Ministerio del Medio Ambiente

Gobierno de Chile

FIRST BIENNIAL UPDATE REPORT OF CHILE

To the United Nations Framework Convention on Climate Change

2014

FIRST BIENNIAL UPDATE
REPORT OF CHILE
To the United Nations Framework Convention on Climate Change

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CLIMATE CHANGE OFFICE

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To the United Nations Framework Convention on Climate Change

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LOW EMISSION CAPACITY BUILDING PROGRAMME CHILE

Tercera Comunicación Nacional sobre Cambio Climático

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PROLOGUE

On a permanent basis, The United Nations Framework Convention on Climate Change draws the attention of countries for them to share information on their progresses facing climate change. In our case, Chile presented its Second National Communication on Climate Change in 2011, gathering actions carried out in the country during the first decade of this century.

Although a relatively short period of time has passed, recent progress institutionalizing climate change in the country has turned out to be singular: the country already runs an operational national system of greenhouse gas inventories on all ministries and services managing the information that allows to prepare and update the national inventory, facilitating the use of results as supporting tools for sectoral policies.

Additionally, nationally appropriate mitigation actions (NAMAs, defined according the Convention) are being deployed starting from their design, financing and progressive implementation in Chile, while the National Congress has recently enacted a law which enables to collect a carbon tax, which will be the most important mitigation action in the country.

Finally, for the first time a systematic survey of public needs and support received in the form of financial resources, capacity-building, technical assistance and technology transfer related to the fight against climate change is available.

All of these progresses, results and associated information are contained in this document called First Biennial Update Report of Chile which origin and contents were agreed in 2011 by the Conference of the Parties.

It consists on an instrument added to our work as a country, aiming to improve our transparency of action. On this document, actions and results occurred from early 2011 to the first half of 2014 are compiled, updating most of the information contained in the Second National Communication.

The assessment of fulfillment of the voluntary commitment on mitigation announced in 2009 by Chile will be an important contribution to consider from the inside of public policies of the country, in order to nurture the national position towards the upcoming negotiations among countries, hoping they end successfully during the COP21, to be held in Paris.

In this regard, the vulnerability of Chile facing climate change effects make a national imperative to develop an energetic action to support common objectives stated by the United Nations in relation to climate change, that will only be effective if all countries make generous contributions

from their corresponding capacities, and those countries able to provide international support facilitate their resources to those countries in need to actively face climate change.

The effort related to the preparation of this First Biennial Update Report in the agreed time shows the will of Chile to work towards an ambitious joint action.

The Climate Change Office from the Ministry of the Environment, thanks to the financial support by international cooperation projects — just to mention a few of the most relevant, the Global Environment Facility, Low Emission Capacity Building-Chile and Information Matters, added to a coordinated work with focal points on climate change existing in the ministries and public services — has been able to present in the COP20 held in Lima its First Biennial Update Report, that was previously approved by the Council of Ministers for Sustainability and Climate Change (CMSCC), in October 2014.

This is a new effort to actively move on toward actions that may allow us to reduce the impacts in the long term. As President Michelle Bachelet stated in the Climate Summit in September 2014 in the United Nations, "future generations will measure us not only for the economical growth we accomplish and its subsequent social projections, but also for our ability to face the climate change challenge".

Pablo Badenier Martínez
Ministry of the Environment
Santiago, Chile, December 2014

EXECUTIVE SUMMARY

Chile's First Biennial Update Report on Climate Change is submitted as part of the country's reporting commitments under the United Nations Framework Convention on Climate Change. In accordance with the Convention's guidelines, this report updates the information of Chile's Second National Communication (2011), specifically in regard to National circumstances and institutional arrangements; National greenhouse gas inventory (NIR); Mitigation policies and actions; and Needs and support received in the area of climate change. In terms of needs and support received, this report considerably expands the coverage and analysis of related information with respect to the Second National Communication.

The Chilean Ministry of the Environment's Climate Change Office coordinated the process of collecting and gathering the information required for this report in collaboration with sectoral public institutions with environmental purview. This information was then validated by the ministerial focal points for climate change, and the Report approved by the Council of Ministers for Sustainability and Climate Change in October 2014.

1 NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

1.1. Geography

Chile is a tri-continental country situated in southwestern South America and stretching from 17° 30′ S latitude in the north to 56° 30′ S latitude in the south. The territory encompasses Easter Island in Oceania and Antarctica in the far south. It extends more than 8000 kilometers and borders Peru to the north, Bolivia and Argentina to the east, the South Pole to the south and the Pacific Ocean to the west. Chile's many different climates are determined mainly by latitude and altitude, prevailing temperate characteristics.

The Chilean population grew rapidly in the 20th century but has begun contracting in the first decade of the 21st century. Progressive development has raised the quality of life of Chile's inhabitants, and the positive evolution of the country's Human Development Index (HDI) in recent years is indisputable proof of these transformations.

1.2. Economy

Chile's export-oriented economy is one of the most open in the world in terms of promoting free trade and trade agreements. Since 2010, Gross Domestic Product (GDP) has grown faster than the regional average and more rapidly than that of most developed countries. Its strong currency made Chile one of the most resilient countries during the 2007–2008 global economic and financial crisis. Today, however, the country faces a potential slowdown in growth.

Table 1 presents some key indicators for Chile that update the information provided in the Second National Communication of Chile to the United Nations Framework Convention on Climate Change (2011)[1].

1 *www.mma.gob.cl/1304/articles-50880_docomunicadoCambioClimatico.pdf*

Table 1. Chile - Key indicators.

Information		Sources
Geographic Indicators		
Total area (km2)	2,006,096	Military Geographic Institute (IGM)
Population 2002	15,745,583	National Statistics Institute (INE)
Estimated population 2010	17,094,275	INE
Estimated population 2013	17,556,815	INE
Estimated population 2050	20,204,779	INE
Rural population (% of total, 2012)	13.00	INE
Annual forested area (new forest tree plantations) (ha, 2013)	6,609	National Forestry Corporation (CONAF)
Annual planted area (new forest tree plantations and reforestation) (ha, 2013)	95,340	CONAF
Human Development		
Human Development Index 2014	0.81	United Nations Development Programme (UNDP)
Youth literacy rate in 2009 (% of persons 15–24 years old)	98.9	World Bank
Adult literacy rate in 2009 (% of persons 15 and above years old)	98.6	World Bank
Life expectancy at birth (in years, as of 2012)	79.6	World Bank
Deaths under 1 year of age and infant mortality in 2009 (per 1000 live births)	7.90	Ministry of Health (MINSAL)
Female infant mortality rate in 2012 (per 1000 live births)	7.10	World Bank
Male infant mortality rate in 2012 (per 1000 live births)	8.60	World Bank
Infant mortality rate in 2012 (< 1 year of age)	8.00	United Nations Children's Educational Fund (UNICEF)
Potable water coverage in 2013 (%)	99.9	Superintendence of Sanitary Services (SISS)
Sanitation system coverage in 2013 (%)	96.5	SISS
Wastewater treatment coverage for population served in 2013 (%)	99.9	SISS
Public expenditure on education as % of GDP (2012)	4.52	World Bank
Economic Activity		
Estimated GDP (ppp) for 2014 (millions of 2014 US$)	352,224	International Monetary Fund (IMF)
Estimated GDP (ppp) per capita for 2014 (2014 US$)	19,887	IMF
GDP growth (ppp) in 2012	0.38	IMF
GDP growth (ppp) in 2013	0.39	IMF
Estimated GDP growth (ppp) in 2014	0.39	IMF
Goods and services exported (% of GDP, 2013)	32.6	World Bank
Sector-specific Activity		
Renewable energy (% of energy matrix in 2012)	33.8	Ministry of Energy
Primary energy imports (% of energy used in 2012)	60.2	Ministry of Energy
Fossil fuels consumed as primary energy (% of total in 2012)	66.2	Ministry of Energy
Annual freshwater extraction for agricultural use in 2011 (% of freshwater extracted)	70.3	World Bank
Consumptive water extraction for agriculture and livestock use in 2011 (% of total)	73.0	Ministry of Public Works

1.3. Institutional arrangements for climate change

1.3.1. Environmental institutional framework

The consolidation of Chile's environmental institutional framework occurred primarily through the creation of the Ministry of the Environment (MMA) and the Ministry of Energy (MINENERGIA) in 2010 and the announcement of the creation of the Ministers Council for Sustainability and Climate Change in 2014.

INE: National Statistics Institute (Instituto Nacional de Estadísticas

1.3.2. Institutional framework and policies for climate change

Since Chile ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994 and became a signatory to its Kyoto Protocol in 2002, the country has participated actively and met its commitments as a developing country. In 1996, the Government of Chile established a National Advisory Committee for Global Change, which played an important role in formulating initial national positions for international negotiations and in creating national

policy instruments for climate change.

Climate Change Office

A major milestone occurred in 2010 with the official creation of the Climate Change Office (OCC) of the Ministry of the Environment. The OCC has been charged with participating in international negotiations on the implementation of the UNFCCC; coordinating the Committee of the Clean Development Mechanism's Designated National Authority; serving as focal point for the Intergovernmental Panel on Climate Change (IPCC) and as technical focal point of the Adaptation Fund; technical leader for climate change for the Global Environment Facility (GEF) and technical secretary of the inter-ministerial committees on climate change.

2008 - 2012 National Action Plan on Climate Change

The first systematic climate policy effort in Chile was the 2008–2012 National Action Plan on Climate Change (PANCC 2008-2012), which was approved and disseminated in Chile by President Michelle Bachelet, on December 2008. The plan was structured around three areas defined in the National Climate Change Strategy of 2006—adaptation, mitigation, and capacity building. Today, the majority of the Plan's proposed measures have been completely or partially implemented.

2015 - 2020 National Action Plan on Climate Change

President Bachelet's Government Agenda for 2014–2018 called for the formulation of a second national climate change plan with a comprehensive, cross-sectoral approach to adaptation, mitigation and capacity building and including measures that will move the country toward a low carbon economy. Work on the plan began in September 2014 and will build upon current knowledge and concrete actions, with a special emphasis on financing and implementing measures.

1.3.3. Sector-specific institutional framework

Most ministries represented on the Ministers Council for Sustainability and Climate Change have defined some basic framework or nominated a person in charge on climate change within their institutions (climate change focal points). Despite evidence of increasing engagement by regional and municipal structures, especially in regard to adaptation, increasing interactions between the Central Government and subnational entities is a pending challenge.

2 CHILE'S NATIONAL GREENHOUSE GAS INVENTORY, 1990–2010 TIME SERIES

This national greenhouse gas inventory (NIR) is the third inventory submitted by Chile to the UNFCCC in fulfillment of Article 4, paragraph 1(a) and Article 12, paragraph 1(a) of the UNFCCC and decision 1/CP.16 of the 16th Conference of the Parties (Cancun, 2010).

Chile's NIR covers the entire national territory (continental, insular and Antarctica) and includes GHG emissions and removals in a complete time series spanning from 1990 to 2010.

2.1. Institutional arrangements and preparation of Chile's NIR

Since 2012, the Ministry of Environment's OCC has been designing, implementing and coordinating the National Greenhouse Gas Inventory System of Chile (SNICHILE), which sets out institutional, legal and procedural measures for the biennial updating of the NIR, thereby ensuring the sustainable preparation of GHG inventories in the country, the consistency of reported GHG flows and the quality of results. SNICHILE has five permanent working areas:

- NIR update
- Continuous improvement system
- Capacity building
- Institutionalization
- Dissemination

Preparation of this NIR began in the first half of 2013 and was completed in mid-2014. Chile's NIR represents the compilation of sectoral GHG inventories (SGHGI), all prepared in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006GL) and using IPCC software. The Energy sector's SGHGI was prepared by the Energy Policy and Outlook Division of the Ministry of Energy (MINENERGIA). The SGHGI of the Industrial processes and other product use (IPPU)[2] sector was prepared by the OCC. The SGHGI for the Agriculture, forestry and other land use (AFOLU)[3] sector was prepared by the Ministry of Agriculture (MINAGRI), with its Office of Agrarian Studies and Policies (ODEPA) coordinating work with the National Forestry Corporation (CONAF) on issues related to land-use change; with the Forestry Institute (INFOR) on matters related to forested lands; and with the Agricultural Research Institute (INIA) on agriculture issues (crops and livestock). The Waste sector's SGHGI was prepared by the Ministry of Environment's Solid Waste Section. Each SGHGI was reviewed by international experts. Then the inventories were compiled by the OCC for use in Chile's NIR and its respective report, both of which also were subject to national and international review.

2 To ensure this report conforms to UNFCCC requirements for developing countries, the IPPU sector was divided into two separate sectors—Industrial processes and Solvent and other product use.

3 To ensure this report conforms to UNFCCC requirements for developing countries, the AFOLU sector was divided into two sectors—Agriculture and Land use, land-use change and forestry.

2.2. Trends in greenhouse gas emissions in Chile

In 2010, the balance of GHG emissions and removals[4] in Chile amounted to 41,698.5 $GgCO_2eq$, while total GHG emissions[5] in the country amounted to 91,575.9 $GgCO_2eq$, the latter representing an increase of 83.5% between 1990 and 2010 (Table 2 and Figure 1). The key drivers of this trend in the GHG balance were the Energy and Land use, land-use change and forestry (LULUCF) sectors. The values in the balance that fall outside of the global trend are primarily the consequence of wildfires (accounted for in the LULUCF sector).

In 2010, the main GHG emitted in Chile was CO_2, which accounted for 76.6% of total GHG emissions, followed by CH_4 with 12.5% and N_2O with 10.6%. HFCs and PFCs together accounted for 0.3% of total GHG emissions.

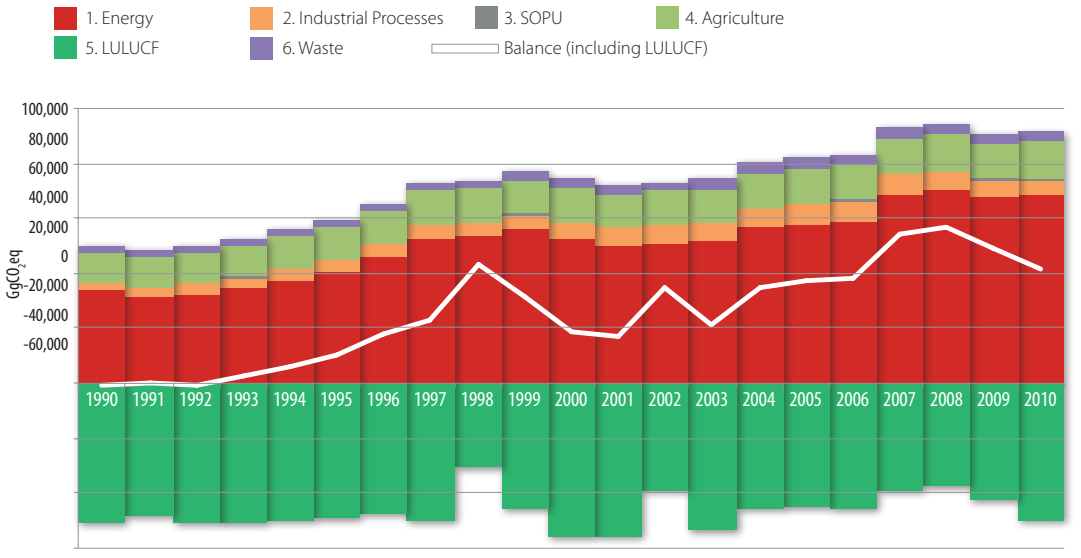
The Energy sector, that represents fossil fuel consumption, is the leading GHG emitter in Chile, accounting for 74.7% of total GHG emissions in 2010. That year, GHG emissions amounted to 68,410.0 $GgCO_2eq$, an increase of 104.0% from 1990. The key drivers of this increase were the increased coal and diesel consumption for electricity generation and the consumption of liquid fuels for road transportation (light gasoline-powered vehicles and heavy diesel-powered vehicles). Emissions in this sector have been decreasing since 2009, mainly due to

Table 2. Chile's NIR: GHG emissions and removals by sector (in $GgCO_2eq$), 1990–2010 series.

Sector	1990	1995	2000	2005	2010
1. Energy	33,530.4	40,370.6	52,346.8	57,936.8	68,410.0
2. Industrial processes	3,108.2	4,242.5	6,399.9	7,354.7	5,543.2
3. Solvent and other product use (SOPU)	82.3	94.8	118.0	110.7	243.0
4. Agriculture	10,710.2	11,892.6	12,493.2	12,736.9	13,825.6
5. Land use, land-use change and forestry (LULUCF)	-50,821.6	-48,743.8	-55,404.6	-44,624.2	-49,877.4
6. Waste	2,465.5	2,685.8	3,130.0	3,866.2	3,554.1
Balance (including LULUCF)	-925.0	10,542.5	19,083.4	37,381.1	41,698.5
Total (excluding LULUCF)	**49,896.6**	**59,286.3**	**74,487.9**	**82,005.2**	**91,575.9**

Source: Prepared in-house by SNICHILE

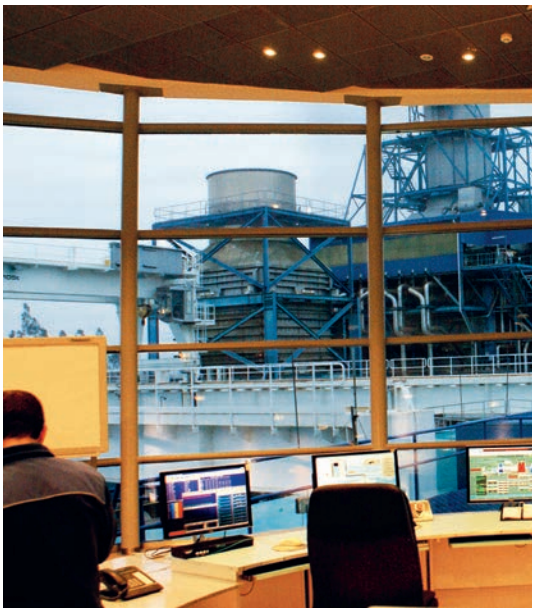
Figure 1. Chile's NIR: GHG emissions and removals trend by sector, 1990–2010 series



4 *The term "balance of GHG emissions and removals" or "GHG balance" refers to the sum of GHG emissions and removals, expressed as carbon dioxide equivalents (CO_2eq). This term includes the LULUCF sector.*

5 *The term "total GHG emissions" refers only to the sum of GHG emissions in Chile, expressed in carbon dioxide equivalents (CO_2eq) and excludes the LULUCF sector.*

the international economic crisis that began in 2008 and, to a lesser extent, to changes in fuel use in the country's energy matrix. At the subcategory level, the Energy industry (mainly electricity generation) is the leading source of GHGs in Chile, accounting for 39.7% of the sector's emissions, followed by Transport (mainly road transportation) with 30.5% and Manufacturing industries and construction with 18.1%. The remaining 10.2% derives from other sectors (mainly Residential). Lastly, the Oil and natural gas subcategory accounted for 1.4% and Solid fuels for 0.1%.



LULUCF is the only sector that consistently removes CO_2 in the country. In 2010 the GHG balance of the sector reported removals for -49,877.4 $GgCO_2eq$. The GHG balance in this sector has tended toward removal over the entire time period, although removals dropped by 1.9% between 1990 and 2010. The key drivers in this category are an increase in biomass from forestry plantations and second-growth natural forests. GHG removals increase near the end of the period due to an increase in the area covered by forest tree plantations (increase in biomass) and a reduction in forest harvesting. At the subcategory level, in absolute terms[6], 96.0% of the GHG balance corresponds to the Forest land category, followed by Grassland with 2.3% and Cropland with 1.2. The remaining 0.6% is accounted collectively by all other categories.

The Agriculture sector is the second emitter of GHGs in Chile, accounting for 15.1% of total GHG emissions in 2010. That year, GHG emissions amounted to 13,825.6 $GgCO_2eq$, an increase of 29.1% since 1990, the key driver being the steady increase in the use of synthetic

6 To enable the direct interpretation of quantitative analyses, removals have been expressed as absolute values (2006GL).

nitrogen-based fertilizers. At the category level, 52.4% of GHG emissions come from Agricultural soils, followed by Enteric fermentation with 34.4%, and Manure management with 12.1%. The remaining 1% derives from the categories Rice cultivation and Field burning of agricultural residues.

The Industrial Processes sector is the third source of GHG emissions in Chile, accounting for 6.1% of total GHG emissions in 2010. In 2010, r this sector's GHG emissions amounted to 5,543.2 $GgCO_2eq$, an increase of 78.3% since 1990. The key driver of this increase is the steady growth in methanol production, the cement industry and the lime industry. Nevertheless, emissions have been falling sharply since 2006 owing to the reduction in natural gas imported from Argentina (the raw material used to produce methanol). At the subcategory level, Cement production was the main emitter in 2010, with 21.5% of the sector's GHG emissions, followed by Nitric acid production with 20.3%, Iron and steel production with 19.7%, and Lime production with 19.4%. Methanol accounted for 12.1% and Aerosols for 2.8% of the sector's total GHG emissions, and the remaining 4.1% corresponded to other subcategories such as Ethylene, Refrigeration and air conditioning and Ferroalloy production.

The Waste sector ranks fourth in Chile for GHG emissions, accounting for 3.9% of total national GHG emissions in 2010. That year, the sector emitted 3,554.1 $GgCO_2eq$, an increase of 44.2% since 1990. The key drivers of this increase were the increase in population and the amount of waste generated. At the subcategory level, 74.4% of GHG emissions from this sector come from Solid waste disposal, followed by Wastewater treatment and discharge with 23.7%, Biological treatment of solid waste with 1.9%, and lastly Waste incineration, with less than 1%.

Solvent and other product use sector is responsible for the lowest level of GHG emissions in Chile. Emissions from this sector amounted to 243.0 $GgCO_2eq$ in 2010, or 0.3% of total GHG emissions, representing an increase of 195.1% since 1990.

In accordance with UNFCCC and 2006GL requirements, GHG emissions from international marine and aviation bunker fuels, as well as CO_2 emissions from biomass burned for energy purposes have been quantified and reported as Memo Items, but were not included in the country's Balance of GHG emissions and removals.

3 GREENHOUSE GAS MITIGATION POLICIES AND ACTIONS

The Government of Chile, through the Ministry of Environment's OCC, has coordinated a series of national initiatives to mitigate GHG emissions in order to move towards sustainable, resilient and low-carbon development. These initiatives are framed within the voluntary commitment that Chile made officially to the UNFCCC in 2010, which affirms: "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 her Government Agenda, President Bachelet reaffirmed the country's willingness to fulfill this commitment.

3.1. Mitigation actions and policies in Chile

The information on GHG emissions and removals presented in Chile's NIR contextualizes and underpins the importance of implementing sector-specific mitigation actions that can impact the country's overall GHG emission trend.

Multiple mitigation actions developed by government agencies are currently under implementation in different sectors in Chile. In the Energy sector, the Ministry of Energy has played a regulatory role by promoting institutional improvements, fostering the slow yet steady introduction of non-conventional renewable energies (NCREs) to the electricity matrix, and advanced toward greater energy efficiency, among other measures. For the Transportation sector, the Ministry of Transportation and Telecommunications' Undersecretary of Transportation is responsible for generating policies, enabling conditions and drafting regulations for the development of efficient, safe and environ-

mentally friendly transport systems. The Ministry of Agriculture promotes, guides and coordinates mitigation activities for the Land use, land-use change and forestry sector (LULUCF), implementing actions to reduce the impact of GHGs that include economic incentives for forestation and forestry management, the Native Forest Law and the soil recovery program. The Ministry of Environment is responsible for designing and applying policies, plans and programs in the Waste sector, and to date has implemented sanitation regulations for waste management, a national solid waste program and regulations for managing sludge in wastewater treatment plants, among other actions.

In addition to these sector-specific actions, other GHG mitigation initiatives currently underway in Chile include cross-cutting measures such as Clean Production Agreements, Sustainable Construction Strategy, local initiatives and private sector actions.

3.2. Nationally Appropriate Mitigation Actions

A variety of sectors have begun to collect data and promote Nationally Appropriate Mitigation Actions (NAMAs) in Chile under the coordination of the OCC. At the national level, a total of nine sectoral NAMAs have been identified to date, with different levels of maturity and data availability (Table 3). Among these, five have been registered with the UNFCCC NAMA Registry, as shown in the table below.

Table 3. Chile's Nationally Appropriate Mitigation Actions.

Name	Institution	Status	Reduction Goal
NAMAs Registered with the UNFCCC			
Expanding Self-Supply Renewable Energy Systems in Chile	MINENERGIA – CER	Under implementation	2 $MtCO_2eq.$
National Program for Catalyzing Industrial and Commercial Organic Waste Management in Chile	MMA	Seeking support for implementation	12 $MtCO_2eq.$
Design and Implementation of a National Forestry and Climate Change Strategy (ENCCRV)	CONAF	Seeking support for implementation	42 $MtCO_2eq.$
Clean Production Agreements in Chile	CPL	Under implementation	18.4 $MtCO_2eq$
Santiago Transport Green Zone (ZVTS)	Municipality of Santiago	Seeking support for implementation	1.43 $MtCO_2eq$
NAMAs in preparation			
Carbon sequestration through the Sustainable Soil Management	INIA and SAG	Design stage	65 to 80 $MtCO_2eq$
Mitigation of GHG emissions from Industrial, Commercial and Institutional Boilers	MINENERGIA	Design stage	1.25 $MtCO_2eq$
National Sustainable Construction Strategy	MINVU	Design stage	ND
Assisted Phytostabilization of Mining Tailings in Chile	MMA	Design stage	ND

3.3. Cross-cutting actions to support progress towards a low-carbon economy

The Government of Chile is executing several internationally funded initiatives intended to create inputs for the design of a low carbon growth strategy. One of these initiatives is the project Mitigation Action Plans and Scenarios (MAPS-Chile), through a participatory multi-stakeholder process, seeks to support decision making by offering public policy options and private initiatives compatible with inclusive, competitive, low-carbon development. Another is the Low Emission Capacity Building (LECB-Chile) project, which has four components — supporting the implementation of the National GHG Inventory System (SNICHILE), creating a Carbon Management Program (Programa HuellaChile), supporting the creation of NAMA Measurement, Reporting and Verification (MRV) Systems, and designing a Low Emission National Development Strategy (LEDS) that incorporates the results of the first three components.

3.4. Market-based instruments for environmental externalities

Chile has supported and implemented projects under the Kyoto Protocol's Clean Development Mechanism (CDM) and is one of Latin America's leading actors in this field after Mexico and Brazil. This leadership has translated into 141 projects approved by the Designated National Authority as of July 2014, 101 of which, as of June 2014, have been officially registered with the CDM Executive Board. Most of the projects are focused on hydroelectric generation, methane sequestration and wind power. Since 2012, however, there has been a marked drop in new projects seeking approval.

In addition to the CDM market, Chile is also exploring potential emissions trading systems through the Partnership for Market Readiness project (PMR). Other economic instruments used for mitigating GHGs include a tax reform passed in 2014 that imposes the first direct tax on CO_2 emissions from stationary sources burning fossil fuels.

3.5. Measurement, reporting and verification of mitigation actions

In Chile, measurement, reporting and verification (MRV) seeks to foster transparency in GHG mitigation actions implemented in the country through mechanisms that enable adequate follow up on how well objectives are being met. In regard to MRV of NAMAs, the OCC is studying the design of institutional arrangements and a general framework for such systems in Chile. Under the authority of the Ministry of Environment, the OCC will coordinate the validation of MRV for each NAMA with the collaboration of sectoral experts. In the next few years Chile hopes to have a consolidated, integrated MRV system capable of following up on individual mitigation actions, on public policies designed to lower GHG emissions and on reduction commitments acquired in international climate change agreements.

4 NEEDS AND SUPPORT RECEIVED IN THE AREA OF CLIMATE CHANGE

Chile is extremely vulnerable to climate change and will potentially suffer significant economic, social and environmental losses if no action is taken. Furthermore, the country has been proactive in assuming voluntary commitments to mitigate GHGs, subject to international support.

4.1. Methodology and time frame

To identify needs and support received, the OCC used the UNFCCC guidelines for the preparation Biennial Update Reports (BURs) for Non-Annex I parties to the Convention (Annex III, Decision 2/CP17[7]) as a methodological framework. These are divided into different areas (financial resources, capacity building, technical assistance and technology transfer) and each area is further divided into five spheres (reporting, mitigation, adaptation, NIR, and international negotiations).

The information needed was collected in a three-stage process that included (I) identification of support initiatives for climate change implemented in the country; (II) cross-checking with donors, implementing agencies and coordinators of those initiatives; and (III) bilateral meetings with the parties involved. The information presented covers the period from January 1, 2011 to July 30, 2014, as defined by the team in charge of this report, and is intended to update the information presented in Chile's Second National Communication to the UNFCCC.

This effort considered only initiatives with public sector participation that were supported by International public and private agencies. While every effort was made to include all such initiatives, some may have been omitted where information was not available at the time this report was closed.

4.2. Needs

Chile's institutional structure and capacities have advanced substantially in recent years, as illustrated in the Second National Communication and in this report. Nevertheless, it is still possible to identify needs, gaps and constraints that hinder the development of climate action in Chile. One barrier is the public sector's inability to receive direct international funding as part of its current annual budget, as the Budget Law does not provide for such a mechanism. Another cross-sectoral barrier identified is the difficulty that some public services face in allocating funding to climate change-related matters within their current annual budgets, as climate change has not been explicitly identified as an area in their Organic Laws.

7 http://unfccc.int/resource/docs/2011/cop17/spa/09a01s.pdf#page=

4.2.1. Reporting

The greatest challenge facing reporting activities in Chile is the need to establish permanent and binding reporting systems for the country's National Communications, Biennial Update Reports and intended nationally determined contributions, and this challenge will only be overcome through earmarking specific budget funds to finance reporting activity on an ongoing basis.

4.2.2. Mitigation

In the area of mitigation, Chile is currently engaged in designing robust institutional arrangements to support the design and implementation of existing and future NAMAs; improving cross-sectoral coordination and synergies; developing, to the extent possible, common tools to enhance understanding; and systematizing information on GHG reductions. For these to be effective, the country must prioritize the development of information management systems in all sectors.

4.2.3. National greenhouse gas inventory

Ongoing funding is needed at the sectoral level for the biennial preparation and continuous improvement of the NIR. Permanent and adequately qualified personnel is needed in each of the corresponding government ministries to prepare sectoral inventories. It is especially important that there be an integrated IT system for housing data and supporting the work of SNICHILE.

4.2.4. Adaptation

The OCC has a permanent line of action focused on adaptation. The 2008–2012 National Climate Change Action Plan envisioned the implementation of vulnerability and impact studies for the ultimate aim of preparing a National Climate Change Adaptation Plan and nine sector-specific plans, all aligned with national priorities. However, to ensure the continuity of these plans, ongoing funding must be available in the Ministry of Environment and in each ministry responsible for sectors identified as adaptation priorities. International financial support is also needed for the implementation of the measures envisioned, and Chile needs more qualified personnel at both the national and regional levels (local governments and municipalities) to enable the effective implementation of such plans.

4.2.5. International negotiations

The main need in this area is to establish permanent teams within pertinent sectoral ministries with sufficient financial and technical capacities to engage in comprehensive, strategic follow up on negotiations.

4.3. Support received

As a developing country, Chile is always seeking international support—in the form of financial resources, capacity building, technical assistance and technology transfer—in order to implement its ambitious portfolio of projects and to fulfill its commitments under the UNFCCC. While the country has received major financial contributions and other kinds of support, in recent years it has used its own resources to finance climate change actions locally. Additionally, the country has worked bilaterally and multilaterally with donor countries to promote South-South cooperation initiatives, while supporting other countries in the region by providing technical assistance and capacity building.

Most initiatives are aimed at mitigation, in line with the country's voluntary commitment to the UNFCCC, and the main form of support Chile has received to date has been financial, followed by capacity building and technical assistance.

4.3.1. Funding

As reported in this document, Chile received a total of USD 8,054,941 between 2011 and 2014, not including contributions approved but not yet available, which amount to USD 39,083,420.

In terms of funding received, the greatest contribution to date was a donation from a group of countries and organizations working collectively on a specific initiative (USD 3,999,643), followed by bilateral-country-specific donations (USD 3,225,298), funding from multilateral funds and institutions (USD 480,000) and, lastly, support from international finance agencies (USD 350,000).

Government projects and programs that have received the bulk of funding earmarked for climate change are MAPS-Chile, LECB-Chile, and climate change projects sponsored by GEF, the Forest Carbon Partnership Facility and the Partnership for Market Readiness (PMR).

4.3.2. Capacity building and technical assistance

Chile received support in the form of capacity building and technical assistance projects, programs and partnerships from the Federal Republic of Germany, the European Commission, the Kingdom of Spain, the World Bank, and other supporting entities. The Federal Republic of Germany is the primary collaborator in the areas of capacity building and technical assistance, supporting with projects, workshops, studies and specific programs that have notably increased Chile's installed technical capacity.

In addition to the above mentioned projects, programs and partnerships, support for capacity building and technical assistance has come through specific projects, studies and other initiatives funded directly by donors without the direct transfer of funds to Chile.

4.3.3. Technology transfer

Over the period analyzed, a variety of initiatives—solar energy, GHG measurement and climate change-resistant crops, among others—have been implemented in Chile through the direct transfer of a specific technology or technologies, accompanied by the required technical support and capacity building.

National environmental institutionalism favors the compliance of international report commitments acquired on climate change subjects.

I NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

Diego Flores

Vega Altoandina
Fifth Region.

1 GEOGRAPHY PROFILE AND SOCIAL DEVELOPMENT

1.1. Territory

Chile is a three-continent country — extending from 17° 30' south latitude, Northern limit, to 56° 30' south latitude — on South American western area, comprising a 2,006,096 km^2 surface in the western and southern area of South America, reaching Easter Island in Oceania and the Antarctica on the South. The Juan Fernández Islands, Salas y Gómez Islands, San Félix and San Ambrosio[1] are also part of the national territory.

It limits in the north with Peru, to the east with Bolivia and Argentina and to the south with the South Pole, to the west with Pacific Ocean up to an extent of more than 8,000 km.

Karina Bahamonde

Puerto Natales.

Its relief posses three longwise morphology features: in the east, the Andes Mountain Range; in the west, the Coastal Range and the Intermediate Depression between both mountain systems, interrupted in several places by cross-wide mountainous cords. These features make Chile a very rugged country, in which plain lands account for no more than 20% of continental territory.

1.2. Climate

Chile has a wide variety of climates, but in general terms, mild climate features are predominant with some variations produced mainly by the latitude and height — originating desert, tropical, Mediterranean, mild and polar climate.

Ocean influence is an important thermal amplitude modulator in the coastal area. Because of it, temperatures present slight changes according to the variation of latitude. In areas where less coastal influence, variability and thermal oscillation tend to be higher, showing an annual cycle following the solar decline seasonal pattern.

Regarding precipitations, three types of distribution are distinguished within the year. In central and central southern areas there is a well

1 *Http://www.ine.cl/canales/menu/publicaciones/compendio_estadistico/pdf/2011/sintesis_nacional_2011.pdf*

defined annual cycle, typical of a Mediterranean regime with a winter maximum and a summer period with a significantly lower amount, increasing towards the south. The southernmost Zone (Zona Austral), in the west side of the Andes Range presents abundant precipitations during the whole year, and a third type of cycle is presented in the Altiplano zone, with moderate precipitations during summer, occasionally intense.

In the southern 30°S latitude, precipitation presents a strong variability in decade time scale, related to changes in South Oscillation and consequently to those derived from year-to-year oceanic-atmospheric perturbations known as the El Niño and La Niña phenomena. It is also possible to detect the influence of Decade Oscillation of the Pacific Ocean.

1.3. Population

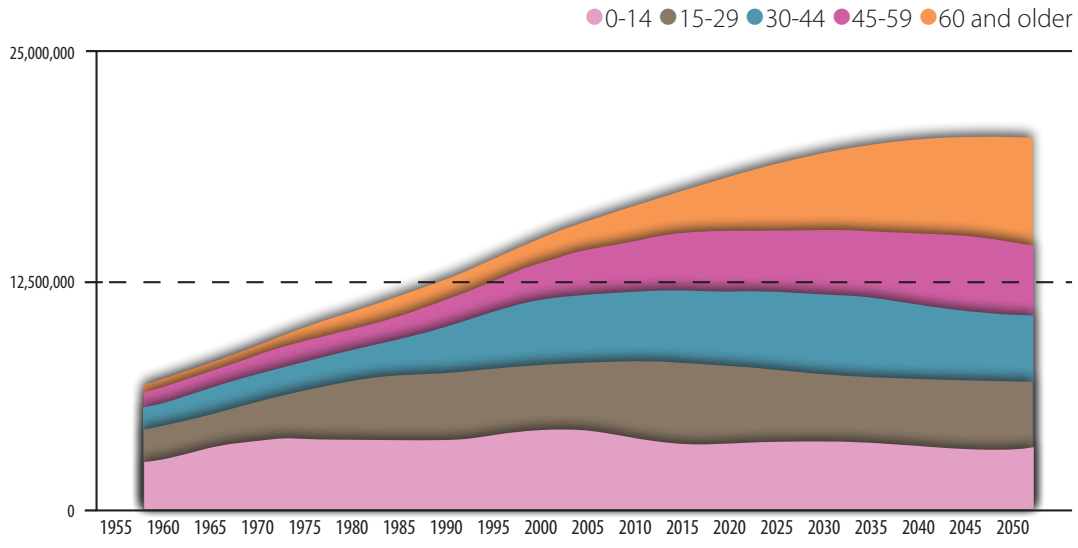
Political administrative organization of Chile is comprised by three territory levels related to each other and dependent on the Central Government of the State of Chile: region, province and commune. Each of these territory levels is subordinated to the corresponding government authority: an Intendant for each region, a Governor for each province and a Mayor for each commune. Chile is divided into fifteen political-administrative regions as the largest territorial units, with relatively similar geographical characteristics, having enough population as to boost their development and having an administrative center or central area acting as a driver for regional activities.

Chilean population experienced an accelerated growth during the 20th Century, a trend that has started a contraction during the first decade of the 21st century, and it is projected to keep slowing down towards 2050, as shown in Figure 1. Total population of Chile estimated in 2013 is 17,631,579 inhabitants — from which, 8,727,358 (49.5%) are men and 8,904,221 (50.5%) are women (INE, 2014). By 2050, an increase in population up to 20,204,779 is estimated, maintaining the proportion between men and women (INE, 2013).

Population density has reached 8.75 inhab/km^2, being the Metropolitan Region — where the Central Government is based on — the most populated of the country, concentrating 40.3% of national population and having the highest population density, 449 inhab/km^2(INE, 2013).

From the total population, only 13%, equivalent to 2,274,481 inhabitants, live in rural areas. Regions that, proportionally have the highest rates of rural population are Maule, with 32.6%, and the Araucanía, with 32.0% of their total population (INE, 2013).

Figure 1. Evolution of total population per age group, 1955-2050.



Source: Social policies Report, Chapter on Aging (MDS, 2013)

Population of 65 years old and older people, estimated in 2013, is 1,718,626 inhabitants (equivalent to 9.02% of total population) in which women represent 56.8% (976,544 individuals) and men represent 43.2% (742,082 individuals) (Figure 1). Metropolitan Region accounts for the highest number of senior citizens — being 39.2%, followed by Valparaíso with 12.1% and Biobío with 12.1% (INE, 2013)

1.4. Social development

Chileans life expectancy reaches an average of 79.1 years (INE, 2013) and their literacy percentage has reached 99.0% among people between 15 and 24 years old. Chile has had a persistent, consistent and permanent public policy on mother-child care for more than 50 years, resulting on a significant reduction of infant mortality rate from 16.0 per every thousand live births in 1990 to 7.66 in 2011, being among the lowest rates in Latin America (MDS, 2013)

Development of the country has resulted in a better quality of life for its inhabitants. Evolution of Human Development Index (IDH - Índice de Desarrollo Humano) is a reliable proof of these transformations, reaching 0.81 for the year 2014, positioning the country in the 40th position world-wide. (UNDP, 2014).

Regarding poverty reduction, an important step forward was taken in the 90s, with a 20 percentage-point decrease of total population living under poverty conditions (Figure 2), reaching 14.4% in 2011 (MDS, 2013).

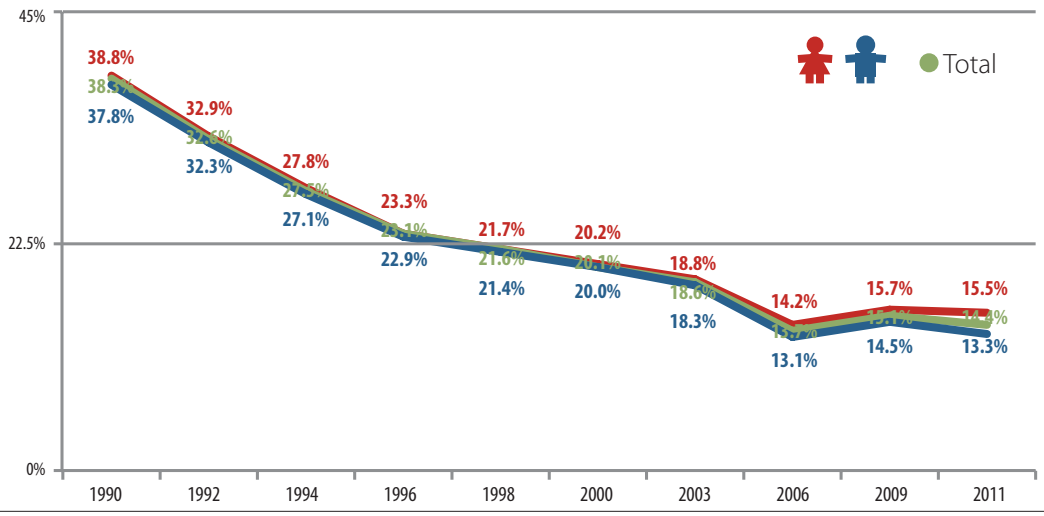
During the last quarter of 2012 (October-December) total labor force in the country was estimated in 8,195,630 individuals — from which, 93.9% were employed and the rest were unemployed (6.1%), being individuals between 25 and 54 years old those having a more active participation rate in terms of employment (INE,2013)

1.5. Education

Educational system in Chile is organized in four levels of teaching: preschool, primary school, secondary school and higher education. Public expenditure in education for 2012 consisted on 4.5% of total GDP (World Bank, 2014), from which 30% was allocated to public education and 70% to private education (INE, 2013).

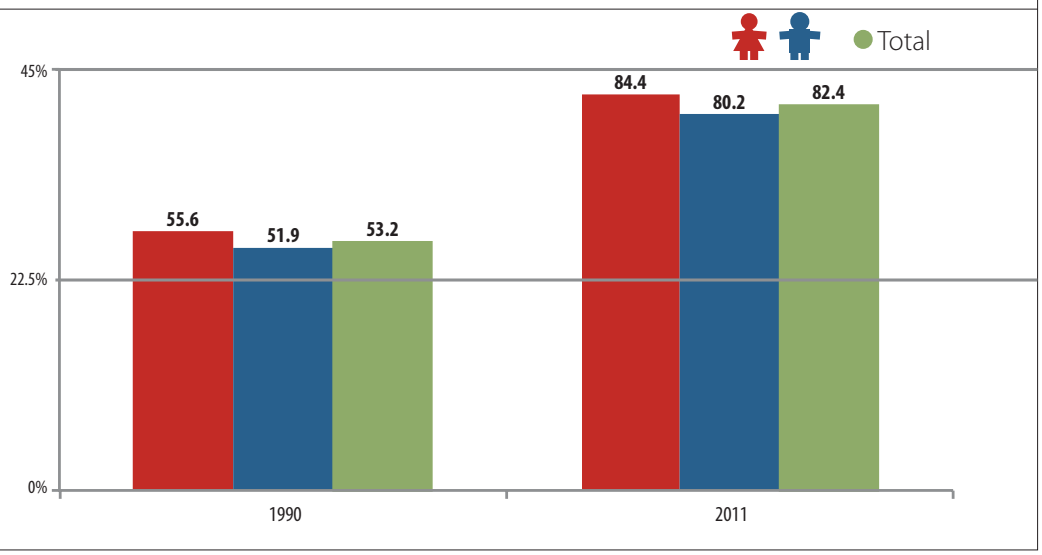
The total amount of enrolled students in 2012 was 4,655,163, from which 2,349,518 (50.5%) were men and 2,305,645 (49.5%) were women. Primary education concentrates the high-

Figure 2. Poverty rate by gender, 1990-2011.



Source: Social policies report, Chapter on Poverty and Inequity, (MDS, 2013).

Figure 3. Secondary education completion rate, 1990 and 2011.



Source: Social policies report, Chapter on Education, (MDS, 2013).

est percentage of enrollments, with 42.5%. The lowest percentage is accounted for special education, with 3.4%. Secondary education covers 22.4%, while higher education (universities, professional institutes and vocational education centers) accounts for 24.2% of the total enrolled students in the country (INE, 2013).

Finishing rate shows that through the years the percentage of people completing secondary school has increased, reaching 82.4% in 2011, as shown in Figure 3. This figure represents an important increase in relation to what occurred 20 years ago, where only 53.2% of the population completed secondary school. When breaking this rate down by gender, a higher percentage of women completing secondary school is observed, compared to men (MDS, 2013).

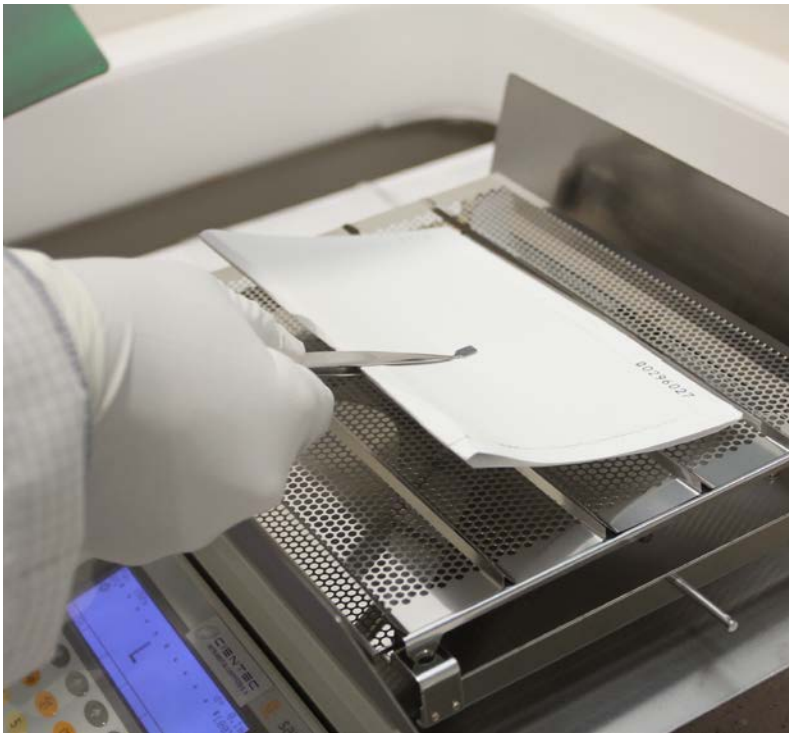
1.6. Science, technology and education

In terms of science, technology and education, there are three components interacting altogether: Government network, universities and research centers, and private institutions.

The government formulates science, technology and innovation system policies and supports national research through organizations dependent on ministries and decentralized-autonomous entities funding an important part of what is carried out by private companies and universities. The latter and the research centers carry out most of the base research at national level and also an important portion of the applied and technology-development research. Therefore, the corporate sector, comprised by public and private companies, finances an important percentage of national expenditure on this area and on development.

A survey called National Survey of Expenditures and Personnel for R+D (Encuesta sobre Gasto y Personal en I+D) is carried out annually in order to gather quantitative information related to financial resources and amount of personnel allocated to research and development activities in the business sector, the State, in higher education (universities) and in non-profit private institutions (IPSFL) during the years surveyed. The main conclusions of this study revealed that during 2009 and 2012, the expenditure on R+D increased 25%, and that funding coming from the private sector increased from 25.4% to 32.9%, within the same period. These results have not yet taken into account the impacts of the new Law on R+D entered in force by the end of 2012 (Minecon, 2014).

Pertaining funding of expenditure on research and development, Figure 4 shows that the State sector maintains a greater participation on R+D funding, similar to other developing countries — where on the early stages of the establishment of knowledge economies, public funding



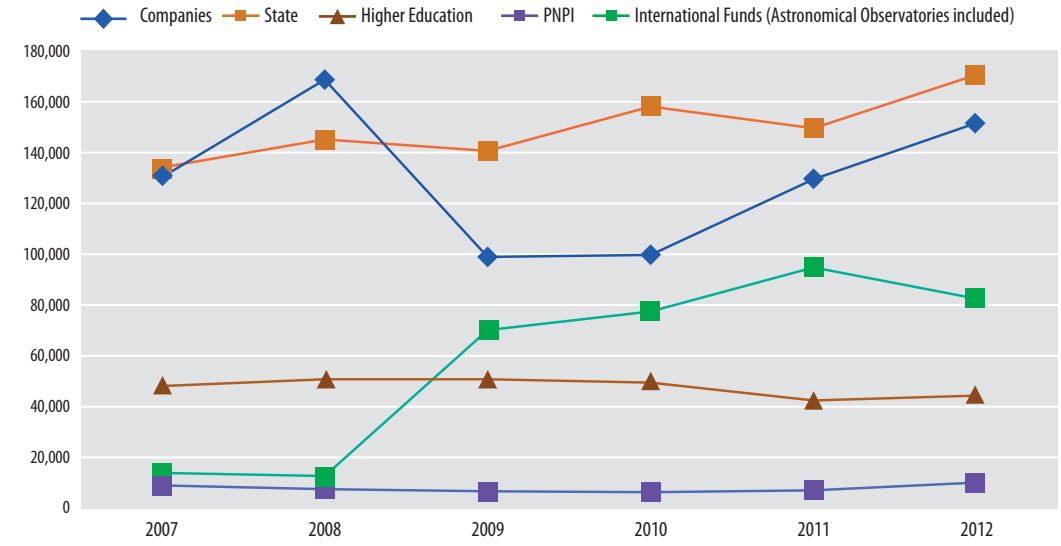
is the first promoter of an increasing investment on R+D.. Regarding personnel, the stock of people involved in R+D activities increased 11.8% during 2011 and 2012 (Minecon, 2014).

Among the positive results, Figure 4 shows that during 2010 and 2012, financial participation of the State sector increases from 25.4% to 32.9%, which reflects an economic appraisal of the private sector for R+D activities, besides closing the gap between the country and developed countries (Minecon, 2014).

1.7. Technology transfer

In Chile, policies and support programs for innovation are promoted by public and private entities, which comprise the technology transfer system of the country. This has a multiple-scale approach according to the operativeness of each institution involved in public or private sphere. Chapter 4 provides a detailed description of the support received by the public sector in terms of technology transfer for the reporting, mitigation, national greenhouse gas inventory (NIR), adaptation and international negotiation fields in a broader framework of climate change.

Figure 4. Evolution of financing sources on R+D, 2007-2012.



Source: Results of 1st, 2nd and 3rd survey on R+D, (Minecon, 2014).

2 ECONOMIC PROFILE

Chile is a small, export-oriented economy and among the most open economies in the world, promoting free trade and trade agreements. It currently holds 23 valid agreements, representing almost 60 countries and over 85% of the World's GDP (DIRECON, 2014).

Chilean economy is also internationally renowned for its sustained growth and macro-financial stability. Since 2010, Gross Domestic Product (GDP) has grown in real terms 5.3% on average, over the average rate in the region and over the average rate of most developed countries. Currency strength, due to timely inflation control, and the different tax benefits, made the country one of the most resilient to the 2007-2008 economic and financial crisis. On the other hand, exchange rate flexibility and the long-lasting expansion of raw material prices favored a beneficial scenario regarding exchange terms. Today, however, there is a risk of a slower growth. Locally, internal activity and demand have shown greater weakness, and investment has decreased; which added to a slowed down private consumption, have made growth projections for 2014 slower than previously expected. Additionally, geopolitical tensions and slowing down economies such as the United States, China and the Euro Zone are also translated into a significant threat to our country.

In short, the proper economic management has led the country to the first position on the raking of Latin American GDP per capita during the last 8 years[2], currently reaching USD 19,067 average GDP per inhabitant (International Monetary Fund, 2014), and approaching levels presented by developed countries, though there are certain pending challenges that need to be addressed in order to move forward.

On the other hand, positive performance so far has shown to be dissimilar, both at a regional level as well as per economic sector. As to distribution of production on different regions of the country, significant differences and a high concentration in the capital region can be observed. Particularly, Metropolitan Region accounts for 48.9% of GDP, followed by the II Region of Antofagasta (10.9%) and the V Region of Valparaíso (8.2%). Yet, it is the III Region of Atacama, XI Region of Aysén del General Carlos Ibañez del Campo and XIV Region de Los Ríos the ones which show a greater dynamism during 2008 and 2013, growing an annual average of 7.2%, 5.6% and 5.5%, respectively (World Bank, 2013).

Related to type of production on different economic activities, 60.9% corresponds to tertiary or service sector, 22.5% to secondary or industrial sector, and the remaining 16.6% to primary sector (Central Bank, 2013). During 2008 and 2013, sectors the that have shown a greater real growth are Electricity, gas and water (9.8% annual average), Financial services (7.6%) and Commerce (7.3%). Sectors that have shown a

2 Except for the year 2011 during on which Argentina slightly surpassed Chile.

slower dynamism are those related to the primary sector: Fishing (1.0%), Mining (1.0%) and Agricultural and Livestock (1.7%). Regarding export of goods, Mining represents 57.3% of total (millions of dollars FOB), in which copper exports represent 91.4% of mining exports. Industrial exports are in second place, which represent 35.2% of the total, where foods and beverages such as salmon and wine stand out. Finally, exports from agricultural, livestock and fishing sectors represent 7.5% of the total, where fruit farming sector stands out. This last group, however, has experienced the greatest annual growth (Central Bank, 2013).

Four main sectors of our country are analyzed in further detail below: Power generation, Agriculture and Forestry, Fishing and Mining.

2.1. Power generation sector

Chile has historically depended on the import of energy from other countries. In 2009, 67.9% of total energy consumption came from imports, increasing to 73.7% in 2012 (NEB, 2012).

Electricity market in Chile is comprised by power generation, transmission and distribution. These activities are developed by companies entirely controlled by private players, while the State only exert regulation, enforcement, investment planning functions on generation and transmission, even though the latter is only a non-compulsory recommendation to companies.

Electrical power generation in the country has two main sources: thermal and hydraulic. Geographical conditions have determined a system of energy transmission characterized by six independent systems: Two large systems (Northern Interconnected System, SING, and Central Interconnected System, SIC) and fours medium-size systems (Los Lagos, Aysén, Magallanes and Easter Island) which capacities together reached 17,744.8 MW by the end of 2013, corresponding to 64.3% thermal, 33.9% hydro, 1.7% wind, 0.1% solar, and 0.1% co-generation. This capacity represents 77.9% installed in the SIC and 21.2% installed in the SING, both accounting for more than 99.1% of the total installed capacity at national level. Smaller systems account for 0.9% of total installed capacity in the country (CNE, 2013).

SING is comprised by generation plants and interconnected transmission lines that supply Arica and Parinacota, Tarapacá and Antofagasta regions. The installed capacity of the SING is 3,759.4 MW by December 2013, with a mainly thermal generation portfolio comprised in 99.1% by coal; diesel; and combined-cycle, natural gas thermal plants. There are only four hydroelectric units providing 0.4% of installed capacity (CNE, 2013)

SIC is the main electric system in the country, supplying over 90% of population. In the north, it comprises from Taltal (Antofagasta Region) to the Chiloé Island, in the South, covering a surface of 326,412 km^2. Its installed capacity was 13,826.4 MW by December 2013, from which 43.2% correspond to hydroelectric power plants, 54.6% to thermal power plants and 2.1% to wind power plants (CNE, 2013).

Easter Island has a very small electric system compared to the remaining electric systems in the country. Easter Island electric system was originated approximately during 1968 and 1969, when the National Aeronautics and Space Administration (NASA) projected the construction of an alternative landing field for space shuttles. By the end of 2013, its installed capacity was 3.09 MW, corresponding 100% to thermal energy, accounting for 0.02% of national installed capacity (CNE, 2013).

Los Lagos Electric System is located in Los Lagos Region. Its consumption is mainly related to industrial clients, associated to production and commercialization of salmon, many of which, until recently, used a self-supplying power generation system based on generator sets. With an installed capacity of 6.17 MW by December 2013, it represents 0.03% of installed power; and its generation is 87.6% comprised by thermoelectric and 12.4% by hydroelectric power generation (CNE, 2013).

Aysén Electric System is located in the southern area of the country. It reaches a surface of 108,494 km ^{2} with an installed capacity of 50.2 MW by December 2013. From its total power generation, 51.0% corresponds to thermoelectric power, 45.1% to hydroelectric power and

San Isidro Thermo-Electric Power Plan.

Karina Bahamonde

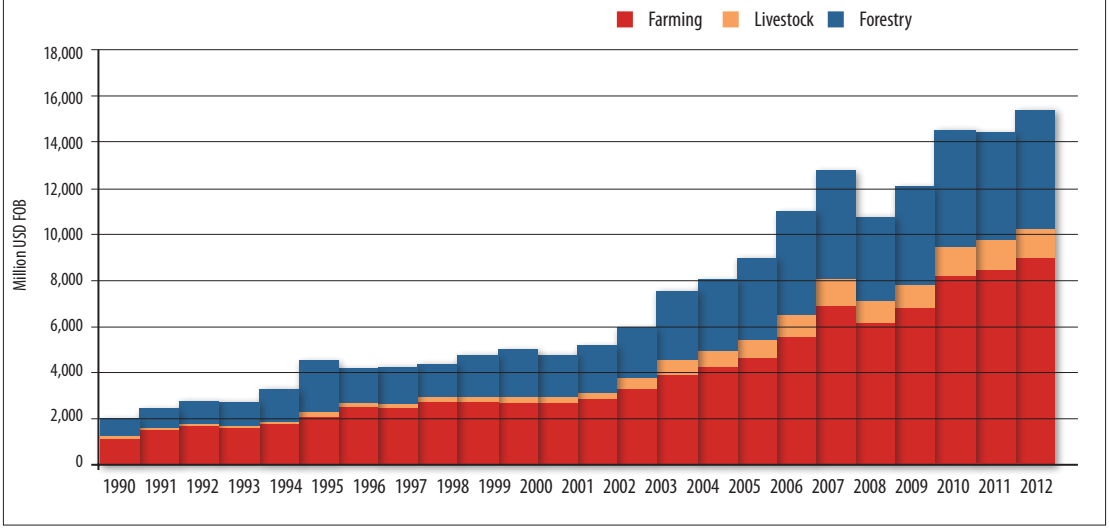
3.9% to wind power generation. This system represents 0.28% of the total installed power in the country (CNE, 2013).

Finally, Magallanes Electric System supplies Punta Arenas, Puerto Natales and Porvenir cities, covering a surface of 38,400 km^2. It has an installed capacity of 99.5 MW, equivalent to 0.56% of the total capacity in the country. 100% of the power generated corresponds to thermoelectric type power (diesel and natural gas) (CNE, 2013).

2.2. Agriculture and Forestry sector

Since an strategy of development based on a wide international opening of the economy abroad was established several decades ago, national agriculture has experienced an important transformation, as shown in Figure 5. Regardless the relative importance of the primary agricultural, livestock and forestry sector on the national GDP, it has been reducing up to 2.6% in 2013; the related industry has been growing, as to account for nearly 9% altogether. However, the value of primary and industrial exports of the sector is currently over the 20% of the total exports of the country (Central Bank, 2014).

Figure 5. Agricultural and Forestry exports development, 1990-2013.



Source: Ministry of Agriculture, ODEPA, 2014

As a result of this development, the agrifood sector has turned into one of the foundations of the economic development, specially in some regions where its involvement is essential. The country has gained a growing relevance in the international market of food products, where some Chilean products are very well positioned in the world trade, specially in the counter season. Products such as industrialized and dried fruits, wines and seeds already have a preferential place in world markets; and meats are also consolidating their position, specially poultry and pork, dairy products, and forestry products such as cellulose.

As a result, a redistribution of farming land use has taken place, comparatively scarce in the country (no more than 21% has potential for farming and livestock use). Thus, fruits and vineyard planted areas have increased to detriment of production of some commodities such as wheat. However, productivity of annual crops has shown an almost continuously increasing trend, maintaining production through time.

Farming area represents nearly 5% of national territory, with a high concentration on the central area of the Country. According to the figures obtained from the 7th National Agriculture and Livestock Census, on 2007, the cropped surface is stabilized around 8.5 million hectares, which have changed their productive structure during the last two decades, increasing the proportion of land allocated to fruit and wine production. The irrigated surface accounts for 13% of the aggregate agricultural surface, showing an increasing trend on the use of more technical irrigation systems, replacing the more conventional ones (INE, 2007).

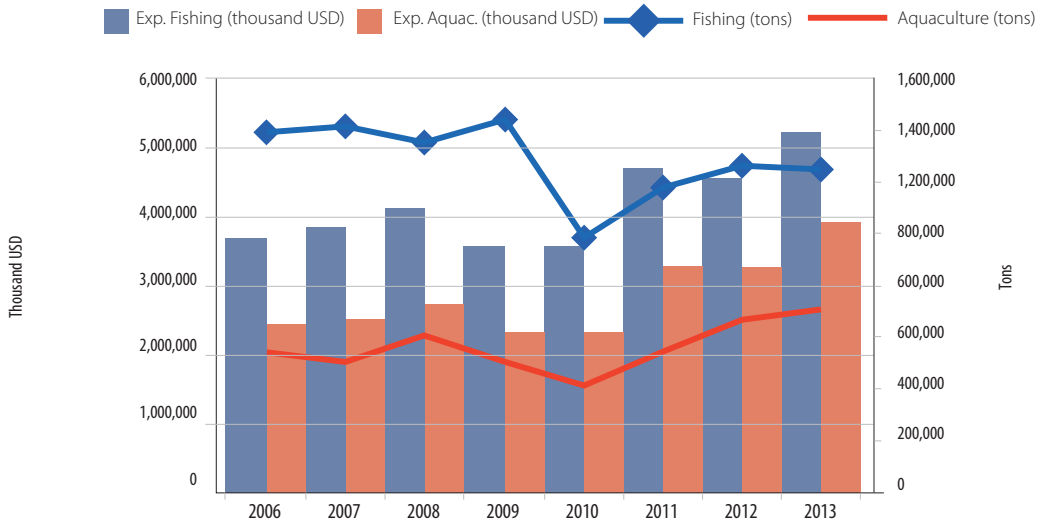
Statistics in the forestry sector show that by 2011, 13.3 million hectares were native forest (CONAF, 2011) and 2.4 million hectares forest tree plantations (INFOR, 2012). The Chilean forestry industry is mainly based on plantations of *Pinus radiata*, *Eucalyptus globulus* y *Eucalyptus nitens* species. Between 2008 and 2010, in Chile there were, annually, on average, 28,000 new hectares planted and 71,000 hectares replanted.

2.3. Fishing Sector

The long shoreline gives Chile privileged conditions from the standpoint of marine biological resources. In the Exclusive Economic Zone (200 nautical miles), in the several thousand kilometers of shoreline, there are highly productive ecosystems, which are translated into almost unique advantages for fishing and aquaculture production of highly valuable and demanded resources in the international markets, which at the same time generate employment and sustain local economies. In 2013, the amount registered of artisan fishermen accounted for 91,395; from which, 22% (20,401) are women and 78% (70,994) are men. On the other hand, that year, the Registry of Artisan Organizations (ROA - Registro de Organizaciones Artesanales) accounted for 1,034 organizations (among workers unions, trade unions, cooperatives and indigenous communities). The total amount of registered artisan fishing ships accounted for 12,662; from which, 12,428 ships belong to natural people, 124 belong to corporate organizations, and 110 belong to indigenous communities. Regarding the industrial fleet, 161 ships operated on 2013, generating 2,139 jobs; likewise, 633 marine resource processing plants operated, generating 34,712 jobs. In the aquaculture sector, 2,329 aquaculture centers operated, which generated around 11,086 permanent jobs (Sernapesca, 2014).

All together, the sector produces unloading operations for more than five millions tons a year, involving 155 target marine species: 80 fish species (sardine, anchoveta, mackerel, among the most important ones), 23 crustaceans (prawn, shrimps, spider crab, among others), 36 mollusks (cuttlefish, clams, jackknives clams, etc.), and 16 algae species (seaweed, luga, gracilaria seaweeds, etc.) From the total unloading operations, 79% correspond to extractive production (fishery), accounting for 2.4 million tons by industrial contribution, and 1.7 million tons by artisan fishing contribution; while 21% production (1.1 million tons) come from aquaculture, whose main species are salmons and at a lesser extent Chilean mussels, as shown on Figure 6 (Subpesca, 2014).

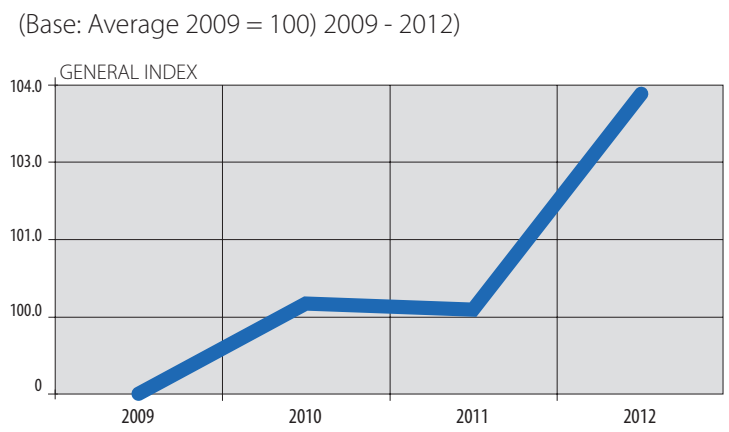
Figure 6. Production (in tons) and valuation (in thousand American dollars) of fishing resources, 2006-2013.



Source: (Subpesca, 2014).

Coquimbo.

Figure 7. 2009 - 2012 Average annual mining production index.



Source: (INE, 2013).

2.4. Mining sector

Chile is a country with huge ore reserves. In metal mining; copper, iron, molybdenum, manganese, lead, zinc, gold and silver mining are highlighted. From these products, the most interesting ones are copper and molybdenum, being the latter a byproduct from copper extraction. As a result of this abundance, mining has been the main productive activity of the country for several decades.

Copper mining property is shared between private companies and the State. The National Corporation of Copper (CODELCO) autonomous public company is particularly important, which is the largest mining company in the country and the main producer in the world.

In 2012, the Mining Production Index showed a 2.7 point increase compared to 2011 (Figure 7). In such period, the indexes that contributed the most to this growth were the metallic production index, which closed 2012 with 2.7% increase; while energy resources showed a 19.6% increase. Finally, the non-metallic mining did not show any fluctuation by the end 2012 (INE, 2013).

Therefore, the final fine copper production during 2012 reached 5,455,237 tons, showing 3.0% increase compared to 2011 (INE, 2013).

In summary, Table 1 presents some key indicators for Chile, updating the information presented by the Second National Communication of Chile to the United Nations Framework Convention on Climate Change in 2011[3](2NC).

Table 1. Key indicators for Chile

Information		Sources
Geography		
Total Surface (km^2)	2,006,096	Geographic Military Institute of Chile (IGM)
Population 2002	15,745,583	National Statistics Institute (Instituto Nacional de Estadísticas, INE)
Estimated population 2010	17,094,275	INE
Estimated population 2013	17,556,815	INE
Estimated population by 2050	20,204,779	INE
Rural population (% of the total, 2012)	13.00	INE
Annual forested surface (new plantations) (ha, 2013)	6,609	National Forestry Corporation (CONAF)
Annual planted surface (new plantations and reforestation) (ha, 2013)	95,340	CONAF
Human Development		
Human Development Index 2014	0.81	United Nations Development Programme (UNDP - Programa de las Naciones Unidas para el Desarrollo Humano)
Literacy rate, youth total 2009 (% of people between 15 and 24 years old)	98.9	World Bank
Literacy rate, adult total 2009 (% of people, 15 years old and more)	98.6	World Bank
Life expectancy at birth (years, 2012)	79.6	World Bank
Deaths of minors under 1 year old and infant mortality 2009 (per 1,000 live births)	7.9	Ministry of Health (Ministerio de Salud, MINSAL)
Infant mortality rate, females 2012 (every 1,000 live birth)	7.1	World Bank
Infant mortality rate, males 2012 (every 1,000 live birth)	8.6	World Bank
Infant mortality rate (< 1 year old), 2012	8.0	United Nations Children's Fund (UNICEF)
Drinking water coverage 2013 (%)	99.9	Sanitary Services Superintendency (Superintendencia de Servicios Sanitarios, SISS)
Sewage system coverage 2013 (%)	96.5	SISS
Coverage of sewage waters treatment over cleaned up population 2013 (%)	99.9	SISS
Public spending on Education as % of GDP (2012)	4.52	World Bank
Economic Activity		
GDP (ppp) 2014 estimate (million USD 2014)	352,224	International Monetary Fund (Fondo Monetario Internacional, FMI)
GDP (ppp) per capita 2014 estimate (USD 2014)	19,887	IMF
GDP (ppp) growth in 2012	0.38	IMF
GDP (ppp) growth in 2013	0.39	IMF
Estimated GDP (ppp) growth in 2014	0.39	IMF
Goods and services exported (% of GDP, 2013)	32.6	World Bank
Sectoral Activity		
Renewable energy (% of energy matrix 2012)	33.8	Ministry of Energy
Primary energy import (% of energy use 2012)	60.2	Ministry of Energy
Fossil fuel consumption as primary energy (% of the total in 2012)	66.2	Ministry of Energy
Annual freshwater extraction for agricultural use 2011 (% of the total of freshwater extraction)	70.3	World Bank
Consumptive water extraction for agricultural and forestry sector 2011 (% of total)	73.0	Ministry of Public Works (Ministerio de Obras Públicas)

3 http://www.mma.gob.cl/1304/articles-50880_docomunicadoCambioClimatico.pdf

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3 INSTITUTIONAL ARRANGEMENTS REGARDING CLIMATE CHANGE

The existent institutional framework is shown below, which works with the aim of promoting the solid coordination and collaboration among the different decision-making levels, including different partners, players and sectors in relation to the environment focused on climate change.

3.1. Environmental institutionalism

During the last few years, a consolidation and improvement process of the Chilean environmental institutionalism has taken place, which has been marked by the creation of the Ministry of the Environment (MMA) and the Ministry of Energy, on 2010; and the announcement of the implementation of the Council of Ministers for Sustainability and Climate Change, in 2014, which is a clear signal of progress on the subject.

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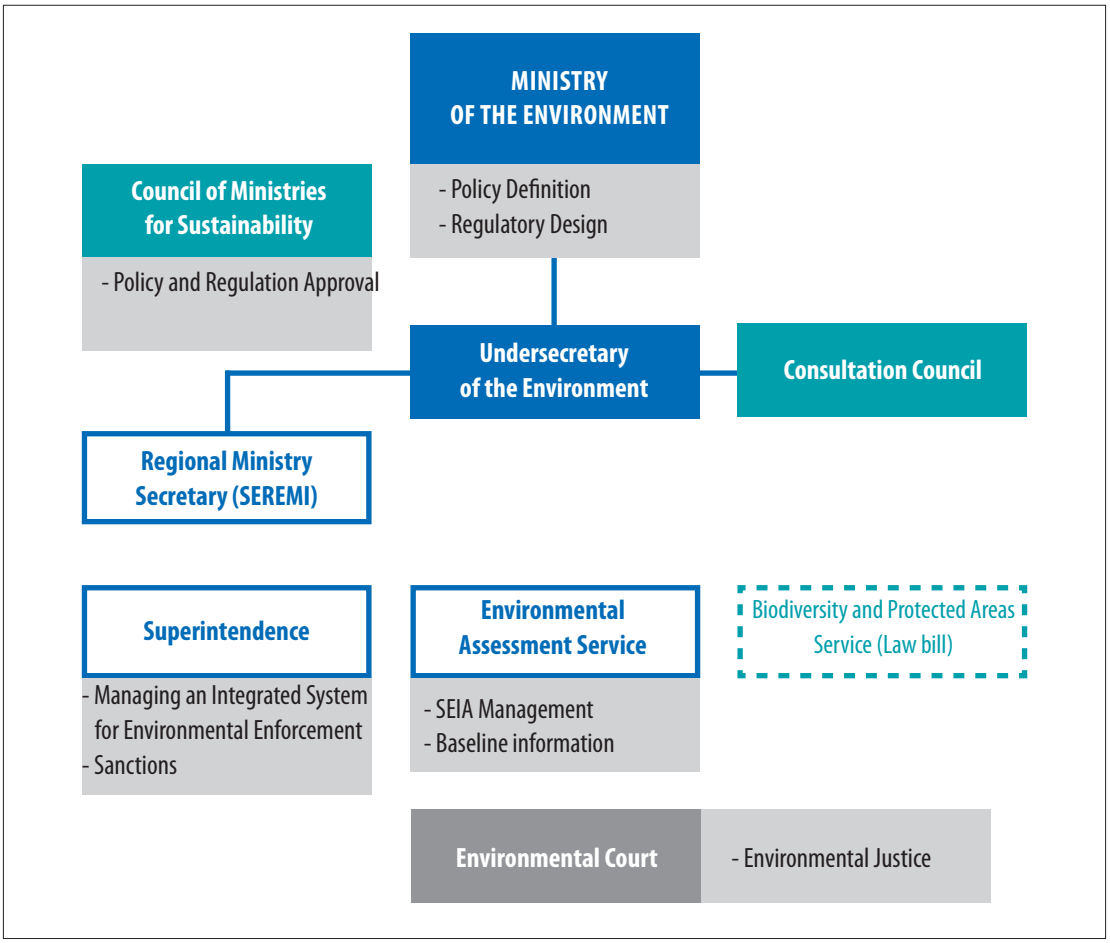
3.1.1. Ministry of the Environment

In 2010, an institutional change took place, encouraged by the need of rationalizing and narrowing the environmental competences; having a ministry in charge of policies; having a fully-technical Environmental Assessment Service (SEA - Servicio de Evaluación Ambiental); a centralized and efficient enforcement system; and finally, having a management system for issues related to biodiversity and protected areas. The process had, as the main legal tool, the Law N° 20,417, dated on 2010, which modified the law on environmental bases (N° 19,300), and transformed the National Environment Council (CONAMA) — which operated based on a multi-sectoral coordination model — into a ministry, following a more centralized and influencing model: The Ministry of the Environment (MMA). In addition, the SEA, the Environmental Commission (SMA), and the Environmental Courts were created. The Regional Ministry Secretariats (SEREMIs) were also created, for the MMA to have a regional representation and operativeness throughout the country. The different components of the environmental institutionalism and the main function of each of them are shown on Figure 8, below.

Figure 8. Environmental Institutionalism of Chile Organization Chart and their Main Functions.



Source: MMA, 2014.

The MMA of Chile is defined as the public entity in charge of collaborating with the President of the Republic on designing and applying environmental policies, plans and programs, as well as on protection and conservation of the biological biodiversity and the natural renewable and water resources, promoting the sustainable development, the integrity of the environmental policy and its regulatory framework.

Law N° 20,417 highlights in an important manner the work allocated to the MMA in the development of the climate change issue in the country, specifically establishing a special mandate at governmental level, for the first time in the Chilean regulation, stating that *'(...) it will be special mandate of the MMA proposing policies and developing plans, programs and action plans regarding climate change'* (Art. 70, section h).

3.1.2. Council of Ministries for Sustainability and Climate Change

The MMA also considers the competence of other sectors through the Council of Ministries for Sustainability, a deliberation entity on public policy and general regulation in relation to the environment, led by the MMA and comprising its peers on Agriculture; Finance; Economy, Development and Tourism; Public Works; Housing and Urban Planning; Transportation and Communication; Mining; and finally, Social Development. Among the competences of the Council of Ministries for Sustainability and Climate Change are:

- Proposing the President of the Republic: (i) the policies for use and leverage of natural resources; (ii) criteria on sustainability that shall be introduced on policies; (iii) the cre-

ation of wild protected areas; (iv) sectoral policies that shall be submitted to Strategic Environmental Assessment.

- Stating its opinion on citizenship participation criteria and mechanism on Environmental Impact Statements (DIA - Declaraciones de Impacto Ambiental).
- Stating its opinion on law bills and administrative actions with environmental impact, whichever the ministry of origin.

The 2014-2018 Government Program of President Bachelet establishes that during her mandate the Council of Ministries for Sustainability will be renamed as Council of Ministries for Sustainability and Climate Change, establishing a concrete signal of the relevance given to this issue. The arrangement in order to make the legal modifications required for this change have already been started. Modifications on this regard consider including the Ministry of Foreign Affairs (MINREL) in such Council, as well as defining new functions for the Council, in the light of the introduction of climate change issues.

3.2. Institutionalism and policies on climate change in Chile

Since Chile ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994 and became signatory to its Kyoto Protocol in 2002, it has been actively present contributing to the discussions and international efforts, and it has met its commitments as a developing country. In 1996, the Government of Chile established by Supreme Decree its main institutionalism at that date, in order to create an Advisory committee on Global Change, comprised by representatives from both the public sector as well as from the academia. This committee played an important role in the discussion of national positions for international negotiations and in creating national policy instruments for climate change. This way, it was in charge of approving the First National Communication on Climate Change, on 2000.

In 2006, the National Advisory Committee established the National Strategy on Climate Change, establishing as critical pillars the adaptation, mitigation and promotion, and capacity-building. In order to materialize such strategy, the CONAMA's Directors Board approved, in 2008, the 2008 - 2012 National Action Plan on Climate Change (PANCC).

3.2.1. Climate Change Office

An important milestone on climate change subjects occurs in 2010 upon the formal creation of the Climate Change Office (OCC), under the umbrella of the Undersecretary of the Ministry of the Environment. This office has an annual budget for research and supporting consultancy for the works it performs. The OCC has also been the public institution in charge of actively participating on the international negotiation processes associated to the implementation of the UNFCCC. It has also been the coordinator of the Designated National Authority (DNA) Committee for the Clean Development Mechanism (CDM), the focal point of the Intergovernmental Panel on Climate Change (IPCC) and the technical secretary in the inter-ministry committees on climate change.

Since it was created, the OCC took the work that had already started, regarding Climate Change, and gave it a new air through the allocation of human and financial resources that enabled a systematic work, having further capabilities in order to interact with the different sectors. The functions it is mandated to perform are the following:

a) Generating and collecting technical and scientific information on Climate Change in order to support policy design and the formulation of plans, programs and action plans in relation to Climate Change;
b) Proposing and executing policies, strategies, programs and plans regarding Climate Change in the Country;
c) Exerting the coordination actions given by the Ministry of the Environment among the different bodies of the State Administration at national, regional and local level, in order to be able to determine the effects of climate change, as well as establishing the necessary adaptation and mitigation measures;
d) Following up and advising the Ministry on the progress in the execution of the public policy instruments on Climate Change in the Country;
e) Advising the Minister of the Environment on matters related to the National Position in front of the United Nations Framework Con-

vention on Climate Change and other international instances related to Climate Change;
f) Proposing, formulating and determining the necessary actions in order to enforce the fulfillment of the United Nations Framework Convention on Climate Change and other Conventions related to Climate Change; and
g) Acting as a link between the international community and the state entities in order to promote the international cooperation and the capacity-building on Climate Change.

In order to achieve such objectives, the work of the OCC is structured in the following strategic pillars:

- **National Greenhouse Gas Inventory and Measurement:** Pillar related to the generation and update of inventories and measurements of anthropogenic-kind GHG emissions and removals, at national level, non-controlled by the Montreal Protocol.
- **Low Carbon Strategy and Mitigation :** Pillar related to the fulfillment of the commitments adopted and ratified by the Country, in relation to GHG emission reduction.
- **Vulnerability and adaptation:** Pillar related to the establishment of progress in understanding impacts of Climate Change on the country, considering its high vulnerability; and also establishing progress of adaptation to Climate Change, whether moderating the damage and leveraging beneficial aspects of climate stimuli.
- **Education and awareness creation:** Pillar related to the need of developing activities that will support dissemination of the Climate Change issue beyond the research instances, trespassing the barrier of the technical complexity surrounding the topics related to Climate Change, allocating efforts to the introduction of different sectors in order to face this issue in a joint manner.
- **Negotiation and international participation:** Pillar related to the technical coordination of the Chilean delegation in the negotiations in front of the UNFCCC which also contributes to the development of the country position, aiming Chile to be acknowledged as a relevant and constructive player in the negotiations on Climate Change.
- **Institutional Arrangements:** Given the cross-institutional and cross-sectoral nature facing the challenges of climate change represents, progressing on the design and implementation of institutional arrangements that enable addressing the issue of climate change in a more efficient way is critical.

In order to fulfill the working pillars described above, the OCC from the MMA has direct participation in the different committees, which are described below:

- **Committee for International Negotiation:** It is leaded by the MINREL and also comprised by the MINENERGIA, MINAGRI and the MMA, which provides the technical advisory in such committee, for the agreement process at national level for the negotiations in the Conference of the Parties (COP) and the fulfillment of the commitments of the Country.
- **Inter-Ministry Committee on Climate Change:** It is comprised by representatives at technical level of the ministries or services having responsibilities in the PANCC or in other tasks performed by the OCC, such as preparing the National Communications, the Biennial Update Reports (BUR); and, in general, developing policies, programs or projects coordinated by the OCC. This committee may operate with all its members or with partial quorum, according to the tasks defined and the responsibilities the Ministries or Services have in such tasks.
- **CDM's Designated National Authority:** Chile established its DNA in 2003, requirement established by the Kyoto Protocol to develop in the country projects of reduction and removal of emissions through the CDM and to participate in the carbon market. The Chile-DNA has a technical committee in charge or reviewing and assessing the background information from each project for granting the National Letter of Approval (LoA). Such committee is led by the MMA, coordinated by the OCC, and permanently comprised by a representative of the MINREL, MINAGRI, MINENERGIA and CPL. The encouragement of CDM at national and international levels, the revision of the projects by the DNA besides the signing of cooperation agreements with industrialized countries in matters related to CDM led Chile to reach a relevant amount of projects registered before the Executive Board of CDM.
- **Designated Authority for the Adaptation Fund:** The Adaptation Fund, established by the UNFCCC

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(Decision N° 10/CP.7, in the UNFCCC's COP N° 7), establishes that interested countries shall nominate their designated authority and should have an implementing agency. In the case of Chile, the Designated Authority is an officer from the OCC from the MMA, which also has an Advisory Committee for the Designated Authority, whose main function is reviewing the most suitable projects for Chile, in relation to concrete measures for adaptation to Climate Change. This committee is comprised by the Ministry of the Environment, Ministry of Agriculture, Ministry of Public Works, and Ministry of Foreign Affairs; and it was created through Exempt Resolution N° 85 from the MMA, on February, 2012. The implementing agency of Chile is the International Cooperation Agency (AGCI) from the MINREL.

- **IPCC's Focal Point:** Chile has a focal point participating on activities of IPCC and coordinates participation of ministries in the processes of revision, inquiry and dissemination of IPCC reports.
- **NAMA Registry's Focal Point:** The OCC is the counterpart of this UNFCCC registry and its functions as such are receiving and reaching agreements on nationally appropriate mitigation actions (NAMAS) by developers and analyze and provide technical support on request of financial support, either for preparation or deployment. The OCC maintains direct contact with the registry's administration to deliver necessary information to register NAMAS, which will then appear in the country's profile requesting support or recognition, accordingly.
- **Other initiatives:** The OCC also participates in several knowledge networks on climate change, as the Ibero-American Network of Climate Change Offices (RIOCC), the Regional Cooperation Programme between the European Union and Latin America, focused on climate change (EUROCLIMA); the Scientific Committee on Climate Change of the Pacific Alliance, and the Inter-American Institute for Global Change (IAI), among others.

3.2.2. National Action Plan on Climate Change 2008 - 2012

Regarding climate policies, the first effort was the 2008-2012 National Action Plan on Climate Change which was approved and disseminated in the country by President Michelle Bachelet, on December 2008. This plan articulated an ensemble of guidelines on public policies, being elaborated mainly by the ministries, the Executive Council of CONAMA and academic and national research institutions. Additionally, this action plan served as guidelines to productive, academic and government institutions, since it contains the subjects considered relevant to the State to be assumed by society in order to face the impacts of climate change.

The plan was structured based on the three pillars defined on the National Strategy on Climate Change, dated on 2006; the adaptation to climate change; the mitigation; and the creation and strengthening of capabilities. The plan determined 22 lines of action with 103 specific actions that were created mainly to generate sufficient information to accomplish preparation, at the end of the period, of national and sectoral adaptation and mitigation plans with a broader deployment aim. The plan established deadlines and responsibilities assigned to 32 entities of 13 ministries.

The design of this plan was based on an assessment which considered climate change state-of-the-art science on national and international spheres, social, economic and environmental vulnerability of the country, and need of action for adaptation. It is stated that Chile is vulnera-

ble to climate change, meeting 7 out of 9 vulnerability criteria established by the UNFCCC[4]. The main effects in Chile are increase of temperatures, changes on precipitation patterns, productivity of crops, occurrence of extreme events and anomalies related to water resources, and therefore, effects on water, energy, farming and forestry resources availability (IPCC, 2007).

In this scenario, it is possible to recognize that Chile meets 7 out of 9 characteristics of previously stated vulnerability. Only for this reason, during middle 1990, government authorities carried out studies to reveal national vulnerability facing climate variations.

In addition, an assessment on the energy sector GHG emissions, emission scenario analysis progress and mitigation potential was included. Also, the capabilities of the country were assessed in terms of legal, institutional and public policies to face climate change and to participate on international negotiations, meetings and revisions of IPCC reports, national and international cooperation initiatives on climate change, CDM and carbon market.

The implementation of measures started with difficulties in 2009, because of a lack of resources, however during the middle of 2010 upon the creation of the OCC, a systematic work with ministries that had committed actions was developed and encouraged through financing of some sectoral studies, guidance and coordination. In 2011 a part-time assessment was carried out to analyze the constraints and advantages of the process and to identify progresses. It was decided in that moment to extend the deadlines of the final assessment of PANCC until early 2014 and provide more time to execute measures.

Currently, a large extent of these measures are totally or partially executed. Regarding mitigation, 5 guidelines were established:

- To create a system to annually update the national and regional inventory of emissions and sinks of GHG,
- To carry out an analysis to determine sectoral and total potential of emission reduction the country could reach in a given time,
- To develop a proposal of impact indicators for the implementation of various plans, policies and strategies.
- To develop mitigation scenarios for a time frame of 15-20 years, which will imply having scenarios for the 2025 or 2030 for those sectors accounting for most of the national GHG emissions,
- To develop a National GHG Mitigation Plan 2010-2025 and Sectoral Plans.

Up to this date, the National Greenhouse Gas Inventory System of Chile has been created (see Chapter 2), the emission reduction potential has been estimated and mitigation scenarios have been developed for various time frames, through the project called MAPSChile, to be detailed (see Chapter 3). Also, measure, report and verification systems (MRV) are being prepared allowing to define impact indicators, as mentioned previously. Similarly, a low-carbon strategy is being designed and various mitigation actions that will become constituent parts of the National Mitigation Plan are being developed. The Voluntary commitment of Chile formalized at the UNFCCC in 2010 of reducing GHG emission in 20% for 2020, over its baseline projected for that year, has provided a greater boost for the already established mitigation actions and has extended its spectrum. In that manner, progress has been made in terms of the development of NAMAs and identification of a series of feasible mitigation options for the country, through MAPS Chile and LECB-Chile, also contributing on the creation of options for a low-carbon economy.

Regarding adaptation, 3 lines of actions were indicated establishing the creation of scenarios to a local level, impact determination, vulnerability and adaptation options on critical sectors, and finally, development of a National Adaptation Plan and 7 sectoral adaptation plans; Water Resources, Biodiversity, Fishing and Aquaculture, Agriculture and Forestry sector, Health, Energy, Infrastructure and Coast Areas, to which two more were added in 2013 (Cities and Tourism sector). Since September 2014 the Agriculture and Forestry sector Plan and Biodiversity Plan were approved by ministries, ready to initiate their deployment, the National Adaptation Plan is intended to assist its formalization process and Fishing and Health plans are in draft status. It is projected to finalize other plans towards the end of 2016.

4 Criteria met by Chile are: Country with low coast areas; Country with arid and semiarid areas, areas with forestry coverage and area exposed to forestry deterioration; Country with areas prone to natural disaster; Country with areas exposed to drought and desertification; Country with areas with high urban atmospheric pollution; Country with fragile ecosystems areas, mountainous ecosystems included.

As to creation and encouragement of capabilities, 8 lines of action were established in PANCC with the objective of strengthening climate change institutionalism, raising awareness and educate population, generating climate variables monitoring capabilities and employing a registry of glaciers in the country, strengthening international negotiation capabilities, creating funds for research on climate change, with total or partial progress. As for media, the climate change subject has been consolidated like no other environmental subject in a brief period of time within citizen environmental concerns.

3.2.3. National Action Plan on Climate Change 2015 - 2020

The governmental program by President Bachelet for 2014-2018 period established that during her mandate *"a second national plan on climate change shall be developed, with a cross-sector and integrated vision; on adaptation, impact mitigation and capacity-building, focused in the measures adopted towards a low-carbon-emission economy that will benefit doubly to Chile: they will contribute to the reduction of greenhouse gases emissions and to the quality of the air we breath in Chile and to the quality of life of Chileans"*

By September, 2014, arrangements for the preparation of this second National Action Plan were already in place, which will be developed under a scenario of deeper knowledge and concrete progress, as for adaptation as well as mitigation and growing political commitment, putting special emphasis on the implementation of measures and their funding.

3.3. Sectoral institutionalism

Most of the ministries comprising the Council of Ministries for Sustainability and Climate Change have defined some sort of basic structure or someone in charge of the climate change issue within the corresponding institution (focal points on climate change). Nevertheless, increasing the interaction between the Central Government and the sub-national authorities is a pending challenge, even though there are signs of further participation in regional and municipal structures, particularly on the scope of adaptation to climate change. The most relevant to present in this opportunity, in terms of the role they play on mitigation and adaptation to climate change or from experimented progress level are the Ministries of Energy and Agriculture, detailed below.

3.3.1. Ministry of Energy

This sector also experienced a change on its institutionalism in 2010, with the approval of

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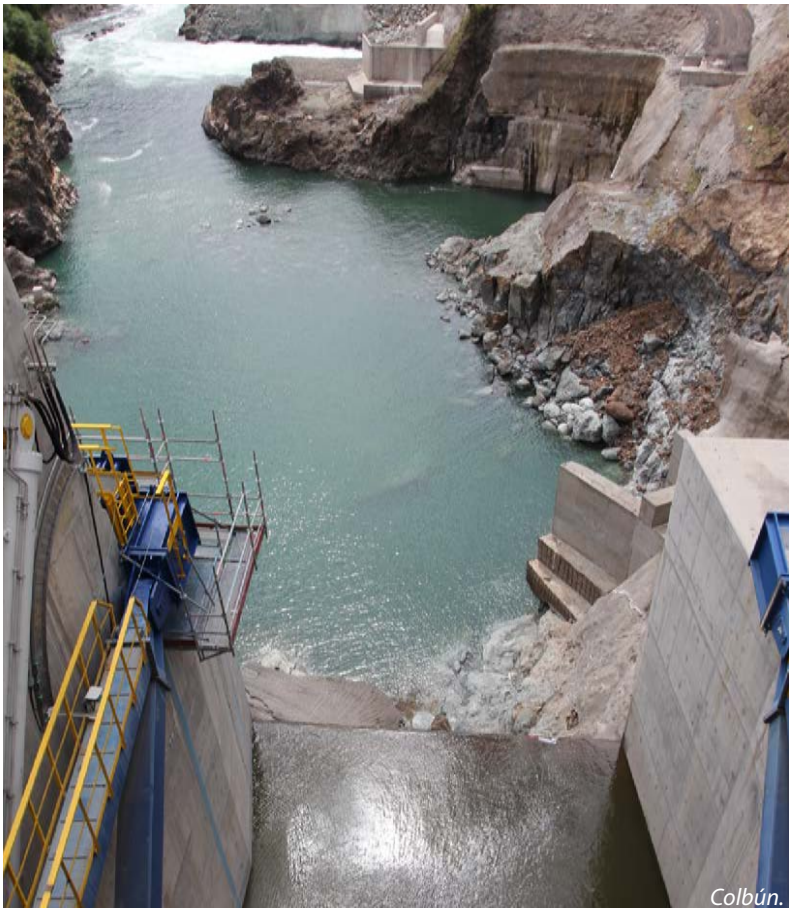
the Law N°20,402, that created the MINENERGIA, based on the National Energy Commission, making a statement on the relevance of energy matters to our country. The central goal of this ministry is to generate and coordinate plans, policies, and standards for the proper functioning and growth of the sector, watch over their fulfillment and to advise the Government on subjects related to energy. Its creation was possible thanks to a national consensus and it was presented as an opportunity to develop an integrated energy policy, coherent with the objectives of security, quality, and competitiveness of the supply and protection of local and global environment.

The structure of the ministry is based on Divisions; Prospective and Energy Policy Division, Security and Energy Market Division, Non- Conventional Renewable Energies Division, Energy Efficiency Division, Sustainable Development Division and Energy Access and Equity Division. Of these, several have an influence on climate change mitigation policies, but it is the Division of Sustainable Development the one explicitly in charge of coordinating and reconciling the energy policy with the local development, climate change and the care of the environment.



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Also, there are two services dependent on the MINENERGIA playing a fundamental role on sectoral mitigation of GHG emissions, these are:

- **Renewable Energy Center (CER):** This center was created in 2009 as an entity dependent of the Chilean Economic Development Corporation (CORFO) and under the direction of MINENERGIA, with the purpose of serving as a "technology antenna" for the development of renewable energies in the country. The model adopted by this center serves as platform to capture knowledge generated in the world on the subject and then analyze viability of implementation in the country and promote its use in the private sector. The CER develops mainly three lines of action: an information center, guidance to NCRE experimental and investment projects, and promotion and dissemination of NCRE.
- **Chilean Agency on Energy Efficiency (AChEE):** In 2005, Chilean government encouraged and brought together public and private players and requested the Ministry of Economy the start up and deployment of the Chilean Program for Energy Efficiency (PPEE - Programa País de Eficiencia Energética) which in 2008 became part of the National Energy Commission. In 2010, the assignment of power given through Law N°20,402 to the recently created MINENERGIA resulted on the creation of AChEE as successor entity for the PPEE, with the participation of the Ministries of Transportation and Telecommunications, Housing and Urban Planning and Energy and involvement of business and academic sectors. This agency assumed an executive role in deploying lines of actions and PPEE projects, while the roles of design and establishment of energy-efficient public policies were carried out by the corresponding division of MINENERGIA.

3.3.2. Ministry of Agriculture (Ministerio de Agricultura)

The MINAGRI is the entity from the State in charge of promoting, orienting and coordinating agricultural and forestry activities in the country. According to Law Decree N°294 of 1960, *"its action is aimed, fundamentally, to obtain*

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the increase of national production, preservation, protection and accretion of natural renewable resources and to achieve improvement on nutrition conditions of the people"

The MINAGRI has an Inter-Ministries Technical Committee created to provide technical assessment for the Climate Change and Agriculture Council (which has not hold a session since 2010). This committee coordinates works on climate change subjects under Agriculture and forestry Adaptation Plan and it is coordinated by the Office of Agricultural Policies and Studies (ODEPA - Oficina de Estudios y Políticas Agrarias) and gathers the institutions part of the MINAGRI:

- Institute for Rural Development (INDAP - Instituto de Desarrollo Agropecuario),
- Agricultural and Livestock Service (SAG - Servicio Agrícola y Ganadero),
- National Commission of Irrigation (CNR - Comisión Nacional de Riego),
- Natural Resources Information Center (CIREN - Centro de Información en Recursos Naturales),
- Institute for Agricultural Research (INIA - Instituto de Investigaciones Agropecuarias);
- Office of Agricultural Policies and Studies (ODEPA - Oficina de Estudios y Políticas Agrarias),
- Agricultural Innovation Foundation (FIA - Fundación para la Innovación Agraria),
- Forestry Institute (INFOR - Instituto Forestal),
- National Forestry Corporation (CONAF - Corporación Nacional Forestal),
- National Climate Risk Management and Agricultural Emergency Unit (UNEA - Unidad Nacional de Emergencias Agrícolas y Gestión del Riesgo Agroclimático), and
- AgroSeguros.

ECLAC.

4 INSTITUTIONAL ARRANGEMENTS FOR THE GENERATION OF REPORTS BEFORE THE UNFCCC

All signatory countries before the UNFCCC must report actions taken to implement the principles of such convention, through national communications and, since 2014, biennial update reports. According to the principle "common but differentiated responsibilities" contents and presentation times for national communications of developed countries differ from those of developing countries. Chile, as signatory country before the convention and in its quality of developing country (Non-Annex I), has presented two national communications, the most recent was generated by the MMA and presented in 2011.

The Conference of the Parties (COP), on its seventeenth period of sessions, approved the guidelines presented on its 2/CP.17 decision for the preparation of biennial update reports (BUR) for Parties not included in annex I of the Convention. These guidelines contain objectives and the range of the information to be communicated. Also in the decision 2/CP.17[5], the COP indicated that Parties not included in the annex, according to their capabilities and level of support provided for the information, must present their first BUR, at the latest, on December of 2014.

Arrangements carried out by Chile for the fulfillment of this report commitment are related to institutionalism presented previously, that is to say, that the entity coordinating the preparation of this report has been the Climate Change Office, which has developed a process for collecting information jointly with environmentally competent public institutions. This information has been validated afterwards by the ministry focal points on climate change, nominated in 2014.

5 http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf

REFERENCES AND BIBLIOGRAPHY

Central Bank. (September 2014). Obtained from Central Bank: http://www.bcentral.cl/index.asp

Central Bank. (2013). National Accounts of Chile 2008-2013. Santiago.

World Bank. (2014). Obtained from http://datos.bancomundial.org/indicador/SE.XPD.TOTL.GD.ZS

CNE. (2013). National Electric System Installed Capacity (Capacidad instalada por sistema eléctrico nacional).

CONAF. (2011). Survey on the Native Vegetable Resources of Chile, change and update monitoring for 1997-2011 (Catastro de los recursos vegetacionales nativos de Chile, monitoreo de cambios y actualizaciones período 1997-2011).

DIRECON. (September 2014). Commercial Agreements Obtained from the web page of the General Office of International Economic Relations: http://www.direcon.gob.cl/acuerdos-comerciales/

INE. (2007). 7th National Agricultural, Livestock and Forestry Census (VII Censo nacional agropecuario y forestal).

INE. (2013). 2013 Statistical Compendium (Compendio estadístico 2013).

INE. (2014). Population forecast (Proyecciones de población).

INFOR. (2012). 2012 Forestry Yearbook (Anuario forestal 2012). Statistical Bulletin N° 136 (Boletín estadístico Nº 136).

International Monetary Fund. (2014). World Economic Outlook-Recovery Strengthens, Remains Uneven, April 2014. Washington.

IPCC (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment. Cambridge, UK: M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E.; Hanson, Eds., Cambridge University Press.

MDS. (2013). Background for social event on the tracking of the Millennium Development Goals (Antecedentes para evento social sobre seguimiento de los Objetivos de desarrollo del milenio).

MDS. (2013). Social Policy Report, Education Chapter (Informe de política social, capítulo educación).

MDS. (2013). Social Policy Report, Poverty and Inequity Chapter (Informe de política social, capítulo pobreza y desigualdad).

MDS. (2013). Social Policy Report, Aging Chapter (Informe de política social, capítulo sobre envejecimiento).

Minecon. (2014). Main Results of the 3rd Survey of Expenditures and Personnel for R+D (Principales resultados 3ra encuesta nacional sobre gasto y personal en I+D).

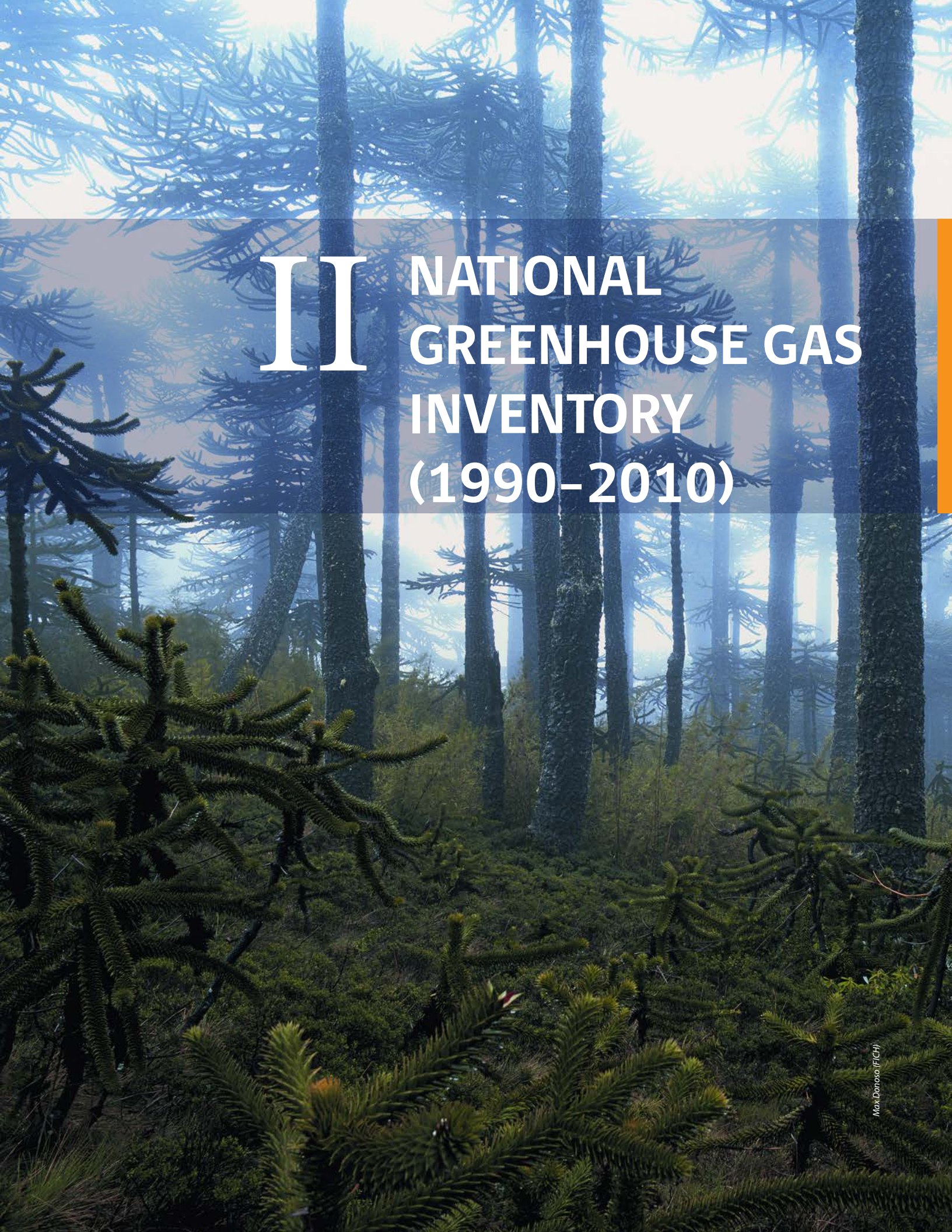
UNDP. (September 12, 2014). www.pnud.cl. Obtained from http://www.cl.undp.org/content/chile/es/home/countryinfo/

Sernapesca. (15 of 09, 2014). Statistical Yearbooks, Fishing National Service (Anuarios estadísticos, Servicio Nacional de Pesca). Obtained from http://www.sernapesca.cl/index.php?option=com_remository&Itemid=54&func=select&id=2

Subpesca. (15 of 09, 2014). Fishery and Aquaculture Sectoral Report, Fishery and Aquaculture Undersecretary (Informe sectorial de pesca y acuicultura, Subsecretaría de pesca y acuicultura). Obtained from http://www.subpesca.cl/publicaciones/606/w3-article-80767.html

The NIR of Chile encompasses all sectors of economy and includes GHG emissions and removals during a full time series, from 1990 until 2010.

II NATIONAL GREENHOUSE GAS INVENTORY (1990–2010)



Max Donoso (FICH)

1 INTRODUCTION

View from Costanera Center.

This national greenhouse gas inventory (NIR) corresponds to the third report Chile has presented to the United Nations Framework Convention on Climate Change (UNFCCC) in compliance with article 4, paragraph 1(a) and article 12, paragraph 1(a), of the Convention and Decision 1 of the 16th Conference of the Parties of Cancun, 2010.

Chile's national greenhouse gas inventory covers the entire national territory and includes anthropogenic greenhouse gas emissions and removals not managed by the Montreal Protocol.

The estimations of GHG emissions and removals are presented by gas, sector, category, subcategory and component for the latest inventory year (2010), unless otherwise indicated. Time series data on emissions and removals for the 1990 to 2010 period is also included herein.

Section 1. The introduction provides general information on NIRs, the institutional arrangements, and how the inventory of Chile was prepared, including the methodologies used. Section 2 details the trends in greenhouse gas emissions and removals in Chile. In sections 3 to 8, detailed information on six sectors is presented: Energy; Industrial processes; Solvent and other products use; Agriculture; Land use, land-use change and forestry; and Waste. Lastly, section 9 summarizes new calculations and improvements undertaken since the last report.

1.1. General Overview

The United Nations Framework Convention on Climate Change (hereinafter the Convention or UNFCCC) came into force on May 9th, 1992, and Chile became a signatory to the Convention in 1994 in order to stabilize greenhouse gas (GHG)[1] concentrations in the atmosphere at a level that would prevent and reduce hazardous human-induced interference in the climate system (UNFCCC, 1992). The ability of the international community to achieve this objective is dependent on an accurate knowledge of GHG emissions trends, and on our collective ability to alter these trends. (UNDP, 2005). For this, every country member of the Convention must produce and constantly update, publish and facilitate national inventories of anthropogenic emissions by sources and removals by sinks of every GHG not controlled by the Montreal Protocol[2] In order to quantify in a credible, consistent manner and being able to compare the inventories of the countries, the Convention recommends that countries use the methodological guidelines prepared by the Intergovernmental Panel on Climate Change (IPCC) when preparing and/or updating their inventories.

National greenhouse gas inventories (NIR) consist of a comprehensive list of the quantities of each anthropogenic GHG emitted into or re-

1. "Greenhouse gases" are understood as those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorbs and re-emits infrared radiation (UNFCCC, 1992). The main anthropogenic GHG are: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFC), Perfluorocarbons (PFC) and sulfur hexafluoride (SF_6).
2. Article 4, paragraph 1(a) and article 12, paragraph 1(a) of the Convention. 1992.

moved from the atmosphere in a given area over a specific period of time, usually one calendar year. These NIRs are intended to determine the magnitude of the national GHG emissions and removals that are directly attributable to human activity and the country particular contribution to the phenomenon of climate change.

In addition to above, according to the United Nations Development Programme (UNDP, 2005), the preparation and presentation of NIR can provide countries with a series of other benefits, including:

- Identifying the economic sectors which have the greatest impact on climate change and their specific contributions;
- Providing useful information for planning and assessing economic development;
- Providing useful information for addressing other environmental problems (such as air quality, land use, waste management, etc.);
- Identifying gaps in national statistics;
- Assessing options for mitigating GHGs collaborating on the approach for low emission development strategies and, therefore, to a more efficient use of natural and financial resources; and
- Providing a foundation for emission trading schemes.

For developing countries such as Chile, the key mechanisms for reporting NIRs to the Convention have been National Communications (NCs) and, since 2014 and on, Biennial Update Reports (BURs). Chile's first official NIR was prepared by the National Environmental Commission (CONAMA) and submitted to the Convention in 2000 as part of the Chile's First National Communication, and it included information on GHG emissions for 1993 and 1994. The second official NIR was prepared by the Ministry of the Environment (MMA) and submitted in 2011 as part of the Second National Communication of Chile. This inventory included time series data from 1984 to 2006. This report comprises Chile's Third official NIR to the UNFCCC and includes time series data from 1990 to 2010.

1.2. Institutional arrangements

In order to facilitate the reporting of progresses in the implementation of the Convention objectives, *in the COP16, in 2010, it was stated that "Developing countries should submit biennial update reports containing updated information on NIR"*[3]*. In addition, in the COP17, in 2011, it was furthermore stated that "non-Annex I Parties… should submit their first BURs by December 2014 [...] covering, at a minimum, the inventory for the calendar year no more than four years prior to the date of the submission"*[4].

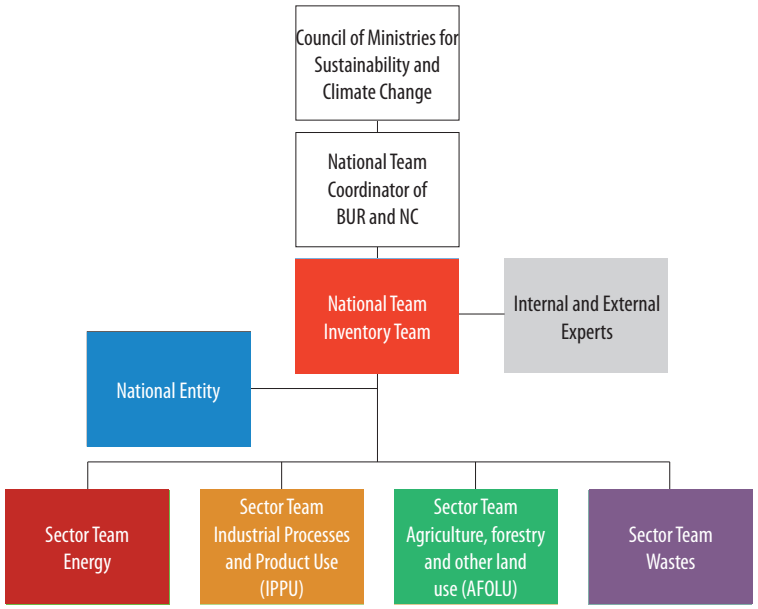
Facing the new commitments the country has undertaken, since 2012, the Climate Change Office (OCC) from the MMA has developed, implemented and coordinated the Chile's National Greenhouse Gas Inventory System (SNICHILE), which contains the institutional, legal and procedural measures established for the biennial (every two years) update of the Chile's NIR; guaranteeing this way sustainability in the development of the GHG inventories in the country, coherence on the intended GHG flows and the quality of the results.

SNICHILE (Figure 1) structure is a decentralized entity where the NIR in the result of an ongoing and joint collaboration of several public agencies. Chile's National GHG Inventory Team is comprised by the national entity (the OCC from the MMA), which coordinates the work of sector teams responsible for preparing their corresponding sector-specific inventories (SGHGIs). Besides, Chilean (internal) and international (external) experts deliver cross collaboration on NIR matters. The National Inventory Team reports to the BUR/NC National Coordinating Team in order to introduce the Chile's NIR into the corresponding report. Lastly, the National Coordinating Team reports to the Council of Ministries for Sustainability and Climate Change, requesting its approval.

3. Decision 1, paragraph 60(c) of the Report of the Conference of the Parties on its 16th session period, held in Cancun from November the 29th to December the 10th, 2010.

4. Decision 1, paragraph 41(a) Report of the Conference of the Parties on its 17th session period, held in Durban from November the 28th to December the 11th, 2011.

Figure 1. Structure of the Chile's National Greenhouse Gas Inventory System.



Since 2013, the national entity has been holding biannual meetings of the National GHG Inventory Team to coordinate and operate the SNICHILE. Bilateral meetings are also held regularly with sector teams to address sector-specific issues.

The permanent work by SNICHILE is divided in the following five areas:

- **Updating Chile's NIR:** This work area is focused on the biennial updating of Chile's NIR, through the collection of biennial updates of sector-specific GHG inventories (SGHGI) by each responsible team, its later compilation and development of cross-cutting issues.

- **Continuous improvement system:** This work area is focused on the quality assurance and quality control system (QA/QC) by means of an improvement plan based on good practice guidelines for NIR development, seeking to guarantee the quality of national NIR results by ensuring information transparency, completeness, consistency, comparability and accuracy. Within these activities, the international expert review of every SGHGIs and of Chile's NIR is highlighted.

- **Building and maintaining capacities:** This work area is focused on building and maintaining the capacities of each sector team through multisector training workshops, identifying and preparing training materials, and international cooperation, among other activities coordinated by the National Entity. It is worth to note that by July 2014, Chile has five expert reviewers of NIR from Parties included in Annex I of the Convention: Aquiles Neuenschwander (Fundación para la Innovación Agraria from the Ministry of Agriculture), lead reviewer and LULUCF sector expert; Sergio González, lead reviewer and Agriculture sector expert; Jenny Mager (OCC from the MMA), expert reviewer in the Industrial Processes sector; Fernando Farías (OCC from the MMA), expert reviewer for the Energy sector; and Paulo Cornejo (OCC from the MMA, and Coordinator of SNICHILE), expert reviewer for the Agriculture sector. All of these individuals actively participate in SNICHILE.

- **Institutionalization:** area of work focused on institutionalization of SNICHILE, through the generation of work agreements between the participating institutions, undertaking responsibilities, terms, budgets and thus ensuring an coordinated interinstitutional work.

- **Dissemination:** This work area is focused on disseminating information related to Chile's NIR, such as: development process, time frames, related activities and results. The dissemination is carried out through a website from SNICHILE, which also serves as a multisector repository for information, knowledge transfer workshops, informative speeches, and printed and digital material.

1.3. Update process

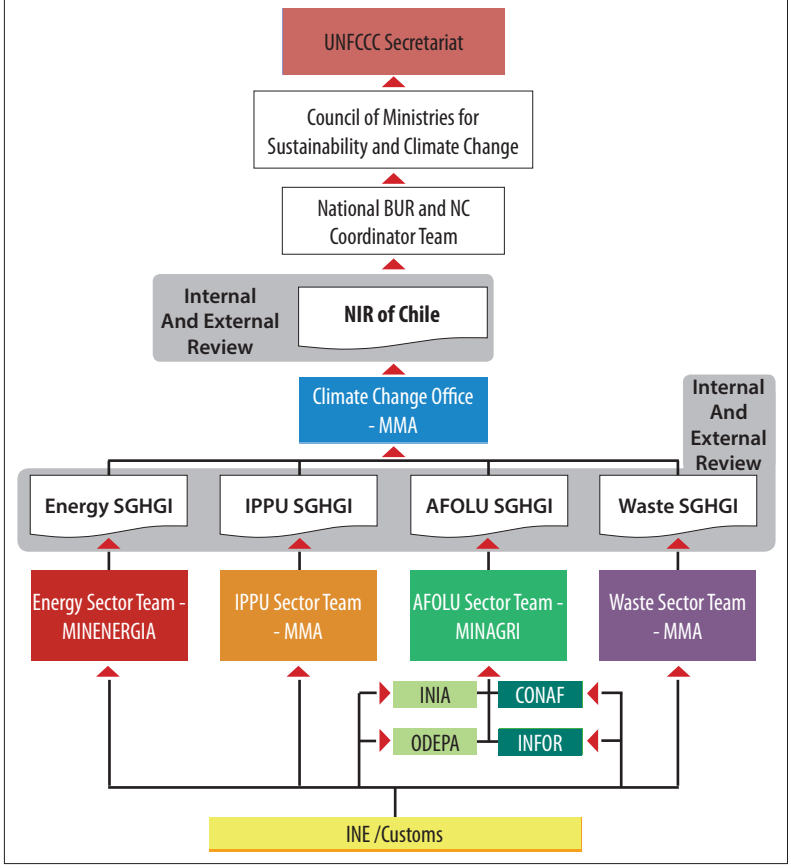
In general, Chile's NIR is updated through a cyclical, biennial work plan. Sectoral inventories are updated during the first year (STAGE I of the cycle), while in the second year (STAGE II of the cycle) the data is compiled and Chile's NIR cross-cutting issues are developed.

The preparation of this NIR began in the first half of 2013 and concluded by mid-2014. As Figure 2 shows, the general statistical information database is provided by the National Statistics Institute (INE) and the National Customs Service (Customs). This information is also used as a

means for verifying the self-developed information from the sectoral teams.

Each sectoral team is in charge of developing the GHG inventories of their corresponding sectors. Thus, the Energy sector inventory was prepared by the Energy Policy and Survey Division of the Ministry of Energy (MINENERGIA); the SGHGI of the Industrial Processes and Product Use (IPPU) sector was prepared by the OCC from the MMA; the inventory of the Agriculture, Forestry and Other Land Use (AFOLU) sector was prepared by the Ministry of Agriculture (MINAGRI), with its Agricultural Research and Policies Office (ODEPA) coordinating tasks with the National Forestry Corporation (CONAF) on issues related to land-use change, with the Forestry Institute (INFOR) on matters related to forest land, and with the Institute for Agricultural Research (INIA) on agriculture and livestock issues; and the GHG inventory for the Waste sector was prepared by the Solid Waste Section (currently part of the Waste and Hazardous Substances Office) of the MMA.

Figure 2. Process for updating Chile's National Greenhouse Gas Inventory.



Each SGHGI was submitted to an international expert review process, being the main recommendations included on the SGHGI, before being submitted to the National Entity. Once the review process concluded, the SGHGIs were compiled by the OCC from the MMA for the preparation of the Chile' NIR and its corresponding report, as well as cross-cutting issues were developed. Once the final report was approved by the sectoral teams, it was submitted to a new review process at a national level. Finally, the Chile's NIR was submitted to the BUR/NC National Coordinating Team to be included in the first BUR of Chile.

The NIR of Chile and all other information required for presentation to the UNFCCC is stored in the MMA, although each sector team also has its own data storage system. Lastly, Chile's NIR is also available on-line through the MMA and SNICHILE websites.

1.4. Methodology and sources of information

1.4.1. Methodologies

The current NIR is the result from the compilation of SGHGIs, which have been produced in accordance with the IPCC guidelines of 2006 for national greenhouse gas inventories (2006GL) and using IPCC software, including the analysis of key categories and uncertainty assessment. From the beginning of the ongoing update process, the national NIR team decided to implement the 2006GL and IPCC software, given that:

- The 2006GL offer the best current globally applicable methods, since they reflect the latest scientific advances in quantifying GHG emissions and removals,
- Both the 2006GL and IPCC software enable emissions to be reported in the format required by the Convention,
- Using these tools reduces the cost of future updating of methodologies in Chile's NIRs, since the international trend, for both developed and developing countries, is to improve methodologies for the preparation of their NIR implementing the 2006GL, and
- Making GHG accounting mechanisms compatible among different initiatives developed by sector teams.

In preparing its NIR, Chile has chosen to use the 2006GL despite the fact that both the UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention (GL-UNFCCC-BUR) and the Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention (GL-UNFCCC-NC) suggest that these countries prepare their inventories in accordance with the Revised 1996 IPCC Guidelines for National GHG Inventories (1996GL), the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories (GPG2000), and the Good Practice Guidance for Land use, land-use change and forestry (GPG-LULUCF). Those instruments divide the inventories into six main sectors: Energy; Industrial processes (IP); solvents and other products use (SOPU); Agriculture; Land use, land-use change and forestry (LULUCF); and Waste. Likewise, the 2006GL divide the inventories in four sectors: Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Other Land Use (AFOLU); and Wastes. In order to close this gap, the sectors defined in the 2006GL were harmonized with those established in the 1996GL, GPG2000 and GPG-LULUCF during the compilation of this NIR, as illustrated by the following Table:

It is worth mentioning that for the NIR report of Chile, the results were adapted to the table presentation format recommended in the GL-UNFCCC-BUR and the GL-UNFCCC-NC.

The methodological approach used to estimate GHG emissions and removals is to combine information on the scope of a given human activity (called activity data or AD, which may be statistical and/or parametric) with coefficients called emission factors (EF), which quantify GHG emissions or removals per unit activity. They are called Emission Factors (EF) Thus, the basic equation is:

GHG Emissions = Activity data (AD) x Emissions Factors (EF)

Although this simple equation is widely used, the 2006GL also offer other methods, such as the mass balance method (primarily used in the LULUCF sector) as well as other more complex ones usually divided into three tiers: Tier 1 is the "default method", which is the simplest methodology, and is usually applied when no country-specific activity data or emission factors are available. Despite Tier 1 methods enable calculations, they present the risk of failing to accurately reflect national circumstances. On the other hand, Tier 2 methods use the same methodological procedure than Tier 1 methods, but they introduce emission factors and/or parametric activity data specific to the country or at least to one of its zones. Under these circumstances, it is very likely that the estimations of GHG emissions and removals to be more accurate; this option should apply for key categories. Tier 3 methods are country-specific ones (models, censuses, and others), whose application is recommended provided they have been duly validated and, in the case of models, are published in peer-reviewed scientific journals (MMA, 2011). Table 2 presents a summary of

Table 1. Standardization of sectors among different IPCC Guidelines.

Sectors in 2006GL	Sectors in 1996GL/ GPG2000/ GPG-LULUCF
1. Energy	1. Energy
2. Industrial Processes and product use (IPPU)	2. Industrial Processes (IP)
	3. Solvents and other products use (SOPU)
3. Agriculture, Forestry and Other Land Use (AFOLU)	4. Agriculture
	5. Land use, land-use change and forestry (LULUCF)
4. Waste	6. Waste

Source: Compilation by SNICHILE based on 1996GL, GPG2000, GPG-LULUCF y 2006GL.

the methods and tiers used to prepare Chile's NIR. From sections 3 to section 8 of this report detailed description of the methodologies and methods applied on each sector is provided.

Table 2. Methods and tiers on Chile's NIR, 2010.

Greenhouse gas source and sinks categories	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	T1	D	T1	D	T1	D						
A. Fuel combustion (sectoral approach)	T1	D	T1	D	T1	D						
1. Energy industries	T1	D	T1	D	T1	D						
2. Manufacturing industries and construction	T1	D	T1	D	T1	D						
3. Transport	T1	D	T1	D	T1	D						
4. Other sectors	T1	D	T1	D	T1	D						
5. Others	NO, C	D	NO, C	D	NO, C	D						
B. Fugitive emissions from fuels	T1	D	T1	D								
1. Solid fuels			T1	D								
2. Oil and natural gas	T1	D	T1	D								
2. Industrial processes	T1,T2	D	T1	D	T1	D	T1	D	T1	D	NE, NO	NE, NO
A. Mineral products	T1,T2	D										
B. Chemical industry	T1	D	T1	D	T1	D						
C. Metal production	T1	D	NO	D								
D. Other production	NE	NE					NE	NE	NE	NE	NE	NE
E. Production of halocarbons and SF6							NE	NE	NE	NE	NE	NE
F. Consumption of Halocarbons and SF6							T1	D	T1	D	NE, NO	NE, NO
G. Others	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvents and other products use	T1	D										
4. Agriculture			T1b, T2	D, CS	T1b	D						
A. Enteric fermentation			T1b, T2	D, CS								
B. Manure management			T1b, T2	D, CS	T1b	D						
C. Rice cultivation			T1b	D								
D. Agricultural soils					T1b	D						
E. Prescribed burning of savannah.			NO	NO	NO	NO						
F. Field burning of agricultural residues			T1a,b	D	T1a,b	D						
G. Others			NA	NA	NA	NA						
5. Land use, land-use change and forestry	T1b, T2	D, CS	T1b, T2	D, CS	T1b, T2	D, CS						
A. Forest Land	T2	CS	T1b, T2	D, CS	T1b, T2	D, CS						
B. Cropland	T1b, T2	D, CS										
C. Grassland	T1b, T2	D, CS	T1a,b	D	T1a,b	D						
D. Wetland	NE	NE	NE	NE	NE	NE						
E. Settlements	T1b, T2	D, CS										
F. Other land	T1b, T2	D, CS										
G. Others	NE	D	NE	D	NE	D						
6. Wastes	T1	D	T1	D	T1	D						
A. Solid waste disposal			T1	D								
B. Wastewater treatment and discharge			T1	D	T1	D						
C. Waste incineration	T1	D										
D. Others			T1	D	T1	D						
Memo Items												
International bunkers	T1	D	T1	D	T1	D						
CO_2 emissions from biomass	T1	D										

T1= Tier 1 Method; T1a= Disaggregation per operational component (crops, species, etc.); T1b= Disaggregation per administrative regions; T2= Tier 2 Method; D= Default; CS= Country-Specific; NA= Not Applicable; NE= Not estimated; NO= Not occurring; C= Confidential.
Source: Compilation by SNICHILE.

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After estimating emissions and removals for each GHG and to facilitate aggregate reporting of GHG values, expressed as carbon dioxide equivalents or CO_2eq, developing countries must use the global warming potentials (GWPs) provided by the IPCC on its Second Assessment Report (SAR), which are based on GHG effects for a 100-year time horizon. GWPs used for the main GHGs are presented in the Table below:

Table 3. Global warming potential used in Chile's NIR

GHG	GWP
CO_2	1
CH_4	21
N_2O	310
HFC-32	650
HFC-125	2,800
HFC-134a	1,300
HFC-152a	140
HFC-143a	3,800
HFC-227ea	2,900
HFC-236fa	6,300
CF_4	6,500

Source: IPCC, 1995.

The 2006GLs provide good practice guidance to generate quality NIRs. The quality NIR indicators are:

- **Transparency:** There must be clear and sufficient documentation as to enable people and groups other than the inventory developers to understand how the inventory was prepared.
- **Completeness:** Estimations must be declared for all pertinent GHG source and sinks categories for the entire national territory.
- **Consistency:** Estimations for different years, gases and categories must be performed in such a way that they reflect actual differences in the balance of emissions. To the extent possible, annual inventory trends should be calculated with the same method using the same data sources every year, and they should be focused on reflecting actual annual fluctuations in emissions and removals without undue influence from methodological differences.
- **Comparability:** The NIR should be reported in a format that enables comparison with the inventories of other countries.
- **Accuracy:** The NIR should not contain estimations that are too high or too low, to the extent this can be determined. This is translated into making all the necessary efforts as to eliminate estimation bias.

In conclusion, inventory compilers should use good practice methods to ensure that NIRs are as transparent, complete, consistent, comparable and accurate as possible so as to ensure they can be continuously improved over time.

Table 4. Main sources of activity data for Chile's NIR.

Sector	Source:
1. Energy	National Energy Balance (NEB) (Ministry of Energy)
	Yearbook: Copper and Other Mineral Statistics (COCHILCO)
	International fuel consumption statistics (National Customs Service)
2. IP	Cement production (Instituto del Cemento y Hormigón de Chile)
	Clinker imports and exports (National Customs Service)
	Lime production (Inacesa, Soprocal, CMPC and Arauco)
	Glass production (SOFOFA)
	Nitric acid production (POCH and Deuman)
	National Energy Balance (NEB) (Ministry of Energy)
	Methanol production (Methanex)
	Lead, zinc, iron and steel production (COCHILCO, SERNAGEOMIN)
	Ferroalloy production (USGS)
	Production, importation and exportation of ODS (INE, National Customs Service)
3. SOPU	Production, importation and exportation of lubricants and paraffin wax (INE, National Customs Service)
4. Agriculture	Agriculture and Forestry Censuses (INE, ODEPA)
	Annual statistics (INE, ODEPA)
	Statistics (FAO)
5. LULUCF	National Forestr Ecosystem Inventory (Inventario Forestal Continuo) (INFOR)
	Forestry statistics (INFOR)
	Vegetation Inventories (CONAF)
	Historic forest fire statistics (CONAF)
6. Waste	Population and Housing Census (Censo de población y vivienda) (INE)
	Adjusted SMW Inventory (Catastro ajustado de RSM) (MMA)
	Quantity of sludges deposited (SISS)

5. For more information, see Annex 1. Activity and parameter data.
6. For more information, see Annex 2. Key categories analysis.

INACESA: Cement National Industry (Industria Nacional del Cemento S.A.)
SOPROCAL: Lime Production Society (Sociedad Productora de Cal)
CMPC: Paper and Cardboard Manufacturing Company (Compañía Manufacturera de Papeles y Cartones
ARAUCO: Arauco and Constitución Cellulose Manufacturer

1.4.2. Sources of information

Table 4 summarizes the primary sources of information (activity data) used by each sector included in Chile's NIR[5]. More detailed information on sources of information used can be found in the sectoral sections and in the References chapter of this report.

1.5. Key categories

As per the 2006GL, it is good practice for each country to identify its key categories in a systematic and objective manner. Key categories are those used to identify the categories which have a significant effect on a country NIR in terms of the absolute level, trends, and/or uncertainty of GHG emissions and/or removals. The key categories must be priority for countries when allocating resources for collecting, compiling, verifying, and controlling the quality of data and for generating reports. Thus, choosing a methodology based on the result of key categories analysis is also considered a good practice. This process is translated into a better quality inventory, as well as into more confidence on the estimations developed.

OCC from MMA has identified the key categories for 1990 and 2010 (the last year reported on the NIR) using the 2006GL Tier 1 Method. However, the results have been adapted to the GPG2000 and GPG-LULUCF reporting formats in order to assess the influence of different source and sinks categories over the absolute levels and trends for the balance of GHG emissions and removals (including LULUCF), while at the same time maintaining the consistency of the reporting Tables in Section 2. Table 5 offers a summary of the identified key categories[6]. This list was used as the basis for discussions with sector teams about the quality of estimations and the possible need for improvements. The key categories of the Chile's NIR are documented in greater detail and also undergo a more comprehensive quality control.

Table 5. Key categories identified using Method 1 of the 2006GL for absolute levels and trends in the Chile's NIR.

IPCC code and category	GHG	Identification criteria, including LULUCF		
		1990 level	2010 level	Trend
1.A.1.a. Main activity electricity and heat production	CO_2	X	X	X
1.A.1.b. Oil refining	CO_2	X	X	X
1.A.2.a. Iron and steel	CO_2	X		X
1.A.2.c. Chemicals	CO_2		X	
1.A.2.f. Non-specified industries	CO_2	X	X	X
1.A.2.f. Non-metallic minerals	CO_2	X	X	X
1.A.2.f. Mining (excluding fuels) and quarrying	CO_2	X	X	X
1.A.3.a. Domestic aviation	CO_2	X		X
1.A.3.b. Road transportation	CO_2	X	X	X
1.A.3.d. Domestic water-borne navigation	CO_2	X		X
1.A.4.a. Commercial / Institutional	CO_2		X	
1.A.4.b. Residential	CO_2	X	X	X
1.A.4.c. Agriculture / Forestry / Fishing	CO_2		X	
1.B.2.a. Oil	CH_4	X		X
1.B.2.b. Natural gas	CH_4	X	X	X
2.A.1. Cement production	CO_2	X	X	X
2.A.2. Lime production	CO_2		X	
2.B.2. Nitric acid production	N_2O		X	
2.B.5.a. Methanol	CO_2	X		X
2.C.1. Iron and steel production	CO_2	X	X	X
4.A.1. Cattle	CH_4	X	X	X
4.B.1. Cattle	CH_4	X	X	X
4.D.1. Direct emissions from agricultural soils	N_2O	X	X	X
4.D.2. Pasture, range and paddock manure	N_2O	X	X	X
4.D.3. Indirect emissions from agricultural soils	N_2O	X	X	X
5.A.1.a. Native forest burned	CO_2	X	X	X
5.A.1.a. Managed native forest	CO_2	X	X	X
5.A.1.a. Forest tree plantations	CO_2	X	X	X
5.A.1.a. Renewals	CO_2	X	X	X
5.A.1.b. Land in transition	CO_2		X	
5.A.1.c. Native species roundwoods	CO_2	X	X	X
5.A.1.c. *Eucalyptus* spp roundwood	CO_2	X	X	X
5.A.1.c. *P. radiata* roundwood	CO_2	X	X	X
5.A.1.e. Firewood	CO_2	X	X	X
5.A.1.f. Native forest burned	CO_2	X	X	X
5.A.1.f. Burned forest tree plantations	CO_2		X	X
5.A.1.g. Substitution	CO_2	X	X	X
5.A.2.2. Land converted to Forest land	CO_2	X	X	X
5.C.2. Land converted to Grassland	CO_2	X	X	X
6.A.1. Managed waste disposal sites	CH_4		X	
6.A.2. Unmanaged waste disposal sites	CH_4	X		X
6.A.3. Others	CH_4	X		X

Source: Compilation by SNICHILE.

1.6. Quality assurance and quality control system

To ensure high quality GHG inventories, through transparency, completeness, consistency, comparability and accuracy of the information, SNICHILE has defined a work area focused on operating a quality assurance and quality control (QA/QC) system in compliance to the good practices for preparing NIRs.

Quality control (QC) is carried out through a system of routine technical activities that assess and maintain the quality of the inventory as it is prepared. QC activities are carried out by sector teams during the preparation of the SGHGIs and also by the SNICHILE coordinator during the compilation and preparation of Chile's NIR.

Quality assurance (QA) is a system of planned review procedures implemented by staff members who are not directly involved in preparing the SGHGIs or in compiling the NIR. Reviews, carried out by third parties, are performed on the SGHGIs and the final NIR.

The section below describes the QA/QC activities that the National Entity, in its role as coordinator of SNICHILE, carried out during the compilation and preparation of the NIR of Chile. The QA/QC activities of sector teams will be addressed in their corresponding sectoral sections.

1.6.1. Quality assurance and quality control activities

Prior to the compilation of the NIR by the OCC from the MMA, through the compilation of SGHGI of each sector, the following activities have been performed:

- The National Entity conducted an internal review of the preliminary numerical results of each SGHGI,
- A qualified NIR reviewer from one of the Parties included in Annex I to the Convention conducted an external review of each SGHGI,
- The findings and recommendations of the external review process were analyzed, and
- The findings and recommendations for each SGHGI were introduced, when applicable.

Afterwards, for the compilation and generation of the Chile's NIR, the following activities have been performed:

- A calculation spreadsheet *(filename 2014_INGEI_CL_vGL2006)* was created and populated with numerical results for the national level following the 2006GL format. The spreadsheet has been created with automated links from report files delivered by each sector — avoiding, this way, potential errors due to manual numeric data entry. Besides, the spreadsheet has a cross-checking function to ensure there is no difference between the values on the sectoral and national inventories,
- A calculation spreadsheet was created *(filename 2014_INGEI_CL_vNAI)* and populated with the numerical results in the formats established in the GL-UNFCCC-BUR and GL- UNFCCC-NC. The spreadsheet was build by standardizing the results of the 2006GL format with the format required by the Convention, using automated links from the *2014_INGEI_CL_vGL2006* spreadsheet — avoiding, this way, potential error due to manual numeric data entry errors. Besides, the spreadsheet has a cross-checking function to ensure there is no difference between the values on the sectoral and national inventories,
- A draft version of the Chile's National GHG Inventory Report (NIR) was produced and submitted to an internal review by experts qualified as reviewers of NIR from Parties included in Annex I to the Convention working within SNICHILE.
- The draft version of the NIR was reviewed by sector teams and ministerial focal points.
- The NIR was reviewed by external experts qualified as reviewers of NIRs from Parties included in Annex I of the Convention.

Once the process was complete, the NIR was submitted to the National BUR/NC Coordinating Team, to generate the corresponding report of the country to the Convention.

1.6.2. Continuous improvement plan

The QA/QC System includes a work plan to continuously improve the quality of the NIR of Chile. This ongoing effort seeks to identify potential areas for improvement and how these should best be implemented. These issues are addressed on an ongoing basis, by the NIR Team during SNICHILE biannual meetings or bilaterally between a particular sectoral team and the National Entity.

1.7. General assessment of uncertainty

According to the 2006GL, uncertainty estimations are an essential part of a complete inventory of GHG emissions and removals. Uncertainty analyses should be considered as a means to prioritize national efforts aiming to reduce uncertainty in future inventories and to drive decisions on the methodology selection.

For the uncertainty analysis of the Chile's NIR, the OCC from the MMA compiled uncertainties for each SGHGI and analyzed them using Method 1: Error Propagation (Tier 1) from 2006GL, which is used to estimate uncertainty across all inventory's individual categories (emission factors, activity data and other estimation parameters) and trends between a given year and the base year. Uncertainty calculations for NIR of Chile include GHG emissions and removals from the LULUCF sector.

In general terms of the Chile's NIR and weighting its share in the overall GHG emissions and removals balance, the sectors that contributed most to uncertainty ("contribution to variance") in 2010 are the LULUCF sector, followed by Agriculture, Waste, Energy and lastly Industrial Processes/SOPU.

In the LULUCF sector, the sources of uncertainty that contributed most to variance in 2010 are CO_2 emissions and removals by forest lands remaining forest land, followed by CO_2 emissions from land converted to forest land. These are primarily the result of uncertainty in the parametric data used, which drive the emission factors.

In the Agriculture sector, the uncertainty sources contributing most to variance in 2010 include direct N_2O emissions from managed soils, followed by indirect N_2O emissions from managed soils, and CH_4 emissions from the enteric fermentation of bovine manure. These are primarily the result of the high level of uncertainty in the default N_2O emission factors used and the activity data related to indirect emissions from agricultural soils.

For the Waste sector, sources of uncertainty that contributed most to variance in 2010 are CH_4 emissions from solid waste disposal, followed by CH_4 and N_2O emissions from domestic wastewater treatment and discharge. This is mainly due to the uncertainties in the emission factors used, except in the case of CH_4 emissions from domestic wastewater treatment and discharge, where uncertainty is mainly related to the activity data used.

In the Energy sector, the sources of uncertainty that most contributed to variance in 2010 are fugitive CH_4 emissions from oil and natural gas extraction, followed by CO_2 emissions from solid fuels used to produce electricity and heat, and CO_2 emissions from liquid automobile fuels. These are mainly derived from uncertainty in the default emission factors used and not from problems with activity data taken from the National Energy Balance.

In the Industrial Processes/SOPU sector, sources of uncertainty that contributed the most to variance in 2010 are N_2O emissions from nitric acid production, followed by CO_2 emissions from cement production, and CO_2 emissions from lime production. This is mainly due to the uncertainties in the default emission factors used.

In conclusion, most uncertainty associated to the Chile's NIR derives from the use of default emission factors.

1.8. General assessment of completeness

The Chile's NIR covers the whole national territory (continental and insular territory and the Antarctica) and includes a complete time series of GHG emissions and removals from 1990 to 2010.

Bocamina Thermo Power Generation Plant

Included GHG are: CO_2, CH_4, N_2O, HFC y PFC. SF_6 was not estimated due to a lack of activity data. Besides, the following precursors were partially included: CO, NOx, NMVOC, SO_2, which were calculated only for the Energy sector and for biomass combustion categories in the Agriculture and LULUCF sectors.

The Chile's NIR includes the vast majority of emission and removal sources by sinks for most of the categories and subcategories comprising the sectors. The following categories were not estimated (NE) due to a lack of activity data:

- 1A2.b. Non-ferrous metals
- 2A3. Limestone and dolomite use
- 2A4. Sodium carbonate production and use
- 2A5. Roofing asphalt material production
- 2A6. Road paving with asphalt
- 2E1. Secondary HFC and PFC emissions
- 2E2. Fugitive emissions
- 2E5. Solvents
- 3A. Paint applications
- 3B. Degreasing and dry cleaning
- 4d1d. Histosol crops
- 4B10. Others
- 5D. Wetland
- 5E1. Settlements remaining Settlements
- 5F1. Other lands remaining other land
- 5G. Other (Harvested wood products)

Categories not estimated (NE) due to lack of a pertinent methodology are as follows:

- 2D1. Pulp and paper industries
- 2D2. Food and beverages

1A5b Category. Mobile has been declared confidential (C), as the Energy sector team was not able to access the confidential military information required. Besides, Biological Nitrogen Fixation category has been removed as a direct source of N_2O due to the lack of evidence of significant emissions arising from the fixation process itself (Rochette and Janzen, 2005 c.p IPCC, 2006).

Regarding carbon deposits in the LULUCF sec-

tor, this exercise includes above-and-below-ground living biomass and a portion of dead biomass, which represented a major advance over the previous series (1984/2006), which included only above-ground biomass. Deposits corresponding to litterfall and soil organic matter (SOM) were not included due to a lack of activity data.

In compliance with the requirements by the UNFCCC and the 2006GL, GHG emissions from marine and air international bunkers and the CO_2 emissions from biomass burned with energy production purposes have been quantified and reported for information purposes, but they have not been included in the GHG emission and removals balance of the country.

Karina Bahamonde

Antenna Landscape

2 GREENHOUSE GAS EMISSION TRENDS IN CHILE

This section offers an overview of trends in GHG emissions and removals in Chile. More detailed information on GHG emissions and removals in each sector can be found in section 3 to section 8 of this report.

Table 6 and Table 7 display categorized results of all GHG sources and sinks, at national level, resulting from human activity in 2010. It is important to highlight that throughout this report the gigagram (Gg) has been used as the unit of mass for GHG emissions and removals in Chile. Positive figures represent GHG emissions, while negative figures represent GHG removals.

In 2010, the national gross CO_2 emissions amounted to 149,540.6 Gg; CH_4 emissions accounted to 570.2 Gg and N_2O emissions were 32.1 Gg. Meanwhile, gross CO_2 removals accounted to -130,055.7 Gg. HFC emissions amounted to 0.1 Gg of HFC-32, 0.3 Gg of HFC-125, 241.1 Gg of HFC-134a, 0.3 Gg of HFC-152a, 9.5 Gg of HFC-143a, 29.9 Gg of HFC-227ea, and 0.1 Gg of HFC-236fa. PFCs emissions amounted to 6.1 Gg of CF_4. SF_6 emissions were not estimated due to a lack of activity data.

Table 6. Chile's NIR: anthropogenic emissions per sources and removals by sinks of all GHG not controlled by the Montreal Protocol and GHG precursors. Year 2010.

Greenhouse gas source and sinks categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NOx (Gg)	COVDMs (Gg)	SO_2 (Gg)
Total national emissions and removals	149,540.6	-130,055.7	570.2	32.1	1,483.6	272.1	170.8	271.4
1. Energy	65,776.0	NO	92.7	2.2	1,072.4	265.4	170.8	271.4
A. Fuel combustion activities (Sectoral approach)	65,774.7		44.3	2.2	1,047.0	262.7	166.2	271.4
1. Energy industry	27,013.2		1.1	0.4	35.1	77.9	0.6	180.7
2. Manufacturing industries and construction	12,262.7		2.2	0.3	114.6	28.1	9.9	59.3
3. Transport	20,425.1		4.7	1.0	263.8	121.3	44.3	14.7
4. Other sectors	6,073.7		36.2	0.5	633.4	35.5	111.4	16.7
5. Other (unspecified)	NO, C		NO, C	NO, C	NO, C	NO, C	NO, C	NO, C
B. Fugitive emissions from fuels	1.3		48.4		25.4	2.7	4.6	NO
1. Solid fuel			1.9		NO	NO	0.8	NO
2. Petroleum and natural gas	1.3		46.5		25.4	2.7	3.7	NO
2. Industrial processes	4,085.6	NO	2.2	3.6	NE	NE	NE	NE
A. Mineral products	2,316.2				NE	NE	NE	NE
B. Chemical industry	627.1		2.2	3.6	NE	NE	NE	NE
C. Metal production	1,142.3		NO, IE	NO	NE	NE	NE	NE
D. Other production	NE				NE	NE	NE	NE
E. Production of halocarbons and SF6								
F. Consumption of Halocarbons and SF6								
G. Others	NA		NA	NA	NA	NA	NA	NA
3. Solvents and other products use	243.0			NO			NE	
4. Agriculture			298.1	24.4	34.2	0.9	NE,NO,NA	NO
A. Enteric fermentation			226.8					
B. Manure management			65.4	1.0			NE	
C. Rice cultivations			4.9				NE	
D. Agricultural soils			NE	23.4			NE	
E. Prescribed burning of savannah.			NO	NO	NO	NO	NO	
F. Field burning of agricultural waste			1.0	0.0	34.2	0.9	NE	
G. Others			NA	NA	NA	NA	NA	
5. Land use, land-use change and forestry	79,435.6	-130,055.7	24.7	0.7	377.1	5.8	NE,NA	NE,NA
A. Forest Land	77,251.4	-130,030.9	24.1	0.7	369.2	5.7	NE	NE
B. Cropland	627.1	-3.1	NA	IE,NA	0.0	0.0	NE	NE
C. Grassland	1,247.0	-21.5	0.5	0.0	7.9	0.1	NE	NE
D. Wetland	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	186.9	-0.1	NO	NO	NE	NE	NE	NE
F. Other land	123.2	NO	NO	NO	NE	NE	NE	NE
G. Others	NA	NA	NA	NA	NA	NA	NA	NA
6. Wastes	0.3		152.6	1.1	NE,NA	NE,NA	NE,NA	NE,NA
A. Solid waste disposal			125.9		NE		NE	
B. Wastewater treatment and discharge			25.2	1.0	NE	NE	NE	
C. Waste incineration	0.3		NO	0.0	NE	NE	NE	NE
D. Others			1.5	0.1	NE	NE	NE	NE
7. Other	NA	NA	NA	NA	NA	NA	NA	NA
Memo Items								
International bunkers	3,631.9		0.2	0.1	6.2	59.2	2.4	64.4
International aviation	1,336.2		0.0	0.0	1.0	2.9	0.5	0.6
International water-borne navigation	2,295.7		0.2	0.1	5.3	56.3	1.9	63.8
CO_2 emissions from biomass	21,770.4							

NA= Not applicable; NE= Not estimated; NO= Not occurring; C= Confidential
Source: Compilation by SNICHILE.

Table 7. Chile's NIR: Anthropogenic emissions of HFC, PFC and SF_6. Year 2010.

Greenhouse gas source and sinks categories	HFCs (Gg)							PFCs (Gg)	SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-152a	HFC-143a	HFC-227ea	HFC-236fa	CF_4	
Total national emissions and removals	0.12	0.32	241.06	0.27	9.52	29.91	0.11	6.14	NE, NO
1. Energy									
A. Fuel combustion (Sectoral approach)									
1. Energy industry									
2. Manufacturing industries and construction									
3. Transport									
4. Other sectors									
5. Other (non-specified)									
B. Fugitive emissions from fuels									
1. Solid fuel									
2. Oil and natural gas									
2. Industrial processes	0.12	0.32	241.06	0.27	9.52	29.91	0.11	6.14	NE, NO
A. Mineral products									
B. Chemical industry									
C. Metal production	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other production	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of halocarbons and SF6	NO	NO	NO	NO	NO	NO	NO	NO	NE
F. Consumption of Halocarbons and SF6	0.12	0.32	241.06	0.27	9.52	29.91	0.11	6.14	NE, NO
G. Others									
3. Solvents and other products use									
4. Agriculture									
A. Enteric fermentation									
B. Manure management									
C. Rice cultivations									
D. Agricultural soils									
E. Prescribed burning of savannah.									
F. Field burning of agricultural waste									
G. Others									
5. Land use, land-use change and forestry									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetland									
E. Settlements									
F. Other land									
G. Others									
6. Wastes									
A. Solid waste disposal									
B. Wastewater treatment and discharge									
C. Waste incineration									
D. Others									
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo Items									
International bunkers									
International aviation									
International water-borne navigation									
CO_2 emissions from biomass									

NA= Not applicable; NE= Not estimated; NO= Not occurring; C= Confidential
Source: Compilation by SNICHILE.

2.1 Trends in aggregate GHG emissions

In 2010, the Chile's balance of GHG[7] emissions and removals represented 41,698.5 $GgCO_2eq$, (Table 8, Figure 3) while the total GHG emissions[8] of the Country accounted for 91,575.9 $GgCO_2eq$, increasing the latter ones in 83.5% between 1990 and 2010 (Figure 3). The Energy and LULUCF sectors contributed most to this trend in Chile's GHG balance. The values observed which are out of the balance trend are primarily the result of wildfires (included in the LULUCF sector). These issues will be addressed and explained in detail in the corresponding sectoral sections of this report.

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PN Conguillío.

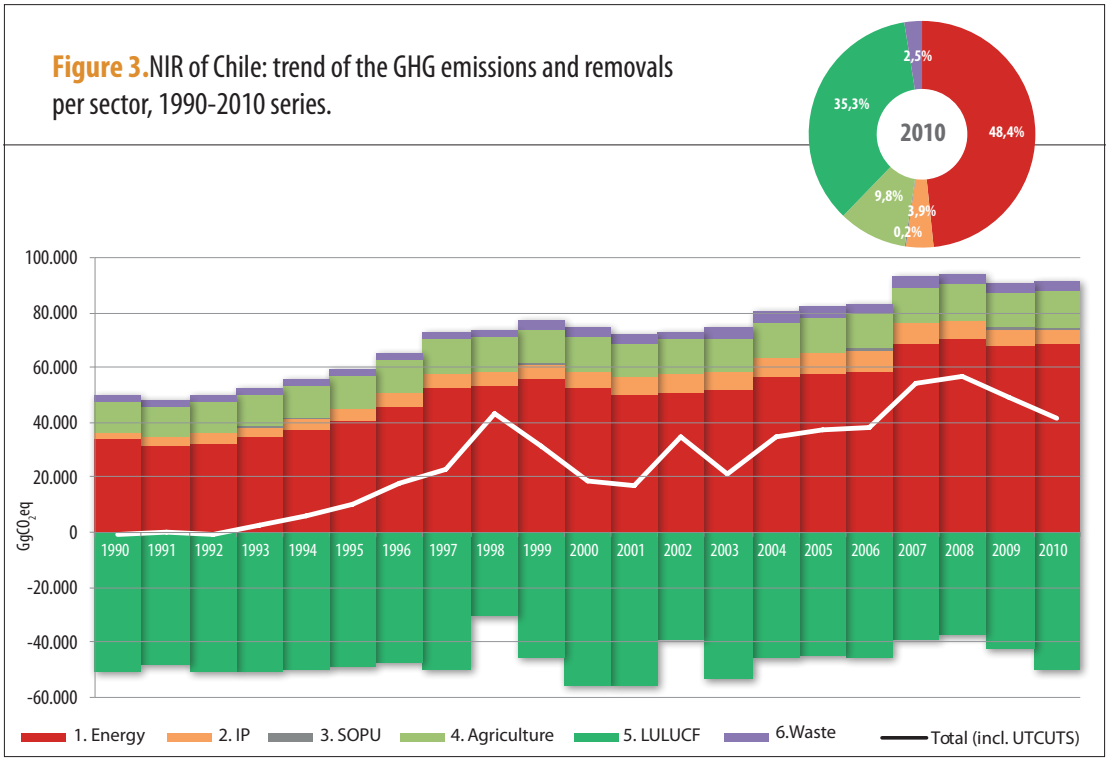
Table 8. Chile's NIR: GHG emissions and removals ($GgCO_2eq$) per sector, series 1990-2010.

Sector	1990	1995	2000	2005	2010
1. Energy	33,530.4	40,370.6	52,346.8	57,936.8	68,410.0
2. IP	3,108.2	4,242.5	6,399.9	7,354.7	5,543.2
3. SOPU	82.3	94.8	118.0	110.7	243.0
4. Agriculture	10,710.2	11,892.6	12,493.2	12,736.9	13,825.6
5. LULUCF	-50,821.6	-48,743.8	-55,404.6	-44,624.2	-49,877.4
6. Waste	2,465.5	2,685.8	3,130.0	3,866.2	3,554.1
Balance (incl. LULUCF)	**-925.0**	**10,542.5**	**19,083.4**	**37,381.1**	**41,698.5**
Total (excl. LULUCF)	**49,896.6**	**59,286.3**	**74,487.9**	**82,005.2**	**91,575.9**

Source: Compilation by SNICHILE.

At sector level, the Energy sector accounts for 74.7% of total GHG emissions, followed by the Agriculture Sector (15.1%), IPPU Sector (6.1%), Waste Sector (3.9%), and SOPU Sector (0.3%) (Figure 4).

Figure 3. NIR of Chile: trend of the GHG emissions and removals per sector, 1990-2010 series.



7. On the current report, the term 'GHG emission and removal balance' or 'GHG balance' refers to the sum of GHG emissions and removals, expressed on Carbon dioxide equivalent (CO_2eq). This term includes the LULUCF sector.

8. On the current report, the term 'Total GHG emissions' refers only to the sum of national GHG emissions, expressed on Carbon dioxide equivalent (CO_2eq) excluding the LULUCF sector.

Figure 4. Chile's NIR: GHG emission trend per sector (excluding LULUCF), 1990 - 2010 series.

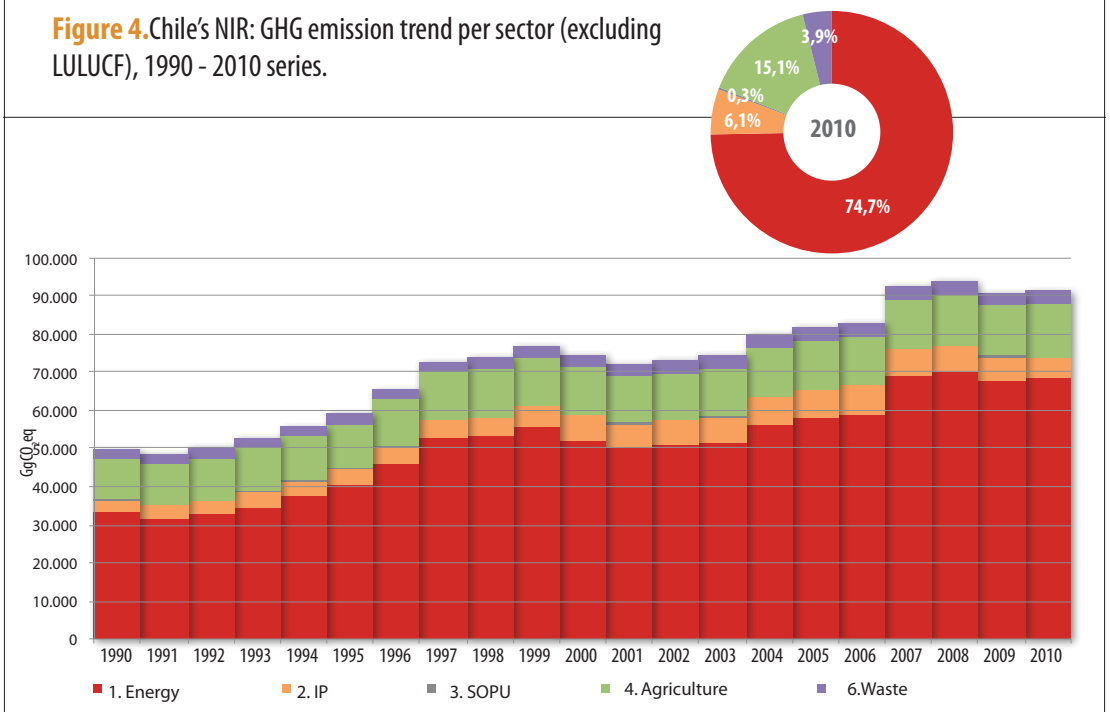


Table 9. Chile's NIR: GHG emissions ($GgCO_2eq$) per GHG type, excluding LULUCF, 1990 - 2010 series.

GHG	1990	1995	2000	2005	2010
CO_2 (incl. LULUCF)	-17,349.9	-7,044.8	-129.9	16,336.1	19,484.9
CO_2 (excl. LULUCF)	33,738.5	42,052.2	55,355.5	61,529.7	70,105.0
CH_4 (incl. LULUCF)	10,605.4	10,802.2	11,694.8	12,604.7	11,973.6
CH_4 (excl. LULUCF)	10,419.3	10,555.9	11,638.4	12,207.6	11,455.9
N_2O (incl. LULUCF)	5,819.6	6,785.2	7,518.4	8,340.2	9,952.5
N_2O (excl. LULUCF)	5,738.8	6,678.2	7,494.0	8,167.8	9,727.7
HFC	0.0	0.0	0.0	99.3	281.3
PFC	0.0	0.0	0.0	0.7	6.1
Total (Incl. LULUCF)	**-925.0**	**10,542.5**	**19,083.4**	**37,381.1**	**41,698.5**
Total (excl. LULUCF)	**49,896.6**	**59,286.3**	**74,487.9**	**82,005.2**	**91,575.9**

Source: Compilation by SNICHILE.

2.2 Emission trends per GHG type

In 2010, CO_2 was the main GHG emitted in Chile, accounting for 76.6% of total GHG emissions, followed by CH_4 with 12.5% and N_2O with 10.6%. Collectively, HFCs and PFCs accounted for 0.3% of total national GHG emissions (Table 9 and Figure 5). While these last two gases are less relevant in absolute terms, they displayed a notable increase of 1,240.3% between 2002 and 2010 (Figure 6).

Hiulo Huilo.

Karina Barhamonde

Figure 5. Chile's NIR: GHG emission trend per GHG type, excluding LULUCF, 1990 - 2010 series.

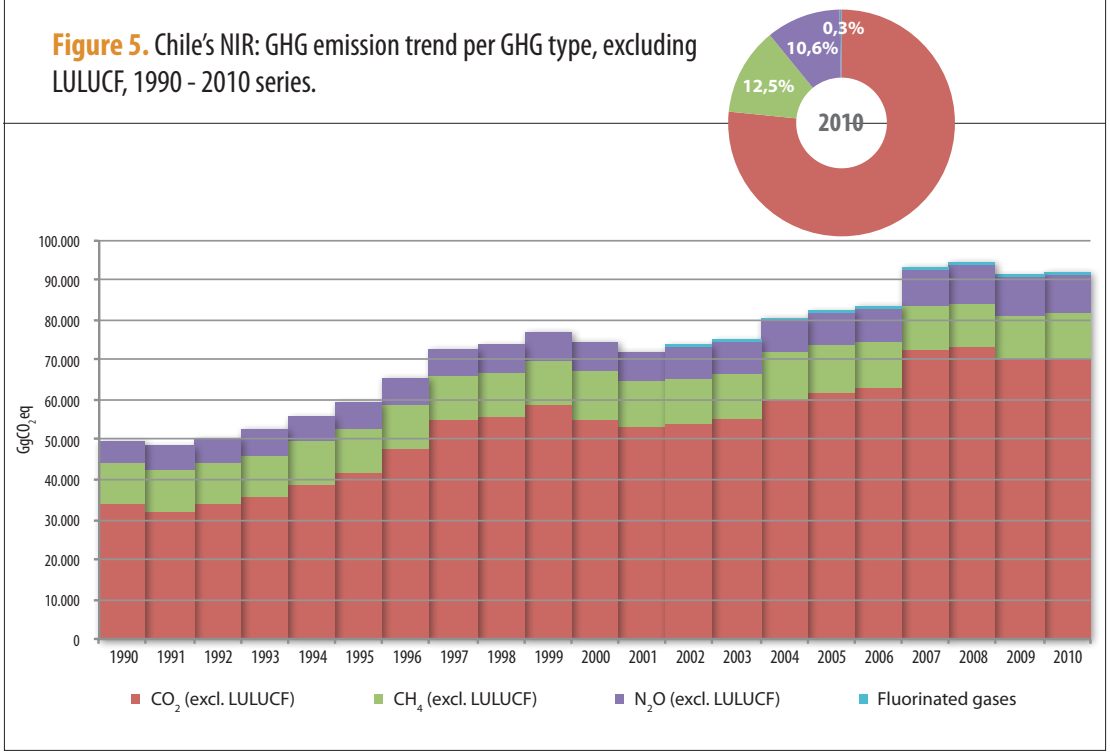
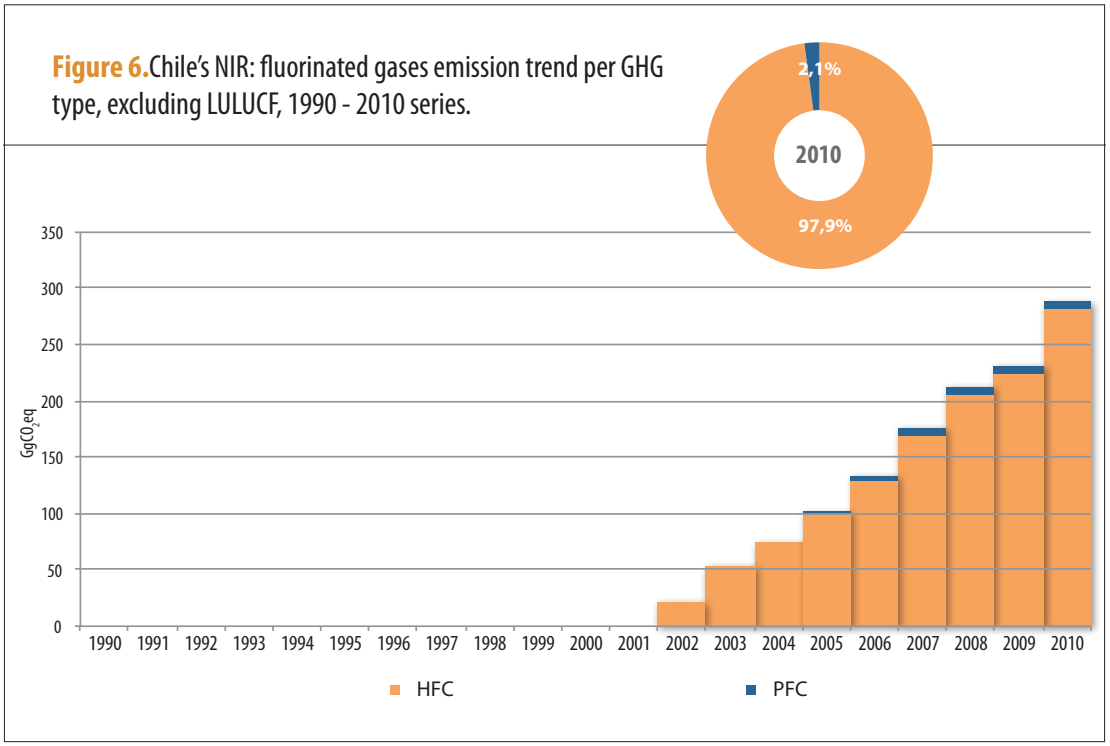


Figure 6. Chile's NIR: fluorinated gases emission trend per GHG type, excluding LULUCF, 1990 - 2010 series.



3 ENERGY SECTOR (1)

3.1. General overview of the sector

In most countries, energy is generated through combustion of fossil fuels. During combustion, carbon and hydrogen from fossil fuels are converted into carbon dioxide (CO_2) and water (H_2O), which release the chemical energy of the fuel in the form of heat (IPCC, 2006). Heat is generally used directly (or with a certain conversion loss) to produce mechanical energy, many times for electricity generation or for transportation.

The Energy sector primarily includes:

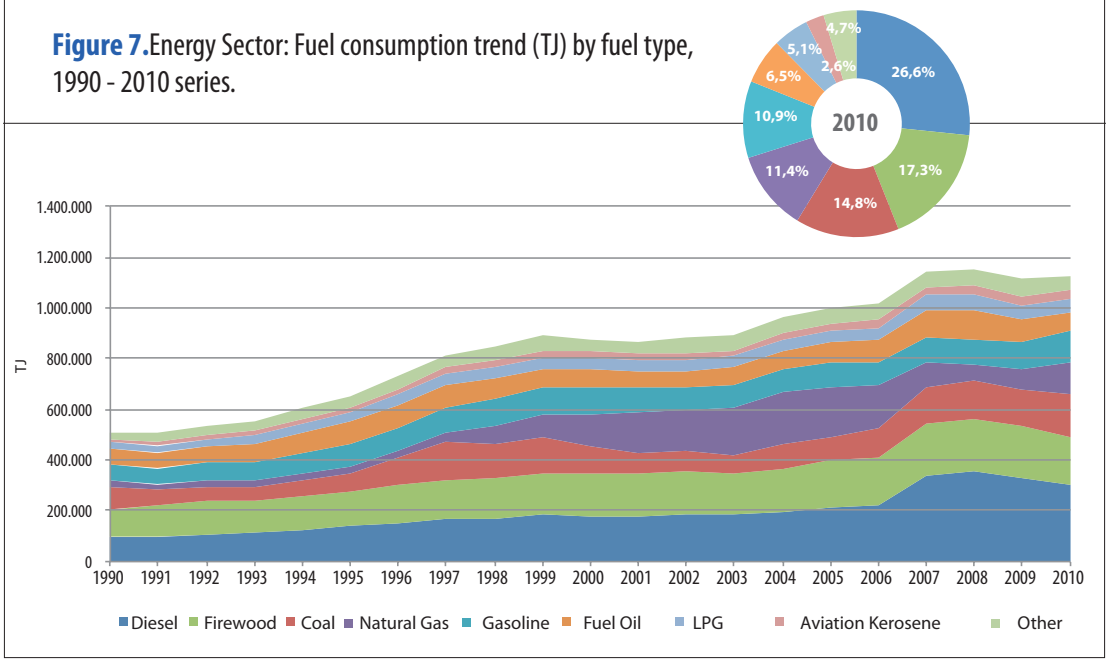
- Exploration and exploitation of primary energy sources,
- Conversion of primary energy sources into secondary sources in refineries and power plants,
- Production, transportation and distribution of fuels, and
- The use of fuels on stationary and mobile applications.

Emissions result from the combustion of fossil fuels or as fugitive emissions during these activities. In this context, it is possible to classify emissions according to their sources, which may be:

- Stationary sources,
- Mobile sources, and
- Fugitive sources.

The energy sector of Chile is primarily based on fossil fuel combustion, which in terms of terajoules (TJ) represents 82.6% of the country's primary energy balance for 2010, while biomass accounts for the remaining 17.4%. Likewise, the country heavily relies on imported fuels, which accounted for 88.2% the same year (MINENERGIA, 2012). The main fuels used in Chile in 2010 were diesel, representing 26.6% of total consumption (298,574.3 TJ); firewood, representing 17.3% (194,220.1 TJ); coal, representing 14.8% (165,536.1 TJ); natural gas, representing 11.4% (127,843.2 TJ); gasoline, representing 10.9% (122,720.6 TJ); fuel oil, representing 6.5% (72,985.0 TJ); liquefied petroleum gas (LPG) for 5.1% (57,303.1 TJ); jet kerosene for 2.6% (29,288.2 TJ); and other fuels for 4.7% (52,559.4 TJ) (Figure 7).

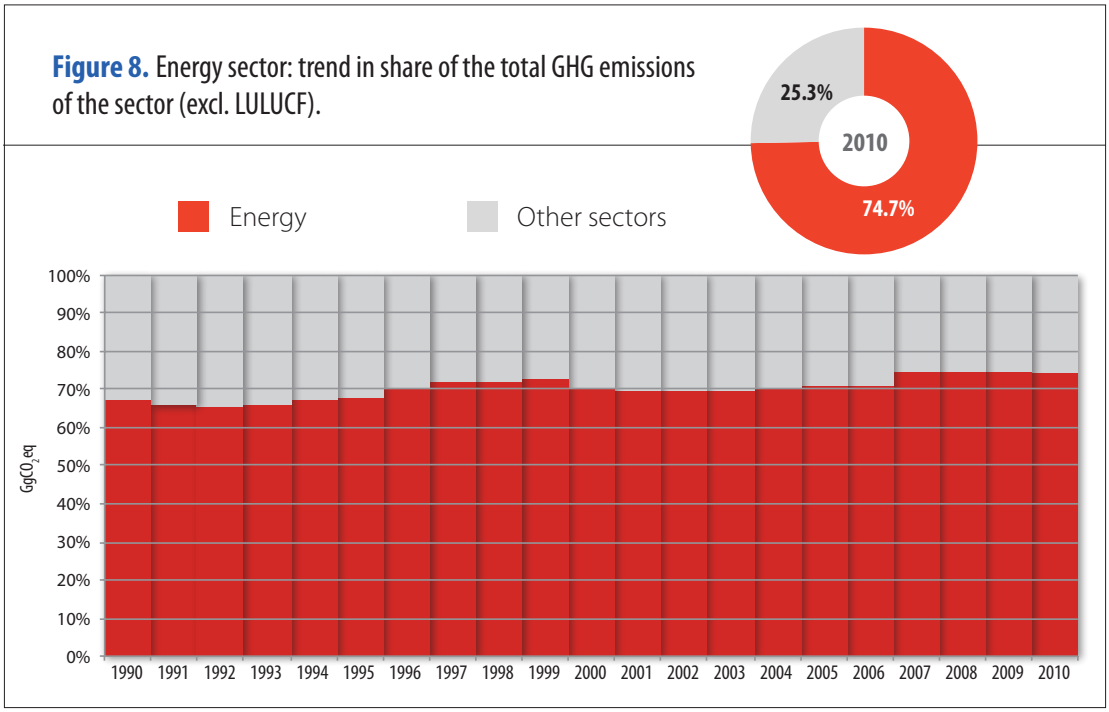
Figure 7. Energy Sector: Fuel consumption trend (TJ) by fuel type, 1990 - 2010 series.



The Energy sector is the main source of GHG emissions in Chile, representing 74.7% of total GHG emissions (Figure 8).

In 2010, GHG emissions for the sector amounted to 68,410.0 $GgCO_2eq$ (Table 10). Since 1990, the sector's GHG emissions have increased by 104.0%. The key drivers of this increase are the increase in coal and diesel consumption for electricity generation (a detailed explanation of this increase can be found in point 3.2.1.1. below, Energy Industry), as well as the liquid fuel consumption for road transportation (light, gas-powered vehicles; and heavy, diesel-powered vehicles). Inter-annual variations observed in Figure 9 for the 1999 - 2007 period are the result of the entry and later on the exit of natural gas imported from Argentina, which has been primarily replaced by coal and diesel. There is an evident decrease in emissions since 2009, which can be attributed to the international economic crisis that began in 2008 and, to a lesser extent, to changes in the fuels used in Chile's electricity matrix. The decrease shown in 2010 was the re-

Figure 8. Energy sector: trend in share of the total GHG emissions of the sector (excl. LULUCF).



sult of the 8.8 magnitude M_W (moment magnitude) earthquake which occurred on February 27th, 2010, which affected the economy of the country throughout that year.

In terms of categories, 98.5% of the GHG emissions sector correspond to the Fuel combustion category and 1.5% correspond to the Fugitive emissions from fuels category.

At the subcategory level, the Energy industry was most important (mainly due to electricity generation), accounting for 39.7% of emissions, followed by Transport (mainly road transportation) with 30.5%. Manufacturing industries and construction accounted for 18.1%, and Other sectors (mainly residential fossil fuel consumption) accounted for 10.2%. Lastly, the Oil and natural gas subcategory accounted for 1.4% and Solid fuels accounted for 0.1% (Figure 10).

Table 10. Energy sector: GHG emissions ($GgCO_2eq$) per category, 1990 - 2010 series

Category	1990	1995	2000	2005	2010
1A. Fuel combustion	31,636.3	39,231.3	51,051.6	56,688.1	67,392.1
1B. Fugitive emissions from fuels	1,894.1	1,139.3	1,295.2	1,248.6	1,017.9
Total	**33,530.4**	**40,370.6**	**52,346.8**	**57,936.8**	**68,410.0**

Source: Compilation by SNICHILE.

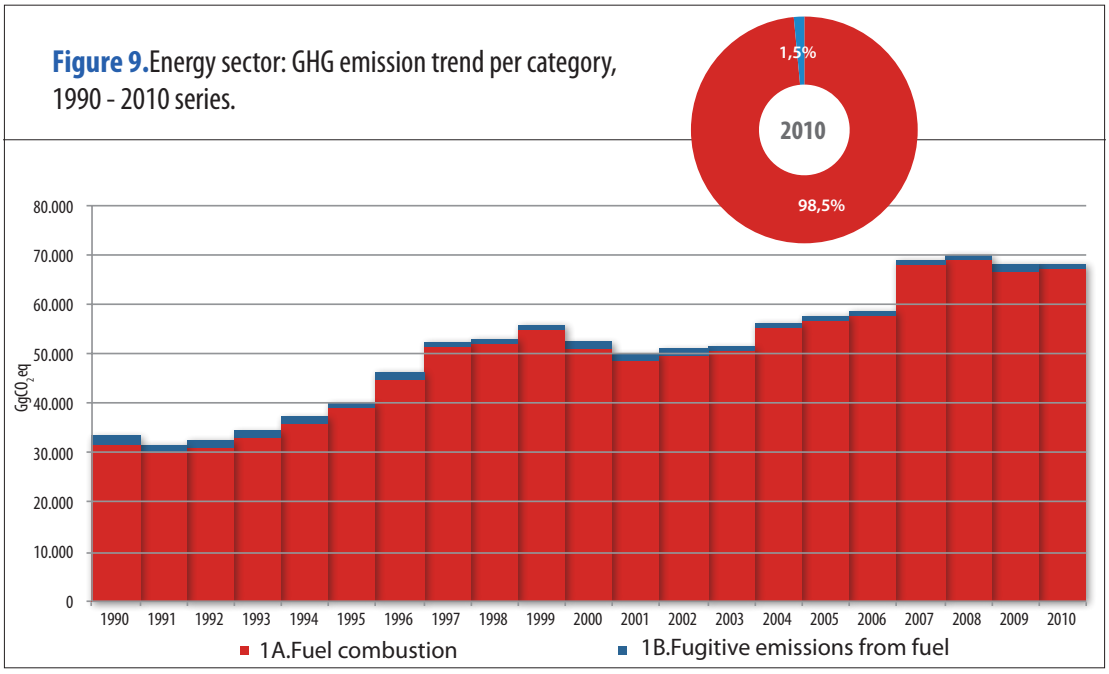


Figure 9. Energy sector: GHG emission trend per category, 1990 - 2010 series.

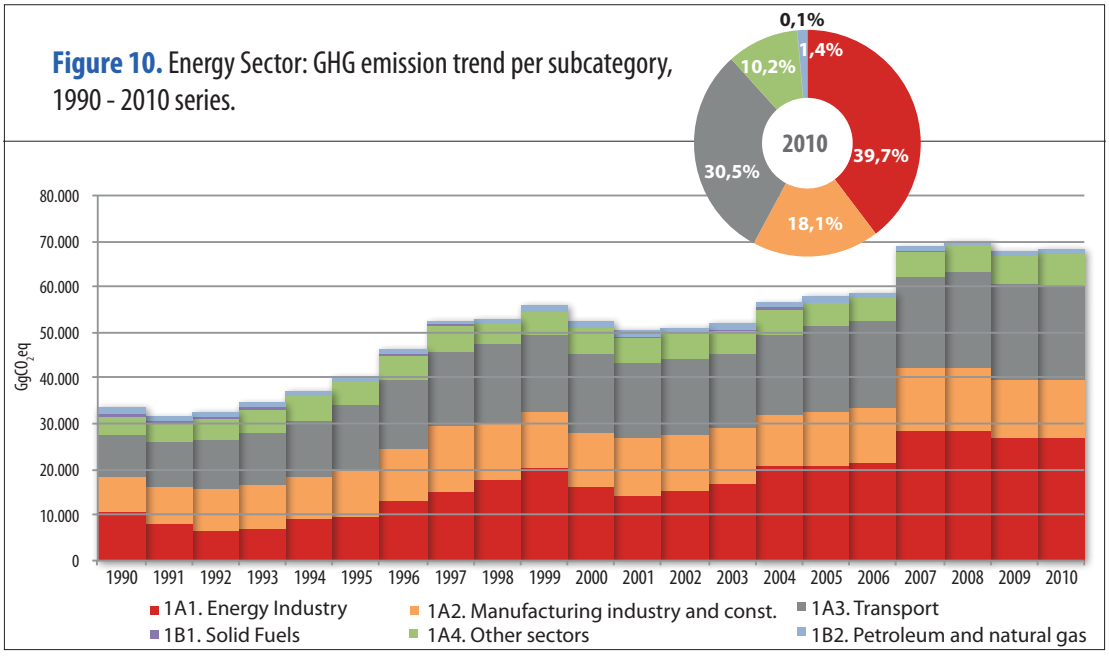


Figure 10. Energy Sector: GHG emission trend per subcategory, 1990 - 2010 series.

In 2010, the main GHG emissions were CO_2, representing 96.1% of GHG emissions of the Sector. It is followed by CH_4 (2.8%) and N_2O (1.0%) (Table 11 and Figure 11).

Table 11. Energy Sector: emissions per GHG type ($GgCO_2eq$), 1990 - 2010 series .

GHG	1990	1995	2000	2005	2010
CO_2	30,730.5	38,054.2	49,653.5	55,226.6	65,776.0
CH_4	2,468.2	1,878.9	2,144.4	2,129.5	1,946.1
N_2O	331.7	437.5	549.0	580.7	687.9
Total	**33,530.4**	**40,370.6**	**52,346.8**	**57,936.8**	**68,410.0**

Source: Compilation by SNICHILE.

3.2. Fuel combustion (1A)

3.2.1. Description of category and GHG emissions

The Fuel combustion category groups together emissions from the intentional oxidation of materials within an apparatus designed to raise heat and provide it either as heat or as mechanical work or for an application outside the apparatus.

The category includes the following subcategories:

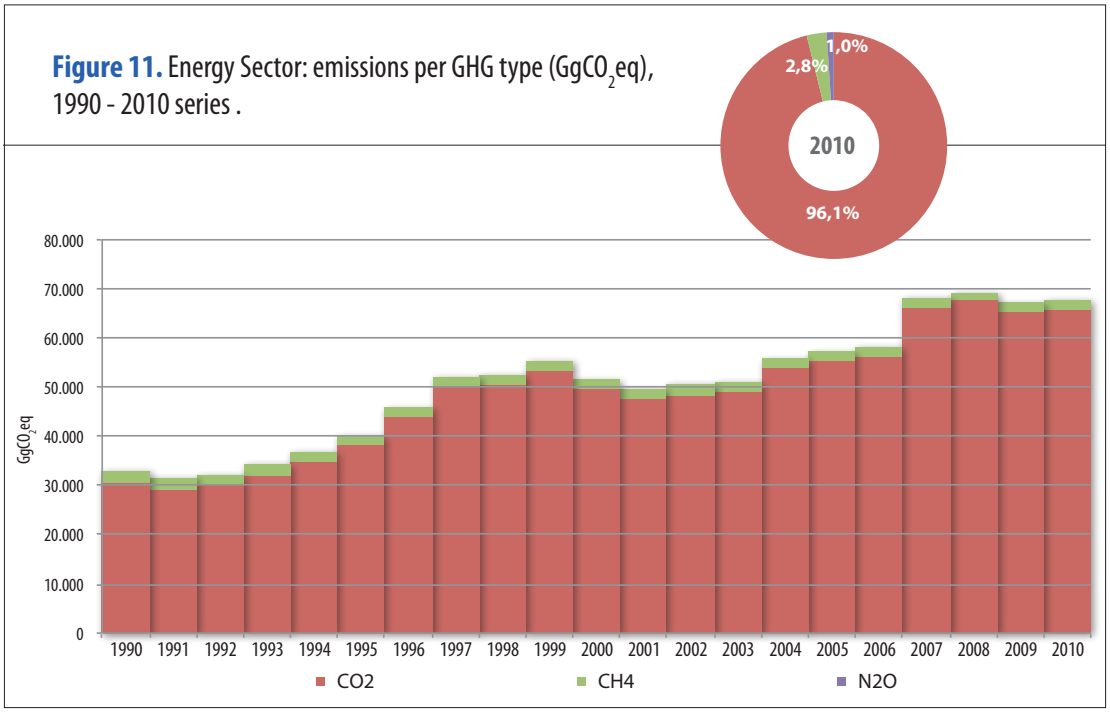
- 1A1 Energy industries.
- 1A2 Manufacturing industries and construction
- 1A3 Transport.
- 1A4 Other sectors.

In the national context, this category includes emissions produced by energy generation and fuel production. According to the Chile's National Energy Balance (NEB), fuel combustion in Chile is divided among 4 sectors:

- Energy system (Transformation centers and Energy sector),
- Transport,
- Industry and mining, and
- Commercial, Public and Residential.

The Fuel Combustion category is the main GHG

Figure 11. Energy Sector: emissions per GHG type ($GgCO_2eq$), 1990 - 2010 series .



emitter of the sector. In 2010, GHG emissions in this category amounted to 67,392.1 $GgCO_2eq$, or 98.5% in the sector. These GHG emissions have increased by 113.0% since 1990 (Table 12 and Figure 12),

At the subcategory level, the Energy industry is the greatest source of GHGs, accounting for 40.3% of emissions in the category, followed by Transport with 30.9%, Manufacturing industries and construction with 18.4% and Other sectors with 10.4% (Figure 12).

In terms of fuel type, liquid fuels are the most important with 60.1%, followed by solid fuels with 27.7%, gaseous fuels with 10.7% and biomass with 1.5% (Figure 13).

Table 12. Fuel combustion: GHG emissions ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
1A1. Energy industry	10,609.9	9,720.2	16,157.0	21,056.2	27,153.3
1A2. Manufacturing industries and construction	7,845.4	10,296.4	12,064.2	11,327.1	12,408.7
1A3. Transport	9,251.9	13,886.7	17,298.5	19,021.9	20,840.9
1A4. Other sectors	3,929.1	5,328.0	5,531.9	5,282.9	6,989.3
Total	**31,636.3**	**39,231.3**	**51,051.6**	**56,688.1**	**67,392.1**

Source: Compilation by SNICHILE.

Figure 12. Fuel combustion: GHG emission trend per subcategory, 1990 - 2010 series .

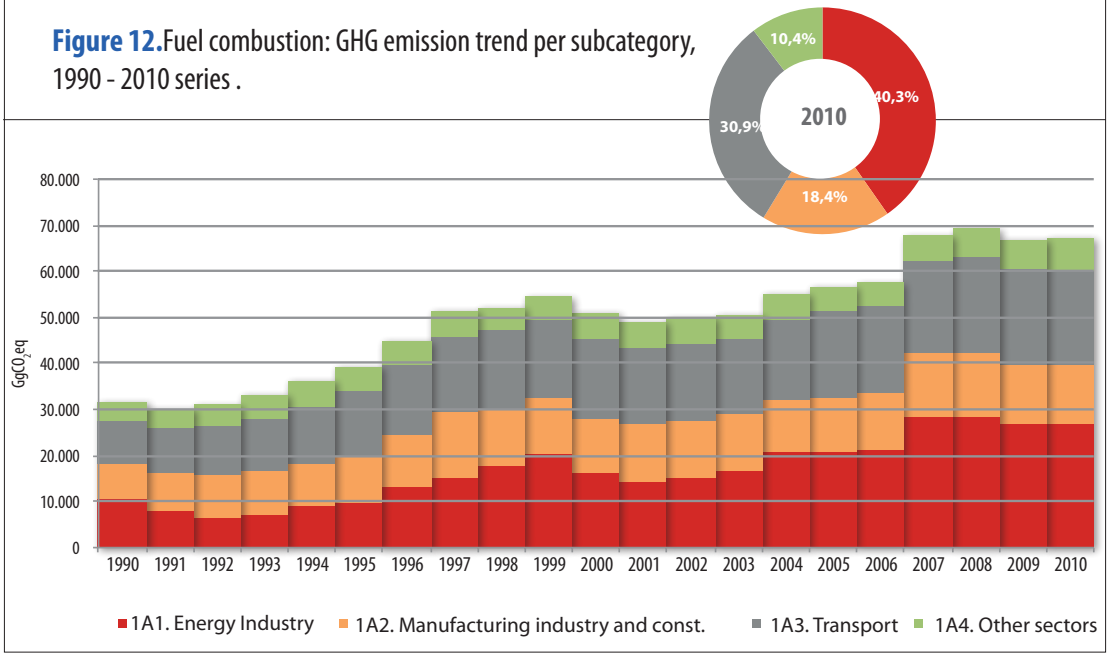
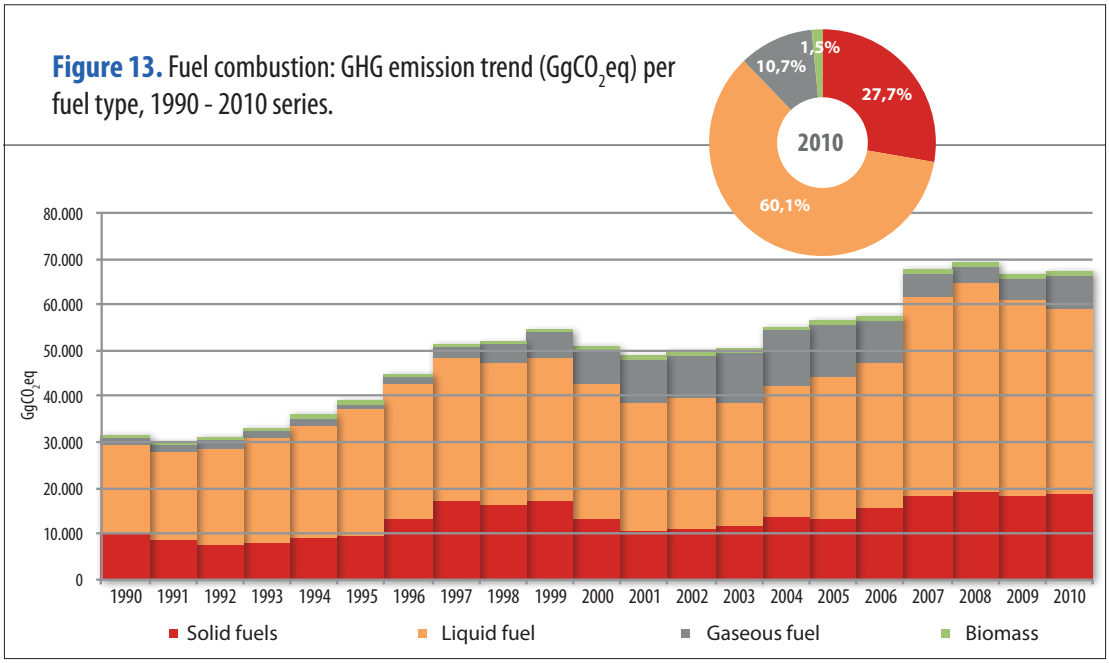


Figure 13. Fuel combustion: GHG emission trend ($GgCO_2eq$) per fuel type, 1990 - 2010 series.



3.2.1.1. Energy industry (1A1)

This subcategory includes emissions from fuel combustion associated with fuel extraction or energy production industries. Its components are:

- 1A1a Main activity electricity and heat production.
- 1A1b Oil refining.
- 1A1c Manufacture of solid fuels and other energy industries.

In this context, Chile's national emissions for this subcategory include:

- all electricity production, both utility generators and self-generation,
- operation of oil refineries, segregating the amount of fuel burned from the amount of fuel transformed (fuel with non-energy purposes),
- energy consumption of solid fuel manufacturing industries, and
- emissions from combustion involved in methanol formation from natural gas.

The Energy industry subcategory is the main source of GHG in this category and, at the same time, within the Energy sector itself. In 2010, GHG emissions in this subcategory amounted to 27,153.3 $GgCO_2eq$, or 40.3% of the category overall. These GHG emissions have increased by 155.9% since 1990 (Table 13),

At the component level, Main activity electricity and heat production is the most significant, accounting for 91.4% of GHG emissions, followed by Oil refining, with 5.7% and Manufacture of solid fuels and other energy industries, with 2.9% (Figure 14).

In terms of fuel types, coal accounts for the largest share with 59.6%, followed by natural gas with 16.7%, diesel with 16.0% and coke with 4.2%. Other fuels account for the remaining 3.5% (Table 14 and Figure 15).

Figure 16 presents electricity generation curves (in GWh) for the main energy sources of the country: hydro power, coal, natural gas, diesel, biomass, wind power and other sources, versus emissions for the Main activity electricity and heat production subcategory. The maximum emissions occur when hydro power generation diminishes and diesel-based and especially

Table 13. Energy industry: GHG emissions ($GgCO_2eq$) per component, 1990 - 2010 series.

Component	1990	1995	2000	2005	2010
1A1a. Main activity electricity and heat production	8,298.1	7,426.0	13,796.1	16,747.7	24,811.4
1A1b. Oil refining	1,925.7	1,863.2	1,630.5	2,827.6	1,552.1
1A1c. Solid compounds manufacturing and other energy related industries.	386.1	431.0	730.4	1,480.9	789.8
Total	**10,609.9**	**9,720.2**	**16,157.0**	**21,056.2**	**27,153.3**

Source: Compilation by SNICHILE.

Figure 14. Energy industry: GHG emission trend per component, 1990 - 2010 series

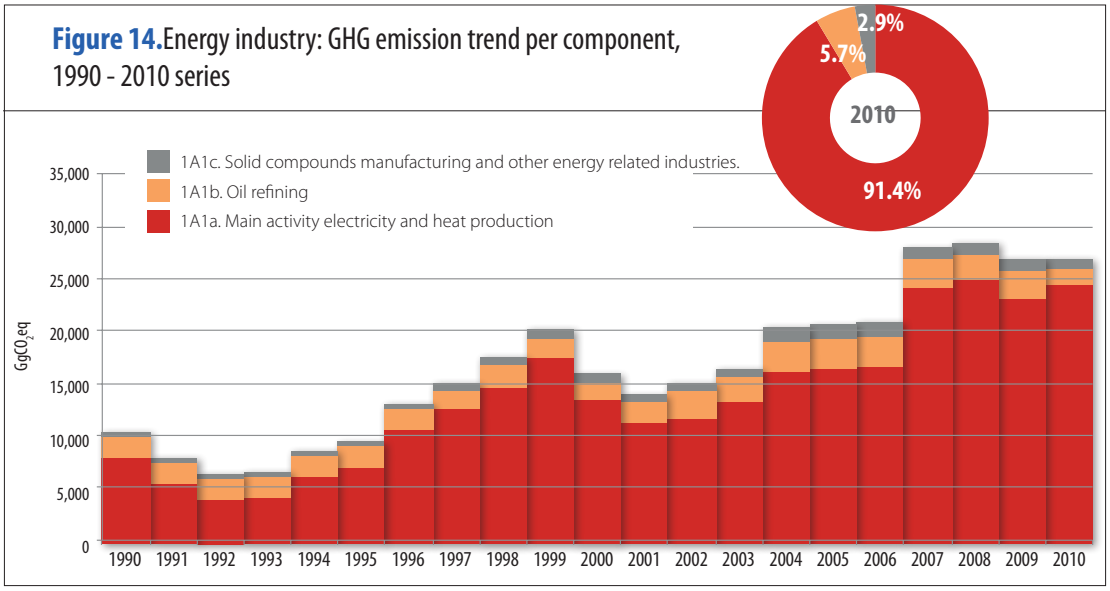


Table 14. Main activity electricity and heat production: GHG emission trend ($GgCO_2eq$) per fuel type, 1990 - 2010 series.

Fuel	1990	1995	2000	2005	2010
Coal	6,568.2	5,538.7	8,292.1	6,830.1	14,794.1
Natural gas	147.1	174.6	3,885.8	6,374.9	4,143.5
Diesel	588.2	211.4	456.9	731.6	3,965.5
Coke	0.0	0.0	620.9	2,334.6	1,050.9
Others	994.7	1,501.3	540.4	476.4	857.3
Total	**8,298.1**	**7,426.0**	**13,796.1**	**16,747.7**	**24,811.4**

Source: Compilation by SNICHILE.

coal-based power generation increases, as observed in 1999 and 2008. He opposite occurs in the 1990 - 1992 and 2005 - 2006 periods, when the hydro power source increases and the increasing trend in the emissions of the subcategory decreases. Besides, it is worth to note the influence of natural gas usage on GHG emissions. Over the 1990 - 2005 period, how GHG emissions decreased as a result of an increase in the consumption of natural gas produced for the entry of an abundant supply of this fuel imported from Argentina — displacing coal and diesel consumption in Chile — is shown. Likewise, since 2007, it could be perceived how the shutdown of the natural gas supply from Argentina, along with a reduction in hydroelectric power due to droughts that have affected the country at the time, produced an increased consumption of coal and diesel, increasing GHG emissions and replicating the increasing trend shown in the 1990 - 1998 period.

Figure 15. Main activity electricity and heat production: GHG emission trend ($GgCO_2eq$) per fuel type, 1990 - 2010 series.

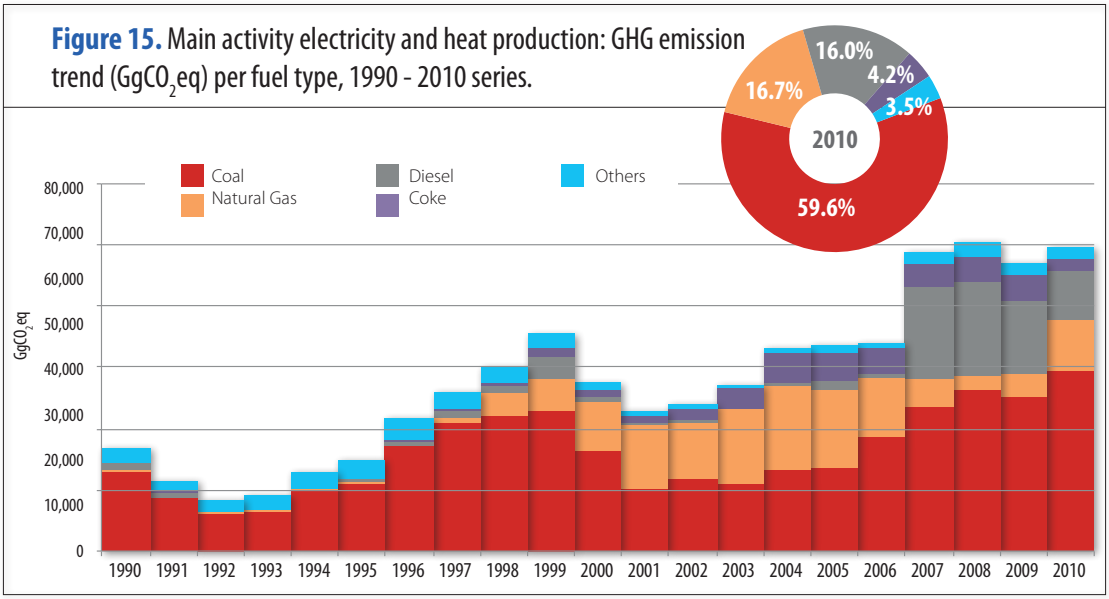
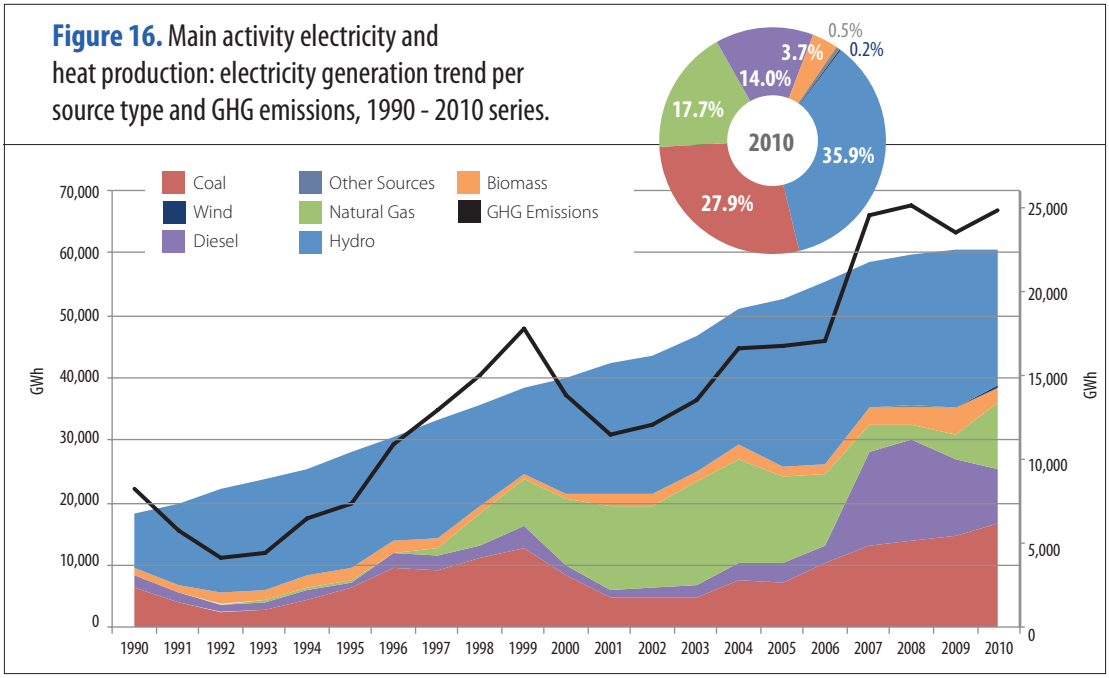


Figure 16. Main activity electricity and heat production: electricity generation trend per source type and GHG emissions, 1990 - 2010 series.



3.2.1.2. Manufacturing industries and construction (1A2)

This subcategory addresses emissions from industrial fuel combustion. Likewise, it includes combustion related to self-generated electricity and heat for self-consumption in those industries. Its components are:

- 1A2a Iron and steel.
- 1A2b Non-ferrous metals.
- 1A2c Chemicals.
- 1A2d Pulp, paper and print.
- 1A2e Food processing, beverages and tobacco.
- 1A2f Other industries.

In this context, national emissions in this subcategory include:

- Iron and steel industries and smelters,
- Manufacturing of chemical substances and products, mainly the petrochemical industry,
- Paper and pulp manufacturing,
- Industries dedicated to the production of food, beverages and tobacco,
- Production of other non-metallic minerals, primarily cement,
- Extraction of metallic minerals and other types of mining and quarrying, including copper, saltpeter, iron and other mining. It is worth noting that mining of fuels such as coal are not included here but they accounted for in category 1B, and
- Unspecified industries, i.e. industries not included in the previous classification.

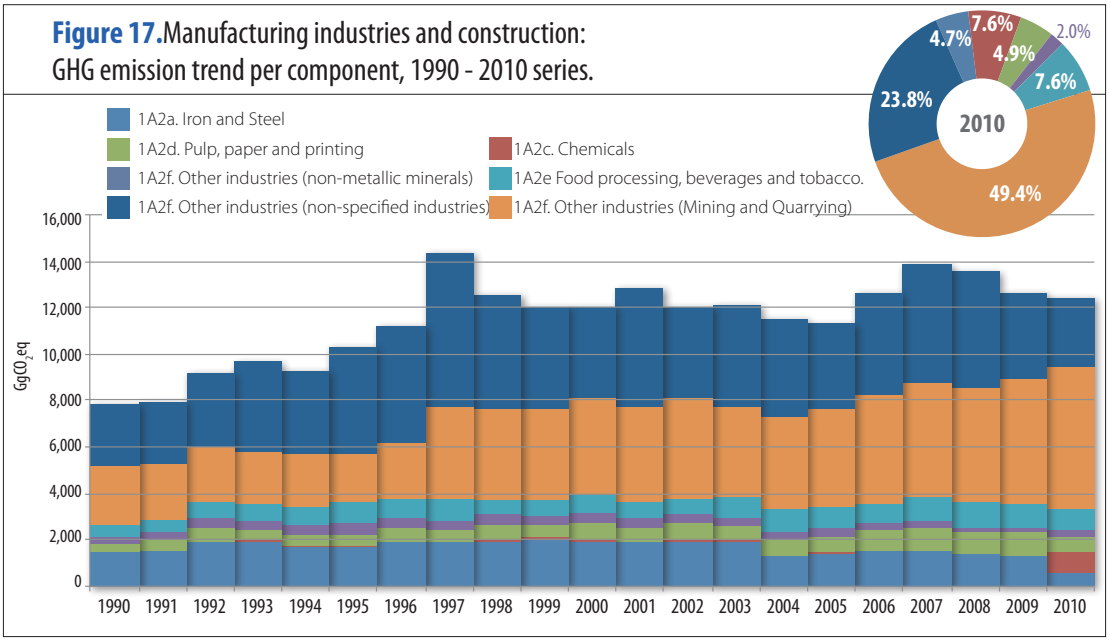
In 2010, GHG emissions by this subcategory amounted to 12,408.7 $GgCO_2eq$, or 18.4% of the entire category. These GHG emissions have increased by 58.2% since 1990 (Table 15), The key driver is Chile's thriving copper mining sector. The inter-annual variations observed in this subcategory's emissions are mainly the result of the abrupt increase in coal consumption in the Non-specified industry component in 1997 (Figure 17).

Table 15. Manufacturing industries and construction: GHG emissions ($GgCO_2eq$) per component, 1990 - 2010 series.

Component	1990	1995	2000	2005	2010
1A2a. Iron and steel	1,488.5	1,721.3	1,967.0	1,451.9	586.0
1A2c. Chemicals	2.7	22.8	28.5	34.6	938.3
1A2d. Pulp, paper and printing	282.6	524.6	741.9	670.5	609.5
1A2e. Food processing, beverages and tobacco.	329.1	434.9	445.0	380.5	250.6
1A2f. Other industries (non-metallic minerals)	537.2	942.1	745.7	866.8	947.3
1A2f. Other industries (Mining and Quarrying)	2,554.1	2,095.4	4,231.0	4,258.9	6,128.4
1A2f. Other industries (non-specified industries)	2,651.2	4,555.3	3,905.1	3,663.8	2,948.6
Total	**7,845.4**	**10,296.4**	**12,064.2**	**11,327.1**	**12,408.7**

Source: Compilation by SNICHILE.

Figure 17. Manufacturing industries and construction: GHG emission trend per component, 1990 - 2010 series.



At component level, Mining and quarrying is the most significant, accounting for 49.4% of GHG emissions, followed by Non-specified industries with 23.8%, Non-metallic minerals with 7.6%, and Chemicals with 7.6%. Pulp, paper and print accounted for 4.9% and Iron and steel for 4.7%. While food, beverages and tobacco component made up the remaining 2.0% (Table 16 and Figure 18).

Among Mining and quarrying components, Copper mining is the most significant, accounting for 58.1% of GHG emissions, followed by Other mining, with 33.1%, Iron with 4.7%, and Saltpeter with 4.1%. It is important to mention that Other mining has no assigned values from 1990 to 1996 because its consumption was accounted for under Miscellaneous Industries

Table 16. Mining and quarrying: GHG emissions ($GgCO_2eq$) per component, 1990 - 2010 series.

Component	1990	1995	2000	2005	2010
Copper	2,117.6	1,668.3	2,315.3	2,553.4	3,557.7
Other Mines	0.0	0.0	1,297.3	1,154.7	2,030.6
Niter	207.6	208.7	303.1	298.6	252.1
Iron	229.0	218.5	315.3	252.3	288.0
Total	**2,554.1**	**2,095.4**	**4,231.0**	**4,258.9**	**6,128.4**

Source: Compilation by SNICHILE.

(Industrias varias) up to the latter year and presented in aggregate form under 1A2f. Other industries (Non-specified industry).

3.2.1.3. Transport (1A3)

The Transport subcategory includes all emissions from fuel combustion associated with all transport activities except military transport Emissions from international transportation are reported separately. Its components are:

- 1A3a Domestic aviation.
- 1A3b Road transportation.
- 1A3c Railways.
- 1A3d Domestic water-borne navigation.
- 1A3e Other types of transportation.

In this context, national emissions in this subcategory include:

- cabotage civil aviation,
- fuel used by ground vehicles including the use of vehicles on paved highways, with cars, motorcycles, heavy trucks and buses,
- railways, both for passenger and freight, and
- maritime and river shipping, excluding fishing boats, which are reported in the subcategory Other sectors.

In 2010, GHG emissions for the subcategory amounted to 20,480.9 $GgCO_2eq$, or 30.9% of the entire category. Since 1990, GHG emissions have increased by 125.3% (Table 17), The key driver of that increase is the steady rise in the number of cars on the country's roads.

At the component level, Road transportation is the most significant, accounting for 93.4% of the subcategory, followed by 3.8% from Domestic

Figure 18. Mining and quarrying: GHG emission trend per component, 1990 - 2010 series.

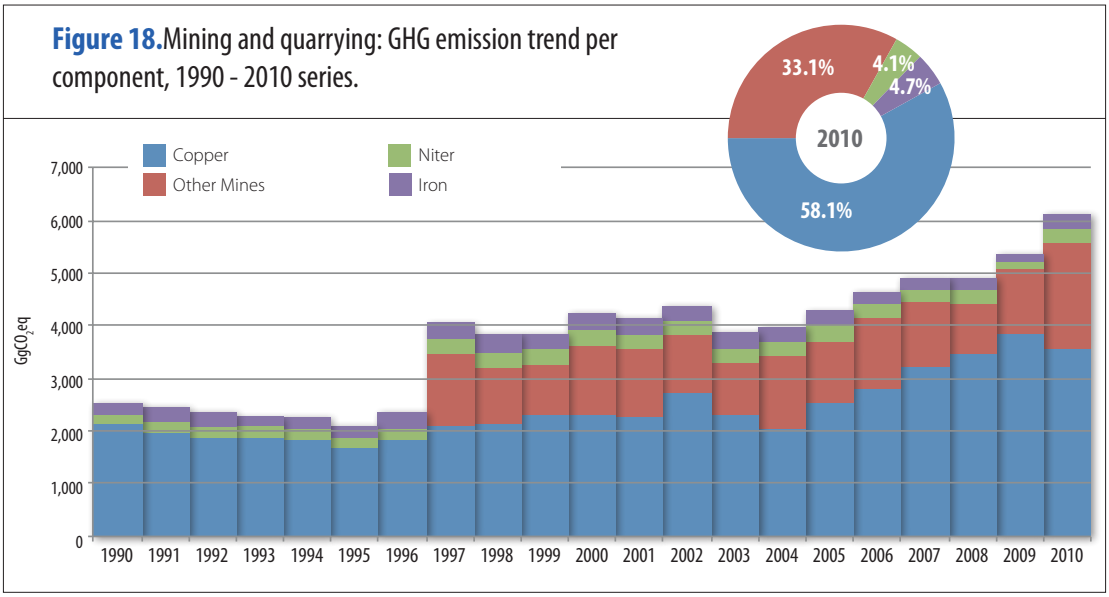


Table 17. Transport: GHG emissions ($GgCO_2eq$) per component, 1990 - 2010 series.

Fuel	1990	1995	2000	2005	2010
1A3a. Domestic aviation	567.9	657.8	682.9	948.5	789.8
1A3b. Road transportation	7,739.0	12,029.2	15,472.5	16,256.7	19,463.5
1A3c. Railways	64.5	41.6	64.1	53.6	153.2
1A3d. Domestic water-borne navigation	880.5	1,158.0	1,078.9	1,763.2	434.4
Total	**9,251.9**	**13,886.7**	**17,298.5**	**19,021.9**	**20,840.9**

Source: Compilation by SNICHILE.

aviation, 2.1% from Domestic water-borne navigation and 0.7% from Railways (Figure 19).

Regarding the types of fuel used by Road transportation, diesel is the most significant, accounting for 53.7%, followed by Gasoline with 44.7%, and other fuels with 1.6% (Table 18 and Figure 20).

Figure 19. Transportation: GHG emission trend per component, 1990 - 2010 series.

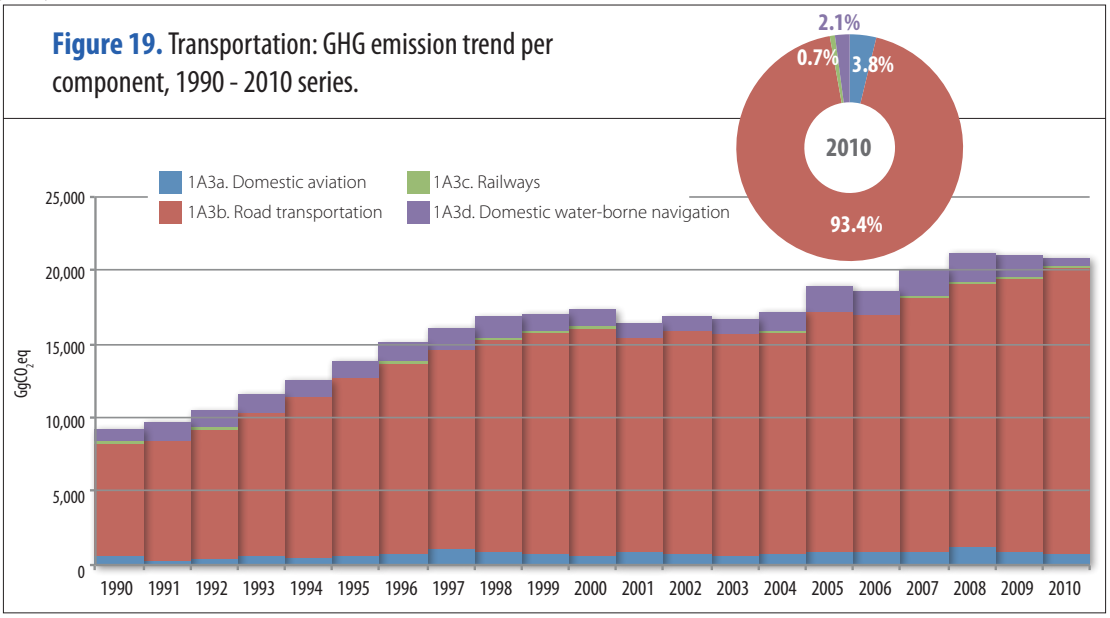


Table 18. Road transportation: GHG emissions ($GgCO_2eq$) per fuel type, 1990 - 2010 series.

Fuel	1990	1995	2000	2005	2010
Diesel	3,379.8	5,661.7	7,926.3	9,489.4	10,444.6
Gasoline	4,345.5	6,352.1	7,526.9	6,645.8	8,705.3
Others	13.8	15.3	19.3	121.5	313.5
Total	**7,739.0**	**12,029.2**	**15,472.5**	**16,256.7**	**19,463.5**

Source: Compilation by SNICHILE.

3.2.1.4. Other sectors (1A4)

This subcategory addresses emissions from combustion activities in commercial and institutional buildings, all emissions from residential fuel combustion and emissions from the combustion of fuels used in agriculture, forestry, fishery and the fishing industry. Its components are:

Figure 20. Road transportation: GHG emission trend per fuel type, 1990 - 2010 series.

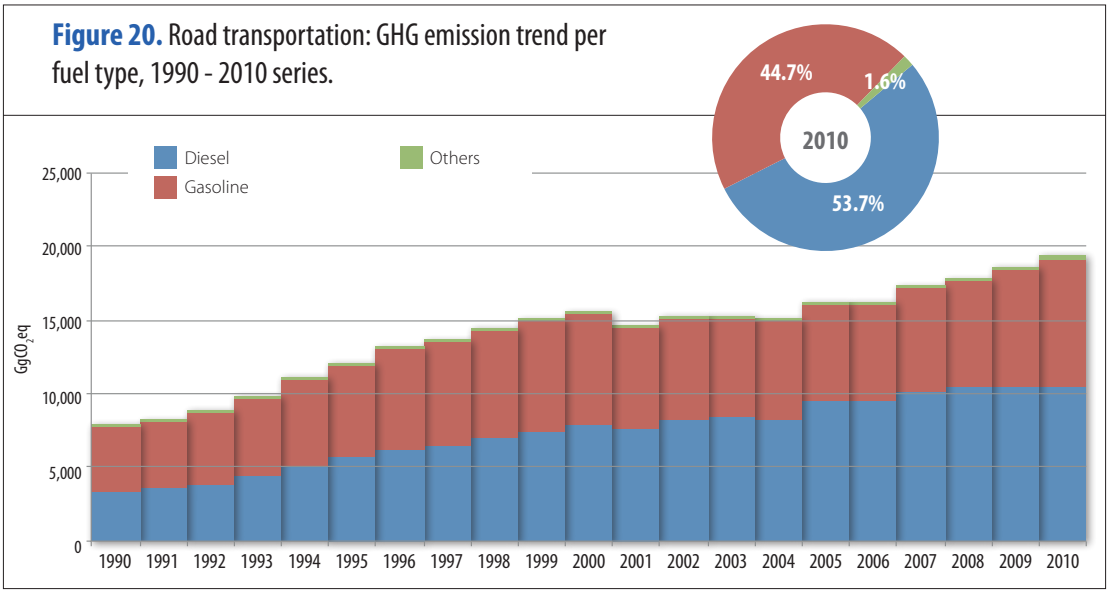
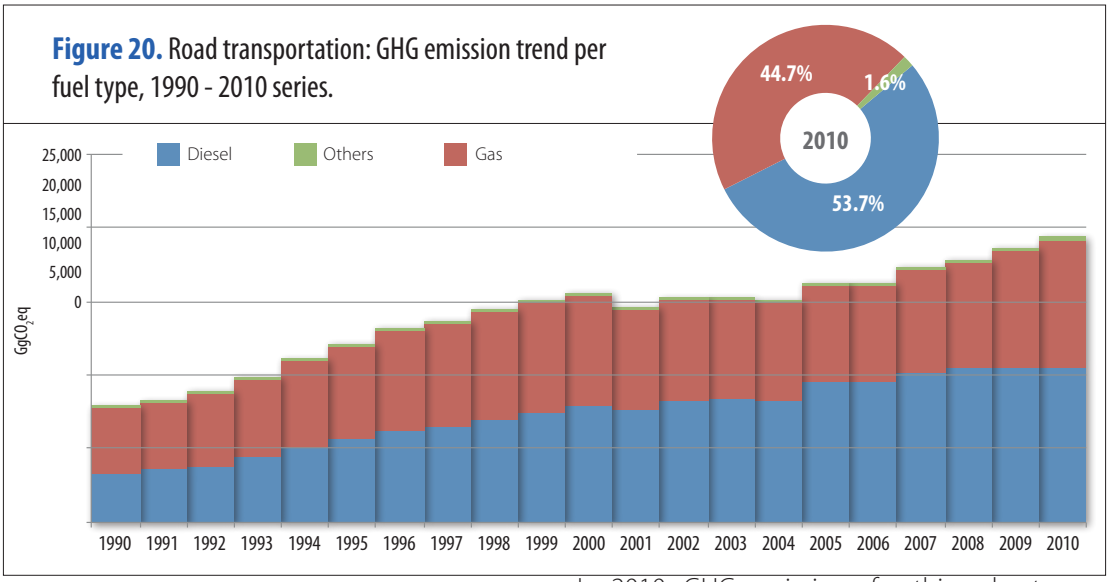


Figure 20. Road transportation: GHG emission trend per fuel type, 1990 - 2010 series.



- 1A4a Commercial / Institutional.
- 1A4b Residential.
- 1A4c Agriculture / Forestry / Fishing.

In this context, national emissions in this subcategory include:

- Fuel combustion in commercial and institutional buildings
- Residential fuel combustion, and
- Fuel combustion in fishing.

In 2010, GHG emissions for this subcategory amounted to 6,989.3 $GgCO_2eq$, or 10.4% of the entire category. Since 1990, GHG emissions in this subcategory have increased by 77.9% (Table 19). Mainly due to the use of liquefied petroleum gas and natural gas by the residential sector.

At the component level, the Residential subcategory is the most significant, with 63.2% of the total, followed by Commercial / Institutional emissions with 24.0%, then Agriculture / Forestry / Fishing with 12.7% (Figure 21).

Table 19. Other sectors: GHG emissions ($GgCO_2eq$) per component, 1990 - 2010 series.

Component	1990	1995	2000	2005	2010
1A4a. Commercial / Institutional	486.7	664.5	612.4	841.6	1,680.6
1A4b. Residential	3,004.1	4,210.6	4,322.8	3,973.0	4,417.6
1A4c. Agriculture / Forestry / Fishing	438.2	452.9	596.7	468.3	891.1
Total	**3,929.1**	**5,328.0**	**5,531.9**	**5,282.9**	**6,989.3**

Source: Compilation by SNICHILE.

Figure 21. Other sectors: GHG emission trend per component, 1990 - 2010 series.

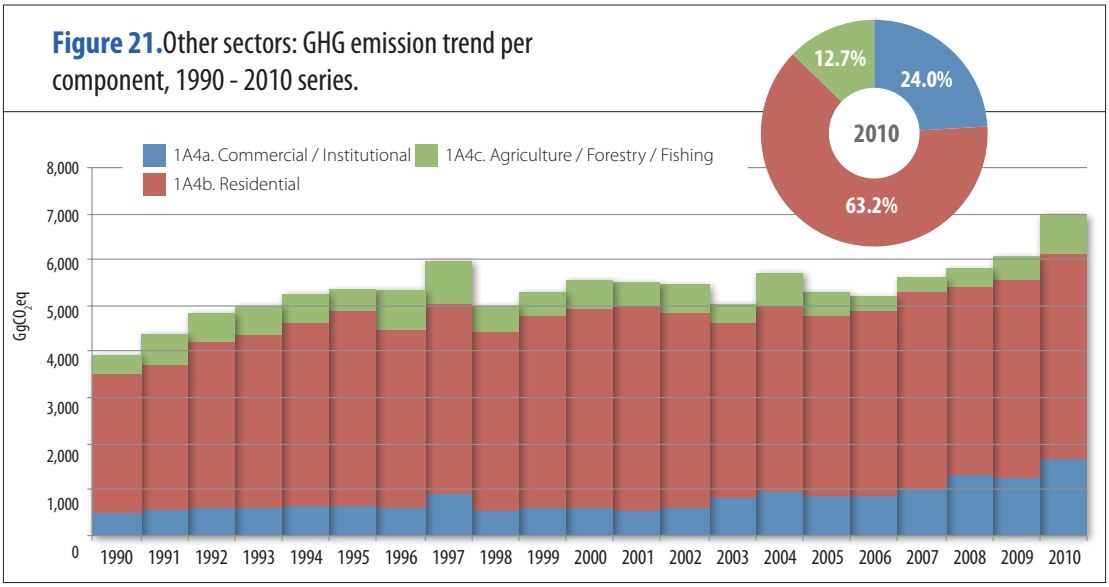
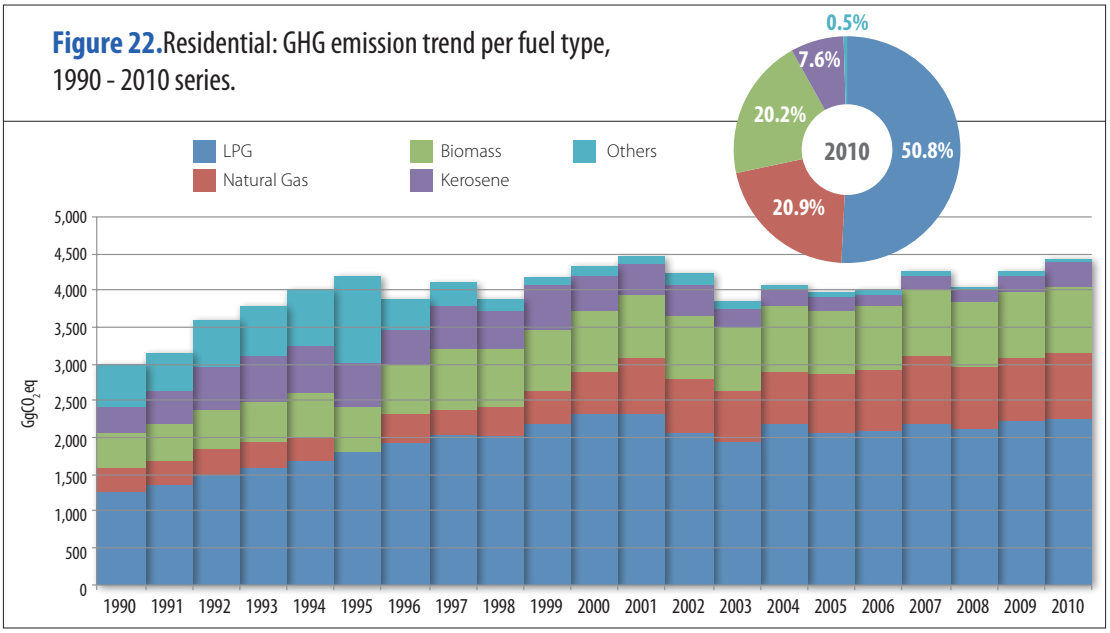


Figure 22. Residential: GHG emission trend per fuel type, 1990 - 2010 series.



In regard to fuel types used in the Residential component, liquefied petroleum gas is the most significant, accounting for 50.8%, followed by natural gas with 20.9%, biomass with 20.2%, kerosene with 7.6% and other fuels with 0.5% (Table 20 and Figure 22).

Table 20. Residential: GHG emissions ($GgCO_2eq$) per fuel type, 1990 - 2010 series.

Fuel	1990	1995	2000	2005	2010
LPG	1,271.9	1,803.3	2,312.0	2,054.4	2,244.5
Natural gas	304.8	0.0	570.7	813.1	922.0
Biomass	488.1	628.8	837.6	871.7	893.7
Kerosene	355.0	580.0	493.7	178.9	335.5
Other	584.1	1,198.5	108.8	54.8	21.9
Total	**3,004.1**	**4,210.6**	**4,322.8**	**3,973.0**	**4,417.6**

Source: Compilation by SNICHILE.

3.2.2. Methodological aspects

The methods applied to prepare the Fuel combustion category are presented in the Table below:

Table 21. Fuel combustion: methods applied.

Greenhouse gas source and sinks categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
A. Fuel combustion	T1	D	T1	D	T1	D
1. Energy industry	T1	D	T1	D	T1	D
a. Main activity electricity and heat production	T1	D	T1	D	T1	D
b. Petroleum refining	T1	D	T1	D	T1	D
c. Manufacture of solid fuels and other energy industries	T1	D	T1	D	T1	D
2. Manufacturing industries and construction	T1	D	T1	D	T1	D
a. Iron and steel	T1	D	T1	D	T1	D
b. Non-ferrous metals	NE	D	NE	D	NE	D
c. Chemicals	T1	D	T1	D	T1	D
d. Pulp, paper and print	T1	D	T1	D	T1	D
e. Food processing, beverages and tobacco	T1	D	T1	D	T1	D
f. Other	T1	D	T1	D	T1	D
Non-metallic minerals	T1	D	T1	D	T1	D
Mining (excluding fuel) and quarrying	T1	D	T1	D	T1	D
Unspecified industries	T1	D	T1	D	T1	D
3. Transport	T1	D	T1	D	T1	D
a. Domestic aviation	T1	D	T1	D	T1	D
b. Road Transportation	T1	D	T1	D	T1	D
c. Railways	T1	D	T1	D	T1	D
d. Domestic water-borne navigation	T1	D	T1	D	T1	D
e. Other types of transportation	NA	NA	NA	NA	NA	NA
4. Other sectors	T1	D	T1	D	T1	D
a. Commercial/Institutional	T1	D	T1	D	T1	D
b. Residential	T1	D	T1	D	T1	D
c. Agriculture/Forestry/Fishing	T1	D	T1	D	T1	D
5. Other	NO, C	D	NO, C	D	NO, C	D
a. Stationary	NO	D	NO	D	NO	D
b. Mobile	C	D	C	D	C	D

T1 = Tier 1 Method; D= Default; NA= Not applicable; NE= Not estimated; NO= Not occurring; C= Confidential. Source: Compilation by SNICHILE.

It is important to note that since the EF set out in the 2006GL IPCC Guidelines require activity data expressed in terajoules (TJ) based on the lower calorific value (LCV) of the fuel in question, the values reported in the NEB — which summarizes data on energy production, importation, exportation, transformation and consumption — expressed in teracalories (Tcal) based on the higher calorific value of fuels (HCV) had to be converted through the following formula:

$$TJ_i = Tcal_i \times Factor\ LC_V \times 4.1868$$

Where:

- TJ_i = *fuel consumption i, expressed in terajoules*
- $Tcal_i$ = *fuel consumption i, expressed in teracalories*
- $LCV_i Factor$ = *factor that converts HCV to* LCV_v *for the fuel i*

GHG emissions are often calculated as the product of fuel consumption and the emission factor specific to the fuel type and GHG type. In general, the equation is as follows:

$$Emission_{GHG} = Fuel\ Consumption_{Fuel\ Type} \times Emission\ Factor_{GHG,\ fuel\ type}$$

GHG emission estimates were calculated by using a Tier 1 method, the most basic level stipulated by the 2006GL for all corresponding GHG. This is due to the lack of necessary information in order to develop country-specific emission factors, which are necessary to move towards a Tier 2 method.

3.2.2.1. Statistical and parametric activity data

The main source of information for the Fuel combustion category is the Chile's National Energy Balance (NEB), which tallies energy consumed in the country (see parametric data on Annex 1). From 1960 to 2009 the NEB was prepared by the National Energy Commission (CNE). In 2010, it was directly handed over to the Ministry of Energy.
(http://www.minenergia.cl/documentos/balance-energetico.html)

The information used for estimating SO_2 emissions was taken from the Statistical Report published by the Office of the Electricity and Fuels Commission (SEC), which provides region-by-region data on the consumption and differentiated sulfur content of hydrocarbons.

In addition, information provided by the National Customs Service (Aduanas) was used to differentiate activity data for domestic and international aviation and domestic and international water-borne navigation. This information is necessary, given the NEB delivers aviation and water-borne navigation consumption data without differentiating the origin and destination of transportation.

3.2.2.2. Emission factors

The default emission factors provided in the 2006GL for the Fuel combustion category were used to calculate GHG emissions for all subcategories and all GHG estimated.

3.3. Fugitive fuel emissions (1B)

3.3.1. Description of category and GHG emissions

In the national context, activities covered under this category include: for the solid fuel category — mining and processing of coal mined from both surface and underground mines; For the oil category, fugitive emissions from venting, production and refining are considered (when these are integrated processes); crude transportation and refining to generate final refined products. For natural gas category, emissions from venting, production, processing, transmission, storage and distribution are considered.

The Fugitive emissions from fuels category includes all intentional and unintentional emissions resulting from the extraction, processing, storage and transportation of fuel to its final consumption point.

The following subcategories are covered under this category:

- Solid fuels (1B1): includes all intentional and unintentional emissions resulting from the extraction, processing, storage and transportation of solid fuels to their final consumption point, and
- oil and natural gas (1B2): includes all fugitive emissions from all oil and natural gas activities. Primary sources of these emissions may include equipment leaks and fuel loss from

evaporation, venting, burning and accidental emissions.

In 2010, GHG emissions in this category amounted to 1,017.9 $GgCO_2eq$, or 1.5% of the entire Energy sector (Table 22). Since 1990, fugitive GHG emissions have decreased by 46.3%. The main drivers of this reduction are the reduction in underground and surface coal mining and the drop in the natural gas supply from Argentina.

The inter-annual variations observed in Figure 23 are primarily the result of changes in the natural gas supply.

In terms of subcategories, Oil and natural gas is the most significant, accounting for 96.1%, followed by Solid fuels with the remaining 3.9%.

3.3.2. Methodological aspects

The methods applied to prepare the Fugitive emissions from fuels category are set out in the Table below:

Table 22. Fugitive emissions from fuels: GHG emissions ($GgCO_2eq$) per subcategory, 1990 - 2010 series

Subcategory	1990	1995	2000	2005	2010
1B1. Solid fuels	481.5	163.0	74.2	50.7	40.0
1B2. Oil and natural gas	1,412.7	976.3	1,221.0	1,198.0	977.9
Total	**1,894.1**	**1,139.3**	**1,295.2**	**1,248.6**	**1,017.9**

Source: Compilation by SNICHILE.

Figure 23. Fugitive emissions from fuels: GHG emission trend per subcategory, 1990 - 2010 series.

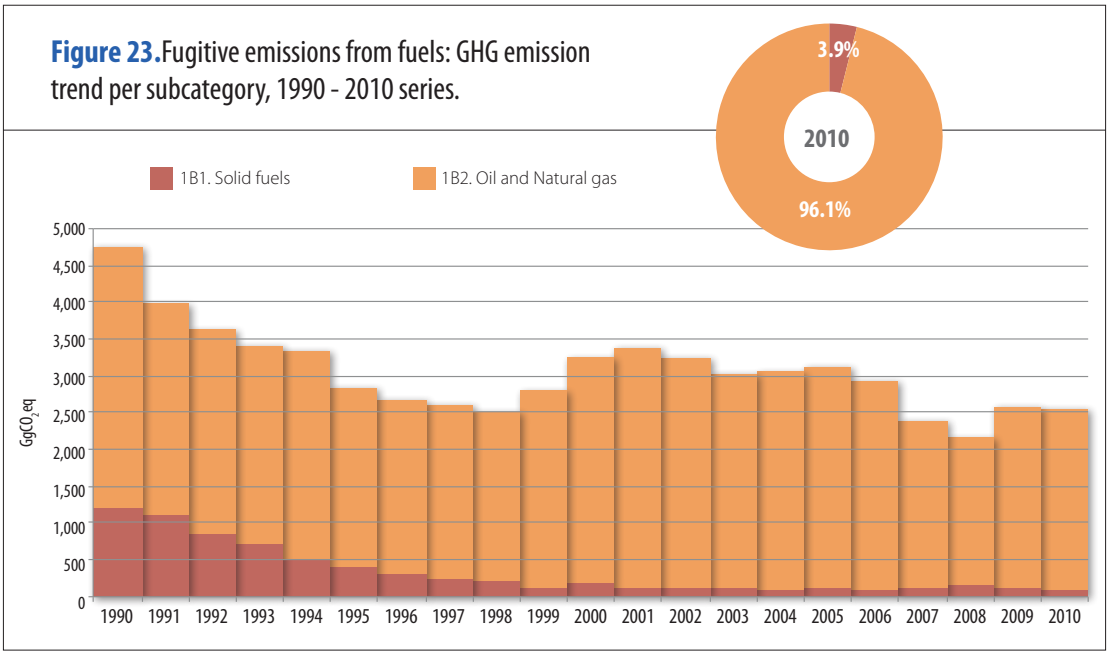


Table 23. Fugitive emissions from fuels: methods applied

Greenhouse gas source and sinks categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
B. Fugitive emissions from fuels	T1	D	T1	D		
1. Solid fuel			T1	D		
a. Coal extraction and handling			T1	D		
b. Solid fuel transformation			NO	NO		
c. Other						
2. Oil and natural gas	T1	D	T1	D		
a. Oil	T1	D	T1	D		
b. Natural gas	T1	D	T1	D		
c. Venting and flaring	T1	D	T1	D		
d. Others	NA	NA	NA	NA		

T1 = Tier 1 Method; D= Default; NA= Not applicable; NO= Not occurring.

Source: Compilation by SNICHILE.

Emissions were estimated using an equation similar to that used for the Fuel combustion category. Emissions are linked to a specific activity data (which in this case may be fuel production, processed fuel, etc.) and its corresponding emission factor.

A Tier 1 method from the 2006GL was used to estimate emissions from the Fugitive fuel emissions category.

Table 24. Oil and Natural gas:
Tier 1 emission factors used for oil.

Oil			
Industry segment	Characteristic	Emission factor chosen	
		CO_2 (Gg/103 m^3)	CH_4 (Gg/103 m^3)
Venting	Weighted value	0.00215	0.0104
Production and improvement	Conventional oil	0.002	0.03
Transportation	Pipeline	0	0.000005
Refining	All	0	0.000022

Source: 2006GL from IPCC

Table 25. Oil and Natural gas:
Tier 1 emission factors used for natural gas.

Natural Gas			
Segment of the Industry	Characteristic	Emission factor chosen	
		CO_2 (Gg/103 m^3)	CH_4 (Gg/103 m^3)
Venting	Transmission	0.0000052	0.0003900
Production	All	0.0000970	0.1220000
Processing	Transmission	0.0000200	0.0002500
Transmission and storage	Weighted value for transmission	0.0000002	0.0006330
Distribution	All	0.0000950	0.0018000

Source: 2006GL from IPCC

Table 26. Fuel combustion: CO_2 emissions ($GgCO_2eq$) sectoral approach and reference approach, 1990–2010 series.

Method	1990	1995	2000	2005	2010
Reference approach	30,051.9	37,470.2	50,829.5	55,550.3	65,991.6
Sectoral approach	30,728.0	38,052.7	49,651.8	55,225.0	65,774.7
Difference	676.1	582.5	-1,177.7	-325.3	-216.9

Source: Compilation by SNICHILE.

3.3.2.1. Statistical and parametric activity data

Activity data for the Solid fuels subcategory was sourced from the Statistical Yearbook for Copper and Other Minerals (Anuario estadístico del cobre y otros minerales), published by the Chilean Copper Commission (COCHILCO). The yearbook reports on a 20-year time series; though, 1990 to 2009 and 1991 to 2010 time series were used herein.
(http://www.cochilco.cl/estadisticas/anuario.asp).

Data for the Oil and natural gas subcategory were extracted from oil and natural gas production data, accordingly, provided in the NEB.

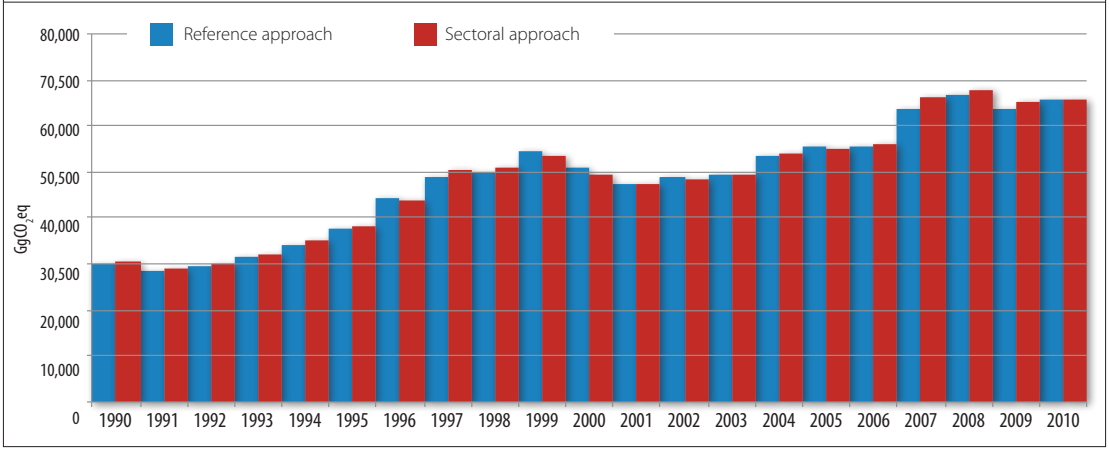
3.3.2.2. Emission factors

The emission factors used to calculate GHG emissions for this category were the default values provided in the 2006GL, differentiating the activities considered and the socioeconomic features of the country (developing country). This information is set out in the Tables 24 and 25:

3.4. Comparison of sectoral approach and reference approach

The validity of calculations performed can be validated by comparing CO_2 emission results obtained using the reference approach and the sectoral approach; The reference approach uses total national statistical values for energy, while the sectoral approach uses partial values narrowed down to each category that together

Figure 24. Fuel combustion: CO_2 emissions of sectoral versus reference approachs, 1990 - 2010 series

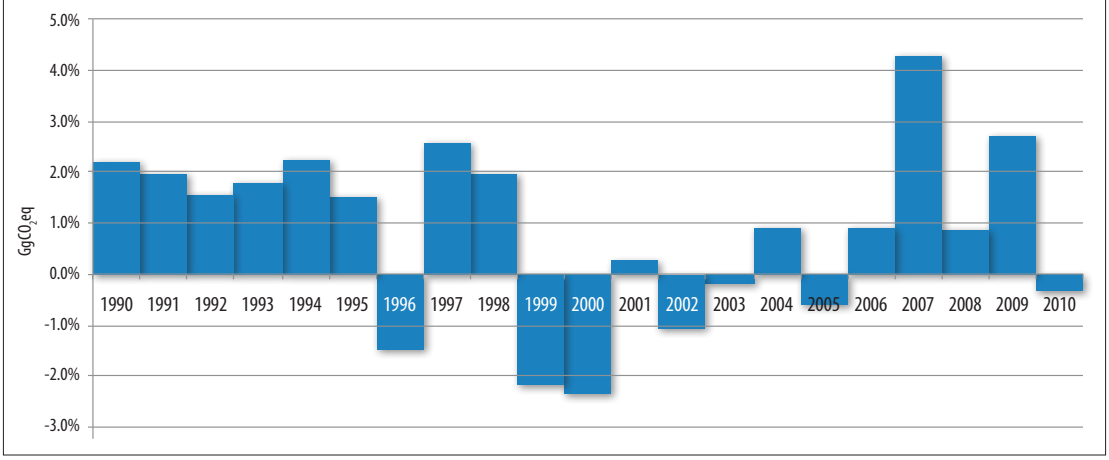


make up the national Energy sector. In both cases the information was obtained from the NEB.

Generally speaking, the GHG emission trends yielded by each method do not differ significantly (Table 26 and Figure 24).

When analyzing the differences per year, the time series displays an average annual difference of 1.6%, which is below the 5% established in the 2006GL as an acceptable difference between the two approaches. Years showing the greatest difference are 2007, with 4.3%, and 2000, with –2.4%. Years with the least difference are 2003, with –0.2%, and 2001, with 0.3% (Figure 25).

Figure 25. Fuel combustion: percentage difference between sectoral and reference approaches, 1990 - 2010 series.



The differences between emission estimations yielded by each of these two approaches can be attributed to statistical errors in the NEB, as in both cases the emission factors used were the default values given by the 2006GL.

3.5. Fuels for international air and maritime transport

For estimating emissions from international aviation and international water-borne navigation it was necessary to disaggregate consumption of these fuels as reported in the NEB, as the Balance does not distinguish between domestic and international fuel consumption. To break down the values, the team used information from the National Customs Service, available for 2002 onwards. For previous years the team used consumption estimations prepared for the study Elaboración de una metodología local del cálculo de emisiones bunker para gases de efecto invernadero (Formulation of a Local Methodology for Calculating Greenhouse Gas Emissions from Bunkers) (Sistemas Sustentables, 2010).

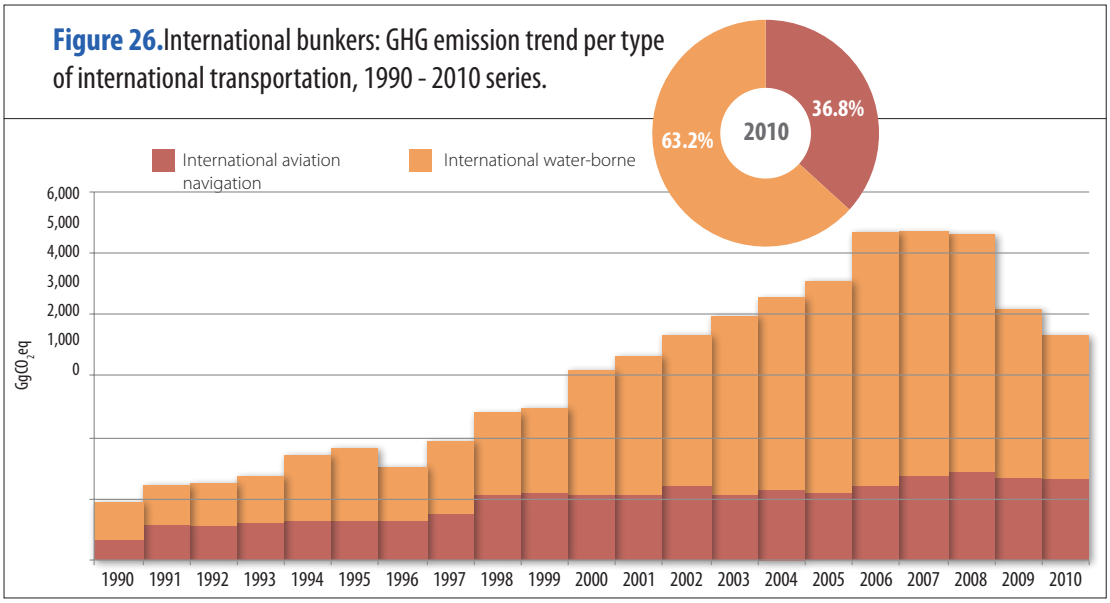
(http://www.sinia.cl/1292/articles-50188_recurso_3.pdf)

As stipulated in the 2006GL, a Tier 1 methodology was used to estimate these emissions; the default emission factors provided in those guidelines were also used.

In 2010, the GHG emissions of Chile from international aviation bunkers amounted to 1,348.0 $GgCO_2eq$, while those from international water-borne navigation were 2,138.5 $GgCO_2eq$ (Table 27 and Figure26). Since 1990, GHG emissions from international aviation have increased by 299.3%, while those from international water-borne navigation have increased by 289.5%. The decreasing trend in such emissions over the last few years of this inventory (2008–2010) resulted from the decrease in international trade caused by the global financial crisis.

In accordance with the 2006GL, a Tier 1 emission estimation methodology was used for both sources. This method required data on the quantity of fuel consumed by international transportation for each mode of transport (wa-

Figure 26. International bunkers: GHG emission trend per type of international transportation, 1990 - 2010 series.



ter-borne or airborne), For that, fuel consumption data obtained from the National Customs Service and default emission factors contained in the 2006GL were used.

3.6. CO_2 emissions from biomass

In accordance with the 2006GL, CO_2 emissions from biomass combustion are not included in national totals, but they are recorded as a Memo item for cross-verification and to prevent double counting in the LULUCF sector.

In 2010, CO_2emissions from biomass amounted to 21,770.4 $GgCO_2eq$. Since 1990, CO_2 emissions have increased by 83.7%. The key driver is t

Table 27. International bunkers: GHG emissions ($GgCO_2eq$) per type of international transportation, 1990 - 2010 series

Transport	1990	1995	2000	2005	2010
International aviation	337.6	647.1	1,055.7	1,117.4	1,348.0
International water-borne navigation	595.2	1,180.2	2,055.8	3,449.7	2,318.5
Total	**932.8**	**1,827.3**	**3,111.5**	**4,567.2**	**3,666.5**

Source: Compilation by SNICHILE.

Table 28. Biomass: CO_2 emissions ($GgCO_2eq$) from biomass, 1990 - 2010 series

Subcategory	1990	1995	2000	2005	2010
CO_2 emissions from biomass	11,851.0	15,280.7	18,952.3	20,486.3	21,770.4
Total	**11,851.0**	**15,280.7**	**18,952.3**	**20,486.3**	**21,770.4**

Source: Compilation by SNICHILE.

he rise in the demand for firewood by the residential sector (Table 28 and Figure 27).CO_2 emissions from biomass were calculated using The Tier 1 methodology provided in the 2006GL, The biomass consumption is reported in the NEB, while the emission factor is the default one according to the 2006GLs

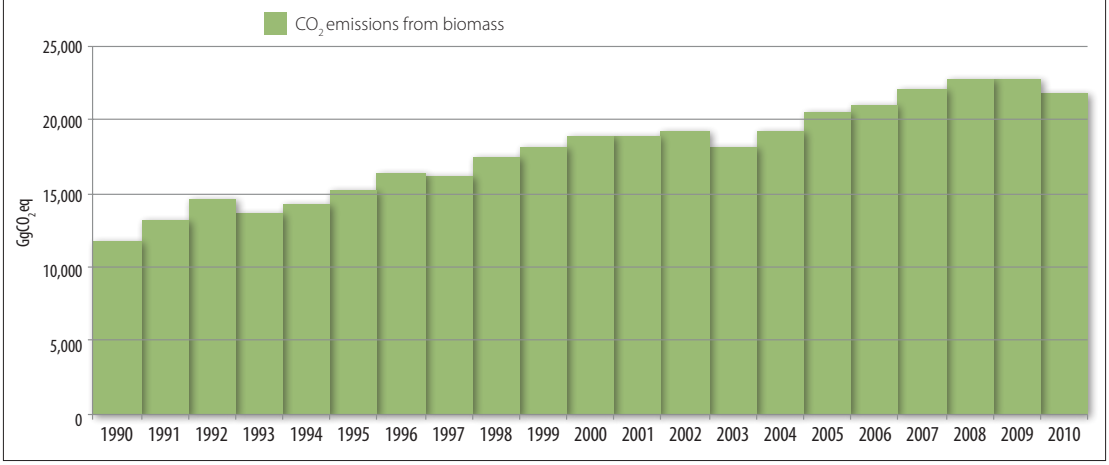
3.7. Quality assurance and quality control procedure

Following, the quality assurance and quality control procedures performed by the sectoral team are described.

3.7.1. Quality control

- Verification of the integrity of files in the database included:
  - o A detailed review of each annual file of the NEB to ensure that all data specifications are correct.
  - o The construction of a conciliated spreadsheet of activity data that uses automated links to translate NEB values into the format required by the IPCC data entry software, Thereby avoiding manual data entry and possible associated errors.
  - o The cross-checking of the data imported from the NEB to the annual conciliated spreadsheet and then from the spreadsheet to the format required by the IPCC software.

Figure 27. CO_2 emissions from biomass trend in CO_2 emissions, 1990-2010 series



- Verification of the consistency of GHG emission trends, identifying potentially anomalous activity data that could lead to anomalous emission values.

- Random comparison of results yielded by IPCC software and staff calculations.

- Comparison of results of the sectoral and reference approachs.

- Comparison of GHG emission results in the Energy SGHGI with other Chilean GHG inventories.

- Verification and checking of uncertainty calculations.

3.7.2. Quality assurance

In June 2014, the Energy SGHGI was reviewed by an expert qualified as a reviewer of NIRs from Parties included in Annex I to the Convention. This review was conducted remotely with permanent communication between the expert reviewer, the Coordinator of SNICHILE and sectoral team professionals to resolve issues as they came up. The sector team then analyzed the assessment report, amended pertinent findings and evaluated the feasibility of introducing the recommendations in the next update of NIR of Chile.

3.8. Planned improvements

Based on the Energy's sectoral team own analysis and the recommendations issued by the expert reviewer of the SGHGI, the following improvements to this sector have been planned:

- National Energy Balance[9]:
  - o Regular audits in addition to checking data from the Electrical-Electronic Industry Association (Asociación de la Industria Eléctrica- Electrónica, AIE).
  - o Coordination with the National Statistics Institute to define and disaggregate some industry values.
  - o Disaggregation of demand by region.
  - o improvement of the representativeness of the information collection.
  - o Decreasing inconsistencies in the information collected in order to identify non-energy-purpose consumption.
  - o Introduction of non-currently-represented key sectors, such as sanitation and others.

- Establishment of institutional arrangements with entities that have potentially relevant information available, such as the Chilean Copper Commission, the General Direction of Civil Aviation, the National Customs Service, the Superintendency of Electricity and Fuels, and others.

- Disaggregating information related to road transportation by mode of transport (cars, motorcycles, buses, trucks, etc).

- Building capacities for collecting information that is currently lacking, especially information related to the carbon content of fuels used in Chile, in order to build country-specific emission factors.

9 Source: Ministry of Energy, 2014.

4 INDUSTRIAL PROCESSES SECTOR

4.1. General overview of the sector

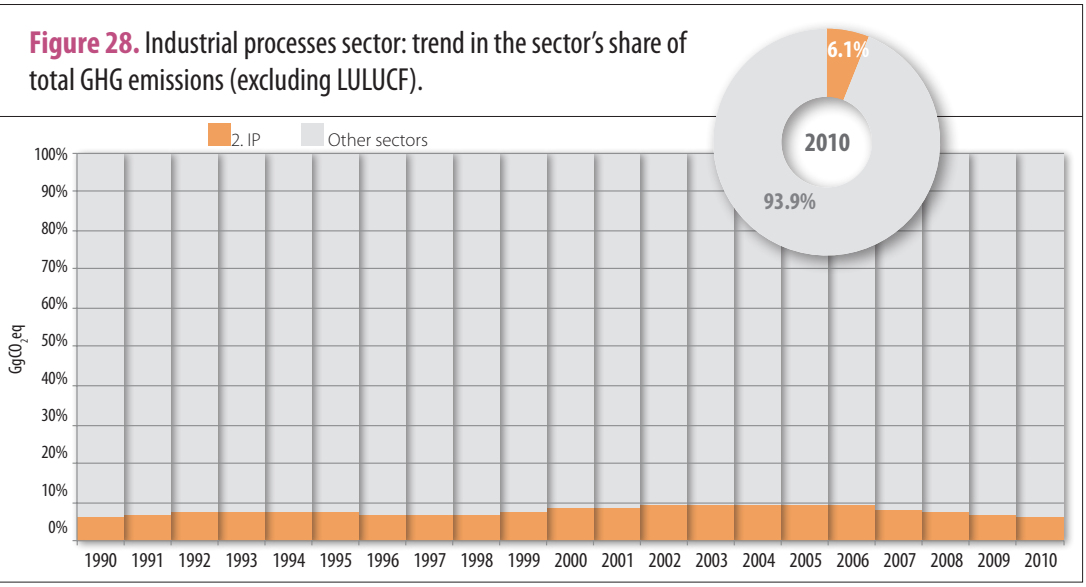
The Industrial Processes sector covers GHG emissions produced by a wide variety of industrial activities, excluding those associated with burning fossil fuels. The main sources are emissions from industrial processes that chemically or physically transform raw material. Besides, GHG are frequently used in products such as refrigerators, foams or aerosol cans.

The wide variety of GHG emissions that can be produced during those industrial processes include CO_2, CH_4, N_2O, hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulfur hexafluoride (SF_6).

In Chile, this sector includes emissions from chemical, metal and mineral industry processes as well as emissions associated with the use and consumption of substitutes for ozone depleting substances (ODS), which have been used in the country since 2002.

The Industrial processes sector is the third largest GHG emitter in Chile, producing 6.1% of total GHG emissions (Figure 28).

Figure 28. Industrial processes sector: trend in the sector's share of total GHG emissions (excluding LULUCF).



In 2010 the sector's GHG emissions amounted to 5,543.2 $GgCO_2eq$ (Table 29). Since 1990, GHG emissions have experienced 78.3% increase. The key driver of this increase between 1990 and 2006 was the sustained growth in methanol production, the cement industry and the lime industry. Since 2006, a sharp decline in emissions has been observed (Figure 29), mainly due to a reduction in the natural gas supply from Argentina, which is the raw material used for methanol production. A sharp decline in industrial activity across the country can also be observed as of 2008, owing to the international economic crisis, which especially affected the iron and steel industry.

At a category level, the Mineral products category contributes 41.8% of the GHG emissions of the sector, followed by the Chemical industry, which contributes 32.4%, Metal production with 20.6% and Consumption of halocarbons and SF_6, with 5.2%.

At a subcategory level, in terms of emissions, Cement production is the most important, accounting for 21.5% of total emissions, followed by Nitric acid production with 20.3%, Iron and steel production with 19.7%, Lime production with 19.4%, Methanol with 12.1% and Aerosol with 2.8%. The remaining 4.1% includes other subcategories such as Ethylene, Refrigeration and air conditioning and Ferrous-alloy production (Table 30 and Figure 30).

Table 29. Industrial Processes Sector: GHG emissions ($GgCO_2eq$) per category, 1990 - 2010 series.

Category	1990	1995	2000	2005	2010
2A. Mineral products	1,055.9	1,694.9	1,739.9	2,265.0	2,316.2
2B. Chemical industry	755.4	903.6	2,768.0	3,092.9	1,797.2
2C. Metal production	1,296.8	1,644.0	1,892.0	1,896.8	1,142.3
2F. Consumption of halocarbons and SF_6	0.0	0.0	0.0	100.1	287.4
Total	**3,108.2**	**4,242.5**	**6,399.9**	**7,354.7**	**5,543.2**

Source: Compilation by SNICHILE.

Figure 29. Industrial Processes Sector: GHG emission trend per category, 1990 - 2010 series

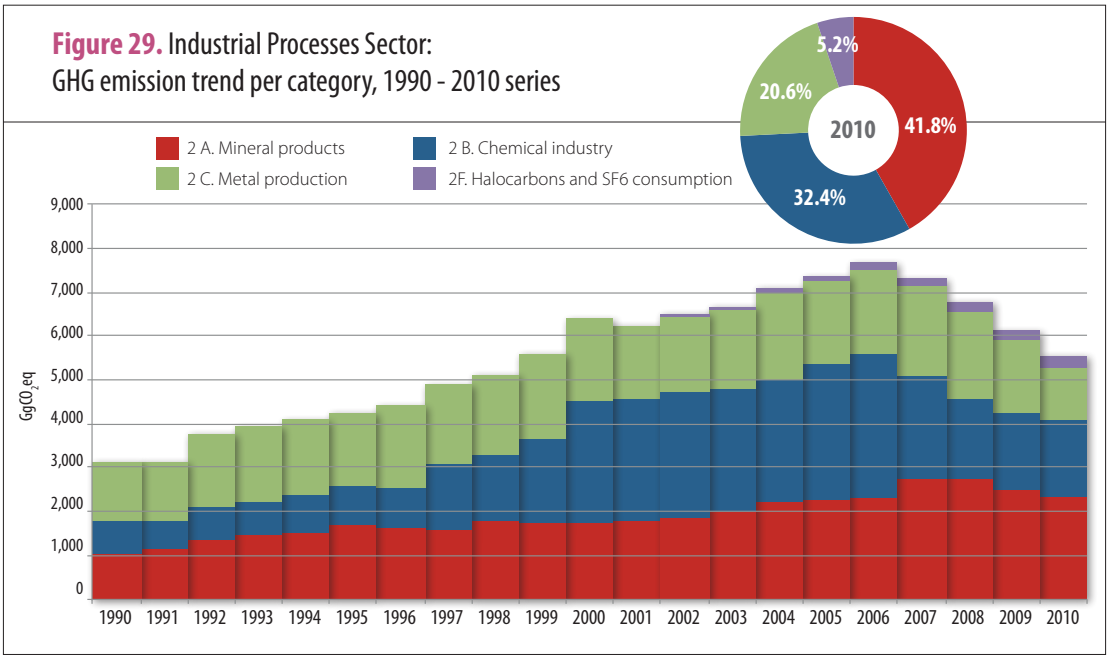


Table 30. Industrial Processes sector: GHG emissions ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
2A1. Cement production	786.7	1,223.4	1,165.1	1,350.0	1,191.8
2B2. Nitric acid production	141.2	298.5	675.2	916.0	1,124.9
2C1. Iron and steel production	1,221.4	1,544.2	1,829.0	1,846.5	1,094.1
2A2. Lime production	256.3	452.6	537.9	866.9	1,076.4
2B5. Others (Methanol)	613.4	604.1	2,091.7	2,175.7	671.6
2F4. Aerosols.	0.0	0.0	0.0	64.9	155.2
2F1. Refrigeration and air conditioning	0.0	0.0	0.0	26.5	95.8
Other	89.2	119.7	101.0	108.3	133.5
Total	**3,108.2**	**4,242.5**	**6,399.9**	**7,354.7**	**5,543.2**

Source: Compilation by SNICHILE.

Figure 30. Industrial Processes sector: GHG emission trend by subcategory, 1990 - 2010 series

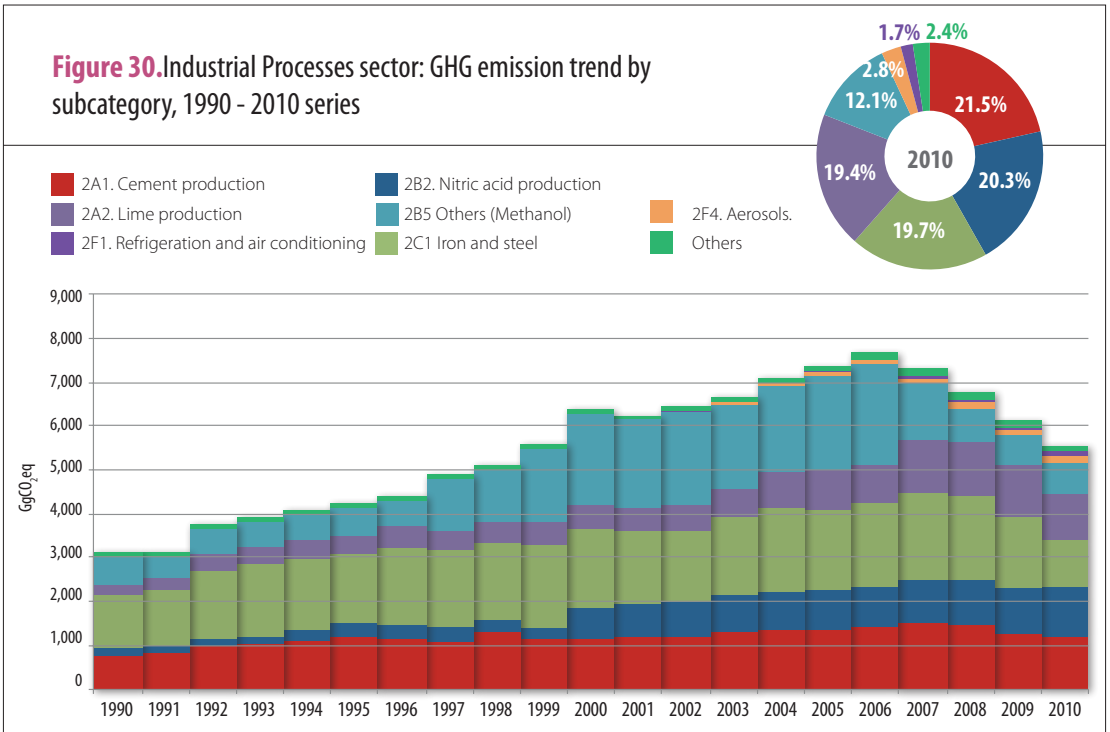


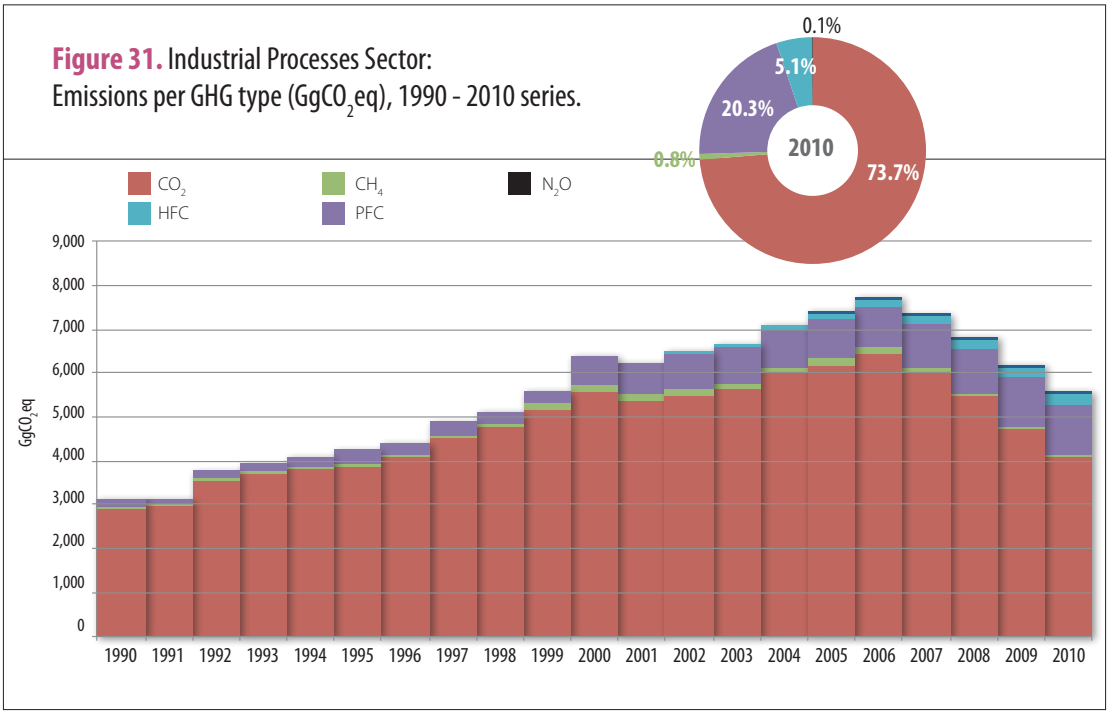
Table 31. Industrial Processes sector: emissions per GHG type ($GgCO_2eq$), 1990-2010 series.

GHG	1990	1995	2000	2005	2010
CO_2	2,925.6	3,903.1	5,583.9	6,192.3	4,085.6
CH_4	41.4	40.8	140.8	146.4	45.2
N_2O	141.2	298.5	675.2	916.0	1,124.9
HFC	0.0	0.0	0.0	99.3	281.3
PFC	0.0	0.0	0.0	0.7	6.1
Total	**3,108.2**	**4,242.5**	**6,399.9**	**7,354.7**	**5,543.2**

Source: Compilation by SNICHILE.

In 2010, the main GHG emissions were CO_2, representing 73.7% of all emissions, followed by CH_4 with 20.3% and N_2O with 5.1%. Halocarbons were responsible for 0.9% of emissions (Table 31 and Figure 31).

Figure 31. Industrial Processes Sector: Emissions per GHG type ($GgCO_2eq$), 1990 - 2010 series.



4.2. Mineral products (2A)

4.2.1. Description of category and GHG emissions

This category concentrates the CO_2 emissions resulting from the use of carbonate raw materials during the production and use of a variety of industrial mineral products. The associated subcategories are as follows:

- 2A1 Cement production.
- 2A2 Lime production.
- 2A3 Limestone and dolomite use.
- 2A4 Sodium carbonate production and use.
- 2A5 Roofing asphalt production.
- 2A6 Road paving with asphalt.
- 2A7 Other.

In Chile, this category includes emissions from the following productive processes:

- Cement production,
- Lime production, and
- Glass production.

Table 32. Mineral products: GHG emissions ($GgCO_2eq$) per category, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
2A1. Cement production	786.7	1,223.4	1,165.1	1,350.0	1,191.8
2A2. Lime production	256.3	452.6	537.9	866.9	1,076.4
2A7. Others (Glass production)	13.0	18.9	36.9	48.1	48.1
Total	**1,055.9**	**1,694.9**	**1,739.9**	**2,265.0**	**2,316.2**

Source: Compilation by SNICHILE.

The Mineral products category is the main GHG emitter for the sector. In 2010, the GHG emissions of the category accounted for 2,316.2 $GgCO_2eq$, or 41.8% of the entire sector (Table 32 and Figure 32). Since 1990, GHG emissions have increased by 119.4%.

4.2.1.1. Cement production (2A1)

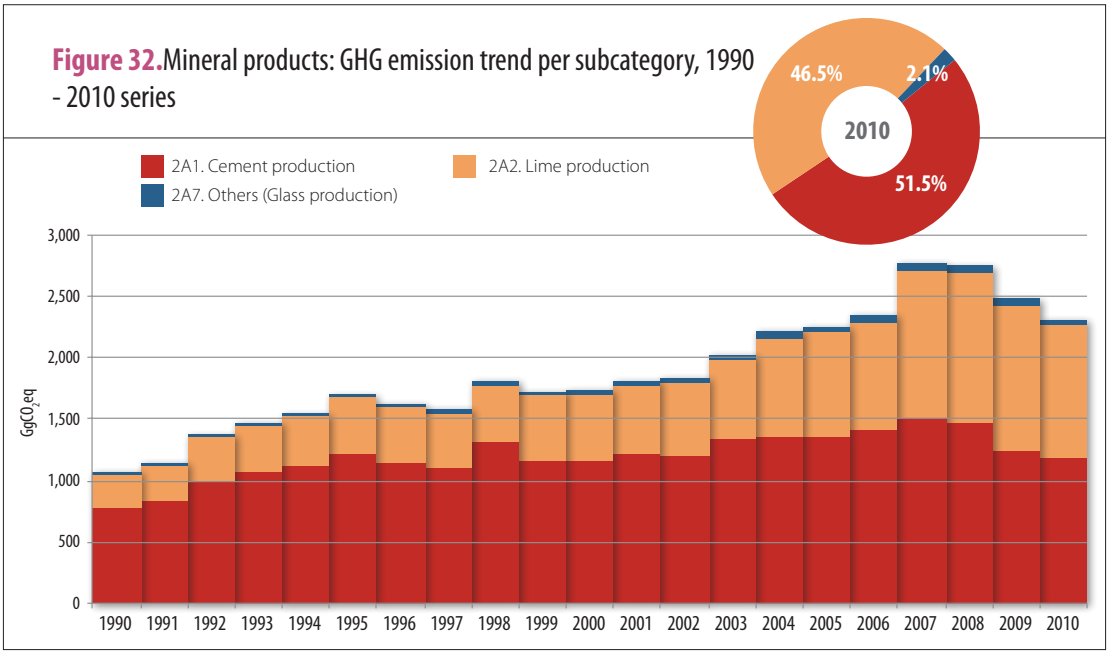
Between 1990 and 2010, cement production in Chile increased, and this has been attributed to the three main production companies that dominate this market.

In 2010, the GHG emissions from the Cement production subcategory accounted for 1,191.8 $GgCO_2eq$, or 51.5% of the entire category. Since 1990, GHG emissions have increased by 51.5%. The main driver of this trend and the inter annual variations observed is the demand of cement for construction, which affects clinker production in Chile. It is important to mention that while in recent years clinker imports have risen steadily, GHG emissions estimations consider clinker produced in Chile only (Table 32 and Figure 32).

4.2.1.2. Lime production (2A2)

Historically, 4 companies have been the main suppliers of lime in Chile (Chilean Mining Magazine 2009). However, other companies produce large quantities of lime for their own consump-

Figure 32. Mineral products: GHG emission trend per subcategory, 1990 - 2010 series



Max Donoso, Fundación Imagen de Chile (FICH).

tion. Considering the different uses this product has, lime production industry in Chile has grown considerably in recent years as the uses for this product expanded, although production has slightly fallen since 2009.

In 2010, GHG emissions from the Lime production subcategory amounted to 1,076.4 $GgCO_2eq$, or 46.5% of the entire category. GHG emissions have increased by 319.9% since 1990. The key driver of this increase is the steady growth in the demand for lime, and therefore the increased production (Table 32 and Figure 32).

4.2.1.3. Others: Glass production (2A7)

Glass produced in Chile is user for manufacturing a wide variety of products such as bottles, lighting, receptacles, crockery, laboratory instruments, as well as a construction material.

In 2010, GHG emissions from the Glass production subcategory amounted to 48.1 $GgCO_2$ eq, or2.1% of the entire category. Since 1990, GHG emissions have increased by 270.5%. The main driver of this increase is the steady growth of the industry (Table 32 and Figure 32).

4.2.2. Methodological aspects

The methods used in the Mineral products category are presented in the Table below:

Table 33. Mineral products: methods applied

Greenhouse gas source and sinks categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
A. Mineral products	T1,T2	D				
1. Cement production	T1	D				
2. Lime production	T2	D				
3. Limestone and dolomite use	NE	D				
4. Sodium carbonate production and use	NE	D				
5. Roofing asphalt material production	NE	D				
6. Road paving with asphalt	NE	D				
7. Other	T1	D				
Glass production	T1	D				

T1= Tier 1 Method; T2= Tier 2 Method; D= Default; NE= Not estimated. Source: Compilation by SNICHILE.

Max Donoso, Fundación Imagen de Chile (FICH).

Cement production

The Cement production subcategory used the Tier 1 method outlined in the 2006GL, in which either production or consumption activity data is multiplied by the corresponding emission factor.

Lime production

Emissions from Lime production were estimated with the Tier 2 method outlined in the 2006GL, which besides considering the kind of lime production, it introduces a LKD correction factor and a hydrated lime correction factor. These factors depend on the type of lime, and the default factors used were those found in the 2006GL. Based on the Tier 2 methodology, CO_2 emissions from lime production were estimated using the following equation:

$$CO_2 \text{ Emissions} = \sum (EF_{lime,i} \times M_{l,i} \times CF_{lkd} \times C_{h,i})$$

Where:

- CO_2 emissions = CO_2 emissions from lime production (tons)
- Ml,i = type i lime production, tons
- EFcal,i = emission factor for type i lime, tons of CO_2/tons of lime
- CFlkd,i = emission correction factor for LKD
- Ch,i = correction factor for type i hydrated lime, without measure
- i = each specific type of lime

Others: Glass production

The Tier 1 method outlined in the 2006GL was used for the Glass production subcategory. This is due to the fact that there were no data available on the glass production by processing carbonates used in the glass industry.

4.2.2.1. Statistical and parametric activity data

Cement production

Activity data for cement production was obtained from the Chilean Concrete Institute website (ICH) (http://ich.cl/?p=109). Clinker import and export data were provided by the National Customs Service. The overall clinker fraction was assumed to be 75%, as per the assumptions sated on the 2006GL (Chapter 2.2.1.2 and 2.2.1.3 , Volume 3, 2006GL) and data reported by cement producers.

Lime production

Detailed activity data were obtained directly from each of the four lime producing companies. Because of the detailed information provided by each of these companies (via e- mail), we were able to stratify lime production by re-

gion; and therefore, GHG emission calculations were made using the Tier 2 methodology at the regional level. For Tier 2 calculation, LKD emissions and hydrated lime correction factors shall be considered, which are shown in the Table below:

Table 34. Basic parameters used to calculate emission factors for lime production.

Parameter	Description	Value
$CF_{lkd,i}$	LKD correction factor	1.02
$C_{h,i}$	Hydrated lime correction factor	0.97

Source: Chapter 2.3.1.3, Volume 3, IPCC 2006.

Others: Glass production

Glass production data were estimated using the physical production index calculated by the Federation of Chilean Industry (SOFOFA) for the Glass and glass products manufacturing economic sector (http://web.sofofa.cl/informacion-economica/indicadores-industriales/informacion-sectorial-de-la-industria/minerales-no-metalicos-y-metalica-basica/).

In terms of the parameter data, the Tier 1 method (Chapter 2.4.1.3, Volume 3, 2006GL) assumes a 50% default cullet proportion.

4.2.2.2. Emission factors

Default emission factors were used for all the corresponding subcategories as per Chapter 2, Volume 3, 2006GL.

Lime production CO_2 emissions were estimated using Tier 2 emission factors, as set out in the following table:

According to information obtained from the lime producers, only quicklime is produced in Chile, and therefore the default 0.75 tons of CO_2/ton of lime value was used for estimating CO_2 emissions for lime with high calcium content.

4.3. Chemical industry (2B)

4.3.1. Description of category and GHG emissions

The Chemical industry category includes GHG emissions resulting from the production of several inorganic and organic chemical products which the experience of several countries have confirmed contribute significantly to national and global GHG emissions. The subcategories included are:

- 2B1 Ammonia production.
- 2B2. Production of nitric acid.
- 2B3 Adipic acid production.
- 2B4 Carbide production.
- 2B5 Others.

In Chile, this category includes emissions from the following productive processes:

- Nitric acid production,
- Methanol, and
- Ethylene.

In 2010, GHG emissions of the category amounted to 287.4 $GgCO_2eq$, or 5.2% of the entire sector (Table 40 and Figure 35). Since 1990, GHG emissions have experienced 137.9% increase. Lately, however, GHG emissions have declined, due to a sharp drop in methanol production — which though has reduced GHG emissions associated with this activity, impacting on the emissions of the category and the sector.

Table 35 Basic parameters used to calculate emission factors for lime production.

Type of lime	Stoichiometric Ratio [t CO_2 per tCaO or CaO·MgO]	CaO content range [%]	MgO content range [%]	Default value for the CaO or Cao·MgO content [fraction]	Default emission factor [t CO_2 per t lime]
Lime with high calcium content	0.785	0.785	0.3-2.5	0.95	0.75
Dolomite lime	0.913	55-57	38-41	0.95 /0.85	0.86 / 0.77
Hydraulic lime	0.785	65-92	NA	0.75	0.59

Source: Table 2.4, Chapter 2, Volume 3, IPCC 2006.

Table 36. Chemical industry: GHG emissions ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
2B2. Nitric acid production	141.2	298.5	675.2	916.0	1,124.9
2B5. Others (a. Methanol)	613.4	604.1	2,091.7	2,175.7	671.6
2B5. Others (b. Ethylene)	0.8	1.0	1.2	1.2	0.7
Total	**755.4**	**903.6**	**2,768.0**	**3,092.9**	**1,797.2**

Source: Compilation by SNICHILE.

4.3.1.1. Nitric acid production (2B2)

Nitric acid is used by the chemical industry to produce metal nitrates, sulfuric acid, arsenic and nitrous acid, among other substances. Nitric acid is also used in the manufacture of explosives, colorants and dyes, pharmaceuticals, photo-etched printing, jewelry, and the engineering industry.

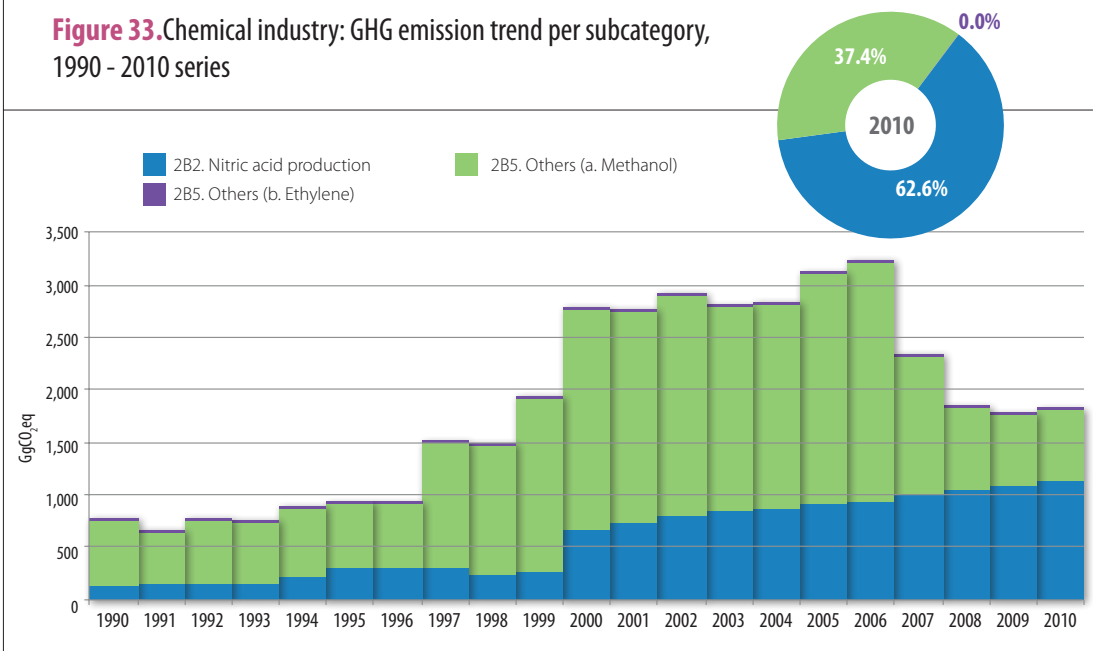
In 2010, GHG emissions from the nitric acid production subcategory amounted to 1,124.88Gg-CO_2eq, or 62.6% of the category. Since 1990, the GHG emissions have increased by 696.8%. The main driver of this increase is the growth of this industry (Table 36 and Figure 33).

4.3.1.2. Others: Methanol (2B5)

Methanol is a versatile liquid chemical produced mainly from natural gas and is used as a raw material in the manufacture of a wide range of consumer products, such as construction materials, foams, resins and plastics. In Chile, the company Methanex produces methanol.

Methanol production in Chile showed an increasing trend between 1990 and 2006. Nevertheless, it experienced a dramatic drop in 2007, and since then annual production has gradually decreased. According to Methanex's latest Annual Report, the company's methanol plants were operating well below their installed production capacity due to a shortage of its main

Figure 33. Chemical industry: GHG emission trend per subcategory, 1990 - 2010 series



raw material: natural gas.

In 2010, GHG emissions from the Methanol subcategory were 671.61 $GgCO_2eq$, or 37.4% of the entire category. GHG emissions have experienced 9.5% increase since 1990. The annual variations observed in the Methanol subcategory are mainly driven by reductions in the supply of natural gas from Argentina (Methanex Annual Report 2012, available at http://www.methanex.cl/noticias/2013/noticia0313a.pdf) (Table 36 and Figure 33).

4.3.1.3. Others: Ethylene (2B5)

Between 1990 and 2010, ethylene production remained relatively constant, without dramatic increases or decreases in production. The maximum annual ethylene production was 1,134 tons in 2002. The minimum annual production of only 630 tons occurred in 2010.

In 2010, GHG emissions from the Ethylene subcategory amounted to 0.74 $GgCO_2eq$. GHG emissions have decreased 12.8% since 1990 (Table 36 and Figure 33).

4.3.2. Methodological aspects

The methods used to estimate GHG emissions for the Chemical industry category are presented in the following table:
The methodology used for estimating GHG emissions in all subcategories is based on multiplying either production or consumption activity data by the corresponding emission factor. The calculations were carried out in accordance with guidelines issued by 2006GL, applying the Tier 1 method to all subcategories.

4.3.2.1. Statistical and parametric activity data

Nitric acid production
Nitric acid production data was obtained from the NIR in the Energy and Industrial processes and Use of Solvents sectors (Pochand Deuman,2008) (http://www.sinia.cl/1292/articles-50188_recurso_1.pdf) for the 1990 - 2006 period, since other potential sources deemed their information to be confidential. The rest of the period was extrapolated from existing data.

Others: Methanol
Methanol production data was obtained from NEB, as Methanex, sole producer in Chile, deems its information to be confidential.

Others: Ethylene
Ethylene production data was also obtained from the NEB for the entire period.

4.3.2.2. Emission factors

Default emission factors for all subcategories were taken from Chapter 3, Volume 3 of the 2006GL.

4.4. Metal industry (2C)

4.4.1. Description of category and GHG emissions

This category includes GHG emissions from metal production. The subcategories included are:

Table 37. Chemical industry: methods applied

Greenhouse gas source and sinks categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
B. Chemical industry	T1	D	T1	D	T1	D
1. Ammonia production.	NO	NO				
2. Nitric acid production					T1	D
3. Adipic acid production.					NO	NO
4. Carbide production.	NO	NO	NO	NO	NO	NO
5. Other	T1	D	T1	D		
Methanol	T1	D	T1	D		
Ethylene	T1	D	T1	D		

T1 = Tier 1 Method; D= Default; NO= Not occurring.
Source: Compilation by SNICHILE.

- 2C1. Iron and steel production.
- 2C2. Ferrous alloy production.
- 2C3 Aluminum production.
- 2C4 SF_6 used in aluminum and magnesium foundries.
- 2C5 Others.

In Chile, this category includes emissions from the following productive processes:

- Iron and steel production,
- Ferrous alloy production,
- Lead production, and
- Zinc production.

In 2010, the category's GHG emissions amounted to 1,142.3 $GgCO_2eq$, or 20.6% of the entire sector (Table 38 and Figure 34). Since 1990, GHG emissions have decreased by 11.9%.

4.4.1.1. Iron and steel production (2C1)

Iron is the most produced metal, in terms of tonnage, accounting for 95% of the global metal production. It has wide applications in metallurgical products, being used as a matrix element in order to store other alloy elements, both metallic as well as non-metallic, giving different properties to the material.

Conversely, the primary local market for steel products is the construction industry, which accounts for 32.4%, followed by steel mills with 25.4%, mining with 19.4% and wire drawers with 11%. The remaining 11.8% is used in the metalworking, packaging and machining industries. (http://www.cochilco.cl/estudios/info-hierro.asp).

Regarding production figures in time, between 1990 and 2009, iron production remained relatively steady, averaging 5,150,000 tons of fine material annually over that 20-year period. In 2009 a significant decline in production is observed.

In 2010, GHG emissions from the Iron and steel production subcategory amounted to 1,094.1$GgCO_2eq$, or 95.8% of the entire category. Since 1990, GHG emissions have decreased by 10.4%. The key driver of this decrease is a dramatic drop in the demand for steel (Table 38 and Figure 34).

4.4.1.2. Ferrous alloys (2C2)

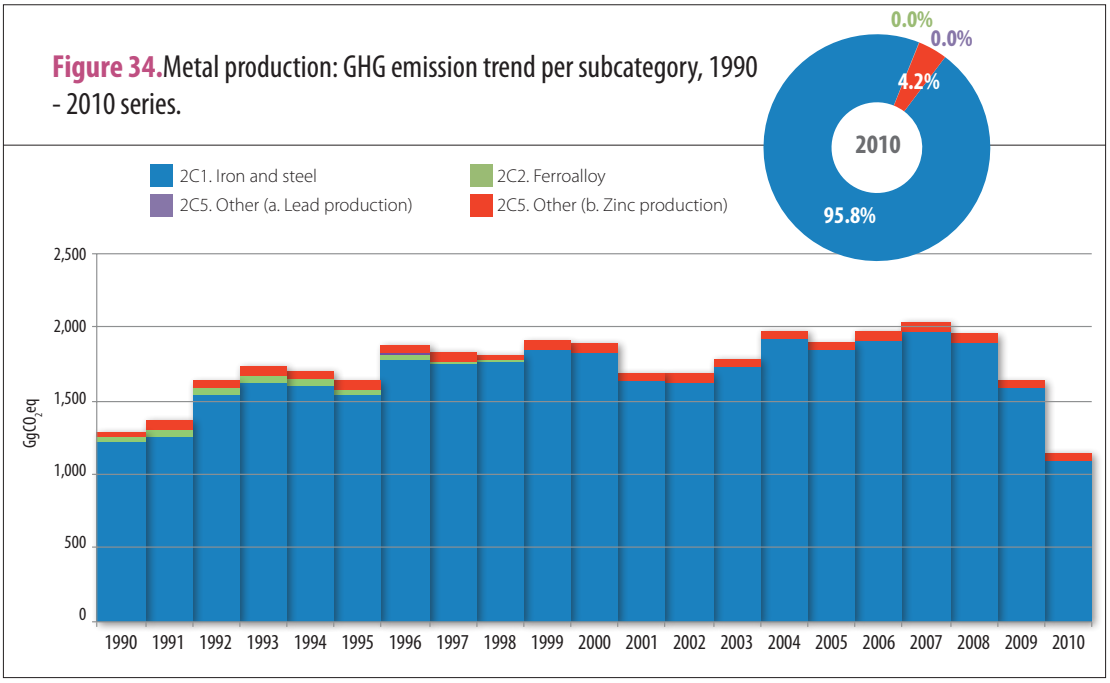
In Chile, four ferrous alloys are produced: ferrochrome, ferromanganese, ferrosiliconmanganese and ferrosilicon. Their production has

Table 38. Metal industry: GHG emissions ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
2C1. Iron and steel production	1,221.4	1,544.2	1,829.0	1,846.5	1,094.1
2C2. Ferroalloy production	31.7	38.4	8.5	0.2	0.2
2C5. Other (a. Lead production)	0.6	0.5	0.4	0.5	0.4
2C5. Other (b. Zinc production)	43.2	60.9	54.0	49.6	47.6
Total	**1,296.8**	**1,644.0**	**1,892.0**	**1,896.8**	**1,142.3**

Source: Compilation by SNICHILE.

Figure 34. Metal production: GHG emission trend per subcategory, 1990 - 2010 series.



significantly decreased. Ferrosilicon production ceased in 2000, ferrosiliconmanganese in 2001 and ferromanganese in 2002. Ferrochrome is still produced in the country, but it has shown a significant decrease. Average annual production stood at 1,951 tons between 1990 and 1998, then ceased altogether from 1990 to 2004, but it was resumed in 2005. From then to 2010, annual average production was 99 tons.

In 2010, GHG emissions from the Ferroalloy production subcategory amounted to 0.24 $GgCO_2eq$, or 0.0% of the category, Since 1990, GHG emissions have experienced 99.2% drop. The key driver of this decline was the cessation of ferrous silicon, ferrous manganese and ferrous silicon-manganese production since 1999 (Table 38 and Figure 34).

4.4.1.3. Others: Lead production (2C5)

In Chile, lead is exclusively produced in the Aysén Region (SERNAGEOMIN 2012, The Chile Mining Yearbook, available on http://www.sernageomin.cl/sminera-anuario.php).). Lead production in Chile was extremely variable between 1990 and 2010. The lowest production was detected in 1992, 298 tons of fine material, only. On the other hand, in 2008 the highest production between 1990 and 2010 was reached, which amounted 3,985 tons of fine material.

In 2010, GHG emissions from the Lead production subcategory amounted to 0.36 $GgCO_2$ eq, or less than 0.1% of the entire category. Since 1990, GHG emissions have decreased by 37.9%. The key driver of this decrease is the unstable lead market (Table 38 and Figure 34).

4.4.1.4. Others: Zinc production (2C5)

In Chile zinc is produced in the Aysén and Metropolitan Regions. It is mainly used in alloys and as rust protection coating for other metals. Iron or steel covered with zinc to avoid oxidation is called galvanized. Zinc alloyed with copper produces brass, which is used in the electrical industry, while zinc alloyed with aluminum and magnesium is used in the aviation industry (http://www.sernageomin.cl/sminera- anuario.php).

Zinc production in Chile has not shown a stable production over the 1990 to 2010 period. In 2008, the highest production was reached, equivalent to 40,519 tons of fine material, while the lowest amount was produced on 1998, equivalent to 15,943 tons of fine material.

In 2010, GHG emissions from the Zinc production subcategory amounted to 47.6 $GgCO_2eq$, or 4.2% of the entire category. Since 1990, GHG emissions have increased by 10.2%. The key driver of this increase was the unstable zinc market (Table 38 and Figure 34).

4.4.2. Methodological aspects

The methods applied to estimate GHG emissions for the Metal production category are presented in the Table below:

Table 39. Metal production: methods applied.

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
C. Metal production	T1	D	NO	D		
1. Iron and steel production	T1	D	NO, IE	NO, IE		
2. Ferroalloy production	T1	D	NO	D		
3. Aluminum production	NO	NO				
4. SF_6 used in aluminum and magnesium foundries	NO	NO				
5. Others	T1	D				
Lead production	T1	D				
Zinc production	T1	D				

T1 = Tier 1 Method; D= Default; NO= Not occurring; IE = Included elsewhere.
Source: Compilation by SNICHILE.

CAP: Pacific Steel Company Holding (Compañía de Aceros del Pacífico)

The general methodology used for estimating GHG emissions is based on multiplying either production or consumption activity data by the corresponding emission factor. The calculations were carried out in accordance with guidelines issued by 2006GL, applying the Tier 1 method to all subcategories.

4.4.2.1. Statistical and parametric activity data

Iron and steel production

Iron data was obtained from the COCHILCO study Copper and Other Mineral Statistics (Estadísticas del cobre y otros minerales) for the 1990 to 1997 period. The Chilean Mining Yearbooks (Anuarios de la Minería de Chile) (yearly published by SERNAGEOMIN) provided information for the remaining years, While parametric data reported on the CAP Mining web site was used to estimate pellet production.

Regarding steel production, it is produced by two local producers, only, namely Compañía de Acero de Pacifico (CAP) and Gerdau Aza (COCHILCO, 2010, Mercado Nacional e Internacional del hierro y acero, available on http://www.cochilco.cl/estudios/info-hierro.asp).

Ferrous alloy production

National statistics on ferrous alloy production were obtained from the U.S. Geological Survey document The Mineral Industry of Chile - 1994 to 2010 (http://minerals.usgs.gov/minerals/pubs/country/sa.html#ci), data detailing ferrous alloy production per type. It is worth mentioning that ferrosilicon production ceased in 1999, and as this was the only process that emitted CH_4, therefore, no emissions of this gas occurred from 2000 to 2010.

Others: Lead and zinc production

Lead production data was obtained from COCHILCO's annual publication, Yearbook on Copper and Other Mineral Statistics, 2002 to 2010 (Anuario de estadísticas del cobre y otros minerales, 2002 a 2010). Besides, the data was corroborated with SERNAGEOMIN's yearly report, Mining Yearbook of Chile, 2007 to 2010. The information provided does not distinguish between different production processes, thus it was assumed that 80% of these metals were produced using Imperial Smelting Furnaces or blast furnaces and the remaining 20% used direct casting methods in Kivcet, Ausmelt and Queneau- Schumann-Lurgi furnaces. This assumption has impact on the emission factor choice. National zinc production was differentiated in the same way, as the data available did not identify specific production processes, either.

4.4.2.2. Emission factors

The default emission factors provided in the 2006GL were used for all corresponding subcategories.

4.5. Other production (2D)

This category was not estimated due to the lack of production data.

4.6. Halocarbons and sulfur SF6 (2E)

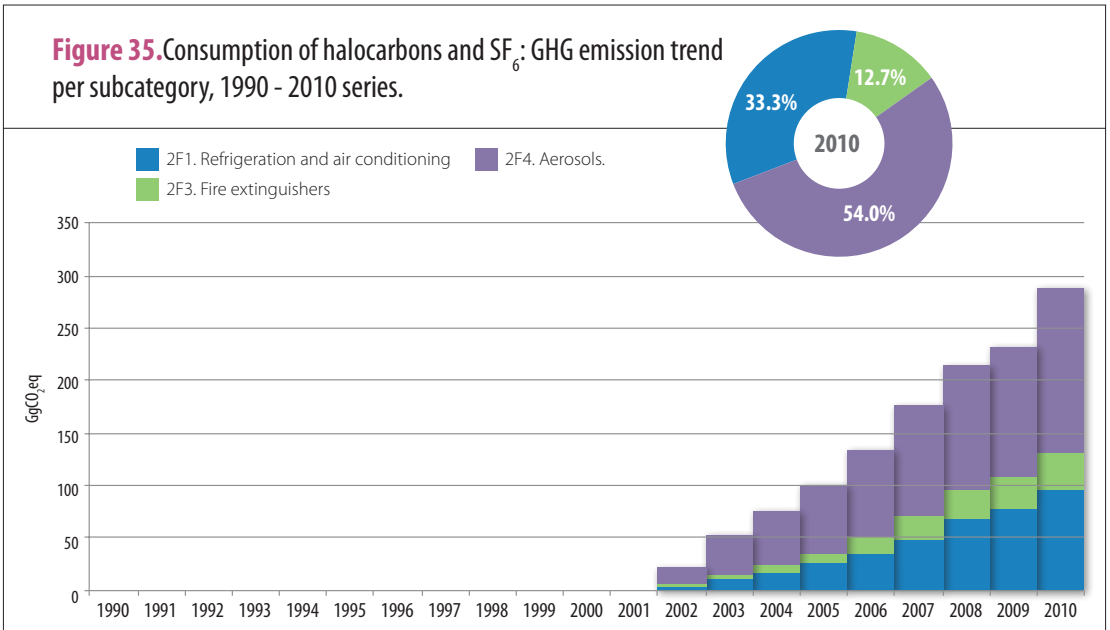
This activity does not occur in Chile.

4.7. Consumptionof halocarbons and SF6 (2F)

4.7.1. Description of category and GHG emissions

HFC gases, and to a very limited extent PFC

Figure 35. Consumption of halocarbons and SF_6: GHG emission trend per subcategory, 1990 - 2010 series.



gases, serve as alternatives to ozone depleting substances (ODS) that are being removed from circulation under the provisions of the Montreal Protocol. The subcategories included are:

- 2F1 Refrigeration and air conditioning equipment.
- 2F2 Foam blowing.
- 2F3. Fire Extinguishers.
- 2F4. Aerosols.
- 2F5. Solvents.
- 2F6 Other applications.
- 2F7 Semiconductor manufacture.
- 2F8 Electrical equipment.
- 2F9 Other.

These substances were first imported to Chile in 2002, according to the National Customs Service. In this context, domestic emissions include:

- Refrigeration and air conditioning,
- Fire and explosion protection, and
- Aerosols.

As these compounds are not produced in Chile, all fluorinated compounds used in refrigeration, air conditioning, fire protection and aerosols are 100% supplied through importation. As mentioned above, importation of these products in Chile began in 2002 and has considerably increased since then. Exports, in contrast, are negligible.

In 2010, the category's GHG emissions amounted to 287.4 $GgCO_2eq$, or 5.2% of the entire sector (Table 40 and Figure 35). The sudden increase in this category occurred when products containing HFC were introduced in the local market in 2002 and when those containing PFC were introduced in 2005.

In 2010, GHG emissions from the Refrigeration and air conditioning equipment subcategory amounted to 95.8 $GgCO_2eq$, or 33.3% of the entire category.

In 2010, GHG emissions from the Fire extinguishers subcategory amounted to 36.5 $GgCO_2eq$, or 12.7% of the entire category.

In 2010, GHG emissions from the Aerosols subcategory amounted to 155.2 $GgCO_2eq$, or 54.0% of the entire category.

Table 40. Consumption of halocarbons and SF_6: GHG emissions ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
2F1. Refrigeration and air conditioning	0.0	0.0	0.0	26.5	95.8
2F3. Fire extinguishers	0.0	0.0	0.0	8.8	36.5
2F4. Aerosols.	0.0	0.0	0.0	64.9	155.2
Total	**0.0**	**0.0**	**0.0**	**100.1**	**287.4**

4.7.2. Methodological aspects

The methods applied to estimate GHG emissions for the category Consumption of halocarbons and SF_6 are presented in the Table below:

Table 41. Halocarbons and SF_6 consumption: methods applied

Greenhouse gas source and sinks categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
F. Consumption of Halocarbons and SF6	T1	D	T1	T1	NE, NO	NE, NO
1. Refrigeration and air conditioning equipment	T1	D				
2. Foam blowing	NO	NO	NO	NO		
3. Fire extinguishers	T1	D	T1	T1		
4. Aerosols.	T1	D				
5. Solvents	NE	NE	NE	NE	NE	NE
6. Other applications.	NO	NO	NO	NO	NO	NO
7. Semiconductor manufacture	NO	NO	NO	NO	NO	NO
8. Electrical equipment	NO	NO	NO	NO	NO	NO
9. Others	NA	NA	NA	NA	NA	NA

T1= Tier 1 Method; D= Default; NA= Not applicable; NE= Not estimated; NO= Not occurring.

Source: Compilation by SNICHILE.

The general method used to estimate GHG emissions is based on multiplying the production activity data by the corresponding emission factor. The calculations were carried out in accordance with guidelines issued by 2006GL, applying the Tier 1 method to all subcategories.

4.7.2.1. Statistical and parametric activity data

The National Customs Service provided activity data for Refrigeration and air conditioning equipment, including specific import and export information on each HFC. It is worth mentioning that imports began on 2002. The same procedure was used to obtain activity data for fire extinguishers and aerosols.

4.7.2.2. Emission factors

The default emission factors provided in the 2006GL were used for all corresponding subcategories.

4.8. Quality assurance and quality control procedure

This section outlines the quality assurance and quality control procedures performed by the sectoral team.

4.8.1. Quality control

- Spreadsheets were built and populated with basic information such as activity data, emission factors, sources and assumptions. This allows maintaining the information to sorted and documented for future updating.
- Activity data, emission factors and other estimation parameters in the base information spreadsheets were cross-checked with data in the report and the IPCC software to ensure consistency across all three.
- Quoted bibliographic references were confirmed.
- Mission units and factors in the spreadsheets were reviewed and corrected.
- A conciliated spreadsheet was developed that aggregated the annual spreadsheets exported from the IPCC software. This conciliated spreadsheet aggregate data per category, GHG and IPPU sector using formulae. All formulae used were reviewed as to avoid calculation errors.
- Official information was cross-checked with information publicly available from the private sector.
- For categories involving processes or products that do not occur in Chile, there was a verification process with external experts outside the sector team.
- The current estimations were compared with those from the previous SGHGI to identify potential data entry or calculation errors. Any divergences were justified.

4.8.2. Quality assurance

In May and June 2014, the IPPU SGHGI was reviewed by an expert qualified as a reviewer of

NIRs from Parties included in Annex I to the Convention. The review was conducted remotely with permanent communication among the expert reviewer, the SNICHILE coordinator and the IPPU Sector Team, so questions and concerns could be solved as they came up.

4.9. Planned improvements

Based on the IPPU Sector Team's internal analysis and the recommendations of the expert reviewer of the SGHGI, the following improvements are planned for this sector:

- Form working groups with representatives from businesses or trade associations responsible for emissions in the sector's key GHG categories to gather first hand statistical and parametric information and verify the country's official information.

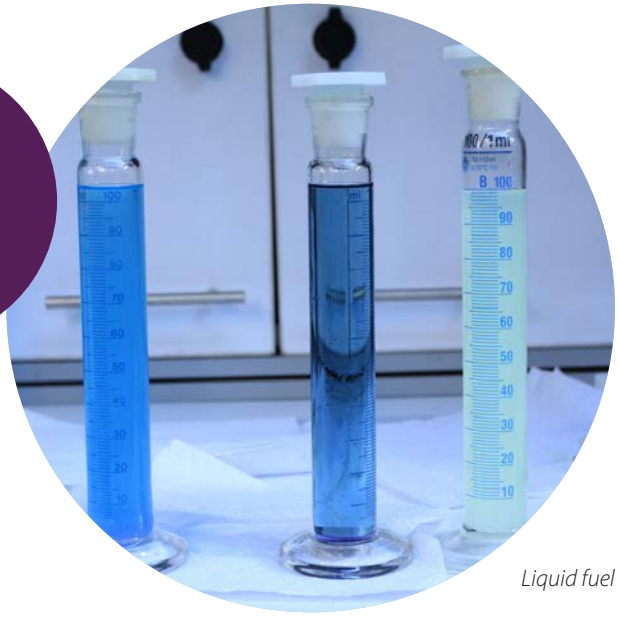
- Compare the results obtained from Tier 1 and Tier 2 methods (or Tier 3, where applicable) to identify possible errors of magnitude or others and resolve the differences observed; and justify the observed differences.

- In the specific case of the lime category, it is important to identify every lime producing company, since there are not only plants producing this product for commercialization, but also there are plats producing for internal consumption.

- In the glass category, it is important to determine the proportion of recycled glass used in Chile. This work will be performed in collaboration with the Waste Sector Team.

- For the category of Use of products and substitute of ozone depleting substances, close work with the Ozone Unit of the MMA will be carried out, since they have developed surveys which have generated new information in that regard.

5 SOLVENT AND OTHER PRODUCTS USE (3)



Karina Bahamonde

Liquid fuel

5.1. General overview of the sector

This sector includes emissions from the use of products such as lubricants, wax, tar, solvents, paints, etc. The sector includes the following categories:

- 3A. Paint application.
- 3B. Degreasing and dry cleaning.
- 3C. Chemical products, manufacture and processing.
- 3D Others.

In Chile, the only category with registered emissions is Chemicals, manufacture and processing. This category includes the use emissions from the following products:

- Lubricants in industrial applications and transport, and
- Paraffin wax in applications.

In Chile, they are mainly used in industrial applications and in transport. Lubricants are produced in refineries during the crude oil separation process, or in petrochemical plants. Consumption of lubricants in the country was extremely variable between 1990 and 2010. During such period, lubricant use was supplied through imports, since domestic production remained much lower. An exception occurred in 2010, according to figures provided by the National Statistics Institute (INE), when 223,618 tons of lubricants were produced.

Paraffin wax is used for applications such as candle making, corrugated boxes, paper coatings, glued plates, food production, bitumen brightness, surfactants (such as those used in detergents), among other uses. Between 1990 and 2010, the wax use in Chile is supported through imports, since domestic production was significantly lower, according to information provided by the National Statistics Institute.

The Solvent and Other Product Sector Use (SOPU) is the less GHG emitter sector in the country. In 2010, GHG emissions accounted for 243.0 $GgCO_2eq$, or 0.3% of the total GHG emissions. Since 1990 the sector's GHG emissions have increased by 195.1%. The key driver of this increase is the shifting demand for lubricants in Chile. At category level, 100% of GHG emissions derive from the Chemicals, manufacture and processing category (Table 42 and Figure 36 and Figure 37). The only GHG emitted by the sector was CO_2.

Table 42. SOPU sector: GHG emissions ($GgCO_2eq$) per category, 1990 - 2010 series.

Category	1990	1995	2000	2005	2010
3C. Chemicals, manufacture and processing.	82.3	94.8	118.0	110.7	243.0
Total	**82.3**	**94.8**	**118.0**	**110.7**	**243.0**

Source: Compilation by SNICHILE.

Figure 36. SOPU sector: Trend in the sector's share of the total GHG emissions of the sector (excl. LULUCF).

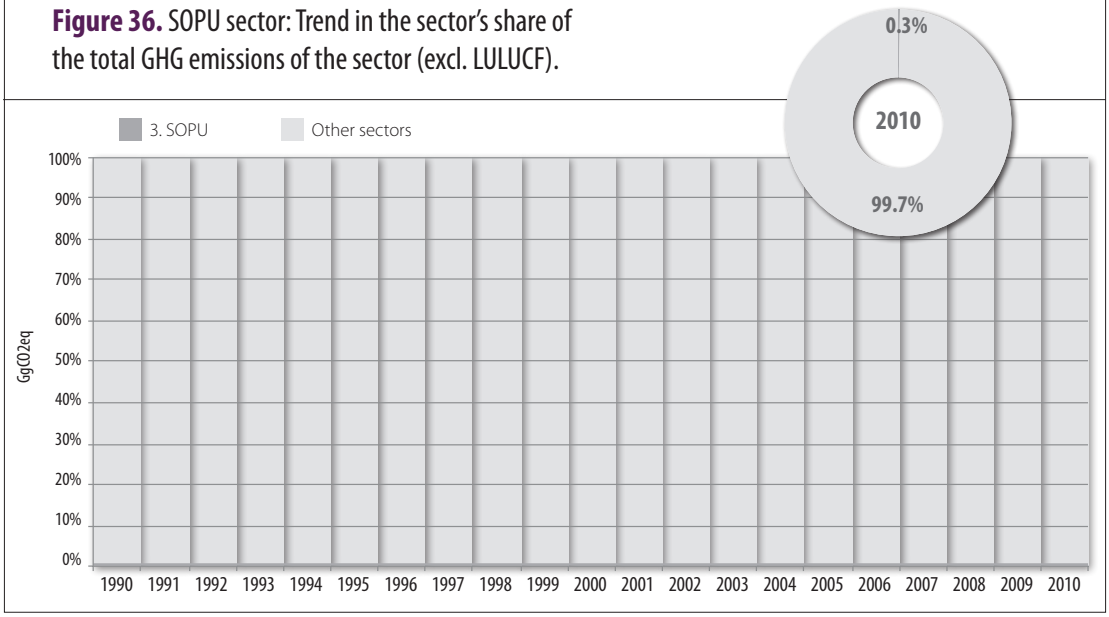
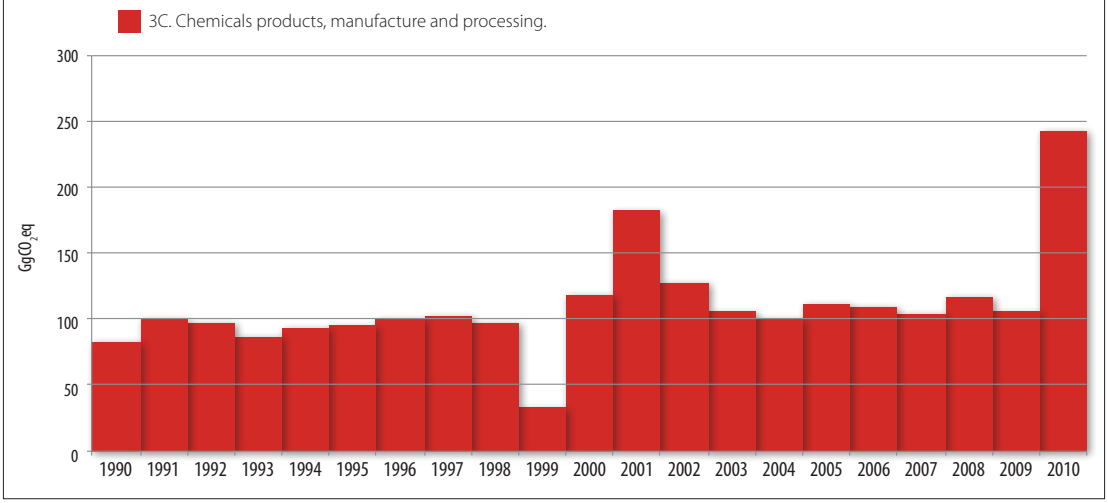


Figure 37. SOPU sector: GHG emission trend per category, 1990 - 2010 series



5.1.1. Methodological aspects

The methods applied to estimate GHG emissions for this category are presented in the Table below:

Table 43. Solvent and other products use: methods applied

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
3. Solvent and other product use	T1	D			NO	NO
A. Paint applications	NE	NE				
B. Degreasing and dry cleaning	NE	NE				
C. Chemical products, manufacture and processing	T1	D				
D. Others	NA	NA	NA	NA	NA	NA

T1= Tier 1 Method; D= Default; NA= Not applicable; NE= Not estimated; NO= Not occurring.

Source: Compilation by SNICHILE.

The method usually used to estimate GHG emissions is based on multiplying the emission factor, that is comprised of the carbon content factor and a factor representing the fossil fuel carbon fraction that is Oxidized During Use (ODU). The calculation included oxidation during first use of lubricants and paraffin wax, only, but not ulterior uses.

5.1.1.1. Statistical and parametric activity data

The activity data on the use of lubricants came from a balance between production, imports and exports. Production data came from the National Statistics Institute, which provided data from 1998 to 2010. Production for 1990 to 1997 was estimated using a customized method as per the 2006GL, while import and export data was provided by the National Customs Service.

Activity data on paraffin use was estimated in a similar way, processing the production data provided by the National Statistics Institute.

5.1.1.2. Emission factors

Default emission factors as per the 2006GL were used for each corresponding category.

5.2. Quality assurance and quality control procedure

The SOPU sector report was prepared by the IPPU Sector Team and therefore employed the same quality assurance and quality control procedure, which can be reviewed in section 4. Industrial Processes

5.3. Planned improvements

The SOPU sector report was prepared by the IPPU Sector Team and therefore includes the same planned improvements, which can be reviewed in section 4. Industrial Processes

6 AGRICULTURE SECTOR (4)

Felipe Cantillana FICH

6.1. General Overview of the sector

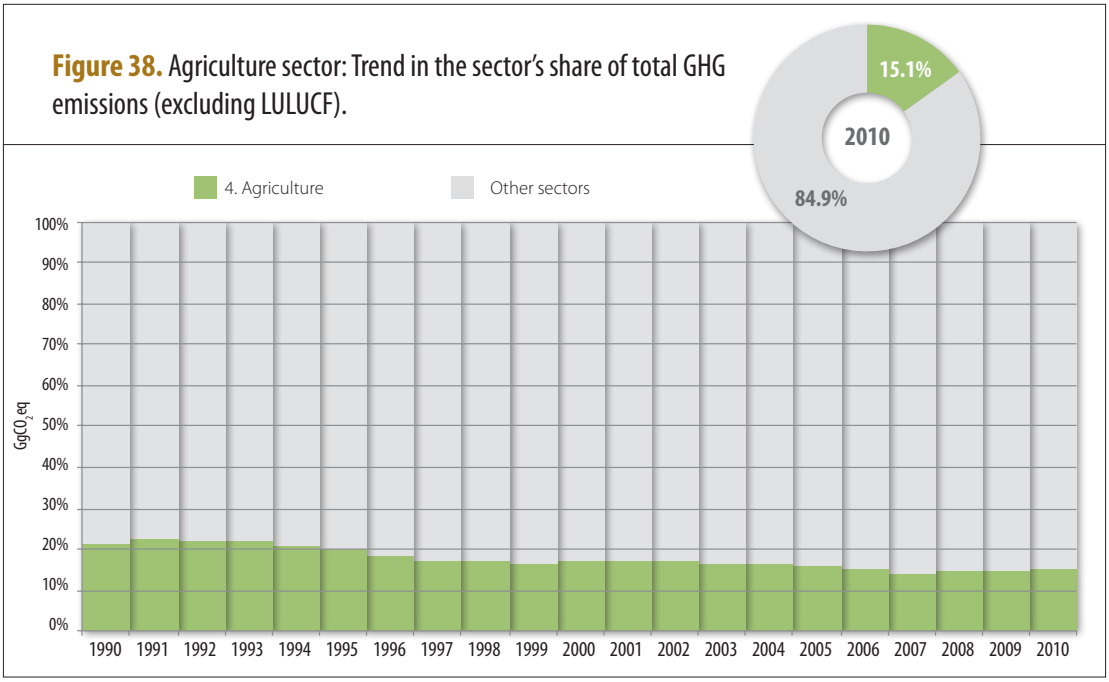
This sector includes greenhouse gas emissions associated with cropping and livestock activities CH_4 and N_2O associated with livestock activity, rice cultivation, anthropogenic nitrogen contributions to the soil and field burning of agricultural waste are quantified. The sector includes the following categories:

- 4A. Enteric fermentation.
- 4B. Manure management.
- 4C. Rice cultivation.
- 4D. Agricultural soils.
- 4E Prescribed burning of savannah.
- 4F Field burning of agricultural residues.

The Chilean inventory includes GHG emissions from all of the categories mentioned above, except for Prescribed burning of savannah, since this vegetation formation does not exist in the country.

The Agriculture sector is the second largest GHG emitter in Chile, accounting for 15.1% of the country's total GHG emissions (Figure 38).

Figure 38. Agriculture sector: Trend in the sector's share of total GHG emissions (excluding LULUCF).



In 2010, GHG emissions from this sector amounted to 13,825.6 $GgCO_2eq$ (Table 44), Since 1990, the sector's GHG emissions have increased by 29.1%. As shown in Figure 39, the key driver of this increase was the steady growth in emissions from the Agricultural soils category, which represents more than 50% of the sector's overall GHG emissions. This increase was caused mainly by more widespread use of synthetic nitrogen-based fertilizers, especially for annual crops.

At the category level, 52.4% of all GHG emissions in this sector come from Agricultural soils, followed by Enteric fermentation with 34.4% and Manure management with 12.1%. The remaining 1% derives from Rice cultivation and Field burning of agricultural waste categories.

In 2010, the main GHG emitted by this sector was N_2O, accounting for 54.7% of the sector's overall GHG emissions. The second most prevalent GHG was CH_4, with 45.3% of the total. CO_2 emissions are not accounted in this sector (Table 45 and Figure 40).

Table 44. Agriculture sector: GHG emissions ($GgCO_2eq$) per category, 1990 - 2010 series.

Category	1990	1995	2000	2005	2010
4A. Enteric fermentation	4,317.1	4,738.3	4,956.7	4,906.1	4,762.5
4B. Manure management	1,254.7	1,423.2	1,593.8	1,585.0	1,678.9
4C. Rice cultivations	137.9	143.6	109.0	105.9	103.8
4D. Agricultural soils	4,856.2	5,500.5	5,764.8	6,081.0	7,251.4
4F. Field burning of agricultural waste	144.3	87.0	68.8	58.9	29.1
Total	**10,710.2**	**11,892.6**	**12,493.2**	**12,736.9**	**13,825.6**

Source: Compilation by SNICHILE.

Table 45. Agriculture sector: emissions per GHG type ($GgCO_2eq$), 1990 - 2010 series.

GHG	1990	1995	2000	2005	2010
CH_4	5,640.9	6,163.0	6,469.0	6,359.4	6,259.8
N_2O	5,069.3	5,729.5	6,024.2	6,377.5	7,565.9
Total	**10,710.2**	**11,892.6**	**12,493.2**	**12,736.9**	**13,825.6**

Source: Compilation by SNICHILE.

Figure 39. Agriculture sector: GHG emission trend per category, 1990 - 2010 series.

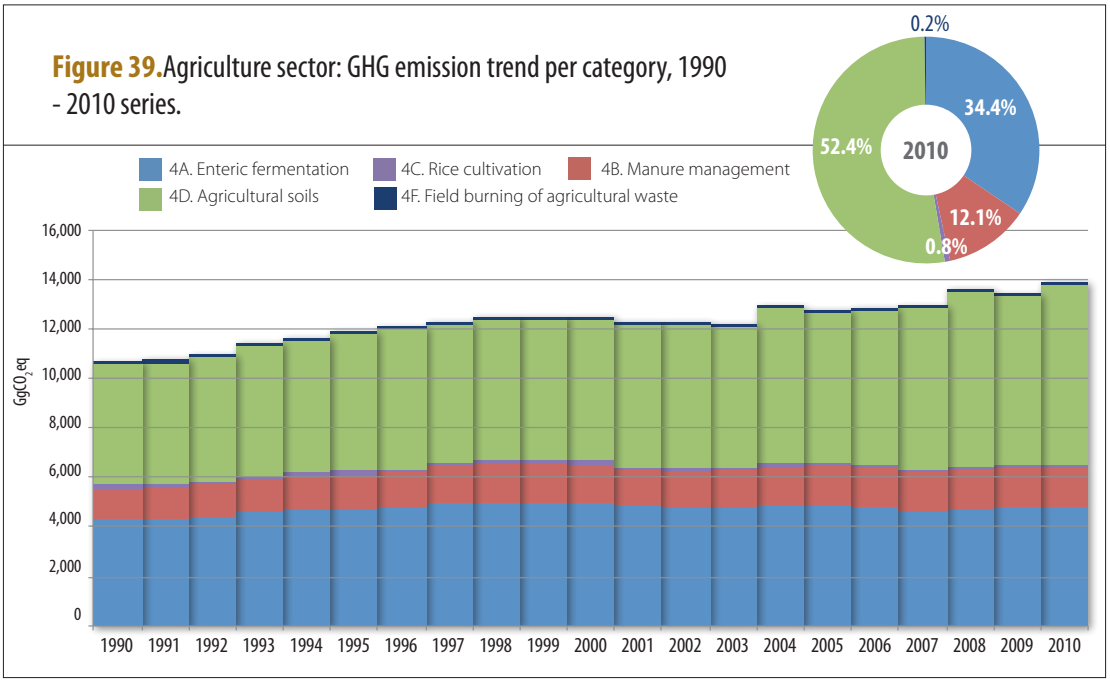
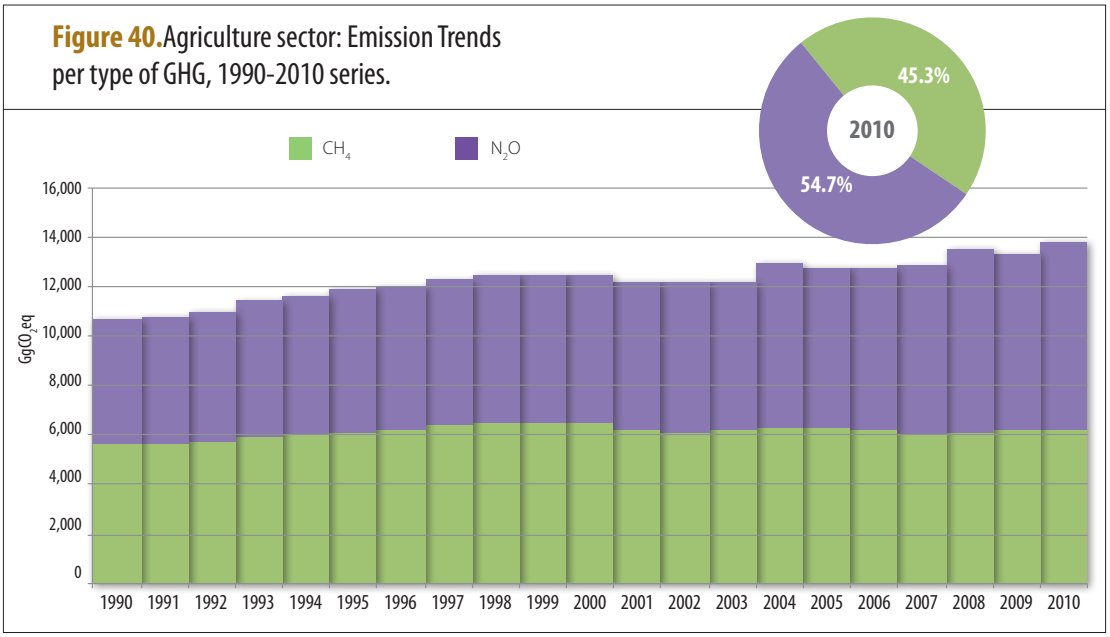


Figure 40. Agriculture sector: Emission Trends per type of GHG, 1990-2010 series.



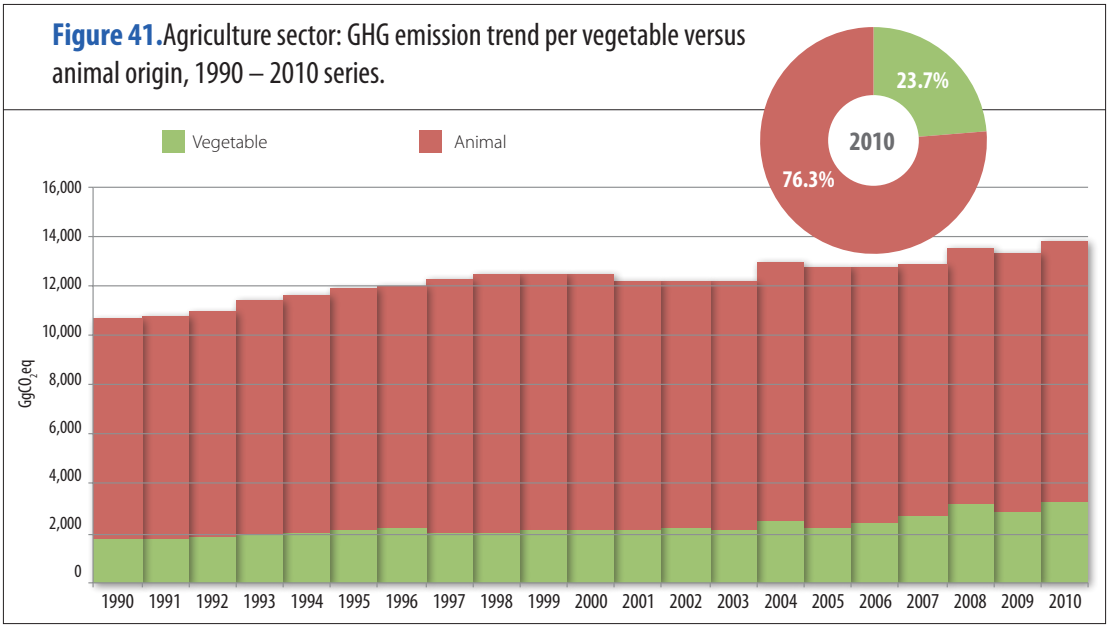
In 2010, GHG emissions of animal origin amounted to 10,547.1 $GgCO_2eq$, while emissions of vegetable origin amounted to 3,278.5 $GgCO_2eq$ (Table 46 and Figure 41). Since 1990, GHG emissions of animal origin have increased by 18.4%, mainly due to the increase in the livestock population linked to increasing confinement, which caused a rise in CH_4 emissions from enteric fermentation and manure management, Meanwhile, GHG emissions of vegetable origin increased by 81.8%, mainly due to the increased use of synthetic nitrogen-based fertilizers, although the increasingly common practice of incorporating organic waste into soils has also contributed to this rise.

Table 46. Agriculture Sector: GHG emissions ($GgCO_2eq$) of vegetable and animal origin, 1990 – 2010 series

Origin	1990	1995	2000	2005	2010
Vegetable	1,803.8	2,153.0	2,180.7	2,242.1	3,278.5
Animal	8,906.3	9,739.5	10,312.5	10,494.8	10,547.1
Total	**10,710.2**	**11,892.6**	**12,493.2**	**12,736.9**	**13,825.6**

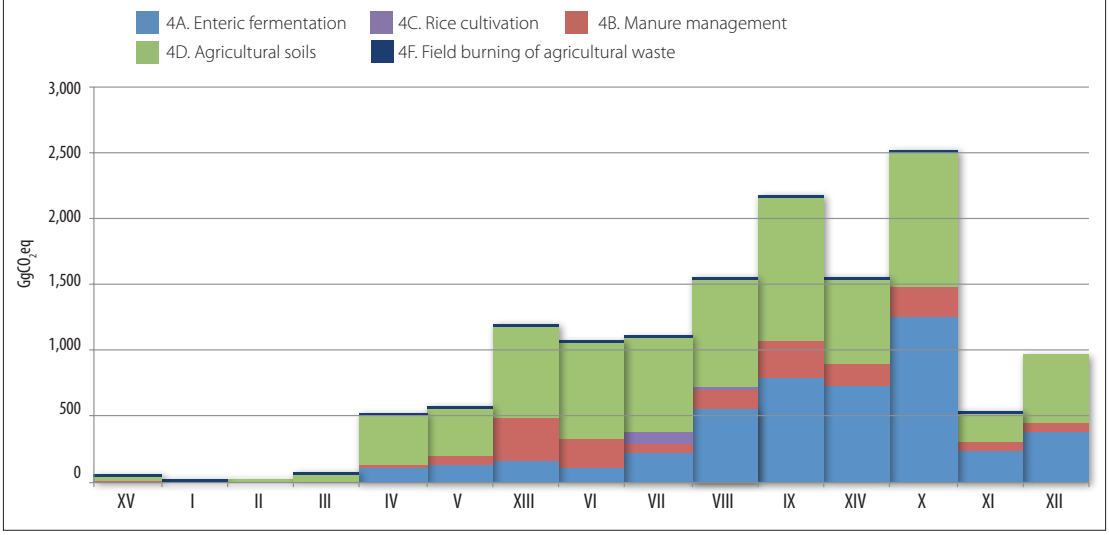
Source: Compilation by SNICHILE.

Figure 41. Agriculture sector: GHG emission trend per vegetable versus animal origin, 1990 – 2010 series.



One distinctive feature of the Agriculture sector on the Chile's NIR, is that its emissions have been counted at an administrative region level. As Figure 42 shows, in 2010, 18.1% of the GHG emissions of the sector were produced in X Los Lagos Region (with bovine cattle activity as the main source), followed by 15.7% from IX La Araucanía Region (with Agricultural soils and Field burning of agricultural residues as the main sources), 11.2% from XIV de los Lagos Region, another 11.2% from VIII Biobio Region, 8.6% from XIII Metropolitan Region of Santiago (with animal manure management as the main source, 8.0%% from VII Maule Region (with rice cultivation as main source) and the remaining 22.7% spread among the remaining nine administrative regions.

Figure 42. Agriculture sector: GHG emissions per administrative category and region, 2010



6.2. Enteric fermentation (4A)

6.2.1. Description of category and GHG emissions

Methane is produced as a byproduct of digestive processes, primarily in animals with a compound stomach (ruminants such as cows and sheep), although non-ruminants (e.g. hogs, horses) also release CH_4.

In Chile, the livestock types included in this category are:

- Cattle[10] (disaggregated as dairy cattle and non-dairy cattle),
- Sheep,
- Goats,
- Camelidae (llamas and alpacas),
- Equidae (horses),
- Mules and Asses, and
- Swine.

In 2010, GHG emissions from this category amounted to 4,762.5 $GgCO_2eq$, or 34.4% of the sector (Table 47), Since 1990, GHG emissions have experienced 10.3% increase. The key driver being growth of the livestock population, specifically bovine cattle.

In regard to livestock types, Non-dairy cattle comprise the most significant group, accounting for 61.0%, followed by Dairy cattle with 24.0%, Sheep with 8.7%, and Horses with 2.2%. Swine accounted for 2.2% and Goats for 1.5%. The remaining 0.3% derived from Llamas and alpacas, and Mules and asses (Figure 43).

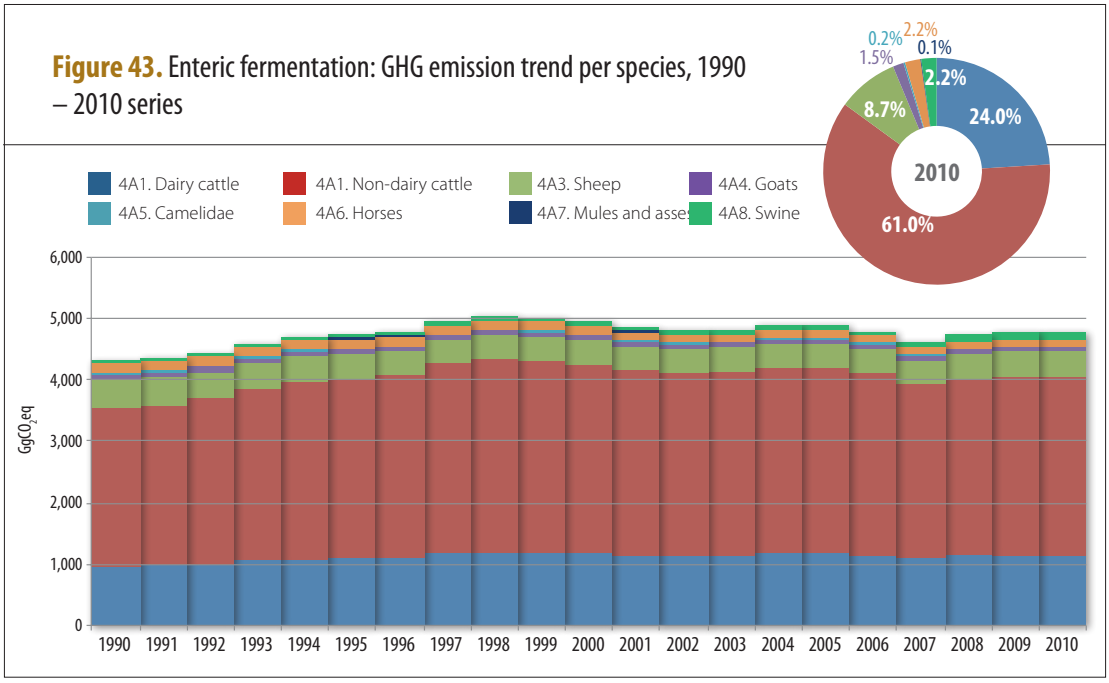
10. "Cattle" shall be understood to refer specifically to bovines.

Table 47. Enteric fermentation: GHG emissions ($GgCO_2eq$) per type of livestock, 1990 – 2010 series

Species	1990	1995	2000	2005	2010
4A1. Dairy cattle	962.2	1,097.1	1,175.1	1,178.8	1,144.3
4A1. Non-dairy cattle	2,587.4	2,925.9	3,083.1	3,021.6	2,904.6
4A3. Sheep	454.0	406.8	394.1	404.3	414.6
4A4. Goats	89.9	80.2	75.7	74.6	73.5
4A5. Camelidae	19.7	20.8	18.8	14.8	11.4
4A6. Horses	154.2	151.6	140.0	122.4	104.8
4A7. Mules and asses	3.8	4.0	4.4	4.8	5.3
4A8. Swine	45.8	51.7	65.6	84.8	103.9
Total	**4,317.1**	**4,738.3**	**4,956.7**	**4,906.1**	**4,762.5**

Source: Compilation by SNICHILE.

Figure 43. Enteric fermentation: GHG emission trend per species, 1990 – 2010 series



6.2.2. Methodological aspects

The methods applied to prepare the Enteric fermentation category are shown in the Table below:

Cattle

Cattle emissions were estimated using a Tier 2 method, which involves using country-specific emission factors, disaggregated regionally. The formula used was the one provided in the

Table 48. Enteric fermentation: methods applied

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
A. Enteric fermentation			T1b, T2	D, CS		
1. Cattle			T2	CS		
2. Buffalo			NO	NO		
3. Sheep			T1b	D		
4. Goats			T1b	D		
5. Camelidae			T1b	D		
6. Horses			T1b	D		
7. Mules and asses			T1b	D		
8. Swine			T1b	D		
9. Poultry			NE	D		
10. Others			NE	D		

T1b= Disaggregation per administrative regions; T2= Tier 2 Method; D= Default; CS= Country-specific; NE= Not estimated; NO= Not Occurring.
Source: Compilation by SNICHILE.

Cattle. Jorge Herreros

2006GL for calculating Tier 2 CH_4 emissions, is the following:

$$FE=\left[\frac{GEx\left(\frac{Ym}{100}\right)x365}{55{,}65}\right]$$

Where:

- EF = Emission factor, kg CH_4 animal^{-1} year^{-1}
- GE= Gross energy ingested, MJ animal^{-1} day^{-1}
- Y_m = methane conversion factor, percentage of gross energy of the feed converted into methane
- The factor 55.65 (MJ/kg CH_4) is the energy content of methane.

Country-specific emission factors were already available for Cattle during the preparation of Chile's previous NIR, Thus, for this opportunity, the focus was on updating the supporting documentation This was possible due to the help of researchers from the Remehue Regional Research Center (Centro de Investigación Regional Remehue) a branch of the Institute for Agricultural Research (INIA), executing a meticulous characterization and managing to produce an estimation on the gross energy consumed by each type of animal in each kind of management system, key variable for the calculations of country-specific emission factors. Using the 2006GL and available expertise, new animal-specific emission factors were estimated.

Other species

Emissions from these subcategories were calculated using a Tier 1b method, which involves disaggregating statistical activity by region and using default emission factors.

6.2.2.1. Statistical and parametric activity data

The population data required for all subcategories were obtained from the 1997 and 2007 National Agriculture and Livestock Censuses, from annual statistics published by ODEPA and from FAOSTAT. This data is disaggregated by administrative region, which allowed to apply a Tier 1b method for the subcategories Sheep, Goats, Camelidae, Horses, Mules and asses and Swine. The parametric data used for these subcategories was the default data according to the 2006GL.

6.2.2.2. Emission factors

Cattle

Since the previous inventory, submitted in the Second National Communication of Chile (MMA, 2011), Tier 2 emission factors were available for the Cattle subcategory. On that occasion, INIA-Remehue researchers[11] reviewed all calculations to ensure that the values were properly adjusted. In order to reach the new emission factors, a meticulous characterization was performed, achieving a gross energy consumed per animal type and management system estimation (Table 49), according to the methodology introduced in 2006GL.

11. Marta Alfaro, Francisco Salazar and Erika Vistoso, mainly.

Table 49. Cattle: Determination of gross energy consumed by Dairy and Non-dairy cattle under direct grazing

Animal groups	Live weight, kg	Default Cf	Net energy needed for maintenance (NEm)	Feed coefficient (Cf)	Net energy for activity (NEa)	Net energy from weight loss	Growth coefficient	Adult body weight, kg	Daily weight gain (kg day-1)	Net energy for growth (NEg)
Lactating dairy cow	600	0.335	40.6	0.17	6.9	0	0.8	600	0	0
Non-lactating dairy cows	600	0.335	40.6	0.17	6.9	0	0.8	600	0	0
Beef cows	500	0.335	35.4	0.17	6.02	0	0.8	500	0	0
Heifers	300	0.322	23.2	0.17	3.95	0	0.8	300	0.4	9.53
Adult beef cattle	450	0.322	31.5	0.17	5.35	0	1	450	0.35	6.96
Juvenile beef cattle	260	0.322	20.8	0.17	3.54	0	0.9	260	0.3	6.36
Calves	150	0.322	13.8	0.17	2.35	0	0.9	150	0.3	6.36
Source:	Expert judgment	2006GL	2006GL	2006GL	2006GL	2006GL	2006GL	Expert judgment	2006GL	2006GL

Animal groups	Pregnancy coefficient	Net energy for pregnancy (NEp)	Productivity, kg milk/day	Fat in milk, %	Energy for lactation (ENI)	Net energy for work	En Ratio for maintenance in diet/Digestible E consumed	En Ratio for growth in diet/ Digestible E consumed	Digestibility of feed (ED)	Gross energy (GE)
Lactating dairy cow	0.1	3.66	9.66	0.0381	14.4	0	0.5195	0.3085	65	194.0489
Non-lactating dairy cows	0.1	3.66	2.57	0.035	3.8	0	0.5195	0.3085	65	162.8604
Beef cows	0.1	3.54	2.57	0.03	3.8	0	0.5195	0.3085	65	144.5261
Heifers	0	0	0	0	0	0	0.5195	0.3085	65	127.9498
Adult beef cattle	0	0	0	0	0	0	0.5195	0.3085	65	143.7321
Juvenile beef cattle	0	0	0	0	0	0	0.5195	0.3085	65	103.9726
Calves	0	0	0	0	0	0	0.5195	0.3085	65	79.5529
Source:	2006GL	2006GL	Expert judgment	Expert judgment	2006GL	2006GL	2006GL	2006GL	Expert judgment	2006GL

Source: 2006GL and expert judgment of investigators from INIA-Remehue.

Emission factors disaggregated per region and type of cattle are presented in Table 50.

Sheep, Goats, Camelidae, Horses, Mules and Asses and Swine

For these species, the default emission factors provided in the 2006GL were used.

6.3. Manure management (4B)

6.3.1. Description of category and GHG emissions

CH_4 is produced by the decomposition of manure under anaerobic conditions, while N_2O is produced under aerobic conditions or a mixture of anaerobic and aerobic conditions. Consequently, GHG emissions from these sources will depend on the kind of manure and how it is stored.

In the national context, CH_4 emissions derive primarily from bovine cattle (disaggregated into dairy cows, beef cows, heifers, calves, adult and juvenile beef cattle), sheep, goats, equidae, mules and asses, South American camelids (llamas and alpacas), swine (divided into sows, boars and piglets) and poultry, specifically broilers.

In the case of N_2O emissions, the following manure management systems (MMS) were taken into account:

- Anaerobic lagoons: Dairy cattle,

Table 50. Cattle: Tier 2 emission factors calculated for bovine cattle

	Emission factors (kg CH_4 animal-1 year-1)														
Type of cattle	XV	I	II	III	IV	V	XIII	VI	VII	VIII	IX	XIV	X	XI	XII
Dairy cows	78.60	78.60	78.60	78.60	79.80	79.80	79.80	79.80	79.80	78.06	77.44	77.48	76.81	76.81	76.81
Beef cows	56.88	56.88	56.88	56.88	56.88	56.88	26.16	12.03	5.54	56.88	56.88	56.88	56.88	56.88	56.88
Heifers	50.35	50.35	50.35	50.35	50.35	50.35	50.35	50.35	50.35	50.35	50.35	50.35	50.35	50.35	50.35
Adult beef cattle	56.56	56.56	56.56	56.56	70.66	70.66	70.66	70.66	70.66	70.66	64.39	58.13	58.13	56.56	56.56
Juvenile beef cattle	40.92	40.92	40.92	40.92	40.92	40.92	40.92	40.92	40.92	40.92	40.92	40.92	40.92	40.92	40.92
Calves	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66

Source: Expert judgment of investigators from INIA-Remehue.

- Solid storage and dry lots: Non-dairy cattle and Poultry, and
- Other management systems: Swine

The other species are assumed to be direct pastured and therefore N_2O emissions from their manure are counted in the category Agricultural soils.

In 2010, GHG emissions in this category amounted to 1,678.9 $GgCO_2eq$, or 12.1% of the entire sector (Table 51). Since 1990, GHG emissions have experienced 33.8% increase. The key driver for this is the growth in the animal population. Interannual variations observed in Figure 44 are mainly the result of the introduction of biodigesters to some major swine production centers (2000).

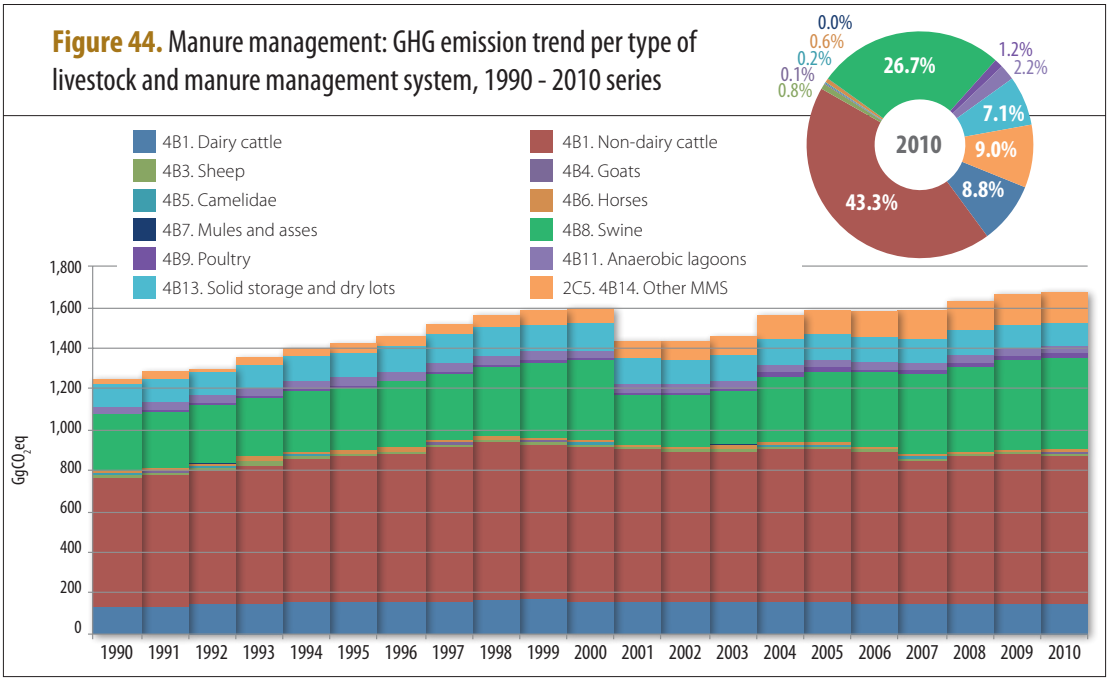
In terms of animal type, Non-dairy cattle are the most important accounting for 43.3%, followed by Swine with 26.7%, Horses with 9.0%, and Dairy cattle with 8.8%. The Solid and dry lot storage system accounted for 7.1% and Anaerobic lagoons for 2.2%. The remaining 2.9% is from the remaining subcategories.

Table 51. Manure management: GHG emissions ($GgCO_2eq$) per type of livestock and manure management treatment system, 1990 - 2010 series

Species	1990	1995	2000	2005	2010
4B1. Dairy cattle	138.1	155.4	161.6	155.0	147.7
4B1. Non-dairy cattle	629.0	712.1	756.6	752.1	727.4
4B3. Sheep	14.5	13.0	12.6	12.9	13.3
4B4. Goats	3.1	2.7	2.6	2.5	2.5
4B5. Camelidae	4.7	5.0	4.5	3.6	2.7
4B6. Horses	14.1	13.8	12.8	11.2	9.5
4B7. Mules and asses	0.3	0.4	0.4	0.4	0.5
4B8. Swine	270.2	304.6	386.5	349.4	448.0
4B9. Poultry	7.6	11.3	15.8	17.6	20.9
4B11. Anaerobic lagoons	33.6	38.0	40.0	39.0	37.4
4B13. Solid storage and dry lots	107.9	124.3	130.5	122.6	118.6
4B14. Other MMS	31.6	42.7	69.9	118.6	150.4
Total	**1,254.7**	**1,423.2**	**1,593.8**	**1,585.0**	**1,678.9**

Source: Compilation by SNICHILE.

Figure 44. Manure management: GHG emission trend per type of livestock and manure management system, 1990 - 2010 series



6.3.2. Methodological aspects

For the preparation of the Manure management category the following methods were applied:

Table 52. Manure management: methods applied.

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
B. Manure management			T1b, T2	D, CS	T1b	D
1. Cattle			T2	CS		
2. Buffalo			NO	NO		
3. Sheep			T1b	D		
4. Goats			T1b	D		
5. Llamas and Alpacas			T1b	D		
6. Horses			T1b	D		
7. Mules and asses			T1b	D		
8. Swine			T2	CS		
9. Poultry			T1b	D		
10. Others			NE	NE		
11. Anaerobic lagoons					T1b	D
12. Liquid -type systems					NO	D
13. Solid storage and dry lots					T1b	D
14. Other MMS					T1b	D

T1b= Disaggregation per administrative regions; T2= Tier 2 Method; D= Default; CS= Country-specific; NE= Not estimated; NO= Not Occurring.

Source: Compilation by SNICHILE.

Cattle and Swine

For estimating CH_4 emissions, Tier 2 emission factors for cattle and swine were used, due tom the important contribution of these species to emissions in the category. Tier 2 method involves the disaggregation of the livestock population into similar animal groupings and the use of country-specific emission factors.

Other species

CH_4 emissions were estimated using the Tier 1 method. For its application, it is enough to know the populations per species, which are multiplied by the corresponding default emission factors.

Manure management systems

For estimating N_2O emissions, Cattle were assigned into different manure management systems, and were also divided as indicated above. The manure management systems used for swine were based on information obtained from the Pork Producers Association of Chile (ASPROCER A.G.).

6.3.2.1. Statistical and parametric activity data

Cattle and other species

Activity data for each type of species were the same as those used for the Enteric fermentation category.

Swine

The swine population was disaggregated by type of manure management system based on information provided by ASPROCER A.G.

Manure management systems

The distribution of livestock populations was determined based on expert judgment[12]. One important parametric datum for estimating the N_2O emissions of each type of livestock is the annual nitrogen excretion rate for each animal species. It is worth noting that these rates were calculated by applying the excretion values for each 1,000 kg of live weight per day, which are provided in the 2006GL (Table 10.19, Chapter 10, Volume 4, 2006GL) and multiplying these by the body mass of each kind of livestock, as determined by expert judgment[13]. The values used are shown in the Table below:

12. INIA-Remehue Researchers

13. INIA-Remehue researchers and ASPROCER A.G. professionals.

Table 53. Nitrogen excretion rate (kg N animal year^{-1}).

Animal	N excretion rate (kg of N 1000 kg live weight-day^{-1})	Average body weight (liveweight in kg)	N Excretion (kg N animal-year^{-1})
Dairy cattle	0.48	650	113.9
Non-dairy cattle			
Beef cows	0.36	550	72.3
Heifers	0.36	350	46.0
Adult beef cattle	0.36	450	59.1
Juvenile beef cattle	0.36	250	32.9
Calves	0.36	150	19.7
Sheep	1.17	60	25.6
Goats	1.37	50	25.0
Llamas and alpacas	0.46	95	16.0
Horses	0.46	450	75.6
Mules and asses	0.46	237.5	39.9
Swine			
Boars	0.50	220	40.2
Sows	0.50	200	36.5
Piglets	0.50	64	11.7
Poultry	0.82	2.5	0.7

Source: Default values provided by the 2006GL; country-specific values based on the expert judgment of INIA-Remehue researchers and ASPROCER A.G. professionals

6.3.2.2. Emission factors

Cattle

GHG emissions for this subcategory were calculated using the Tier 2 emission factors for CH_4 emitted under the Manure management category and are presented in the Table below:

Table 54. Cattle: Tier 2 emission factors calculated for bovine cattle

	Emission factors (kg CH_4 (animal-year)$^{-1}$)														
Type of cattle	XV	I	II	III	IV	V	XIII	VI	VII	VIII	IX	XIV	X	XI	XII
Dairy cows	19.2	19.2	19.2	19.2	28.4	28.4	28.4	28.4	28.4	14.6	9.7	10.1	4.8	4.8	4.8
Beef cows	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.1	36.3	36.3	36.3	36.3	36.3
Heifers	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.8	1.1	1.1	1.1	1.1	1.1
Adult beef cattle	1.6	1.6	1.6	1.6	35.4	35.4	35.4	35.4	35.4	35.4	0.9	0.8	0.8	0.8	0.8
Juvenile beef cattle	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.7	39.2	39.2	39.2	39.2	39.2
Calves	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.3	2.3	2.3	2.3	2.3	2.3

Source: Expert judgment of investigators from INIA-Remehue.

Swine

The Tier 2 emission factors for CH_4 in the Manure management category calculated using parametric data provided by ASPROCER A.G. and which were used for this subcategory emissions calculation are shown in the Table below:

Table 55.

Swine: Tier 2 emission factors calculated.

Emission Factors (kg CH_4 (animal-year)$^{-1}$)	
Sows	26.07
Boars	20.85
Piglets	6.95

Source: Expert judgment of ASPROCER A.G. professionals.

Other species and Other MMS

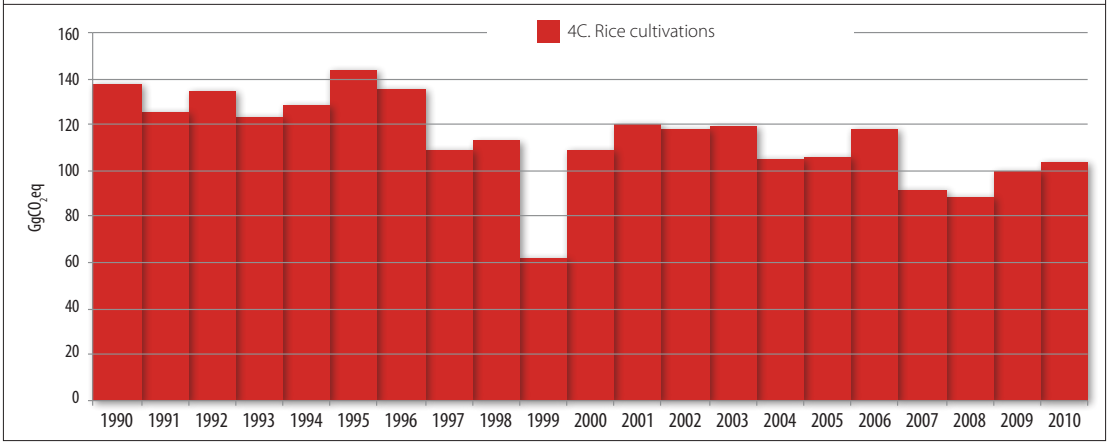
The default emission factors provided in the 2006GL were used for all remaining subcategories.

6.4. Rice cultivation (4C)

6.4.1. Description of category and GHG emissions

The anaerobic decomposition of organic material in flooded rice paddies produces CH_4,

Figure 45. Rice cultivation: methane emission trend, 1990 - 2010 series



which is released into the atmosphere, primarily through water bubbles and by being transported through the rice plants. The quantity emitted varies with the rice variety, the duration of flooding, the number and duration of crop cycles, the soil temperature, the irrigation method and whether or not organic substrates are incorporated.

In the case of Chile, this species is cultivate in a dew central administrative regions, in all cases under permanent flooding and without the incorporation of organic substrates, and having one harvest a year.

In 2010, GHG emissions in this category amounted to 103.8 $GgCO_2eq$, or 0.8% of the sector's total emissions (Table 56 and Figure 45). Since 1990, GHG emissions have experienced 24.7% drop, due to a steady decrease in the cropped surface.

Table 56. Rice cultivation: methane emissions ($GgCO_2eq$), 1990 - 2010 series

Management	1990	1995	2000	2005	2010
4C. Rice cultivations	137.9	143.6	109.0	105.9	103.8
Total	**137.9**	**143.6**	**109.0**	**105.9**	**103.8**

Source: Compilation by SNICHILE.

6.4.2. Methodological aspects

The methods used to prepare the Rice cultivation category are shown in the Table below:

Table 57. Rice cultivation: methods applied.

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
C. Rice cultivations			T1b	D		
1. Irrigated			T1b	D		
2. Rainfed			NO	D		
3. Deep water			NO	D		
4. Others			NO	D		

T1b= Disaggregated per administrative regions; D= Default; NO= Not Occurring.

Source: Compilation by SNICHILE.

6.4.2.1. Statistical and parametric activity data

The annual cultivation surface was obtained from the National Agriculture and Forestry Census (Censo Nacional Agropecuario y Forestal) and from the Crop Statistics data compiled by ODEPA. The information collected enabled disaggregation of the data per region.

6.4.2.2. Emission factors

A default emission factor was used in this calculation, on the assumption that (1) no flooding occurred for at least 180 days before the rice was sown; (2) paddies were permanently inundated throughout the entire growing period; and (3) no organic substrate was added to the soil (EFc)

6.5. Agricultural soils (4D)

6.5.1. Description of category and GHG emissions

N_2O emissions from soil surfaces result primarily from the microbial processes on the soil; emissions are the result mainly of the amount of nitrogen added to the soil in the form of synthetic fertilizers, animal manure, crop residues and sludges from wastewater treatment plants or other organic nitrogen substrates which may release nitrogen directly when applied or indirectly when the nitrogen is leached as NO_3 or volatilized as NH_3 and NO_x and then deposited in other places.

In 2010, GHG emissions from this category amounted to 7,251.4 $GgCO_2eq$, or 52.4% of the emissions of the sector (Table 58). Since 1990, GHG emissions have increased by 49.3%, The main driver of this is the increase on the use of synthetic nitrogen-based fertilizers.

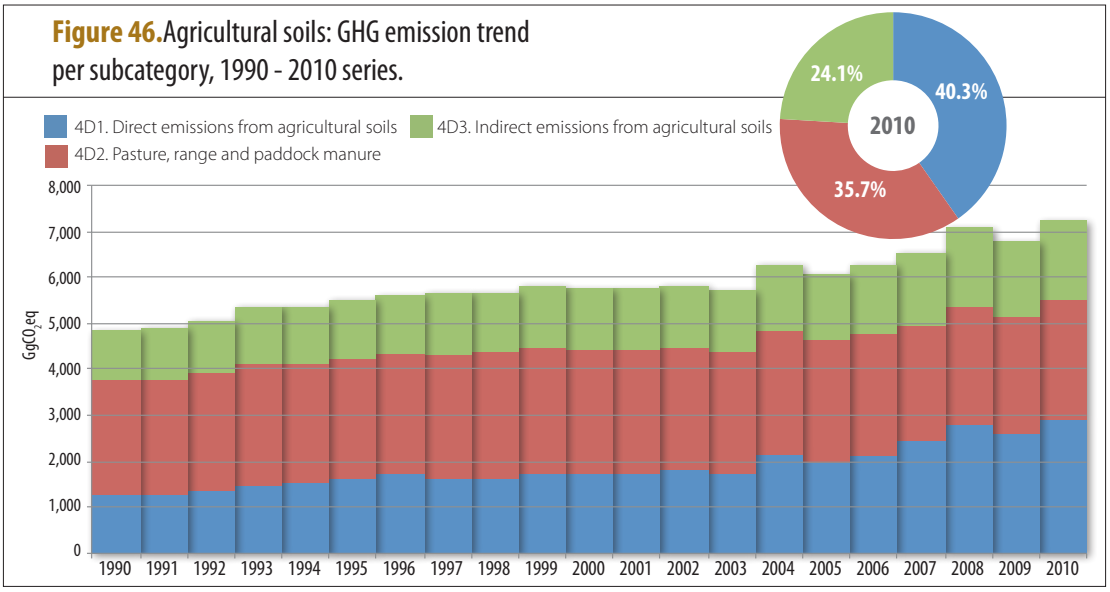
At a subcategory level, Direct emissions from agricultural soils are the most significant, ac-

Table 58. Agricultural soils: GHG emissions ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
4D1. Direct emissions from agricultural soils	1,282.9	1,625.1	1,719.8	1,973.4	2,920.1
4D2. Pasture, range and paddock manure	2,464.4	2,628.5	2,727.9	2,663.7	2,586.7
4D3. Indirect emissions from agricultural soils	1,108.9	1,246.8	1,317.1	1,443.9	1,744.6
Total	**4,856.2**	**5,500.5**	**5,764.8**	**6,081.0**	**7,251.4**

Source: Compilation by SNICHILE.

Figure 46. Agricultural soils: GHG emission trend per subcategory, 1990 - 2010 series.



counting for 40.3%, followed by 35.7% from pasture, range and paddock manure, and 24.1% from indirect emissions from agricultural soils (Figure 46).

6.5.1.1. Direct emissions from agricultural soils (4D1)

In the Chilean context, direct N_2O emissions from managed agricultural soils are the result of nitrogen applied to the soil in the following forms:

- Synthetic fertilizers,
- Animal manure applied to soils, and
- Crop residues.

N_2O emissions from organic soils (histosols) were not included due to a lack of data related to the management of this type of soils in the country.

In 2010, GHG emissions from this subcategory amounted to 2,920.1 $GgCO_2eq$, or 40.3% of the category's total (Table 59). Since 1990, GHG emissions of this subcategory have increased 127.6%, The main driver of this is the increased use of synthetic nitrogen-based fertilizers.

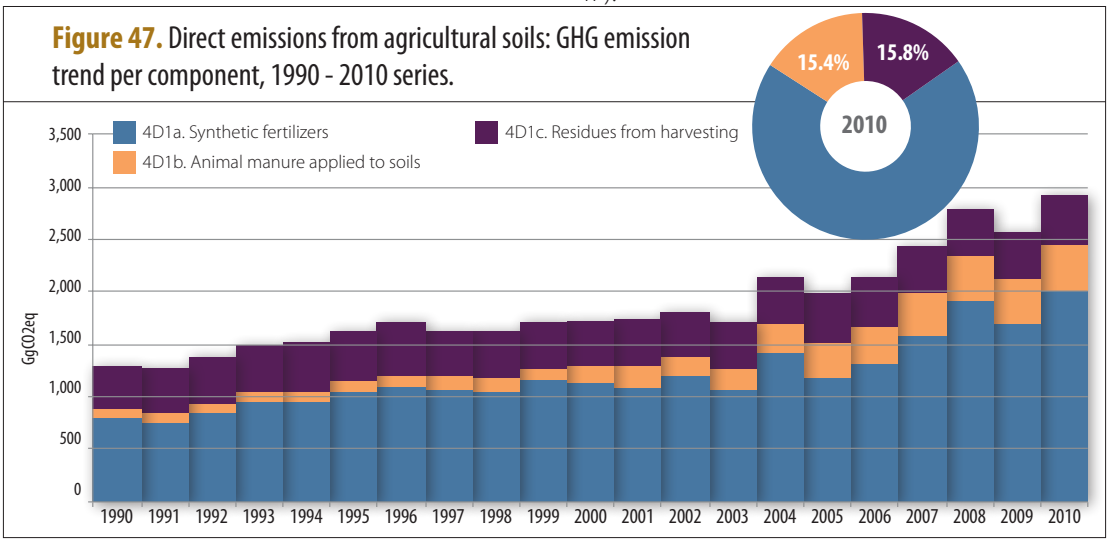
In terms of components, Synthetic fertilizers are the most important, accounting for 68.8%, followed by Crop residues with 15.8% and Animal manure applied to the soil with 15.4% (Figure 47).

Table 59. Direct emissions from agricultural soils: GHG emissions ($GgCO_2eq$) per component, 1990 - 2010 series

Component	1990	1995	2000	2005	2010
4D1a. Synthetic fertilizer	799.4	1,047.4	1,144.8	1,172.6	2,009.5
4D1b. Animal manure applied to soils	79.7	106.7	140.6	334.8	450.1
4D1c. Residues from harvesting	403.8	471.0	434.5	466.0	460.5
Total	**1,282.9**	**1,625.1**	**1,719.8**	**1,973.4**	**2,920.1**

Source: Compilation by SNICHILE.

Figure 47. Direct emissions from agricultural soils: GHG emission trend per component, 1990 - 2010 series.



6.5.1.2. Pasture, range and paddock manure (4D2)

In 2010, GHG emissions in this subcategory amounted to 2,586.7 $GgCO_2eq$, or 35.7% of total emissions in the category (Table 58 and Figure 46), Since 1990, GHG emissions have increased by 5.0%.

6.5.1.3. Indirect emissions from agricultural soils (4D3)

Indirect N_2O emissions included in this subcategory are:

- Volatilization (as NH_3 and NO_X) of N applied as synthetic and organic fertilizers, and
- Leaching and surface runoff of N from synthetic and organic fertilizers, and crop residues.

In 2010, GHG emissions from this subcategory amounted to 1,744.6 $GgCO_2eq$, or 24.1% of total emissions of the category (Table 60 and Figure 48). Since 1990, GHG emissions have increased by 57.3%, The main driver of the increase is application of organic N to the soil in the form of animal manure and, to a lesser extent, from synthetic nitrogen-based fertilizer use.

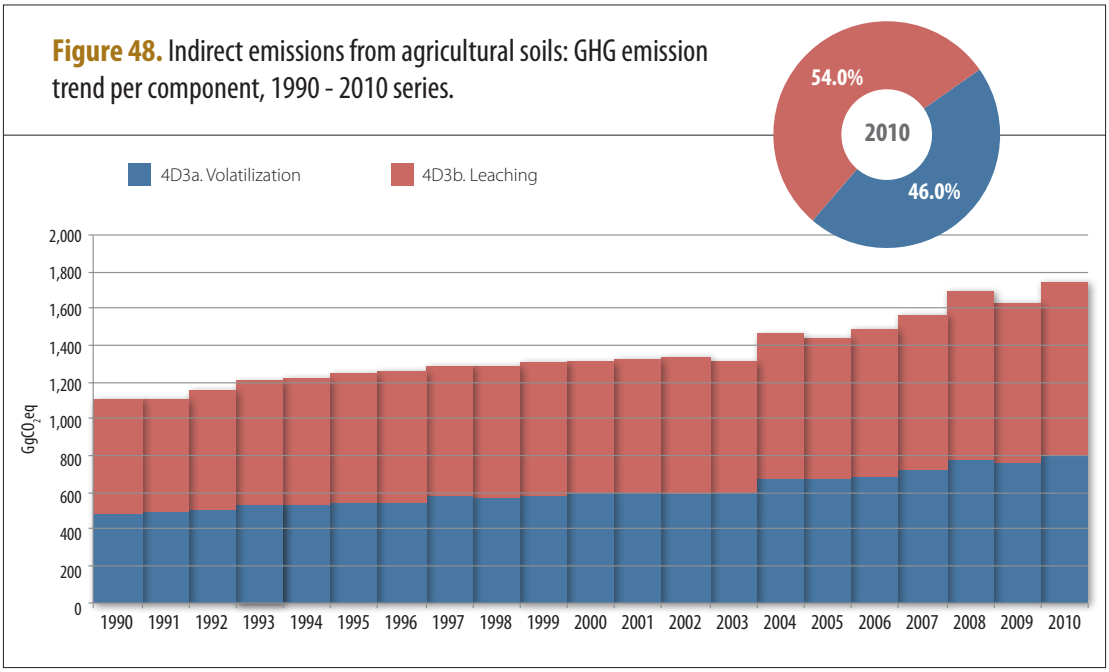
In terms of components, Leaching is the most significant, accounting for 54.0%, followed by Volatilization with 46.0% (Figure 48).

Table 60. Indirect emissions from agricultural soils: GHG emissions ($GgCO_2eq$) by component, 1990 - 2010 series.

Component	1990	1995	2000	2005	2010
N-Synthetic fertilizers	79.9	104.7	114.5	117.3	201.0
N-Animal manure applied to soils	15.9	21.3	28.1	67.0	90.0
N-Pasture, range and paddock manure	323.0	332.7	339.7	332.9	324.8
N-Manure management	70.3	90.3	111.8	155.6	187.4
4D3a. Volatilization	489.2	549.1	594.1	672.7	803.2
N-Synthetic fertilizers	147.6	193.4	211.4	216.5	371.0
N-Animal manure applied to soils	17.9	24.0	31.6	75.3	101.3
N-Pasture, range and paddock manure	363.4	374.3	382.2	374.5	365.4
N-Crop residues	90.9	106.0	97.8	104.9	103.6
4D3b. Leaching	619.8	697.7	723.0	771.2	941.3
Total	**1,108.9**	**1,246.8**	**1,317.1**	**1,443.9**	**1,744.6**

Source: Compilation by SNICHILE.

Figure 48. Indirect emissions from agricultural soils: GHG emission trend per component, 1990 - 2010 series.



6.5.2. Methodological aspects

The methods applied to prepare the Agricultural soils category are shown in the Table below:

Table 61. Agricultural soils: methods applied.

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
D. Agricultural soils					T1b	D
1. Direct emissions from agricultural soils					T1b	D
2. Animal manure applied to soils					T1b	D
3. Indirect emissions from agricultural soils					T1b	D
4. Others					NO	NO

T1b= Disaggregated per administrative regions; D= Default; NO= Not Occurring.

Source: Compilation by SNICHILE.

Emissions in this subcategory were calculated with a Tier 1b method, which uses data disaggregated by region and default emission factors.

6.5.2.1. Statistical and parametric activity data

Direct emissions from soils

The collected data corresponds to the tons of synthetic nitrogen fertilizer consumed annually in Chile The only available source in the country is de FAO data base (FAOSTAT), which provides figures on apparent annual consumption. To disaggregate consumption by region, information was gathered on the area under cultivation in each region for each of 13 different crop areas and surfaces with different irrigation regimes from the VII Agriculture and Livestock Census (VII Censo Agropecuario y Forestal) (INE, 2007). This data allowed the N data to be disaggregated by region in proportion to the area under cultivation in each. The estimations also employed data on crop residues (generated using productivity data from agriculture and livestock censuses and from annual statistics published by ODEPA). Emissions from subcategories related to animal manure were calculated under the Manure management category.

Pasture, range and paddock manure

Data was calculated by using N excretion rates multiplied by the direct-pastured animal population.

Indirect emissions from soils

The data used for this subcategory are the same used to calculate Direct soil emissions.

In accordance with the 2006GL, indirect emission calculations do not include any areas under mechanized irrigation as this watering system eliminates leaching and runoff.

6.5.2.2. Emission factors

In accordance with the 2006GL, the emission factors for this category correspond to the default values.

6.6. Prescribed burning of savannahs (4E)

This activity does not occur in Chile.

6.7. Field burning of agricultural residues (4F)

6.7.1. Description of category and GHG emissions

Although, CO_2 emissions from in situ burning of crop residues do occur, they do not generate a net release of CO_2 into the atmosphere because the vegetation grows again between burning cycles. Nevertheless, agricultural burns release other GHG gases (CH_4, N_2O) as well as GHG precursors (CO and NO_x).

In 2010 the category's GHG emissions amounted to 29.1 $GgCO_2eq$, or 0.2% of the sector total (Table 62 and Figure 49). Since 1990, GHG emissions have experienced 79.8% increase. The driver of the emissions reduction is the implementation of regulations controlling this practice that limits it to certain months of the year in the Metropolitan Region and the Province of Cachapoal, and by the adoption of good agricultural practices across the country.

6.7.2. Methodological aspects

The methods applied to estimate GHG emissions for the category Field burning of agricultural residues are shown in the Table below:

Table 62. Field burning of agricultural residues: GHG emissions ($GgCO_2eq$), 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
4F. Field burning of agricultural residues	144.3	87.0	68.8	58.9	29.1
Total	**144.3**	**87.0**	**68.8**	**58.9**	**29.1**

Source: Compilation by SNICHILE.

Figure 49. Field burning of agricultural residues: GHG emission trend, 1990 - 2010 series.

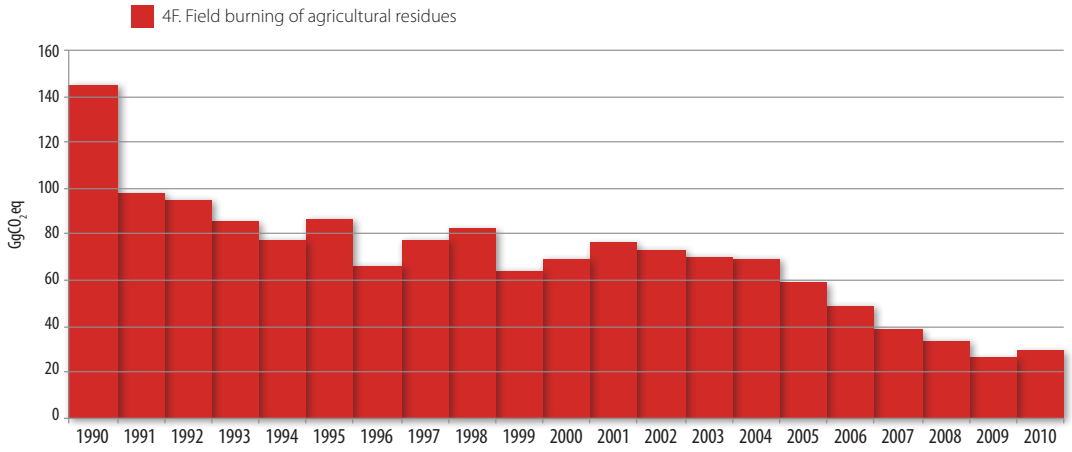


Table 63. Field burning of agricultural residues: methods applied

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
F. Field burning of agricultural residues			T1a,b	D	T1a,b	D

T1a = Disaggregated by operational component (crop, species, etc.); T1b = Disaggregated by administrative region; D = Default.

Source: Compilation by SNICHILE.

Emissions from Field burning of agricultural crop residues were estimated using a country-specific methodology and default emission factors.

6.7.2.1. Statistical and parametric activity data

Calculations in this category used crop production with an assumed percentage of burned area, along with country-specific parameters for the proportion of crop residues actually burned, as well as for harvest rates, dry material and the fraction oxidized. The country-specific parametric values were obtained from the national literature and expert judgment and are the same ones used to estimate emissions from crop residues introduced into the soil.

The parametric data required were a combination of the default values provided by the 2006GL and domestic values obtained from ODEPA, INE, FAOSTAT and expert judgment.

6.7.2.2. Emission factors

In accordance with the 2006GL, the emission factors for this category correspond to the default values.

6.8. Quality assurance and control procedure

The paragraphs below describe the quality assurance/quality control procedures used by the AFOLU Sector Team. It is important to mention that the AFOLU team prepares the SGHGI for both Agriculture and LULUCF sectors, and therefore the QA/QC procedures below involves both sectors.

6.8.1. Quality control

- Management of statistical activity data:
  - o Statistical activity data were entered automatically onto the worksheets from their point of origin to prevent manual data entry errors.
  - o National totals activity data are prepared by adding together regional totals and crosschecking the data to ensure they match properly.

- Emission factors, conversion factors and constants (parametric activity data):
  - o All of these data are grouped together in a single spreadsheet linked to the worksheets, in order to centralize the data to

facilitate quick review and updating, as applicable.

- Worksheets:
  - All worksheets are automatically linked to the activity data and emission factor worksheets.

6.8.2. Quality assurance

The AFOLU SGHGI (Agriculture and LULUCF sectors) was reviewed by two experts qualified as reviewers of NIRs from Parties included in Annex I to the Convention in June 2014. The review was conducted remotely in March and April 2014 and included a two-day visit to Chile by the expert reviewers, who worked in close coordination with the AFOLU Sector Team in the Chilean Ministry of Agriculture. This direct contact among experts enabled an in-depth review process. The sector team then analyzed the assessment report, amended pertinent findings and evaluated the feasibility of introducing the recommendations in the next update of NIR of Chile.

6.9. Planned improvements

Based on the analysis undertaken internally by the AFOLU Sector Team and the recommendations of the SGHGI expert review, the following improvements are planned for the sector:

- Improved coordination and management among government entities that possess/generate statistical data for future reporting to international sources. The objective of this action is to maintain the consistency of national and international databases.

- Creation of working groups with the main non-governmental entities (trade associations, institutions, etc.) that possess parametric data necessary to generate country-specific emission factors. This is particularly important for important or key categories and/or subcategories.

- Developing and improving country-specific emission factors for key categories such as Enteric fermentation and Agricultural soils emissions. The possibility of having funds which allow the execution of projects through competitive public grants shall be evaluated.

Jorge Herreros

7 LAND USE, LAND-USE CHANGE AND FORESTRY (5)

7.1. General Overview of the sector

The Land use, land-use change and forestry (LULUCF) sector focuses on CO_2 emissions and removals that occur as a result of changes in land use and management. This sector includes:

- Changes in the stock of forests and other perennial vegetation formations. The effects of human interaction with forestry and wood products are considered part of a broad category that includes commercial management, harvesting of roundwood and combustible wood (firewood), manufacture and use of basic wood products, and creation and management of forest tree plantations, as well as planting of trees in urban, municipal and other non-forest locations.

- Conversion of forests and Grassland. The conversion of forests and pasture land into grassland, cropland or for other land management uses may significantly reduce biomass and soil carbon stock. Deforestation is one example of this type of conversion.

- Abandonment of managed land (cropland, meadows, forest tree plantations or other managed land). Over time, abandoned land often accumulates carbon in biomass and soil, particularly if the conditions are similar to those found in grassland and natural forests.

- CO_2 emissions and removals for soil. Changes in management may alter CO_2 emissions and removals of soil, particularly through the implementation of conservation practices or increases in crop and fodder production.

The categories included are divided into the following categories, by type of soil and use:

- 5A. Forest land.
- 5B. Cropland.
- 5C Grassland.
- 5D Wetland.
- 5E Settlements.
- 5F. Other land.

Nationally, both removals (caused by biomass growth in forest tree plantations and the existence of a significant area of second-growth native forests, known as "renewals") and emissions (basically generated by forest harvesting and wildfires) increased steadily during the time series analyzed, with the a continuous favorable balance, although near neutral.

The SGHGI covers virtually the entire territory. Though no statistical activity data were available on land-use changes between the XV Arica and Parinacota Region and the IV Coquimbo Region (country's northern zone), which corresponds to 39.8% of the national territory (excluding Antarctica). While this percentage may seem

significant, 65.9% of it corresponds to the "Other land" category (in this case, the Atacama Desert) and 32.7% to "Grassland" (non-intervened natural), with practically no change in carbon stocks.

For categories associated to agricultural crops, territorial coverage increased 22.0% over the previous inventory to encompass 93.4% (1,555,038 ha) of Chile's cultivated land, according to figures from the 7th National Agricultural and Forestry Census (INE, 2007).

Carbon deposits

The 2006GL recognizes the following carbon stocks:

- Above-ground living biomass,
- Below-ground living biomass (roots),
- Standing dead biomass and/or coarse waste (necromass),
- Soil dead biomass, consisting mainly of fallen leaves and smaller fragments (litterfall), and
- Organic matter incorporated to the soil.

From these stocks, the present inventory included living biomass (above-ground and below-ground) within the total national territory and dead biomass (necromass) only between the VI Region of Libertador Bernardo O'Higgins, and the XII Region of Magallanes and the Chilean Antarctic Region, which amounted to 56.0% of the national area (excluding the Antarctic territory), a significant advancement over the previous time series (1984/2006), which only considered above-ground living biomass. There was consensus to exclude other carbon stocks (litterfall and soil organic matter) from this exercise, for the following reasons:

- Litterfall: lack of adequately supported stock data for each forest type; existing data is fragmentary and only covers the territory between the VII Maule Region and the XII Magallanes and Chilean Antarctic Region, which corresponds to 53.8% of the national area (excluding the Antarctic territory), and
- Soil organic matter: lack of country-specific data. As these values are heavily site-dependent (in terms of climate, soil and management), default values could not be relied upon for accuracy; furthermore, the country lacks geo-referenced data for linking agricultural activities to soil types.

Land-use changes

For the data of statistical data of the sector, in terms of the land-use change categories, specifically the exchange annual rates, the matrices of land-use change available at the CONAF's Forestry Ecosystem Monitoring Department were used.

Subsequently, CONAF's land use categories (urban and industrial areas, agricultural land, meadows and scrubland, forests, wetlands, areas without vegetation, snow and glaciers, bodies of water and uncharted areas) were aligned with the categories defined in the 2006GL, resulting in those listed in the Table below:

Table 64. Standardization of land-use change, CONAF vs. IPCC categories.

CONAF	IPCC
Agricultural land	Cropland (CL)
Meadows and scrubland	Grassland (GL)
Native forest, Mixed forest and Forest tree plantations	Forest Land (FL), subdivided into Native Forest (FL-NF) and Forest Tree Plantations (FL-FP)
Wetland	Wetland (WL)
Urban and industrial areas	Human Settlements (HS)
Areas without vegetation, snow and glaciers, bodies of water and uncharted areas	Other Land (OL)

Source: Compilation by the AFOLU Sector Team.

Finally, based on land-use change matrices of CONAF and the above-mentioned standardized categories, matrices were constructed for annual rates of change between land uses for the different working subcategories. Table 65 presents a summary of annual rates of land-use change. It is presented that the highest conversion rate (75,576.1 ha/year) was for Land converted to Forest tree plantations and the lowest (13.7 ha/year) was for Land converted to Wetland.

It should be noted that these annual rates of change have been calculated for each of the country's administrative regions included in this analysis, as only two land coverage images are available, taken in different years; although they represent real data, the values clearly illustrate historical rather than current trends in land-use change.

GHG removals and emissions

The LULUCF sector is the only sector in Chile that consistently removes CO_2. In 2010, this sector's GHG balance amounted to -49,877.4 $GgCO_2eq$ (Table 66). Over the time series covered in this inventory the balance has tended toward GHG removal, although it has decreased by 1.9% between 1990 and 2010. The main driver of removals in this sector is the increased biomass of forest tree plantations and native forest renewals. Year-to-year variations observed in Figure 50 are caused mainly by wildfires in native forests and forest tree plantations. An increase in GHG removal can be observed towards the end of the period, that is the result of an increase in forest tree plantations (especially Eucalyptus spp.) and therefore in biomass and a reduction in harvesting (see point 7.2.1.1. Forest land remaining forest land).

At the category level, in absolute terms[14] 96.0% of the sector's GHG balance corresponds to the Forest land category, followed by 2.3% for Grassland, 1.2% for Cropland and 0.6% for all other categories (Figure 50).

Table 65. Land-use conversion matrix (ha/year).

Category	FL-NF	FL-FP	CL	GL	WL	HS	OL	TOTAL
Forest land – native forest		7,868.0	304.1	4,142.9	0.0	70.1	411.6	12,796.5
Forest Land - forest tree plantations	586.1		841.2	1,842.0	0.2	407.0	89.9	3,766.4
Cropland	320.6	25,557.7		2,220.3	2.5	4,572.4	113.7	32,787.3
Grassland	5,266.3	40,420.9	7,975.5		10.6	1,616.7	850.3	56,140.3
Wetland	6.1	246.7	61.1	61.5		40.8	1.3	417.4
Settlements	1.3	13.9	8.0	4.7	0.0		0.4	28.3
Other land	27.4	468.8	135.6	802.5	0.5	71.8		1,506.7
TOTAL	**6,207.8**	**74,576.1**	**9,325.4**	**9,073.9**	**13.7**	**6,778.8**	**1,467.1**	**107,442.8**

Source: Compilation by the AFOLU Sector Team, using area data from the land-use change matrices of CONAF's Forestry Ecosystem Monitoring Department.

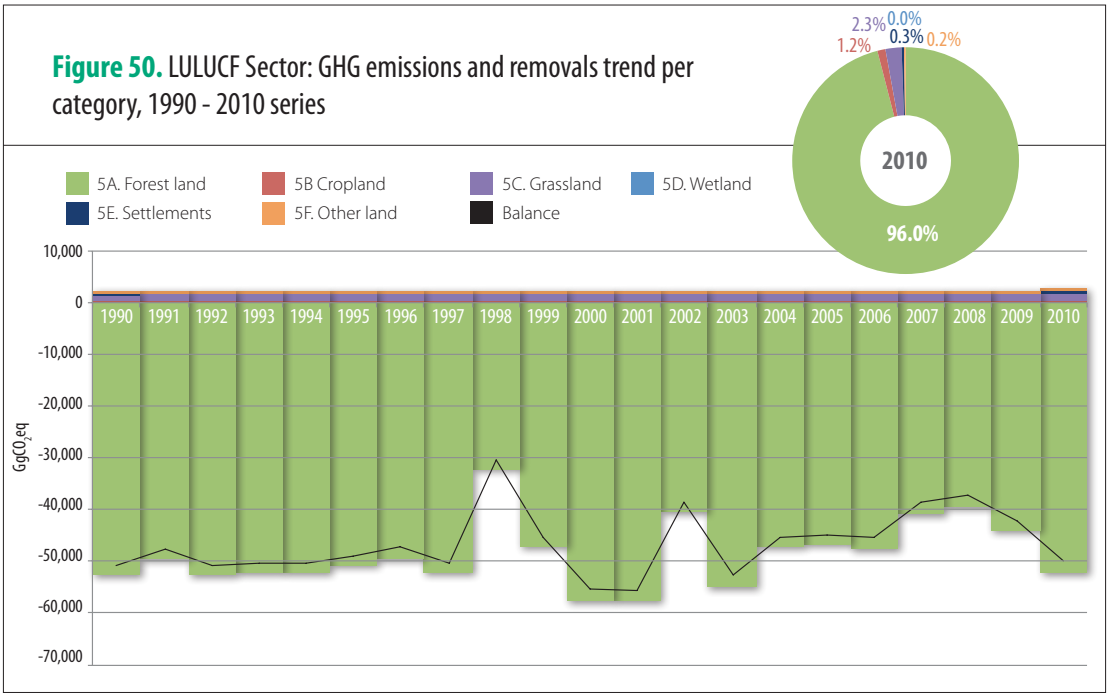
Table 66. LULUCF Sector: GHG emissions and removals ($GgCO_2eq$) per category, 1990 - 2010 series.

Category	1990	1995	2000	2005	2010
5A. Forest Land	-52,689.2	-50,681.6	-57,439.5	-46,696.5	-52,052.5
5B. Cropland	326.2	397.2	496.7	522.6	624.0
5C. Grassland	1,232.4	1,232.7	1,230.6	1,243.1	1,241.1
5D. Wetland	0.0	0.0	0.0	0.0	0.0
5E. Settlements	187.2	186.6	186.3	185.7	186.8
5F. Other land	121.8	121.3	121.2	120.9	123.2
Balance	**-50,821.6**	**-48,743.8**	**-55,404.6**	**-44,624.2**	**-49,877.4**

Source: Compilation by SNICHILE.

14. To facilitate the direct interpretation of quantitative analysis, removals have been expressed as absolute values (2006GL).

Figure 50. LULUCF Sector: GHG emissions and removals trend per category, 1990 - 2010 series



In 2010, the balance's main GHG in absolute terms was CO_2, which amounted to 98.6% of the sector total, followed by CH_4 with 1.0% and N_2O with 0.4% (Table 67 and Figure 51).

One peculiarity of the LULUCF Sector is that its GHG removals and emissions have been estimated for each administrative region. Figure 52 shows that in 2010, 23.0% of the removals of this sector occurred in the IX Araucanía Region, 19.6% in the XI Aysén del General Carlos Ibañez del Campo Region, 18.8% in the X Los Lagos Region, 18.1% in the VII Maule Region, and the remaining 20.5% in other regions of the country.

Table 67. LULUCF Sector:
Emissions and removals per type of GHG ($GgCO_2eq$), 1990 - 2010 series

GHG	1990	1995	2000	2005	2010
CO_2	-51,088.4	-49,097.0	-55,485.4	-45,193.6	-50,620.0
CH_4	186.1	246.3	56.3	397.1	517.8
N_2O	80.8	106.9	24.5	172.4	224.8
Total	**-50,821.6**	**-48,743.8**	**-55,404.6**	**-44,624.2**	**-49,877.4**

Source: Compilation by SNICHILE.

Figure 51. LULUCF Sector: emissions and removals trend per type of GHG, 1990 - 2010 series.

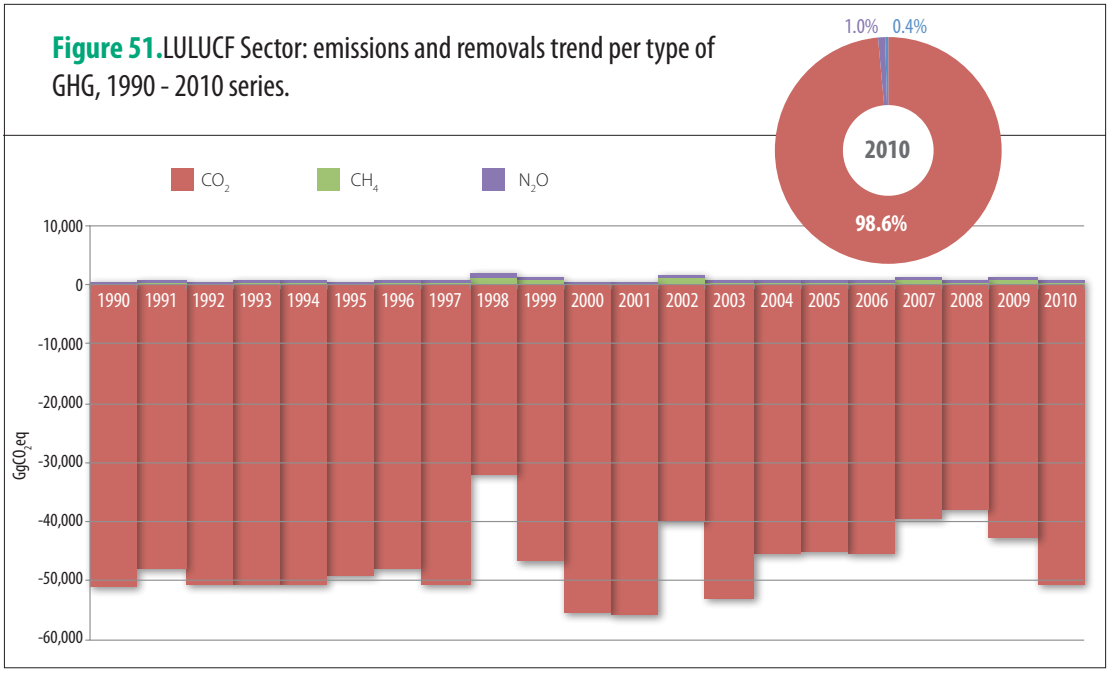


Figure 52. LULUCF Sector: GHG removals and emissions per category and administrative region, 2010.

7.2. Forest land (5A)

7.2.1. Description of category and GHG emissions

This category includes GHG emissions and removals caused by changes in biomass, dead organic matter in Forest land, and Land converted to forest land. The sources of emissions and removals by sinks included:

- Removal due to growth in forest biomass (above-ground and below-ground) of:
  - Forest tree plantations, disaggregated by species: Monterey pine (*Pinus radiata*), Eucalyptus (*Eucalyptus globulus* and *Eucalyptus nitens*), Algarrobo (*Prosopis chilensis*) / Tamarugo (*Prosopis tamarugo*), Oregon pine (*Pseudotsuga menziesii*), Poplar (*Populus spp.*) and Other species,
  - second growth native forests, corresponding to a forested area intervened between 50 and 100 years ago that is currently in the process of returning to its natural state (as a second growth native forest),
  - managed native forest, for three management stages (cumulative over the past 10 years), and
  - native forest affected by wildfires (cumulative, over the past 80 years),
- Emission by:
  - harvest of roundwood from forest tree plantations and native forests (including above-ground and below-ground biomass),
  - harvest -or rather extraction- of firewood (considering only above-ground biomass), and
  - wildfires in forest tree plantations and native forests (considering only above-ground biomass).

In 2010, the GHG balance for this category was -52,052.5 $GgCO_2eq$, or 96.0% of the sector, in absolute figures (Table 68). Since 1990, the category's GHG balance has tended towards removal, although this value has decreased by 1.2%. The main driver of removals in this sector is the increased biomass of forest tree plantations and native forest renewals. Year-to-year variations observed in Figure 53 are caused mainly by wildfires in native forests and forest tree plantations. Approaching the end of the period, there was a sharp increase in GHG removal due to an increase in the forest tree plantation area , and therefore, an increase on biomass (especially *Eucalyptus spp.*) and a decrease in harvest.

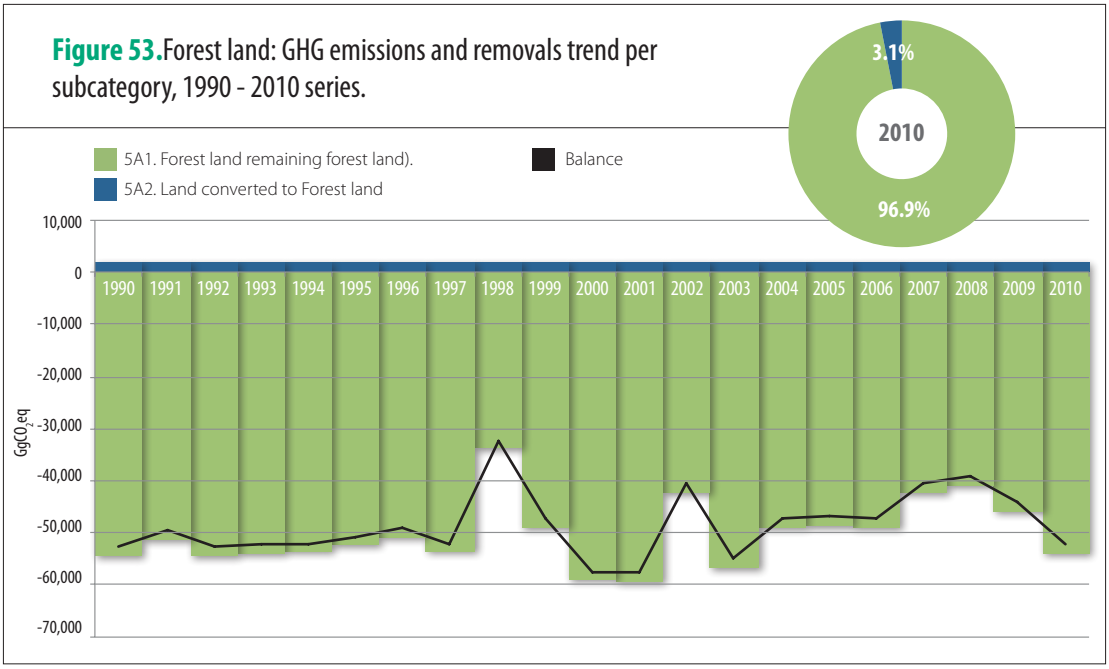
At the subcategory level, Forest land remaining forest land is the leading sink in absolute terms, accounting for 96.9% of the balance, while Land converted to forest land accounted for 3.1% of the balance.

Table 68. Forest land: GHG emissions and removals ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
5A1. FL remaining forest land	-54,396.2	-52,388.6	-59,146.5	-48,403.6	-53,759.5
5A2. Land converted to FT	1,707.1	1,707.1	1,707.1	1,707.1	1,707.1
Balance	**-52,689.2**	**-50,681.6**	**-57,439.5**	**-46,696.5**	**-52,052.5**

Source: Compilation by SNICHILE.

Figure 53. Forest land: GHG emissions and removals trend per subcategory, 1990 - 2010 series.



7.2.1.1. Forest land remaining Forest land (5A1)

In 2010, the GHG balance for this subcategory amounted to -53,759.5 $GgCO_2eq$, or 96.9% of the entire category, in absolute figures (Table 69). Since 1990, the subcategory's GHG balance has tended to favor GHG removal, although this value has decreased by 1.2%. The main driver of removals in this sector is the increased biomass of forest tree plantations and native forest renewals. Year-to-year variations observed in Figure 54 are caused mainly by wildfires in native forests and forest tree plantations. Approaching the end of the period, there was an increase in GHG removal due to an increase in the forest tree plantation area, and therefore, an increase on biomass (especially *Eucalyptus spp.*) and a decrease in harvest.

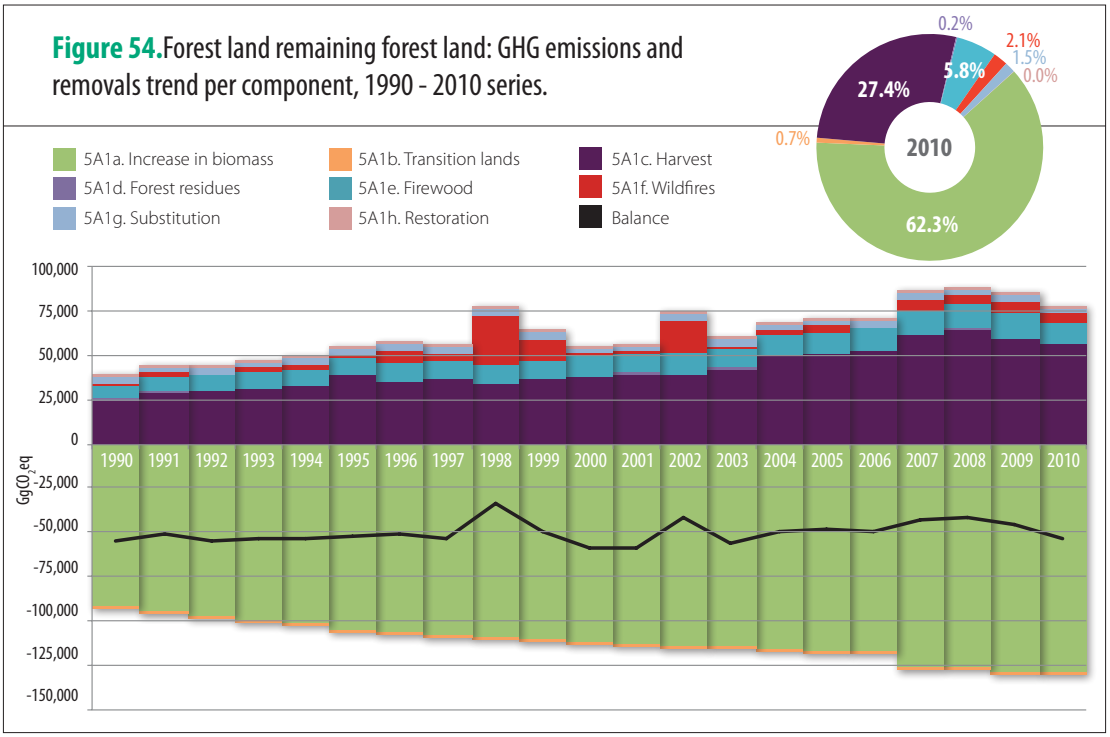
At the component level, and in absolute terms the increase in biomass is the most important, accounting for 62.3%, followed by harvest with 27.4%, firewood with 5.8%, and wildfires with 2.1%. Substitution amounted to 1.5% and Land in transition amounted to 0.7%. The remaining 0.2% corresponded to Forest residues.

Table 69. Forest land remaining forest land: GHG emissions and removals ($GgCO_2eq$) per component, 1990 - 2010 series.

Component	1990	1995	2000	2005	2010
5A1a. Increase in biomass	-91,610.4	-105,381.2	-112,105.6	-116,969.8	-128,600.0
5A1b. Land in transition	-68.1	-408.8	-749.5	-1,090.2	-1,430.9
5A1c. Harvest	25,171.7	39,190.0	38,166.9	50,619.8	56,461.1
5A1d. Forest residues	152.2	213.5	0.0	313.1	361.1
5A1e. Firewood	7,160.9	9,233.5	11,451.2	12,377.8	11,945.8
5A1f. Wildfires	1,569.8	1,537.5	863.7	3,120.2	4,274.6
5A1g. Substitution	3,161.2	3,161.2	3,161.2	3,161.2	3,161.2
5A1h. Restoration	66.5	65.8	65.6	64.5	67.6
Balance	**-54,396.2**	**-52,388.6**	**-59,146.5**	**-48,403.6**	**-53,759.5**

Source: Compilation by SNICHILE.

Figure 54. Forest land remaining forest land: GHG emissions and removals trend per component, 1990 - 2010 series.



Increase in biomass

In 2010, GHG removal amounted to -128,600.0 $GgCO_2eq$, or 62.3% in absolute values in the category (Table 70). Since 1990, GHG removal has increased by 40.4%. The key driver of the increase on removals is the increase in forest tree plantation biomass.

At the component level, Forest tree plantations were the most important, with 59.9%, followed by Renewals with 35.2%, Native forest burned with 2.9% and Managed native forest with 2.0% (Figure55).

Figure 55. Increase in biomass: trend in CO_2 removals per component, 1990 - 2010 series

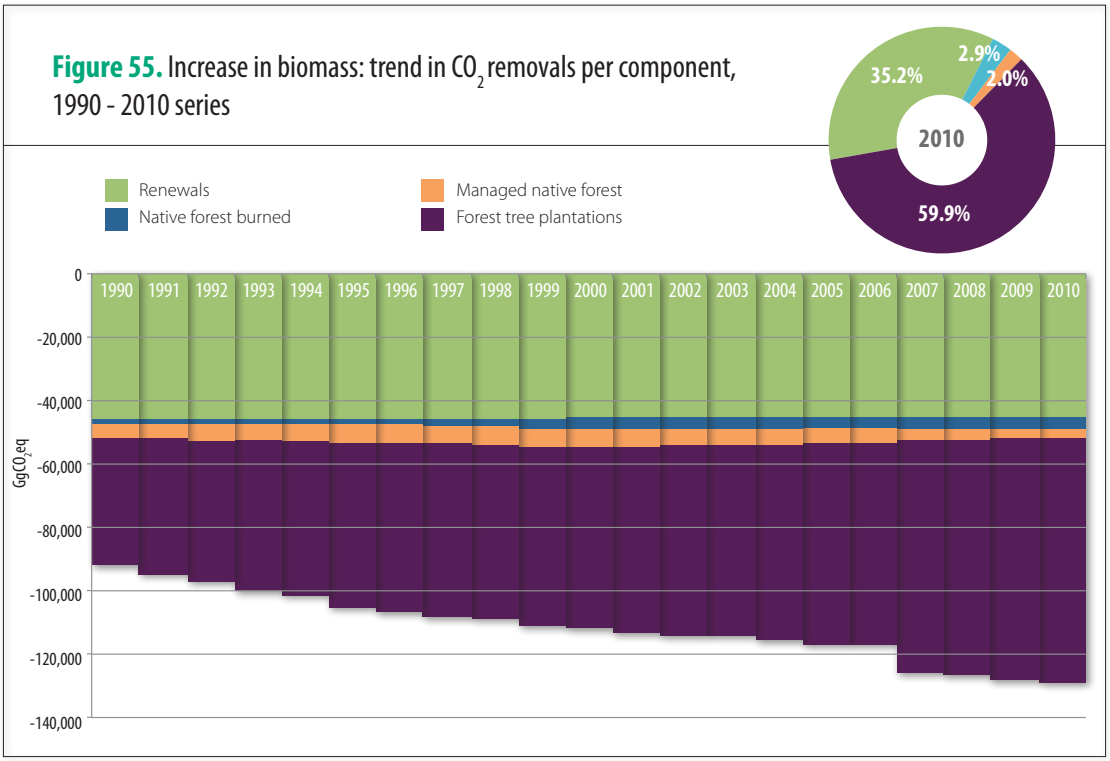


Table 70. Increase in biomass: CO_2 removals ($GgCO_2eq$) per component, 1990 - 2010 series

Component	1990	1995	2000	2005	2010
Renewals	-45,706.7	-45,653.6	-45,564.9	-45,452.7	-45,274.9
Native forest burned	-1,953.1	-2,119.3	-3,100.3	-3,498.7	-3,736.2
Managed native forest	-4,060.7	-5,219.6	-6,035.4	-4,606.8	-2,610.4
Forest tree plantations	-39,890.0	-52,388.8	-57,405.0	-63,411.6	-76,978.4
Total	**-91,610.4**	**-105,381.2**	**-112,105.6**	**-116,969.8**	**-128,600.0**

Source: Compilation by SNICHILE.

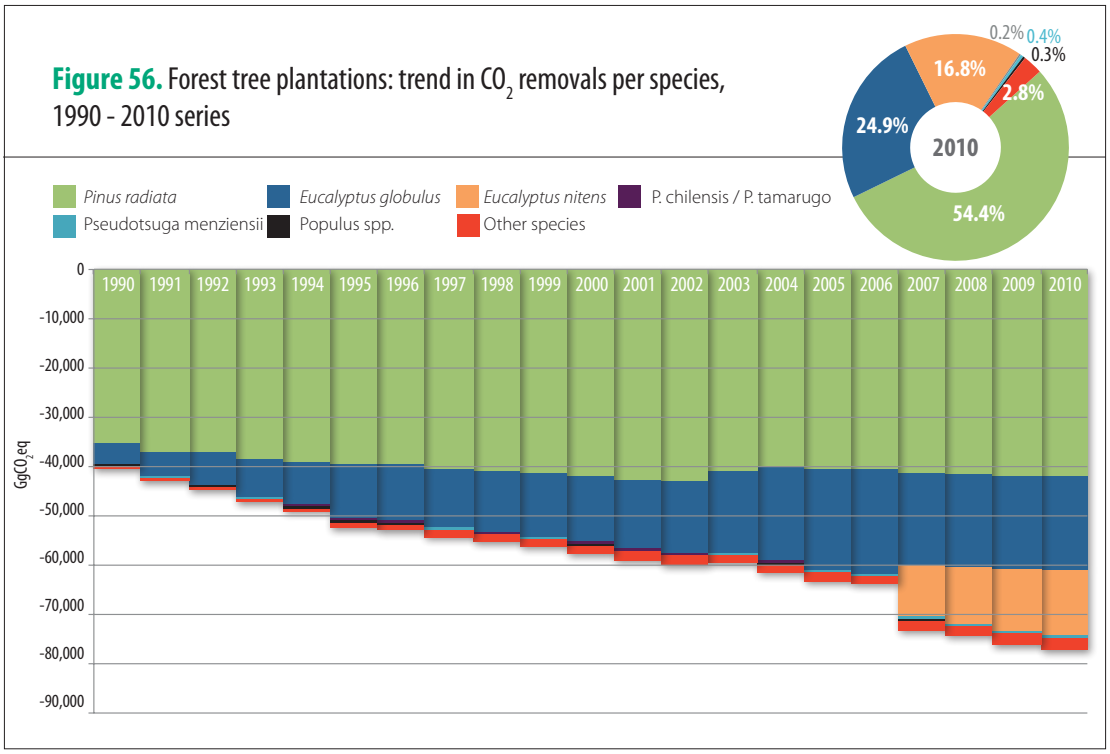
Table 71. Forest tree plantations: CO_2 removals per species, 1990 - 2010 series.

Species	1990	1995	2000	2005	2010
Pinus radiata	-35,376.0	-39,361.7	-41,992.4	-40,585.6	-41,904.8
Eucalyptus globulus	-3,917.6	-11,335.2	-13,410.0	-20,321.6	-19,190.9
Eucalyptus nitens	0.0	0.0	0.0	0.0	-12,969.0
P. chilensis / P. tamarugo	-159.8	-159.6	-161.9	-181.1	-178.1
Pseudotsuga menziensii	-233.1	-257.7	-278.5	-315.2	-319.0
Populus spp.	-126.0	-137.3	-148.1	-213.0	-252.1
Other species	-77.4	-1,137.3	-1,414.1	-1,795.1	-2,164.4
Total	**-39,890.0**	**-52,388.8**	**-57,405.0**	**-63,411.6**	**-76,978.4**

Source: Compilation by SNICHILE.

For Forest tree plantations and at species level *P. radiata* is the most important for GHG removal, accounting for 54.3%, followed by *E. globulus* with 24.9%, *E. nitens* with 16.8% (both species contributing 41.8%), and Other species with 2.8%. *P. menziensii* and *Populus spp.* accounted for 0.4% and 0.3% of removals, respectively. The remaining 0.2% came from *P. chilensis / P. tamarugo*. It is worth mentioning that, while P. radiata is the most important species, its removals have increased by only 18.5% since 1990, while removals by Eucalyptus spp. have increased by 720.9% (Table 71 and Figure 56).

Figure 56. Forest tree plantations: trend in CO_2 removals per species, 1990 - 2010 series



Harvest

In 2010, GHG emissions for the subcategory amounted to 56,461.1 $GgCO_2eq$, or 26.4% in absolute terms in the category (Table 72), making it the sector's leading source of emissions. Since 1990, GHG emissions have increased by 124.3%, although from 2008 to 2010 GHG emissions from harvests fell by 12.9%, in direct proportion to the area harvested.

At the component level, *P. radiata* is the most important species, accounting for 57.2%, followed by *Eucalyptus spp.* with 40.1%, Native species with 1.5%, and Other exotics with 1.1% (Figure 57).

Wildfires

In 2010, GHG emissions amounted to 4,274.6 $GgCO_2eq$, or 2.0% of the subcategory, in absolute figures (Table 73). Since 1990, GHG emission has increased by 172.3%, Year-to-year variations observed in Figure 58 were driven mainly by the variable, unpredictable nature of wildfires in native forests and forest tree plantations.

At the component level, Wildfires in forest tree plantations account for 79.2% of GHG emissions, while Wildfires in native forests account for 20.8% (Figure 58).

Table 72. Harvest: CO_2 emissions ($GgCO_2eq$) per species, 1990 - 2010 series.

Species	1990	1995	2000	2005	2010
Roundwood *P. radiata*	15,135.5	26,193.1	26,558.3	36,334.6	32,323.7
Roundwood *Eucalyptus spp.*	3,204.0	4,604.0	8,292.0	12,373.3	22,625.7
Roundwood Other exotic	265.8	266.2	292.3	582.2	641.8
Native species roundwoods	6,566.5	8,126.8	3,024.4	1,329.7	869.8
Total	**25,171.7**	**39,190.0**	**38,166.9**	**50,619.8**	**56,461.1**

Source: Compilation by SNICHILE.

Figure 57. Harvest: trend in CO_2 emissions per species, 1990 - 2010 series.

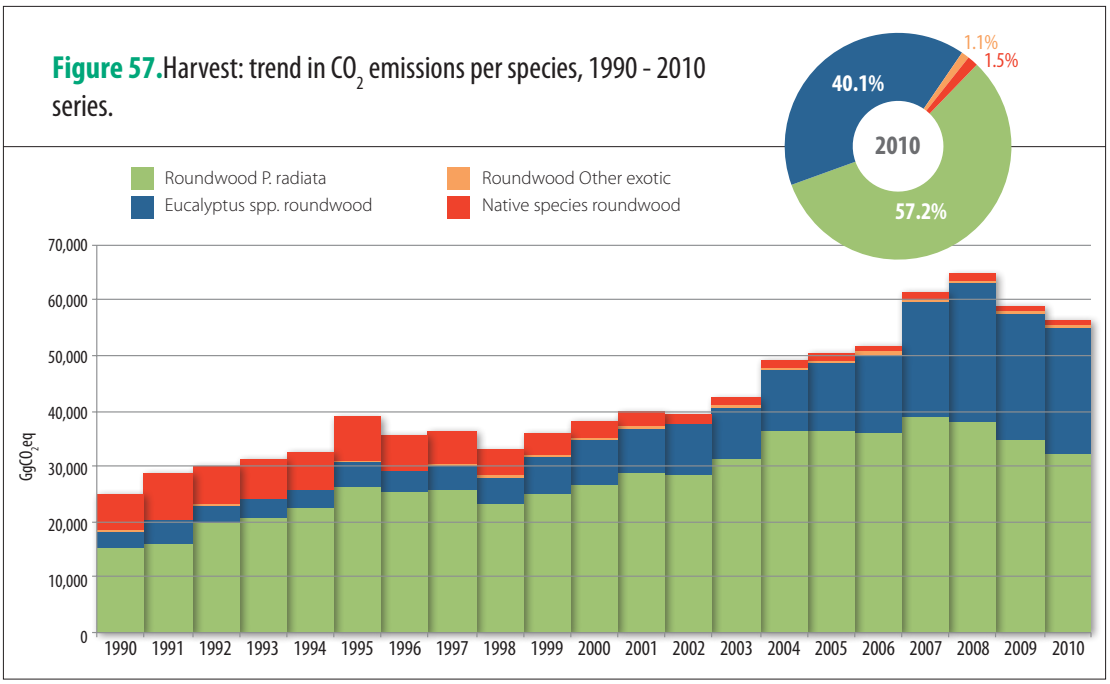
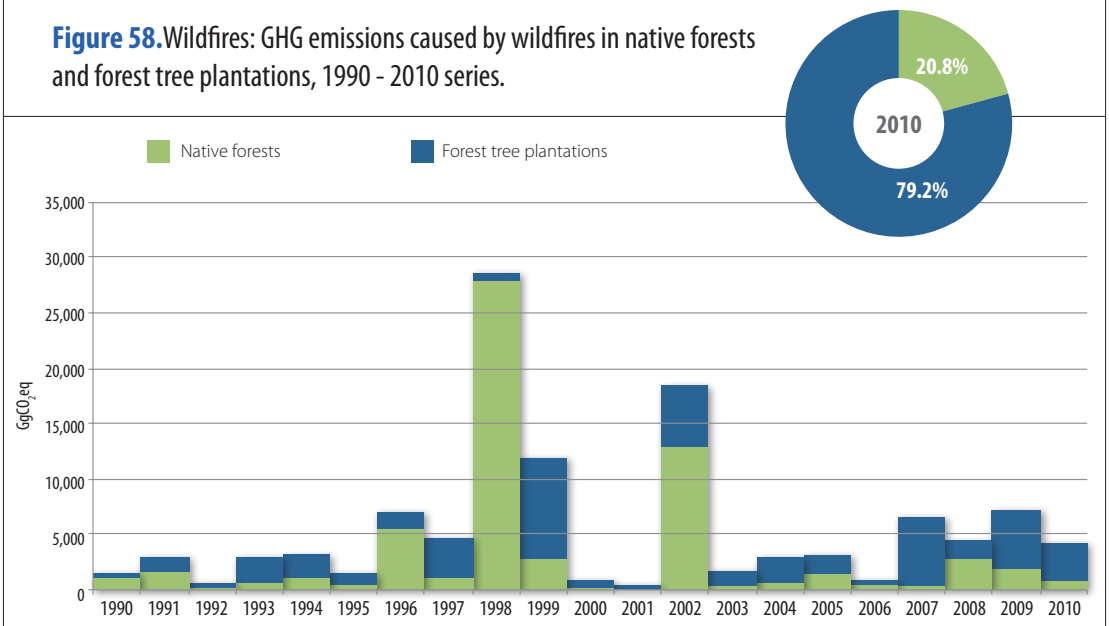


Table 73. Wildfires: GHG emissions ($GgCO_2eq$) caused by wildfires in native forests and forest tree plantations, 1990 - 2010 series.

Component	1990	1995	2000	2005	2010
Native forests	1,050.1	353.2	165.9	1,458.1	887.9
Forest tree plantations	519.7	1,184.2	697.8	1,662.1	3,386.7
Total GHG emissions	**1,569.8**	**1,537.5**	**863.7**	**3,120.2**	**4,274.6**

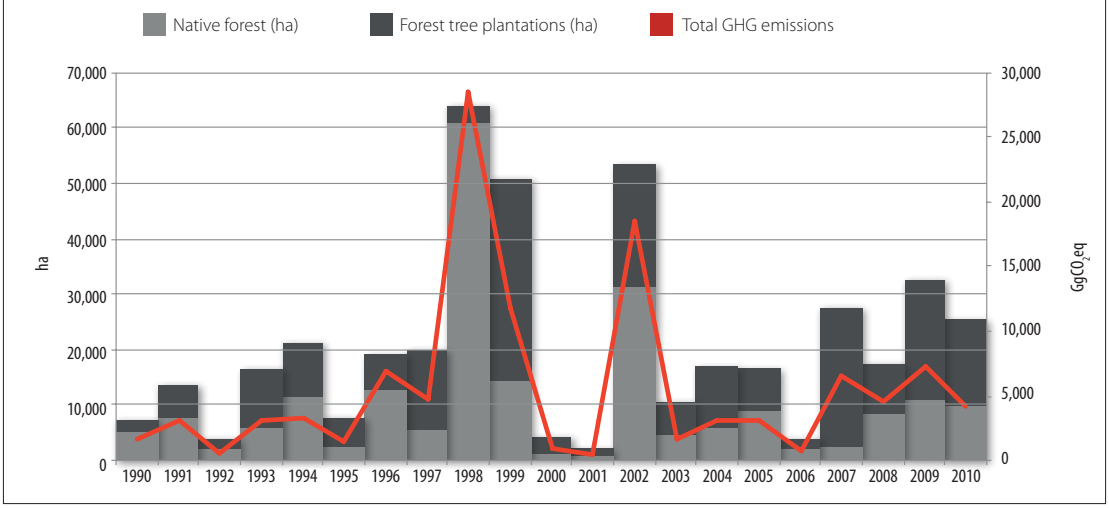
Source: Compilation by SNICHILE.

Figure 58. Wildfires: GHG emissions caused by wildfires in native forests and forest tree plantations, 1990 - 2010 series.



The variation in GHG emissions from wildfires is mainly caused by the area burned annually, as the hectares burned are directly proportional to the GHG emissions generated, which in turn explains the significant year-to-year variation in these GHG emissions. As Figure 59 shows, for instance, the largest areas were burnt in 1998 and 2002, which were also the years with the highest GHG emissions for the time series.

Figure 59. Wildfires: trend in annual area affected by wildfires and GHG emissions, 1990 - 2010 series.



Wildfires are particularly significant for the GHG balance for their ability to alter the trend, as the high emissions in 1998 and 2002 attest to. Figure 60 presents a scenario of sensitization that compares the national GHG balance excluding GHG emissions and removals caused by wildfires (green line) to the balance including emissions and removals by wildfires (red line), alongside GHG emissions and removals for each sector (bars in greyscale). As a conclusion, excluding GHG emissions and removals from wildfires smooths out the overall trend of the national GHG balance. In this same sense, methodological options are being evaluated to face the interannual variability of the GHG emissions of the wildfires within NIR. The results of this activity are to be reported on the next Biennial Update Report Of Chile.

In 2010, GHG emissions for this subcategory amounted to 1,707.1 $GgCO_2eq$, or 2.7% of the category total, in absolute terms (Table 74). Since 1990, the GHG balance in this subcategory has tended to favor GHG emissions, which have remained constant.

At the component level, Grassland converted to forest land is the most important, accounting for 66.6% of the balance, followed by Cropland converted to forest land with 33.4% and Settlements converted to forest land with 0.1% (Figure 61).

7.2.1.2. Land converted to Forest land (5A2)

Figure 60. Chilean NIR: trend in GHG emissions and removals by sector excluding wildfires in forests, 1990 - 2010 series

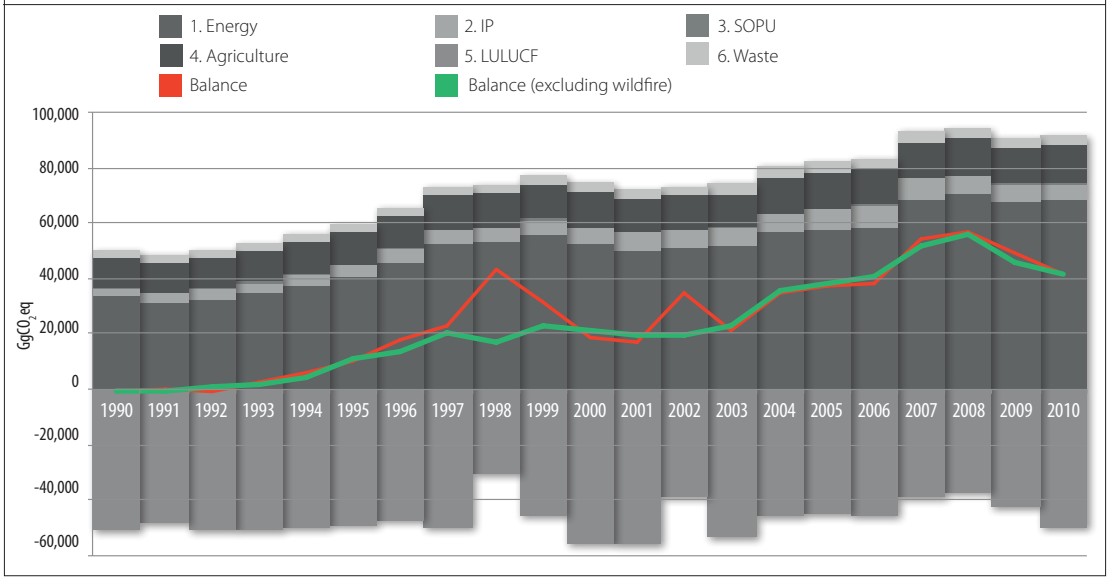
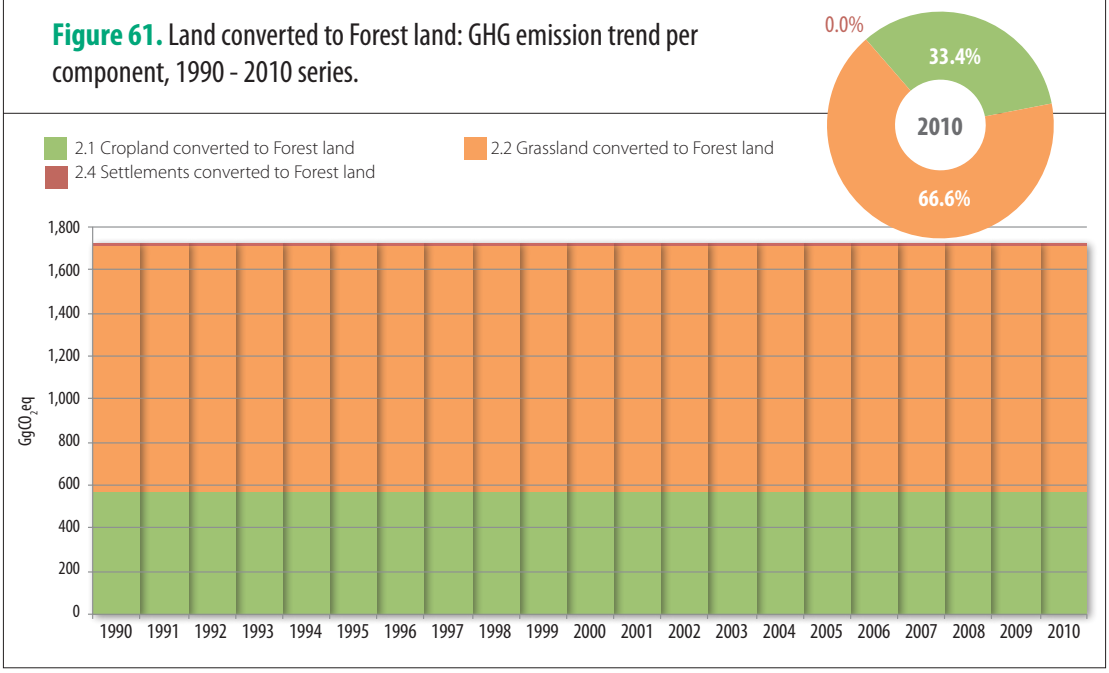


Table 74. Land converted to Forest land: GHG emissions ($GgCO_2eq$) per component, 1990 - 2010 series.

Component	1990	1995	2000	2005	2010
2.1 Cropland converted to Forest land	569.3	569.3	569.3	569.3	569.3
2.2 Grassland converted to Forest land	1,137.7	1,137.7	1,137.7	1,137.7	1,137.7
2.4 Settlements converted to Forest land	0.1	0.1	0.1	0.1	0.1
Balance	**1,707.1**	**1,707.1**	**1,707.1**	**1,707.1**	**1,707.1**

Source: Compilation by SNICHILE.

Figure 61. Land converted to Forest land: GHG emission trend per component, 1990 - 2010 series.



Dead forest

7.2.2. Methodological aspects

The methods applied to develop the Forest land category are presented in the following table:

Forest land remaining forest land

The estimation calculation of GHG emissions and removals was based on the changes in the carbon stock of above-ground living biomass, below-ground living biomass and necromass deposits, although, according to the Tier 1 method, net changes in necromass stocks are supposedly equal to zero. There is no information on the dynamics of necromass deposits — that is, annual production and decomposition rates — as to include them in the carbon balance for this subcategory.

All CO_2 emission and removal estimations for this subcategory were based in the IPCC methodology described in the 2006GL, specifically Volume 4, Chapter 4 ("Forest Land"), Section 4.2., which addresses land that has been forest land for a period of time greater than the transitional period required to reach new levels of soil carbon; for Chilean native forests this period was assumed to be 80 years.

Table 75. Forest land: methods applied.

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
A. Forest Land	T2	CS	T1b, T2	D, CS	T1b, T2	D, CS
1. Forest land remaining Forest land	T2	CS	T1b, T2	D, CS	T1b, T2	D, CS
2. Land converted to Forest land	T2	CS				

T1b= Disaggregation per administrative regions; T2= Tier 2 Method; D= Default; CS= Country-Specific.

Source: Compilation by SNICHILE.

A Tier 2 method based on national parametric data and regionally disaggregated statistical data was used to estimate the emissions/removals of Increase in biomass; A similar methodology was used to calculate emissions/removals of Commercial wood and Firewood harvest The same criteria applies for transition lands.

Emissions/removals of Wildfires were calculated using a combination of Tier 1 and Tier 2 methods based on national parametric data and default values in accordance with the 2006GL, as well as statistical data disaggregated by region. The destination of the biomass of removed carbon was not specified.

Wildfires were included after CONAF, national authority in terms of the forestry patrimony, declared years ago that all wildfires in Chile were anthropogenic. The estimations carry different assumptions, depending on the type of vegetation burned:

- It is assumed that forest tree plantations affected by fire will be replanted immediately after the event, and therefore the area will remain planted and the only loss will be the burnt biomass (CO_2 emissions) and non-CO_2 gases by the fire, and

- It is assumed that an area of native forest affected by fire will subsequently undergo natural regeneration, making it necessary to account for emissions caused by the fire and, later, the regeneration of above-ground biomass for a transitional period until the forest achieves a stable state (as mentioned above, an 80-year period was agreed to).

CONAF's Forest Update and Inspection System (SAFF) provides data on the area of managed native forests in Chile for given years without specifying spatial location making it impossible to determine whether the same stands are intervened in different years; for this reason and to avoid overestimating the managed area, a 10-year interval was established, corresponding to the average period between two consecutive management interventions in the same stand.

Since CONAF has information on the management plans approved each year but not information on the execution of those plans, it was assumed that "an approved plan is a plan executed the same year it is approved", a similar approach to how forest harvests are addressed, in the sense that all GHG emissions from harvest are deemed to occur during the year of harvest.

One notable change in this stage is that CONAF's "mixed forest" category was included in the IPCC Forest land category specifically under the subdivision "Native forest land". This change was made because mixed forests in Chile are comprised of 33% to 66% native forest, which is important enough to include in GHG emissions estimates.

Land converted to Forest land

In the national context, based on an analysis of the regional Land-Use Change matrices found in CONAF's Vegetation Survey, it was determined that the annual area of land converted to forest land was 72,329.8 ha, with 92.2% of this area converted to forest tree plantations (66,708.1 ha) and 7.8% to native vegetation formations (5,621.7 ha).

The methodology used to estimate GHG emissions and removals in this case was the same described in Volume 4, Chapter 2 of the 2006GL. It enables estimating the annual changes on the carbon existence for each of the five carbon deposits acknowledged by the IPCC (live, aerial and underground biomass; dead organic matter (necromass and litterfall); and ground organic matter).

7.2.2.1. Statistical and parametric activity data

Forest land remaining forest land

CONAF and INFOR professionals conducted an exhaustive review of the activity data used to build the 1984-2006 times series and new activity data was collected for the 1990-2010 time series.

In general, the following statistical and parametric activity data were used for this subcategory:

- Increase in biomass: The required statistical data include the area of forest tree plantations by species (Figure 62), area of renewals and area of managed native forest. These data are provided by INFOR (using a regression methodology for renewals area) and CONAF. The required parametric data are vol-

ume growth in forest tree plantations by species (generated by INFOR and MMA), volume growth in native forests by region and forest type (INFOR and MMA), expansion factors of commercial biomass to total aboveground biomass (Gayoso, 2002), ratios between below ground and aboveground biomass (Gayoso *et al.*,2002), and basic wood density by species.

- Commercial wood harvest: The key statistical indicator is the volume of the commercial roundwood harvest, a value generated by INFOR (Figure 63). The parametric data used are expansion factors of commercial biomass to total aboveground biomass (generated by Gayoso, 2002), the ratio of below ground to aboveground biomass (Gayoso *et al.*, 2002), and basic wood density.

- Firewood harvest: The key statistical indicator is the volume of firewood harvested, a value generated by INFOR and MINENERGIA for the NEB. The parametric data used are expansion factors of commercial biomass to total aboveground biomass (generated by Gayo-

Figure 62. Forest tree plantations: trend in annual surface per species, 1990 - 2010 series.

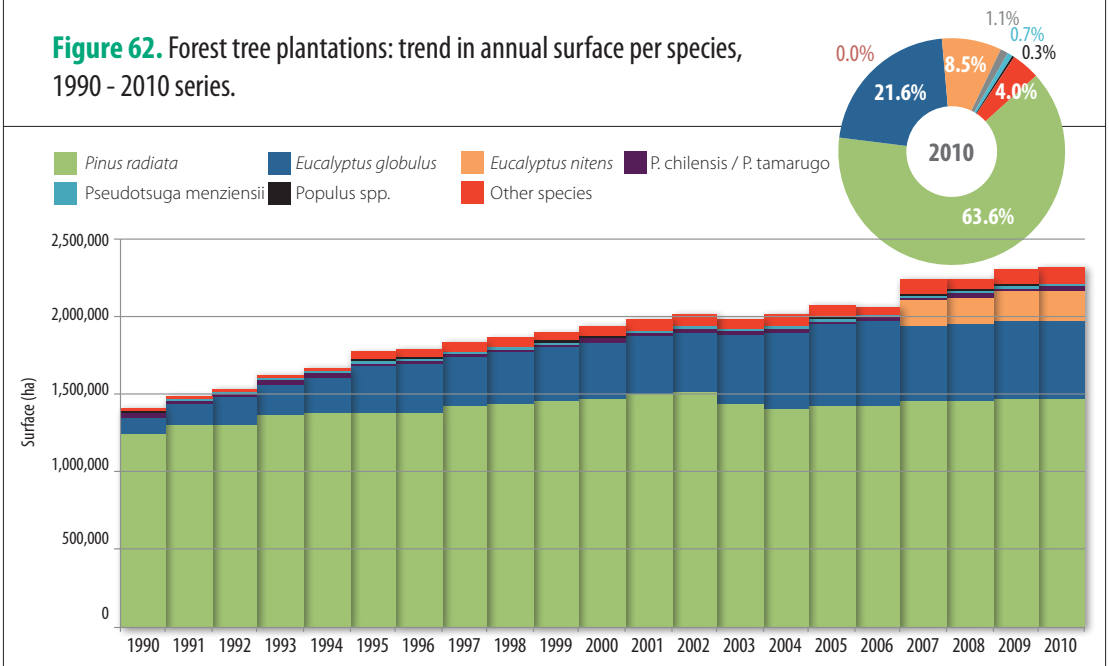
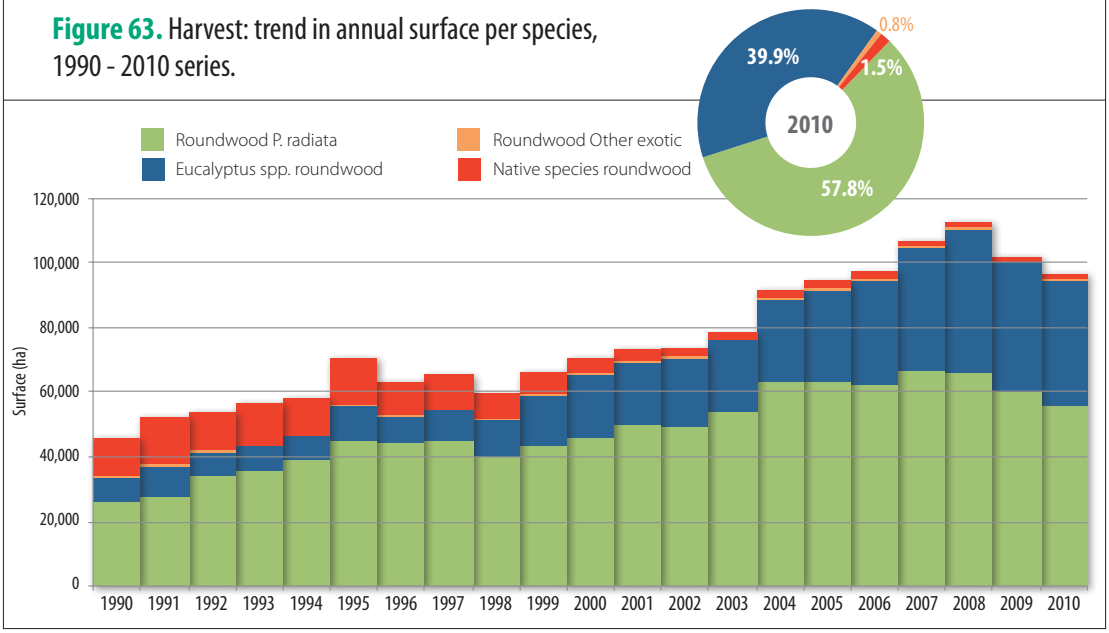


Figure 63. Harvest: trend in annual surface per species, 1990 - 2010 series.



so, 2002), the ratio of below ground to aboveground biomass (Gayoso *et al.*, 2002), and basic wood density.

- Wildfires: The key statistical indicator is the annual area affected by wildfires in native forests and forest tree plantations (CONAF-Empresas 1985-2010 in http://www.conaf.cl/incendios-forestales/incendios-forestales-en-Chile/estadisticas-historicas/) (Figure 64). The parametric data used include the accumulated volume for native forests by region (INFOR and MMA), the accumulated volume of forest tree plantations per species (INFOR and MMA), expansion factors of commercial biomass to total aboveground biomass (Gayoso, 2002), the ratio (R) of below ground biomass (roots) to aboveground biomass (Gayoso *et al.*, 2002) Basic wood density is also necessary

Land converted to Forest land

The subcategory Land converted to Forest land includes the area of Cropland, Grassland, Settlements and Other Land converted annually to native forest and/or forest tree plantations. These figures were disaggregated per administrative region and per type of land, using data obtained from CONAF's Vegetation Survey. The data of this reports had to be interpolated and/or extrapolated for certain years.

The parametric data (biomass accumulated in converted land) required to estimate emissions and removals of this subcategory to be the default values found in the 2006GL.

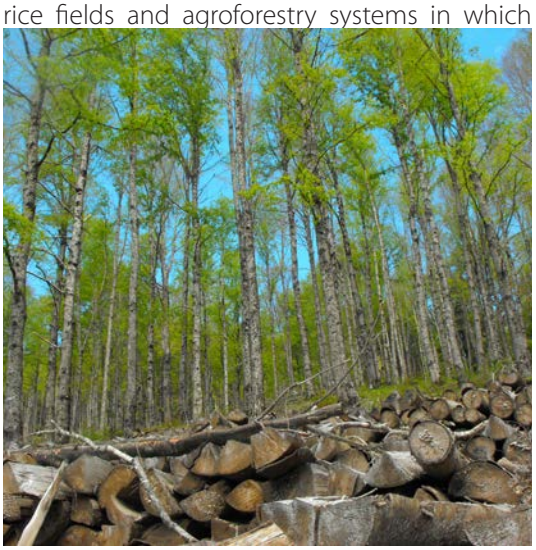
7.2.2.2. Emission factors

These are the same parametric data described above.

7.3. Cropland (5B)

7.3.1. Description of category and GHG emissions

Cropland includes arable and workable land, rice fields and agroforestry systems in which



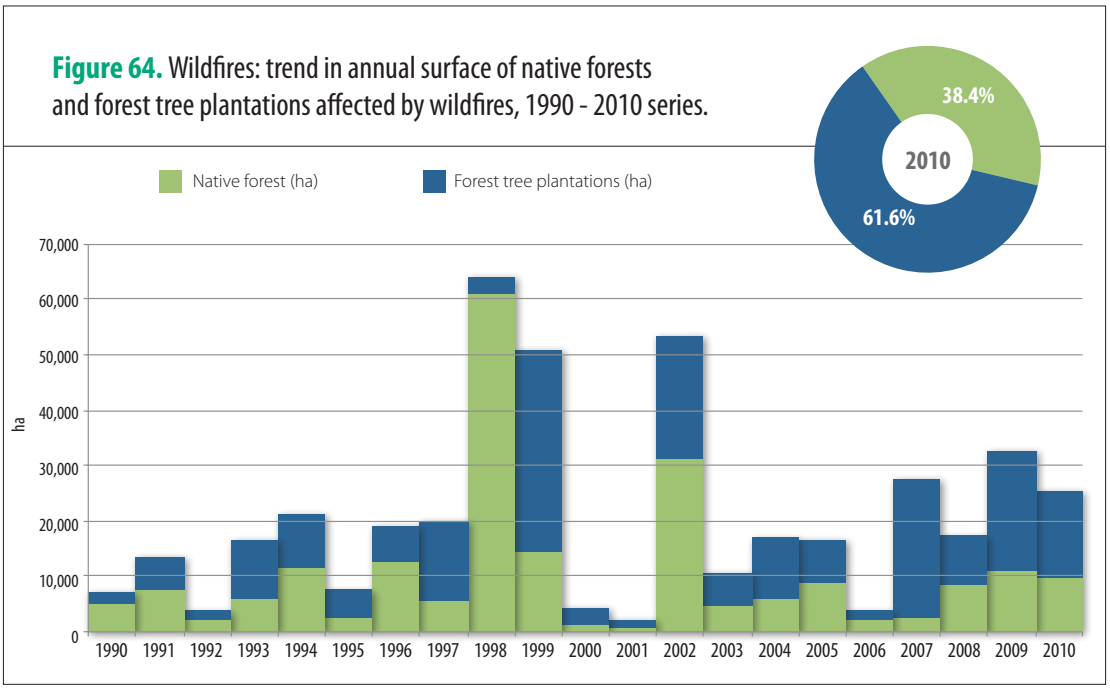


Figure 64. Wildfires: trend in annual surface of native forests and forest tree plantations affected by wildfires, 1990 - 2010 series.

the vegetation structure is below the thresholds used for the Forest land category and is not expected to exceed them in the future. Cropland includes every annual and perennial crops as well as temporary fallow land. Crops may be annual, biannual or permanent except when the land use meets the criteria for labeling it as Forest land. Cropland also includes arable land normally used for annual crops but temporarily employed for forage crops or grassland as part of an annual crop-pasture rotation (mixed system).

This category includes the following subcategories:

- Cropland remaining Cropland: This subcategory considers emissions and removals from Cropland that has undergone no change in land use during the inventory period.

- Land converted to Cropland: This subcategory considers emissions and removals from land that previously had a different use and was converted to Cropland.

In 2010, GHG emissions for this category amounted to 624.0 $GgCO_2eq$, or 1.0% of the sector in absolute figures (Table 76). Since 1990, GHG emissions for this category have increased by 91.3%. The cause being mainly by the steady increase in the use of lime and urea.

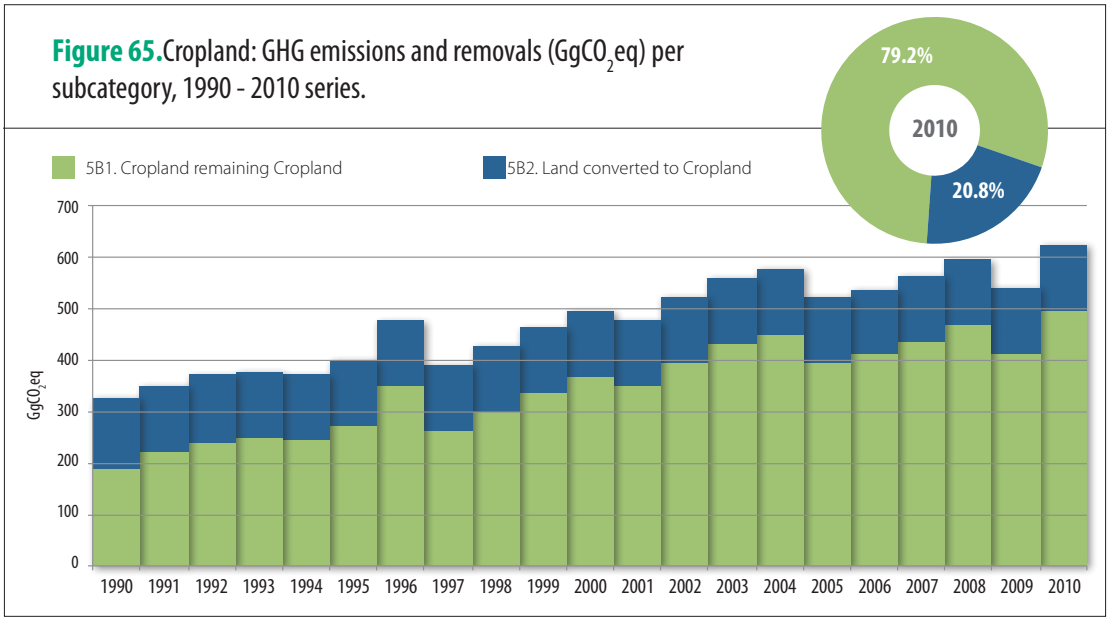
At the subcategory level, Cropland remaining Cropland leads, with 79.2% of the category's emissions, while Land converted to Cropland accounted for 20.8% (Figure 65).

Table 76. Cropland: GHG emissions and removals ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
5B1. Cropland remaining Cropland	191.4	269.2	368.7	396.2	494.1
5B2. Land converted to Cropland	134.8	128.1	128.0	126.4	129.9
Balance	**326.2**	**397.2**	**496.7**	**522.6**	**624.0**

Source: Compilation by SNICHILE.

Figure 65. Cropland: GHG emissions and removals ($GgCO_2eq$) per subcategory, 1990 - 2010 series.



7.3.2. Methodological aspects

The methods applied to prepare the inventory of the Cropland category are presented in the Table below.

Table 75. Forest land: methods applied.

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
B. Cropland	T1b, T2	D, CS				
1. Cropland remaining Cropland	T2	CS				
2. Land converted to Cropland	T1b, T2	D, CS				

T1b= Disaggregation per administrative regions; T2= Tier 2 Method; D= Default; CS= Country-Specific.

Source: Compilation by SNICHILE.

Cropland remaining Cropland

For the purpose of the generation of the inventory, notice must be taken on the lack of country or region specific values in terms of carbon deposits, specially about the above and below ground biomass for perennial crops, which makes impossible to calculate CO_2 emissions from these sources for the subcategory of Cropland remaining cropland. The emissions that were considered were those deriving from the use of lime in cultivated soils and from the application of urea to soils.

Emissions from lime on cultivated soil depend mostly on the type of lime, and in the case of Chile, only calcite is considered. As the data were disaggregated per region, emissions were estimated using the corresponding default emission factors. The same procedure was used to calculate emissions from urea application.

In terms of lime use or liming, Chile only reports CO_2 emissions from lime used in agricultural soil; given the lack of information available, the assumption is that 100% of reported consumption corresponds to calcite.

Land converted to Cropland

Considering the lack of country/region-specific figures that could be used to differentiate the area converted to annual cropland from the area converted to perennial crops, the producer team worked under the assumption that all conversions were to annual crops. However, by using combined parametric data (national for Forest land and default for the rest) and the available regionally disaggregated activity data, it was possible to employ a Tier 2 method for the "Forest land converted to cropland" component.

7.3.2.1. Statistical and parametric activity data

Cropland remaining Cropland

Since there are no official statistics available on lime consumption, data was collected from the following sources:

- SOPROCAL,
- IANSA,
- SERNAGEOMIN (2011. Mining Yearbook of Chile. 208 pages. Santiago de Chile), and
- ODEPA and ASAGRIN Ltda. (2010. Market Diagnosis Survey and Survey on the Fertilizer Commercialization Chain in Chile).

Regional disaggregation of lime consumption was based on the expert review applied to the previous inventory.

Regarding the urea application data, the survey on tons or urea reported by the Market Diagnosis Survey and Survey on the Fertilizer Commercialization Chain in Chile, conducted by ODEPA and ASAGRIN Ltda., was used as data source. These values were broken down per region.

These sources provide different figures for national lime production and lack information that may help to differentiate between living lime (CaO or $Ca(OH)_2$), calcite ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$) (the latter two pertinent for CO_2 emissions); for this reason, emission estimates for this subcategory are highly imprecise. For this inventory, the assumption that all lime used in agriculture was calcite was assumed.

Land converted to Cropland

The activity data for all land converted to cropland were obtained from the Survey of native vegetation resources in Chile and the Monitoring of changes and updates for the 1997-2011 period, both performed by CONAF.

The parametric data used included: biomass stocks in Forest land (from INFOR and CONAF), biomass stocks in cropland (default 2006GL values), biomass stocks in settlements (based on expert judgment).

7.3.2.2. Emission factors

The 2006GL default factors were used for liming emissions and urea application.

7.4. Grassland (5C)

7.4.1. Description of category and GHG emissions

To distinguish it from "forest", grassland is considered to be an ecosystem with tree coverage below a certain threshold, which varies by region. Grassland has predominantly below-ground carbon, found mainly in roots and soil organic matter. In terms of rainfall and soil gradients, the transition between grassland and forests is often gradual. Bushes with a high proportion of perennial woody biomass may be considered a type of grassland, and therefore they are considered within the grassland category.

According to the 7th National Agricultural and Forestry Census (INE, 2007), in Chile grassland primarily includes what are known as "natural meadows", which occupy an area of 10.8 million ha, and "improved meadows", which cover 1.06 million ha. Many of these vegetation formations include annual herbaceous plants and bush formations known as "scrubland", which according to the same Census cover a total of 1.92 million hectares.

In 2010, GHG emissions for this category amounted to 1,241.1 $GgCO_2eq$, or 2.0% of the sector in absolute figures (Table 78). Since 1990, GHG emissions for this category have increased by 0.7%. Driven mainly by an increase in Forest land converted to grassland.

At the subcategory level, Land converted to Grassland was the most important, accounting for 98.7% of GHG emissions, while Grassland remaining Grassland was much lower, with 1.3% (Figure 66).

Figure 66. Grassland: GHG emission and removal trend per subcategory, 1990 - 2010 series.

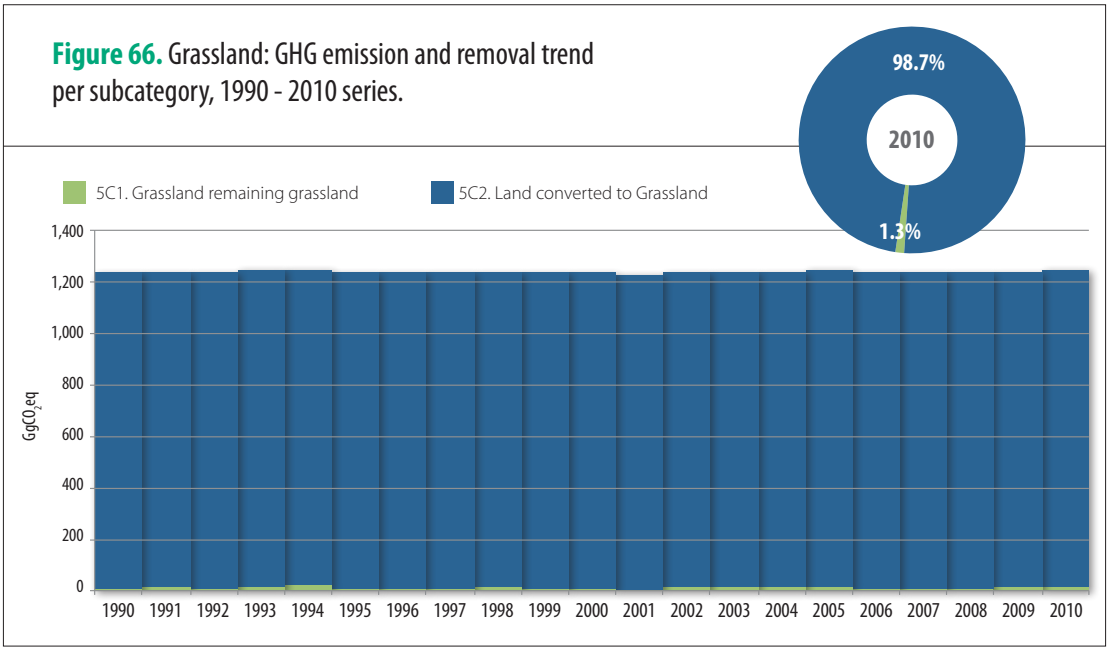


Table 78. Grassland: GHG emissions and removals ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
5C1. Grassland remaining grassland	6.9	7.2	5.1	17.6	15.6
5C2. Land converted to Grassland	1,225.5	1,225.5	1,225.5	1,225.5	1,225.5
Balance	**1,232.4**	**1,232.7**	**1,230.6**	**1,243.1**	**1,241.1**

Source: Compilation by SNICHILE.

7.4.2. Methodological aspects

The methods applied to prepare the inventory for the Grassland category are presented in the Table below:

Table 79. Grassland: methods applied

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
C. Grassland	T1b, T2	D, CS	T1a,b	D	T1a,b	D
1. Grassland remaining grassland			T1a,b	D	T1a,b	D
2. Land converted to Grassland	T1b, T2	D, CS				

T1a= Disaggregation by operational component (crops, species, etc.); T1b= Disaggregation per administrative regions; T2= Tier 2 Method; D= Default; CS= Country-Specific.

Source: Compilation by SNICHILE.

For inventory effects, it should be noted that the lack of country or region-specific values for natural meadows, and specifically in reference to bushy scrubland, made it impossible to include this land fully in the GHG national inventory. Only the herbaceous strata was considered, using default values.

This gap led to a difference with the previous series of inventories (1984-2006 series), which addressed only aboveground living biomass and estimated scrubland biomass from expert judgment. Another difference this time, is the exclusion of the area planted with Atriplex from the Forest land category, where it was before, and its inclusion under this category. Lastly, due to a lack of national data on bushy formations, their annual biomass expansion was not recorded.

Given the absence of national parametric data (forest land biomass), a Tier 2 method was used to estimate the emissions/removals of Forest land converted to grassland.

7.4.2.1. Statistical and parametric activity data

Grassland remaining grassland

The activity data indicator required for this subcategory is the area of burnt grassland (Estadísticas Históricas Incendios Forestales, CONAF-Empresas 1985-2010, in http://www.conaf.cl/incendios-forestales/incendios-forestales-en-chile/estadisticas-historicas/). Default parametric data from the 2006GL were used.

Jorge Herreros

Land converted to Grassland

The statistical activity data required — the area of Forest land, Cropland, Wetland, Settlements and Other land converted to Grassland — is available in CONAF surveys.

The parametric data used included: biomass stock in forest land (generated by INFOR and CONAF), biomass stock in cropland (default as per 2006GL), and biomass stock in settlements (based on expert review).

7.4.2.2. Emission factors

In accordance with the 2006GL, the emission factors for this category correspond to the default values.

7.5. Wetland (5D)

This category was not estimated due to a complete lack of country/region-specific parametric activity data and emission factors.


Wetland.

Alejandro Armendariz

7.6. Settlements (5E)

7.6.1. Description of category and GHG emissions

This category includes herbaceous vegetation, bushy vegetation and trees in residential areas, urban areas, public and private gardens and parks, among others, linked either functionally or administratively to cities, towns or other types of human settlements, as long as these are not counted in another land use category.

According to CONAF statistics (2011), settlements cover an area of 248,002 ha, equal to 0.33% of the national territory. Meanwhile, the area annually converted to settlements, calculated using the land-use change matrices found in CONAF's survey of native Chilean vegetation resources, is 6,778.8 ha, with Cropland and Grassland being the most affected by that conversion.

In 2010, GHG emissions in this category amounted to 186.8 $GgCO_2eq$, or 0.3% of the sector's total, in absolute figures (Table 80). GHG emissions in this category have remained constant since 1990.

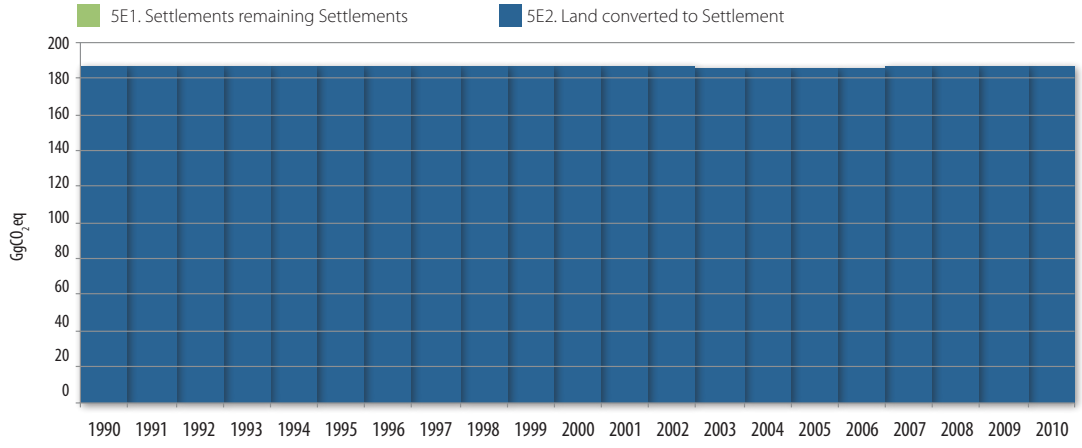
At a subcategory level, Settlements remaining settlements are the most relevant with 100% (Figure 67).

Table 80. Settlements: GHG emissions and removals ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
5E1. Settlements remaining Settlements	0.0	0.0	0.0	0.0	0.0
5E2. Land converted to Settlement	187.2	186.6	186.3	185.7	186.8
Balance	**187.2**	**186.6**	**186.3**	**185.7**	**186.8**

Source: Compilation by SNICHILE.

Figure 67. Settlements: GHG emission and removal trend per subcategory, 1990 - 2010 series.



7.6.2. Methodological aspects

The methods applied to prepare the inventory for the Settlements category are presented in the Table below:

Table 81 Settlements: methods applied

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
E. Settlements	T1b, T2	D, CS				
1. Settlements remaining Settlements	NE	NE				
2. Land converted to Settlements	T1b, T2	D, CS				

T1b= Disaggregation per administrative regions; T2= Tier 2 Method; D= Default; CS= Country-Specific; NE= Not estimated.

Source: Compilation by SNICHILE.

Emissions and/or removals from the Settlements remaining settlements subcategory were not quantified because country-specific parametric data are lacking.

The methodology used for the Land converted to settlements subcategory is the same as that used for the Land converted to Forest land subcategory and involves estimating the annual change in carbon stock of the carbon sinks included in this inventory (living biomass and necromass).

7.6.2.1. Statistical and parametric activity data

The required statistical activity indicator — the area of Forest land, Cropland, Grassland and Other land converted to Settlements — is available in CONAF surveys.

The parametric data used include biomass stock in forest land (from INFOR and CONAF), biomass stock in cropland (2006GL default value), biomass stock in grassland (2006GL default value).

7.6.2.2. Emission factors

In accordance with the 2006GL, the emission factors for this category correspond to the default values.

7.7. Other land (5F)

7.7.1. Description of category and GHG emissions

According to the 2006GL, the Other land category consists of bare soil, rock, ice and all other land not belonging to the other five land-use categories. For this inventory, the "Other Land" category consists of the following categories recognized by the National Forestry Corporation (CONAF):

- Areas without vegetation,
- Ice and glaciers,
- Bodies of water, and,
- Uncharted areas.

Together, these areas cover 30,678,266 ha, or 41% of the total national area (CONAF, 2011).

In 2010, GHG emissions in this category amounted to 123.2 $GgCO_2eq$, or 0.2% of the sector, in absolute figures (Table 82). GHG emissions in this category have remained constant since 1990.

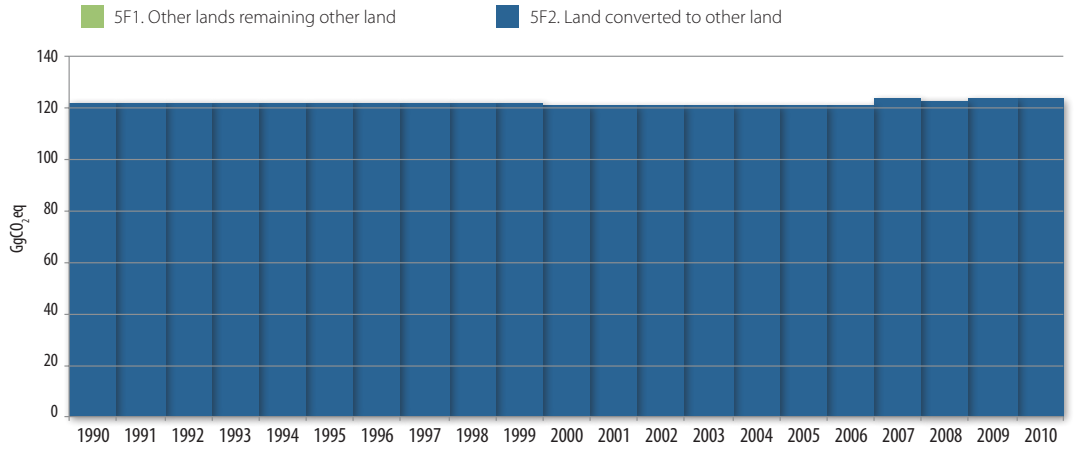
Land converted to other land was the most relevant subcategory, accounting for 100% (Figure 68).

Table 82. Other land: GHG emissions and removals ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
5F1. Other lands remaining other land	0.0	0.0	0.0	0.0	0.0
5F2. Land converted to other land	121.8	121.3	121.2	120.9	123.2
Balance	**121.8**	**121.3**	**121.2**	**120.9**	**123.2**

Source: Compilation by SNICHILE.

Figure 68. Other Land: GHG emission and removal trend by subcategory, 1990 - 2010 series.



7.7.2. Methodological aspects

The methods applied to develop the Other Land category are presented in the following Table:

7.7.2.2. Emission factors

In accordance with the 2006GL, the emission factors for this category correspond to the default values.

Table 83. Other land: Methods applied.

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
F. Other land	T1b, T2	D, CS				
1. Other lands remaining other land	NE	NE				
2. Land converted to other land	T1b, T2	D, CS				

T1b= Disaggregation per administrative regions; T2= Tier 2 Method; D= Default; CS= Country-Specific; NE= Not estimated.

Source: Compilation by SNICHILE.

As in the previous cases, this category recorded changes in carbon stocks using the methodology described for the Land converted to forest land subcategory.

7.7.2.1. Statistical and parametric activity data

The required statistical activity indicator — the area of Forest land, Cropland, Grassland and Settlements converted to other land — is available in CONAF inventories.

The parametric data used included biomass stock in forest land (from INFOR and CONAF), biomass stock in cropland (2006GL default values), biomass stock in grassland (2006GL default values), and biomass stock in settlements (based on expert judgment).

7.8. Quality assurance and control procedure

As mentioned previously, the LULUCF sector inventory was prepared by the AFOLU Sector Team, and thus employed the same quality assurance and quality control procedures, which can be reviewed in section 6. Agriculture.

7.9. Planned improvements

Based on the analysis undertaken internally by the AFOLU Sector Team and the recommendations of the SGHGI expert review, the following improvements are planned for the sector:

- Improved coordination and management among government entities that possess/ generate statistical data for future reporting

to international sources. The objective of this action is to maintain the consistency of national and international databases.

- Creation of working groups with key non-governmental entities (trade associations, institutions, etc.) that possess parametric data necessary to generate country-specific emission factors. This is particularly important for important or key categories and/or subcategories.

- Development of country-specific emission factors. The possibility of having funds which allow the execution of projects through competitive public grants shall be evaluated.

- Improvement of information contained in CONAF's Survey of Native Vegetation, through:
  - o Updating the land-use change matrices for the country's remotest regions. It is understood that land-use change occurs much less frequently than in central and southern-central regions of Chile.
  - o Increasing the frequency of aerial images used to construct land-use change matrices.

- Improvement of parametric data on native forest management through INFOR's implementation of the GEF project, Integrated national monitoring and assessment system on forest ecosystems (SIMEF) in support of policies, regulations and SFM practices incorporating REDD+ and biodiversity conservation in forest ecosystems which is scheduled to begin in 2015.

8 WASTE SECTOR (6)

Sanitary landfill
Western Santiago

8.1. General Overview of the sector

The Waste sector accounts for GHG emissions generated by anaerobic reactions that result from the decomposition of waste in final disposal sites, those resulting from domestic and industrial wastewater management, those generated by combustion processes such as incineration and open burning of waste, and emissions from the biological treatment of waste (composting and anaerobic digestion). Therefore, the sector has been divided into the following categories:

- 6A Solid waste disposal.
- 6B Wastewater treatment and discharge.
- 6C. Waste incineration.
- 6D Other (Biological treatment of solid waste).

In recent years, Chile has improved its waste disposal capabilities by establishing regulatory requirements that govern the location, construction, startup and closure of these facilities. Unmanaged, uncategorized waste sites that have not met these new sanitation and environmental standards (garbage dumps and some landfills) have gradually been replaced by sites that are managed according to current regulations (sanitary landfills). The country has also seen an increase in waste valuation initiatives, including the biological treatment of solid waste (composting). Regulations have also been introduced for waste incineration. Additionally, the coverage of domestic wastewater treatment and discharge has expanded significantly, Liquid industrial waste has been regulated since 2006 by a new legal framework that, coupled with technological advances in treating discharged wastewater, has reduced GHG emissions.

It is worth noting here that the 2006GL use different terms for the Waste sector than those used in Chile for the Waste sector. Table 84 shows the denominations used in the 2006GL versus those used in the country, and how they were adapted.

Table 84. Wastes: Standardization of sector-specific terminology.

2006GL Denomination	National denomination	Denomination used
Solid Waste Disposal	Waste Disposal	Solid Waste Disposal
Municipal Solid Waste (MSW)	Residential Solid Waste	Municipal Solid Waste (MSW)
Solid Waste Disposal Sites (SWDS)	Final Disposal Sites for Domiciliary Waste	Solid Waste Disposal Sites (SWDS)
Biological Treatment of Solid Waste	Biological Treatment of Waste	Biological Treatment of Solid Waste
Incineration, and Open Waste Incineration	Incineration and Open Burning of Waste	Incineration and Open Burning of Waste
Wastewater Treatment and Disposal	Wastewater Treatment and Disposal	Wastewater Treatment and Discharge
Domestic Wastewater	Wastewater	Domestic Wastewater
Industrial Wastewater	Liquid Industrial Wastes (LIW)	Industrial Wastewater
Biochemical Oxygen Requirement (BOD)	Biochemical Oxygen Demand (BOD)	Biochemical Oxygen Demand (BOD)
Chemical oxygen Requirement (COD)	Chemical Oxygen Demand (COD)	Chemical Oxygen Demand (COD)

Note: Chilean legal provisions do not use the term "desechos" but rather "residuos", and therefore the latter term has been employed in adapting local terminology to the 2006GL.
Source: Compilation by the Waste Sector Team.

The Waste sector is the fourth largest source of GHGs in Chile, accounting for 3.9% of total GHG emissions (Figure 69).

In 2010, GHG emissions from this sector amounted to 3,554.1 $GgCO_2eq$ (Table 85), Since 1990, the sector's GHG emissions have increased by 44.2%. The GHG emissions increase are primarily driven by a constant increase in the population and the steady rise in waste generated. The decrease in GHG emissions observed since 2007 (Figure 70) is mainly due to CH_4 recovery in Solid waste Disposal Sites (SWDS) in the latter years of this time series (for more detail see section 8.2., Solid waste disposal).

At a category level, Solid waste disposal accounts for 74.4% of GHG emissions from this sector, followed by Wastewater treatment and discharge with 23.7%, Biological treatment of solid waste with 1.9%, and Waste incineration, with less than 1%.

Figure 69. Waste Sector: sector share trend on total GHG emissions (excl. LULUCF).

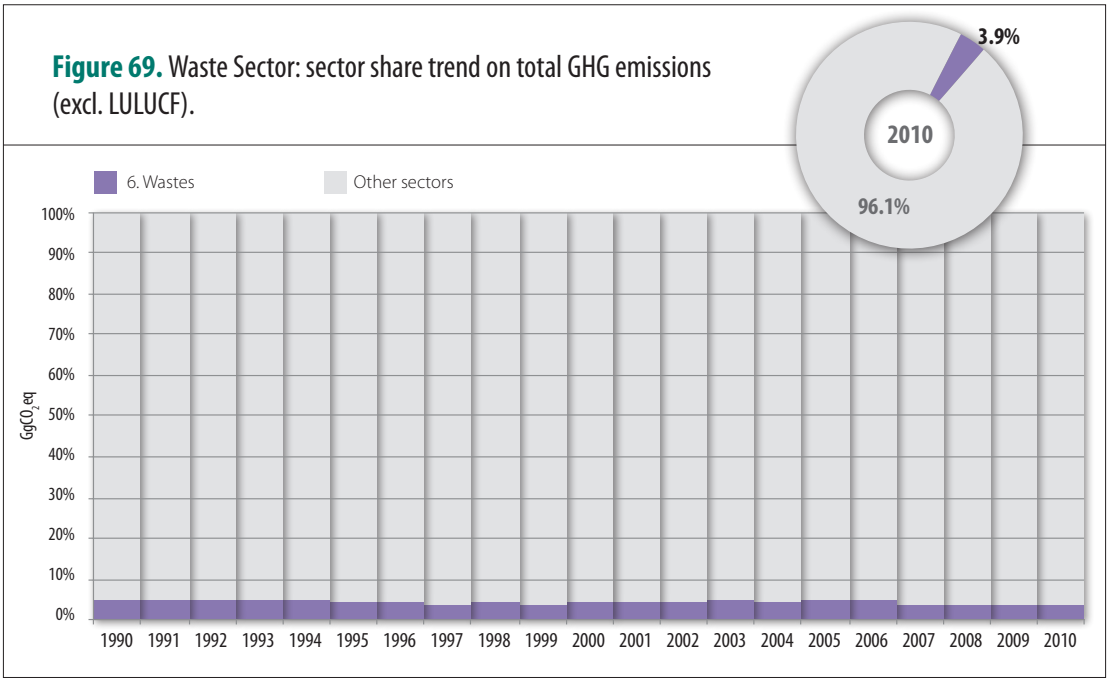


Table 85. Waste sector: GHG emissions ($GgCO_2eq$) per category, 1990 - 2010 series.

Category	1990	1995	2000	2005	2010
6A. Solid waste disposal	1,916.3	2,187.1	2,564.1	3,104.9	2,643.7
6B. Wastewater treatment and discharge	533.2	482.7	546.8	714.6	842.2
6C. Waste incineration	0.1	0.1	0.1	0.2	0.3
6D. Others (Biological treatment of solid wastes)	15.9	15.9	19.0	46.5	67.9
Total	**2,465.5**	**2,685.8**	**3,130.0**	**3,866.2**	**3,554.1**

Source: Compilation by SNICHILE.

Figure 70. Waste Sector: GHG emission trend per category, 1990 - 2010 series.

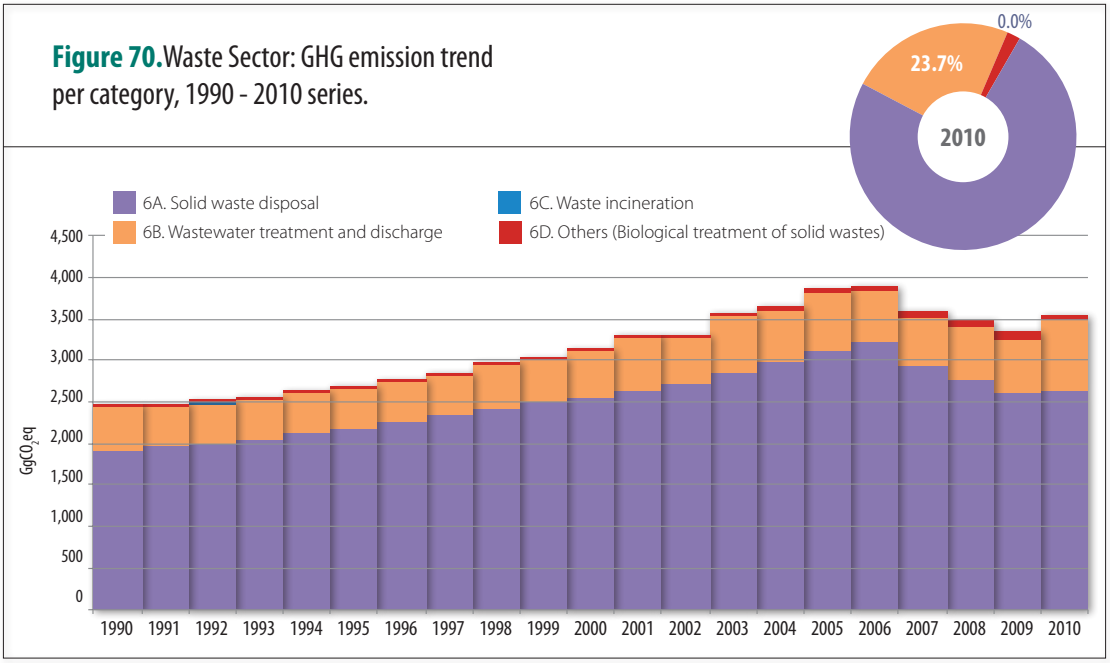


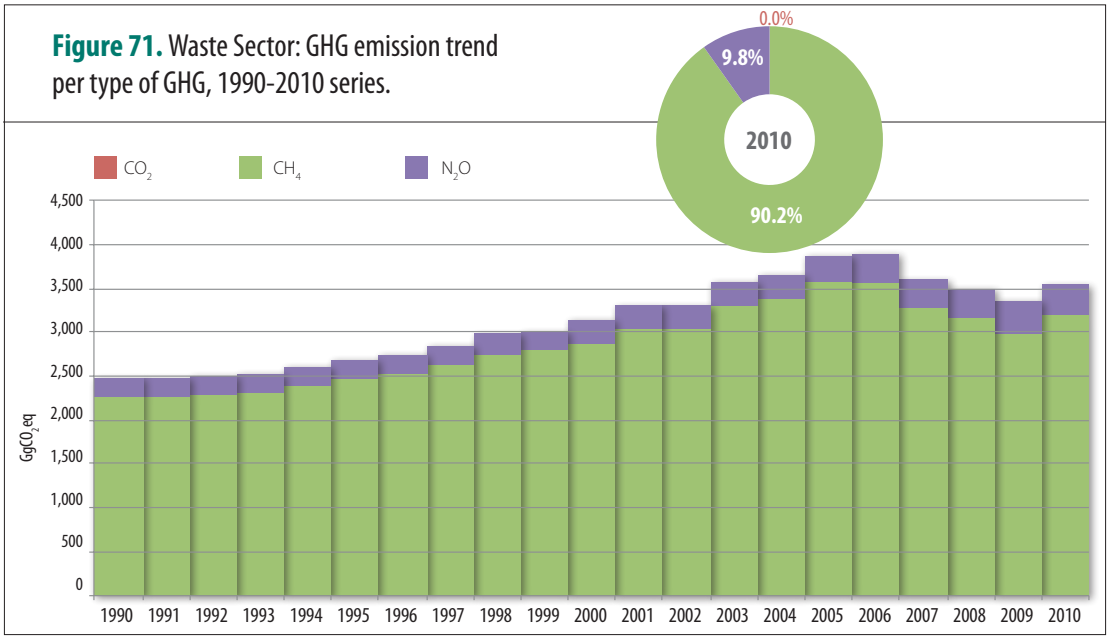
Table 86. Waste Sector: Emissions per type of GHG ($GgCO_2eq$), 1990 - 2010 series.

GHG	1990	1995	2000	2005	2010
CO_2	0.1	0.1	0.1	0.2	0.3
CH_4	2,268.8	2,473.1	2,884.3	3,572.3	3,204.8
N_2O	196.7	212.6	245.6	293.7	349.0
Total	**2,465.5**	**2,685.8**	**3,130.0**	**3,866.2**	**3,554.1**

Source: Compilation by SNICHILE.

In 2010, the leading GHG emitted by this sector was CH_4, which accounted for 90.2% of the sector's total GHG emissions, followed by N_2O with 9.8% and CO_2 with less than 1% (Table 86 and Figure 71).

Figure 71. Waste Sector: GHG emission trend per type of GHG, 1990-2010 series.



8.2. Solid waste disposal (6A)

8.2.1. Description of category and GHG emissions

The treatment and disposal of municipal, industrial and other solid waste produces significant amounts of CH_4, In addition to CH_4, SWDSs also produce biogenic CO_2 and NMVOCs, as well as small quantities of N_2O, NOx and CO. The subcategories included in this category vary with the characteristics of the disposal site. These are as follows:

- 6A1 Managed waste disposal sites.
- 6A2 Unmanaged solid waste disposal sites.
- 6A3 Others.

In general in Chile, solid waste is disposed in one of the following types of sites:

- Sanitary landfill (compliant with current regulations, Supreme Decree N° 189/2008),
- Garbage dump site (not compliant with the 1980 regulations or current ones), and
- Landfill (compliant with 1980 regulations and Resolution N° 2004).

In 2010, the total quantity of residential solid waste (RSW) produced in Chile was approximately 6,000 Gg, Approximately 47% of this waste is generated in the Metropolitan Region (RM), the region that concentrates most of the population of the country (MMA, 2014).

Industrial waste generated by at a municipal level, small businesses and commercial establishments are counted as municipal solid waste (MSW) when disposed of in solid waste disposal sites.

The category Solid waste disposal accounts for the largest volume of GHGs emitted in this sector. In 2010, GHG emissions from this category amounted to 2,643.7 $GgCO_2eq$, or 74.4% of the sector's total emissions (Table 87). Since 1990, GHG emissions from sources in this category have risen by 38%. Caused mainly as a result of steady population growth. The interannual variations observed in Figure 72 are driven mainly

Table 87. Solid waste disposal: GHG emissions ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
6A1. Managed waste disposal sites – sanitary landfills	0.4	585.8	831.3	2,029.8	1,823.8
6A2. Unmanaged solid waste disposal sites – Garbage dump site	489.4	380.2	350.4	234.3	206.9
6A3. Other (Uncategorized waste disposal sites) – Landfills	1,426.4	1,221.1	1,382.4	840.7	613.1
Total	**1,916.3**	**2,187.1**	**2,564.1**	**3,104.9**	**2,643.7**

Source: Compilation by SNICHILE.

Figure 72. Solid waste disposal: GHG emission trend per subcategory, 1990 - 2010 series.

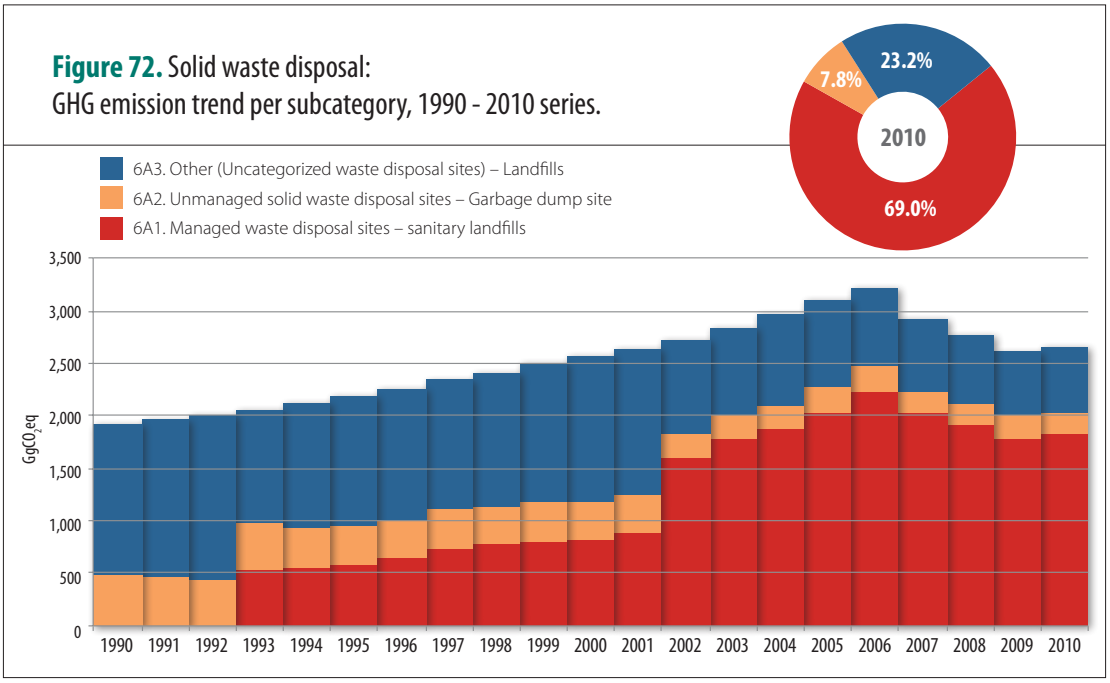


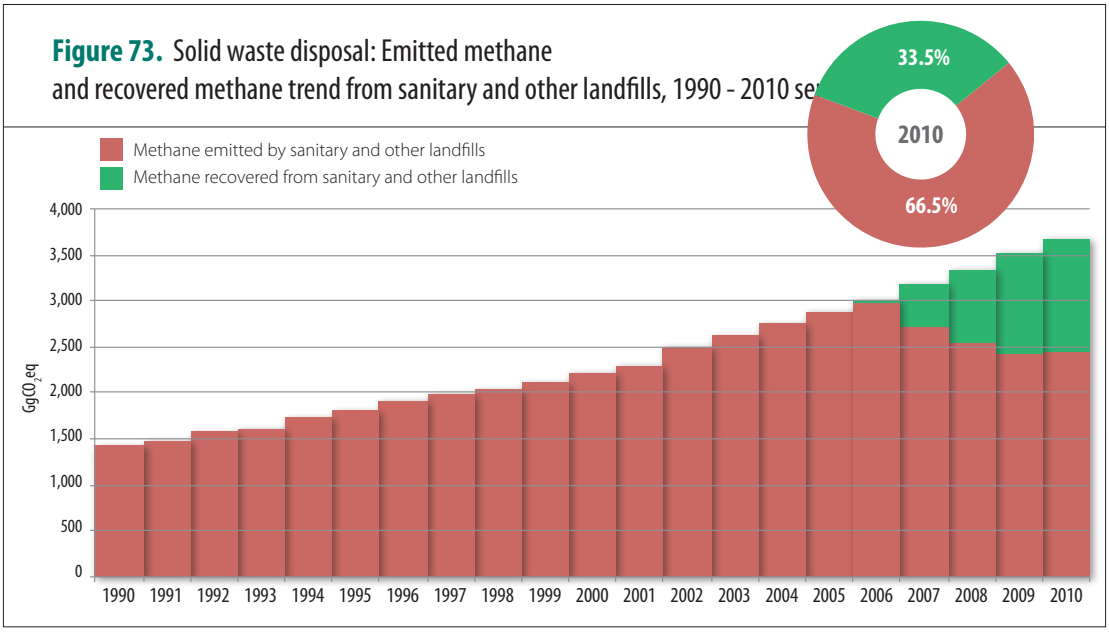
Table 88. Solid waste disposal: emitted methane ($GgCO_2eq$) and recovered methane ($GgCO_2eq$) from sanitary and other landfills, 1990 - 2010 series.

Component	1990	1995	2000	2005	2010
Methane emitted by sanitary and other landfills	1,426.9	1,806.9	2,213.7	2,870.5	2,436.8
Methane recovered from sanitary and other landfills	0.0	0.0	0.0	0.0	1,228.3
Total	**1,426.9**	**1,806.9**	**2,213.7**	**2,870.5**	**3,665.1**

T1 = Tier 1 Method; D= Default.

Source: Compilation by SNICHILE.

Figure 73. Solid waste disposal: Emitted methane and recovered methane trend from sanitary and other landfills, 1990 - 2010 se



by CH_4 recovered from solid waste disposal sites in the latter years of the series.

In terms of subcategories, Managed waste disposal sites (sanitary landfills) make up the most significant, accounting for 69.0% of all GHG emissions in this category, followed by Uncategorized waste disposal sites with 23.2% (landfills) and Unmanaged solid waste disposal sites (dumps) with 7.8%.

The notable reduction in GHG emissions that can be observed as of 2006 is driven mainly by an increase in CH_4 recovery in sanitary landfills and Landfills. The release and recovery of CH_4 from these landfills is shown in Table 88 and Figure 73. In 2010, 33.5% of all CH_4 generated was recovered, mitigating 1,228.3 $GgCO_2eq$.

8.2.2. Methodological aspects

The methods applied in preparing the Solid waste disposal category are presented in the Table below:

Table 89. **Solid waste disposal: methods applied.**

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
A. Solid waste disposal			T1	D		
1. Managed waste disposal sites			T1	D		
2. Unmanaged solid waste disposal sites			T1	D		
3. Others			T1	D		

T1 = Tier 1 Method; D= Default.

Source: Compilation by SNICHILE.

To calculate GHG emissions from this category, data gather from country-specific information was considered, with adjustments and estimations in case of discrepancies and data gaps respectively, whereas for emission parameters and factors, the 2006GL default values were considered.

The method used to estimate emissions in the Solid waste disposal category is based on the First Order Decay (FOD) model, a Tier 1 method provided in the 2006GL. This method involved disaggregating national figures into climatic macro zones to identify different waste degradation conditions.

The Northern Macro zone covers XV, I, II, III, IV, V, XIII and VI regions and was classified under the climate zones set out in the 2006GL as "boreal and dry temperate", regarding the climatic conditions in those regions. Similarly, the Southern Macro zone covers VII, VIII, IX, XIV, X, XI and XII regions and is classified as "boreal and wet temperate".

Table 90. Final solid waste disposal sites with methane recovery operations.

Region		Company Name	Project Name
IV	Coquimbo	TASUI Norte	El Panul
V	Valparaíso	I. Municipality of Viña del Mar	Former Lajarilla Landfill
	Valparaíso	Stericycle	El Molle and Cartagena
	Valparaíso	KDM	El Belloto
	Valparaíso	GEA	La Hormiga
XIII	Metropolitan	Proactive	Western Santiago
	Metropolitan	Santa Marta Consortium	Santa Marta
	Metropolitan	KDM	Loma los Colorados
VI	O'Higgins	Proactive	La Yesca
VIII	Biobío	Hidronor	Hidronor
	Biobío	Cermarc	Cermarc
XII	Magallanes	Punta Arenas	Leña dura

Source: MMA, 2013.

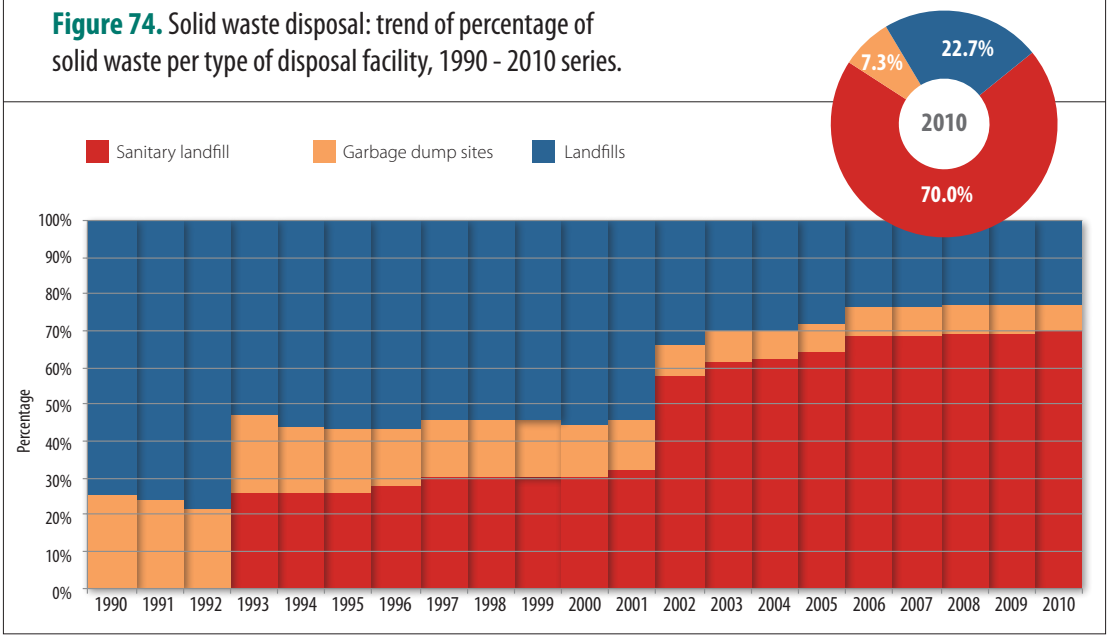
8.2.2.1. Statistical and parametric activity data

Data on the quantity of waste deposited in disposal sites was obtained from historical information generated by the Waste Area of the MMA (formerly CONAMA) since 2000 and adjusted through a specific study which allowed consistency of the data to be enhanced. These data considered three categories according to the level of compliance with Chilean waste regulations. Then, these data were classified as per the 2006GL.

Sludge data was estimated based on the quantity of residential waste deposited in solid waste disposal sites, with the information published by the Office of the Superintendent of Sanitation Services (SISS).

For estimating CH_4 recovery, information was obtained from each of the 12 disposal sites in Chile that carry out methane recovery (Table 90). The assumptions made were always validated by experts responsible for compiling waste disposal data at the national level.

Figure 74. Solid waste disposal: trend of percentage of solid waste per type of disposal facility, 1990 - 2010 series.



The percentage of Solid Residential Waste sent to SWDS was obtained from the regional offices of the Ministry of the Environment (SEREMI), which reported on the matter according to their respective regions. The quantity of waste disposed of in each municipality was used to calculate the percentage per type of final disposal. This information was completed in case of data gaps and compared against the information contained in the "ECOAMERICA, 2012" inventory. In 2010, 70% of all municipal solid waste of the total of SRW was disposed of in sanitary landfills, 22.7% was taken to landfills, and 7.3% ended up in garbage dumps (Figure 74).

The parametric data necessary the default values provided in the 2006GL.

8.2.2.2. Emission factors

The default emission factors provided in the 2006GL were used for all corresponding subcategories.

8.3. Wastewater treatment and discharge (6B)

8.3.1. Description of category and GHG emissions

This category includes CH_4 emissions from the anaerobic reactions that occur during treatment of domestic and industrial wastewater, Likewise, this category considers the N_2O emissions generated by indirect emissions from Residential Wastewater after the disposal of effluents on inland waterways, lakes or the sea.

In 2010, GHG emissions from this category amounted to 842.2 $GgCO_2eq$, or 23.7% of total emissions in this sector (Table 91). This represents an increase of 57.9% on GHG emissions since 1990. This is mainly due to increases in the population and in coverage of residential wastewater treatment.

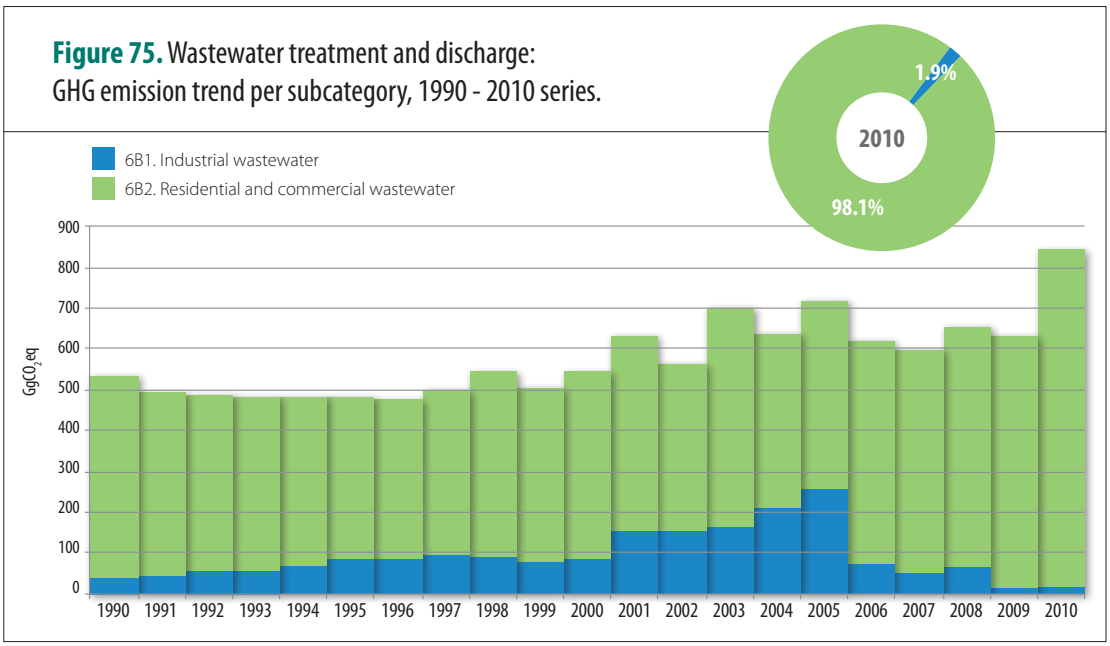
In terms of subcategories, residential and commercial wastewater is the most significant, accounting for 98.1%, while Industrial wastewater accounted for 1.9% (Figure 75). Since 2006, the emissions from the Residential wastewater subcategory have dropped because of the enactment of a new decree, S.D. N° 90/00: Emission standard for regulating pollutants associated with liquid waste discharged into marine or inland surface waters.

Table 91. Wastewater treatment and discharge: GHG emissions ($GgCO_2eq$) per subcategory, 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
6B1. Industrial wastewater	40.5	83.8	87.0	258.2	16.3
6B2. Residential and commercial wastewater	492.8	398.9	459.7	456.4	825.9
Total	**533.2**	**482.7**	**546.8**	**714.6**	**842.2**

Source: Compilation by SNICHILE.

Figure 75. Wastewater treatment and discharge: GHG emission trend per subcategory, 1990 - 2010 series.



8.3.2. Methodological aspects

The methods applied in preparing the Wastewater treatment and discharge category are listed in the Table below:

Table 92 Wastewater treatment and discharge: methods applied

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
B. Wastewater treatment and discharge			T1	D	T1	D
1. Industrial wastewater			T1	D		
2. Residential and commercial wastewater			T1	D	T1	D
3. Others			NE	D	NE	D

T1= Tier 1 Method; D= Default; NE= Not estimated.

Source: Compilation by SNICHILE.

Industrial wastewater

The Office of the Sanitation Services Superintendency (SISS) is responsible for monitoring those facilities generating industrial wastewater since 2006, when the decree, D.S N° 90/00, came fully into force. Emission standard for regulating pollutants associated with liquid waste discharged into marine or inland surface waters. SISS monitors the compliance of each establishment in the country producing industrial wastewater according to the parameters set out in the regulations.

However the decree makes no reference to different types of wastewater treatment, the amount of sludge generated or CH_4 removal during the treatment process, and therefore this information has not been collected at the national level. However, experts in the SISS Environmental Unit have assigned specific types of treatment to each industry sector, for three different periods (1990–2000, 2001–2005 and 2006–2010).

The methodological level used in this category is a Tier 1 method in terms of using default values for emission factors and estimations to fill in the gaps in activity data for some years.

Residential and commercial wastewater

The SISS is the entity responsible for establishing regulations and regulating sanitation companies, This entity manages the total coverage data for residential wastewater treatment at a national level. It began keeping such records in 1991, when sewage treatment only covered 6.8% of the total population. By 2010, coverage had risen to 84%, an increase of 77.2%. The population segment covered by the sanitation system is denominated "high-income urban", while the remaining segments of the population with their own forms of wastewater treatment and/or discharge are classified as "low-income urban" or "rural".

In the Chilean context, the sludge removed during wastewater treatment is sent to different destinations. A large portion of it ends up in sanitary landfills, authorized dump sites and mono-landfills, and CH_4 emissions for these types of final disposal sites are accounted for under the Solid waste disposal category. Another portion of sludge is disposed of in agricultural operations as compost.

Chile has six wastewater treatment plants that recover and burn CH_4, though none of them to date does so to generate energy.

8.3.2.1. Statistical and parametric activity data

Industrial wastewater

Information for the entire country has been available since 2006, when the aforementioned S.D. N° 90/00 came fully into force and SISS was charged with monitoring and enforcing compliance among establishments generating industrial wastewater. The information obtained from this institution covers the period 2006–2010; unreported years were estimated using data extrapolated from this period, in addition to considering recorded BOD_5 values, which were subsequently converted into COD values.

Residential and commercial wastewater

The data employed for this subcategory flow rates, types of treatment, volume of sludge and amounts of recovered CH_4 were provided almost entirely by SISS — the agency responsible for establishing, monitoring and enforcing regulations applicable to sanitation companies. While, population data was obtained from INE. Using data on the coverage of wastewater treatment plants, it was possible to calculate coverage of wastewater treatment per inhabitant. The population was separated by income segment (rural population, low-income urban and high-income urban) according to sanitation coverage based on studies conducted by the Office of the Undersecretary of Regional and Administrative Development (SUBDERE) in order to obtain figures about the sanitation deficit. Additionally, some Environmental Approval Permits (RCA) from the Environmental Impact Evaluation System (SEIA) were also used to complete the information available.

To estimate nitrous oxide emissions, figures on protein consumption per capita were obtained from the Ministry of Health (MINSAL), In some cases, the opinion of local experts was also requested. Table 93 shows national consumption values.

Table 93. Residential and commercial wastewater: national protein consumption (kg/person/year), 1990 - 2010 series.

Year	1990	1995	2000	2005	2010
Protein	25.59	28.4	28.69	31.76	33.06

Source: Ministry of Health (Ministerio de Salud)

8.3.2.2. Emission factors

The default emission factors provided in the 2006GL were used for all corresponding subcategories.

8.4. Waste incineration (6C)

8.4.1. Description of category and GHG emissions

Incineration involves the combustion of solid and liquid waste without energy recovery. Waste can also be burned outside, in other words, unwanted materials such as paper, wood, plastic, textiles, rubber, oils and other materials are sometimes burned in the open or in open landfills in Chile. In these cases, smoke and other emissions are released directly into the atmosphere. This also occurs with incinerators that do not control the combustion air. Chilean regulations prohibit the open incineration of waste, and no figures exist on the scope of this practice in the country.

However, some authorized facilities to incinerate hospital waste without energy recovery can be identified. Another activity included under the waste incineration category is the cremation of cadavers and human remains, which is carried out in crematoria associated with the country's cemeteries.

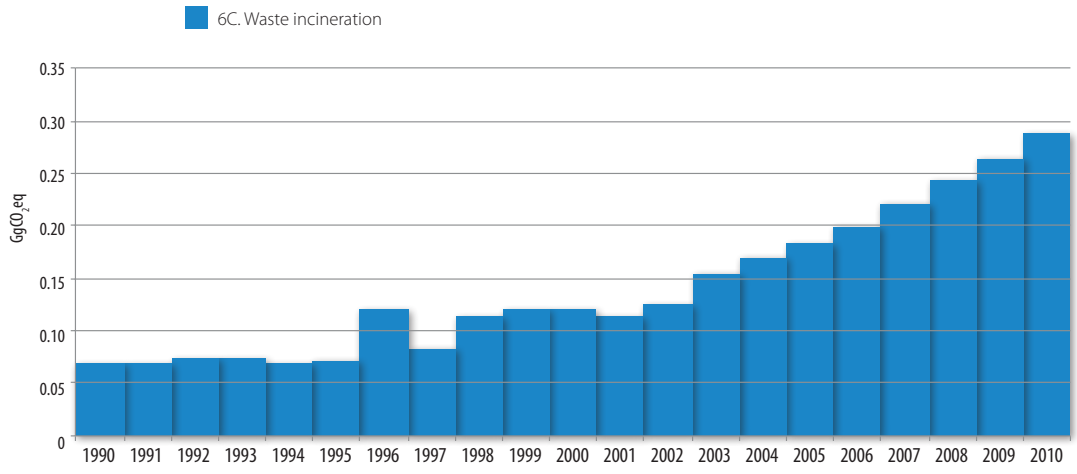
In 2010, GHG emissions from this category amounted to 0.3 $GgCO_2eq$, or less than 1% of total GHG emissions in the sector (Table 94). Since 1990, GHG emissions have experienced 321.0% increase. Mainly due to the increase in hospital waste incinerated (Figure 76).

Table 94. Waste incineration: GHG emissions ($GgCO_2eq$), 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
6C. Waste incineration	0.1	0.1	0.1	0.2	0.3
Total	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**

Source: Compilation by SNICHILE.

Figure 76. Waste incineration: GHG emission trend, 1990 - 2010 series.



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8.4.2. Methodological aspects

The methods applied to the Waste incineration category are shown in the Table below:

Table 95. Waste incineration: methods applied.

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
C. Waste incineration	**T1**	**D**			**T1**	**D**

T1 = Tier 1 Method; D= Default.

Source: Compilation by SNICHILE.

The Tier 1 methods provided in the 2006GL were used for the Waste incineration and open incineration category.

8.4.2.1. Statistical and parametric activity data

Information was collected on the incineration of hospital waste, which is regulated by Supreme Decree N° 6/09 Regulation on the management of waste in health care establishments, as well as on the number of cadavers and quantity of human remains in crematories. The Ministry of Health was consulted about this information, which the entity responsible for enforcing compliance with waste combustion regulations. Information on hospital waste incineration was also requested from the companies contracted to perform this activity, while cremation data was obtained from a some of the country's cemeteries.

8.4.2.2. Emission factors

Almost all of the emission factors and parametric data were the default values provided in the 2006GL, though a few were obtained from Chile's previous NIR of the 2NC of Chile (MMA, 2011).

8.5. Others: Biological treatment of solid waste (6D)

8.5.1. Description of category and GHG emissions

Approximately 50% of solid waste generated consists of organic matter that can be transformed through biological treatment of composting or anaerobic digestion, into a stable and much smaller volume that is free from pathogens and can be used to produce biogas as a form of energy. The final product of this process can be used as fertilizer and soil compost, or can be disposed of in a solid waste disposal sites.

Chile has some composting facilities or projects, and this activity is governed by the "Chilean Standard for Compost Quality" (ChN 2880, INN). Biological digestion projects , however, are in its infancy in Chile, with a few projects already approved but none currently in operation, as of 2010. The exceptions are wastewater treatment plants that process sludge through anaerobic digestion with the treatment they perform, an activity that is addressed within the category wastewater treatment and discharge.

In 2010, GHG emissions in this category amounted to 67.9 $GgCO_2eq$, less than 1% of all Waste sector GHG emissions (Table 96), Since 1990, GHG emissions in this category have risen by 326.1%, Mainly due to the increase in the number of facilities conducting these operations. Interannual variations observed in Figure 77 are primarily the result of the closure of some plants in 2009 and 2010.

Table 96. Others (Biological treatment of solid wastes): GHG emissions ($GgCO_2eq$), 1990 - 2010 series.

Subcategory	1990	1995	2000	2005	2010
6D. Others (Biological treatment of solid wastes)	15.9	15.9	19.0	46.5	67.9
Total	**15.9**	**15.9**	**19.0**	**46.5**	**67.9**

Source: Compilation by SNICHILE.

8.5.2. Methodological aspects

The methods applied to the category Other (Biological treatment of solid waste) are shown in the table below:

Figure 77. Others (Biological treatment of solid wastes): GHG emission trend, 1990 - 2010 series.

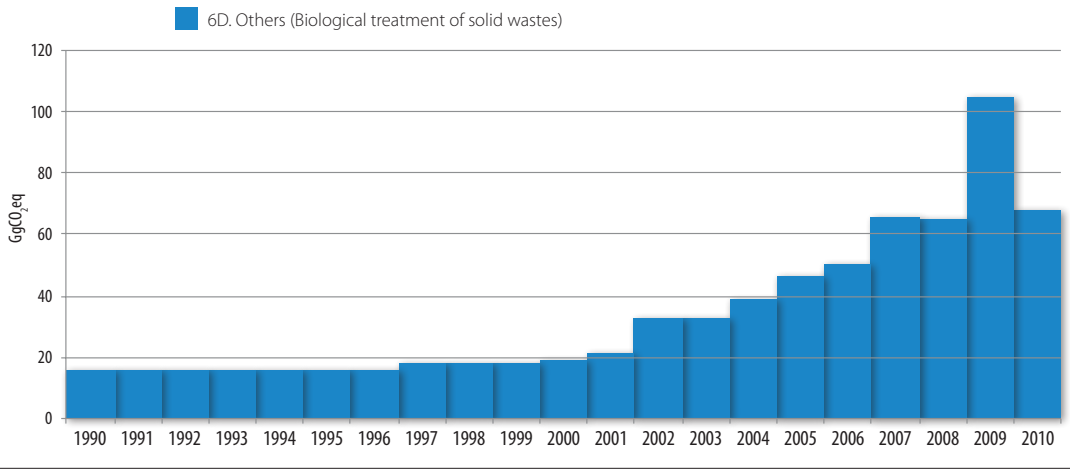

Table 97. Other (Biological treatment of solid waste): methods applied.

Greenhouse gas source and sink categories	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
D. Others			T1	D	T1	D
Biological treatment of solid waste			T1	D	T1	D

T1 = Tier 1 Method; D= Default. Source: Compilation by SNICHILE.

A Tier 1 methodology that involved the use of default emission factors provided in the 2006GL, according to what is established on these guidelines.

8.5.2.1. Statistical and parametric activity data

As there is no registry of Chilean facilities that perform biological treatment, to build the activity data the team recurred to projects of this kind evaluated by the Environmental Impact Assessment System. They reviewed every project and identified the ones currently in operation. Only composting projects were found to be in operation, while anaerobic digestion initiatives had been approved but were not yet operating, and thus were not considered. This information was complemented with studies conducted by SUBDERE on the funding of residential composting programs. The team also visited and contacted some companies and large municipalities that had composting programs in place in order to generate useful figures.

8.5.2.2. Emission factors

The default emission factors provided in the 2006GL were used for all corresponding subcategories.

8.6. Quality assurance and control procedure

This section outlines the quality assurance and quality control procedures performed by the sectoral team.

8.6.1. Quality control

- Comparison of the current Waste SGHGI with the NIR submitted with the Second National Communication (MMA, 2011).

- Activity data:
  - o Trend analysis on the activity data surveyed to identify anomalies in values.
  - o Development of the study Adjustment of the Survey of Municipal Solid Waste, 1990/2012 series (Ajuste del Catastro de Residuos Sólidos Municipales, Serie Temporal 1990/2012) (MMA, 2014) to verify and adjust the statistics on the total quantity of waste eliminated in final disposal sites.
  - o Verification of the experience and expertise of the experts providing their opinions
  - o Use of spreadsheets with a standard format for activity data, detailing each source

- Emission factors, conversion factors and constants:
  - o Verification that the parameters and emission factors are the most up to date and relevant ones.
  - o Verification of the relevance of the default values provided in the 2006GL. In the case of COD (kg COD/m^3) for the category 4.D.2 Industrial wastewater treatment and discharge, the team determined that the default value is overestimated in terms of the organic load of industrial wastewater produced in Chile.

8.6.2. Quality assurance

The Waste SGHGI was reviewed by an expert qualified as a reviewer of NIRs from Parties included in Annex I to the Convention in July 2014. This review was conducted remotely with permanent communication between the expert reviewer, the Coordinator of SNICHILE and the sectoral team professionals to resolve issues as they came up. The sector team then analyzed the assessment report, amended pertinent findings and evaluated the feasibility of introducing the recommendations in the next

update of NIR of Chile.

8.7. Planned improvements

Based on its own analysis and the recommendations made by the SGHGI expert reviewer, the team has planned the following improvements:

- Improving the generation and compiling of activity data.
- Improving processing of activity data.
- Using new information that will be made available from the entry into force of Supreme Decree N° 1, Regulations for the Registration of Pollutant Releases and Transfers (Reglamento del registro de emisiones y transferencias de contaminantes). These Regulations correspond to a national inventory or database of environmental information, including information on the disposal of municipal solid waste at a national level. This registry will become operational in 2015 and will collect information that can be used to update future inventories.

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9 RECALCULATIONS AND IMPROVEMENTS

9.1. Rationale for recalculations and improvements

Methodological changes are essential to improving the quality of the inventories. For the present NIR, GHG emissions and removals were estimated using the 2006GL of the IPCC, which produced a major methodological change compared to the previous NIR presented in the 2NC, which was prepared in accordance with the 1996GL, GPG2000 and GPG-LULUCF.

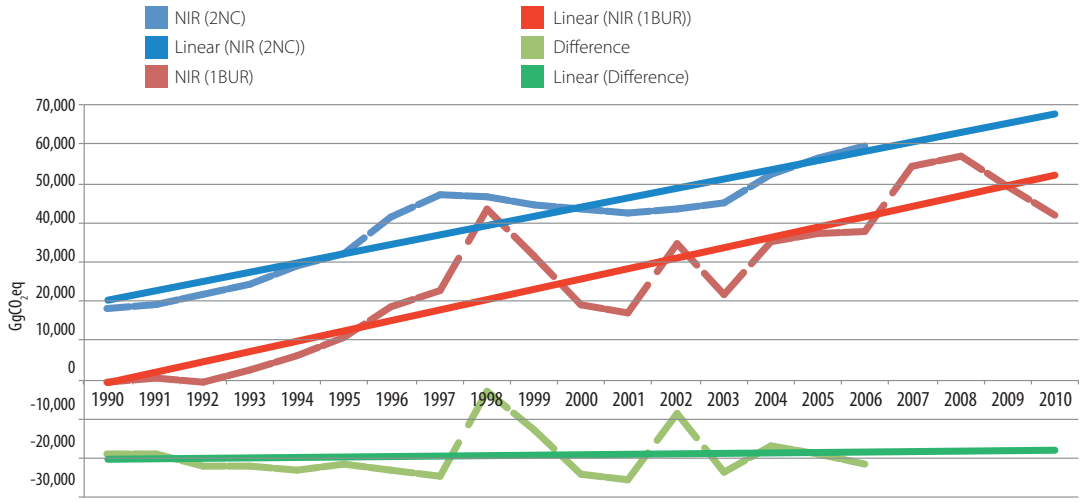
This methodological change responds mainly to Chile's desire to improve the quality of emissions estimations, preferring the methodologies, emission factors and parametric data included in the 2006GL, as these are more up-to-date than those of earlier versions (more details in section 1.4.1. Methodologies).

Methodological refinements were also made to categories such as Lime production, which was estimated using a Tier 2 methodology, and to some Agriculture and LULUCF categories, which were disaggregated regionally. The calculation of emissions and removals in the Forest land category in LULUCF was also upgraded to Tier 2.

9.2. Implications for emission levels

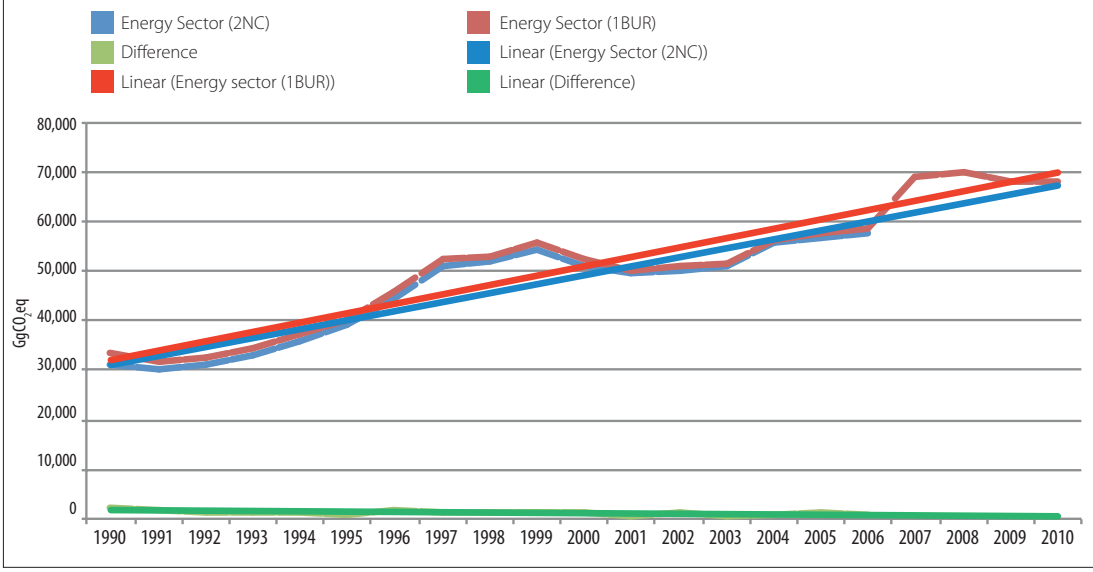
In general, this NIR represents an average reduction of 19,384.0 $GgCO_2eq$ in the GHG balance compared to the 1990-2006 time series presented in the 2NC's NIR (Figure 78). This is primarily due to the inclusion of the carbon pool that corresponds to below ground living biomass (roots) of forest tree plantations, which increased GHG removals in the LULUCF sector. The greatest difference came in 2001 with 25,630.9 $GgCO_2eq$, while the smallest difference came during 1998 with around2,885.2 $GgCO_2eq$. The linear trend shows a slight reduction in the trend in 2006.

Figure 78. Chile's NIR: net GHG emission trend reported in the Second National Communication of Chile and the First Biennial Update Report, 1990 - 2010 series.



As observed in Figure 79, recalculating the Energy sector presents no significant changes in emissions, with an average increase of 1,258.6 $GgCO_2eq$ in emissions during the 1990-2006 series (a 2.8% increase over the NIR of the 2NC). The difference is mainly attributable to the use of the 2006GL default emission factors, which, unlike the GPG2000 default emission factors, assume a default oxidation factor for carbon of 1, which in turn assumes that all carbon contained in fuels is oxidized and emitted into the atmosphere as CO_2. There is also a change in the source of data for copper mining (from COCHILCO to NEB) and a disaggregation of emissions for domestic and international civil aviation and water-borne navigation (more details in Section 3. ENERGY SECTOR).

Figure 79. Energy Sector: GHG emission trend reported by Chile in the Second National Communication and the First Biennial Update Report, 1990 - 2010 series.



As observed in Figure 80, the recalculation of the Industrial Processes and Solvent and Other Products Use sectors presents changes in emissions, with an average increase of 1,211.1 $GgCO_2eq$ in emissions during the 1990-2006 series (a 29.6% increase compared to the NIR of the 2NC). The difference is caused by the inclusion of GHG emissions in categories not considered in the 1996GL and GPG2000, such as CO_2 emissions caused by methanol and ethylene production, for example. A different methodology was also used to estimate HFC and PFC emissions than the one used in the NIR of the 2NC (more details in Section 4. INDUSTRIAL PROCESSES SECTOR).

As observed in Figure 81, there is a recalculation of the Agriculture sector, which presents no significant changes in emissions, but an average emission reduction of 893.2 $GgCO_2eq$ over the 1990-2006 series (6.9% reduction compared to the NIR of the 2NC). The difference is mainly due to the adjustment of country-specific emission factors for the Enteric Fermentation and Manure Management categories and the refinement of

Figure 80. Industrial Processes Sector: GHG emission trend reported by Chile in the Second National Communication and the First Biennial Update Report, 1990 - 2010 series.

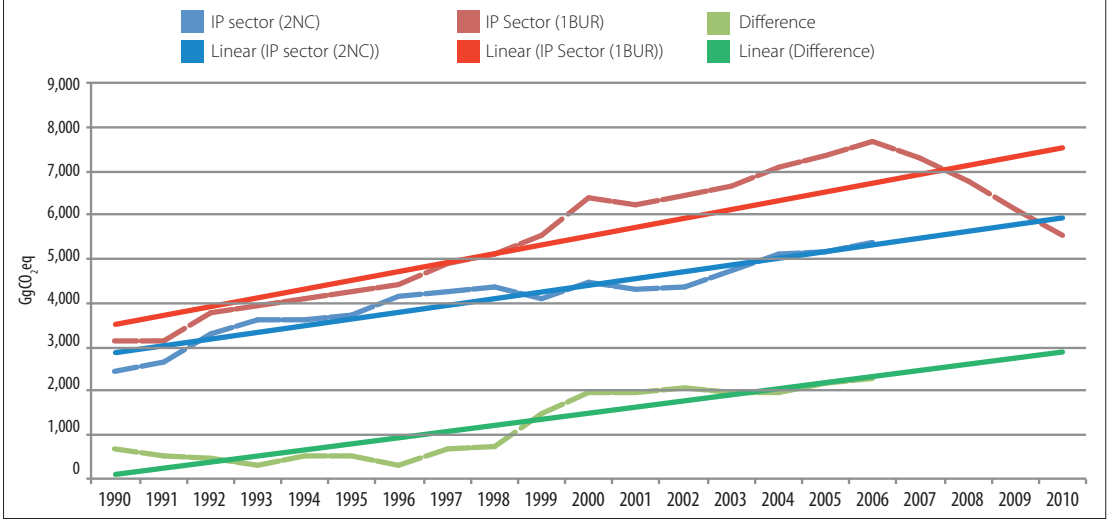
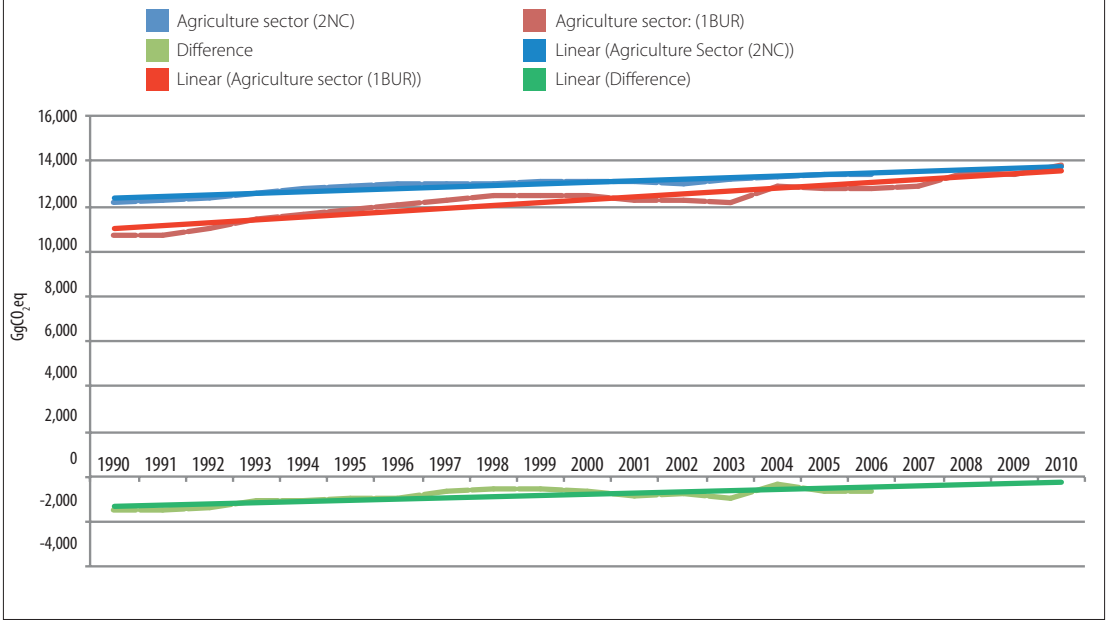


Figure 81. Agriculture Sector: GHG emission trend reported by Chile in the Second National Communication and the First Biennial Update Report, 1990 - 2010 series.



activity data for the animal population (more details in Section 6. AGRICULTURE SECTOR).

As observed in Figure 82, there is a recalculation of the LULUCF sector, which presents the greatest changes, with an average increase in GHG removals of 22,344.9 $GgCO_2eq$ for the 1990-2006 series (an 88.7% increase in GHG removals compared to the 2NC's NIR). These increases in removals are primarily caused by the inclusion of the carbon pool corresponding to below-ground living biomass (roots) in forest tree plantations, which increases removals for the LULUCF sector. Biomass expansion factors were also updated, producing a favorable change to GHG removal. It is important to mention that this trend changed in 1998 and 2002, Due to considerable increases in the areas affected by wildfires those years (more details in Section 7. LAND USE, LAND-USE CHANGE AND FORESTRY SECTOR).

As observed in Figure 83, there is a recalculation of the Waste sector, which presents the greatest change, with an average removals increase of 1,281.6 $GgCO_2eq$ for the 1990-2006 time series (73.2% increase over the NIR of the 2NC). This increase was caused mainly by methodological changes, as the 2006GL include improvements to the default methods for the Final disposal sites category, as well as including the Biological treatment of waste category, which was absent from previous guidelines. It is also important to note, the country has better statistical information available on the generation and final destination of municipal solid and liquid waste (more details in Section 8. WASTE SECTOR).

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Figure 82. LULUCF Sector: net GHG emission trend reported by Chile in the Second National Communication and the First Biennial Update Report, 1990 - 2010 series.

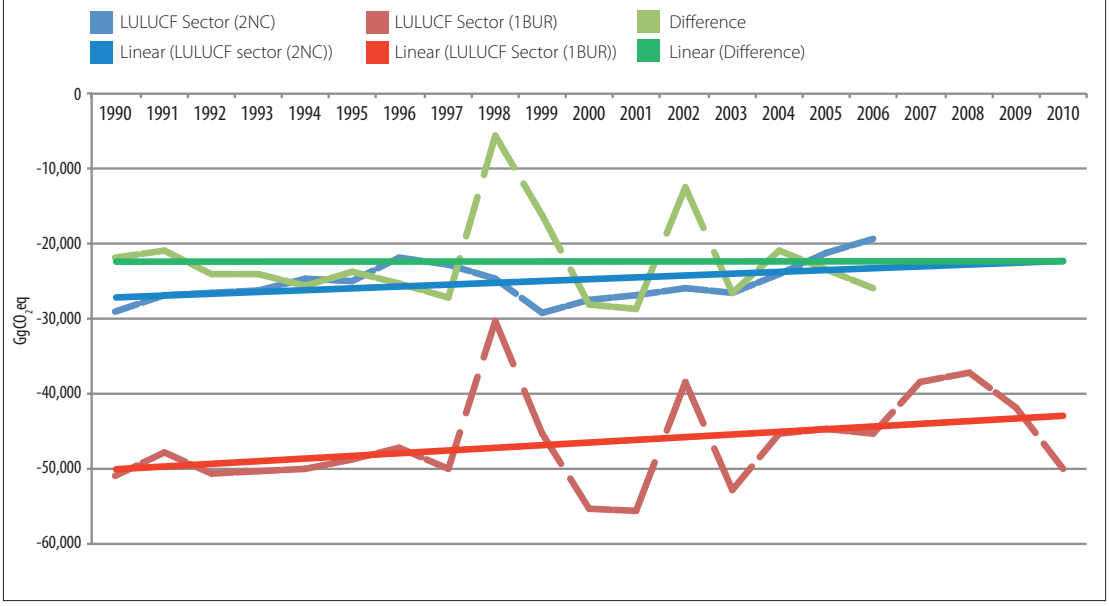
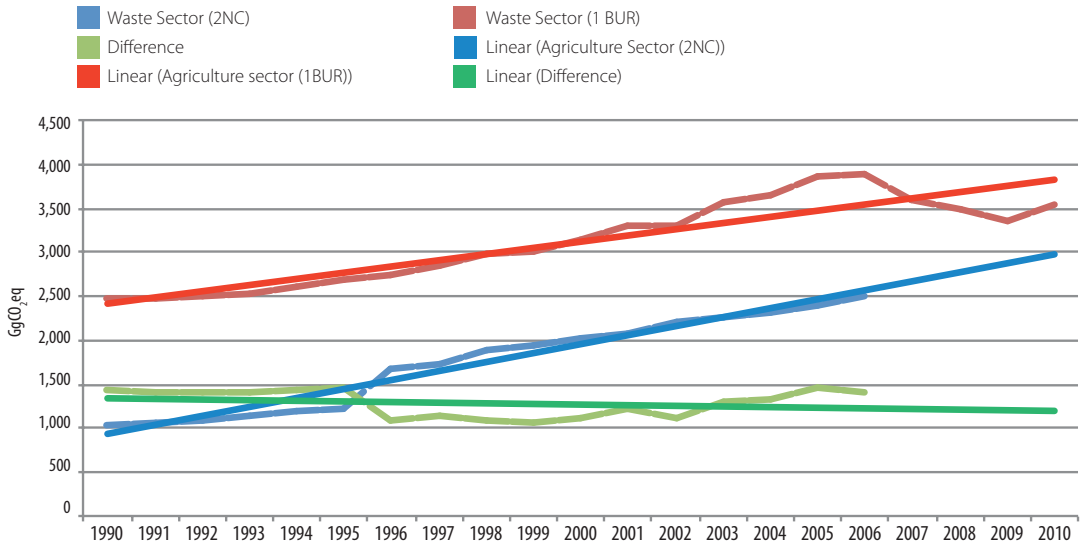


Figure 83. Waste Sector: GHG emission trend reported by Chile in the Second National Communication and the First Biennial Update Report, 1990 - 2010 series.



BIBLIOGRAPHY

General

UNFCCC (2012). Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November to 11 December 2011.

UNFCCC (2011). Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010.

UNFCCC (2006). Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11.

UNFCCC (2003). Report of the Conference of the Parties on its sixteenth session, held in Cancun from 23 November to 1 December 2002.

UNFCCC (2002). Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2001.

EPA. (2011). Development of National Greenhouse Gas Inventory System, Worksheets.

IPCC (2006). IPCC Guidelines for the preparation of national greenhouse gas inventories.

IPCC (2003). Good Practice Guideline for Land Use, Land-Use Change and Forestry.

IPCC (2000). IPCC Guidelines on Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories preparation

IPCC (1996). IPCC Guidelines for the preparation of national greenhouse gas inventories. Reviewed in 1996.

IPCC (1995). IPCC Second Assessment Report: Climate Change 1995 (SAR)

Ministry of the Environment (2011). Second National Communication of Chile under the United Nations Framework Convention on Climate Change Santiago: Maval.

UNITED NATIONS (1992). United Nations Framework Convention on Climate Change

OCDE. (2003). Current status of national inventory preparation in annex I parties and non-annex I parties.

UNDP. (2005). Managing the National Greenhouse Gas Inventory Process. Obtained from http://www.undp.org/cc

Energy Sector

COCHILCO. (2001-2012). Comisión Chilena del Cobre. Retrieved on 2013, from the Ministry of Mining: http://www.cochilco.cl/estadisticas/anuario.asp

COCHILCO. (2010). Energy consumption and greenhouse gas emissions associated to copper mining in Chile.

Gómez, D. (2014). Report on expert evaluation of the sectoral greenhouse gas inventory on Energy sector of Chile

IEA. (s.f.). Chile: Electricity and Heat 2010. Retrieved on 2014, from Statistics: http://www.iea.org/statistics/statisticssearch/report/?&country=CHILE&year=2010&product=ElectricityandHeat

Ministry of Energy. (Every available year) National Energy Balance Retrieved on 2013, from: http://www.minenergia.cl/documentos/balance-energetico.html

ENVIRONMENTAL POCH. (2008). Greenhouse Gas Inventory

SUSTAINABLE SYSTEMS. (2010). Formulation of a Local Methodology for calculating greenhouse gas emissions from bunkers.

Industrial Processes Sector

Acevedo, H. y., & Chile, U. d. (2005). Technical and economic feasibility of the exploitation of a Lime Ore body on the Metropolitan Region Retrieved on 2013, from http://www.tesis.uchile.cl/bitstream/handle/2250/111195/tesis%20caliza.pdf?sequence=1

Asociación de Industriales Químicos (Chemical Industrial Association) (2013). ASIQUIM A.G. Obtained from http://www.asiquim.cl/web/Guia2011/produc_quimicos/proc_provee.html

CAP Minería. (2013). Obtained from http://capmineria.cl

COCHILCO. (2010). Energy consumption and greenhouse gas emissions associated to copper mining in Chile.

COCHILCO. (2006, 2008, 2010). National and International Market of Iron and Steel. Obtained from http://www.cochilco.cl/estudios/info-hierro.asp

COCHILCO. (2001-2012). Copper and Other Mineral Statistics. Retrieved on 2013, from: http://www.cochilco.cl/estadisticas/anuario.asp

Editec. (2009). Minería Chilena Journal Retrieved on 2013, from: http://www.mch.cl/revistas/index_neo.php?id=1006

Cement production (Instituto del Cemento y Hormigón de Chile) ICH Retrieved on 2013, from: http://ich.cl/?page_id=64
Methanex. (2012). Obtained from http://www.methanex.cl/noticias/2013/noticia0313a.pdf

SERNAGEOMIN (2007-2012). Mining Yearbook of Chile. Retrieved on 2013, from: http://www.sernageomin.cl/sminera-anuario.php

National Customs Service Current Custom Tariff. Retrieved on 2013, from: http://www.aduana.cl/arancel-aduanero-vigente/aduana/2011-12-22/114144.html

SOFOFA. (s.f.). Industrial Indicators Retrieved on 2013, from: http://web.sofofa.cl/informacion-economica/indicadores-industriales/informacion-sectorial-de-la-industria/minerales-no-metalicos-y-metalica-basica/

U.S. Geological Survey. (1994-2010). The Mineral Industry of Chile. Retrieved on 2013, from: http://minerals.usgs.gov/

minerals/pubs/country/sa.html#ci

Solvent and Other Products Use Sector

INE. (2010). Annual National Industry Survey.

Agriculture sector

FAO. (s.f.). Fertilizers Retrieved on 2013, from: http://faostat3.fao.org/faostat-gateway/go/to/download/R//S*

FAO. (s.f.). Cattle Population Retrieved on 2013, from FAOSTAT Domains: http://faostat3.fao.org/faostat-gateway/go/to/download/R/RF/S

FAO. (s.f.). Crops Production. Retrieved on 2013, from FAOSTAT Domains: http://faostat3.fao.org/faostat-gateway/go/to/download/Q/QC/S

INE. (2007). 7th National Agricultural, Livestock and Forestry Census.

INIA (2010). Complements and Updates of the Greenhouse Gas Inventory for Chile in the Agriculture, Land Use, Land-Use Change and Forestry, and Anthropic Wastes Sectors.

Manterola, H., & Cerda, D. &. (1999). Agricultural Wastes and their Use on Rumiants. FIA and University of Chile.

ODEPA. (2000-2010). National Winegrowing Land Register. Retrieved on 2013, from: http://icet.odepa.cl

ODEPA. (s.f.). Fruitgrowing Land Registers. Retrieved on 2013, from: http://icet.odepa.cl

ODEPA. (s.f.). Livestock Statistics. Retrieved on 2013, from ICET, Territorial Statistics Retrieval System: http://icet.odepa.cl

ODEPA. (s.f.). Vegetable Statistics. Retrieved on 2013, from: http://icet.odepa.cl
ODEPA. (s.f.). Diary Cattle Statistics. Retrieved on 2013, from: http://icet.odepa.cl/

ODEPA. (s.f.). Beef Cattle Statistics. Retrieved on 2013, from: http://icet.odepa.cl/

Taboada, M. (2014). Report on expert evaluation of the sectoral greenhouse gas inventory on Agriculture sector of Chile.

Land Use, Land-Use Change and Forestry.

Cairns, M., Brown, S., Helmer, E., & Baumgardner, G. (1997). Root biomass allocation in the worlds upland forests. Oecologia, 111, 1–11.

CONAF. (2013). Report on Managed Native Forest. Department of Sectoral Prospection (DPS), World Forestry Resource Assessment.

CONAF. (2011). Survey on the Native Vegetable Resources of Chile. Change and Update Monitoring. 1997-2011 Period.

CONAF. (All the available periods). Survey on the Land Use and Vegetation. Monitoring and Update.

CONAF. (s.f.). Historic Statistics on Wildfires CONAF - Companies 1985-2012. Retrieved on 2013, from: http://www.conaf.cl/incendios-forestales/incendios-forestales-en-chile/estadisticas-historicas

CONAF and CONAMA. (1999). Survey and Assessment on the Native Vegetable Resources of Chile. Report with environmental variables.

Consorcio Lechero S.A., FIA, INIA. (2009). Permanent Meadows in the Diary Production Areas of Chile.

Coomes, D., & Grubb, P. (2000). Impacts of root competition in forests and woodlands: a theoretical framework and review of experiments. Ecol. Monogr., 70, 171–207.

Davel, M., & Jovanovski, A. &. (2005). Basic Density of Douglas Fir Wood and its Relationship with the Growing Conditions in the Andean Argentinian Patagonia. Bosque 26(3), 55-62.

Gayoso, J., Chile, U. A., & INFOR. (2002). FONDEF Project: Measurement of Carbon Sequestration Capacity in Forests of Chile and Promotion in the Worldwide Market. Biomass Inventory and Carbon Accountability. Technical Report.

Gayoso, J., Guerra, J., & Alarcón, D. (2002). FONDEF Project: Measurement of Carbon Sequestration Capacity in Forests of Chile and Promotion in the Worldwide Market. Carbon Content and Biomass Function on Native and Exotic Species. Technical Report.

Gorrini, B., Poblete, H., & Hernández, G. &. (2004). Particle and MDF Boards made of Eucalyptus nitens: Industrial-Scale Trials. Bosque 25(3), 89-97.

Hernández, G. &. (2010). Properties of Wood from Native and Exotic Forestry Species of Chile. Concepción Monographs, Chile: INFOR. Technical Report No 178.

INE. (2007). 7th National Agricultural, Livestock and Forestry Census.

INFOR. (Every available year). Forestry Yearbook.

INFOR. (Every available year). Statistical Bulletin. Forestry Statistics. Santiago, Chile.

INFOR. (2007). Availability of Eucalyptus Wood in Chile, 2006-2025.

INFOR. (2005). Availability of Pinus Radiata Plantations Wood in Chile, 2003-2032.

INFOR. (1992). Technical Report No. 130. Assessment of Firewood Consumption in Chile.

INFOR. (2011). Forestry Resources in Chile. Continuous Inventory of Native Forest and Update of Forest Tree Plantations. Final Report.

INFOR and Corfo. (1986). Forestry Species with Economic Interest for Chile.

Oyhantçabal, W. (2014). Report on expert evaluation of the sectoral greenhouse gas inventory on LULUCF Sector of Chile.

Prado, J. &. (1989). Eucalyptus. Forestry and management principles. Santiago, Chile.

Rodríguez, J. (1994). Handbook on Fertilization. Agronomy Faculty of the Catholic University of Chile.

UACH-FIA. (2012). Raw Material Characterization in Solid Wood Fuels (CSM). Technical Report 2.

Wylie W., A. (2011). Characterization of the Carbon Balance: Chilean Exportation Fruitgrowing Case and Possibilities for Mitigation of CO_2 Emissions. Santiago: FONDEF.

Waste Sector

Calvo, E. (2014). Report on expert evaluation of the sectoral greenhouse gas inventory on Wastes Sector of Chile.

UNFCCC (s.f.). CDM Projects Monitoring Report. Retrieved on 2013, from: http://cdm.unfccc.int/Projects

CONAMA. (2008). Survey on Final Domiciliary Solid Wastes Facilities.

CONAMA. (2000). Survey of Final RSD Disposal Facility Sites, years 1996 and 2000.

ECOAMERICA. (2012). Second Survey of Final Disposal, Management, and Solid, Domiciliary and Industrial Wastes Treatment.

Chile Foundation. (2010). Supporting Consultancy for Environmental Standard Processes in Water Systems: Cost Estimations in Contaminant Remotion on Liquid Wastes.

INE. (s.f.). Population and Housing Census (Censo de población y vivienda) Retrieved on 2013, from: http://www.ine.cl/canales/usuarios/censos_digitalizados.php

Ministry of Health, Food and Nutrition Department (Ministerio de Salud, Depto de Nutrición y alimentos). (2007). Protein Availability in Chile 1990-2007.

Ministry of the Environment (2014). Adjustment on the Survey on Municipal Solid Wastes, 1990-2012 Series.

Ministry of the Environment (2012). Hospital waste, cadaver and human remains burning survey.

Ministry of the Environment (2012). Regional Diagnosis of Final disposal of Wastes.

Ministry of the Environment (2011). Report on the Status of the Environment.

OECD. (2012). Report of generation and collection of municipal wasts 2011 and 2012.

PUCV. (2012). Solid waste group: Survey and Analysis of Generation and Management of Organic Wastes in Communes of Chile and Proposal Presentation for their Valuation.

SISS (2013). Survey on Bio-gas recovered and burned by domestic wastewater treatment plants at national level, in 2012.

SISS (2013). Survey on sludges generated by domestic wastewater treatment plants at national level, in 2010 and 2011.

SISS (2013). Survey of Liquid Industrial Waste Treatment Plants at National Level, 2006-2010.

SISS. (s.f.). Sanitary Sector Coverage, 1990-2011. Retrieved on 2013, from http://www.siss.gob.cl/577/w3-propertyvalue-3445.html

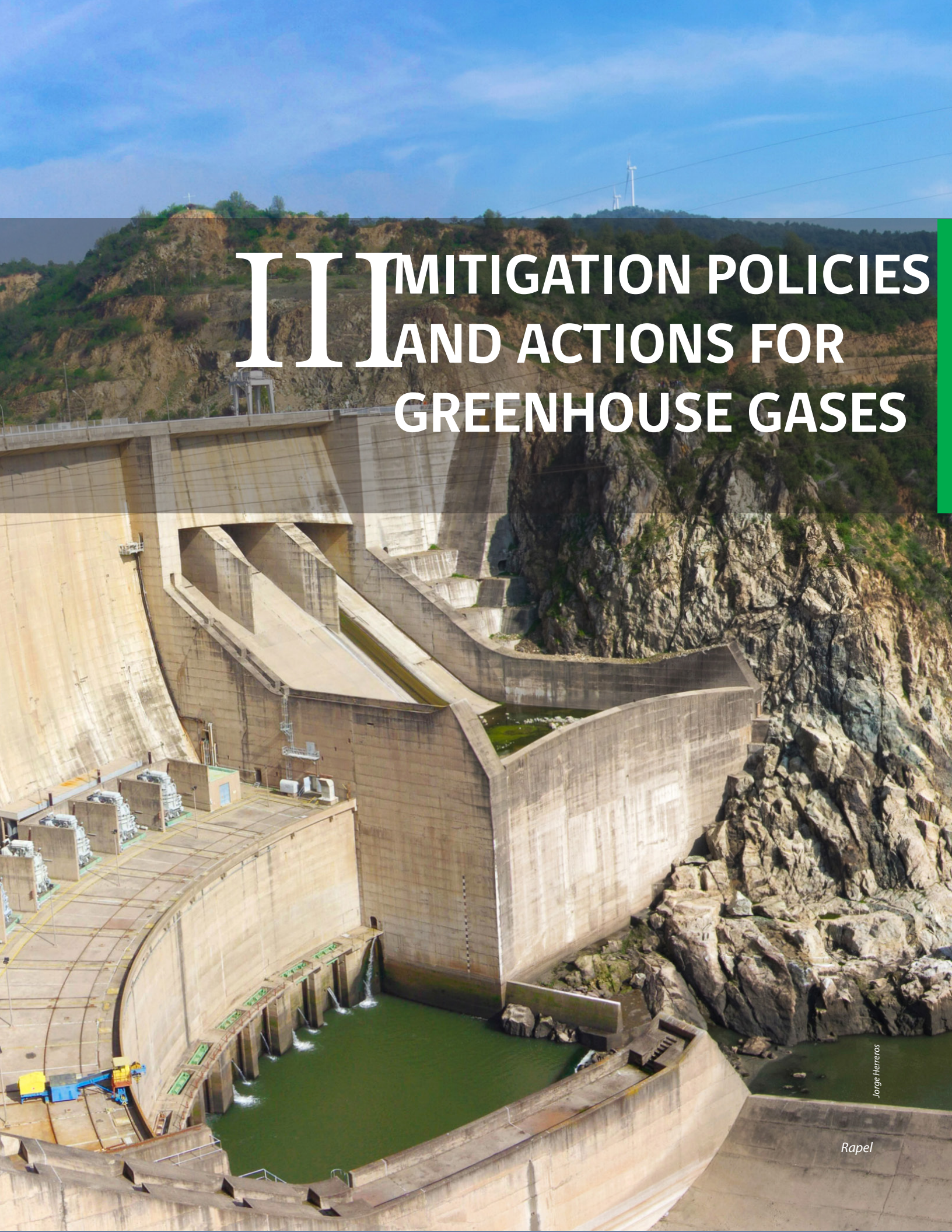
SISS. (s.f.). Management reports for sanitary sector 1996-2011. Retrieved on 2013, from http://www.siss.gob.cl/577/w3-propertyvalue-3443.html

SUBDERE. (2013). Sanitary Decontamination Program, National Sanitary Decontamination Deficit.

Tchobanoglous, G., L., B. F., & David, S. H. (2003). Wastewater engineering: treatment and reuse. Boston, USA: Metcalf & Eddy, Inc. McGraw-Hill, Boston, United States.

At a national level, different initiatives intended to mitigate GHG emissions are taking place, in order to tend towards a sustainable, resilient and low carbon development.

III MITIGATION POLICIES AND ACTIONS FOR GREENHOUSE GASES



Jorge Herreros

Rapel

1 INTRODUCTION

Jorge Herreros

Bernardo O'Higgins NP.

1. Introduction

Mitigation is understood as human actions intended for reducing the Greenhouse Gases (GHG) emissions or to increase its absorption. Through the United Nations Framework Convention on Climate Change (UNFCCC), the countries of the world have worked jointly to address the challenges related to the consequences of the increase on GHG concentrations in the atmosphere. This translates into multilateral negotiations where countries agree on actions to reduce emissions; addressing a fundamental principle of common but differentiated responsibilities, and corresponding capacities, and an equality principle between the developed and developing countries As part of the alignment produced by the UNFCCC, all the Parties have legal or political commitments for producing, implementing, publishing and updating national and regional programs containing answers for climate change (MAPS, 2013).

According to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), the increase on the GHG emissions has accelerated despite the efforts to reduce it, which means that 'without additional efforts to reduce GHG emissions beyond those in place today, emissions growth is expected to persist driven by growth in global population and economic activities' (IPCC, 2014).

The Government of Chile, through its Climate Change Office (OCC - Oficina de Cambio Climatico) of the Ministry of the Environment (MMA - Ministerio del Medio Ambiente), is coordinating at a national level different initiatives intended to reduce GHG emissions, in order to tend towards a sustainable, resilient and low carbon development. Considering a strategic aim, the work addressed to mitigation seeks to identify and encourage the most cost-effective mitigation options for Chile on the different production areas within the short, medium and long term, in a multi-player scenario, which allows to include the public and private areas, as well as the academia and civil society.

The following chapter presents the programs, actions and policies on matters of mitigation at a national level, where the state of the art is reported in matters of emissions reduction, related institutions and regulations which have an impact on the mitigation or elimination of GHG.

2 INTERNATIONAL SCENARIO

At an international stage, on 2011 the Parties of UNFCCC and signatories of the Kyoto Protocol achieved an historical and transformational progress: launching a platform to increase the ambition of the world answer for climate change called 'Durban Platform for Enhanced Action (ADP)[1]'. The process launched seeks to define a new protocol or legal instrument applicable to every Party and which allows to achieve definitely the ultimate objective of the UNFCCC and the global objective of limiting the increase of the average temperature of the planet at no more than two Celsius degrees.

ADP represents a fundamental change in terms of the previous framework defined by UNFCCC and the Kyoto Protocol: not only the developed countries shall have legal obligations for reducing its GHG emissions, but all the parties are encouraged to contribute and will have legally binding obligations for reducing emissions.

Almost three years after releasing the ADP process and with the agreements reached at Doha And Warsaw at the consecutive Conferences of the Parties (COPs), the Parties are currently facing the challenge of defining their nationally determined contributions, with terms that despite being flexible (within the first quarter of 2015, in case the Parties are prepared to do so and with enough time in terms of the meeting of December 2015, in Paris), they highlight the need of Chile for acting promptly. Chile is at an advantageous position to do this, considering that during 2 years, it has performed a prospective exercise which allows it to assess the emission and effort levels achievable for the country, with the MAPS Chile project (see section 6.1). In this way, Chile is able of proposing and evaluating the mitigation measures, considering the priorities of development for the country, thus informing the international voluntary commitment on the country emissions reduction by 2020, and preparing the base of the national contribution on the potential binding commitment under the climate agreement of 2015.

1 http://unfccc.int/portal_espanol/newsletter/items/6753.php

3 CHILE TOWARDS MITIGATION

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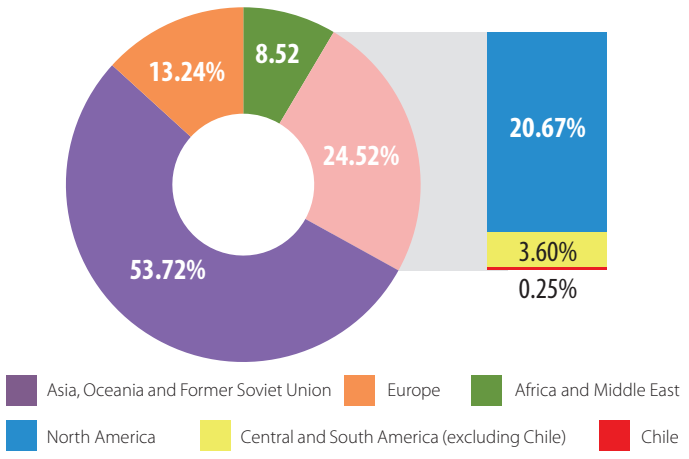
The UNFCCC, in force since March 1994, established several differentiated commitments for developed countries (included on Annex I of the Convention) and developing countries (not included on Annex I, also called Non-Annex I), among which the obligation of the first group is highlighted in terms of reducing its GHG emission to the emissions level each of them generated on 1990, and of financing the costs countries may incur on the development for implementing its commitments The developing countries, on the other hand, are not mandated to reduce their emissions under this Convention and they must prepare a report for the country (National Communication), which details their efforts for implementing this Convention. Chile ratified the Convention in 1994, being considered as Non-Annex I country.

Figure 1. Distribution of CO_2 emissions at world level and contribution of Chile, 2011.



Source: Compilation based on IEA information, 2014.

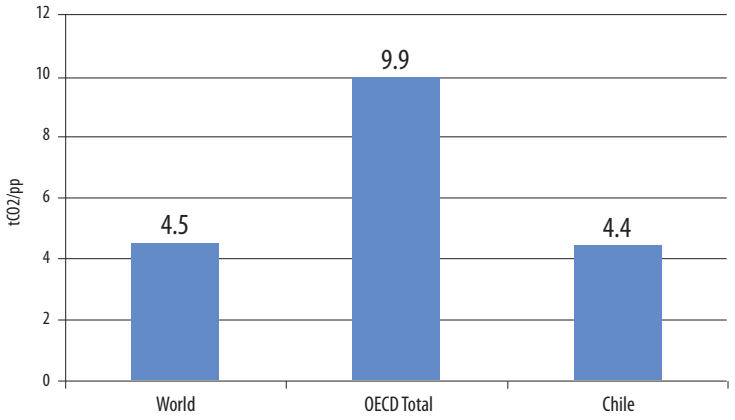
In 2002, Chile ratified the Kyoto Protocol, which entered into force in 2005. This instrument establishes that the countries included on Annex I of the UNFCCC must achieve a reduction percentage in comparison to 1990. Chile, belonging to the Non-Annex I developing countries, does not have any binding commitment for GHG emissions reduction under this protocol.

In terms of the GHG emissions at an international context, Chile is not an significant emitting country. According to the statistics of the International Energy Agency[2] (IEA), its total contribution on emissions is approximately 0.25% at a world level[3], as shown on Figure 1. According to the data of this agency, at a Latin American level, Chile contributes with 4.8% of the emissions, under Mexico, Brazil, Argentina and Venezuela.

2 http://www.iea.org/publications/freepublications/publication/name,43840,en.html

3 The emissions considered on the IEA statistics, are those originated by fuel combustion, and it does not consider all the areas of the inventory stated by the IPCC guidelines.

Figure 2. World average CO_2 emissions per person (tCO_2/pp), OECD and Chile average. Year 2011



Source: Compilation based on IEA information, 2014.

The world average CO_2 emissions per person is 4.5 tons. Chile is very close to the world average, with 4.4 tCO_2/pp, and far below the 9.9 tCO_2/pp average of the OECD countries (Figure 2). (IEA, 2013).

3.1 20/20 Voluntary Commitment of Chile for the Mitigation of its GHG Emissions

With the objective of achieving a new agreement on the long term cooperation within all the Parties, the 15th Conference of the Parties of the UNFCCC was held in 2009, in Copenhagen, Denmark On this instance, the Minister and President of the National Environment Council (Comisión Nacional del Medio Ambiente - CONAMA) stated on its speech before the Parties on the Convention, that Chile, as a country, was willing to contribute on the world mitigation efforts, through a significant deviation of the base line (forecasted since 2007) up to a 20% in 2020, financed mostly with national resources.

During the first semester 2010, CONAMA led an interministerial work through the Interministerial Technical Committee on Climate Change (Comite Tecnico Interministerial de Cambio Climatico) to agree on the information Chile should deliver the United Nations for its enlistment on Annex II of the Copenhagen Accord[4]. This year, the President of the Republic on its address to the nation of the 21st of May, stated that 'On matters of Greenhouse Gases, global warming and biodiversity, Chile has committed to and will fulfill a 20% reduction by 2020'.

The Interministerial Technical Committee and the Interministerial Committee on Climate Change approved the statement of Chile, on meetings held on the 27th of July and the 13th August, 2010. The voluntary commitment made by Chile, was communicated officially to the UNFCCC Secretariat through the national focal point of Chile, function exerted by the Ministry of Foreign Affairs, on the 23rd of August, 2010[5].

The voluntary commitment made by Chile

Cachagua Island NM. *Javiera Ferreyra*

4 http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5265.php
5 http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/chilecphaccord_app2.pdf

states that *'Chile will perform nationally appropriate mitigation actions in order to achieve a deviation of 20% under the increasing trajectory of the 'business-as-usual' emissions by 2020, forecasted since 2007'*. The statement also made clear that *'In order to achieve this objective, Chile will require a relevant level of international support'*. Besides, it was communicated that '*The energy efficiency, renewable energies measures and land use, land-use change and forestry measures, will be the main focus of the nationally appropriate mitigation actions of Chile'*. President Bachelet confirmed on its Government Program the willingness to fulfill this commitment.

3.2 Implementation of the Voluntary Commitment made by Chile

The OCC of the MMA develops a specific work axis in terms of Low Carbon Mitigation and Strategy, which it is working with on the coordination and support of different national initiatives, to fulfill the mitigation objective of Chile.

Through the voluntary commitment statement, Chile confirms that the manner of addressing this challenge will be through Nationally Appropriate Mitigation Actions (NAMAs), according to what has been worked on the international negotiation. For this purpose, the OCC has led the information generation and support for the register of the Chilean initiatives, on the Official Registry the UNFCCC has. In terms of other actions with a transversal nature, Chile is working on the evaluation of different mitigation scenarios, which include the implementation of different sets of actions and policies for emission reduction. Besides, the OCC will encourage and support mitigation actions on public and private organizations, through the implementation of the National Program of Carbon Management (Programa Nacional de Gestion del Carbono) (Huella Chile Program).

4 ACTIONS AND POLICIES RELATED TO MITIGATION IN CHILE

Karina Balhamonde

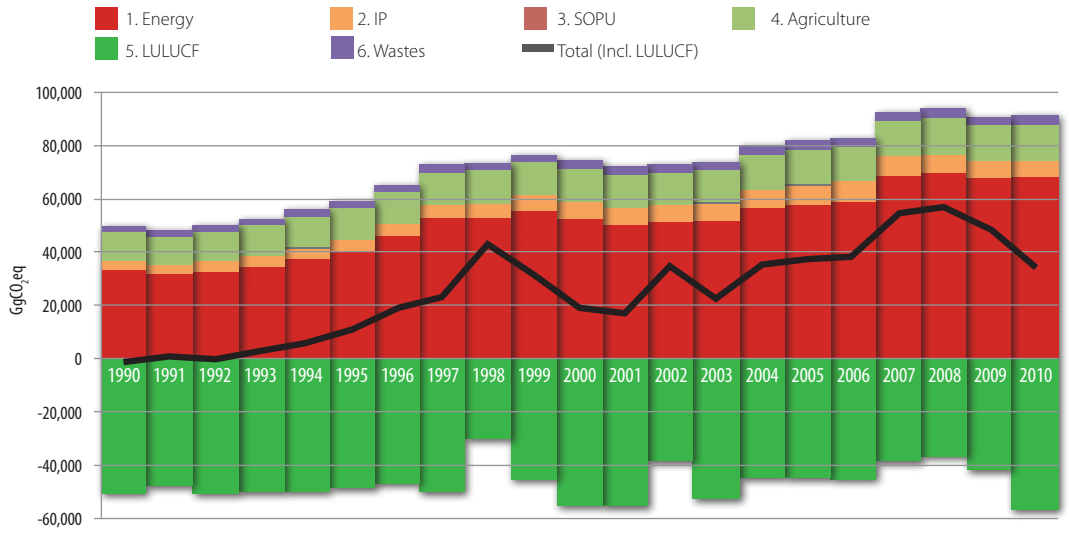
Leed Building.

According to the National Greenhouse Gas Inventory of Chile (NIR (See Chapter 2) for 2010, the balance of emissions and removals of GHG[6] of Chile, represented 41,698.5 $GgCO_2eq$, while the total GHG emissions of the Country reached 91,575.9 $GgCO_2eq$, which represents an 83.5% increase between 1990 and 2010 (Figure 3).

At a sectoral level, the Energy sector is the largest emitting area with a 74.7% of the total GHG emissions, followed by Agriculture (15.1%), Industrial Processes (IP) (6.1%), Wastes (3.9%), and the Solvents and Other Products Use (SOPU) (0.3%) (Figure 4).

The information presented on the inventory, provides the context and basis to understand the importance of the sectoral mitigation actions, given that the gradualness of the implementation of this actions, is to be reflected on the GHG emissions tendency of the country.

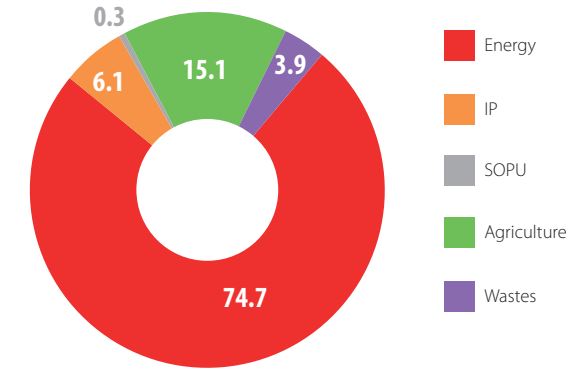
Figure 3. NIR of Chile: trend of the GHG emissions and removals per sector, series 1990-2010.



Source: Compilation based on SNICHILE, 2014.

6. On the current report, the term 'balance of GHG emissions and removals' or 'GHG balance' refers to the sum of GHG emissions and removals, expressed on Carbon dioxide equivalent (CO_2eq). This term includes the LULUCF sector.
7. On the current report, the term 'Total GHG emissions' refers only to the sum of national GHG emissions, expressed on Carbon dioxide equivalent (CO_2eq) excluding the LULUCF sector.

Figure 4. NIR of Chile: trend of the GHG emissions per sector (excluding LULUCF)



Source: Compilation based on SNICHILE, 2014.

4.1 Sectoral Actions

4.1.1. Energy Sector

On this sector, the normative and regulatory role is currently exerted by the State, through the Ministry of Energy (Ministerio de Energia) and its dependent or related institutions, being the private sector responsible of investing on this. The energy sector emissions, are comprised by the activities of survey, exploitation, generation, transmission, transportation, storage, distribution, consumption, efficient use, import, export and any other matter related to electricity, gas, oil and derivatives; nuclear, geothermal, solar power and other energy sources. The emissions are originated mainly by the generation and consumption of different types of energy. (Ministry of the Environment, 2011).

During the last years, the Government has taken a series of measures on institutional, policy and regulation matters in order to improve the institutionalism, introducing non conventional renewable energies to the grid, move to a cleaner grid and to a more efficient use of the energy, and at the same time reducing the GHG emissions from the energy sector. On the 15th of May, 2014, the Energy Agenda of Chile was presented as a result of an open and participative dialog held by the Government, including different social and politic players, members of the parliament, local governments, companies, civil society and academia; which have reflected and assessed the power situation of the country. The Energy Agenda brings to light that energy is, and will continue to be, a pillar on the economic growth of the country, and will encourage the efforts of social inclusion that Chile shall continue performing. With it, the Government seeks to generate a Government Energy Policy, with social, politic and technical validation, which is in charge of, among other relevant challenges in terms of energy, decreasing the access and volatility risks of the prices compared to fossil fuels, developing own energy sources at affordable prices; and minimizing and managing the environmental impacts of the sector, at the same time increasing the involvement of the local communities on the benefits of the energy developments.

The presentation of the existing constraints for non-conventional renewable energy (NCRE) (committing that 45% of the electrical energy generation capacity by 2025 is produced by this type of sources); as well as the encouragement for efficient use of energy as a power resource (establishing a saving goal of 20% by 2025) are part of the specific goals and objectives of the aforementioned Agenda.

In terms of NCRE, from 2010 the Chilean electrical system must reach a quota of injection for this type of energies. This quota was increased in 2013 by the law 20,698, which demands that in 2025, 20% of the injections are originated from NCRE sources for the contracts subject to this law. During 2014, at least 1,000 MW will be incorporated on the electrical grid, with a diverse portfolio of wind, photo-voltaic, biomass and small hydro-electrical plants projects, reaching 10% of the installed capacity. Nevertheless, the constraints affecting the materialization of the new generation projects also affect the NCREs expansion. The actions considered on the Energy Agenda related to the expansion of the transmission system, improving competition, providing flexibility to the operation of electrical systems and the processing of permits, among others, will be key to improve in a socially and economically efficient manner the large NCRE potential Chile has available. Besides the definition of action lines and objectives focused to

diversification, promotion and expansion of this type of power. (Ministry of Energy, 2014).

In matters of efficient use of energy and the definition of the saving objective of 20% by 2025, the action lines and objectives presented by the Agenda, are addressed to the approval of the Energy Efficiency Law; which will include measures for the industrial, residential and public sector; promotion and support for projects of energy efficiency; Energy Efficiency on the sector of Housing and Construction; support for energy management at local level and; communication and education campaigns. (Ministry of Energy, 2014).

Since the creation of the Electrical Development Policy, in the early 80's, the dynamism of the world and the national circumstances require a State which performs a more active role on the strategic planning, adapting to the current needs and demands which lead to new policy, technological and sociocultural responsibilities and transformations, framed on the fulfillment of a guaranteed long term vision ensuring common welfare. (Ministry of Energy, 2014). The development of this Agenda is framed on the 50 measures of the 100 first days of the Administration of the President Bachelet.

Table 1 presents a chronological summary of the measures that have been established for the Energy sector, which may have an impact on the GHG mitigation.

Table 1. Measures related to GHG emission mitigation in the Energy sector.

Name	Type[8]	Year	Description/Objective	Goal	Progress
Short Law I (Law 19,940) and Short Law II (Law 20,148)	Economic Incentive	2004 and 2005	They establish encouragements and connection rights to the grid for non conventional generation sources and small generation sources (under 9Mw and between 9 and 20 MW); at the same time encouraging the development of investment through tenders supply.	N/A	W/I
Regulations on Geothermal Energy Concessions (Law 19,657 from 2000)	Normative	2004	In the framework of this Law and its regulations, in 2009, 16 areas of concession of geothermal energy exploration were awarded. In march 2013, this document is repealed and replaced by the new Regulations for the implementation of the Law N° 19,657 where some normative constraints which did not provide legal certainty to whom was awarded a exploration were overcome, thus ensuring its right to obtain the exploration of the respective concessions.	N/A	Currently, there are 32 concessions of Exploration and 8 concessions of Exploitation in force. There are 52 requests for concession of exploration and 19 of exploitation in process.
Establishment of the Energy Efficiency Country-Wide program (Programa Pais de Eficiencia Energetica).	Institutional	2005	Systematic efforts destined to enlarge the knowledge on how the energy in Chile is being used and to detect economical and reachable potentials of Energy Efficiency (EE). In 2010, this Program becomes the Chilean Agency on Energy Efficiency (AChEE).	N/A	More than 50 EE programs in public institutions and private companies with more than 400 beneficiaries.
Law 20,257 of Non-Conventional Renewable Energy (NCRE).	Normative	2008	Introduces modifications to the General Law on Electrical Services, where the obligatory nature of crediting the participation of the NCRE in the power generation in the grid of Chile is established, for the power generation companies with installed capacity superior to 200MW.	10% of generation through NCRE by 2024.	In 2013 the Law is modified (through Law 20,698) widening the quota up to 20% towards 2025 for contracts signed after the 1st of July, 2013. The compliance rate by 2013 was 7.8%.
Law 20,402	Institutional	2009	Establishment of the Ministry of Energy. The political authority decides to separate the regulatory and executory functions of the EE activities through the establishment of the Energy Efficiency Division (February 2010), and the transformation of the PPEE into the Chilean Agency on Energy Efficiency (AChEE) in November, 2010.	N/A	N/A

Table 1.continuation, Measures related to GHG emission mitigation in the Energy sector.

Name	Type[8]	Year	Description/Objective	Goal	Progress
Law 20,365	Fiscal	2010	Tax exemption for thermal solar systems for domestic hot water. The exemption is directed towards the constructor companies incorporating solar systems in their new housing projects, allowing access to discounts from their taxes the amount of the installed collectors.	The amount of the subsidy was equal to 100% of the investment for houses under 2,000 UF, 40% for houses between 2,000 and 3,000 UF and 20% for houses between 3,000 and 4,500 UF.[9]	This law was in force since August 2010 until the 31st of December, 2013. 37,000 houses were benefitted, which represents about 129,500 people. Currently, work is being undertaken to modify the Law for the renewal of the validity of the Tax Exemption (TE) that was established by Law 20,365 during the years 2015 and 2018, for houses under 3,000 UF and the elimination of the tax benefit for houses of greater value. Besides, a direct subsidy will be incorporated within the housing subsidy to incorporate this technology in houses subsidized by the Government.
Instructions on the application of the measures for energy saving in the public administration.	Normative	2011	Ministry of the Interior and Public Security and the Ministry of Energy formalize the instructions on the application of the measures for energy saving in the public administration. The tracking of these instructions will be led by the AChEE through the Platform for energy consumption record of public buildings.	5% reduction of electrical consumption in public buildings.	W/I
Net Billing / Net Metering Law (Law 20,571).	Economic incentive.	2012	It establishes the normative bases for small generation centers, oriented towards self-supply, to inject their surplus to the network.	W/I	This Law will enter into force once its Regulations are published, currently under revision in the Comptroller's Office.
Energy Efficiency Action Plan (PAEE2020),	Policy	2013	It establishes a series of specific measures to be implemented with the support of the National Energy Strategy to reach the goal of reducing a 12% of the final energy projected towards 2020.	N/A	As part of that task, the Energy Efficiency Interministerial Committee (CIEE) was established, the program of labeling devices was strengthened, works to define the Minimum Energy Performance Standard (MEPS) were initiated, the Energy Efficiency Seal for companies was launched, the energy rating system for new houses was created, altogether with the vehicular labeling, among other initiatives.
Law 20,698 (Law 20/25)	Normative	2013	It establishes that the participation of NCREs in the power generation grid in Chile must reach 20% towards 2025, increasing the challenge of the Law 20,257 from 2008.	20% of generation by means of NCRE by 2025.	Currently NCREs have a 8,2% share (1,600MW) of the total power installed in the electrical systems, with a 36% (572 MW) originated from wind generation, 29% biomass (461MW), 21.3% mini-hydraulic (340 MW), 12% solar (184 MW) and 3% biogas (43 MW).
Energy Efficiency Government Bill (Included in the Energy Agenda).	Economic / Normative Incentive	2014	The Bill will contemplate at least three components: (a) Energy Efficiency in Industry and Mining; (b) Energy Efficiency for houses, small industries and commerce; (c) Energy Efficiency in the public sector	W/I	W/I

8 The type of instrument is classified according to a economical, fiscal, technological, normative-regulatory, institutional or policy measure, as the case may be.

9 The value of the houses used in this scale corresponds exclusively to the value of the land plus the construction costs, according to what is established in the Law 20,365, which means that the commercial value of the houses is typically a 30% more.

Table 1.continuation, Measures related to GHG emission mitigation in the Energy sector.

Name	Type[8]	Year	Description/Objective	Goal	Progress
Energy Agenda	Policy	2014	Launched in 2014, presents the route sheets with specific measures to build an energy policy for Chile though the following lines of action. A new role of the State for energy development. Reduction of energy prices with greater competition, efficiency and diversification in the energy market Development of own energy resources. Connectivity for energy development An efficient energy sector which manages consumption. Encouragement for energy investment for the development of Chile. Citizen participation and land management.	Reduction of the marginal costs during this Government period up to a 30%. Reduction of tendering prices. Encouragement of the development of NCRE to reach the 20% goal in 2025. Development of the energy efficient usage as an energy resource to reduce up to a 20% the consumption estimated by 2025. Transformation of the Chilean National Oil Company (Empresa Nacional del Petróleo - ENAP) into a key player in the energy challenges of the country. Development of an Energy Development Strategy by 2035 which will be validated by the Chilean society by 2050.	W/I

W/I = Without Information; N/A = Not Applicable - Source: Compilation based on sectoral Information.

4.1.2. Transportation Sector

The emissions of the Transportation Sector come mainly from the fuel combustion used for the passenger and load transportation, considering the subcategories of air, road, railroad and maritime.

The Ministry of Transportation and Communications (MTT) through the Undersecretary of Transportation is the public institution in charge of the creation of policies, conditions and regulations for the development of efficient, safe and environmental-friendly transportation systems. The technical analysis is executed by the Secretariat of Transport Planning which belongs to the Ministry of Social Development (former Ministry of Planning), which assesses the investment in infrastructure and management of the transportation systems in Chile.

In the 2000's, these institutions, along dependent and related programs, developed initiatives mainly oriented towards the reduction of local contaminants and non specifically to the GHG reduction. However, in recent years, the Government has taken a series of Measures related to research, institutional strengthening, creation of policies and regulations, research

to improve the management of transportation system and safeguard the rights of the users, which also have an impact in the reduction of the GHG emissions, among others. Table 2, below, shows a list of the most relevant initiatives from the mitigation point of view.

Table 2. Measures related to GHG emission mitigation in the Transportation sector.

Name	Type	Year	Description/Objective	Goal	Progress
Change your Truck Program.	Economic Incentive - highway cargo transportation sub-sector.	2007	Program from the former PPEE[10], which provided economic incentives to change the trucks that were older than 20 years, destroying the old vehicles.	W/I	Over one hundred old trucks were turned into scrap by the program.
Technical Assistance Program.	Education - highway cargo transportation sub-sector.	W/I	Annual assistance and follow up programs for transportation companies, supporting them in the introduction of the energy efficiency criterion in their decision making, usually through energy management systems model encouraged by the recently published ISO 50,001 standard (2011). Execution through the AChEE (former PPEE).	W/I	During the pilot programs, 4.2% average emission reduction in cargo transportation of companies has been reached.
Efficient Driving Programs	Education - highway cargo transportation sub-sector.	2008 and on	Pilot programs on efficient driving in cargo transportation, performed by the AChEE (former PPEE).	W/I	A few already implemented pilot programs allow the estimation of 5 to 17% reductions in the period implemented (between 3 and 9 months).
Programs on Aerodynamics in Transportation.	Technological - highway cargo transportation sub-sector.	W/I	Programs for measuring the impact of aerodynamics on cargo transportation were implemented.	W/I	Pilot programs result on up to 15.4% average increase in mileage performance per vehicle.
Change your Bus Program.	Economic incentive - passenger transportation sub-sector.	2011 – 2012	The program delivered through the MTT, more than 2 billion pesos on investment in the different regions of the country between 2011 and 2012, aiming to destroy old buses and replace them with buses with new technologies.	W/I	W/I
Transantiago	Economic /Technological / Regulatory /Corporate Incentive - passenger transportation sub-sector.	2005 and on	Reform of the system of buses for public transportation in the Metropolitan Region of the country, considering a renewal of the bus fleet and a reduction of distance trammed.	W/I	In 2011, a 30% reduction in CO_2 emissions was estimated, compared to the public transportation system in 2006.
AChEE initiatives	Others - passenger transportation sub-sector.		The AChEE has also promoted the EE in public transportation, through surveys comprising pilot programs in matters such as technical assistance, efficient driving, idle time reduction campaign, among others nationwide.	W/I	W/I
New vehicles labeling.	Others - light vehicles sub-sector.	2013 and on	A compulsory label for energy efficiency on new vehicles over 2,700 Kg, demands reporting on their energy consumption (km/l) and emissions (gCO_2/km) A joint initiative among MTT, MMA and MINENERGIA.	W/I	W/I
Driving control platform.	Others - light vehicles sub-sector.	2012 and on	AChEE released a web page which enables management and improved driving for private vehicle users.	W/I	W/I

W/I = Without Information.

Source: Compilation based on sectoral information.

Framed on these same sub-sectors, other actions from companies, which also have an impact on GHG reduction can be identified (Sustainable Systems, 2014). Table 3 shows a summary of these measures

Table 3. Measures related to GHG emission mitigation in Transportation companies.

Company	Type of measure	Year	Description/Objective	Goal	Progress
Metro	Others - Private.	2007-2012	In this period, projects intended to enhance the tube network were performed. In addition, during 2012, two new additional tube lines for the Santiago Metropolitan Train were announced, which in total will add 37 km to the current network, which is equivalent to 36% more compared to the current network length. The new Line 6 (15 km) will start operating in 2017, and the new Line 3 (22 km) will start operating in 2018.	W/I	The Santiago Metropolitan Train Network has been enlarged from 85 km to 103 km.
Railway Company.	Others - Private.	2014-2015	In the second half of 2014, an express railway passenger transportation project joining Santiago, Nos and Rancagua is contemplated.	W/I	W/I
LAN	Others - Private.	2016-2018	The LAN (JAC) company has been working since 2011 in order to decrease its CO_2 emissions, aligned with the sector strategy encouraged by the IATA (International Air Transport Association), through the introduction of highly-efficient aircrafts, between 2016 and 2018.	2% reduction in annual fuel consumption.	W/I

W/I = Without Information.

Source: Compilation based on sectoral information.

10 In 2005, the National Energy Commission (Comisión Nacional de Energía - CNE), dependent on the Ministry of Economy of Chile, created the Energy Efficiency Country-Wide program (PPEE), which after the creation of the Ministry of Energy in 2010 became the Chilean Agency on Energy Efficiency (ACHEE).

4.1.3. Land Use, Land-Use Change and Forestry Sector

The Land-Use, Land-Use Change and Forestry Activity (LULUCF) comprises the emissions and removals from forest lands, meadows and brushwood, agricultural land, urban land, wetlands and bare soils. Emissions are produced when forestry felling (thinning or crops), when illegal firewood extraction and illegal felling, managed native forest felling, and forest fires occur. On the other hand, removal capture sources are mainly due to young native forests; regeneration of managed native forest, and plantation of forestry species, mainly exotic species. This sector in Chile is the only one accounting for GHG removal.

The Ministry of Agriculture is the only organism from the State in charge of promoting, orienting and coordinating the activity of this sector in the country. Through its support services, such as the National Forest Corporation (Corporación Nacional Forestal - CONAF), the Institute for Agricultural Research (Instituto de Investigaciones Agropecuarias - INIA) the Foundation for Agricultural Innovation (Fundación para la Innovación Agraria - FIA) and the Institute for Rural Development (Instituto de Desarrollo Agropecuario - INDAP), among others, it contributes to the sector development through a series of regulations and programs intended to technological transfer, innovation and financial support for small producers, in order to boost productivity and competitiveness of agricultural, livestock and forestry activities.

The relevant regulatory framework with impact on mitigation of emissions and promotion of removals comprises the regulation and programs shown in Table 4.

Table 4. Measures related to GHG emission mitigation in the LULUCF.

Name	Type	Year	Description/Objective	Goal	Progress Indicators
Decree-law 701 and its modifications.	Economic incentive.	1998	It considered economic incentives for afforestation and payment for forestry management activities. In 1998, the Law N° 19,561 was passed, which modified L.D. N° 701, was issued, promoting forestry plantation on land owned by small privates, soil recovery practices, and afforestation on fragile and degraded soils. Ulterior modifications were focused on maintaining these benefits for the small forest land owners of the country, existing up to 2012. Currently, this law is under renewal process.	W/I	W/I
Native Forest law and its regulation.	Economic incentive.	2008	Protection, recovery and improvement of native forests in order to ensure forest sustainability and the environmental policy. It promotes the sustainable management of forests.	W/I	W/I
Soil Recuperation Program (Law N° 20,412).	Economic incentive.	2010	It is an instrument which aim is to recover the productive potential of degraded agriculture and stock breeding soil and to keep the improvement levels achieved. This encouragement instrument is for a 12-year period, from the entry in force of the law.	W/I	W/I

Source: Compilation based on sectoral information. W/I: Without Information.

4.1.4 Waste Sector

Emissions from the Waste Sector are comprised by the emissions from final disposal of municipal solid waste (MSW), sewage water treatment and liquid industrial wastes, and the corresponding sludges generated; incineration of hospital wastes; and nitrous oxide emissions from human feces. Nonetheless, the largest portion of GHG in Chile in this sector is generated by the MSW.

In Chile, the Organic Constitutional Law on Municipalities[11] entitles municipalities to exclusively manage the wastes generated within the boundaries of their communes, whose mandate is regulated by the Sanitary Code[12]. Municipalities perform this attribute directly and with their own resources or outsourcing the waste collection, transportation and/or final disposal services. Regarding final disposal, municipalities of Chile mostly choose the service outsourcing option.

Regarding the financial aspect, the Law on Municipal Income[13] established that the municipalities shall annually determine the actual costs of their domiciliary garbage removal service, in order to establish the fee for these services. These costs must be equally divided among all the users, resulting on the fee amount for the garbage removal service which shall be charged to each user. The same law establishes that those users whose tax assessment of the house or residential facility affected by the service is equal or lower than 225 monthly tax units are automatically exempt from this payment, which represents more than 70% of the population. Re-

11 *Law 18,695 (1988, updated in 2007) from the Ministry of the Interior, Organic Constitutional Law on Municipalities.*

12 *Sanitary Code N° 725 (1968).*

13 *Law 3,063 (1972, updated in 1999) from the Ministry of the Interior on Municipal Income.*

garding the regulation for waste management, the Sanitary Code regulates specific aspects associated to environmental hygiene and safety and workplaces. Historically, the emphasis in waste management has been put in accurately solving their final disposal. This Code establishes that municipalities shall be in charge of sanitary issues.

The Ministry of the Environment is in charge of the application of environmental polices, plans and programs; among them, there are also waste management programs. Currently, the comprehensive solid waste management policy is being updated.

An important part of the MSW are the organic wastes, which are mostly directly derived to final disposal. Regarding this, a working area is promoting the application of the waste management hierarchy, promoting prevention in waste management and, if not possible, promote actions in this order: valuation, including reuse; recycling and energy valuation, leaving final disposal as the last alternative. This vision enables leveraging the most from materials and energy contained in wastes before just disposing them without taking advantage of these.

In particular, looking for valuation initiatives, the Ministry of the Environment has performed surveys in several municipalities, concluding that:

- The amount of municipal wastes are not enough as to develop valuation initiatives by themselves, basically because the residential waste removal with separation by users requires years of preparation. Currently, useful organic wastes comes pruning, fairs, restaurants and hotels.
- Valuation projects cannot compete with the rates applied to final disposal in some areas of the country, which are very low.
- Many industries are willing to perform a suitable management of their wastes, but there are no valuation alternatives available.
- As part of the conclusions, a high potential for a coordinated work between municipalities and industries in order to perform organic waste relocation programs is identified.

From the institutional, policy and regulatory standpoint, the Government has taken a series of measures during the last few years, aiming to improve the comprehensive waste management, reduce final disposal into illegal facilities, and improve sanitary requirements. Table 5 shows a summary of actions and policies associated to GHG mitigation in the wastes sector.

Table 5. Measures related to GHG emission mitigation in the Wastes Sector.

Name	Type	Year	Description/Objective	Goal	Progress Indicators
S.D. Nº148	Normative	2005	It establishes the Sanitary Regulation on Hazardous Waste Management.	N/A	W/I
National Program on Solid Waste	Policy	2005	It encourages increasing Urban Solid Waste (USW) with suitable final disposal in Sanitary Landfills (SL) and closing facilities without environmental or sanitary permits.	Eliminate final disposal in illegal dump sites or facilities.	W/I
S.D. N° 45 (modified on 2013, S.D. N° 29).	Normative	2007	It approves the emission standard for incineration and co-incineration.	W/I	W/I
S.D. Nº4	Normative	2010	It establishes the regulation on management of sludges generated in sewage treatment plants.	W/I	W/I
S.D. Nº6	Normative	2010	It approves the regulation on management of wastes generated in health care centers.	W/I	W/I
S.D. Nº3	Normative	2012	Regulation for management of sludges from effluent treatment from fruit and vegetable processing plants.	W/I	W/I
S.D. N°1	Normative	2013	Regulation on the Registry of Emissions and Pollutant Transfer, REPT.	W/I	W/I
Bill on Waste Management and Producer Extended Liability (PEL).	Normative / Economic Incentive/ Fiscal	2013	Currently under assessment in the Congress. This law introduces the focus on prevention, waste valuation and Producer Extended Liability (PEL).	W/I	W/I

W/I = Without Information.

Source: Compilation based on sectoral information.

Regarding the quality of the information of the Sector, it is important to note that there are no reliable and public sources delivering high-quality information in order to validate the estimations made in the sector. In this context, it is worth to note that the Regulation on the Pollutant Release and Transfer Register (Registro de Emisiones y Transferencias de Contaminantes - RETC) established that starting on 2015, generators and receivers of non-hazardous industrial wastes generating, valuating or disposing more than 12 tons a year, as well as all the municipalities, shall declare domiciliary waste generated in their communes. Likewise, the bill on Recycling Encouragement[14] proposes an important progress regarding the record of information, establishing that: *'generators and managers of wastes will be mandated to keep an updated, publicly-disclosed electronic record. Such record will contain, at least, information related to the amount, origin, nature, management and destination of wastes. The information shall be available at all times, for any person and State office requiring it in order to fulfill their duties, in a database, by any controllable or enforceable means, for at least 5 years'.* Therefore, tracking and record systems for solid wastes, particularly those in electronic format, represent a very relevant traceability tool for emission and volume estimation purposes.

14 http://www.camara.cl/pley/pley_detalle.aspx?prmID=9501&prmBL=9094-12

4.2. Other mitigation actions

In this section, additional initiatives, besides the ones mentioned in the sections above, are described. These contribute to GHG mitigation because of their nature, but they involve taking actions in more than one Sector.

4.2.1. Clean Production Agreements

The Clean Production Council (Consejo de Produccion Limpia - CPL) was created by the Agreement N° 2091/2000 of the Board of Directors of the Chilean Economic Development Corporation (CORFO) on December, 2000; Its origins date back to 1998 with the creation of the Public-Private Clean Production Committee, by the Ministry of Economy

The CPL is defined as a dialog and joint-action instance involving the public sector, companies, and their workers, in order to spread and establish an environmental management focus putting the emphasis on prevention of pollution rather than on its final control. For that, it should know and assess the initiatives promoting clean production and prevention of pollution in the productive sector, and safeguard the adoption of the necessary measures for that purpose in diverse public institutions.

The main management instrument created by the CPL is the Clean Production Agreements (Acuerdos de Produccion Limpia - APL), defined on Article N° 2 of the Law on Clean Production Agreements, according to the dispositions of the Article 10 of the Law N° 20,416 of the Ministry of Economy, Promotion and Reconstruction, setting special regulations for small size companies, and establishing that '*for the purposes of this law, it will be understood as Clean Production Agreement the agreement entered into by a corporate sector, company or companies and the State administration offices with competency in environmental, sanitary, hygiene and labor-safety, energy usage and productive promotion issues, which purpose is applying the clean production through specific goals and actions.'*

During the first years, the APLs did not consider specific actions oriented to reducing GHG. Nevertheless, a series of measures framed in such APL, are translated into real reductions. Because

of that, in 2010 the Council hired a survey in order to estimate GHG reductions of 16 APLs in different industrial sector, having 54 APLs implemented and certified by the CPL on the period 2002-2010. Results show that the activities of the APLs in the 16 sectors analyzed have reduced GHG emissions in 4,050,973 tCO_2eq. Taking into account the 8-year term in order to achieve these reductions and supposing they are linear in their origin, the mean annual reduction per each of the 16 APLs considered is estimated in 31.6 $ktCO_2eq$.

4.2.2. Sustainable Construction

The Ministry of Housing and Urban Planning (MINVU) introduces sustainable development in its management, policies, plans and/or strategies. In this context, within the initiatives led by the Ministry of Housing and Urban Planning (MINVU)[15] is the development of the National Policy on Urban Development, where four goals are established: to improve the quality of life of people, to support decentralization of the country, to promote an institutional reorganization for the development of cities and territory, and to support the existence of a sense of unity and coherence in the implementation of the legislation and regulation in order to respond to the new requirements of the society. For this, five topical areas are defined:

- Social integration, where is defined that cities shall be inclusive places for people to feel part of the urban benefits;
- Economic Growth, where cities are sources of innovation, entrepreneurship, and employment creation, and where public and private officers should be accountable for social effects and externalities;
- Environmental balance, where a development balanced with the natural environment is promoted, and where natural systems are considered as a key support;
- Identity and Heritage, where these two items are considered as social goods; and
- Institutionalism and Governance, where the need of an institutional restructuring is established, favoring the existence of an integrated and decentralized system focused on a governed planning.

This policy — in force since March, 2014 — is currently on the implementation stage, in a process led by a National Council on Urban Development, with broad and diverse national representation, defined by the President of the Republic and the Ministry of Housing and Urban Planning. Regarding climate change, diverse guidelines and objectives of this policy contribute mitigating GHG emissions. A few examples of these are those measures aiming to decrease energy consumption, the adoption of the concept of life cycle in building assessment, and the reduction of pollutant emissions during construction stages and service life of infrastructure. Likewise, more efficient and comprehensive planning actions are proposed, making climate change adoption processes easier, among other aspects.

Other initiative led by MINVU is the preparation and implementation of the National Strategy on Sustainable Construction and the Code of Sustainable Construction, through a coordinated, interministerial work that establishes the guidelines for introducing the concept of sustainable development in the whole construction process. For this, articulating and linking the energy and environmental plans developed and currently in force in the country is sought, among other actions. The strategy presents four axes (Ministry of Housing and Urban Planning, 2013)[16]:

- Habitat and Welfare: Mainly associated to benefits in the quality of life that could be achieved when considering sustainability concepts on buildings and infrastructure. This is keeping the balance between protection/preservation and the use of natural goods, not only related to the construction process but also to the immediate surroundings of buildings.
- Education: related to the development of national parameters guiding the construction sector and serving as a reference to improve the regulatory framework. Besides creating awareness through the development of education and training programs, particularly for the end users of these buildings. In this axis, the importance of preparing buildings in relation to natural disasters and possible effects

15 Based on review www.minvu.gob.cl

16 www.csustentable.cl

of climate change is pointed out.

- Innovation and Competitiveness: related to the introduction of new design and technological solutions responding to both the local needs as well as the global needs. This is mainly achieved developing a more informed and aware market.

- Governance: associated to the consolidation of an accurate informational data repository on the progress status of the sustainable construction, in order to implement an efficient management control, favor the coordination among the relevant players, and for developing a strategic plan concretely orienting the actions in this topic.

The National Strategy on Sustainable Construction and the Code of Sustainable Construction establish the guidelines for directing the future construction of buildings and infrastructure of cities, where a few of the considerations mentioned in the National Policy on Urban Development are established, but exclusively focused on the object, whether it is building, infrastructure or urban elements. This is relevant to note due to the importance on the GHG emissions, both during the construction stage as well as during the operation, where the main polluter is the energy consumption. If sustainability standards are established — such as the ones related to energy efficiency in buildings, both public and private — a contribution in order to decrease GHG emissions could be made.

Under the scope of the axes, actions intended to fulfill the goals proposed are developed. In addition, actions introducing one or several sustainability criteria have been developed — mainly in energy, water, wastes, health, welfare, and construction management and operation issues. A large amount of these actions have an impact on climate change, mainly because they generate reductions in energy, fuel or water consumption, as well as involving responsible disposal of construction wastes.

4.2.3. Local efforts on climate change mitigation

Due to the relevance climate change has acquired in decision making, its introduction in public policies has been necessary and increasingly evident. This is not only applied at national level, but also in decision making at local level. Because of this, in January 2014, the Chilean Network of Municipalities For Climate Action

(Red Chilena de Municipios ante el Cambio Climático - RCMCC) has been created.

This network is a community open to and all municipalities in Chile that seek to make an explicit commitment to plan and manage their territories, services and goals by taking climate change into consideration, as a new scenario that is already determining the major challenges that lie ahead in the 21st century (Adapt - Chile, 2014).

The objectives of the network are:

a. Promote management practices and policies that integrate climate change on a municipal scale;
b. Provide visibility to the planning and management efforts that municipalities are already undertaking in order to confront climate change;
c. Facilitate consensus regarding the role that municipalities play regarding climate change (both in terms of greenhouse gas mitigation and adaptation to climate change impacts);
d. Facilitate access to information and the exchange of best practices between national and international municipalities;
e. Coordinate a consolidated municipal message regarding regional and national challenges that increase municipal vulnerability to climate change;
f. Promote alliances with the private sector and national government;
g. Generate international alliances that allow for a fluid exchange of best practices.

By July, 2014, nine municipalities are part of this Network, specifically: Santiago, Providencia, Independencia, La Pintana, Colina, Peñalolén, Calera de Tango, Recoleta and Paine.

In order to fulfill its objectives, the RCMCC operates according to a working agenda with six objectives[17], among which the mitigation of GHG in sectors such as transportation, energy, and waste management is included; even though there are also side benefits attached to the Biodiversity and Green Areas (due to the capacity of sequestration of green areas), and infrastructure (i.e. green purchases).

On May, 2014, a workshop with the RCMCC called Mitigation in Chilean Municipalities: Low Carbon Development Pathways (Mitigación en las Municipalidades de Chile: Senderos de Desarrollo Bajo en Carbono) was performed, sponsored by the Municipality of Providencia. During this workshop, methodologies in order to measure the municipal carbon footprints; different mitigation measures; and the wide variety of constraints, limitations, opportunities and feasibility of implementing effective measures, and the possibility of integrating a periodic municipal footprint measurement were discussed. The most remarkable measures were those related to recycling and composting programs, bike-sharing or municipal bicycle systems — along with the development of local cycleways — and energy efficiency measures in municipal facilities, through training, technological changes and the use of NCRE at local level (Adapt-Chile, 2014).

4.3 Mitigation efforts in the private sector

Mitigation is not only actions or policies implemented or designed at governmental level. The private sector is a key player when achieving an effective reduction of GHG emissions.

Since Chile is an export-oriented country with diverse Free Trade Agreements in force with countries that all together represent 80% of the World's GDP, the national private sector should consider that in the short run there might be trade constraints based on environmental factors. One example of this is the increasing trend for demanding the carbon footprint estimation in exportation products (Institute of Engineers of Chile, 2013).

Currently, there are initiatives in the private sector in order to report and manage their GHG emissions. Within these initiatives, the Center of Entrepreneurial Leaders Against Climate Change (Centro de Líderes Empresariales contra el Cambio Climatico - CLG-Chile) and the Global Compact Network could be mentioned, among others.

The Center of Entrepreneurial Leaders Against Climate Change (CLG-Chile) is part of the international organization Corporate Leaders Network for Climate Action. One of its objectives is generating joint debate and discussion instances among entrepreneurs, authorities and schol-

17 http://www.adapt-chile.org/red_de_municipios_agenda.htm

ars in order to face the challenges imposed by the Climate Change phenomenon. In 2009, the CLG-Chile organization, supported by Prince Charles, was born in our country, thanks to the joint efforts of the Faculty of Economics and Businesses of the University of Chile, the British Chilean Chamber of Commerce, and the British Embassy. Nowadays, it comprises approximately 16 member companies from diverse sectors (CLG-Chile, 2014).

The UN Global Compact Network is the largest Social Responsibility Initiative in the world, with a presence in 145 countries, with more than 12 thousand participating organizations. In Chile, the network works under the Andrés Bello University; and it has more than 70 adherent organizations, with presence in the Valparaíso and Biobío regions, through Regional Councils.

The 20th of September, 2013 the Summit of Leaders from the Global Compact Network was held in New York. In this activity, the Secretary-General of the United Nations, Ban Ki-moon, introduced the new Post-2015 Architecture. Within this context, Food and Agriculture, Water and Sanitation, and Energy and Climate were defined as priority topical areas. In Chile, the Network has a Working Group focused on Climate Change, through which issues of interest of the adherent organizations — based on the Caring for Climate initiative, from the headquarters — will be developed.

The Global Compact Network also has an Integrated System for the Promotion of Global Compact Principles (SIPP), for support and feedback from the adherent organizations on network principle implementation processes in issues such as Human Rights, Environment, and Anti-Corruption (Global Compact Network, 2013).

This system and its report become relevant since it is the pioneer on reporting actions related to climate change in the private sector. In the report, actions from diverse companies from the service, energy, mining, retail, massive consumption, etc. sectors are considered.

The 2013 SIPP report, developed from the analysis of the progress communications and sustainability reports from 32 of the adherent companies, during 2012, reports the following regarding Climate Change:

- The initiatives oriented towards reducing energy consumption represent one of the most reported aspects by the analyzed companies, since 88% of the organizations account for that; being the most recurrent the use of efficient luminaire, awareness campaigns and usage of NCRE (Global Compact Network, 2013).

- Regarding GHG emissions, the reporting companies account for 54% of the sample. This measurement has become more important in relation to the impact generated by the company, which is noted by the fact that the 4 energy and mining companies reporting through the standard Global Reporting Initiative (GRI) report their emissions in the period. On the other hand, only 2 out of 5 Engineering and Construction companies do. It is particularly interesting the lack of measurements of this kind in such companies, taking into account that this is an industry that generates significant impacts (Global Compact Network, 2013).

- Greenhouse Gases (GHG) emissions are measured according to their scope. There are scopes from 1 to 3, depending on whether they are directly or indirectly generated by the company. In this line, the companies who adhere to the Global Compact Network measure their emissions with other method, considering, in few cases, the three types of range; in others, only direct emissions; and in few cases, the level of detail of such measurement is not mentioned. In total, the analyzed companies generated 228,720,570 tons of CO_2 equivalent in 2012, 17,593,890 on average per company; being 13 companies (54%) accounting for such impact.

These are examples showing that the private sector is taking certain actions in relation to Climate Change — whether directly reducing emissions through mitigation plans, or reporting and quantifying them, which would result in concrete actions to manage them.

5 NATIONALLY APPROPRIATE MITIGATION ACTIONS (NAMAS)

According to the UNFCCC, the NAMA concept refers to any action that reduces emissions in developing countries and is prepared under the umbrella of a national governmental initiative They can be policies directed at transformational change within an economic sector, or actions across sectors for a broader national focus. NAMAs are supported and enabled by technology, financing, and capacity-building and are aimed at achieving a reduction in emissions relative to *business as usual* emissions in 2020. (UNFCCC, 2014)

5.1 The NAMAs of Chile

The OCC of the MMA started on October 2010, a process for surveying NAMAs ideas and proposals from the main polluter sectors of Chile; for which, international support through a technical sheet developed for such purposes by the Ministry, was requested. During this process, several NAMAs proposals were received, in particular from the Agriculture, Energy and Transportation Ministries, which comprise the starting point in order to have an initial NAMA portfolio in Chile.

In addition, it is worth to note that the technical sheet developed by the MMA was a baseline for the Chilean position in the negotiations in the COP17, in Durban, on the issue of the NAMA registry. In particular, Chile played an active role in proposing which should be the minimum information delivered by the developing countries in order to subscribe in the Registry a NAMA requesting international support.

On August, 2012, the Secretary of the UNFCCC released the prototype of the Registry of Nationally Appropriate Mitigation Actions of developing countries. The purpose of the Registry is facilitating the delivery of international support to developing countries for the preparation and/or implementation of their NAMAs, as well as recognizing NAMAs developing countries are undertaking with domestic resources. The registry currently has four different forms in order to facilitate information gathering from developing countries requesting support for their NAMAs, and on developed countries and other institutions offering financial support for such NAMAs.

With the release of the prototype NAMA registry and after the official registry (NAMA Registry), Chile has been able to concrete the work being developed since 2010, in order to survey and develop NAMAs, becoming the first country in the World to register a NAMA in the UNFCCC, on October 2012.

5.2 Public NAMA Board

In order to systematize an ongoing work in Chile regarding NAMAs, on October, 2013, for the first time, a Board comprised by institutions of the Government for the work on Design and Implementation of NAMAs held session, which was called the Public NAMA Board. This board had held a session for the last time on 2012, but as Board for the National Registration of Mitigation Actions of Chile. In 2013, the call for the table was extended with representatives from a larger amount of ministries and public services, establishing the following objectives:

- To increase the amount of new NAMAs in Chile.
- To involve new key sectors
- To design a strategy in order to ensure an ongoing flow of funding for NAMA development.
- To promote NAMAs nation wide.

The OCC of the MMA assumed the role of secretaryship of the Board, and it proposed a bi-yearly working plan for the October, 2013 - March, 2014 period. This set as objective a series of products: a NAMA portfolio (containing the information update and gathering on registered, under development and new NAMAs), technical documents on constraints and development opportunities, exploration of funding sources, Chilean NAMA spreading, and a compilation of documents and web sites in order to create a library for consultation on NAMAs.

As a conclusion of the bi-yearly cycle of this public working instance, it could be accounted that there is a sector interest on the development of NAMAs. Nevertheless, the constant need of technical support and the need of capacity-building for the different sectors were identified. As a final agreement, it was decided to continue with the training and spreading activities by the OCC towards the different sectors, as well as giving bilateral technical support in the NAMA registration process before the UNFCCC.

5.3. Summary of Chilean NAMAs

Nation-wide, nine sectoral NAMAs are identified, with different levels of maturity and information available. From them, 5 are registered in the UNFCCC's NAMA Registry. Table 6 shows a summary of Chilean NAMAs with different levels of maturity, with the following attributes: Description/Objective, Stage, Nature, Sector, Gases, Related Dates, Reduction Goal, Progress Indicator, Planning and Progress of its Implementation. Likewise, Table 7 considers: Reduction Estimation Methodology, Assumptions, Side Benefit Identification, Progresses in their Implementation and Measurement, Report and Verification System (MRV).

Table 6. Summary of NAMAs, in its attributes of Description/Objective, Stage, Nature, Sector, Gases, Related Dates, Reduction Goal, Progress Indicator, planning and progress of its implementation.

Name of the Action	Head Institution	Description/Objective	Stage	Nature or type of action	Sector(s)
Nationally Appropriate Mitigation Actions Registered before the UNFCCC					
Renewable Energy for Self-Consumption in Chile.	Ministry of Energy through the Renewable Energy Center (CER).	Increase the penetration of low-scale renewable energy systems in the different sectors, through the creation of technical and financial conditions for the early stages of development of this emerging industry.	Under implementation	Pre-investment subsidies, subsidies for the investment, collateral fund in order to facilitate the access to banking loans and strengthening of capabilities.	Power Generation; Power Consumption; Agriculture; Industry and Industrial Processes; and Wastes.
National Program for Industrial and Commercial Catalyzing on Organic Waste Management in Chile	Ministry of the Environment (Ministerio del Medio Ambiente), Waste Section.	The main goal is to support the implementation of the first plants of industrial and commercial organic waste management in Chile (excluding household organic waste).	In planning.	National Program, with investment in infrastructure and technology.	Wastes
Design and implementation of the National Climate Change and Forestry Resources Strategy (Estrategia Nacional de Cambio Climático y Recursos Vegetacionales - ENCCRV) including the Platform for the Generation and Trading of Carbon Credits from the Forestry Sector in Chile (Plataforma de Generación y Transacción de Bonos de Carbono del Sector Forestal de Chile - PBCCh).	National Forestry Corporation (CONAF)	Government mechanism to facilitate the access of forest owners, xerophytic formations and soils feasible to afforest, to the benefits associated to carbon and environmental services of the forests in a national and international level.	Planned and under implementation.	National Climate Change and Forestry Resources Strategy of Chile (ENCCRV).	Corporation
Clean Production Agreements in Chile.	Clean Production Council.	Register 10 APLs per year, between 2013 and 2020. These APLs will contemplate the implementation of energy efficiency, the best practices in solid waste management, liquid waste management, water efficiency and sustainable practices in specific areas, such as fertilization.	Under implementation	National and sectoral program, implemented through clean production agreements (APLs)-	Agriculture, Building, Power Generation, Power Consumption, Forestry/ LULUCF, Industrial and Industrial Processes, Wastes and Transportation and its infrastructure
Green Zone for Transportation in Santiago (Zona Verde para el transporte en Santiago - ZVTS).	Municipality of Santiago.	GHG emission reduction promoting sustainable, scalable and replicable transportation initiatives, through the use of new low carbon vehicular technologies and promoting integration and modal change.	In planning.	Sectoral program with a set of investment projects in technology and infrastructure.	Transportation and its infrastructure.
Nationally Appropriate Mitigation Actions in preparation for the register before UNFCCC.					
Carbon sequestration through sustainable soil management.	Agricultural Research Institute (Instituto de Investigaciones Agropecuarias - INIA) and Agricultural and Livestock Service (Servicio Agrícola y Ganadero - SAG).	CO_2 capture by the soil, through their stabilization.	Under conceptual design.	National Sectoral Program.	Agriculture, Forestry / LULUCF.
Mitigation of GHG emissions emerging from Industrial, Commercial and Institutional Boilers.	Ministry of Energy (Ministerio de Energia).	It seeks to promote the implementation of more efficient commercial and institutional boilers (used for heating and steam generation) which could allow a cost-effective reduction of GHG emissions.	Conceptual	Sectoral, focused in technological replacement.	Energy

Treated Gas(es)	Implementation	Accumulated reduction goal	Identification of Progress Indicator	Planning to comply with the reduction goal	Progress	Progress of the reduction goal
CO_2, CH_4, N_2O.	6 years, 2015-2021.	2 $MtCO_2eq$.	Accumulated reductions in $MtCO_2eq$.	. Program . - Development of a fundable projects portfolio. . - Training and consulting services for the financial sector. - Investment support. - Establishment of the collateral fund - Training - Technical assistance and virtual platform. - Knowledge exchange Program. - Dissemination and awareness-raising. -MRV System.	Progress has been made in the pilot program, selecting 10 projects. Additionally the financial component (with KFW and CORFO) and the technical component (GIZ) are under development.	Without results yet. Pilot projects under design.
CO_2, CH_4	5 years, 2015 to 2020.	12 $MtCO_2eq$.	Accumulated reductions in $MtCO_2eq$.	Five components: regulatory improvement; co-financing of feasibility studies; financial support; guarantee fund and MRV generation.	The Government of Chile is making progress in the regulatory improvements.	Without results yet. NAMA without implementation of waste treatment projects yet.
CO_2	9 years, 2012-2020 referred to the ENCCRV.	42 $MtCO_2eq$. according to 2007.	Reduction / capture per year per jurisdiction.	1. ENCCRV design. 2. PBCCh design. 3. ENCCRV socializations. 4. Gap Analysis per jurisdiction. 5. Characterization of jurisdictions. 6. Validation of jurisdictions. 7. Implementation of mitigation and adaptation activities defined for each jurisdiction. 8. Implementation and adjustments of MRV systems for effective verification of GHG reductions/captures.	Stages 1 to 7 in different implementation levels. Stage 8 starts in 2015.	The stage that impacts in emission reduction has not been implemented yet.
CO_2, CH_4, N_2O, HFC, PCF, SF_6 y NF3.	9 years, 2012-2020.	18.4 $MtCO_2eq$ in total, with an average of 2.25 $MtCO_2eq$ per year.	- APL signed per year - Accumulated reduction in ($MtCO_2eq$) - Reduction per APL in ($MtCO_2eq$)	10 APL per year, where each APL goes through the following steps: (1) Base diagnose of the sector; (2) APL Proposal; (3) Negotiation; (4) Implementation; (5) Final Audit; (6) Public Services Assessment; (7) Issuing of the Clean Production certificate (valid for 3 years with 2 maintenance audits). The complete process lasts a maximum of 3 years.	4 signed APL in the process from 2012 to date. In the three years of NAMA, a reduction of 6.75 $MtCO_2eq$ is estimated.	W/I
CO_2. N_2O.	2 years, late 2014 to 2016.	1,43 $MtCO_2eq$.	Accumulated reductions in $MtCO_2eq$.	Four components. **Initiative 1:**promotion of light ZLEV (zero level emission vehicles) vehicles. **Initiative 2:**more efficient buses for public transportation. **Initiative 3:** Promotion of non-motorized vehicles. **Initiative 4:** Transit management and redesign.	Initiatives 1, 3 and 4 are under implementation.	There is no impact in the reductions yet.
CO_2	30 months of preparation. 25 years to be adopted, without starting date yet.	65 to 80 $MtCO_2eq$.	Capture per year per jurisdiction.	**Stage 1:**Base research to generate a Geographical Information System to asses the current conditions of soils. NAMA design and development of a software to account the measurements of C captures in soil and their impact, developed for Chilean conditions. **Stage 2:**Design of positioning and software dissemination plan. **Stage 3:**Dissemination of the software to its final recipients. **Stage 4:** implementation and encouragement of conservation-oriented soil management	It has not been implemented yet.	It has not been implemented yet.
CO_2	5 years, starting the second semester of 2015.	1,25 $MtCO_2eq$.	Accumulated reductions in $MtCO_2eq$; Reduction in diesel consumption.	It seeks to eliminate the financial barriers and encourages the adoption of measures to reduce GHGs in boilers. This is through 2 components: **Financial:**co-founding for the replacement of boilers and changes of fuel; Co-founding for improvements on energy efficiency in existing boilers. **Technical:** Capacities Building; Knowledge Transfer Program; Dissemination; MRV design.	Even though it is still not registered in the NAMA registry, it has been part in the application process to the NAMA Facility fund.	It has not been implemented yet.

Table 6. (continuation), Summary of NAMAs, in its attributes of Description/Objective, Stage, Nature, Sector, Gases, Related Dates, Reduction Goal, Progress Indicator, Planning and Progress of its Implementation.

Name of the Action	Head Institution	Description/Objective	Stage	Nature or type of action	Sector(s)
Nationally Appropriate Mitigation Actions in conceptual design stage.					
National Strategy for Sustainable Construction.	Ministry of Housing and Urban Planning.	Development of a strategy that seeks to establish the concept of responsible sustainable development in the construction area of Chile.	Under conceptual design and planning.	National Sectoral Strategy.	Construction, Wastes, Transportation and its infrastructure, Power Consumption.
Assisted phytostabilization of mining tailings in Chile.	Ministry of the Environment (Ministerio del Medio Ambiente), Waste Section.	Stabilization of mining tailings.	Conceptual.	Investment Projects in infrastructure and technology.	Wastes, Agriculture, Forestry/ LULUCF, Industry and processes.

Table 7. Summary of NAMAs in its attributes of reduction estimation methodology, assumptions, side-benefits identification, progresses in their implementation and MRV.

Full Name of the Mitigation Action	Methodologies	Assumptions
Nationally Appropriate Mitigation Actions Registered before the UNFCCC		
Renewable Energy for Self-Consumption in Chile.	Production of forecast for the estimation of reduction.	Composition of the portfolio in projected period: PV 35%, the 33% of the biomass, biogas 16%, solar water-heating 9%, Micro hydroelectric 4%, Wind 3%. Average cost of the delivery: PV 3,800 $/KWe, Biomass 812 $/KWe, Biogas 1,800 $/KWe, solar water-heating 1,345$/KWe, Micro hydro 3,529 $/ KWe, wind 2,225 $/KWe. Expected annual change of the costs: PV -6%, 0% of the biomass, biogas 0%, solar water-heating 0%, Micro hydro 0%, Wind -3%. Average emission factor: PV 598 $gCO_2eq/kWhe$, Biomass 204 $gCO_2eq/kWhe$, Biogas 204 $gCO_2eq/kWhe$, solar water-heating 598 $gCO_2eq/kWhe$, micro hydro 598 $gCO_2eq/kWhe$, Wind 598 $gCO_2eq/kWhe$. Average life of the facilities: PV 30 years, 25 years Biomass, Biogas 25 years, Solar water-heating 20 years, micro hydraulic 25 years, Wind 25 years. Average capacity factor: PV 18.5%; 50% in biomass; biogas 50%; solar water-heating 27%; micro hydro 40%; Wind 25%.
National Program for Industrial and Commercial Catalyzing on Organic Waste Management in Chile	Methodology of estimation of expected reductions.	It is considered to support around 14 projects of 40,000 tons each, through their different instruments; it is considered a life cycle of the project of 20 years; and that the plant will be able to produce biogas with a methane concentration of around 60%. This is transformed into electricity and thermal energy which then can be used to replace fossil fuels of the grid. The reference value used as emission factor is from the Central Interconnected System (Sistema Interconectado Central - SIC) which at the moment of the calculation was 0.35 tCO_2eq/MWh.
To design and implement of the ENCCRV including the Platform for the Generation and Trading of Carbon Credits from the Forestry Sector in Chile (PBCCh).	Methodology of estimation of Baseline.	Data of the uses of land use and land-use change Register managed by CONAF and statistics of firewood consumption, logs and forest fires managed by INFOR are being used. Emission factors / capture correspond to the data of continuous forest inventories that INFOR and CONAF develop, as well as the compendium of biomass and allometric functions that are managed in the country. Baselines are determined at jurisdictional levels and they are differentiated according to the following activities: deforestation, degradation and increase of carbon existence. Once that all the jurisdictional baselines are available, they will be integrated at a national level.
Clean Production Agreements in Chile.	Methodology of estimation of Baseline.	Previous study indicates that in 16 APL, implemented between 2002 and 2010, an average of 31.6 $KtCO_2eq$ were reduced per year per APL. This value is extrapolated, assuming that each APL has a reduction potential of 31.6 $KtCO_2eq$ per year. A total number of 45 APL is considered in the diagnosis stage, which will be implemented in the NAMA period and 80 new APLs that are expected to be signed in the full period.

Treated Gas(es)	Implementation	Accumulated reduction goal	Identification of Progress Indicator	Planning to comply with the reduction goal	Progress	Progress of the reduction goal
CO_2, CH_4-	NAMA: 8 years, the strategy contemplates the period 2013-2020.	Under estimation.	Reductions in $MtCO_2eq$.	4 strategic axes: habitat and welfare; Education; Innovation and competitiveness; Education; and Governance. Each one with specific goals, measure criteria and lines of action. In total, there are 16 specific goals and each one has 2 lines of action, reaching the 32 measures in matter of sustainable construction.	The Code of Sustainable Construction, which delivers the standards for the sector and for the lines of action of the strategy has been finalized. A budget for 32 programs in the framework of this Strategy has been allocated for 2014.	W/I
CO_2	20 years, without starting date yet.	W/I	Accumulated reductions in $MtCO_2eq$.	Under conceptual discussion.	It has not been implemented yet.	It has not been implemented yet.

Identification of side benefits / other impacts	Accomplished or expected progress (side benefits)	MRV description
Renewable energy capacity installed: Indicates the total capacity of MW of installed renewable energy. This indicator is divided in subsets according to technology. Employment creation: Indicates the number of permanent and temporary positions which are created as a result of renewable energy projects which are part of the program. Express in position units equivalent to full time. Leverage ratio of the private sector: Indicates the contribution of the private sector to the renewable energy projects in the framework of the program. It is expressed as a proportion of the funds (NAMA: the private funds).	Without results yet.	In trial phase and improvement of digital MRV platform, designed as a project management system that will allow: to standardize and organize projects from CER; supervise and control the variables of each project; elaborate reports for each project and all the CER projects; verify that the variables are being monitored, since the system can be audited, reviewed and modified in the future, according to CER requirements; gather information, indicators, status, etc., from different types of projects; and report the projects results considering the MRV style outputs.
Number of job positions created (directly and indirectly) by the projects. - Production of energy per ton of waste. -Critical environmental episodes associated with the project, if any. -Number of job positions created (directly and indirectly) by the projects.	It has not been implemented yet.	Currently under design through the LECB initiative. It could be supported with a centralized platform of the Pollutant Release and Transfer Register (PRTR).
Perfected forestry governance, towards the strengthening of its management for the proper execution of the activities the project requires. Increase of the utilization of Non-Wood Forest Products (NWFP).	The results have not been quantified yet.	As a part of the NAMA, a platform is being designed, to strengthen the current management and information systems which currently function within CONAF and from which a base statistic information that reports the country in every aspect is elaborated.
Economic/ Productivity: Increased productivity; Improve corporate image; Save in costs related to waste management, water and power consumption; Opening to international markets through exportation of more sustainable products. **Environmental:**Reduction of pollution of the liquid effluents through an improvement in management and prevention; Reduction of the environmental problems related to irregular waste management (uncontrolled landfill sites); Reduction of the water consumption through the incorporation of clean technologies and sustainable practices; Reduction of the carbon footprint of the facilities and/or companies. **Social:**Improvement in the working conditions through the assurance of the compliance with labor regulations; Improvement of the workers capacities; Minimization of work risks through prevention practices.	W/I	In trial phase through the digital platform 'compite más' (compete more).

Table 7 (continuation), Summary of NAMAs in its attributes of reduction estimation methodology, assumptions, side-benefits identification, progresses in their implementation and MRV.

Full Name of the Mitigation Action	Methodologies	Assumptions
Green Zone for Transportation in Santiago (ZVTS).	Methodology of estimation of expected reductions.	The stated goal indicates the emission reductions estimated in 10 years, in a scenario of greater coverage of the ZVTS. It includes the 15% of the taxi fleet in Santiago (3,525 substituted units) and the 15% of the Transantiago bus fleet (975 substituted units). In both cases, the existing technology is substituted by electric technology. This reduction potential could be greater if a bigger percentage of the fleet is substituted. If ZVTS only considers the two square kilometers of the intervention in Santiago, it is reduces 13.000 tCO_2eq in 10 years.
Nationally Appropriate Mitigation Actions in preparation for the Register before UNFCCC.		
Atmospheric carbon sequestration by the soils.	Methodology of estimation of expected CO_2 capture.	The calculation was executed on the base that 5% of the agricultural land of the country (figure rounded in 100 thousand ha), will be managed conservatively and that the expected organic carbon increase of the soil will be 4 percentage points, each point meaning 45 tC or 169 tCO_2 per hectare. This comes from the assumption: • Bulk density: 1.5 g cc-1. • Soil depth impacted in the first 30 cm of the soil profile.
Mitigation of GHG emissions emerging from Industrial, Commercial and Institutional Boilers.	Expected reductions methodology (based in the experience of the USEPA with similar measures).	It is assumed that the existing boilers have an annual consumption of diesel equivalent to 780,000 tons, which would be equivalent to 2,500,000 tCO_2/year. The estimated reductions will be reached if a 10% reduction is achieved in power consumption.
Nationally Appropriate Mitigation Actions in Conceptual Design Stage.		
Assisted phytostabilization of mining tailings in Chile-	Under conceptual discussion.	Under conceptual discussion.
National Strategy for Sustainable Construction.	W/I	W/I

W/I = Without Information; N/A = Not Applicable.
Source: Compilation based on information provided by each person in charge of NAMA.
Information with greater level of detail of the registered NAMAs, is presented in Annex 4 of this report.

Identification of side benefits / other impacts	Accomplished or expected progress (side benefits)	MRV description
-Generation of technical capacities associated to the use of new technologies. -Improvements in the commerce within the area of intervention in the ZVTS. - Possible increase in accident rates.	It has not been implemented yet.	Under conceptual discussion.
Social:generation/preservation of permanent jobs; decrease of poverty; reduction of the rural-urban migratory process. **Economic:** increase of the agricultural productivity; economic valuation of organic waste; creation of new activities; lower production cost, due to less use of agrochemical supplies; less risk of export rejection due to environmental reasons; valuation of the agricultural products produced under 'conservative' styles. **Environmental:** increase of the agricultural biodiversity; restitution of the soil productivity; increase of the capacity of the soil to infiltrate and collect water; greater recovery of aquifers; effective containment of edaphic erosion; less environmental dispersion of synthetic pesticide waste; less diffuse contamination indexes of continental water; reduction of the sediment load of shallow waters; normalization of the hydrological cycle of the surface water courses; less damage to the built infrastructure due to less incidence alluvial downstream of rivers and streams; less losses of cultivated areas due to the same reason; preservation of the aquatic biotic community, both in fresh and salt water.	It has not been implemented yet.	Under conceptual discussion.
Environmental: reduction of local pollutants (MP,SO_2,NO_x); reduction on the demand of fossil fuels. **Economic:** Cost reduction due to the usage of more efficient technologies; creation of new market opportunities; Reduction of energy loss in the transmission systems. **Social:** Creation of jobs for qualified installers; Improvement in the design of public policies given by better quality information on the features of the equipment.	It has not been implemented yet.	Under conceptual discussion.
Social: Quality of life and reduction of exposure to pollutants. **Economic:**Savings due to the substitution of fossil fuel by biofuel. **Environmental:** recovery of landscapes and natural ecosystem.	It has not been implemented yet.	Under conceptual discussion.
Social: Improvement in quality of life. **Economic:** increase in the commercial value of houses. **Environmental:** decrease of local pollutant emissions, incorporation of greater control in the construction and operation stages of the projects.	W/I	A control system for the implementation of the strategy and a monitoring network (in housing, national) are being designed. A project for the design of the system will be tendered, which integrates the current initiatives under the scope of the Strategy, thus standardizing the features of sustainability.

6 TRANSVERSAL ACTIONS IN SUPPORT TOWARDS A LOW CARBON ECONOMY

6.1 MAPS Program CHILE

MAPS Chile is a governmental project that delivers evidence, projections and options to reduce GHG emissions in Chile, through a research process and a multi-player participation which is to be executed between 2012 and 2015. Particularly, this project seeks to support the decision-making of public and private players, offering options for public policies and private initiatives, suitable with the goals of inclusive, competitive and low-carbon development.

In the mandate of the MAPS project four key questions were defined to analyze them during the development of it, these are detailed on Figure 5.

Figure 5: Key questions of the mandate of MAPS Chile.

- What are the most efficient and effective mitigation options to comply with the international commitments on climate change? Among them, which are the most feasible and favorable to be implemented?
- What are the opportunities and compensations related to the different mitigation options, in terms of poverty relief, contribution to macro and micro economic positive results and to allowing Chile to earn and ensure its international competitiveness?
- What are the key bonds between the mitigation and adaptation options in the country?
- What are the public policies, key private instruments and initiatives that will contribute to the mitigation of the climate change with the aim of improving low carbon development?

Source: MAPS Chile Interministerial mandate (2012).

The funds for its execution come from the Switzerland and Denmark governments, as well as international institutions such as CIFF (Children's Investment Fund Foundation), CDKN (Climate Development Knowledge Network) and UNDP (United Nations Development Programme) and co-funding in money and supplies from the Government of Chile.

The MAPS Chile project seeks to study different projection scenarios of the GHG emissions, relevant for enabling the generation of the necessary evidence on different action courses the country might follow. Specifically, a series of emissions paths will be projected through research, modeling and simulation results.

The MAPS Chile project is being conducted in 3 stages. During Stage 1 (results presented on July, 2013), the projection of the scenario 2007-2030 Baseline or Unrestricted Growth (Crecimiento sin Restricciones) and the scenario Required by Science (Requerido por la Ciencia). On Stage 2, the scenario 2013-2030 Baseline was projected, mitigation measures for the economy sectors included in the project were assessed, different mitigation scenarios were identified and assessed and the results on the economical impact of the implementation of the mitigation measures and scenarios based in a general balance model were delivered. Finally, in a third stage of the project, it is expected to refine the

results of Stage 2, elaborate instruments to facilitate the visualization of the results, analyze side benefits of the mitigation measures and identify mitigation options for 2030-2050 with a non traditional or out of the box approach. (MAPS Chile, 2014).

Figure 6 represents the set of paths that shaped the theoretical action framework during the full project.

The red line represents the emission scenario according to the development trends existing until December 2006, where special GHG mitigation actions implemented after December 2006 are not considered; this scenario has been named 2007-2030 Baseline or Unrestricted Growth (Crecimiento sin Restricciones). This is a relevant scenario because it represents the base of the voluntary commitment subscribed by the country with respect to the Copenhagen Accord (projection starting on 2007). The red stripe represents the uncertainties (expressed in sensibilities) related to the projections. The studies and estimations of the red line and associated stripe were subject to tenders coordinated by UNDP, in which several sectoral consultant teams participated.

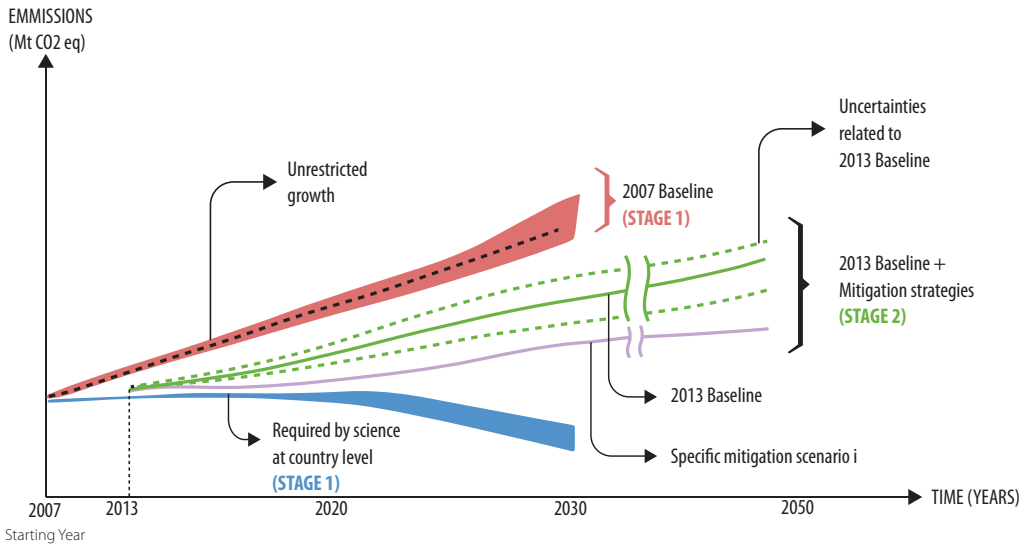
On the other hand, the light blue zone represents the 'Required by Science' (Requerido por la Ciencia) scenario of emissions stabilization for Chile, for the control of the climate change. This stripe seeks to represent how is feasible to interpret the global requirements of emission reduction at a country level (MAPS Chile, 2014).

The 2013-2030 Baseline, in green, represents the projection of GHG emissions considering the current development trends and the mitigation measures, plans and laws that were already approved until December, 2012. Lastly, the purple line represents a specific Mitigation Scenario whose trajectory of emissions is deviated with respect to the 2013-2030 Baseline. The mitigation scenarios will be the result of the joint application of a series of mitigation measures additional to the ones already implemented or approved in the country until December 2012. The studies and estimations of the 2013-2030 Baseline and the Mitigation Scenarios were subject to tenders coordinated by UNDP in which several sectoral consultant teams participated. (MAPS Chile, 2014).

Additionally, MAPS Chile has commissioned international experts, through the Ministry of Finance (Ministerio de Hacienda), the generation of a macro-economic tool (a dynamic stochastic general equilibrium - DSGE) which will allow to assess the greenhouse gases mitigation options, analyzing its impacts on macro-economic variables as economic growth. (MAPS Chile, 2014).

One of the main results of Stage 2 of the project, was to propose a series of likely measures with

Figure 6. Path of emissions for different scenarios.



Source: MAPS Project Chile Stage 2, 2014.

the goal of modeling the different mitigation scenarios for each analyzed sectors (power generation and transportation; commercial, public and residential; industry and mining; transportation and urban planning; anthropic waste and agriculture and forestry waste). This translates in a portfolio of possible mitigation data sheets for the sectors previously mentioned.

Each sheet has specific information on the description, modeling, costs, uncertainty, feasibility and side benefits, information developed by a consultant team with expertise in the topic and reviewed by the research team of MAPS project and by the members of the technical teams of each sector; later they were reviewed again by the members of the scenario construction group, instance that groups representatives of technical, political, public and private institutions, academy and civil society levels. This has contributed with a view from different viewpoints, revealing the integration of perspectives and validating a consultancy process which is actively participative. Table 8 presents a summary of this portfolio of measures grouped by sectors; Annex 5 presents additional descriptive information of each of these measures.

Table 8. Portfolio of Mitigation Measures per sector.

Sector	Name of the Measure
Electric Power Generation and Transmission	Substantial increase on generation with LNG (LNG Subsidy)
	Carbon Capture and Storage
	Reduction of Electrical Power Loss
	Hydroelectric Expansion in Aysén
	Electrical Power Generation in irrigation works
	Demand Management: Reduction of voltage
	Incentive to Nuclear Energy
	Incentive to a specific technology - Solar Concentration
	Incentive to specific technology - Wind
	Incentive to a specific technology - Geothermal
	Incentive to a specific NCRE technology - mini-hydro
	Incentive to a specific technology - Solar Photovoltaic
	Regional interconnection
	Modification to the NCRE Law: 30/30
	Standards or incentives for cleaner carbon technologies
	Wind Power storage system
	Solar Power storage system
Commercial, Public and Residential	Increase in the requirements of the Thermal Regulations
	Electrical and residential self-supply
	Energy rating of existing housing
	Energy rating of new housing
	Minimum standards for residential lighting
	Minimum standards for commercial refrigerator
	Minimum standards for refrigerators of the Residential sub-sector
	Minimum standards for fluorescent tubes and ballasts
	Minimum labeling and standards for air conditioners (Minimum Standards)
	Minimum labeling and standards for air conditioners (Labeling)
	Minimum labeling and standards for washing machines (Minimum Standards)
	Minimum labeling and standards for washing machines (Labeling)
	Program on adoption of thermal solar systems
	Aerator Exchange Program

Table 8(continuation), Portfolio of Mitigation Measures per sector.

Sector	Name of the Measure
Industry and Mining	Development of Projects for Self-Generation of Electric Power with NCRE in Industrial and Mining Plants
	Assessment and encouragement of alternatives for construction of desalination plants for mining.
	Promotion of the usage of low-GHG-emission non-conventional fuels for thermal purposes in the industrial and mining sectors.
	Implementation of energy efficiency measures for transportation in mining.
	Implementation of systems for heat surplus recovery from thermal processes in the industrial and mining sectors.
	Encouragement for efficient energy usage in industrial sector, through energy audits and the application of detected energy efficiency measures.
	Encouraging of Mining Industry to Perform Power Generation Projects with NCREs in Electric Market and Accounting Reductions on Industry and Mining Sectors.
	Encouragement for the use of low-GHG-emission non-conventional fuels for thermal purposes in the industrial and mining sectors.
	Implementation of co-generation on existent plants
	Implementation of CO_2 capture and storage systems (CCS) in high-intensity-GHG-emission sub-sectors.
	Investment on renewable energies for thermal purposes in new and existing industries and mines.
	Investment on the implementation of energy management systems in the industrial and mining sectors.
	Promotion of the application of a standard (voluntary) of energy efficiency criteria on new mining projects.
	Replacement of electric motors in the industrial and mining sectors.
	Potential energy recovery from material falling in mining.
	Restrictions to the entry of inefficient electric motors, through minimum energy performance standards (MEPS)
	Restrictions to the entry of transformers, through minimum energy performance standards (MEPS)
Transportation and Urbanism	Technical Assistance
	Mode Change in Cargo Transportation, Truck-Cabotage
	Mode Change in Cargo Transportation, Truck-Train
	Scrapping of lightweight vehicles
	Efficient Driving
	Labeling of efficient tires for lightweight vehicles
	Extension of Passenger Urban Railways
	Implementation of Infrastructure in the Public Transportation
	Bicycle-Mode Infrastructure
	Aerodynamic improvements in trucks
	Technological improvements in air mode
	Energy consumption and CO_2 emission goals for the average new-vehicle fleet.
	E-Mobility Readiness Plan
	Public bicycle program
	Electric bicycle subvention program
	Renovation of the cargo train fleet.
	Renovation of cargo truck fleet and scrapping
	Street billing and increasing parking prices
	Zero and Low Emission Vehicles
	Zero and Low Emission Vehicles - Buses
	Green Zone for Transportation
Anthropic Wastes	Thermal use of biogas
	Increase of sequestration and biogas burning with torches.
	Increase of recycling
	Aerobic Composting of Sludges from Waste Water Treatment Plants (WWTP).
	Composting of SMW from Fair Shops
	Domiciliary composting
	Composting in plant
	Anaerobic digestion of sludges from WWTP
	Power generation with biogas in sanitary landfills.
	Incineration of SMW
	Biogas injection into the natural gas network
	Palletization of SMW
	Anaerobic digestion plant based on SMW
	Mechanical biological treatment (MBT)

Table 8(continuation), Portfolio of Mitigation Measures per sector.

Sector	Name of the Measure
Stock Breeding	Promotion of organic agriculture
	Implementation of biodigesters
	Improvement of bovine feeding diet.
	Genetic-vegetable improvement
	Atmospheric Carbon Sequestration by the Soils Through Non-Tillage.
	Carbon sequestration on agricultural soils by the application and introduction of organic stabilized matter in a regular basis.
	Use of fertilizers with nitrogen cycle inhibitors.
	Use of non-conventional renewable energy (NCRE) in agriculture in irrigation.
Corporation	Increase on productivity in crops through technology adoption
	CO2 sequestration through degraded native forest recuperation
	Wood construction and sequestration in wood of harvested products
	Instrument for Encouragement of Afforestation
	Reduction of illegal felling in Native Forests
	Silvopastoral Systems.
	Energetic Use of Thinning

6.2 LECB Project - Chile

The Low Emission Capacity Building Project (LECB-Chile) started in 2012, and it is part of an initiative by the United Nations Development Programme (UNDP) in 25 countries. The project is funded by the governments of Germany, Australia and the European Commission in order to promote and create capacity from the public and private sectors in the measurement and mitigation of GHG emission through suitable actions for the country, in order to achieve its development with low carbon emissions and improve public policies addressing climate change.

In the case of Chile, it started on September 2012, for a three-year period; and it is executed by the Climate Change Office from the Ministry of the Environment, with the support of UNDP; and it will contribute with results under the following four components:

- **Component 1.** Updating the National Greenhouse Gas Inventory and the of a national inventory system of these gases.
- **Component 2.** Implementation of the National Carbon Management Program
- **Component 3.** Measurement, reporting and verification system (MRV) for Nationally Appropriate Mitigation Actions in the public and private sectors.
- **Component 4.** Designing a National Low-Emission Development Strategy (LEDS) incorporating the results from the first three components.

Component 1 has been addressed through the Chile National Greenhouse Gas Inventory System (SNICHILE), where the NIR Updating Process is under institutionalization. Component 2 is addressed through the National Carbon Management Program (HuellaChile) described in the section below. Component 3 is being partly addressed through each NAMA, since the systems shall respond to the features of each of them. In addition — with the collaboration of the additional support by NAMA Net, delivered by the UNDP Global Support Unit, for the LECB program and the Prosperity Fund Project, in order to develop a generic MRV for the Chilean NAMAs (See Section 8.1 of this chapter) — work is being undertaken in order to develop this system. Finally, Component 4 contemplates supply delivery in order to have a LEDS strategy in place, with its route map, for Chile, for the Low-Carbon-Emission Development for Chile, detailing a strategy with concrete measures and policies in order to achieve a low-carbon-emission economic development for Chile.

Recently, additional funds were approved in order to extend the LECB project up to December, 2016, in order to deepen the encouragement for the involvement of the private sector in mitigation, increasing the funding options for mitigation actions, and analyzing the public and private expenditure of Chile in matters of Climate Change.

6.3 Implementation of the National Carbon Management Program: HuellaChile

The OCC from the MMA, under the scope of the LECB-Chile Project, is formulating the National Carbon Management Program (HuellaChile). The goal of the program is supporting and promoting the voluntary quantification, report and management of GHG emissions at corporate level, whether in the public and/or private scope, delivering the suitable tools for calculating the corporate carbon footprint, standardized formats for reporting and report disclosing channels, support on designing mitigation and permanent tracking plans.

The HuellaChile Program was born as a response from the institutionalism to the need of support and suitable tools by the public and private organizations or reporting and managing GHG emissions.

The Program development considers two stages:

- Design and planning stage (during 2013), that consisted in developing a corporate carbon footprint calculation tool based on the NCh-ISO 14064:2013 standard, using official emission factors, approved by the MMA. This tool will work through the Centralized Platform for the Pollutant Release and Transfer Register, (PRTR). In addition, during this stage a trial period for this tool was performed, in order to identify errors and improvements. More than 40 organizations participated on this trial.

- Implementation Stage (from 2014), considering the startup of the program, including: own web site development for the calculation tool; standardized forms for reporting; and an analysis of the corresponding incentives designed to encourage the voluntary participation by the organizations of the program. In addition, this stage includes the execution of training and spreading workshops nation-wide.

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7 APPLICATION OF MARKET INSTRUMENTS FOR ENVIRONMENTAL EXTERNALITIES

Chile has previously used market tools for natural resource management, mainly in water rights, fishery and air quality issues.

While the world continues to explore global mitigation efforts of GHG post-2012, countries like Chile are exploring new innovative and profitable ways to intensify the reduction of the emissions and to encourage the financial flows, including the implementation of instruments based on the market.

7.1 Clean Development Mechanism of the Kyoto Protocol

Since the adoption of the Kyoto Protocol in 1997, in Chile projects under the Clean Development Mechanism (CDM) of the Protocol have been promoted and executed, turning into a relevant player at Latin American and global level in terms of the registered projects and the approved methodologies.

Chile established its Designated National Authority (DNA) in 2003, requirement established by the Protocol to develop in the country projects of reduction and removal of emissions through the CDM and to participate in the carbon market. The encouragement of CDM at national and international levels, the revision of the projects by the DNA besides the signing of cooperation agreements With industrialized countries in matters related to CDM have helped to have 141 projects approved by the DNA in July 2014, from which 101 have reached the status of registered before the Executive Board of CDM (in June, 2014). The typology with the greatest development regarding the number of approved projects corresponds to hydro-electrical plants, followed by methane removal projects and wind plants.

In terms of the evolution of the number of projects requesting for national approval to participate in the CDM, it is relevant to mention that since 2007 there was a falling trend in the number of projects, having only four projects approved by the DNA in 2009. This trend was reversed in the following years, reaching a maximum of national approval in 2012 with 49 projects, including individual projects and activity programs, raise that is attributed to the first commitment period with the Kyoto Protocol. During 2013, only 4 projects were approved. To July 2014, no project approval letter has been delivered. Table 9 shows the number of projects approved by the DNA of Chile per year.

Regarding the number of projects that have reached the register before the Executive Board of the United Nations for the CDM, Chile is the third at Latin American level with 101 registered projects, for which there have been 18,674,678 Emission Reduction Certificates (Certificados de Reducción de Emisiones - CERs)[18] already issued

Table 9. Projects approved by the Designated National Authority

Typology	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Afforestation	1				1			1					3
Biomass		2	2		1	2		2	1	1			11
Change of Fuel	1							1	1				3
Methane Removal	3			10	3	3	2	2	1				24
Co-Generation	1												1
EE Own Generation (energy or industrial recovery)								2					2
Wind					1		1	5		11			19
Methane Avoidance										2			2
Biogas Generation										2			2
Geo-thermal										1			1
Hydroelectric	1	1	2	3	3	3		9	5	15	1		43
N_2O					1			1	1				3
Activity Program										11	2		13
Methane Recovery			3	1			1						5
Fertilizer Management System									2				2
Solar								1		6			7
Transportation								1					1
Total per year	**7**	**3**	**7**	**14**	**10**	**8**	**4**	**25**	**11**	**49**	**4**	**-**	**141**

Source: Compilation based on the OCC of the MMA

representing 1.3% of the certified reductions at global level and positioning Chile as the sixth country with more CERs issued.

Regarding the voluntary cancellation of CERs, Chile accumulates 10% of the canceled CERs at global level, with a total of 78,4 kCERs[19], according to official information by UNFCCC.

7.2 Partnership for Market Readiness – PMR [20, 21]

Consistent with its interest in market instrument for emission mitigation, the Government of Chile represented by the Ministry of Energy, expressed officially its interest to be a part of the Initiative 'Partnership for Market Readiness' (PMR) of the World Bank, recognizing in it a valuable platform for learning and cooperating with countries that have already established schemes of emission exchange and other instruments based in the market, in order to limit the growth of their greenhouse gas emissions and to learn from their experiences.

Chile entered to the PMR in May 2011, after the Assembly (PA) approved their expression of interest (EOI) and assigned them USD 350,000 for the preparation stage. The donation in this stage was used for a series of base analysis, among them, the necessary elements for the design and application of a tradable emissions system in Chile, including its MRV system, as well as proposals to design and implement mechanisms of sectoral carbon credits. Besides, the donation for the preparation stage enable study tours to visit the other regulators of the ETS systems in other countries.

The country presented its final proposal of Market Readiness Proposal (MRP) to the Assembly of PMR, instance that reviewed and approved the proposal and assigned USD 3 million as a donation to implement the activities established in it. The Ministries of Finance and Environment will support the Ministry of Energy on its function of supervising and focal point for the execution of the project in Chile. To provide technical and political supervision during the execution of the project, a Steering Committee was established in March, 2012. It is formed by the ministries of foreign affairs, finance, economy, agriculture, mining, transportation of communications, energy and environment. Below, the technical components of the project are presented, which will help to create capacities and to design and implement price instruments for carbon in the country, with initial emphasis in the Energy Sector:

- **Component 1:** Assessment of feasibility of one or more price setting instruments for the carbon in the energy sector, considering the necessary regulatory, institutional and economical analysis for its implementation.

18. http://cdm.unfccc.int/Statistics/Public/CDMinsights/index.html#iss
19. https://cdm.unfccc.int/Registry/vc_attest/index.html
20. "Document of information about the project, PMR Chile' World Bank. May 2014 Document Number 88,154 Identification Number of the Project P130378.
21. Market Readiness Proposal (MRP) for Chile, prepared by the Government of Chile through the Ministry of Energy and the steering committee from other Ministries, to be presented in the Fifth Partnership Assembly Meeting of the PMR. March 2013.

- **Component 2:** Design and implementation of a frame of MRV and a registration system, for on line monitoring and registering the emissions of greenhouse gas (GHG). Considering the existence of PRTR, the legal attributes related to data gathering of this register, as well as its capacity to serve as unique platform for the reporting of emissions, the Government of Chile contemplates to improve and strengthen the calculation and report in the specific area of GHG of the PRTR.
- **Component 3:** Strategy of communication and commitment of participation from the several players related to the instruments to be assessed. Among others, gaps and training needs in the public and private sectors will be identified, and technical visits will be done to countries with experience in this instruments.

7.3 Green Taxes

The 26th of September of 2014, President Bachelet enacted the Law of Tax Reform. This includes, for the first time in Chile, the introduction of 'green taxes'. The reform introduces three new taxes. Them applies to light vehicles according to their urban performance and NOx emissions. The second applies to Stationary Sources and taxes the emissions of SO_2, NOx and MP to the atmosphere. It is expected that these taxes have important, but indirect side benefits in GHG reduction. The reform introduces a direct tax to the CO_2 emission of USD 5 the ton. The tax is oriented to those facilities which sources are composed by boilers and turbines and jointly account a thermal power greater or equal to 50 MWt (thermal megawatts), considering the superior limit the energy value of the fuel, with which mainly the power generation plants are taxed. It is estimated that between 100 and 150 facilities will be part of the tax, covering approximately 12% of the total emissions.

This tax will not apply to stationary sources which operate based in non-conventional renewable generation means, whose primary power source is biomass energy.

The expected collection, according to initial analysis, from taxes on emissions is USD 163 million annually to 2018. Per company, the average charge is estimated in USD 23 million annually. The previous charges redound in approximately an increase of average costs of USD 2.8 per MWh generated.

Consistent with the priorities of national politics, the collection will tax in a greater extent the CO_2. The collection for this GHG will be 84% of the total collection of the set of green taxes. The 91% of the collection will be due to produced carbon emissions.

Despitethe impact this tax will have in the reduction of global emissions of CO_2 not being clear yet, preliminary estimations indicate that there will be a significant impact. For example, KAS consultants estimates an important reduction even when they do not specify the amount (KAS Engineering, 2013). While another study from the Pontificia Universidad Católica indicates an emission reduction of 3 millio tons of CO_2 (6% of the total) by 2020 and 6 million by 2030 (11% of the total). The accumulated reduction in the period 2017-2030 reaches 59 million tons (CCG-UC, 2014).

8 MEASUREMENT, REPORT AND VERIFICATION (MRV) OF THE MITIGATION ACTIONS

Measure, Report and Verification (MRV) is a term used to describe all the measures that the countries take for the: collection of emission data, mitigation and support actions; compilation of this information in reports and inventories and submission of this information to some form of revision or analysis. (International Partnership on Mitigation and MRV, 2014).

In the framework of the UNFCCC, the concept of MRV is not new and has been implicit, in one way or the other, in the decisions and multilateral mechanism as fundamental part in the following of the process of each Part in issues related to mitigation of climate change. However, it is not until the Conference of the Parties held in Bali in 2007 (COP13), that the term MRV starts to be commonly used to group all the aspects related to the transparency in the climate regimen (International Partnership on Mitigation and MRV, 2014).

8.1 Working line and General Framework

The goal of MRV in Chile is to promote the transparency of the GHG mitigation activities developed in the country, through mechanisms which allow tracking the compliance of its goals.

In the spirit of the international focus on MRV, Chile divides its efforts in two lines of action: National MRV and NAMAs MRV. The national MRV is related to the tracking of the voluntary commitment of reduction in Chile. This MRV will be conducted internationally by the UNFCCC and will include the national mitigation efforts and the national emission inventory of GHG, which will be reported through the biennial update report (UNEP-RISOE, 2013).

During 2014, the OCC and thanks to the financing of the United Kingdom through the Prosperity Fund, is developing a study named Design for the institutional arrangements for a general framework for Measure, Report and Verification (MRV) of the mitigation actions for climate change in Chile. The objective of this project is to improve the coordination of the MRV of NAMAs in Chile, which will allow increasing the public knowledge about this actions and also the trust in the estimated benefits related to GHG reduction and other non-GHG, this is translated into a potential improvement of the national and international financial support.

This study will have to design a clear and simple MRV framework for Chile, to improve transparency, comparability and quality of the data. This will be done through the design and agreement on common technical requirements for MRV systems; design of the processes and institutional coordination and the dissemination of these.

The institutional arrangements meant for an integrated MRV system in Chile are still being discussed, however, and given the competences of the Ministry of the Environment, the Climate Change Office will be the coordinator body. For this, they will be supported by sectoral experts for the evaluation and validation of MRVs of specific actions. The criteria used for selection of basic indicators and minimum standards in the MRV systems must be agreed by all the parts that will be identified in the initial design of the general framework, currently in process.

8.2 MRV System of NAMAs

Currently, there are different initiatives at national level related with the individual MRV systems. Some of them have started from the NAMAs proposed by public services and in other cases by complementary initiatives, which may potentially support the tracking of the different mitigation actions.

In Table 10, the existing and under construction systems are summarized, the goals for which they have created, the related actions, the service in charge and the platform, if any, are indicated.

Starting from this information and having the technical and financial support of international projects *(Prosperity Fund, Information Matters y LECB*), as well as the own accumulated experience of the OCC of the MMA, the possibility of compiling in an integrated system, most of the existing and future initiatives of MRV, is being assessed; with the purpose of obtaining a transparent and coherent report of the actions currently being developed in Chile to mitigate the climate change.

The design of a general framework and a manual of MRV of domestic NAMAs are part of the actions destined to serve as help and guide for the NAMAs developers and to obtain comparable information that can be presented by Chile, both in the reports to UNFCCC and also to possible donors and collaborators.

It is expected, that in the following years, Chile has a consolidated and integrated MRV System that allows tracking the individual mitigation actions, state policies with impact in GHG emissions and the reduction commitments agreed in the framework of the international negotiation in matters of climate change.

Table 10 National MRV Systems and their features.

MRV	Objective	Related Mitigation Actions	Person/ Institution in charge	Platform
Clean Production Agreements (APL)	To have a tracking system of all the actions and measures of the APL.	Clean Production Agreements in Chile.	Clean Production Council (CPL).	Compite más (Compete More).
Transantiago	To track and control the contracts of passenger public transportation.	Green Zone for Transportation in Santiago (Zona Verde para el transporte en Santiago - ZVTS).	Transantiago	W/I
Chilean Agency on Energy Efficiency (AChEE).	To track and control the energy consumptions and savings of the beneficiaries of the programs of the Agency.	There are no defined actions associated to this system.	ACHEE	VerificatEE, in trial phase.
Pollutant Release and Transfer Registers (REPT).	To track and control the emissions and transfers of local and global pollutants at national level.	National Program for Industrial and Commercial Catalyzing on Organic Waste Management in Chile Assisted phytostabilization of mining tailings in Chile. Huella Chile Program	Ministry of the Environment (Ministerio del Medio Ambiente)	PRTR
National Forestry Corporation (CONAF)	To consolidate and modernize the current management and information systems currently working within CONAF.	To design and implement of the ENCCRV including the Platform for the Generation and Trading of Carbon Credits from the Forestry Sector in Chile (PBCCh).	CONAF	Platform under design
Renewable Energy Center (CER).	To track and control the infrastructure of renewable energies implemented in Chile for the interconnected system, as well as self-supply.	Renewable Energy for Self-Consumption in Chile.	CER	CER Platform, in trial phase.

Source: Compilation based on the OCC of the MMA, based in the information delivered by the people in charge.

REFERENCES AND BIBLIOGRAPHY

Adapt-Chile. (July, 2014) Chilean Network of Municipalities for Climate Action Obtained from the web page of Adapt-Chile: http://www.adapt-chile.org/red_de_municipios.htm

CCG-UC. (2014). Tax Reform: A progress towards a lower carbon economy. Centro de Cambio Climático Global UC, Santiago.

CLG-Chile. (July, 2014) CLG: Entrepreneurial Leaders Against Climate Change Obtained from http://www.clgchile.cl/

UNFCCC (July, 2014) United Nation Framework Convention on Climate Change. Obtained from http://unfccc.int/focus/mitigation/items/7172.php

Generators of Chile. (2014). Generation Sector Electrical Market Newsletter, 4.

IEA. (2013). CO2 Emissions From Fuel Combustion. France: OECD/International Energy Agency.

Instituto de Ingenieros de Chile (Engineers Institute of Chile). (2013). Climate Change: Perceptions and Impacts for our Economy. Santiago.

International Partnership on Mitigation and MRV. (July, 2014) International Partnership on Mitigation and MRV. Obtained from http://mitigationpartnership.net/

IPCC (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment. Cambridge, UK: M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E.; Hanson, Eds., Cambridge University Press.

KAS Engineering (2013). To identify the effects in prices of the electricity and environmental impacts associated to taxes per pollutant emission. Santiago: Prepared for United Nations Development Programme (UNDP).

MAPS Chile. (2013). Report of Results Stage 1. Santiago.

MAPS Chile. (2014). Report of Results Stage 2. Santiago.

Ministry of Energy. (2014). Energy Agenda: A challenge for the country, Progress for Everyone. Santiago: Yankovic.

Ministry of Housing and Urban Planning. (2013). National Strategy for Sustainable Construction. Santiago.

Ministry of the Environment (2011). Second National Communication of Chile to the United Nations Framework Convention on Climate Change Santiago.

Global Compact Network. (2013). Integration System for the Promotion of Global Compact Principles (Sistema Integración de los Principios del Pacto Global - SIPP) Santiago.

Sustainable Systems. (2014). Scenario Projection Trend Line 2012 and Mitigation Scenario of Transport and Urbanism Sector. Santiago.

Chile has had a favorable position to assume voluntary GHG mitigation commitments. To comply with them, it is relevant to have international support oriented towards the needs identified in the country

IV NEEDS AND SUPPORT RECEIVED REGARDING CIMATE CHANGE

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Arica Harbour

1 INTRODUCTION

This chapter delivers significant information on the needs regarding Climate Change in Chile, including an analysis of existing constraints and gaps and the international support received, whether on financial resources, capacity-building and technical assistance, and technology transfer. It is worth noting that the information presented was collected taking into account only those projects or activities that have been developed with the international public-private support on which participation of the national public sector took place. In addition, even though the best possible effort was made in order to compile the initiatives, there is a possibility that a few of them were not included since the necessary information was not available by the closing date of this report.

1.1. General background

Internationally, it is recognized that the financial and technical support for developing countries is critical in order to help them addressing the issues related to Climate Change. In general, the needs of these developing countries have required a close cooperation with developed countries since the establishment of the United Nations Framework Convention on Climate Change (hereinafter, the Convention or UNFCCC) and its Kyoto protocol. According to the UNFCCC, developed countries listed on annex II shall provide financial resources in order to support developing countries on implementing the Convention. In order to facilitate that, the Convention itself has established a financial mechanism (Global Environment Fund) as to provide funds for developing countries based on the principle of common but differentiated responsibility and on the corresponding capabilities. On the other hand, the Kyoto Protocol also recognizes, on its Article N° 11, the need of mechanisms in order to fund activities in developing countries (UNFCCC, 2014).

In this cooperation context, the role of the report of each of the contributions received and delivered by the member countries of the Convention is particularly relevant in order to ensure transparency and coherence of the information presented to the Convention. This way, in Decision N° 1, Paragraph 60(c) from the COP16 from 2010, it was defined that '*Developing countries should submit biennial update reports containing updated information on NIR and information on mitigation actions, needs and support received*'. (UNFCCC, 2010)

As it has been described on Chapter 1 of this Report, Chile is a very sensitive country regarding climate change, which is translated into economic, social and environmental losses it my suffer due to the lack of action could be significant, reaching 1.1% of the GDP per year until 2100 (ECLAC, 2012). In addition, the country has had a proactive position as to assume volun-

tary GHG mitigation commitments; but having international support oriented to the specific needs of the country is critical in order to fulfill them.

1.2 Methodology and Period

For the development of this Chapter, the Climate Change Office from the Ministry of the Environment (OCC from the MMA) has applied the Convention Guidelines as methodological framework for presenting the Biennial update reports for Parties not included in annex I of the Convention (annex III, Decision 2/CP17 [1]), which specify that the countries not included on annex I of the Convention shall provide updated information on:

- Needs regarding financial resources, capacity-building and technical assistance, and technology transfer. Including the analysis of their gaps and constraints.

- Financial resources, technology transfer, capacity-building and technical support received from the Global Environment Facility, Parties included in Annex II to the Convention and other developed country Parties, the Green Climate Fund and multilateral institutions.

In order to survey the support received and the needs, a three-stage process was developed, which is described below:

- **Stage I:** Identification of the different initiatives and the international support received regarding Climate Change in the country, from those coordinated by the MMA up to those performed by other public institutions. The latter is performed through a basic (but formal) survey of the initiatives where the OCC from the MMA participates as the technical counterpart.

- **Stage II:** Once the information was gathered and the diverse initiatives and their support received are identified, a cross check with the supporting sources (donors), implementing organizations and/or managers of such initiatives was performed, in order to compare and analyze the coherence of the information reported.

- **Stage III:** Lastly, bilateral meetings were held with each of the support sources and receivers in order to validate the information gathered and perform an analysis of additional needs, their gaps and constraints.

The information presented in this chapter encompasses the period between January 1st, 2011 (the year of the presentation of the Second National Communication of Chile on Climate Change — 2NC—) and July 30th, 2014, determined by the team in charge of developing this report, whose purpose is updating the information presented on 2NC.

1.3 Definitions

In addition, in order to report the information requested, Chile will understand the concepts of financial resources, capacity-building and technical assistance, and technology transfer in the following way:

- **Financial Resources (or financial support):** It refers to the mobilization of funds that may come from public, private or alternate funding sources (UNFCCC, 2014). These funds are usually delivered to the executors through an implementation agency. For this report purposes, only those financial resources addressed and/or executed through the public sector are considered.

- **Capacity-building and technical assistance:**It is understood as enhancing the ability of individuals, organizations and institutions in developing countries and in countries with economies in transition to identify, plan and implement ways to mitigate and adapt to climate change.. This process takes place on three different levels:
  - o Individual level: developing educational, training and awareness-raising activities;
  - o Institutional level: fostering the development of organizations and institutions, including their missions, mandates, cultures, structures, competencies, and human and financial resources, as well as the cooperation between organizations, institutions and sectors;
  - o Systemic level: creating enabling environments through economic and regulatory

1 http://unfccc.int/resource/docs/2011/cop17/spa/09a01s.pdf#page=

policies and accountability frameworks in which institutions and individuals operate (UNFCCC, 2014)

- **Technology transfer:** It is defined as a broad set of processes comprising the exchange of knowledge, funding and goods among the different entities involved, leading to dissemination of the technology for Climate Change mitigation or adaptation. It includes the process comprising the dissemination of technologies — hardware and software — and technological cooperation across and within the countries (IPCC, 2014).

1.4. Spheres

In order to report the information, five spheres (scopes) regarding the support received and the needs required — whether on financial resources, capacity-building and technical assistance, and technology transfer — were determined. These information spheres identified are the following:

- **Reporting (R):** It refers to those activities, projects or programs developed with the purpose of fulfilling the commitments of the country in terms of the reporting of progress on the implementation of the objectives set by the Convention regarding Climate Change, through the National Communications (NC), the Biennial Update Reports (BUR), and the corresponding intended nationally determined contributions (INDC).
- **Mitigation (M):** It refers to those actions, policies, projects and programs developed with the aim of directly or indirectly contributing to the objective of reducing GHG emissions or increasing removals.
- **Adaptation (A):** It refers to the development of policies, plans, programs and actions oriented to face and minimize the adverse impacts and emerging risks of Climate Change. The activities shall be oriented to the generation of visible and tangible results in practice, through the reduction of vulnerability and increasing resilience of human and natural systems in order to respond to the impacts of Climate Change (UNFCCC 2014).
- **National Greenhouse Gas Inventory (I):** It refers to those actions performed with the aim of systematizing the biennial update (every two years) the Chile's National Greenhouse Gas Inventory (NIR), guaranteeing this way sustainability in the development of the GHG inventories in the country, coherence on the intended GHG flows and the quality of the results.
- **International Negotiation (N):** It refers to the support received with the aim of strengthening the national capabilities in the multilateral negotiation on Climate Change.

2 NEEDS

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Since Chile assumed commitments under the Convention and the Kyoto Protocol, it has sustained in a steady way an institutional and technical development aligned to its vision of resilient and low-carbon development, materialized on the different institutional arrangements and policies related to Climate Change (further details on Chapter 1). Also driven by an increasingly scarce access to international funds, since it is classified as a high-income country by the World Bank[2] and it has a high human development index according to the United Nations Development Programme (UNDP)[3], Chile has performed studies that enable identification and strengthen technical aspects of its climate response; its information systems; and, in general, strengthen its climate institutionalism, in order to attract donors and investors willing to invest on the development vision the Country has traced[4]. Additionally, framed in its voluntary commitment of emission reduction, Chile has broadly stated that it will need international financial support.

Even though the institutionalism and capabilities of Chile have shown a significant progress during the last few years, as it has been presented in 2NC of Chile and on this report, it is still possible to identify needs, gaps and constraints that block, by now, the development of the climate action in Chile, or in areas where there still a high potential for mitigation. A constraint being faced by the public sector for receiving and executing international financial resources is that those funds cannot be directly received on its ordinary annual budget, since the Public Budget Law does not consider such mechanism. Another cross-cutting constraint identified is the difficulty of a few public services to allocate financial resources to climate change issues within their ordinary annual budget, since the Climate Change scope is not explicitly defined in their organic law.

The main gaps and needs regarding funding and in terms of training and technology transfer have been grouped in the following sections and tables. They are sorted according to the kind of support required.

2.1. Report

Table 1 shows the current status, needs, constraints and gaps identified for the scope of this report. The biggest challenge for reporting activities in Chile is the ultimate implementation of permanent reporting systems for their NC, BUR, and INDC, which necessarily involves allocating specific budget sustaining the reporting activity in an iterative fashion.

2. http://datos.bancomundial.org/pais/chile

3. http://hdr.undp.org/en/content/table-1-human-development-index-and-its-components

4. In particular, MAPS Chile, a project combining research — through modeling long term mitigation scenarios and options — with participation of a multi-player team comprised by individuals from different sectors and experience in Climate Change. It generates, analyzes and validates information, modeling and research on the trajectory of GHG emissions in Chile and identifies diverse actions for emission mitigation in the country, which are compatible with the national development strategies www.mapschile.cl

Table 1. Summary of needs, gaps and constraints in the scope of the report.

Reporting Initiative	Needs Area	Current Status	Need Description	Gaps	Constraints
BUR	Financial Resources	For the preparation of the first BUR (2014), the funding from GEF is approved (USD 352,000).	Budget sustaining the activity in an iterative fashion, as established by the decisions made in the COP.	Budget restricted to the technical-administrative team fully advocated to the development of the document. The surveys must be outsourced / called for bids through external professionals and consultancy, which implies a lack of internalization of knowledge in the Ministry teams.	The economic resources granted through bidding processes make difficult the establishment of a sustainable system for fulfilling the commitments of the report.
	Capacity-building and technical assistance.	The report is developed with the work of the technical and administrative team from the OCC, based on the interpretation of the guidelines by the UNFCCC.	Methodological guidelines and training for the implementation of the guidelines, in order to understand the prioritization of the information that must be reported and the expected level of detail.	Methodological and technical gaps for information gathering, particularly in relation to progress indicators related to mitigation actions and policies and support received.	Lack of specific knowledge at sectoral and institutional level; difficulties for having access to training, both due to financial resources as well as for language barriers.
TNC	Financial Resources	For TNC preparation, there is a funding received from GEF (USD 480,000).	Budget sustaining the activity in an iterative fashion, as established by the decisions made in the COP.	Budget restricted to the technical-administrative team fully advocated to the development of the document.	The limited economic resources make difficult the establishment of a sustainable system for the reporting obligations.
	Capacity-building and technical assistance.	Report established structure based on previous exercises (1NC and 2NC).	Capacity-building on specific adaptation and vulnerability issues; lack of regional experts.	Deficiencies in the ongoing update of the information to be reported; lack of technical capacity, specifically on issues related to adaptation and vulnerability (indicators, interpreting climate models).	Lack of specific knowledge at sectoral and institutional level; financial and language difficulties for having access to training.
INDC	Financial Resources	Currently, the development of the INDC is covered with own resources and man hours of the negotiation team under the coordination of the MMA and the support from the MAPS Chile project.	Depending on the review systems that could be negotiated on the after 2020 framework, the frequency the information and methodologies associated to the INDC should be reviewed at will be identified.	By the end of the first period, there will be an estimation of its value and the financial gaps involved.	The limited economic resources make difficult the establishment of a sustainable system for the reporting obligations.
	Capacity–building and technical assistance.	The capacities currently developed in Chile allow the necessary modeling and scenario work for designing the Intended Nationally Determined Contribution proposal, framed on the after 2020 agreement.	Not currently applicable.	Not currently applicable.	Not currently applicable.

Source: Compilation by the Climate Change Office from the MMA.

2.2 Mitigation

The needs identified in the scope of mitigation are particularly important, specially provided that Chile has reaffirmed its voluntary commitment by 2020 of GHG emission reductions (refer to Chapter 3). The progress made by Chile from the communication of this commitment in

2009, has necessarily gone through the international support received up to date; and the opportunity that Chile is able to fulfill the commitment assumed will depend on the volumes and effectiveness of the support it would receive by 2020. From Table 2, which summarizes the current status of the needs in the mitigation sector, specifically for the development of NAMAs, it could be conclude that for Chile progressing on the development of Information Management Systems is a priority in every sector, in this subject. Chile is advocated to enable robust institutional arrangements in service of designing and implementing the existing and future NAMAs; to improve synergies and coordination among sectors; to develop, as far as possible, common tools for a better understanding and systematization of the information on their reductions. The latter is specifically related to the measurement, reporting and verification systems (MRV), and format the information is surveyed through this is managed accordingly, enabling comparison between its progress indicators, as to make the action performed at national level transparent, and efficiently accounting for reductions.

In particular, regarding funding and support received for mitigation efforts (and other items from the national climate response), the need of definitively having structures and processes for data gathering, assessment and probable report development has been identified in the country. That way, having a general overview on the support, both the received one as well as the necessary one, and having progress on matching the support reported by donors and the support received (*matching*) is desirable.

Table 2. Summary of needs, gaps and constraints in the scope of mitigation (specifically related to NAMAs).

Type of Support	Current Status	Need Description	Gaps	Constraints
Financial Resources	There are 4 NAMAs registered on the NAMA Registry looking for support for implementation. One of them (NAMA CER) has funding approved through the NAMA Facility fund. Financial resources have been received for preliminary and design studies. Part of the funding considered for NAMAs comes from National funds. There are different ideas of NAMAs in the portfolio, with different maturity statuses, under preparation status.	Funding for implementation, preparation or design (concept note) according need of every NAMA. This funding can be focused either on the design of NAMA's executive aspects, their MRV or their estimated global funding.	Difficulty of business models design for financial resource flow obtained internationally-Funding for preliminary studies on NAMAs new potentials.	Delay on implementation is caused by experience and knowledge gaps of state agencies on the flow of international resources destined to NAMAs. Lack of financial incentives to encourage participation of feasible actors.
Capacity-building and technical assistance.	Favorable institutional structures to work locally. Experience of some sectors on financial instruments such as subsidies according existing Chilean normative. Received training on NAMAs and MRV on a framework of international projects.	Technical assistance on NAMA's key elements (baselines definition, co-benefits), Institutional capacity on different sectors to gather and prepare information for designing potential NAMAs.	Problems of professional and infrastructure capacity. Lack of synergy on sectoral information systems for the follow up of mitigation activities progress. Lack of definition for common minimal indicators allowing comparative evaluation of different NAMAs. Problems upon elaboration of base lines.	Lack of coordination between sectors and definition of attributions and competences, specifically on the management of relevant information. Lack of information necessary to generate baselines. Lack of awareness of involved actors over technologies and instruments intended for the implementation of the NAMA.

Source: Compilation by the Climate Change Office from the MMA.

2.3. National greenhouse gas inventory

Regarding emissions and removals of GHG of Chile, the country has worked methodically on the preparation of its 2NC to generate its NIR system[5] (SNICHILE). As such, a permanent working line has existed in the OCC of the MMA, provided with personnel, technical and basic financial resources. Through international projects and budget of the MMA it was possible to prepare a series of time 1990-2010 presented on this report. The effort of the MMA to design, deploy, coordinate and maintain SNICHILE should be progressively complemented with participation of sectoral ministries, in charge of sectoral GHG inventories (Energy, IPPU, AFOLU, Wastes), in order to allocate resources to regular preparation of inventory updates and reports.

SNICHILE not only facilitates preparation and deployment of the inventory, but also is systematically searching ways of improving technical aspects such as used data quality, elaboration of national emission factors specific to main categories, control and quality assurance, development of guidelines for the application of cross-cutting issues (uncertainty, main categories, documentation and archive, other). Given the scale of tasks necessary to generate a sustainable NIR, is particularly relevant to have an integrated IT system for storage and management of data generated for the inventory, supporting the work of SNICHILE. Consequently, the national team of inventories has planned the deployment of a web platform to support the objectives of dissemination and centralized reservoir of information.

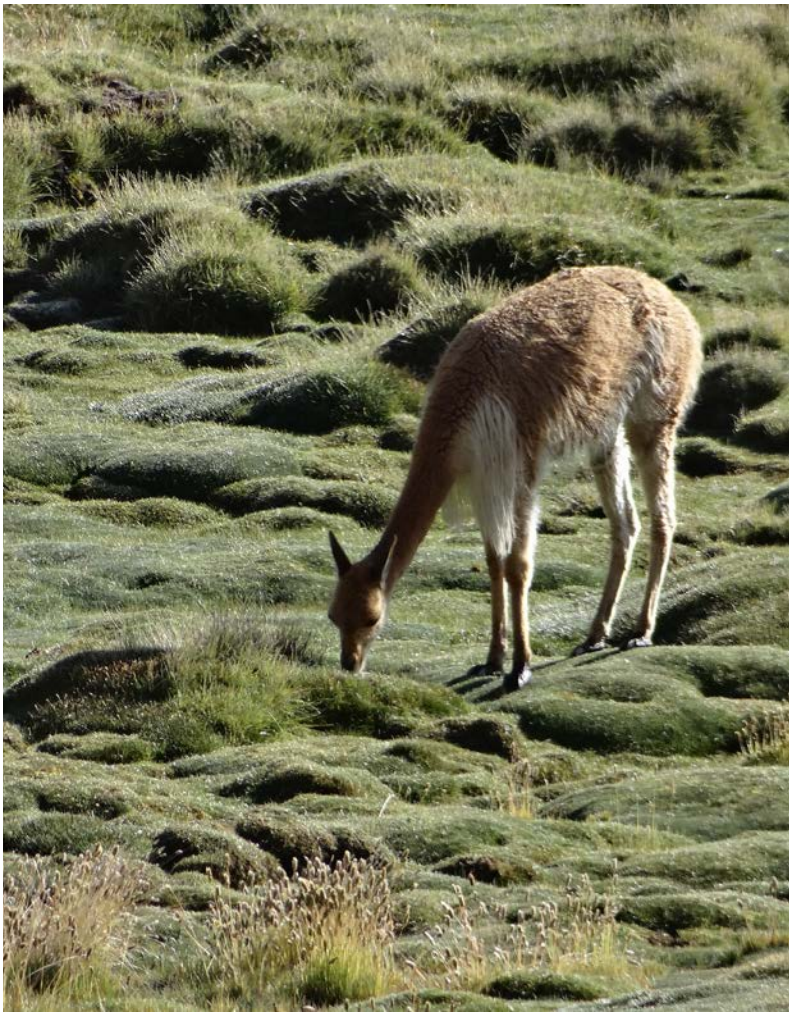
Table 3 briefly summarizes the needs associated to the NIR of Chile, and presents the most relevant identified gaps and constraints.

Table 3. Summary of needs, gaps and constraints related to the NIR

Needs Area	Current Status	Need Description	Gaps	Constraints
Financial Resources	During 2013 SNICHILE was funded mainly through the budget of MMA and LECB-Chile project. A permanent work team in the MMA was created and consultants were hired to support sectoral teams that impulsed generation of the NIR.	Permanent funding for professionals on different sectoral teams and support of donor countries for the update and constant improvement of the NIR. Funding for development of country-specific emission factors.	Permanent budget of Chilean public sector (inter-ministry) and support of donor countries for the update of the inventory. Lack of government funding for research of country-specific emission factors.	Scarce relevance given by the ministries to the preparation of NIR and the assignment of associated financial resources, resulting on a lack of resources destined to scientific research of NIR.
Capacity-building and technical assistance.	The SNICHILE is operational since 2013 and has been in charge of preparation and gathering of NIR. Installed capacity in the MMA for preparation and gathering of NIR, including three expert reviewers of NIR of Annex I Parties of the Convention, Limited technical capacity of sectoral teams for the development of their own GHG inventories, Emerging research on emission factors in national research centers, Establishment of a new QA/QC system.	Having a greater amount of professionals on a permanent basis with enough technical skills to generate GHG inventories inside SNICHILE, at a central level as well as in sectoral teams. Lack of technical capacity on the elaboration of GHG inventories other than those directly involved in SNICHILE (NGO, Academy, etc.), that could contribute on quality assurance of NIR and elaboration of country-specific emission factors.	Limited number of experts on GHG inventories inside public and private sectors. Capacity of permanent research of country-specific emission factors on main categories of NIR.	Scarce relevance given by ministries to preparation of GHG inventories and the assignment of related human resources. Limited interest by the scientific community on research as to enable continuous improvement of NIR.

5 Further information on Chapter 2.

Source: Compilation by the Climate Change Office from the MMA.



2.4. Adaptation

The OCC has maintained a permanent working line focused on adaptation issues. The 2008 - 2012 National Action Plan on Climate Change established the execution of vulnerability and impact studies in the country; and as a final objective, it established the realization of a National Plan on Adaptation to Climate Change and nine sectoral plans, defined according to the priorities of the country. Two sectoral plans have been materialized. In 2013 the Adaptation Plan for Climate Change for the Agriculture and Forestry sector was approved and in 2014 the Adaptation Plan for Climate Change for Biodiversity. Other seven sectoral plans for adaptation are on different development stages and will be focused on Fishing and Aquaculture, Health, Infrastructure, Water Resources, Cities, Energy and Tourism sectors. National Adaptation Plan for Climate Change has been elaborated and subjected to citizen consultation and its approval is expected for the second semester of 2014. All of this accomplishments have been carried out by the MMA and sectoral ministries, in a jointly work to identify vulnerabilities and develop lines of action to face the impacts of climate change.

Funding for this studies and designing of plans have been accomplished through international contributions and internal resources. Funds from the support project to elaborate the Third National Communication have been used (GEF and internal resources from the Ministry of the Environment and some sectoral ministries such as Health, Public Works and Fishing). Also, there have been regional initiatives of adaptation in which regional government entities have obtained international funding.

Collaborative work between sectors has raised the interest on adaptation subjects by relevant actors such as academia, through universities and excellence centers, the private sector, NGOs and other actors from society, greatly enriching policies development processes and specific measures. Additionally, there is a growing interest for adaptation work at municipality scale, for which activities in that direction are being encouraged and supported.

The two sectoral plans that have been approved (Agriculture and Forestry) are currently on implementation status. It is expected to develop experimental projects focused on some of the lines of action of such plans. Recently, the project *Enhancing resilience to climate change of the small agriculture in the Chilean Region of O'Higgins* has been presented to the Adaptation Fund looking for funding to implement an experimental project based on a series of measures extracted from the Adaptation Plan to Climate Change for the Agriculture and Forestry sector on rainfed agriculture areas of O'Higgins Region.

Table 4 briefly summarizes the needs related to the scope of adaptation in Chile, and presents the most relevant identified gaps and constraints.

Table 4. Summary of needs, gaps and constraints in the scope of adaptation.

Needs Area	Current Status	Need Description	Gaps	Constraints
Financial Resources	A work team is permanently maintained for adaptation subjects in the OCC, two professionals hired by the MMA and a professional partially funded by the Federal Republic of Germany and the MMA. Vulnerability studies have been funded in several sectors with National Funds and with project funds coming from the TNC.	Permanent funding is needed on the MMA and on each of the sectoral ministries that have been prioritized. International financial support is required for the implementation of measures from the national plan of adaptation and sectoral plans. Permanent funding is required for research and academia initiatives.	Lack of permanent budget from the public sector, ministries, regional and local government for implementation of adaptation measures in the country. Permanent budget for research on climate change adaptation. Funding for generating studies and capacities.	Climate change adaptation has not received enough attention as a funding priority inside ministries and regional and local governments, Regulations tools are lacking to direct funding towards specific needs on climate change adaptation.
Capacity-building and technical assistance.	Installed capacity of MMA for elaborating adaptation plans. Minimal capacity on a few sectoral ministries for elaborating adaptation plans. Minimal or non-existent capacity in some regions of the country for implementing adaptation plans. Universities and research centers and two excellence centers in Santiago working on climate change adaptation subjects. Open communication between public and academic sectors which has permitted the development of public policies using research generated in the country as a resource.	Trained personnel in all public ministries at national and regional level. Trained personnel in regional governments and municipalities. Researchers and specialized academia trained on climate change adaptation in the Metropolitan Region and mostly in the rest of regions. A communicational strategy is required to raise awareness and educate different sectors of society. It is required to have permanent updated climate scenarios obtained from regional models in order to observe behavior trends at a local scale. To take a closer look at vulnerability studies for some sectors such as Health, Fishing, Energy and Water Resources. Promote development of methodologies and tools to evaluate costs and benefits and prioritize adaptation options. Creation of process and effectiveness indicators on climate change adaptation. To improve and extend climate variables monitoring.	Strengthening of climate change institutionalism on sectoral ministries and in local government and municipalities. Limited number of experts and other human resources trained on climate change adaptation subjects in national government, at central and regional level, Permanent and excellence research on climate change adaptation subjects, nationally and territorially.	Climate change adaptation has not received enough attention as a work priority inside ministries and regional and local governments- In some sectors and some regions there is limited interest to work on climate change adaptation subjects. Limited interest in national science community to develop projects and research on climate change adaptation subjects- Limited base information to develop impact studies on climate change in different sectors.

Source: Compilation by the Climate Change Office from the MMA.

2.5. International Negotiation

Regarding international negotiations, the main need is to establish permanent teams in relevant sectoral ministries, having enough technical and financial capabilities to generate a strategic and comprehensive follow up of negotiations. Table 5 summarizes needs on this scope.

Table 5. Summary of needs, gaps and constraints of International Negotiations

Needs Area	Current Status	Need Description	Gaps	Constraints
Financial Resources	Chilean delegation is currently integrated based on financial effort of every ministry or service, covering in a very basic manner, in most cases, sessions and relevant negotiation process.	Although important donations make possible a minimal functioning of negotiation capacity, to have resources according to the variety of strategic subjects is of great importance.	Lack of specific budget to permit creation and support of a specialized and permanent negotiation team.	As the transversal approach of resiliency and low carbon development become understood and included among the objectives of the country, this should result in a greater budget allocation, which is now minimal and insufficient.
Capacity-building and technical assistance.	Minimal amount of expert professionals, inferior to what is necessary to provide a strategic follow up of negotiations.	Chile requires a permanent installed capacity to face negotiations strategically.		

Source: Compilation by the Climate Change Office from the MMA.

3 SUPPORT RECEIVE

Chile, as a developing country, is permanently applying for international support opportunities in the areas of financial resources, capacity-building, technical assistance, and technology transfer in order to implement an ambitious project portfolio and contribute to the fulfilment of the goals stated by the UNFCCC. It is important to highlight that, even though the country has been receiver of important financial contributions and diverse types of support, during the last few years, private funds have been allocated to fund actions intended to face the climate change issue locally. The Ministries of Finance and Environment will initiate in 2014 a systematic analysis of such funds and will compile through an established international methodology of climate change initiatives for financial accounting, with support of the project*Low Emission Capacity Building-Chile* (LECB-Chile). The application of the results of such methodology are expected to be presented by Chile on its next official report in 2016.

In addition to the above, the country has bilaterally and multilaterally worked with donor countries, encouraging south-south cooperation initiatives; but it also has supported other countries in the Region on capacity-building and technical assistance. Associated to that, we would like to express our gratitude for the support the country has received, which has allow us to move forward on different subjects related to climate change during the past years and support future challenges. A summary of support received by Chile is presented in Table 6, where initiatives, donors or organizations are identified, scope of support (report, mitigation, NIR, adaptation and international negotiation) and the type of support received, divided in financial resources, capacity-building and technical assistance and technology transfer.

In general, most initiatives point to the scope of mitigation, which is aligned with the voluntary commitment subscribed by Chile under UNFCCC. The main area of support received by the country is materialized in financial resources, followed by capacity-building and technical assistance. To see areas of support received, they will appear in sections below.

Table 6. Summary of initiatives generated in the country with international support, time period 2011-2014.

Scope	Initiative name	Donor/Organizer	Type of Support received		
			Financial Resources	Capacity-building and technical assistance	Technology transfer
Main projects and programs having international support of financial resources					
R	Third National Communication of Chile under the United Nations Framework Convention on Climate Change	Global Environmental Facility	•		
R	Biennial Update Report (BUR)	Global Environmental Facility	•		
M,I	Low Emission Capacity Building-Chile (LECB-Chile)	European Commission | Federal Republic of Germany | Australian Communities Foundation	•	•	
M	Options of Mitigation to Face Climate Change (MAPS Chile) - STAGE I	The Children's Invest Fund Foundation | Climate and Development Alliance | Swiss Confederacy | The Kingdom of Denmark	•		
M	Options of Mitigation to Face Climate Change (MAPS Chile) - STAGE II	Swiss Confederacy | The Children's Invest Fund Foundation	•		
M	Partnership for Market Readiness (PMR)	World Bank	•		
Other initiatives having international support of financial resources					
M	Mitigation actions on Easter Island	United Kingdom	•		
M	Regional support for development of NAMAs	Inter-American Development Bank	•		
M	Technological assistance for sustainable building	United Kingdom	•		
M	Low-carbon Center of Mayor University (Centro bajo en carbono de la Universidad Mayor, CEEBEC)	United Kingdom	•		
M	Design of a generic framework for MRV of climate change mitigation actions	United Kingdom	•		
M	Design of a program for technology improvement of buses from public transportation of Santiago	United Kingdom	•		
M	Design and implementation of the ENCCRV including the Platform for the Generation and Trading of Carbon Credits from the Forestry Sector in Chile (NAMA).	Swiss Confederacy	•		
M	Design of Green Zone of Transportation in Santiago	United Kingdom	•		
M	Expansion of self-supply of non-conventional renewable energy in Chile (SSREs)	NAMA Facility	•	•	
M	Funding for Renewable Energy	United Kingdom	•		
M	Cooperative Carbon Fund (Payment per results stage)	World Bank	•		
M	Cooperative Carbon Fund (Preparation stage)	World Bank	•		
M	Road map of sea energy	United Kingdom	•		
M	Implementation of low-emission taxis	United Kingdom	•		
M	Report on sea energy	United Kingdom	•		
M	Measurement of carbon footprint of Easter Island	United Kingdom	•		
M	Measurement of carbon footprint of Juan Fernández Island	United Kingdom	•		
M	Mobilize transition towards energy efficiency of lighting	Global Environmental Facility	•		
M	Renewable energies MRV	United Kingdom	•		
M	Transantiago MRV	United Kingdom	•		
M	Solar panels in Liceo Menesiano Sagrado Corazón (Llay Llay)	Australian Communities Foundation	•		
M	Action plan for strategy of renewable energy of Antofagasta city.	United Kingdom	•		
M	CALAC Program: Climate and clean air of cities in Latin America	Swiss Confederacy	•		
M	Promote development of biogas with energy purposes in small and medium size agro-industries	Global Environmental Facility	•		
M	National registry of GHG mitigation actions	United Kingdom	•		
M	Certification System of Climate Change for municipalities in Chile	United Kingdom	•		
M	Integrated System of Monitoring and Evaluation of Forestry Systems in support of policies, regulations and sustainable forestry management practices (SFM) incorporating REDD+ and biodiversity conservation in forestry ecosystems.	Global Environmental Facility	•		
A	Design of a terrestrial, aquatic and marine biodiversity monitoring network in the context of climate change.	UNFCCC	•		

Table 6. (continuation), Summary of initiatives generated in the country with international support, time period 2011-2014.

Scope	Initiative name	Donor/Organizer	Type of Support received		
			Financial Resources	Capacity-building and technical assistance	Technology transfer
Main international initiatives with permanent participation of Chile					
R,M,I	Information Matters	Federal Republic of Germany		•	
M,A	EUROCLIMA	European Commission		•	
M,A	Latin America and Caribbean Regional Platform: LEDS LAC	Multilateral		•	
M,A	Iberoamerican Network of Climate Change Bureaus (Red Iberoamericana de Oficinas de Cambio Climático, LARIOCC)	The Kingdom of Spain		•	
M,I	Global Research Alliance (GRA)	New Zealand | GRA		•	•
M,N	International Partnership on Mitigation and MRV	Federal Republic of Germany | Republic of South Africa | Republic of Korea		•	
M,N	Mitigation Action Implementation Network (MAIN)	Federal Republic of Germany | Kingdom of Denmark | Canada		•	
M	The Mitigation Momentum project	Federal Republic of Germany | World Bank		•	
N,M,A	Cartagena Dialogue for Progressive Action	Multilateral		•	
N	Ambition Leaders: Supporting the AILAC countries at the climate negotiations	Federal Republic of Germany		•	
Other initiatives related to capacity-building and technical assistance					
M,I	Climate change and livestock breeding: Quantification and mitigation options for methane emissions and nitrous oxide of bovine origin in grazing conditions	FONTAGRO		•	
M	Update of Green Zone design for transportation in Santiago	Inter-American Development Bank		•	
M	Assessing the impact on SOC content of soil conservation management practices as a source of information for decision makers to develop a NAMA	Canada		•	•
M	Energy efficiency and co-generation in public hospitals (Pilot project)	Federal Republic of Germany		•	
M	Non-Conventional Renewable Energy - Stage II	Federal Republic of Germany		•	
M	Expansion strategy of renewable energies on electricity interconnected systems	Federal Republic of Germany		•	
M	Technical and institutional strengthening of energy efficiency	Federal Republic of Germany		•	
M	NAMA Proposal: Self-supply renewable energy (SSRE) in Chile	The Mitigation Momentum project		•	
M	National program for industrial and commercial catalyzing on organic waste management in Chile.	CAF		•	
M	State property lands for energy generation projects based on renewable energies	Federal Republic of Germany		•	
A	Strategic framework for adaptation of climate change infrastructure	Environment Canada		•	
Initiatives related to technology transfer					
M	Solar energy for electricity and heat production	Federal Republic of Germany			•
M	Encouragement of solar energy generation (CSP focused)	Federal Republic of Germany			•
I	Equipment for GHG measurement	Australian Communities Foundation		•	•
A	Phenotyphic characterization of high pressure on wheat: Genetic enhancement to develop cultivated species tolerant to drought.	FONTAGRO			•
A	Challenge to develop potatoes and wheat varieties tolerant to climate change	FONTAGRO | Inter-American Development Bank			•
Workshops, courses and seminars related to capacity-building and technical assistance					
R	First LAC Technical Dialog on INDCs	LECB Internacional		•	
R	Global training workshop on the preparation of BURs	UNFCCC		•	
R	Training workshop for LAC on the preparation of BUR for the Parties Non-Annex I of the UNFCCC	UNFCCC		•	
M	5th Latin American regional dialogue of MAIN on development of NAMAs	Center for Clean Air Policy		•	
M	Attracting Climate Finance for Low Emission Development	Low Emission Capacity Building-Chile		•	
M	Autumn School on MRV – today, tomorrow and the future	International Partnership on Mitigation and MRV		•	
M	Training course on Tradeable Emission Systems for emerging and developing countries	ICAP		•	

Table 6. (continuation), Summary of initiatives generated in the country with international support, time period 2011-2014.

Scope	Initiative name	Donor/Organizer	Type of Support received		
			Financial Resources	Capacity-building and technical assistance	Technology transfer
M	Development and Mitigation Forum	MAPS International | Energy Research Center-University Cape Town		•	
M	Forestry technical tour to New Zealand	New Zealand		•	
M	Hands-on training workshop in mitigation assessment	UNFCCC		•	
M	LECB Programme NAMA Net Introductory Meeting	Low Emission Capacity Building-Chile		•	
M	LECB-Programme: Technical Workshop on NAMAs	Low Emission Capacity Building-Chile		•	
M	Policy and Action Standard & Mitigation Goals Standard (Pilot Testing & Technical Working Group)	World Resources Institute		•	
M	LAC workshop of NAMAs MRV as key element of MRV national systems	International Partnership on Mitigation and MRV | Partnership for Market Readiness		•	
M	LAC regional workshop to involve private sector in climate change mitigation	International LECB		•	
M	Workshop con life cycle and NAMAs MRV	LECB-Chile		•	
M	Workshop on bottom-up approach for MRV of GHG reduction policies, actions and measures in Chile's energy sector	International Partnership on Mitigation and MRV		•	
I,M	First conference on greenhouse gases in agriculture and livestock systems of Latin America (GALA)	International LECB		•	
I,M	Korean training program on NIR and mitigation models	Republic of Korea		•	
I	Cooperation between ministries of the environment of Chile and New Zealand	New Zealand		•	
I	Training course on GHG quantification in livestock systems	New Zealand | FONTAGRO		•	
I	Meeting and training of IPCC experts on IPCC guidelines of 2006 and calculation and compiling software for NIR	IPCC		•	
I	Training workshop for LAC region on the use of UNFCCC software for NIR of the Parties Non-Annex I	UNFCCC		•	
I	Training workshop for expert NIR reviewer	UNFCCC		•	
I	Latin American workshop on national GHG inventory systems	International LECB | IPCC		•	
A	'Climate change impacts, vulnerability and adaptation' Seminar, results of the IPCC 5° Assessment Report on Climate Change	IPCC		•	

R= Reporting; M= Mitigation; I= NIR; A= Adaptation; N= International Negotiation.

Source: Compilation by the Climate Change Office from the MMA.

3.1. Financial resources

This section addresses financial resources received and/or to be received (approved, but not transferred) by Chile for fulfillment of commitments in report, mitigation, NIR, adaptation and international negotiation scopes. This contributions refer to direct cash flows received by the country to develop activities and specific programs. It should be remembered that this section details only contributions such as financial resources and not those corresponding to capacity-building and technical assistance, and technology transfer, which will be detailed on section 3.3 of this chapter.

Financial resources cash flows are categorized, according to type of donor, as follows:

- **Bilateral/countries:** Financial resources coming from a specific country working together with Chilean government on a project.
- **Funds and multilateral institutions:** These are funds that receive contributions from various developed countries to be distributed towards developing countries (example, Global Environmental Facility); as for multilateral institutions, their activities are funded by various Donor parts (example, UNFCCC).
- **International financial institutions:** These are institutions created to provide financial sup-

port through donations and credits to developing countries or less developed countries (example, World Bank).

- **Other multilateral contributions:** Donations made by a group of countries or organizations gathered for a specific initiative (example, MAPS Chile).

During report period (January 1st 2011 to July 30th 2014), the country has received a total of USD 9,874,030. It is important to mention that this amount does not consider approved contributions in reception process, which account for USD 37,368,269 including funds destined to elaboration of BUR. It can be observed in Table 7, in general, that financial resources has been mostly focused on supporting mitigation initiatives.

The largest contribution in terms of financial resources received is donations by a group of countries or organizations gathered for a specific initiative (USD 3,999,643), followed by bilateral/country donations (USD 3,116,298), multilateral funds and institutions (USD 2,480,089) and, lastly, from international financial institutions (USD 350,000).

It should be noted that in terms of financial resources to be received, most of them will come from funds and multilateral institutions (USD 29,010,269), and are intended to support report, mitigation and climate change adaptation. Then follows international financial institutions (USD 7,630,000) and other multilateral contributions (USD 728,000).

When analyzing resource sources received and to be received in detail (Table 8), it can be noted that, as for bilateral donations, main contributions as direct cash flow come from Swiss Confederacy and the United Kingdom. Switzerland stands out for its financial support for the forestry sector through forestry NAMA and the United Kingdom for its support to the energy sector, transportation and other cross sectors, mainly through its Prosperity Fund.

For the analyzed period, the GEF fund is the only one supporting report commitment (through NC and BUR) and, together with UNFCCC, have been the main sources of funding for subjects related to adaptation. Governments of New Zealand, Federal Republic of Germany, Australia and also the European Commission have contributed to the elaboration of the NIR of Chile, through implementation of a NIR System (SNICHILE) for the country.

Regarding international negotiation, the contribution of Federal Republic of Germany is based on financial resources for the functioning of a technical secretariat supporting the country group of AILAC, which is comprised by Chile and other Latin American countries. However, these are destined to finance this alliance globally and there is no detail on a specific amount destined to Chile.

Table 7. Summary of financial resources received and to be received, time period 2011-2014.

Type of donor	Financial resources received (USD)	Financial Resources to be received (USD)	Scope					Sectors
			R	M	I	A	N	
Bilateral/countries	3,116,298	-		●	●		●	Cross-cutting | Energy | Transportation | Agriculture | Forestry | Water Resources | Wastes
Funds and multilateral institutions.	2,480,089	29,010,269	●	●		●		Cross-cutting | Energy | Forestry | Fishing and aquaculture | Biodiversity
International financial institutions.	350,000	7,630,000		●				Energy | Financial Instruments | Transportation | Forestry
Other multilateral contributions	3,999,643	728,000		●	●			Cross-cutting
Total	**9,874,030**	**37,368,269**						

R = Report; M = Mitigation; I = NIR; A = Adaptation; N= International Negotiation.

Source: Compilation by the Climate Change Office from the MMA.

Table 8. Detail of financial resources received and to be received, per type of donor, time period 2011-2014.

Type of donor	Financial resources received (USD)	Financial Resources to be received (USD)	Scope					Sectors
			R	M	I	A	N	
Bilateral/countries	**3,116,298**	-						
United Kingdom	1,300,298	-		•				Cross-cutting | Energy | Transportation
Swiss Confederacy	1,800,000	-		•				Forestry
Australian Communities Foundation	16,000	-		•				Energy
Funds and multilateral institutions	**2,408,089**	**29,010,269**						
Global Environmental Facility (GEF)	2,408,089	8,960,269	•	•		•		Cross-cutting | Energy | Forestry | Fishing and aquaculture
NAMA Facility	-	19,800,000		•				Energy
UNFCCC	-	250,000				•		Biodiversity
International financial institutions	**350,000**	**7,630,000**						
World Bank	350,000	7,450,000		•				Energy | Financial Instruments
Inter-American Development Bank (IDB)	-	180,000		•				Transportation | Forestry
Other multilateral contributions	**3,999,643**	**728,000**						
Federal Republic of Germany | Australian Communities Foundation | European Commission	856,000	728,000		•	•			Cross-cutting
The Children's Invest Fund Foundation | Climate and Development Alliance | Swiss Confederacy | The Kingdom of Denmark	1,853,265			•				Cross-cutting
Swiss Confederacy | The Children's Invest Fund Foundation	1,290,378			•				Cross-cutting
Total	**9,874,030**	**37,368,269**						

R= Reporting; M= Mitigation; I= NIR; A= Adaptation; N= International Negotiation.
Source: Compilation by the Climate Change Office from the MMA.

3.1.1. Main projects of financial resources

Government projects and programs executing the main financial resources on climate change are MAPS Chile (Table 9), LECB-Chile (Table 10), Third National Communication (Table 11), Biennial Update Report (Table 12) and PMR (Table 13). Annex 6 of this report presents a detailed description of other initiatives having international support of financial resources.

Table 9. Information document of the Project Options of Mitigation to Face Climate Change in Chile.

Title:					
Options of Mitigation to Face Climate Change (MAPS Chile)					
Objective:					
Contribute with information for decision-making on mitigation of GHG emissions in order to advance towards a low carbon development in the country.					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
Stage I: The Children's Invest Fund Foundation | Climate and Development Alliance | Swiss Confederacy | The Kingdom of Denmark	Cross-cutting	1,853,265	Received	2011	2014
Stage II. Swiss Confederacy | The Children's Invest Fund Foundation	Cross-cutting	1,290,378	Received	2014	2015
Description of the project:					
Project MAPS generates information to facilitate the fulfillment of the voluntary commitment of Chile in Copenhagen (COP16) of reducing GHG emissions. It is characterized by the combination of research, through modeling of long term mitigation scenarios and options, with participation of a multi-player team comprised by individuals from different sectors and experience in climate change, on a professionally facilitated process.					
Scope:		**Areas of support:**			
Mitigation		Financial Resources			

Source: Compilation by the Climate Change Office from the MMA.

Table 10. Information data sheet of the Low Emission Capacity Building Project – Chile.

Title of the project:					
Low Emission Capacity Building - Chile (LECB-Chile)					
Objective:					
To promote and create capacity from the public and private sectors in the measurement and mitigation of GHG emission through suitable actions for the country, in order to achieve its development with low carbon emissions and improve public policies addressing climate change.					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
European Commission | Federal Republic of Germany | Australian Communities Foundation	Cross-cutting	856,000	Received	2012	2016
		728,000	Approved		
Description of the project:					
The project started in 2012, and it is part of an initiative by the United Nations Development Programme (UNDP) in 25 countries.					
Scope:			**Areas of support:**		
Mitigation			Financial Resources; Capacity-building and technical assistance		

Source: Compilation by the Climate Change Office from the MMA.

Table 11. Information data sheet for the Third National Communication Project

Title of the project:					
Third National Communication of Chile under the United Nations Framework Convention on Climate Change (TNC).					
Objective:					
Communicate to the Conference of the Parties the information of Chile, according to article 12 of the UNFCCC					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
Global Environmental Facility (GEF)	Cross-cutting	480,000	Received	2012	2016
Description of the project:					
Inform the UNFCCC about the state of the situation in the country on climate change, for the time period after the First BUR.					
Scope:			**Areas of support:**		
Reporting			Financial Resources		

Source: Compilation by the Climate Change Office from the MMA.

Table 12. Information data sheet of the Biennial Update Report Project.

Title of the project:					
Biennial Update Report (BUR)					
Objective:					
Improve information to be communicated to the Conference of the Parties on application, according to article 12 of the UNFCCC.					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
Global Environmental Facility (GEF)	Cross-cutting	352,000	Approved	2014	2016
Description of the project:					
The BUR will update and increase the information presented on the Second National Communication (2011), specifically on the following subjects: national circumstances and institutional agreements, national GHG inventories; information on mitigation actions and their effects, including assumptions and associated methodologies; information on the level of support received to allow the preparation and presentation of the biennial update reports and any other information considered relevant by the country in order to achieve the objectives of the UNFCCC.					
Scope:			**Areas of support:**		
Reporting			Financial Resources		

Source: Compilation by the Climate Change Office from the MMA.

Table 13. Information data sheet of the Partnership for Market Readiness Project.

Title of the project:					
Partnership for Market Readiness (PMR)					
Objective:					
Provide funding to build technical capabilities and evaluate, design and ultimately implement market instruments to reduce GHG emissions.					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
World Bank	Energy	350,000	Received	2011	2015
		3,000,000	Approved		
Description of the project:					
A series of studies and activities to build technical capacities at a national level were developed during the preliminary stage. On stage II, the project considers the following components: Assessment of feasibility of one or more price setting instruments for carbon in the energy sector; Design and implementation of a MRV framework and a registration system, and Strategy of communication and commitment of participation from the several players related to the instruments to be assessed.					
Scope:		**Type of Support:**			
Mitigation		Financial resources; Capacity-building and technical assistance.			

Source: Compilation by the Climate Change Office from the MMA.

3.2. Capacity-building and technical assistance

This section addresses the supports received by the country in the area of capacity-building and technical assistance. The concept of capacity-building and technical assistance has been developed in Chile through two lines of work:

- **National:** In the National Climate Change Strategy (2006) a strategical plan of capacity-building and encouragement was established which was later ratified in the National Action Plan on Climate Change (2008). Its main objective was defined as: '*Spread and create awareness among the citizens regarding environmental issues and particularly, towards the issues derived from climate change, encouraging education, awareness and research on this matter in Chile*' The work has been focused in the formal and informal education among citizens, other institutions and public and private services, supporting the incorporation of basic concepts in educators, students and professionals besides suggesting hands-on activities to facilitate its incorporation.

- **International:** Chile has received the generous contribution from different countries which have contributed with training and technical support projects in the different matters related to climate change, this through projects and programs with specific goals in the area of mitigation and various workshops and technical visits for the capacity-building at institutional level.

Regarding relevant projects, programs and alliances for capacity-building and technical assistance, Table 14 shows a summary with information of the international initiatives in which Chile is permanent participant, where the contributions made and the support given by the Federal Republic of Germany, the European Commission, the Kingdom of Spain, the World Bank, among others, are highlighted and acknowledged. It is worth mentioning that The Federal Republic of Germany is the main contributor in terms of capacity-building and technical assistance, cooperating through projects, workshops, specific surveys and programs, which have favorably impacted on the growth of the installed technical capacity in the country.

It is important to point that even though these initiatives have a global funding, there is no detailed information regarding the amounts destined to fund specific activities in Chile.

Table 14. Main international initiatives with permanent participation of Chile, 2011-2014 period.

Scope	Initiative name	Objective	Description
R,M,I	Information Matters: Capacity development through peer exchange, for ambitious information and the facilitation of international mutual learning.	To support the institutions in the counterpart countries in the analysis of their monitoring and communication processes, and how to close the existing gaps, also how to improve such processes according to international standards and UNFCCC requirements.	The project gives technical assistance to four selected countries: Philippines, Ghana, Dominican Republic and Chile. In consultation with the counterparts, the specific necessities and priorities of the MRV systems and the GHG monitoring are identified and such systems are improved through workshops and customized courses elaborated in situ for capacity development.
M,A	EUROCLIMA	To facilitate the integration of strategies and mitigation and adaptation measures for climate change, in policies and public development plans in Latin America.	It is a Regional Cooperation Programme between the European Union and Latin America, focused on climate change. The Programme seeks to reach the following results: To improve the information and experiences exchange about climate change, increasing the political awareness and strengthening the institutional capacity; to Identify and prioritize the adaptation and mitigation measures 'useful in every case' and/or with additional benefits, and to reinforce the food safety in Latin America contributing to a sustainable agriculture with a greater capacity to mitigate the effects and to adapt to climate change. It has 5 partners: Economic Commission for Latin America and the Caribbean (ECLAC), Inter-American Institute for Cooperation on Agriculture (IICA), Joint Research Centre of the European Commission (JRC), United Nations Environment Programme (UNEP) and the EuropeAid (European Commission DG Development and Cooperation), supported by the Technical Assistance. (EUROCLIMA, 2014).
M,A	Latin America and Caribbean Regional Platform: LEDS LAC	To strengthen the quality, support and leadership of the LEDS strategies in the region, adopting an effective implementation of these encouraging their development at national and sub national level.	It is part of the Low Emissions Development Strategy Global Partnership (LEDS-GP) established in 2011, which operates through an innovative distributed leadership model, with regional institutions managing the local platforms from the countries and international organizations giving technical support (LEDS GP, 2012).
M,A	Ibero-american Network of Climate Change Offices (LARIOCC).	To function as a permanent dialogue instrument about mitigation and adaptation in climate change matters.	It is composed by the national offices or units of climate change of the Ministries of the Environment of the countries of the Ibero-American Community of Nations (21 countries). The contact point of LARIOCC is usually the responsible for climate change of each country. The network establishes relations with other networks, agencies and institutions, especially with the regional ones which are highly useful to promote synergy among studies and experiences in the region (LARIOCC, 2012).
M,I	Global Research Alliance (GRA)	To gather countries to find ways to produce more food without increasing GHG emissions.	The GRA started in December, 2009; currently it has 41 member countries from all the regions of the world, focusing on the research, development and extension of technologies and practices that help to offer ways to produce more food without increasing GHG emissions. The members of the Partnership have as objective to deepen and broaden the research efforts through the mitigation of the sub-sectors of rice, crops and livestock, and the cross-cutting issues of the soil carbon measurement problems, the nitrogen cycle and GHG inventories
M,N	International Partnership on Mitigation and MRV.	To support a practical exchange in activities related to GHG mitigation between developing and developed countries, to help closing the global ambition gap.	This partnership is focused mainly in collaborating in the design of the national low emissions development strategies (LEDS), NAMAS and MRV systems. It is composed by approximately 60 member countries of which more than half are developing countries (International Partnership on Mitigation and MRV, 2014).
M,N	Mitigation Action Implementation Network (MAIN).	To boost ambitious NAMAs through the identification of optimal procedures, efficient funding mechanism and MRV and to initiate the knowledge exchange at regional and global level and the dialogue about development and implementation of NAMAs among the developing countries in Latin America and Asia.	It consists of both, a technical cooperation and also the organization of workshops and regional and global dialogues about development and implementation of specific NAMAs in the transportation, energy and waste areas. The project is based in the work of another project of the International Climate Initiative which established the MAIN initiative and that addressed mainly the development of general knowledge with regard of the NAMA in the member countries.
M	The Mitigation Momentum project.	To support the development of the NAMAs contributing to the concrete development of proposals besides encouraging the cooperation and exchange of knowledge of NAMAs among the community.	It consists of: To progress in the development of NAMAs; To contribute to knowledge and good practices associated to NAMAs; To increase the exchange of knowledge and cooperation, and to progress in the debate about climate policies focused in mitigation. Chile, Peru, Tunisia, Georgia, Ethiopia, Kenya, Thailand and Indonesia are involved (Mitigation Momentum, 2013).

Donor	Starting Year	Status	Observations
Federal Republic of Germany	2013	Ongoing program.	Information Matters has a global funding of USD 4,224,000 for the development of activities in the counterpart countries.
European Commission.	Stage I (2010-2013) and Stage II (2014-2016).	Ongoing program.	Global Funding Stage I: USD 6,831,000 (Contribution EU: USD 6,600,000). Global Funding Stage II: USD 16,615,500 (Contribution EU: USD 15,114,000). 18 associated countries from Latin America.
Multilateral	2011	Ongoing program.	Chile had the presidency of this initiative during 2014.
The Kingdom of Spain	2004	Ongoing program.	Since its establishment in 2004, one reunion per year has been held.
New Zealand | GRA	2011	Ongoing program.	GRA had held different meetings at global level, where Chile has participated thanks to the support of several countries members of the partnership.
Federal Republic of Germany | Republic of South Africa | Republic of Korea	2010	Ongoing program.	It develops activities of capacity-building and experiences exchange through seminars, summer schools, webinars, among others.
Federal Republic of Germany | Kingdom of Denmark | Canada	2012	Ongoing program.	Its main technical partners are the Center for Clean Air Policy (CCAP) and the World Bank Institute
Federal Republic of Germany | World Bank	2012	Ongoing program.	This project is a collaboration between ECN Studies and Ecofys Germany. Besides, it is part of the International Climate Initiative and supported by BMUB

Table 14. (continuation) Main international initiatives with permanent participation of Chile, 2011-2014 period.

Scope	Initiative name	Objective	Description
N,M,A	Cartagena Dialogue for Progressive Action	To build an ambitious, comprehensive and legally-binding regimen under the UNFCCC.	Chile participates in the informal dialogue forum about climate change which gathers the countries maintaining a high level of commitment towards the goals of GHG reduction and supporting a process which culminates on a universal and legally binding agreement. Chile has participated in the Dialogue since the first meeting in Cartagena, Colombia in March, 2010.
N	Ambition Leaders: Supporting the AILAC countries at the climate negotiations.	To support the AILAC countries to provide counseling to the delegations, their experts and the implementation of logistic task, both in the negotiations as well as the periods between sessions.	For the fulfillment of the goals, a reliable and efficient support infrastructure is being build which will allow complex issues to be analyzed and this information to be summarized for the delegations, as well as negotiation strategies to be developed, efficient communication structures to be established and training in negotiation abilities to be provided.

R = Report; M = Mitigation; I = NIR; A = Adaptation; N= International Negotiation.

Source: Compilation by the Climate Change Office from the MMA.

In addition to the aforementioned projects, programs and alliances, Chile has received support on the area of capacity-building and technical assistance through other initiatives that have comprised projects and/or development of specific studies, which were directly funded by the donors, without direct transfer of financial resources to Chile. It is for this that there is no valuation of the activities related to such studies. It is highlighted in Table 15 that four initia-

Table 15. Other initiatives related to Other initiatives related to capacity-building and technical assistance, 2011-2014 period.

Scope	Initiative name	Objective
M,I	Climate change and livestock breeding: Quantification and mitigation options of methane and nitrous oxide emissions of cattle origin in grazing conditions.	To quantify CH_4 and N_2O emissions of the grazing cattle and to establish options for its mitigation, in function of the productive reality of the member countries of the consortium.
M	To update the design of the Green Zone for Transportation in Santiago.	To promote low-carbon emissions means of transportation.
M	Assessing the impact on SOC content of soil conservation management practices as a source of information for decision makers to develop a NAMA.	To generate objective information about the removal of atmospheric C by soils, in order for decision makers can include some conservationist practices of land management as part of an agricultural program of mitigation of GHG emissions or in other mitigation strategy the country can define in the future.
M	Energy efficiency and co-generation in public hospitals (Pilot project)	To analyze the feasibility and later installation of co-generation systems in three hospitals.
M	Non-Conventional Renewable Energy - Stage II	To identify and remove the constraints which limit the development of NCRE in Chile
M	Strategies of expansion of the renewable energies in the interconnected electrical systems.	Assessment of medium and long term alternatives for the expansion of the renewable energies in the interconnected electrical systems.
M	Technical and institutional strengthening of energy efficiency.	To improve the technical and institutional capacities of the public and private players for the implementation of energy efficiency measures, both in the industry as well as in the housing and construction sectors.

Donor	Starting Year	Status	Observations
Multilateral	2011	Ongoing program.	Up to this date, the meetings have been held in Colombia, Maldives, Costa Rica, Malawi, Samoa, Chile, Nairobi, Tajikistan, Thailand, Bangladesh and Ghana with the administrative and financial support of Australia, the United Kingdom, the European Commission, New Zealand, the Netherlands, Sweden, Norway and Germany.
Federal Republic of Germany	2013	Ongoing program.	Budget for the totality of the project: USD 3,960,000-

tives have had as objective contributing to the development of NAMAs in the waste, agriculture, energy and transportation sector, which is a direct collaboration to the fulfillment of the voluntary commitment of the country regarding GHG emissions reduction (20/20 commitment).

Description	Donor	Starting Year	Finishing Year
International research project led by Uruguay in which Argentina, Colombia, Dominican Republic and Chile also participates.	FONTAGRO	2011	2014
The NAMA is composed by four specific initiatives to promote low-carbon emissions means of transportation, which will be done within an area defined in Santiago downtown, Chile; area that corresponds to the jurisdiction of the Municipality of Santiago.	Inter-American Development Bank	2013	2014
This project is born from the necessity of the country of having more GHG emission reduction options which allows the voluntary commitment of the country to be comfortably met. Because the C removal by soils is a mitigation strategy already being used in other countries (USA, Australia, Brazil), it is postulated that Chile could present a specific NAMA in this area. For this to be operational, it is required to have field information about the consequences, in terms of profits or loss of carbon by soils, when being subject to different land management practices.	Canada	2012	2013
The pilot contemplates the hospitals in Santiago, Coyhaique and Punta Arenas. It is expected to demonstrate in the practice the feasibility of a greater energy security, a reduction of the operation costs of hospitals and, at the same time, a reduction of the GHG emissions of these. It is expected the technology to be multiplied in the health area and in other areas as well.	Federal Republic of Germany	2010	2014
From 2011, GIZ has supported the development of policies, regulations and instruments to accelerate the participation of the NCRE in the electrical market. Another line of work is to contribute to the generation of information about energy potentials available through surveys and studies; and the installation of wind and solar monitoring stations in selected places. Besides, the project has published and disseminated a series of orientation guides for investors and developers of national and international projects; about issues as planning and environmental assessment of projects and the functioning of the electrical market for investments in renewable sources. Likewise, the project contributes to improving the local capacities organizing seminars, conferences and technological missions. The project also advices on the implementation of pilot projects and performs Public-Private-Partnership measures (PPP).	Federal Republic of Germany	2007	2012
An optimal expansion strategy was reached (based in meteorological models, geographical information systems and different scenarios analysis) which considers economic efficiency criteria, supply security and environmental sustainability. This work in all its complexity is the most complete analysis of the electrical energy sector in the country and serves for planning of expansion of the electrical system in the medium and long term considering the potentials of the utilization of NCRE in Chile.	Federal Republic of Germany	2009	2014
Interventions at businesses partnership level were performed in the industry sector. Work was done in the development of energy services of quality, as specialized consultancies, technological supplies, equipment and services. Dissemination of information about energy efficient technology was done, for example, new technologies of lighting and co-generation, both with applications in the industry and construction sector. The activities in the construction sector were started in social housing, achieving the construction of the first thermally improved social housing of Chile. It should be clarified, that the development of other projects of the construction sector was also achieved with the goal of reducing the energy consumption, for example the health center and public buildings.	Federal Republic of Germany	2006	2011

Table 15.(continuation), Other initiatives related to capacity-building and technical assistance, 2011-2014 period.

Scope	Initiative name	Objective
M	NAMA Proposal: Self-supply renewable energy (SSRE) in Chile.	To develop a NAMA proposal to be registered in the registration of the United Nations (NAMA Registry).
M	National program for industrial and commercial catalyzing on organic waste management in Chile.	To catalyze the implementation of the first facilities of industrial and commercial organic waste management in Chile (without including domestic organic waste).
M	Fiscal land for energy generation projects based on renewable energies.	Identification, valuation and generation of procedures for the administration of fiscal lands for the execution of electrical generation projects based on NCRE.
A	Strategic framework for adaptation of infrastructure to climate change.	To assess the impacts of climate change in the public infrastructure being developed by the Ministry of Public Works (MOP) and analysis of adaptation measures.

R= Reporting; M= Mitigation; I= NIR; A= Adaptation; N= International Negotiation.
Source: Compilation by the Climate Change Office from the MMA.

Besides the relevant projects and other developed initiatives, professionals from the country have participated actively in workshops, courses, seminars and other training activities.

Table 16. Workshops, courses and seminars related to capacity-building and technical assistance, 2011-2014 period

Scope	Year	Initiative name
R	2014	First LAC Technical Dialog on INDCs
R	2014	Training workshop for LAC about BUR preparation of the Non-Annex I Parties of the UNFCCC.
R	2013	Global training workshop on the preparation of BURs
M	2014	Training course on Tradeable Emission Systems for emerging and developing countries
M	2014	LECB Programme NAMA Net Introductory Meeting.
M	2014	LAC workshop of NAMAs MRV as key element of MRV national systems
M	2014	LAC regional workshop to involve private sector in climate change mitigation
M	2014	Workshop con life cycle and NAMAs MRV
M	2013	5th Latin American regional dialogue of MAIN on development of NAMAs

Description	Donor	Starting Year	Finishing Year
The development of the proposal was addressed in a consultation process involving the key players of the public and private sector and civil society. Based in existing knowledge and initiatives in the energy sector, as well as the governmental policy in the short and medium term for the development goals.	The Mitigation Momentum project.	2011	2011
The National Program seeks to promote a solution for the management of organic waste in Chile through the support in the installation of five facilities of organic waste management (specifically dry fermentation plants which include in-house treatment, energy generation or 'waste to energy' and compost products obtained from the organic treatment process).	CAF	2014	2014
As main components wind and solar radiation measurement campaigns in fiscal land were started in the north of Chile. The suitability of the land was analysed through technical and economical studies and cooperation between the Ministry of Energy and the Ministry of National Assets was started to reserve lands and perform bids for its usage for renewable energy projects.	Federal Republic of Germany	2008	2011
Three case studies were considered: Irrigation reservoirs, bridge and port. In them, methodologies including adaptation to climate change elements were assessed and a strategical proposal to incorporate this issues in the MOP.	Environment Canada	2012	2013

Table 16 shows a summary of these activities since 2011. It is important to highlight that some initiatives have been executed in the framework of the projects or partnerships previously described.

Objective	Donor / Organizer
To support the countries in the preparation process and commissioning of their INDCs. The dialogue took place in Lima, Peru	LECB Internacional
To provide technical support to the Non-Annex I Parties in how to report the information in their respective BUR, in conformity with annex III of the decision 2 of the Conference of the Parties 17 (Durban, 2011) using the training material developed by the CGE of the UNFCCC. The workshop was performed in Panama City.	UNFCCC
To provide technical support to the Non-Annex I Parties about how to report the information in their BUR in relation to Annex III of the decision 2 of the COP 17 using training materials developed by the GCE; and to have feedback about the training materials including design and technical content to ensure these materials effectively fulfil the needs of assistance of the Non-Annex I countries. The workshop was performed in Bonn, Germany.	UNFCCC
To provide the participants knowledge about Tradeable Emission Systems, of the experiences of the countries which already have this system and the lessons learned with the objective of encouraging its application in developing countries and to contribute to emissions reduction for the mitigation of climate change. The course was developed in Santiago de Chile.	ICAP
To present the NAMA-Net vision to support the LECB projects (including key conclusions of previous meetings); To introduce the scope of the consultant consortium and to agree on an initial work plan to deliver the technical support; and to identify recommendations from countries on how these can share knowledge and good practices. The workshop was performed in New York, United States.	Low Emission Capacity Building-Chile
To contribute to the exchange of good practices and to the encouragement of capacities for the development of MRV System of NAMAs in LAC; To explore possible key similarities and differences between MRV processes applicable to the GHG report at facilities level and to NAMAs; and to discuss fundamental aspects related to reflect the impact of NAMAs in NIR and reports at national level. The workshop took place in Mexico City.	International Partnership on Mitigation and MRV | Partnership for Market Readiness
To initiate a dialogue for the inclusion of the private sector in climate change issues; To discuss experiences in the private sector related to mitigation and NAMAs; To involve several players in the discussion about policies and innovative approximations to support the mitigation and NAMAs; and The Exchange of lessons learned in the improvement of market conditions to encourage private investment. The workshop took place in Santiago de Chile.	International LECB
To know the main background information and concepts about NAMAs, aspects y most relevant steps to consider when identifying and developing NAMAs, information in the NAMA Idea Note (NINO); To present study cases of NAMAs; To know the main concepts and key considerations for GHG of NAMA MRV, steps for the election and implementation of the proper MRV system; and presentation of a MRV case study for a NAMA. The workshop took place in Santiago de Chile.	LECB-Chile
Analysis of the investment for a low emission development; Opportunities for NAMAs funding; To overcome constraints for mitigation in the waste sector; and to identify the path in a future of clean energy, creating an effective politic framework. The workshop took place in Lima, Peru	Center for Clean Air Policy

Table 16. (continuation), Workshops, courses and seminars related to capacity-building and technical assistance, 2011-2014 period.

Scope	Year	Initiative name
M	2013	Attracting Climate Finance for Low Emission Development.
M	2013	Development and Mitigation Forum
M	2013	Policy and Action Standard & Mitigation Goals Standard (Pilot Testing & Technical Working Group).
M	2012	Autumn School on MRV – today, tomorrow and the future.
M	2012	Training course on Tradeable Emission Systems for emerging and developing countries
M	2012	Hands-on training workshop in Mitigation Assessment.
M	2012	LECB-Programme: Technical Workshop on NAMAs.
M	2012	Workshop about *bottom-up* approach for MRV of policies, actions and GHG reduction measures in the energy sector in Chile.
M	2011	Forestry technical tour to New Zealand
I,M	2014	First conference on greenhouse gases in agriculture and livestock systems of Latin America (GALA)
I,M	2012	Korean training program on NIR and mitigation models.
I	NA	Cooperation between ministries of the environment of Chile and New Zealand
I	2014	Training course on GHG quantification in livestock systems
I	2014	Training workshop for LAC region on the use of UNFCCC software for NIR of the Non-Annex I Parties.
I	2013	Latin American workshop on national GHG inventory systems
I	2012	Meeting and training of IPCC experts on IPCC guidelines of 2006 and calculation and gathering software for the compilation of NIR
I	2012	Training workshop for expert NIR reviewer
A	2014	'Climate change impacts, vulnerability and adaptation' Seminar, results of the IPCC 5° Assessment Report on Climate Change

R = Report; M = Mitigation; I = NIR; A = Adaptation; N= International Negotiation.
Source: Compilation by the Climate Change Office from the MMA.

Objective	Donor / Organizer
To present the participants national experiences and good practices for a low emission development; To fund climate; and models in order to determine how to create a context that facilitates such development (combination of both previous topics) to catalyze the investment in a low emissions development. The workshop took place in Hanoi, Vietnam.	Low Emission Capacity Building-Chile
To provide space for researchers, professionals and experts from the world in climate mitigation issues to show and discuss their works developed in the framework of the complex challenge of addressing climate change. The forum was held in Cape Town, South Africa.	MAPS International | Energy Research Center-University Cape Town
To share feedback of the pilot participants regarding the practical use of the standards drafts, *Policy and Action Standard* and the *Mitigation Goals Standard* done in different countries and/or cities; To understand how the assessment of the pilot is going to support the objectives of the policy or action; and to discuss and recommend reviews to the standards drafts based on the feedback about the results of the assessments to consider them for the final versions of the standard. The workshop took place in Washington DC, United States.	World Resources Institute
To support activities related to the mitigation and MRV among developing countries and developed countries, to help close the gap in the global challenges. The course was taught in Berlin, Germany.	International Partnership on Mitigation and MRV
To provide the participants knowledge about Tradeable Emission Systems, of the experiences of the countries which already have this system and the lessons learned with the objective of encouraging its application in developing countries and to contribute to emissions reduction for the mitigation of climate change. The course was developed in Dublin, Ireland.	ICAP
To continue the implementation of the work program of the CGE for 2012 approved by SBI in its XXXII Session in June, 2010 through the support to the activity *UNFCCC Hands-On Training Workshop for the LAC region on mitigation assessment* and to provide the participants an introduction to the purpose, key steps and considerations of relevant designs in the process of conducting an assessment of the GHG mitigation actions, and the issues involved in the generation of these assessments to create more detailed national action plans. The activity took place in St. Marys, Antigua & Barbuda.	UNFCCC
To start the technical work in reference scenes as a base to build NAMAs and LEDs; To facilitate the exchange of lessons learned among the countries that are part of the program; To discuss relevant technical and political aspects related to the reference scenes, NAMAs, LEDs, MRV systems including the institutional strengthening for decision making; and To identify tracking actions to assist countries on the implementation of the projects including technical assistance and training priorities. The workshop took place in Marrakech, Morocco.	Low Emission Capacity Building-Chile
To develop a *bottom-up* strategy for the MRV of policies, measures and actions in the energy sector of Chile. The workshop took place in Santiago de Chile.	International Partnership on Mitigation and MRV
To know the emission transaction scheme of New Zealand, the Permanent Forest Sink Initiative and the aspects of MRV of both systems. The workshop took place in New Zealand.	New Zealand
To train people involved in the generation of local emission factors in countries of Latin America and the Caribbean. The conference was held in Osorno, Chile.	International LECB
Capacity-building and strengthening on developing countries, specifically in NIR issues and mitigation modelling. The course was taught in Inchon, Republic of Korea.	Republic of Korea
Cooperation around NIR and low carbon development strategies.	New Zealand
To train researchers in the generation of local emission factors in LAC countries. The course was taught in Osorno, Chile.	New Zealand | FONTAGRO
To create capacities in the Latin American and Caribbean experts in the use of the software for the National Inventories of GHG of the Non-Annex I Parties of the United Nations Framework Convention on Climate Change.	UNFCCC
To increase the capacities at governmental level in the elaboration of national inventories of GHG through the implementation of solid National GHG Inventories System. The workshop took place in Santiago de Chile.	International LECB | IPCC
To create capacities in the compilers of NIR for the application of the 2006 IPCC Guidelines for the NIR and the use of the corresponding software. The meeting was held in Bali, Indonesia.	IPCC
To create capacities in the review of NIR for national experts to collaborate with the assessment of emissions reports for the UNFCCC and at the same time to strengthen the national processes of elaboration and review of inventories. The seminar was held in Bonn, Germany.	UNFCCC
To disseminate the results of the 5th Report of IPCC in Adaptation and Vulnerability issues. The seminar was held in Santiago de Chile.	IPCC

3.3. Technology transfer

This section addresses the support received by the country in the area of technology transfer. This is related to the direct transfer of some specific technology, as well as the technical support and the specific capacity-building in order to develop such technology. Table 17 shows the initiatives developed in the country.

Table 17. Initiatives related to technology transfer, 2011-2014 period.

Scope	Initiative name	Objective	Description	Donor	Starting Year	Finishing Year
M	Solar energy for the generation of electricity and heat.	Power and heat generation through photovoltaic and thermal solar plants at small scale.	The execution of several activities is contemplated in this framework, among which is worth to highlight the installation of photovoltaic laboratories for training on training centers and also the support to the Ministry of Energy program about the dissemination of these systems in the public sector. The applications are found in the residential, commercial and industrial sectors. Through the improvement of the current conditions of the regulatory framework, the development of innovative business models and the strengthening of local competencies, new markets for solar energy technologies should be encouraged.	Federal Republic of Germany	2012	2016
M	Encouragement of solar energy generation (CSP focused)	To establish markets for renewable energies at large-scale, with focus in the utilization of solar energy with Concentrated Solar Power (CPS) and Photovoltaic Systems.	The work lines include issues topics as training, large-scale NCRE integration to the network, identification of new technological applications and dissemination of the experiences of Chile in these topics at international levels. This project of technical cooperation is part of an agreement between Chile and Germany, which also has a financial component covered by the German Development Bank, Kreditanstalt für Wiederaufbau (KfW)-	Federal Republic of Germany	2014	2019
I	Equipment for GHG measurement	To donate equipment for the semiautomated measurement of GHG emissions from agricultural soil.	Initiative generated inside the GRA with the objective of strengthening the nexus of Australia in South America.	Australian Communities Foundation	2012	2013
A	Phenotyphic characterization of high pressure on wheat: Genetic enhancement to develop cultivated species tolerant to drought.	To identify and standardize genotype selection methods resistant to drought and high temperatures.	During two growing seasons (2011-2012 and 2012-2013) 384 wheat accessions were established in two representative environments of the cereal zone of Chile. Both environments present Mediterranean climate, where the wheat crop suffers a terminal drought during the grains filling stage.	FONTAGRO	2010	2014
A	The challenge to develop potatoes and wheat varieties resistant to climate change	To generate cultivars of wheat and potato, mainly rainfed crop, more tolerant to extreme climate conditions (high temperatures and water shortage).	The INIA-Chile, INIA-Uruguay and the International Potato Center (CIP - Centro Internacional de la Papa) consortium seeks to increase the competitiveness and sustainability of potato and wheat crops to climate change through selection and development of genotypes with greater tolerance to drought and high temperatures. Besides, they seek to make available for the regional genetic improvement programs; genotypes tolerant to drought and to high temperatures, efficient and standardized genetic and phenotypic characterization protocol.	FONTAGRO | Inter-American Development Bank	2010	2014

R= Reporting; M= Mitigation; I= NIR; A= Adaptation; N= International Negotiation.

Source: Compilation by the Climate Change Office from the MMA.

REFERENCES AND BIBLIOGRAPHY

ECLAC. (2012). Climate Economy in Chile (La Economía del Cambio Climático en Chile). Santiago: United Nations

UNFCCC. (2012). Report of the Conference of the Parties on its seventeenth session, held in Durban from November 28th to December 11th, 2011. Conference of the Parties, (page 93). Durban.

EUROCLIMA (2014). EUROCLIMA Obtained from EUROCLIMA: A REGIONAL COOPERATION PROGRAMME: http://www.euroclima.org/es/euroclima/que-es-euroclima

GEF. (2013). Global Environment Facility. Obtained from Technology Transfer for Climate Change: http://www.thegef.org/gef/Technology_Transfer

International Partnership on Mitigation and MRV. (2014). International Partnership on Mitigation and MRV. Obtained from About the Partnership: http://mitigationpartnership.net/about-partnership

IPCC. (2014). Intergovernmental Panel on Climate Change. Obtained from Working Group III: Mitigation : Technology Transfer: http://www.ipcc.ch/ipccreports/tar/wg3/index.php?idp=421

LARIOCC. (2012). Iberoamerican Network of Climate Change Bureaus Obtained from Quienes somos (Who we are): http://www.lariocc.es/es/quienes-somos/

LEDS GP. (2012). LEDS Global Partnership. Obtained from About the Partnership: http://ledsgp.org/about
Mitigation Momentum. (2013). The Mitigation Momentum Project. Obtained from Project: http://www.mitigationmomentum.org/project.html

UNEP RISOE. (2013). Understanding the Concept of Nationally Appropriate Mitigation Action. Denmark: UNEP Risø Centre.

UNFCCC. (September 2014). United Nation Convention on Climate Change: Climate Finance . Obtained from http://unfccc.int/cooperation_and_support/financial_mechanism/items/2807.php

UNFCCC. (September 2014). United Nation Framework Convention on Climate Change. Obtained from Glossary of climate change acronyms: http://unfccc.int/essential_background/glossary/items/3666.php

UNFCCC. (September 2014). United Nation Framework Convention on Climate Change. Obtained from Capacity Building: Background: unfccc.int/cooperation_and_support/capacity_building/items/7061.php

ACRONYMS AND ABBREVIATIONS

2CN	2NC Second National Communication of Chile under the United Nations Framework Convention on Climate Change (Segunda Comunicación Nacional de Chile ante la Convención Marco de las Naciones Unidas sobre Cambio Climático).
Customs	National Customs Service (Servicio Nacional de Aduanas)
AFOLU	Agriculture, forestry and other land use
IEA	International Energy Agency
ASPROCER A.G	Pork Producers Association of Chile (Asociación Gremial de Productores de Cerdos de Chile)
NEB	National Energy Balance (Balance Nacional de Energía)
CH4	Methane
UNFCCC	United Nations Framework Convention on Climate Change
NC	National Communications
CNE	National Energy Commission (Comision Nacional de Energía)
CO	Carbon monoxide
CO2	Carbon dioxide
CO2eq	Carbon dioxide equivalent
COCHILCO	Chilean Copper Commission (Comisión Chilena del Cobre)
CONAF	National Forest Service (Corporacion Nacional Forestal)
CONAMA	National Environment Commission (Comision Nacional del Medio Ambiente)
NMVOC	Non-methane volatile organic compounds
CRI	Regional Research Center (Centro Regional de Investigación)
AD	Activity data
BOD	Biochemical oxygen demand
DGAC	General Direction of Civil Aviation (Dirección General de Aeronáutica Civil)
COD	Chemical oxygen demand
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO statistical databases
EF	Emission factor
FOD	First Order Decay
QA/QC	Quality assurance and quality control
GHG	Greenhouse Gas
Gg	Gigagrams
1996GL	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
2006GL	2006 IPCC Guidelines for National Greenhouse Gas Inventories
GL-UNFCCC-NC	Guidelines for the preparation of National Communications From Non-Annex I Parties
GL-UNFCCC-BUR	Guidelines for the preparation of BURs from non-Annex I Parties
GPG2000	Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
GPG-LULUCF	Good Practice Guidance for Land Use, Land-Use Change and Forestry
GWh	Gigawatt per hour
HFC	Hydrofluorocarbons
BUR	Biennial Update Reports
NIR	National greenhouse gas inventory report
INE	National Statistics Institute (Instituto Nacional de Estadisticas)
INFOR	Forestry Institute of Chile (Instituto Forestal de Chile)
NIR	National Greenhouse Gas Inventory
INIA	National Agricultural Research Institute (Instituto de Investigaciones Agropec-

	uarias)
IPCC	The Intergovernmental Panel on Climate Change (Grupo Intergubernamental de Expertos sobre el Cambio Climático)
IPPU	Industrial processes and product use (Procesos industriales y uso de productos)
SGHGI	Sectoral Greenhouse Gas Inventory
LKD	Lime Kiln Dust
MINAGRI	Ministry of Agriculture (Ministerio de Agricultura)
MINENERGIA	Ministry of Energy (Ministerio de Energía)
MINSAL	Ministry of Health (Ministerio de Salud)
MMA	Ministry of the Environment (Ministerio del Medio Ambiente)
MW	Moment Magnitude
N2O	Nitrous oxide
NOx	Nitrogen oxides
ODEPA	Agricultural Studies and Policies Office (Oficina de Estudios y Políticas Agrícolas)
ODU	Fraction oxidized during use
GWP	Global Warming Potential
LCV	Lower Calorific Value
HCV	Higher Calorific Value
PFC	Perfluorocarbons
IP	Industrial processes
UNDP	United Nations Development Programme
RCA	Environmental Qualification Resolution (Resolución de Calificación Ambiental)
LIW	Industrial wastewater
MSW	Municipal solid waste
SAFF	Forestry Update and Inspection System (Sistema de Actualización y Fiscalización Forestal)
ODS	Ozone-depleting substances
SAR	Second Assessment Report
SWDS	Solid waste disposal sites
SEC	Electricity and Fuels Superintendency (Superintendencia de Electricidad y Combustibles)
SWDA	Solid waste disposal areas
SEIA	Environmental Impact Evaluation System (Sistema de Evaluación de Impacto Ambiental)
SERNAGEOMIN	National Geology and Mining Service (Servicio Nacional de Geología y Minería)
SF6	Sulfur hexafluoride
SIMEF	National Monitoring And Evaluation System For Forestry Ecosystems (Sistema nacional integrado de vigilancia y evaluación de los ecosistemas forestales)
SISS	Sanitary Services Superintendency (Superintendencia de Servicios Sanitarios)
MMS	Manure Management System
SNICHILE	Chile's National Greenhouse Gas Inventory System (Sistema Nacional de Inventarios de Gases de Efecto Invernadero de Chile)
SO2	Sulphur dioxide
SOFOFA	Federation of Chilean Industry (Sociedad de Fomento Fabril)
SUBDERE	Undersecretary of Regional and Administrative Development (Subsecretaría de Desarrollo Regional y Administrativo)
Tcal	Teracalories
TJ	Terajoules
SOPU	Solvents and other products use
USGS	United States Geological Survey
LULUCF	Land use, land-use change and forestry
INACESA	Industria Nacional del Cemento S.A.
SOPROCAL	Sociedad Productora de Cal

ANNEXES

Annex 1. Activity data and parameters

Energy Sector

Energy Sector: densities and calorific values used in NEB.

Product	Density Ton/m³	Higher Calorific Value KCal/Kg	
National Crude Oil	0.825	10,963	*
Imported Crude Oil	0.855	10,860	
5 Fuel Oil	0.927	10,500	
IFO 180 Fuel Oil	0.936	10,500	
6 Fuel Oil	0.945	10,500	
Naphta	0.700	11,500	
Liquefied Petroleum Gas	0.550	12,100	
Motor Gasoline	0.730	11,200	
Aviation Gasoline	0.700	11,400	
Jet kerosene	0.810	11,100	
Kerosene	0.810	11,100	
Diesel	0.840	10,900	
Processed Natural Gas	-	9,341	**
Firewood	-	3,500	
Coal	-	7,000	
Coke	-	7,000	
Biogas	-	5,600	**
Refinery Gas	-	4,260	**
Electricity	-	860	**** (1)

Notes: (*) Island, Continent and Off-Shore Average; (**) KCal/m3; (1) Practical Caloric Equivalent of Chile 2,750 KCal/KWh since 1997 and 2,504 KCal/KWh since 1998

Source: NEB, Ministry of Energy

Energy Sector: fuel consumption (TJ) per fuel type, 1990-2010 series.

Year/ Type	Diesel	Firewood	Coal	Natural gas	Gasoline	Fuel Oil	Liquefied Petroleum Gas	Jet kerosene	Others
1990	98,446.1	107,152.8	89,906.5	24,785.1	61,217.1	60,620.5	25,815.3	12,294.3	28,630.7
1991	100,186.9	118,198.2	64,160.4	23,322.3	63,345.0	61,362.3	27,603.0	12,123.1	36,931.1
1992	108,949.1	131,224.4	56,320.8	25,824.4	69,832.3	62,205.5	30,655.9	14,161.5	38,011.7
1993	115,086.8	121,244.9	55,441.8	24,925.4	73,674.5	74,778.2	33,524.1	16,092.6	41,264.5
1994	126,348.3	127,398.0	68,977.1	25,340.9	82,739.1	79,378.2	34,331.1	15,413.1	42,211.3
1995	138,716.4	136,434.8	74,505.8	24,995.4	89,484.9	88,142.5	37,729.4	17,844.9	45,077.8
1996	152,204.5	146,271.1	110,676.8	24,574.1	95,817.0	87,166.0	40,869.2	19,203.8	50,845.0
1997	172,580.9	145,616.9	151,088.6	40,480.9	99,643.3	89,123.4	42,656.9	24,282.0	48,937.3
1998	169,773.1	156,306.2	140,428.2	67,990.8	103,680.5	81,611.5	46,181.9	28,358.8	53,976.9
1999	185,139.1	161,986.0	145,511.4	87,742.1	105,768.6	72,721.9	47,294.3	26,427.6	57,534.6
2000	174,088.6	169,217.1	107,896.6	127,209.6	106,035.1	74,161.7	47,417.7	23,888.6	47,287.0
2001	177,264.4	168,890.9	80,392.4	159,173.4	96,986.4	63,054.7	45,384.6	26,999.8	47,672.2
2002	183,214.2	171,575.7	82,432.9	157,268.4	96,409.7	61,755.7	44,184.6	27,035.6	56,494.9
2003	183,182.4	162,097.4	76,586.0	182,358.3	93,633.4	66,342.0	44,678.5	23,137.6	57,156.3
2004	196,857.4	171,473.6	91,697.4	205,045.3	94,063.7	67,974.6	46,293.7	25,392.5	63,823.3
2005	216,223.5	182,913.6	89,546.5	202,190.1	93,837.8	79,699.4	44,760.6	27,228.3	66,299.3
2006	224,150.7	188,137.9	116,900.6	166,373.1	92,619.0	89,061.7	44,822.7	29,005.9	66,033.9
2007	342,118.3	198,240.8	142,652.4	97,670.3	98,630.7	113,142.9	56,245.7	32,412.6	60,752.0
2008	357,125.7	203,525.0	154,465.4	58,529.3	102,347.2	115,570.0	56,829.6	37,789.8	64,893.6
2009	328,820.1	203,964.1	141,962.2	80,175.0	111,048.7	87,697.9	58,654.9	30,834.1	70,682.7
2010	298,574.3	194,220.1	165,536.1	127,843.2	122,720.6	72,985.0	57,303.1	29,288.2	52,559.4

Source: NEB, Ministry of Energy.

1A1a. Main activity electricity and heat production: fuel consumption per type (TJ), 1990-2010 series.

Year/ Type	Jet kerosene	Kerosene	Diesel	Fuel Oil	Liquefied Petroleum Gas	Naphtha	Refinery Gas	Coal	Coke	Work Gas	Blast Furnace Gas	Natural Gas	Firewood
1990	-	-	7,911.2	12,556.8	3.8	-	-	69,076.6	-	37.7	41.5	2,618.8	3,707.0
1991	-	-	3,945.6	11,745.4	3.8	-	-	46,059.0	1,340.2	37.7	-	1,058.8	3,977.5
1992	-	-	1,829.6	10,814.7	3.8	-	-	31,672.5	-	37.7	-	2,897.7	6,714.0
1993	-	-	1,905.2	12,978.5	-	-	-	33,482.3	-	41.5	-	2,965.5	7,179.3
1994	-	-	2,135.9	15,615.5	3.8	-	-	51,472.3	-	37.7	-	3,093.6	7,839.6
1995	-	-	2,843.9	19,087.8	-	-	-	58,249.9	-	30.1	-	3,108.7	9,506.1
1996	-	-	3,408.7	22,826.6	7.5	-	-	89,373.5	1,344.4	-	-	3,161.5	12,688.1
1997	-	-	8,346.4	17,314.2	6.8	-	-	109,797.5	1,340.2	-	-	6,920.1	13,035.2
1998	-	-	7,779.9	16,331.5	7.5	-	-	115,887.3	1,841.6	22.6	-	33,837.7	17,035.5
1999	-	-	22,126.6	15,142.2	-	-	-	120,835.2	7,087.8	11.3	-	47,768.5	15,468.3
2000	-	-	6,145.2	6,642.4	-	-	-	87,205.8	5,739.5	-	-	69,201.5	13,169.4
2001	-	-	2,808.1	4,991.7	-	-	103.4	53,154.8	5,453.1	-	-	93,675.5	19,481.6
2002	-	-	2,414.3	3,480.3	22.6	-	83.5	61,077.9	9,744.8	-	-	83,154.9	17,397.4
2003	-	-	1,964.9	3,186.0	11.3	-	596.6	58,309.6	14,660.9	-	-	107,206.8	17,115.0
2004	-	0.4	3,747.6	3,627.1	5.6	1.1	344.2	70,804.4	22,229.9	-	-	121,547.0	17,959.8
2005	-	-	9,840.2	4,964.0	2.1	1.2	836.3	71,831.1	21,579.9	-	-	113,530.1	22,711.2
2006	2.7	-	5,302.6	4,270.6	4.3	-	721.2	99,061.2	18,523.9	-	-	84,966.4	20,048.3
2007	-	-	100,485.1	11,679.4	3.0	-	520.9	125,240.4	18,676.2	-	-	38,477.0	20,660.4
2008	-	-	104,218.4	12,308.7	144.8	0.1	682.0	138,583.7	19,185.0	-	-	19,871.8	21,447.0
2009	-	-	79,922.9	10,220.5	491.1	0.1	749.9	133,269.8	20,016.1	-	-	32,375.7	23,388.2
2010	-	-	53,336.9	10,308.0	-	-	338.9	155,586.9	9,713.8	-	-	73,790.2	19,996.9

Source: NEB, Ministry of Energy.

1A2f. Other industries (Mining and Quarrying): fuel consumption per type (TJ), 1990-2010 series.

Year/ Type	Jet kerosene	Kerosene	Diesel	Fuel Oil	Liquefied Petroleum Gas	Naphtha	Coal	Coke	Regular Gas	Natural Gas	Firewood
1990	-	795.5	8,531.7	19,064.0	64.1	-	3,842.2	111.4	-	-	15.9
1991	-	815.4	8,603.2	17,302.0	64.1	-	3,874.1	115.4	-	-	11.9
1992	-	735.8	8,440.2	16,944.0	90.4	-	3,496.2	99.4	-	-	95.5
1993	-	712.0	8,304.9	15,663.2	98.0	-	4,057.0	103.4	-	-	99.4
1994	-	620.5	10,313.6	15,010.9	79.1	-	3,030.8	87.5	-	-	23.9
1995	-	497.2	10,731.2	13,396.1	94.2	-	2,167.7	83.5	-	-	23.9
1996	-	485.3	12,385.8	14,430.2	67.8	-	2,983.1	39.8	-	-	27.8
1997	-	1,046.1	27,671.2	19,290.7	171.1	159.1	4,182.7	43.8	-	-	9.6
1998	-	783.6	30,021.9	15,718.9	113.1	135.2	2,597.3	330.1	-	199.7	83.5
1999	-	990.4	30,403.7	14,764.3	324.1	163.1	2,239.3	123.3	-	1,616.5	83.5
2000	-	600.6	32,830.0	17,115.0	569.0	198.9	2,394.4	234.7	-	2,027.3	15.9
2001	-	632.4	35,904.5	12,115.3	293.9	222.7	2,434.2	186.9	-	3,640.0	8.0
2002	-	385.8	37,837.6	11,176.7	520.0	226.7	2,708.6	314.2	-	5,810.4	8.0
2003	-	600.6	32,822.0	7,768.0	437.1	131.3	2,760.4	576.7	-	7,374.2	8.0
2004	-	451.4	35,018.6	6,544.4	297.7	74.6	2,855.5	334.3	0.0	8,851.0	-
2005	0.0	889.7	39,158.0	5,959.9	210.3	54.7	2,461.9	304.9	0.0	9,544.1	-
2006	-	608.1	44,543.8	6,506.1	200.5	4.5	4,242.2	154.4	-	6,264.0	-
2007	-	543.4	50,722.8	8,866.4	267.2	22.7	2,254.0	425.8	0.0	2,475.0	-
2008	-	546.6	51,435.4	8,925.2	329.1	69.6	2,331.6	556.4	-	1,067.0	-
2009	-	551.9	57,807.0	8,853.8	292.0	-	1,412.1	339.5	-	2,583.6	-
2010	-	1,509.6	63,097.5	10,357.2	913.4	-	2,285.8	409.0	-	3,641.7	-

Source: NEB, Ministry of Energy.

1A3b. Road transportation: fuel consumption per type (TJ), 1990-2010 series.

Year/Type	Gasoline	Aviation Gasoline	Jet kerosene	Kerosene	Diesel	Fuel Oil	Liquefied Petroleum Gas	Naphtha	Natural Gas
1990	61,217.1	-	-	-	44,830.0	-	-	-	233.6
1991	63,345.0	-	-	-	47,475.0	-	-	-	286.4
1992	69,832.3	-	-	-	50,808.1	-	-	-	169.6
1993	73,674.5	-	-	-	59,685.8	-	-	-	222.3
1994	82,739.1	-	-	-	67,736.1	-	-	-	260.0
1995	89,484.9	-	-	-	75,098.4	-	-	-	260.0
1996	95,817.0	-	-	-	82,082.8	-	-	-	256.2
1997	99,643.3	-	-	-	86,668.9	-	-	-	218.6
1998	103,680.5	-	-	-	92,300.9	-	-	-	229.9
1999	105,768.6	-	-	-	99,364.9	-	-	-	237.4
2000	106,035.1	-	-	-	105,136.2	-	-	-	327.8
2001	96,986.4	-	-	-	101,146.8	-	-	-	418.3
2002	96,409.7	-	-	-	109,109.7	-	-	-	953.3
2003	93,633.4	-	-	-	111,555.8	-	-	-	968.4
2004	93,816.0	0.7	1.8	170.7	110,696.4	6.1	72.0	-	1,107.2
2005	93,622.5	0.8	4.6	594.0	125,869.1	10.8	21.9	0.2	1,290.2
2006	92,397.2	0.6	6.2	52.1	125,883.4	3.5	104.9	0.6	1,347.2
2007	98,621.2	0.7	6.3	82.5	134,359.3	2.6	163.4	0.2	953.2
2008	102,148.8	1.9	6.7	50.8	139,236.2	7.6	135.3	9.8	541.2
2009	110,889.6	-	-	-	139,871.9	-	-	-	841.4
2010	122,636.3	0.8	-	20.0	138,539.7	3,217.4	298.4	-	742.7

Source: NEB, Ministry of Energy.

1A4b. Residential: fuel consumption per type (TJ), 1990-2010 series.

Year/ Type	Kerosene	Diesel	Fuel Oil	Liquefied Petroleum Gas	Methanol	Coal	Work Gas	Natural Gas	Firewood
1990	4,911.0	5,352.4	530.5	20,114.3	-	640.0	1,779.9	5,420.9	64,735.5
1991	6,109.4	5,230.4	254.6	21,591.3	-	99.4	1,835.1	5,697.4	67,974.8
1992	8,022.5	6,546.9	377.9	23,882.3	-	488.2	2,019.7	5,916.0	70,707.3
1993	8,420.3	7,390.1	163.1	25,272.8	-	222.7	2,080.0	6,044.1	74,235.3
1994	8,754.4	7,891.3	533.0	26,452.2	-	326.2	2,162.9	6,096.8	78,698.0
1995	8,022.5	867.1	6,964.5	28,517.1	6,345.5	254.6	2,215.7	-	83,395.4
1996	6,531.0	2,931.4	871.1	30,936.3	-	282.4	2,313.6	6,511.3	88,383.1
1997	8,006.9	3,055.1	77.3	32,041.8	-	-	1,938.5	6,680.2	107,858.6
1998	6,892.9	994.4	51.7	32,371.9	-	-	2,106.4	6,454.8	107,840.9
1999	8,396.4	855.2	63.6	34,629.0	-	-	1,235.9	7,822.6	110,008.6
2000	6,829.3	791.5	55.7	36,562.1	-	-	1,021.2	10,147.6	111,082.5
2001	5,783.2	739.8	55.7	37,002.9	-	-	960.9	13,267.6	113,305.9
2002	5,636.1	1,893.3	43.8	32,925.8	-	-	738.6	12,747.6	113,874.7
2003	3,766.7	449.5	4.0	30,476.6	-	-	712.2	12,687.3	114,443.5
2004	3,188.7	450.7	3.8	34,548.7	-	5.0	418.7	12,957.5	115,037.8
2005	2,474.4	451.3	6.1	32,488.5	-	26.9	403.5	14,459.6	115,614.4
2006	1,999.1	598.1	-	33,326.5	-	1.1	517.3	14,564.2	116,191.0
2007	2,758.2	582.7	-	34,967.4	-	0.4	559.1	16,211.7	116,772.0
2008	2,270.9	209.0	-	33,783.7	-	0.6	442.4	14,899.7	117,355.8
2009	3,344.5	252.8	-	35,143.0	-	0.4	425.1	15,446.4	117,942.6
2010	4,640.7	128.7	6.4	35,494.4	-	-	264.5	16,394.5	118,532.3

Source: NEB, Ministry of Energy.

Industrial processes sector and Solvents and other products use sector

2A1. Cement production.

Year	Cement production (ton) (1)	Clinker Imports (ton) (2)	Clinker Exports (ton) (2)
1990	2,017,082.0	21.0	-
1991	2,161,157.5	-	-
1992	2,621,486.0	59,612.0	-
1993	3,020,173.0	219,594.9	-
1994	2,995,353.0	92,067.8	-
1995	3,274,389.0	103,185.3	-
1996	3,634,035.0	533,246.4	-
1997	3,736,078.0	681,113.6	-
1998	3,847,622.0	369,768.6	-
1999	3,036,227.0	40,100.0	-
2000	3,376,570.7	291,935.7	-
2001	3,512,648.4	276,680.0	0.1
2002	3,461,682.0	265,429.2	-
2003	3,622,411.2	150,042.6	2.6
2004	3,797,603.1	247,095.2	1.1
2005	3,999,122.0	403,231.2	-
2006	4,111,533.2	362,677.7	8,124.2
2007	4,439,966.7	437,809.4	28,168.4
2008	4,622,328.7	632,233.6	3,002.0
2009	3,876,297.4	527,558.9	-
2010	3,871,103.0	617,201.8	5,760.0

Source: INACESA, SOPROCAL, CMPC AND ARAUCO.

2A2. Lime production.

Year/ Region	II Region (ton)	III Region (ton)	MR (ton)	VII Region (ton)	VIII Region (ton)	XIX Region (ton)	IX Region (ton)
1990	80,590.0	-	79,611.0	74,327.4	110,886.2	-	-
1991	65,490.0	-	88,520.0	91,545.4	138,891.5	-	-
1992	50,233.0	-	92,660.0	69,083.4	222,385.3	-	53,521.0
1993	28,372.0	-	102,171.0	68,749.1	239,579.1	-	77,563.0
1994	47,202.0	-	98,088.0	66,742.8	253,611.9	-	92,421.0
1995	63,324.0	-	115,704.0	69,793.0	268,780.8	-	92,338.0
1996	81,795.0	-	107,638.0	70,961.7	269,634.9	-	95,295.0
1997	55,134.0	-	126,697.0	67,876.9	257,023.2	-	97,162.0
1998	49,692.0	-	135,709.0	83,038.5	274,047.5	-	100,662.0
1999	144,966.0	-	103,307.0	79,162.2	289,254.9	-	100,674.0
2000	137,064.0	-	93,043.0	83,490.2	308,873.5	-	102,451.0
2001	154,155.0	-	94,487.0	88,171.1	298,938.6	-	109,166.0
2002	118,547.0	92,410.0	85,573.0	90,153.3	306,550.9	-	106,100.0
2003	169,092.0	105,697.0	72,708.0	87,742.6	319,134.5	-	126,395.0
2004	252,612.0	112,468.0	63,836.0	89,666.7	324,265.9	120,983.2	134,101.0
2005	297,281.0	109,512.0	98,864.0	121,554.9	312,264.3	92,256.2	136,539.0
2006	310,779.0	137,572.0	54,838.0	117,205.0	314,840.7	110,699.0	130,210.0
2007	347,510.0	134,511.0	82,184.0	97,386.6	687,797.0	113,548.1	137,688.0
2008	338,163.0	129,006.0	70,186.0	110,903.3	743,501.1	127,849.3	130,355.0
2009	328,938.0	109,739.0	64,377.0	112,584.8	742,997.4	127,061.0	125,646.0
2010	338,591.0	158,001.0	62,326.0	90,150.4	565,646.5	104,937.3	130,888.0

Source: INACESA, SOPROCAL, CMPC AND ARAUCO.

2B5. Others, Methanol.

Year	Methanol production (ton)
1990	854,000.0
1991	693,000.0
1992	840,000.0
1993	807,000.0
1994	874,000.0
1995	841,000.0
1996	853,000.0
1997	1,635,000.0
1998	1,700,000.0
1999	2,309,000.0
2000	2,912,000.0
2001	2,784,000.0
2002	2,932,000.0
2003	2,703,000.0
2004	2,692,000.0
2005	3,029,000.0
2006	3,182,000.0
2007	1,841,000.0
2008	1,088,000.0
2009	942,000.0
2010	935,000.0

Source: NEB.

2C1. Iron and steel.

Year	BOF steel (ton)	EAF steel (ton)
1990	735,802.0	-
1991	763,466.0	-
1992	972,582.0	22,249.0
1993	1,022,434.0	41,243.0
1994	997,306.0	58,250.0
1995	950,138.0	73,269.0
1996	1,104,541.0	106,583.0
1997	1,087,436.0	126,780.0
1998	1,090,109.0	149,810.0
1999	1,149,575.0	182,851.0
2000	1,135,508.0	206,132.0
2001	1,001,359.0	205,172.0
2002	1,013,149.0	232,211.0
2003	1,077,027.0	274,104.0
2004	1,208,424.0	339,409.0
2005	1,152,869.0	355,509.0
2006	1,184,517.0	334,095.0
2007	1,219,445.0	447,622.0
2008	1,158,164.0	496,356.0
2009	967,927.0	417,454.0
2010	617,606.0	308,803.0

Source: Compilation based on information provided by CAP Company.

Agriculture sector

Animal population per specie (thousand of heads).

Year	Dairy cows	Other cattle	Swine	Sheep	Goats	Horses	Mules and asses	Camels (llamas and alpacas)	Poultry
1990	590.4	2,813.5	1,455.5	4,323.6	856.6	408.0	18.2	117.0	20,178.0
1991	601.0	2,859.6	1,492.8	4,233.8	838.1	406.6	18.4	118.3	23,694.3
1992	618.6	2,938.9	1,530.2	4,144.0	819.7	405.2	18.6	119.6	26,502.7
1993	642.7	3,049.0	1,567.5	4,054.2	801.2	403.8	18.8	120.9	28,202.1
1994	664.8	3,149.4	1,604.8	3,964.4	782.7	402.5	19.0	122.2	29,947.5
1995	673.3	3,185.0	1,642.2	3,874.6	764.3	401.1	19.1	123.5	29,799.8
1996	683.8	3,229.8	1,722.4	3,710.5	738.2	398.7	17.1	124.6	29,020.2
1997	716.7	3,380.6	1,716.9	3,695.1	727.3	398.3	19.5	126.1	41,694.1
1998	731.0	3,429.0	1,838.6	3,714.5	725.2	389.0	20.0	121.4	34,861.7
1999	729.8	3,404.2	1,960.4	3,733.9	723.0	379.7	20.4	116.7	35,902.9
2000	721.5	3,346.5	2,082.1	3,753.3	720.9	370.4	20.8	112.0	41,881.1
2001	709.3	3,270.7	2,203.9	3,772.8	718.7	361.1	21.3	107.2	39,822.3
2002	703.2	3,223.8	2,325.6	3,792.2	716.6	351.7	21.7	102.5	35,090.5
2003	707.6	3,224.4	2,447.4	3,811.6	714.4	342.4	22.2	97.8	38,664.7
2004	721.4	3,267.6	2,569.1	3,831.0	712.3	333.1	22.6	93.1	42,496.9
2005	724.3	3,260.7	2,690.9	3,850.5	710.1	323.8	23.1	88.4	46,658.2
2006	712.5	3,187.5	2,812.7	3,869.9	708.0	314.5	23.5	83.7	47,313.4
2007	683.2	3,036.6	2,934.4	3,889.3	705.8	305.2	24.0	78.9	52,153.2
2008	697.9	3,102.1	3,056.2	3,908.7	703.6	295.9	24.4	74.2	53,199.1
2009	707.1	3,142.9	3,177.9	3,928.2	701.5	286.5	24.9	69.5	54,245.0
2010	703.4	3,126.6	3,299.7	3,947.6	699.3	277.2	25.3	64.8	55,290.9

Source: ODEPA AND FAOSTAT.

Regional nitrogen consumptions (ton N), applied as synthetic fertilizers, disaggregated regionally.

Year/ Region	XV	I	II	III	IV	V	MR	VI	VII	VIII	IX	XIV	X	XIV	XII
1990	634.5	252.4	165.6	1,812.2	13,889.4	8,836.3	13,390.1	21,284.9	25,655.5	24,986.4	30,901.5	9,655.2	10,307.8	1,679.2	646.9
1991	608.6	242.1	158.9	1,738.3	13,322.5	8,475.6	12,843.6	20,416.1	24,608.3	23,966.6	29,640.2	9,261.1	9,887.1	1,610.6	620.5
1992	672.8	267.7	175.6	1,921.6	14,727.6	9,369.5	14,198.1	22,569.3	27,203.6	26,494.2	32,766.1	10,237.8	10,929.8	1,780.5	685.9
1993	754.0	300.0	196.8	2,153.5	16,505.0	10,500.3	15,911.7	25,293.2	30,486.8	29,691.8	36,720.7	11,473.4	12,248.9	1,995.4	768.7
1994	754.0	300.0	196.8	2,153.5	16,505.0	10,500.3	15,911.7	25,293.2	30,486.8	29,691.8	36,720.7	11,473.4	12,248.9	1,995.4	768.7
1995	831.3	330.7	217.0	2,374.4	18,197.8	11,577.2	17,543.6	27,887.3	33,613.7	32,737.1	40,486.9	12,650.2	13,505.2	2,200.0	847.6
1996	869.9	346.1	227.1	2,484.8	19,044.2	12,115.7	18,359.6	29,184.4	35,177.1	34,259.7	42,370.0	13,238.5	14,133.4	2,302.4	887.0
1997	850.6	338.4	222.1	2,429.6	18,621.0	11,846.5	17,951.6	28,535.9	34,395.4	33,498.4	41,428.5	12,944.4	13,819.3	2,251.2	867.3
1998	831.3	330.7	217.0	2,374.4	18,197.8	11,577.2	17,543.6	27,887.3	33,613.7	32,737.1	40,486.9	12,650.2	13,505.2	2,200.0	847.6
1999	912.5	363.0	238.2	2,606.3	19,975.0	12,707.8	19,256.9	30,610.7	36,896.2	35,934.0	44,440.7	13,885.5	14,824.1	2,414.9	930.4
2000	908.6	361.5	237.2	2,595.3	19,890.7	12,654.2	19,175.6	30,481.5	36,740.5	35,782.4	44,253.1	13,826.9	14,761.5	2,404.7	926.4
2001	873.8	347.7	228.1	2,495.9	19,128.9	12,169.5	18,441.2	29,314.1	35,333.4	34,412.0	42,558.3	13,297.4	14,196.2	2,312.6	890.9
2002	952.4	378.9	248.6	2,720.2	20,848.5	13,263.5	20,099.0	31,949.3	38,509.7	37,505.4	46,384.0	14,492.7	15,472.3	2,520.5	971.0
2003	854.8	340.1	223.1	2,441.5	18,711.9	11,904.2	18,039.2	28,675.1	34,563.1	33,661.8	41,630.5	13,007.5	13,886.7	2,262.2	871.5
2004	1,131.6	450.2	295.4	3,232.3	24,772.8	15,760.1	23,882.2	37,963.1	45,758.4	44,565.0	55,114.9	17,220.7	18,384.7	2,994.9	1,153.8
2005	930.7	370.3	243.0	2,658.3	20,373.8	12,961.5	19,641.4	31,221.9	37,632.9	36,651.5	45,328.0	14,162.8	15,120.1	2,463.1	948.9
2006	1,048.4	417.1	273.7	2,994.5	22,950.8	14,601.0	22,125.7	35,171.0	42,392.9	41,287.4	51,061.3	15,954.2	17,032.5	2,774.7	1,069.0
2007	1,254.2	499.0	327.4	3,582.5	27,456.8	17,467.7	26,469.8	42,076.3	50,716.1	49,393.5	61,086.4	19,086.5	20,376.6	3,319.4	1,278.8
2008	1,525.7	607.0	398.3	4,357.8	33,399.3	21,248.2	32,198.6	51,182.9	61,692.6	60,083.8	74,307.4	23,217.4	24,786.7	4,037.8	1,555.6
2009	1,336.6	531.8	348.9	3,817.9	29,261.0	18,615.5	28,209.1	44,841.1	54,048.7	52,639.2	65,100.5	20,340.7	21,715.6	3,537.5	1,362.9
2010	1,594.9	634.6	416.4	4,555.6	34,915.4	22,212.7	33,660.2	53,506.2	64,493.1	62,811.1	77,680.4	24,271.3	25,911.8	4,221.1	1,626.2

Source: INE (2007) and FAOSTAT.

Annual harvest (ha) per type of crop.

Year	Annual crops (ha)	Orchards (ha)	Vegetables (ha)	Annual forage (ha)	Permanent woody forages (ha)
1990	1,083,946.9	238,925.3	74,566.8	526,378.6	39,157.1
1991	981,013.8	245,003.3	81,396.5	525,471.2	40,906.6
1992	966,828.6	251,144.2	84,797.5	524,563.8	42,656.2
1993	856,728.5	254,913.0	85,218.4	523,656.4	44,405.7
1994	820,084.7	250,345.7	92,713.2	522,749.0	46,155.2
1995	859,763.0	254,403.2	93,274.2	521,841.7	47,904.7
1996	848,011.8	264,025.9	86,883.5	520,934.3	49,654.3
1997	832,919.3	278,471.9	67,599.0	520,026.9	51,403.8
1998	848,183.7	295,013.7	67,078.8	507,355.1	52,022.0
1999	772,395.7	311,555.4	66,558.6	494,683.4	52,640.2
2000	823,535.2	329,933.1	66,038.4	482,011.7	53,258.4
2001	862,542.1	350,415.7	65,518.1	469,339.9	53,876.6
2002	855,600.3	374,169.6	64,997.9	456,668.2	54,494.8
2003	857,433.0	400,496.4	64,477.7	443,996.4	55,113.0
2004	883,684.6	432,976.4	63,957.5	431,324.7	55,731.2
2005	868,403.6	469,347.6	63,437.3	418,653.0	56,349.4
2006	785,991.3	511,776.7	62,917.0	405,981.2	56,967.6
2007	601,889.7	566,718.1	62,396.8	393,309.5	57,585.8
2008	686,794.0	569,020.6	63,106.4	380,689.9	58,204.0
2009	686,233.8	574,507.5	63,818.4	368,239.5	58,822.3
2010	654,976.0	587,081.8	62,834.4	355,974.0	59,440.5

Source: INE (2007).

Forest tree plantations: annual surface (ha) per species, 1990-2010 series.

Year/ Species	*Pinus radiata*	*Eucalyptus globulus*	*Eucalyptus nitens*	P. chilensis / P. tamarugo	Pseudotsuga menziensii	Populus spp.	Other species
1990	1,243,293.0	107,700.0	-	23,882.1	11,343.0	3,526.0	3,735.0
1991	1,305,325.0	130,915.0	-	23,874.1	11,731.0	3,660.0	7,608.0
1992	1,312,812.0	171,520.0	-	23,882.1	12,135.0	3,718.0	7,956.0
1993	1,360,918.0	206,711.0	-	23,895.3	12,090.0	3,798.0	7,299.8
1994	1,375,886.0	238,312.0	-	23,941.9	12,379.0	3,798.0	9,032.8
1995	1,379,746.0	302,248.0	-	23,862.0	12,477.0	3,842.0	47,736.0
1996	1,387,041.0	308,762.0	-	23,880.0	12,477.0	4,055.0	50,454.0
1997	1,420,015.0	317,211.0	-	23,951.0	12,620.0	4,115.0	54,693.0
1998	1,437,520.0	330,952.0	-	24,057.0	13,225.0	4,287.0	55,481.0
1999	1,458,320.0	342,415.0	-	24,113.0	13,942.0	4,298.0	58,413.0
2000	1,474,773.0	358,616.0	-	24,165.0	14,286.0	4,151.0	60,216.0
2001	1,497,340.0	376,786.0	-	24,263.0	14,184.0	4,077.0	67,071.0
2002	1,513,004.0	387,975.0	-	24,422.0	14,922.0	3,942.0	73,200.0
2003	1,446,414.0	436,706.0	-	24,539.0	15,627.0	5,084.0	59,511.0
2004	1,408,430.0	489,602.1	-	25,254.0	16,460.0	6,009.0	65,086.0
2005	1,424,569.0	525,057.0	-	26,039.0	16,769.0	5,983.0	78,434.0
2006	1,419,300.0	552,337.0	-	26,306.0	16,665.0	3,103.0	42,725.0
2007	1,461,212.0	478,569.0	160,342.0	25,799.0	16,075.0	6,395.0	92,091.0
2008	1,457,224.0	500,269.0	167,900.0	25,878.0	16,677.0	6,278.0	73,613.0
2009	1,478,368.9	496,259.0	184,664.2	24,739.0	17,045.3	6,422.5	97,329.2
2010	1,471,806.1	500,428.1	196,965.7	25,878.0	16,866.7	7,060.3	93,600.4

Source: INFOR.

5A1c. Harvest: annual surface (ha) per species, 1990-2010 series.

Species	P. radiata Roundwood	Eucalyptus spp. Roundwood	Other exotic Roundwoods	Native species Roundwood
1990	26,253.0	7,272.9	302.1	11,621.8
1991	27,860.7	9,403.9	400.1	15,027.1
1992	34,310.4	7,339.6	305.7	11,728.4
1993	35,826.2	7,776.8	328.2	12,427.0
1994	39,010.2	7,202.4	325.7	11,368.9
1995	45,344.8	10,459.5	327.0	14,428.8
1996	44,233.2	8,241.3	275.8	10,832.3
1997	45,141.6	9,344.1	362.7	10,588.3
1998	40,348.1	11,260.1	281.5	7,890.7
1999	43,654.1	15,424.3	387.4	6,644.7
2000	46,127.8	19,401.5	354.6	4,957.1
2001	49,913.0	19,400.3	405.5	3,818.6
2002	49,412.6	21,377.2	368.9	2,482.9
2003	54,013.8	22,034.4	345.4	2,194.8
2004	63,245.9	25,771.5	506.5	2,147.1
2005	62,910.0	28,607.9	724.3	2,252.4
2006	62,459.8	32,148.9	764.9	1,808.5
2007	67,180.8	37,541.4	716.5	1,728.7
2008	66,017.7	44,300.3	699.8	1,742.6
2009	60,449.8	39,525.7	669.4	1,417.4
2010	56,025.8	38,660.9	746.0	1,480.9

Source: INFOR.

5A1f. Wildfires: annual affected surface (ha), 1990-2010 series.

Component	Native forest (ha)	Forest tree plantations (ha)
1990	4,906.6	2,401.6
1991	7,673.8	5,901.2
1992	1,941.4	1,866.0
1993	5,912.7	10,430.2
1994	11,520.4	9,532.0
1995	2,353.6	5,237.3
1996	12,582.8	6,500.7
1997	5,554.9	14,595.2
1998	61,181.1	2,965.8
1999	14,399.1	36,499.0
2000	1,147.5	3,087.6
2001	687.7	1,594.6
2002	31,281.7	22,241.9
2003	4,748.8	6,002.0
2004	6,097.0	10,806.4
2005	8,951.9	7,470.1
2006	2,241.1	1,800.7
2007	2,408.5	25,040.7
2008	8,683.0	8,514.6
2009	10,950.4	21,667.6
2010	9,734.8	15,598.2

Source: CONAF.

Waste Sector

Year	Municipal Solid Waste	National Population	National protein consumption	Total production of industrial wastewaters
	Wastes (Gg)	Population (1,000 inhab)	(kg/person/year)	LIW Production (1,000 t/year)
1990	3,848.0	13,735.0	25.6	55.1
1991	3,920.0	13,768.0	25.6	62.4
1992	3,933.0	13,645.0	28.1	74.8
1993	4,063.0	13,372.0	28.5	78.8
1994	4,135.0	13,398.0	28.5	89.5
1995	4,207.0	13,424.0	28.4	113.9
1996	4,269.0	13,445.0	28.8	119.1
1997	4,332.0	13,467.0	28.5	128.4
1998	4,395.0	14,671.0	28.4	121.4
1999	4,458.0	14,795.0	28.0	110.2
2000	4,520.0	15,326.0	28.7	118.3
2001	4,515.0	15,582.0	29.1	106.6
2002	4,647.0	15,849.0	30.1	103.4
2003	4,802.0	15,853.0	30.9	112.2
2004	4,964.0	15,444.0	31.3	143.5
2005	5,114.0	15,825.0	31.8	175.5
2006	5,311.0	16,018.0	32.5	72.2
2007	5,493.0	16,467.0	31.8	314.1
2008	5,608.0	16,893.0	32.2	227.1
2009	5,780.0	17,268.0	32.6	260.3
2010	5,936.0	17,694.0	33.1	325.3
Source	MMA, 2014; INE 1982, 1992, 2002.	INE	MINSAL	SISS

Annex 2. Key categories analysis.

Key categories analysis, using Method 1 of the 2006GL for absolute levels of Chile's NIR in the year 2010.

IPCC code and categories	GHG	Estimation year 1990 ($GgCO_2eq$)	Absolute value of estimation for the year 1990	Level assessment	Accumulative total
5.A.1.a. Second growth native forests	CO_2	-45,706.68	45,706.68	0.25	0.250
5.A.1.a. Forest tree plantations	CO_2	-39,889.96	39,889.96	0.22	0.469
5.A.1.c. P. radiata roundwood	CO_2	15,135.53	15,135.53	0.08	0.552
1.A.1.a. Main activity electricity and heat production	CO_2	8,252.36	8,252.36	0.05	0.597
1.A.3.b. Road transportation	CO_2	7,577.35	7,577.35	0.04	0.639
5.A.1.e. Firewood	CO_2	7,160.86	7,160.86	0.04	0.678
5.A.1.c. Native species Roundwood	CO_2	6,566.47	6,566.47	0.04	0.714
5.A.1.a. Managed native forest	CO_2	-4,060.69	4,060.69	0.02	0.736
4.A.1. Cattle	CH_4	3,549.58	3,549.58	0.02	0.756
5.A.1.c. Eucalyptus spp. roundwood	CO_2	3,203.99	3,203.99	0.02	0.773
5.A.1.g. Substitution	CO_2	3,161.17	3,161.17	0.02	0.791
1.A.2.f. Non-specified industries	CO_2	2,628.30	2,628.30	0.01	0.805
1.A.2.f. Mining (excluding fuels) and quarrying	CO_2	2,544.38	2,544.38	0.01	0.819
1.A.4.b. Residential	CO_2	2,503.66	2,503.66	0.01	0.833
4.D.2. Manure deposited on pasture, range and paddock	N_2O	2,464.39	2,464.39	0.01	0.846
5.A.1.a. Burned native forest	CO_2	-1,953.05	1,953.05	0.01	0.857
1.A.1.b. Oil Refining	CO_2	1,922.56	1,922.56	0.01	0.867
5.A.2.2. Land converted to Forest land	CO_2	1,707.05	1,707.05	0.01	0.877
1.A.2.a. Iron and steel	CO_2	1,483.45	1,483.45	0.01	0.885
6.A.3. Others	CH_4	1,426.44	1,426.44	0.01	0.893
4.D.1. Direct emissions from agricultural soils	N_2O	1,282.87	1,282.87	0.01	0.900
5.C.2. Land converted to Grassland	CO_2	1,247.01	1,247.01	0.01	0.907
2.C.1. Iron and steel	CO_2	1,221.37	1,221.37	0.01	0.913
4.D.3. Indirect emissions from agricultural soils	N_2O	1,108.94	1,108.94	0.01	0.919
5.A.1.f. Burned native forest	CO_2	990.88	990.88	0.01	0.925
1.A.3.d. National water-borne navigation	CO_2	871.49	871.49	0.00	0.930
2.A.1. Cement production	CO_2	786.65	786.65	0.00	0.934
4.B.1. Cattle	CH_4	767.08	767.08	0.00	0.938
1.B.2.b. Natural gas	CH_4	756.28	756.28	0.00	0.942
1.B.2.a. Oil	CH_4	634.19	634.19	0.00	0.946
2.B.5.a. Methanol	CO_2	572.18	572.18	0.00	0.949
1.A.3.a. Domestic aviation	CO_2	562.97	562.97	0.00	0.952
1.A.2.f. Non-metallic minerals	CO_2	533.52	533.52	0.00	0.955
6.A.2. Unmanaged solid waste disposal sites	CH_4	489.43	489.43	0.00	0.957
1.B.1.a. Coal extraction and handling	CH_4	481.46	481.46	0.00	0.960
5.A.1.f. Burned forest tree plantations	CO_2	471.14	471.14	0.00	0.963
4.A.3. Sheep	CH_4	453.98	453.98	0.00	0.965
1.A.4.c. Agriculture / Forestry / Fishing	CO_2	424.68	424.68	0.00	0.968
1.A.4.b. Residential	CH_4	417.00	417.00	0.00	0.970
1.A.4.a. Commercial / Institutional	CO_2	406.17	406.17	0.00	0.972
1.A.1.c. Manufacture of solid fuels and other energy industries	CO_2	385.88	385.88	0.00	0.974
1.A.2.e. Food processing, beverages and tobacco	CO_2	326.03	326.03	0.00	0.976

(continuation) Key categories analysis, using Method 1 of the 2006GL for absolute levels of Chile's NIR in the year 2010.

IPCC code and categories	GHG	Estimation year 1990 ($GgCO_2eq$)	Absolute value of estimation for the year 1990	Level assessment	Accumulative total
6.B.2. Domestic and commercial wastewater	CH_4	304.43	304.43	0.00	0.978
4.B.8. Swine	CH_4	270.18	270.18	0.00	0.979
5.A.1.c. Other exotic roundwoods	CO_2	265.76	265.76	0.00	0.981
2.A.2. Lime production	CO_2	256.31	256.31	0.00	0.982
1.A.2.d. Pulp, paper and printing	CO_2	244.93	244.93	0.00	0.983
5.B.1. Cropland remaining Cropland	CO_2	191.44	191.44	0.00	0.984
6.B.2. Domestic and commercial wastewater	N_2O	188.32	188.32	0.00	0.985
5.E.2. Land converted to Settlement	CO_2	187.35	187.35	0.00	0.986
4.A.6. Horses	CH_4	154.22	154.22	0.00	0.987
2.B.2. Nitric acid production	N_2O	141.17	141.17	0.00	0.988
4.C.1. Irrigated	CH_4	137.90	137.90	0.00	0.989
5.B.2. Land converted to Cropland	CO_2	137.90	137.90	0.00	0.990
5.F.2. Land converted to Other land	CO_2	121.77	121.77	0.00	0.990
1.A.3.b. Road transportation	N_2O	115.14	115.14	0.00	0.991
4.B.13. Solid storage and dry lots	N_2O	107.91	107.91	0.00	0.991
5.A.1.d. Wastes	CH_4	106.14	106.14	0.00	0.992
4.F.F. Field burning of agricultural residues	CH_4	104.39	104.39	0.00	0.993
4.A.4. Goats	CH_4	89.95	89.95	0.00	0.993
1.A.4.b. Residential	N_2O	83.42	83.42	0.00	0.994
3.C.C. Chemical products, manufacture and processing	CO_2	82.35	82.35	0.00	0.994
5.A.1.b. Lands in transition	CO_2	-68.14	68.14	0.00	0.994
1.A.4.a. Commercial / Institutional	CH_4	67.02	67.02	0.00	0.995
5.A.1.h. Restoration	CO_2	66.54	66.54	0.00	0.995
1.A.3.c. Railways	CO_2	57.56	57.56	0.00	0.995
1.A.3.b. Road transportation	CH_4	46.55	46.55	0.00	0.996
5.A.1.d. Wastes	N_2O	46.08	46.08	0.00	0.996
4.A.8. Swine	CH_4	45.85	45.85	0.00	0.996
2.C.5.b. Zinc production	CO_2	43.17	43.17	0.00	0.996
5.A.1.f. Burned native forest	CH_4	41.29	41.29	0.00	0.997
2.B.5.a. Methanol	CH_4	41.25	41.25	0.00	0.997
1.A.1.a. Main activity electricity and heat production	N_2O	40.61	40.61	0.00	0.997
6.B.1. Industrial wastewater	CH_4	40.48	40.48	0.00	0.997
4.F.F. Field burning of agricultural residues	N_2O	39.95	39.95	0.00	0.997
5.A.1.f. Burned forest tree plantations	CH_4	33.84	33.84	0.00	0.998
4.B.11. Anaerobic lagoons	N_2O	33.61	33.61	0.00	0.998
4.B.14. Other MMS	N_2O	31.59	31.59	0.00	0.998
2.C.2. Ferroalloys	CO_2	31.56	31.56	0.00	0.998
1.A.2.d. Pulp, paper and printing	N_2O	25.02	25.02	0.00	0.998
5.C.2. Land converted to Grassland	CO_2	-21.53	21.53	0.00	0.998
4.A.5. Camelidae	CH_4	19.66	19.66	0.00	0.999
1.B.2.c. Venting and flaring	CH_4	19.63	19.63	0.00	0.999
5.A.1.f. Burned native forest	N_2O	17.92	17.92	0.00	0.999
1.A.2.f. Non-specified industries	N_2O	15.79	15.79	0.00	0.999
5.A.1.f. Burned forest tree plantations	N_2O	14.69	14.69	0.00	0.999
4.B.3. Sheep	CH_4	14.53	14.53	0.00	0.999
4.B.6. Horses	CH_4	14.05	14.05	0.00	0.999
1.A.4.a. Commercial / Institutional	N_2O	13.53	13.53	0.00	0.999
2.A.7.a. Glass production	CO_2	12.98	12.98	0.00	0.999
1.A.2.d. Pulp, paper and printing	CH_4	12.61	12.61	0.00	0.999

(continuation) Key categories analysis, using Method 1 of the 2006GL for absolute levels of Chile's NIR in the year 2010.

IPCC code and categories	GHG	Estimation year 1990 ($GgCO_2eq$)	Absolute value of estimation for the year 1990	Level assessment	Accumulative total
1.A.4.c. Agriculture / Forestry / Fishing	CH_4	11.98	11.98	0.00	0.999
6.D.1. Biological treatment of solid waste	N_2O	8.37	8.37	0.00	0.999
4.B.9. Poultry	CH_4	7.63	7.63	0.00	0.999
6.D.1. Biological treatment of solid waste	CH_4	7.56	7.56	0.00	1.000
1.A.3.d. National water-borne navigation	N_2O	7.26	7.26	0.00	1.000
1.A.2.f. Mining (excluding fuels) and quarrying	N_2O	7.14	7.14	0.00	1.000
1.A.2.f. Non-specified industries	CH_4	7.08	7.08	0.00	1.000
1.A.3.c. Railways	N_2O	6.84	6.84	0.00	1.000
1.A.1.a. Main activity electricity and heat production	CH_4	5.13	5.13	0.00	1.000
1.A.3.a. Domestic aviation	N_2O	4.89	4.89	0.00	1.000
5.C.1. Grassland remaining Grassland	CH_4	4.80	4.80	0.00	1.000
4.B.5. Camelidae	CH_4	4.72	4.72	0.00	1.000
4.A.7. Mules and asses	CH_4	3.82	3.82	0.00	1.000
1.A.2.a. Iron and steel	N_2O	3.47	3.47	0.00	1.000
5.B.2. Land converted to Cropland	CO_2	-3.13	3.13	0.00	1.000
4.B.4. Goats	CH_4	3.06	3.06	0.00	1.000
1.A.2.c. Chemicals products	CO_2	2.66	2.66	0.00	1.000
1.A.2.f. Mining (excluding fuels) and quarrying	CH_4	2.63	2.63	0.00	1.000
1.A.2.f. Non-metallic minerals	N_2O	2.57	2.57	0.00	1.000
1.A.1.b. Oil Refining	N_2O	2.17	2.17	0.00	1.000
1.A.2.e. Food processing, beverages and tobacco	N_2O	2.10	2.10	0.00	1.000
5.C.1. Grassland remaining Grassland	N_2O	2.08	2.08	0.00	1.000
1.B.2.a. Oil	CO_2	2.00	2.00	0.00	1.000
1.A.3.d. National water-borne navigation	CH_4	1.72	1.72	0.00	1.000
1.A.4.c. Agriculture / Forestry / Fishing	N_2O	1.58	1.58	0.00	1.000
1.A.2.a. Iron and steel	CH_4	1.57	1.57	0.00	1.000
1.A.2.f. Non-metallic minerals	CH_4	1.15	1.15	0.00	1.000
1.A.2.e. Food processing, beverages and tobacco	CH_4	0.98	0.98	0.00	1.000
1.A.1.b. Oil Refining	CH_4	0.97	0.97	0.00	1.000
2.B.5.b. Ethylene	CO_2	0.75	0.75	0.00	1.000
2.C.5.a. Lead production	CO_2	0.58	0.58	0.00	1.000
1.B.2.b. Natural gas	CO_2	0.55	0.55	0.00	1.000
6.A.1. Managed solid waste disposal sites	CH_4	0.43	0.43	0.00	1.000
4.B.7. Mules and asses	CH_4	0.34	0.34	0.00	1.000
5.E.2. Land converted to Settlement	CO_2	-0.13	0.13	0.00	1.000
1.A.1.c. Manufacture of solid fuels and other energy industries	N_2O	0.13	0.13	0.00	1.000
2.C.2. Ferroalloys	CH_4	0.11	0.11	0.00	1.000
2.B.5.b. Ethylene	CH_4	0.09	0.09	0.00	1.000
1.A.3.a. Domestic aviation	CH_4	0.08	0.08	0.00	1.000
1.A.1.c. Manufacture of solid fuels and other energy industries	CH_4	0.08	0.08	0.00	1.000
1.A.3.c. Railways	CH_4	0.07	0.07	0.00	1.000
6.C.C. Waste incineration	CO_2	0.07	0.07	0.00	1.000
1.B.2.c. Venting and flaring	CO_2	0.01	0.01	0.00	1.000
1.A.2.c. Chemicals products	N_2O	0.00	0.00	0.00	1.000
6.C.C. Waste incineration	N_2O	0.00	0.00	0.00	1.000
1.A.2.c. Chemicals products	CH_4	0.00	0.00	0.00	1.000
Total		**-924.98**	**182,481.66**	**1.00**	

Key categories analysis, using Method 1 of the 2006GL for absolute levels of Chile's NIR in the year 2010.

IPCC code and categories	GHG	Estimation year 2010 ($GgCO_2eq$)	Absolute value of estimation year 2010	Level assessment	Accumulative total
5.A.1.a. Forest tree plantations	CO_2	-76,978.37	76,978.37	0.26	0.255
5.A.1.a. Second growth native forests	CO_2	-45,274.92	45,274.92	0.15	0.405
5.A.1.c. P. radiata roundwood	CO_2	32,323.74	32,323.74	0.11	0.512
1.A.1.a. Main activity electricity and heat production	CO_2	24,673.95	24,673.95	0.08	0.594
5.A.1.c. Eucalyptus spp. roundwood	CO_2	22,625.72	22,625.72	0.07	0.669
1.A.3.b. Road transportation	CO_2	19,075.50	19,075.50	0.06	0.732
5.A.1.e. Firewood	CO_2	11,945.81	11,945.81	0.04	0.772
1.A.2.f. Mining (excluding fuels) and quarrying	CO_2	6,107.65	6,107.65	0.02	0.792
4.A.1. Cattle	CH_4	4,048.98	4,048.98	0.01	0.805
5.A.1.a. Burned native forest	CO_2	-3,736.23	3,736.23	0.01	0.818
1.A.4.b. Residential	CO_2	3,514.87	3,514.87	0.01	0.829
5.A.1.g. Substitution	CO_2	3,161.17	3,161.17	0.01	0.840
5.A.1.f. Burned forest tree plantations	CO_2	3,067.67	3,067.67	0.01	0.850
4.D.1. Direct emissions from agricultural soils	N_2O	2,920.10	2,920.10	0.01	0.860
1.A.2.f. Non-specified industries	CO_2	2,913.12	2,913.12	0.01	0.869
5.A.1.a. Managed native forest	CO_2	-2,610.45	2,610.45	0.01	0.878
4.D.2. Manure deposited on pasture, range and paddock	N_2O	2,586.71	2,586.71	0.01	0.887
6.A.1. Managed solid waste disposal sites	CH_4	1,823.75	1,823.75	0.01	0.893
4.D.3. Indirect emissions from agricultural soils	N_2O	1,744.58	1,744.58	0.01	0.898
5.A.2.2. Land converted to Forest land	CO_2	1,707.05	1,707.05	0.01	0.904
1.A.4.a. Commercial / Institutional	CO_2	1,673.63	1,673.63	0.01	0.910
1.A.1.b. Oil Refining	CO_2	1,550.06	1,550.06	0.01	0.915
5.A.1.b. Lands in transition	CO_2	-1,430.89	1,430.89	0.00	0.919
5.C.2. Land converted to Grassland	CO_2	1,247.01	1,247.01	0.00	0.924
2.A.1. Cement production	CO_2	1,191.78	1,191.78	0.00	0.928
2.B.2. Nitric acid production	N_2O	1,124.88	1,124.88	0.00	0.931
2.C.1. Iron and steel	CO_2	1,094.11	1,094.11	0.00	0.935
2.A.2. Lime production	CO_2	1,076.37	1,076.37	0.00	0.938
1.A.2.f. Non-metallic minerals	CO_2	941.35	941.35	0.00	0.942
1.A.2.c. Chemicals products	CO_2	937.45	937.45	0.00	0.945
1.A.4.c. Agriculture / Forestry / Fishing	CO_2	885.18	885.18	0.00	0.948
4.B.1. Cattle	CH_4	875.01	875.01	0.00	0.950
5.A.1.c. Native species Roundwood	CO_2	869.80	869.80	0.00	0.953
5.A.1.f. Burned native forest	CO_2	841.05	841.05	0.00	0.956
1.B.2.b. Natural gas	CH_4	796.39	796.39	0.00	0.959
1.A.1.c. Manufacture of solid fuels and other energy industries	CO_2	789.16	789.16	0.00	0.961
1.A.3.a. Domestic aviation	CO_2	782.91	782.91	0.00	0.964
1.A.4.b. Residential	CH_4	753.23	753.23	0.00	0.967
5.A.1.c. Other exotic roundwoods	CO_2	641.78	641.78	0.00	0.969
2.B.5.a. Methanol	CO_2	626.45	626.45	0.00	0.971
6.A.3. Others	CH_4	613.08	613.08	0.00	0.973
1.A.2.a. Iron and steel	CO_2	583.26	583.26	0.00	0.975
1.A.2.d. Pulp, paper and printing	CO_2	530.99	530.99	0.00	0.976
6.B.2. Domestic and commercial wastewater	CH_4	512.44	512.44	0.00	0.978
5.B.1. Cropland remaining Cropland	CO_2	494.06	494.06	0.00	0.980
4.B.8. Swine	CH_4	448.03	448.03	0.00	0.981
1.A.3.d. National water-borne navigation	CO_2	430.06	430.06	0.00	0.983

(continuation) Key categories analysis, using Method 1 of the 2006GL for absolute levels of Chile's NIR in the year 2010.

IPCC code and categories	GHG	Estimation year 2010 ($GgCO_2eq$)	Absolute value of estimation year 2010	Level assessment	Accumulative total
4.A.3. Sheep	CH_4	414.62	414.62	0.00	0.984
6.B.2. Domestic and commercial wastewater	N_2O	313.50	313.50	0.00	0.985
1.A.3.b. Road transportation	N_2O	289.86	289.86	0.00	0.986
5.A.1.d. Wastes	CH_4	251.80	251.80	0.00	0.987
1.A.2.e. Food processing, beverages and tobacco	CO_2	248.89	248.89	0.00	0.988
3.C.C. Chemical products, manufacture and processing	CO_2	243.04	243.04	0.00	0.989
5.A.1.f. Burned forest tree plantations	CH_4	222.42	222.42	0.00	0.989
6.A.2. Unmanaged solid waste disposal sites	CH_4	206.85	206.85	0.00	0.990
5.E.2. Land converted to Settlement	CO_2	186.91	186.91	0.00	0.991
1.B.2.a. Oil	CH_4	164.09	164.09	0.00	0.991
2.F.4. Aerosols	HFC	155.18	155.18	0.00	0.992
4.B.14. Other MMS	N_2O	150.42	150.42	0.00	0.992
1.A.4.b. Residential	N_2O	149.49	149.49	0.00	0.993
1.A.3.c. Railways	CO_2	136.67	136.67	0.00	0.993
5.B.2. Land converted to Cropland	CO_2	133.03	133.03	0.00	0.993
5.F.2. Land converted to Other land	CO_2	123.24	123.24	0.00	0.994
4.B.13. Solid storage and dry lots	N_2O	118.64	118.64	0.00	0.994
1.A.1.a. Main activity electricity and heat production	N_2O	115.80	115.80	0.00	0.995
5.A.1.d. Wastes	N_2O	109.33	109.33	0.00	0.995
4.A.6. Horses	CH_4	104.79	104.79	0.00	0.995
4.A.8. Swine	CH_4	103.94	103.94	0.00	0.996
4.C.1. Irrigated	CH_4	103.79	103.79	0.00	0.996
1.A.3.b. Road transportation	CH_4	98.16	98.16	0.00	0.996
5.A.1.f. Burned forest tree plantations	N_2O	96.57	96.57	0.00	0.997
2.F.1. Refrigeration and air conditioning	HFC	95.77	95.77	0.00	0.997
4.A.4. Goats	CH_4	73.45	73.45	0.00	0.997
5.A.1.h. Restoration	CO_2	67.55	67.55	0.00	0.998
1.A.2.d. Pulp, paper and printing	N_2O	52.15	52.15	0.00	0.998
2.A.7.a. Glass production	CO_2	48.08	48.08	0.00	0.998
2.C.5.b. Zinc production	CO_2	47.58	47.58	0.00	0.998
2.B.5.a. Methanol	CH_4	45.16	45.16	0.00	0.998
1.B.1.a. Coal extraction and handling	CH_4	39.96	39.96	0.00	0.998
4.B.11. Anaerobic lagoons	N_2O	37.38	37.38	0.00	0.998
6.D.1. Biological treatment of solid waste	N_2O	35.52	35.52	0.00	0.999
5.A.1.f. Burned native forest	CH_4	32.70	32.70	0.00	0.999
6.D.1. Biological treatment of solid waste	CH_4	32.36	32.36	0.00	0.999
2.F.3. Fire extinguishers	HFC	30.35	30.35	0.00	0.999
1.A.2.d. Pulp, paper and printing	CH_4	26.39	26.39	0.00	0.999
1.A.2.f. Non-specified industries	N_2O	24.00	24.00	0.00	0.999
1.A.1.a. Main activity electricity and heat production	CH_4	21.64	21.64	0.00	0.999
5.C.2. Land converted to Grassland	CO_2	-21.53	21.53	0.00	0.999
4.F.F. Field burning of agricultural residues	CH_4	21.07	21.07	0.00	0.999
4.B.9. Poultry	CH_4	20.90	20.90	0.00	0.999
1.A.3.c. Railways	N_2O	16.35	16.35	0.00	0.999
6.B.1. Industrial wastewater	CH_4	16.28	16.28	0.00	0.999
1.B.2.c. Venting and flaring	CH_4	16.09	16.09	0.00	0.999
1.A.2.f. Mining (excluding fuels) and quarrying	N_2O	15.34	15.34	0.00	1.000

(continuation) Key categories analysis, using Method 1 of the 2006GL for absolute levels of Chile's NIR in the year 2010.

IPCC code and categories	GHG	Estimation year 2010 ($GgCO_2eq$)	Absolute value of estimation year 2010	Level assessment	Accumulative total
5.A.1.f. Burned native forest	N_2O	14.20	14.20	0.00	1.000
4.B.3. Sheep	CH_4	13.27	13.27	0.00	1.000
1.A.2.f. Non-specified industries	CH_4	11.44	11.44	0.00	1.000
4.A.5. Camelidae	CH_4	11.36	11.36	0.00	1.000
5.C.1. Grassland remaining Grassland	CH_4	10.87	10.87	0.00	1.000
4.B.6. Horses	CH_4	9.55	9.55	0.00	1.000
4.F.F. Field burning of agricultural residues	N_2O	8.06	8.06	0.00	1.000
1.A.3.a. Domestic aviation	N_2O	6.78	6.78	0.00	1.000
2.F.3. Fire extinguishers	PFC	6.14	6.14	0.00	1.000
1.A.2.f. Mining (excluding fuels) and quarrying	CH_4	5.38	5.38	0.00	1.000
4.A.7. Mules and asses	CH_4	5.31	5.31	0.00	1.000
5.C.1. Grassland remaining Grassland	N_2O	4.72	4.72	0.00	1.000
1.A.2.f. Non-metallic minerals	N_2O	4.11	4.11	0.00	1.000
1.A.4.a. Commercial / Institutional	CH_4	4.05	4.05	0.00	1.000
1.A.4.c. Agriculture / Forestry / Fishing	CH_4	3.68	3.68	0.00	1.000
1.A.3.d. National water-borne navigation	N_2O	3.52	3.52	0.00	1.000
5.B.2. Land converted to Cropland	CO_2	-3.13	3.13	0.00	1.000
1.A.4.a. Commercial / Institutional	N_2O	2.93	2.93	0.00	1.000
4.B.5. Camelidae	CH_4	2.73	2.73	0.00	1.000
4.B.4. Goats	CH_4	2.50	2.50	0.00	1.000
1.A.4.c. Agriculture / Forestry / Fishing	N_2O	2.20	2.20	0.00	1.000
1.A.2.a. Iron and steel	N_2O	1.86	1.86	0.00	1.000
1.A.2.f. Non-metallic minerals	CH_4	1.85	1.85	0.00	1.000
1.A.1.b. Oil Refining	N_2O	1.36	1.36	0.00	1.000
1.A.2.e. Food processing, beverages and tobacco	N_2O	1.21	1.21	0.00	1.000
1.A.2.a. Iron and steel	CH_4	0.84	0.84	0.00	1.000
1.A.3.d. National water-borne navigation	CH_4	0.84	0.84	0.00	1.000
1.B.2.b. Natural gas	CO_2	0.81	0.81	0.00	1.000
1.A.1.b. Oil Refining	CH_4	0.70	0.70	0.00	1.000
2.B.5.b. Ethylene	CO_2	0.66	0.66	0.00	1.000
1.A.2.e. Food processing, beverages and tobacco	CH_4	0.55	0.55	0.00	1.000
1.B.2.a. Oil	CO_2	0.51	0.51	0.00	1.000
1.A.2.c. Chemicals products	N_2O	0.50	0.50	0.00	1.000
4.B.7. Mules and asses	CH_4	0.48	0.48	0.00	1.000
1.A.1.c. Manufacture of solid fuels and other energy industries	N_2O	0.42	0.42	0.00	1.000
2.C.5.a. Lead production	CO_2	0.36	0.36	0.00	1.000
1.A.2.c. Chemicals products	CH_4	0.34	0.34	0.00	1.000
6.C.C. Waste incineration	CO_2	0.28	0.28	0.00	1.000
2.C.2. Ferroalloys	CO_2	0.24	0.24	0.00	1.000
1.A.1.c. Manufacture of solid fuels and other energy industries	CH_4	0.20	0.20	0.00	1.000
1.A.3.c. Railways	CH_4	0.16	0.16	0.00	1.000
5.E.2. Land converted to Settlement	CO_2	-0.13	0.13	0.00	1.000
1.A.3.a. Domestic aviation	CH_4	0.11	0.11	0.00	1.000
2.B.5.b. Ethylene	CH_4	0.08	0.08	0.00	1.000
6.C.C. Waste incineration	N_2O	0.01	0.01	0.00	1.000
1.B.2.c. Venting and flaring	CO_2	0.01	0.01	0.00	1.000
Total		**41,698.50**	**301,809.80**	**1.00**	

Key categories analysis, using Method 1 of the 2006GL for Chile's NIR trend during the years 1990 and 2010.

IPCC code and categories	GHG	Estimation year 1990 ($GgCO_2eq$)	Estimation year 2010 ($GgCO_2eq$)	Trend assessment	Contribution to trend	Accumulative total
5.A.1.a. Second growth native forests	CO_2	-45,706.68	-45,274.92	1.12	0.25	0.247
5.A.1.a. Forest tree plantations	CO_2	-39,889.96	-76,978.37	1.00	0.22	0.467
5.A.1.c. P. radiata roundwood	CO_2	15,135.53	32,323.74	0.38	0.08	0.551
1.A.1.a. Main activity electricity and heat production	CO_2	8,252.36	24,673.95	0.21	0.05	0.597
1.A.3.b. Road transportation	CO_2	7,577.35	19,075.50	0.19	0.04	0.639
5.A.1.e. Firewood	CO_2	7,160.86	11,945.81	0.18	0.04	0.679
5.A.1.c. Native species Roundwood	CO_2	6,566.47	869.80	0.16	0.03	0.713
5.A.1.a. Managed native forest	CO_2	-4,060.69	-2,610.45	0.10	0.02	0.735
5.A.1.c. Eucalyptus spp. roundwood	CO_2	3,203.99	22,625.72	0.09	0.02	0.755
4.A.1. Cattle	CH_4	3,549.58	4,048.98	0.09	0.02	0.774
5.A.1.g. Substitution	CO_2	3,161.17	3,161.17	0.08	0.02	0.791
1.A.2.f. Non-specified industries	CO_2	2,628.30	2,913.12	0.06	0.01	0.805
1.A.2.f. Mining (excluding fuels) and quarrying	CO_2	2,544.38	6,107.65	0.06	0.01	0.820
1.A.4.b. Residential	CO_2	2,503.66	3,514.87	0.06	0.01	0.833
4.D.2. Manure deposited on pasture, range and paddock	N_2O	2,464.39	2,586.71	0.06	0.01	0.847
5.A.1.a. Burned native forest	CO_2	-1,953.05	-3,736.23	0.05	0.01	0.857
1.A.1.b. Oil Refining	CO_2	1,922.56	1,550.06	0.05	0.01	0.868
5.A.2.2. Land converted to Forest land	CO_2	1,707.05	1,707.05	0.04	0.01	0.877
1.A.2.a. Iron and steel	CO_2	1,483.45	583.26	0.04	0.01	0.885
6.A.3. Others	CH_4	1,426.44	613.08	0.03	0.01	0.892
4.D.1. Direct emissions from agricultural soils	N_2O	1,282.87	2,920.10	0.03	0.01	0.900
5.C.2. Land converted to Grassland	CO_2	1,247.01	1,247.01	0.03	0.01	0.906
2.C.1. Iron and steel	CO_2	1,221.37	1,094.11	0.03	0.01	0.913
4.D.3. Indirect emissions from agricultural soils	N_2O	1,108.94	1,744.58	0.03	0.01	0.919
5.A.1.f. Burned native forest	CO_2	990.88	841.05	0.02	0.01	0.924
1.A.3.d. National water-borne navigation	CO_2	871.49	430.06	0.02	0.00	0.929
2.A.1. Cement production	CO_2	786.65	1,191.78	0.02	0.00	0.933
4.B.1. Cattle	CH_4	767.08	875.01	0.02	0.00	0.937
1.B.2.b. Natural gas	CH_4	756.28	796.39	0.02	0.00	0.941
1.B.2.a. Oil	CH_4	634.19	164.09	0.02	0.00	0.945
2.B.5.a. Methanol	CO_2	572.18	626.45	0.01	0.00	0.948
1.A.3.a. Domestic aviation	CO_2	562.97	782.91	0.01	0.00	0.951
1.A.2.f. Non-metallic minerals	CO_2	533.52	941.35	0.01	0.00	0.954
5.A.1.f. Burned forest tree plantations	CO_2	471.14	3,067.67	0.01	0.00	0.957
6.A.2. Unmanaged solid waste disposal sites	CH_4	489.43	206.85	0.01	0.00	0.959
1.B.1.a. Coal extraction and handling	CH_4	481.46	39.96	0.01	0.00	0.962
4.A.3. Sheep	CH_4	453.98	414.62	0.01	0.00	0.964
1.A.4.c. Agriculture / Forestry / Fishing	CO_2	424.68	885.18	0.01	0.00	0.967
1.A.4.a. Commercial / Institutional	CO_2	406.17	1,673.63	0.01	0.00	0.969
1.A.4.b. Residential	CH_4	417.00	753.23	0.01	0.00	0.971
1.A.1.c. Manufacture of solid fuels and other energy industries	CO_2	385.88	789.16	0.01	0.00	0.973
1.A.2.e. Food processing, beverages and tobacco	CO_2	326.03	248.89	0.01	0.00	0.975
6.B.2. Domestic and commercial wastewater	CH_4	304.43	512.44	0.01	0.00	0.977
2.A.2. Lime production	CO_2	256.31	1,076.37	0.01	0.00	0.978
4.B.8. Swine	CH_4	270.18	448.03	0.01	0.00	0.980
5.A.1.c. Other exotic roundwoods	CO_2	265.76	641.78	0.01	0.00	0.981
1.A.2.d. Pulp, paper and printing	CO_2	244.93	530.99	0.01	0.00	0.983
5.B.1. Cropland remaining Cropland	CO_2	191.44	494.06	0.00	0.00	0.984
6.B.2. Domestic and commercial wastewater	N_2O	188.32	313.50	0.00	0.00	0.985
5.E.2. Land converted to Settlement	CO_2	187.35	186.91	0.00	0.00	0.986

(continuation) Key categories analysis, using Method 1 of the 2006GL for Chile's NIR trend during the years 1990 and 2010.

IPCC code and categories	GHG	Estimation year 1990 ($GgCO_2eq$)	Estimation year 2010 ($GgCO_2eq$)	Trend assessment	Contribution to trend	Accumulative total
2.B.2. Nitric acid production	N_2O	141.17	1,124.88	0.00	0.00	0.987
4.A.6. Horses	CH_4	154.22	104.79	0.00	0.00	0.988
5.B.2. Land converted to Cropland	CO_2	137.90	133.03	0.00	0.00	0.988
4.C.1. Irrigated	CH_4	137.90	103.79	0.00	0.00	0.989
5.F.2. Land converted to Other land	CO_2	121.77	123.24	0.00	0.00	0.990
1.A.3.b. Road transportation	N_2O	115.14	289.86	0.00	0.00	0.990
5.A.1.d. Wastes	CH_4	106.14	251.80	0.00	0.00	0.991
4.B.13. Solid storage and dry lots	N_2O	107.91	118.64	0.00	0.00	0.991
4.F.F. Field burning of agricultural residues	CH_4	104.39	21.07	0.00	0.00	0.992
5.A.1.b. Lands in transition	CO_2	-68.14	-1,430.89	0.00	0.00	0.993
4.A.4. Goats	CH_4	89.95	73.45	0.00	0.00	0.993
3.C.C. Chemical products, manufacture and processing	CO_2	82.35	243.04	0.00	0.00	0.994
1.A.4.b. Residential	N_2O	83.42	149.49	0.00	0.00	0.994
5.A.1.h. Restoration	CO_2	66.54	67.55	0.00	0.00	0.994
1.A.4.a. Commercial / Institutional	CH_4	67.02	4.05	0.00	0.00	0.995
1.A.3.c. Railways	CO_2	57.56	136.67	0.00	0.00	0.995
1.A.3.b. Road transportation	CH_4	46.55	98.16	0.00	0.00	0.995
5.A.1.d. Wastes	N_2O	46.08	109.33	0.00	0.00	0.996
4.A.8. Swine	CH_4	45.85	103.94	0.00	0.00	0.996
2.C.5.b. Zinc production	CO_2	43.17	47.58	0.00	0.00	0.996
1.A.1.a. Main activity electricity and heat production	N_2O	40.61	115.80	0.00	0.00	0.996
2.B.5.a. Methanol	CH_4	41.25	45.16	0.00	0.00	0.996
5.A.1.f. Burned native forest	CH_4	41.29	32.70	0.00	0.00	0.997
6.A.1. Managed solid waste disposal sites	CH_4	0.43	1,823.75	0.00	0.00	0.997
6.B.1. Industrial wastewater	CH_4	40.48	16.28	0.00	0.00	0.997
4.F.F. Field burning of agricultural residues	N_2O	39.95	8.06	0.00	0.00	0.997
5.A.1.f. Burned forest tree plantations	CH_4	33.84	222.42	0.00	0.00	0.998
4.B.14. Other MMS	N_2O	31.59	150.42	0.00	0.00	0.998
4.B.11. Anaerobic lagoons	N_2O	33.61	37.38	0.00	0.00	0.998
2.C.2. Ferroalloys	CO_2	31.56	0.24	0.00	0.00	0.998
1.A.2.d. Pulp, paper and printing	N_2O	25.02	52.15	0.00	0.00	0.998
1.A.2.c. Chemicals products	CO_2	2.66	937.45	0.00	0.00	0.998
5.C.2. Land converted to Grassland	CO_2	-21.53	-21.53	0.00	0.00	0.998
1.B.2.c. Venting and flaring	CH_4	19.63	16.09	0.00	0.00	0.999
4.A.5. Camelidae	CH_4	19.66	11.36	0.00	0.00	0.999
5.A.1.f. Burned native forest	N_2O	17.92	14.20	0.00	0.00	0.999
5.A.1.f. Burned forest tree plantations	N_2O	14.69	96.57	0.00	0.00	0.999
1.A.2.f. Non-specified industries	N_2O	15.79	24.00	0.00	0.00	0.999
4.B.3. Sheep	CH_4	14.53	13.27	0.00	0.00	0.999
4.B.6. Horses	CH_4	14.05	9.55	0.00	0.00	0.999
2.A.7.a. Glass production	CO_2	12.98	48.08	0.00	0.00	0.999
1.A.4.a. Commercial / Institutional	N_2O	13.53	2.93	0.00	0.00	0.999
1.A.2.d. Pulp, paper and printing	CH_4	12.61	26.39	0.00	0.00	0.999
1.A.4.c. Agriculture / Forestry / Fishing	CH_4	11.98	3.68	0.00	0.00	0.999
6.D.1. Biological treatment of solid waste	N_2O	8.37	35.52	0.00	0.00	0.999
6.D.1. Biological treatment of solid waste	CH_4	7.56	32.36	0.00	0.00	0.999
4.B.9. Poultry	CH_4	7.63	20.90	0.00	0.00	0.999
1.A.2.f. Mining (excluding fuels) and quarrying	N_2O	7.14	15.34	0.00	0.00	1.000
1.A.3.d. National water-borne navigation	N_2O	7.26	3.52	0.00	0.00	1.000
1.A.2.f. Non-specified industries	CH_4	7.08	11.44	0.00	0.00	1.000
1.A.3.c. Railways	N_2O	6.84	16.35	0.00	0.00	1.000

(continuation) Key categories analysis, using Method 1 of the 2006GL for Chile's NIR trend during the years 1990 and 2010.

IPCC code and categories	GHG	Estimation year 1990 ($GgCO_2eq$)	Estimation year 2010 ($GgCO_2eq$)	Trend assessment	Contribution to trend	Accumulative total
1.A.1.a. Main activity electricity and heat production	CH_4	5.13	21.64	0.00	0.00	1.000
5.C.1. Grassland remaining Grassland	CH_4	4.80	10.87	0.00	0.00	1.000
1.A.3.a. Domestic aviation	N_2O	4.89	6.78	0.00	0.00	1.000
4.B.5. Camelidae	CH_4	4.72	2.73	0.00	0.00	1.000
4.A.7. Mules and asses	CH_4	3.82	5.31	0.00	0.00	1.000
1.A.2.a. Iron and steel	N_2O	3.47	1.86	0.00	0.00	1.000
2.F.4. Aerosols	HFC	0.00	155.18	0.00	0.00	1.000
5.B.2. Land converted to Cropland	CO_2	-3.13	-3.13	0.00	0.00	1.000
4.B.4. Goats	CH_4	3.06	2.50	0.00	0.00	1.000
1.A.2.f. Mining (excluding fuels) and quarrying	CH_4	2.63	5.38	0.00	0.00	1.000
1.A.2.f. Non-metallic minerals	N_2O	2.57	4.11	0.00	0.00	1.000
1.A.1.b. Oil Refining	N_2O	2.17	1.36	0.00	0.00	1.000
5.C.1. Grassland remaining Grassland	N_2O	2.08	4.72	0.00	0.00	1.000
2.F.1. Refrigeration and air conditioning	HFC	0.00	95.77	0.00	0.00	1.000
1.A.2.e. Food processing, beverages and tobacco	N_2O	2.10	1.21	0.00	0.00	1.000
1.B.2.a. Oil	CO_2	2.00	0.51	0.00	0.00	1.000
1.A.3.d. National water-borne navigation	CH_4	1.72	0.84	0.00	0.00	1.000
1.A.4.c. Agriculture / Forestry / Fishing	N_2O	1.58	2.20	0.00	0.00	1.000
1.A.2.a. Iron and steel	CH_4	1.57	0.84	0.00	0.00	1.000
1.A.2.f. Non-metallic minerals	CH_4	1.15	1.85	0.00	0.00	1.000
1.A.2.e. Food processing, beverages and tobacco	CH_4	0.98	0.55	0.00	0.00	1.000
1.A.1.b. Oil Refining	CH_4	0.97	0.70	0.00	0.00	1.000
2.B.5.b. Ethylene	CO_2	0.75	0.66	0.00	0.00	1.000
2.F.3. Fire extinguishers	HFC	0.00	30.35	0.00	0.00	1.000
2.C.5.a. Lead production	CO_2	0.58	0.36	0.00	0.00	1.000
1.B.2.b. Natural gas	CO_2	0.55	0.81	0.00	0.00	1.000
4.B.7. Mules and asses	CH_4	0.34	0.48	0.00	0.00	1.000
1.A.1.c. Manufacture of solid fuels and other energy industries	N_2O	0.13	0.42	0.00	0.00	1.000
2.F.3. Fire extinguishers	PFC	0.00	6.14	0.00	0.00	1.000
2.C.2. Ferroalloys	CH_4	0.11	0.00	0.00	0.00	1.000
2.B.5.b. Ethylene	CH_4	0.09	0.08	0.00	0.00	1.000
1.A.1.c. Manufacture of solid fuels and other energy industries	CH_4	0.08	0.20	0.00	0.00	1.000
1.A.3.a. Domestic aviation	CH_4	0.08	0.11	0.00	0.00	1.000
6.C.C. Waste incineration	CO_2	0.07	0.28	0.00	0.00	1.000
1.A.3.c. Railways	CH_4	0.07	0.16	0.00	0.00	1.000
1.A.2.c. Chemicals products	N_2O	0.00	0.50	0.00	0.00	1.000
1.B.2.c. Venting and flaring	CO_2	0.01	0.01	0.00	0.00	1.000
1.A.2.c. Chemicals products	CH_4	0.00	0.34	0.00	0.00	1.000
6.C.C. Waste incineration	N_2O	0.00	0.01	0.00	0.00	1.000
5.E.2. Land converted to Settlement	CO_2	-0.13	-0.13	0.00	0.00	1.000
Total		**-924.98**	**41,698.50**	**38.03**	**1.00**	

Annex 3. Greenhouse gas emissions

NIR of Chile: anthropogenic emissions by sources and removals by sinks of GHGs not controlled by the Montreal Protocol and GHG precursors. Year 1994.

Greenhouse gas source and sink categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NOx (Gg)	NMVOCs (Gg)	SO_2 (Gg)
Total national emissions and removals	**89,936.2**	**-101,594.1**	**518.0**	**21.2**	**1,061.1**	**150.8**	**116.9**	**250.9**
1. Energy	**34,950.7**	**NO**	**96.9**	**1.3**	**729.3**	**144.6**	**116.9**	**250.9**
A. Fuel combustion activities (Sectoral approach)	34,948.8		33.5	1.3	701.0	141.7	109.6	250.9
1. Energy industry	8,878.8		0.4	0.1	11.2	25.2	0.2	102.5
2. Manufacturing industries and construction	9,220.1		1.3	0.2	70.8	15.3	4.9	113.8
3. Transportation	12,311.0		3.1	0.6	176.3	82.9	22.1	17.2
4. Other sectors	4,538.9		28.6	0.4	442.7	18.3	82.4	17.5
5. Other (non-specified)	NO, C		NO, C	NO, C	NO, C	NO, C	NO, C	NO, C
B. Fugitive emissions from fuels	1.9		63.5		28.3	3.0	7.3	NO
1. Solid fuels			9.5		NO	NO	3.3	NO
2. Oil and natural gas	1.9		53.9		28.3	3.0	4.0	NO
2. Industrial processes	**3,845.3**	**NO**	**2.0**	**0.7**	**NE**	**NE**	**NE**	**NE**
A. Mineral products	1,550.4				NE	NE	NE	NE
B. Chemical industry	586.4		2.0	0.7	NE	NE	NE	NE
C. Metal production	1,708.5		0.0	NO	NE	NE	NE	NE
D. Other production	NE				NE	NE	NE	NE
E. Halocarbons and SF6 production								
F. Halocarbons and SF6 consumption								
G. Others	NA		NA	NA	NA	NA	NA	NA
3. Solvent and other products use	**93.4**			**NO**			**NE**	
4. Agriculture			**289.2**	**18.0**	**90.3**	**2.5**	**NE,NO,NA**	**NO**
A. Enteric fermentation			223.1					
B. Manure management			57.3	0.6			NE	
C. Rice crop			6.1				NE	
D. Agricultural soils			NE	17.3			NE	
E. Prescribed burning of savannah			NO	NO	NO	NO	NO	
F. Field burning of agricultural residues			2.7	0.1	90.3	2.5	NE	
G. Others			NA	NA	NA	NA	NA	
5. Land use, land-use change and forestry	**51,046.7**	**-101,594.1**	**15.8**	**0.5**	**241.5**	**3.7**	**NE,NA**	**NE,NA**
A. Forest land	49,115.9	-101,569.3	15.1	0.4	231.2	3.6	NE	NE
B. Croplands	375.8	-3.1	NA	IE,NA	0.0	0.0	NE	NE
C. Grassland	1,247.0	-21.5	0.7	0.0	10.3	0.2	NE	NE
D. Wetland	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	186.7	-0.1	NO	NO	NE	NE	NE	NE
F. Other land	121.3	NO	NO	NO	NE	NE	NE	NE
G. Others	NA	NA	NA	NA	NA	NA	NA	NA
6. Wastes	**0.1**		**114.1**	**0.7**	**NE,NA**	**NE,NA**	**NE,NA**	**NE,NA**
A. Solid waste disposal			100.7		NE		NE	
B. Wastewater treatment and discharge			13.1	0.7	NE	NE	NE	
C. Waste incineration	0.1		NO	0.0	NE	NE	NE	NE
D. Others			0.4	0.0	NE	NE	NE	NE
7. Others	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo items								
International Bunker	1,715.4		0.1	0.0	2.9	27.4	1.1	31.7
International aviation	655.7		0.0	0.0	0.5	1.4	0.2	1.2
International water-borne navigation	1,059.8		0.1	0.0	2.4	26.0	0.9	30.5
CO_2 emissions from biomass	14,271.3							

NA= Not applicable; NE= Not estimated; NO= Not occurring; C= Confidential.

Source: Compilation by SNICHILE.

NIR of Chile: anthropogenic emissions of HFC, PFC and SF. Year 1994.

Greenhouse gas source and sink categories	HFCs (Gg)							PFCs (Gg)	SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-152a	HFC-143a	HFC-227ea	HFC-236fa	CF_4	
Total national emissions and removals	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NE, NO**
1. Energy									
A. Fuel combustion activities (Sectoral approach)									
1. Energy industry									
2. Manufacturing industries and construction									
3. Transportation									
4. Other sectors									
5. Other (non-specified)									
B. Fugitive emissions from fuels									
1. Solid fuels									
2. Oil and natural gas									
2. Industrial processes	NO	NO	NO	NO	NO	NO	NO	NO	NE, NO
A. Mineral products									
B. Chemical industry									
C. Metal production								NO	NO
D. Other production	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of halocarbons and SF6	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Consumptionof halocarbons and SF6	NO	NO	NO	NO	NO	NO	NO	NO	NE, NO
G. Others									
3. Solvent and other products use									
4. Agriculture									
A. Enteric fermentation									
B. Manure management									
C. Rice crop									
D. Agricultural soils									
E. Prescribed burning of savannah									
F. Field burning of agricultural residues									
G. Others									
5. Land use, land-use change and forestry									
A. Forest land									
B. Croplands									
C. Grassland									
D. Wetland									
E. Settlements									
F. Other land									
G. Others									
6. Wastes									
A. Solid waste disposal									
B. Wastewater treatment and discharge									
C. Waste incineration									
D. Others									
7. Others	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items									
International bunker									
International aviation									
International water-borne navigation									
CO_2 emissions from biomass									

NA= Not applicable; NE= Not estimated; NO= Not occurring; C= Confidential.

Source: Compilation by SNICHILE.

NIR of Chile: anthropogenic emissions by sources and removals by sinks of GHGs not controlled by the Montreal Protocol and GHG precursors. Year 2000.

Greenhouse gas source and sink categories	CO_2 Emissions (Gg)	CO_2 Removal (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NOx (Gg)	NMVOCs (Gg)	SO_2 (Gg)
Total national emissions and removals	**112,750.1**	**-112,879.9**	**556.9**	**24.3**	**1,100.0**	**206.8**	**153.3**	**244.2**
1. Energy	**49,653.5**	**NO**	**102.1**	**1.8**	**978.2**	**204.0**	**153.3**	**244.2**
A. Fuel combustion activities (Sectoral approach)	49,651.8		40.5	1.8	946.2	200.6	147.4	244.2
1. Energy industry	16,077.7		0.6	0.2	22.6	44.3	0.4	103.2
2. Manufacturing industries and construction	11,937.6		1.9	0.3	103.9	22.5	7.8	101.8
3. Transportation	16,959.4		4.0	0.8	225.2	111.1	28.7	25.2
4. Other sectors	4,677.1		33.9	0.5	594.6	22.7	110.5	14.1
5. Other (non-specified)	NO, C		NO, C	NO, C	NO, C	NO, C	NO, C	NO, C
B. Fugitive emissions from fuels	1.7		61.6		32.0	3.5	5.9	NO
1. Solid fuels			3.5		NO	NO	0.8	NO
2. Oil and natural gas	1.7		58.1		32.0	3.5	5.1	NO
2. Industrial processes	**5,583.9**	**NO**	**6.7**	**2.2**	**NE**	**NE**	**NE**	**NE**
A. Mineral products	1,739.9				NE	NE	NE	NE
B. Chemical industry	1,952.1		6.7	2.2	NE	NE	NE	NE
C. Metal production	1,892.0		NO, IE	NO	NE	NE	NE	NE
D. Other production	NE				NE	NE	NE	NE
E. Production of halocarbons and SF6								
F. Consumptionof halocarbons and SF6								
G. Others	NA		NA	NA	NA	NA	NA	NA
3. Solvent and other products use	**118.0**			**NO**			**NE**	
4. Agriculture			**308.0**	**19.4**	**80.8**	**2.2**	**NE,NO,NA**	**NO**
A. Enteric fermentation			236.0					
B. Manure management			64.5	0.8			NE	
C. Rice crop			5.2				NE	
D. Agricultural soils			NE	18.6			NE	
E. Prescribed burning of savannah			NO	NO	NO	NO	NO	
F. Field burning of agricultural residues			2.4	0.1	80.8	2.2	NE	
G. Others			NA	NA	NA	NA	NA	
5. Land use, land-use change and forestry	**57,394.5**	**-112,879.9**	**2.7**	**0.1**	**41.0**	**0.6**	**NE,NA**	**NE,NA**
A. Forest land	55,340.0	-112,855.1	2.5	0.1	38.4	0.6	NE	NE
B. Croplands	499.8	-3.1	NA	IE,NA	0.0	0.0	NE	NE
C. Grassland	1,247.0	-21.5	0.2	0.0	2.6	0.0	NE	NE
D. Wetland	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	186.5	-0.1	NO	NO	NE	NE	NE	NE
F. Other land	121.2	NO	NO	NO	NE	NE	NE	NE
G. Others	NA	NA	NA	NA	NA	NA	NA	NA
6. Wastes	**0.1**		**137.3**	**0.8**	**NE,NA**	**NE,NA**	**NE,NA**	**NE,NA**
A. Solid waste disposal			122.1		NE		NE	
B. Wastewater treatment and discharge			14.8	0.8	NE	NE	NE	
C. Waste incineration	0.1		NO	0.0	NE	NE	NE	NE
D. Others			0.4	0.0	NE	NE	NE	NE
7. Others	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo items								
International bunker	3,082.1		0.2	0.1	5.4	52.2	2.1	57.7
International aviation	1,046.5		0.0	0.0	0.8	2.3	0.4	0.2
International water-borne navigation	2,035.6		0.2	0.1	4.7	49.9	1.7	57.5
CO_2emissions from biomass	18,952.3							

NA= Not applicable; NE= Not estimated; NO= Not occurring; C= Confidential.

Source: Compilation by SNICHILE.

NIR's NGHGI: anthropogenic emissions of HFC, PFC and SF_6. Year 2000.

Greenhouse gas source and sink categories	HFCs (Gg)							PFCs (Gg)	SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-152a	HFC-143a	HFC-227ea	HFC-236fa	CF_4	
Total national emissions and removals	NO	NO	NO	NO	NO	NO	NO	NO	NE, NO
1. Energy									
A. Fuel combustion activities (Sectoral approach)									
1. Energy industry									
2. Manufacturing industries and construction									
3. Transportation									
4. Other sectors									
5. Other (non-specified)									
B. Fugitive emissions from fuels									
1. Solid fuels									
2. Oil and natural gas									
2. Industrial processes	NO	NO	NO	NO	NO	NO	NO	NO	NE, NO
A. Mineral products									
B. Chemical industry									
C. Metal production								NO	NO
D. Other production	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of halocarbons and SF6	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Consumptionof halocarbons and SF6	NO	NO	NO	NO	NO	NO	NO	NO	NE, NO
G. Others									
3. Solvent and other products use									
4. Agriculture									
A. Enteric fermentation									
B. Manure management									
C. Rice crop									
D. Agricultural soils									
E. Prescribed burning of savannah									
F. Field burning of agricultural residues									
G. Others									
5. Land use, land-use change and forestry									
A. Forest land									
B. Croplands									
C. Grassland									
D. Wetland									
E. Settlements									
F. Other land									
G. Others									
6. Wastes									
A. Solid waste disposal									
B. Wastewater treatment and discharge									
C. Waste incineration									
D. Others									
7. Others	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items									
International bunker									
International aviation									
International water-borne navigation									
CO_2 emissions from biomass									

NA= Not applicable; NE= Not estimated; NO= Not occurring; C= Confidential.

Source: Compilation by SNICHILE.

Annex 4. NAMAS data sheets

Self-Supply Renewable Energy in Chile (SSREs)

NAMA's General Information		
Full name	Self-Supply Renewable Energy in Chile (SSREs)	
Short name	Self-Supply NAMA	
Stage	☐ Conceptual/Feasibility x Planned or under planning	☐ Adopted: under implementation ☐ Implemented
Registered in the United Nations	x Yes	☐ No
Category	☐ Unilateral, searching for recognition ☐ Bilateral, searching planning support	o Bilateral, searching support for implementation ☐ Credits
Description	The Renewable Energy Centre (CER) Chile, as part of the Chilean government's economic development agency (CORFO) and implementing agency of the Ministry of Energy, has developed a proposal for a NAMA on "Self-supply energy systems based on renewable energy. NAMA's general objective is to promote the incorporation of renewable energy systems for self-supply in Chile through the creation of financial conditions and proper techniques for early development stages of this emerging industry. The NAMA will address technical and financial obstacles for renewable energy systems at all scales for self-supply in industrial, agricultural and commercial sectors, through instruments such as financial, technical assistance and dissemination and awareness activities with support of the Renewable Energy Center. Specifically, the NAMA's objective is: ● To increase the insertion of low-scale renewable energy systems across economy sectors. ● To contribute to Chile's objective of achieving a 20% GHG variance under BAU by 2020. ● To support the development of an emerging industry of energy services and to further develop the market of renewable energies in Chile. The NAMA will achieve these objectives through a comprehensive program addressing technical and financial constraints simultaneously in order to implement renewable energies at a low scale. The NAMA will be coordinated by the Renewable Energy Center (CER) of Chile, a public institution promoting and facilitating conditions for the establishment of non-conventional renewable energies in Chile. NAMA's components are: 1. Financial Component: i) Co-funding for pre-feasibility studies; ii) Co-funding for project investment; iii) Partial Credit Guarantee System for local financial institutions; and, iv) Consultancy services for institutions from the financial sector. 2. Technical support component: i) Training and capacity strengthening: Through workshops and training courses. Groups of the private and public sector (except from the financial sector, which is covered by the financial component) shall be trained in the following areas: SSREs feasibility analysis; assessment and project management; RE technologies introduction, etc. ii) Technical help desk and virtual platform, providing information and technical support to project developers on questions related to technology, project development, network connection and regulatory and legal matters. The technical assistance service shall be the main entry point for project developers and other involved parts. iii) Knowledge exchange: Draw up and carry out an exchange program with national and international experts, to exchange experiences and knowledge. iv) Dissemination and awareness-raising: The NAMA will facilitate awareness-raising on usage options of SSRE in Chile's industry. Technical tours and field visits sponsored by the NAMA will establish contact between potential investors and technology, and current users. v) Measurement, Report and Verification (MRV): Development of a GHG inventory in the energy sector at a low scale and design of a MRV system for the NAMA. Design of templates and formats for reporting, data aggregation and verification process for the NAMA.	
Nature or type of action	xStrategy, Policy or Programs. Specify related instrument[1]: Pre-investment subsidies, subsidies for the investment, collateral fund in order to facilitate the access to banking loans and strengthening of capabilities. ☐ Project or group of projects (technology and infrastructure investment) ☐ Other (s) ……..……..	
Sector (s) considered by the NAMA	x Agriculture ☐ Construction x Energy generation x Use of Energy ☐ Forestry/LULUCF	x Industry and industrial processes x Waste ☐ Transportion and its infrastructure x Transverse (check all that apply) ☐ Others (s)……..……..

1.- Economic, fiscal, inventive, voluntary agreements, regulatory, information management, capacity-building, research, etc., type of instrument.

Technology	Solar Energy, Geothermal Energy, Bioenergy, Hydro Power Energy and Wind Energy.	
Gas (es) covered by the NAMA	x Carbon dioxide (CO_2) x Methane gas (CH_4) x Nitrous oxide (N_2O)	☐ Hydrofluorocarbons (HFC) ☐ Perfluorocarbons (PFC) ☐ Sulfur hexafluoride (SF_6) ☐ Nitrogen trifluoride (NF3)
Jurisdiction	x National ☐ Regional ☐ Cross-regional.	
Implementation dates	Period	6 years
	Year initiated or expected initiation year	2015
	Finishing year	2021

NAMA's objectives

1. To increase the penetration of low-scale renewable energy systems in the different sectors, through the creation of technical and financial conditions for the early stages of development of this emerging industry.
2. To reduce GHG and also contribute to Chile's objective of achieving a 20% GHG variance under BAU in 2020.
3. To overcome constraints for SSREs.
4. To encourage the development of an industry and market maturity for renewable energy technologies in Chile.
5. To improve knowledge and local capacities related to SSRE technologies through technical support.

NAMA's constraints

1. Human resources:
   i) Lack of access to qualified installers and consulting companies to develop and implement projects; specialized consultants market and installers is still small and new, therefore availability is limited; service companies with little experience and scarce project history increase risk perception.
   ii) Lack of access to qualified technicians to operate and maintain equipments outside Santiago and lack of general knowledge on the functioning of RE systems.
2. Financial Constraints:
   i) Absence of a portfolio of projects eligible to be funded; lack of will to invest on pre-feasibility studies due to high initial costs and high risk.
   ii) High incremental costs of renewable energy technologies facing other capital investment (BAU) establishes constraints to investment for project promoters; recovery periods are longer and with a lower return rate compared to alternative investments.
   iii) Access to loans from commercial banks is difficult for this type of projects; transaction costs for lower-scale projects are perceived as prohibitive by banks, choosing large-scale projects to achieve scale economy; lack of familiarity to SSRE project investment leads to perception of high risk by the banking.
3. Technology Constraints:
   i) Company or investment resources owners are not familiarized to technologies and are not certain about the potential these can offer to their businesses operation. Existing SSRE projects are not available to public, only some reference projects, contributing to an unawareness environment.

NAMA's Quantitative Goals

Quantitative goals (reductions)	Progress indicators per each goal (reductions)	Additional information per goal
Reduces around 2 $MtCO_2eq$.	Accumulated reduction in $MtCO_2$	Expected reduction considers a useful life of the implemented projects (20 to 25 years), at an average cost per program of USD$9-USD$12 per tonne.

Methodologies and assumptions (scopes, effects, goals and progress assessment)

Methodologies	Assumptions
1. Forecast generation the NAMA.	**Composition of the portfolio:** PV 35%, the 33% of the biomass, biogas 16%, solar water-heating 9%, Micro hydroelectric 4%, Wind 3%. **Average cost of the delivery:** PV 3,800 $/KWe, Biomass 812 $/KWe, Biogas 1,800 $/KWe, solar water-heating 1,345$/KWe, Micro hydro 3,529 $/ KWe, wind 2,225 $/KWe. **Expected annual change of the costs:** PV -6%, 0% of the biomass, biogas 0%, solar water-heating 0%, Micro hydro 0%, Wind -3%. **Average emission factor:** PV 598 $gCO_2eq/kWhe$, Biomass 204 $gCO_2eq/kWhe$, Biogas 204 $gCO_2eq/kWhe$, solar water-heating 598 $gCO_2eq/kWhe$, micro hydro 598 $gCO_2eq/kWhe$, Wind 598 $gCO_2eq/kWhe$. **Average life of the facilities:** PV 30 years, 25 years Biomass, Biogas 25 years, Solar water-heating 20 years, micro hydraulic 25 years, Wind 25 years. **Average capacity factor:**PV 18.5%; 50% in biomass; biogas 50%; solar water-heating 27%; micro hydro 40%; Wind 25%.

Implementation planning and progress		
Planning	Progress	Achieved and expected results (progress indicators)
Action (s) step (s): activities/years	Progress status	Accomplished or expected reductions[2]
●Pilot Program • Development of a fundable projects portfolio • Training and consulting services for the financial sector • Investment support • Establishment of the collateral fund • Training • Technical assistance and virtual platform • Knowledge exchange Program • Dissemination and awareness-raising. • MRV System	Progress has been made in the pilot program, selecting 10 projects. The Ministry of Energy, CER and CORFO have already contributed an amount of USD$ 10 million to co-fund capital costs of these first pilot projects. The objective is to disseminate pilot project in order to foster the creation of a SSRE market that has not been exploited in Chile.	There are still no results achieved. It is expected: To reduce around 2 $MtCO_2eq$, considering the useful life of the implemented projects to an average cost per program of USD$9-USD$12 per tonne.

Achieved or expected co-benefits per stage		
Steps (previously defined)	Indicator Name[3] (co-benefit)	Achieved and expected results
●Pilot Program. • Development of a fundable projects portfolio. • Training and consulting services for the financial sector. • Investment support. • Establishment of the collateral fund • Education and training • Technical assistance platform. • Knowledge exchange program. • Dissemination and awareness-raising. • MRV System.	Renewable energy capacity installed: Indicates the total capacity of MW of installed renewable energy. This indicator is divided in subsets according to the technology. Employment creation: Indicates the number of permanent and temporary positions created as a result of renewable energy projects which are part of the program. Expressed in position units equivalent to full time. Leverage ratio of the private sector: Indicates the contribution of the private sector to the renewable energy projects in the framework of the program. It is expressed as a proportion of the funds (NAMA: the private funds).[4]	No results accomplished yet. It is expected: To implement approximately 112 electric projects, with an average installed capacity of 270kW, and 15 thermal projects with 2.1MW average. 500 trained individuals 1,000 projects consulted through a technical assistance help platform. 50 consulted projects in network connection. Leverage of about USD$100 million. At least 60 appearances in public media and public activities. All SSRE projects incorporated in MRV system.

NAMA's costs		
Estimated cost of preparation	Cost	W/I
	Calculation description	W/I
Implementation cost estimation	Cost	USD 43.36 million
	Calculation description	W/I
Incremental cost of implementation	Cost	W/I
	Calculation description	W/I

Funding source	
Own resources	USD 19.42 million
Received resources	USD 20 million of NAMA Facility
Resources to be requested (total, detailed information is explained below)	W/I In conversations with Germany and the United Kingdom NAMA is still in design stage and open to discussion in terms of finding the more effective and proper types of financial support for different components. In any case, the Chilean Government has already obtained about 20 million USD for the preparation of the NAMA and its registry. The objective is to increase the amount of financial resources available for this program in order to extend and accelerate its impact during the following years. Based on the structure of the NAMA, different financial vehicles shall be designed and implemented according to specific needs of every sector and development stage of the market. The total amount of financial support is USD 20,000,000 which includes the sum of USD 2,527,000 for capacity-building.

2.- May be time series.

3.- Side-benefits can include social, economic, and environmental effects others than GHG reduction. These may be qualitative or quantitative.

4.- For example, a 1:2 value would indicate that for each $ 1 spend in the program $ 2 were contributed by the private sector.

Required support for NAMA's costs		
Financial resources	Required amount	USD 17.47 millions
	Type of required resources	Subsidy
	Comments	N/A
Technology	Required amount	N/A
	Type of required resources	N/A
	Comments	N/A
Capacity-building	Required amount	USD 2.53 million
	Type of required resources	Subsidy
	Comments	W/I

Description of the MRV

The MRV system was designed as a digital platform of MRV, and conceived as a project management system allowing: to standardize and organize projects from CER; supervise variables of each project; to elaborate individual and group reports per type of CER projects; to verify that the variables are being monitored, since the system can be audited, reviewed and modified in the future, according to CER requirements; to gather information, indicators, status, etc., from different types of projects; and to report the projects results considering the MRV style outputs. Accordingly, the objective of the platform is for CER professionals to have information available in order to develop necessary reports, according to established requirements, for instance, by the MMA or the donors funds. The platform clearly specifies, in every stage, which are the parameters to be controlled and generates indicators that allow to optimize project management.

As for reports, it is important to consider that format and requirements depend on who is requesting the report. For instance, if a Convention Framework follow-up report is needed in a CDM (Clean Development Mechanism) context, is an available format type, based on methodologies, guidelines and requirements that are unique for the CDM and are not necessarily the same for CER projects. Therefore, the platform considers filters that allow to obtain different levels of information and reports.

It is important to emphasize that, there are elements involved in the NAMA, registered under the UNFCCC that have not yet been solved by the platform. For example, emission factors report, side-benefits indicators, specifically, "leverage ratio of the private sector", "benefits for sustainable local development", etc.; delivery frequency of reports has not been solved either, they depend on the update capacity of the base information required per project and mainly on the agreements between the donor and the CER. Finally, regarding verification, there are no clear guidelines, therefore their definition will depend on future Conference of the Parties (there is no agreement yet) and on what the Chilean Government decides.

Must be noted that user manuals of the platform according to the type of project have been created, and a MRV management manual. The platform is currently is in trial phase, in its self-supply project section and operating the network-connected project section.

Related policies and regulations

National Energy Strategy, link:
http://www.minenergia.cl/estrategia-nacional-de-energia-2012.html
National Action Plan on Climate Change, link: http://www.mma.gob.cl/1304/articles-49744_Plan_02.pdf

Related NAMAs

NAMA CPL, which clean production agreements may consider some SSREs projects co-funded by CER funds.

Contact data for NAMA coordinator/manager

Responsible institution	Renewable Energy Center (CER) of CORFO, Ministry of Economy, Government of Chile.
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Alternate contact	N/A

National Program for Industrial and Commercial Catalyzing on Organic Waste Management in Chile

NAMA's General Information		
Full name	National Program for Industrial and Commercial Catalyzing on Organic Waste Management in Chile.	
Short name	NAMA Industrial Wastes.	
Stage	☐ Conceptual/Feasibility. ☐Planned or under planning.	☐ Adopted: under implementation. ☐ Implemented.
Registered in the United Nations	x Yes	☐ No
Category	☐ Unilateral, searching for recognition ☐ Bilateral, searching planning support	x Bilateral, searching for implementation support ☐ Credits
Description	The objective of this NAMA is to catalyze the implementation of the first facilities of industrial and commercial organic waste management in Chile. The wastes sector in Chile currently accounts for 3% of GHG emissions in the country, mostly generated by industrial wastes. This NAMA will contribute to the fulfillment of the national voluntary commitment before the United Nations, consisting on achieving a 20% variance in emissions under the growing trajectory of BAU in 2020, according to projections starting in the year 2007. The National Program seeks to promote a solution for the management of organic waste in Chile through the support in the installation of five facilities of organic waste management (specifically dry fermentation plants which include in-house treatment, energy generation or 'waste to energy' and compost product obtained from the organic treatment process). The National Program will be directed specifically to organic wastes produced by the agroindustry (wine, fruits, cereals), aquaculture, livestock industry (poultry and pork) and wastes generated by the commercial activity of pruning and the functioning of local food markets, hotels and restaurants. Currently in Chile, municipalities are responsible for the final disposal of domestic and commercial wastes, while the industrial sector is responsible for the disposal of their own wastes. The National Program has been designed to face financial, economic, cultural and social constraints for the development of organic waste management facilities in Chile. With it, the creation of an organic waste management market will be supported, and once mature, will allow waste management companies of the private sector to develop these projects without support. Financial models that have been developed to prepare this NAMA indicate that total cost for implementing this program and resulting organic wastes management facilities implemented by the private sector in Chile, will account for a total of USD 160 million. The National Program will include four (4) areas of action: 1. Regulatory Improvement: The Ministry of the Environment of Chile will be in charge of supervising the National Program and has started by developing national standards to regulate organic waste management (Quality standard for digestate, Compost Standard review, requirements for biodigesters installation. Likewise, the Ministry is working on the Design of a MRV system (monitoring, report and verification) as part of the NAMA's implementation. This national contribution is estimated in USD 200,000. 2. Co-funding of feasibility studies: the Chilean Economic Development Agency has available funds (accessible through a competitive application process) to co-fund up to a 50% of the amount needed by the private sector for feasibility studies related to organic waste management projects (estimated in a national contribution of USD 900,000). 3. Financial support: Support is necessary to cover part of the initial investment for the installation of an approximate of five work plants. Financial support will only be required and available for the first projects funded by the NAMA's fund (USD 10,000,000 of international contribution in subsidy form). 4. Credit Collateral Fund: Since organic waste management will include technologies that have not yet been tested or installed in Chile, first projects will require special guarantees covering construction and the first year of plant operation, leaving funding to the private sector (USD$10,000,000 international contribution as collateral). Financial models indicate this collateral will be able to cover the first 8 to 10 organic waste management plants installed in Chile. The Ministry of the Environment will use a public bidding process with pre-established criteria and conditions to select projects (installation of organic waste facilities) that will receive support. The contribution to be granted to each project is calculated as a discount percentage of the turning rate projected to a market value. First selected projects for the NAMA will be supported with a maximum turning rate discount of a 50% the first year, a 35% discount in the second year and a 20% in the third year. Starting from the fourth year, full commission will be paid by waste generators. This will lead to the granting of incentives between a 10-25% of the initial investment, that for a dry fermentation plant represents 40,000 tonnes per year. Selected projects during the second bidding process will receive less financial support, accounting for, as a maximum, the income gap created by a discount on the quota of a 30% the first year, a 20% the second year, and a 10% the third year. Starting from the fourth year, full commission will be paid by waste generators. That is to cover up to a 20% of initial investment, that for a dry fermentation plant of 40,000 tonnes a year, equals a contribution of USD 2 million. By the third bidding process, all financial support will be eliminated, since costs of alternative options for waste disposal will be higher than today.	

Nature or type of action	x Strategy, Policy or Programs. Specify related instrument[5]: Policy or National/Sectoral Program x Project or group of projects (technology or infrastructure investment) ☐ Other (s) ……...……..		
Sector (s) considered by the NAMA	☐ Agriculture ☐ Construction ☐ Energy Generation ☐ Energy Usage ☐ Forestry/LULUCF ☐ Industry and industrial processes		x Wastes ☐ Transportation and its infrastructure ☐ Transverse (check all that apply) ☐ Others (s)……...…….
Technology / methodology	Bioenergy		
Gas (es) covered by the NAMA	x Carbon dioxide (CO_2) x Methane gas (CH_4) ☐ Nitrous oxide (N_2O)		☐ Hydrofluorocarbons (HFC) ☐ Perfluorocarbons (PFC) ☐ Sulfur hexafluoride (SF_6) ☐ Nitrogen trifluoride (NF_3)
Jurisdiction	x National	☐ Regional	☐ Cross-regional.
Implementation dates	Period		5
	Year initiated or expected initiation year		2015
	Finishing year		2020

NAMA's objectives

1. The main goal is to support the implementation of the first plants for industrial and commercial organic waste management in Chile (excluding household organic waste). This NAMA will help to overcome several constraints (financial, economic, cultural, and social) that have held back the development of alternative market for waste disposal. Its objective is to create a new market and exhibit technology, facilitating in a near future, independent development of projects by private companies.
2. It will also contribute to the fulfillment of the national voluntary commitment of GHG emission variance made before the United Nations.
3. The creation of an organic waste management market in Chile will be supported, and with this support, the private sector will become more actively involved.

NAMA's constraints

1. Information constraints: Industrial waste real generation data is lacking (it is expected to solve this problem through RETC compulsory statement in May of 2014).
2. Management and political coordination constraints: Municipalities adopt waste management models based on costs minimization, regardless of the environmental impact, in order to use budget on more visible projects. There are no alternatives to replace dump sites. The sector is paralyzed by uncertainty and no relevant actor decides to take the first step. Project developers are not willing to undertake projects based on uncertainty surrounding the closing of dump sites, and authorities closing dump sites for a lack of alternatives for waste disposal.
3. Financial constraints: The Government has limited resources and many other priority expenses, such as education, housing and health sectors, therefore, it can not currently invest on funds for this NAMA.
4. Political and regulatory constraints: The law prohibits dump sites, yet there are no alternatives for waste disposal, consequently, dump sites keep operating. Many private companies would pay suitable salaries for disposal of their wastes and close the life cycle of their products, but there are no facilities to do so. Regulations do not properly encourage the valuation of organic wastes.
5. Social constraints: There is a growing opposition of the community to waste management projects, due to their social and environmental impact.
6. Technology constraints: There is a lack of confidence on alternative technologies, maintaining a status quo in the sector. Alternative technologies for organic wastes are relatively new in the country, and financial institutions are not willing to invest without special collaterals.

5.- Economic, fiscal, voluntary agreements, regulatory, information management, capacity-building, research resources, etc.

NAMA's Quantitative Goals		
Quantitative goals (reductions)	Progress indicators per each goal (removals)	Additional information per goal
It is expected to reduce 12 $MtCO_2eq$.	Accumulated reductions in $MtCO_2eq$;	It is planned to support the development of about 14 dry fermentation projects, of 40,000 tonnes each, reducing up to 11MMt of organic wastes and avoiding 12 $MtCO_2eq$ during the life of the projects. Levering private investments around MM130 million, of private investment.

Methodologies and assumptions (scopes, effects, goals and progress assessment)	
Methodologies	Assumptions
Estimation methodology of expected reductions	GHG emission reduction considers a base line of waste disposal in dump sites, since private companies are responsible of the management of their own wastes and currently can not be discharged on Sanitary Landfills. Some used assumptions are: It is considered to support around 14 projects of 40,000 tons each, through their different instruments; it is considered a life cycle of the project of 20 years; and that the plant will be able to produce biogas with a methane concentration of around 60%. This is transformed into electricity and thermal energy which can be used to replace fossil fuels of the grid. The reference value used as emission factor is from the Central Interconnected System (Sistema Interconectado Central - SIC) which at the moment of the calculation was 0.35 tCO_2eq/MWh.

Implementation planning and progress		
Planning	Progress	Achieved and expected results (progress indicators)
Action (s) step (s): activities/years	Progress status	Accomplished or expected reductions[6]
To accomplish its objective, the NAMA has five components: regulatory improvement; co-financing of feasibility studies; financial support; collateral fund and MRV generation. This consists of an innovative model of private-public business in Chile: projects will be required to be supported by local municipalities, which in return, will create a communitarian fund and provide preferential discharge fees to municipalities, promoting their waste deviation and possible selective collection.	The Government of Chile is making progress in the regulatory improvements.	There are still no successful reduction activities accomplished. Expected reductions account for a total of 12 $MtCO^2eq$.

Achieved or expected side-benefits per stage		
Steps (previously defined)	Indicator Name[7] (side-benefit)	Achieved and expected results (progress indicators)
Five components: regulatory improvement; co-financing of feasibility studies; financial support; collateral fund and MRV generation.	• Generated biogas per ton of treated waste efficiency. • Valued Organic waste tons • Energy production per ton of waste. • Critical environmental episodes associated with the projects, if any. • Number of job positions created (directly and indirectly) by the projects.	W/I

NAMA's costs		
Estimated cost of preparation	Cost	W/I
	Calculation description	W/I
Implementation cost estimation	Cost	USD 160 million
	Calculation description	W/I
Incremental cost of implementation	Cost	USD 30 million
	Calculation description	W/I

Funding source	
Own resources	W/I
Received resources	Expecting to apply to NAMA Facility.
Resources to be requested (total, detailed information is explained below)	USD 30 million.

6.- Can be time series.

7.- Co-benefits can include social, economic, and environmental effects others than GHG reduction. These may be qualitative or quantitative.

Required support for NAMA's costs		
Financial resources	Required amount	USD 30 million
	Type of required resources	Subsidies and collaterals.
	Comments[8]	International financial support worth USD 10 million as subsidies Credit collateral of USD 10 million to cover the construction and first year of plant operations for boosting private sector financing.
Technology	Required amount	N/A
	Type of required resources	N/A
	Comments	N/A
Capacity-building	Required amount	N/A
	Type of required resources	N/A
	Comments	N/A

Description of the MRV

LECB program has awarded the MRV System design to the consortium formed by POCH, Factor CO_2 Ideas and Perspectives Climate Change. This consortium has presented a work plan with the following objectives, activities, and results:

1. Objective 1: MRV system for NAMA, compatible with the National Generic MRV system basic aspects, as for its design process.
   a. Activity 1: To design the MRV system for the NAMA, compatible with the National Generic MRV system basic aspects, as for its design process.
   b. Activity 2: To design the specific indicators for monitoring environment variables and side benefits related to implementing the NAMA.
2. Objective 2: To identify institutional arrangements and to reinforce the capacities the MRV system will request from NAMA.
   a. Activity 3: To identify key stakeholders, whose participation is required for the development and implementation of the MRV system.
   b. Activity 4: To develop a procedures guideline for the implementation the MRV System.
   c. To develop a training and communication plan.

This work plan has been recently approved by the technical counterpart, which is starting the execution process, considering a final delivery of finished products by March 2015.

During the design process, it will be assessed whether the system can be supported with a centralized platform of the Pollutant Release and Transfer Register (RETC - Registro de emisiones y transferencias de contaminantes) or not, which is led by the MMA. RETC is a catalog or database that holds information regarding emissions and transfers to the environment, in terms of potentially harmful chemical substances. RETC includes information regarding the nature and quantity of emissions and transfers coming from fixed sources (factory) and mobile sources (transportation). RETC started in May 2014 and the experience in its design and available platforms can be a contribution for the MRV System design waste NAMA requires.

Related policies and regulations

In 2010, the Law N°20,417 of the Government of Chile creates the Ministry of the Environment (MMA), the Environmental Assessment Service (SEA) and the Environmental Commision (SMA). This Superintendency is in charge of enforcing the environmental laws in Chile. (http://www.leychile.cl/Navegar?idNorma=1010459)

The Chilean Government, through the Regional Development Undersecretary (SUBDERE), has a National Program on Solid Waste (PNR - Programa Nacional de Residuos Sólidos). The goal is to improve the environmental quality and sanitation of disposal centers located in urban and rural areas at a national level, by following an integrated and sustainable strategy designed for the urban waste management.

The Ministry of the Environment is developing a new Waste Law which will introduce the concept of "extended product responsibility" in Chile by requesting a producer (manufacturer or importer) to be responsible for the products sold once they reach the very first stage of the disposal chain.

The Ministry of the Environment is developing an "Integrated and sustainable waste management policy" (2014-2020) which will set the framework for the development of activities and initiatives in the waste management field for the next years. This policy's goal is to set a new approach for waste management in Chile, from health risk control to waste management, as well as to introduce environmental variables for waste management. This policy's main goal is to guarantee a rational environmental management of waste by setting up a waste management hierarchy and a sustainable management of resources.

Also, the National Waste System (SINADER) is available as well. This system will use statistic data and analyze each of the stages in waste management, so that the political stakeholders can develop better public policies and/or regulations for waste management.

Related NAMAs

NAMA CPL.

Contact data for NAMA coordinator/manager

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Alternate contact	N/A

8.- Information not confirmed by the sectoral counterpart.

Green zone for transportation in Santiago

NAMA's General Information		
Full name	Green zone for transportation in Santiago	
Short name	NAMA ZVTS	
Stage	☐ Conceptual/Feasibility. x Planned or under planning.	☐ Adopted: Under implementation. ☐ Implemented.
Registered in the United Nations	☐ Yes	x No
Category	☐ Unilateral, searching for recognition ☐ Bilateral, searching for planning support	x Bilateral, searching for implementation support ☐ Credits
Description	NAMA is comprised by four specific initiatives promoting low emissions transportation methods, to be carried out within a defined area in Santiago, Chile. Such area is under the jurisdiction of the Santiago Municipality. Initiatives include: 1) To promote zero and low emissions vehicles for light vehicle fleets (taxis and municipal vehicles) and charging stations; 2) More efficient buses for public transportation; 3) To promote non-motorized vehicles, including the development of 6 Km of new bicycle lanes, a pilot program for a shared-bicycle system, a connectivity solution for the current bicycle lanes and signs for bicycles in two areas of the ZVTS. 4) Transit management and redesign, with new pedestrian and semi-pedestrian paths, exclusive lanes for buses with zero and low emissions, and bicycle parking lots. The proposed geographical perimeter for the ZVST was defined jointly with the Santiago Municipality. This area includes the city downtown historical triangle, which covers an area of approximately two square kilometers. Within the ZVST, several places of historical interest can be found; these include the City Square, the Santiago Cathedral, The Government Palace of "La Moneda", the Municipal Theater, the Santiago Central Market, the Forest Park (Parque Forestal), among others. The selected area is very popular, touristic and commercial, so all of the ZVST initiatives will certainly have a high impact and high visibility. One of the main conclusions of the participative process with the stakeholders interested in developing the ZVST has left is that this must be considered a pilot project with huge potential for escalation and replicability, adding to the redefinition of the urban transportation model by offering a new approach towards an integrated and sustainable transportation system. The ZVTS implementation will also offer new ways to reduce greenhouse gases emissions and local pollutants. Also, it is highly replicable in other cities, it can be expanded from its initial area to a broader area within the same city.	
Nature or type of action	x Strategy, Policy or Programs. Specify related instrument[9]: Program or sectoral policy x Project or group of projects (technology or infrastructure investment) ☐ Other (s)	
Sector (s) considered by the NAMA	☐ Agriculture ☐ Construction ☐ Energy generation ☐ Energy usage ☐ Forestry/LULUCF ☐ Industry and industrial processes	☐ Wastes x Transportation and its infrastructure ☐ Transverse (check all that apply) ☐ Other (s) ..... .
Technology/ methodology	Zero and Low Emission Vehicles.	

9.- Economic, fiscal, voluntary agreements, regulatory, information management, capacity-building, research resources, etc.

Gas (es) covered by the NAMA	x Carbon dioxide (CO_2) ☐ Methane gas (CH_4) x Nitrous oxide (N_2O)	☐ Hydrofluorocarbons (HFC) ☐ Perfluorocarbons (PFC) ☐ Sulfur hexafluoride (SF_6) ☐ Nitrogen trifluoride (NF3)
Jurisdiction	☐ National x Regional RM ☐ Cross-regional	
	Period	2
	Year initiated or expected initiation year	By the end of 2014
	Finishing year	By the end of 2016

NAMA's objectives

To reduce GHG emissions in the transportation sector by promoting sustainable, scalable, and replicable initiatives through the use of new vehicle technologies that offer low carbon emissions and by promoting mode integration and change.

NAMA's constraints

Technology: both technological initiatives require specialized technical assistance. This is not affordable with the current resources held by the taxis and buses fleets. Nevertheless, in this early stage of technology use and testing, technology providers would follow-up and deliver a full after sales and training service for the technology users.

Economy: Technological measures mean a high increase in capital costs, so the technology receiver (taxi and bus operators) must assume a high risk for the investment, considering this technology has not been tested in this country. For this early stage, providers are offering (in several cases) operating leasing agreements with their cost included in payments.

Culture: Promotion of non-motorized vehicles measures and traffic re-design and management are of minor popularity, since they take space from private vehicles and give it to bicycles and pedestrians. In order to break down these constraints automatic flow counting technology for pedestrians and bicycles can be used; by doing so, which can support with real figures the benefit of these measures in terms of people mobility instead of vehicles mobility.

NAMA's Quantitative Goals

Quantitative goals (reductions)	Progress indicators per each goal (removals)	Additional information per goal
1.43 $MtCO_2eq$ in total, for the whole period.	Accumulated reductions in $MtCO_2eq$.	Include assumptions for each escalated initiative. Represents a scenario assessed in 10 years.

NAMA's Quantitative Goals

Methodologies	Assumptions
Expected reduction estimation.	The stated goal indicates the emission reductions estimated in 10 years, in a scenario of greater coverage of the ZVTS. It includes the 15% of the taxi fleet in Santiago (3,525 substituted units) and the 15% of the Transantiago bus fleet (975 substituted units); both cases substitute existent technology for electrical technology. This reduction potential could be greater if a larger percentage of the fleet is substituted. If ZVTS only considers the two square kilometers of the intervention in Santiago, it is reduces 13.000 tCO_2eq in 10 years.

Implementation planning and progress

Planning	Progress	Achieved and expected results[10]
Quantitative goals (reductions)	Progress indicators per each goal (removals)	Additional information per goal
Initiative 1: To promote light ZLEVs (zero level emission vehicles).	In October 2014, 5 charging stations were inaugurated for electric vehicles within the ZVTS area. This was done because the first electric taxis tendered by the SEREMIT RM were to start their operations by that month and because ZVTS would be working on the infrastructure, financed locally.	Initiative 1 includes 39 taxis and 15 municipal vehicles. Expected reductions under estimation process.
Initiative 2: More efficient buses for the public transportation.	Not implemented	Initiative 2 includes 5 electric buses and 5 hybrid buses. Expected reductions under estimation process.

10.- Can be time series.

Initiative 3: Promotion of non-motorized vehicles	As for the public bicycles system, this is integrated to the SIPB[11] which was tendered in July 2014 and should be awarded between August 2014 and September 2014. First stage should be implemented by the end of 2014.	Expected reductions under estimation process.
Initiative 4: Transit management and redesign	Pedestrianisation: 1 out of the 6 blocks is already implemented Semi-pedestrianisation: 11 out of the 22 blocks shall start in 2014. 100 bicycle parking places shall be completely implemented by 2014.	Expected reductions under estimation process.

Achieved or expected side-benefits per stage		
Steps (previously defined)	**Indicator Name[12](side-benefit)**	**Achieved and expected results**
Initiatives 1 to 4.	• Funds awarded by donors. • Funds awarded by the local government and private sector. • Accidentability • Technical capacity-building regarding the use of new technologies • Improvements in businesses within the area of intervention on ZVTS	W/I

NAMA's costs		
Estimated cost of preparation	Cost	W/I
	Calculation description	W/I
Implementation cost estimation	Cost	USD 17.6 million
	Calculation description	Total cost includes 50 light vehicles of zero and low emissions, 21 electrical charging points, 5 hybrid buses, 5 electric buses, 6 Kms. of new bicycle lanes, 1 connectivity solution for connecting two existing bicycle lanes, 1 autopilot for the public bicycles system with 13 stations and 130 bicycles, 6 new pedestrian blocks, 22 new semi-pedestrian blocks, 150 parking places for bicycles, 4 automatic vehicle counters, 4 automatic pedestrian counters, and hiring 5 backup professionals for the execution and follow-up.
Incremental cost of implementation	Cost	USD 2.7 million
	Calculation description	Includes the difference of capital cost between a conventional light vehicle and a plug in electrical vehicle. Also, it includes the difference of monthly leasing cost between conventional diesel buses, hybrid buses, and electric buses. Finally, it includes the cost of 21 electrical charging points.

Funding source	
Own resources	USD 7.64 million
Received resources	No international resources have been received
Resources to be requested (total, detailed information is explained below)	USD 9.96 million

Required support		
Financial resources	Required amount	USD 9.6 million
	Type of required resources	Subsidy
	Comments	The Municipality of Santiago is looking for financial support for the Santiago Green Zone, in order to finance the incremental costs of zero and low emissions buses/vehicles in contrast to the cost of traditional vehicles. This support also requests infrastructural co-financing as for the electrical charging points, new bicycle lanes, connectivity solution 1 for connecting two existing bicycle lanes, parking lots for bicycles and the construction of new pedestrian areas within the Green Zone. It also includes hiring 5 backup professionals for project execution and follow-up.

11.- SIBP: Public Bicycles Integrated System, integrating 10 communes

12.- Side-benefits can include social, economical, and environmental effects others than GHG reduction. These may be qualitative or quantitative.

Technology	Required amount	0
	Type of required resources	N/A
	Comments	No technological support is requested at this stage, because the zero and low emissions vehicle providers are to provide the necessary technical support and after-sales services.
Capacity-building	Required amount	USD 0.36 million
	Type of required resources	Institutional development, human resources, and regulations.
	Comments	The Municipality of Santiago will require additional human resources for leading the NAMA ZVTS during its implementation process and MRV process. Additionally, NAMA's execution will require a high level of administrative workforce, as for executing and supporting the budget, and for reporting to international donors.

Required support

Initiative 1: MRV is carried out according to the amount of kilometers per year and the performance of each vehicle. The Municipality of Santiago has a strong control over its fleet mileage, whereas taxis provide this information at Technical Check Plants.
Initiative 2: There is a study which includes the whole MRV protocol for the inclusion of new technologies based on data generated by the DTPM, for regulating the operations and services of licensees. (Design of a Monitoring, Reporting and Verification, MRV, British Embassy in Santiago for the DTPM).
Initiative 3 and 4 pedestrians and cyclists flow must be quantified, as well as the modal change by means of design and by carrying out surveys. Currently, there is no methodology developed in this country for quantifying the impact of measures promoting more sustainable activities, such as in the case of public transportation and non-motorized vehicles, so the recommendation of the ZVTS is to design a pilot methodology to be tested in this NAMA and then adjust it for the final change for the MRV to the mode change of all transportation projects.

Related policies and regulations

1. The MR SEREMI launched a tender by the end of 2013 for taxis exclusively using electric engines, awarding a total of 19 spots for basic taxis. According to what this entity of the MTT has reported, it is expected to continue with this initiative as soon as the first results from the first vehicles are gathered by October 2014.
2. The DTPM[13] is developing a study to improve the incentive program in contracts for operators, so that the use of clean technologies can be promoted aiming for the renovation of fleets in the current contracts and for the next tenders starting in 2018.
3. The promotion of non-motorized vehicles is mainly handled by alliances between local governments or municipalities, which are backed up by the central government, represented by the SEREMIT and the MTT
4. The management and re-design aspect is somewhat similar to the previous one, as majors are trying to improve their civic centers by offering more space to pedestrians.

Required support

N/A.

Contact data for NAMA coordinator/manager

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Responsible institution	N/A.

13.- DTPM: Metropolitan Public Transportation Board

Design and implementation of the ENCCRV including the Carbon Credits Generation and Trading Platform of the Forestry Sector in Chile (PBCCh)

Required support			
Full name	Design and implementation of the ENCCRV including the Carbon Credits Generation and Trading Platform of the Forestry Sector in Chile (PBCCh).		
Short name	Chilean Forestry NAMA within the ENCCRV framework		
Registered in the United Nations	☐ Conceptual/Feasibility. x Planned or under planning.	x Adopted: under implementation. ☐ Implemented.	
Name	x Yes[14]	☐ No	
Category	☐ Unilateral, searching for recognition x Bilateral, searching for planning support	x Bilateral, searching for implementation support ☐ Credits	
Description	Forestry NAMA acts as a technical and financial support agent of the ENCCRV, currently funded through CONAF with USD 1.8 million from the Swiss Agency (COSUDE). This also includes financing CONAF has acquired through the Forest Carbon Partnership Facility (FCPF) for USD 3.8 million (Readiness Fund) and USD 650,000 (Carbon Fund), the Environmental Global Fund (EGF) for USD 5.8 million, the Inter-American Development Bank (IDB) for USD 180,000, plus funds from the Chilean private sector and CONAF's budget.		
Nature or type of action	x Strategy, Policy, or Programs[15]: National Climate Change and Forestry Resources Strategy of Chile (ENCCRV) ☐ Project or group of projects (technology and infrastructure investment) ☐ Other (s)		
Sector (s) considered by the NAMA	☐ Agriculture ☐ Construction ☐ Energy generation ☐ Energy usage x Forestry/LULUCF	☐ Industry and industrial processes ☐ Wastes ☐ Transportation and its infrastructure ☐ Transverse (check all that apply) ☐ Other (s)	
Technology / methodology	As a base methodology, the ENCCRV includes defining GHG mitigation to jurisdictional scales (one or more grouped regions) to satisfy the REDD+ decisions associated to the UNFCCC which states actions have to be of national nature, with a chance to escalate them at a subnational level (in this case, jurisdictionally). At first, 6 jurisdictions with political/administrative limits associated to the Chilean regional division have been defined. These jurisdictions are: ● Jurisdiction I Arid Eco-Region (Regions XV, I, II, and III). ● Jurisdiction II Semi-arid Eco-Region (IV Region). ● Jurisdiction III Mediterranean Forests Eco-Region (Regions V, RM, and VI). ● Jurisdiction IV Temperate Forests Eco-Region (Regions VII, VIII, IX, XIV, and X). ● Jurisdiction V Southern Forests Eco-Region (Regions XI, and XII). ● Jurisdiction VI Oceanic and Insular Territories Eco-Region. Work is carried out in each of these regions. The purpose is to reach carbon levels (reference lines and MRV systems) which can satisfy the IPCC guidelines and global standards such as the Verified Carbon Standard (VCS); as for the social and environmental areas, decisions related to UNFCCC's REDD+, the national regulations, World Bank Operational Policies, Climate standard Principles and Criteria, Community and Biodiversity Alliance (CCBA) and its jurisdictional REDD+SES program. This is intended to validate each of the jurisdictions so that later, starting in 2015 and on, activities such as the GHG reduction or removal activities can be implemented; this is to be carried out through the national MRV system for quantifying benchmarks following the previously defined baseline.		
Gas (es) covered by the NAMA	x Carbon dioxide (CO_2) ☐ Methane gas (CH_4) ☐ Nitrous oxide (N_2O)	☐ Hydrofluorocarbons (HFC) ☐ Perfluorocarbons (PFC) ☐Sulfur hexafluoride (SF_6) ☐ Nitrogen trifluoride (NF_3)	
Jurisdiction	x National	☐ Regional	☐ Cross-regional.
Gas (es) covered by the NAMA	Period	2012-2020 related to the ENCCRV	
	Year initiated or expected initiation year	2012	
	Finishing year	First stage is set to be finished by 2020; nonetheless, it is intended to be a permanent line of action within the current and future regulation and encouragement instruments, by means of law.	

14.- http://www4.unfccc.int/sites/nama/Lists/NAMA/DispForm.aspx?ID=5

15.- Economic, fiscal, voluntary agreements, regulatory, information management, capacity-building, research resources, etc.

NAMA's objectives
1.- To contribute to the design and implementation of a state mechanism that helps the owners of forest, xerophytic formations and soils apt for forestry to gain access to the benefits associated to carbon and the environmental services of forests at both national and international level. 2.- To reduce 42 $MtCO_2eq$, with an important milestone subject to national and international financing by 2020, by means of forestry activities within the UNFCCC, such as preventing/reducing deforestation, avoiding/reducing degradation and boosting afforestation or restoration of degraded forests.

NAMA's constraints
1.- Less possibilities for increasing international financial cooperation since Chile is a member of the OECD. 2.- Other constraint to consider is the additional difficulty for the country when implementing methodologies initially planned for tropical forests and national territories with higher forest/climate homogeneity parameters when compared to Chile. 3.- Incentives for forestation, (Law Decree N°701, 1974) has no mechanisms for encouraging owners of soils apt for afforestation. 4.- For the process of setting up reference lines based on historical activity data, we do not always have the desired quality information (spatial resolution, for instance) with the necessary frequency. 5.- For MRV, in general, we need to systematize national scope larg data (something difficult to do). Also, there are certain data associated to illegal activities, such as the use of wood for household heating systems and this information is not comprehensively entered into the national accounting systems. 6.- Lack of understanding and awareness in this regard. Lack of engagement in relevant stakeholders in Chile as for the climate change and its link with the forestry sector. 7.- Scarce specialized technical capacities in the vegetation resources and climate change in Chile. 8.- Lack of integration in traditional promotion programs, lack of vegetation resources acts made according to international guidelines in terms of forests and climate change.

NAMA's Quantitative Goals		
Quantitative goals (reductions)	Progress Indicators per goal (reductions)	Additional information per goal
1.- 42 $MtCO_2eq$ as a potential goal for 2020, with the adequate international and national financing.	1.- Annual reduction/removal at a national level is estimated at 8.4 million tCO_2eq (it is expected to reach 42$MtCO_2eq$ in 5 years) with the adequate international financing.	
	2.- Since this is a national strategy which includes the Wall to Wall approach,[16] the total national territory must be considered (continental and insular), that is 75,633,601 hectares. Nonetheless, the forestry area is 16,676,875 hectares, so it is necessary to add the feasible to forest soils, around 2 million hectares (potential current use from soil of "non-forest" to forest), and xerophytic formations not yet precisely determined as for its surface at a national scale; nevertheless, it will be clarified by means of using satellite imaging, inventories, etc.	

Methodologies and assumptions (scopes, effects, goals and progress assessment)	
Methodologies	Assumptions
1. Operational methodology of the ENCCRV. The ENCCRV is based on generating key demonstrative instances with national and international funds which can leverage the adaptation to and the mitigation of the climate change; it also expects to institutionalize them by the creation and adjustments to public policies, on the regulation instruments and sector encouragement. This will be implemented with pilot actions on each of the selected jurisdictions, considering their social and environmental differences, by means of different plans related to forestation, degradation, and carbon stock increases (for example through afforestation and restoration of degraded forests) to be carried out through specific mitigation activities, probably "Baseline Management Plans" promoted by CONAF. Although at first it will be centered on mitigation by reduction/removal of GHG, it is expected to later add climate change adaptation practices (for instance, in water resources) by including them in CONAF's conventional operating plans such as forestry extension, incentives and payment programs, as well as in not exclusively carbon flow-related MRV systems.	1.- Soil availability, land owners and developers willing to carry out pilot projects.

16.- Method that consist on the sampling of the total of the national territory, not excluding any part of the territory.

1.- Methodology Definition for the Scope of Action The ENCCRV considers REDD+ as for its strategical activities, so it includes the following: 1.- To avoid or diminish deforestation (first D in REDD+). Although this is a marginal problem in Chile, with less than 10,000 hectares reported each year, it is considered as a line of action for reaching the necessary strength in terms of reaching jurisdictional levels of carbon. 2.- To avoid or diminish degradation (second D in REDD+) poses a challenge in terms of its definition (still not internationally agreed), but it also is one of the greatest forestry concerns at a national level. For this reason, Act 20,283 tries to partially solve it. 3.- An increase in carbon stock (+ sign in REDD+) means more carbon than the baselines defined by each jurisdiction; this includes afforestation, restoration of degraded forests during the period which comprises the baseline and the revegetation process by, for instance and in some cases, planting xerophytic formations which do not necessarily form an actual forest. The aforementioned presents an emphasis on emissions reduction and removal, nevertheless, regarding the UNFCCC, the carbon voluntary market, and within payments per performance schemes, non-carbon attributes within the forestry sector are of growing importance; at the same time, it is one of the defined goals for the ENCCRV implementation.	1.- Significant progress in the international preparation process related to actual and timely financing of REDD+ activities 2.- Lands, land owners and/or project developers with activities allowed and qualified by REDD+.
2.- Crediting and Certification Methodology for Reductions/Removals The ENCCRV and all of its components must follow the COP's decisions related to independent international reviews. This is for both, data CONAF provides for making GHG inventories and for payment schemes based on results of carbon reduction/removal and zero carbon attributes implemented. This is because Chile has signed the UNFCCC agreement, so all decisions deriving from it become Law of the Republic. Also, within CONAF's payments per results approach, a series of voluntary additional measures has been added for the carbon measurements and for the social and environmental protection, by following the World Bank's Operational Policies, the Carbon Fund Methodology Framework, the IPCC guidelines, and the VCS and CCBA standards, as well as the Gold Standard Foundation (GSF) guidelines.	1.- Demand for local and international carbon bonds. 2.- Chilean carbon bonds marketing options, mainly for the internal market, so that reductions can be validated by calculating the country's total reduction.
3.- Baseline estimation methodology Official data of the uses of land use and land-use change Register managed by CONAF and statistics of firewood consumption, roundwoods and forest fires managed by INFOR are being used. It is the same base information used in the third NIR update which will officialize Chile at the UNFCCC in its first biennial update report. Emissions/removal factors correspond to data from continuous forest inventories which INFOR and CONAF develop, as well as the compendium of biomass and allometric functions managed within the country[17]. Baselines are being determined at jurisdictional levels and they are differentiated by the following activities: deforestation, degradation and carbon stock increases.	
4.- Reduction/sequestration estimation methodology The reduction/removal estimations of GHG is made for mitigation activities per reference line (deforestation, degradation or stock increase) and by individual action according to each identified precursor. One example is the unsustainable firewood extraction on the degradation reference line. Alphanumeric historical data for its consumption is available for each jurisdiction. One line of mitigation for this precursor is to setup collection centers for firewood coming only from places approved by CONAF and with extraction schemes under sustainable performance. In this regard, associated reductions/removals are based on biomass availability-related data at regional level, implementation costs, potential for sustainable extraction and assumptions regarding degradation. This must be confirmed by the international verification processes each jurisdiction will be subject to, by means of Monitoring Reports which detail what actually happened and then compare this with the previously approved baseline and a soon to be implemented activity's potential for reduction/removal. Estimations for the future are to be adjusted with more sources of information.	

17.- http://www.conaf.cl/wp-content/files_mf/compendio-funciones-alometrica_UCC.pdf

5.- Social Participation Methodology By having ENCCRV the World Bank as an Executing Partner, their Operational Policies are to be followed. For this reason, an Strategic Environmental and Social Assessment (SESA) must be done. CONAF has made stakeholders maps of every region of the country for the purpose of holding strategy design and support backup workshops based on a free and previously informed process. As a voluntary action from CONAF and as an effort for giving more transparency to the ENCCRV, initiative implementation follow-up principles and criteria are to be defined inclusively, by following the CCBA REDD+SES program guidelines in order to establish a permanent Protection Information System (SIS Sistema de Información de Salvaguardas) following the required gender approaches to satisfy the international requirements. Also, an indigenous population enquiry following the ILO Agreement N°169 guidelines is programmed by 2015. Each of these efforts shows signs of a benefit distribution system and a conflict resolution schema in a participative way.	1.- Complete and updated map of stakeholders. 2.- Protection information system. 3.- Majority acceptance from stakeholders of schemes promoting the ENCCRV.
6.- Sustainability methodology The main goal is to develop knowledge for empowering the inclusion of lessons learned through public policies that can include, in the future, permanent and defined funds for fighting climate change by means of forestal resources and xerophytic formations. An important milestone is to prove the owners of these resources it is possible to improve their family income by following an environmental performance payment system and that these actions are fully compatible with the selling activity of all resources coming from the forestry sector. In this regard, one of the actions included by the ENCCRV is to strengthen cross-institutional arrangements in order to add these actions to the new regulation, as well as the sector promotion as a way to decrease inequity gaps and support the enforcement of international agreements on emissions reduction. The Chilean Tax Reform must be taken into account too, as it includes a green tax related to carbon dioxide generation which will have to consider several fixed sources (>50MWt) located in the national territory.	1.- The payment system for environmental services must be able to generate enough resources for making it competitive against the cost of opportunity incomes coming from regular and commercial uses of soil represent. 2.- Future national regulation for the emission limits per sector; or a green tax which penalizes emissions and stimulates compensations for reductions.

Implementation planning and progress		
Planning	Progress	Achieved and expected results (progress indicators)
Action (s) step (s): activities/years	Progress status	Achieved or expected reductions[18]
1.- ENCCRV design	Under constant validation and adjustment due to the international dynamic context and as stated by the social protection mechanisms.	Does not include direct reductions
2.- PBCCh design	Its implementation continues, as well as its adjustments by fusing its components with the MRV systems development, registries, and ENCCRV benefits distribution.	Does not include direct reductions
3.- ENCCRV socialization	Under national implementation. The first workshops have been carried out in July 2013, in the VIII and IX regions.	Does not include direct reductions
4.- Gap analysis per jurisdiction.	2 out of the six jurisdictions have an 80% completeness rate. The rest will end their gap analysis during this year.	Does not include direct reductions
5.- Characteristics of each jurisdiction	2 out of the six jurisdictions have an 80% completeness rate. The rest will end their gap analysis during this year.	Does not include direct reductions
6.- Jurisdictions validation	In progress and to be started by the end of 2014.	Does not include direct reductions
7.- Implementation of mitigation and adaptation activities defined for each jurisdiction.	2015-2020 2016 and on.	Potentially 8.4 million tons per year at a national level, depending on available funds.
8.- Implementation and adjustments of MRV systems for effective verification of GHG reduction/removal.	2016 and on.	Does not include direct reductions

18.- Can be time series.

Achieved or expected side-benefits per stage		
Steps (previously defined)	Indicator name[19] (side-benefit)	Achieved and expected results
1.- Characteristics of each jurisdiction.	Perfected forestry governance for improving its effectiveness in order to adequately execute project-related activities.	Number of projects defined/agreed per jurisdiction by their local communities during the Social and Environmental Evaluation process.
2.- Implementation of mitigation and adaptation activities defined for each jurisdiction.	Increase in Non-Wood Forest Products (NWFP) use.	Increase in forestal resource owners incomes by selling NWFP when compared to their historical incomes.

Achieved or expected side-benefits per stage		
Estimated cost of preparation	Cost	USD 11,000,000
	Calculation description	Readiness stage related to strategy design and capacity-building according to the sequence established for REDD+ at a national level, adopted by the ENCCRV.
Implementation cost estimation	Cost	USD 22.800.000
	Calculation description	It is a minimum value allocated to executing demonstrative field implementation activities which can effectively reduce/remove emissions.
Incremental cost of implementation	Cost	USD120,000,000.- (cost is estimated by the last information available from CONAF about afforestation and management average values per hectare).
	Calculation description	This includes the implementation cost at a pilot level for including, based on a successful performance results obtained with international support, these guidelines in modifications and/or updates to forestry promotion tools that include a stable set of budget details (included in the national budget law).

Funding source	
Own resources	USD 8,400,000 (valued by CONAF's regular activities which support the ENCCRV).
Received resources	USD 1.8 million - Swiss cooperation (2013-2015), USD 3.8 million - FCPF Readiness Fund (2015-2018), USD 650,000 - FCPF Carbon Fund (2015), USD 5.8 million - GEF (2015-2019), USD 180,000 - IDB (2014-2015), USD 400,000 - national private sector (2014-2016).
Resources to be requested (total, detailed information is explained below)	USD 120,000,000

Required support		
Financial resources	Required amount	USD 94,500,000
	Type of required resources	Donation for implementing reduction/removal of GHG activities at levels able to reach the proposed goals, at least by 2020.
	Comments	3 phases are considered in the REDD+ context. The 1st one is a preparation phase, the 2nd one is an implementation phase for the mitigation measures, and the 3rd one relates to payments per results. In this regard, funds are required for the 2nd phase including the execution of strategic measures per jurisdiction, which relate to the reduction/removal activities which generate results and get paid.
Technology	Required amount	USD 25,000,000
	Type of required resources	Apt technologies for reinforcing the MRV and benefits distribution systems continuously.
	Comments	Constant funds are required for making per-results payment schemes feasible and for defining values regarding site-specific carbon content under and over soils for creating valid monitoring reports within the international verifications framework.
Capacity-building	Required amount	USD 500,000
	Type of required resources	• Continuity Masters Degree in Climate Change and Vegetation Resources jointly dictated by Universidad Mayor and Universidad de Concepción for CONAF workers. • Continuity Courses for auditors for the purpose of validation and verification of GHG reduction/removal initiatives. • Multilevel courses in increasing social awareness of the ENCCRV.
	Comments	Financing is covered by CONAF funds associated to the FCPF Readiness Fund.

19.- Side-benefits can include social, economic, and environmental effects others than GHG reduction. These may be qualitative or quantitative.

Description of the MRV
An important conceptual element in the design of the Chilean MRV forestry system relates not only to satisfy the international requirements for monitoring GHG emissions by forestal degradation but also to modernize and consolidate the current management and information systems currently active within CONAF. These same systems are to work as base statistic information reported by the country in every aspect... To sum up, the idea is to include every action related to the registration, control, and audit in several areas in a geographically distributed manner that will allow a significant increase in institutional skills regarding public forestry management, policy evaluation, programs, projects, etc. By following the same ideas, it is expected to create a multilevel Monitoring System which can be used in different areas, based on basic geographical and alphanumerical information and processing methodologies specifically defined for each element. Basically, these requirements relate to the forestry management activities, including REDD+ guidelines and their associated Social and environmental protective measures. All requirements are related and add to a system which must follow the characteristics defined by the IPCC regarding estimations as for their robustness, transparency, comparability, consistency and precision. It must be noted that as of this date all the information Chile could use for its forestry monitoring system qualifies as Tier 2, using the IPCC naming convention. It is therefore expected to increasingly generate a system which can fulfill Tier 3 requirements for emission/removal factors and other aspects when funds allow so. It will be defined, within the ENCCRV, to what extent of detail it is economically feasible to monitor, report, and verify emissions associated to forest degradation, deforestation and increased stocks of carbon. Also, a solid analysis sequence, from the methodological point of view, has been established within the ENBCC from general to particular aspects. For reference levels and for the MRV, information regarding activities is based on the Chilean Native Vegetation Resources Registry and on the INFOR forestry statistics. Then, the allometric functions and the Carbon and Dendro Energy Monitoring for Forestry Resources (emission and removal factors) are used. It must be noted that the Ministry of Agriculture, coordinated by INFOR, is working on the GHG project called "Integrated national monitoring and assessment System on Forest Ecosystems (SIMEF) in support of policies, regulations and SFM practices incorporating REDD+ and biodiversity conservation in forest ecosystems", which will be a fundamental part in progressing towards the design and implementation of the national MRV system. It is estimated that this project will be approved by GEF in the year 2015 and it will have a time horizon of 4 years. It is worth to mention that the aforementioned will be strengthened with the Swiss funding because a consultancy was given to a consortium composed of the Austral University, SIIGSA and Winrock International named 'Design of a support system and public information, based in Measurement, Report and Verification (MRV) in the ENCCRV framework which has the following expected results: 1) Base supply compendium the system uses, created with the respective analysis of each element. 2) Analysis for the complete compliance with the national and international requirements of transparency, effectiveness and uncertainty. 3) Publishable document with all the supplies the country already has which are useful for a complete and internationally valid MRV system, detailing work lines to address the missing requirements with emphasis in the independent verification processes requested in this framework. 4) Identification and analysis of information and proposal gaps of the methodological elements to amend them (with cost proposal included), according to what has been planned to address in the ENCCRV framework in what is referring to carbon market and associated projects as Forestry NAMA, FCPF and GEF project of Sustainable Management of Land. 5) Analysis of entities, steps, control costs and system verification, as well as minimum data quality criteria. 6) Logical design and minimum and computerized requirement analysis to establish an application which properly integrates the totality of the supplies identified for the functioning of the created system. 7) System developed with a prototype validated by the technical counterpart which is scalable to the national reality. 8) Prototype validation that allows to prove the operative functioning of the PBCCh related to a reliable system, with the consequent scenario modeling necessary for it. 9) Cost estimation analysis related to the implementation, operation and replicability at national level of the System about the bases and the established requirements. 10) Preparation and delivery of the operative handbooks for its proper management and use. This work was started in March, 2014 and it has a duration of 8 months to deliver a final report.

Related policies and regulations
● Law Decree N°701 from 1974 about forestry development[20].
● Law N°20,283 from 2008 about recovery of the native forest and forestry development and its regulations.
● Decisions of the COP about safeguards for REDD+ of Cancun 2010 and Durban 2011.

20.- Since year 2012 and until this date, the component of incentives for afforestation is not valid.

Related policies and regulations
● NAMA from Georgia funded by the Ministry of Agriculture, Forestry, Environment and Water from Austria titled "Adaptive, Sustainable Forest Management in Borjomi-Bakuriani Fores District".
● NAMA from Mali that is waiting to be funded for its implementation titled 'NAMA in the forestry sector'.
● Initiative of NAMA 'Panama Canal Green Route'. Not registered in the UNFCCC yet. It integrates reduction for the vessels that transit through the Canal, for energy efficiency and the usage of renewable energies in the operation of the Canal and projects of forestry carbon in the Panama Canal basin.

Contact data for NAMA coordinator/manager	
Responsible institution	National Forestry Corporation (CONAF) from the Ministry of Agriculture.
Contact professional	Angelo Sartori, ENCCRV Person in charge, Management of Development and Forestry Development (GEDEFF), CONAF. angelo.sartori@conaf.cl
Alternate contact	Osvaldo Quintanilla, GEDEFF Professional, CONAF. osvaldo.quintanilla@conaf.cl
Alternate contact	Not applicable.

Clean Production Agreements in Chile.

NAMA's General Information		
Full name	Clean Production Agreements in Chile.	
Short name	NAMA APL	
Stage	☐ Conceptual/Feasibility ☐ Planned or under planning.	x Adopted: under implementation. ☐ Implemented.
Registered in the United Nations	x Yes	☐ No
Category	x Unilateral, searching for recognition ☐ Bilateral, searching for planning support	☐ Bilateral, searching support for implementation ☐ Credits
Description	In Chile, the promotion of clean Production is promoted and coordinated by the National Clean Production Council (CNPL - Consejo Nacional de Producción Limpia), institution depending on the Ministry of Economy. One of the goals of the CNPL for 2020 is to contribute to greenhouse gas reduction through its main instrument, the Clean Production Agreement (APL). This voluntary agreement is negotiated and signed by a representative of the industrial organization from the companies of a particular productive sector and a sector of the public administration. The purpose of the agreement is to implement the clean production through goals and actions in a determined time. This instrument is supported by a specific national legislation (DS N° 20416/2012), and by the National Institute of Standards that has developed a series of rules (ChN2796-Of2003, ChN2797-Of2009, ChN2807-Of2009, ChN2825-Of2009) with the purpose of creating the framework for their creation, implementation and certification. An APL is a standard that establishes goals and specific actions to be implemented by a productive sector, based mainly in the better techniques available in the market. This instrument is co-funded by the government of Chile, that will co-fund around 70% of the costs, covering the sector sustainability diagnosis, mid-term audits, technical guidance, training, certification, impact studies and general coordination of the implementation of the APL. The remaining 30% is funded by the sector, in particular by the private companies that adhere to the APLs. However, the funding granted by the CPL does not offer support for the purchase and acquisition of technology. The government of Chile wishes to thank to the PNUMA-RISO Center for its support in the preparation of the NAMA data sheets.	
Nature or type of action	x Strategy, policy, or programs[21] National Climate Change and Forestry Resources Strategy of Chile (ENCCRV) ☐ Project or group of projects (technology and infrastructure investment) ☐ Other (s)	
Sector (s) considered by the NAMA	x Agriculture x Construction x Energy generation x Use of Energy x Forestry/LULUCF	x Industry and industrial processes x Waste x Transportation and its infrastructure x Transverse (check all that apply) ☐ Other (s) ..... .

21.- Economic, fiscal, voluntary agreements, regulatory, information management, capacity-building, research resources, etc.

Technology / methodology	Several technologies for the different sectors. The CPL, through the Clean Production Agreements has as a mission to promote the insertion of clean technologies in the different industrial and sectoral processes, but the entrepreneur is who decides which technology will implement. For this, the technologies to be incorporated are diverse.		
Gas (es) covered by the NAMA	x Carbon dioxide (CO_2) x Methane gas (CH_4) x Nitrous oxide (N_2O)		x Hydrofluorocarbons (HFC) x Perfluorocarbons (PFC) x Sulfur hexafluoride (SF_6) x Nitrogen trifluoride (NF_3)
Jurisdiction	x National	☐ Regional	☐ Cross-regional
Implementation dates	Period		9 years
	Year initiated or expected initiation year		2012
	Finishing year		2020

NAMA's objectives

Register 10 APLs per year, between 2013 and 2020. These APLs will be focused in the development of proper practices to reduce GHG emissions through the implementation of energy efficiency, the best practices in solid waste management, liquid waste management, water efficiency and sustainable practices in specific areas, such as fertilization.

NAMA's constraints

1.- The constraints for this NAMA are related to the lack of knowledge and capacities of the companies that are adhered to the APL. In particular, the lack of awareness regarding the needs of data registration related to the GHG emissions and its capacity to raise and deliver the proper information.

2.- Information constraints: The access to all the information registered along the APL process is necessary to manage the assessment of the compliance and effect of this APL. The owner of the company must be whom compiles the data. On the other side, there is no standardized method for the quality control of the data along the APL process.

3.- Coordination Policies: A lack of coordination with other developing NAMAs is seen, in terms of methodology and predetermined parameters that are considered.

4.- Constraints for MRV: The low data availability of the companies is an important constraint. SMEs do not have registry of the information required to calculate the GHG emission reduction, so from now on and until 2020 all the signing APL companies must register their data to allow the calculation of the baseline and the reduction emissions.

5.- Methodology constraints: The current NAMA will be based in CDM methodologies that have been adapted at a smaller scale according to the SME capabilities. Therefore, the tracking plans are similar to CDM, but several parameters have been taken by default. However, there is no consensus about what parameters must be calculated or taken as default value, so it is considered as a constraint.

6.- Lastly, the lack of specification about the verification requirement and certification is another constraint.

NAMA's Quantitative Goals

Quantitative goals (reductions)	Progress indicators per each goal (removals)	Additional information per goal
Expected reduction of 18.4 $MtCO_2eq$ in total, with an average of 2.25 $MtCO_2eq$ per year.	• APL signed per year • Accumulated reductions in ($MtCO_2eq$) • Reductions per APL in ($MtCO_2eq$)	N/A

Methodologies and assumptions (scopes, effects, goals and progress assessment)

Methodologies	Assumptions
The methodology for the estimation of reduction potential starts with a survey to compile information about the GHG emissions before the implementation of an APL. The CPL gathers the information of the participating companies related to solid and liquid wastes, transportation, energy and water consumption, energy and fertilizer use; and uses this information to continuously monitor the GHG emissions of each company. This allows the calculation of indicators which are present in the final impact report once the APL is completed.	Relevant Assumptions: Previous study indicates that in APL 16, implemented between 2002 and 2010, an average of 31.6 $KtCO_2eq$ were reduced per year per APL. To estimate the reductions of the current NAMA this value is extrapolated, assuming that each APL has a reduction potential of 31.6 $KtCO_2eq$ per year. A total number of 45 APL is considered in the diagnosis stage, which will be implemented in the NAMA period and 80 new APLs that are expected to be signed in the full period. Such amount is currently under reconsideration, due to the recalculation of the baseline considering the UNFCCC/IPCC criteria and performing a sensitivity analysis about reduction potential for the different economical sectors.

Implementation planning and progress		
Planning	Progress	Achieved and expected results (progress indicators)
Action (s) step (s): activities/years	Progress status	Accomplished or expected reductions[22]
It is expected to sign and implement 10 agreements per year in the 2012-2020 period. For this the following steps will be taken: 1.- Base diagnosis of the sector 2.- APL proposal 3.- Negotiation with the sector and signing of the agreement 4.- Implementation, which is composed by: an initial diagnosis of the companies ascribed to the agreement; implementation of the actions, with the tracking and control of the agreement and intermediate audits. 5.- Final Audit. 6.- Public Services Assessment. 7.- Issuance of the Clean Production certificate (valid for 3 years with 2 maintenance audits). The complete process lasts a maximum of 3 years.	There are 92 APL in total up to this date, in different stages of their processes. 4 agreements have been signed since 2012 to this date, which are in the implementation stage.	There are no validated results yet. In the three years of NAMA, a reduction of 6.75 $MtCO_2eq$ is estimated.
Achieved or expected side-benefits per stage		
Steps (previously defined)	Indicator name[23](side-benefit)	Achieved and expected results
It is expected to sign and implement 10 agreements per year in the 2012-2020 period.	These are annual indicators that comprehend social and productive aspects. **Economic/ Productivity:** ● Productivity Increase ● Better corporate image ● Save in costs related to waste management, water and power consumption. ● Opening to international markets through exportation of more sustainable products. **Environmental:** ● Reduction of the pollution of the liquid effluents through an improvement in management and prevention. ● Reduction of the environmental problems related to irregular waste management (uncontrolled dump sites). ● Water consumption reduction through the incorporation of clean and sustainable practical technologies. ● Reduction of the carbon footprint of the facilities and/or companies. **Social:** ● Improvement in the working conditions through the assurance of the fulfillment of the working regulations. ● Improvements of the workers capacities. Minimization of work risks through prevention practices.	There are still no results measured. There is no information regarding the expected results
Achieved or expected side-benefits per stage		
Estimated cost of preparation	Cost	USD 35,500
	Calculation description	W/I
Implementation cost estimation	Cost	USD 160 million
	Calculation description	W/I

22.- Can be time series.

23.- Side-benefits can include social, economic, and environmental effects others than GHG reduction. These may be qualitative or quantitative.

Incremental cost of implementation	Cost	0.05
	Calculation description	W/I

Achieved or expected side-benefits per stage	
Own resources	USD 160 million
Received resources	N/A
Resources to be requested (total, detailed information is explained below)	N/A

Required support		
Financial resources	Required amount	N/A
	Type of required resources	N/A
	Comments	N/A
Technology	Required amount	N/A
	Type of required resources	N/A
	Comments	N/A
Capacity-building	Required amount	N/A
	Type of required resources	N/A
	Comments	N/A

Description of the MRV

The MRV system is under design, through the project funded by the Program of Innova Chile of Corfo "Bienes Públicos para la Competitividad" (Public Goods for Competitiveness) 12BPC2-13428, where the Management and Strengthening Center for the Clean Development Mechanism (CGF – MDL) from the Pontificia Universidad Católica de Valparaíso participates as beneficiary, associated with the Under-Secretariat of the Environment with the technical advice of the National Council for Clean Production.
Through this project, indicators to measure the performance of companies ascribed to an APL has been built. The indicators are the ones described previously (GHG reduction and side-benefits), which will be built on the base of the information that is requested to companies. These are annual indicators that comprehend social and productive aspects and other environmental impacts included GHG. In the platform the carbon footprint is registered with scopes 1, 2 (and 3 depending on the productive sector), but the main axis are indicators of side-benefits of the APL and therefore of the NAMA.
The companies are monitored before and after the implementation of the Clean Production Agreements through a series of environmental, social and productive indicators generated through the Innova Project. The calculation methodology will respond to those internationally validated; the base information and the indicators are systematized and calculated through the digital platform www.compitemas.cl (watch video in http://www.compitemas.cl/index.php/vt_principal/accedes).
The companies will be in charge of uploading the required base information to estimate the indicators; the auditors of APLs will be in charge of verifying that such information is correct; and the CPL will issue the APL certificates as long as the committed actions and goals are fulfilled within the APL term.

Related policies and regulations

Law N°2016, which fixates special standards for smaller companies.
Link: http://www.munitel.cl/Actualidad_Legislativa/Ley_20.416.pdf

Related NAMAs

In general, this NAMA could be related to all the sectoral NAMAs that count with achieved reductions per companies that participates in some of the APL that are signed in the 8 years of the current NAMA. Among them could be:
NAMA Self-Supply .
NAMA Sustainable Building.
NAMA Industrial Wastes.

Contact data for NAMA coordinator/manager

Responsible institution	Renewable Energy Center (CER) of CORFO, Ministry of Economy committee, Government of Chile.
Contact professional	Verónica Baquedano, National Coordinator of Clean Production Agreements. Almirante Lorenzo Gotuzzo 124 piso 2, Santiago, Chile. (56 2)26884500 veronica.baquedano@cpl.cl
Alternate contact	Clean Production Agreements Almirante Lorenzo Gotuzzo 124 piso 2, Santiago, Chile. (56 2)26884500 ximena.ruz@cpl.cl
Alternate contact	Not applicable.

Annex 5. Summary tables on mitigation measures considered in the assessment of scenarios, MAPS Chile

Table. Summary measures considered Agricultural sector

Name of the Measure	General Description	Scope	Affected GHG	Years	Type of Instrument	Side-benefits	Comments
Promotion of organic agriculture	To promote the application of organic matter to the soil in permanent systems of application with associated certification.	National	CO_2, N_2O	35	Fiscal	A - S - E	CO_2 removal and it could have N_2O emissions
Implementation of biodigesters	To encourage the implementation of biodigesters to remove emissions generated in wells and accumulation lagoons.	National	CH_4	35	Fiscal	A - S - E	Government promotes, private costs of operation
Improvement of bovine feeding diet.	To improve the bovine feeding diet to optimize the functioning of the rumen.	National	CH_4, N_2O	35	Fiscal, information, research	A - S - E	Measures to private
Genetic-vegetable improvement	To integrate to the meat and milk breeder systems new alternatives of fodder plants selected and genetically improved.	National	CH_4	35	Fiscal	A - S - E	It requires complete programs
Atmospheric carbon sequestration by the soils through non-tillage.	To increase the organic carbon of soils as consequence of a zero farming strategy and incorporation of crop wastes.	National	CO_2	35	Fiscal, economical, research	A - S - E	It requires research
Carbon sequestration on agricultural soils by the application and introduction of organic stabilized matter in a regular basis.	Incorporation to the soil, materials with high stabilized carbon content.	Regional	CO_2	35	Fiscal, economical, research	A - S - E	C Removal
Use of fertilizers with nitrogen cycle inhibitors.	To apply urease inhibitors and/or of the nitrification with nitrogenous sources to the crops/grassland to delay the ammonia denitrification and volatilization.	National	N_2O	35	Fiscal	A - S - E	There is information to encourage the investigation
Use of non-conventional renewable energy (NCRE) in agriculture in irrigation.	Replace the electrical power in pumping systems by non conventional renewable energies, particularly solar.	National	CO_2	35	Fiscal, information	A - S - E	

Source: compilation based in MAPS Chile Stage 2 report.

Summary measures considered Forestry sector and Land-use change.

Name of the Measure	General Description	Scope	Affected GHG	Years	Type of Instrument	Side-benefits	Comments
Increase on productivity in crops through technology adoption	Increase of the productivity of pine plantations, *Eucalyptus globulus* and *Eucalyptus nitens* categorized by type of owner.	Regional	CO_2	21	Economical	S - E	Plans of transfer by the State
CO_2 removal through degraded native forest recovery	Recovery of 83 thousand hectares of degraded forest to increase the CO_2 removal.	Regional	CO_2	20	Economical	E	
Wood construction and removal in wood of harvested products	To encourage the use of wood and its derivatives considered by the IPCC, through an annual diffusion program.	Regional	CO_2	15	Fiscal, Information	A	
Instrument for Encouragement of Afforestation	To encourage through bonus the establishment of forest tree plantations for the generation of biomass.	Regional	CO_2	19	Economical	A - S	
Reduction of illegal felling in Native Forests	Implementation of measures for the reduction of illegal felling through change in the use of technology and institutional capacity.	Regional	CO_2	15	Fiscal		The reduction is mentioned, but not the calculation
Silvopastoral Systems.	To promote and encourage the establishment of windbreaks, with tree species that allow to remove the emissions coming from the livestock sector.	Regional	CO_2	19	Economical	A - S - E	
Energy use of thinning	To allocate the products extracted from the native forest management (thinning) to biomass with energy purposes.	Regional	CO_2	35	Fiscal	A - E	

Source: compilation based in MAPS Chile Stage 2 report.

Summary of measures considered in Commercial, Public and Residential sectors.

Name of the Measure	General Description	Scope	Affected GHG	Years	Type of Instrument	Side-benefits	Comments
Increase in the requirements of the Thermal Regulations	To increase the level of thermal requirements (isolation) of the housing in Chile, updating the requirements every 10 years.	National	CO_2	36	Normative	A - S - E	
Electrical and residential self-supply	To promote the injection to the generation grid based in a net metering regimen or net billing.	National	CO_2	36		A - S - E	
Energy rating of existing housing	To promote the use of energy rating for existing housing as requirement to access to reconditioning programs.	National	CO_2	36	Fiscal, economical	S - E	
Energy rating of new housing	To promote the use of energy rating for new housing during a 5 year period and from this date.	National	CO_2	36	Fiscal, economical	A - S	
Minimum standards for residential lighting	It is the second stage of the labeling program of 2007, with the objective of raising the bulb efficiency standard.	National	CO_2	36	Normative	A - S - E	
Minimum standards for commercial refrigerators	The establishment of minimum energy consumption standards for refrigeration artifacts.	National	CO_2	36	Normative	A - S - E	
Minimum standards for refrigerators of the Residential sub-sector	Measure that is combined with the labeling program, with the objective of increasing the refrigerator efficiency standard.	National	CO_2	34	Normative	A - S	It requires or considers stakeholders trainings and diffusion
Minimum standards for fluorescent tubes and ballasts	Program whose goal is to raise the efficiency standard of fluorescent tubes with magnetic ballast.	National	CO_2	33	Normative	A - S - E	
Minimum labeling and standards for air conditioners (Minimum Standards)	To raise the standard of efficiency of artifacts in the Residential sub-sector.	National	CO_2	31	Normative	A - S - E	
Minimum labeling and standards for air conditioners (Labeling)	To raise the standard of efficiency of artifacts in the Residential sub-sector.	National	CO_2	34	Normative	A - S - E	
Minimum labeling and standards for washing machines (Minimum Standards)	To raise the standard in washing machine efficiency in the Residential sub-sector.	National	CO_2	32	Normative	A - S - E	
Minimum labeling and standards for washing machines (Labeling)	To raise the standard in washing machine efficiency in the Residential sub-sector.	National	CO_2	35	Normative	A - S - E	
Program on adoption of thermal solar systems	To promote the use of thermal solar systems in new and existing housing to heat sanitary water.	National	CO_2	37	Fiscal, normative, economical	A - S	Program based in state subsidy and normative
Aerator Exchange Program	The measure considers the exchange and installation of aerator in the showers of new and existing housing in the Residential sub-sector.	National	CO_2	36	Fiscal	A - S - E	

Source: compilation based in MAPS Chile Stage 2 report.

Summary of possible measures considered in the Mining sector and Other Industries

Name of the Measure	General Description	Scope	Affected GHG	Years	Type of Instrument	Side-benefits	Comments
Development of Projects for Self-Generation of Electric Power with NCRE in Industrial and Mining Plants	The possibility of industrial and mining companies to generate electrical power from renewable energy source has been raised.	Regional	CO_2	35	Fiscal	A - S - E	Promotion Activity
Assessment and encouragement of alternatives for construction of desalination plants for mining.	To asses alternatives to the water desalination process to avoid the high consumption of energy per m^3 and to improve the efficiency of this technology.	Regional	CO_2	33	Research	A - S	Project
Promotion of the usage of low-GHG-emission non-conventional fuels for thermal purposes in the industrial and mining sectors.	Incentive in the future to change the use of conventional fuels by developing fuels such as synthetic, hydrogen, others.	Regional	CO_2	25	Fiscal		Promotion Activity
Implementation of energy efficiency measures for transportation in mining.	Implementation of energy efficiency measures of low investment cost for the transportation to the interior of the mining site.	Regional	CO_2	36	Fiscal	E	Promotion Activity
Implementation of systems for heat surplus recovery from thermal processes in the industrial and mining sectors.	Application of a public information instrument to promote and encourage the use of heat surplus recovery in industrial processes.	Regional	CO_2	36	Fiscal, information	A - S - E	Promotion Activity
Efficient energy usage encouragement in the industrial sector, through the execution of energy audits and the application of the energy efficiency measures detected.	Implementation of energy efficiency audits in the industry and mining areas.	Regional	CO_2	36	Fiscal, normative, economical	A - S - E	Mandatory and regular for large companies, and voluntary and co-funded for companies which are not members of this group.
Encouraging the Mining Industry to Perform Power Generation Projects with NCREs in the Electric Market and Accounting Reductions in the Industry and Mining Sectors.	Generation of legal bases for the acknowledgment of the emission reduction due to electric consumption in renewable generation projects.	Regional	CO_2	33	Fiscal, research, normative		Promotion Activity that consists in studies and requires normative framework
Encouragement for the use of low-GHG-emission non-conventional fuels for thermal purposes in the industrial and mining sectors.	Conversion from thermal systems that operates with diesel, combustible oil and coal, to natural gas.	Regional	CO_2	33	Fiscal	A - S	Promotion Activity
Implementation of co-generation on existent plants	To promote the installation of co-generation technologies in all the sub-sectors of the industrial and mining sector.	Regional	CO_2	33	Fiscal	A - S - E	Promotion Activity
Implementation of CO_2 removal and storage systems (CCS) in high-intensity-GHG-emission sub-sectors.	To encourage the investment in systems and technologies of storage and removal of CO_2 in the industry and mining sub-sector.	Regional	CO_2	25		A - S - E	Promotion Activity
Investment on renewable energies for thermal purposes in new and existing industries and mines.	To promote the installation of NCRE technology.	Regional	CO_2	37	Fiscal	A - S - E	Promotion Activity
Investment on the implementation of energy management systems in the industrial and mining sectors.	To promote the investment in regulated energy management systems.	Regional	CO_2	36		A - S - E	Promotion Activity and SGE promotion
Promotion of the application of a standard (voluntary) of energy efficiency criteria on new mining projects.	Generation of voluntary agreements in which the companies are committed to implement a standard to analyze and improve the energy efficiency in new projects.	Regional	CO_2	36	Voluntary Agreements	A - S - E	
Replacement of electric motors in the industrial and mining sectors.	Replacement of inefficient and/or standard motors between 1 HP and 10 HP.	Regional	CO_2	36		E	
Potential energy recovery from material falling in mining.	Installation of system which allow to generate electricity through potential energy recovery existing in different types of fall.	Regional	CO_2	35			Promotion Activity
Restrictions to the entry of inefficient electric motors, through minimum energy performance standards (MEPS)	To establish minimum energy performance standards in a legal way for imported induction motors which are commercialized in the country.	Regional	CO_2	35	Normative	A - S - E	
Restrictions to the entry, through minimum energy performance standards (MEPS)	To establish minimum performance standards in a legal way for the commercialization in the country of certain types of equipment used by the industry.	Regional	CO_2	33	Normative	A - S - E	

Source: compilation based in MAPS Chile Stage 2 report.

Summary of considered measures Waste Sector.

Name of the Measure	General Description	Scope	Affected GHG	Years	Type of Instrument	Side-benefits	Comments
Technical Assistance	Systematization of energy diagnosis and implementation of energy management system in cargo transportation companies with high levels of activity.	National	CO_2	37		S - E	Technical assistance program
Mode Change in Cargo Transportation, Truck-Cabotage	To assess the reduction of activity level of the truck park replacing the transported load in this by more efficient modes such as maritime.	National	CO_2	15	Fiscal, normative, research	A - S - E	Impractical, it could be done through a decree.
Mode Change in Cargo Transportation, Truck-Train	To assess the reduction of activity level of the truck park replacing the transported load in this by more efficient modes such as railroads.	National	CO_2	10	Fiscal, normative, research	A - S - E	Impractical, it could be done through a decree.
Scrapping of lightweight vehicles	Scrapping of a percentage of lightweight vehicles	National	CO_2	9	Fiscal	A - S - E	Scrapping Program
Efficient Driving	Training about Eco Driving to lightweight vehicles, buses, collective taxis and truck drivers.	National	CO_2	9	Fiscal	A - S - E	Training Programs, requirement in drivers license
Labeling of efficient tires for lightweight vehicles	Program of tire labeling for lightweight vehicles that informs the user about the attribute of energy efficiency in the use of this accessory-	National	CO_2	32	Fiscal, normative	A - S - E	Voluntary program Similar to the labeling of refrigerators
Extension of Passenger Urban Railways	To assess the construction of additional kilometers of urban railroads in cities that already have this service	Local	CO_2	26	Fiscal, research	A - S	
Implementation of Infrastructure in the Public Transportation	Implementation of Infrastructure in the Public Transportation, such as exclusive and separate corridors and bus stops with payment in the exterior of the bus.	Local		35	Fiscal	A - S	
Bicycle-Mode Infrastructure	Intervention in roads and public places in the country with bike lanes and several complementary projects.	National	CO_2	35	Fiscal	A - S	Project
Aerodynamic improvements in trucks	Implementation of aerodynamic equipment to improve fuel performance in interurban trucks.	National	CO_2	35	Economical, fiscal	E	AChEE Fund
Technological improvements in air mode	To encourage the incursion of technological improvements in the air mode through reconditioning new units with better technological features.	National	CO_2	35	Fiscal	A - S	
Energy consumption and CO_2 emission goals for the average new-vehicle fleet.	To reduce progressively the average CO_2emissions of the new vehicles fleet that enter the national vehicle park.	National	CO_2	36	Normative, fiscal	A - S	
E-Mobility Readiness Plan	To promote the introduction of taxis connectible to the network (grid-enabled vehicles) It is part of the NAMAs of the government of Chile.	National	CO_2	32	Fiscal	A - S - E	
Public bicycle program	To establish at least 1 system of shared or public bicycles per region in the country.	National	CO_2	34	Fiscal	A - S	Pilot Program
Electric bicycle subvention program	Subsidy to the purchase of electric bicycles	National	CO_2	36	Economical, fiscal	A - S	Subsidy Program
Renovation of the cargo train fleet.	To encourage energy efficiency through the renovation of the rolling material of national railroad mode which is characterized for having more than 30 years.	National	CO_2	35	Fiscal	A - S	Pilot Program
Renovation of cargo truck fleet and scrapping	Renovation of trucks with more than 25 years old by new trucks with better performance, taking the firsts out of the streets.	National	CO_2	9	Fiscal, economical	A - S - E	Possible subsidy
Street billing and increasing parking prices	Implementation of street billing and increasing parking prices in some areas of Santiago focused to the private transportation.	Local	CO_2	35	Fiscal	S - E	
Zero and Low Emission Vehicles	To encourage the entry of zero and low CO_2 emission vehicles to the lightweight vehicles park that enter the country.	National	CO_2	35	Fiscal	A - S	
Zero and Low Emission Vehicles - Buses	To encourage the entry of zero and low CO_2 emission buses to the lightweight vehicles park that enter the country.	National	CO_2	32	Fiscal	A - S - E	
Green Zone for Transportation	NAMA of the government of Chile that has 4 main initiatives: 1) Promotion of zero and low emission vehicles, 2) Low emission public transport buses, 3) Promotion of the non-motorized modes and 4) Traffic redesign and management	National	CO_2	8	Fiscal	A-S	NAMA:

Source: compilation based in MAPS Chile Stage 2 report.

Summary of measures considered Electric Power Generation and Transmission Sector

Name of the Measure	General Description	Scope	Affected GHG	Years	Type of Instrument	Side-benefits	Comments
Substantial increase on generation with LNG (LNG Subsidy)	To displace the use of coal and oil as fuel replacing it by LNG.	Regional	CO_2	30	Economical, Normative, fiscal	A - S	It is necessary to generate a high subsidy for this to be implemented. The achievement of this goal can be reached through different instruments: the creation of a standard or a tax.
Carbon Capture and Storage	To remove CO_2 and later storage under the surface.	Regional	CO_2	20	Research	A - E	Analysis Study
Reduction of Electrical Power Loss	To reduce the electrical power loss through improvements and technological measures.	Regional	CO_2	30	Fiscal	A - S - E	Incentive plan in the regulation.
Hydroelectric Expansion in Aysén	To increase the Hydroelectric expansion in the Aysén area due to its great potential and low seasonality.	National	CO_2	29	Fiscal	E	
Electrical Power Generation in irrigation works	To use the irrigation works and generate power through the water that circulates in them.	Regional	CO_2	36	Fiscal	A - E	To generate the proper incentives.
Demand Management: Reduction of voltage.	To reduce voltage for the residential sector in the SIC.	Regional	CO_2	30	Fiscal	A - S - E	Reduction of voltage for the residential sector in the SIC.
Incentive to Nuclear Energy	To achieve the inclusion of the nuclear energy in the Chilean electric system.	Regional	CO_2	19	Fiscal	S - E	Inclusion of nuclear energy
Incentive to a specific technology - Solar Concentration	To promote the use of solar concentrators in the electric power generation.	National	CO_2	36	Economical, fiscal	A - S - E	CORFO funding and support.
Incentive to specific technology - Wind	To promote the use of wind energy in the electric power generation.	National	CO_2	36	Fiscal	A - S - E	
Incentive to a specific technology - Geothermal	To promote the use of geothermal energy in the electric power generation.	National	CO_2	33	Fiscal	A - S - E	
Incentive to a specific NCRE technology - mini-hydro	To create the necessary incentives to encourage the inclusion of mini-hydro generation.	National	CO_2	35	Fiscal	A - S - E	To generate the necessary incentives.
Incentive to a specific technology - Solar Photovoltaic	To encourage the use of solar photovoltaic energy and thus increasing the system capacity	National	CO_2	36	Fiscal	A - S - E	Incentive
Regional interconnection	To analyze the regional interconnection alternatives that are technically feasible.	Regional	CO_2	30	Research	S - E	Study to analyze the regional interconnection alternatives.
Modification to the NCRE Law: 30/30	To maintain the current energy situation until 2025 and then incorporate a 30% of NCRE.	National	CO_2	25	Normative	A - S - E	
Standards or incentives for cleaner carbon technologies	To create standards or incentives for cleaner carbon technologies	Regional	CO_2	30	Normative, economical, fiscal	S - E	To create standards or incentives.
Wind Power storage system	To consider power storage system to facilitate the integration of NCRE technologies.	Regional	CO_2	20	Fiscal	S	
Solar Power storage system	To consider power storage system to facilitate the integration of NCRE technologies.	Cross-regional.	CO_2	20	Fiscal	S	

Source: compilation based in MAPS Chile Stage 2 report.

Annex 6. Other initiatives having international support of financial resources

Title of the project:

Mitigation actions on Easter Island

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Transverse	19,950	Received	2012	2013

Scope: Mitigation

Other areas of support:

Title of the project:

Regional support for development of NAMAs

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
IDB	Forestry	180,000	Approved	2015	2016

Scope: Mitigation

Other areas of support:

Title of the project:

Technological assistance for sustainable building

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Transportation	117,943	Received	2013	2014

Scope: Mitigation

Other areas of support:

Title of the project:

Low-carbon Center of Universidad Mayor CEEBEC

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom		60,590	Received	2011	2012

Scope: Mitigation

Other areas of support:

Title of the project:

Design of a generic framework for MRV of climate change mitigation actions

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Transverse	76,166	Received	2014	2015

Scope: Mitigation

Other areas of support:

Title of the project:

Design a program for technology improvement for buses from public transportation of Santiago

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Transportation	59,760	Received	2014	2015

Scope: Mitigation

Other areas of support:

Title of the project:

Design and implementation of the ENCCRV including the Platform for the Generation and Trading of Carbon Credits from the Forestry Sector in Chile (NAMA).

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
Swiss Confederacy	Forestry	1,800,000	Received	2013	2014

Scope: Mitigation

Other areas of support:

Title of the project:					
Design of Transportation Green Zone in Santiago					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
United Kingdom	Transportation	92,092	Received	2011	2012
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:					
Expansion of self-supply of non-conventional renewable energy in Chile (SSREs)					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
NAMA Facility	Energy	19,800,000	Approved	2013	2017
Scope:			**Other areas of support:**		
Mitigation			Capacity-building		

Title of the project:					
Funding for Renewable Energy					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
United Kingdom	Energy	109,095	Received	2012	2013
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:					
Cooperative Carbon Fund (Payment per results stage)					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
World Bank	Forestry	650,000	Approved	2015	2015
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:					
Cooperative Carbon Fund (Preparation stage)					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
World Bank	Forestry	3,800,000	Approved	2015	2018
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:					
Road map of sea energy					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
United Kingdom	Energy	108,058	Received	2012	2014
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:					
Implementation of low-emission taxis					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
United Kingdom	Transportation	46,476	Received	2013	2014
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:					
Report on sea energy					
Source of support	**Sector**	**Total fund (USD)**	**Status of the fund**	**Starting Year**	**Finishing Year**
United Kingdom	Energy	131,721	Received	2011	2012
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:

Measurement of carbon footprint of Easter Island

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Transverse	26,508	Received	2011	2012

Scope:	Other areas of support:
Mitigation	

Title of the project:

Measurement of carbon footprint of Juan Fernández Island

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Transverse	34,928	Received	2012	2013

Scope:	Other areas of support:
Mitigation	

Title of the project:

Mobilize transition towards energy efficiency of lighting

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
Global Environmental Facility	Energy	2,744,683	Approved	2013	2017

Scope:	Other areas of support:
Mitigation	

Title of the project:

Renewable energies MRV

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Energy	92,417	Received	2012	2013

Scope:	Other areas of support:
Mitigation	

Title of the project:

Transantiago MRV

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Transportation	110,918	Received	2012	2013

Scope:	Other areas of support:
Mitigation	

Title of the project:

Solar panels in Liceo Menesiano Sagrado Corazón (Llay Llay)

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
Australian Communities Foundation	Energy	16,000	Received	2013	2013

Scope:	Other areas of support:
Mitigation	

Title of the project:

Action plan for strategy of renewable energy of Antofagasta city.

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Energy	99,600	Received	2014	2015

Scope:	Other areas of support:
Mitigation	

Title of the project:

CALAC Program: Climate and clean air of cities in Latin America

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
Swiss Confederacy	Transportation	Not valuated	Received	2013	2015
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:

Promote development of biogas with energy purposes in small and medium size agro-industries

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
Global Environmental Facility	Energy	1,928,089	Received	2013	?
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:

National registry of GHG mitigation actions

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Transverse	51,737	Received	2012	2013
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:

Certification System of Climate Change for municipalities in Chile

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
United Kingdom	Multi-sector	62,339	Received	2014	2015
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:

Integrated System of Monitoring and Evaluation of Forestry Ecosystems in support of policies, regulations and sustainable forestry management practices (SFM) incorporating REDD+ and biodiversity conservation in forestry ecosystems.

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
Global Environmental Facility	Forestry	5,863,586	Approved	2013	2016
Scope:			**Other areas of support:**		
Mitigation					

Title of the project:

Design of a terrestrial, aquatic and marine biodiversity monitoring network in the context of climate change.

Source of support	Sector	Total fund (USD)	Status of the fund	Starting Year	Finishing Year
UNFCCC	Biodiversity	250,000	Approved	2014	2015
Scope:			**Other areas of support:**		
Adaptation					

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Ministerio del Medio Ambiente

Gobierno de Chile

CLIMATE CHANGE OFFICE