized as carbon neutral, meaning that the emissions counted in the GHG inventories from agriculture and livestock activities are less (in tons of CO_2 equivalent) to those captured through forestry activity.

While the Ministry of Agriculture's regulatory frameworks and incentives are not explicitly directed at addressing climate change, the Ministry has made available to this sector several instruments that lead to the mitigation of GHG emissions.

According to the Ministry of Agriculture, GHG emissions associated with this sector's activities can be reduced by increasing energy efficiency and productive efficiency, applying better agricultural practices in both productive and environmental terms, reducing forest fires, increasing the forestry sector's capacity for capturing GHG emissions through sustainable native forest management and decreasing soil degradation.

Projections

As there are no official sector-specific estimates that project emissions for the agriculture, livestock and forestry sector, this National Communication presents projections based on the results of the 2010 study "Análisis de opciones futuras de mitigación de GEI para Chile asociadas a programas de fomento en el sector silvoagropecuario" (Analysis of future GHG mitigation options for Chile associated with development programs in the agriculture, forestry and livestock sector). These include projections of emissions for some subsectors. The subsectors analyzed were livestock, annual and perennial crops, degraded soil, and forestry.

Table 8 shows projected annual GHG emissions (Gg CO_2eq) for the subsectors considered here. The study indicated that in all of these subsectors, the trend is toward increased emissions (or decreased carbon capture, in the case of forestry) as a direct result of increased agricultural and livestock production and the new focus of the state fun-

ded program *Incentive System for the Recovery of Degraded Soils,* which emphasizes productive activities. For forestry plantations, annual capture decreases primarily because the area forested is decreasing each year. Without the incorporation of new acreage, carbon capture would decrease gradually between 2020 and 2050.

TABLE 8. Projected GHG emissions for selected subsectors of the agriculture, livestock and forestry sector for use in sectoral development instruments

Subsector	2020	2030	2050
	(Gg CO_2eq/year)	(Gg CO_2eq/year)	(Gg CO_2eq/year)
Forestry	-150.0	-149.4	-96.1
Degraded soils	-33.8	0	0
Annual and perennial crops	1,371.1	1,428.5	1,527.2
Livestock	5,534.4	5,800.3	6,266.6
Total	**6,721.8**	**7,079.4**	**7,697.7**

Source: CCG UC, 2011

Photo: Ministry of Agriculture Government of Chile

Transportation sector

Chile's transportation sector, like that of most countries, accounts for a high percentage of national GHG emissions because of its high consumption of fossil fuels. According to figures from the 2006 GHG emissions inventory, emissions of CO_2eq from this sector in Chile are caused mainly by road transport (92.3%), followed by domestic aviation (5.1%), maritime transport (2.2%), and finally rail transport (0.4%).

Projections

Two studies commissioned in 2009 by the Government of Chile examined emission trends and mitigation options for the transportation sector. They predicted a rise in GHG emissions based on the impact associated with projected fuel consumption in this sector (Figure 10).

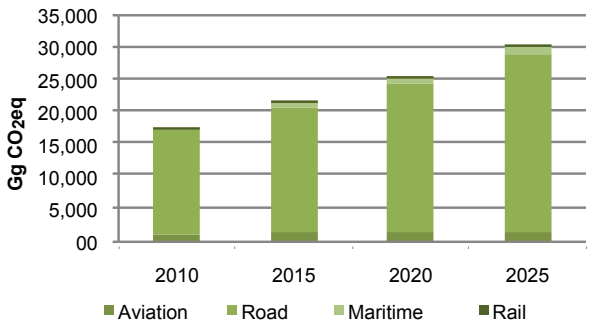


Figure 10. Projected emissions of CO_2eq in Chile's transportation sector (2010-2025)
Source: Ministry of the Environment, based on information from a study by Sistemas Sustentables, 2010

Chile's road transport sector has been especially active in seeking sector-specific options that benefit the environment and also contribute to mitigating GHG emissions. These options can be classified as follows:

· Promoting the penetration of low carbon vehicle technologies.

· Restructuring the urban transit system.

· Switching the technology of vehicle fleets.

· Promoting alternative modes of transport.

· Implementing energy efficiency measures in high priority fleets.

Copper mining sector

Chile is the largest cooper producer in the world, accounting for 34% of global cooper production. As such, copper mining is highly important to the national economy. The copper sector is also a major energy consumer, through its direct consumption of fuels and electricity. Copper extraction and production in Chile involves a series of processes that range from ore extraction (from open pit or underground mines), to concentration and refining, to pyrometallurgy in the case of copper sulfide; and to hydrometallurgy (extraction by solvents and electrowinning) in the case of ore that can be lixiviated. These operations consume energy at different rates.

The approach to emissions mitigation in the Chilean copper mining industry has mainly consisted of exploring ways to improve the energy efficiency of industrial processes associated with copper production. Energy efficiency has been an important tool in this regard, as it can lower production costs and thereby improve competitiveness. For this reason the copper industry has been a leader in energy efficiency applications in Chile.

Projections

Studies conducted by the Ministry of Mining's Chilean Copper Commission show that projected indirect emissions from copper production—those generated by electricity use in mining operations—represent over 73% of the sector's emissions (Figure 11). This is primarily because of the projected importance of fossil fuels in the country's electricity-generating grids that supply the sector´s principal mining operations.

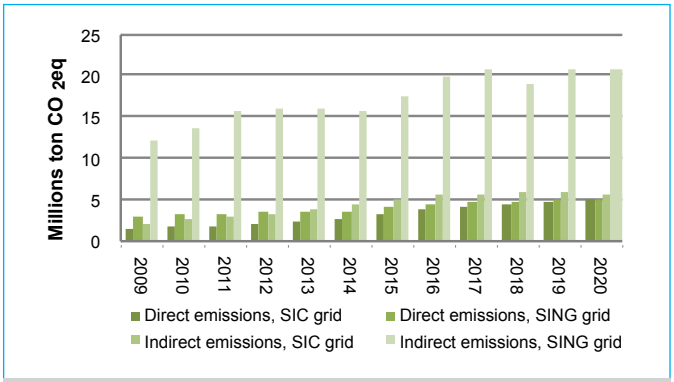


Figure 11. Projected direct and indirect GHG emissions of Chile's copper mining sector, by electricity grid
Source: "Estudio prospectivo de emisiones de gases de efecto invernadero de la minería del cobre en Chile". Chilean Copper Commission, 2009

4.3 MULTI-SECTOR ACTIONS

Carbon markets

Since the Kyoto Protocol was adopted in 1997, Chile has remained actively interested in promoting and implementing projects under the Protocol's Clean Development Mechanism (CDM), taking a leading role in Latin America and globally in terms of the number of projects registered and methodologies approved. The country took an early interest in making use of the CDM, establishing its Designated National Authority (DNA) in 2003. As of 2010, this office has approved a total of 73 national letters of approval, and by the end of 2010 the Executive Board of the CDM had registered 42 of these projects. The Chilean projects registered are expected to achieve an aggregate reduction of 4,957,224 tons of CO_2 equivalent. The most common projects in Chile are hydroelectric projects, followed by methane capture in landfills and agroindustrial activities.

Carbon footprint

As part of its effort to mitigate GHG emissions in the agriculture, livestock and forestry sector, in 2009 the Ministry of Agriculture commissioned the Institute for Agriculture and Livestock Studies (INIA) to analyze the carbon footprint of Chilean agriculture and livestock exports, in order to maintain the country's competitiveness in international markets. The English standard (PAS 2050: 2008 BSI, based on ISO 14067) was used to assess life cycles of specific varieties of fruit, vegetables, grains, dairy and animal products. In general, the main GHG emission sources in these categories are energy sources, supplies used, and the animals themselves in the case of animal products. International long-distance transport is a minor contributor to Chile's product carbon footprint.

In 2010, the Ministry of the Environment commissioned a study to characterize its own GHG emissions and design a plan to reduce its institutional carbon footprint, becoming the first ministry to do so.

Photo: Ministry of Agriculture Government of Chile

5. ADDITIONAL INFORMATION PERTINENT TO ACHIEVING THE CONVENTION'S OBJECTIVE

5.1 TECHNOLOGY TRANSFER

In Chile, policies and programs that support innovation are promoted by public and private entities that together make up the country's technology transfer system. This system operates on different levels, depending on the institutions involved. These different levels include:

- General coordination entities.
- Implementing agencies.
- Sector-specific and regional entities.
- Institutions focused on technology research and promotion.

The last decade in Chile has been a time of technological experimentation, with the identification of more and better opportunities for addressing climate change, the development of specific technical knowledge, the country's participation in emerging international technology markets and the creation of a legal, regulatory, and support framework for technology transfer. Public sector initiatives have produced a series of instruments aimed at developing and encouraging the adoption of non-conventional renewable energies in Chile and the application of energy efficiency measures in different GHG producing sectors. These include instruments of support for the NCRE project pre-investment and investment stages and other instruments that support innovation, financing and investment in this area. Over the past decade, the private sector has also participated very actively in implementing the Kyoto Protocol's CDM, allowing Chile to remain a leader in CDM projects, a notable achievement for an economy of its size.

5.2 SYSTEMATIC OBSERVATION OF CLIMATE VARIABILITY AND CLIMATE CHANGE

In Chile, climate and climate variability are systematically observed through the monitoring of key meteorological, atmospheric, oceanographic and terrestrial parameters. This monitoring is carried out using modern equipment and automated communication devices, relying on the country's installed capacity for operating equipment and processing the information generated.

In Chile, systematic climate observation programs are operating at the national level with the close involvement of research organizations and government institutions. National institutions also participate in international climate research and observation systems. However, gaps have been identified in meteorological, atmospheric and oceanographic research and observation, and there are some priority areas in which additional knowledge and information would lead to an improved understanding of the national and regional climate system.

The creation of the Glaciology and Snow Unit under the Ministry of Public Works' General Directorate of Water in 2008 has led to the implementation of several public sector activities to monitor glaciers, including the collection and systematization of information to build a National Glacier Registry, which is expected to be finalized in 2011.

5.3 RESEARCH PROGRAMS

Chile has several research programs focused on different aspects of climate change such as climate change science, vulnerability and adaptation, mitigation of emissions, and, still in the early stages, emission factors. Specific public sector agencies support these programs, mainly by providing funding, while investigators situated in academic and other research centers carry out this work.

Chilean researchers also participate on an ongoing basis in several networks oriented toward environmental sustainability and global change, both in Latin America and internationally. Chilean experts also collaborate with the Intergovernmental Panel on Climate Change (IPCC), the United Nations' principal scientific and technical entity for climate change.

Over the past decade, research centers in Chile have established or strengthened lines of investigation in areas related to climate change such as meteorology, oceanography, glaciology and vulnerability and adaptation to climate change.

5.4 INFORMATION ABOUT EDUCATION, TRAINING AND AWARENESS-RAISING RELATED TO CLIMATE CHANGE

Chile has seen some notable changes between 2000 and 2010, especially in regard to public participation in the

climate change debate and public access to information about this phenomenon. Changes in this area have come from institutions and initiatives to promote the development of public education and awareness programs; initiatives and programs geared specifically to primary, secondary and tertiary educational levels; and campaigns for public education, training and awareness led and/or promoted by different segments of Chilean society.

5.5 BUILDING LOCAL AND NATIONAL CAPACITIES FOR CLIMATE CHANGE, FINANCIAL RESOURCES AND TECHNICAL SUPPORT

Capacity building at the local and national levels has generally been focused on improving dissemination of information, education and research on climate change, improving the quality of information available, and increasing capacities for climate observation. It has also sought to develop institutional capacities to respond to the challenges of mitigation and adaptation and to develop and transfer technologies for mitigation and adaptation, reinforcing international cooperation and establishing synergies between climate change and other global environmental problems. Capacities have also been developed in the private sector, among non-governmental organizations, and in local community groups, according to their different interests.

The international technical and financial collaboration that Chile has received during the decade covered in this report has been crucial for the development, promotion and strengthening of activities related to climate change in the country. A notable supporter of these efforts has been the Global Environment Facility (GEF) and its implementing agencies. Support has also come from international environmental cooperation agreements signed by the Government of Chile and from bilateral cooperation initiatives.

The funding that the Government of Chile has provided for managing climate change in the country has enabled the creation of permanent working groups charged with addressing climate change from within their ministries and the allocation of budgets to implement their activities.

6. BARRIERS, GAPS AND NEEDS RELATED TO FINANCIAL AND TECHNICAL MATTERS AND CAPACITIES

For Chile, the important task of fulfilling its commitments under the UNFCCC will involve overcoming obstacles, filling in important gaps, and meeting various needs related to financial and technical matters and the development of local capacities.

As a developing country, Chile is committed to contributing to efforts aimed at mitigating and to adapting to the impacts of climate change that are occurring at the national and global level. The work already done and the achievements made to date reflect the equitable balance between national efforts and international support. This collaboration has enabled such advancements as the establishment of a new environmental institutional framework, the generation of technical capacities and the development of new lines of work. The country's achievements to date demonstrate how national efforts can be supported by developed countries to achieve the ultimate objective of the Convention.

6.1 FINANCIAL RESOURCES AND TECHNICAL SUPPORT

In moving toward low carbon development, Chile's central challenges will revolve around generating permanent and sufficient national and international funding mechanisms for implementing climate change mitigation and adaptation projects and for measuring, reporting and verifying GHG reductions. Other challenges will include strengthening the country's research and development capacities.

6.2 SECTOR-SPECIFIC NEEDS

The list below identifies some areas in which Chile expects to carry out additional sector-specific efforts to establish and strengthen its climate change-related capacities.

- National greenhouse gas emissions inventory.
- National water resources affected by climate change.

- Systematic observation of climate variability and climate change.
- Electricity generation from renewable sources and energy efficiency.
- Transportation.
- Development of infrastructure focused on adaptation to climate change.
- Agriculture, livestock and forestry activities.
- Biodiversity.
- Warning systems for climatic events and natural disaster management.
- Strengthening participation in national climate change actions.

Beginning in 2011, Chile will embark on a campaign to implement the diverse actions required of developing countries under the Cancun Agreements. The country will also take action on mitigation by working to design and implement NAMAs that will allow Chile to follow through on its voluntary commitment to achieving a 20% reduction in its emissions growth trajectory by 2020, as projected from the year 2007. The approaching challenges are significant, but future achievements will allow the country to advance along a path of low carbon sustainable development.