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Preface

Natural resources are a pillar of Chile's economy. Chile is the world's largest copper producer, as well as a major exporter of agricultural, forestry and fishery products. It benefitted from the commodity price boom of the 2000s, and economic growth has been sustained for most of the last 15 years. It has greatly improved living standards, and massive investments have led to more people having access to key services such as wastewater treatment and urban public transport. However, strong growth has been accompanied by a stubborn persistence of income inequality and increasing environmental pressures, notably air pollution, water shortage, habitat loss, and soil and water contamination.

In response to these environmental challenges, since 2010, Chile has strived to strengthen its environmental institutions and design a comprehensive environmental policy framework. New policy instruments have been recently put in place, including a carbon tax. However, the positive effects on the environment have not yet fully materialised. In this respect, the next decade must witness rigorous reform implementation; this is the main message of the second *OECD Environmental Performance Review of Chile*.

The *Review* assesses Chile's progress in achieving its environmental policy objectives, focusing on the period since 2005, when the first *Environmental Performance Review* was released. It provides 54 recommendations to help Chile green its economy and improve its environmental governance and management, with a strong emphasis on climate change and biodiversity policies.

Climate change is an increasingly important issue for Chile. Greenhouse gas (GHG) emissions have continued to increase in line with economic growth and are projected to continue rising. The country is vulnerable to the impacts of climate change, including flooding, extreme heat and declining water availability. In 2015, Chile committed to reducing GHG emission intensity by 30% by 2030 compared to the 2007 level, and by up to 45% if sufficient international support is provided. Achieving this commitment will be part of the global effort to meet the goals of the Paris Agreement. It will entail moving beyond the piecemeal approach that has characterised Chilean climate policy so far, towards implementing more ambitious and cost-effective mitigation policies that can be sustained and deepened over time. The *Review* recommends the clarification of institutional responsibilities for implementing climate change mitigation and adaptation policies, as well as the adoption of a financing strategy that facilitates private-sector investment in low-carbon and climate-resilient infrastructure.

Many regions of Chile are significant to global biodiversity, but pressures on ecosystems from economic activities and infrastructure development remain intense. Protected areas are a cornerstone of biodiversity policy; they cover more than 19% of the land area and the new Nazca-Desventuradas Marine Park is the largest in the Americas. However, effectively managing protected areas remains a challenge. The *Review* encourages the swift adoption of the proposed legislation creating a new Biodiversity and Protected Areas Service and an

integrated national protected areas system. This would help improve biodiversity governance and management, partly through greater use of economic instruments such as payments for ecosystem services. Enhancing the participation of stakeholders and local and indigenous communities in decision making will be essential to address recurrent environmental conflicts, including water-use conflicts.

This *Review* has been prepared by the OECD in cooperation with the Economic Commission for Latin America and the Caribbean (ECLAC). It is the result of a constructive policy dialogue between Chile and the other countries participating in the OECD Working Party on Environmental Performance. We are confident that this collaborative effort will be useful to tackle our shared environmental challenges and steer economic development in a direction that is more environmentally sustainable and socially equitable.

Alicia Bárcena
Executive Secretary
Economic Commission for
Latin America and the Caribbean
(ECLAC)

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Organisation for Economic
Co-operation and Development
(OECD)

Foreword

The principal aim of the OECD Environmental Performance Review programme is to help member and selected partner countries improve their individual and collective performance in environmental management by:

- *helping individual governments assess progress in achieving their environmental goals;*
- *promoting continuous policy dialogue and peer learning; and*
- *stimulating greater accountability from governments towards each other and public opinion.*

This report reviews Chile's environmental performance since the first review in 2005. Progress in achieving domestic objectives and international commitments provides the basis for assessing the country's environmental performance. Such objectives and commitments may be broad aims, qualitative goals or quantitative targets. A distinction is made between intentions, actions and results. Assessment of environmental performance is also placed within the context of Chile's historical environmental record, present state of the environment, physical endowment in natural resources, economic conditions and demographic trends.

The OECD is indebted to the government of Chile for its co-operation in providing information; for the organisation of the review mission to Santiago, the municipality of Santo Domingo, the El Yali National Reserve and Emiliana Organic Vineyards (6-11 July 2015); and for facilitating contacts both inside and outside government institutions.

Thanks are also due to the representatives of the two examining countries, Kelly Torck (Canada) and Roger Lincoln (New Zealand).

This review was co-ordinated by the OECD and benefited from the co-operation with the United Nations Economic Commission for Latin America and the Caribbean (ECLAC). The authors of this report were Nils Axel Braathen, Ivana Capozza, Britta Labuhn, Eugene Mazur and Michael Mullan from the OECD Environment Directorate, and Rachel Samson of Carist Consulting. Ivana Capozza co-ordinated the review and Nathalie Girouard provided oversight and guidance. Carla Bertuzzi provided statistical support; Annette Hardcastle provided editorial and administrative support; and Mark Foss copy-edited the report. Preparation of this report also benefited from inputs from Mauricio Pereira from ECLAC, Gérard Bonnis from the OECD Environment Directorate, Gerado Aragon Castaño and Ada Ignaciuk from the OECD Trade and Agriculture Directorate, and Michelle Harding from the OECD Centre for Tax Policy and Administration, as well as from comments provided by members of the OECD Secretariat.

The OECD Working Party on Environmental Performance discussed the draft Environmental Performance Review of Chile at its meeting on 10 March 2016 in Paris, and approved the Assessment and Recommendations.

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Reader's guide

General notes

Signs

The following signs are used in Figures and Tables:

. . : not available

– : nil or negligible

. : decimal point

Country aggregates

OECD Europe: This zone includes all European member countries of the OECD, i.e. Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

OECD: This zone includes all member countries of the OECD, i.e. the countries of OECD Europe plus Australia, Canada, Chile, Israel, Japan, Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.

Currency

Monetary unit: Chilean Peso (CLP)

In 2015, USD 1.00 = CLP 654.32

In 2014, USD 1.00 = CLP 570.64

In 2012, USD 1.00 = CLP 485.98

In 2010, USD 1.00 = CLP 509.98

Cut-off date

This report is based on information and data available up to February 2016.

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Abbreviations and acronyms

AGCID	Chilean International Co-operation Agency for Development
AMERB	Area of Management and Exploitation of Benthic Resources
APL	Clean Production Agreement
BAU	Business-as-usual
CBD	United Nations Convention on Biological Diversity
CDM	Clean Development Mechanism
CEPAL	United Nations Economic Commission for Latin America and the Caribbean
CH_4	Methane
CIFES	National Sustainable Energy Innovation and Promotion Centre
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO_2	Carbon dioxide
CONAF	National Forest Corporation
CONAMA	National Environmental Commission
CORFO	Chilean Economic Development Agency
DAC	OECD Development Assistance Committee
DGA	General Water Directorate
DIA	Environmental Impact Declaration
ECLAC	United Nations Economic Commission for Latin America and the Caribbean
EGS	Environmental goods and services
EIA	Environmental impact assessment
FDI	Foreign direct investment
GDP	Gross domestic product
GEF	Global Environment Facility
GERD	Gross domestic research and development expenditure
GHG	Greenhouse gas
GNI	Gross national income
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
LAC	Latin America and the Caribbean
LNG	Liquefied natural gas
LULUCF	Land use, land-use change and forestry
MAPS	Mitigation Action Plans and Scenarios
MINVU	Ministry of Housing and Urbanism
MMA	Ministry of Environment
Mt CO_2 eq	Million tonnes of carbon dioxide equivalent
NAMA	Nationally Appropriate Mitigation Action
NCRE	Non-conventional renewable energy source
NGO	Non-governmental organisation
NO_x	Nitrogen oxides
N_2O	Nitrous oxide
OCC	Office of Climate Change
ODA	Official development assistance
PES	Payments for ecosystem services
PM	Particulate matter
PPDA	Pollution Prevention and Decontamination Plan
PPP	Public-private partnership/Purchasing power parity

PRTR	Pollution Release and Transfer Register
R&D	Research and development
RCA	Resolution of Environmental Qualification
RTA	Regional trade agreement
SBAP	Biodiversity and Protected Areas Service
SEA	Strategic environmental assessment
SEIA	System of Environmental Impact Assessment
SIRDS-S	Agricultural Soil Environmental Sustainability Incentive System
SMA	Environmental Superintendence
SME	Small and medium-sized enterprise
SNAP	National Protected Areas System
SNASPE	National System of Public Protected Forest Areas
SO_x	Sulphur oxides
SO_2	Sulphur dioxide
SUBDERE	Undersecretary for Regional and Administrative Development
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UTM	Monthly tax unit
VAT	Value added tax

BASIC STATISTICS OF CHILE (2014 or latest available year)*

(OECD average values in parentheses)[a]

PEOPLE AND SOCIETY

Population (million)	17.7		Population density per km^2	23.4	(35.0)
Share of population by type of region:			Population annual growth rate, latest 5 years	0.9	(0.6)
Predominantly urban (%)	48.4	(48.7)	Income inequality (Gini coefficient)	0.5	(0.3)
Intermediate (%)	15.7	(26.1)	Poverty rate (% of population with less than 50% med.income)	18.0	
Rural (%)	35.9	(25.3)	Life expectancy	78.8	(80.1)

ECONOMY AND EXTERNAL ACCOUNTS

Total GDP (GDP, national currency, billion)	147 185		Imports of goods and services (% of GDP)	32.3	(29.2)
Total GDP (GDP, 2010 PPP, billion)	368		Main exports (% of total merchandise exports)		
GDP, latest 5-year average annual real growth	4.6	(1.9)	Copper and articles thereof	28.8	
GDP per capita (1 000 USD 2010 PPP)	20.8	(36.5)	Ores, slag and ash	25.8	
Value added shares (%)			Edible fruit and nuts; peel of citrus fruit or melons	7.5	
Primary	3.3	(1.5)	Main imports (% of total merchandise imports)		
Industry including construction	35.1	(23.7)	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	21.2	
Services	61.5	(74.8)	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	12.1	
Exports of goods and services (% of GDP)	33.8	(29.0)	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof	11.0	

GENERAL GOVERNMENT

Percentage of GDP

Expenditure	22.4	(45.7)	Education expenditure	4.3	(6.1)
Revenue	20.8	(43.5)	Health expenditure	4.1	(7.4)
Gross financial debt	23.1	(87.8)	Environment protection expenditure	0.1	(0.7)
Net lending/net borrowing	-0.4	(-2.2)	Environmental taxes: (% of GDP)	1.1	(1.6)
			(% of total tax revenue)	5.6	(5.1)

LABOUR MARKET, SKILLS AND INNOVATION

Unemployment rate (% of civilian labour force)	6.4	(7.9)	Patent applications in environment-related technologies (% of all technologies, average of latest 3 years)[b]	15.7	(11.3)
Tertiary educational attainment of 25-64 year-olds (%)	21.0	(31.5)	Environmental management	13.2	(4.8)
Gross expenditure on R&D, % of GDP	0.4	(2.4)	Water-related adaptation technologies	1.2	(0.5)
			Climate change mitigation technologies	7.3	(8.6)

ENVIRONMENT

Energy intensity: TPES per capita (toe/cap.)	2.19	(4.14)	Exposure to air pollution ($PM_{2.5}$) ($\mu g/m^3$)	6.4	
TPES per GDP (toe/1 000 USD, 2010 PPP)	0.1	(0.1)	Road vehicle stock (veh./100 inhabitants)	24.1	(58.4)
Renewables (% of TPES)	32.39	(9.2)	Material productivity (USD, 2010 PPP/DMC, kg)	0.44	(2.1)
Carbon intensity (energy-related CO_2):			Land area (1 000 km^2)	743.5	
per capita (t/cap.)	4.67	(9.58)	% of arable land and permanent crops	2.4	(12.1)
per GDP (t/1 000 USD, 2010 PPP)	0.2	(0.3)	% of permanent meadows and pastures	18.8	(23.2)
GHG intensity:[c]			% of forest area	23.0	(31.2)
per capita (t/cap.)	5.4	(12.5)	% of other land (built-up and other land)	55.7	(33.5)
per GDP (t/1 000 USD, 2010 PPP)	0.29	(0.3)			

*) Values earlier than 2010 are not taken into consideration.

a) OECD average values = simple or weighted averages of available countries' values.

b) Higher-value inventions that have sought patent protection in at least two jurisdictions.

c) Excluding emissions/removals from land use, land-use change and forestry.

Source : Calculations based on data extracted from databases of the OECD, IEA, Eurostat, the World Bank and national sources.

Executive summary

Institutional and policy reforms have not yet delivered the desired environmental outcomes

During the last decade, Chile has made remarkable progress in strengthening its environmental institutions and policy framework, as recommended by the 2005 *Environmental Performance Review*. In 2010, Chile established the Ministry of Environment, the Council of Ministers for Sustainability, an inspectorate and an environmental assessment agency. This has helped raise the profile of environmental policy and clarify environmental management and sustainable development responsibilities within the government. However, the environmental benefits of institutional reforms are lagging behind; rigorous implementation is needed to tackle environmental pressures as Chile's income level continues to catch up with the OECD average.

Sustained economic growth and investment in environment-related infrastructure and services have helped improve the well-being of the Chilean population over the last 15 years, although income inequality remains the highest among OECD member countries. Nearly all the urban population is connected to drinking water supply and wastewater treatment infrastructure. Dwellers in the capital region have access to an integrated public transport system and the most extensive metro network in South America. Energy market reforms have enabled rapid growth in renewable electricity generation, without subsidies. Renewables cover nearly a third of Chile's total energy needs, the fifth highest share in the OECD.

However, energy and material consumption, greenhouse gas (GHG) emissions and waste generation have continued to increase in line with economic growth. Chile is among the most resource-intensive OECD economies, which reflects the key role of copper mining and smelting, agriculture, forestry and fishery in the economy. Air pollution remains high, particularly in large urban and industrial areas. Over 95% of waste continues to be landfilled. Water scarcity and pollution are of concern in the regions where mining and agriculture concentrate (the north and central regions, respectively). Distortions in the allocation and trade of water-use rights and the lack of integrated water resource management result in overexploitation of some aquifers and exacerbate local conflicts.

Environmental laws need to be better enforced

The human and technical capacity of environmental institutions has grown remarkably, but not yet to the level required by their functions. Improving inter-institutional co-operation at national level and with local authorities is essential to ensure effective policy implementation and law enforcement. The environmental impact assessment is the backbone of Chile's environmental regulation. It is closely linked to one-window environmental permitting, but it should better guarantee public participation in its early

stages and consider potential environmental impacts and suitable project alternatives. There is also a need to further strengthen the information base to support environmental decision making. Chile's first comprehensive study on environmental expenditure indicated that 0.5% of total expenditure by central government agencies (equivalent to 0.1% of GDP) went to environmental protection in 2012. Chile should systematically review its environmental expenditure to better assess spending effectiveness and efficiency.

Greening the tax system is under way

The 2014 tax reform includes a tax on light motor vehicles (based on emissions of nitrogen oxides and fuel economy) and a tax on emissions of local air pollutants and carbon dioxide (CO_2) from large stationary sources. These new taxes are expected to increase revenue from environmentally related taxes, which, at 1.2% of GDP in 2014, was below the level observed in many OECD member countries. However, the emission tax primarily affects thermal electricity generation and leaves out other major emission sources such as copper smelters. The CO_2 tax rate (USD 5 per tonne of CO_2) is relatively low and should be progressively increased. In addition, due to the interactions between the tax and the electricity price-setting mechanisms, some power generators, small businesses and households will not bear the full cost of the tax. With the exception of the CO_2 tax, which will enter into force in 2017, fuel tax rates are not linked to fuels' carbon content and do not apply to fuels used in sectors other than transport. In 2006, Chile introduced a specific tax on mining profits, but overall taxation of mineral resources appears relatively low in Chile compared to other resource-rich members of the OECD.

Investment in environment-related infrastructure has been high, but needs remain large

Chile has well-developed infrastructure, notably when compared to other Latin American countries. Extensive use of public-private partnerships has attracted private investment in water and transport infrastructure. User tariffs generally allow recovering operating and maintenance costs and partly reflect environmental and social costs such as water scarcity and road congestion. However, infrastructure needs remain large, particularly to upgrade wastewater treatment facilities, reduce water losses, and expand sanitary landfills and urban public transport systems. Major investment packages, including the 2014 National Infrastructure Plan, comprise investment in environment-related infrastructure, but most such plans lack systematic consideration of environmental and climate components.

Green markets are expanding and eco-innovation capacity is improving

Openness to international trade and a favourable investment environment have eased the penetration of advanced environmental technology. This has helped reduce industry's environmental footprint and rapidly expand solar and wind energy generation. While domestic production capacity for green technology is limited, expenditure in research and development (R&D) targeting the environment grew to 9% of total R&D expenditure in 2012, one of the highest shares in Latin America. The number of patent applications in environment-related technologies, albeit small, increased almost twice as much as that in all other technology domains. Chile's environmental goods and services sector has grown faster than the rest of the economy and was estimated at 1.7% of GDP in 2010. Ensuring consistent enforcement of environmental regulation and introducing fully-fledged green

public procurement and eco-labelling procedures would further stimulate demand for green products. The National Programme on Sustainable Consumption and Production is expected to consolidate the multitude of support initiatives.

Chile needs a robust, coherent climate policy

Chile's GHG emissions grew by 23% in 2000-10 and are projected to continue increasing in line with economic growth and energy use. Emissions from the transport sector are projected to grow by up to 95% by 2030, with increasing wealth and demand for travel, low-density urban expansion and the shift from public to private transport. GHG emissions from agriculture have also been steadily rising and represent 15% of Chile's total emissions. However, the integration of transport and agriculture into climate policy remains at an early stage.

In advance of the Paris climate change conference in December 2015, Chile committed to reducing GHG emissions intensity by 30% by 2030 relative to 2007 if economic growth is maintained at current rates; and by up to 45% if adequate international financial support is received. Such conditions leave some uncertainty about the ambition of the commitment, which implies slowing the increase in GHG emissions, rather than reducing them in absolute terms. Achieving the commitment will, nevertheless, require improved policy coherence and cost-effective mitigation policies across all emitting sectors. It will entail strengthening institutional arrangements and broadening the funding base to compensate for the likely reduction of international finance as Chile joins the circle of high-income economies. Infrastructure choices, notably in the energy and transport sectors, should be examined carefully to avoid locking in emissions.

Chile is vulnerable to the impacts of climate change, including increased flood risk, reduced availability of water for hydropower, reduced agricultural production and loss of biodiversity. Implementation of the sectoral adaptation plans will be essential in preparing for these changes, combined with robust monitoring and evaluation.

Biodiversity policy is advanced, but effectively managing protected areas is challenging

With growing economic activity, extraction and use of natural resources, and development and expansion of infrastructure, pressures on Chile's biodiversity are increasing. High income inequality exacerbates environmental conflicts and fuels mistrust. Biodiversity objectives are progressively being mainstreamed into other policy areas such as agriculture, forestry and mining, but tangible results have not yet materialised.

Chile has made significant progress in developing strategies and policies to promote biodiversity conservation and sustainable use. Instruments, such as a market of water-use rights, a fishing quota system and entrance fees to protected areas, have long been in place. Nonetheless, there is scope to expand the use of economic instruments and explore innovative ways to raise revenue and leverage private sector investment, including payments for ecosystem services and biodiversity offsets.

Protected areas cover 19.5% of the land area, although important land-based ecoregions, such as the Chilean matorral, are not adequately represented. Once officially established, the new Nazca-Desventuradas Marine Park will bring Chile's marine protected areas to 24% of its exclusive economic zone. However, many protected areas lack sufficient financial and human resources, and their management plans are only partially implemented, incomplete

or outdated. Despite current efforts, it is likely that Chile will not have operational management and administration for all protected areas until 2050.

The governance systems for biodiversity and water management are highly complex and fragmented. Financing for biodiversity has grown considerably since the mid-2000s, but resources remain inadequate to attain biodiversity objectives or bring Chile in line with biodiversity funding provided in other South American countries. A dispersal of resources across many different institutions has also reduced expenditure effectiveness. In 2014, the government proposed a legislation establishing a new Biodiversity and Protected Areas Service and an integrated national protected areas system, with a view to addressing institutional fragmentation, improving policy coherence, increasing funding and better involving the private sector and local and indigenous communities.

Assessment and recommendations

The Assessment and recommendations present the main findings of the Environmental Performance Review of Chile *and identify 54 recommendations to help Chile make further progress towards its environmental policy objectives and international commitments. The OECD Working Party on Environmental Performance reviewed and approved the Assessment and recommendations at its meeting on 10 March 2016.*

1. Environmental performance: Trends and recent developments*

Chile is a small, open economy with abundant mineral resources. It has experienced a long period of strong economic growth, which has helped reduce poverty and improve the well-being of its population, even though inequality remains large. As the world's largest copper producer and exporter, Chile benefited from the commodities boom of the 2000s and well weathered the 2009 global economic crisis. However, gross domestic product (GDP) growth and investment have weakened as raw material prices and external demand began declining in the early 2010s (OECD, 2015a).

Natural resources are a pillar of the economy, with copper mining, agriculture, forestry and fish production constituting a large share of national income and exports. Chile is among the most resource-intensive economies in the OECD, reflecting extensive mining activities and wood and biomass use. Economic growth, extraction and use of natural resources, and rising consumption have increased environmental pressures, notably air pollution, water shortage, loss of native forests and biodiversity, and soil and water contamination (MMA, 2012). Climate change is expected to exacerbate some of these pressures.

Energy mix and intensity

Energy used by the economy (total primary energy supply or TPES) grew by 54% between 2000 and 2014, with rapid economic growth, increased mining and industrial production, and growing transport demand. Nevertheless, the energy intensity of the Chilean economy (TPES per unit of GDP) has decreased to slightly below the OECD average. Per capita energy use is significantly lower than in other OECD member countries, reflecting the remaining income gap.

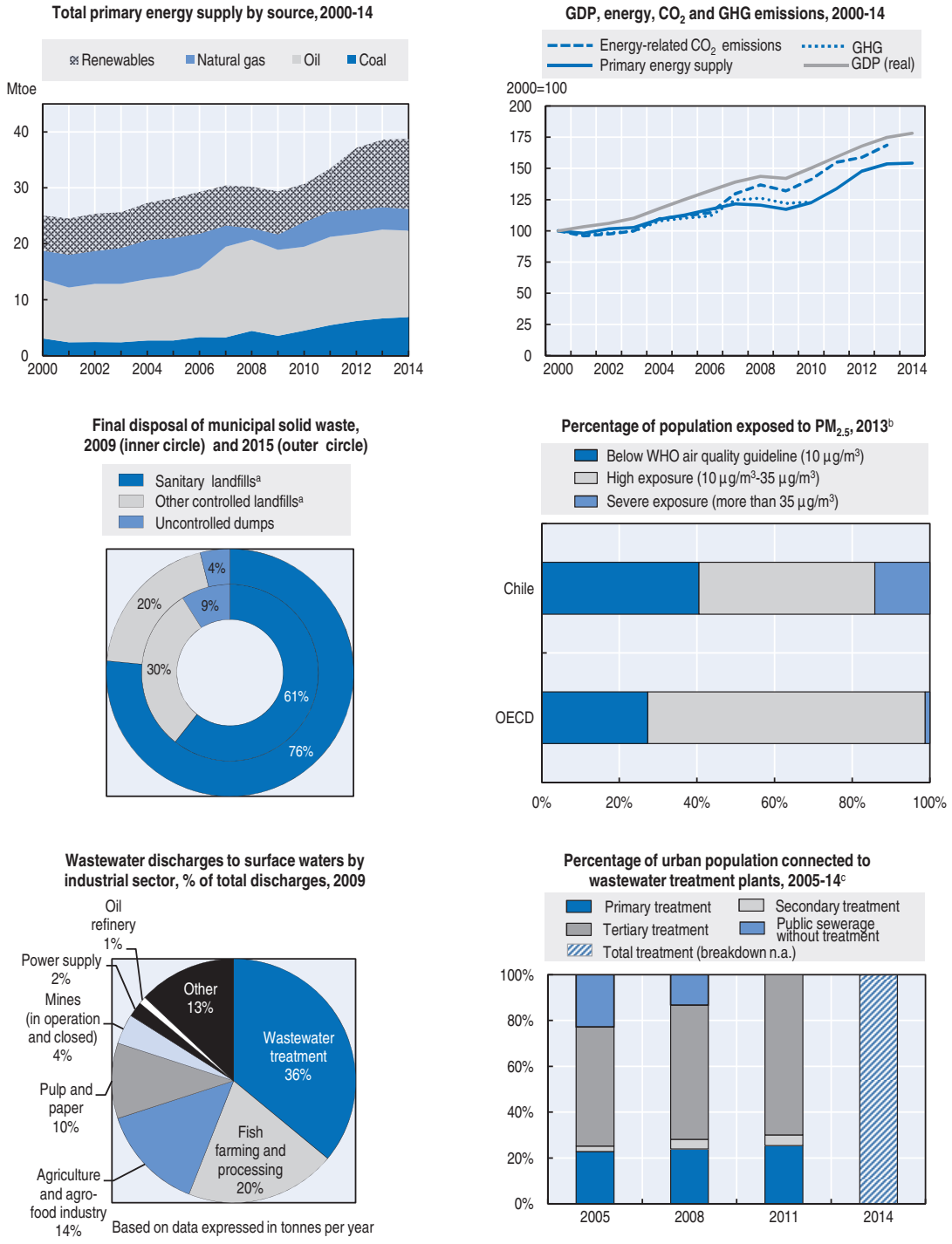
Chile's energy mix relies predominantly on imported fossil fuels. Supply shortages of natural gas in the mid-2000s led to a sharp increase in the use of coal and diesel for electricity generation (Figure 1), resulting in increased emissions of local air pollutants and greenhouse gases (GHGs) (Section 4). Energy production from renewable sources has doubled since 2000, but has not kept pace with the growth in energy demand. In 2014, renewable energy sources, mainly firewood used for residential heating, accounted for 32% of energy supply, among the highest shares in the OECD. More than 40% of power generation comes from renewables, mostly hydropower, but the carbon intensity of electricity generation is higher than the OECD average.

Air emissions and air quality

Since 2005, emissions of most air pollutants have increased, reflecting the increase in thermoelectric power generation, growing freight and passenger transport (notably diesel vehicles), and continuously strong reliance on firewood for residential heating. A notable

* See Sections 4 and 5 for climate change and biodiversity.

Figure 1. **Selected environmental indicators**



a) Sanitary landfill: site operating in compliance with current sanitary and environmental regulations; controlled landfill: site operating in compliance with 1980 regulations.

b) Data based on remotely sensed satellite data calibrated with ground-based measurements. Data for Chile likely underestimate $PM_{2.5}$ since they do not reflect nighttime wood burning, which contributes to high $PM_{2.5}$ concentrations. Satellite retrievals are also limited for higher wintertime emissions due to more frequent winter cloud cover.

c) Data refer to population living in urban areas served by wastewater treatment plants.

Source: CONAMA (2010), *Primer Reporte del Manejo de Residuos Sólidos en Chile*; IEA (2015), *IEA World Energy Statistics and Balances* (database); Ministry of the Environment, 2015; MMA (2012), *Official Environment Status Report 2011;* OECD (2015), *OECD Environment Statistics* (database); OECD (2016), Preliminary data based on Brauer, M. et al. (2016), "Ambient Air Pollution Exposure Estimation for the Global Burden of Disease 2013", *Environmental Science &Technology*, 50 (1).

StatLink http://dx.doi.org/10.1787/888933388219

exception, sulphur oxide (SO_X) emissions from copper smelting decreased markedly, but remain high. Air emission standards are now in place for two major industrial sectors (thermoelectric power plants and copper smelters) and some pollutants (Section 2). Vehicle emission standards were strengthened.

Despite progress, especially in Santiago, Chile continues to face high levels of air pollution. Ambient air quality standards are now in place for all major pollutants, including fine particulate matter ($PM_{2.5}$), but they are often exceeded, particularly in areas with high concentration of population and mining industry. On average each year, 15% of the Chilean population is exposed to severe $PM_{2.5}$ concentration levels (above 35 micrograms/cubic metre), well above the OECD average (Figure 1). Pollution Prevention and Decontamination Plans (PPDAs) are the main instrument for air management, but lack of inter-institutional co-ordination and insufficient engagement of local stakeholders have hampered their effective implementation. The development of PPDAs is lagging behind, especially in southern Chile; existing plans are subject to review every five years, but many have not been updated for much longer. There is also a need to improve air quality monitoring networks, as many stations cannot measure concentrations of $PM_{2.5}$ and nitrogen and sulphur oxides.

Waste management and circular economy

Waste generation increased by nearly 30% over the 2000s, although data are not fully reliable. Per capita municipal solid waste generation is low compared to OECD levels, but is higher than in regional peers such as Mexico and Brazil. Landfills absorbed 96% of total collected municipal solid waste in 2010/11, while 4% was recovered or recycled. Inadequate landfills or uncontrolled garbage dumps received about one-quarter of total landfilled waste in 2015, compared to nearly 40% in 2009 (Figure 1). Two out of three municipalities lacked access to sanitary landfills in 2010. To extend access, the government plans to double the number of sanitary landfills by 2020. However, a stronger focus on waste prevention and recycling may reduce the need for additional capacity.

Chile does not have a recycling industry, which is linked to limited incentives for waste reduction and reuse. Municipalities can charge their inhabitants for waste services, but about 80% of households are exempt from such a charge. Municipalities have little incentive to reduce landfilled waste, as their costs for disposal in privately operated landfills decrease with the volume of disposed waste. Some 80% of municipalities do not have a waste management plan and many have insufficient resources to run adequate waste management programmes.

A proposed waste framework law, submitted to parliament in 2013, would expand the policy focus from sound waste disposal to waste reduction and reuse. It would introduce a system of extended producer responsibility for a wide range of environmentally harmful products, as well as paper and packaging. Full implementation of the law would help significantly reduce the volume of landfilled municipal solid waste, the related financial burden on local governments, and environmental and health risks associated with the landfilling of hazardous products. The Ministry of Environment (MMA) is also developing a policy for waste prevention and recovery, a regulation on the transboundary movement of waste and a revised regulation on hazardous waste management. The swift adoption and implementation of these legal instruments are key steps towards compliance with all OECD Council Acts on environmentally sound waste management.

Water resource management

The main sources of surface water pollution are urban and industrial wastewater, fish farming and processing, and the agriculture and agro-food industry (Figure 1), with substantial regional variations. Limited tertiary wastewater treatment (Figure 1) and large agricultural runoff have resulted in nutrients contamination and eutrophication of coastal lakes, wetlands and estuaries; mining effluents have increased the concentration levels of heavy metals and other toxic pollutants in surface waters (Section 5). Chile has adopted standards for sewerage discharges, as well as water quality standards for ecosystem protection for four river basins and two lake catchments (which provide water to major cities). Such standards are still being developed for some river basins in northern Chile, which are the worst affected by mining activities, and standards for industrial effluents are being updated. As of early 2016, a water quality and ecological information platform was under development to regroup and publish all available data on water quality. The lack of comprehensive and consistent data is a serious obstacle to managing water resources.

Chile's plentiful water resources are unevenly distributed across the country. Water demand regularly exceeds supply in the arid north, where most of the water-intensive mining activities take place, and increasingly in the central parts of the country, where agricultural production and the population concentrate. Water tables in several aquifers decreased dramatically and their monitoring is limited. The structural water supply deficit is projected to worsen with economic growth, increased water use and climate change. While water efficiency has increased in the mining sector, irrigation efficiency has remained low (Section 5). A third of the water abstracted for public water supply is lost during distribution, due to inadequate infrastructure.

Since adoption of the 1981 Water Code, the allocation and use of water resources are based on a system of tradable water-use rights. However, insufficient regulation and transparency of the water market have led to over-allocation and extreme concentration of water rights, overexploitation of some aquifers, drinking water shortages in some rural areas and conflicts among water users. The 2005 reform of the Water Code strengthened regulation on groundwater management and set minimum flow requirements for new water rights to preserve the resilience of water bodies, but many market and information failures remain unsolved.

A new set of amendments being discussed in parliament seeks to ensure that new user rights are temporary (they are now for life), do not undermine the resilience of freshwater systems and give priority to drinking water supply and sanitation. It proposes more stringent provisions for non-use of rights and for restricting the exercise of user rights in the public interest (e.g. in case of drought). These are steps in the right direction. Future reforms will also need to address the issue of currently over-allocated water-use rights, improve market transparency and ensure that water rights and their transactions are registered. Efforts should focus on developing the knowledge base on risks for water resource availability and quality and their potential economic, environmental and social consequences. This would help determine the effective availability of water for allocation and better inform decisions about priority uses. Chile's multi-stakeholder water roundtables can help identify risks and policy priorities.

Recommendations on air, waste and water management

Air quality management

- Develop Pollution Prevention and Decontamination Plans (PPDAs) for all areas that do not comply with air quality standards, and evaluate and update those that already exist; closely engage local authorities in the design, implementation and evaluation of specific policy measures within each PPDA.
- Continue to improve the air quality monitoring network and ensure that air pollution information is made available to the public.

Waste management and circular economy

- Adopt the draft waste framework law at the earliest opportunity and implement extended producer responsibility schemes for key types of environmentally harmful products.
- Update and implement regulation on hazardous waste management and transboundary movement of waste to comply with international best practice.
- Encourage waste prevention, recycling and recovery of products not covered under the planned extended producer responsibility schemes (e.g. organic waste), including by: i) making greater use of charges and taxes on generated waste; ii) considering fiscal incentives for recycled products; iii) reviewing the incentives and funding mechanisms for waste management in small municipalities; and iv) raising awareness among citizens.

Water management

- Introduce a risk-based approach to water resource management by developing the knowledge base on water risks to inform decision making; consider enhancing the role of water roundtables to resolve water conflicts.
- Design and implement further reforms of the water allocation regime to ensure an effective and enforceable cap on abstractions that reflects environmental and ecological requirements and sustainable use; establish "essential" water uses (such as public water supply, sanitation and ecosystem services) as a high priority use; speed up the regularisation and registration of water-use rights to make the public register on water rights fully operational and transparent; consider auctioning the allocation of new rights (for systems that are not already over-allocated); strengthen enforcement and sanctions for illegal abstractions.
- Develop a strategy to address over-allocation in basins and aquifers where water-use rights exceed the sustainable capacity of the water body.
- Continue expanding coverage of water quality standards and accelerate implementation of the planned water quality and ecological information platform, with a view to systematically collecting and publishing water quality data; improve monitoring of soil contamination, as well as of water abstraction to protect ecosystems, notably wetlands.

2. Environmental governance and management

Institutional framework

Chile has strengthened its institutional framework for environmental management at the national level. Distinct agencies are now responsible for environmental impact assessment and compliance assurance. Despite the steady increase of their budgets, however, the national environmental authorities, especially the Environmental Superintendence (inspectorate), still lack human and technical capacity to adequately perform their functions.

The Council of Ministers for Sustainability provides an important mechanism for horizontal co-ordination among a myriad of national authorities with environmental responsibilities. In Chile's centralised system of environmental governance, sub-national units of those authorities also need to collaborate effectively. At the municipal level, the rapidly developing System of Environmental Certification of Municipalities is an important capacity building tool. Local authorities, however, lack the autonomy and resources to play a more substantial role in local environmental management and to adapt national policies to local needs.

Regulatory framework

The MMA has been increasingly using regulatory impact analysis, including the assessment of benefits (using health impact parameters) and costs of draft environmental regulations. The methodology for this *ex ante* evaluation has put growing emphasis on quantitative analysis of regulatory impact. In 2014, the MMA introduced regular *ex post* evaluation of environmental regulations, as well as of environmentally relevant government programmes, but this practice is still evolving.

Chile has reinforced the regulatory framework for air and water pollution control, adopting a range of environmental quality and emission/effluent standards. However, the system of air emission and wastewater discharge standards remains patchy. It covers some, but not all, regulated pollutants and only selected activity sectors. These standards do not prescribe specific abatement methods, but their values are set based on reference end-of-pipe pollution control technologies and not integrated process solutions.

The System of Environmental Impact Assessment (SEIA) remains the backbone of Chile's environmental regulation. Projects subject to full environmental impact assessment (EIA), as opposed to the simpler environmental impact declaration, correspond to over 40% of the value of new investments, reflecting the effectiveness of the screening procedure. EIA is closely linked to permitting: a Resolution of Environmental Qualification (RCA) constitutes a one-window environmental permit that prescribes environmental impact mitigation measures. However, the existing provisions for public participation in the EIA process do not ensure adequate consideration of project alternatives or minimisation of potential environmental impacts, which may potentially lead to environmental and social conflicts.

While the coverage of territorial planning has increased considerably over the last decade, it generally lacks coherence and mostly reflects sectoral priorities. Municipalities have the power to make planning decisions on their territory, but inter-communal and metropolitan plans overseen by the central government prevail over communal plans. Strategic environmental assessment (SEA) has been increasingly used. Most territorial plans are required to undergo an SEA, although less than half of them do. Integration of environmental concerns into territorial plans at all levels and public participation in their development need to be enhanced.

Compliance assurance

The institutional framework for compliance assurance remains highly fragmented. The Environmental Superintendence (SMA) has a wide range of administrative enforcement tools at its disposal, but severely lacks the capacity to act. It has to rely on sectoral competent authorities for compliance monitoring of specific RCA conditions,

which undermines their enforceability. Unlike most OECD member countries, Chile does not have criminal sanctions for environmental offences.

The problem of past land and water contamination, caused particularly by abandoned mining sites, has been widely recognised. The Mine Closure Law requires companies to develop detailed mine closure plans and provides for the establishment of financial guarantees, a post-closure fund and monetary penalties for infringement. But there is no specific regulation on the remediation of the hundreds abandoned mines, tailing dams and contaminated areas, no specific agency charged with their identification and clean-up, and no mechanism to cover the substantial related costs. The absence of strict liability (irrespective of legal fault) for future environmental damage and of decontamination standards is likely to further aggravate this problem. There is also a need of better knowledge and transparency on the location of mining activities and environmental liabilities, and the state and safety of the latter. There is very limited information available about environmental impacts generated by the medium- and small-scale mining industries.

At the same time, Chile has made remarkable progress in promoting environmentally friendly business practices through a variety of non-regulatory instruments. These include Clean Production Agreements (APLs), corporate social responsibility initiatives in exporting sectors, publication of sector-specific green practice guides and introduction of initial elements of sustainable public procurement. The broad engagement of the business community could further promote these initiatives.

Environmental democracy

The MMA has been engaging the public in the design of policy instruments (e.g. environmental quality and emission standards), environmental assessment, development of Pollution Prevention and Decontamination Plans and wildlife conservation initiatives. The Environmental Protection Fund supports projects implemented by non-governmental organisations (NGOs) and other non-profit institutions. At the same time, Chile lacks an effective mechanism for addressing special rights of indigenous communities, which contributes to socio-environmental tensions in many local communities.

Since 2005, Chile has greatly enhanced access to environmental information through a range of legal guarantees, the improvement of the National Environmental Information System, the publication of regular environmental reports, and the enhancement and consolidation of the Pollutant Release and Transfer Register. It also leads the work to conclude a wide-ranging regional agreement on access to information, public participation and justice on environmental matters in Latin America and the Caribbean. However, serious problems persist with respect to information availability, coverage and completeness. In particular, there is little information on water abstraction and use, as well as on biodiversity protection and negative impacts on ecosystems. Air and water quality monitoring stations often collect data on only a few parameters. As a result, Chile has difficulties in providing environmental statistics under international conventions and to international organisations.

Establishment of environmental courts has strengthened access to justice, as has the right to sue against decisions of environmental institutions, including standards, EIA decisions and SMA enforcement actions, and to seek measures for environmental remediation. In principle, the extensive environment-related litigation demonstrates that access to justice in Chile is functioning. In practice, however, the cost of legal counsel often puts this access out of reach of NGOs and private citizens.

Chile's education system increasingly incorporates environmental considerations, as witnessed by the successful implementation of the National System of Environmental Certification of Educational Establishments, as well as several socio-environmental awareness-raising initiatives. However, environmental curricula quickly become outdated. There is a need for much bigger outreach to various non-government actors to raise their capacity to contribute meaningfully to environmental policy making.

Recommendations on environmental governance and management

Regulatory framework

- Develop and implement a coherent policy for regulating pollution releases into air and water from stationary sources, including technique-based emission/effluent limit values for large, high-risk industrial installations and sector-specific emission and effluent standards for facilities with lower environmental impact.
- Improve the EIA process to ensure it includes meaningful consideration of project alternatives, guarantees public participation in its early stages and takes better account of potential environmental impacts, particularly on ecosystems.
- Enhance the practical application of SEA to territorial development plans and ensure the implementation of relevant mitigation measures; better integrate housing and infrastructure planning with public investment in water and waste management services, and nature protection; empower municipalities to take more control over local territorial planning by reinforcing the role of Regulatory Communal Plans.

Compliance assurance

- Harmonise environmental compliance and enforcement policies across various national competent authorities and ensure the involvement of SMA inspectors in assuring compliance with sector-specific environmental permits; increase the enforcement capacity of the SMA; consider introducing criminal penalties for egregious environmental offences.
- Introduce a strict liability regime for future damage to water bodies, land, species and ecosystems; develop and implement environmental remediation standards and plans, particularly for soil contamination with heavy metals; empower the SMA to enforce liability provisions through administrative actions.
- Maintain and frequently update risk assessment inventories of abandoned contaminated sites; establish a financial instrument to impose decontamination fees on hazardous industrial installations and mines, and earmark the revenue to constitute a fund to be used for clean-up of past land and water pollution.
- Upscale efforts to monitor and control the resource use (e.g. energy, water) and environmental impacts generated by medium- and small-scale mining industries, and support the adoption of new processes and technology to increase their efficiency and safety.

Environmental democracy

- Strengthen the information base to support environmental decision making by expanding data collection and management with respect to water allocation, abstraction and quality, air pollution, biodiversity protection, etc., and make this information available to the public, as well as to international bodies.

3. Towards green growth

Chile has made significant progress towards green growth since 2005. In line with the 2009 OECD Declaration on Green Growth, it launched a major Green Growth Strategy in 2013. The government plans to revamp the strategy, with a view to placing more emphasis on environmental equity, health, gender, cultural diversity and protection of valuable ecosystems. The new strategy aims to be an umbrella for all major sectoral strategies and plans related to green growth, many of which are already underway. The MMA is also developing the National Programme on Sustainable Consumption and Production, which will constitute a major pillar of the new Green Growth Strategy.

Greening taxes and subsidies

In 2014, Chile approved a major tax reform, seeking to reduce the fiscal gap, make the tax system more progressive and reduce income inequality. In line with a recommendation from the 2005 *OECD/ECLAC Environmental Performance Review*, the reform includes new environmentally related taxes. Among them, a new tax on light motor vehicles addresses both the emissions of nitrogen oxides (NO_x) and the fuel economy of the vehicle, thereby discouraging the purchase of higher emission vehicles, which are mostly diesel fuelled. However, the tax does not apply to commercial vehicles. The emission-related components of the tax increase with the vehicle's price, thereby making the tax progressive. However, the vehicle price does not affect the environmental damage done by a unit of emissions; untying the emission-related component of the tax from the vehicle price would help better address both environmental and equity considerations.

A tax on emissions of local air pollutants and carbon dioxide (CO_2) from large stationary sources will be charged from 2017. The Chilean tax is innovative: for emissions of local air pollutants, the tax rates are based on the social costs of the different pollutants and on the size of the affected population (residents of the municipalities where the emissions take place). However, the rate of the CO_2 tax, at USD 5 per tonne of CO_2, is relatively low. The tax covers boilers and turbines and, therefore, primarily affects thermal electricity generation (responsible for 27% of CO_2 emissions) and leaves out other major emission sources such as copper smelters and other industrial plants. There are also interactions with the system for setting electricity prices that effectively shield some power generators, small businesses and households from the costs of the tax. The government should accelerate the ongoing assessment of these interactions, which influence the effectiveness of the tax in encouraging electricity savings and investment in cleaner generation.

These new taxes are particularly welcome, as the use of environmentally related taxes in Chile has been relatively limited so far. In 2014, revenues from environmentally related taxes amounted to 1.2% of GDP, among the lowest of all OECD member countries. Many energy tax rates do not adequately reflect the cost of environmental damage. Energy use outside of the transport sector (for heating and electricity generation, for example) is untaxed, despite being responsible for about 80% of the country's CO_2 emissions. The forthcoming CO_2 tax will help address this issue. Tax rates on petrol and diesel are very low compared to those applied in most OECD member countries. Diesel is taxed at a much lower rate than petrol, which is not consistent with the carbon content of these fuels and the local pollutants generated by their use. In addition, diesel used in truck transport receives a tax credit. As a result, the effective carbon price implicit in energy taxation is among the lowest in the OECD (OECD, 2015b).

Support for fossil fuels has been scaled back over recent years, but a fuel price smoothing mechanism is still in place. This mechanism reduces the excise rates on petrol and diesel when international fuel prices are above a certain threshold, and raises them when international prices are lower, with a cap on fiscal expenditure. This system should be examined carefully to ensure that it does not function as an implicit fossil fuel subsidy. The strong decrease in international oil prices since mid-2014 is an opportunity to phase out all remaining fuel price stabilisation measures.

Fiscal revenues from non-renewable natural resources are substantial in Chile, amounting to 2.1% of GDP in 2013, although much less than in other Latin American countries. A tax on mining extraction and exploration rights, levied per hectare of land, has long been in place. It accounts, however, for a negligible share of environmentally related tax revenue. In 2006, Chile introduced a specific tax on mining profits, aiming to increase the financial contribution of the mining sector to social expenditure, as recommended by the 2005 *OECD/ECLAC Environmental Performance Review*. The average annual revenues from this tax are about 0.45% of GDP; overall taxation of mineral resources appears relatively low in Chile compared to other resource-rich members of the OECD (OECD, 2015a).

Expenditure for environmental protection

Central government budget allocations to environmental protection increased by 174% (in real terms) between 2000 and 2014, more than the total budget. Allocations to water supply increased even more (280%), mainly to secure drinking water supply in rural areas.

In 2015, in a welcome move, Chile published its first comprehensive study on public expenditure on environmental protection, covering 30 central government agencies. The study estimated public expenditure at 0.1% of GDP or 0.5% of total public expenditure by central government agencies in 2012. Biodiversity and landscape protection attract more than one-quarter of this expenditure; a relatively small share targets water and sanitation (the sector was privatised in the late 1990s) and air and climate, despite the considerable air pollution challenges and rapidly increasing GHG emissions.

Chile should build on this environmental expenditure accounting exercise, conducting it periodically and eventually expanding it to the sub-national level. This would facilitate analysis of spending effectiveness and efficiency and help ensure that budget allocations meet environmental policy priorities. The implementation of the Pollution Release and Transfer Register provides a starting point for data collection and analysis for private expenditure and investment.

Investment in environmental and low-carbon infrastructure

Chile has well-developed infrastructure, notably when compared to other Latin American countries. Since the early 1990s, it has attracted extensive private investment through concession-based public-private partnerships. Infrastructure needs remain large, however. Several major investment packages were launched in recent years, including the 2014 National Infrastructure Plan, which also includes investment in environment-related infrastructure such as public transport. However, investment plans lack systematic consideration of environmental and climate components or sustainability criteria and indicators in implementation.

Mobility and transport

The road network has been expanded and upgraded, notably in the core regions around Santiago. Road pricing applies to most motorways and for the urban highways around Santiago, on which road tolls vary with traffic congestion levels. Investment in the rail system has been limited, however, and most freight and passenger transport relies on roads. Different initiatives and investments have improved, upgraded or expanded the range of public transport in Chilean cities, mostly in the Santiago Metropolitan Region. Yet the expansion of the metropolitan transport system has not kept pace with the rapid rate of urbanisation and the steep increase in the vehicle fleet (+40% over the 2000s). This results in oversaturated metro and persistent traffic congestion, with severe air pollution impacts and increasing GHG emissions (Section 4). The stronger emphasis on public transport and sustainable mobility by the USD 23 billion Santiago 2025 Master Plan is much welcome.

Renewable energy

Investment in non-conventional renewable energy sources (i.e. excluding large hydro) has increased sharply in recent years, reaching a record high of about USD 2.4 billion in 2015 (BNEF, 2016), and is expected to grow further. Investment has concentrated on wind and solar energy since 2010, reflecting the market competitiveness of these renewables technologies in Chile and a supporting regulatory framework (Section 4). The government and its agencies have provided soft loans and other financial incentives that have helped kick-start the financing of renewables projects. Nonetheless, investors continue to face difficulties in accessing finance on the domestic market (Nasirov et al., 2015); many renewables projects are financed by international development institutions.

Water and sanitation

Large investment by water companies brought the share of urban households connected to wastewater treatment services to more than 96% in 2014 (from roughly 20% in 2000). However, only two-thirds of urban dwellers were connected to advanced (secondary and tertiary) treatment in 2011, which was low by OECD standards (Figure 1). Water and mining companies have responded to drought and water shortages with significant investment in alternative supply sources (e.g. seawater desalination). Investment is projected to decline markedly after 2020, and to focus largely on public water supply. This reflects the priority given to securing continuity of water supply services, rather than building new treatment capacity. Reducing the large losses in drinking water distribution networks should also be a priority.

Water tariffs for urban water services rose considerably in the early 2000s to finance the expansion of sewage treatment infrastructure; drinking water consumption per household has decreased by 18% since then. Water prices allow water companies to recover almost twice their operating costs, which is more than in most other countries in the region. The tariffs consider the value of water, determined by the market price of water-use rights, and thus reflect water scarcity and encourage water conservation in resource-scarce areas.

In rural areas and remote communities, water supply is mostly operated by municipal authorities and investment financed by the state. In these areas, water tariffs are not subject to regulation and their levels are often too low to recover maintenance and investment costs. As a result, infrastructure has deteriorated over time (Donoso, 2015).

Accentuated by consecutive years of drought, this meant that several rural water supply installations in northern and central Chile have not been able to supply drinking water to the population, forcing the state to rely on high-cost emergency solutions (e.g. cistern trucks and desalination of brackish rivers). Investment is also needed to expand rural wastewater treatment, which currently is limited.

Eco-innovation

Chile's innovation system has matured considerably since the formulation of the first specific innovation policies in 2005. Expenditure in research and development (R&D) increased with the establishment of the Innovation Fund for Competitiveness, which is partly financed by revenue from the specific tax on mining. Yet it remains the lowest in the OECD (at 0.4% of GDP in 2014) and focuses largely on the publicly-funded university sector. Investment and innovation performance of businesses have improved, but remain well below average OECD levels, particularly among small and medium-sized enterprises (SMEs). The 2014 Growth, Innovation and Productivity Agenda aims to address longstanding weaknesses in this area, including poor industry-science co-operation, insufficient skills and fragmented policy.

Chile does not have a formal eco-innovation strategy. Policies that promote eco-innovation have to date focused on renewables, notably through the establishment of a promotion centre and international centres of excellence for renewable energy technologies. R&D expenditure targeting the environment has increased faster than total spending on R&D since 2000; it reached 9% of total expenditure in 2012, one of the highest shares in Latin America. Patenting activity in environment-related technologies, albeit small, increased almost twice as much as general patenting activity. This was driven by a strong increase in patent applications in renewable energy technologies, common to many OECD member countries, and in water pollution abatement technologies. Overall, the dynamics of eco-innovation in Chile are incipient, but encouraging.

Green markets and employment

Strengthened environmental policy instruments and external market demand for environmentally sustainable products have encouraged the development of an environmental goods and services (EGS) market in Chile. There are no official statistics on the market volume, however. USAID and APEC (2011) estimated that the Chilean "environment industry" grew faster than the rest of the economy prior to the financial crisis and accounted for 1.7% of GDP in 2010. The actual market volume of Chile's EGS sector is likely larger, as the study did not consider important market segments such as renewable energy, energy efficiency and green products and services (e.g. sustainable agriculture and tourism).

Openness to international trade and a favourable investment environment have eased access to high-level environmental technology. More than 60% of water, waste and air pollution technology was provided by imports in 2010, hinting to a weak domestic production capacity of high-value innovation and technology. The renewable energy technology market is also expanding rapidly, with rising imports, especially in the solar and wind segments. Investing in renewables bears economic, social and environmental benefits: greater renewables penetration may increase GDP by USD 1.6 billion between 2013 and 2028, create 7 700 additional jobs and mitigate 9 000 tonnes of $PM_{2.5}$ emissions (NRDC, 2014).

Chile developed several initiatives that stimulate the consumption and production of environment-friendly goods and services, yet these have been relatively piecemeal. Regulations allow for the consideration of environmental criteria in public procurement, but these have not been defined yet. Eco-labelling regulations are missing; the variety of international and independent eco-labels in the Chilean market tends to confuse consumers. Inconsistent environmental regulation and enforcement remain barriers to the domestic EGS sector. The lack of information about the sector and of a common definition of "environmental goods and services" has hampered the development of coherent, cross-sectoral policy responses. The development and implementation of the National Programme on Sustainable Consumption and Production will likely strengthen policy coherence in this domain.

Chile is a regional hub for multinational environmental consulting and engineering firms. At the same time, many businesses, especially SMEs, lack knowledge and skills to comply with environmental regulation and claim a lack of training in this area. Environmental skills needs are not well studied and there is no co-ordination among relevant ministries (e.g. environment, industrial development, education). This has hampered the development of training offers (Government of Chile, 2013) and contributes to a mismatch between education/training and labour-market demands in this domain.

International trade and development co-operation

Chile has concluded numerous regional trade agreements, most of which include some type of environmental provisions. Agreements concluded with Canada, the European Union and the United States included strong environmental requirements, which Chile accepted in exchange for market access. They provided momentum for Chile to overhaul and codify its environmental legislation, resulted in various co-operation projects and helped strengthen institutional capacity in the country. In recent years, Chile has proactively supported the integration of environmental provisions into new agreements concluded with emerging and developing countries. Assessments of the environmental impacts of trade agreements (such as of those conducted with Canada, the European Union and the United States) can help assess the effectiveness of environmental provisions and identify pressures arising from expanding productive sectors, particularly those that cannot be identified through project-focused environmental impact assessments.

As an upper-middle income country in 1993-2012, Chile received lower amounts of official development assistance (ODA) than other Latin American countries. However, ODA has been an important source for the implementation of environment-related programmes, including in the fields of climate and biodiversity (Sections 4 and 5). One-third of total ODA disbursements to Chile over 2005-14 targeted environment-related sectors. These resources may decline, however, as Chile will likely no longer be eligible for receiving ODA as of 2017. Chile's activity as a development co-operation provider is expanding. While there are no official statistics, it is estimated that 10% of Chile's co-operation projects in Latin America target the environment, one of the highest shares among donors in the region (SEGIB, 2014). No mechanisms are yet in place to ensure mainstreaming of environmental criteria throughout international activities and systematic monitoring and evaluation of results.

Recommendations on green growth

Greening taxes and subsidies

- Increase the tax rates on petrol and diesel; gradually reduce the petrol-diesel tax gap and phase out the tax refund for the diesel used by heavy goods vehicles.
- Assess the fuel price stabilisation mechanism to ensure it does not function as an implicit fossil fuel subsidy.
- Consider revising the new tax on emissions of local air pollutants and CO_2 from large stationary sources: i) increase the tax rate on CO_2 on the basis of pre-defined steps, to better reflect the social cost of emissions; ii) include additional emission sources, such as copper smelters and other industrial plants; iii) assess the interactions between the electricity price-setting mechanisms and the CO_2 tax, and consider the adjustments needed to safeguard the full effectiveness of the tax; and iv) expand the geographical basis of the air pollution component of the tax to relevant airsheds.
- Explore the introduction of a cap and trade system for relevant pollutants and emitters that are not covered by the new tax on emissions of local air pollutants and CO_2.
- Broaden the coverage of the vehicle tax to commercial vehicles; delink the environmental and price elements of the vehicle tax; consider increasing the rates of the energy efficiency and NO_x components of the tax.

Environment-related expenditure and investment

- Conduct systematic surveys of public environmental protection expenditure, building on the experience gained with the 2015 survey; extend the survey to sub-national institutions and private expenditure; develop a system for systematically evaluating effectiveness of environmental expenditure.
- Ensure that major investment programmes systematically consider environmental and climate objectives, include sustainability criteria to guide implementation and indicators to monitor environmental impacts.
- Continue to encourage investment in public water supply infrastructure with a view to securing drinking water supply, reducing water distribution losses and enhancing resilience against water shortages; maintain investment to improve wastewater treatment capacity, especially in rural areas.
- Continue to invest in urban public transport systems to counteract the continuous shift from public to private passenger transport and reduce congestion and emissions of GHGs and air pollutants.

Eco-innovation, green markets and employment

- Consolidate initiatives for promoting eco-innovation into a coherent strategy or framework and set long-term objectives for eco-innovation; strengthen co-ordination of industrial development, innovation and environmental policies across the government with a view to integrate eco-innovation into broader growth and competitiveness strategies and programmes.
- Develop statistics and indicators for the environmental goods and services sector, including employment, with a view to informing the evaluation of environmental policies, and policy making more generally.
- Improve the national labelling system for environmentally sustainable products; accelerate the definition of environmental criteria for public procurement.

Recommendations on green growth *(cont.)*

- Develop programmes on jobs and skills that include profiles, training plans and activities for green jobs; improve co-ordination between relevant ministries and agencies (i.e. education, industrial development, environment) and consider linking the concept of green jobs to the National Training and Employment Service.

Development and trade

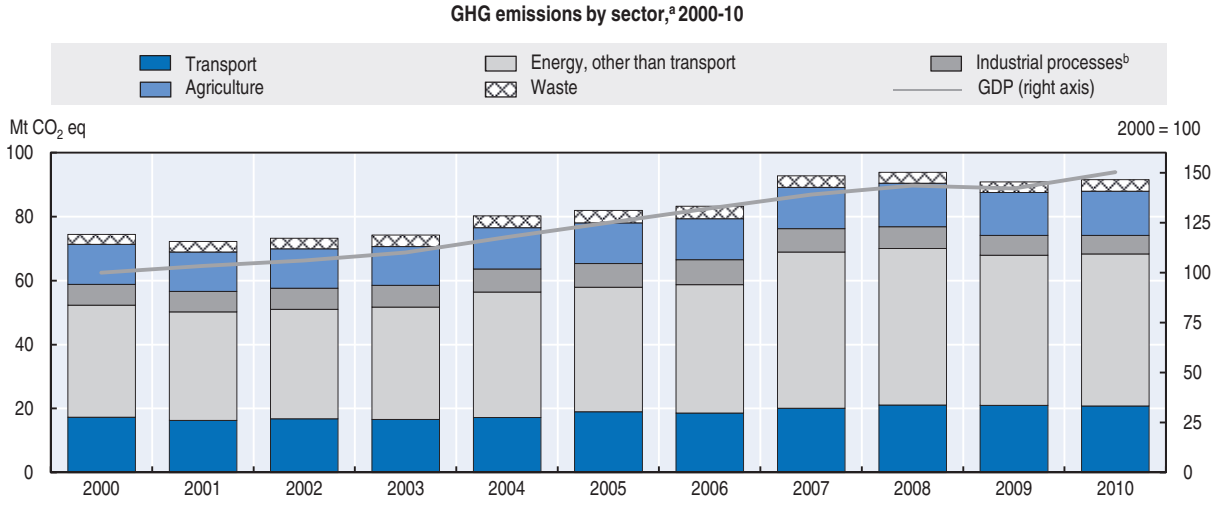
- Continue to promote environmental considerations in trade policies; assess effectiveness of environmental provisions in regional trade agreements.
- Ensure that environmental and sustainability criteria are mainstreamed throughout international development co-operation activities and that results are monitored and evaluated.

4. Climate change

Greenhouse gas emissions and impacts of climate change

Climate change is an increasingly important environmental issue for Chile. The most recent data, from 2010, shows that Chile's GHG emissions (excluding land use, land-use change and forestry, or LULUCF) grew by 23% in 2000-10, driven by Chile's rapid economic growth (Figure 2). Emissions from most sectors – especially energy production and transport – increased during this period. The CO_2 emission intensity of the economy has declined over time, but there is still a positive correlation between growth in emissions, energy supply and GDP (Figure 1). GHG emissions per capita were the lowest of all OECD member countries, reflecting the remaining difference in income levels. However, as GDP per capita catches up with the OECD average, Chile's emissions per capita are projected to rise.

Figure 2. **Greenhouse gas emissions increased with economic growth**



a) Excluding emissions/removals from land use, land-use change and forestry.
b) Includes solvents.
Source: OECD (2015), "Greenhouse gas emissions by source", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388222

Chile is vulnerable to the impacts of climate change, due to its geography and socio-economic characteristics (in particular, high levels of inequality). The May 2015 flooding and mudslide in northern Chile provided a vivid illustration of the types of impacts that could be felt: it led to 31 casualties and more than 16 000 people left homeless. The risk of flooding is projected to increase with climate change, as will incidents of extreme heat. In addition to changes in extremes, Chile will be affected by a longer-term trend of declining water availability, negatively affecting hydropower generation and agricultural production.

Policy framework for climate change mitigation and adaptation

Chile is putting in place many of the elements required for an effective policy response to climate change. The 2005 *Environmental Performance Review* (OECD/ECLAC, 2005) recommended that Chile develop a strategy for addressing climate change, with a focus on energy efficiency and GHG mitigation. In line with this recommendation, Chile developed a climate change strategy in 2006 and the 2008-12 Climate Action Plan. Energy efficiency has been an increasingly prominent component of the government's energy strategy, alongside measures to encourage forestry and renewable energy.

In 2009, Chile pledged to reduce GHG emissions by 20% by 2020 compared to business-as-usual, with some ambiguity about what this would consist of in absolute terms. It is likely to meet this target, provided that the emissions reductions in the Nationally Appropriate Mitigation Actions (NAMAs) are realised. In advance of the Paris climate change conference in December 2015, Chile submitted its Intended Nationally Determined Contribution (INDC) to complement its 2009 commitment. The level of ambition will depend upon certain criteria being met. Chile commits to reducing GHG emissions (excluding LULUCF) per unit of GDP by 30% relative to 2007 if economic growth is maintained at current rates; it has a separate target for forestry. This will be strengthened to 35-45% if there is sufficient international financial support. The INDC is more transparent than the 2009 pledge, but the use of conditions on growth and financing leaves some uncertainty about the strength of the commitment. Overall, the INDC would slow the increase in GHG emissions, rather than reducing them in absolute terms. By 2030, Chile is projected to have a GDP per capita similar to that of Spain and France now, but higher per capita emissions.

The overarching challenge is moving to an emission trajectory that is consistent with limiting global temperature rise below 2°C, as indicated in the 2015 Paris Agreement. This will require Chile to develop measures to peak emissions as soon as possible and achieve more stringent emissions reductions thereafter. Chile will also need to avoid locking in emissions that will make future reductions more challenging to achieve. This is not yet happening in the energy sector, where planned generation capacity still contains a considerable share of unabated coal-based power generation. More generally, infrastructure choices should be examined carefully to ensure their consistency with the transition to a low-carbon economy.

Adaptation policy has taken shape with the release of the National Climate Change Adaptation Plan in 2014. This contains institutional reforms to improve horizontal and vertical co-ordination, as well as developing the evidence base for adaptation. Chile is developing sectoral adaptation plans to implement the national plan; those for biodiversity, forestry and aquaculture have already been completed. Chile would benefit from undertaking a national assessment of the risks (and opportunities) from climate change, as well as the interdependencies across sectors. This should be complemented with strengthened efforts to mainstream climate change into budget allocation, project appraisals and strategic environmental assessments.

Overall, adaptation planning is further developed than is the case for mitigation. The 2008-12 Climate Action Plan primarily aimed to lay the groundwork for policy action, rather than to implement measures to reduce emissions or enhance resilience. The national and sectoral adaptation plans are building on this to identify more concrete approaches. Meanwhile, mitigation policy has been piecemeal, reflecting constrained resources and uneven engagement across sectors. The forthcoming climate change action plan 2016-21 will need to build on experiences gained from the adaptation plans to translate Chile's international commitments into concerted domestic action.

Policy development, monitoring and evaluation

There is strong commitment to enhance public, business and civil society access to climate information and their inclusive participation in key climate policy decisions. The INDC process was transparent and responsive to significant public engagement. The Mitigation Action Plans and Scenarios (MAPS) project provides a transparent mechanism for understanding the implications of different emissions trajectories. It is also helping clarify the implications of available mitigation options. Stakeholder engagement used to develop national and sectoral adaptation plans is helping raise awareness about climate issues.

Chile has developed a robust and comprehensive system for assessing emissions trends over time, but there remain challenges with the frequency of updates; the most recent data available are for 2010. The methodology for the 2011 GHG emission inventory strengthens the treatment of emissions from land use. Reinforcement of capacity for developing inventories would assist with the transition to biennial reporting to the United Nations Framework Convention on Climate Change, and support monitoring progress towards mitigation goals more generally.

In contrast to mitigation, there is no single metric that can assess progress in relation to climate change adaptation. Moreover, the effectiveness of adaptation measures may only become clear over long time horizons, or if an extreme weather event occurs. To address this, and other methodological challenges, Chile could adopt a pragmatic combination of four tools for assessing progress: climate change risk and vulnerability assessments; indicators; evaluations and national audits; and climate change expenditure reviews.

The Chilean approach to monitoring and evaluation for adaptation has yet to be implemented, but some constituent elements are in place. The final evaluation of the 2008-12 Climate Action Plan focused on the extent to which actions had been implemented rather than on their effectiveness in achieving their intended goals. The National Climate Change Adaptation Plan requires national monitoring reports to be submitted annually to the Council of Ministers for Sustainability. The INDC states that a full evaluation of progress on adaptation will not be completed until 2026. This timescale is considerably longer than adopted by other OECD member countries, and risks missing opportunities to inform the evolution of adaptation in a timely manner.

Governance and financing challenges

Achieving the voluntary commitment and the INDC will require concerted efforts across all emitting sectors. This will entail moving beyond planning, analysis and standalone measures to implementing policies that deliver a robust, coherent set of climate policies across emitting sectors.

Two major challenges will need to be addressed to strengthen implementation of mitigation actions. The first is the need to further strengthen institutional arrangements for embedding climate change policy in government operations. Progress is being made, with an increasing number of ministries now having climate change focal points. The Office of Climate Change in the environment ministry, overseen by the Council of Ministers for Sustainability, provides co-ordination. However, most responsibilities relevant to implementing climate policy lie outside of the environment ministry's remit. Implementation relies heavily upon voluntary engagement by, and sufficient capacity within, other ministries, resulting in delays in the delivery of information and variable implementation of climate change actions.

The second major challenge is to ensure adequate and sustainable financing for the implementation of climate change policies. The absence of sufficient and consistent funding was a barrier to action by ministries to implement the 2008-12 Climate Action Plan (University of Chile et al., 2015). A funding strategy is due in 2018, which is intended to strengthen co-ordination and improve understanding of trends in public spending on climate action. International climate finance has been a major contributor to the development of climate measures to date, but Chile will likely no longer be eligible for ODA from 2017. Meeting climate goals will require efforts to broaden and strengthen the funding base: encourage private sector investment, take advantage of new international mechanisms such as the Green Climate Fund and ensure the benefits of climate policy are reflected in domestic budgeting decisions.

Mainstreaming climate change in energy, transport and agriculture

Mitigation policy to date has largely focused on enhancing energy efficiency through voluntary measures (such as Clean Production Agreements), providing subsidies and public investment programmes (e.g. street lighting, heating systems). There has been limited use of regulatory measures, with exceptions including energy labelling and minimum performance standards for new buildings. Achieving the target of reducing energy use by 20% by 2025 appears challenging. The 2014 Energy Agenda proposes the development of an energy efficiency law. Among other things, this law would require large energy users to develop energy management systems and energy conservation plans, and encourage distributors to work with customers to reduce their electricity consumption. Chile would benefit from swiftly approving this law.

Chile is experiencing rapid growth of renewable generation, mostly without subsidies. This provides a strong basis for the transition to a low-carbon economy. The proportion of solar and wind energy is growing rapidly. Chile is on track to meet its 2025 target of generating 20% of electricity from non-conventional renewable energy sources ahead of schedule. With limited domestic fossil fuel resources, Chile faces some of the highest energy prices in Latin America. This, combined with a geography that is well-suited to solar and wind power, makes renewables price-competitive with fossil fuel generation. A renewables quota obligation (implemented in 2010 and rising over time) and policy reforms to improve market transparency have further encouraged investment. Nevertheless, use of non-conventional renewables is still far from matching its potential, as various barriers persist, including grid capacity constraints; a concentrated market structure; permitting delays; disputes about local environmental impacts; access to finance; and the failure to fully internalise the environmental and social costs of alternative forms of generation. The

announced carbon tax will help correct the very low effective carbon price implicit in energy taxation (Section 3) and further stimulate investment in renewables and energy efficiency.

Transport, particularly road, represents a key challenge for the achievement of Chile's GHG emission reduction targets. CO_2 emissions from transport are large (30% of total CO_2 emissions from fuel use) and increasing (+44% in 2000-13). Economic growth and rising incomes are the main driver of this increase. The average efficiency of the vehicle fleet is improving, but not enough to offset the effects of increasing demand for travel and the shift from public to private transport (car ownership doubled in 2000-14). GHG emissions from the transport sector are projected to grow by up to 95% by 2030, with economic growth, increasing wealth and low-density urban expansion (MAPS Chile, 2014). However, the integration of transport into climate policy remains at an early stage. Similarly, climate policy has received limited attention in transport planning. While the 2013 National Transport Policy does not explicitly cover climate change, it aims to expand and upgrade public transport systems and improve the infrastructure for cycling.

GHG emissions from agriculture have been steadily rising and represent 15% of Chile's total emissions. Yet there are no policies or measures designed to address agriculture's contribution to GHG emissions. At the same time, climate change impacts on agricultural production are expected to be significant. The 2013 sectoral adaptation plan for agriculture focuses on improving water use, which would be beneficial even in the absence of climate change. Forestry is a major carbon sink in Chile and it has long been encouraged with subsidies to afforestation activities. The effectiveness of these measures in supporting climate policy has not been formally evaluated, however.

Recommendations on climate change

Governance and financing

- Strengthen and formalise the institutional basis for climate change policy to provide clear responsibilities for implementation, in line with Chile's national circumstances and international commitments.
- Identify likely resource requirements, and financing sources, to implement the forthcoming climate change action plan 2016-21, including resources needed for core functions (e.g. co-ordination and monitoring progress); adopt a funding strategy at the earliest opportunity; develop a strategic approach to facilitate private sector investment in climate change, including energy production.

Policy development, monitoring and evaluation

- Establish and implement the suite of domestic climate policies to achieve Chile's Intended Nationally Determined Contribution (INDC) for 2030; implement the NAMAs or adopt alternative measures to ensure that the 2020 target is achieved.
- Identify the long-term trajectory consistent with zero net emissions by the second half of the 2050s; communicate long-term commitment to climate policy, whether through legislative or other means.
- Continue improving the evidence base and capacity for mainstreaming climate change adaptation into public sector decision making; make the results of climate projections more accessible to end users (through a web portal, for example) to encourage adaptation by the private sector and other stakeholders.

Recommendations on climate change *(cont.)*

- Implement a monitoring and evaluation framework for climate change adaptation and mitigation policies, including clear accountability mechanisms; reinforce capacity to produce timely emissions inventories; consider using intermediate milestones for longer-term emissions goals; undertake a national climate risk and vulnerability assessment, evaluate the climate resilience of large projects and develop indicators to monitor progress towards adaptation objectives.

Mainstreaming

- Analyse the consistency of current policy choices with decarbonisation in the longer term, particularly in the transport and energy sectors, and ensure that the necessary adjustments are made; design climate policy measures to ensure a coherent, aligned and integrated policy mix across key sectors responsible for emissions (e.g. energy and transport) and removals (e.g. land sector).
- Mainstream climate change adaptation in public sector appraisal systems, such as strategic environmental assessment, the National System of Public Investment and project appraisals; integrate climate resilience in the development of relevant regulations, norms and standards, such as those for infrastructure and building design.

5. Biodiversity conservation and sustainable use

Chile's biodiversity: State, trends and pressures

Chile's unique geography results in a variety of climates, ecosystems and vegetation, and in a large number of endemic species (that are found nowhere else in the world). Many of its ecoregions are considered significant to global biodiversity. Central Chile, including the matorral (shrubland) and Valdivian temperate rainforest ecoregions, is among the world's biodiversity hotspots, due to the concentration of endemic species and the high rate of habitat loss (CEPF, 2015).

Pressures on biodiversity from land-use change (e.g. conversion of forest lands and agricultural expansion), fishery, mining, urban and infrastructure development remain intense. Forest fires, climate stress and exotic invasive species exacerbate these pressures. Sixteen of the 127 terrestrial ecosystems in continental Chile lost more than half of their native vegetation between 1992 and 2012, mostly in central and south-central Chile. Pressures on inland water ecosystems are significant and increasing, especially in the northern regions (Section 1). More than 60% of species classified in Chile are threatened, although only about 3.5% of known species in the country have been classified. Conservation plans are in place for less than 10% of threatened species. According to the 2015 Ocean Health Index, the marine ecosystems across Chile's exclusive economic zones are in relatively good health, but several coastal and inland fish stocks are fully exploited or overexploited.

Improving the knowledge base for biodiversity policy

Chile has improved knowledge on the status of, and pressures on, biodiversity. It has systematically assessed terrestrial ecosystems, identified priority sites for conservation and developed national registries for wetlands and protected areas. However, significant knowledge gaps remain, especially about the conservation status of species, soil contamination and marine and freshwater ecosystems, as well as about the value of biodiversity and ecosystems and the costs associated to their loss. Further work is needed to

develop an accurate biodiversity baseline to assess trends, identify priorities for action, inform decision making and build public consensus around biodiversity conservation and sustainable use. The environment ministry should accelerate development of a national ecosystem assessment, which is planned for 2016 or 2017.

Governance and policy framework

Chile has made significant progress in developing strategies, plans and policies to promote biodiversity conservation and sustainable use. Chile's National Biodiversity Strategy, first published in 2003, has led to progress in several areas, including building knowledge and expanding protected areas. However, it has been only partially implemented (MMA, 2014). The revised strategy for 2015-30, which was intended for release in 2015, aims to align biodiversity policy with the Aichi targets and to correct many implementation challenges of the previous strategy. It is also expected to indicate financial needs for implementation and mechanisms to monitor progress. The 15 regional biodiversity strategies are also being updated, taking into consideration territorial and local community needs.

Biodiversity governance is highly fragmented. While the MMA oversees biodiversity policy, two separate institutions manage protected areas: the National Forestry Corporation (CONAF) is responsible for most terrestrial protected areas; and the National Fishing and Aquaculture Service (SERNAPESCA) is in charge of marine protected areas. Water governance is also complex and fragmented. Different institutions are in charge of water allocation, water quality and pollution, regulation of water utilities, irrigation and water ecosystems. In spite of some high-profile policy initiatives, such as the 2008 National Strategy for Integrated Watershed Management, Chile has made little progress in introducing integrated water resource management: it has neither river basin institutions nor a system of river basin water quality planning. This division of roles creates significant governance and co-ordination challenges, and makes it difficult to develop coherent, integrated biodiversity policy that addresses trade-offs with water management, urban and infrastructure development and sectoral policies.

The 2005 OECD/ECLAC *Environmental Performance Review* recommended that Chile review institutional and legislative arrangements for the management of biodiversity. In following up on this recommendation, in June 2014, the government submitted to parliament a draft legislation establishing the Biodiversity and Protected Areas Service (SBAP). The bill foresees the creation of an integrated national protected areas system, which would comprise official marine and terrestrial protected areas and private protected areas. It also enables greater use of economic instruments and financial incentives to promote biodiversity conservation and sustainable use. At the time of writing, however, the legislation was pending in parliament. Its approval is an opportunity for strengthening the governance, co-ordination and effectiveness of Chile's biodiversity policy; better involving the private sector; and improving mainstreaming of biodiversity in decision making. The centralised governance model for biodiversity would also benefit from better engaging NGOs, local governments and indigenous communities earlier in the policy-making process, as well as in implementation. This would help re-build trust and enlist a broader set of resources.

In 2014, the government proposed legislation to protect and preserve glaciers and regulate activities that can take place within their surroundings, which would need to undergo environmental impact assessment. There has been criticism that the proposed law does not adequately protect glaciers, which are an essential source of water. Others have expressed concern that it will limit mining activity in the Andes Mountains.

Policy instruments

Chile has implemented a wide set of policy instruments to promote biodiversity conservation and sustainable use. The policy heavily relies on regulatory instruments, including protected areas and water quality standards for ecosystem protection (Section 1). EIA and SEA procedures are the main instruments to mainstream biodiversity considerations in major sector-specific projects and plans (Section 2). However, consideration of biodiversity impacts within the EIA process has been ad hoc, leading to uneven treatment of projects and protection of sites.

Chile uses some economic instruments to promote biodiversity conservation and sustainable use. A market of water-use rights has long been in place (Section 1), although the current allocation of user rights does not allow for meeting ecological requirements in half of the river basins in northern Chile. A quota system governs the fishing industry. Entrance fees to protected areas have been widely used: together with concessions and sales they provide nearly a quarter of the total available funding for protected areas. This is among the highest shares in Latin America (Bovarnick et al., 2010).

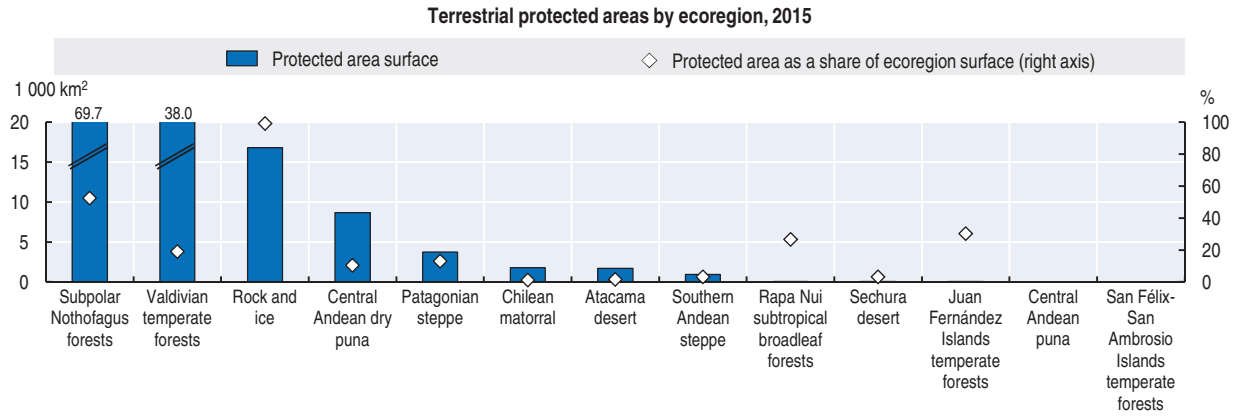
Nonetheless, there is scope to expand use of economic instruments. There are no examples of payments for ecosystem services (PES) in Chile and the use of biodiversity offsets is at an early stage, with some examples in the mining sector. Water effluents, pesticides and fertilisers are not taxed or charged. The taxation of mining operations pays little attention to their environmental impact (Section 3). The proposed legislation creating the SBAP provides the framework for expanding the use of economic instruments. This would help Chile fulfil the 2004 OECD Council Recommendation on the use of economic instruments in promoting the conservation and sustainable use of biodiversity.

Protected areas

With 19.5% of its land protected within the National System of Public Protected Forest Areas, Chile has already exceeded the Aichi target of protecting at least 17% of its terrestrial and inland water areas by 2020. However, important land-based ecoregions are not adequately represented in the protected area system (Figure 3), such as the Chilean matorral; public protected areas in the central and northern parts of the country are also mostly small and fragmented (ELI, 2003). In October 2015, the MMA announced plans for the Nazca-Desventuradas Marine Park. Once officially established, this will be the largest marine reserve in the Americas and bring Chile's marine protected areas to 24% of its exclusive economic zone (from the current 4.3%), well beyond the Aichi target of protecting at least 10% of such areas by 2020. However, the largest marine protected areas are far from shore and large population centres, where the urgency for protection is greatest.

Chile faces considerable challenges in managing its protected areas. More than 80% of protected areas have management plans, but many plans are only partially implemented, incomplete or need to be updated. Most protected areas lack sufficient financial and human resources, including park rangers. This also affects the ability to involve the local communities effectively and to ensure co-ordination with the local governments and their territorial plans (Fuentes et al., 2015). The government expects that 60% of protected areas will have revised their management plans and developed systematic monitoring programmes by 2030. It is likely, therefore, that Chile will not have operational management and administration for all protected areas until 2050.

Figure 3. **Coverage of protected areas varies widely across ecoregions**



Source: Ministry of Environment, 2015.

StatLink http://dx.doi.org/10.1787/888933388231

Private conservation initiatives cover about 2% of Chilean territory, which is remarkable considering that no financial incentives are in place. Many of these initiatives, however, have limited budgets and lack management plans. The proposed SBAP legislation will allow for bringing private areas into the overall protected area system. This could help fill the gaps in ecosystem representativeness and build connectivity across pre-existing protected areas. Designing an incentive system to encourage private conservation initiatives would help enhance private and NGO involvement in the expansion and management of protected areas in priority ecoregions (e.g. the matorral), where a significant proportion of land is privately owned.

Financing biodiversity policy and protected areas

Since 2006, Chile has significantly increased financing for biodiversity from public resources and from entry charges and concessions at protected areas. However, financial resources remain inadequate to attain biodiversity objectives or bring Chile in line with biodiversity funding provided in other South American countries (Bovarnick et al., 2010). A dispersal of resources across many different institutions has also reduced expenditure effectiveness. The proposed SBAP legislation includes an increase in funding, though not to the levels independent studies have concluded are needed (Figueroa, 2012). Chile will need to explore new and innovative ways to raise revenue and leverage private sector investment, such as PES and biodiversity offsets.

Mainstreaming biodiversity considerations in other policy areas

With growing economic activity, extraction and use of natural resources, and development and expansion of infrastructure, pressures on biodiversity and environmental conflict are increasing. This makes mainstreaming all the more important. However, while biodiversity objectives are now being incorporated into several other policy areas, tangible results from these efforts – beyond a few local examples – are not yet apparent.

Organic agricultural land has expanded, but still amounts to a negligible share of total agricultural land. Increased use of fertilisers and pesticides poses considerable risks to soil and water. While support to farmers has declined and is modest compared to other OECD

member countries, it is mostly linked to input use (OECD, 2015c). This indirectly encourages agricultural production and increases risk of overuse or misuse of water and potentially harmful inputs. These subsidies include support to investment in on-farm irrigation systems. Irrigation subsidies have encouraged the adoption of water-saving techniques, but their impacts on groundwater recharge and ecosystems have not been assessed (Donoso, 2015). For example, they allow drainage of wetlands and canalisation of natural water courses in areas of ecological value. Despite these subsidies, Chile still has among the highest irrigation water application rates in the OECD (OECD, 2013). Existing irrigation capacity should be used more efficiently before constructing new irrigation reservoirs, as foreseen in the National Irrigation Plan.

Chile's forest products sector has increasingly certified its production processes to conform to market demand and trade agreements. The forest area certified under the Forest Stewardship Council has increased more than five-fold since 2010 (FAO, 2015). Chile has long subsidised forest plantation and, more recently, the preservation of native forests. While afforestation subsidies can contribute to increasing carbon sequestration capacity, they may have encouraged replacing native forests by plantations with exotic species. The tree plantation subsidy programme ended in 2012, but is expected to be renewed. In designing the new programme, Chile should rebalance the incentives, traditionally in favour of forest plantation, and carefully assess costs, benefits and trade-offs between carbon sequestration and biodiversity objectives.

In 2001, Chile introduced a fishery quota system, which helped reduce fishing effort. On the contrary, fish production from aquaculture almost tripled over 2000-12. The effluent, pesticides and medicines flowing from the fish farms are a major source of pollution of, and pressure on, inland waters, estuaries and marine ecosystems. Financial and human resources are inadequate to systematically monitor these impacts and enforcement is weak (MMA, 2014). The fisheries legislation is being amended to limit emissions of solid and liquid waste from aquaculture.

Excessive extraction of groundwater, soil and water contamination and hazardous waste represent the mining sector's greatest risks to biodiversity in Chile. Mining development is expected to continue to be a source of environmental conflict, as a result of disputes over land and water. The mining industry has greatly improved water use efficiency and increasingly used seawater. Seawater use is projected to expand massively to meet rising water demand. In addition to increasing energy needs, an expansion of desalination may alter salt concentrations and chemical compositions at discharge sites, with unknown impacts on ecosystems and biodiversity. The 2012 Mine Closure Law strengthened regulation on mining waste and environmental liabilities, but there is a need to improve knowledge and transparency about the location and state of abandoned mining sites, as well as about environmental impacts of small-scale mining operations (Section 2). Subsidies to small-scale mining can encourage exploitation of natural resources, increase the risk of pollution of water table and affect biodiversity.

Recommendations on biodiversity conservation and sustainable use

Knowledge base and evaluation

- Accelerate efforts to build the knowledge base on the status and trends of biodiversity, including classification of species and assessment of the status of terrestrial, inland water and marine ecosystems; further engage academic and research centres in filling knowledge gaps and support policy development.
- Conduct a national ecosystem assessment at the earliest opportunity to improve knowledge of the values of biodiversity and ecosystem services and of the costs associated with their loss; ensure the values of ecosystem services are integrated into national accounts, as well as policy design and evaluation.

Governance and policy framework

- Approve the proposed legislation creating the Biodiversity and Protected Areas Service and accelerate its implementation; ensure the proposed service has adequate financial and human resources to fulfil its mandate.
- Reinitiate institutional and policy reforms to implement integrated watershed management that would bring together water quantity and quality planning and regulation.
- Ratify and implement the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS).
- Improve participation of NGOs, local governments and indigenous communities at all stages of biodiversity policy development and implementation to build trust and enlist a broader set of resources for executing action plans.

Protected areas

- Focus investment in protected areas on increasing the representativeness of priority ecoregions and the protection of the coasts and marine areas of continental Chile, and on conserving the habitats and nesting grounds of priority species.
- Accelerate the development and update of the management plans for all protected areas, and systematically review their implementation; ensure that the plans set clear priorities, targets and progress indicators.
- Develop and implement a strategy to encourage private conservation initiatives through carefully designed incentives (e.g. incentives for donations of land in priority areas to the protected area system; contracts with landowners); bring private conservation initiatives into the national system of protected areas; and support financing management plans and protection activities.

Economic instruments

- Further expand the use of economic instruments to encourage biodiversity conservation and sustainable use, raise additional revenue and leverage private sector investment; in particular, consider introducing water effluent charges, taxes on fertilisers and pesticides, and payments for ecosystem services programmes; expand the use of biodiversity offsets.

Mainstreaming

- Systematically integrate biodiversity conservation objectives into land-use planning, marine planning and sectoral policies; further mainstream biodiversity considerations into project and plans appraisal mechanisms, such as EIA and SEA.

Recommendations on biodiversity conservation and sustainable use *(cont.)*

- Expand efforts to increase water use efficiency in all economic sectors, particularly in agriculture and mining; systematically monitor freshwater abstraction and the use of desalinated seawater to prevent negative impacts on water ecosystems.
- Systematically assess the impacts of subsidies for irrigation and small-scale mining on groundwater recharge, biodiversity and ecosystems, with a view to reforming these subsidies; decouple agricultural support from input use and the expansion of agricultural land, to ensure the protection of sensitive ecosystems.
- Review the incentives for afforestation and native forest protection, and carefully assess costs, benefits and trade-offs between carbon sequestration and biodiversity objectives.

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ANNEX A

Actions taken to implement selected recommendations from the 2005 OECD/ECLAC Environmental Performance Review of Chile

RECOMMENDATIONS	ACTIONS TAKEN
Environmental performance: Trends and recent developments	
Make further progress with the implementation of air quality programmes, including those concerning the mining sector and those focusing on $PM_{2.5}$, PM_{10} and ozone; monitor progress and the programmes' impact on health through appropriate indicators.	Chile adopted Air Pollution Prevention and Decontamination Plans for ten cities or areas across the country and work on further plans is in progress, focusing mostly on fine particulate matter ($PM_{2.5}$).
Develop air monitoring in all major cities and an integrated air data management system.	The Ministry of Environment (MMA) developed a National Air Quality Information System (SINCA) that integrates information from public and private networks. The Pollution Release and Transfer Register (PRTR) captures air emission data from roughly 7 000 stationary sources.
Develop nationwide emission standards (e.g. for a range of industrial sources and for toxic air pollutants).	Chile adopted a primary air quality standard (designed to protect human health) for $PM_{2.5}$ and national emission standards for furnaces, copper smelters and thermal power plants, which are so far the only sectors covered by such standards. Emission standards for mobile sources were strengthened.
Increase the effective treatment of industrial effluents, and strengthen water inspection and enforcement capacities.	Emission standards for industrial discharges in public sewerage were amended to include new parameters and set more stringent maximum limits. Cross-sectoral effluent standards for industrial discharges into marine and continental surface waters and groundwater are being updated.
Improve the information and knowledge base for water management (e.g. monitoring of ambient water quality, registry of water rights, data on expenditure and financing).	Efforts to monitor eutrophication in coastal areas and freshwater ecosystems increased following the issuance of water quality standards. The 2005 reform of the Water Code allowed for keeping better record of water rights transactions.
Strengthen chemical and hazardous waste management according to international agreements, notably the Stockholm, Rotterdam and Basel Conventions; complete and implement national plans for persistent organic pollutants and hazardous waste; strengthen enforcement activities, develop pollutant release and transfer registers and improve the regulatory framework to better manage chemicals throughout their life cycle.	The PRTR, created in 2002, compiles data on pollutant releases into air, water and soil, as well as waste generation and disposal. It also includes data on compliance with environmental regulations. A 2013 regulation created a one-window system for reporting relevant data, which now covers over 20 000 facilities reporting on 132 pollutants. The National Policy on Chemical Safety was reformulated in 2012 and updated for the period 2015-19. A regulation on the transboundary movements of waste, which would implement the Basel Convention, is expected to be enacted in 2016.
Environmental governance and management	
Develop and strengthen the environmental institutions at national and regional levels.	The 2010 Environmental Quality Law (20.417/2010) replaced the National Environmental Commission (CONAMA) with three institutions that have distinct policy making, environmental assessment and compliance assurance responsibilities.
Formalise institutional integration mechanisms relating to sustainable development.	The Council of Ministers for Sustainability was established in 2010 and is chaired by the MMA. It advises the president on sectoral policies, including draft laws and regulations that concern the environment.

RECOMMENDATIONS	ACTIONS TAKEN
Further develop and strengthen regulatory frameworks (e.g. standards) to improve environmental health and to achieve Chile's international commitments; review ways to strengthen compliance and enforcement capacity, including through institutional reforms, for instance the establishment of an environmental inspectorate.	In 2010, Chile established the Environmental Superintendence (SMA) to manage compliance monitoring and enforcement. The compliance assurance system includes direct enforcement by the SMA, as well as through sub-programmes implemented by other public authorities. Chile adopted a large number of standards, including environmental quality standards and sector-specific emission or effluent standards, particularly in the area of air pollution control.
Further reduce the environmental impact of the mining sector (e.g. air pollution by SO_2 and arsenic, water pollution, abandoned sites and tailing dams).	Chile introduced a national emission standard for SO_2, PM and arsenic emissions from copper smelters. A new law regulates the closure of mining works (2012 Mining Closure Law). First surveys on the location and state of mining environmental liabilities have been conducted.
Further develop and strengthen land use plans: municipal and intermunicipal plans, regional urban development plans and coastline and watershed management plans; survey wetlands and assure their protection through regulations and incentives. Speed up progress towards establishing an effective land-use planning system capable of taking biodiversity values into account.	There are currently 4 regional plans, 19 inter-communal plans and 270 communal plans, while the remaining municipalities are formulating or approving their plans.
Develop economic analyses of environment-related policies, expanding both economic information on the environment (e.g. on environmental expenditure, environment-related taxes, health risk assessment, water and energy prices) and cost-benefit analysis of projects and legislation relating to the environment.	General and Social Analysis (AGIES) of draft environmental regulations, which corresponds to regulatory impact analysis in other OECD member countries, includes cost-benefit analysis. Since 2000, 47 regulations related to environmental quality, emission standards and pollution abatement plans have been analysed, with a growing emphasis on quantitative analysis. AGIES covers both compliance costs of the regulated community and administrative costs of regulatory authorities. Where benefits are difficult to quantify, AGIES evaluates the cost effectiveness of draft environmental regulations.
Undertake strategic environmental assessments concerning i) Chile's energy policy framework and ii) long-term transport plans for the Santiago Metropolitan Region, for other urban areas and at national level.	According to the 2010 Environmental Quality Law, all territorial development plans are subject to strategic environmental assessment (SEA), but there is no established list of sectoral policies and plans that must undergo SEA. 29 of 155 territorial plans elaborated in 2013 have undergone SEA.
Consolidate efforts to produce environmental data, state of the environment reports and environmental indicators to strengthen decision making and public information, taking into account international methodologies.	The 2009 Transparency Law (20.285/2009) and the 2010 Environmental Quality Law provide guarantees of access to environmental data and administrative documents. The MMA has consolidated and improved the National Environmental Information System (SINIA), which consists of databases and procedures for managing environmental information. SINIA makes environmental indicators and statistics available to the public through its website. The MMA created in 2012 an Inter-Ministerial Committee on Environmental Information. The MMA has also been upgrading the PRTR, created in 2002.
Continue to develop public participation in processes such as project-based environmental impact assessments and strategic environmental assessments of public policies, plans and programmes.	In accordance with the 2011 Law on Associations and Citizen Participation in Public Management (20.500/2011) and several respective presidential guidelines, many environmental regulations now specify procedures for public participation. Public participation is mandatory for a full environmental impact assessment process; and may be requested by citizens for Environmental Impact Declarations. The formation of Councils for Environmental and Social Recovery is envisaged for "environmentally vulnerable territories" (that are faced with severe environmental degradation).
Strengthen environmental education and awareness through a long-term strategy of environmental learning and a national environmental education plan, including: i) further integration of environmental material in primary and secondary school curricula and ii) development of environmental knowledge through professional associations and environmental management systems within enterprise.	The 2009 General Law on Education (20.370/2009) stipulated that the education system should encourage respect for the environment and promote sustainability. The National Education Policy for Sustainable Development (2009) has led to the creation of several initiatives to address environmental education and awareness in the country, including a National System of Environmental Certification of Educational Establishments (SNCAE).
Towards green growth	
Review the scope for introducing new economic instruments (e.g. product charges on hazardous waste, air emission charges, water pollution charges) and improve trading mechanisms. Further apply the polluter pays and user pays principles through appropriate charges (e.g. on waste management, for access to protected areas, for natural resources), with due regard to social constraints.	Chile introduced a tax on vehicle purchases based on NO_x emission and fuel efficiency; a tax on emissions of CO_2 and local air pollutants from some stationary sources (in force in 2017); and a tax on fish extraction rights. The transferable fish quota system, introduced in 2001, was revised. Municipalities can apply charges for waste services, but about 80% of households are exempt from such charges. Water tariffs for urban water services (supply and treatment) are in place throughout the country; they reflect scarcity of the water resource (the price of water-use rights) and allow water companies to recover almost twice their operating costs. Many protected areas charge entry fees, which generated about USD 10 million in revenue in 2012.

RECOMMENDATIONS	ACTIONS TAKEN
Review ways and means of integrating environmental concerns in fiscal instruments and policies.	A Green Growth Strategy was launched in 2013. The 2014 tax reform introduced the tax on purchases of motor vehicles (based on NO_X emission and fuel efficiency) and a tax on emissions of CO_2 and local air pollutants from some stationary sources.
Increase the financial contribution of the mining sector to support long-term investment in human and social capital and to apply the polluter pays principle according to the General Environmental Framework Law; consider a mechanism for proper capture of resource rents associated with mineral exploitation.	Chile introduced a specific tax on mining in 2006, which amounts to a progressive percentage of the operating income of mining companies. Part of the tax is allocated for specific purposes. About 30% of the tax has fed the Innovation Fund for Competitiveness.
Continue to invest in sewerage, wastewater treatment and other sanitation infrastructure in urban and rural areas.	Investment in, and coverage of, sewerage and wastewater treatment increased (urban population connected to wastewater treatment plant was 96% in 2014). In recent years, investment has focused on securing water supply due to drought and water shortage. The 2015 National Policy for Water Resources plans to build desalination plants to increase public water supply in two northern regions. The Rural Drinking Water Programme finances water and sanitation services in rural areas.
Implement air, traffic and transport management plans in the Metropolitan Region; develop and implement improved plans to reduce emissions from transport in all cities.	Transantiago reformed and integrated public transport in the Metropolitan Region. The Santiago 2025 Master Plan aims to increase sustainable mobility, including through an expanded metro network, new mass transit corridors, suburban commuter trains and a large expansion of bicycle paths. The 2014 National Transport Policy also promotes public transport in Santiago and other major cities (Valparaíso and Concepción).
Continue to promote mutually supportive trade and environment policies through effective implementation and strengthening of the environmental regulatory framework and promotion of corporate social responsibility.	The Ministry of Economy, Development and Tourism created a Social Responsibility for Sustainable Development Council in 2013. Some large mining companies have established rigorous voluntary environmental and community standards.
Ensure that co-operative activities associated with trade agreements are targeted to mitigate any adverse environmental impacts from large-scale natural resource exportation.	Most trade agreements concluded since 2005 include environmental provisions. Several environmental co-operation activities have been carried out with major trade partners; some previously concluded agreements (e.g. with Canada, the European Union and the United States) have been subjected to environmental impact assessments.
Climate change	
Develop energy efficiency measures for all aspects of energy consumption.	The Energy Efficiency Action Plan 2012-20 established a target of reducing energy use by 12% by 2020, compared to business-as-usual, and contains measures for the building sector, mining and other industries; passenger and freight transport; and home appliances. The contained measures were further strengthened in the 2014 Energy Agenda. The Chilean Agency for Energy Efficiency was created in 2006.
Review the future energy supply mix (including contingency plans), taking into account environmental concerns (such as emissions of air pollutants and greenhouse gases).	The 2014 Energy Agenda and the Energy Policy to 2050 presage an increasingly active role by the government in balancing environmental, social and economic elements of the energy supply mix. The Energy Agenda recommits to the goal of generating 20% of energy from non-conventional renewable energy sources (i.e. excluding large hydro) by 2025.
Based on analysis of the social cost and benefits of energy efficiency and non-conventional renewables, consider providing a positive financial incentive to encourage faster uptake.	Since 2008, Chile has provided long-term, low-cost funding to commercial banks for on-lending to non-conventional renewable energy projects. Subsidies are also available for pre-feasibility and pre-investment studies for renewable energy projects and for the installation of solar thermal systems in public, commercial, household and industrial buildings.
Develop a balanced, scheduled strategy concerning climate change issues; strengthen energy efficiency and greenhouse gas mitigation policies, including through a cleaner energy mix, and promote the use of clean development mechanisms in the context of the UNFCCC and the Kyoto Protocol.	The National Climate Change Action Plan 2008-12 laid the groundwork for a co-ordinated response to climate change. This was subsequently elaborated by the development of national and sectoral adaptation strategies. A climate action plan for 2016-21 is under preparation. Mitigation policies have been strengthened and measures taken to increase the share of renewables in the energy mix. Chile has made extensive use of the Clean Development Mechanism.
Biodiversity conservation and sustainable use	
Complete, firmly implement and devote adequate resources to the national and regional biodiversity strategies and action plans.	The 2003 National Biodiversity Strategy included 315 actions, half of which had been completed and 23% were either partially completed or in process by 2014. The strategy is being updated; it will cover the 2015-30 period and incorporate the Aichi targets. Budget allocation to biodiversity protection grew by 174% between 2000 and 2014 in real terms.
Review institutional and legislative arrangements for the management of nature and biodiversity.	A draft legislation, presented in June 2014, proposes the creation of a Biodiversity and Protected Areas Service (SBAP) as the last pillar of the new environmental institutional system. The MMA aims to have the new Service created by 2018.

RECOMMENDATIONS	ACTIONS TAKEN
Develop a strategic vision of the complementary roles of state and private protected areas in order to achieve a coherent network of core protected areas, buffer zones and ecological corridors.	The proposed legislation establishing the SBAP will establish a National Protected Areas System (SNAP), which would integrate the management of marine and terrestrial protected areas. The SNAP will also incorporate private areas into the system and establish incentives for private parties to collaborate on preservation and sustainable use of areas important for biodiversity conservation.
Step up financial efforts to meet the target of protecting 10% of all significant ecosystems in Chile (including coastal and marine areas) and boost nature-related enforcement activities.	In 2012, the total financial resources available for official protected areas were about USD 41 million, of which three-quarters came from central government ministries and agencies. Entry charges, concessions and sales at protected areas generated revenue of USD 10 million. The proposed legislation establishing the SBAP includes a request for an increase in financial resources to approximately USD 47 million.
Mount a co-ordinated effort by state agencies and academia to build the scientific knowledge base (including cataloguing of living species) required for nature management.	The MMA has co-operated with universities and civil society organisations to assess ecosystems using internationally acknowledged threat categories. About 1 000 species have been classified by conservation status (3.5% of all species known in Chile). The MMA considers launching a national ecosystem assessment.
Identify and use further mechanisms, including economic instruments, for creating win-win opportunities in tourism and nature policies.	Economic instruments used to promote biodiversity conservation include access fees to protected areas and tradable fishing quotas. The proposed legislation creating the SBAP provides scope for establishing payments for ecosystem services, biodiversity offsets, and compensation and certification. It also provides for the use of revenue from ecotourism concessions in protected areas to be used to administer the SNAP and for a National Biodiversity Fund. Chile is also a part of the REDD+ mechanism (Reducing Emissions from Deforestation and Forest Degradation).
Adopt and implement measures to assure sustainable management of native forest, including rewards for environmental services, cross-compliance mechanisms, partnerships and co-operation among stakeholders on overall management.	The 2008 Native Forest Recovery and Forestry Promotion Law created a financial incentive for the protection and preservation of native forests.
Develop an integrated watershed approach to improve water and forest resource management and to provide environment-related services more efficiently.	A National Strategy for Integrated Watershed Management (IWM) was issued in 2008 and three IWM pilot schemes were initiated in 2009, but there has been no follow-up since. The National Irrigation and Drainage Policy is being updated to create irrigation management plans for each watershed.
Give greater weight in water management to protection of aquatic ecosystems; improve the integration of nature concerns in water management by setting up a robust regime for minimum ecological flows and biological water quality standards.	The 2005 reform of the Water Code introduced a minimum ecological flow (of 10% to 20% of the average annual river flow), which was updated in 2014 (replacing the 10% floor with a more flexible 50% of monthly river flows while the 20% cap was maintained). Since 2010, six secondary environmental quality standards have been adopted to protect aquatic life; five others are being developed. Once all are approved, they will cover nine river basins and two lake catchments spread across the country.
Reduce the effects of agriculture (e.g. those related to irrigation, nutrients, pesticides and salinisation) on water quality and quantity.	Chile has heavily invested in irrigation infrastructure and subsidised on-farm investment in irrigation and drainage, with a view to promote the adoption of water conservation techniques.

Source: Country submission.

PART I

Progress towards sustainable development

PART I

Chapter 1

Environmental performance: Trends and recent developments

Strong economic growth has helped Chile improve the well-being of its citizens. Economic growth, extraction of natural resources and rising resource and energy use have exerted increasing environmental pressures, however. This chapter examines Chile's progress in decoupling economic activity from environmental pressures, focusing on the period since 2000. It presents the key socio-economic developments and reviews Chile's progress in moving towards an energy-efficient and low-carbon economy; resource efficiency in material consumption and waste management; and sustainable management of the natural asset base, including biodiversity and water resources.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Introduction

Chile has experienced a long period of strong economic growth, which has helped reduce poverty and improve the well-being of its citizens, even though inequality remains large. Natural resources have been a key driver of growth, with copper mining and agriculture, forestry and aquaculture constituting a major share of national income and exports. The strong reliance on natural resources, along with rising living standards and increased consumption, has increased environmental pressures, including air pollution, loss of native forests, soil erosion, and soil and water contamination.

This chapter provides an overview of Chile's main environmental achievements, as well as remaining challenges on the path towards green growth. Drawing on indicators from national and international sources, it reviews progress against national policy goals, as well as international commitments and targets, focusing on the period since 2000. To the extent possible, it compares the state of the environment and key environmental trends with those of other OECD member countries. The chapter sketches out major policy developments in relevant environmental sectors, including air, climate, waste, water and biodiversity.

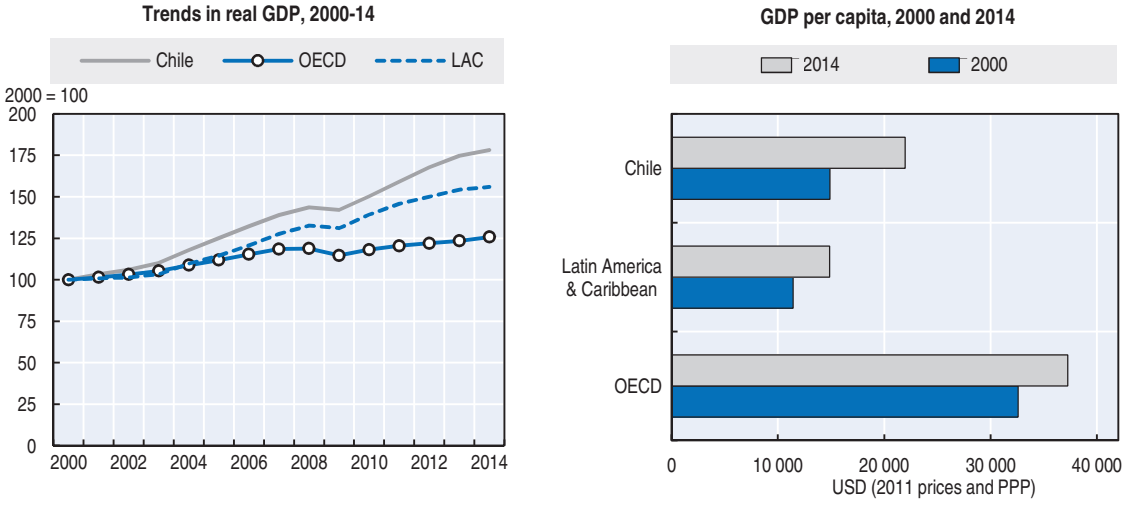
2. Key economic and social developments

2.1. *Economic performance*

Chile is an open and export-oriented economy. Its real gross domestic product (GDP) increased at an average rate of 4.2% per year in 2000-14, well above the average of OECD and Latin American countries (Figure 1.1). As the world's largest copper producer and exporter, Chile benefited from the commodities boom in the 2000s and weathered the 2009 global economic crisis. Declining raw material prices and lower external demand, however, resulted in a drop in GDP growth in 2014. A strong fiscal stimulus helped the growth rate exceed 2% in 2015; growth is expected to gradually accelerate in 2016-17, but will remain below the pre-2014 boom years (EIU, 2015; OECD, 2015a; see Chapter 3). The unemployment rate declined to a record low of 5.9% in 2013, but has been on the rise since.

Chile's macroeconomic performance has traditionally been strong, characterised by tight monetary policies and a generally balanced fiscal position (see Basic Statistics; Chapter 3). Its tax-to-GDP ratio (20% in 2014) is significantly below the OECD average (34%). In 2014, Chile approved a major tax reform, seeking to reduce the fiscal gap and to finance additional expenditures in education, health and infrastructure. The reform aims to raise an additional 3% of GDP in tax revenue and make the tax system more progressive. It also includes an expansion in the use of environmentally related taxes, notably the introduction of a tax on the emissions of carbon dioxide (CO_2) and local air pollutants from stationary sources, and a vehicle tax that considers the fuel economy and the emissions of local air pollutants (Chapter 3). Revenue from environmentally related taxes amounted to 1.2% of GDP in 2014, one of the lowest shares in the OECD (Chapter 3).

Figure 1.1. **Chile's economy has been growing faster than the OECD average**



Source: CEPAL (2015), *CEPALSTAT* (database); OECD (2015), *OECD National Accounts Statistics* (database); World Bank (2015), *World Development Indicators* (database).

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With a large network of free trade agreements, Chile is well integrated into the global economy (Chapter 3). Both exports and imports have tripled in value since 2000, and together represented almost 70% of GDP in 2013, above the OECD average (see Basic Statistics). Main import products are fossil fuels and manufactured goods.

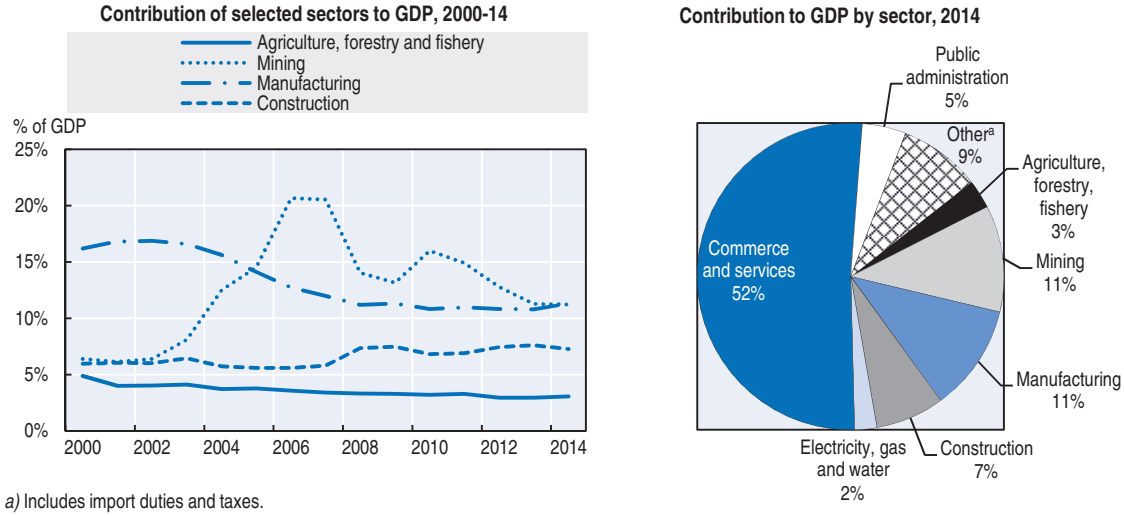
Export of natural resources has historically been at the core of Chile's economic activity. The country has abundant mineral resources, including the largest copper reserves in the world and about half of global lithium reserves.[1] Mining activity, mostly of copper, contributed to more than half of merchandise exports in 2014. Between 2006/07 and 2014, the contribution of mining to GDP dropped from 21% to 11% (Figure 1.2), which reflects falling ore quality and higher energy and labour costs. Mining concentrates in the northern desert region, where it contributes to up to half of regional GDP. Chile is also a major exporter of fish, fruits and wine. Total agricultural production increased by 30% over 2002-13, although the contribution of agriculture to GDP has slightly declined (Figure 1.2; Chapter 3). Forestry contributed 5.2% to national exports in 2013, the third highest value in the OECD after Finland and Sweden (OECD, 2015c). Services, including public administration, accounted for about 60% of value added in 2014, well below the OECD average (see Basic Statistics).

The OECD Economic Survey of Chile recommends that Chile further reduce its dependence on natural resources, increasing its knowledge-based contribution to global value chains and boosting productivity, which has been close to zero for much of the past decade (OECD, 2015a).[2] Productivity of Chilean businesses is constrained by a complex regulatory framework and administrative burden, weaknesses in the competition law and low investment in innovation (Chapter 3).

2.2. Inclusiveness of growth

Thanks to strong economic growth, per capita income increased by nearly 50% over 2000-14 to become the highest in the region. However, it is still about 40% lower than the OECD average (Figure 1.1). Rising incomes helped substantially reduce poverty: the ratio of the population considered poor (living on less than USD 3.10 a day) declined from 9% to

Figure 1.2. **The economy's reliance on natural resources remains high**



a) Includes import duties and taxes.
Source: Central Bank of Chile (2015), *Statistics database* (database).

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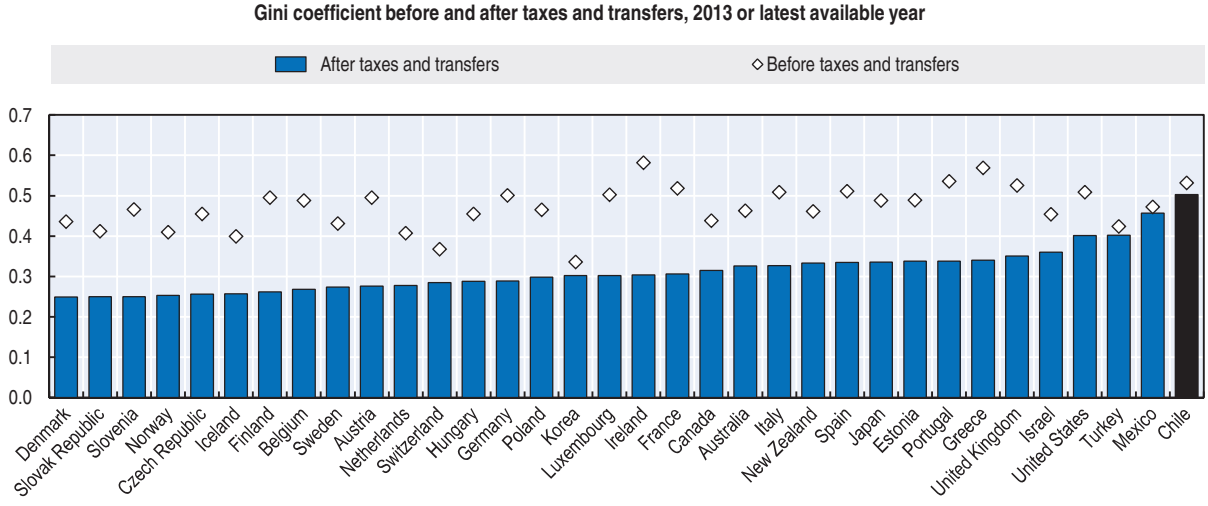
2.1% over 2000-13; during the same period, the ratio of those considered extremely poor (less than USD 1.90 a day) decreased from 3.1% to 0.9% (World Bank, 2015). Poverty rates are now among the lowest in the region.

Despite progress, Chile remains a highly unequal society. Income inequality, as measured by the Gini coefficient, declined slightly, but is still the highest in the OECD (Figure 1.3). Chile's tax-transfer system is characterised by low progressivity and is significantly less effective in reducing poverty and income inequality than in other OECD member countries (Figure 1.3). The concentration of income among the richest 1% of the population is by far the highest in the OECD, which is linked to the prevalence of family-based business conglomerates (OECD, 2015b).[3]

Figure 1.3. **Inequality is high and not much reduced through the tax-transfer system**



Note: The Gini coefficient is a common measure of income inequality that scores 0 when everybody has identical incomes and 1 when all the income goes to only one person.
Source: OECD (2015), "Income Distribution",*OECD Social and Welfare Statistics* (database).

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The labour market performance has been generally good, with a lower unemployment rate than in the OECD as a whole (see Basic Statistics). Youth unemployment stood at 16% in 2013, which is equivalent to the OECD average. Although women's participation in the labour market is rising, it remains among the lowest in the OECD. Considerable differences remain in the type and quality of jobs held by women; between 2006 and 2011, the gender wage gap widened from 4% to 16% (OECD, 2015a, 2014a). The government is striving to address inequality and improve social mobility, including through reforms of the tax system, the education system and the labour market.

While population density is relatively low (see Basic Statistics), 85% of Chile's population concentrates in urban areas (INE, 2015). Nearly 40% of people live in the Santiago Metropolitan Region; Valparaíso and Concepción, Chile's second biggest cities, each host 5% of the population. Chile's peculiar geography, with desert land in the north, mountainous terrain throughout the country and ice in the south (Section 5), results in a demographic concentration that is almost twice the OECD average, surpassed only by Iceland. Economic concentration (geographic concentration of GDP and per capita income) is the highest among OECD member countries (OECD, 2015b, 2014b).

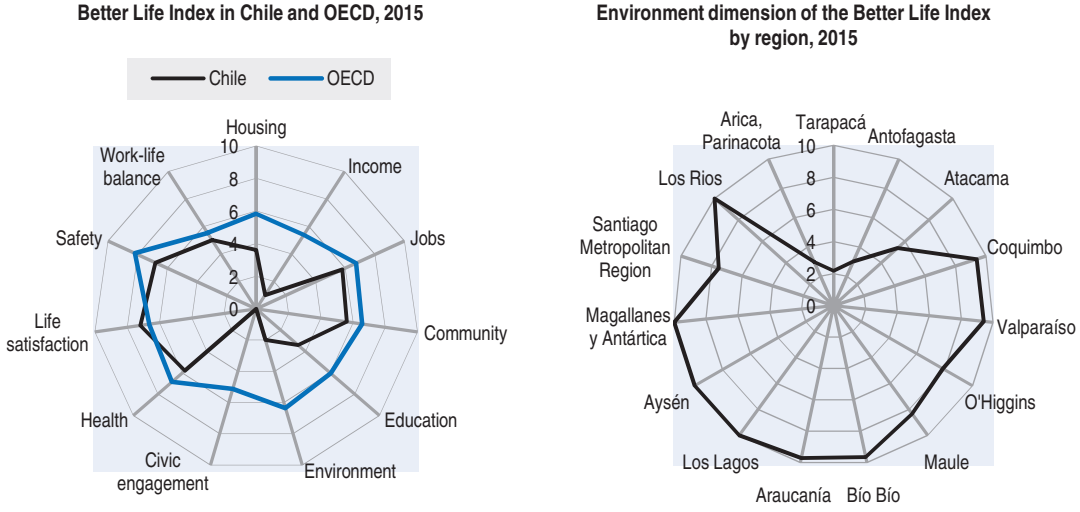
Access to key public services has improved since 2000. Lower secondary education is now virtually universal and enrolment rates for higher education have increased. The quality of education also improved. Scores from the Programme for International Student Assessment (PISA) are the highest in the region, yet still below most OECD levels. High quality of education is, however, often reserved for well-off families, which constrains social mobility (OECD, 2015b). The ongoing education reform aims to improve equal opportunities for accessing quality education and reduce skills gaps across socio-economic groups. Investment in public health care provision and the supply of health workers increased, but is low compared with other OECD member countries. Life expectancy stood at 78.8 years in 2013,[4] a gain of two years since 2000 and only slightly below the OECD average (see Basic Statistics).

2.3. Well-being and environmental awareness

Subjective well-being has improved: the percentage of Chilean people declaring to be very satisfied with their lives increased from 42% to 55% between 2007 and 2012, which is above the OECD average (OECD, 2014c). Notwithstanding, Chile performs well in only a few measures of well-being relative to most other countries in the OECD Better Life Index; it also ranks last in environmental quality, which is driven by very low scores in some northern regions. Other major constraints to life quality are relatively low disposable income, education and housing (Figure 1.4).

Environmental awareness is high. Two out of three Chileans report being "very concerned" about environmental issues (UNAB-IPSOS, 2012). According to the first National Survey on the Environment, air pollution is conceived as the biggest environmental problem (see Section 3.3), followed by urban waste and noise pollution (Figure 1.5). More than 80% of the population would support measures to reduce air pollution in their cities such as restricting vehicle circulation or firewood heaters (MMA, 2015a). Traffic is the main source of noise pollution in urban areas; more than half of the population is exposed to noise levels above maximum limits recommended by the OECD and European Union, with potentially high health impact (MMA, 2012).[5] The environmental impact of mining dominates environmental concerns in northern Chile (MMA, 2015a).

Figure 1.4. **Subjective well-being is high, but many aspects constrain quality of life**



Note: The OECD Better Life Initiative (BLI) framework is based on 11 topics considered a good measure of the concept of well-being. Each dimension is based on one to three indicators, averaged with equal weights and then normalised into scores ranging from 0 (worst performance) to 10 (best performance). The environment dimension of the well-being indicator focuses on citizens' satisfaction with local water quality and on annual population exposure to fine particulates ($PM_{2.5}$).
Source: OECD (2015), *OECD Better Life Index*, www.oecdbetterlifeindex.org.

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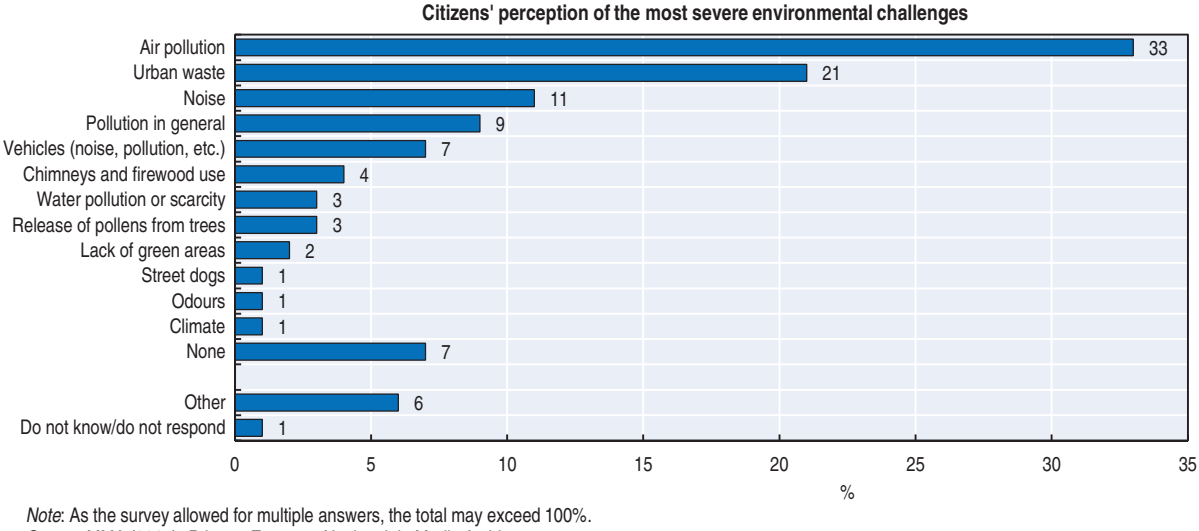
Figure 1.5. **Air pollution is considered the biggest environmental challenge**



Note: As the survey allowed for multiple answers, the total may exceed 100%.
Source: MMA (2015), *Primera Encuesta Nacional de Medio Ambiente.*

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3. Transition to an energy-efficient and low-carbon economy

3.1. Energy structure, intensity and use

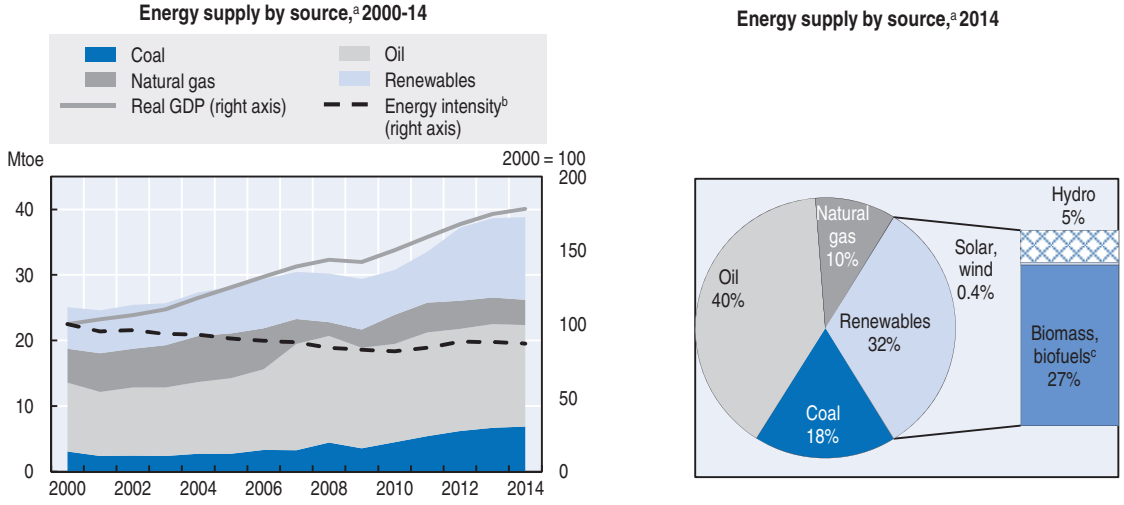
Energy mix

Chile's energy mix relies predominantly on fossil fuels (oil, natural gas and coal), which accounted for 68% of total primary energy supply (TPES) in 2014 (Figure 1.6). Energy generation from renewable sources has increased since 2000, but has not kept pace with

growth in total energy demand. With limited domestic resources, Chile imports most oil, natural gas and coal, which makes it vulnerable to price volatility and supply interruptions.[6] Energy security remains, therefore, high on the policy agenda (Chapters 3 and 4).

Oil is the most important energy source (Figure 1.6). As in many OECD member countries, oil is predominantly used as a transport fuel, but is also used as a substitute for natural gas in power generation. Use of natural gas decreased notably in the mid-2000s due to import supply shortages (Figure 1.6).[7] Since the second half of the 2000s, coal has met much of the growth in electricity demand; it accounted for 37% of electricity generation and 18% of the energy mix in 2014. Coal is extensively used in the north of the country for power generation, mainly for the mining industry (IEA, 2015). As a result, electricity generation in Chile is more carbon-intensive than in most other OECD member countries (Figure 4.6).

Figure 1.6. **Chile's energy mix relies on fossil fuels**



a) Total primary energy supply. Breakdown excludes electricity trade.
b) Total primary energy supply per unit of GDP at constant prices.
c) Includes the burning of firewood for residential heating.
Source: IEA (2015), *IEA World Energy Statistics and Balances* (database).

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Energy production from renewable sources has doubled since 2000, reaching 32% of TPES in 2014. This is among the highest shares in the OECD and well above the OECD average (see Basic Statistics; Annex 1.A). Biomass is the dominant renewable source, mainly in the form of firewood for residential heating and notably in the isolated southernmost region; this, however, has significant impacts on air pollution and public health (Section 3.3). Hydropower is the main renewable source for electricity generation, especially in central Chile. It accounted for 32% of electricity generation in 2014, compared to the OECD average of 13% (IEA, 2015). Other renewables such as solar and wind still play a marginal role (Figure 1.6), though their deployment is increasing rapidly. As Chapters 3 and 4 discuss, Chile has favourable conditions to deploy renewables and its supportive regulatory framework has encouraged massive investment in the sector.

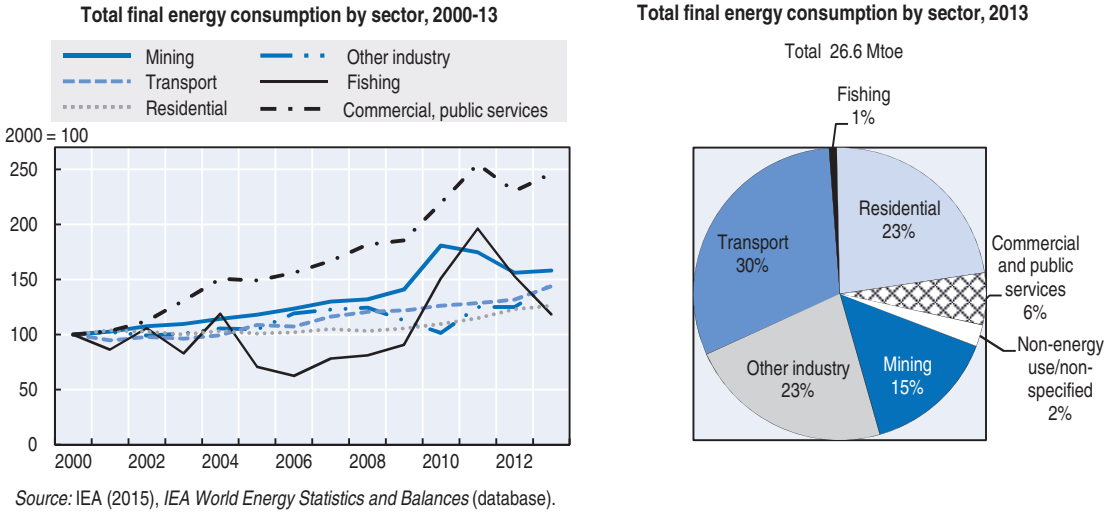
Energy intensity

The energy intensity of Chile's economy (TPES per unit of GDP) has decreased to slightly below the OECD average (see Basic Statistics; Annex 1.A). Total energy used by the

economy (as measured by the TPES) grew by 54% between 2000 and 2014, but this was slower than GDP (Figure 1.6). TPES per capita is significantly below the OECD average, reflecting the remaining income gap. It increased by 34% over 2000-14, while the OECD average decreased by 10% (IEA, 2015).

Mining and other industry together account for the largest share of energy use (38%), followed by transport and the residential sector (Figure 1.7). Energy demand in the industrial sector increased by 50% over 2000-13, driven by the energy-intensive mining industry and paper and pulp production. Projections indicate that the mining industry's electricity consumption alone may double until 2025.[8] Energy demand in the transport sector also increased strongly (44%) (Figure 1.7), and is projected to rise by roughly 50% until 2035. Energy consumption in the commercial and public services sector has more than doubled since 2000, reflecting expanded use of heating and air conditioning (Figure 1.7).

Figure 1.7. **Energy consumption is rising rapidly**



Source: IEA (2015), *IEA World Energy Statistics and Balances* (database).

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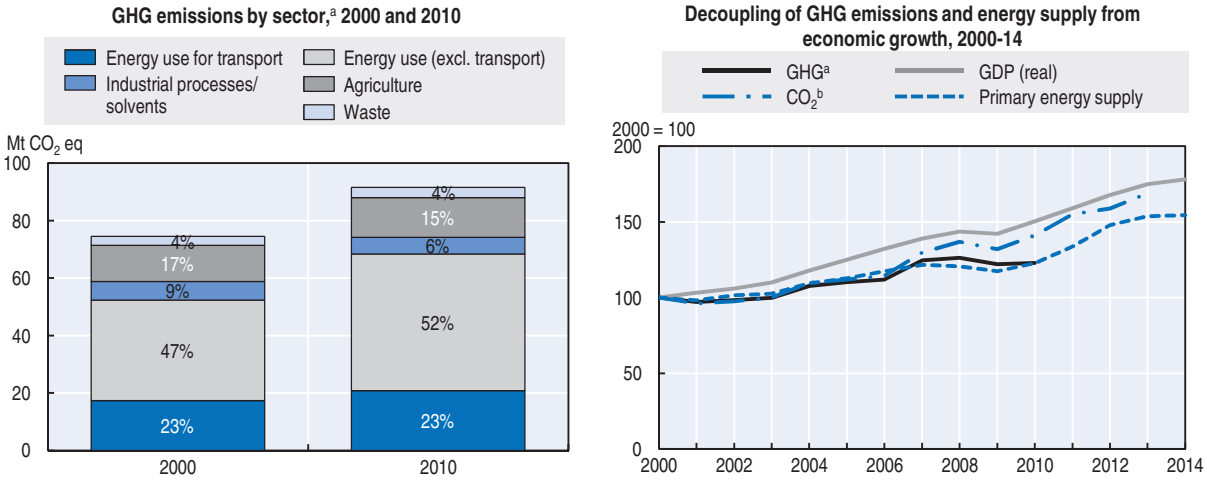
3.2. Greenhouse gas emissions

Chile's greenhouse gas (GHG) emissions, excluding land use, land-use change and forestry (LULUCF), increased by 23% between 2000 and 2010 (Figure 1.8). While this increase is less than half the GDP growth in the same period (+50%), it remains one of the largest among OECD member countries (Annex 1.B).[9] Compared to 1990, Chilean GHG emissions had almost doubled (+84%) by 2010. CO_2 is the largest component of GHG emissions in Chile, accounting for 77% of total emissions in 2010. Methane (CH_4) and nitrous oxide (N_2O) account for the remaining 23%, which is larger than the OECD average and reflects the importance of agriculture and the prevalence of landfilling of waste.

Energy production and consumption remain the largest and fastest growing sources of emissions, accounting for three quarters of total GHG emissions in 2010. About 30% of energy-related emissions, or 23% of total GHG emissions, come from the transport sector alone, reflecting a rapid rise in road transport demand and vehicle fleet. CO_2 from energy use increased even faster than TPES, largely due to the shift from natural gas to more carbon-intensive fuels (coal and diesel) for electricity generation in the second half of the 2000s (Figure 1.8). Yet the carbon intensity of the economy (measured as the ratio of CO_2

Figure 1.8. **The energy sector is the primary source of GHGs, and emissions are growing fast**



a) Excluding emissions/removals from land use, land-use change and forestry.
b) CO_2 emissions from energy use only; sectoral approach; excludes international marine and aviation bunkers.
Source: IEA (2015), *IEA CO_2 Emissions from Fuel Combustion Statistics* (database); IEA (2015), *IEA World Energy Statistics and Balances* (database); OECD (2015), "Greenhouse gas emissions by source", *OECD Environment Statistics* (database); OECD (2015), *OECD National Accounts Statistics* (database).

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emissions from fuel combustion over GDP) declined in 2000-13 and remains slightly below the OECD average (see Basic Statistics). CO_2 emissions per capita were among the lowest in the OECD (Annex 1.B).

Agriculture generated 15% of total GHG emissions in 2010. It was the second largest source of emissions, reflecting the country's strong agricultural sector. LULUCF absorbs roughly 50 million tonnes of CO_2 per year. After a 30% decline in emissions removed by LULUCF over 2000-07, the absorbed volume turned back towards 2000 levels. This has been attributed to an increase in forest areas through tree plantations, as well as less forest harvesting (MMA, 2014a; see also Chapter 5). Wildfires are responsible for large yearly variations in some years (e.g. 2002).

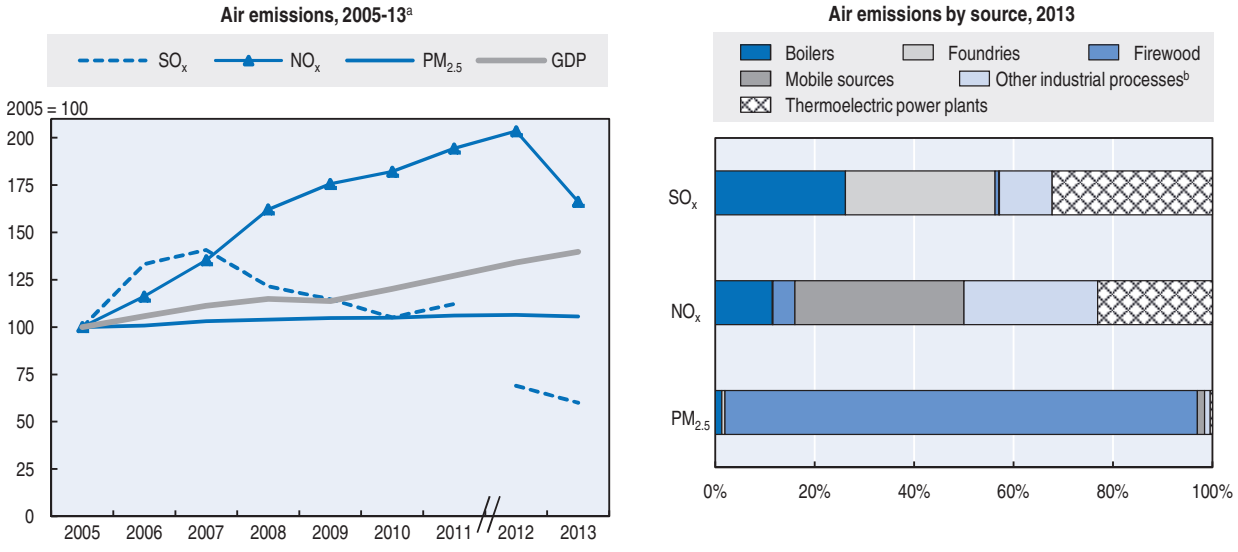
In its Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC), Chile pledged to reduce GHG emissions per unit of GDP by 30% by 2030 relative to 2007, if economic growth is maintained at current levels (excluding LULUCF, which has separate targets). The share will be increased to 35-45% if there is sufficient international financial support. Chile has launched a series of programmes and measures to reduce GHG emissions and adapt to climate change, which are discussed in Chapter 4.

3.3. Air emissions and air quality

Air emissions

Since 2005, emissions of most major air pollutants have increased. At the national level, the emission of particulate matter ($PM_{2.5}$ and PM_{10}) and carbon monoxide (CO) increased by roughly 10% over 2005-11, showing a relative decoupling from economic performance. Emissions of nitrogen oxides (NO_x) nearly doubled over that period, by far outpacing GDP growth (Figure 1.9). A notable exception, sulphur oxide (SO_x) emissions decreased by 20% between the peak in 2007 and 2011 (Figure 1.9).

Figure 1.9. **Air emissions are increasing**



a) Break in time series in 2012 due to methodological changes in the reporting forms (mainly affecting SO_x emissions of basic metals manufacturing).
b) Includes emissions from mining activities.
Source: MMA (2015), *Segundo Reporte del Estado del Medio Ambiente*; OECD (2015), *OECD National Accounts Statistics* (database).

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The decrease in SO_x emissions was driven by a large reduction (-56%) in emissions from Chile's seven copper foundries, which historically accounted for the bulk of SO_x emissions.[10] This has been attributed to pollution control plans (see below), which helped foundries improve their efficiency. SO_x emissions from energy generation increased in the mid-2000s, along with the shift from natural gas to coal combustion (Section 3.1).[11] They declined, however, in the second half of the 2000s, thanks to stricter emission controls set in the environmental permits for new power plants (MMA, 2012; environmental permitting is discussed in Chapter 2).

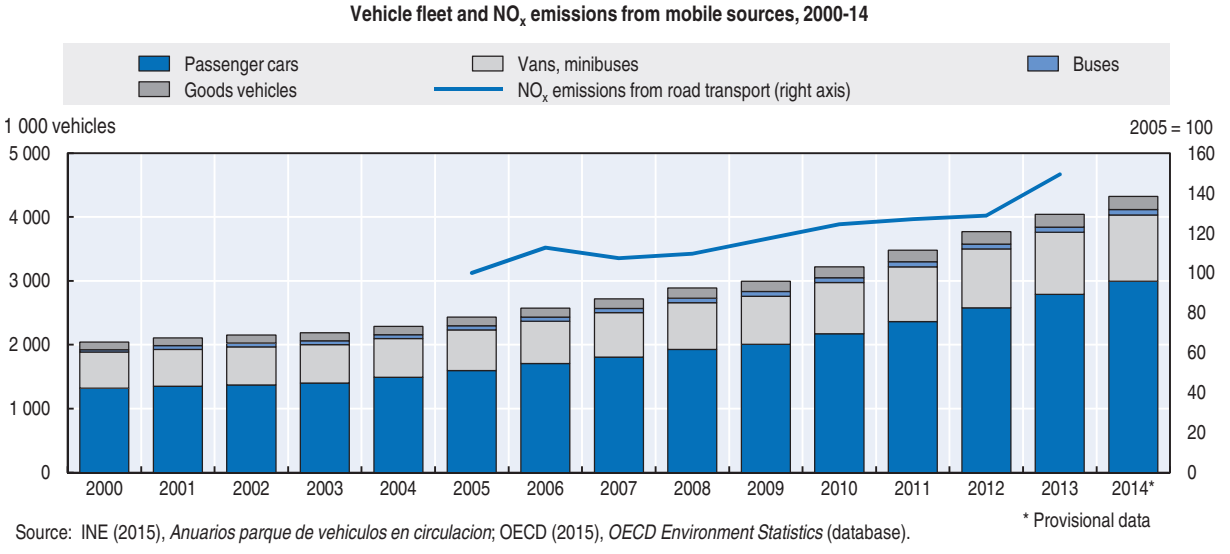
Fine particulate matter ($PM_{2.5}$) emissions stem from the extensive use of firewood for residential heating (Figure 1.9), notably in southern Chile. $PM_{2.5}$ emissions from burning of firewood increased by 17% over 2005-13. High emissions from firewood heating primarily result from bad wood quality (high humidity) and low efficiency and bad operation of heaters. Firewood and other wood-derived products are not directly regulated. The Ministry of Environment (MMA) is developing measures to reduce the use of firewood consumption, including more efficient heaters, energy-efficient housing and district heating (Chapter 3).

NO_x emissions increased across all major polluting sectors over 2005-11, namely transport (+27%), thermoelectric power generation (+77%) and industrial processes (+248%); a sharp reduction of emissions from industrial diesel combustion reversed the trend in 2012-13 (Figure 1.9).

Transport accounted for one-third of national NO_x emissions in 2013 (Figure 1.9). It is the single largest source of NO_x emissions in the Santiago Metropolitan Region, which alone accounts for 22% of national NO_x emissions. The government adopted several measures to control emissions from transport, including stricter vehicle standards,[12] incentives to renew the national bus and truck fleet, and development of integrated public transport systems (Chapters 3 and 4). However, NO_x emissions kept rising with the growth

of transport demand, mileage driven and the vehicle fleet, which has more than doubled since 2000 (Figure 1.10). Within the total vehicle stock, the share of diesel vehicles, which emit more pollutants than vehicles running on petrol, has nearly doubled; this can be explained by the much lower tax rate on diesel than on petrol (Chapter 3).

Figure 1.10. **The vehicle fleet has doubled since 2000, increasing air pollution**



Source: INE (2015), *Anuarios parque de vehiculos en circulacion*; OECD (2015), *OECD Environment Statistics* (database).

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Compared to other OECD member countries, Chile still has relatively few motorised vehicles per inhabitant (Annex 1.A). A further expansion of the fleet is to be expected, calling for the development of a comprehensive strategy to manage transport and limit associated air and GHG emissions (Chapter 4). In 2015, the government began introducing a passenger vehicle purchase tax based on a vehicle's fuel efficiency and NO_x emissions. This is a step in the right direction and can contribute to modifying the composition of the fleet towards clean vehicles (Chapter 3).

National emission standards for thermoelectric power plants were established in 2011 (covering SO_x, NO_x, PM and mercury); and for copper smelters in 2013 (covering SO_x and arsenic emissions). No national standard exists for emissions from industrial processes, including mining processes other than copper smelting. As from 2018, Chile will tax emissions of CO_2, PM, NO_x and SO_2 from large energy and industrial facilities, mainly fossil fuel-based electricity plants, but not on copper smelters (Chapter 3).

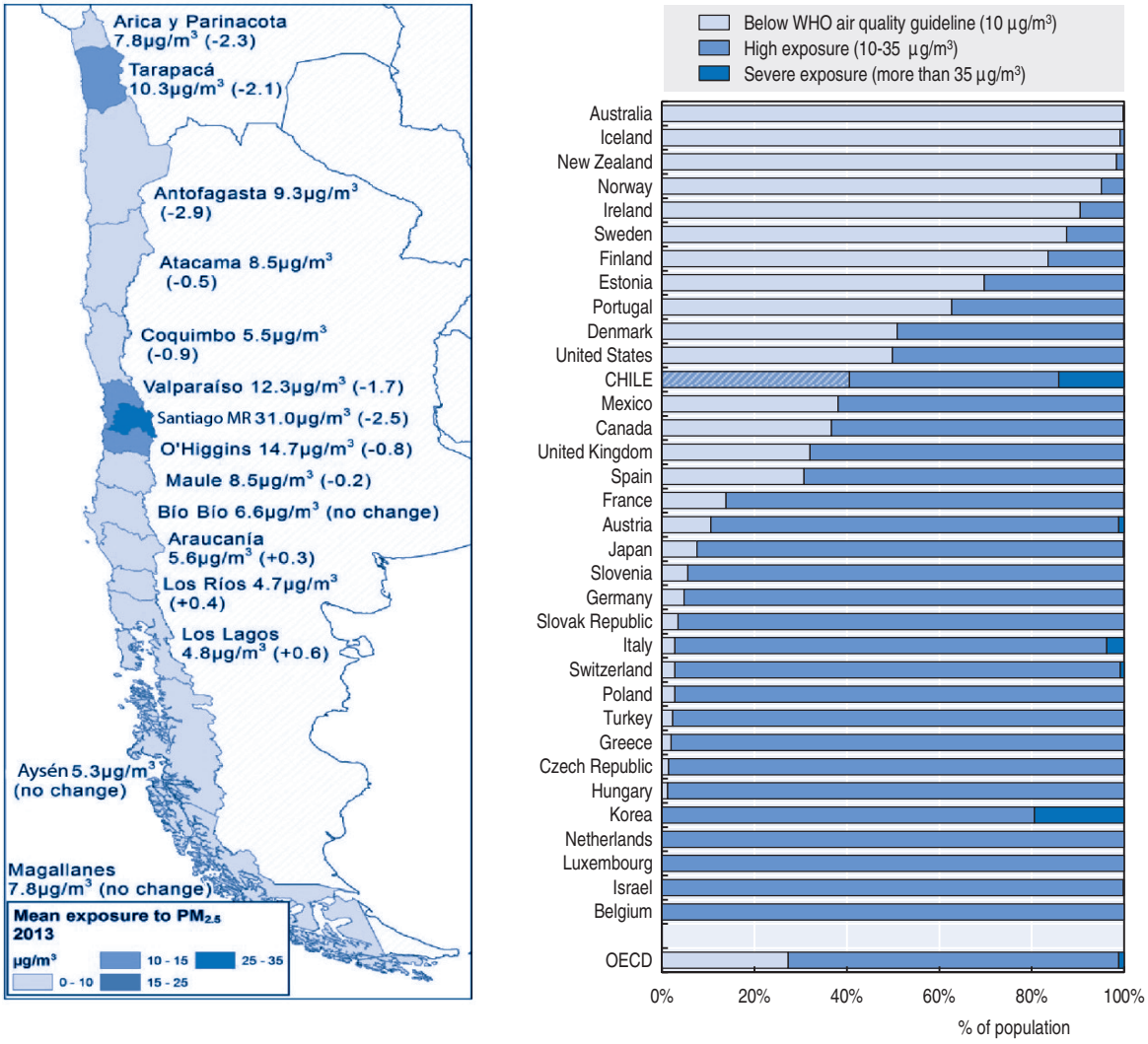
Air quality

Poor air quality remains a major public concern across the country, particularly in large metropolitan areas, in the surroundings of large industrial and mining sites and in cities where wood burning prevails. Air quality standards exist for all major air pollutants, including for $PM_{2.5}$ since 2012, but these continue to be exceeded regularly. According to data from national monitoring stations, 44% of cities or regions surpassed the annual PM_{10} standard, 15% the daily PM_{10} standard, 67% the annual $PM_{2.5}$ standard and 77% the daily $PM_{2.5}$ standard (MMA, 2014c). It is estimated that more than half the Chilean population is exposed to annual average $PM_{2.5}$ concentration levels above the national standard of

20 micrograms/cubic metre (µg/m^3); more than 4 000 people die prematurely each year due to cardiopulmonary diseases associated with chronic $PM_{2.5}$ exposure (MMA, 2012). On average each year, an estimated 15% of the Chilean population is exposed to more than 35 µg/m^3, the second highest share in the OECD (Figure 1.11). PM_{10} and $PM_{2.5}$ constitute the primary air quality concern in most cities, where firewood burning (in southern cities) and transport (notably in the Santiago Metropolitan Region; see Box 1.1) concentrate.[13] SO_x and NO_x concentrations are elevated in areas with mining industry and thermoelectric power generation.

Figure 1.11. **A large share of the population is exposed to severe $PM_{2.5}$ pollution levels**

Population exposure to $PM_{2.5}$, 2013



Note: Figures in parenthesis show net change from 2000. $PM_{2.5}$ data are based on a hybrid approach based on remotely sensed satellite data calibrated with ground-based measurements. Data for Chile likely underestimate $PM_{2.5}$ since they do not reflect nighttime wood burning, which contributes to high $PM_{2.5}$ concentrations. Satellite retrievals are also limited for higher wintertime emissions due to more frequent winter cloud cover.
Source: OECD (2016), Preliminary results based on data from Brauer, M. et al. (2016), "Ambient Air Pollution Exposure Estimation for the Global Burden of Disease 2013", *Environmental Science & Technology*, 50 (1).

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Box 1.1. **Air pollution in Metropolitan Santiago**

The Santiago Metropolitan Region faces particularly high air pollution, which is partly related to the city's geographic location.[a] Average annual exposure to $PM_{2.5}$ in Santiago is higher than in any other region in Chile (Figure 1.11). The Ministry of Environment estimates that about 27 000 people suffer from air pollution-related problems each year in Santiago, causing more than 1 600 deaths per year (mostly during winter). The region's Pollution Prevention and Decontamination Plan (PPDA) has helped improve air quality, with the number of pre-emergency days (related to PM_{10}) dropping from 37 to 3 in 1997-2014 (MMA, 2015b).[b] However, emissions have not substantially declined since 2009 and the PPDA's target of meeting PM_{10} and ozone standards by 2010 was not met. The forthcoming PPDA's most recent update, called Santiago Respira, aims to reduce $PM_{2.5}$ emissions from transport by 78%, from residential heating by 91% and from industry by 31%. This will ultimately cut the exceedances of air quality standards by 90% in 10 years. The plan includes a ban of wood burning heaters, restrictions on the use of the most polluting road vehicles and implementation of the Euro 6 standard for public buses.

a) Santiago is in an enclosed valley with limited wind and little rain, which favours the transformation and accumulation of pollutants from traffic, industry and residential firewood use.

b) Environmental emergencies are declared when the Chilean Air Quality Index (ICAP) exceeds level 500 (equalling a PM_{10} concentration of 330 ug/m^3 per 24 hours); environmental pre-emergencies are declared at ICAP levels between 300 and 499 (PM_{10} concentration levels between 240 ug/m^3 and 329 ug/m^3 per 24 hours).

The 1994 Environmental Basic Law requires for Pollution Prevention and/or Decontamination Plans (PPDAs) in saturated zones (areas that exceed air quality standards for the protection of human health) and in latent zones (areas that come close to exceeding these standards) (Chapter 2).[14] PPDAs have been developed for ten zones throughout the country, mostly to control for excess PM pollution. However, lack of co-ordination at the administrative level, and insufficient engagement of local institutions and stakeholders, hamper effective implementation of the PPDAs (OECD, 2013a). Although the plans must be reviewed every five years, many have not been updated in a long time. In addition, several areas that exceed (or nearly exceed) national air quality standards have not yet been declared as saturated/latent zones, particularly in southern Chile, and lack PPDAs. The 2014-18 Atmospheric Pollution Control Strategy foresees the declaration of six new saturated areas and completion of 14 PPDAs addressing 87% of the national risk associated with air pollution (MMA, 2014c). As of 2015, 11 of the 14 foreseen PPDAs were either published, under public review or in design.

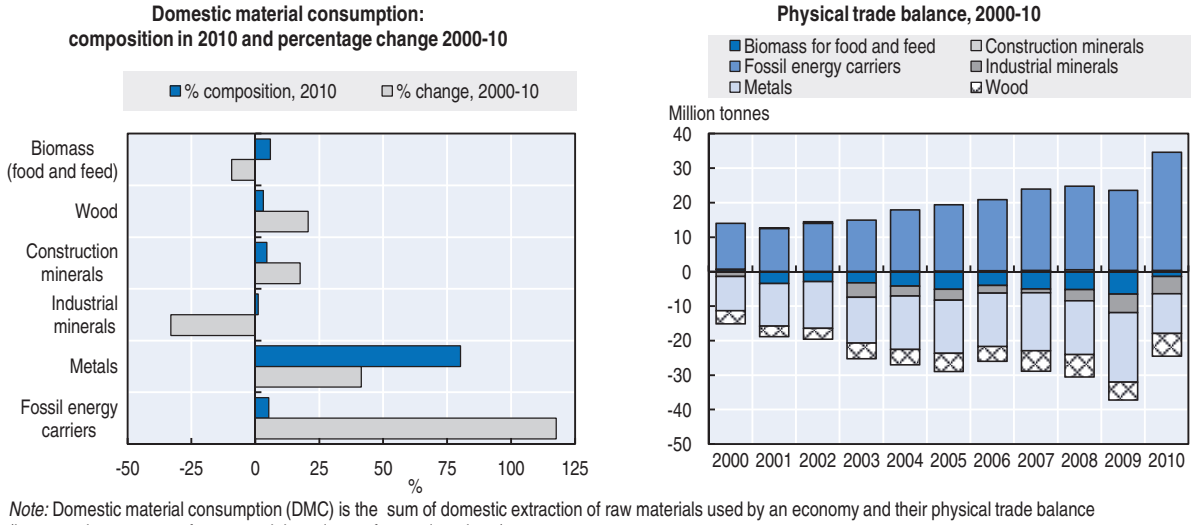
Since 2012, responsibility for air quality monitoring has passed from the Ministry of Health to the MMA. With a view to standardise and improve the management of air quality information, the MMA developed a National Air Quality Information System (SINCA) that integrates information from public and private networks. Coverage of the national monitoring network has expanded in recent years, but important information gaps remain, notably on $PM_{2.5}$; less than 30% of monitoring stations report to SINCA (Toro et al., 2015). Data on air emissions improved following a 2005 Ministry of Health decree stipulating mandatory declaration of emissions from facilities in a wide range of economic sectors, as well as with the implementation of the Pollution Release and Transfer Register (PRTR), which contains an inventory of over 7 000 stationary sources of air pollution (Chapter 2).

4. Transition to a resource-efficient economy

4.1. Material consumption

Chile's economy is among the OECD's most resource intensive. Domestic material consumption (DMC)[15] grew by 36% over 2000-10, compared to an average decrease of 7% in OECD member countries. Although Chile's material productivity (GDP per DMC) improved by 10% in the 2000s, it remained the lowest in the OECD in 2010 (Annex 1.C). While metals accounted for 80% of DMC in 2010, fossil fuel consumption has registered the strongest increase since 2000, reflecting the increase in conventional energy generation (Figure 1.12). Chile's dependence on fossil fuel imports increased over time, as did its dependence on primary goods exports (Figure 1.12).

Figure 1.12. **Chile depends on fossil fuel imports and primary goods exports**



Note: Domestic material consumption (DMC) is the sum of domestic extraction of raw materials used by an economy and their physical trade balance (imports minus exports of raw materials and manufactured products).
Source: OECD (2015), "Material resources", *OECD Environment Statistics* (database).

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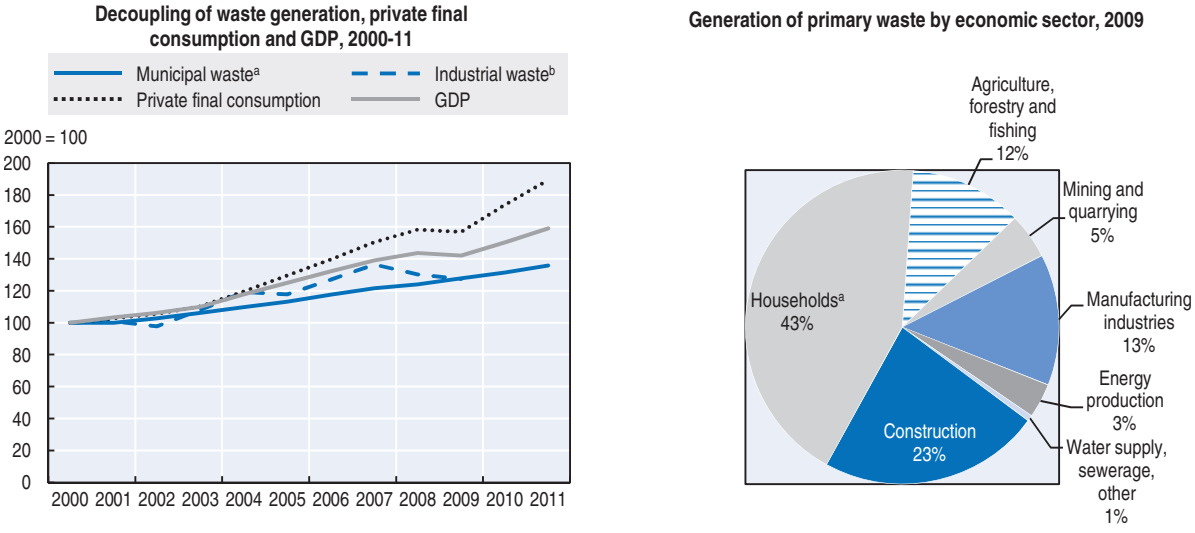
4.2. Waste management

Waste generation, disposal and recycling

With increased economic activity and private consumption, total waste generation increased by 28% between 2000 and 2009. Industrial waste and municipal solid waste (MSW) grew roughly at the same pace of 3% per year (Figure 1.13). Per capita MSW remains low compared to OECD levels (Annex 1.C), but is higher than in regional peers such as Mexico and Brazil (MMA, 2012); this reflects differences in per-capita income levels and consumption. Roughly half of MSW is generated in the Santiago Metropolitan Region, where most people live (MMA, 2015b). Most hazardous waste stems from the exploitation of mines and quarries (42%) and manufacturing industries (35%) (MMA, 2012).

Landfills absorbed more than 96% of total collected waste in 2010/11, while 4% was recovered for reuse, recycling and composting. In 2015, about 25% of total landfilled waste was disposed of either in inadequate landfills (which comply with regulation dating from 1980) or in uncontrolled garbage dumps, compared to nearly 40% in 2009 (CONAMA, 2010). Only 30% of municipalities had access to a sanitary landfill in 2010, but the government aims to bring this percentage up to 75% by 2020.[16] It foresees doubling the number of sanitary landfills in the country (Fernández, 2013; see Chapter 3).

Figure 1.13. **Both industrial and urban waste generation have increased**



a) It includes waste generated by households, as well as similar waste collected by or for municipalities, and disposed in landfills (according to official estimates, 96% of total municipal waste was landfilled in 2011).
b) 2010-11 data are not available. Data include estimates based on partial data; waste from the mining sector is largely underestimated.
Source: MMA (2012), *Official Environment Status Report 2011*; OECD (2015), "Waste generation by sector", *OECD Environment Statistics* (database).

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Recycling is negligible in Chile. Collection rates of tires (15%) have improved following a voluntary agreement signed between the government and the four largest tire producers. Recycling rates are higher for selected products, such as batteries (52%) and paper/carton (52%), which is mainly linked to high market prices within the informal sector. It is estimated that 60 000 waste pickers, who earn their living by informally collecting recyclables and selling them to private recycling companies, contribute to 60% of recycling in Chile (El Dinamo, 2014). Informal recyclers work in parallel with the formal waste management system, although some privately operated recycling centres integrate waste pickers into the formal retail sector. Some municipalities pioneered formal recycling schemes through contracts for differentiated collection, but the scale is often too small for recycling to be a profitable business (Chapter 3). Waste management services remain inadequate in most municipalities; about 80% of municipalities do not have a waste management plan, which is largely due to resource constraints of smaller local authorities (Chapter 3).

A long overdue Waste Framework Law, which is expected to be adopted in 2016, aims to expand the policy focus from waste collection and disposal in sanitary landfills to waste reduction and reuse. The law will introduce a system of extended producer responsibility for a wide range of environmentally harmful products (Box 1.2). Full implementation of the law would significantly help reduce the volume of landfilled municipal solid waste and the related financial burden on local governments (Chapter 3). In addition, the MMA initiated the development of a policy for waste prevention and recovery in 2015 that would promote resource productivity, recovery of organic waste, data collection and citizen awareness.

A revised regulation on hazardous waste management and a new regulation on the transboundary movements of waste are also expected to be enacted in 2016. The latter will implement the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, which Chile ratified in 1998.[17] The swift adoption

Box 1.2. **Extended producer responsibility**

The draft Framework Law for Waste Management aims to introduce a system of extended producer responsibility for nine product lines: tyres, lubricating oils, batteries, electrical and electronic equipment (including lamps), pharmaceuticals, expired pesticides, paper, packaging and end-of-life vehicles. The Ministry of Environment expects to establish specific recovery and recycling targets through implementing decrees for each product group before 2020. The draft law will allow producers to meet their product recovery and recycling obligations through either individual arrangements or collective management schemes. The ministry should give implementation priority to the most environmentally harmful products so as to avoid the environmental and health risks associated with their landfilling. The law is designed to fill gaps in Chile's waste management framework and would not repeal any existing waste-related laws or regulations.

and implementation of these regulations, and of the waste management law and policy described above, are key steps towards compliance with seven OECD Council Acts on environmentally sound waste management practices and transboundary movements of waste. Chile has complied with the remaining two waste-related acts.

Mining waste and contaminated mining sites

Waste generated from ore extraction contains chemicals and heavy metals, which pose serious risks to human health and ecosystems when released to the environment. High risks are also associated with acid mine drainage (outflow of acidic water from mines) and damage to tailing ponds, where hazardous mining waste is stockpiled, due to earthquakes, heavy rainfalls and landslides. Large volumes of tailings have already contaminated soil, surface water and groundwater, and some have been discarded into the Chilean Pacific Ocean, with potential negative impacts on marine biodiversity (Chapter 5). The projected increase in mining production calls for systematic assessments of soil and water contamination from mining activities, which currently are limited.

The inventory of abandoned mining sites, last updated in 2015, reported 651 abandoned and/or inactive mining sites, dozens of which pose an environmental hazard. The 2012 Mining Closure Law strengthened regulation on the management of mining waste and environmental liabilities, as discussed in more detail in Chapter 2.

4.3. *Chemicals management*

Regulatory systems for several types of chemical products, including agricultural pesticides and biocides, have been in place for a number of years and Chile has developed the technical capacities to test, assess and manage these substances. The National Policy on Chemical Safety was reformulated in late 2012 and updated for the period 2015-19. Progress has been made in protecting the environment from harmful effects of specific chemicals like polychlorinated biphenyls (PCBs) and in applying the polluter-pays principle to accidental pollution.

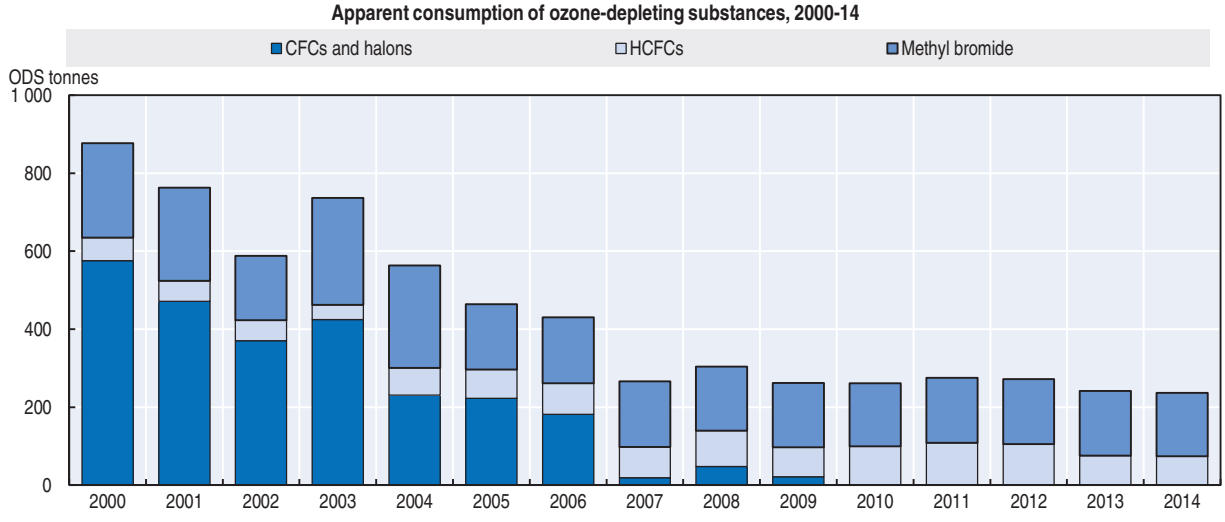
However, further efforts are needed to establish a consistent framework for the sound management of chemicals. Important gaps remain as regards the legal and institutional system for industrial chemicals. As no chemical inventory is available yet, a lack of information exists on the potential risks from imported, produced and used chemicals (except for imports of hazardous substances). The implementation of the Chilean Chemical

Substance Reporting System and of the Globally Harmonized System of Classification of Chemicals (GHS) should be stepped up as a matter of priority. Making progress towards full compliance with the OECD Council Acts will require taking a more systematic approach to chemicals management and strengthening capacity for testing and assessing risks from industrial chemicals.

4.4. *Ozone-depleting substances*

Chile, which ratified the Vienna Convention and the Montreal Protocol in 1990, has complied with related targets to diminish the consumption of ozone-depleting substances (ODS). Since 2000, total ODS consumption decreased by 73% (Figure 1.14); the gradual phase-out of chlorofluorocarbons (CFCs), completed by 2010, drove this considerable reduction. Methyl bromide, which is used as a pesticide and accounted for 70% of total ODS in 2014, has remained stable since 2005; it was phased out by 2015 as import restrictions became effective.[18] Chile is particularly vulnerable to ozone layer depletion, given its near location to the Antarctic Ozone Hole, and is developing several ozone layer monitoring initiatives (MMA, 2012).

Figure 1.14. **The consumption of ozone-depleting substances decreased**



Source: UNEP/Ozone Secretariat (2016), *Data access centre* (database).

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The use of hydro chloro-fluorocarbons (HCFCs), which have less potential to deplete the ozone than CFCs but are more likely to contribute to global warming, increased by about 30% over 2000-13, but slightly decreased in 2014 (Figure 1.14). In compliance with the Montreal Protocol, an HCFC phase-out plan was adopted in 2011 with the aim to freeze consumption in 2013 at 2009/10 levels, and to gradually phase out its use by 2040. Chile introduced an HCFC regulatory system that includes import quotas and a licensing system, sectoral support programmes, and monitoring and awareness-raising programmes. Chile also collaborates with the United Nations Environment Programme (UNEP) to reduce HCFCs in the retail sector.

5. Managing biodiversity and water

Chile's continental territory hosts a variety of climates, ecosystems, vegetation and land-use patterns. The north of the country is extremely dry; a temperate Mediterranean climate prevails in central and southern Chile where vegetation is richer and river valleys

and fertile soil encourage farming and, at higher altitudes, extensive forestry. The extreme south has a snow-prone Alpine climate, with glaciers and fjords providing good conditions for fishing and fish farming (Chapter 5).

5.1. Ecosystems and biodiversity

As Chapter 5 discusses, the expansion of planted forests, agricultural land and urban area are among the major pressures on Chile's biodiversity. Other threats include illegal logging, the introduction of exotic species, high pesticide and fertiliser use, forest fires, water scarcity and pollution, and climate change. Aquatic ecosystems are vulnerable to eutrophication, water shortages resulting from river diversion for irrigation and other human activity, and water infrastructure development. More emphasis on mainstreaming biodiversity considerations into decision making is needed as economic activity expands and conflicts over use of water, land and other natural resources intensify (Chapter 5).

Chile hosts globally significant ecoregions, such as the Valdivian temperate rainforests, and 127 terrestrial ecosystems, about 13% of which are considered under threat. These threats are particularly apparent in central Chile where the rate of vegetation loss has been particularly high over the past 20 years (Chapter 5). Forest cover has expanded since 2000, to about 23% of the country's total land area (FAO, 2015). Forest plantation of non-native tree species, however, has increased pressures on native vegetation and contributed to water scarcity (Chapter 5).

Information about the loss or alteration of inland water and marine ecosystems is limited (MMA, 2014d). It indicates, however, that quality and quantity of water in many rivers, lakes and wetlands have been deteriorating. Chile's extensive coastline comprises one of the most productive marine ecosystems in the world. Indeed, according to the Ocean Health Index, Chile has been relatively successful in maintaining marine biodiversity compared to other Latin American countries (Ocean Health Index, 2015). A major fishing country, Chile introduced a tradable fishery quota system in 2001. This has helped address severe depletion of its fish stock by reducing fish catches by 64% between 2004 and 2013 (Figure 5.11). By contrast, aquaculture production, a major source of water pollution (MMA, 2012), almost tripled over 2000-12 (Chapter 5).

Chile's distinct topography and geographic isolation result in a relatively low diversity of flora and fauna species compared to some other South American countries, but also in a high degree of endemism. Between 22% and 25% of the almost 31 000 described species in Chile are endemic (found nowhere else in the world) (MMA, 2014d). More than 60% of the 1 000 species classified in Chile are considered threatened, mostly marine fish, vascular plants and bird species (Figure 5.4). Considerable knowledge gaps on species conservation remain, however, as only 3.5% of all species known in Chile have been classified (Chapter 5).

Protected areas

Official protected areas cover about 19.5% of Chile's land area (including inland waters). This surpasses the Aichi target of protecting at least 17% by 2020, established under the United Nations Convention on Biological Diversity (CBD).[19] Since 2000, Chile has expanded the surface of protected land by nearly 7%. The majority of protected areas are classified within the highest protection level categories (nature reserves and national parks). Chile has the third highest share of total land area within national parks in the OECD (Figure 5.6; see Chapter 5).

As Chapter 5 discusses, protected areas are not equally represented across ecosystems and regions. Official protected areas do not cover several vulnerable ecosystems, notably terrestrial ecosystems in the centre and the north of the country and wetlands (MMA, 2014d). More than 80% of protected areas are located in the two southernmost regions (Aysén and Magallanes) and cover large extents of ice and rock.

The surface of marine protected areas expanded to reach 4.3% of total marine area in 2015, with the establishment of an extensive marine park around the Sala-y-Gómez Island. In October 2015, the environment ministry announced the establishment of an extensive marine park around the oceanic islands known as the Desventuradas. This will bring protected areas to 24% of total marine area, well beyond the Aichi target of 10%. Yet protected marine areas along the continental edge remain marginal and should be expanded (Chapter 5).

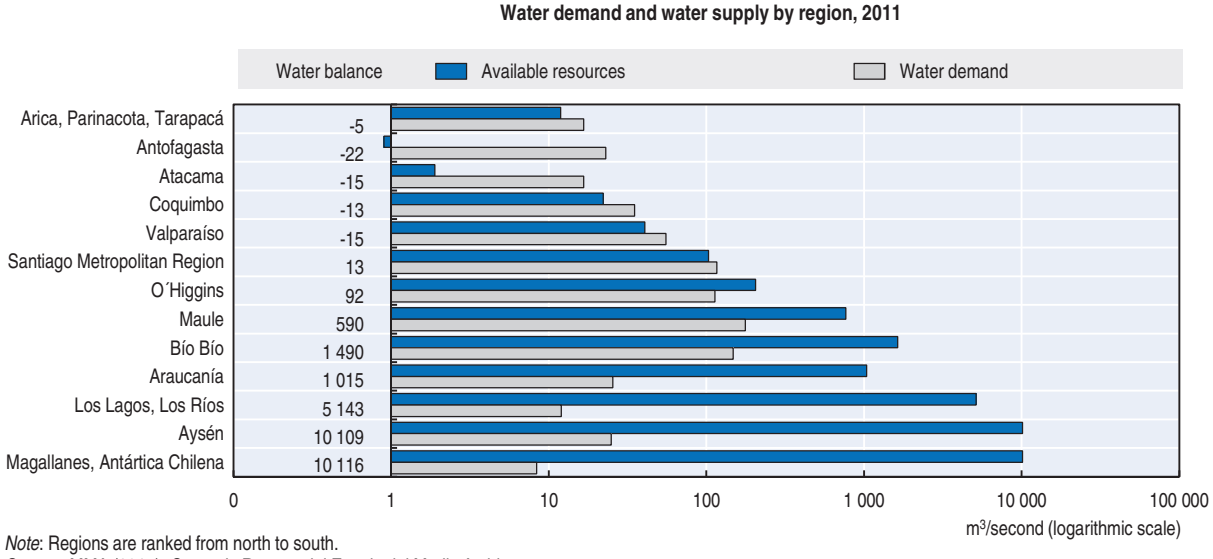
5.2. *Management of water resources*

Water resources

Numerous rivers cross Chile, providing plenty of water resources and considerable hydropower potential. Chile also has a significant volume of underground resources, as well as reservoirs in the form of lakes and notably glaciers, the primary water sources feeding Chilean rivers. Water resources are not homogenously distributed across the country, however, with annual average water availability ranging from 52 m^3 per person in Antofagasta (northern Chile) to nearly 3 000 000 m^3 in Aysén (the scarcely populated southern Chile) (World Bank, 2011); this leads to distinct water management challenges in different parts of the country. On average, Chile endows about 56 000 m^3 of renewable freshwater resources per capita, the fifth highest value in the OECD (OECD, 2015c).

Water demand exceeds supply in various regions, notably in the arid north, where most of the water-intensive mining takes place. Increasingly, it also exceeds supply in the central parts of the country, where agricultural production is concentrated (Figure 1.15).

Figure 1.15. **Water demand exceeds supply in northern and central Chile**



Note: Regions are ranked from north to south.
Source: MMA (2015), *Segundo Reporte del Estado del Medio Ambiente.*

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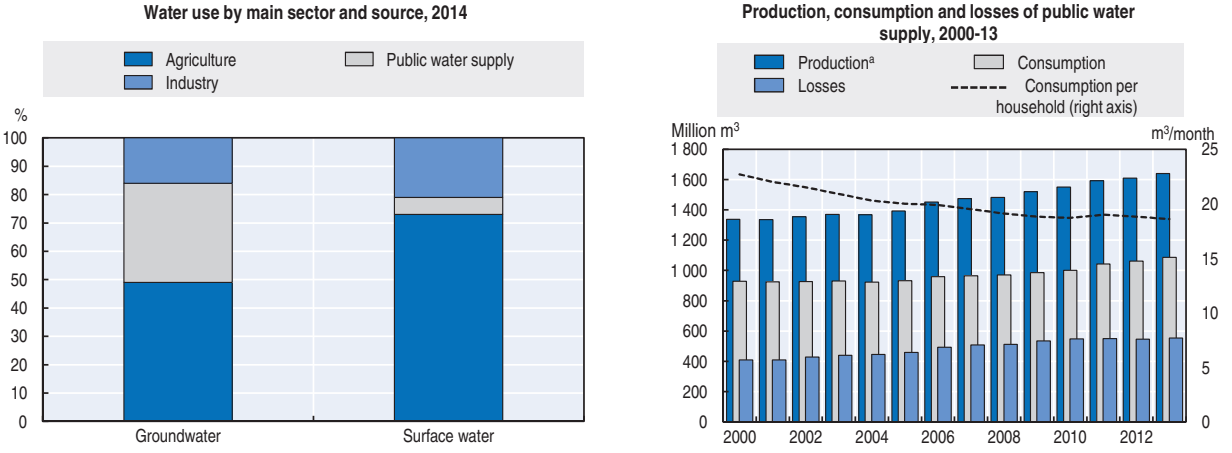
Accentuated by seven consecutive years of drought, this structural water supply deficit has led to severe water shortages in numerous municipalities (Chapter 3).[20] The situation is expected to worsen with economic growth, increased water use and the predicted reduction of rainfall and glacier reservoirs from climate change (MISP, 2015). Since 2005, the General Water Directorate (DGA) has monitored groundwater withdrawals. Limited human, technical and financial resources, however, result in significant gaps in the registry of wells and measurements of extraction and recharge balances (Hearne and Donoso, 2014).

The majority of water abstraction (about 89%) is for non-consumptive use, namely hydroelectric power generation (MISP, 2015).[21] Agriculture, which accounted for half of groundwater use and most of surface water use (Figure 1.16), dominates consumptive use. Most irrigation areas (72%) still rely on relatively old irrigation techniques, resulting in low efficiency compared to other OECD member countries (OECD, 2013b; see Chapter 5).

Figure 1.16. **Water losses in public water supply are considerable**



a) Abstraction for public water supply in urban areas served by water utilities.
Source: MMA (2015), *Segundo Reporte del Estado del Medio Ambiente.*

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Rising water tariffs helped reduce drinking water consumption per urban household by 18% between 2000 and 2013, while total consumption of drinking water grew by 17% (Chapter 3). During the same period, the amount of water abstracted for public water production increased by 23%, which points to inefficiencies in distribution: water losses increased by 35% between 2000 and 2013, when leakages exceeded one-third of production (Figure 1.16). Groundwater supplies two-thirds (67%) of drinking water (MISP, 2015); public water supply accounts for about one-third to total groundwater use (Figure 1.16).

Freshwater abstraction in the mining sector has grown moderately (by 4% over 2009-14) and less than total mining production. Water scarcity has encouraged investment in more efficient water use, closed loop water systems and alternative water sources, notably desalination (Cantallopts, 2015; see Chapter 3). Despite greater water efficiency, water needs for mining are expected to rise by 40% over 2014-25 due to growing production and declining ore grades.[22] Seawater use is projected to expand massively to meet these needs, resulting in increasing energy demand and potentially negative impacts on ecosystems and biodiversity (Chapter 5).

According to the 1981 Water Code and its 2005 reform, the allocation and use of water resources are based on a system of tradable private water-use rights (Box 1.3). This approach aims to set a price that reflects the real opportunity cost of the water resource, thereby achieving an efficient reallocation of water from low value to higher value activities. Distortions in allocation rules and practices, however, have led to over-allocation and extreme concentration of water-use rights (DAAs).[23] This has exacerbated over-exploitation of some aquifers in northern and central Chile (MMA, 2012), drinking water shortages in rural villages and conflicts among local communities (including indigenous communities), farmers and mining and hydropower companies (Box 1.3).

Box 1.3. **Chile's market of water-use rights**

The 1981 Water Code, as reformed in 2005, defines water resources as "national property for public use". The General Water Directorate (DGA) allocates water-use rights (DAAs) to users upon request, free of cost and for life (they are inheritable). In case there is more than one request over the same water source and not enough resources to satisfy them all, the water right is allocated via a tender process. Water-use rights, which are separate from land titles, can be freely traded.

Water rights are issued without specification of water use or good water management obligations. This, together with water rights being granted for free, has encouraged speculation and hoarding of DAAs. Consequently, water resources available for allocation have declined, although the water rights are not actually being used. Only water rights registered with the DGA can be traded, but many are not – only 20% of water rights and 50% of transactions had been recorded in the late 2000s (World Bank, 2011). In addition, in 110 aquifers, user rights have been granted beyond the aquifer recharge capacity (over-allocation), which has led to a dramatic decrease of the water table.

The 2005 reform of the Water Code enabled the DGA to restrict groundwater use to preserve the resilience of aquifers and set minimum ecological flow requirements for newly allocated water rights.[a] Of 238 hydrological sectors surveyed in 2010, 45% were declared restricted areas (i.e. temporarily restricting the exercise of water-use rights), while new groundwater abstraction was prohibited in six hydrological sectors. Such site-specific restrictions can be effective in addressing the risk of water shortage in aquifers. However, it is not clear how well these restrictions and the minimum ecological flow requirements are enforced; existing user rights do not allow for meeting the minimum flow in half of the river basins in northern Chile.

The 2005 reform also introduced a "tax for the non-use" of water rights, levied on DAAs that are not actually used (for which a water intake has not been constructed).[b] The tax aims to discourage speculation and hoarding of rights. Tax rates increase based on how long the rights stay unused and water scarcity (with higher rates in northern regions). Holders of small use rights are exempt. The tax has helped reactivate water markets, but not to the extent hoped. In 2007-10, 12% of DAAs for consumptive uses and only 0.1% of DAAs for non-consumptive use (hydropower) were sold on the market or started to be actually used. In general, tax rates have been too low compared to the DAA market prices to stimulate sale of rights. Hydropower companies have tended to keep their DAAs to prevent entry of new players in the electricity market (Valenzuela et al., 2013). Increasing tax rates, which would improve tax effectiveness, has been under discussion for years. The tax, however, creates perverse incentives to waste water and discourage registration of DAAs, as only registered DAAs are liable to pay the tax.

Box 1.3. **Chile's market of water-use rights** *(cont.)*

The water market has gradually expanded since the 2005 reform. Nearly two-thirds of the DAAs in circulation have been granted since the reform and 60% of transactions have occurred since then (Cruz, 2014). Most transactions have occurred among farmers, although many of them maintain surplus DAAs to mitigate the risk of drought. There has been limited inter-sectoral trading (Hearne and Donoso, 2014). Average prices are decreasing from north to south, indicating that prices are capturing the relative scarcity of water. However, there is a great dispersion of prices, which suggests a lack of transparency about trading and prices (Cristi, 2011).

Overall, speculation and the hoarding of water-use rights have been reduced, freeing up water to be accessed by a broader number of potential users and thereby improving the equity of allocation (OECD, 2015d). However, historical over-allocation and concentration of DAAs remain, as do market and information failures. Making transactions, mortgage and eligibility for irrigation subsidies conditional to registration has not created sufficient incentives to regularise and register the user rights. Overlapping claims on water rights remain, including unsettled claims by indigenous people. High transaction costs and insufficient transparency and information (about water availability, potential buyers and sellers, and prices) limit the efficiency of the water market and exacerbate tensions.

a) Minimum ecological flows aim to preserve the hydrological and ecological functions of rivers, e.g. by preventing rivers from drying-up or significantly altering their physical regimes. The minimum ecological flow was set at 10% to 20% of the annual average flow rate in 2012, and replaced in 2014 by a more flexible 50% of monthly river flow rates, while the 20% cap has remained. These definitions are commonly used in environmental impact assessments of hydroelectric projects.

b) However, the mere existence of a water intake infrastructure does not ensure that the water is actually abstracted and used.

A new set of amendments to the Water Code, proposed in 2011 and under parliamentary discussion at the time of writing, requires that new water rights be temporary (maximum 30 years) and do not undermine the resilience of freshwater systems; it identifies priority water uses, namely human consumption and sanitation, when granting new rights and, in exceptional cases only, for existing rights; it introduces provisions for termination and forfeiture of non-used rights; and it strengthens restrictions in the exercise of user rights in the public interest (e.g. in case of drought). These steps are in line with the recommendations of the OECD study on water resource allocations (OECD, 2015d).

In addition, Chile should improve market transparency. It should consider introducing effective and enforceable abstraction limits that reflect environmental requirements and sustainable use, making sure that water rights and trading arrangements are consistent with such limits (OECD, 2015d). Efforts should focus on developing the knowledge base on risks for water resource availability and quality and their potential economic, environmental and social consequences. This would help determine the effective availability of water for allocation, beyond that needed for ensuring the resilience of water systems, and better inform decisions about priority uses. Chile's multi-stakeholder water roundtables can be a useful forum to help identify risks and policy priorities.

Water quality

In the far south, where most lakes and lagoons are located and where population densities are low and economic activities limited, water quality is generally very good. However, in central Chile, limited access to tertiary wastewater treatment and large

agricultural runoff have caused eutrophication of coastal lakes, wetlands and estuaries (Chapter 5). Mining activity has led to elevated copper and salinity levels in some rivers. In the northern regions, mining effluent adds to naturally high concentrations of heavy metals and sulphates in surface water, which often exceed permissible or recommended limit values (MMA, 2012).

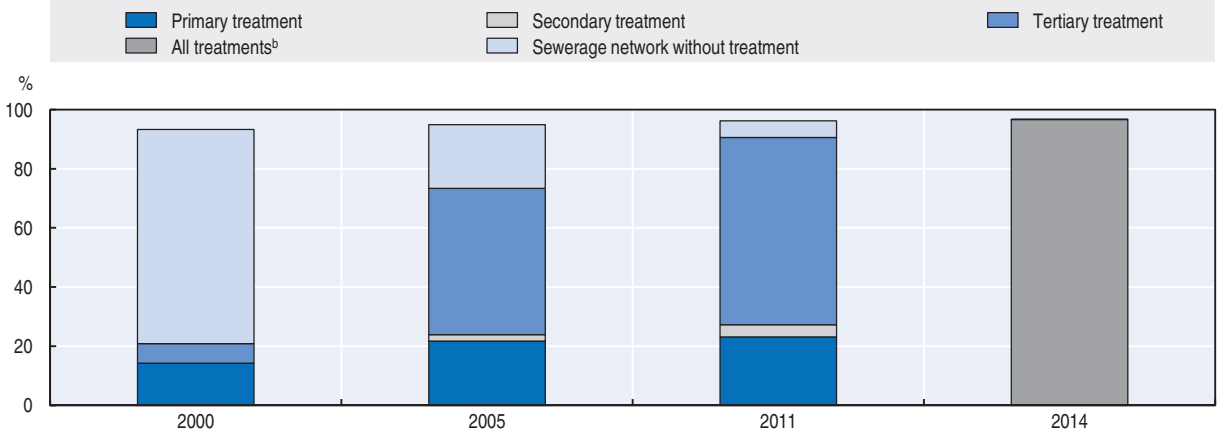
Since 2010, Chile has adopted secondary surface water quality standards (designed for ecosystem protection) for four river basins and two lake catchments.[24] However, such standards have yet to be introduced for most river basins in northern Chile, which are the worst affected by mining activities (Chapter 5). There is no water quality standard for groundwater other than for aquifers intended for drinking water supply. Standards for sewerage discharges apply throughout the country, but are not linked to the water quality in the receiving water bodies; standards for industrial discharges are being updated. PPDAs must be developed for areas that fail to meet one or more quality standards, fully (saturated areas) or in part (latent areas). The DGA monitors water quality, but monitoring data are insufficient to adequately characterise the status of water bodies and coastal areas (World Bank, 2011) and enforce the water quality standards. This partly explains why no saturated or latent areas have been declared yet. A water quality and ecological information platform is currently being developed.

Access to water supply and sanitation

Nearly all the urban population has continuous access to potable water. Water and sanitation utilities have massively invested in the expansion of urban wastewater treatment facilities (Chapter 3), which served 96.6% of the urban population in 2014 (Figure 1.17). This is high compared to regional peers, although only two-thirds of urban dwellers were connected to advanced (secondary and tertiary) treatment in 2011; this is low by OECD standards. Most wastewater treatment plants do not remove nutrients in urban wastewater. Some municipalities discharge wastewater at sea using submarine outfalls after only primary treatment.

Figure 1.17. **Wastewater treatment services increased considerably**

Percentage of urban population connected to sewerage and wastewater treatment plants by type of treatment, 2000-14[a]



a) Data refer to population living in urban areas served by wastewater treatment facilities (about 89% of the total population in 2014). Primary treatment: includes preliminary treatment and underwater outfalls. Tertiary treatment: activated sludge systems achieving a faecal coliform density less than 1 000 in 100ml but without treatment of nutrients.

b) Breakdown by type of treatment not available.

Source: OECD (2015), "Water: Wastewater treatment", *OECD Environment Statistics* (database); SINIA (2015), *Indicadores y Estadísticas Ambientales* (database).

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Official data on access to water supply and wastewater treatment in rural areas – where about 15% of the population lives – are lacking. Rural wastewater treatment systems depend on public subsidies and have deteriorated over time (Donoso, 2015; see Chapter 3). The Rural Potable Water programme aims to achieve universal access to potable water in "semi-concentrated" and "dispersed" rural localities by 2035, which register very low access levels (MOP, 2012).

Recommendations on air, waste and water management

Air quality management

- Develop Pollution Prevention and Decontamination Plans (PPDAs) for all areas that do not comply with air quality standards, and evaluate and update those that already exist; closely engage local authorities in the design, implementation and evaluation of specific policy measures within each PPDA.
- Continue to improve the air quality monitoring network and ensure that air pollution information is made available to the public.

Waste management and circular economy

- Adopt the draft waste framework law at the earliest opportunity and implement extended producer responsibility schemes for key types of environmentally harmful products.
- Update and implement regulation on hazardous waste management and transboundary movement of waste to comply with international best practice.
- Encourage waste prevention, recycling and recovery of products not covered under the planned extended producer responsibility schemes (e.g. organic waste), including by: i) making greater use of charges and taxes on generated waste; ii) considering fiscal incentives for recycled products; iii) reviewing the incentives and funding mechanisms for waste management in small municipalities; and iv) raising awareness among citizens.

Water management

- Introduce a risk-based approach to water resource management by developing the knowledge base on water risks to inform decision making; consider enhancing the role of water roundtables to resolve water conflicts.
- Design and implement further reforms of the water allocation regime to ensure an effective and enforceable cap on abstractions that reflects environmental and ecological requirements and sustainable use; establish "essential" water uses (such as public water supply, sanitation and ecosystem services) as a high priority use; speed up the regularisation and registration of water-use rights to make the public register on water rights fully operational and transparent; consider auctioning the allocation of new rights (for systems that are not already over-allocated); strengthen enforcement and sanctions for illegal abstractions.
- Develop a strategy to address over-allocation in basins and aquifers where water-use rights exceed the sustainable capacity of the water body.
- Continue expanding coverage of water quality standards and accelerate implementation of the planned water quality and ecological information platform, with a view to systematically collecting and publishing water quality data; improve monitoring of soil contamination, as well as of water abstraction to protect ecosystems, notably wetlands.

Notes

1. Other abundant minerals and metals include molybdenum and manganese (by-products from copper mining), lead, zinc, iron, gold and silver.
2. Although outside of the mining sector, total factor productivity growth has been positive.
3. The top 1% of the population holds 21% of total income; while the bottom 40% holds less than 1.7% of total income (OECD, 2015a).
4. Female life expectancy stood at 81.4 years in 2013 (compared to an OECD average of 83.1); male life expectancy stood at 76.3 years (compared to an OECD average of 77.8).
5. Chile was the first country in Latin America to develop "noise maps" for selected major cities, including Antofagasta and Providencia (2009) and then Santiago (2010), to determine population exposure to noise levels (MMA, 2012). High exposure to traffic noise has severe health impacts, including on cardiovascular health and cognitive functions (EEA, 2010).
6. The limited domestic oil and natural gas resources are located in the Chilean Magallanes and Antarctic region, while coal reserves are located in central and southern Chile.
7. The steep fall in natural gas in TPES between 2006 and 2008 was caused by a progressive curtailment of natural gas supplies from Argentina, which was the only supplier that time.
8. Energy consumption of copper mines increased by 60% over 2005-14, driven by both production growth and structural changes in the industry (notably, declining ore grades, increasing rock hardness and extraction at increasingly greater depth and distance, which drive up energy intensity in the production process). Even though the industry saw energy efficiency gains, the processes with the highest energy demand (open pit mining and concentration) have increased their energy use per tonne extracted. The Chilean Copper Commission projects that electricity consumption by the copper industry, the largest mining segment, will increase by 96% to 118% over 2013-25 (Cochilco, 2014).
9. The increase for Chile refers to 2000-10, while increases for other OECD member countries in Annex 1.B refer to 2000-12.
10. Ore smelting is the highest-impact mining activity in terms of air quality. Copper foundries accounted for nearly 60% of total SO_x emissions over 2005-11.
11. Pollutant emissions from coal-fired power plants are significantly higher than in combined-cycle power plants using natural gas.
12. The Euro 5 standards for new light duty diesel vehicles and petrol cars were introduced in 2012 and 2014, respectively.
13. NO_x emissions are precursors of PM, i.e. they react in the atmosphere to form PM.
14. Latent zones are declared where pollutant concentrations are above 80% of the air quality standards.
15. DMC is the sum of domestic raw materials extraction used by an economy and their physical trade balance (imports minus exports of domestic raw materials and manufactured products).
16. The target is set in the National Health Strategy to Achieve the 2011-2020 Health Objectives. The strategy served to provide conditions for the implementation of the 2007 Ministry of Health regulations on the sanitary design of landfills.
17. It provides for export requirements (including financial guarantees), control procedures and sanctions in the case of non-compliance, in addition to a platform for information exchange between concerned authorities.
18. Chile does not produce ODS and hence imports all consumed ODS. The import of CFCs, halons and carbon tetrachloride have been prohibited since 2010; the import of methyl bromide has been prohibited since January 2015.
19. Official protected areas refer to those areas administered by public institutions, including the National Forestry Corporation, the National Fishing and Aquaculture Service and the Ministry of Environment. They include: national parks, national reserves, nature sanctuaries, natural monuments, marine reserves, marine parks and multiple use marine coastal protected areas. The government estimated the total area under some form of protection at almost 40% of the territory.
20. In 2014, for example, a water shortage was declared in 41 municipalities and an agricultural emergency in 54 municipalities in central Chile (MISP, 2015). Emergency measures, such as using cistern trucks for securing water supply, implied high costs for local authorities' budgets.

21. Hydroelectric power generation is a non-consumptive water use, as most of the water abstracted for this purpose goes back into the water source as a return flow.

22. Lower ore grades make the extraction and processing of copper more difficult and typically lead to increased use of chemicals, water and energy per produced tonne.

23. For example, only three companies possess 90% of water rights for power generation nationwide (Larrain and Schaeffer, 2010).

24. Secondary water quality standards regulate biological contamination, nutrient levels (nitrogen, phosphorus), heavy metals, and toxic contaminants (phenols, polycyclic aromatic hydrocarbons, organic halogen compounds and some pesticides).

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ANNEX 1.A

Energy and transport data

Figure 1.A1. **Energy structure and intensity**

Notes: Data may include provisional figures and estimates. Total primary energy supply: the breakdown excludes electricity trade. GDP at 2010 prices and purchasing power parities.

Source: IEA (2015), *IEA World Energy Statistics and Balances* (database); OECD (2015), "Population projections", Historical population data and projections, *OECD Employment and Labour Market Statistics* (database); OECD (2015), *National Accounts Statistics* (database).

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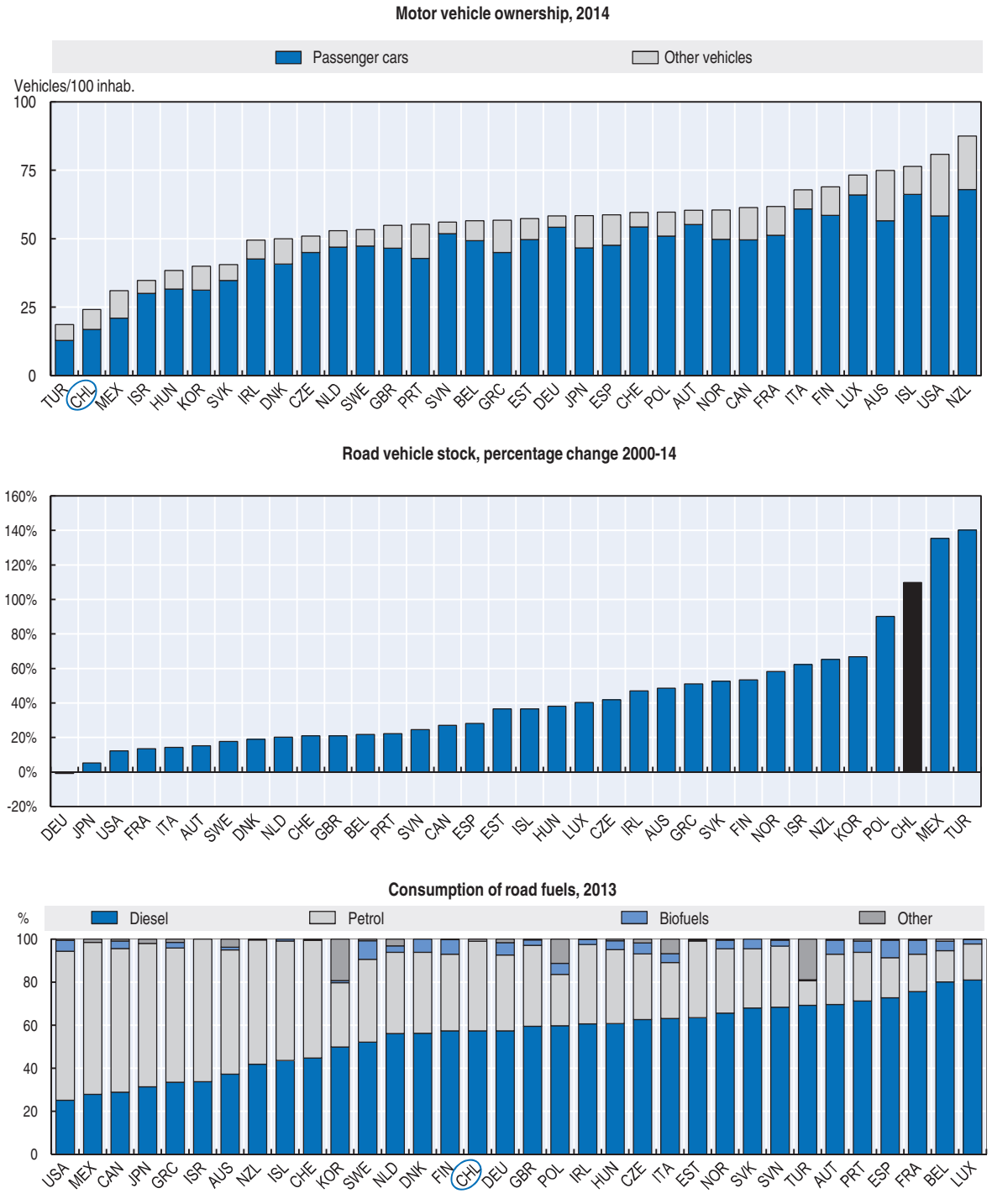
Figure 1.A2. **Road transport**



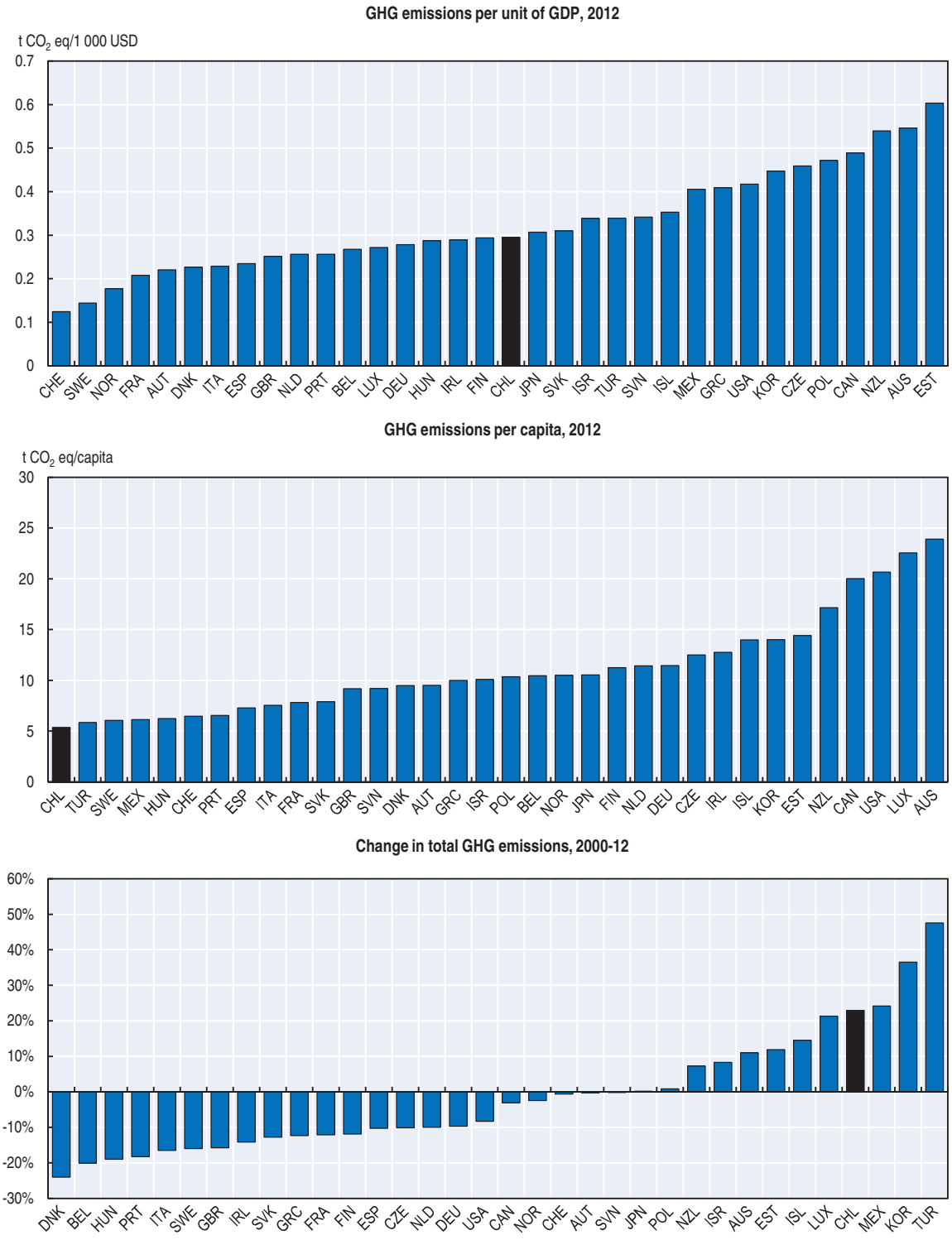
Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
Motor vehicles with four or more wheels.
Source: Eurostat (2015), *Transport Statistics* (database); IEA (2015), *IEA World Energy Statistics and Balances* (database); North American Transportation Statistics (NATS) (2015), *Statistics Online Database*; UNECE (2015), "Transport", *UNECE Statistical Database*; national sources.

StatLink http://dx.doi.org/10.1787/888933388076

ANNEX 1.B

Climate change and air pollution data

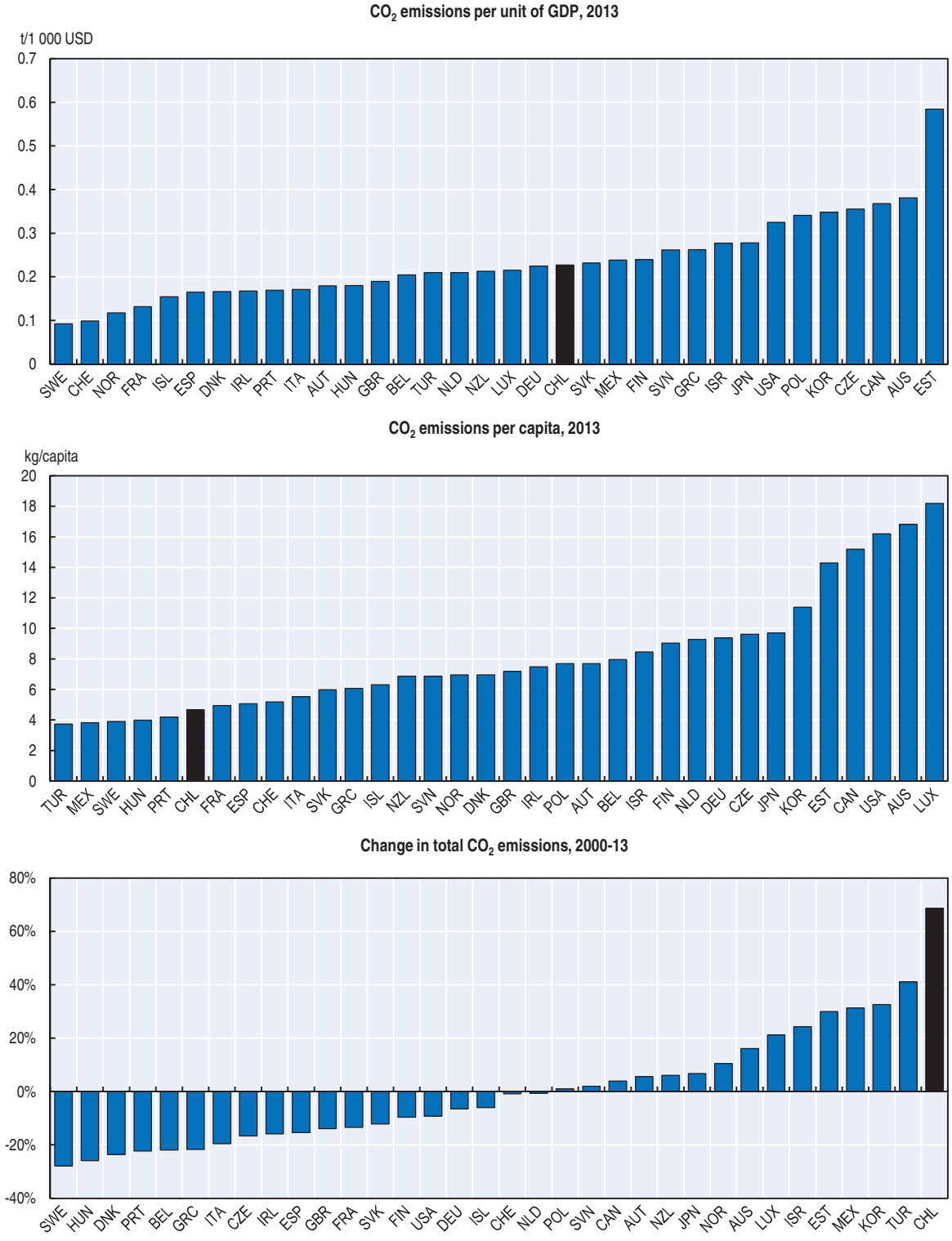
Figure 1.B1. **GHG emissions and intensity**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
GHG emissions excluding emissions/removals from land use, land-use change and forestry. CHL: data refer to 2010. ISR: 2000 data exclude F-gases.
GDP at 2010 prices and purchasing power parities.
Source: OECD (2015), "Greenhouse gas emissions by source", *OECD Environment Statistics* (database); OECD (2015), "Labour Force Statistics: Population projections", *OECD Employment and Labour Market Statistics* (database); OECD (2015), *OECD National Accounts Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388089

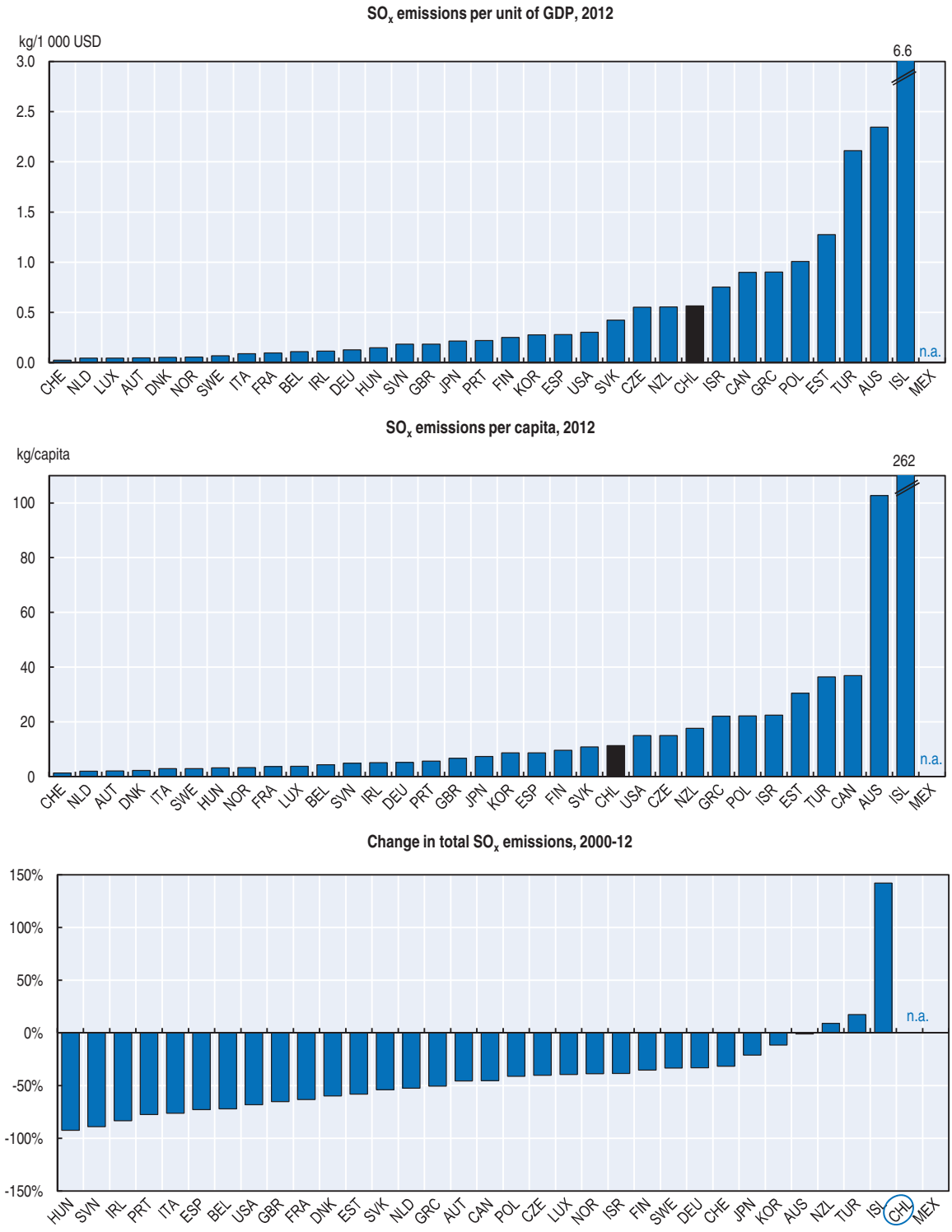
Figure 1.B2. CO_2 emissions and intensity



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
CO_2 emissions from energy use only; excluding international marine and aviation bunkers; sectoral approach. GDP at 2010 prices and purchasing power parities.
Source: IEA (2015), *IEA CO_2 Emissions from Fuel Combustion Statistics* (database); OECD (2015), "Labour Force Statistics: Population projections", *OECD Employment and Labour Market Statistics* (database); OECD (2015), *OECD National Accounts Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388090

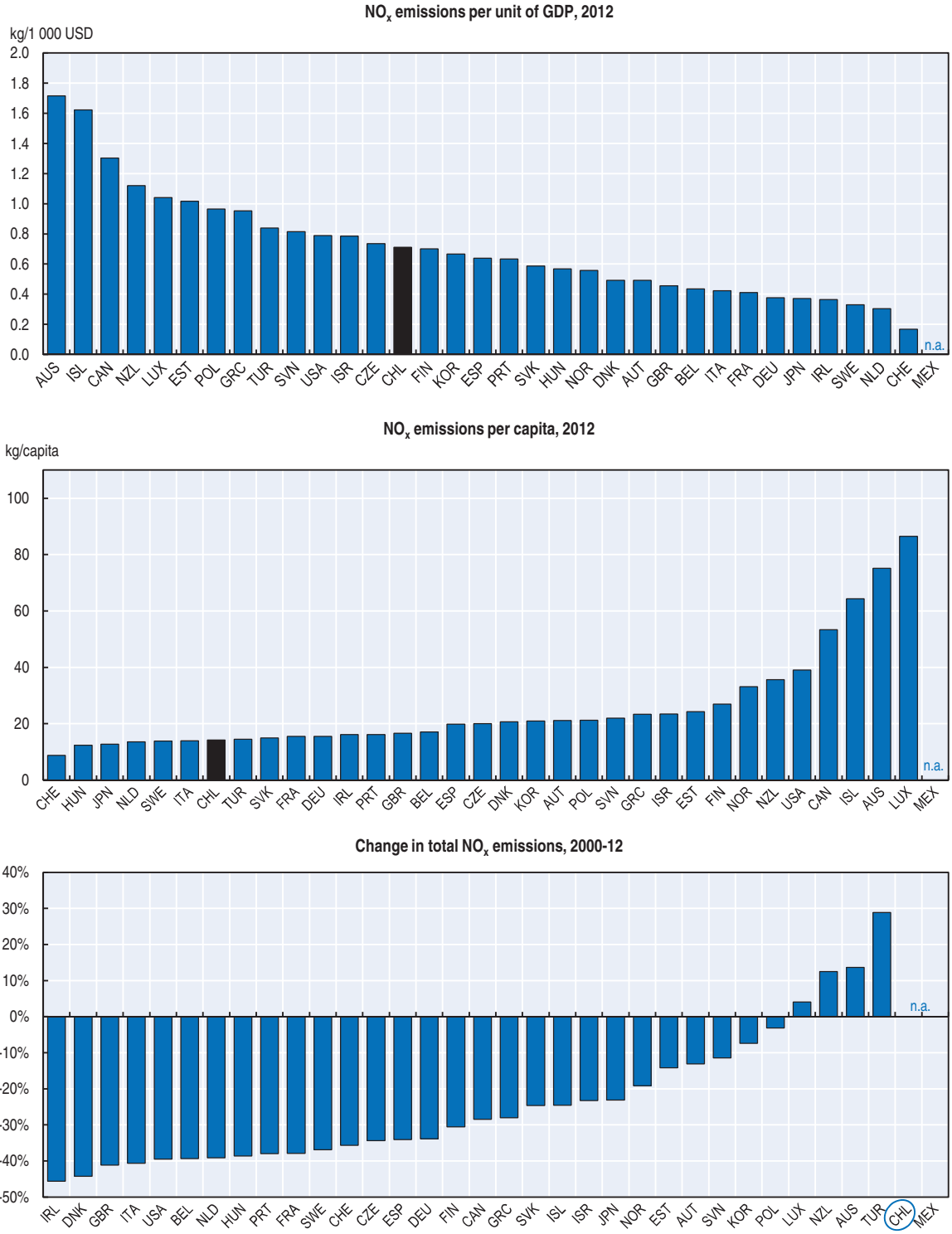
Figure 1.B3. SO_x emissions and intensity



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
GDP at 2010 prices and purchasing power parities. ISL: includes emissions from geothermal energy (80% of total emissions in 2012).
Source: MMA (2015), *Segundo Reporte del Estado del Medio Ambiente;* OECD (2015), "Air emissions by source", *OECD Environment Statistics* (database); OECD (2015), "Labour Force Statistics: Population projections", *OECD Employment and Labour Market Statistics* (database); OECD (2015), *National Accounts Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388109

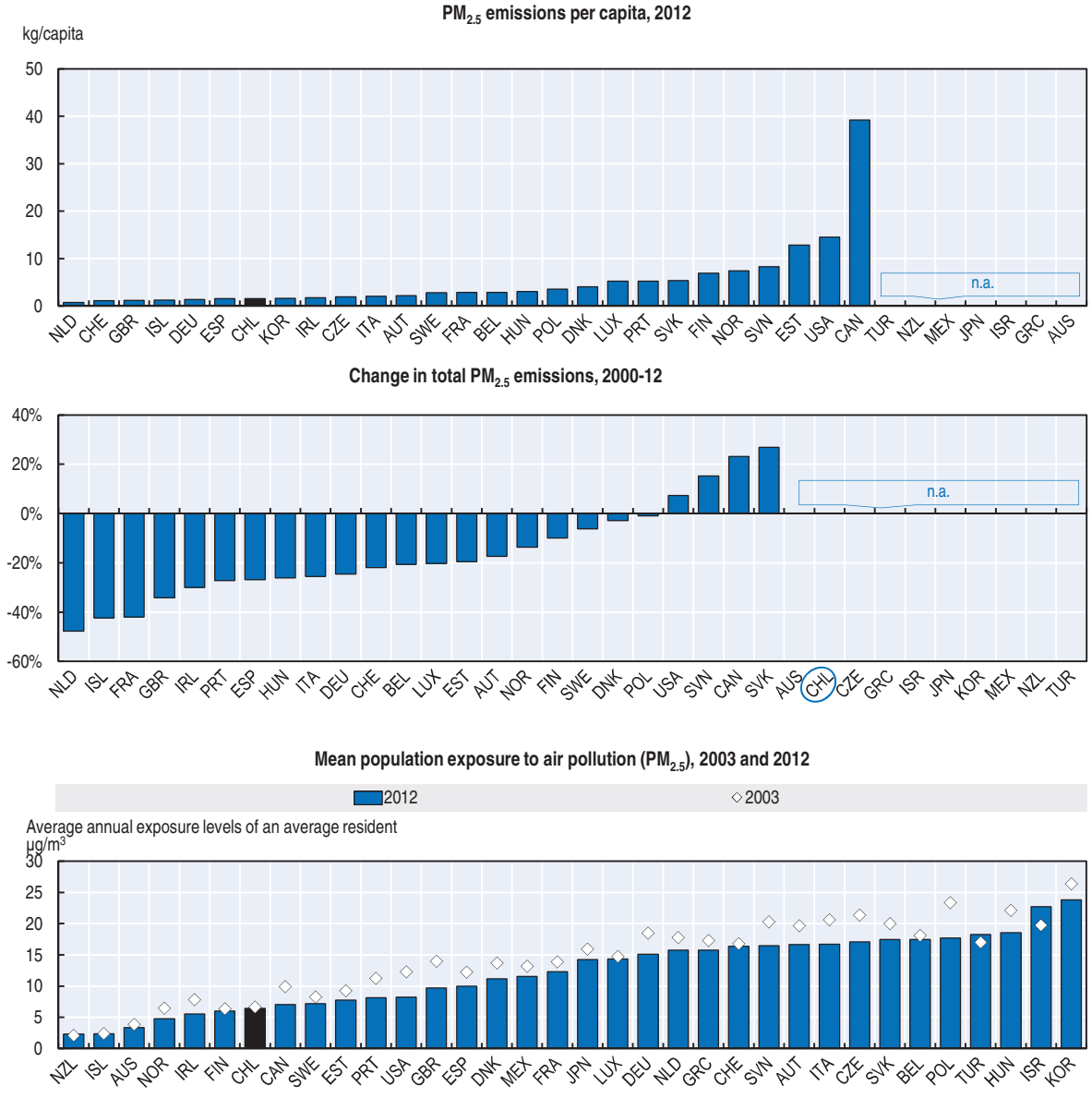
Figure 1.B4. NO_x emissions and intensity



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
GDP at 2010 prices and purchasing power parities. LUX: data exclude emissions from "fuel tourism".
Source: MMA (2015), *Segundo Reporte del Estado del Medio Ambiente;* OECD (2015), "Air emissions by source", *OECD Environment Statistics* (database); OECD (2015), "Labour Force Statistics: Population projections", *OECD Employment and Labour Market Statistics* (database); OECD (2015), *National Accounts Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388116

Figure 1.B5. **$PM_{2.5}$ emissions and intensity**



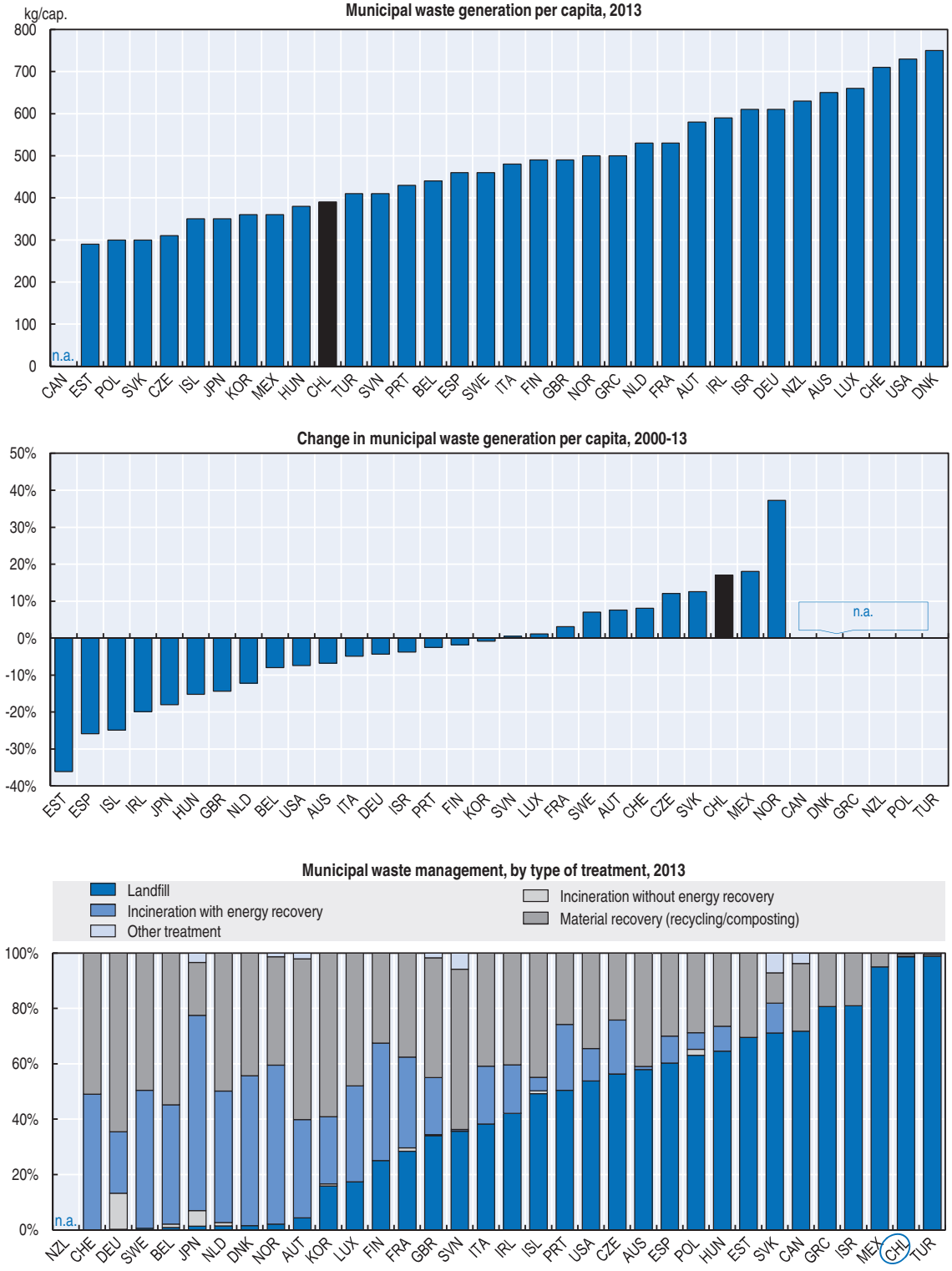
Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
Mean population exposure to air pollution: estimates based on satellite imagery data; three-year average data.
Source: OECD (2015), "Air emissions by source", *OECD Environment Statistics* (database); OECD (2015), "Labour Force Statistics: Population projections", *OECD Employment and Labour Market Statistics* (database); OECD (2015), *OECD Regional Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388120

ANNEX 1.C

Waste and resource management data

Figure 1.C1. **Waste generation and management**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Waste collected by or for municipalities. It includes household, bulky and commercial waste, and similar waste handled at the same facilities.
CAN: Includes construction and demolition waste.
Source: OECD (2015), "Municipal waste", *OECD Environment Statistics* (database).

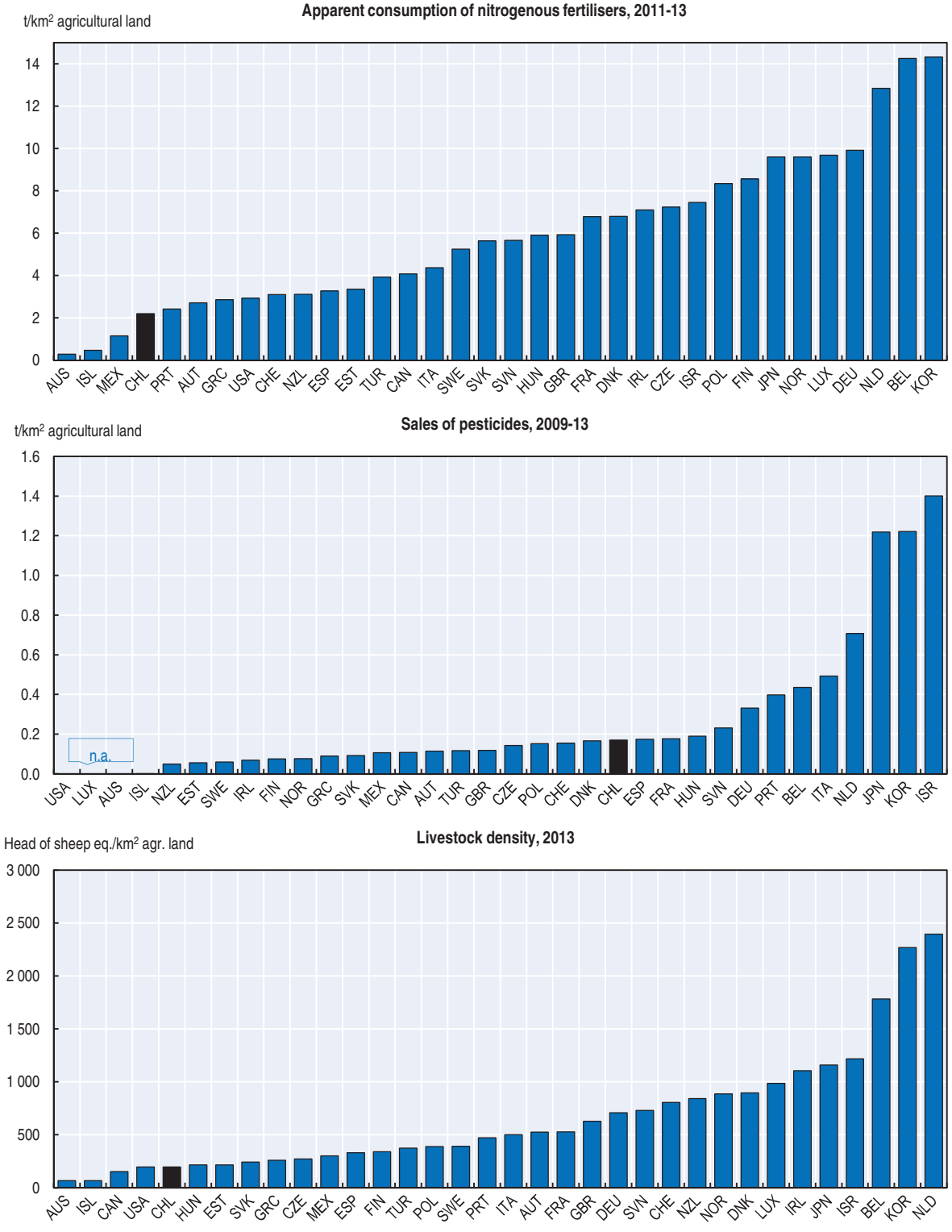
StatLink http://dx.doi.org/10.1787/888933388130

Figure 1.C2. **Material consumption and productivity**

Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
Domestic material consumption (DMC) equals the sum of domestic extraction of raw materials used by an economy and their physical trade balance (imports minus exports of raw materials and manufactured products). DMC productivity designates the amount of GDP generated per unit of materials used and is calculated as the ratio of GDP to domestic material consumption (DMC). GDP at 2010 prices and purchasing power parities.
Non-metallic minerals: domestic extraction and trade of minerals used in industry and construction, plus trade of derived processed products; fossil energy carriers: coal, crude oil, natural gas, peat and traded-derived products; metals: domestic extraction of metal ores, plus trade of metal ores, metal concentrates, refined metals, products mainly made of metals, and scrap; biomass: domestic production from agriculture, forestry and fisheries, plus trade of raw and processed products from these sectors.
Source: EUROSTAT (2015), *Material flows and resource productivity* (database); OECD (2015), "Material resources", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388144

Figure 1.C3. **Agricultural inputs and livestock density**



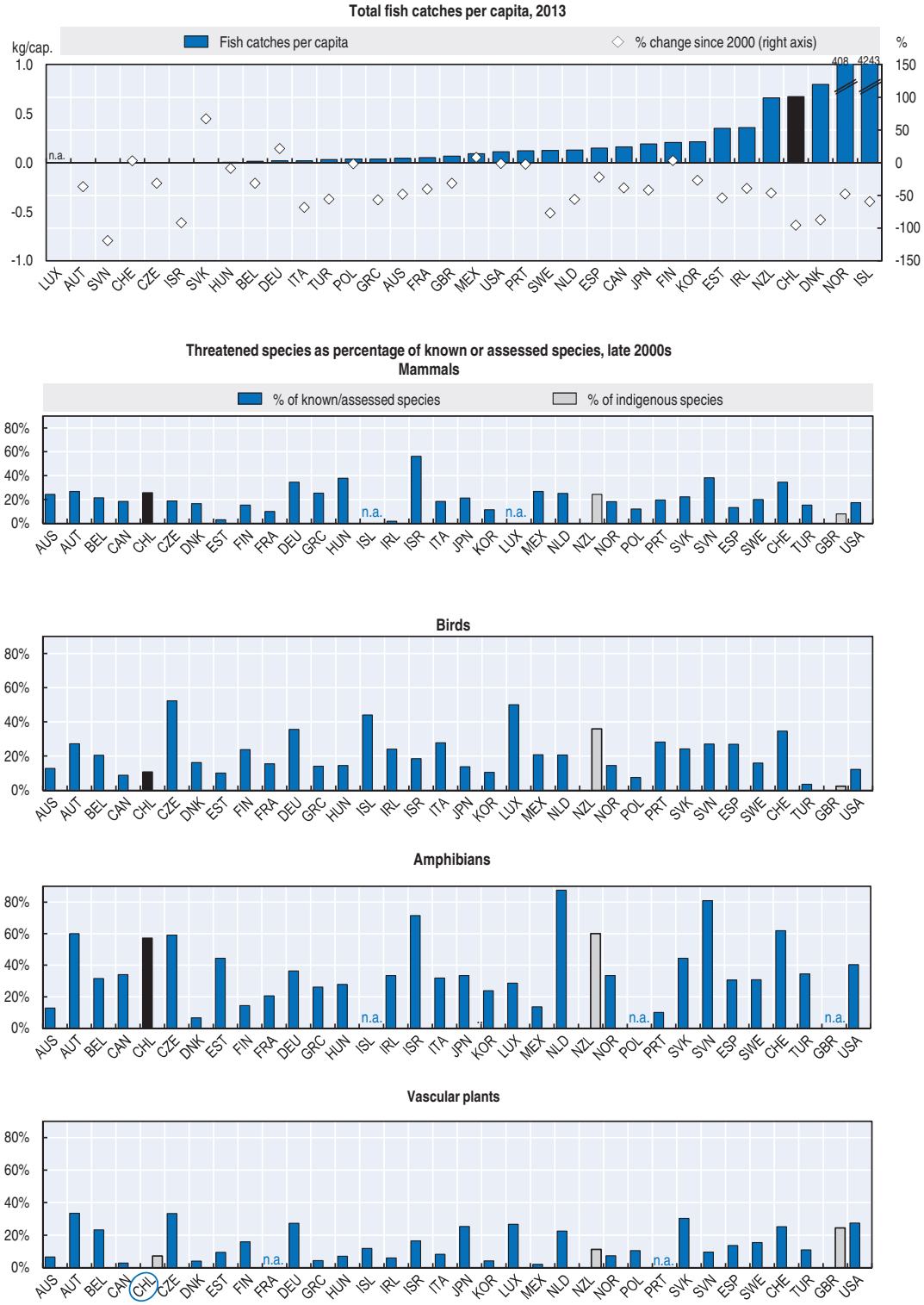
Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
Source: FAO (2015), *FAOSTAT* (database); OECD (2015), "Environmental Performance of Agriculture", *OECD Agriculture Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388157

ANNEX 1.D

Biodiversity and water data

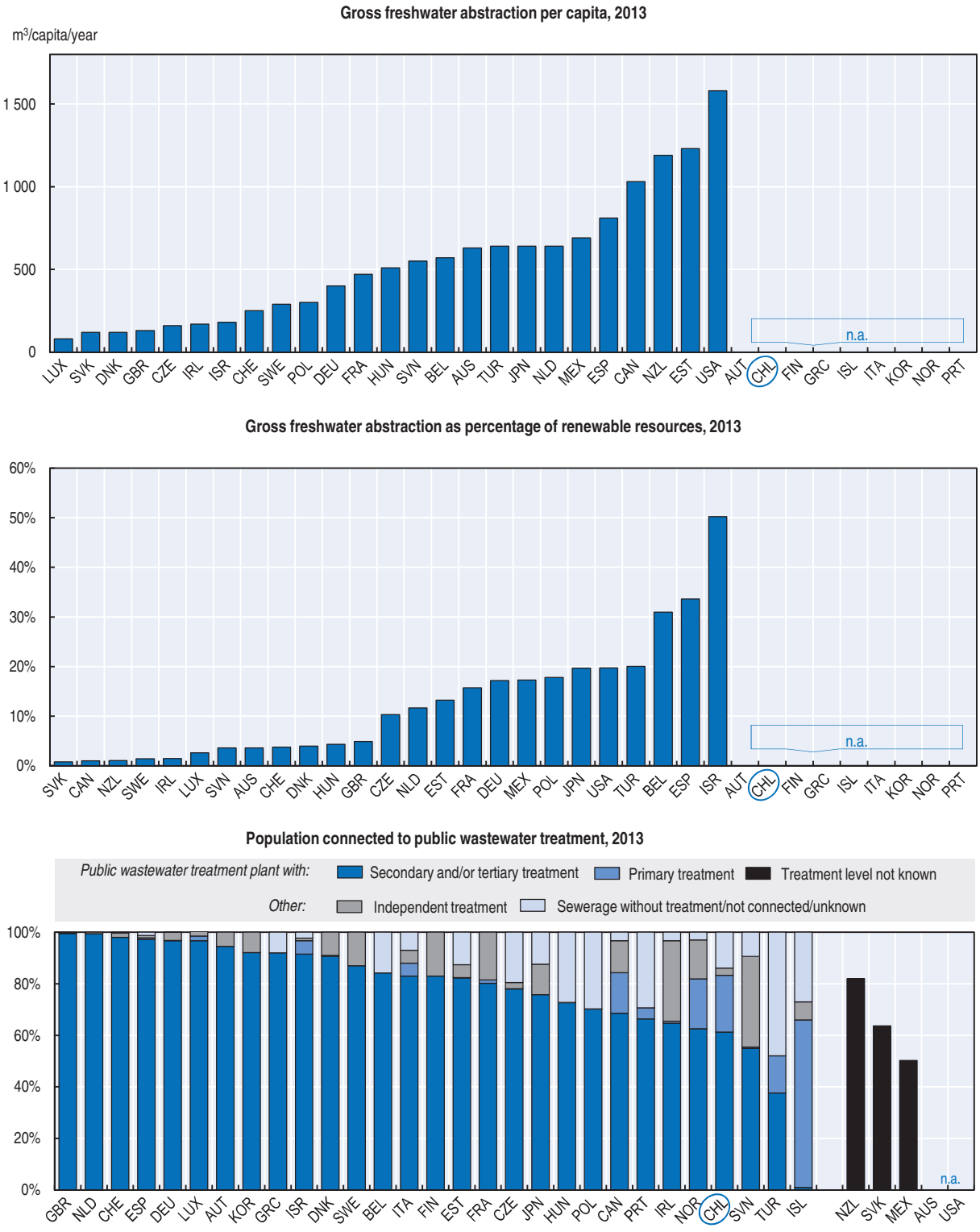
Figure 1.D1. **Fish catches and threatened species**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
Total fish catches: volumes of fish catches in inland waters and marine areas. Excludes marine mammals, crocodiles and alligators, aquatic plants and miscellaneous aquatic products.
Threatened species: IUCN categories critically endangered, endangered and vulnerable in percentage of known or assessed species.
Sources: FAO (2015), *FAOSTAT* (database); OECD (2015), "Threatened species", *OECD Environment Statistics* (database)

StatLink http://dx.doi.org/10.1787/888933388166

Figure 1.D2. **Water abstraction and wastewater treatment**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Freshwater abstraction: for some countries, data refer to water permits and not to actual abstractions. CHL, wastewater treatment: data refer to population living in urban areas served by the sewerage network.

Source: OECD (2015), "Water: Freshwater abstractions", "Wastewater treatment", OECD (2015), *OECD Environment Statistics* (database).

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PART I

Chapter 2

Environmental governance and management

Chile has significantly strengthened its institutional framework for environmental management and reinforced the regulatory framework for pollution control. Insufficient human and technical capacity and persisting socio-environmental tensions, however, generate implementation challenges. This chapter analyses Chile's environmental governance system, including horizontal and vertical co-ordination mechanisms. It reviews the regulatory framework for environmental impact assessment and permitting, and discusses steps taken to improve compliance with environmental law. The chapter also assesses progress in promoting public participation in decision making and access to environmental information, education and justice.

1. Introduction

Following the 2005 *OECD/ECLAC Environmental Performance Review* (EPR), Chile established an environment ministry and distinct agencies responsible for environmental impact assessment and compliance assurance – a major environmental policy achievement of the last ten years. Over the same period, Chile has significantly strengthened its regulatory framework for air and water quality protection, and in recent years has given priority to biodiversity conservation and climate change mitigation.

Chile has the highest income inequality and among the highest poverty rates across OECD member countries (Chapter 1). This makes the issues of environmental governance closely intertwined with social issues, raising their political profile. The need to improve environmental and social justice and address simmering environmental conflicts has largely driven the government's recent environmental institutional reforms and significant advances in enhancing environmental democracy.

While developing new environmental regulations for air, water and waste management, the government also seems to be particularly mindful of the large policy implementation gap. Specifically, it seeks to strengthen environmental compliance assurance, enhance the information base for decision making and build the capacity of young environmental institutions.

2. Institutional framework for environmental governance

Chile has a four-tier government system comprising the national level, 15 regions, 53 provinces and 345 municipalities. Regional and provincial administrations, which depend on the presidency, function as branches of the national government. While they have some territorial planning responsibilities, they play a minor role in environmental management. Municipalities are responsible for land-use planning and water supply, sanitation and solid waste management services. They also play a role in environmental impact assessment (EIA) procedures and in channelling citizen complaints about environmental offences to appropriate enforcement authorities.

2.1. National institutions and horizontal co-ordination

Since its last *OECD/ECLAC Environmental Performance Review* (2005), Chile's institutional framework for environmental governance has undergone significant changes. The 2010 Environmental Quality Law (20.417/2010) replaced the National Environmental Commission (CONAMA) with three institutions that have distinct policy making, environmental assessment and compliance assurance responsibilities to raise the profile and capacity of each of these important functions:[1]

- The Ministry of Environment (MMA) is responsible for policy design, regulatory drafting and information management in all environmental domains and has a strong regional presence (Regional Secretariats).

- The Environmental Assessment Service is a decentralised technical agency under the MMA, based at the regional level, in charge of administering the System of Environmental Impact Assessment (SEIA), including an information system on environmental permits.
- The Environmental Superintendence (SMA) is in charge of compliance monitoring and enforcement with respect to activities and projects that are subject to the SEIA or covered by Pollution Prevention and Decontamination Plans (PPDAs), environmental quality or emission standards.[2]

These institutional changes, recommended by the previous review (OECD/ECLAC, 2005), are expected to be complemented by the establishment of a Biodiversity and Protected Areas Service (Chapter 5). So far, the institutional reform has led to a significant increase of the budget allocation to national environmental authorities: while CONAMA's total budget in 2006 was USD 22.5 million, the combined budget of the MMA and its affiliate bodies in 2011 was USD 61.8 million. Between 2011 and 2015, the budgets of the MMA, the Environmental Assessment Service and the SMA increased (in nominal terms) by another 51%, 31% and 156%, respectively. However, more staff are needed, particularly for the SMA, which currently has a weak inspector presence on the ground (Section 3.3).

The MMA is working to improve its performance management in line with international good practices. It currently tracks six key performance indicators, some of them related to policy outcomes (e.g. incidence of severe air pollution episodes, number of non-attainment areas for air and water quality standards). In addition to reporting on results annually to the Ministry of Finance to justify its budget, it has established a Budget, Planning and Management Control Office in charge of monitoring performance indicators.

With only 22% of the country's environmental expenditures associated with the MMA's responsibilities, many environment-related competences reside with sectoral authorities (CEPAL and MMA, 2015). The General Water Directorate under the Ministry of Public Works plans and manages continental water resources; the General Directorate of the Marine Territory and Merchant Shipping manages marine resources; and the Ministry of Health is responsible for preventing pollution with a potentially negative impact on human health, including regulation of waste management and several aspects of air and water quality and pollution control. Chemicals management responsibilities are shared by many ministries and agencies, principally the Ministries of Environment, Health and Agriculture.

The Council of Ministers for Sustainability, established in 2010, is the main horizontal co-ordination mechanism. It advises the president on sectoral policies, including draft laws and regulations that concern the environment. It is chaired by the Minister of Environment and comprises Ministers of Agriculture, Finance, Health, Economy, Development and Tourism, Energy, Public Works, Housing and Urban Development, Transport and Telecommunications, Mining and Social Development.

There are a number of issue-specific co-ordination committees at the national and, sometimes, regional level. For example, the Committee on Sustainable Consumption and Production under the MMA develops a national programme on these issues (Box 3.1). It is made up of over 50 professionals representing 18 public institutions. The Inter-institutional Committee on Environmental Information (CIIA), which includes representatives of about 50 public agencies and services, is chaired by the MMA. Created in 2012, it establishes guidelines and procedures for the collection and management of environmental information, and validates information provided by various public institutions.

2.2. Sub-national institutions

Municipalities in Chile have little institutional autonomy. For example, they cannot go beyond national environmental standards to take account of more severe local environmental conditions, a practice that exists in many other OECD member countries. They also have very little fiscal autonomy (Chapter 3) and lack financial resources to implement their limited responsibilities for environmental services. The MMA has a statutory obligation to work together with local authorities through collaborative agreements. The Ministry of Finance must approve these agreements if they involve a transfer of funds.

A System of Environmental Certification of Municipalities, created in 2009, is a useful tool for local environmental management capacity building, consistent with existing practices in some OECD member countries.[3] It is a voluntary programme, supported by the national government, to assess the internal and external municipal environmental management. It also promotes local environmental governance through stakeholder co-ordination and community involvement, consistent with the principles of Local Agenda 21. The conditions for certification include:

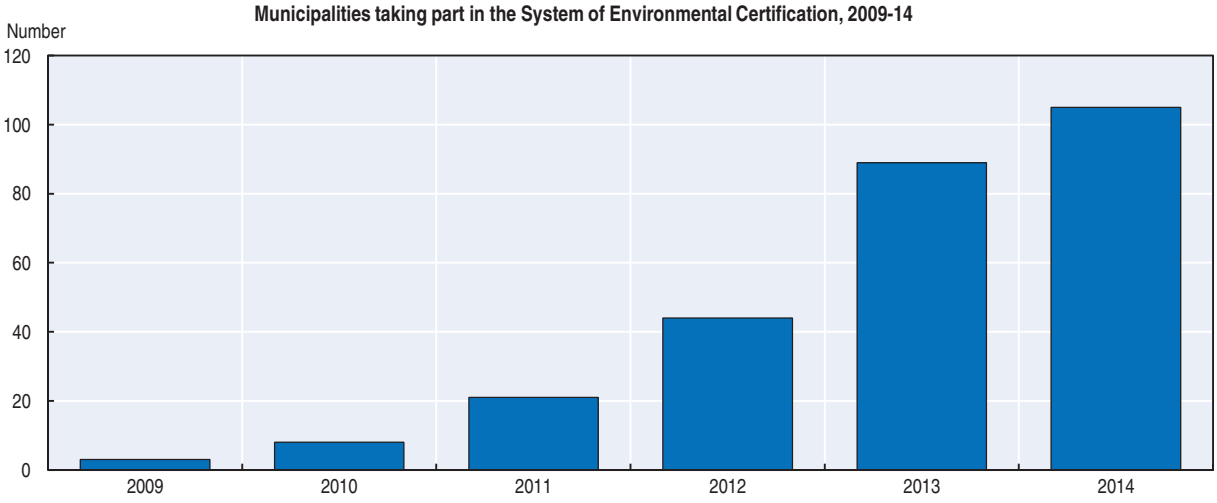
- creation of a municipal environmental committee and/or an environmental unit in the local government
- development of a community environmental strategy
- design and implementation of a mechanism to manage environmental complaints from citizens
- sustainability of local government operations
- regular provision of environmental information to the national government
- citizen participation in local environmental decision making
- strengthened environmental education.

The number of municipalities participating in this programme grew steadily in its first five years of operation (Figure 2.1). As of April 2015, 164 municipalities have entered the system, of which 14 have been certified at the "excellent" level, 42 at the intermediate level and 59 at the basic level (which mostly reflects environmental awareness of municipal employees). Others are still working towards basic-level certification. Chile should build upon this achievement to expand the coverage and the level of environmental engagement of local governments. Initial steps of the programme include funding for personnel in charge of implementing the requirements for the different certification levels.

3. Setting of regulatory requirements

Since 2005, Chile has emphasised environmental regulation, adopting a large number of standards, particularly in the area of air pollution control. The main elements of the environmental regulatory framework are environmental quality standards and sector-specific emission or effluent standards. "Primary" environmental quality standards establish pollutant concentrations based on risk to human health, while "secondary" standards do the same based on risk to ecosystems or economic activity. The national law requires the issuance of PPDAs in all areas where primary environmental quality standards are exceeded (so-called saturated zones) or close to being exceeded (so-called latent zones).[4] PPDAs have been developed for ten areas presenting air pollution problems (mainly from particulate matter), but many are outdated and more are needed. The development of

Figure 2.1. **More municipalities engage in environmental certification**



Source: Ministry of Environment, 2015.

StatLink http://dx.doi.org/10.1787/888933388412

PPDAs for contaminated water bodies is lagging behind (Chapter 1). As mentioned above, local governments in the PPDA area cannot impose more stringent emission or effluent requirements than those stipulated by national norms. Instead, they rely on other instruments to improve air or water quality.

3.1. Standards for environmental quality and pollution releases air quality and emission standards

Over the last decade, Chile has adopted a range of regulatory requirements for air quality protection: a primary quality standard (designed to protect human health) for major pollutants, including fine particulate matter ($PM_{2.5}$), and national emission standards for furnaces, copper smelters and thermal power plants, which are so far the only sectors covered by such standards (Chapter 1).[5] The power plant emission standard is in effect for existing and new installations and has spurred investments in abatement and monitoring technology worth hundreds of millions of dollars. Other emission standards are implemented in the context of PPDAs, but do not have national-scale application. While not prescribing particular technologies, the sectoral emission standards are predominantly based on end-of-pipe pollution control technology references rather than integrated cleaner production process solutions.[6] In Germany and Austria, for example, such standards are closely linked to best available techniques, which minimise cross-media environmental impacts. End-of-pipe solutions tend to be more costly than process-oriented ones and impede innovation in cleaner production. At the same time, Chile has updated its vehicle emission standards, introducing Euro 5 standards for new light duty diesel vehicles in 2012 and for petrol vehicles in 2014. New buses and trucks must meet the Euro 5 standard as of 2014.

The regulatory framework in this policy area remains incomplete. In the absence of emission requirements for many pollutants and categories of stationary sources, Chile is using the "emission compensations" scheme for areas where ambient air quality standards are exceeded. In these cases, an operator of a new emission source in the area must finance the reduction from other sources of the equivalent of 150% of its emissions. For example,

with respect to particulate matter emissions, the commonly used compensation measures are road paving and the creation of green areas. This scheme, applied mostly in the Santiago metropolitan area, appears rather complex in terms of calculating equivalent emission reductions. It is also poorly adapted to situations where air quality standards are not exceeded, as it creates a perverse incentive for establishing new emission sources there. The forthcoming Santiago Respira pollution attainment programme (under public consultation at the time of writing) would limit compensation measures to the same polluting activity (e.g. fuel combustion).

The MMA developed the 2014-18 Atmospheric Pollution Control Strategy to replace the Clean Air Programme of 2010, which foresees the declaration of six new saturated areas and completion of 14 PPDAs (Chapter 1). In planning regulatory improvements for air pollution control, Chile may learn from other OECD member countries, especially European ones. These countries favour bespoke, facility-specific emission limit values for large industrial installations that are inscribed in environmental permits and based on local air quality requirements and best available techniques (often not entailing excessive costs). In their experience, this approach is significantly more economical than emission standards that impose the same requirements on every facility within the sector.

Water quality and effluent standards

Since 2011, Chile has adopted secondary (designed for ecosystem protection) surface water quality standards, mostly for nitrogen and phosphorus compounds (eutrophication being an important problem), but only for four river basins (out of 14 significant ones) and two lake catchments. It is updating cross-sectoral effluent standards for industrial discharges into marine and continental surface waters and groundwater, including new nutrient standards.

However, the effluent standards for discharges into water bodies would be based on the capacity of reference treatment technologies (without prescribing specific ones), but without ensuring that such treatment leads to compliance with quality standards in the receiving water bodies. Chile may benefit from introducing the "combined approach" to setting effluent limit values, stipulated in the European Union's Water Framework Directive and implemented in most EU member states. With this approach, even when complying with technology-based standards, effluents from any point source of pollution should not lead to exceedance of surface water quality standards established to protect the designated use of the receiving water body (fishing, drinking water supply, bathing, etc.).

3.2. Regulatory impact analysis

The 1994 Environmental Basic Law (19.300/1994) requires the MMA to conduct *ex ante* General Economic and Social Analysis (AGIES) of draft environmental regulations. This assessment, which corresponds to regulatory impact analysis in many other OECD member countries, includes an assessment of related benefits and costs. Since 2000, 47 regulations, dealing with environmental quality and emission standards as well as PPDAs, have been analysed. The AGIES-calculated benefit/cost ratio for the 18 regulations and PPDAs assessed since 2011 varied from 0.2 to 6.3; no regulation has been rejected as a result of such analysis.

The methodology for this evaluation has been gradually improving, with a growing emphasis on quantitative analysis. With respect to air quality regulations, AGIES uses parameters of people's exposure to pollutants and of related health impacts and other benefits such as reduced fuel use, congestion and noise to demonstrate the benefits of

government intervention. The analysis covers both compliance costs of the regulated community and administrative costs of regulatory authorities. Where benefits are difficult to quantify, AGIES evaluates cost effectiveness of proposed regulatory measures.

In 2014, the MMA introduced a requirement for *ex post* evaluation of environmental regulations, as well as of environmentally relevant government programmes, every five years. This practice is being tested in the case study of the PPDA for Metropolitan Santiago.

3.3. Environmental impact assessment and permitting

Environmental impact assessment (EIA), introduced by the 1994 Environmental Basic Law, is the oldest, most important and most developed instrument of environmental regulation in Chile. It includes the evaluation and permitting of projects defined by that law as having a potentially significant environmental impact. Since 2010, the Environmental Assessment Service has administered the system.

EIA procedures were further defined in an implementing decree (40/2013, the so-called New Statute for SEIA). An Environmental Evaluation Commission – which includes the Regional Director of Environmental Assessment, the Ministerial Regional Secretary of the Environment and Public Regional Directors with jurisdiction over environmental issues – has been established in each region of the country. Each approved project receives a Resolution of Environmental Qualification (RCA), which is an equivalent of an environmental permit, and a consolidated evaluation report. These are available to the public.

The project proponent determines whether the project should undergo a full EIA, or if a simpler Environmental Impact Declaration (DIA) is sufficient. A DIA describes the activity and indicates applicable requirements and permits, whereas a full EIA requires in-depth analysis of environmental impact and respective mitigation measures. A full EIA is required in the case of a potential risk to public health or the environment; location in or near towns, protected areas or cultural heritage sites; or potential alteration of an area's scenic or tourism value. However, even a full EIA does not thoroughly consider alternative development scenarios. Old, and often highly polluting, facilities that pre-date the 1994 law are not subject to any environmental regulatory requirements.

In 2013, 219 EIAs were conducted and 5 542 DIAs submitted, approximately 4% and 96% of all the procedures, respectively. At the same time, EIA cases corresponded to 40% of the value of investment associated with the evaluated projects, reflecting the effectiveness of the screening procedure. Since 1994, the approval rate has been relatively low – 64% for EIAs and 67% for DIAs – with very little variation across economic sectors. There is, however, a notable tendency to split projects into smaller parcels to avoid triggering the EIA requirement (OECD, 2013).

Public participation is mandatory for a full EIA process. The project proponent must publish a summary of the EIA study with the project's essential details in a local newspaper. Representatives of the public (whether or not directly affected by the project) have 60 days to submit their comments. Municipalities are supposed to ensure community participation in the EIA on development projects proposed on their territory.

The Environmental Evaluation Commission must consider public comments and observations on the EIA (Section 4.3). Under a DIA procedure, the Environmental Assessment Service may, at its discretion, invite public participation if it is requested by at least two citizen organisations or by ten individuals in the affected community. However, since public participation occurs at an advanced stage of project development, where the

consideration of alternative solutions is unlikely, the local community is essentially asked to approve a pre-designed project. As a result, public participation can only affect the prescribed environmental mitigation measures. Individuals and legal entities whose comments in the EIA process were not taken into account may appeal to the Environmental Assessment Service and demand modification of the respective RCA. A Presidential Advisory Committee for the evaluation of the SEIA, established in April 2015, has recommended to introduce public participation at an early stage, before projects undergo formal evaluation, and to extend mandatory public participation to DIAs.

A separate, sector-specific environmental permit from a sectoral competent authority (e.g. a water permit from the DGA, a waste permit from the Ministry of Health) may be required in addition to an RCA. However, it is administered as part of the same procedure based on the single window principle. A sectoral permit may have only environmental content, in which case a favourable RCA authorises all sectoral authorities to grant such permits. Alternatively, it may combine environmental and non-environmental content (e.g. a permit for the building and operation of mine tailings from the Ministry of Mining). In this case, the EIA process verifies the project's conformity to sector-specific environmental requirements.

An RCA prescribes environmental impact mitigation measures, including those related to sector-specific permits. However, to the extent these measures concern the competence of sectoral ministries, the SMA does not monitor compliance with them (even though it imposes non-compliance sanctions in co-ordination with other ministries), which undermines the enforceability of permit conditions. This is different from the systems of other OECD member countries with integrated environmental permitting (notably, EU member states), where both the issuance of, and monitoring compliance with, environmental permits is done on a cross-media basis.

3.4. Land-use planning and strategic environmental assessment

The rapid growth of big cities and the poor management of the land market have led to a gap between urban expansion and infrastructure development, creating social segregation in many areas. Territorial planning generally lacks coherence and mostly reflects sectoral priorities. To address this challenge, the National Policy on Urban Development (2014) emphasised the need to move to integrated territorial planning. This would link land-use decisions with public investment in transport, road infrastructure, water, energy and waste management services (MINVU, 2014). While the National Policy set a target of balancing development and the natural environment, more needs to be done to integrate environmental concerns into land-use planning.

Land-use planning in Chile, which is focused on urban areas, is mostly regulated by the General Law on Urbanism and Construction (1976, with subsequent amendments). It establishes the levels of territorial planning and respective instruments: Ministerial Regional Secretaries of the Ministry of Housing and Urbanism (MINVU) develop Regional Plans of Urban Development (which are indicative rather than binding), as well as Regulatory Inter-communal or Metropolitan Plans. Municipalities prepare Regulatory Communal Plans.

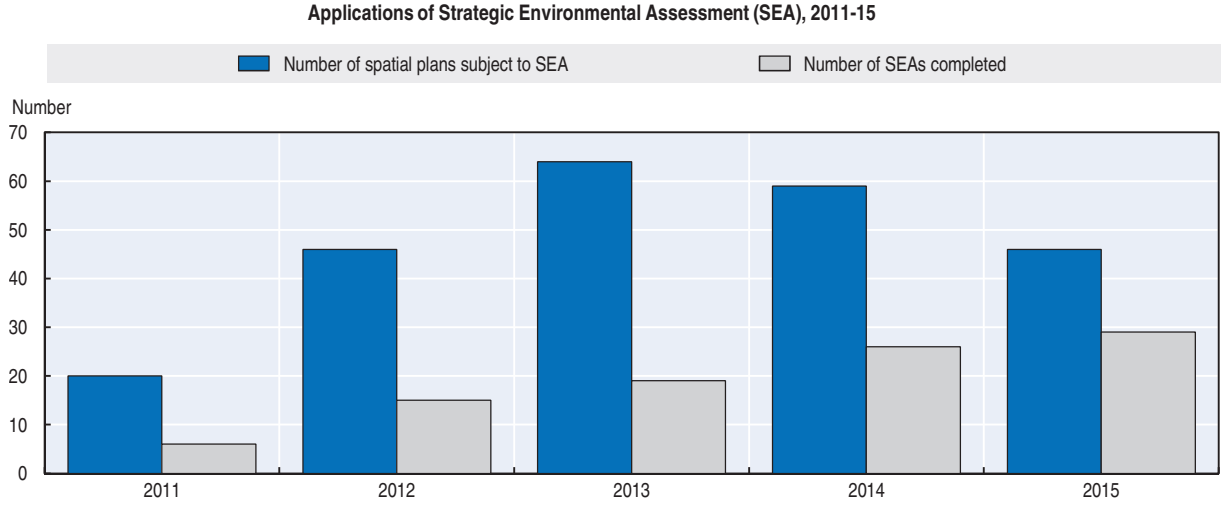
The coverage of territorial planning has increased considerably over the last decade, although it still falls short of the entire country. There are currently 4 regional plans, 19 inter-communal plans and 270 communal plans, while the remaining municipalities are

formulating or approving their plans. However, municipalities do not have real power to make planning decisions on their territory; in many cases, the central government overrules them. In theory, all regulatory plans (inter-communal, metropolitan and communal) are legally binding. In practice, inter-communal and metropolitan plans take precedence over communal ones. Furthermore, the National Policy on Urban Development proposed to give regional governments more powers and resources to manage inter-communal and metropolitan plans.

According to the 2010 Environmental Quality Law, all territorial development plans are subject to strategic environmental assessment (SEA). SEA applies to all land-use plans, as well as other non-environmental regulatory policies and plans as determined by the president upon recommendation of the Council of Ministers for Sustainability (as was the case for the current energy policy). The MMA has developed SEA guidelines for other government agencies. The new Strategic Environmental Assessment Regulation published in November 2015 further addressed four elements in particular: evaluation of regional, inter-communal and municipal land-use plans; coastal zone planning (which should be performed by the MMA); the role of other government authorities; and public participation.

However, contrary to good international practice (represented by the EU Directive on strategic environmental assessment 2001/42/EC), there is no established list of sectoral policies and plans that must undergo SEA. While the application of SEA has substantially increased since 2011, only 95 of 235 spatial plans elaborated in 2011-15 have undergone this assessment (Figure 2.2). In addition, there is little evidence that SEAs have led to any significant modification of land-use plans in terms of better mitigating the environmental problems in urban areas (OECD, 2013). Housing and infrastructure planning remains poorly integrated with public investment in water and waste management services and does not consider nature protection.

Figure 2.2. **Strategic environmental assessment of spatial plans is expanding**



Source: Ministry of Environment, 2015.

StatLink http://dx.doi.org/10.1787/888933388428

4. Compliance assurance

4.1. *Environmental inspections*

The Environmental Superintendence (SMA) is responsible for monitoring compliance with RCAs, PPDAs and environmental quality and emission standards. It currently acts in collaboration with 15 sectoral government bodies, which execute specific inspections on its behalf, albeit the power to apply sanctions is exclusive to the SMA. For example, the 2010 Environmental Quality Law limited the competence of the Sanitary Services Inspectorate (under the Ministry of Public Works) to industrial effluents discharged into a municipal sewerage system and gave the SMA the responsibility for controlling direct industrial wastewater discharges into water bodies.

However, inspection activities even with respect to direct discharges continue to be conducted by the Sanitary Services Inspectorate under an Inspection Delegation and Collaboration Agreement. In 2013, the Sanitary Services Inspectorate inspected about 3 200 industrial facilities discharging into public sewers and over 500 facilities with direct discharges into water bodies. The SMA is supposed to undertake enforcement actions based on the Sanitary Services Inspectorate's protocols on identified violations, but rarely does so due to capacity constraints.

The SMA, which started operations in 2013, is expanding its regional presence. To date, it has established only 6 of 15 regional offices. It administers a National Environmental Surveillance Information System, which includes RCAs, as well as information on all enforcement cases and respective penalties imposed.

In 2014, the SMA conducted 10 840 compliance checks (including 4 272 site inspections) and handled over 1 700 complaints.[7] In 2014, the number of inspections nearly tripled from the year before, when just 1 377 site visits were carried out. This increase reflects the growing political emphasis on compliance monitoring and enforcement. Most inspections were related to different aspects of PPDAs, but only 311 to compliance with RCAs. Almost 70% of inspections were conducted in the Santiago Metropolitan Region where most enterprises are located (SMA, 2015). While some of the site visits are undertaken by the 40 field inspectors (out of 130 staff) of the central SMA office, most are conducted by sectoral competent authorities under above-mentioned delegation agreements.

Outside the SEIA process, the SMA has little control over compliance with environmental regulations issued by sector-specific competent authorities. These authorities have power to monitor compliance in all matters and instruments outside the SMA's jurisdiction, but their budgets for compliance and enforcement activities are generally insufficient. Despite the creation of the SMA, co-ordination of various sectoral enforcement authorities remains too complex and fragmented to conduct coherent compliance assurance efforts. In order to address this institutional fragmentation, a National Environmental Inspection Network (RENFA) was created in 2014 (following the example of Spain and several other EU countries) in order to promote the harmonisation of criteria and procedures for environmental inspections and build capacity of different public bodies undertaking compliance monitoring.

4.2. *Enforcement tools*

The SMA has a range of administrative sanctions at its disposal, including, in escalating severity, a written notice; a fine from 1 to 10 000 "annual tax units" (USD 824 to USD 8.2 million per violation);[8] temporary or permanent shut-down; and revocation of the

RCA. For activities not subject to the SEIA, each sectoral competent authority can apply discretionary fines (subject to limits set out in the relevant legislation), withdraw the respective permit or order the activity to stop. In November 2015, the SMA issued an administrative enforcement policy that makes the fine depend on several aggravating and attenuating factors. It also takes into account the economic benefit incurred as a result of non-compliance. This follows the example of a long-standing practice of the US Environment Protection Agency, which some other OECD member countries such as Israel have also used as a model. There is already a provision that if an offender voluntarily, adequately and promptly reports its violation, the respective sanction may be reduced up to its entire amount.

Chilean criminal law does not contain distinct provisions for environmental violations, an issue of debate for the last ten years. Chile should pursue its plans to establish criminal liability for several categories of severe environmental offences and distinguish clearly between violations subject to administrative and criminal sanctions.

In 2014, the SMA initiated a total of 113 penalty procedures. Three-quarters resulted from an inspection, while complaints from citizens, municipalities or sectoral authorities triggered the rest. According to SMA (2015), 33.5% of complaints referred to noise, and another 11.5% to odour and air pollution. The total value of administrative fines imposed was CLP 9.2 trillion, or USD 16.1 million in 2014. The low number of penalty procedures compared to that of site inspections is primarily due to the fact that the SMA lacks the human resources to prepare more penalty cases that would withstand scrutiny of an environmental court.

4.3. Environmental liability

The Environmental Basic Law defines environmental damage as "any loss, reduction, detriment or significant impairment inflicted on the environment or one or more of its components". Liability for environmental damage is fault-based, i.e. it covers only negligent and wilful actions proven to have caused the damage. In addition, when environmental regulations have been violated, liability for environmental damage is legally presumed. This legal regime diverges from the dominant practice in OECD member countries, where environmental liability is strict (i.e. it does not in most cases require proof of illegal behaviour or negligence of the responsible party), but conforms to the provisions of the OECD Council Recommendation on the application of the polluter pays principle to accidental pollution, which requires the party responsible for the accident to bear the costs of remediating the resulting damage.

The existing environmental liability regime envisages two types of corrective action. First, individuals and entities that have suffered damage or the State Defence Council may file a suit for environmental remediation before an environmental court. Any person may also request the municipal government under whose jurisdiction environmental damage has occurred to file the corresponding remediation suit. However, the municipality is not obliged to heed such requests, especially given the lack of resources to do so. The environmental court may order remediation measures to be carried out at the offender's expense and require periodic reports to monitor compliance.

Alternatively, the directly affected party may file a civil suit for monetary compensation for damage to health and welfare in a court of general jurisdiction.[9] Such suits can be settled through an extra-judicial agreement. The compensation is paid to the

state treasury, but it could be partly earmarked to the community where the damage occurred. In principle, insurance covering civil liability for environmental damage is available. In practice, however, there is no regulation governing its scope and exemptions.

Chile is missing a legal framework for administrative liability for damage to the environment (as represented by the Environmental Liability Directive 2004/35/EC in the EU). Under the Environmental Quality Law, a polluter can file a remediation plan (supported by a technical study) with the SMA and the Environmental Assessment Service as a means of avoiding an environmental damage suit. If the SMA approves the plan, no action can be brought for environmental damage once the polluter executes the plan to the satisfaction of the SMA. However, there have been very few real cases of environmental remediation, showing that the system is not working well in the absence of enforceable legal requirements such as remediation standards.

Remediation of abandoned mine sites

As of 2015, the national mining service (Sernageomin) had catalogued more than 650 abandoned and/or inactive mine sites throughout Chile, including storage facilities (such as tailing dams) mostly in the Atacama and Coquimbo regions. Some are located near communities and cause significant environmental and public health concerns and related social inequalities. However, very few sites have been closed in accordance with modern standards due to the absence of coherent legal requirements (Weeks, 2015).

The 2009 National Policy for the Management of Polluted Sites stipulates different elements, such as their identification, risk assessment, mitigation of negative impacts and monitoring. The remediation of abandoned mine sites containing large amounts of heavy metals is a government priority. The 2012 Mine Closure Law required all new mines to get approval for end-of-life closure plans, and more than 1 300 such plans were presented to Sernageomin in 2012-13 (Box 2.1). However, the Mine Closure Law does not apply to already abandoned mining sites, for which decontamination plans are yet to be developed. In 2015, the ministries of environment and health together with Sernageomin started a process of designing soil quality standards for heavy metals.

A first cadastre of abandoned mining sites was established in 2007, and since 2010 it includes information about tailings deposits. Inventories should be expanded and updated in a systematic manner to improve knowledge and transparency on the location and state of environmental liabilities. Sernageomin has issued non-binding risk evaluation guidelines, and there are plans to develop much-needed standards for heavy metal concentrations in soils. However, there is no specific regulation on the remediation of contaminated areas and no specific agency responsible for the investigation and clean-up of contaminated land. Limited financing of decontamination activities comes from the state budget, but a longer-term funding solution is necessary to address this important issue. One possibility would be to impose decontamination fees on hazardous industrial installations and earmark the revenue for a fund to clean up past land and water pollution.

4.4. Promotion of compliance and green practices

Government promotion of compliance can reduce costs for businesses by allowing them to achieve and maintain compliance as efficiently as possible. It may also reduce regulatory costs by increasing the efficiency of compliance monitoring and enforcement.

Box 2.1. **Legal framework and financing challenges for mine closure**

The 2012 Mine Closure Law (20.551/2012) had an explicit objective of preventing the creation of abandoned mine sites in the future. It required mining companies to provide financial guarantees for each operation and develop detailed mine closure plans to regulate the physical and chemical stability of mine sites. This mechanism is supposed to generate sufficient funds to execute site closure should the operator default on its decommissioning obligations specified in its RCA. The first phase of the law's implementation affected every mine over a minimum size threshold with an approved closure plan. These companies had to provide, by November 2014, a cost estimate that took into account remaining mine life and a discount rate based on a state-provided index. Once Sernageomin approved the estimate, the mining company had to provide a guarantee for the amount, using one of the approved financial instruments.

Initially, only 20% of the present value is required to be guaranteed. The amount gradually increases over 15 years (or two-thirds of the remaining mine life, whichever is shorter) to the full present value of closure costs. The law allows for partial reductions of the guarantee. The total amount to be guaranteed is estimated to be well over USD 30 billion. It is unclear how well these requirements will be applied in practice in the absence of an enforcement mechanism.

There have been a few positive cases of mine closure, but the financing arrangements varied. The locally owned Lo Aguirre copper mine site just west of Santiago was closed in 2008 based on a voluntary closure plan presented in 2000. Lacking the resources of international mining companies, the closure works were self-financed, largely through the sale of scrap generated in closure activities and the sale of copper obtained through reprocessing of select wastes.

Source: Weeks, 2015.

Compliance promotion is particularly effective when targeted at the small and medium-sized enterprise (SME) community. Lack of knowledge and capacity, along with cultural resistance to enforcement, are the primary reasons for non-compliance among SMEs (Mazur, 2012). So far, Chilean environmental authorities have not given compliance promotion the attention it deserves.

Clean production agreements

Decree 156 of 2007 established a National Clean Production Policy and a Council for Clean Production (CPL) under the Ministry of Economy. It also strengthened the framework for Clean Production Agreements (APLs), which were first put in place in the late 1990s. In an APL, enterprises and a competent government authority set specific targets and actions to foster clean production, including the use of best available techniques (BAT), that go beyond the minimum legal requirements. BAT are suggested as part of an APL, but are not mandatory.

Since 1999, 100 four-year-long APLs have been signed with different production sectors. They have engaged about 6 000 enterprises, two-thirds of which are from the agricultural sector. APLs can also be territorial, addressing complex environmental problems that go beyond a single industrial sector. In 2011, for example, a territorial APL was concluded for the industrial zone of Puchuncaví-Quintero in the Region of Valparaíso. Between 2005 and 2014, the number of enterprises covered by APLs increased from just

over 150 to over 1 600 (Government of Chile, 2013). APLs receive modest co-financing from the budget, amounting to USD 4.7 million between 2006 and 2014. The most recent APLs include provisions to evaluate their results, including economic benefits accrued by businesses themselves. While there are positive projections of how APLs can reduce greenhouse gas emissions (18.4 million tonnes by 2020; see Chapter 4), the overall environmental effectiveness of these agreements is difficult to evaluate.

The National Clean Production Policy (2010) set an objective of promoting cleaner production practices in the public and private sectors to modernise production processes and increase competitiveness of domestic producers. Similarly, the "Clean Production Agenda 2014-18: Alignments for a National Policy" interprets cleaner production as an economic development strategy that emphasises environmental and social opportunities as drivers for increased productivity. It sets, among others, the following targets focusing on SMEs:

- Involve at least 4 000 new companies, mostly SMEs, into APLs.
- Promote clean production practices in micro-enterprises through training and information dissemination.
- Design mechanisms of financial support for adoption of cleaner technologies by enterprises, in addition to the funds made available through the Economic Development Agency (CORFO) – a public agency promoting increased competitiveness of Chilean industry, particularly SMEs.
- Create a new framework for agreements between companies and their communities to promote socio-environmental responsibility.

Corporate social responsibility

In addition to APLs, corporate social responsibility has become increasingly important in Chile, especially in mining, agriculture and tourism. The Ministry of Economy, Development and Tourism created a Social Responsibility for Sustainable Development Council in 2013. Some large mining companies (such as CODELCO, Chile's state-owned copper company) have established rigorous voluntary environmental and community standards.

In 2013, the MINVU adopted a Sustainable Construction Code – a good practice guide for the construction industry targeting such issues as material use efficiency and waste management. The National Tourism Service has developed a "Chile for Sustainable Tourism: Best Practices Manual" (2012) and launched a Seal of Distinction system to recognise tourism companies' efforts in the field of sustainability (although the level of adherence to these green practice guides is unclear). Such initiatives are similar to those successfully implemented in other OECD member countries such as the "Small Environmental Guide for Construction Workers" in Scotland and Ireland's Green Hospitality Programme (Mazur, 2012). The relevant government authorities in Chile would benefit from other countries' experience in terms of engaging business associations in disseminating and promoting green practices.

Greening public procurement

Chile has also followed best practices in other OECD member countries by introducing environmental considerations into its public procurement policies. In 2012, ChileCompra – an agency under the Ministry of the Treasury that operates the country's public procurement

system – published a Sustainable Purchasing Policy. It also changed the 2004 Procurement Regulations, allowing government bodies to assign additional points in bidding processes in accordance with environmental and social criteria (although the criteria themselves have not been defined to date). ChileCompra and the MMA jointly developed and published a Sustainable Purchasing Manual in 2014. Plans are underway to train over 10 000 public procurement officials across the country on this new policy.

According to ChileCompra, 36% of public procurement orders in 2014 included some kind of sustainability criteria, compared to just 2.7% in 2009 (Government of Chile, 2013). Green public procurement can play a significant role in creating or boosting consumer demand for green products and services, particularly where public purchases represent a large share of the market (e.g. construction, health services and public transport). The national market for environmental goods and services reached 1.7% of GDP in 2010 and is developing rapidly (Chapter 3).

Eco-labelling schemes

Chile has no policies or legal instruments related to eco-labelling. There are, however, several initiatives to identify environmentally preferred products. These include the National System of Agricultural Organic Products Certification, which was created in 2006, and the Technical Standard DS No. 17/2007 (UNEP, 2011).

Chile has taken initial steps at eco-labelling that can enable producers to harness consumer demand for environmentally friendly goods. The country uses several international eco-labels, as well as several independent eco-labels, but the latter lack the recognition of a single agency and tend to confuse consumers. For example, Certfor is a voluntary label of the Chilean Sustainable Forest Management Certification System administered by the National Institute of Standardisation. However, it co-exists with other sustainable forestry labels such as the local *Marcha Blanca* and *Sello Verde* and the international label of the Forest Stewardship Council (Chapter 5). The forthcoming Framework Waste Law is expected to give the MMA authority for product certification and labelling.

Environmental management system certifications

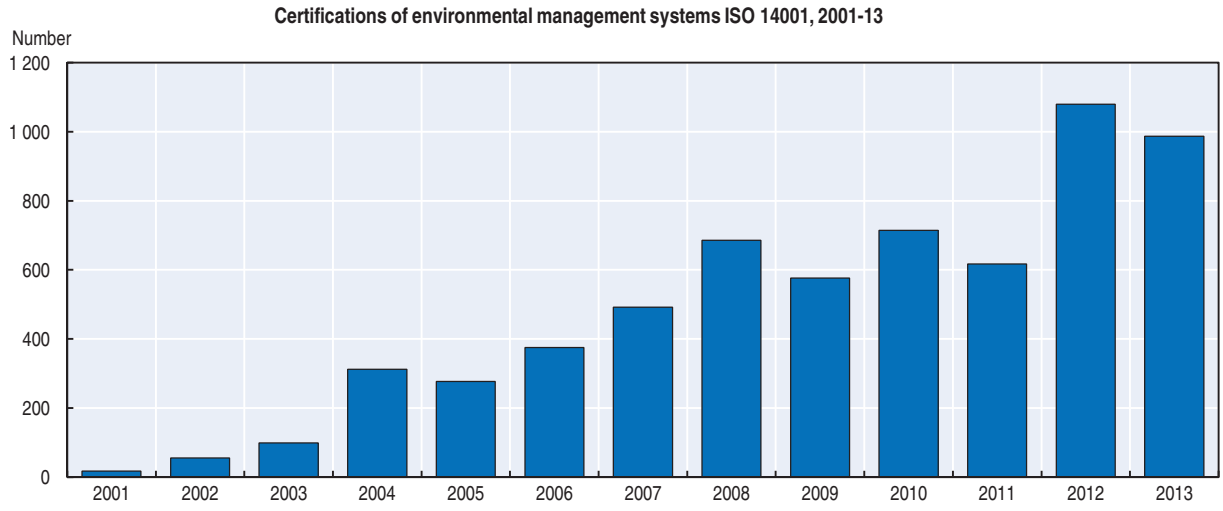
The number of ISO 14001 environmental management system (EMS) certifications increased more than three-fold between 2005 and 2013 (Figure 2.3). While the government does not provide any regulatory or financial incentives for EMS certification, this growth has been fuelled by supply chain pressure, mainly in Chilean exporting industries. Such progress in corporate environmental management is an important factor in improving compliance and adopting more resource-efficient production practices.

At the same time, there is a big capacity gap preventing the business community from meeting and going beyond environmental requirements. This concerns SMEs in particular, which do not have the knowledge and skills to stay abreast of, and comply with, relevant regulations. There is a need to improve training in these areas, as Chapter 3 discusses.

5. Promoting environmental democracy

EJOLT (2014) ranked Chile ninth among 76 countries in the world, and fourth in South America, with respect to the number of environmental conflicts. These relate to a wide range of issues such as land acquisition, access to water, industrial and mining sites, exposure to pollution, and are particularly intense with some indigenous communities

Figure 2.3. **Rapid growth in new ISO 14001 EMS certifications in Chile**



Source: ISO (2015), *ISO Survey 2013* (database).

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(e.g. in the Mapuche territory in Southern Chile). Non-governmental organisations (NGOs) have been increasingly vocal in their opposition to development. According to the first National Survey on the Environment, conducted in 2014, slightly more than a third of Chileans think the government is doing its best to protect the environment, or that environmental regulations are sufficiently stringent (MMA, 2015a). All this makes the effectiveness of environmental democracy mechanisms particularly important.

Since 2005, Chile has implemented the previous OECD/ECLAC review's recommendations to improve access to environmental information, enhance public participation and strengthen environmental education (Annex A; OECD/ECLAC, 2005). According to the Environmental Democracy Index (WRI, 2015), Chile ranks 24th in the world on the basis of a composite indicator which factors in public participation, transparency and access to justice considerations. Chile scores well on transparency and access to justice mainly due, respectively, to the public's clear right to access environmental information and the legal provisions for the review of administrative decisions related to the environment. Chile has a lower score on public participation, which often intervenes too late in the decision-making process (Section 3.3).

5.1. Public participation in environmental decision making

The MMA has been using different mechanisms for public participation in the design of policy instruments (e.g. environmental quality and emission standards), EIA (Section 3.3) and SEA (Section 3.4), development of PPDAs and wildlife conservation initiatives. NGOs and representatives of business and academia also have an opportunity to participate in environmental rule-making through the Advisory Council at the MMA and in the review of compliance assurance activities via the Civil Society Council at the SMA. In accordance with the 2011 Law on Associations and Citizen Participation in Public Management (20.500/2011) and several respective presidential guidelines, many environmental regulations now specify procedures for public participation. However, issue-specific permitting, which is not part of the EIA process, is not open to public participation.

In addition, the formation of Councils for Environmental and Social Recovery is envisaged for "environmentally vulnerable territories" faced with severe environmental degradation. The MMA would lead the multi-stakeholder council (with broad participation of the local public), which would propose time-bound measures to address the community's socio-environmental challenges. Such councils were established in Quintero and Puchuncavi communes in 2014, and three more are planned for 2015. At the same time, while Chile ratified in 2009 Convention 169 of the United Nations International Labour Organization that states that indigenous communities should be consulted prior to development processes that will affect them, there is no effective mechanism for addressing special rights of indigenous communities.

The Environmental Protection Fund, operated since 1998 by the MMA, has been supporting environmental projects implemented by NGOs and other non-profit institutions. It is the only public environmental fund in Chile. More than three-quarters of its funding (CLP 12 billion) have gone to community organisations. Since 2011, the fund's disbursement is focused on four areas: local environmental management, information and research, networking and indigenous communities.

5.2. Access to environmental information

Since 2005, Chile has greatly enhanced both the availability of, and access to, environmental information. Both the 2009 Transparency Law (20.285/2009) on access to administrative documents and the Environmental Quality Law provide guarantees of access to environmental data. Refusals of access to information can be appealed in court. Chile also leads the work to conclude a wide-ranging regional agreement on access to information, public participation and justice on environmental matters in Latin America and the Caribbean.

In recent years, the MMA has been actively consolidating and improving the National Environmental Information System (SINIA), which consists of databases (cartographic, graphic, documentary, legal, etc.) and procedures for managing environmental information. SINIA makes environmental indicators and statistics available to the public through its website. It also allows any person to access geo-referenced information on environmental quality and impacts. To enhance stakeholder collaboration on these issues, the MMA created in 2012 an Inter-Ministerial Committee on Environmental Information. The committee, which meets up to four times a year, brings together more than 50 public agencies with competence over environmental matters.

The National Institute of Statistics (INE) has been publishing an Environmental Statistics Yearbook since 1996. In addition, the Environmental Quality Law obliges the MMA to prepare state of the environment reports every four years (since 2012) and annually (since 2014). The annual report, a shorter document covering 71 national and regional indicators, shows trends on various environmental issues. About one-third of these indicators characterise environmental outcomes. A National Environmental Accounts Plan is expected to be developed in 2016. Feasibility studies of Environmental Satellite Accounts have recommended gradual implementation, starting with those areas where Chile has most experience (forestry and mining), followed by water, land and ecosystems accounts.

The MMA has also been upgrading the PRTR. The register, created in 2002, consists of a database on pollutant releases into air, water and soil, as well as waste generation and disposal. It also includes data on compliance with environmental regulations. The recent

(2013) regulation concerning PRTR created a one-window system for reporting relevant data, which now covers over 20 000 facilities reporting on 132 pollutants. The National Information System on Waste (SINADER), which covers generation and disposal of all non-hazardous waste, was introduced in 2013 as part of the PRTR system. From 2015, all producers and recipients of waste (hazardous and non-hazardous) have the obligation to report to national registries, linked to the PRTR. In an innovative practice to allow data verification, the PRTR has been connected to the tax agency's database to correlate pollution release and production information. The PRTR is used to generate periodic reports on local environmental impacts.

While Chile has created systems for managing environmental information, serious issues remain with respect to coverage and completeness. For example, little information is available on water abstraction and use, and almost none on biodiversity protection and negative impacts on ecosystems. Air and water quality monitoring stations often collect data on only a few parameters. As a result, Chile has difficulties in providing environmental statistics under international conventions and to international organisations such as the OECD.

5.3. *Access to justice*

The 2012 Law on Environmental Courts (20.600/2012) substantially enhanced access to environmental justice. Currently, the court in Santiago is handling cases from the central and northern parts of Chile, while the court in Valdivia has jurisdiction over the southern region. In creating these courts, Chile followed the example of the Environmental Appeals Board in the United States.

An environmental court is independent, but a Court of Appeals or the Supreme Court can overturn its decisions on appeal. Each environmental court is staffed by three judges: two lawyers and one environmental scientist, increasing the technical level of environmental rulings. Hearings are open to the public and broadcast live on the internet. However, ordinary civil courts will continue to hear constitutional actions based on the right to live in an unpolluted environment. This provision may lead to parallel actions in both courts regarding the same project.

The Law on Environmental Courts stipulates the right to sue against environmental standards, EIA decisions (Box 2.2) and SMA enforcement actions, as well as to seek environmental remediation measures. The Santiago court handled 133 cases over 2013-15, the majority of which dealt with EIA. Any physical or legal person can file a claim against a regulatory decision, while only victims of environmental damage, affected municipalities or the state (through the State Defence Council) have legal standing to demand environmental remediation. Chilean law also provides for administrative or judicial review of the implementation of most environment-related laws and regulations.

The high number of environment-related court actions demonstrates that civil society has access to justice in Chile. However, citizens and NGOs often face a major barrier in the unaffordable cost of legal expertise, especially in damage-related cases. Although the Constitution requires that legal services be provided to those who cannot afford them, there are few measures to reduce such financial barriers. Studies show that Chilean citizens have very little trust in their country's judicial system: according to a 2013 Gallup poll, Chile is the OECD member country with the lowest level of public confidence in the judiciary: 19% of respondents stated they had confidence in the judiciary, compared to the average of 35% in Latin America and the Caribbean and 50% globally (Gallup, 2014).

Box 2.2. **Citizen suits against environmental permits**

There have been several recent cases of RCAs for mining, energy and industrial projects revoked by a court as a result of citizen suits filed based on the constitutional right to live in an unpolluted environment.

In a high-profile decision, the Supreme Court accepted a constitutional action and invalidated the RCA of El Morro, Goldcorps mining project. It ordered a new consultation with the indigenous community as part of the EIA process. The Supreme Court stated that while the competent authority for these kinds of matters is the environmental court, it decided to adjudicate the case based on an urgent need to protect constitutional rights.

The Supreme Court also accepted a civil suit against the construction of a tailings pond of Los Pelambres, Antofagasta Minerals' mining project because its construction was harming surrounding communities. Although the tailings pond had undergone an EIA, the Supreme Court evoked the precautionary principle: where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason to postpone action to prevent environmental degradation.

In a similar case, the Supreme Court rejected constitutional action filed against the RCA for Punta Alcalde, ENDESA's power generation project. However, it required several mitigation measures that were not considered during the EIA process.

Source: Eyzaguirre, 2015.

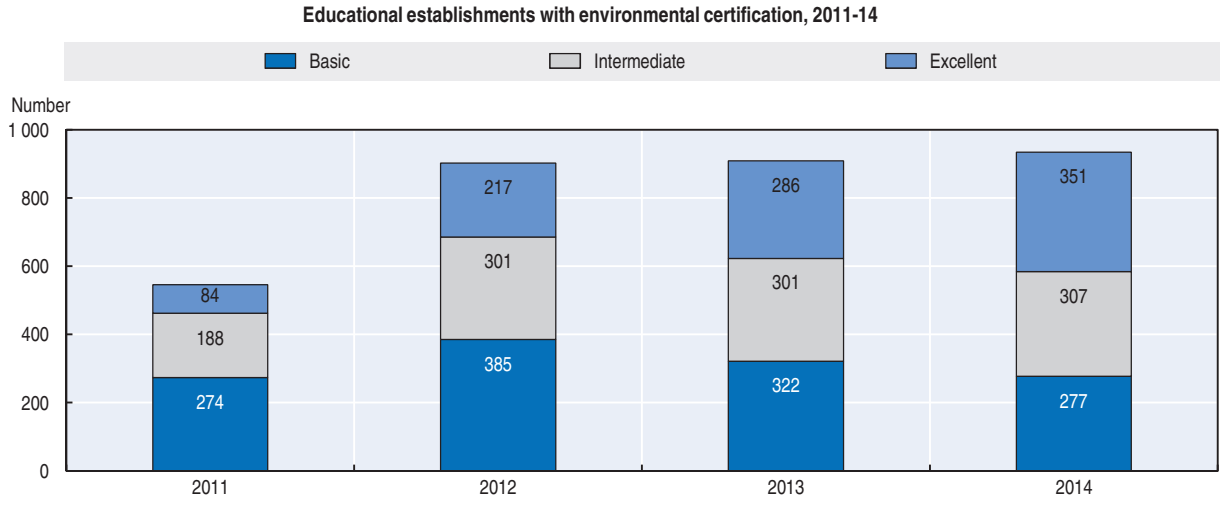
5.4. *Environmental education and awareness*

Over the last decade, Chile's education system has increasingly incorporated environmental considerations. The 2009 General Law on Education (20.370/2009) stipulated that the education system should encourage respect for the environment and promote sustainability. The National Education Policy for Sustainable Development (2009) has led to the creation of several initiatives to address environmental education and awareness in the country.

One such initiative was the creation of a National System of Environmental Certification of Educational Establishments (SNCAE). This voluntary programme for all establishments accredited by the Ministry of Education is administered jointly with the MMA and the National Forestry Corporation (CONAF). SNCAE has three levels of certification: basic, intermediate and excellent. The certification is based on self-assessment matrices developed for early childhood education, primary and secondary schools, focusing on three areas: curriculum, environmental management and community relations. Between 2011 and 2014, the number of certified educational establishments increased from 546 to 935, and the share of the "excellent" grade grew significantly to over one-third of all certifications (Figure 2.4).

The MMA has also established an Environmental Creators Club to promote interaction among different stakeholders in the government, business and civil society, as well as socio-environmental initiatives. However, environmental curricula quickly become outdated; the government's environmental education efforts are falling behind the rapid developments in the environmental policy arena. More outreach is needed to enable various non-government actors to contribute meaningfully to environmental policy making. The Ministry of Education should become a member of the Council of Ministers for Sustainability and take a more active role in facilitating these efforts.

Figure 2.4. **Growing environmental excellence of educational establishments**



Source: MMA (2015), "Listado de establecimientos educacionales con certificación vigente a febrero de 2015".

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Overall, the Chilean public is acutely aware of environmental issues: two-thirds of the population are concerned or very concerned about environmental problems (UNAB-IPSOS, 2012), mainly about air and noise pollution and urban waste (Figure 1.5). Chile conducted its first National Survey on the Environment in 2014. According to the survey, most Chileans (85%) believe that environmental protection yields social benefits. While more environmental information has become available and accessible over the past decade (Section 5.2), the majority of Chileans (66%) still believe more could be done to promote environmental education (MMA, 2015a).

Recommendations on environmental governance and management

Regulatory framework

- Develop and implement a coherent policy for regulating pollution releases into air and water from stationary sources, including technique-based emission/effluent limit values for large, high-risk industrial installations and sector-specific emission and effluent standards for facilities with lower environmental impact.
- Improve the EIA process to ensure it includes meaningful consideration of project alternatives, guarantees public participation in its early stages and takes better account of potential environmental impacts, particularly on ecosystems.
- Enhance the practical application of SEA to territorial development plans and ensure the implementation of relevant mitigation measures; better integrate housing and infrastructure planning with public investment in water and waste management services, and nature protection; empower municipalities to take more control over local territorial planning by reinforcing the role of Regulatory Communal Plans.

Compliance assurance

- Harmonise environmental compliance and enforcement policies across various national competent authorities and ensure the involvement of SMA inspectors in assuring compliance with sector-specific environmental permits; increase the enforcement capacity of the SMA; consider introducing criminal penalties for egregious environmental offences.

Recommendations on environmental governance and management *(cont.)*

- Introduce a strict liability regime for future damage to water bodies, land, species and ecosystems; develop and implement environmental remediation standards and plans, particularly for soil contamination with heavy metals; empower the SMA to enforce liability provisions through administrative actions.
- Maintain and frequently update risk assessment inventories of abandoned contaminated sites; establish a financial instrument to impose decontamination fees on hazardous industrial installations and mines, and earmark the revenue to constitute a fund to be used for clean-up of past land and water pollution.
- Upscale efforts to monitor and control the resource use (e.g. energy, water) and environmental impacts generated by medium- and small-scale mining industries, and support the adoption of new processes and technology to increase their efficiency and safety.

Environmental democracy

- Strengthen the information base to support environmental decision making by expanding data collection and management with respect to water allocation, abstraction and quality, air pollution, biodiversity protection, etc., and make this information available to the public, as well as to international bodies.

Notes

1. This type of arrangement also exists in several other OECD member countries. For example, environmental assessment is performed by an independent agency in Finland, while the Netherlands has an independent environmental inspectorate.
2. For projects or activities that are not subject to the SEIA, the competent sectoral government authority is in charge of enforcing environmental legislation.
3. For example, a number of cities in France and Sweden have obtained certification in accordance with the ISO 14001 environmental management systems standard.
4. Saturated zones are the equivalent of "non-attainment areas" in the United States. Latent zones are declared where 80% of the environmental quality standards are exceeded.
5. National emission standards for thermoelectric power plants were established in 2011 (covering SO_x, NO_x, PM and mercury); and for copper smelters in 2013 (covering SO_x and arsenic emission).
6. For example, the emission standards for copper smelters require that new foundries achieve a 98%-capture rate for SO_x and existing smelters 95% (SO_x can be captured and converted into sulphuric acid, which is used in various industrial processes). This compares with an average capture level of about 90% in 2010, the same level as in 2001 and significantly below that found in West-European countries and Japan (University of Chile, 2013). These standards aim to achieve a 53% reduction in SO_x emissions by 2018, compared to the 2007-11 average.
7. Municipalities are responsible for collecting citizen complaints about potential environmental offences and reporting them to the SMA.
8. The monthly tax unit and annual tax unit (or UTM and UTA, respectively) are indexed account units used in Chile for the payment of taxes and fines. Their value is adjusted monthly for inflation. As of December 2015, a UTM was 44 955 CLP and a UTA was 539 460 CLP.
9. Civil liability for damage from oil spills and releases of other harmful substances into the marine environment is governed by the 1978 Navigation Act.

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PART I

Chapter 3

Towards green growth

An export-oriented and natural-resource based economy, Chile experienced strong economic growth for most of the 2000-15 period. The national Green Growth Strategy is being revamped with a view to better balancing economic, environmental and equity considerations. This chapter presents Chile's progress in using economic and tax policies to pursue environmental objectives. It analyses public and private investment in environment-related and low-carbon infrastructure, and reviews the promotion of environmental technologies, goods and services as a source of economic growth and jobs. The role of Chile as both a recipient and provider of environment-focused development assistance is also discussed.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Introduction

Chile is an open and export-oriented economy. It has experienced a long period of strong economic growth, which has helped reduce poverty and improve the well-being of its citizens, although income distribution remains highly unequal (Figure 1.3). Gross domestic product (GDP) increased by almost 80% between 2000 and 2014, with an annual average growth rate of 4.6%, well above the average of the OECD or Latin American countries (Figure 1.1).

As the world's largest copper producer and exporter, Chile has benefited from the commodities boom of the 2000s. Growing investment in the mining sector has generated large economic spill-over effects to other sectors, in particular construction.[1] This, together with a construction boom following the 2010 earthquake, has helped the economy to recover quickly from the 2009 global economic crisis.[2] However, declining raw material prices and lower external demand, notably from the People's Republic of China (hereafter China), have discouraged investment in mining and resulted in a sharp decline in GDP growth to around 2% in 2014/15. The unemployment rate declined to a record low of 5.9% in 2013, but has been on the rise since (OECD, 2015a).

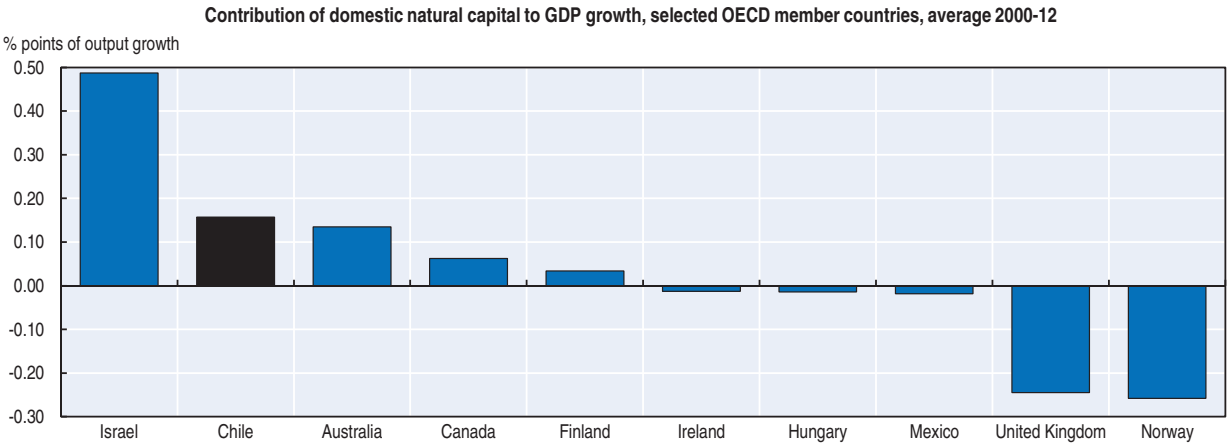
Chile's macroeconomic performance has traditionally been strong, characterised by tight monetary policies and a generally balanced fiscal position, guided by a fiscal rule linking public spending to long-term government revenue.[3] In 2013/14, both the fiscal deficit and general government debt were significantly below the respective OECD averages (see Basic Statistics). This gave the government some room to implement a strong fiscal stimulus in 2015 (OECD, 2015a).[4] GDP grew by 2.2% in 2015 and is expected to accelerate to 2.6% in 2016; however, it will remain below the pre-2014 boom years (OECD, 2015a; EIU, 2015).

Natural resources have been a key driver of growth. Mining, mostly of copper, contributed to 11% of GDP in 2014 (Figure 1.2). Chile is also a major exporter of agricultural goods (notably fish, fruits and wine) and forest products (wood pulp). Forestry contributed 5.2% to national exports in 2013, the third highest value in the OECD after Finland and Sweden (OECD, 2015b). Overall, agriculture, forestry and fishery contributed to 3% of GDP in 2014 (Figure 1.2).

OECD (2016) estimated that the extraction of natural capital contributed nearly 0.2 percentage points to Chile's GDP growth over 2000-12. This is the second highest value in the OECD and stands in contrast to most other OECD member countries, where natural resource extraction explains only a very small portion of output growth (Figure 3.1). Chile relies mainly on extraction of copper (58%), iron (35%) and gold (8%) to generate income from natural capital.

The strong reliance on natural resources, along with urbanisation and rising living standards, has increased environmental pressures, including air pollution, loss of native forests and sensitive habitats, soil erosion, and soil and water contamination. OECD (2016) estimated that if the growth accounting framework considered greenhouse gas (GHG)

Figure 3.1. **Domestic natural capital largely contributes to Chile's growth**



Note: The measured contribution of natural capital to output growth provides a lower bound to the contribution of the natural resources extraction industry. The contribution of the extraction industry to output growth is greater because it also includes investment in produced capital and labour force. The chart compares the five countries at the top and at the bottom of the range.
Source: OECD (2016), *Environmentally Adjusted Multifactor Productivity: methodology and empirical results for OECD and G20 countries* (forthcoming).

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emissions, Chile's GDP growth between 2000 and 2012 would be lower by nearly 0.03 percentage points. This may suggest the country has achieved economic growth at the expense of environmental quality. For most other OECD member countries, accounting for GHG emission abatement leads to an upward adjustment of their economic performance.

The *OECD Economic Survey of Chile* recommends that Chile further reduce its dependence on natural resources, increasing its knowledge-based contribution to global value chains and boosting productivity, which has been close to zero for much of the past decade (OECD, 2015a). Advancing the 2014 Growth, Innovation and Productivity Agenda, which is meant to broaden the base of the economy, is hence essential. Structural reforms to open the market further to competition will be particularly important to boost investment outside the mining sectors, increasing growth and making it more inclusive and environmentally sustainable.

2. A framework for green growth initiatives

Chile has improved the institutional set-up of its environmental policies with, for example, the creation of a Council of Ministers for Sustainability (Chapter 2). In 2013, Chile launched a Green Growth Strategy, jointly developed by the Ministry of Finance and Ministry of Environment (MMA). In line with the 2009 OECD Declaration on Green Growth, the strategy encourages an extended use of economic instruments to ensure that polluters pay for environmental and social costs, promotes the environmental goods and services market, and calls for monitoring and measuring of the strategy.[5] The strategy is based on five principles (prevention, polluter pays, efficiency, gradualism and realism) and proposes actions over different time-scales (Government of Chile, 2013).

The current government is revamping the Green Growth Strategy, with a view to introducing additional principles. These include environmental equity, health, gender, cultural diversity and protection of valuable ecosystems. This shift in focus is linked to the highly skewed income distribution in Chile (Chapter 1). The new strategy aims to be an

umbrella for all major sectoral strategies and plans related to green growth, many of which are already underway (e.g. on climate change, biodiversity, energy and air pollution control). Several ministries and the Council of Ministers for Sustainability are involved in the preparation of the revised strategy, and the government plans extensive consultations with the general public. The MMA is also developing a National Programme on Sustainable Consumption and Production, which will constitute a major pillar of the new Green Growth Strategy (Box 3.1).

Box 3.1. **The National Programme on Sustainable Consumption and Production**

In 2014, the Ministry of Environment (MMA) launched a four-year programme to raise the profile of sustainable consumption and production at the national level. It sought to co-ordinate the related actions of the public sector, facilitate dialogue with the private sector and develop implementation tools.

A cross-sectoral committee, composed of 18 ministries and public institutions, was established in September 2014 to oversee the development and implementation of the National Programme on Sustainable Consumption and Production. A multi-stakeholder body with representatives from the private sector, civil society and academia was established to advise the committee. The MMA expects the committee to develop an action plan for the programme's implementation by 2016, including indicators to monitor progress. The action plan's first phase is expected to be implemented by 2018 (which would include the development of criteria for the definition of green products and a national plan on sustainable procurement, among others).

As a first step, the committee surveyed sustainable consumption and production initiatives across various public institutions, with a view to taking stock of existing efforts and building consensus on definitions and methodologies. The survey identified 157 such initiatives across 16 ministries or agencies. About two-thirds of initiatives target the production side (with most initiatives stemming from the energy, industry and agriculture sectors), while nearly 30% promote sustainable consumption (notably in energy, construction and education). Most sustainable consumption and production initiatives target energy efficiency, but a significant number also focus on areas like eco-labelling and certification, sustainable product design and eco-innovation. The MMA launched most of the initiatives (followed by the ministries for urban development and energy), while the ministries of tourism and public works were the ones that engaged the most in initiatives launched by others.

3. Greening the tax system

3.1. Overview

Total tax revenues measured against GDP have varied considerably over the last decade. In 2014, they equalled 19.8% of GDP, which is well below the OECD average of 34.4%, as well as lower than the average for Latin America and the Caribbean (21.7% in 2014). This is also lower than the tax-to-GDP ratio that most OECD member countries were collecting when they had similar levels of GDP per capita. This suggests there is scope to raise more tax revenues to meet growing public spending needs (OECD, 2015a). Chile's tax system depends heavily on indirect taxes (mainly value added tax), while personal income tax revenue is very low.[6] This is common to most Latin American countries, partly because consumption taxes have a limited impact on export activities and are easier to collect than

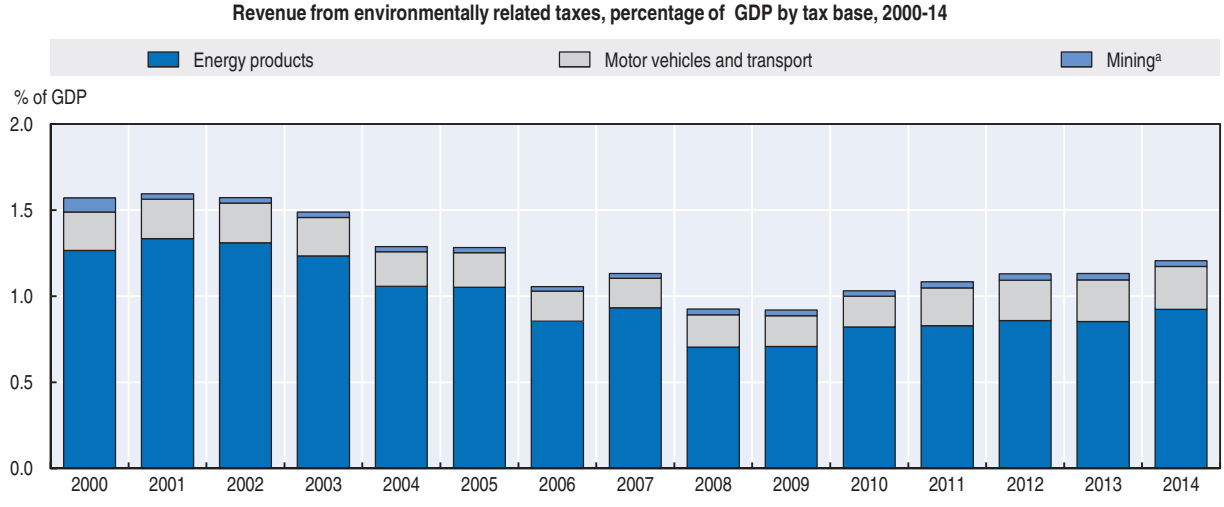
income taxes; however, it also implies a less progressive tax system (OECD/ECLAC/CIAT/IDB, 2015). The central government collects the bulk of revenues, reflecting Chile's highly centralised government structure; total tax revenues collected by local governments only equalled 1.5% of GDP in 2014, against an OECD average of 3.9% (in 2013).

In 2014, Chile approved a major tax reform, seeking to reduce the fiscal gap and to finance additional expenditures in education, health and infrastructure. The reform aims to raise an additional 3% of GDP in tax revenue, make the tax system more progressive and reduce income inequality. In line with a recommendation from the 2005 *OECD/ECLAC Environmental Performance Review*, the reform includes several new environmentally related taxes. A tax on purchases of motor vehicles, with tax rates depending on energy efficiency and nitrogen oxides (NO_x) emissions, was introduced in 2015; a tax on emissions of carbon dioxide (CO_2) and several local air pollutants will be implemented from 2017. In addition, in 2014, the government introduced a tax on fisheries extraction rights based on the size of the fishing quotas of each industrial operator (Section 3.5).

As the following sections discuss, however, many rates of environmentally related taxes do not reflect the cost of environmental damage. The wide range of preferential tax treatment continues to send contradictory signals. For example, energy use outside the road transport sector is effectively not taxed at all. Tax rates on petrol and, especially, diesel are very low compared to those applied in most OECD member countries. In spite of the low tax rate at the outset, heavy goods transport also gets a refund on diesel taxes paid.

In 2014, revenues from environmentally related taxes were among the lowest of all OECD member countries, amounting to USD 3.1 billion, 1.2% of GDP and 6.1% of total tax revenues (Annex 3.A).[7] Between 2000 and 2014, revenues from environmentally related taxes declined as a share of GDP and of total tax revenue, from 1.6% and 8.4%, respectively (Figure 3.2). Several factors contributed to this, including a significant increase in the end-user prices of petrol in line with international fuel prices, which reduced demand of petrol per unit of GDP until 2006 (Figure 3.3); the introduction of fuel price stabilisation mechanisms that lower the fuel tax rate when international fuel prices are above a certain

Figure 3.2. **Revenue from environmentally related taxes declined**



a) Mining patents for extraction and exploration only; data exclude revenues from the specific tax on mining.
Source: OECD (2015), *OECD Database on Instruments Used for Environmental Policy and Natural Resources Management.*

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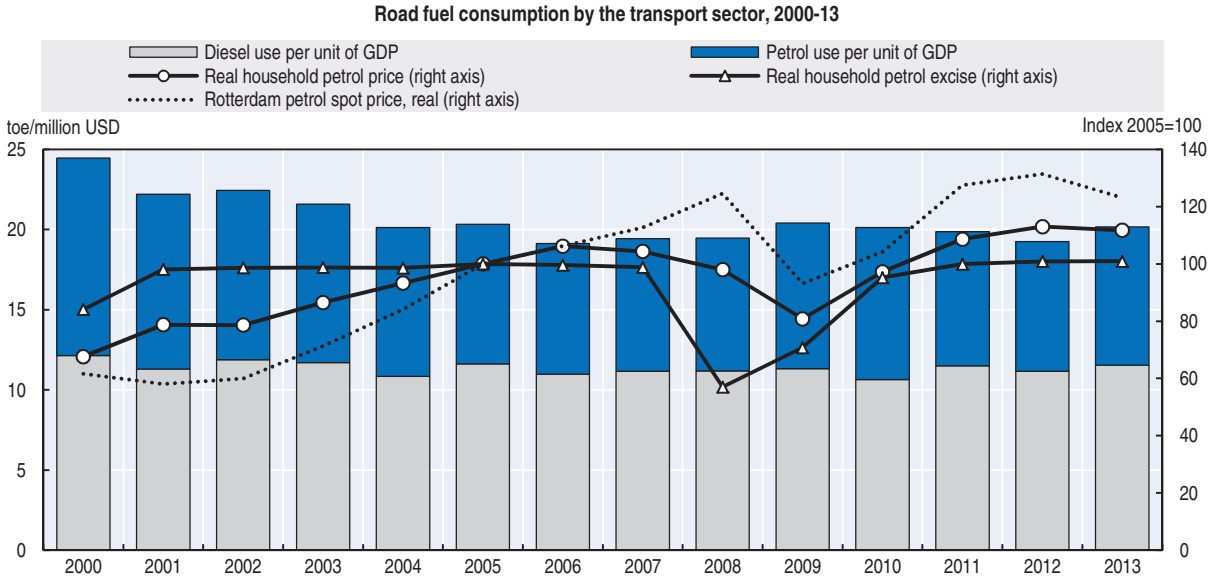
Figure 3.3. **Road fuel consumption decreased within increasing fuel prices**



Source: IEA (2015), *IEA World Energy Statistics and Balances* (database); IEA (2015), *Energy Prices and Taxes*, (database); OECD (2015), *OECD Database on Instruments Used for Environmental Policy and Natural Resources Management.*

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threshold (Section 3.2); and an increased use of diesel, which is taxed at a lower rate than petrol. While total petrol use grew by 22% in 2000-13, diesel use grew by 66%. The increase in diesel use occurred mainly for two reasons: the passenger vehicle fleet partially shifted from petrol to diesel; and freight transport grew strongly, linked to economic growth (the vast majority of heavy goods vehicles run on diesel). This ultimately lowered environmentally related tax revenues compared to GDP, as petrol is more taxed than most other energy products in the economy (Section 3.2).

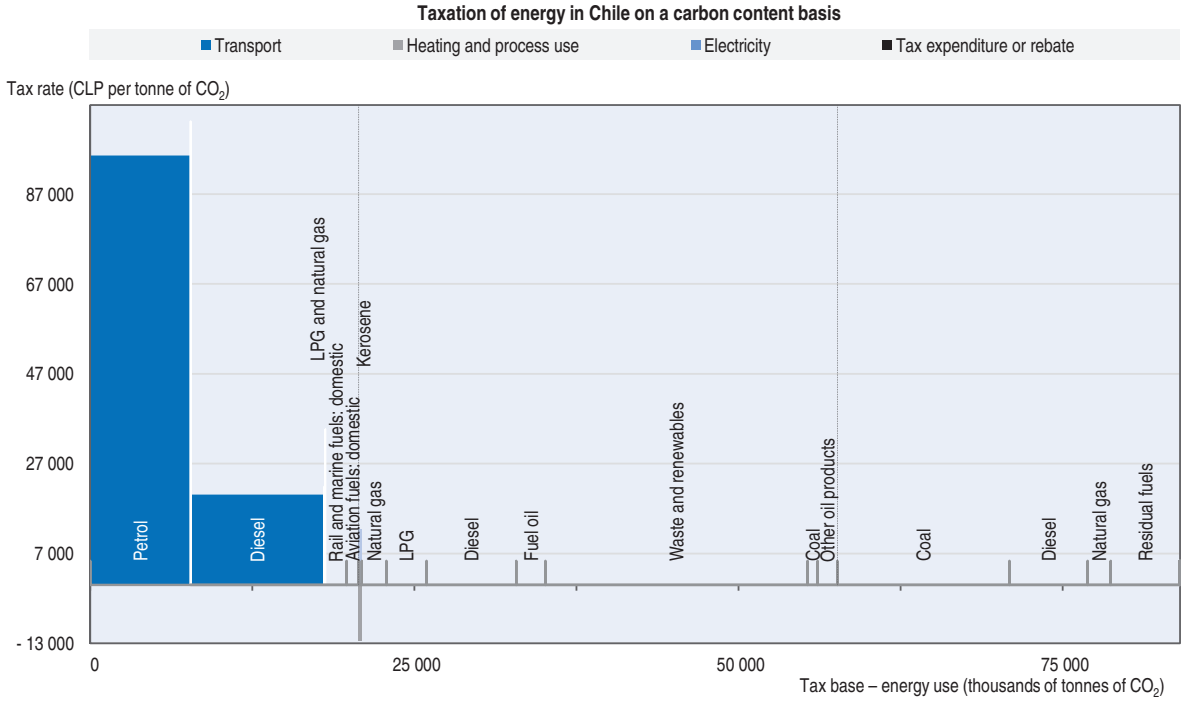
3.2. *Taxes on energy products*

In Chile and most other OECD member countries, taxes on energy use generate the largest amount of revenues among environmentally related taxes (Annex 3.A). In 2014, they contributed 77% of environmentally related tax revenues, above the OECD average of 70%, although Chile's energy tax rates are relatively low in international comparison. Revenues raised on other tax bases (vehicles, pollution and natural resources) are lower in Chile than the OECD average.

Effective tax rates on energy

Chile's energy taxation only partly reflects environmental externalities, including those linked to climate change and air pollution. OECD (2013a) calculated the implicit tax rates of all energy taxes in OECD member countries, expressed per tonne of CO_2 emitted. Figure 3.4 shows that only CO_2 emissions from burning petrol and diesel are taxed in Chile, which corresponds to about 20% of emissions associated with energy use in the country (represented by the horizontal axis in the chart). With respect to taxes on energy use, Chile only taxes fuels for road transport. There are no taxes on aviation fuels; diesel used for powering trains is taxed, but enjoys a credit against value added tax (VAT) payments.[8] Kerosene for heating and cooking is actually subsidised.

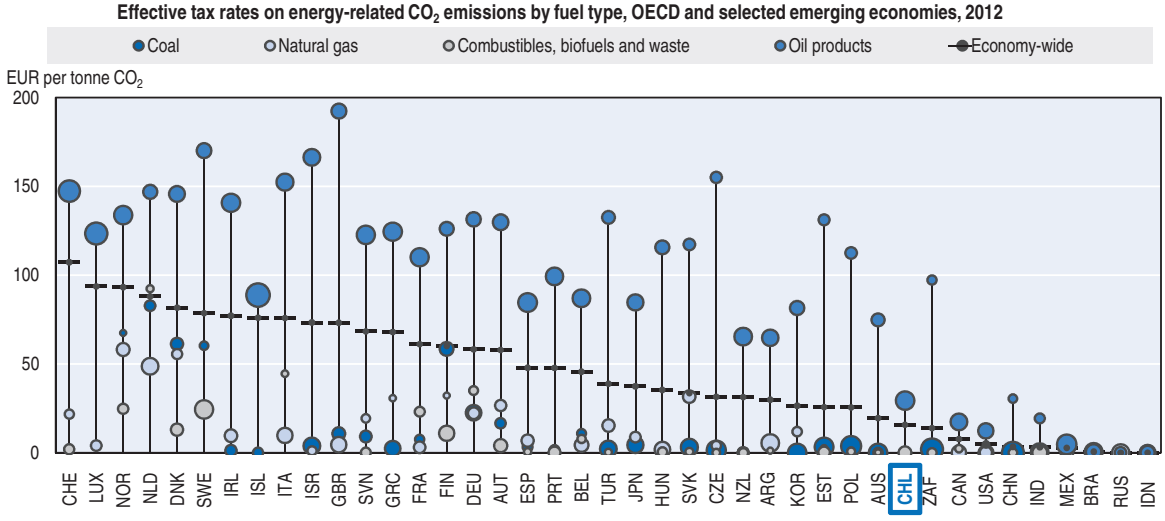
Figure 3.4. **Energy taxes are levied only on road fuels in Chile**



Note: Tax rates as of May 2012; energy use as of 2009. The negative value for kerosene reflects the credit provided by the Petroleum Price Stabilisation Fund. Abbreviations: Res. = residential; comm. = commercial; ind. = industrial; ag. = agricultural; fish. = fishery; energy transf. = energy transformation; heat = merchant heat.
Source: OECD (2013), *Taxing Energy Use: A Graphical Analysis.*

As Figure 3.5 shows, this tax system differs from most other OECD member countries, which apply taxes on other fuels such as coal and natural gas. As a consequence, the effective tax rate on CO_2 emissions from energy use is well below that of most OECD member countries, excluding Canada, Mexico and the United States, although above that of most emerging economies.

Figure 3.5. **The effective carbon tax rates on fuels are low in Chile**



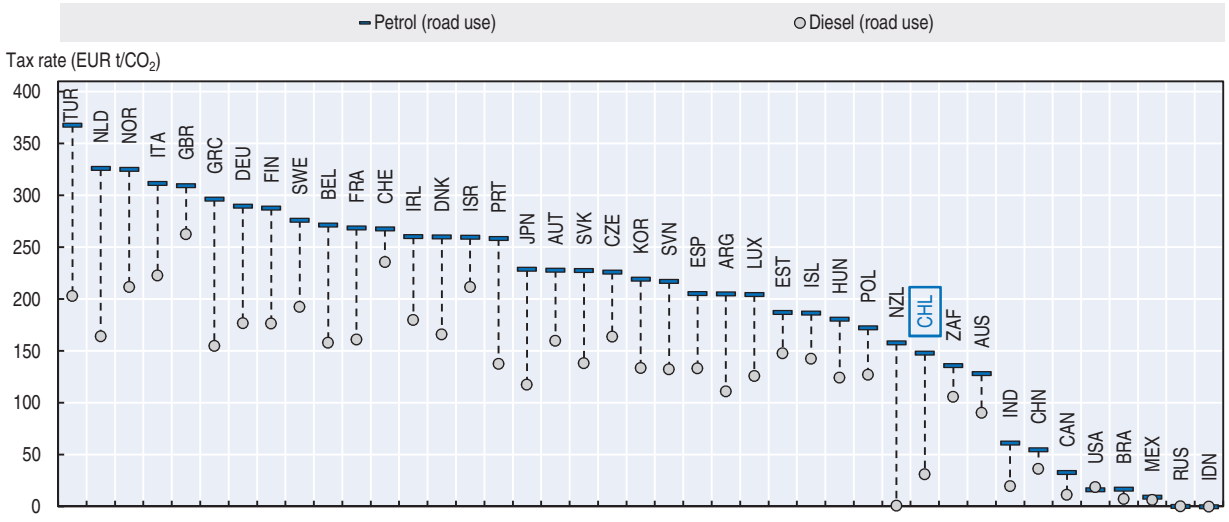
Note: Tax rates as of May 2012, energy use data are IEA data for 2009.
Source: OECD (2015), *Taxing Energy Use 2015: OECD and Selected Partner Economies.*

The petrol-diesel tax gap

Figure 3.6 compares the tax rates on petrol and diesel across all OECD member countries. Chile's tax rate on petrol is higher than in any other country covered in the Americas,[9] Australia and New Zealand, but lower than in the rest of the OECD. And the country has, with the exception of New Zealand, the largest relative difference between the tax rates on petrol and diesel, making the Chilean diesel tax rate exceptionally low. In addition, diesel used in truck cargo transport receives a tax credit. This credit effectively subsidises transport externalities; evidence suggests it has given rise to far-reaching avoidance behaviour, such as setting up companies for the sole purpose of avoiding the tax (OECD, 2013b). The petrol-diesel gap is not consistent with the carbon content of the different fuels and the local pollutants generated by their use.

Figure 3.6. **There is a wide gap between the effective carbon tax rate on petrol and diesel**

Tax rates on road fuels on a CO_2 emission basis, OECD and selected emerging economies, 2012



Notes: Tax rates are as of 1 April 2012, except 1 July 2012 for AUS and 4 April 2012 for ZAF. Figures for CAN, IND and USA include only federal taxes. NZL applies a road-user charge to diesel that is not included in the figure. Tax rates converted using standard carbon emission factors from the Intergovernmental Panel on Climate Change and energy conversion factors from the IEA.
Source: Adapted from OECD (2015), *Taxing Energy Use 2015: OECD and Selected Partner Economies.*

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The much lower tax rate on diesel than on petrol, together with growing freight traffic, has contributed to a marked increase in the share of diesel vehicles in the total vehicle stock since the early 2000s: from 13% to 23% between 2002 and 2014 in the country as a whole, and from 9% to 18% in the Santiago Metropolitan Region (INE, 2015).[10] As a consequence, diesel consumption increased more than petrol consumption, which has also contributed to growing NO_x and particulate matter (PM) emissions from transport (Figure 3.3; Figure 1.10; Chapter 1). The diesel share in the vehicle fleet in Chile is, however, relatively low compared to most European countries.

Parry and Strand (2012) estimate "corrective" petrol and diesel tax rates for Chile. Such tax rates would reflect all the negative external effects caused by use of these fuels in road transport. Their estimates are USD_{2006} 2.35 and USD_{2006} 2.09 per gallon – approximately EUR 0.47 and EUR 0.42 per litre in current money value – respectively. The authors indicate the petrol estimate is substantially larger than comparable calculations for the United

States even though the valuation of travel time and health risk is lower in Chile. They explain those factors are offset by a much higher accident externality in Chile, due to a high incidence of pedestrian fatalities. In addition, they point out that the high percentage of the country's population residing in Santiago has two important implications: a large share of nationwide driving occurs under congested conditions; and a large share of the population is exposed to high health risks from air pollution.

As pointed out by Parry and Strand (2012), fuel taxes are not ideal instruments to address external costs covered in their calculations such as congestion and road accidents. Road-user charges that vary with the place and timing of the driving, and – to address local air pollution – with the environmental quality of the vehicles, would be better suited. Road pricing applies to most motorways and an extensive system of urban toll roads is applied on the ring road around Santiago (Box 3.2). Where road charges do not apply, fuel taxes are second-best instruments to address the externalities caused by road transport. Parry and Strand (2012) indicate that Chile would need to increase the petrol tax rate by some 25% to reflect – on average – the road traffic externalities covered in their assessment. The corrective tax on diesel the authors estimated is lower than their petrol tax estimate. Nevertheless, it would imply an increase in the current "normal" diesel tax rate of almost 500%.[11]

Box 3.2. **Road pricing in Santiago**

Toll road concessions, which Chile has been granting to private operators since the 1990s, helped significantly expand the country's highway network, including around the Santiago Metropolitan Region. Santiago was the world's first city to implement urban highways almost simultaneously with interoperable free-flow toll charges.[a] Tolls reflect both the cost of road use and externalities linked to traffic, namely congestion. They increase with the length of road stretches and weight of vehicles, and vary with time of day (off-peak, peak or saturation)[b] (PPIAF, 2009). Congestion charges have economic and environmental advantages. They allow not only for recovery of investment costs, but also for adequate pricing of limited space, environmental externalities (e.g. air pollution) and fairer competition among different transport modes. Linking the tolls to emission levels and fuel efficiency of vehicles would further stimulate a shift towards cleaner vehicles. Tolls could be extended to critical parts of the untolled network in Santiago (e.g. congested road sections in the city centre); and similar systems could be applied to other major cities.

a) Highways were tendered to different operators. An inter-operable free-flow tele-toll allows users to avoid stopping when paying the toll, passing under a portico that permits information to be exchanged for automatic invoicing.

b) Peak time rates come into effect when traffic reduces the average travelling speed to levels below the road's design speed; saturation rates come into effect when average speeds are far below the level designed for the road.

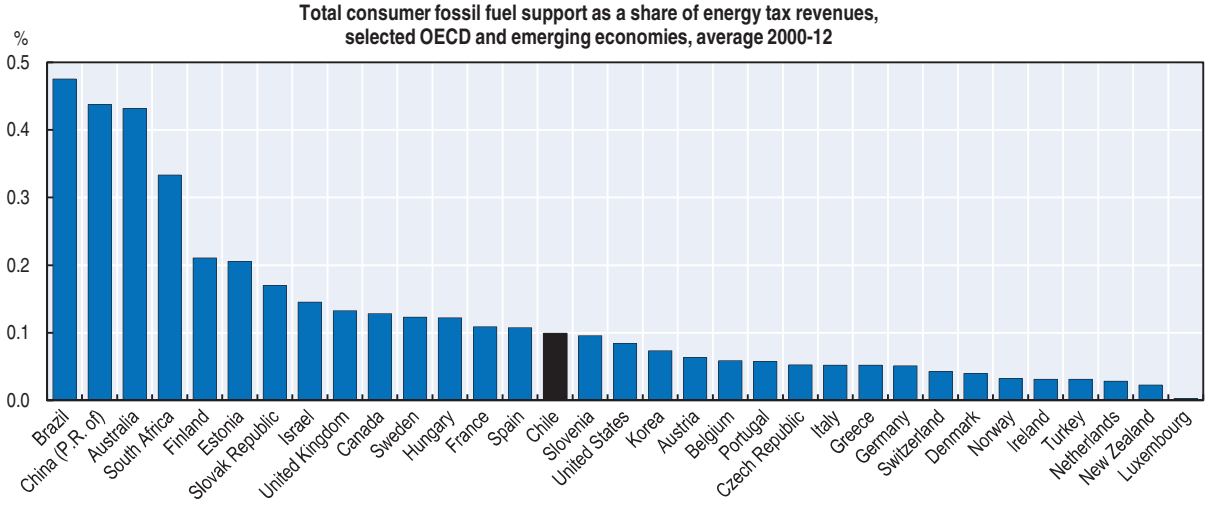
Flues and Thomas (2015) analyse the impacts of the motor fuel taxes on income distribution in Chile on the basis of the 2006/07 household expenditure survey.[12] The authors look at the share of the sum of these taxes in total income and total expenditure of households in different income and expenditure deciles. They rank households by current income levels, which gives a measure of the short-term distributive impacts of the tax. They find that the low-income deciles of the population spent a much lower share of their income on transport fuels compared to the high-income decile households. Ranking households by current expenditures, which might better represent expected lifetime

earnings, give similar results.[13] Using both ways of ranking households, transport fuel taxes stand out as progressive in Chile. In other words, the country's low fuel tax rates largely benefit the richer parts of the population, which spend larger shares of their income on transport fuels; Chile forgoes tax revenues it could spend on programmes benefiting the poorer population.[14]

Tax exemptions and other fossil fuel subsidies

Chile's consumer-related fossil fuel support, measured as a share of revenue from energy taxes, is relatively low compared to that of other countries (Figure 3.7). Energy tax revenue in Chile is relatively low, which tends to enlarge the magnitude of support compared to tax raised.[15]

Figure 3.7. **Total consumer fossil fuel support is relatively low**



Note: Data for Australia include the country's Fuel Tax Credits. Data for Brazil and Greece are for the period 2010-11 only.
Source: OECD (2015), *OECD Companion to the Inventory of Support Measures for Fossil Fuels.*

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Prices for petroleum-based fuels are freely set by the refiner and throughout the distribution chain (OECD, 2013b). However, some mechanisms lower fossil fuel prices compared to what they would otherwise be. As indicated above, fuels other than petrol and diesel used for road transport are not taxed, including fuel used in agriculture, fishery, industry, mining and power generation.

In addition, several systems to reduce volatility of fuel prices have been introduced over the years. Most recently, the Fuel Price Stabilisation Mechanism (MEPCO) – introduced in 2014 – applies to transport fuels (petrol, diesel, liquefied and compressed natural gas). Similar to previous systems, the MEPCO adjusts excise rates weekly to keep fuel prices within a given band around a reference price; this is calculated as an average of past and projected fuel prices over a certain time. In practice, this lowers the tax rate when the international fuel price is higher than the threshold, and raises it when the price is below the band. MEPCO expenditure is capped at USD 500 million per quarter. The MEPCO replaced all previous stabilisation mechanisms,[16] with the exception of the Petroleum Price Stabilisation Fund (FEPP). Since 2011, the FEPP has applied only to domestic use of kerosene, which is widely used for heating several areas of the country.

The strong decrease in international oil prices since mid-2014 reduces any need for support to vulnerable groups. It should be seen as an opportunity to phase out all remaining fuel price stabilisation measures. These measures should be monitored carefully to ensure they are not functioning as implicit fossil fuel subsidies, which can be fiscally costly and contribute to more fuel use and higher CO_2 emissions.

3.3. Tax on emissions from stationary sources

Chile will implement a tax on emissions of CO_2, PM, NO_x and sulphur dioxide (SO_2) beginning 1 January 2017. The tax will be levied on stationary sources with boilers or turbines that generate at least 50 thermal megawatts (MWt); this will affect approximately 100 facilities, particularly fossil fuel-based electricity plants, but also cellulose plants, for example. Given the selected criterion, the tax will not cover a number of facilities with major emissions; these include the country's copper smelters, which cause large amounts of local air pollution (Chapter 1).

For CO_2 emissions, the tax rate has been set to USD 5 per tonne of CO_2. The MMA estimates the tax will address around 27% of Chile's CO_2 emissions (Chapter 4). The tax does not apply to stationary sources with boilers or turbines operating on non-conventional renewable energy generation (mainly on biomass). CO_2 emissions of plants will be measured as from 2017 and the tax will be charged in 2018.

The tax intends to increase the costs faced by fossil fuel-based power generation, thereby encouraging the shift to low-carbon sources of electricity. The design of the system for auctioning long-term generation contracts, however, will shield some fossil-fuel power generators from the full costs of the tax. In addition, the CO_2 tax is designed to limit the pass-through of its costs to households and small businesses, which could reduce its effectiveness in encouraging more efficient consumption. The government should assess the interactions between the electricity market and the CO_2 tax, as well as their impacts on the tax effectiveness. If necessary, it should consider wider reforms so that the aims of the tax are not frustrated by other aspects of the electricity market design. Alternative mechanisms could be considered to achieve the distributional objective of sheltering lower-income households from the effect on this tax on electricity prices.

While households are sheltered from increases in electricity prices, major industrial users, including the mining sector, are not. In 2013, for example, mining and quarrying used about 37% of all electricity in Chile. These firms, however, will only be affected indirectly by the tax. From an environmental point of view, it would have been preferable for the tax to affect all major emission sources directly.

The introduction of a CO_2 tax element clearly is a step in the right direction. The tax rate chosen, however, is low compared to most available estimates of monetary carbon values (Smith and Braathen, 2015). Hence, it could be desirable to apply a higher tax rate at the outset, and to phase-in further increases gradually. A recent OECD survey of *ex post* analyses found that various carbon pricing mechanisms in use around the world had few, if any, impacts on sectoral competitiveness (Arlinghaus, 2015).

For emissions of PM, NO_x and SO_2, the tax will depend on the population in the commune where emissions take place, on the air quality of the commune and on the social costs of different pollutants. The tax rate will be higher for "saturated" (or "latent") communes, where air quality standards are exceeded (or nearly exceeded). The social costs per unit emitted vary across the three pollutants, with the highest costs attached to a unit of $PM_{2.5}$ emissions.

The tax takes into account the size of the population affected by the pollution, which is a positive feature. However, the formula only considers the population of the municipality where the emission source is located. As local air pollutants can be transported over relatively large areas, it would be preferable to take the total population in the whole relevant airshed into account when calculating the tax for each polluter. Ideally, it would also be useful to consider other impacts, such as water pollution caused by NO_x emissions to air. As with the CO_2 component of the tax, it would also be desirable to apply the tax to all major sources, including the mining sector. An ideal tax should cover all sources contributing a given type of pollution. However, continuous monitoring of emissions can be relatively costly. There is, hence, a trade-off as to how much coverage makes environmental and economic sense.

3.4. Vehicle taxes and subsidies

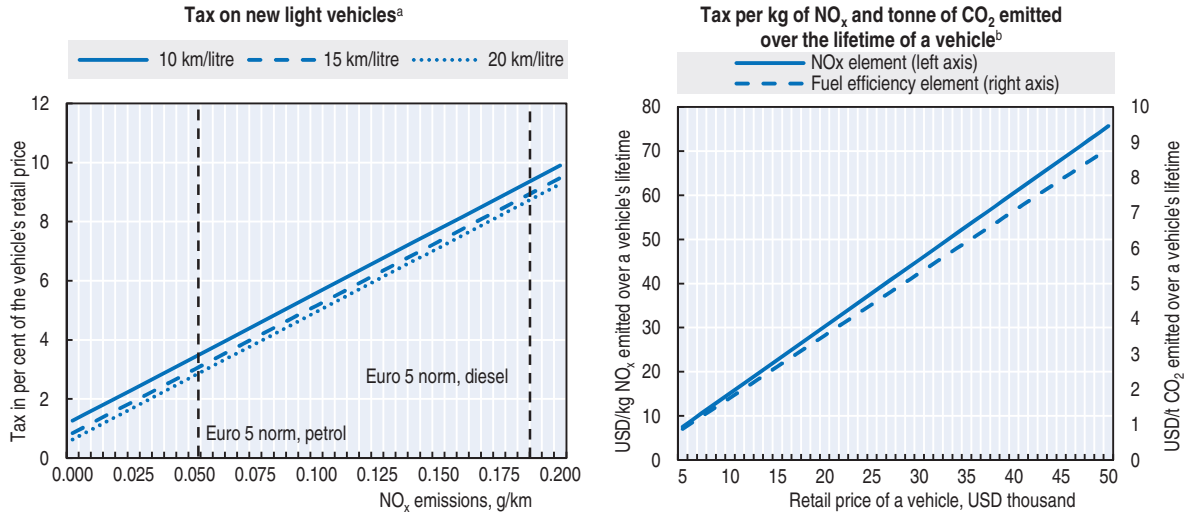
Taxes on motor vehicles

Since January 2015, Chile has been phasing in a tax on new private passenger vehicle registrations. Such a tax can help gradually modify the composition of the car fleet. From an environmental point of view, however, it is less efficient than taxes on vehicle fuels and road pricing because it is not linked to vehicle use.[17] A number of OECD member countries apply vehicle taxes that vary with the fuel efficiency or CO_2 emissions of the vehicles; fewer countries address local air pollutants in their vehicle taxes (Israel and Norway are among the exceptions). The Chilean tax is differentiated according to the vehicles' test-cycle urban fuel efficiency, their NO_x emissions,[18] and their retail price. The government is phasing in the NO_x element of the tax gradually; in 2016, this element will be 75% of the full value to be applied from 2017. Since the tax has been applied only for a short period, it is not yet possible to assess its overall impact. Some indications, however, suggest that consumption is changing in the expected directions, with increasing market share for low-emission vehicles.

Figure 3.8 illustrates how the tax varies depending on the NO_x emissions for different levels of fuel efficiency. It uses a passenger vehicle with an assumed retail price of approximately USD 10 000 as the example. The tax in per cent of the retail price increases proportionally with NO_x emissions. At the Euro-5 NO_x emission limit for diesel vehicles, the tax rate is 8% to 9% of the retail price, given the selected fuel efficiency levels. For a petrol vehicle complying with the Euro-5 limit, the tax rate is 3% to 4% (the Euro-5 emission limit is stricter for petrol vehicles than for diesel vehicles). Accordingly, in absolute terms, the petrol vehicle would pay in the order of USD 500 less in tax than the diesel one.

As Figure 3.8 shows, assuming each vehicle is driven 200 000 km over its lifetime, the tax rate per unit of both NO_x and CO_2 lifetime emissions increases with the price of the vehicle. There is no environmental argument in favour of tying the emission-related components of the tax to retail price: a unit of the two pollutants does the same environmental and health damage whether it stems from a cheap or an expensive vehicle (assuming in the case of NO_x that vehicles are driven at places with similar population densities and environmental conditions). The tax per kg of NO_x exceeds USD 30 for more expensive vehicles (vehicles with a retail price higher than USD 20 000).[19] As a comparison, the NO_x element in the Norwegian motor vehicle registration tax is constant at around USD 26, under similar assumptions. On the other hand, the tax on lifetime CO_2 emissions is quite low – below the rate of the new tax on CO_2 emissions from stationary sources, discussed in the previous section, for all vehicles with a retail price lower than approximately USD 30 000.

Figure 3.8. **The vehicle tax is lower for cleaner and cheaper vehicles**



a) The tax level depends on the price of the vehicles. In this chart, data refer to vehicles with an assumed retail price of CLP 6 000 000 (approximately USD 9 000). The tax rates shown are for 2017.
b) The calculation assumes that each vehicle is driven 200 000 km over its lifetime. The tax rates shown are for 2017.
Source: OECD calculations.

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The motor vehicle tax does not apply to commercial vehicles since businesses need such vehicles for their activity. There are good reasons to exempt inputs in production activities from taxation; however, the same rationale does not exist for exempting such inputs from taxes meant to ensure the polluter pays all social and environmental costs. The emissions from a combustion engine cause the same environmental damage, regardless of whether vehicles are driven on or off the roads, for business or for private purposes. This could be an additional argument for applying the NO_x and CO_2 elements of the tax on vehicles used for business purposes, while exempting them from the price element. In addition, sport utility vehicles (SUVs) are exempted from the tax. This seems unfortunate, as it will encourage people who can afford an expensive vehicle to buy large, often energy-inefficient SUVs, rather than other types of high-standard vehicles.

Electrical vehicles are also exempt from this tax. These vehicles cause no direct emissions of greenhouse gas or local air pollutants when driven. In Chile's case, however, emissions caused through electricity generation should be considered.[20] If increased use of electrical vehicles requires more electricity generation in coal-fired power plants, for example, any environmental gain compared to a petrol vehicle could be very modest. The cost effectiveness of this exemption, therefore, could be usefully assessed. As a minimum, application of the price element of the tax could be considered on such vehicles.

Company car taxation

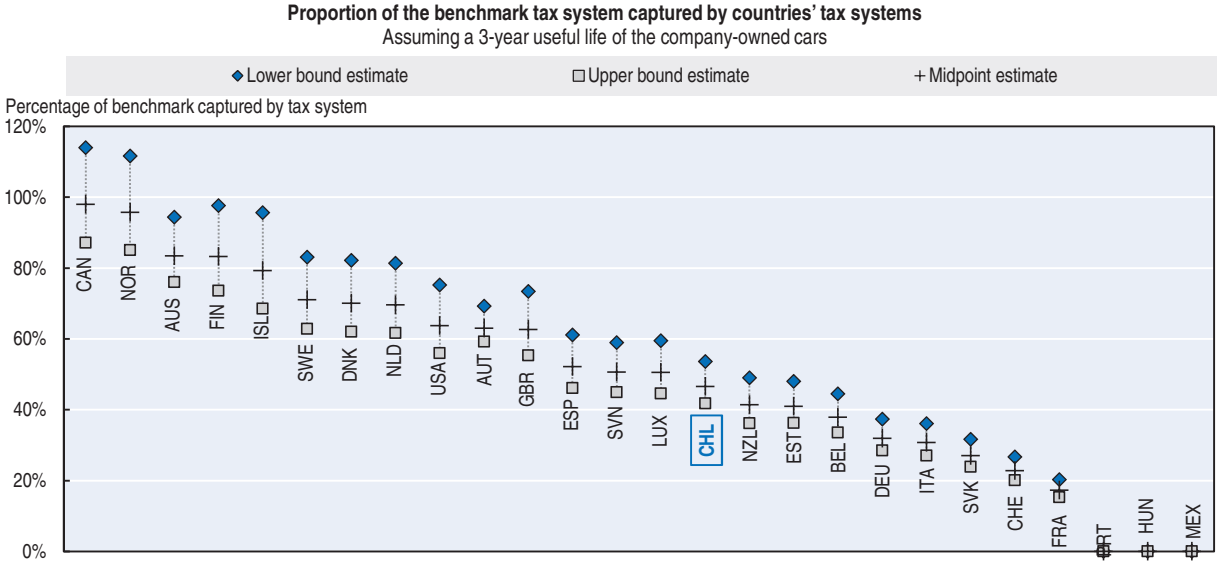
In most OECD member countries, the benefits reaped by individuals who can use a company-owned car are taxed more leniently than other types of income. This has several disadvantages: it results in revenue losses; it is highly regressive; and it leads to negative environmental impacts. One recent OECD study suggests the forgone revenue related to such under-taxation is substantial in many countries (Harding, 2014); Roy (2014) indicates the related environmental and other social costs caused by increased air

emissions, more traffic accidents and greater congestion are significantly higher than the estimated forgone revenue.

In Chile, those who benefit from personal use of company-owned cars add at least 20% of the car's net book value (according to company accounts) to their income. From 2017, the benefit amount will be deemed to be either 20% of the net value book or the annual depreciation applicable to the vehicle in question, whichever of the two is greater.

Harding (2014) developed a "benchmark" for neutral tax treatment of company car benefits relative to cash wage income. Using three different sets of assumptions, the benchmark can help estimate the value of the tax expenditure resulting from the company car tax settings in each country (Figure 3.9). According to these estimates, Chile sits in the mid-range of the countries covered, capturing slightly less than half of the benchmark value. Assuming about 30% of new registered vehicles are company cars, this favourable tax treatment led to approximately USD 103 million in revenues forgone in 2012; this represents about 16.5% of tax revenue from vehicle taxes in the same year.

Figure 3.9. **Chile could improve its tax treatment of company car benefits**



Source: OECD (2015), Updated OECD calculations based on Harding (2014), "Personal Tax Treatment of Company Cars and Commuting Expenses: Estimating the Fiscal and Environmental Costs", *OECD Taxation Working Papers, No. 20.*

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Tax treatment of company car benefits has become gradually stricter. Still, the variable part of the taxation (related to operational costs such as fuel, insurance and maintenance) could be strengthened. This would provide stronger incentives to reduce distance travelled and yield potential environmental benefits.

Commuting expenses

Employees cannot deduct expenses related to commuting between home and work from their taxable income. Hence, long commuting distances do not benefit from implicit subsidies that can trigger additional peak-hour traffic. But employees also receive no incentive to use public transport, as would be the case if only expenses for public transport

use were deductible. Free or subsidised parking spaces provided by the employer are considered to be taxable income for employees, which helps limit the use of private vehicles for commuting purposes.[21]

Subsidies for cleaner vehicles

In addition to exempting electric cars from the vehicle tax, Chile provides direct subsidies to encourage renewal of the fleet towards less polluting and more fuel-efficient vehicles. The Change Your Truck programme, established in 2009, provides subsidies to replace trucks more than 20 years old with new ones, destroying the old ones in circulation. The old truck had to be replaced by one of equal size that complied with the Euro III or EPA98 standards, which entailed reduced emissions per vehicle. However, when the scheme was introduced, the Euro V standard for heavy duty diesel engines was already in place, demanding 60% and 80% lower emission limits for NO_x and PM, respectively. Hence, the environmental requirement of the Chilean programme was not ambitious.

During the three years of the programme implementation, a relatively modest number of vehicles (352) were replaced.[22] The Ministry of Energy estimates that the new trucks could drive more than double the distance per litre of fuel than the old ones. In addition, the ministry estimates that replacing an old truck implies a reduction (relative to its emissions) of 81%, 44%, 67% and 17% of CO_2, CO, NO_x and $PM_{2.5}$ emissions, respectively. An assessment of the 2011 programme found that the programme was not cost-effective: the value of the fuel savings (CLP 950 million) was less than the amount of grants (CLP 1.1 billion); the programme was discontinued. However, this assessment disregards the cost to society of such a scheme (i.e. the remaining value of the vehicles that were scrapped), as well as the social and environmental benefits, including emission reductions and any improvements in road safety.[23] Sufficient information is not available to estimate whether the economic value of the health and environmental benefits of emission reductions exceeded the social costs of the subsidy scheme.[24]

The Change Your Bus programme provided regions with grants of around CLP 20 billion (around USD 40 million) between 2011 and 2014 for destroying buses at least 12 years old and replacing them with ones at least 5 years younger that had better technologies. The programme approved 3 000 of nearly 5 000 applications. While these replacements probably reduced pollutant emissions, the value of environmental and health impacts versus the value of the scrapped buses was not assessed.

3.5. Taxation of natural resources

Taxes on renewable natural resources

Chile mainly uses market mechanisms to provide incentives for the sustainable use of renewable natural resources. In particular, while there is no tax on water abstractions, water-use rights are freely tradable; this aims to ensure that market prices capture the resource value and reflect scarcity (Chapter 1). Transferable fish quotas are used to regulate use of fish resources (Chapter 5). In 2014, Chile also introduced a tax on fisheries extraction rights, based on the size of the fish quotas of each industrial operator. The amount of tax due is based on the higher of two alternative calculations. The first method depends in part on the price per tonne of each species; the second depends on the volume of transactions and the price during the previous business year. Such a tax should help secure a part of the resource rents related to the fish stocks for society as a whole.

Taxes on non-renewable natural resources

Fiscal revenues from non-renewable natural resources are substantial in Chile, amounting to 2.1% of GDP in 2013, although much less than in other Latin American countries.[25] This compares with annual average revenue of 3.5% of GDP in 2005-08 (OECD/ECLAC/CIAT, 2014). The continued slide in copper prices affected mining fiscal revenues, which fell 8% in 2013 alone; they are expected to continue declining (OECD/ECLAC/CIAT/IDB, 2015).

A tax on mining patents (extraction and exploration rights), levied per hectare of land, has been long in place. It accounts, however, for a negligible share of environmentally related tax revenue (Figure 3.2). In 2006, Chile introduced a specific tax on mining. This was in line with the recommendation of the 2005 *OECD/ECLAC Environmental Performance Review* to increase the financial contribution of the mining sector to social expenditure and to apply the polluter pays principle. The tax amounts to a progressive percentage of the operating income of mining companies. The percentage tax rate increases with company size, measured as annual volume of (extracted and) sold copper, which in part accounts for exploitation of the natural resource. However, the specific tax on mining is more a tax on profits than on extracted minerals. As such, it falls outside the OECD's definition of environmentally related taxes.[26] For that reason, this tax is not included among the environmentally related taxes discussed in previous sections. The tax raised on average an amount equal to 0.45% of GDP between 2007 and 2013, with large variations from year to year. If the environmentally related tax revenue presented in Annex 3.A and Figure 3.2 included the specific tax on mining, it would amount to about 1.4% of GDP (which remains a low value, relative to other OECD countries).

Part of the tax and non-tax revenue from mineral resources is allocated for specific purposes. All revenue from the mining patent tax, for example, is earmarked for the Regional Development Fund and the regions that host mining activities. About 30% of revenue from the specific tax on mining has fed the Innovation Fund for Competitiveness.[27] The *Ley Reservada del Cobre* stipulates that 10% of the value of copper exports of Codelco, Chile's state-owned copper company, is earmarked for the armed forces, with a minimum annual financial transfer of USD 180 million (Korinek, 2013). This is equal to about 20% of the average revenues raised by the specific tax on mining between 2007 and 2013. Chile could consider reviewing these revenue-earmarking provisions with a view to enhancing government oversight, as well as efficiency and flexibility of fiscal policies.

The period of extraordinarily high commodity prices is seemingly over. Nevertheless, for many governments in Latin America, the experience highlighted the need to appropriate more rents from the exploitation of natural endowments and invest them to ensure long-term development (OECD/ECLAC/CIAT/IDB, 2015). Although hard to measure, natural resource rents are generally thought to be high in Chile (Korinek, 2013). The World Bank estimates they were 19% of GDP in 2008-12 (OECD, 2013c). While the state-owned mining company pays a large portion of taxes, overall taxation of mineral resources appears relatively low in Chile compared to other resource-rich members of the OECD (Pwc, 2016). Both the 2005 *OECD/ECLAC Environmental Performance Review* and the 2013 *OECD Economic Survey* recommended that Chile ensure that natural resource rents are sufficiently taxed; actions taken so far appear insufficient (OECD, 2015a; see also Annex A).[28]

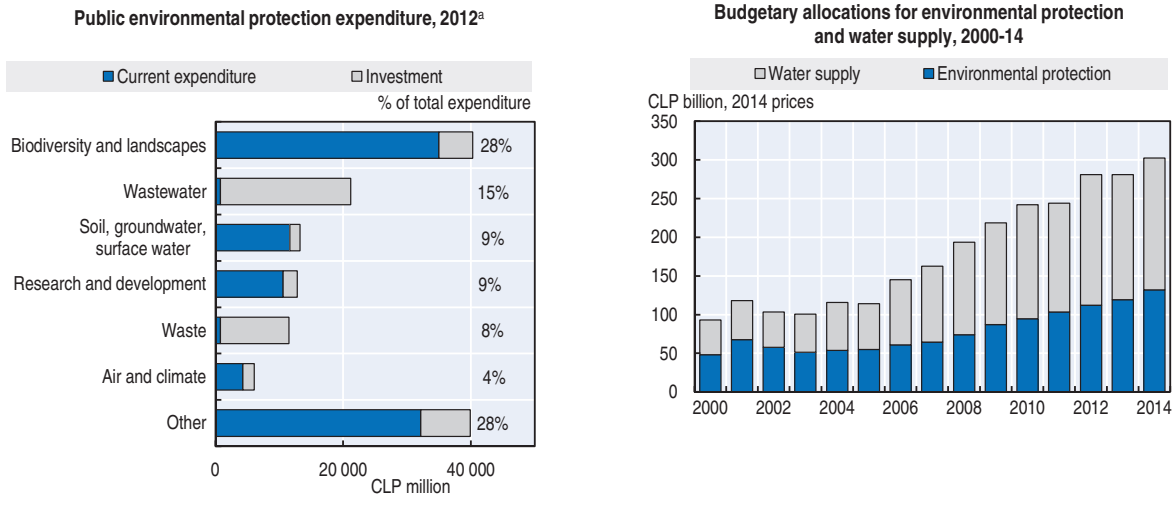
4. Investing in the environment to promote green growth

4.1. *Public environmental expenditure*

In 2015, Chile published its first comprehensive study on public expenditure on environmental protection in co-operation with the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), covering 30 central government agencies. The study estimated public expenditure at CLP 145 billion (USD 298 million) in 2012, equivalent to CPL 8 900 (USD 18) per person; this represented 0.5% of total public expenditure by central government agencies that year (CEPAL and MMA, 2015).[29] This equals an expenditure of 0.1% of GDP, below the shares of regional peers such as Colombia (0.6% of GDP) and Mexico (1%), as well as of most other OECD member countries. Such cross-country comparisons should be treated cautiously, however.[30] In particular, Chile's total environmental expenditure is likely higher, as the 2015 survey excludes large expenditure by private operators, mainly water utilities. Similarly, the survey excludes public environmental expenditure by sub-national government; these amounts, however, are likely to be relatively small given that government is highly centralised.[31]

Biodiversity and landscape protection attracts more than a quarter of total environmental expenditure (Figure 3.10). Water and sanitation, the sector that commonly attracts most resources, receives a relatively small share in Chile, which is explained by the large role of private operators in financing water-related infrastructure (Section 4.2). Only 4% of total environmental expenditure targets air and climate, despite the considerable health and social impact of air pollution on the country (Chapter 1) and rapidly increasing GHG emissions (Chapter 4). Capital investment, which accounted for about one-third of total environmental expenditure, concentrates heavily on sewerage (e.g. public investment to expand rural sanitation) and waste management (e.g. transfers to regional governments for investment in waste collection equipment and disposal facilities); only CLP 1.8 billion (USD 3.5 million) targeted air and climate in 2012 (Figure 3.10).

Figure 3.10. **Public expenditure on environmental protection focuses on biodiversity**



a) Expenditure by the central government according to the CEPA classification of environmental protection activities. The category "other" refers to expenditure for noise protection, environmental impact studies, inspections and audits, and measures aimed at strengthening the institutional framework for environmental management.
Source: DIPRES (2015), "Estado de Operaciones del Gobierno Central 1990-2014"; CEPAL and MMA (2015), *Estimación del gasto público en protección ambiental en Chile.*

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Most environmental expenditure occurs outside the auspices of the MMA. The Ministry of Agriculture accounts for the largest share (31%), mainly through the National Forest Corporation (CONAF), which administers Chile's protected areas (Chapter 5). The Ministry of the Interior, which finances sewage networks and channels resources through regional governments (e.g. for waste management), accounts for 26% of environmental expenditure. The MMA financed 22% of total environmental expenditure in 2012.

The 2015 survey includes only 2012 data. The Ministry of Finance's budget classifications by government function (DIPRES, 2015) allows the analysis of environmental expenditure over time, although the classification differs from the one used by CEPAL and MMA (2015). Environmental protection expenditure of the central government increased by 174% (in real terms) between 2000 and 2014 (Figure 3.10), more than the total budget (139%). While spending for biodiversity protection increased significantly (Chapter 5), spending on pollution abatement decreased (by 2%) over that period. Public expenditure on water supply increased by 280%, reflecting consecutive years of water scarcity and the increasing priority to secure water supply. In 2014, public spending on water supply was 30% higher than on environmental protection (Figure 3.10).

Chile would benefit from building on these first expenditure accounting efforts. It could periodically repeat the exercise and integrate results into the broader National Environmental Information System (Chapter 2). This would help identify trends in environmental expenditure over time, as well as aid analyses on the effectiveness and efficiency of spending. It could also extend the survey to the sub-national government level and the private sector, given the large share of private environment-related infrastructure investment (notably water supply and sewage; see Section 4.2). Implementation of the Pollution Release and Transfer Register (PRTR) provides a starting point for data collection and analysis for private expenditure and investment. As efforts in this area evolve, mechanisms will be needed to ensure that expenditure analysis feeds into future budget allocation decisions so that budget allocation meets environmental policy priorities.

4.2. Investing in environmental and low-carbon infrastructure

Overview

Chile has a well-developed infrastructure, notably when compared to other Latin American countries. Extensive private investment, largely through public-private partnerships (PPPs) in the form of concessions, has spurred infrastructure expansion since the early 1990s, although public investment has also increased.

Infrastructure needs remain large, however. The Chilean Construction Chamber estimates that Chile needs to invest USD 113 billion in infrastructure between 2014 and 2023 (the equivalent of 5% of GDP on average per year) to maintain its competitiveness; especially in urban roads and public transport systems, energy and water resource development (CCHC, 2014).

While overall government investment is low compared to other regional economies,[32] public investment on infrastructure is on the rise. A major public investment package of USD 4 billion was launched in 2009 in response to the global financial crisis, without any environmental or climate component (Robins et al., 2009). In 2014, partly in order to revive the weakened economy (Section 1), President Bachelet presented a National Infrastructure Plan of USD 28 billion until 2021. The plan includes investment worth USD 18 billion in public works such as highways, airports, ports and water reservoirs; this would increase

public works spending by a percentage point of GDP (Esposito and Gregorio, 2014). The plan also includes investment in environment-related infrastructure such as public transport. Rather than explicitly aiming to reduce environmental pressures such as greenhouse gas emissions (Chapter 4), however, it mainly seeks to accommodate patterns of demand for transport. Overall, public investment programmes do not systematically consider environmental and climate components or sustainability criteria and indicators in implementation.

Transport infrastructure and urban public transport

Chile's transport infrastructure has improved considerably over past decades. Concession-based PPPs have helped attract large private investment in the expansion and upgrade of roads, ports, airports and public transit. Investment has focused heavily on the road network in the core regions around Santiago; private involvement in road infrastructure investments in peripheral regions has been low (OECD, 2009). Road pricing applies to most motorways and for the urban highways around Santiago (Box 3.2).

Investment in the rail system has been limited, although reforms in the 1990s revitalised rail freight transport by transferring operations to the private sector. Passenger services virtually disappeared, with the exception of six systems in the central region (and urban rails in Santiago, Valparaíso and Concepción). Maritime transport plays a more important role than in many other economies, given Chile's geographical location and physical geography. Ports handle approximately 95% of export volume, with domestic supply chains relying heavily on road transport. A new major port on the central coast of Chile will stress hinterland transport infrastructure; and major investment in rail appears needed to avoid congestion (OECD/ITF, 2015). Nonetheless, low-carbon means of transport, such as electric railway and sea freight, remain underused and represent a potential way to improve transport services (OECD, 2009).

Different initiatives and investments have improved, upgraded or expanded the range of public transport in Chilean cities. Much emphasis has been placed in Santiago, as well as Chile's next major cities, Valparaíso and Concepción (OECD, 2013c). Urban mobility transport in Santiago changed significantly in 2007 with the integrated transport system Transantiago (Box 4.3). However, despite the expansion of its public transport system and the most extensive metro network in South America, Santiago's roads and metro networks are persistently congested and air pollution from traffic densities is high (Chapter 1). The vehicle fleet grew by 40% over the 2000s in Metropolitan Santiago and is projected to continue growing. Capacity bottlenecks are expected to worsen in several segments of the road network (Box 4.3).

In recent years, the government launched new transport related plans, namely the Santiago 2025 Master Plan and the Plan for Public Transport Infrastructure (Box 4.3). Both plans focus on public transport, which is welcome. They may help address rising GHG emissions from transport and the city's air quality problems, while reducing economic costs from congestions and social inequalities with respect to mobility.

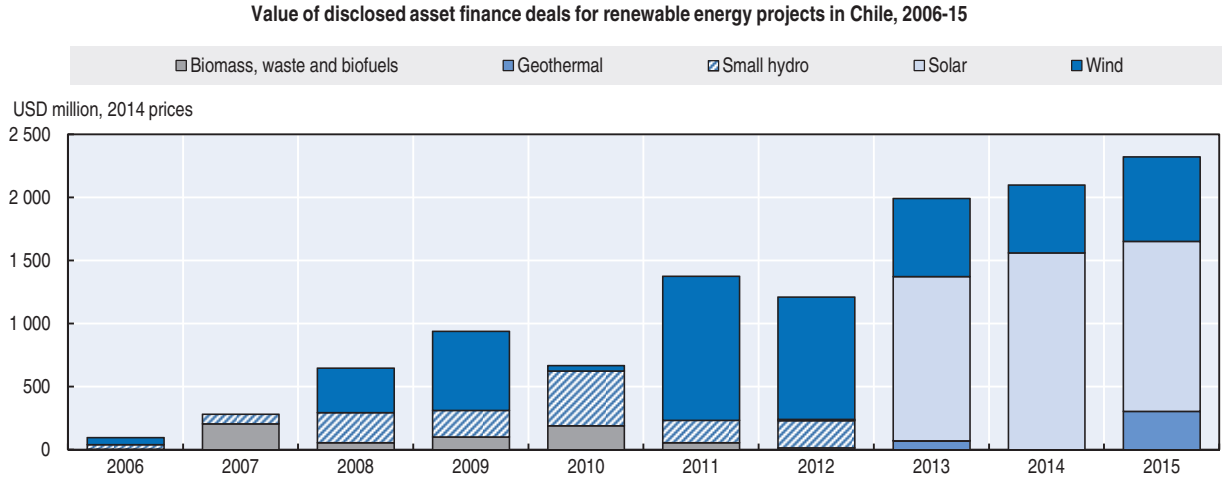
Investment in renewable energy and energy efficiency

The 2014 Energy Agenda set the goals of generating 20% of energy from non-conventional renewable energy sources (i.e. excluding large hydro), or NCREs,[33] and of reducing energy use by 20% compared to business-as-usual by 2025. The economic and social benefits of greater renewables penetration are potentially large: they include

increasing GDP by up to USD 1.6 billion between 2013 and 2028, creating 7 700 additional jobs and mitigating 9 000 tonnes of $PM_{2.5}$ emissions as compared to a baseline scenario (NRDC, 2013).

Investment in renewables has increased sharply in recent years. Factors explaining this growth include: the favourable geographic conditions, the cost-competitiveness of renewable energies with conventional sources and a supportive regulatory framework (Chapter 4). Investment in renewables reached a record high of about USD 2.4 billion in 2015, according to Bloomberg New Energy Finance (Figure 3.11). While investment has focused on small hydro in the 2000s, wind and solar have accounted for the bulk of investment since 2010 (Figure 3.11). The value of imported solar photovoltaic modules increased almost ten-fold in 2008-13, with China and Malaysia supplying more than 80% of imports in 2013 (Borregaard et al., 2015). Chile ranks among the top ten renewable energy export markets for US exporters for 2015-20 (US Department of Commerce, 2012). With a large number of projects in the pipeline (Table 4.4), the outlook for investment and growth in the sector is impressive. Nevertheless, non-conventional renewables are still far from matching their potential, as various financial, technical and regulatory barriers persist (Chapter 4).

Figure 3.11. **Investment in non-conventional renewable energy sources is taking off**



Source: Based on *Bloomberg New Energy Finance* (database) (accessed March 2016).

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The government has facilitated investment in NCREs through a quota obligation,[34] investment in research and development, and promotion of market transparency (Chapter 4). In addition, tax and financial incentives have promoted solar thermal systems and other renewables, including in rural areas (Box 4.1). The government has also supported investment to improve energy efficiency in the building and government sectors, among others (Box 4.2). The enactment of a carbon tax (Section 3.3) will further support the competitiveness of renewables.

In parallel, the Economic Development Agency (CORFO), an autonomous government agency for industrial policy development, and the National Energy Commission (CNE) have developed diverse financial instruments to support investment in renewable energy development (Box 3.3). These have helped kick-start the financing of renewables projects in Chile, but finance barriers continue to restrain faster development of renewables

Box 3.3. **Renewables support through the Economic Development Agency**

Since 2008, CORFO, in co-operation with the German development bank KfW, has provided long-term, low-cost funding to commercial banks for on-lending to non-conventional renewable energy projects. By 2011, 15 projects, mostly small hydro, had benefited from support totalling USD 140 million. Even though only 2 of 23 commercial banks participated in the programme, it helped kick-start the financing of renewables projects in Chile. Today, one-third of operating banks in Chile are actively involved in the financing of renewables projects, including wind, photovoltaic and small hydro (Violic, 2015). The loan programme was extended in 2011 (with USD 90 million); three years later, it was expanded to provide targeted support to solar projects (with USD 133 million).

CORFO has also been providing financial support to renewable energy projects in pre-investment stages. In 2005-09, it subsidised up to half of the total cost of pre-feasibility studies (with a USD 60 000 cap) and pre-investment studies (USD 160 000 cap); this benefited 217 wind, biomass, biogas, geothermal and small-scale hydro projects (IEA/IRENA, 2014). Between 2008 and 2010, CORFO received a budget of USD 2 million from the Ministry of Energy and the National Energy Commission to continue the programme.

Since 2012, the Renewables Energy Center (now CIFES), under CORFO, has developed three new contests to subsidise pre-investment studies of renewable projects, with the support of KfW. The last three tenders provided co-financing of up to 40% to 121 individual projects with a total capacity of 3 462 megawatts (MW) (mostly wind and solar projects). The last tender, held in 2014, involved CLP 780 million (about USD 1.4 million) of investment (Ministry of Energy, 2014).

capacity. In the solar technology sector, a lack of regulations on certifications or standards for solar modules (which would support longevity, safety and related market guarantees) results in greater risk in terms of guarantees that local Chilean financial institutions often cannot afford (Borregaard et al., 2015). Due to limited local finance, many international organisations like the European Investment Bank, the Inter-American Development Bank or the World Bank have taken the lead in developing projects, notably for larger ones. For example, until recently, most large-scale solar projects were supported through multilateral financing institutions (Borregaard et al., 2015). Private investors from the United States, Europe and China have also been involved (BNEF, 2012).

Water and sanitation

Water and sanitation in Chile has high levels of access and good service quality, though these remain low in some rural areas (Chapter 1). Privatisation of the urban water and sanitation sector, beginning in the late 1990s,[35] went hand in hand with significant investment in the sector, which was estimated at USD 3.5 billion for 1999 to 2009 (UK Trade & Investment, 2011). Roughly 40% of this volume targeted wastewater treatment, which helped increase the share of the population served with wastewater treatment services from 21% to over 96% between 2000 and 2014 (Chapter 1). In 2014, total investment in the sector was reported at USD 320 million, half of which was in drinking water supply and the other half in sewage and wastewater treatment (SISS, 2015a).

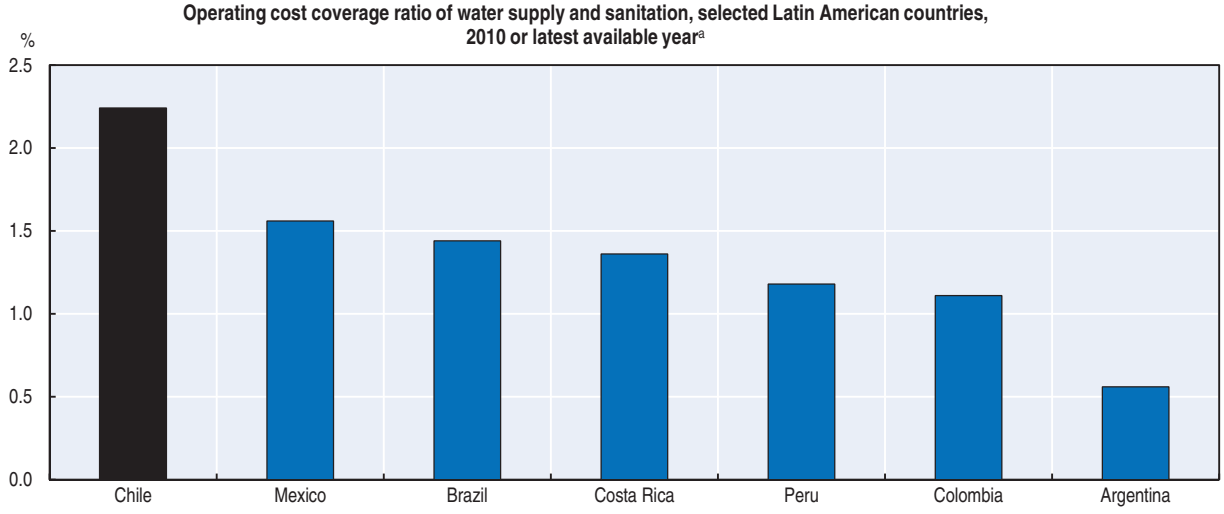
Investment is expected to drop considerably after 2020. In 2020-25, annual average investment is expected to be 80% below the 2014 level (SISS, 2015b).[36] The share targeting wastewater treatment is projected to decline to 3% in 2021-25, despite the currently limited level

of tertiary wastewater treatment infrastructure (Chapter 1). Public water supply will receive the lion's share (70%) of projected investment, reflecting the priority of securing water supply.

Drought and water scarcity have prompted severe water supply shortages in recent years (Chapter 1) and stimulated significant investment in safer supply sources, both from water companies and the water-intensive mining industry. The mining industry has heavily invested in alternative water sources, notably seawater, and water efficiency and reuse.[37] The use of seawater (desalinated or salt water) increased almost ten fold between 2009 and 2014; it served 16% of mining water supply, while the average water reuse rate increased from 69% to 74% (Cantallopts, 2015). The 2015 National Policy for Water Resources plans to build 11 new desalination plants to increase public water supply in two northern regions (Antofagasta and Atacama), which requires USD 114 million of investments (MISP, 2015). Investment will also be needed to reduce inefficiencies in distribution (as almost one-third of water is lost before reaching consumers; see Chapter 1), also with a view to reduce the need for costly investment associated with risk mitigation and emergency response measures.[38]

With the first companies partly privatised by the early 2000s, the government began opting for concessions in 2001. Concessions, usually granted for 30 years, are based on a model grounded on the principles of self-funding and efficiency. Water operators were allowed to set water tariffs at a level that allows them to fully recover the cost of service provision, thereby enabling investment in coverage and quality of service. Rates cannot be differentiated for reasons other than associated costs, protecting consumers from monopolistic charges. The marginal costs are calculated separately for drinking water supply and sewage treatment, and the calculation formula is to be revised every five years. Water tariffs consider the value of water, determined by the market price of traded water-use rights, thereby reflecting water scarcity and encouraging water conservation in resource-scarce areas.[39] According to the International Benchmarking Network for Water and Sanitation Utilities (IBNET), revenues recover almost twice the operating costs of water supply and sewage utilities; they can thus generate surpluses to self-finance a portion of their investments. This share is higher than in other countries in the region (Figure 3.12).

Figure 3.12. **Chilean water utilities recover almost twice their operating costs**



a) Total billed revenues as percentage of total operational expenses.
Source: The International Benchmarking Network for Water and Sanitation Utilities (2015), *IBNET Database*.

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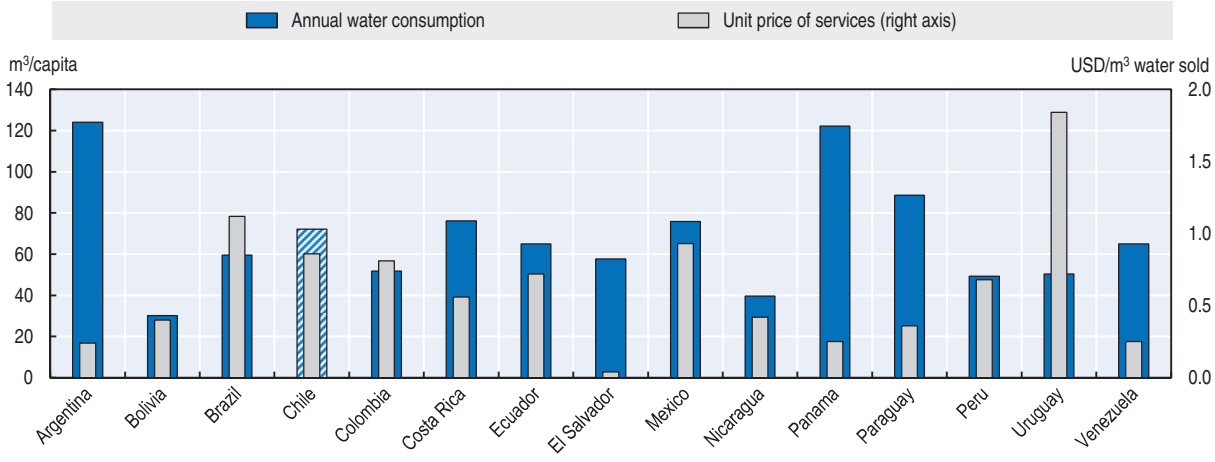
The tariffs applied by utilities to supply and treat water rose considerably in the early 2000s. They continued to rise alongside the expansion of new wastewater treatment services. Reported revenue per client rose by 43% between 2005 and 2013 (SISS, 2015a). Rising prices encouraged an 18% reduction in drinking water consumption per household in urban areas between 2000 and 2014 (SISS, 2015b). The government subsidises vulnerable households through a deduction of the bill.[40] In 2011, 15% of water company clients benefited from this subsidy at a cost of USD 80 million (Donoso, 2015). The current average tariff is USD 1.4 per cubic metre (m^3), which is high compared to other Latin American countries (Figure 3.13). Tariffs are almost double in some northern regions, reflecting water scarcity, as well as in the far south, possibly reflecting difficult conditions for providing water supply and sewerage to users (SISS, 2014).

Figure 3.13. **Tariffs for urban water supply and sanitation are among the highest in Latin America**

Unit price of water supply and sanitation, selected Latin American countries, 2010 or latest available year



Source: The International Benchmarking Network for Water and Sanitation Utilities (2015), I*BNET Database*.

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In rural areas and remote communities, water and sanitation is largely operated by municipal authorities and investment financed publicly through the Rural Drinking Water Programme.[41] Rural water user committees (RWCs) manage water provision in their areas, which includes tariff setting. Unlike urban water providers, RWCs are not regulated. This has led to tariff levels that cover operating costs, but which are too low to recover maintenance costs, let alone the costs of investment needed to attend growing demand. This, in turn, has led to deteriorated infrastructure, increasing the need for further subsidies to restore the quality of systems to former levels (Donoso, 2015). Due to consecutive years of drought, several rural water supply installations in northern and central Chile have not been able to supply water to the population. In 2015, 13 of Chile's 15 regions used cistern trucks to secure water supply to approximately 400 000 people, at an estimated monthly cost of USD 4.5 million to local authorities (MISP, 2015). Urban water suppliers, by contrast, have been able to supply all water demands. A bill to regulate rural sanitation services and strengthen the institutional framework, for instance, by creating a new sub-directorate of the Ministry of Public Works, is yet to be approved.

Waste management

As in most OECD member countries, the management of urban solid waste is a municipal responsibility and financed through municipalities' budgets. Municipalities usually award contracts to private operators for collection and disposal of waste. They have the power to charge residents a fee for waste services, based on both fixed and variable costs associated to the service. Low-income households (with income below 225 UTM,[42] about USD 15 500) are automatically exempt from payment; wealthy households (above 900 UTM) pay through land taxes. Municipalities may partially or totally waive the payment based on users' socio-economic conditions. Most municipalities took this option: an estimated 80% of households are exempted from the charge. In 2012, the revenues of such fees were estimated at CLP 87 billion (USD 179 million) (OECD, 2014d). No information is available on what percentage of municipalities' total costs associated with waste management is covered by the charge. Many municipalities report that available resources are insufficient to finance adequate waste management programmes.

In 2012, the central government transferred about CLP 10 billion (USD 21 million) to regional governments (see also Section 4.1) for construction of sanitary landfills, closure of uncontrolled dumps, recycling centre construction, acquisition of equipment for residential solid waste collection, and the like (CEPAL and MMA, 2015). More investment in environmentally sound waste landfills will be needed soon, as waste generation is increasing, while nearly all collected waste is landfilled (Chapter 1). The government plans to double the number of sanitary landfills installed in the country, with a view to increasing access to sanitary landfills from 30% of municipalities to 75% between 2010 and 2020 (Fernández, 2013). A stronger focus on waste prevention and recycling may reduce the need for additional capacity.

Investment in waste prevention, recovery and recycling has generally been modest. Chile does not have a recycling industry with developed markets and a competitive cost structure. In some segments, such as polyethylene terephthalate (PET), Chilean recycling facilities import the large majority of their raw material due to lack of domestic supply. The low level of market development can be explained by the lack of incentive structures for waste recovery and recycling. In particular, privately operated landfills are paid a fixed amount per tonne of waste disposed by the municipality, which is lower when disposed waste volumes are large. This means that municipalities have few incentives to reduce waste disposed of in landfills. Some municipalities have introduced contracts for differentiated collection; a major recycling initiative in the Metropolitan Region has successfully increased recycling rates of some products (Box 3.4). Yet most municipalities limit their waste management to disposal, with little consideration to prevention or recovery and recycling (AmCham Chile, 2012). Chile should, therefore, consider reviewing the financing structure for municipal waste management.

A draft Waste Framework Law, under discussion since 2009, aims to gradually implement extended producer responsibility (EPR) programmes (Chapter 1). This may provide momentum for investment in the sector and will likely reduce the financial burden on municipalities. Municipalities will need to secure finance to strengthen administrative capacities and to raise awareness and build a culture for recycling among citizens. The National Solid Waste Programme (Chapter 1) provides resources for implementing integrated and sustainable municipal solid waste management; the Undersecretariat for Regional and Administrative Development (Subdere) is developing a four-year investment

Box 3.4. **Santiago Recycles**

Santiago Recycles (*Santiago Recicla*) is Chile's most important waste recycling programme. Launched in 2009 by the National Environmental Commission, the government of Santiago Metropolitan Region and the Casa de la Paz Foundation, it seeks to integrate public and private action for efficient and sustainable waste management throughout the region. The programme's main goal is to increase the recycling of household solid waste to 25% in 2020, up from only 14% in 2009. It is based on municipal initiatives and inter-municipal co-operation. To date, 41 municipalities have invested in the first phase of the programme's action plan. This phase is oriented towards recuperation of paper, cardboard, glass, aluminium and metal scraps, PET and Tetra Pak beverage containers. The plan also includes projects to encourage civil participation and raise awareness of the value of recycling.

Source: OECD (2013), *OECD Urban Policy Reviews: Chile*.

plan, with the involvement of various regional and local institutions (Subdere, 2014). Taxation of waste production and/or favourable treatment of recycled products (notably of streams not covered under the EPR programmes) would further help encourage investment in waste recovery, and separation and recycling.

5. Eco-innovation, green markets and employment

5.1. *Eco-innovation*

General innovation policy and performance

Chile's innovation system has improved since 2005, when the country began formulating and implementing explicit policies for innovation. Chile will need, however, to further strengthen its innovation capacity to diversify the economy, improve productivity, further raise living standards and close the income gaps with more advanced OECD member countries (OECD, 2015a, 2015c).

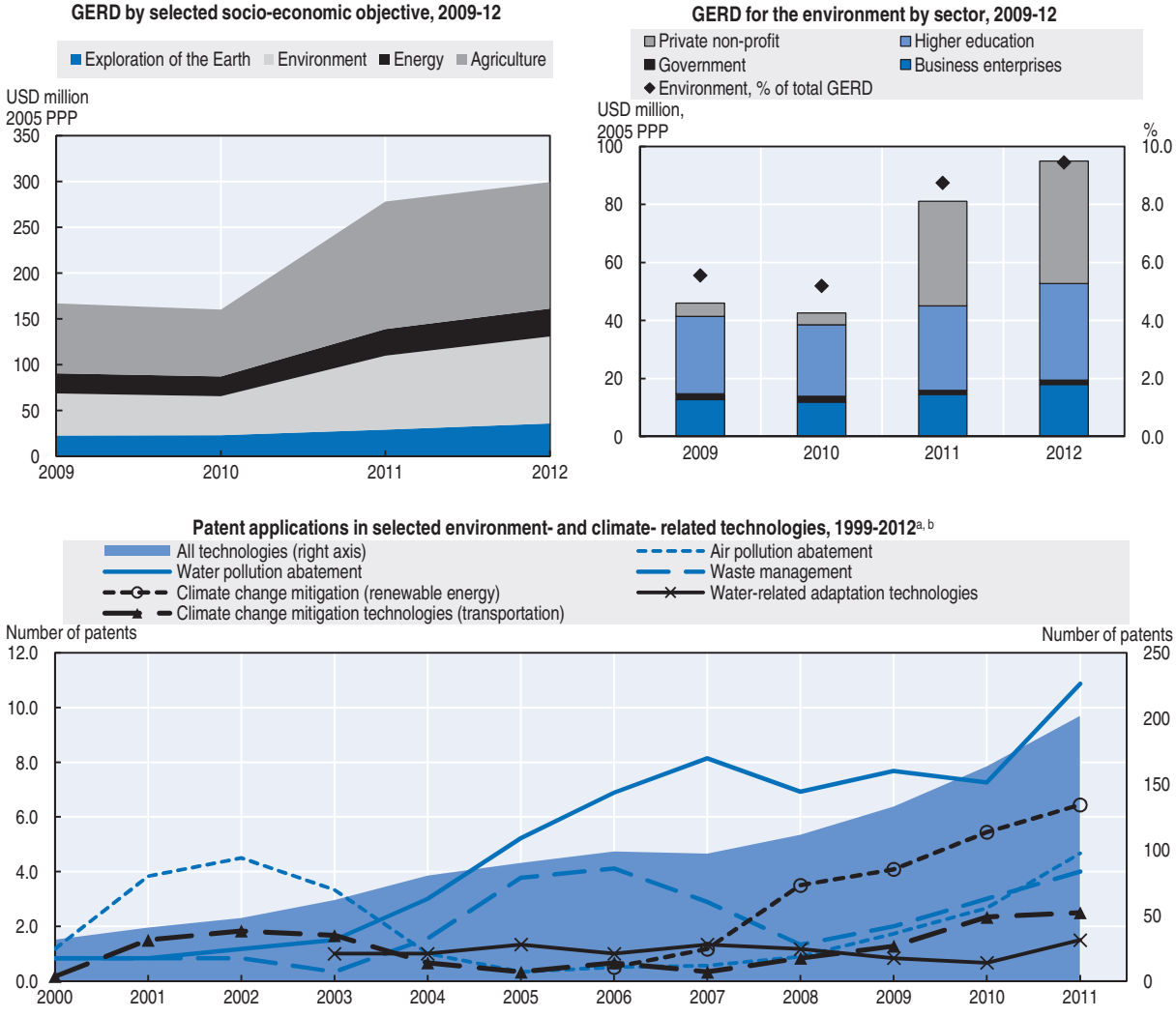
Gross domestic research and development expenditure (GERD) increased with the establishment of the Innovation Fund for Competitiveness in 2005, which is partly financed by revenue from the specific tax on mining (Section 3.5). It was less than 0.4% of GDP in 2014, however, the lowest value in the OECD and significantly below the OECD average (see Basic Statistics). Investment in innovation relies on public money and focuses largely on the publicly funded university sector. At 0.14% of GDP in 2013, business enterprise expenditure on research and development (BERD) was the lowest in the OECD (OECD, 2015d).

Innovation performance of businesses, measured by patents, trademarks and copyrights, has improved, but remains well below OECD levels, particularly among small and medium-sized enterprises (SMEs). This reflects the structure of Chile's economy, which is based on natural resources and has a relatively small manufacturing sector compared to other OECD countries (Chapter 1). It also reflects persistent bottlenecks in Chile's innovation system such as skills shortages, weak industry-science co-operation, fragmented policies and lack of institutional coherence (OECD, 2015c, 2014a). The 2014 Growth, Innovation and Productivity Agenda seeks to address longstanding weaknesses in these areas, with a view to enhancing the productivity and diversity of the economy.

Performance of eco-innovation

Of total GERD, 9% targeted the environment in 2012, one of the highest shares among Latin American countries (OECD, 2015d; RICYT, 2015). Environmental GERD more than doubled in real terms over 2009-12 (Figure 3.14), faster than in any other research branch. The increase was driven by massive growth in expenditure by private non-profit organisations such as foundations and charities; they accounted for almost half of environmentally related research and development (R&D) expenditure in 2012. Conversely, the government R&D budget allocated to the environment decreased by 26% over 2009-12 (Figure 3.14), to 2.2% of total government R&D in 2013, slightly below the OECD average (Annex 3.A). By comparison, the public R&D budget for agriculture (which may include

Figure 3.14. **R&D investment and patenting in environmental technologies are taking off slowly**



a) Data refer to fractional counts of filings based on the priority data and the inventor's country of residence.
b) Three-year moving average data.
Source: OECD (2015), "Patents in environment-related technologies: Technology development by inventor country", *OECD Environment Statistics* (database); OECD (2015), "Research and Development Statistics: R-D expenditure by sector of performance and type of R-D", *OECD Science, Technology and R&D Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388561

research in the area of water technologies) increased to reach 12% of government R&D outlays in 2013, one of the largest shares in the OECD, reflecting the importance of agriculture to the Chilean economy.

Patenting activity in environment-related technologies is limited but growing. The number of environment-related patent applications, albeit small, increased almost twice as much as that of patent applications in all technology fields. This was driven by a strong increase in renewable energy technologies, common to many OECD member countries, yet also by water pollution abatement technologies (Figure 3.14).[43] In 2010-12, 13% of patent applications filed by Chilean inventors were environment-related; slightly higher than in 2000-02 (11%) (OECD, 2015e), and above the OECD average (10%).[44] Few Chilean patent applications are considered higher value,[45] but 16% of these were environment-related in 2010-12, the third highest share in the OECD, after Denmark and Luxembourg (Annex 3.B). This indicates that Chile has been gradually developing a specialisation in environment-related inventions.[46]

Setting up a framework for eco-innovation

Chile does not have a formal eco-innovation strategy. However, it has identified several environmentally-relevant sectors as priority areas in strategic innovation policy documents, such as the recent Programme for Business Innovation for Strategic Sectors.[47] CORFO and Fundación Chile, a public-private non-profit organisation, also run innovation programmes targeting environment-related sectors. Policy efforts to promote eco-innovation have been sector-specific and focused particularly on renewable energy technologies, which, together with growing worldwide interest, helps explain the recent increase in patenting activity in this field (Figure 3.14).[48] Chile has also made significant efforts to strengthen research-industry linkages, international co-operation and technology diffusion through the renewables promotion centre CIFES (Chapter 4) and the recent establishment of International Centres of Excellence in this area (Box 3.5).

Box 3.5. **Attracting investment in (green) technology and innovation: International Centres of Excellence**

In 2009, Chile launched a call for the installation of International Centres of Excellence (ICEs) in the country. ICEs are joint R&D institutions, bringing together cutting-edge international players with local partners. They aim to ease access to international resources, skills and technology, while promoting a local environment for innovation, building local skills and strengthening links between research and Chilean businesses.

By early 2015, 13 ICEs had been established, including for activities related to green growth. The Centre for Solar Energy Technologies, for example, is jointly operated by the German Fraunhofer Institute for Solar Energy Systems and the Catholic University of Santiago. It was inaugurated in May 2015. Supported by CORFO with USD 12 million over eight years, the centre will conduct applied research on solar electricity generation, solar heat for industrial use and solar water treatment; test high radiation solar technologies; and provide quality assurance (i.e. standards and certification). The Chilean government also approved an ICE on marine energy in mid-2015, with the French-based DCNS Group and several Chilean institutions as executing partners. With USD 13 million of co-financing from CORFO, the project is expected to be funded with USD 20 million over eight years.

Source: Häberle, 2015, "R&D for solar technologies in Chile".

Overall, environment-related innovation is in its infancy in Chile and suffers from a generally weak innovation environment and policy framework, as discussed in the previous section. Recent and ongoing reforms of environmental governance and management – with expanded use of pollution taxes and other market-based instruments and stricter law enforcement – are expected to encourage the development or adoption of more environmentally friendly technology. Ambitious policy that is stringent, predictable and flexible enough for firms to meet environmental objectives will positively influence environmental-friendly entrepreneurship and innovation (OECD, 2011). Setting long-term objectives and associated measures for eco-innovation can help ensure that capacity for research, innovation and entrepreneurship on environment-related technology develops as the general innovation environment matures.

5.2. The environmental technology, goods and services market

More stringent environmental policy and external market demand encouraged the development of an environmental goods and services (EGS) market in Chile. Chilean companies increasingly recognise environmental sustainability as an important element of business competitiveness, which is reflected in the growing number of environmental certifications and products with eco-labels (Chapter 2). International commitments (such as on climate change and biodiversity) and growing citizen concern for their health and the environment have also helped strengthen the EGS market (Martínez-Fernández, 2013).

The information base on the EGS sector is thin and there are no official statistics. The most comprehensive characterisation of the sector, conducted in 2011, estimated the Chilean "environment industry" market at USD 3.5 billion and 1.7% of GDP in 2010 (USAID and APEC, 2011; see Table 3.1). The actual market volume of Chile's EGS sector is likely to be significantly larger, however, as the study did not include important market segments such as renewable energy, energy efficiency and relevant green products and services like sustainable agriculture and tourism. The environment industry grew faster than the rest of the economy prior to the financial crisis (at an annual growth rate of 7-9% from 2004-08); similar growth rates were projected for the early 2010s.

Table 3.1. **Characterisation of the Chilean EGS market, 2010**

	Market size (USD million)	Imports	Exports	Industry (USD million)	Companies (no.)	Employees (no.)
Equipment						
Water equipment and chemicals	507	60%	8%	221	160	1 260
Air pollution control equipment	140	65%	6%	52	50	330
Instruments and monitoring systems	40	65%	4%	15	40	90
Waste management equipment	80	70%	7%	26	130	160
Services						
Solid waste management	380	1%	1%	380	800	7 000
Hazardous waste management	120	2%	0%	118	80	1 380
Consulting and engineering	161	20%	19%	160	250	1 860
Remediation	30	25%	18%	27	40	320
Analytical services	15	10%	5%	14	60	210
Water utilities, WWT	2 010	0%	0%	2 012	400	16 000
Total	**3 483**	**15**	**2**	**3 024**	**2 010**	**28 600**

Note: Market size indicates revenue generated by worldwide companies from Chilean customers. Industry size indicates revenue generated by Chilean companies, including domestic markets and exports (market size minus imports plus exports).
Source: Based on USAID and APEC (2011), *Chile Environmental Industry 2011*.

Consistent with its policy of a flat import tariff (Section 6), Chile does not apply reduced import tariffs for EGS. Yet its large number of regional trade agreements (Section 6) results in low tariff barriers for most EGS imports, easing access to advanced environment-related technology. In market segments with sufficient market drivers and demand, such as water, this has allowed for significant technology transfer, which has put systems on par with those in the more advanced OECD economies. Imports provided more than 60% of water, waste and air pollution technology in 2010 (Table 3.1); local manufacturers supply most commodity equipment such as pipes, pumps and valves. In aggregate, imports of EGS equipment outnumbered exports by a factor of about 20 to 1 in 2010 (USAID and APEC, 2011). This hints at weak domestic capacity to produce high value innovation and technology (see Section 5.1).

Various policies stimulate demand for EGS, including Clean Production Agreements, green public procurement and eco-labelling initiatives (Chapter 2). However, these policies have often been piecemeal. With the notable exception of renewable energies, there has been limited policy focus on the potential synergies between greener production and consumption, competitiveness and growth opportunities. The development and implementation of the National Programme on Sustainable Consumption and Production (Box 3.1) promises to strengthen policy coherence in this domain.

Inconsistent environmental regulation and enforcement remain barriers to the domestic EGS sector (USAID and APEC, 2011; see also Chapter 2). Opinion surveys reveal that limited supply and a lack of information and credibility prevent consumers from purchasing "green products" (UNAB-IPSOS, 2012). As experience of other countries shows, further strengthening the stringency, transparency and enforcement of environmental regulation would help boost demand for EGS and improve Chile's eco-innovation performance (Sauvage, 2014). Chile would also benefit from developing a definition, objectives and indicators for the EGS sector; this would improve analysis of linkages between environmental policies, economic growth, competitiveness and employment.

5.3. Green jobs

New professional profiles will continue to emerge as the EGS market expands and environmental policies progress. USAID and APEC (2011) indicate that Chile's EGS industry employed 28 600 workers in roughly 2 000 private companies in 2010 (Table 3.1). As in other countries, most green jobs are related to water and solid waste management, sectors that are typically labour intensive. Waste management, sustainable agriculture and eco-tourism are sectors with good employment prospects, as well as higher-skill sectors such as renewable energy or environmental engineering and consulting services (Martínez-Fernández et al., 2013).

Market openness and integration in global EGS markets have contributed to the development of a competitive environmental consulting and engineering market. In the water sector, exposure to the world's leading equipment companies has made Chilean consulting firms considerably more competitive and qualified to design, implement and manage water and wastewater projects and infrastructure, both domestically and regionally (USAID and APEC, 2011). Multinational consulting and engineering firms have frequently chosen Chile as a regional hub in Latin America thanks to its more advanced market, plentiful engineers and overall more sophisticated and competitive service business compared to other Latin American countries. Much of the consulting and engineering business in Chile is related to mining.

Nevertheless, many businesses, especially SMEs, lack knowledge and skills to comply with environmental regulation (Chapter 2), and claim a lack of training in this area (Martínez-Fernández et al., 2013); hiring specialists can be prohibitively costly. This points to a mismatch between education and training and labour market demands in this domain. Similarly, many officials in charge of public procurement lack training or education on environmental issues (Martínez-Fernández et al., 2013).

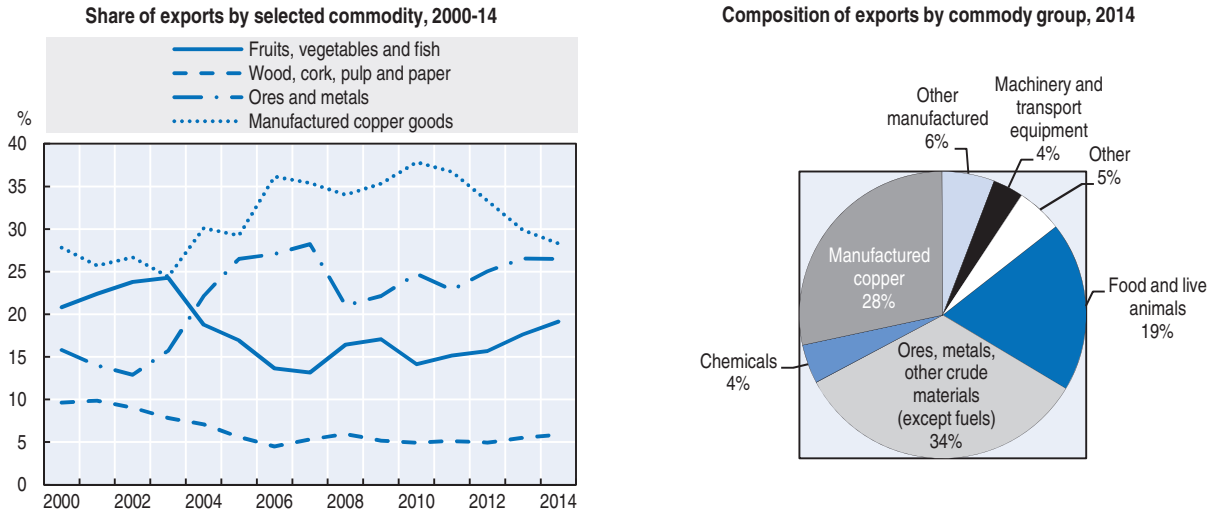
Offer of tertiary education programmes in environmentally relevant subjects has increased in recent years (Martínez-Fernández et al., 2013), even though many degree programmes, including the master's in business administration, still lack sustainability components. The National Training and Employment Service (SENCE), which promotes labour skills, offers technical courses with environmental relevance, although in less than 100 of its more than 3 000 technical training agencies. In 2013, an estimated 1.6% of about 1 million individuals trained by SENCE took courses relating to green skills (Government of Chile, 2013). The majority of green courses offered were not connected to job profiles or specific training plans; SENCE does not have a cluster for "green skills" or specific funding arrangements for these jobs. To date, the absence of an integrated national or sectoral programme related to green jobs has hampered the development of training offers (Government of Chile, 2013). Chile needs to co-ordinate relevant public ministries and agencies (e.g. for the environment, industrial development and education) to foster professional knowledge and green skills needed in industry and business.

6. Environment and trade

An open and export-oriented economy, Chile applies no export restrictions other than those falling under international agreements (e.g. endangered species, hazardous waste) and a flat import tariff of 6%. Numerous preferential trade agreements (see below) have contributed to a three-fold increase in the value of trade since 2000, which reached almost 70% of GDP in 2013 (see Basic Statistics). Ores and metals, mostly copper, and agricultural products dominate the export portfolio (Figure 3.15); main import products are fuels and manufactured goods. Chile attracts significant volumes of foreign direct investment (FDI); it received third largest amount in Latin America in 2014 (USD 20 billion) following Brazil and Mexico, and the largest relative to the size of its economy (8% of GDP). Mining attracts nearly half of FDI, yet foreign investment has also been important for road and energy infrastructure development, sectors in which the government is keen to further promote FDI.

Trade openness and integration into global markets allowed Chile to import environmentally friendly technologies that have helped reduce air and water pollution from industrial activity (Section 5.2). Moreover, access to low-cost solar photovoltaic panels has helped Chile rapidly increase its renewable energy capacity (Figure 3.11; Chapter 4) as the country lacks domestic manufacturing capacity. At the same time, with a large share of exports stemming from natural resource-based sectors, the opening of the economy has raised concerns about potential impacts of trade liberalisation on the natural resource base and the environment. Studies point to a reinforcement of environmental pressures through trade liberalisation due to greater production and exports, as well as scales of operation in sectors like mining, forestry, some agricultural activities and tourism (Borregaard, 2004; O'Ryan et al., 2010).

Figure 3.15. **Most exports are natural-resource based**



Source: OECD (2015), "SITC Revision 3" (Standard International Trade Classification), *International Trade by Commodity Statistics* (database).

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Environmental dimensions in regional trade agreements

By mid-2015, Chile had concluded 24 regional trade agreements (RTAs) with 65 countries. Seventeen of these contained environmental provisions of varying scope and depth (Table 3.2). The first RTAs with environmental dimensions – concluded with Canada, the European Union and the United States – included strong requirements, which Chile was willing to take on in return for economic integration and access to new export markets. They involved obligations to promote high standards of environmental protection, to enforce environmental laws effectively and to not derogate such laws to attract investment.[49] The negotiations of these RTAs drove reform, encouraging Chile to overhaul and codify its environmental legislation (OECD, 2007; OECD/ECLAC, 2005). Chile has proactively supported the integration of environmental provisions in more recent trade agreements. Most agreements since the late 2000s include substantive environmental provisions in a dedicated environment article or chapter (Table 3.2).[50]

Environmental provisions in RTAs resulted in various co-operation projects. These included the Pollutant Release and Transfer Register (through the Chile-Canada and the Chile-US agreements), as well as various environment-related capacity building activities (Ministry of Foreign Affairs, 2014; OECD/ECLAC, 2005).[51] Under the Chile-US agreement alone, 77 environmental co-operation activities have been carried out since 2005. Chilean officials stated that activities under RTA-related instruments have helped strengthen institutional capacity and environmental management more generally.

Chile has participated in extensive assessments of the environmental impacts of its RTAs with the European Union (Box 3.6) and the United States, at the initiative of these partners. Similar exercises could be envisaged for agreements with emerging and developing economies, as they can help evaluate the effectiveness of environmental provisions in trade agreements. They can also help identify environmental pressures arising from expanding productive sectors, particularly those that cannot be identified through project-focused environmental impact assessments, and to formulate specific preventive or reactive actions. This, in turn, would likely increase public acceptance of

Table 3.2. **Environmental provisions in Chile's trade agreements**

RTA	Year	Environmental provision	Scope of environmental provision
Bolivia	1993		
Venezuela	1993		
Mercosur	1996		
Canada	1997	X	Co-operation agreement
Mexico	1999	X	Note in preamble
Central America	2002		
European Union	2003	X	Article in the homonymous chapter
Korea	2004	X	Note in preamble; memorandum of intent
European Free Trade Association (EFTA)	2004	X	Note in preamble
United States	2004	X	Co-operation agreement
Trans-Pacific Strategic Economic Partnership (P4)	2006	X	Co-operation agreement
China (People's Republic of)	2006	X	Memorandum of intent
India	2007		
Japan	2007	X	Joint statement
Cuba	2008		
Panama	2008	X	Co-operation agreement
Peru	2009	X	Note in preamble
Australia	2009	X	Article in homonymous chapter
Colombia	2009	X	Chapter
Ecuador	2010		
Turkey	2011	X	Article in homonymous chapter
Malaysia	2012	X	Article in homonymous chapter
Viet Nam	2014	X	Article in homonymous chapter
Hong Kong (China)	2014	X	Chapter

Source: Based on Ministry of Foreign Affairs (2015); "Acuerdos Comerciales" website (October 2015); and Ministry of Foreign Affairs (2014), "Ex-Post Assessment of the Environmental Provisions of RTAs Subscribed by Chile".

trade agreements. Civil society has criticised environmental provisions in Chilean RTAs, or associated co-operation agreements, for being too general and lacking clear links to the implementation of trade and investment provisions. Criticism has also been raised with respect to insufficient co-ordination of policies and institutions; lack of specific action plans and concrete funds for public-sector capacity building; and weak monitoring and reporting procedures, including little or no public involvement (George, 2011).

Box 3.6. **Sustainability assessment of the Chile-EU Association Agreement**

The European Commission undertook two *ex-post* analyses of the environmental provisions of the RTA with Chile. The first analysis found it has encouraged exporters in some industries (notably the fruit and wine sectors) to adopt higher environmental and social standards; this was due to larger trade volumes with European buyers who were putting increased pressure on exporters to demonstrate compliance. The second study also identified improvements in environmental standards and management practices, but cited numerous instances of continuing environmental deterioration in sectors where Chilean exports have risen. In both cases, however, the second study conceded it was difficult to distinguish the influence of the RTA from other factors. It concluded the RTA's negative impact on the environment seems marginal; higher environmental standards imposed through trade with the European Union (as well as United States, Canada and Japan) have helped reduce the pollution intensity of some sectors.

Source: Based on George (2013), *Developments in Regional Trade Agreements and the Environment: 2012 Update.*

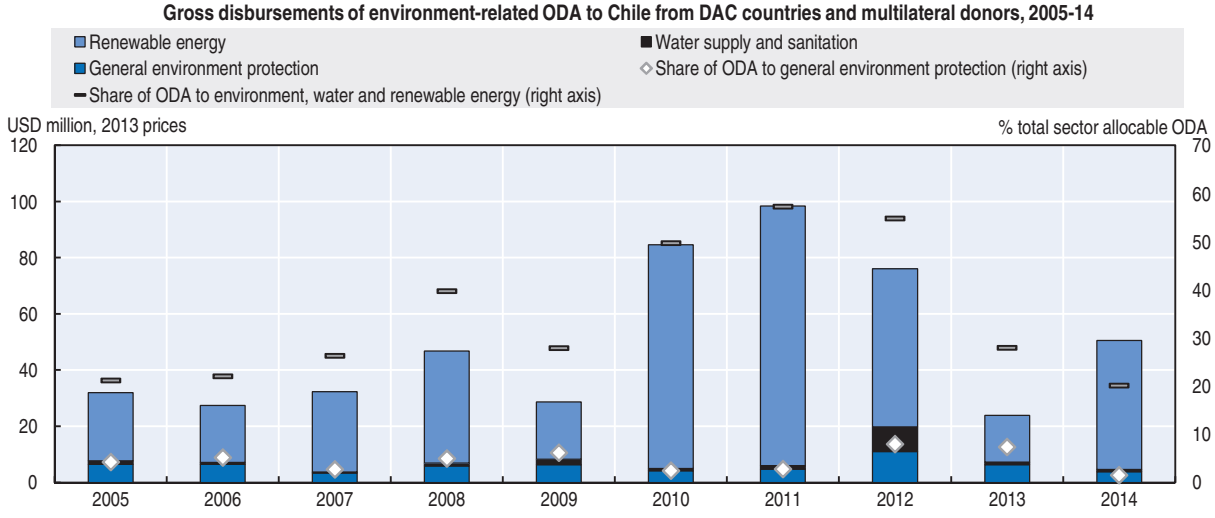
7. Environment and development co-operation

7.1. Chile as a recipient of development co-operation

Chile both receives and provides development co-operation. As an upper-middle income country between 1993 and 2012, Chile received less official development assistance (ODA) than most other countries in the region. Net ODA inflows averaged at less than 0.1% of Chile's annual gross national income (GNI) over 2005-13; per capita ODA reached USD 4.50 in 2013, the third lowest value in Latin America.

One-third of total ODA disbursements to Chile over 2005-14 targeted environment-related sectors. Most of this finance targeted renewable energy development (which alone accounted for 29% of total ODA disbursements), with a peak in 2010-11 (Figure 3.16). Water and sanitation and general environmental protection together accounted for about 6% of ODA disbursements to environment-related sectors. Despite being relatively low, ODA and other international finance have been an important source of funding for Chile's efforts on climate change mitigation and biodiversity conservation (Chapters 4 and 5). As Chile is now considered a high-income country, it will likely be ineligible for ODA as of 2017.[52] This will make financial contributions to Chile less attractive for bilateral donors, as public international finance would no longer count as ODA. As a result, Chile will have to expand its use of domestic public resources and private finance to pursue environmental objectives.

Figure 3.16. **Renewable energy receives a large share of official development assistance**



Note: Amounts of gross ODA disbursed by donors in a given year. These amounts become net once loan repayments, debt offsetting and grant recoveries are subtracted.
Source: OECD (2016), *OECD International Development Statistics* (database).

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7.2. Chile as a provider of development co-operation

Chile has been providing bilateral development co-operation since 1993, mostly in the form of technical assistance and scholarships and mainly in Latin America and the Caribbean (LAC). In recent years, Chile has emerged as a leading proponent of triangular co-operation: according to the Ibero-American General Secretariat, it was the top provider of triangular South-South co-operation within LAC in 2013, as measured by the numbers of projects executed. It was also among the top five providers in bilateral South-South co-operation in the region (SEGIB, 2015).

Chile is an observer to the OECD Development Assistance Committee (DAC) and hence not obliged to report statistics on the volume of ODA provided. OECD (2014c) estimated that Chile's total concessional finance for development ("ODA-like" flows) doubled over the past four years, reaching USD 49 million in 2014. This equals about 0.02% of GNI, lower than the share of DAC members with similar per capita income levels such as Greece (0.11% in 2014) or Poland (0.08%). However, as is the case with other emerging donors, several government agencies directly provide and finance bilateral technical co-operation, which is not reflected in the OECD estimate. The Chilean International Co-operation Agency for Development (AGCID) estimated total development assistance at USD 57 million in 2013 (OECD, 2014b).

The Co-operation Strategy for International Development 2015-18 defined principles, objectives and sectoral priorities for Chile's development co-operation activities for the first time. "Inclusive and sustainable development" is one of three strategic axes, under which "environment, natural resources and energy" is listed as a thematic area.[53] Institutional strengthening for climate change, renewable energy sources, and sustainable water use and sanitation are emphasised (AGCID, 2015). While the AGCID does not track aid flows to sectors or socio-economic objectives, the Ibero-American General Secretariat estimates that 10% of Chile's development co-operation activities in Latin America targets environmental objectives, one of the highest shares among providers in the region (SEGIB, 2014). As Chile's development co-operation system matures, and demand to share its experiences grows, Chile should work to mainstream environmental and sustainability criteria in the design and implementation of its development policies and programmes. It should also move towards screening technical co-operation projects for potentially negative environmental impacts. Management information and statistical systems can be designed to monitor environmental finance or sustainability in project design.

Recommendations on green growth

Greening taxes and subsidies

- Increase the tax rates on petrol and diesel; gradually reduce the petrol-diesel tax gap and phase out the tax refund for the diesel used by heavy goods vehicles.
- Assess the fuel price stabilisation mechanism to ensure it does not function as an implicit fossil fuel subsidy.
- Consider revising the new tax on emissions of local air pollutants and CO_2 from large stationary sources: i) increase the tax rate on CO_2 on the basis of pre-defined steps, to better reflect the social cost of emissions; ii) include additional emission sources, such as copper smelters and other industrial plants; iii) assess the interactions between the electricity price-setting mechanisms and the CO_2 tax, and consider the adjustments needed to safeguard the full effectiveness of the tax; and iv) expand the geographical basis of the air pollution component of the tax to relevant airsheds.
- Explore the introduction of a cap and trade system for relevant pollutants and emitters that are not covered by the new tax on emissions of local air pollutants and CO_2.
- Broaden the coverage of the vehicle tax to commercial vehicles; delink the environmental and price elements of the vehicle tax; consider increasing the rates of the energy efficiency and NO_x components of the tax.

Recommendations on green growth *(cont.)*

Environment-related expenditure and investment

- Conduct systematic surveys of public environmental protection expenditure, building on the experience gained with the 2015 survey; extend the survey to sub-national institutions and private expenditure; develop a system for systematically evaluating effectiveness of environmental expenditure.
- Ensure that major investment programmes systematically consider environmental and climate objectives, include sustainability criteria to guide implementation and indicators to monitor environmental impacts.
- Continue to encourage investment in public water supply infrastructure with a view to securing drinking water supply, reducing water distribution losses and enhancing resilience against water shortages; maintain investment to improve wastewater treatment capacity, especially in rural areas.
- Continue to invest in urban public transport systems to counteract the continuous shift from public to private passenger transport and reduce congestion and emissions of GHGs and air pollutants.

Eco-innovation, green markets and employment

- Consolidate initiatives for promoting eco-innovation into a coherent strategy or framework and set long-term objectives for eco-innovation; strengthen co-ordination of industrial development, innovation and environmental policies across the government with a view to integrate eco-innovation into broader growth and competitiveness strategies and programmes.
- Develop statistics and indicators for the environmental goods and services sector, including employment, with a view to informing the evaluation of environmental policies, and policy making more generally.
- Improve the national labelling system for environmentally sustainable products; accelerate the definition of environmental criteria for public procurement.
- Develop programmes on jobs and skills that include profiles, training plans and activities for green jobs; improve co-ordination between relevant ministries and agencies (i.e. education, industrial development, environment) and consider linking the concept of green jobs to the National Training and Employment Service.

Development and trade

- Continue to promote environmental considerations in trade policies; assess effectiveness of environmental provisions in regional trade agreements.
- Ensure that environmental and sustainability criteria are mainstreamed throughout international development co-operation activities and that results are monitored and evaluated.

Notes

1. Investment in the mining sector increased from 2% of GDP in 2002 to almost 7% in 2012.
2. In April 2010, Chile was hit by a magnitude 8.8 earthquake near the northern coast, prompting a tsunami and a series of strong aftershocks.
3. The 2006 Fiscal Responsibility Law instituted a rule linking public spending to long-term government revenue, based on GDP estimates and long-term prices of copper and molybdenum. During surplus years, excess tax revenue and profits from the state-owned copper mining firm are put into two

sovereign wealth funds according to formula approaches. During deficit years, the stabilisation fund is used to cover government expenditure, which must be approved by the Chilean Congress.

4. The 2015 stimulus measures increased public spending by 10% compared to 2014 (OECD, 2015a).

5. This accompanies fully implementing existing environmental legislation, developing new policy tools to fill gaps, developing sectoral strategies (e.g. for tourism, energy, mining and agriculture) and implementing the best regulatory practices.

6. Total taxes on income, profits and capital gains for individuals and firms equalled 6.5% of GDP in Chile in 2014, compared to an OECD average of 11.7%. In addition, social security contributions were equal to 1.4% of GDP, compared to an OECD average of about 9%.

7. This refers to revenues raised on energy products (including motor vehicle fuels), motor vehicles and other taxes on transport activities, as well as other taxes of environmental relevance, such as taxes on air and water pollution, waste and hazardous chemicals, and taxes related to natural resource management.

8. Freight transport by rail is subject to VAT, and thus benefits from a refund of taxes paid on the diesel used. But as passenger transport by rail is exempted from VAT, there is no refund for taxes paid on diesel used for this purpose.

9. According to Agostini and Jiménez (2015), the tax on petrol and diesel was introduced in 1986 primarily to help finance reconstruction of the country after a major earthquake in 1985.

10. These shares include all vehicle categories, also heavy goods vehicles, for which there are hardly any alternatives to diesel engines.

11. This is because the authors assumed that only trucks use diesel. Trucks travel a shorter distance on a litre of fuel than passenger cars, which substantially reduces driving-related externalities, such as accidents, per litre of diesel use.

12. This survey only represents the population in Greater Santiago and the 14 other regional capitals, covering 57% of the total population of the country. Income levels and expenditures on motor vehicle fuels are likely lower in other parts of the country, which would tend to strengthen the robustness of the findings.

13. When ranking households by current income, the poorest decile of the population spent 0.4% of its income on transport fuels, the fifth decile spent 0.6%, the ninth decile spent 1% and the tenth decile spent 0.8%. When ranking households by current expenditures, the poorest decile spent 0.1% of expenditures on transport fuels. The respective numbers for the fifth, ninth and tenth deciles were 0.7%, 1.3% and 1.2%, respectively.

14. Agostini and Jiménez (2015) looked even more specifically at the distributive impacts of only the tax on petrol, and reached similar conclusions as Flues and Thomas (2015).

15. This is even more the case for Brazil, where energy tax revenues are very modest.

16. The Fuel Price Stabilisation Fund (FEPCO), applied in 2005-10, and the Consumers' Protection System (SIPCO), applied in 2011-14.

17. A tax on actual emissions of different pollutants from the vehicles could be even more efficient, but is not technologically feasible with current technologies.

18. New diesel light vehicles must also comply with the NO_x limits of the EURO 5 or EPA Tier 2 bin 5 standards. Imports of second-hand vehicles are not allowed, except in the free trade zones located in the north and south of the country.

19. The graph stops at a vehicle retail price of around USD 50 000, but the tax per unit of pollutants continues to increase linearly with higher retail prices.

20. In countries that include electricity generation under a binding emission cap (such as the European Union's emission trading system for greenhouse gases, EU ETS), emissions from power generation associated with the use of electric vehicles would be already accounted for.

21. The calculation of this income depends on whether the parking space belongs to the firm or a third party. If the company owns the asset, the minimum value of the benefit is 11% of the fiscal appraisal in effect on 1 January of the year when the tax is declared. If a third party owns the parking space, the value of the benefit corresponds to the amount paid by the employer.

22. The programme was implemented in 2009, with total grants of CLP 1.8 billion (USD 3.2 million), and 2011, with total grants of CLP 1.1 billion (USD 2.3 million). In 2012, it was implemented only for the Aysen region, involving grants of CLP 200 million (USD 0.4 million).

23. For a discussion of the costs and benefits of some scrapping schemes for passenger vehicles, see ITF (2011).

24. A partial assessment can still be conducted based on reported emission reductions and the tax rates on new vehicles and air emissions from stationary sources as "proxies" for the values of emission reductions. The scheme was more beneficial to society than the 2011 assessment suggested. Unless the remaining value of each scrapped truck was more than approximately USD 70 000, benefits would have exceeded costs – even when only looking at emission reductions. This calculation used the relatively high tax rate (USD 17.5 per kg) for NO_x emissions stemming from a passenger vehicle costing USD 10 000 as a starting point for valuations. Using the Swedish NO_x tax rate on stationary sources (USD 7.3 per kg), quantified benefits would be larger than costs if the remaining value of the scrapped trucks was lower than USD 20 000; this seems likely, given the age of the scrapped trucks.

25. Fiscal revenue from natural resources amounts to over 8% of GDP in Bolivia, Mexico and Venezuela.

26. The OECD considers environmentally related taxes levied on tax-bases (e.g. products, resources) of environmental relevance. A tax levied per tonne of a mineral extracted would clearly fall within the scope of this definition; a tax on the profits of some companies would normally not do so.

27. The Fund has raised almost USD 215 million per year since its establishment.

28. The 2005 *OECD Environmental Performance Review* recommended to "consider a mechanism for proper capture of resource rents associated with mineral exploitation" and the 2013 *OECD Economic Survey* recommended that Chile "carry out a review of natural resource rents and ensure that they are taxed sufficiently to ensure sustainable development".

29. These values are larger than those stipulated in the Ministry of Finance's budget allocation for 2012, when expenditure for environmental protection (in nominal prices) amounted to CLP 105 billion (or 0.38% of GDP). This is explained by a different methodology (including a more detailed classification of expenditures) applied within the CEPAL and MMA (2015) methodology.

30. The analysis on public environmental expenditure in Colombia and Mexico, for example, covered the whole government (i.e. federal, state and local governments). Mexico's study also included household expenditure.

31. On average, the central government accounts for more than 95% of total public expenditure in Chile, including all expenditure domains.

32. Government investment in Chile amounted to 1.4% of GDP in 2013, significantly below the Latin American average of 11% (OECD, 2014d).

33. The Chilean government uses the term non-conventional renewable energy sources for solar, wind, geothermal, biomass, tidal power and hydropower below 40 MW.

34. The quota obligation, introduced in 2010 and strengthened in 2013, requires electricity companies to gradually increase the share of renewables in their power supply with a view to reach 20% in 2025 (Chapter 4).

35. In contrast to many other OECD member countries, urban water supply and wastewater treatment services were fully privatised in Chile between 1989 and 2004. The market share served by private water companies increased from 10% to 95% between 1997 and 2008.

36. Total investment for 2015-25 is projected at USD 1.4 billion, less than half of volume invested over 1999-2009 (SISS, 2015a).

37. The Chilean Copper Commission (COCHILCO) estimates that up to USD 10 billion may be invested in desalination technologies by 2025 (El Mercurio, 2014). This has implications for energy needs and potentially ecosystems and biodiversity (see Chapters 1 and 5).

38. Risk mitigation measures for the Metropolitan Region (e.g. water reserve tanks and the construction of a damn) are estimated to require USD 140 million; this, in turn, would increase tariffs of 1.5 million customers by 2.5% (SISS, 2014).

39. Water tariffs include a fixed and a variable part. The variable tariff for each water provider considers the market price of traded water-use rights. Fixed tariffs also vary according to water scarcity: they represented nearly USD 2/m^3 in the dry north and less than USD 1/m^3 in the southern areas (Donoso, 2015).

40. The central government transfers money to municipalities for them to cover a share of poor households' water bill (from 15% to 85%, with the poorest families getting the highest share). The subsidy may cover up to either i) 20 m^3 of monthly consumption, or ii) 85% of the total bill, above

which poor households must pay the full tariff so as not to distort price signals (except beneficiaries of the Chile Solidarity Programme who are fully covered).

41. Since 1991, the Rural Drinking Water Programme targets water and sanitation in "concentrated towns" (towns with over 300 inhabitants and a minimum density of 15 households per km^2) and "semi-concentrated towns" (towns with at least eight inhabitants and a minimum density of eight households per km^2) (Donoso, 2015).

42. The monthly tax unit and annual tax unit (or UTM and UTA, respectively) are indexed account units used in Chile for the payment of taxes and fines. Their value is adjusted monthly for inflation. As of December 2015, a UTM was 44 955 CLP (or about USD 69) and a UTA was 539 460 CLP (or about USD 824).

43. Better innovation performance in water pollution abatement may be related to the expansion of the wastewater treatment services over this period (see Section 4.2).

44. Data are based on three-year averages.

45. Higher value patents are those that seek intellectual protection in at least two jurisdictions. Chile counted a total of 25 higher value patents in 2012. The number has fluctuated between 10 and 39 per year since 2005.

46. The specialisation in environmental technologies is also measured by the "revealed technology advantage" (RTA) index, which compares a country's share of patents in a particular technology field to its share in all patent fields. The index is equal to zero when the country holds no patents in a given sector; 1 when the country's share in the sector equals its share in all fields (no specialisation); and above 1 when a specialisation is observed. Chile has an RTA in environment-related technologies of 1.2, the seventh highest value in the OECD (OECD, 2015d).

47. The Programme for Business Innovation for Strategic Sectors defines solar energy and sustainable aquaculture as strategic sectors, along traditional export-oriented activities such as mining, agriculture and construction.

48. Energy-related SMEs, in co-operation with university research centres, are some of the main beneficiaries of InnovaChile: the agency supported more than 120 innovation projects with about USD 40 million to transfer, improve or develop renewable energy technology between 2005 and 2010 (Pueyo et al., 2011).

49. The agreement with Canada involved the establishment of a joint commission to implement, monitor and assess environmental co-operation, and provided for public access and consultation structures (Gallagher and Serret, 2011; George, 2013).

50. The agreement between Chile and Malaysia (2012), for example, establishes co-operation in areas of common global or domestic interest (such as climate change, air pollution and environmental impact assessment) and provides that countries shall not relax or fail to enforce their environment laws and regulations to encourage trade and investment.

51. On areas like climate change, biodiversity, protected areas, restoration of contaminated sites, waste and air management, environmental data, strategic environmental assessment and civil society participation.

52. According to the World Bank's country classification, Chile became a high income economy in 2012 (the classification is based on GNI per capita in USD; see *http://data.worldbank.org* for details). The OECD Development Assistance Committee (DAC) revises its *List of ODA Recipients* every three years and removes countries that have exceeded the World Bank's high-income threshold for three consecutive years at the time of review. Chile will therefore likely graduate from the list in the next review in 2017.

53. This accompanies other domains such as social development, local development, agricultural development, disaster risk reduction, and strengthening of democratic institutions.

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ANNEX 3.A

Data on green growth performance

Figure 3.A1. **Environmentally related taxes**

Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.

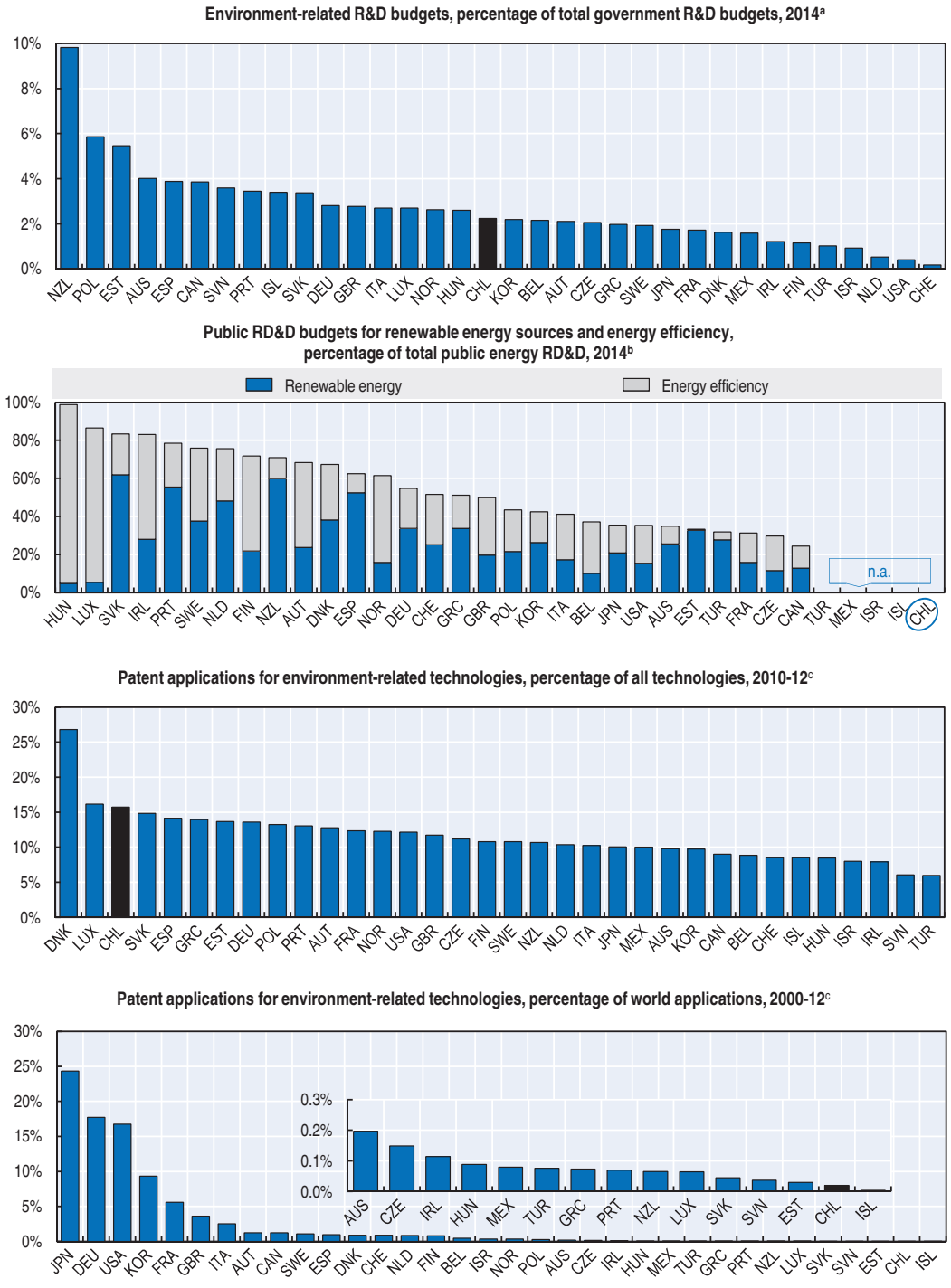
a) Until 2014, the system used to stabilise end-use prices of motor fuels caused tax revenue to turn negative (i.e. become a subsidy) in years when the international oil price was high. Mexico's 2013 Tax Reform corrected this mechanism and introduced a tax on fossil fuels based on their carbon content, which will yield positive revenue.

b) Diesel: automotive diesel for commercial use, current USD; petrol: unleaded premium (RON 95), except Japan (unleaded regular), USD at current prices and purchasing power parities.

Source: IEA (2015), *IEA Energy Prices and Taxes Statistics* (database); OECD (2015), *OECD Database on Instruments Used for Environmental Policies and Natural Resources Management* (database).

StatLink http://dx.doi.org/10.1787/888933388184

Figure 3.A2. **Green innovation**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.

a) Government budget appropriations or outlays for research and development (R&D); breakdown according to the NABS 2007 classification.

b) Public energy technology budgets for research, development and demonstration (RD&D).

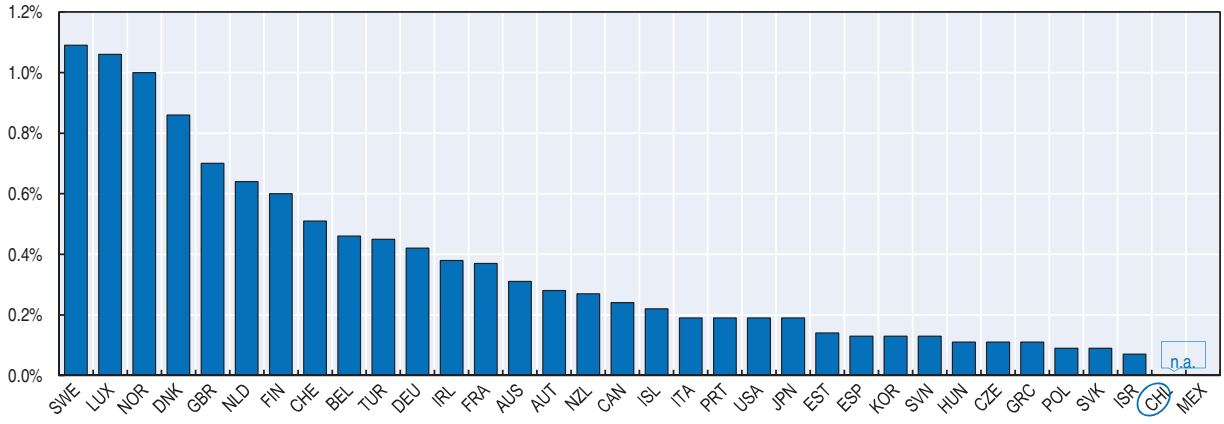
c) Higher-value inventions that have sought patent protection in at least two jurisdictions. Data are based on patents applications filed under the Worldwide Patent Statistical Database (PATSTAT) of the European Patent Office (EPO) and refer to fractional counts of patents by inventor's country of residence and priority date.

Source: IEA (2015), *IEA Energy Technology RD&D Statistics* (database); OECD (2015), "Patents in environment-related technologies: Technology development by inventor country", *OECD Environment Statistics* (database); OECD (2015), "Research and Development Statistics: Government budget appropriations or outlays for RD", *OECD Science, Technology and R&D Statistics* (database).

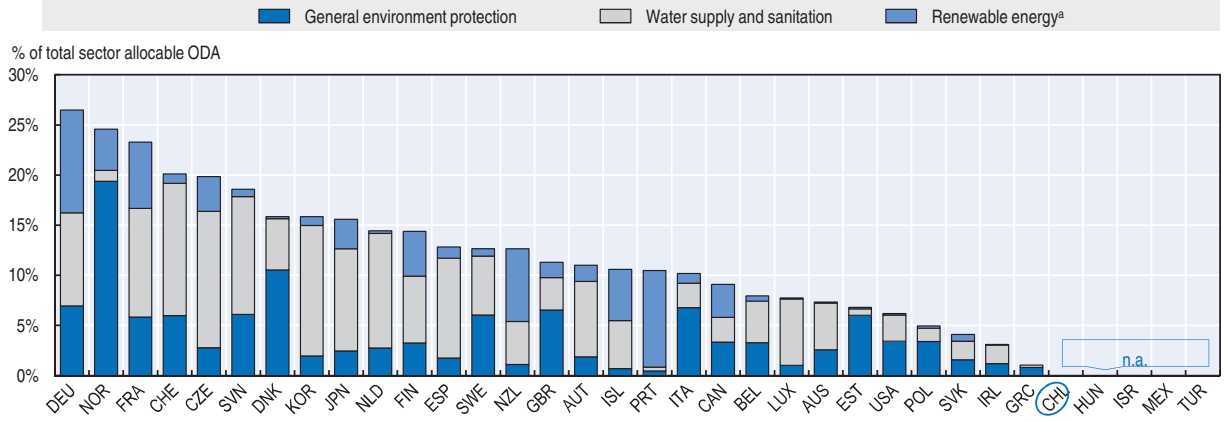
StatLink http://dx.doi.org/10.1787/888933388199

Figure 3.A3. **International development co-operation**

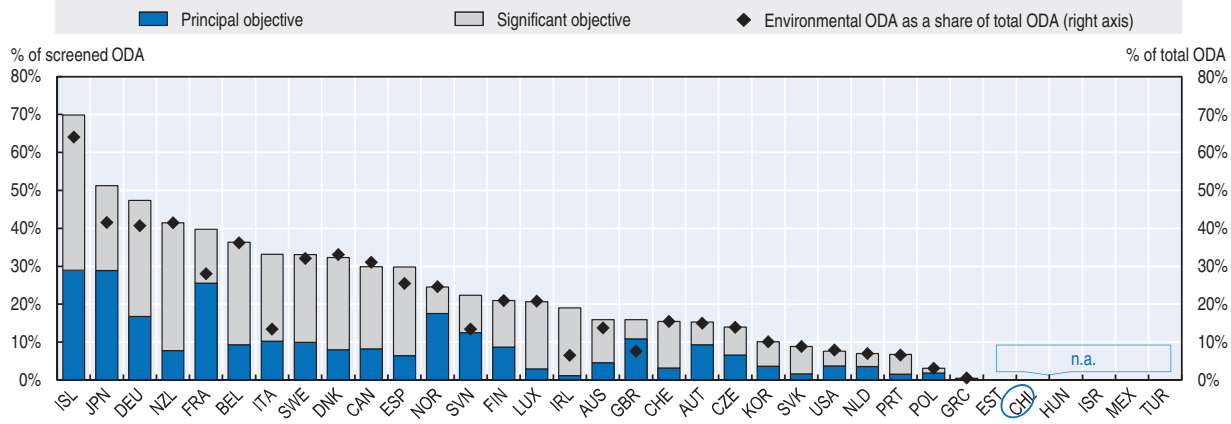
Net disbursements of Official Development Assistance (ODA) as percentage of gross national income, 2014



Bilateral ODA commitments to the environment, water and renewable energy sectors, average 2012-14



Bilateral ODA commitments targeting the environment sector, average 2013-14[b]



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. CHL, EST, HUN, ISR, MEX and TUR are not members of the OECD Development Assistance Committee.

a) Renewable energy includes power generation/renewable sources, hydro-electric power plants, geothermal energy, solar energy, wind and ocean power, and biomass

b) In comparing data across countries it should be noted that the coverage ratio of the environmental policy objective (i.e. the proportion of aid which is screened against the environment policy marker) varies considerably among countries; low coverage rates can increase significantly the shares of environmental-focused aid.

Source: OECD (2015), OECD *International Development Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388207

PART II

Progress towards selected environmental objectives

PART II

Chapter 4

Climate change

Chile's emissions of greenhouse gases are below the OECD average, but are growing rapidly. Meanwhile, it is vulnerable to the effects of a changing climate. In addition to exploring the evolution of mitigation policies in Chile across a range of key sectors, including energy, this chapter analyses the country's strategy for adapting to the impacts of climate change.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Introduction

Chile ratified the United Nations Framework Convention on Climate Change in 1994 and the Kyoto Protocol in 2002. It has made active use of the mechanisms under these treaties, with more than 100 Clean Development Mechanism (CDM) projects approved. Although not subject to quantitative limits on its emissions under Kyoto, it has now taken on international commitments: at Copenhagen in 2009, it pledged to reduce emissions by 20% in 2020, compared to business-as-usual. Chile's Intended Nationally Determined Contribution (INDC) commits it to reduce its emissions intensity (greenhouse gas emissions per unit of GDP) by 30% in 2030, which could be enhanced to 45% contingent on receipt of adequate international financial support.

A strengthened, comprehensive policy response will be required to ensure that Chile meets its international commitments. Domestic climate policies provide a firm foundation for this, particularly through improvements to the evidence base and institutional reforms. Reforms to energy market policies have enabled rapid growth in renewable generation, without subsidies. The introduction of carbon pricing should help encourage low-carbon generation more generally. The challenge now is to build on these achievements to tackle emissions across all sectors, including transport and agriculture.

Climate policy is also tackling the challenge of adapting to climate change. These impacts will vary across Chile's diverse geography, but will include: increased flood risk, reduced availability of water for hydropower, reduced agricultural production and impacts on biodiversity. Implementation of the sectoral adaptation plans will be essential in preparing for these changes, combined with robust monitoring and evaluation to ensure that vulnerability is being reduced.

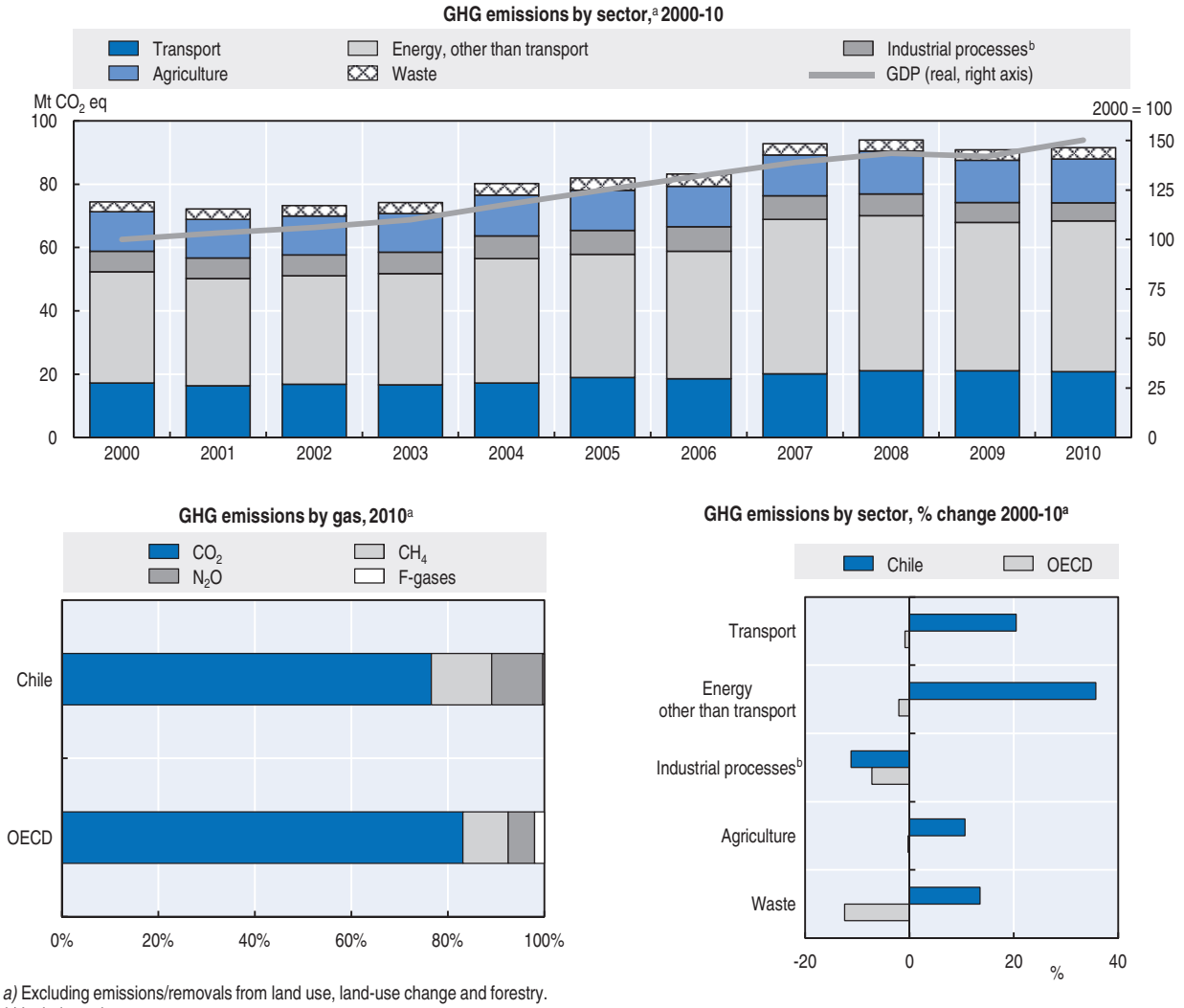
1. State and trends

1.1. Trends in greenhouse gas emissions

Chile's contribution to global greenhouse gas (GHG) emissions is small (0.2% in 2010), as is its share of OECD emissions (0.6%) (IEA, 2015). Its emissions have increased rapidly, however, due to its fast rate of economic growth (Figure 4.1). Chile's latest national emissions inventory provides GHG data until 2010. Total GHG emissions were 91.6 million tonnes of carbon dioxide equivalent (Mt CO_2 eq) in 2010, excluding land use, land-use change and forestry (LULUCF) (Government of Chile, 2014a). This represents an increase of 23% from 2000 and compares to an average decrease of about 1.5% in the OECD over the same period (Annex 1.B).[1] Net removals from LULUCF stayed largely constant at about 50 Mt CO_2 eq during this time.

Emissions from most sectors grew between 2000 and 2010, especially from energy production and use (Figure 4.1). Energy-related emissions rose by 31% during this period, reaching 75% of total GHG emissions. Increased use of coal and oil for power generation and of petrol and diesel for transport were the main driver of this growth. Rising nitrous oxide (N_2O) emissions from fertiliser use linked to increasing production sparked a growth in agricultural emissions (which accounted for 15% of total emissions in 2010; see Figure 4.1).

Figure 4.1. **GHG emissions increased with economic growth**



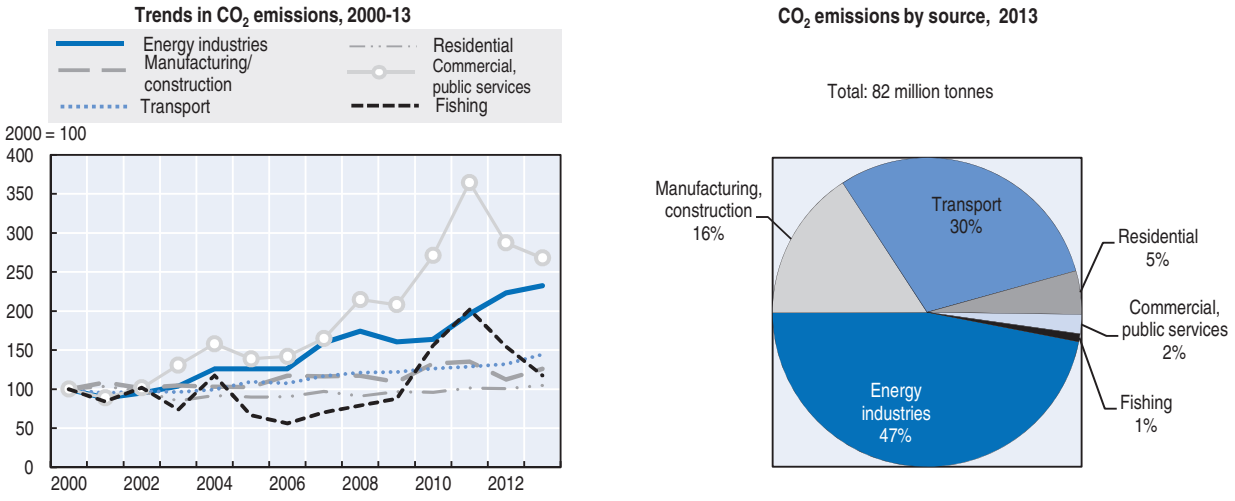
a) Excluding emissions/removals from land use, land-use change and forestry.
b) Includes solvents.
Source: OECD (2015), "Greenhouse gas emissions by source", *OECD Environment Statistics* (database); OECD (2015), *OECD National Accounts Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388596

More recent International Energy Agency's data indicate that electricity and heat production and transport are the major sources of carbon dioxide (CO_2) emissions from fuel combustion (IEA, 2015). CO_2 emissions from energy industries more than doubled between 2000 and 2013, and those from transport increased by 44%. Emissions from commercial and public services grew even faster, although they represent a minor share of total CO_2 emissions from fuel combustion (Figure 4.2).

CO_2 was the largest component of GHG emissions in Chile, accounting for 77% of total emissions in 2010 (IEA, 2015). Emissions of methane (CH_4) and N_2O, which both arise predominantly from agriculture and play a larger role in Chile than in the OECD as a whole, together accounted for 23% of GHG emissions in 2010 (Figure 4.1). Waste, which is mostly landfilled (Chapter 1), and energy are also major contributors to methane emissions. Emissions of fluorinated gases (F-gases) were negligible.

Figure 4.2. **Energy production and transport are the major sources of CO_2 emissions**



Note: CO_2 emissions from energy use only; excludes international marine and aviation bunkers; sectoral approach.
Source: IEA (2015), *IEA CO_2 Emissions from Fuel Combustion Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933388601

In 2010, Chile's GHG emissions per capita were the lowest of all OECD member countries (Annex 1.B). Energy-related CO_2 emissions per capita were nearly half the OECD average (see Basic Statistics). This reflects the remaining difference in income levels (Chapter 1). However, as GDP per capita catches up with the OECD average, Chile's emissions per capita are likely to follow the same trend.[2]

As of 2010, Chile's GHG emissions intensity (GHG emissions per unit of GDP) was in line with the OECD average (see Basic Statistics). The carbon emissions intensity of economic activity has been decreasing over time, but there is still a positive correlation between growth in emissions, energy supply and GDP (Figure 1.8). Between 2000 and 2013, real GDP increased by 75%, while CO_2 emissions from fuel combustion rose by 69% (IEA, 2015).

The Mitigation Action Plans and Scenarios (MAPS) project has estimated emissions trajectories for Chile until 2030 (MAPS Chile, 2014). These projections estimate business-as-usual (BAU) emissions in the absence of any further mitigation policies beyond those approved by the end of 2012. According to the latest baseline projections, emissions could increase by 58% by 2020, compared to 2010.[3] By 2030, GHG emissions could rise to 178.9 Mt CO_2 eq (an increase of 95% from 2010) and per capita emissions to 9.1 tCO_2e (excluding LULUCF). Removals from forestry would decline very slightly under all scenarios. These estimates do not include the effect of mitigation policies introduced in the past two years, which are likely to reduce emissions relative to that baseline.

1.2. Current and projected impacts of climate change

Given Chile's diverse geography and topography, the impacts of climate change do not manifest equally throughout the country. Temperatures along the coast of Chile have declined by approximately 1°C since the 1960s as a result of more intense trade winds. There has been discernible warming, however, in the Central Valley and Andes mountains (Magrin et al., 2014).

Precipitation displays considerable variation between decades, driven by processes such as El Niño and La Niña[4] (Magrin et al., 2014). It is also strongly affected by location,

A corrigendum has been issued for this page. See: http://www.oecd.org/about/publishing/Corrigendum-EPR-Chile.pdf

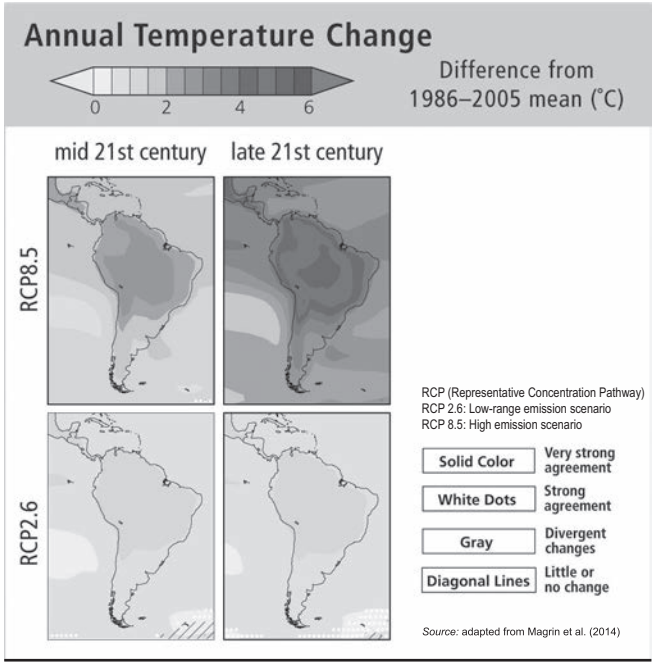
with the result that sub-national trends are more informative than average changes at the national level. The main changes that have occurred are the following (Government of Chile, 2011):

- Northern Chile: precipitation has decreased since the mid-1970s.
- North-Central: no clear trend.
- South-Central and Southern Chile: precipitation increased until the 1970s and has since declined.

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) summarises the latest results of climate modelling relevant to Chile (Magrin et al., 2014). Some of the variation in climate and geography along Chile's 4 300 kilometres (km) length is reflected in projected changes in temperature and precipitation (Figures 4.3 and 4.4). Warming is most pronounced in the north, declining towards the south of the country. Under a high emissions scenario (known as RCP 8.5), for example, temperatures are projected to increase by more than 2°C in the Atacama and 1°C in Patagonia. Chile's 2014 National Climate Change Adaptation Plan notes that increase in average temperatures in Chile will be lower than average global increases (Government of Chile, 2014e).

Figure 4.3. **Temperature increases are projected to be highest in northern regions**

Projected changes in annual average temperature in South America

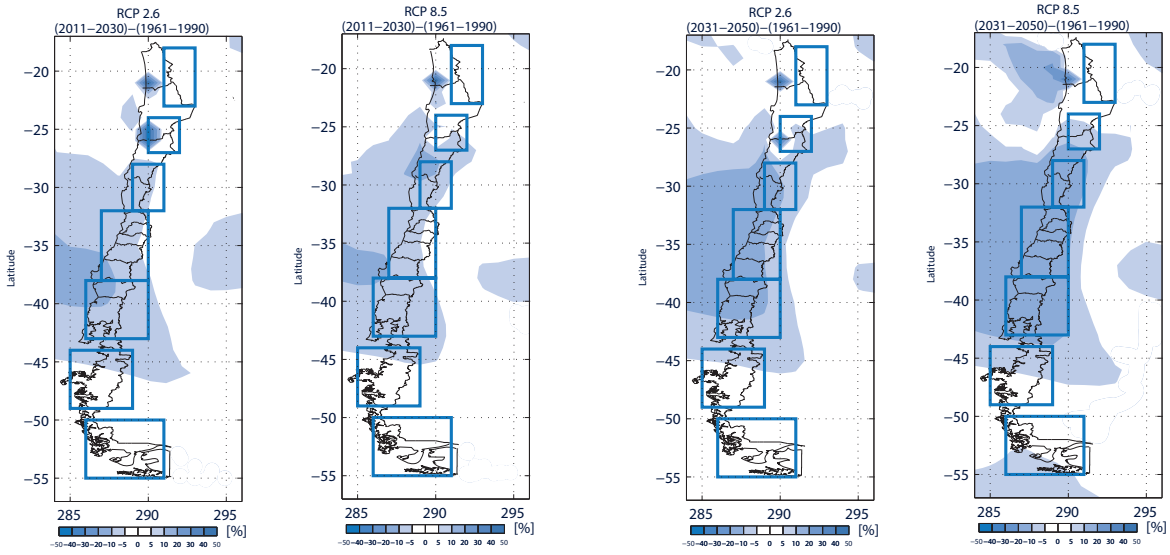


Chile has detailed climate projections, but they need to be updated and extended. The country's metrological institute developed geographically detailed simulations for 2030-60 for both low-emissions and high-emissions scenarios. However, these were created before some of the latest scientific developments in climate modelling in the IPPC's Fifth Assessment Report. An official set of climate projections for Chile, including consistent scenarios for planning that cover periods relevant for long-lived infrastructure, would aid adaptation

A corrigendum has been issued for this page. See: http://www.oecd.org/about/publishing/Corrigendum-EPR-Chile.pdf

Figure 4.4. **Climate change is projected to reduce precipitation in the central region**

Average change in precipitation by Chilean region



Source: Government of Chile (2014e)

planning. Preferably, these projections would be based on – and consistent with – the latest IPCC science.

The National Climate Change Adaptation Plan (2014) summarises the latest information on how climate change will affect extreme weather events over the course of the century. The trend with temperatures is clearest: the frequency of hot days will increase. Temperatures experienced once every 20 years will occur every two years in most regions of Chile by the end of the century. The majority of climate model simulations predict that droughts, defined as two consecutive years of low precipitation, will become much more frequent. The combination of climate change and key socio-economic trends, such as more people and assets concentrated in vulnerable areas, is projected to increase global losses from extreme weather events. The May 2015 flooding and mudslide in northern Chile demonstrated the types of possible impacts: it led to 31 casualties and left 16 588 people homeless (ONEMI, 2015). The Chilean government estimated recovery costs of at least USD 1.5 billion for this incident (O'Brien and Esposito, 2015).

The national plan identifies a range of potential impacts arising from reductions in water availability, rising temperatures and extreme weather events (Government of Chile, 2014e):

- Lack of water could constrain hydropower, with CEPAL (2012) estimating potential reductions in electricity generation in the range of 10% to 22%. Less available water for cooling could also affect thermal generation. Patterns of consumption will shift, as demand for cooling increases and that of heating decreases.
- Increased soil erosion would negatively affect agricultural production. Pests are likely to increase, while some diseases could diminish. The zones of suitability for forestry, fruit and wine production will shift. Irrigated land could become more productive as temperatures rise, provided enough water is available.

- Negative impacts on biodiversity could arise as the pace of climate change exceeds species' ability to adapt. It could take several centuries for ecosystems to find a new equilibrium, following disruption caused by climate change (Chapter 5).
- Risk of flooding could increase. For example, CEPAL (2015) estimates that coastal floods that now occur in Valparaíso once every 50 years will occur every 11 years by 2070.

CEPAL (2010) provided monetary estimates for some of these potential impacts from now until 2100. It found economic benefits for agriculture and forestry, but net costs for fruit growing, livestock, hydropower and drinking water provision. Overall, economic losses would amount to 1.1% of GDP under a higher-warming scenario (equivalent to a global temperature increase of 3.4 C). Moreover, reduced hydropower would increase emissions by 3 Mt CO_2 eq per year if thermal generation were used to fill the gap. A range of important impacts, however, were not considered. These include increased deaths in hot weather, either directly or as a result of interactions between temperatures and air quality; extreme weather; impacts on businesses; and biodiversity. As such, these monetary estimates only capture a fraction of the potential costs of climate change in Chile.

The evidence base on adaptation is improving, but risks and opportunities from a changing climate have not yet been analysed systematically. Such an analysis could build on the results of CEPAL (2010; 2012; 2015) to inform the planning of subsequent phases of the national adaptation plan. Decision making for adaptation could also be improved by making the results of climate projections more accessible to end users. A web portal, for example, could be created as proposed in the national adaptation plan.

2. Institutional framework

Since the 2005 *OECD/ECLAC Environmental Performance Review*, Chile has strengthened its institutional arrangements for climate policy development and implementation. Prior to 2010, the National Commission on the Environment (CONAMA) led climate policy, co-ordinating activities across various sectors. In 2010, responsibility was moved to the newly-created Ministry of Environment (Chapter 2). Within the environment ministry, the Office of Climate Change (OCC) was established to co-ordinate and support climate policy across government. Its remit includes proposing and implanting climate-related policies, as well as generating and collating analysis to support policy development. In addition to monitoring Chile's progress in implementing climate policies, the OCC serves as the focal point for international processes, including the CDM and Adaptation Fund.

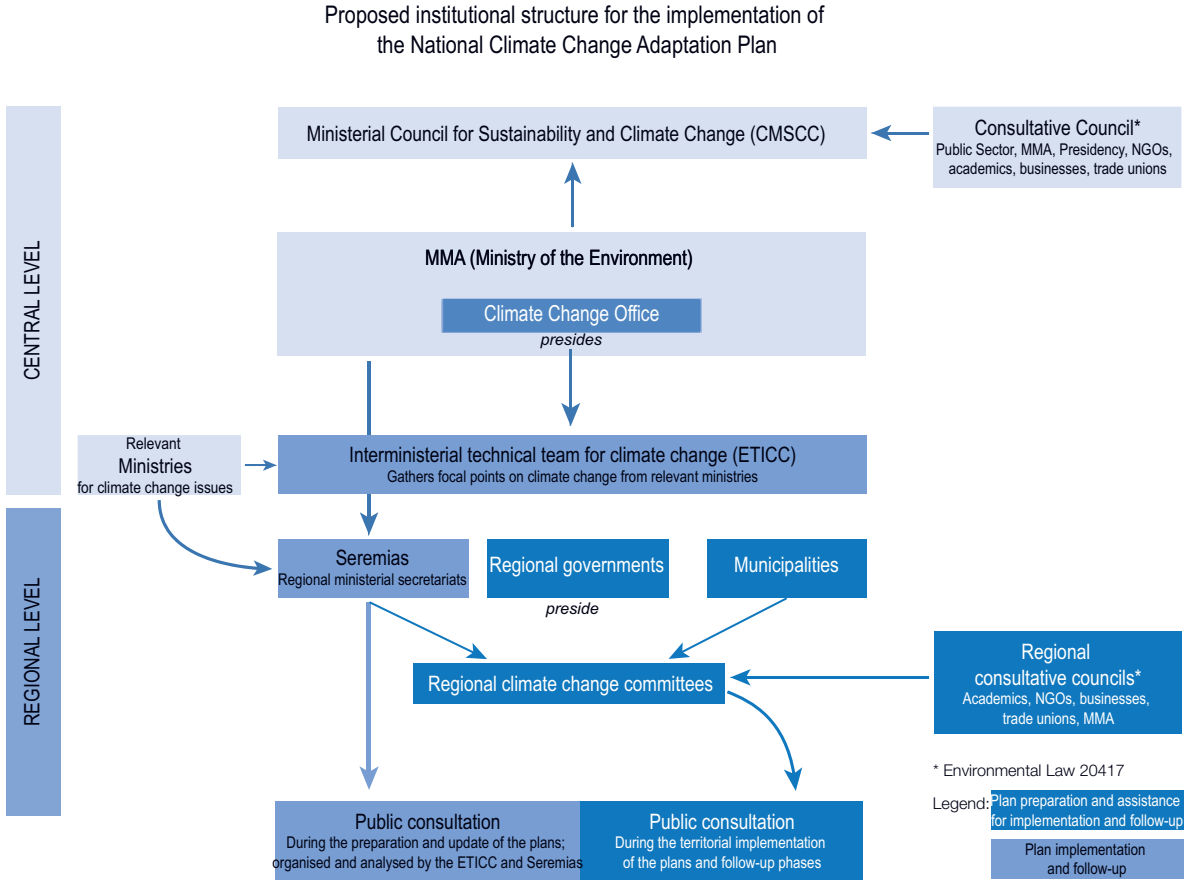
The Council of Ministers for Sustainability oversees cross-government climate policy, bringing together most relevant ministries. The government plans to change the name of this group to Council of Ministers for Sustainability and Climate Change, which demonstrates the increasing importance given to climate change by the current administration. The government is also considering expanding the group's mandate so it can influence climate policy, as well as expanding its membership to include the Ministry of Foreign Affairs (Chapter 2). However, this group already has a broad remit and meets only several times per year. As such, its role has predominantly been to approve policies, rather than inform their strategic direction.

The 2014 Biennial Update Report (Government of Chile, 2014a) notes the relevant ministries have taken some initial steps to build capacity for mainstreaming climate policy. This includes establishing focal points within these ministries for climate issues. The Ministry of Energy has a division for sustainable development, as well as agencies to

support key mitigation activities: energy efficiency and renewable energy. Most ministries, however, have not moved to mainstream climate policy.

The national adaptation plan includes reforms to strengthen the institutional basis for climate adaptation, and support mitigation policy. Each relevant ministry will designate climate change focal points to enhance horizontal co-ordination. New regional climate change committees (*Comités Regionales de Cambio Climático*), will enhance vertical co-ordination; they will bring together the local representatives of central government, as well as representatives of local government and regional consultative councils (Figure 4.5).

Figure 4.5. **Institutional structure for climate change adaptation**



Source: Government of Chile (2014e)

There are, however, some underlying challenges with the current institutional arrangements. The environment ministry co-ordinates climate policy, but other ministries control policy levers and resources for implementation. The absence of a strong institutional mandate means that implementation of climate policy depends upon the willingness and capacity of the relevant ministries to take action. The final evaluation of the National Climate Change Action Plan 2008-12 (University of Chile et al., 2015) found this had resulted in uneven levels of engagement across sectors, as well as at the local and regional levels. The evaluation also highlighted the absence of sufficient and consistent funding for climate change as a barrier to action by ministries.

As in other OECD member countries, Chile finances climate policy through the usual budget process. In principle, this can help avoid distortions in spending decisions that can arise from "earmarked funds". It can also support a more integrated approach, recognising that spending for climate concerns is often intertwined with other purposes. However, climate focal points perceived that more immediate spending priorities are squeezing out spending on climate. A particular challenge to date has been the limited engagement of the Ministry of Finance in institutional arrangements for climate policy.

3. Policy framework

3.1. Chile's objectives and commitments

As a "non-Annex 1" country, Chile was not required to make quantitative emissions reductions under the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Under the 2015 Paris Agreement, however, all countries are now committed to peak emissions as soon as possible, and then achieve rapid reductions thereafter. Each country will have to communicate Nationally Determined Contributions (NDCs) every five years. These will need to become increasingly ambitious over time to meet the overall aim of the agreement of limiting temperature rise below 2°C. This aim will require achieving a global balance between emissions and removals by the end of this century. The ambition of these NDCs should reflect countries' common but differentiated responsibilities, with developed countries taking the lead. Chile is also required to submit regular National Communications to the UNFCCC, including an inventory of anthropogenic emissions and measures taken to reduce emissions and tackle climate change.

At the Copenhagen climate conference in 2009, Chile made a voluntary commitment to take Nationally Appropriate Mitigation Actions (NAMAs) 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 LULUCF measures are the main focus of Chile's NAMAs (Government of Chile, 2010).

In advance of the Paris climate change conference in December 2015, Chile submitted its INDC to complement its 2009 commitment (Government of Chile, 2015). Unlike many other countries, the government worked extensively to raise awareness and solicit public input. The Ministry of Environment led web-based public consultations on the draft INDC and held open meetings throughout the Chilean regions. The consultation led to separating reforestation from improved management in the forestry target. The final draft reduced the level of ambition for emissions intensity, but it is not clear if this was related to consultations.

Chile's INDC commits it to reduce its intensity of emissions (relative to GDP) by 30% by 2030 (relative to 2007). This target is not directly comparable with those proposed by other Latin American countries, as they are expressed using a variety of metrics and use different approaches to key sectors such as LULUCF:

- Argentina: reduce 2030 emissions by 15% relative to business-as-usual, with the possibility of a 30% reduction conditional on international support.
- Brazil: reduce 2025 emissions by 37% below 2005 levels, with an indicative contribution of a 43% reduction by 2030 relative to 2005.
- Colombia: reduce 2030 emissions by 20% relative to business-as-usual, with a conditional offer of 30%.

- Costa Rica: reduce 2030 emissions by 25% compared to 2012 emissions.
- Mexico: reduce emissions of GHGs and short-lived climate pollutants by 25% in 2030 relative to business-as-usual, which could be strengthened to a 40% reduction conditional on international support.

Chile's contribution is, however, contingent upon the achievement of sustained growth over the commitment period. The level of ambition could rise (35% to 45%) if international grants cover the additional costs of the necessary mitigation measures. This target covers all sectors of the economy except for LULUCF, which is subject to a separate target given that emissions from this sector are not directly linked to GDP. The commitment for forestry is expressed in absolute terms: to sustainably manage and restore 1 000 square kilometres (km^2) and plant an additional 1 000 km^2 of predominantly native forest.

A key test of mitigation policies is their impact on the trajectory of absolute emissions over time. In the case of Chile, both the pace of economic growth and the timing of emissions reductions over the INDC period will affect that trajectory. These indicators are not known, but MAPS projects that proposed targets will slow the growth of emissions rather than reducing them in absolute terms. By 2030, Chile's per capita emissions will rise to 9.1 tCO_2e under the baseline, which would be reduced to 8.1 tCO_2e with the 30% target (Table 4.1). By this date, Chile is projected to have GDP per capita similar to that of Spain and France now, but with higher per capita emissions: France emitted 7.8 tCO_2e/capita and Spain 7.3 tCO_2e/ capita in 2012, excluding LULUCF.

Table 4.1. **Estimate of GHG emissions reduction from Chile's INDC**

In Mt CO_2 eq, excluding LULUCF

	Low GDP growth scenario	Medium GDP growth scenario	High GDP growth scenario
1990 emissions	50 (3.8 t per capita)		
2010 emissions	92 (5.4 t per capita)		
Baseline emissions in 2030 (LB2013 excl. LULUCF)	163	179 (9.1 t per capita)	195
30% target	147	160 (8.1 t per capita)	175
35% to 45% target	116-137	127-149 (6.5 t-7.6 t per capita)	138-163

Source: Authors' calculations based on MAPS Chile (2014) and Government of Chile (2015).

There are some ambiguities still with the INDC that could be usefully clarified in the forthcoming climate change action plan for the period 2016-21 (Section 3.2). The economic growth condition is open to interpretation in assessing what constitutes "similar rates of economic growth". Given the rapid and sustained growth over the past decade (excluding 2008 and 2009) and the recent slowdown (Chapter 1), economic growth could prove a stringent criterion to maintain these rates until 2030. Clarifying how to assess if the economic growth condition holds, and then communicating results for the period to 2030, could be helpful. It would also be useful to clarify the consequences of not meeting the target for economic growth.

The target of 35% to 45% reduction in emissions, contingent upon international financial support, could also be clarified. There are no specific estimates of the level of funding needed to meet this target. In principle, international grants would cover the full costs of mitigating beyond 30%. In practice, this adds a further layer of uncertainty about the nature of the commitment due to inherent challenges in assessing the additional impact of international funding.

3.2. Strategies and programmes for climate change mitigation and adaptation

The 2006 National Climate Change Strategy set the broad outlines for domestic climate policy, which the National Climate Change Action Plan 2008-12 (Climate Action Plan) subsequently elaborated. This plan was designed to minimise the adverse impacts of climate change and mitigate GHG emissions through actions across three priority areas: adaptation, mitigation and capacity building. Its 22 "lines of action" had 103 specific actions and identified clear timelines for implementation, as well as the institution(s) responsible. The majority of actions have now been completed (Government of Chile, 2014a).

The Climate Action Plan was primarily intended to lay the foundation for future mitigation and adaptation actions. It does not include direct measures to strengthen resilience to climate change or reduce GHG emissions. Nor does it directly touch upon the question of how these climate measures should be financed. The plan focused on improving the evidence base, including trends, future vulnerabilities and analysis of potential mitigation options. There were also initial measures to strengthen the institutional basis of climate policy in Chile, including establishing the OCC.

For climate change adaptation, the Climate Action Plan called for a national adaptation plan and sectoral plans. These are intended to improve understanding of the main vulnerabilities and propose responses in some of the essential sectors for adaptation, including water, agriculture, biodiversity and energy. The Ministry of Environment, in collaboration with the relevant sectoral ministries, had overall responsibility for producing these plans.

At the end of 2014, the government approved the National Climate Change Adaptation Plan to strengthen the framework for adaptation at the national level. It aims to raise awareness, build capacity and mainstream adaptation into sectoral and local decision making. At the same time, the plan is meant to enhance co-ordination and provide an overall framework to support adaptation; concrete adaptation actions are to be elaborated in the sectoral plans. The actions in this plan include the creation of a web portal with information on adaptation, as well as creation of networks to help exchange information on climate change adaptation and the institutional reforms described in Section 2. Beyond this, the national plan includes actions to manage cross-sectoral risks. It adds the requirement to develop sectoral adaptation plans for two additional sectors: cities and tourism.

One of the challenges with having both a national plan and a series of sectoral plans is the treatment of cross-cutting risks between, for example, energy, infrastructure and water. Each sectoral plan has a lead ministry and co-responsible ministries, but its operation in practice will need to be evaluated. Thematic strategies, such as the one on cities, could be a potentially useful model for considering interactions across existing sectoral silos.

The government is finalising the climate change action plan for 2016-21, which will build on experiences gained from the national adaptation plan. According to the INDC, the new action plan will provide an integrated approach to mitigation, adaptation and capacity building, and assign responsibilities for implementation. In particular, it could outline concrete measures linked to a financing framework, as well as clear mechanisms for measuring progress.

3.3. Measuring progress and accountability

Emissions commitments play an important domestic and international role in supporting accountability. Internationally, commitments must encourage mutual trust and

increasing levels of ambition over time. Domestically, clear and credible targets can reinforce mitigation activity by shaping expectations and investment decisions, within the public and private sector. The INDC commitment builds on the 2009 commitment, but there is still room for improvement.

Chile's 2020 voluntary commitment needs further clarification before it can be used as a benchmark for measuring progress and achieving accountability. In particular, there is a need to specify the absolute level of emissions that would be consistent with meeting that relative goal. Phase 1 of the MAPS project has helped fill a key gap by estimating baselines for 2020 for a range of different emissions trajectories (MAPS Chile, 2014). The size of reductions required to meet the target will depend upon the scenario used to assess the target.[5] At present, Chile's growth is tracking the "PIB Medio Alto [GDP medium high]" scenario. This would mean a target for total emissions of 126.9 Mt CO_2 eq (excluding LULUCF), which is an increase of 39% compared to emissions in 2010.

The updated projections from MAPS Phase 2 suggest that announced policies will be sufficient for Chile to meet its voluntary commitment. The treatment of emissions from LULUCF in relation to this target, however, will be critical. Given that LULUCF policies will be used to achieve this target, it is clear that LULUCF will be included in some form. However, there are different methodologies for doing so and the choice of approach used for this sector has significant implications for the stringency of the target (Briner and Prag, 2013). Chile has yet to specify which approach will be used to account for LULUCF for its voluntary commitment to 2020.

The INDC addresses some challenges of monitoring progress against the voluntary commitment, in particular with regards to transparency. Specifically, it sidesteps debates about the realism of the BAU projections by adopting a target using readily available data: GHG emissions and GDP. LULUCF is treated separately, with a target expressed in absolute terms. As Section 3.1 discusses, however, the forthcoming climate change action plan could still clarify ambiguities in the INDC.

As a non-Annex 1 country, Chile complies with the international monitoring requirements established under the UNFCCC process:

- National Communications: these include an inventory of emissions and descriptions of measures to reduce emissions and adapt to climate change. These are required to be produced every four years, with the most recent one being released in 2011.
- Biennial Update Reports (BUR): these are intended to update the information provided in the national communications. Chile was one of the first non-Annex 1 countries to submit a BUR in 2014.
- Monitoring, Reporting and Verification for CDM and NAMAs: the UNFCCC process has established these methodologies to ensure projects deliver the intended reductions in emissions.

Chile has established a comprehensive system for generating GHG emissions inventories based on the latest IPCC methodology (IPCC, 2006). This improves the assessment of emissions from land-use compared to the approach used for the 2006 inventory. The OCC produces national inventories, building on sectoral inventories by the relevant ministries. International exports review these inventories to ensure they are robust and consistent with the relevant IPCC guidelines. These inventories rely upon data provided from a range of other sectors, which are then processed and analysed by the Ministry of Environment.

Due to delays in acquiring the relevant data, alongside resource constraints, the most recent set of comprehensive statistics date from 2010. Emissions data are important for identifying a need to change course, and emerging trends that could have policy implications. Alternative data sources, such as the International Energy Agency's statistics on CO_2 emissions from fuel combustion (IEA, 2015), can partially fill these gaps by providing more recent estimates of major trends in CO_2 emissions. However, reinforcement of capacity in this area would assist with the transition to biennial reporting to the UNFCCC.

In contrast to mitigation, no single metric can assess progress in relation to climate change adaptation. Moreover, the effectiveness of adaptation measures may only become clear over long time horizons, or if an extreme weather event occurs. To address this, and other methodological challenges, OECD (2015c) recommends a pragmatic combination of four tools: climate change risk and vulnerability assessments; indicators; evaluations and national audits; and climate change expenditure reviews.

The Chilean approach to monitoring and evaluation for adaptation has yet to be implemented, but some constituent elements are in place. The final evaluation of the Climate Action Plan examined progress across the range of actions complemented with qualitative analysis (University of Chile et al., 2015). The plan, however, had no specified targets or indicators. The evaluation thus focused on the extent to which actions had been implemented, but not their effectiveness.

Climate change risks and vulnerability assessments have been developed, which can provide a baseline for understanding the evolution of risks over time. The national adaptation plan commits to developing a monitoring framework for each sectoral plan. These will inform the development of an annual national monitoring report, which will be submitted to the Council of Ministers on Sustainability and Climate Change. The plan also contains a commitment to perform an independent mid-term evaluation and final evaluation. Importantly, it emphasises that the results of this evaluation will inform subsequent phases of national adaptation planning.

3.4. International co-operation, climate finance and official development assistance

Chile was an attractive location for hosting projects under the CDM due to its strong institutional environment, political stability and streamlined permitting process (Sanhueza and de Guevara, 2014).[6] As such, it has made extensive use of the CDM for reducing domestic emissions. Chile has registered 102 projects with the UNFCCC (with emissions reductions equal to 11.3 Mt CO_2 eq), ranking it third among Latin American countries. Most reductions have been realised from utility-scale renewable energy projects. The most recent project was registered in December 2014; there are no more projects in the pipeline in part due to uncertainty about the future of the CDM. A case study on low-carbon technology transfer to Chile found that carbon credits from the CDM provide supplementary revenue to renewables projects; project developers, however, did not consider them when assessing the economic feasibility of new projects, as the CDM registration process is too long, costly and uncertain (Pueyo, 2013).

Chile has benefited from international support for achieving its climate goals. More than half of official development assistance (ODA) received by Chile is now linked to climate change objectives. OECD Development Assistance Committee (DAC) statistics show that USD 251 million was committed in 2014 for mitigation and USD 3.1 million for

adaptation (OECD, 2015e). These figures do not include non-concessional finance supporting climate objectives, such as the USD 200 million loan from the Inter-American Development Bank (IDB) to support the Alto Maipo hydropower plant. These figures reflect the total sums for projects where climate change was a principal or significant objective, rather than an attempt to calculate the marginal additional resources for climate change.

Chile's most recent BUR provides a detailed breakdown of funding sources to support research, reporting, mitigation and adaptation (Table 4.2). Based on amounts pledged, multilateral funds and institutions have been the largest contributors to climate action in Chile. The differing definitions used to assess finance flows mean these two sets of estimates are not directly comparable. The estimates of funding received consider only those projects directly linked to achievement of climate outcomes, while OECD Development Assistance Committee (DAC) statistics also help identify the extent to which climate considerations are being mainstreamed in existing aid flows.

Table 4.2. **International finance for climate change, 2011-14**

Type of financial support	Received (USD)	To be received (USD)	Field					Sector
			R	M	I	A	N	
Bilateral (countries)	3 116 298	-		•	•		•	Cross-cutting, energy, transport, farming, forest, water resources, waste
Funds and multilateral institutions	2 480 089	29 010 269	•			•		Cross-cutting, energy, forest, fishery and agriculture, biodiversity
International financial institutions	350 000	7 630 000		•				Energy, financial instruments, transport, forest
Other multilateral contributions	3 999 643	728 000		•	•			Cross-cutting
Total	**9 874 030**	**37 368 269**						

Note: R = Reporting; M = Mitigation; I = GHG Inventory; A = Adaptation; N= International negotiations.
Source: Government of Chile (2014a), *Chile's First Biennial Update Report to the United Nations Framework Convention on Climate Change*.

In 2017, Chile will most likely graduate from the OECD-DAC list of countries eligible to receive ODA. Consequently, as public climate finance would no longer count as ODA, Chile will be a less attractive destination for bilateral donors. Non-concessional funding will still be available from multilateral development banks. Climate finance available through UNFCCC mechanisms remains opaque. Although finance is restricted to "developing countries", it is not clear which countries are included in this category. As a result, Chile will have to expand its use of alternative funding sources, including domestic resources and private climate finance.

4. Instruments and financing for climate change mitigation and adaptation

4.1. *Policy instruments for reducing GHG emissions*

Chile has relied upon voluntary mechanisms, subsidies and projects funded by international climate finance to support mitigation of GHG emissions. It is, however, starting to move to a "polluter pays" approach with approval of taxes on both new vehicles and carbon. While primarily intended to improve air quality, the vehicle tax should also encourage the purchase of more fuel-efficient models (Chapter 3). The carbon tax aims to internalise the costs of CO_2 emissions by charging USD 5 per tonne of CO_2 emitted; it would be levied on large stationary sources of emissions, including power plants, beginning in

2018 (Section 5.1). This tax will affect about 27% of total CO_2 emissions (Government of Chile, 2014a). For an optimal pricing scheme, the tax rate should be equal to the marginal damage caused by each unit of emissions. The estimated values are contentious, but commonly accepted values in OECD member countries are significantly higher. Policies to reduce sectoral emissions are discussed in more detail in Section 5.

Chile has developed a set of NAMAs to help it meet its 2009 mitigation commitment (Table 4.3). Under the international climate convention, NAMAs can communicate mitigation actions and help connect opportunities to funding sources. Any action that reduces emissions under the umbrella of a national government initiative is eligible for a central registry hosted by the UNFCCC. Funders can then use the registry to identify projects for support.

Table 4.3. **Chile's Nationally Appropriate Mitigation Actions**

Name	Institution	Status	Reduction goal to 2020
NAMAs registered with the UNFCCC			
Expanding Self-Supply Renewable Energy Systems in Chile	MINENERGIA – CER	Under implementation	2 Mt CO_2 eq
National Programme for Catalysing Industrial and Commercial Organic Waste Management in Chile	MMA	Seeking support for implementation	12 Mt CO_2 eq
Design and Implementation of a National Forestry and Climate Change Strategy (ENCCRV)	CONAF	Seeking support for implementation	42 Mt CO_2 eq
Clean Production Agreements in Chile	CPL	Under implementation	18.4 Mt CO_2 eq
Santiago Transport Green Zone (ZVTS)	Municipality of Santiago		1.4 Mt CO_2 eq
NAMAs in preparation			
Carbon sequestration through the Sustainable Soil Management	National Agriculture Research Institute and Agricultural and Livestock Service	Design stage	65 to 80 Mt CO_2 eq
Mitigation of GHG emissions from Industrial, Commercial and Institutional Boilers	MINENERGIA	Design stage	1.25 Mt CO_2 eq
National Sustainable Construction Strategy	MINVU	Design stage	ND
Assisted Phytostabilisation of Mining Tailings in Chile	MMA	Design stage	ND

Source: Government of Chile (2014), *Chile's First Biennial Update Report to the United Nations Framework Convention on Climate Change*.

Clean Production Agreements are both the largest potential source of reduced emissions and the only NAMA to be funded domestically. They are negotiated between the government and industry associations, setting goals and targets for emissions that are usually based on the best available technology (Chapter 2). The costs of technical studies for identifying emissions reduction opportunities are split 70-30 between the government and beneficiaries. The private sector covers the cost of any necessary investments for implementation (Government of Chile, 2012).

Table 4.3 indicates the main potential for mitigation from NAMAs arises from LULUCF, which accounts for more than half of the total emissions reduction potential. Increasing sequestration through sustainable soil management could double the total volume of mitigation achieved. Most measures listed in the NAMAs attempt to pick off the "low-hanging fruit" and are, therefore, relatively cost effective, with an average cost of less than USD 5/tCO_2e. There will be some overlap with reductions that are likely to be realised following introduction of a carbon tax. More expensive (per tonne of CO_2e) measures may need to be explored to achieve higher emissions reductions.

If implemented, the emissions reductions in individual NAMAs would be sufficient to meet Chile's commitment to reduce emissions by 2020. Two NAMAs (the Clean Production Agreements and Self-Supply of Renewable Energy Systems), with estimated total emissions reductions of 20.4 Mt CO_2 eq, are funded and being implemented. However, other NAMAs have substantial funding gaps. For example, a national forestry strategy has received USD 12.6 million in external support, but still requires USD 120 million to meet the required objectives. If those resources are not forthcoming, alternative funding streams and/or revisions to programme design will be needed.

In addition to the specific need to fund measures contained within the NAMAs, there is the wider challenge of securing sufficient finance for the transition to a low-carbon and climate-resilient economy. OECD guidance emphasises setting clear goals to shape investors' expectations, and ensuring that policies are aligned in support of the low-carbon transition (Corfee-Morlot et al., 2012).

The government has encouraged private investment, but some areas are further advanced than others. Long-term goals, such as the INDC, play a useful role in shaping investment decisions by setting private sector expectations. However, enabling policies and incentives for investment need to be strengthened. In keeping with its wider economic policy, Chile has a free-market approach to investment. This reduces the risk of policy-induced distortions, but also means that market failures can block investment in low-carbon technology. In particular, as noted in Chapter 3, Chile has some of the lowest effective carbon prices among OECD member countries. This means that carbon costs do not consistently inform investment decisions; this is starting to change with the introduction of a carbon tax for the energy sector. Increasing the rate and coverage of this instrument would support low-carbon investment.

4.2. Policy instruments to facilitate adaptation to climate change

Although the Ministry of Environment is considering whether to include adaptation within the strategic environmental assessment process, adaptation is not yet mainstreamed in public sector decision making. Its integration into standard tools such as project appraisal guidance would help ensure that benefits of climate resilience are reflected in information provided to decision makers. Sectoral strategies can facilitate this process by providing information on the range of potential impacts and risks arising from a changing climate. Identifying concrete adaptation options also raises awareness within ministries.

Public funding will be an essential component of Chile's adaptation response, but the scale of needs and how they will be met are not clear. The national adaptation plan identifies a range of potential funding mechanisms, but without specifics. Consistent with approaches by other OECD member countries, domestic funding for adaptation is likely to be mainstreamed in existing sectoral budgets. According to the plan, each sector needs to allocate resources to climate change within its budget; the extent of follow-through is unclear.

Most expenditure is likely to occur for concrete measures within the sectoral plans rather than for capacity building in the national plan. Some measures may have been taken ahead of the sectoral plans, and so may not reflect "additional" resource requirements. Sectoral plans vary in the level of financing detail. The forestry and agriculture plan estimates resources required for each action, as well as the funding source. The biodiversity plan identifies available funding sources in general terms, but not the level of resources required (Chapter 5).

Even with investment in risk reduction, the consequences of extreme climate events must still be addressed. The national adaptation plan identifies disaster risk management as a priority area, but without providing details. The 2014 disaster risk management plan is intended to contribute to this goal by identifying and characterising underlying drivers of risk, including climate change (Government of Chile, 2014d).

Chile has a robust system for the financial management of extreme events, which puts it in a strong position to handle projected increases in losses from climate change. Although unrelated to climate change, the 2010 Chilean earthquake provided a strong test of these arrangements. Total economic losses from this event were estimated at USD 30 billion, equivalent to 18% of GDP; this made it proportionately one of the costliest natural disasters to ever affect an OECD member country (SVS, 2012). Despite the scale of these losses, there were no apparent lasting negative fiscal consequences: GDP growth actually rose to 6% the following year (Useem et al., 2015).

A central pillar of Chile's approach to risk financing is the wide uptake of private insurance. Chile has the highest penetration of insurance of any country in South America, partly because catastrophic risk coverage is a precondition for a mortgage. Private insurers paid out USD 8 billion during the 2010 earthquake, thereby reducing losses incurred by households and businesses, as well as the need for recourse to public funds. Crucially, the extensive use of international reinsurance for catastrophic risk meant that policies could be honoured without risking the solvency of insurance companies (IMF, 2014). Large companies widely use insurance against natural catastrophes, which is mandatory for infrastructure concessionaires (OECD, 2013e).

5. Mainstreaming climate change in sectoral policies

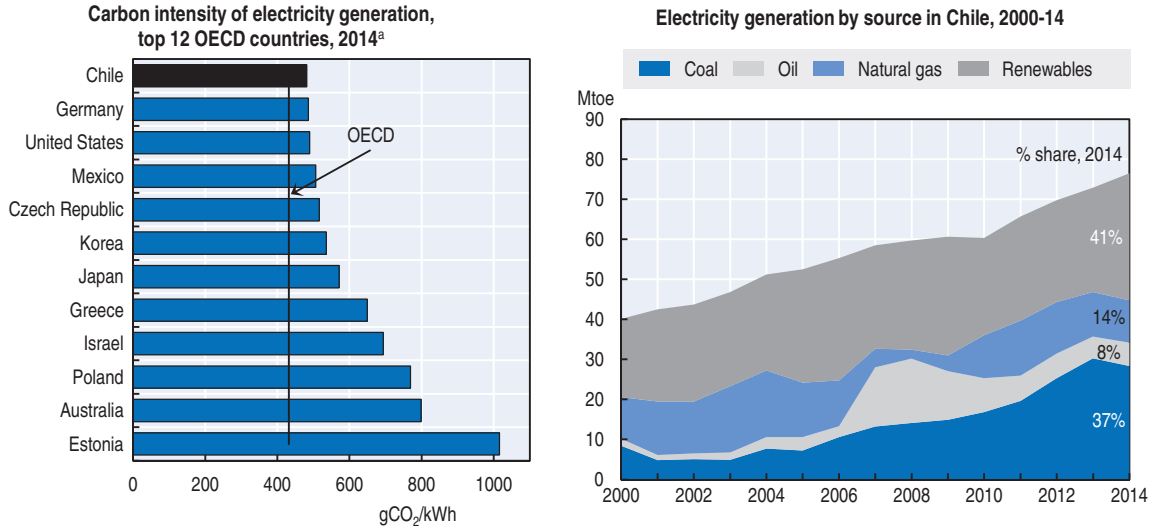
5.1. *Energy*

Mitigation in Chile's energy sector will be vital for meeting overall climate objectives. It will also bring important co-benefits, such as improving energy security and reducing local air pollution (Chapter 3). Under its traditionally *laissez-faire* approach to energy policy, Chile has relied heavily upon hydropower and coal. High energy prices and concerns about security of supply have led the government to take a more active role in this sector. Through the 2014 Energy Agenda and the development of an Energy Policy to 2050, Chile has the opportunity to embed climate change within the energy sector.

Fossil fuels account for nearly 60% of electricity generation, with coal and oil playing an increasingly large role. As a result, CO_2 emissions in the energy industry are large and have more than doubled since 2000 (Figures 4.1 and 4.2). While energy generation from renewable sources has grown, it has not kept pace with the increasing energy demand of a growing economy. In 2014, renewables accounted for 32% of primary energy supply, among the highest shares in the OECD, and 41% of electricity generation (Annex 1.A). Yet the carbon intensity of electricity generation is higher than the OECD average and close to that of Germany and United States (Figure 4.6).

The energy sector is also vulnerable to the effects of climate change, particularly as changes in water availability will affect electricity supply from hydropower. Patterns of energy consumption may change, due to increased demand for cooling in the summer and reduced needs for heating in winter. Energy infrastructure will also be vulnerable to extreme weather events. The sectoral adaptation plan for the energy sector is not due for completion until 2017, alongside the plan for water resources.

Figure 4.6. **Electricity production from fossil fuel sources increased twice as much as from renewables**



a) Emissions of CO_2 per unit of electricity generated.
Source: IEA (2015), *IEA World Energy Statistics and Balances* (database).

StatLink http://dx.doi.org/10.1787/888933388641

In addition, the energy sector in Chile faces a number of major challenges. With few domestic fossil fuel resources, it relies on imports for 60% of total primary energy needs (Government of Chile, 2014c). Electricity prices are volatile, with Chile facing some of the highest prices in Latin America. Supplies are also vulnerable to disruption, as happened with gas imports from Argentina since 2004. Chile has invested heavily to develop capacity to import liquefied natural gas (LNG) with the aim of a more secure supply and less reliance on more polluting forms of generation, such as coal and diesel.

Chile has four separate electricity systems with varying characteristics rather than a unified national electricity grid. The northern system (SING) and the central system (SIC) account for 99.2% of Chile's generation capacity. The Aysén and Magallanes systems in the far south account for the remaining 0.8%. The SING covers the sparsely populated north, with the bulk of energy demand arising from the mining industry. It relies heavily upon conventional generation, predominantly coal and natural gas; the SIC benefits from Chile's extensive hydroelectric potential;[7] Aysén uses diesel, hydro and some wind power; and Magallanes relies upon natural gas and diesel.

The 2014 Energy Agenda was developed to address the main challenges Chile's energy sector is facing. It does not contain an overall mitigation target for this sector, but has measures likely to help reduce emissions relative to business-as-usual. The Agenda recommits to the goal of generating 20% of energy from non-conventional renewable energy sources (i.e. excluding large hydro), or NCREs, by 2025. To that end, it targets the generation of 45% of new capacity between 2014 and 2025 from non-conventional renewables. The project pipeline is consistent with that goal, mainly due to the significant contribution of wind and, more recently, solar (see below). The Agenda also aims to reduce energy use by 20% compared to business-as-usual by 2025, as well as to increase the competitiveness of LNG so it can substitute for diesel generation. It does not, however, directly tackle the future role of coal-fired generation within Chile's energy mix.

Chile does not tax most energy use (Chapter 3), including electricity and fuels for generation. The main exception is a Specific Excise Tax levied on transport fuels, which includes a variable component to moderate the effect of fluctuations in international oil prices. Diesel is subject to lower taxes than petrol, with Chile having the second-lowest rate of diesel taxation of all OECD member countries (OECD, 2015a, 2015b). Chile will introduce a carbon tax of USD 5/tCO_2 for the energy sector beginning in 2018 after rejecting a cap-and-trade mechanism (Section 4.1; Chapter 3).[8]

Renewable energy

Chile's geography and the challenges with conventional generation make it a promising candidate for renewable energy. The Andes provide extensive hydroelectric potential, only a fraction of which is exploited, while the north is well suited to solar generation. Renewable energy is now commercially competitive with conventional sources in Chile, thanks to the continuing decline in renewable technology costs and access to international markets (Chapter 3),[9] lack of domestic fossil fuel resources and favourable geography. It is projected that most renewable technologies will be cheaper than or competitive with fossil thermal technologies by 2030 (BNEF, 2011; IRENA, 2014). However, further efforts are needed to fully tap this potential.

The government supports renewable-based electricity through regulatory measures, financial incentives and investment in research and development (Box 4.1). The main policy instrument is a quota obligation, established by the 2008 Non-Conventional Renewable Energy Law (Law 20.257). The quota system requires generators to source a rising proportion of their electricity sales from non-conventional renewables – from 5% in 2010 to 10% in 2024 – either directly or indirectly through bilateral purchases from other generators.[10] Companies failing to fulfil this obligation would pay a penalty, initially set at approximately USD 25 per megawatt hour (MWh), rising over time. The quota, however, did not spark significant growth of renewables projects beyond small hydropower. This has been attributed to a relatively low target and lack of a transparent trading system for renewables certificates, among other reasons (Pueyo, 2013).[11]

In response, the quota obligation was strengthened in 2013 (Law 20.698), with the target raised to 20% of generation by 2025. In addition, the reform established an NCRE certificates system, facilitating the purchase of credits from developers or power producers that generate excess NCRE. Reforms also introduced the possibility of public auctions for technology-neutral renewables energy capacity in years when the quota will not likely be filled. By complementing the renewables quota system with a market-based mechanism, Chile differs from many emerging economies, which have opted for feed-in tariffs. In parallel, the government, partly through agencies such as the Economic Development Agency has provided various forms of support to investment in renewable energy development (Box 4.1; see also Box 3.3).

The increasingly supportive regulatory framework and the decline in technology costs have contributed to a steady increase in renewable generation (Figure 4.7). Electricity production from renewables has systematically exceeded the targets; in 2014-15, targets were exceeded by a factor of two (CIFES, 2015). The share of NCRE in total generation rose from 5% in 2008 to nearly 12% in October 2015 (US EIA, 2015; CIFES, 2015). The mining industry drove much of this growth: facing high energy prices and longer lead times for the approval of conventional energy projects, several mining companies opted for bilateral agreements with wind and solar developers to supply their energy-intensive mines.

Box 4.1. **Selected measures to promote renewable energy sources**

In 2001, the Rural Electrification Programme with Renewables was launched in co-operation with the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP) with a budget of USD 32.4 million. By its conclusion in 2012, the programme had resulted in the installation of more than 6 000 individual solar photovoltaic systems. It also helped build the capacity of small businesses and co-operatives for operating and maintaining renewable energy systems. The more recent, smaller-scale programme provided USD 2.4 million in 2014 to expand energy provision for public services and productive uses. It gave priority to renewable sources (mainly solar in northern and central Chile and small hydro and wind in the central-south regions). Subsidies and co-financing for rural energy supply through renewables is also provided by the Ministry of Agriculture (e.g. for solar photovoltaic pumps for farmers) and the Ministry of Energy (e.g. for electricity supply for indigenous communities and the substitution of diesel generators on islands) (IRENA, 2015).

The 2004 Short Law I (Law 19.940) set conditions for connecting small-scale generators (i.e. plants with less than 9 megawatts (MW) installed capacity, the size of many energy plants for renewables) to trunks transmission and distribution networks; it exempted small-scale (< 9 MW) and partially medium-scale producers (9 MW to 20 MW) from transmission fees (IRENA, 2015).

In 2009, Chile created the Renewable Energy Centre, now the National Sustainable Energy Innovation and Promotion Centre (CIFES). It aims to promote and facilitate new renewables projects, better co-ordinate public and private initiatives, and develop skills. Each month, CIFES publishes an update regarding NCRE project status and installed capacity in Chile. It also runs an online platform on the renewable resources per region, which includes environmental recommendations (e.g. consideration of local biodiversity and protected areas in each region). Chile plans to expand the platform to provide comprehensive, geo-referenced data on potential resources for each region, as well as state-owned land available for development and information on local energy demand and land-use planning. CIFES also promotes renewable energy technologies through the InnovaChile programme and the recent establishment of International Centres of Excellence in this area (Chapter 3).

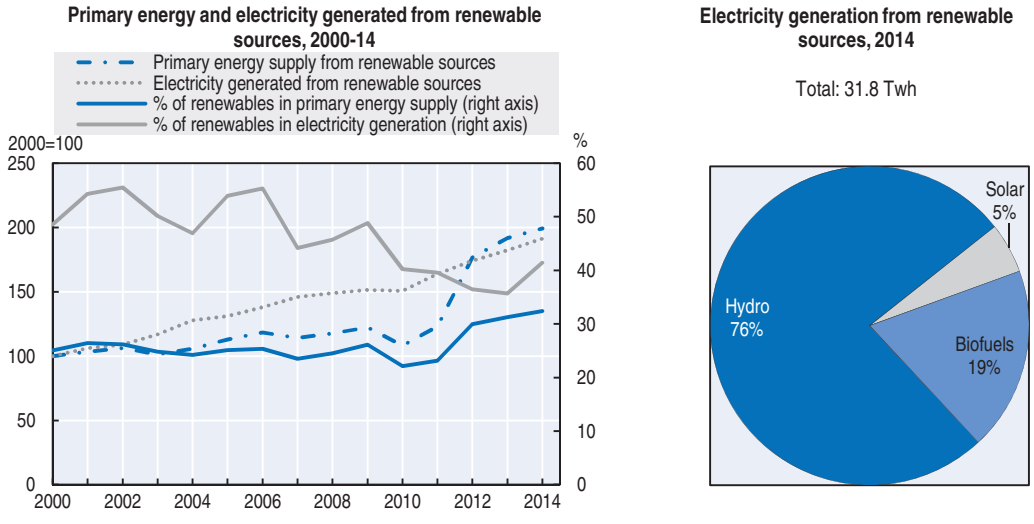
In 2012, Chile introduced the legal framework for net metering, enabling generators to feed excess renewable electricity to the grid in return for credit on their electricity bill (IEA/IRENA, 2015).

In 2013, the Budget Law approved USD 85.5 million for the Ministry of Energy to provide soft loans for pilot projects in the area of renewables. These resources have been used, among other things, for public contests to support pilot projects for energy self-sufficiency and concentrated solar power plants, as well as for implementation of a Centre of Excellence for Research and Development on solar energy (IEA, 2013b).

In December 2014, the National Energy Commission adopted new rules for the power auction to simplify long-term contracts. The new design allowed developers to offer to supply electricity in blocks (i.e. at certain times of the day rather than around the clock), which better suits intermittent technologies such as solar and wind. This helped maintain strong demand for renewables even as demand from mining industry began weakening (Dezem, 2015).

Analysis of new construction presages an even stronger shift to renewables. Of the USD 11 billion in electricity generation projects under construction, 44% are NCRE, with a further 26% for hydropower. Solar and wind projects together account for more than 90%

Figure 4.7. **Energy generated from renewable sources is increasing steadily**



Source: IEA (2015), *IEA World Energy Statistics and Balances* (database).

of NCRE projects under construction or planned (Table 4.4). Overall, the International Energy Agency (IEA) estimates that Chile's renewable energy capacity will surpass 15% in 2020 (OECD, 2015d).

Table 4.4. **Capacity of non-conventional renewable energy sources in Chile**

Installed and planned renewables capacity, in megawatts, November 2015

	In operation	Under construction	With environmental approval (not yet under construction)	Without environmental approval
Biomass	417	0	73	86
Biogas	44	0	8	0
Wind	901	224	5 820	1 439
Geothermal	0	48	120	0
Small hydro	394	67	429	104
Solar photovoltaic	747	2 206	10 350	3 938
Solar CSP	0	110	980	105
Total	2 504	2 655	17 780	5 672

Source: CIFES (2015), "Reporte ERNC. Estado de proyectos ERNC en Chile" (November 2015).

While investment and growth outlook in the sector are impressive, renewable generation has not kept pace with growth in total energy demand (Figure 4.7). Use of NCRE is still far from matching its potential, as various financial, technical and regulatory barriers persist. The sites with the greatest generation potential are far from existing grid infrastructure;[12] grid capacity constraints prevent renewable generators from supplying all the electricity they generate. This constraint is compounded by a concentrated market structure that favours incumbent generators; the difficulty of securing long-term generation contracts; the failure to fully internalise the environmental and social costs of alternative forms of generation; and permitting delays. Access to finance also remains a barrier for Chile's renewables sectors (Chapter 3). Disputes about environmental impacts, and the need to address the concerns of affected communities, have slowed exploitation of renewables, especially large-scale hydro generation.[13] For example, the 2 750 megawatts

(MW) HidroAysén dam project was rejected by the government in 2014 following concerns about its environmental and social impacts. Recent policy changes, such as adjustments in bidding conditions for power auctions (Box 4.1), aim to overcome some of these barriers.

Energy efficiency

Chile ranks in the middle of OECD member countries in terms of energy intensity of GDP (a measure of efficiency; see Annex 1.A). This standing is despite comparatively high energy prices faced by domestic and industrial consumers. Barriers that hinder uptake of technically cost-effective measures include lack of information, split incentives,[14] upfront costs and perceived "hassle" arising from installation.

The government is strengthening its policy response to overcome these barriers. The 2005-10 Energy Efficiency Programme, for example, aimed to gather information on potential areas for energy savings within the Chilean economy; the Chilean Agency for Energy Efficiency was created in 2006. The Energy Efficiency Action Plan 2012-20, adopted in 2013 after five years of discussion, set a target of reducing energy use by 12% compared to a projected baseline by 2020. It contains measures for the building sector, mining and other industries; passenger and freight transport; and home appliances (Ministry of Energy, 2013). The annual budget was set at CLP 28 billion (USD 50 million) in 2014. A baseline study commissioned for the elaboration of the plan estimated direct and indirect economic benefits at USD 12 to USD 23 billion; the cost of implementing measures would not exceed USD 2 billion, even in the most pessimistic scenario (NRDC, 2014). Box 4.2 presents examples of public investment in energy efficiency in Chile.

Box 4.2. **Selected public investment in energy efficiency**

In the residential sector, public investment has focused on improving efficiency of heating systems (which are largely based on firewood) with a view to reducing air pollution and associated health impacts (Chapter 1). Between 2011 and 2015, more than 10 000 heaters were replaced through CLP 5.4 billion (about USD 10 million) of investment, with preference for low-income households. This may have important social benefits, given that poorer households spend a much larger share of their income on energy bills. The government plans to significantly upscale the programme, investing CLP 26 billion per year over 2016-20 including in public institutions, multi-building and district heating. The increased funding for these measures is welcome and will help expand the coverage to a larger part of the housing stock. In parallel, the government is subsidising the retrofitting of houses to improve thermal insulation and reduce energy leakages, with about USD 70 million of annual investment for 2016-18, as well as the installation of solar thermal systems for public, commercial, household and industrial buildings. A residential street lighting programme aims to accelerate the deployment of efficient lighting technologies in the residential and public sectors. Following the programme's first public call, it is estimated that more than 125 000 lamps will be exchanged through investment of USD 80 million (Ministry of Energy, 2015).

The 2014 Energy Agenda revised the Action Plan's target to reduce energy use by 20% by 2025. It estimates this would save 20 000 gigawatt hours (GWh) per year from 2025. The Agenda also commits to a range of initiatives, including energy efficient street lighting, energy labelling and subsidies to retrofit existing dwellings. Targeted investment programmes have already been launched and implemented (Box 4.2). The Agenda also

proposes the creation of an energy efficiency law, including the following strands (Government of Chile, 2014c):

- Commercial energy users: requirement for large energy users to develop energy management systems and develop medium- and long-term plans for energy conservation.
- Households and small businesses: decouple income of energy companies from their sales of electricity. Encourage distributors to work with customers to implement energy efficiency measures.
- Public sector: clear allocation of responsibility for energy use. If appropriate, develop energy plans for increasing energy efficiency.

The Energy Agenda addresses some limitations of the 2013 Action Plan identified by NRDC (2014): it strengthens efforts to understand and improve energy efficiency by industrial users and the public sector. It also provides clear timelines for the implementation of measures. However, more needs to be done to improve transparency and accountability with established targets. How measures are expected to contribute to the overall target is not clear. In addition, given the number of factors driving energy consumption, a 20% reduction in energy use by 2025 may be unrelated to the effectiveness of energy efficiency policy.

5.2. *Transport*

Transport is the second largest contributor to CO_2 emissions in Chile, accounting for 30% of total CO_2 emissions from fuel use (Figure 4.2). Public transport by road, including collective taxis, plays a large role, both within and between cities (Table 4.5). An extensive network of long-distance coaches provides the dominant mode of transport between cities. The railway network is predominantly used for freight transport. Valparaíso, Concepción and Santiago have metro or urban rail networks, but otherwise public transport is via bus and collective taxis.

Table 4.5. **Modal split for passenger transport in selected regions**

Mode	Region II – Antofagasta			Region V – Valparaíso			Santiago Metropolitan Region			Region VIII – Bío Bío		
	2013	2020	2030	2013	2020	2030	2013	2020	2030	2013	2020	2030
Private transport	42.2	52.5	60.3	37.3	45.7	51.8	50.9	60.6	69.1	27.0	30.5	34.6
Taxi / collective taxi	35.1	28.6	24.6	30.7	26.7	24.6	7.3	5.3	3.9	28.3	22.8	18.3
Bus	22.6	18.3	15.0	29.3	25.2	22.2	28.5	19.1	13.8	41.5	43.6	45.3
Metro	0	0	0	2.6	2.0	1.4	6.3	9.2	8.6	0.5	0.4	0.3
Not motorised	0.1	0.7	0	0.1	0.4	0	7.1	5.8	4.7	2.7	2.7	1.4

Source: MAPS Chile (2014), *Opciones de Mitigacion para Enfrentar el Cambio Climatico*.

Transport-related CO_2 emissions, 90% of which are from road transport, increased by 44% between 2000 and 2013. Increased car ownership, and rising demand for travel, are the main reasons for these increases. Car ownership is strongly correlated with GDP per capita. Rising incomes have led to a doubling of car ownership in 2000-14 (Figure 1.10), but levels remain less than half the average for OECD member countries (see Basic Statistics). The average efficiency of the vehicle fleet is improving, but not enough to offset the effects of increasing demand for travel and the shift from public to private transport. The fuel efficiency of passenger vehicles is projected to be below the Latin American average in 2025 (IEA, 2013a). Under business-as-usual, the MAPS 2013-30 baseline projects an increase of

GHG emissions from the transport sector by 61% to 95% by 2030, depending on GDP growth. Transport, particularly road, represents a key challenge for the achievement of Chile's GHG emission reduction targets.

The integration of transport into climate policy remains at an early stage. The 2008-12 Climate Action Plan focuses on building capacity rather than implementing specific transport policies. Similarly, climate policy has received limited attention to date in transport planning. The 2014 tax reform introduced a tax on new cars, which is assessed on the basis of nitrogen oxides (NO_x) emissions and fuel economy (Chapter 3). Although primarily an air quality measure, this will have some ancillary benefits with respect to climate change.

The national policy framework, set by the National Transport Policy (2013), does not explicitly cover climate change. Instead, it sets out two overarching objectives: supporting economic development and social inclusion. These objectives are underpinned by the aims of increasing the quality, efficiency and capacity of the transport network. The plan would be implemented using various regulatory levers of the transport ministry.

Although climate change has not been a primary influence on transport policy to date, other policies will nonetheless influence emissions from this sector. This is generally achieved through a combination of avoiding, shifting and improving transport methods:

- Avoid – reduce the need for travel.
- Shift – encourage travel via less polluting modes of transport, such as cycling or public transport.
- Improve – reduce emissions from motorised transport, for example by improving fuel efficiency or using lower-carbon fuel sources (such as electric mobility).

Urban planning, the primary tool for reducing travel lies outside the mandate of the national transport ministry; responsibilities are also split at the municipal level. Although Chile is a heavily urbanised country with a stable population, urban development continues, driven in part by the need to improve the quality of the housing stock. The National Transport Policy (2013) notes the prevailing trend for low-density urban expansion, which both increases the need for travel and also the costs of providing public transport for new developments. Moreover, housing for poorer populations has concentrated on the peripheries of urban areas, which tend not to be well served by public transport.

As noted above, increasing wealth is shifting demand away from public transport towards higher-emitting cars. Transport policy seeks to make public transport more attractive through expanded service, and improved service quality and reliability. In line with these objectives, Santiago promoted an integrated public transport system (Box 4.3). The National Transport Policy (2013) also aims to support cycling and walking through improved infrastructure such as dedicated lanes for cyclists. Despite these policies, the modal split is projected to continue moving towards higher emission transport modes. MAPS estimates the share of private cars will continue to increase (Table 4.5), while the use of buses and non-motorised transport will decline (MAPS Chile, 2014).

The 2014 National Infrastructure Plan outlines USD 28 billion of investment until 2012, much of which was related to improved transport links (Chapter 3). The majority of transport expenditure is intended to improve connectivity through building roads and enhancing airports. Although USD 116 million was allocated for two cable car links, the investment programme aims to accommodate demand for transport rather than explicitly aiming to reduce emissions.

Box 4.3. **Investment in public transport in Metropolitan Santiago**

The Santiago Urban Transport Plan 2000-10 laid the ground for the development of Transantiago, an integrated public transport system. The system, which is financed through concessions to private entities, modernised the bus fleet, restructured routes and developed specialised infrastructure (e.g. dedicated bus lanes and intermodal transfer stations). Ultimately, it centralised a vast informal network of public, private and semi-informal bus services into one large public scheme, integrating fares and services with the metro network. The Santiago underground network expanded from 40 km to more than 100 km over 2000-12. It is the most extensive in South America, with good service quality and administrative and financial management. The metro will reach about 140 km when two additional lines are completed in 2017/18. Government transfers have largely financed investment in the metro system, while a consortium of private investors is financing extensions.

However, the expansion of Santiago's transport system has not kept pace with the rapid rate of urbanisation and the steep rise of the vehicle fleet in the Metropolitan Region (+40% over the 2000s). Consequently, the roads and metro are persistently congested, especially in peak hours and air pollution from traffic densities is high, with severe impacts on human health (Chapter 1). Santiago has recently announced restrictions on the circulation of vehicles when air pollution levels are high. The vehicle fleet is projected to continue growing in the Santiago Metropolitan Region, from 1.3 million to 2.7 million vehicles between 2012 and 2025 (MTT, 2013). Capacity bottlenecks are expected, particularly in the periphery where urban roads lack capacity to absorb the increased number of cars in 2030. Congestion is also expected to worsen in most of the centre and eastern districts, where financial and commercial activities are concentrated (UFZ et al., 2010).

In response, in 2013, the Ministry of Transport and Telecommunication launched the Santiago 2025 Master Plan, which foresees investing USD 22.8 billion until 2025. The plan aims to increase sustainable mobility, including through an expanded metro network, new mass transit corridors, new suburban commuter trains and a large expansion of bicycle paths (MTT, 2013).

In late 2014, the government announced a Plan for Public Transport Infrastructure, which foresees investment of USD 1.9 billion mobilised through concessions and USD 2.2 billion of public investment. Most of this volume (70%) is foreseen to benefit the Metropolitan Region, financing construction of new suburban trains and the expansion of the metro network, among others (Government of Chile, 2014f). Outside the Metropolitan Region, concessions are planned for several cable car lines (e.g. in Valparaíso and between Iquique and Antofagasta), as well as feasibility studies for diesel-powered trains in two of Chile's southern cities.

The government tried to improve the quality of the vehicle fleet with respect to both air quality and energy efficiency. Initiatives included the 2009 "Change your truck" programme, which took some 350 old trucks off the road; and the 2011 "Change your bus" programme, which allocated CLP 20 billion (about USD 40 million) to replace outdated vehicles (Chapter 3). Mandatory emissions labelling for vehicles below 2.7 tonnes, introduced in 2013, complement these measures. In practice, the labelling programme captures new commercial vehicles, but not new cars. In addition, an education and outreach programme has encouraged more efficient driving practices. Pilot studies found that working with companies to improve fleet management practices could reduce

emissions by 4.7%. Working with drivers to encourage efficient driving practices had the potential to reduce emissions by between 5% to 17% (Government of Chile, 2014a).

The CDM was not used much for reducing transport emissions in Chile, but one project has been proposed as a NAMA: the Santiago Clean Transport Zone (Table 4.3). This proposal, registered under the UNFCCC and seeking support for implementation, includes measures to encourage use of electric vehicles, improved facilities for cyclists and improved traffic management systems. The NAMA proposal estimates these measures would save 13 800 tonnes of CO_2 (over 10 years) at a cost of USD 17.7 million. This equates to USD 1 283 per tonne of CO_2 saved, which is expensive compared to other mitigation options being pursued in Chile. However, there would also be some potential co-benefits (such as improved air quality) that would arise from the switch from conventional to electric vehicles, public transport and biking. In 2011, Santiago became the first Latin American city to install publicly accessible infrastructure for the charging of electric vehicles. However, charging stations remain largely underutilized (Beeton and Meyer, 2015).

The MAPS project analysed a range of technically feasible mitigation options in the transport sector. These included improving fleet efficiency, improving bicycle facilities and encouraging the use of electric cars. MAPS estimated a technical mitigation potential of 4.2 Mt CO_2 eq per year, which would be enough to slow rather than offset the projected rise in emissions from this sector (up to 95% by 2030). Additional measures, such as increased use of biofuels, would be expensive relative to the scale of potential emissions reductions.

Climate change will also affect the transport sector, mainly through the impact of extreme events on roads and railway lines. It will also strengthen the case for action to reduce air quality impacts from transport, as rising temperatures magnify the negative health consequences of local air pollution. The Ministry of Transport will help develop the adaptation strategy for infrastructure; it should also be formally engaged in the health strategy.

5.3. Agriculture and forestry

Agriculture and forestry are a significant source of export earnings and employment for Chile (Chapter 1). Forestry is a major carbon sink in Chile, with removals from LULUCF (almost entirely forestry) being about 50 Mt CO_2 eq in 2010. The emissions removed from LULUCF declined over 2000-07, but an increase in forest areas through tree plantations and a reduction in forest harvesting has brought the absorbed volume back towards 2000 levels by 2010. Meanwhile, GHG emissions from agriculture have been steadily rising, reaching 13.8 Mt CO_2 eq (15% of total emissions, excluding LULUCF) in 2010 (Figure 4.1). More than half of these emissions were due to releases from agricultural soils, while 4.8 Mt CO_2 eq were the result of CH_4 emissions from livestock.

Forestry has long been encouraged within Chile, with the Decree Law 701 established in 1974 to subsidise afforestation activities. More recently, the focus has broadened to support co-benefits (including carbon sequestration and watershed management) through reforms such as the 1998 amendment to Decree Law 701 and the Native Forest Law (2008). The effectiveness of these measures in supporting climate policy has not been formally evaluated. Chile is at the early stages of a National Climate Change and Vegetation Resource Strategy. This strategy is intended to help the country meet its NAMA commitment to restore 1 000 km^2 of degraded and deforested land through afforestation and measures to combat forest fires.

There are no policies or measures designed to address emissions of GHG emissions specifically from agriculture, despite its significant share of Chile's total emissions. The Agricultural Soil Environmental Sustainability Incentive System (SIRDS-S), however, is a long-standing policy to improve degraded land. It is primarily aimed at improving productivity and ecosystem health, but some measures could improve the soil's ability to sequester carbon. The MAPS project identified a further eight potential options for reducing emissions from this sector. If all were implemented, they would reduce total emissions by about 6% of 2010 emissions (or 0.8 Mt CO_2 eq).

Box 4.4 shows some potential impacts of climate change on agricultural production. Chile published a sectoral adaptation plan for agriculture in 2013, which preceded the release of the national plan. This plan outlines 21 specific actions to prepare the sector for the effects of climate change. Improving water use remains a major focus of adaptation activities for this sector. Many of these actions, such as improving the management of water for agriculture, would be beneficial even in the absence of climate change. Research and monitoring have complemented these actions to identify and prepare for the impact of longer-term trends. Each action specifies the time horizons and responsibility for implementation, and estimates of the required budget. They also specify the indicators to measure success.

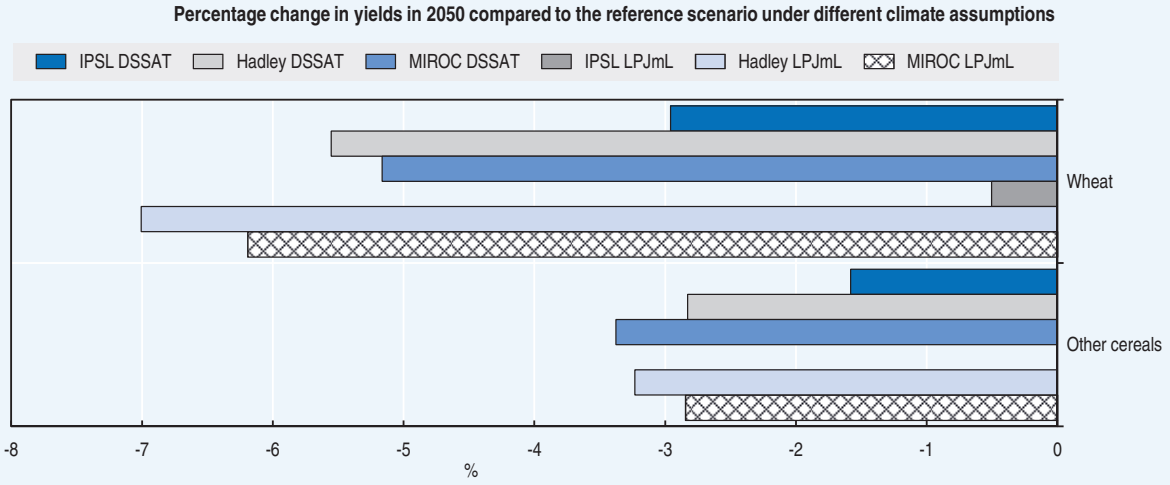
Box 4.4. **Potential impact of climate change on agricultural production**

Chile's agriculture has been dealing with warmer temperatures and extreme climate events that are likely to be more frequent and severe. A severe drought, which Chile has been facing for the last seven years, has resulted in significant land-use change driven by substantial reductions in wheat cultivation. In 2010-15, the mean of the total cultivated agricultural land was 14% lower than during 2000-05 (INE, 2015).

Climate change will affect the Chilean economy via a decreased supply of many agricultural commodities for both domestic and foreign markets. Yields of wheat and other cereals, which are important commodities for the domestic market, are likely to be hindered by climate change (Figure 4.8). The production of wheat and other cereals is particularly vulnerable to variation in rainfall because it is located primarily in rain-fed areas.

Production of grapes and wine, which together represent the most important export commodity for Chile, relies heavily on water supply; 81% of land used for grapes production is irrigated (INE, 2007). If the recharge and storage capacity of the water reservoirs decrease, the production could fall and Chile would lose its competitive position on the international wine market. Some wineries have been moving in the direction of more sustainable practices to adapt to climate change and reduce the impact on biodiversity (Box 5.9).

Figure 4.8. **Change in Chile's crop yields of wheat and other cereals will be lower as a consequence of climate change in Chile in 2050**



Note: The figure shows the projected change in yields of wheat and other cereals (including barley, oats and rye) depending on future climate states, as determined on the basis of the IPSL and Hadley global circulation models. These models project changes in the monthly averages of regional temperatures and precipitation. The results from the IPSL and Hadley global circulation models then feed into two different crop models, LPJmL and DSSAT. Each of these models calculates the yield effect associated with biophysical changes induced by specific sets of temperature and precipitation on specific crops (11 arable crops in the LPJmL model; rice, wheat, maize, soybeans and groundnuts in the DSSAT model).
Source: Own calculations based on the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT); Ignaciuk and Mason-D'Croz (2014), "Modelling Adaptation to Climate Change in Agriculture", *OECD Food, Agriculture and Fisheries Papers*, No. 70.

Recommendations on climate change

Governance and financing

- Strengthen and formalise the institutional basis for climate change policy to provide clear responsibilities for implementation, in line with Chile's national circumstances and international commitments.
- Identify likely resource requirements, and financing sources, to implement the forthcoming climate change action plan 2016-21, including resources needed for core functions (e.g. co-ordination and monitoring progress); adopt a funding strategy at the earliest opportunity; develop a strategic approach to facilitate private sector investment in climate change, including energy production.

Policy development, monitoring and evaluation

- Establish and implement the suite of domestic climate policies to achieve Chile's Intended Nationally Determined Contribution (INDC) for 2030; implement the NAMAs or adopt alternative measures to ensure that the 2020 target is achieved.
- Identify the long-term trajectory consistent with zero net emissions by the second half of the 2050s; communicate long-term commitment to climate policy, whether through legislative or other means.
- Continue improving the evidence base and capacity for mainstreaming climate change adaptation into public sector decision making; make the results of climate projections more accessible to end users (through a web portal, for example) to encourage adaptation by the private sector and other stakeholders.

Recommendations on climate change *(cont.)*

- Implement a monitoring and evaluation framework for climate change adaptation and mitigation policies, including clear accountability mechanisms; reinforce capacity to produce timely emissions inventories; consider using intermediate milestones for longer-term emissions goals; undertake a national climate risk and vulnerability assessment, evaluate the climate resilience of large projects and develop indicators to monitor progress towards adaptation objectives.

Mainstreaming

- Analyse the consistency of current policy choices with decarbonisation in the longer term, particularly in the transport and energy sectors, and ensure that the necessary adjustments are made; design climate policy measures to ensure a coherent, aligned and integrated policy mix across key sectors responsible for emissions (e.g. energy and transport) and removals (e.g. land sector).
- Mainstream climate change adaptation in public sector appraisal systems, such as strategic environmental assessment, the National System of Public Investment and project appraisals; integrate climate resilience in the development of relevant regulations, norms and standards, such as those for infrastructure and building design.

Notes

1. The increase for Chile refers to 2000-10, while increases for other OECD member countries in Annex 1.B refer to 2000-12.
2. Chile has the third-lowest gross domestic product (GDP) per capita (purchasing power parity) of all OECD member countries, but is also sustaining more rapid growth than the OECD average (Chapter 1).
3. The baseline is LB2013 medium GDP projection. Under this scenario, total emissions rise to 144.3 Mt CO_2 eq by 2020, excluding LULUCF. Per capita emissions would be 7.7 tCO_2e in 2020, excluding LULUCF.
4. El Niño and La Niña are two phases of the El Niño Southern Oscillation. During El Niño, sea surface temperatures are unusually high in the equatorial Pacific, leading to increased precipitation in Chile. Temperatures are unusually low during La Niña, leading to reduced precipitation.
5. The absolute size of reductions ranges from 24.9 to 35.6 Mt CO_2 eq and total emissions ranging from 99.4 to 142.4 Mt CO_2 eq.
6. The CDM allows countries to meet their commitments under the Kyoto Protocol by supporting mitigation projects in developing countries.
7. In April 2015, conventional sources accounted for 97% of electricity generated in the SING and 58% of that generated in the SIC. Hydropower made up 30% of the SIC electricity, while other renewable energy sources made up the remaining 12%.
8. Both carbon pricing and cap-and-trade encourage producers to consider the environmental costs of their activities when making investment and operational decisions. The key difference is that carbon pricing provides certainty about the marginal cost of abatement, but offers no guarantee about the resulting volume of emissions reductions, while cap-and-trade does the converse.
9. Many renewable energy technologies (including biogas, small hydro, wind and geothermal) were already cost-competitive with conventional sources in 2011; some solar photovoltaic plants reached grid parity in 2014, although to different extents in diverse locations of the country (BNEF, 2011; IRENA, 2014).
10. The law targets electricity companies that are connected to one of the two main electricity grids (SIC and SING) and operate over 200 megawatts (MW) installed capacity.
11. The targets only affected electricity supply contracts signed after 31 August 2007, a minority of total commercialised electricity. The 5% target starting in 2010 has been exceeded in three consecutive years.

12. Connection delays reach up to 1.5 years.
13. More than 75% of the megawatts from new energy projects (renewable and conventional) whose construction had already been approved by the Environmental Authority (SEA) are paralysed due to legal or administrative claims against them (Borregaard et al., 2015).
14. Split incentives exist, for example, in rented properties where the landlords have less incentive to invest in retrofits to enhance energy efficiency because tenants pay the energy bills.

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PART II

Chapter 5

Biodiversity conservation and sustainable use

This chapter reviews the pressures on Chile's biodiversity, its status and trends, as well as institutional, governance and financing arrangements to promote conservation and sustainable use. It also assesses Chile's progress in using regulatory and economic instruments for biodiversity conservation, efforts to mainstream biodiversity considerations into sectoral and other policies, and mechanisms to improve the knowledge base and promote research, development and innovation.

Introduction

Chile's approach to biodiversity has been significantly influenced by its participation in the United Nations Convention on Biological Diversity and other international agreements, as well as by its accession to the OECD. With nearly a fifth of its land protected, Chile has made a significant commitment to biodiversity conservation. However, pressures on biodiversity from urban and infrastructure development, agriculture, forestry, fishery and mining remain intense. High income inequality exacerbates environmental conflicts and fuels mistrust (Chapter 2). All this calls for enhancing biodiversity mainstreaming in sectoral policies.

Chile has made significant progress in developing strategies and plans to promote biodiversity conservation and sustainable use, but faces considerable implementation challenges. The governance systems for biodiversity and water management are highly centralised, complex and fragmented. Public financing for biodiversity has grown considerably since the mid-2000s and Chile has used several economic instruments to encourage the sustainable use of biodiversity and generate financial resources (e.g. fees to access protected areas, fishing quotas). Yet financial resources remain inadequate to attain biodiversity objectives or bring Chile in line with biodiversity funding provided in other South American countries. A proposed legislation creating a new Biodiversity and Protected Areas Service aims to address institutional fragmentation, improve policy coherence and increase funding. It also opens the door to greater use of economic instruments for biodiversity management and better involvement of the private sector and local and indigenous communities.

1. Chile's biodiversity: State and pressures

Chile's geography and climate vary greatly, with an extremely dry north, temperate Mediterranean climate and rich vegetation in the central and southern regions, and subpolar forests, icefields and fjords in the extreme south (Box 5.1). Many of its ecoregions are considered significant to global biodiversity. Central Chile, including the matorral (shrubland) and Valdivian temperate forest ecoregions, is considered one of the top biodiversity hotspots in the world. This is due to the concentration of endemic species (that are found nowhere else in the world) and the high rate of habitat loss (CEPF, 2015).[1] Northern Chile is included in the Tropical Andes Hotspot.[2]

Box 5.1. **Terrestrial ecoregions of Chile**

Chile can be divided into 13 distinct terrestrial ecoregions; 10 on the mainland and 3 on islands offshore. Each is briefly described below.

- The *Sechura desert* extends along 2 000 km of the Pacific coast and its southern portion extends into northern Chile. The region contains plants that shelter species endemic to the desert (e.g. lomas vegetation) and is an important corridor for migratory birds. High population density and urban expansion are ongoing threats to biodiversity.

Box 5.1. **Terrestrial ecoregions of Chile** *(cont.)*

- The *Atacama desert* covers 1 600 km along the coast of northern Chile. It is a virtually rainless plateau and one of the driest places in the world. The animal species that have adapted to the desert environment are unique to the world. Some cacti, perennials and mesquite occur in basins with occasional water accumulation. Pressures in the region are from roads and mining operations, overgrazing, collection of firewood and commercial gathering of rare plants.
- The *Central Andean puna* and the *Central Andean dry puna* include snow-capped peaks, volcanoes, salt flats, lagoons and high plateaus in the Andes. The dry puna is home to rare species that have adapted to the extreme temperatures and altitudes of the region, including the Polylepis forests and Andean camelids (alpacas). The region is under pressure from livestock grazing, vegetation and forest clearing for crops and firewood collection.
- The *Chilean matorral* (shrubland) ecoregion – a biodiversity hotspot – covers over 100 km along the central coast of Chile. Roughly 95% of the plant species in this region are endemic. This populous central ecoregion faces threats from mining, deforestation, overgrazing, fires, garbage dumps, urbanisation, air pollution, water pollution and soil contamination.
- The *Southern Andean steppe* ecoregion is situated at high altitudes unsuitable for farming. There are several protected areas in this region, and limited potential threats to biodiversity from increases in ecotourism and mountain sports.
- The *Valdivian temperate forests* are considered a biogeographic island, with high levels of endemic species that have been separated from climatically similar areas by ocean and desert. This biodiversity hotspot is facing threats from deforestation from agriculture, overgrazing, forestry plantations, commercial logging and wildfires, as well as high population density in some areas.
- The *Patagonian steppe* ecoregion is a cold desert scrub area characterised by high wind velocities and frosts. It contains high levels of endemism in both plants and animals.
- The *Subpolar Nothofagus forest* ecoregion, in southern Chile, is among the most extensive and pristine areas in the world, with rare unexplored biodiversity. It includes high mountain peaks, enormous icefields and fjords, with several endemic plant and animal species.
- *Rock and ice areas* are largely devoid of vegetation and have low species habitat value.
- The *San Félix-San Ambrosio Islands temperate forests* cover two tiny (about 2.5 km^2 surface) and largely unexplored volcanic islands around 850 km off the coast of Chile. The vegetation is a mix of matorral, barren rock, trees, shrubs, ferns and perennial herbs.
- The *Juan Fernández Islands temperate forests* cover three islands 667 km off the coast of Chile. The islands were designated a National Park in 1935 and a World Biosphere Reserve in 1977, and are listed by BirdLife International as a critical conservation priority. They are the Chilean islands with the highest number of endemic species relative to their surface. Logging, grazing and invasive species are significant threats to the islands' endemic species.
- The *Rapa Nui and Sala-y-Gómez subtropical broadleaf forests* cover the most remote inhabited spot on Earth (3 700 km west of Chile's mainland). While Rapa Nui (or Easter Island) was once covered in forest, it is now completely grass covered except for a few stands of trees and shrubs. Sala-y-Gómez is a small reef 415 km northeast of Easter Island designated as a nature sanctuary because of the large populations of seabirds that use the island for breeding.

Source: Hogan (2013); MMA (2014a); World Bank (2012); WWF (2015).

1.1. *Terrestrial ecosystems*

Land-use change

Forests cover about 23% of Chile's total land area; arable land and pastures account for 21% and the remaining is open land covered by rock and ice areas, low vegetation, wetlands or water, or occupied by urban areas and other infrastructure. Estimates indicate that anthropic ecosystems (dominated by human use) occupy 12% of land area (MMA, 2014a).

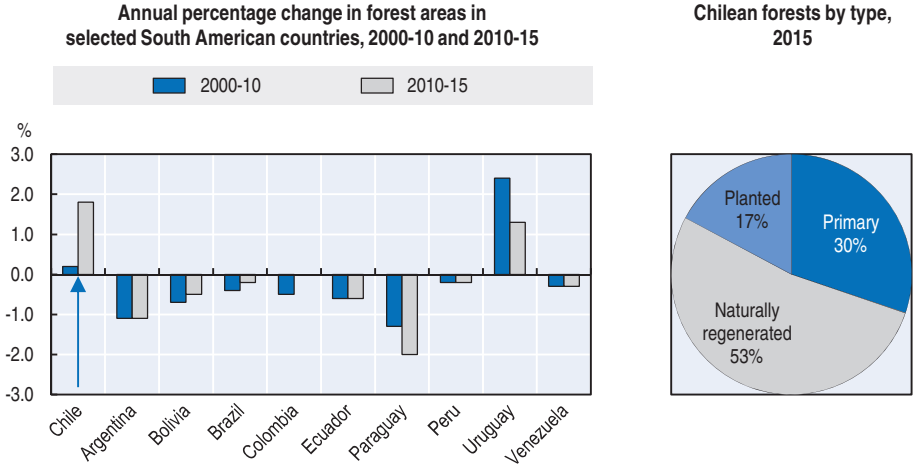
Rapid infrastructure and agricultural development in central and northern Chile have led to significant land conversion. This, in turn, has resulted in loss and degradation of habitat functions and services, interruption of the migration of mammals and the degradation of riparian ecosystems (adjacent to bodies of water) and wetlands (World Bank, 2012). The Chilean matorral shows some of the highest human density in the country, with 75% of the population in approximately 25% of the territory, and the highest land conversion rates to agriculture and other uses (World Bank, 2012).[3] Poor land management practices contribute to accelerated soil erosion on cultivated lands and desertification; decreased rainfall and rising temperatures associated with climate change can worsen these conditions (GEF, 2009). Estimates indicate that about half of Chile's land area suffers from soil erosion (MMA, 2014a).

Sixteen of the 127 terrestrial ecosystems in continental Chile are threatened; they lost a large part of their native vegetation coverage between 1992 and 2012, mainly due to forestry plantation, agriculture and urban expansion.[4] The most affected ecosystems are located between central and south central Chile (between Valparaíso and Los Ríos) (MMA, 2014a).[5]

Forests

Chile is the only country in Latin America, together with Uruguay, to experience a net gain in forest coverage (Figure 5.1). Over 2010-15, Chile recorded the third greatest annual forest gain in the world (after the People's Republic of China and Australia), accounting for 7% of global annual forest gain (FAO, 2015). Planted forests account for 17% of forested land (Figure 5.1). Native forests concentrate in southern Chile.

Figure 5.1. **Chile has the fastest growth rate in forest areas in South America**



Source: FAO (2015), *Global Forest Resources Assessment 2015.*

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Forest expansion has been primarily driven by the plantation of non-native tree species (in particular radiata pine and eucalyptus). While forest plantations help increase Chile's capacity to absorb CO_2 emissions, stabilise soil and halt erosion, they can fragment native vegetation and habitat-specific species (CEPF, 2015). In addition, the choice of non-native species has increased pressures on water resources.[6] According to WWF (2015), non-native tree species replace about 120 000 hectares (ha) of native forest every year.

Pressures remain in certain areas such as the Valdivian forests, primary forests in the coastal range and the Polylepis forests in the Andean Puna (World Bank, 2015; see also Box 5.1). If the current rates of deforestation outside the areas of protection continue, the Valdivian forests will disappear within the next 20 years (Hogan, 2013). Between 3.5% and 4.5% of native forest cover is lost annually (MMA, 2014a).

Forest fires

Accidental and deliberate fires are a major source of forest loss in Chile. There are approximately 5 000 fires annually, affecting 520 km^2 and causing a financial loss of USD 50 million on average. While the average annual number of fires has decreased, the average size of the fire has increased over time (MMA, 2014a). The regions most affected by fires include the Bío Bío, Valparaíso and Araucanía, which have a high proportion of meadows, shrubbery and forests. Plantation forests can increase the risk of fire spreading to vulnerable native forests (CEPF, 2015).

1.2. Marine ecosystems

Chile's extensive coastline, which extends to more than 6 000 km, comprises one of the richest marine ecosystems in the world. The oceanic islands of Chile are also home to a number of marine species, many of which are endemic. Sala-y-Gómez and Easter Island are considered hotspots of reef fish and live coral. Chile ranked 74th in the 2015 Ocean Health Index assessment, which assesses marine ecosystems across 221 exclusive economic zones in the world.[7] This is the best ranking among South American countries (Figure 5.2). Chile received a relatively high score for marine biodiversity and clean water, with moderate improvement from 2014 (Ocean Health Index, 2015).[8]

1.3. Inland aquatic ecosystems

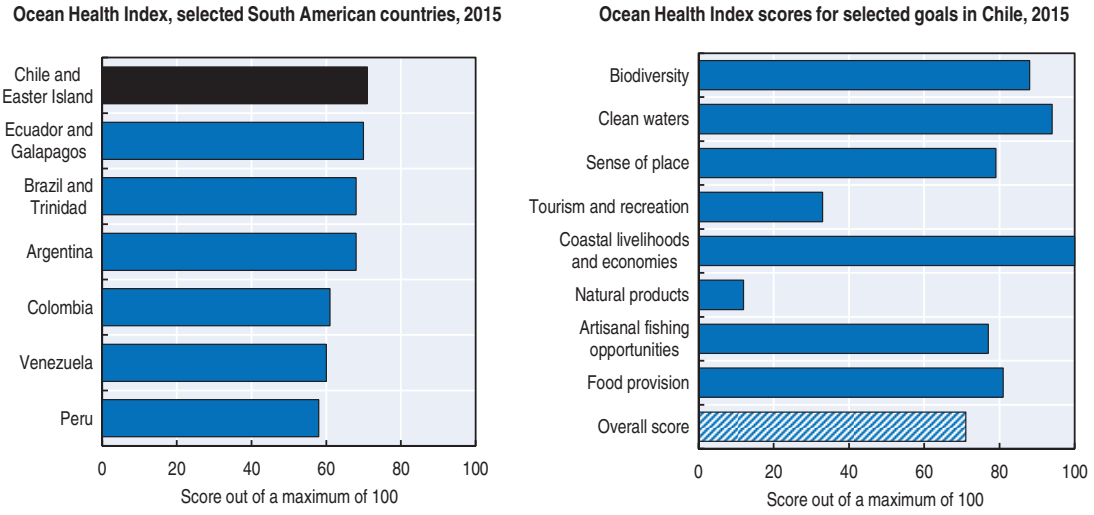
Water contamination

The main sources of water pollution are urban and industrial wastewater, fish farming and processing, and the agriculture and agro-food industry, with substantial regional variations (Figure 5.3). The impact of water contamination on biodiversity has not been assessed for most ecosystems.

In central Chile, limited access to tertiary wastewater treatment and large agricultural runoff have resulted in high levels of nutrients and caused eutrophication of coastal lakes, wetlands and estuaries (MMA, 2012).[9] Impact on water and soil quality from increased use of fertilisers and pesticides is considerable (Section 6.1).[10] Estuaries are increasingly at risk from development, with evidence that the saline line is mixed in some areas (MMA, 2015). The growth of ports for enhanced export capacity is also altering natural coastal ecosystems.

Water quality is considered good in the far south of Chile, where 80% of its 16 000 lakes and lagoons are located, and where population densities are low and economic activities

Figure 5.2. **Chile has a high Ocean Health Index score compared to other South American countries**



Source: Ocean Health Index 2015.

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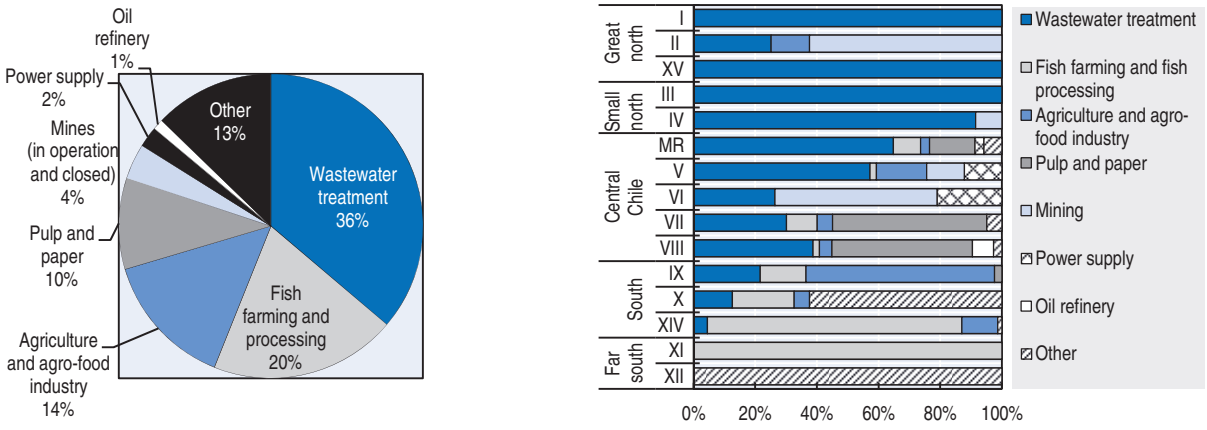
Figure 5.3. **Sources of surface water pollution vary greatly across the country**

Wastewater discharges to surface waters by industrial sector, percentage of total discharges,[a] total and by administrative region,[b] 2009



a) Percentages based on data expressed in tonnes of discharged wastewater per year.
b) Regions: I & XV. Arica, Parinacota, Tarapacá ; II. Antofagasta; III. Atacama; IV. Coquimbo; V. Valparaíso; VI. O´Higgins; VII. Maule; VIII. Bío Bío; IX. Araucanía; X. & XIV. Los Lagos, Los Ríos; XI. Aysén; XII. Magallanes, Antártica Chilena; MR. Santiago Metropolitan Region
Source: MMA (2012), *Official Environment Status Report 2011*.

StatLink http://dx.doi.org/10.1787/888933388669

limited. However, fjords in southern Chile host unique aquatic ecosystems due to the Humboldt Current and deep water; they are vulnerable to eutrophication and excessive use of antibiotics and chemicals from salmon farming and other forms of aquaculture.

Mining activities have led to elevated copper and salinity in some rivers. These include in the Maipo River, the major source of irrigation and potable water for the Santiago Metropolitan Region and nearby Valparaíso. In the northern regions, mining effluent adds to naturally high concentrations of heavy metals and sulphates in surface water. This

increases their acidity and conductivity to levels often exceeding permissible national limits and/or international recommendations (MMA, 2012). Abandoned mine tailings ponds also pose risks of water and soil contamination from heavy metals (Section 6.5).

Water quantity

Water use also continues to be a challenge to biodiversity. Water demand exceeds supply in various regions, notably in the arid north, where most of the water-intensive mining takes place. Increasingly, it also exceeds supply in the central parts of the country, where agricultural production is concentrated (Figure 1.15; Chapter 1). Water scarcity reduces the ability of water bodies to eliminate excessive nutrients, thereby contributing to eutrophication.

Chile has approximately 15 000 km^2 of wetlands.[11] Several wetland ecosystems are in critical condition, with those in the Chilean highlands and along the central coast showing decreases in water. Overuse of groundwater is threatening the ability of the wetlands to recharge their water resources (MMA, 2014a). Wetlands, other habitats and the nesting grounds of birds are increasingly impacted by the lack of water (Box 5.2).

Box 5.2. **Pressures facing El Yali National Reserve**

El Yali National Reserve is a coastal wetland in the central region of Valparaíso. It is a Ramsar site (under the Ramsar Convention on Wetlands of International Importance) and the most important wetland complex in central Chile, as 28% of all birdlife found in Chile is estimated to frequent the site for feeding, nesting and refuge. The black-necked swan and Chilean flamingo are two notable bird species that visit the wetland. It is a unique wetland, one of only five in the world located in a Mediterranean region.

Despite its status as a protected area, several threats face the species dependent on the wetland. Invasive eucalyptus forests and nearby cattle farms, crop irrigation and wastewater threaten both the quantity and quality of water in the area, which is also vulnerable to drought during the La Niña phenomenon.[a] Chilean frogs that were previously abundant in the wetland have died off, with the habitat they used to reproduce now dry (Box 5.3). The loss of water is attributed to the canalisation of a creek that supplied the wetland, as well as climate change.

The 2010 earthquake and tsunami also altered the balance of the ecosystem, destroying vegetation, altering nesting sites and leaving a large number of dead birds. The tsunami wave penetrated more than a kilometre inshore, breaking the coastal bar that separated a coastal lagoon from the sea. The wave also deposited algae, stones, waste and debris along the site.

a) La Niña is a recurring climate pattern that is the counterpart of El Niño, as part of the El Niño Southern Oscillation. During La Niña sea surface temperatures are unusually low in the equatorial Pacific, leading to reduced precipitation. By contrast, temperatures are unusually high during El Niño, leading to increased precipitation.

Source: Dusaillant, Galdames and Sun (2007); Birdlife (2010); Vidal-Abarca (2011); Acuna et al. (2014); Naturalista (2015); Ramsar (2015).

Glaciers are a significant source of freshwater in Chile and the headwaters of many rivers. With more than 6 000 white glaciers and 1 500 rock glaciers, Chile hosts more than three-quarters of the glacier area in South America, the vast majority located in the far south. However, glaciers have experienced a strong decrease in extent (MISP, 2015).

1.4. Species

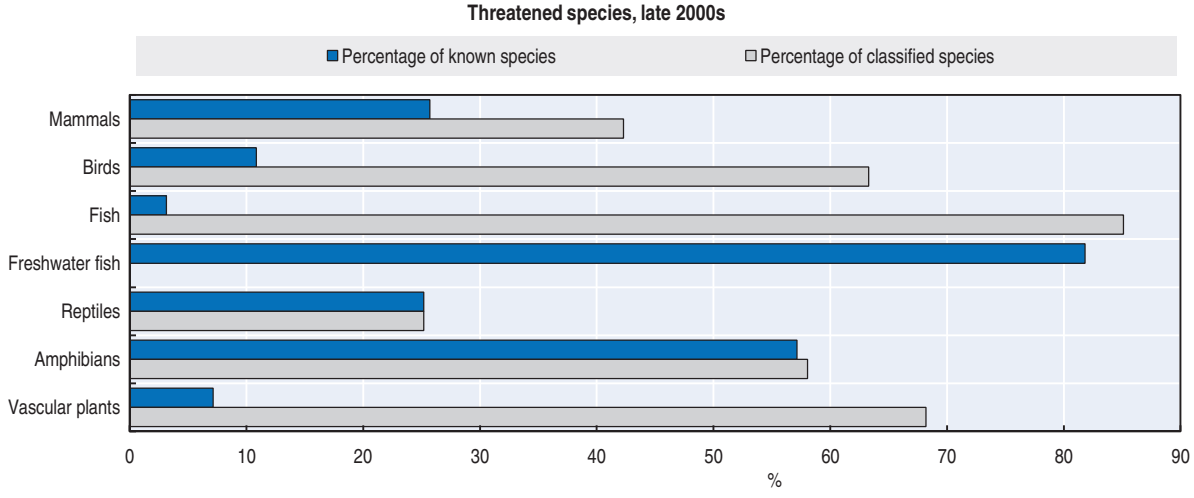
Chile is home to nearly 31 000 species, with about a quarter of them endemic. Of the about 1 000 species classified in Chile, 62% are considered threatened. The most threatened groups are marine fish species, vascular plants and birds (Figure 5.4). However, it is also important to consider the number of species classified within each group. Overall, less than 3.5% of known species in Chile have been classified (over 90% of amphibians, but less than 4% of fish species). Significant progress is needed to classify described species in Chile to fully understand their status (MMA, 2014a).

Box 5.3. **The Chilean frog**

The Chilean frog (*calyptocephalella gayi* and *caudiverbera caudiverbera*), an endemic species located in the Andean foothills in central Chile, is at risk from over-collection by locals who both eat the frogs and sell them illegally; agricultural runoff that is polluting water; rising water temperatures from climate change; and loss of habitat from urban expansion. The frogs have seen a 30% decline in their population over the last ten years. The frogs were given "vulnerable" status by the Chilean government in 2008 and are already on the International Union for Conservation of Nature (IUCN) Red List, but a formal conservation plan has not yet been adopted. Having such a plan in place is required for listing under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which would restrict trade of the frog among the 181 parties to the international agreement.

Source: Hoffman (2010).

Figure 5.4. **Many species are threatened**



Note: IUCN categories "critically endangered", "endangered" and "vulnerable" in % of known and classified species.
Freshwater fish and vascular plants: % of known indigenous species.
Source: OECD (2015), "Threatened species", *OECD Environment Statistics* (database).

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Fish resources

Chile's marine ecosystems are among the most productive in the world, thanks to the Humboldt Current. Fish resources are, however, under increasing pressure from fishing, invasive species, solid waste and wastewater discharges into the sea, algal blooms and

habitat fragmentation from development. In 2013, 8 out of 28 described fisheries were in the exhausted category, up from 3 in the previous year. In some areas, the seabed has been damaged from fishing trawlers and other harmful fishing practices (MMA, 2014a).

Exotic invasive species

There are almost 2 000 naturalised exotic species in Chile – non-native species that have spread into the wild and reproduced sufficiently to maintain their population. Twenty-six of these species are qualified as the world's 100 most invasive by the International Union for Conservation of Nature (IUCN); none have been targeted by an official control programme (MMA, 2014a).[12]

Invasive species represent a significant risk to biodiversity, impacting natural systems and the resilience of ecosystems to other pressures. They are deemed to be the main pressure in Easter Island and the Juan Fernández Archipelago, where 91% of evaluated species are threatened. Progress has been made in eradicating the rabbit on Santa Clara Island and in the Humboldt Penguin National Reserve. The most harmful invasive species – such as the beaver and mink – are increasing, however (Box 5.4). A type of microalgae – didymo – was also introduced to Chile and is spreading in rivers and lakes, with a suspected link to the decline in fish and other aquatic species (MMA, 2014a).

Box 5.4. **The Canadian beaver in Chile**

In 1946, 20 beavers were trapped in Canada and flown to Tierra del Fuego, an island at the southern tip of South America straddling the border between Argentina and Chile. The initiative was meant to foster a fur trade and associated economic development in the region. The Canadian beaver is estimated to have grown to a population in the tens of thousands. It now occupies all of Tierra del Fuego, several islands in the south of it and even some areas north of the Strait of Magellan.

The Patagonian forests were found to be particularly vulnerable to beavers. Unlike North American trees, none of the region's endemic tree species grew back once gnawed or flooded. Beavers have damaged half of Tierra del Fuego's riparian forests. Beaver ponds also cause rivers to retain 75% more organic matter than they otherwise would, altering the carbon cycle of watersheds.

Faced with growing destruction from continued beaver expansion, Chile and Argentina created a binational committee in 2006 aimed at eradication. A feasibility study estimated the cost at USD 35 million. Both countries have received grants from the Global Environment Facility (GEF) for pilot projects. Researchers are also investigating whether carbon offset funding could be used to finance reforestation.

Source: MMA (2014a); Worth (2014).

2. Institutional framework for biodiversity policy

2.1. Current institutional arrangements

Several institutions are directly and indirectly involved in biodiversity policy and in managing protected areas. The Ministry of Environment (MMA) oversees national biodiversity policy, while two separate institutions manage protected areas: the National Forestry Corporation (CONAF) under the Ministry of Agriculture, in charge of most terrestrial protected areas; and the National Fishing and Aquaculture Service (SERNAPESCA),

responsible for marine protected areas. The Environmental Superintendence (SMA) and its regional offices enforce environmental laws, including in protected areas. They lack resources, however, to fully perform their tasks (Chapter 2).

Water governance is also complex and fragmented in Chile. Different institutions are in charge of water allocation, water quality and pollution, regulation of water utilities, irrigation and water ecosystems.[13] In 2014, the president appointed a Presidential Delegate on Water Resources with a mission to improve inter-institutional co-ordination. The delegate released a National Water Resources Policy in 2015, which proposed the creation of a water agency (following the example of Brazil) and a co-ordination committee. Chile has 101 small river basins, but no river basin institutions. It lacks a system to plan river basin water quality and quantity. As the 2005 *OECD/ECLAC Environmental Performance Review* (OECD/ECLAC, 2005) recommended, Chile should introduce an integrated watershed approach to water resource management (Annex A). This implies creating larger river basin agencies and reconciling their territorial jurisdiction with existing administrative boundaries. The 2008 National Strategy for Integrated Watershed Management proposed reforms in this direction, but institutional fragmentation and opposition from large owners of water rights were among the main impediments to reform.

The establishment of the Council of Ministers for Sustainability in 2010 provided a tool for policy co-ordination and improving mainstreaming of biodiversity considerations in policy making. Several inter-institutional and multi-stakeholder committees co-ordinate specific biodiversity-related policy aspects. This includes the classification of species by conservation status,[14] invasive exotic species control and national protected areas (Section 4.2). Nevertheless, this fragmentation of roles creates significant governance and co-ordination challenges. With each organisation focused on its individual mandate, it is difficult to develop coherent, integrated biodiversity policy that addresses trade-offs with water management, urban and infrastructure development, and sectoral policies.

2.2. A new biodiversity governance framework

In June 2014, the government submitted to parliament a draft legislation proposing the establishment of the Biodiversity and Protected Areas Service (SBAP). The new Service would address biodiversity-related governance challenges and complete reform of environmental institutions (Chapter 2). This is in line with the recommendation of the 2005 *OECD/ECLAC Environmental Performance Review* to review institutional and legislative arrangements for the management of nature and biodiversity (Annex A). The bill aims to reduce institutional fragmentation; improve the co-ordination, efficiency and effectiveness of biodiversity policy; increase participation of the private sector and the public in policy development and implementation; and, ultimately, to help achieve the country's international commitments (Section 3.1).

The bill is working its way through Chile's legislative process, with the aim of creating the SBAP by 2018. It foresees the creation of an integrated National Protected Areas System (SNAP), which would comprise official marine and terrestrial protected areas and private protected areas (Box 5.5). It would also enable expanding the use of economic instruments to promote biodiversity conservation and sustainable use (Section 4.1). By shifting law enforcement responsibility in protected areas from the SMA to the SBAP, the bill is expected to help improve implementation and enforcement of laws impacting on biodiversity; CONAF rangers, who will be brought under the Service, will be able to directly inspect and identify breaches in the protected areas.

Box 5.5. **Proposed law creating a new Biodiversity and Protected Areas Service**

The Ministry of Environment would supervise the proposed Biodiversity and Protected Areas Service (SBAP). It would manage and monitor the National System of Protected Areas (SNAP); implement policies, plans and programmes related to the preservation, restoration and promotion of sustainable use of species and ecosystems; and develop and implement studies and research to improve the state of biodiversity knowledge inside and outside of protected areas. In particular:

- The SBAP will consolidate activities currently being undertaken by other organisations such as CONAF and SERNAPESCA. It will have the power to create new protected areas, with a specific consultation procedure and approval of the Council of Ministers for Sustainability, determine the cost of entry to protected areas and collect relevant revenues for operations. It will co-ordinate with other public agencies that have jurisdiction over natural resources and sectoral laws if there are implications for protected areas, priority sites or threatened ecosystems.
- The SBAP will have the ability to certify private protected areas and provide incentives, although the bill does not detail design or amount of such incentives. Compensation banks are also envisioned, which will enable biodiversity offsets for major projects or private investments in conservation projects as part of corporate social responsibility plans.
- The SBAP will be empowered to enforce management plans on protected areas, and monitor the enforcement of other laws such as those relevant to hunting, fishing and forestry on protected areas, priority sites and on threatened and degraded ecosystems. It will be able to impose penalties.
- The SBAP will monitor and inventory species and ecosystems, classify threatened ecosystems, develop restoration plans and provide new powers to prevent, control and eradicate invasive species for reasons of biodiversity (whereas the previous focus was on health). Responsibility for conservation measures relating to aquatic organisms will remain with the SERNAPESCA.

In addition, the bill states that each protected area must have a management plan in place consistent with objectives of the protected area. Concessions for private activities can only be granted in protected areas that have management plans in place, and only for activities related to ecotourism, scientific research or education. A technical committee will guide the granting of concessions. A National Biodiversity Fund will be created to finance conservation programmes outside of protected areas.

Source: MMA (2014a); MMA (2014b).

The proposed institutional setting is in line with international practice, as many countries have agencies dedicated to protected area management and other aspects of biodiversity (e.g. Brazil, Canada, Colombia, South Africa, United States). It will ultimately help raise the profile of, and resources for, biodiversity policy. However, the bill faces challenges in moving forward from economic ministries, private interests, workers in CONAF concerned about transfer into the new Service, and non-governmental organisations (NGOs) and indigenous communities that feel insufficiently consulted on the proposal (Vía Ambiental, 2015).

The centralised governance model for biodiversity would benefit from better involving local governments and indigenous communities earlier in the policy-making process, as well as in implementation. This would help re-build trust and reduce conflicts, and enlist a broader set of resources to implement biodiversity action plans.

3. Policy and legislative framework

3.1. *Major biodiversity strategies and initiatives*

Chile has made significant progress in developing strategies, plans and policies to promote biodiversity conservation, broadly in line with its international commitments. Chile is a party to the United Nations Convention on Biological Diversity (CBD) and to several other biodiversity-related international and regional agreements. These include the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Wetlands of International Importance (RAMSAR) and the United Nations Convention to Combat Desertification.[15]

Overall, most policy initiatives to date are focused on the Aichi targets 4 (implementation of plans for sustainable production and consumption), 6 (sustainable management and harvesting of fish and invertebrate stocks) and 11 (protected areas). Fewer projects and initiatives are focused on Aichi targets 3 (phasing out incentives and subsidies harmful to biodiversity), 10 (minimise human pressures on coral reefs), 18 (respect the traditional knowledge and practices of indigenous and local communities relevant to biodiversity) and 19 (improve, share and apply knowledge relating to biodiversity).

The National Biodiversity Strategy

Chile's National Biodiversity Strategy, first published in 2003, was expected to be updated by the end of 2015. It has led to progress in several areas, including building knowledge of terrestrial and aquatic ecosystems; expanding protected areas; improving species protection; better management of invasive species; and improved citizen participation (MMA, 2014a). It also helped recognise the role of private actors and sectoral policies in the development and implementation of biodiversity action plans. The strategy laid the foundation for the launch of several international projects (e.g. those funded by the Global Environment Facility) and several cross-border and regional initiatives.

However, a 2014 assessment showed that only half of the 315 actions outlined in the 2003 strategy had been completed, with another 23% either partially completed or in progress. The main reasons for incompletion were shifting priorities; a lack of human or financial resources; a lack of co-ordination; lack of agreement across entities; and a lack of political will (MMA, 2014a). In addition, the strategy did not consider marine and coastal environments or the Oceanic Islands.

The revised National Biodiversity Strategy, which will cover 2015-30, is aligned with the 2011-20 CBD Strategic Plan and incorporates the Aichi targets. It aims to correct many of the implementation challenges of the previous strategy. It shifts focus from direct actions to enablers such as knowledge, capacity, awareness, education and inclusion of biodiversity considerations in other public policies and private activities. It will include a National Strategy for Coastal and Marine Conservation, and link to the Climate Change Adaptation Plan (Chapter 4; Section 7). The new strategy also includes greater emphasis on ecosystem restoration and connectivity across ecosystems. Another important improvement will be the identification of financial resources required to carry out action plans. A Steering Committee identifies specific actions and indicators to accompany the strategy (MMA, 2014a). The 15 Regional Biodiversity Strategies are also being updated.

Other key strategies and policies

Several policies, strategies or plans deal with specific biodiversity-related issues, such as a national policy for the protection of threatened species (in place since 2005). CONAF has been implementing conservation plans for 31 prioritised species.[16] However, the conservation plans cover less than 10% of threatened species. The MMA (2014a) noted that limited human and financial resources, as well as a lack of co-ordination and appropriate tools, are limiting effective measures to prevent the extinction of species. In response, a committee was created in 2015 to oversee preparation and implementation of species recovery, conservation and management plans. In 2014, a strategy for the prevention, control and eradication of exotic species was also developed. A new legislation, under discussion at the time of writing, would bring Chile into compliance with CITES by establishing the required authorities and domestic measures to track and restrict trade in endangered species.

National plans or strategies are also in place for glacier protection and wetland conservation.[17] The National Glacier Strategy and Policy were adopted in 2009 to prepare adaptation measures to glacier melting due to climate change. In 2014, the MMA presented a legislative proposal to protect and preserve specified glaciers and regulate activities that can take place within them. The bill is not a blanket prohibition of all economic activities; some industry and businesses would be authorised (e.g. tourism) provided the required environmental assessment and permits are obtained. Sanctions would penalise actions that harm or damage glaciers, whether from a malicious act or through negligence. The bill provides for transitory measures for activities affecting glaciers. There has been some criticism that the law would not sufficiently protect glaciers, which are an essential source of water. Others have expressed concern that it will limit mining activity in the Andes Mountains.

Chile has not signed or ratified the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) to the CBD. It is estimated that about 11% of species in Chile have potential for medicinal use (particularly plants of arid and semi-arid areas). The Ministry of Health includes traditional knowledge of the use of natural resources and biodiversity for medicines as part of its Indigenous Health Programme (MMA, 2014a). However, no legal or regulatory framework governs access to, and use of, genetic resources.

International and regional co-operation

Chile has numerous initiatives with international organisations and other national governments that are helping improve conservation. Initiatives with Canada and the United States focus on improving management of protected areas.[18] Co-operation with the IUCN on biodiversity conservation and protected areas and GEF financing have also played a significant role in developing Chile's biodiversity policies and plans, and in supporting pilot projects (Section 5).

Partnerships with other countries in South America can also help improve biodiversity conservation, and are particularly important for species that straddle borders. Chile is part of an environmental biodiversity co-operation agreement with other South American countries, including Argentina, Ecuador and Uruguay. It also has bilateral or multilateral memoranda of understanding with several countries in the region for the conservation of several species and their habitats (MMA, 2014a).[19] Chile and Argentina have joined efforts

for beaver management in Terra del Fuego (Box 5.4). Chile could benefit from further information sharing and dialogue with countries that have implemented successful initiatives in particular areas.

3.2. Improving knowledge of status and value of biodiversity for decision making

Chile has made progress in improving knowledge on the status of, and pressure on, biodiversity. As part of implementing the 2003 National Biodiversity Strategy, Chile has conducted systematic assessment of terrestrial ecosystems, identified priority sites for conservation efforts and developed national registries for wetlands and protected areas. However, significant knowledge gaps remain, especially about the conservation status of species and marine and freshwater ecosystems, as well as about the value of biodiversity and ecosystems and the costs associated to their loss. Further work is needed to develop an accurate biodiversity baseline to assess trends, identify priorities for action, inform decision making and build public consensus around biodiversity conservation and sustainable use. The MMA should accelerate its current plans to develop a National Ecosystem Assessment.

Chile has conducted several assessments of species conservation status, but it needs to accelerate research. About 1 000 species have been classified, or only about 3.5% of known species in Chile (Section 1.4; Figure 5.4); the MMA expects to assess 1 500 species by 2020. Chile would benefit from an assessment of marine ecosystems, for example using the international Ocean Health Index methodology (Section 1.2), as other South American countries do (e.g. Colombia, Ecuador and Venezuela). This would help understand where to focus protection efforts.

The General Water Directorate (DGA) of the Ministry of Public Works monitors water quality and the status of rivers, lakes and glaciers. The data and variables monitored do not, however, allow for adequate assessment of the status of water bodies and coastal areas (World Bank, 2011). Biological parameters are not monitored and coastal lakes are not part of the monitoring network, despite being particularly vulnerable to nutrient pollution. A water quality and ecological information platform, which would regroup and publish all available data on water quality, was under development at the time of writing. The lack of systematic data is a serious obstacle to managing water resources.

Some progress has been made in estimating the value of biodiversity and ecosystems in Chile (Box 5.6). Chile joined the World Bank WAVES (Wealth Accounting and the Valuation of Ecosystem Services) initiative and was selected by the United Nations for pilot projects on ecosystem accounting (CBD, 2015). A National Environmental Accounts Plan is scheduled for 2016. When fully implemented, it is expected to include water, land and ecosystems accounts (Chapter 2).

Given its limited financial and human resources dedicated to biodiversity conservation, Chile could benefit from a more targeted approach to financing biodiversity research. This should focus on filling gaps in the scientific knowledge base; improving information on biodiversity pressures; and expanding linkages to social science research to improve biodiversity outcomes and address competing interests.

Box 5.6. **Examples of economic evaluation of biodiversity in Chile**

Nahuelhual et al. (2007) estimated economic values for the Valdivian rainforest ecoregion, finding values of USD 3 742 per ha for sustainable forest management, with higher values of USD 4 546 for old growth forests. The estimated annual value of maintaining soil fertility was USD 26.3 per ha, while the value of water supply for human consumption was an estimated USD 235 per ha. Annual benefits from recreation were estimated at between USD 1.6 and USD 6.3 per ha for two parks studied.

A 2010 study estimated the monetary value of ecosystem goods and services from Chile's National System of Protected Areas. The study included indirect use of regulating services such as water purification and regulation, pollination, waste treatment, climate regulation, erosion control, species shelter and habitat, as well as others. It also captured direct uses such as the supply of food and fibre, water, fuel, tourism and recreation and included the provision of genetic resources and cultural services. The study was done at two different levels: i) formally recognised protected areas; and ii) formal protected areas, private conservation areas and priority sites for conservation. The estimated value of formal protected areas was USD 1.37 million, and the second was USD 2.05 million, per year. However, it was not possible to estimate all of the values due to a lack of information (MMA, 2014a).

4. Policy instruments for biodiversity conservation and sustainable use

4.1. *The policy mix*

Chile has implemented a wide set of policy instruments to promote the protection, restoration and sustainable use of biodiversity. Following OECD (2013a), these instruments can be classified in regulatory, economic, and voluntary and information approaches. Table 5.1 summarises key instruments in each category that Chile has implemented.

Table 5.1. **Main policy instruments for biodiversity conservation and sustainable use in Chile**

Regulatory instruments	Economic instruments	Information and voluntary approaches
Restrictions or prohibitions on use or on access: • Protected areas • Restrictions on trade in animal and wild plant specimens • Fishing restrictions • Water quality and emission standards Environmental impact assessment Strategic environmental assessment	• Market of water-use rights • Fishing quotas • Protected area entrance fees and concessions • Subsidies for conservation of native forests • Biodiversity compensation banks or biobanks (pending) • Incentives for private conservation (pending) • Biodiversity Fund (pending)	Certifications, including: • Forest Stewardship Council • Sustainable Wines of Chile • Organic farming • Best aquaculture practices Reporting/inventorying: • Peat extraction • Abandoned mines • Wetlands Agreements with the business sector: • Clean production agreements

Source: Adapted from OECD (2013a), *Scaling-up Finance Mechanisms for Biodiversity*.

Regulatory instruments

As in other environmental policy areas, Chile has to date focused primarily on regulatory initiatives to support biodiversity conservation, mainly protected areas (discussed in Section 4.2). Chile restricts trade in animal and wild plant specimens, as well as certain fishing activities (Section 6.3). It has adopted water quality standards for ecosystem protection for four river basins and two lake catchments, although standards

have yet to be introduced for most river basins in northern Chile, which are the worst affected by mining activities.[20] Standards for sewerage discharges apply throughout the country, but are not linked to water quality in the receiving water bodies; standards for industrial discharges are being updated (Chapters 1 and 2).

Environmental impact assessment (EIA) and strategic environmental assessment (SEA) procedures are the main instruments to mainstream environmental considerations, including those related to biodiversity and wildlife, in major sector-specific projects and plans. However, consideration of biodiversity impacts within the EIA process has been ad hoc, leading to uneven treatment of projects and uneven protection of sites. EIA only applies to major projects, leaving few tools available to address impacts from smaller projects or urban and agricultural expansion. As Chapter 2 discusses, EIA often comes too late in project design to thoroughly consider alternative development scenarios; it is not required if significant changes in the activity occur during the project or plant operation. While public participation is mandatory, it occurs at an advanced stage of project development and the local community is essentially asked to approve a pre-designed project.

Since 2010, all territorial development plans are subject to SEA. A methodological guide for SEAs has also been completed, as well as a guideline for applying SEA to coastline zoning. However, an SEA has been conducted on less than half of territorial plans and there has generally been limited consideration of environmental and biodiversity considerations in land-use planning to date. This is partly due to insufficient involvement of local governments and the public (Chapter 2).

Economic instruments

Chile uses some economic instruments to promote biodiversity conservation and sustainable use. A market of water-use rights has long been in place, with the aim of ensuring that allocation and use of water resources reflect their scarcity and value (Box 1.3). However, existing user rights do not allow for meeting the minimum ecological flow in half of the river basins in northern Chile (Chapter 1).[21] A quota system governs Chile's fishing industry (Section 6.3). Protected areas have entrance fees (Section 5). Additionally, subsidies are provided for conservation of native forest (Section 6.2).

The use of biodiversity offsets is at the very early stages, with some examples in the mining sector (Section 6.5). In 2014, the MMA and the Environmental Assessment Service released a guide on biodiversity offsets as compensatory measures in EIA (see also Chapter 2). In line with international guidelines, the EIA regulations incorporate the concepts of adequate compensation (equivalence between the negative impact to be compensated and the offset) and mitigation hierarchy, considering offsets as a last resort option (after avoidance, minimisation, mitigation and restoration) (Azzopardi, 2014). To scale up the use of offsets, Chile needs to put in place an adequate monitoring, reporting and verification framework to ensure that biodiversity benefits at offset sites are equivalent to losses at the impact sites. Effective mechanisms to involve local communities and stakeholders are also necessary to manage social implications (OECD, 2013a).

There is scope to expand use of economic instruments. There are no examples of payments for ecosystem services (PES) in Chile. While there is a price on water abstraction, via the market of water rights, water effluents, pesticides and fertilisers, which are sources of increasing pressures on water bodies, are not taxed or charged (Section 6.1). The taxation of mining operations pays little attention to their environmental impact (Chapter 3).

The proposed legislation creating the Biodiversity and Protected Areas Service (Box 5.5) provides the legislative framework for extending the use of economic instruments, including PES, biodiversity offsets and biobanks (i.e. repositories of certified and quantified gain in biodiversity resulting from conservation initiatives to offset the impact of development and business projects). It also provides for a National Biodiversity Fund to implement the new biodiversity instruments and finance conservation programmes outside protected areas. However, details regarding the scale, scope and design of these instruments have not yet been developed. Swift adoption and implementation of this law will be a key step towards fulfilling the 2004 OECD Council Recommendation on the use of economic instruments in promoting the conservation and sustainable use of biodiversity.[22]

Removing subsidies harmful to biodiversity

In its Fifth National Report on Biodiversity to the CBD, Chile acknowledges that there is no registry of perverse incentives and those that are known have not been eliminated (MMA, 2014a). The identification and reform of subsidies potentially harmful to biodiversity are among the objectives of the BIOFIN Project, an initiative co-ordinated by the United Nations Development Programme (UNDP) in co-operation with Chile's finance and environment ministries (BIOFIN, 2014). By the end of 2015, the BIOFIN project identified two subsidies harmful to biodiversity: support to irrigation infrastructure, discussed in Section 6.1, and subsidies for small-scale mining (Section 6.5). In addition, subsidies for forest plantations have encouraged replacing native forests by plantations with exotic species. While these subsidies ended in 2012, they are expected to be renewed (Section 6.2). Chile should build on the BIOFIN exercise to accelerate efforts to eliminate or reform subsidies for activities harmful to biodiversity.

Voluntary approaches

Use of international and domestic certifications (such as the Forest Stewardship Council) can provide guidance to industry on best practices, as well as additional information for consumers. International customers increasingly demand sustainable production methods from suppliers – particularly in forestry, aquaculture and agriculture – and certifications or eco-labels can help Chilean companies access these markets (Section 6; also see Chapter 3).

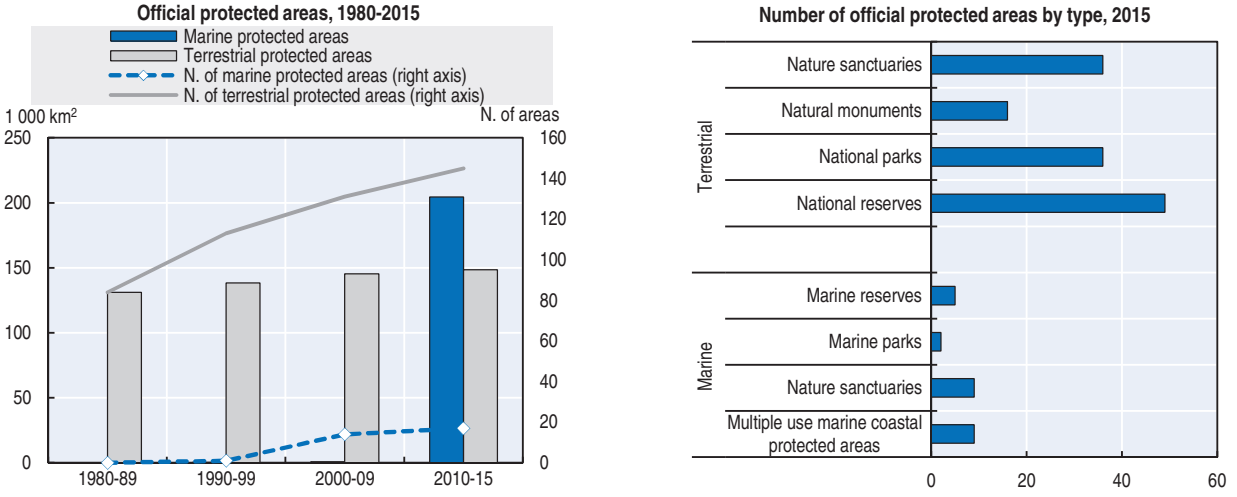
The 2010 Environmental Quality Law established the National Clean Production Council under the MMA and strengthened the framework for Clean Production Agreements (APLs). In an APL, enterprises and a competent government authority set specific targets and actions to foster clean production in exchange of budgetary support (Chapter 2). Though the focus has been on eco-efficiency (energy use, waste, water use), APLs are seeking to incorporate biodiversity objectives. An agreement with the fruit sector, for example, seeks to reduce the impact of pesticides on pollinators.

4.2. Protected areas

As a signatory to the CBD, Chile committed to achieving Aichi Target 11 on conserving at least 17% of terrestrial and inland water areas, and 10% of coastal and marine areas, by 2020. Chile has established national targets consistent with its convention commitment. This includes to protect at least 10% of its priority terrestrial and marine ecosystems identified as

part of Chile's 2003 National Biodiversity Strategy and regional strategies (MMA, 2014a). In line with these objectives, Chile has significantly extended the areas under nature protection. It has now more than 160 official terrestrial and marine protected areas (Figure 5.5).[23]

Figure 5.5. **The land and marine area under protection has expanded**



Source: MMA (2015), *Segundo Reporte del Estado del Medio Ambiente.*

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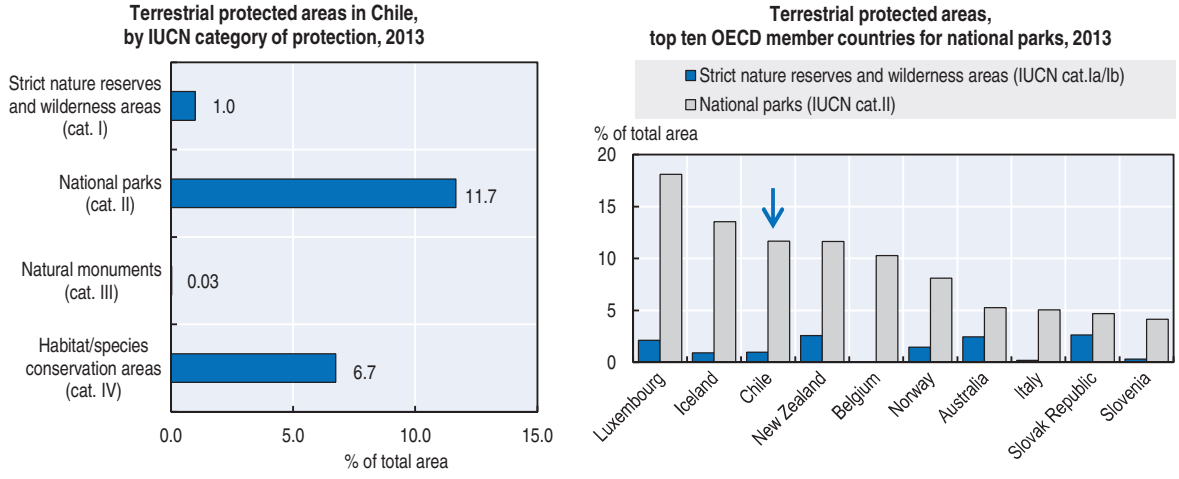
Terrestrial protected areas

With 19.5% of its land and inland water area protected in 2015, Chile has exceeded its Aichi target. Since 2000, Chile has created more than 30 new terrestrial protected areas, expanding the surface of protected land by nearly 7% (Figure 5.5). The majority of protected areas are classified within the highest protection level categories (nature reserves and national parks). Chile has the third highest share of total land area included in national parks in the OECD (Figure 5.6).

Figure 5.6. **Most protected areas are in the highest protection categories**



Source: OECD (2015), *Environment at a Glance 2015: OECD Indicators.*

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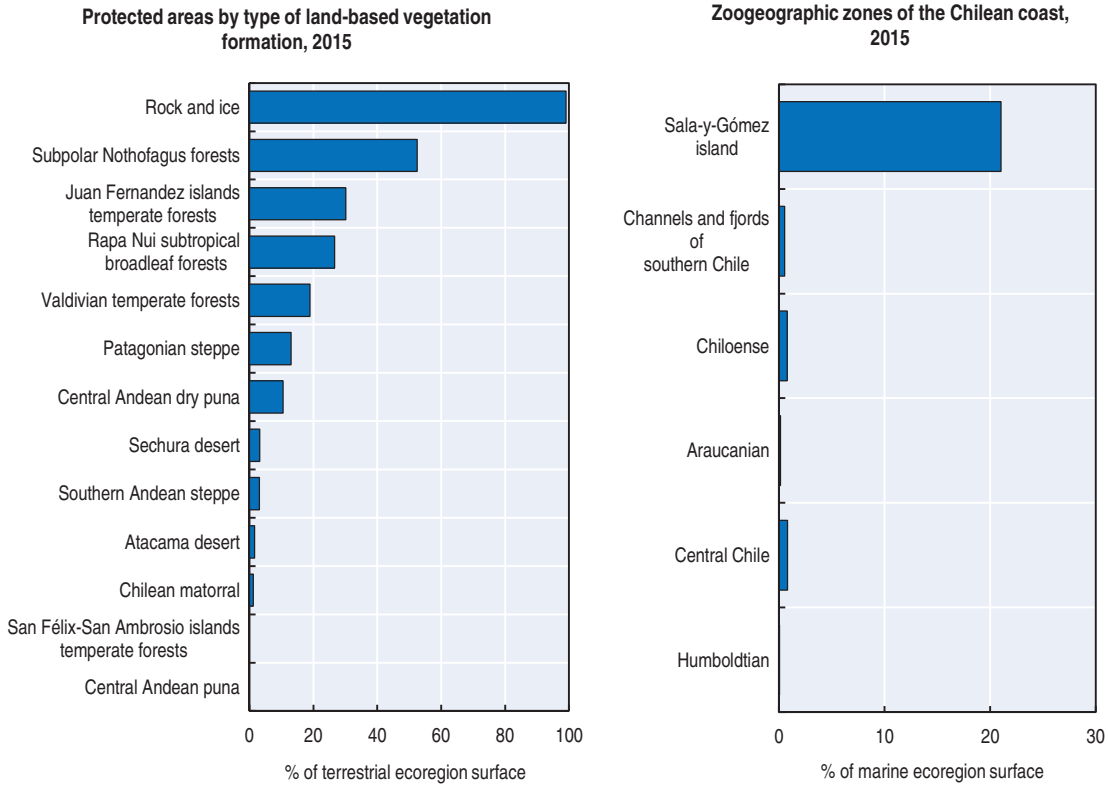
However, important gaps remain in the representativeness of protected areas across ecoregions and ecosystems. More than 80% of protected areas are located in the two southernmost regions (Aysén and Magallanes) and cover large extents of ice and rock (Figure 5.7). In these regions, low population, low commercial value and lack of land claims from private interests have made nature protection historically easier (Pauchard and Villarroel, 2002).

Figure 5.7. **Protected area coverage differs across terrestrial and marine ecosystems**



Source: Ministry of Environment, 2015.

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Protected areas cover only just over 3% of the Southern Andean steppe and 1% of the matorral, despite the high biodiversity value of these ecoregions (Box 5.1; Figure 5.7). Public protected areas in the central and northern parts of Chile have historically been small and fragmented and are considered inadequate to conserve biodiversity (ELI, 2003). This is due to a combination of pre-existing development, significant population concentration, high land value and highly productive agricultural land (Pauchard and Villarroel, 2002). Growing pressures from urban and industrial development and agriculture are increasing the importance of near-term action to protect biodiversity in the region. Rainforest along the coast is also insufficiently protected, with many of the protected areas at mid-elevations (CEPF, 2015).

Only 11 of 68 sites identified as national protection priorities are fully or partially within the boundaries of official protected areas. The protection of inland aquatic ecosystems is limited, with the only formal protection from the 12 internationally designated Ramsar Wetland Sites. Less than 1% of Chile's wetlands (which extend to about 15 000 km^2) are protected (MMA, 2014a).

Marine protected areas

The surface of marine protected areas expanded from 60 km^2 to 151 000 km^2 between 2000 and 2015, reaching 4.3% of total marine area (as measured by the exclusive economic zone or EEZ). In October 2015, the MMA announced plans for the Nazca-Desventuradas Marine Park (surrounding the islands of San Ambrosio and San Félix, known as the Desventuradas Islands). Once officially established by decree, this will be the largest marine reserve in the Americas (460 000 km^2) and will bring Chile's marine protected areas to 24% of its EEZ, well beyond the Aichi target of 10%. Much of the marine life in the reserve is endemic, and there is some threat from long-distance fishing fleets and bottom-trawling. The Chilean Navy will help enforce the no-fishing zone (Lee, 2015).

While Chile's progress on marine protection is significant, there has been some criticism that the largest protected areas are far from shore and large population centres, where the urgency for protection is greatest (Lee, 2015). As of 2015, most of the marine area under protection was around Isla Sala y Gómez, a small uninhabited island in the Pacific Ocean (Figure 5.7).

Management of protected areas

Terrestrial and marine protected areas are the responsibility of two separate institutions. CONAF manages the terrestrial protected areas under the National System of Public Protected Forest Areas (SNASPE). Established in 1984, the SNASPE covers the vast majority of terrestrial protected areas.[24] SERNAPESCA is responsible for marine protected areas.

Chile faces considerable challenges in managing its protected areas. All protected areas must have management plans that include objectives, baseline data and guidelines. More than 80% of the terrestrial protected areas have a management plan in place, but many of them only partially implement it. Many management plans are incomplete or need to be reviewed and updated. Most protected areas lack sufficient financial and human resources, including park rangers and a monitoring system (Section 5). This also affects the ability of the protected area management to involve the local communities effectively and to ensure co-ordination with the local governments and their territorial plans (Fuentes, Domínguez and Gómez, 2015). Some areas are also remote and hard to access.

No specific legal frameworks regulate participation of local authorities and communities in the establishment and management of protected areas. Many local governments and communities feel the national government does not adequately address their concerns and that they are not consulted sufficiently on plans and policies that will impact their regions. At the same time, some local governments have pursued their own biodiversity conservation initiatives (Box 5.7).

As discussed in Section 2, the 2014 legislative proposal establishing the Biodiversity and Protected Areas Service foresees the creation of an integrated National Protected Areas System (SNAP), which would bring terrestrial, marine and private protected areas under a unique framework. This is expected to bring greater effectiveness in the management of protected areas, as well as better engagement of the private sector, local governments and indigenous communities. A project funded by the GEF and UNDP is helping guide development of a strategic vision for the SNAP.

In 2014, a National Protected Areas Committee was created to define a National Action Plan for Protected Areas for 2015-30. At the time of writing, the plan was pending approval.

Box 5.7. **Examples of local biodiversity conservation initiatives**

The municipality of Santo Domingo on the coast of central Chile established its own protected area for the wetland, estuary and beach located within its district. It restricted certain activities in the area, including kite surfing, which was harmful to migratory birds. The municipality of Coronel in the Bío Bío region also developed its own recovery plan for the wetland Boca Maule (MMA, 2014a).

A 2014-19 GEF project aims to strengthen public-private initiatives for the conservation of biodiversity and ecosystem services in the Santiago and Valparaíso regions. The project has three components: strengthening local environmental management at the municipal level; minimising the impact of productive sectors on biodiversity (e.g. agriculture, tourism, forestry, mining, construction); and improving existing instruments, creating new incentives and integrating soil, water and forest conservation (MMA, 2014a). If the project proves successful, it would be worth building on lessons learned to expand the approach to other municipalities.

According to the draft plan and in line with the new legislation, 60% of SNAP protected areas will have revised their management plans by 2030 and developed systematic monitoring programmes. It is likely, therefore, that Chile will not have operational management and administration for all protected areas until 2050.

4.3. Private initiatives for biodiversity conservation and sustainable use

Private protected areas

One of the challenges in expanding public protected areas is that a significant proportion of land in areas where biodiversity conservation would be a priority is privately owned. Roughly 80% of land in the continental territory of Chile is privately owned (ELI, 2003). Agriculture, logging, livestock and introduction of exotic species on adjacent lands can also increase pressure on protected areas (Pauchard and Villarroel, 2002). Private conservation initiatives, where individuals purchase land for conservation and ecotourism activities, can therefore help address gaps in ecosystem, species and ecological function protection, as well as build connectivity across pre-existing protected areas. Despite a lack of public policies promoting private conservation, private initiatives emerged in Chile in the 1990s (OECD and LEED, 2014; see Box 5.8).

A 2013 survey found that 246 private conservation initiatives cover over 16 500 km^2 in Chile, or about 2% of the country's territory (compared to the nearly 149 000 km^2 covered by public protected areas) (MMA, 2013).[25] More than 60% of the private conservation initiatives belong to small landowners, but five of the larger private conservation initiatives account for 63% of the land area.

More than 40% of the private conservation initiatives partially overlap with priority biodiversity conservation sites. Most private protected areas are in the Valdivian temperate rainforests, the Subpolar Nothofagus forests and the Chilean matorral. Private initiatives in the matorral represent 13% of total area (public and private) under protection in the ecoregion; initiatives in the Valdivian forests represent 11% of total protection in this ecoregion (MMA, 2013).[26] This shows that private initiatives in these biodiversity hotspot regions could make an important contribution to conservation.

Box 5.8. **Pumalín Park: Private conservation initiative**

American businessman Douglas Tompkins – founder of clothing company *The North Face* – was a regular visitor to Chile, climbing, skiing, kayaking and hiking throughout the southern region. In 1991, he purchased 17 000 ha in southern Chile to protect its primeval native temperate rainforest, which was at risk for logging.

Over time, Pumalín Park grew, acquiring another 283 000 ha, mainly from absentee landowners. A network of campgrounds, trails, information centres and other public facilities provided public access to the park. It is now one of the world's largest private protected areas.

In 2005, Chile's president designated Pumalín Park as a nature sanctuary, granting it additional protections to secure its ecological value and prevent development. The protected lands have since been donated to Fundación Pumalín, a Chilean foundation, for their administration and ongoing preservation as a public park under private initiative.

Source: Pumalìn Park (2015).

The primary conservation initiatives in private areas are surveillance and patrolling, fence construction, scientific and monitoring research, and restoration. More than 60% of these initiatives do not, however, have a conservation plan to guide decisions. About one-quarter run on an annual operational budget less than the equivalent of CLP 1 million (about USD 1 500). NGOs administer more than 10 000 km^2 of the private lands (MMA, 2013).

The private protection initiatives are not currently inside the official protected areas system, which means there is no support for creating management plans or biodiversity monitoring. Proposed new legislation (see Section 2) will create the possibility of bringing private areas into the official protected areas system, and of financing their management plans and protection activities. It will establish incentives for private parties to collaborate on preservation and sustainable use of areas important for biodiversity conservation.

The survey of private conservation initiatives showed that nearly 60% of private owners would be willing to have their protected areas formally recognised by the government depending on requirements and incentives involved. Other countries have incentive systems to involve landowners in biodiversity conservation. South Africa's biodiversity stewardship programme, for example, is based on contracts with landowners that provide benefits commensurate with degree of biodiversity preservation, i.e. increasing with the constraints imposed on land use (OECD, 2013b). Canada provides attractive income tax benefits for "ecogifts" – permanent donations of land for conservation (Give Green Canada, 2015).

More generally, greater engagement of NGOs and private companies is necessary. NGOs play an important role in conservation efforts in Chile.[27] The private sector can also be an important driver of change, as it responds to changing international and domestic market demands (e.g. organic foods and certified forest products). The financial resources of private companies also hold the potential to fill gaps in an under-resourced public protected area and species conservation system.

Role of indigenous communities

The 2013 Survey of Private Conservation Initiatives also identified 33 initiatives on indigenous lands, covering approximately 2 570 km^2. These represented 15.5% of private

conservation efforts, demonstrating that indigenous communities can be important partners. In addition, a large proportion of the people living near Chile's protected areas are rural or indigenous.

The MMA funds indigenous community environmental projects under the Environmental Protection Fund. The Environmental Protection and Natural Resources programme of the Indigenous Development Corporation (CONADI) includes a biodiversity component (MMA, 2014a). The indigenous traditions and use of natural resources along the coastline are protected by law. Indigenous community associations comprising two or more communities may also jointly administer indigenous coastal marine areas.

However, as Chapter 2 discusses, the mechanisms for addressing special rights of indigenous communities have not been effective. These communities generally have low access to education or adequate training, and limited capital for developing a business related to ecotourism (Pauchard and Villarroel, 2002). It may be worth considering the potential for training rural and indigenous populations to play a greater role in local efforts for biodiversity conservation and sustainable use as a strategy to address inequality, reduce conflict and improve management of remote areas.

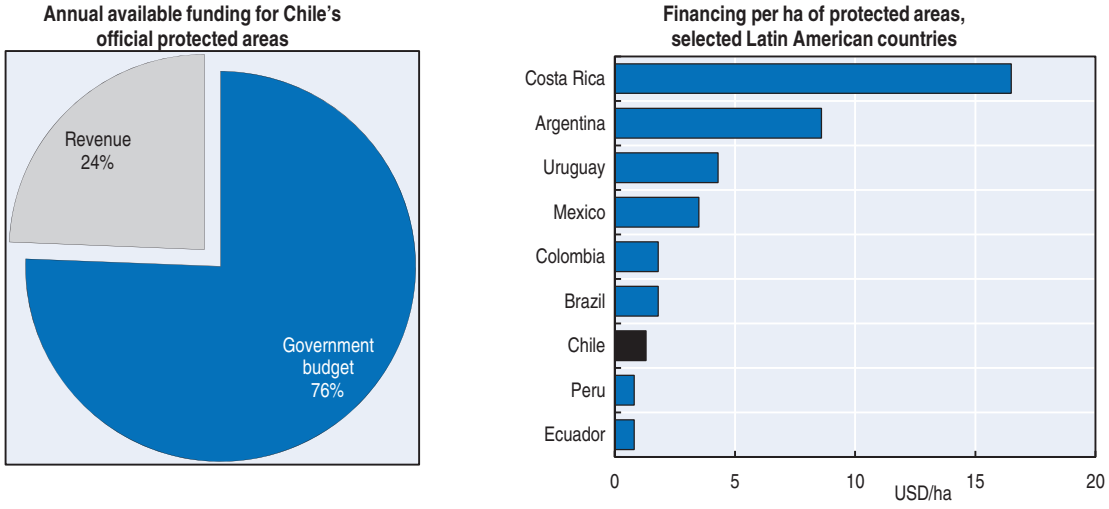
5. Financing biodiversity management and protected areas

Chile has significantly increased financing for biodiversity from public resources, as well as from entry charges and concessions at protected areas. Budget allocation to biodiversity protection grew by 176% between 2000 and 2014 (in real terms), slightly faster than total central government outlays for environmental protection (+174%) and more than the total government budget (+139%) (DIPRES, 2015; see Chapter 3). According to Chile's first comprehensive study on public expenditure on environmental protection, published in 2015, spending on biodiversity and landscape protection reached about USD 84 million (CLP 40.3 billion) in 2012, spread over 30 central government institutions. The Ministry of Agriculture (mainly through CONAF) spent 80% of this amount and the MMA less than 10% (CEPAL and MMA, 2015). Biodiversity accounted for the largest share of all estimated environmental protection expenditure in 2012 (28%) and 0.26% of the 2014 central government budget (CEPAL and MMA, 2015; DIPRES, 2015).

In 2012, the total financial resources available for official protected areas were about USD 41 million, of which three-quarters came from central government ministries and agencies. Entry charges, concessions and sales at protected areas generated revenue of USD 10 million, nearly a quarter of the total available funding for protected areas (Figure 5.8). This is among the highest shares in Latin America, together with Argentina, Costa Rica and Ecuador (Bovarnick et al., 2010). CONAF receives the bulk of the available protected areas funding (72%, including revenue from entry fees) to manage the SNASPE. This compares to the 3% received by the MMA to manage the natural sanctuaries and the negligible 0.3% received by SERNAPESCA to manage marine protected areas (Ladrón de Guevara, 2013).

Chile has benefited from international support for biodiversity conservation and protected area management. In particular, the GEF and UNDP have been helping Chile establish the SNAP. International co-operation accounts for a relatively minor share of available funding to protected areas. For example, GEF support accounted for about 4.3% of funding available to protected areas in 2012. Chile's transition to a high-income country will impact its eligibility for financing that would be considered official development assistance (ODA) as from 2017 (Chapter 3), likely reducing the number of new internationally funded projects.

Figure 5.8. **Protected area funding is among the lowest in South America**



Source: Bovarnick, A. et al. (2010), *Financial Sustainability of Protected Areas in Latin America and the Caribbean: Investment Policy Guidance*; de Guevara, L. (2013), *Proposed 2015-2030 Financial Strategy for the Chile National Protected Areas System;* MMA, 2015.

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While funding for biodiversity protection and protected areas has increased substantially since the mid-2000s, resources remain inadequate to attain biodiversity objectives or bring Chile in line with biodiversity funding in other South American countries. A dispersal of resources across many different institutions has also reduced expenditure effectiveness. The total available funding per hectare of protected areas averages at USD 1.3. As Figure 5.8 shows, this is significantly below spending in other South American countries (Bovarnick et al., 2010; Ladrón de Guevara, 2013). Chile's Fifth National Report on Biodiversity to the CBD notes that budgets for protected areas only allow for basic management activities and seriously limit effective management (MMA, 2014a). Figueroa (2012) estimated that an additional USD 35 million per year would be needed to finance an improved protected areas system, including improved compliance with management plans and integrated species monitoring.

The proposed legislation establishing the Biodiversity and Protected Areas Service includes a request for an increase in public financial resources to approximately USD 47 million per year (MMA, 2015). The government expects the new Service to be fully funded by 2020. While this would still fall short of the estimated USD 76 million needed, it would represent a significant improvement over the historical underfunding of biodiversity activities. The improved governance structure could also enable more efficient and effective management of scarce financial resources. In order to meet objectives, the new Service will need to actively pursue alternative sources of revenue and opportunities to leverage private sector and local actions, such as ecotourism concessions, payments for ecosystem services and biodiversity offsets (Section 4.1). The proposed bill opens the opportunity of using these instruments for generating additional revenue, and the ongoing BIOFIN project aims to design a plan to further mobilise public and private resources towards biodiversity (BIOFIN, 2014).

6. Mainstreaming biodiversity into sectoral and other policies

The Chilean export-oriented economy depends on the use of its natural resources, with copper production, fishing and aquaculture, forestry, tourism and agricultural

industries providing the greatest contribution to GDP (Chapter 1; Figure 1.2; Chapter 3). With growing economic activity, infrastructure development and expansion into new areas, pressures on biodiversity and environmental conflict are increasing (Chapter 2). This makes mainstreaming all the more important, especially in biodiversity hotspot areas with growing population density, such as the Chilean matorral, the Valdivian forests and the Sechura desert (Hogan, 2013).

While biodiversity objectives are now being incorporated into several other policy areas, tangible results from these efforts – beyond a few local examples – are not yet apparent. There has generally been a lack of knowledge among decision makers of the role that biodiversity and ecosystem services play in supporting Chile's economy and the quality of life of its citizens (MMA, 2014a). Improving knowledge, building awareness and actively engaging local stakeholders are, therefore, necessary to make the case for actions towards biodiversity conservation and sustainable use, to address trade-offs and social conflicts and, ultimately, to ensure effective mainstreaming.

The new National Biodiversity Strategy (under development at the time of writing) increases emphasis on mainstreaming. It promotes work with trade associations of the major producing sectors to address biodiversity concerns and creates an Advisory Steering Committee with representation from 11 ministries, 2 NGOs, 2 scientific institutions and 5 trade associations. Mainstreaming biodiversity considerations into land-use planning, marine planning and sectoral policies can also help leverage new sources of financing for pursuing biodiversity-related objectives, such as with tourism in protected areas.

As discussed in the following sections, key mainstreaming areas of focus should include reform of environmentally harmful subsidies such as those for irrigation works and small-scale mining; reductions in fertiliser and pesticide application; improved monitoring of the impacts of aquaculture on ecosystems; improved monitoring of soil and water contamination from mining; and the development of decontamination plans for abandoned mines.

6.1. Agriculture

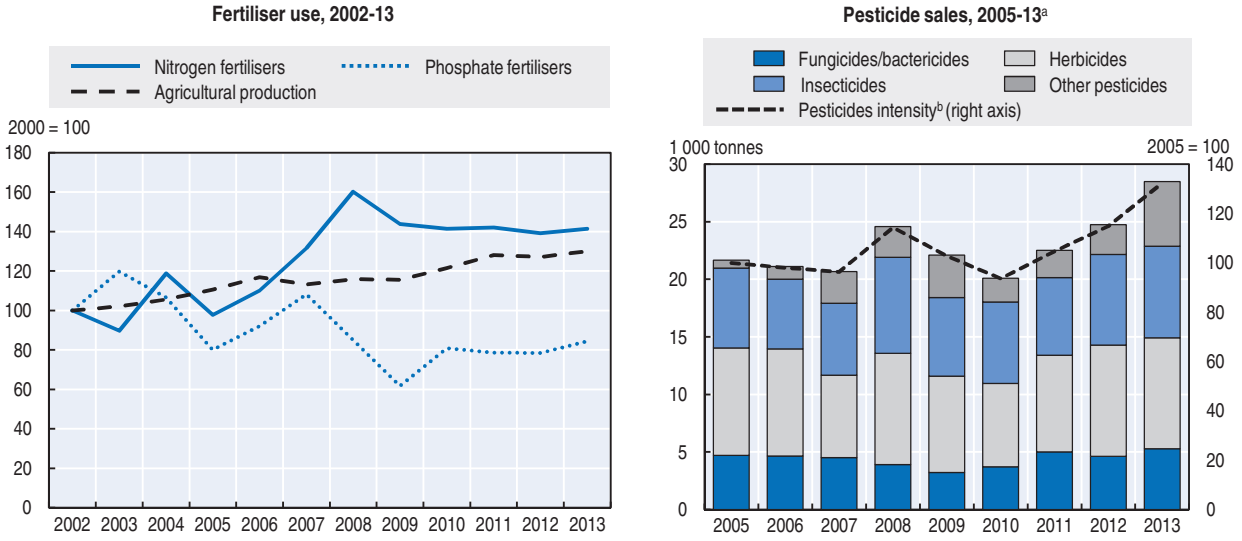
Agriculture is a mainstay of the Chilean economy and an important source of exports and employment. Total agricultural production increased by 30% over 2002-13. It concentrates on high quality export products, notably fruit farming (40% of agricultural GDP) and animal husbandry. The country is one of the world's leading exporters of fresh fruit and wine. Several trade agreements are pushing Chile to improve the sustainability of its products (Chapter 3), and market demand is driving greater production of organic products.

Controlling the use of fertilisers and pesticides

The use of nitrogen fertilisers and pesticides increased faster than total agricultural production and the expansion of agricultural land (Figure 5.9). Chile had the highest average annual increase in pesticide sales among OECD member countries, mainly linked to the growth of the horticulture and vine sub-sectors (OECD, 2013c). The use of pesticide per unit of agricultural land has grown rapidly since 2000. It is now similar to that of many OECD member countries (Figure 5.9; Annex 1.C). Wageningen (2013) indicates that small farmers in Chile often spray more pesticides than necessary.

Risks to soil and water from pesticide and fertiliser use in agriculture appear to be considerable, yet Chile has no comprehensive system to monitor soil and water quality

Figure 5.9. **The use of agricultural chemicals increased**



a) Data refer to imports in formulated products for use in agriculture, forestry and veterinary and sanitary sectors.
b) Based on data expressed in tonnes per km^2 of agricultural land.
Source: FAO (2015), *FAOSTAT* (database).

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(notably in remote regions). Chile is the only OECD member country that does not estimate its national (soil surface) nitrogen and phosphorus balances (OECD, 2013c). To date, controls have not been sufficient to address nutrient releases from agricultural activities into inland water systems. In addition, Chile has long subsidised the recovery of the production potential of degraded agricultural soils, which can entail nutrient contamination from chemical fertilisers, although some measures could improve the soil's ability to sequester carbon (Chapter 4).

NGOs have reported massive deaths of bees after pesticide sprays and academic research found pesticide residues in honey (CIAP, 2012).[28] This calls for adequate restrictions based on pesticide risk assessments such as those conducted in the EU.[29] While no taxes are in place on fertilisers and pesticides or on water effluents, the proposed extended producer responsibility legislation does include disposal of unused pesticides (Chapter 1).

Improving water use

The agriculture sector's demand for water is a significant threat to biodiversity in Chile, draining wetlands and eroding soil (Section 1.3). A large part of Chilean agriculture produce relies on irrigation technology. Chile has heavily invested in irrigation infrastructure and subsidised on-farm investment in irrigation and drainage works.[30] The irrigation subsidies have encouraged the adoption of water-saving techniques. Coverage of modern irrigation methods and irrigation efficiency have increased,[31] together with the expansion of irrigated areas by 8 000 ha per year. However, Chilean agricultural sector has generally not yet transitioned to sophisticated irrigation systems that minimise water use. Traditional gravitational irrigation still accounts for over 70% of irrigated area (Guzmán, 2012). Chile still has among the highest irrigation water application rates in the OECD, which suggests a low efficiency of irrigation water use (OECD, 2013c).[32]

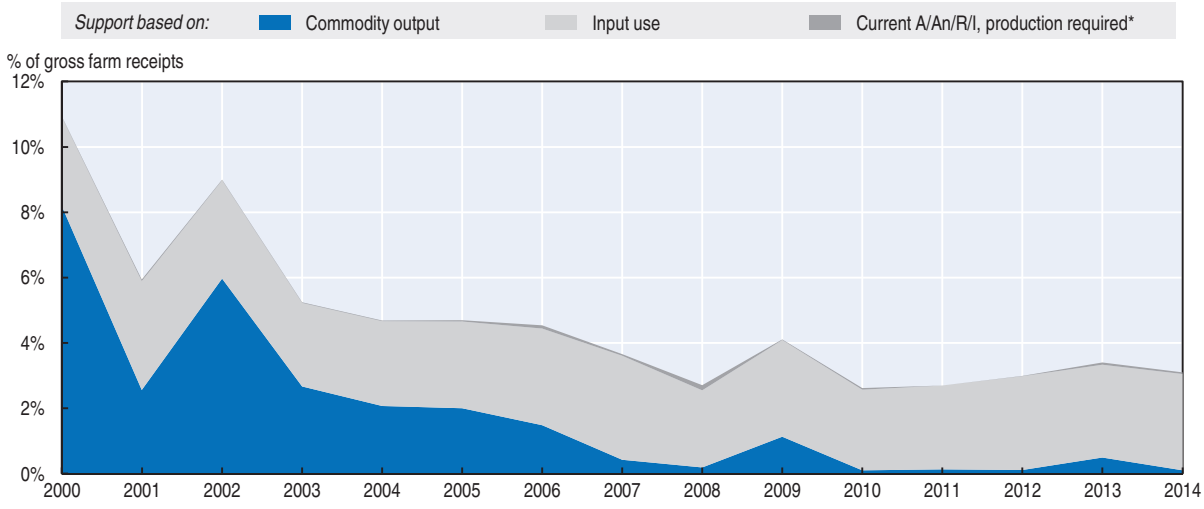
The impacts of irrigation subsidies on groundwater recharge and sustainability have not been assessed (Donoso, 2015). The subsidies do not incorporate any environmental criteria. They allow drainage of wetlands or installation of an irrigation system on pronounced hillslopes with bushes and rich biodiversity, which is replaced by a monoculture that does not contribute to biological diversity. They also promote drainage or canalisation of natural water courses in areas of ecological value or promote degraded soil recovery, allowing non-regulated development in natural environments. Drawing on policies in Australia's Murray Darling Basin, economic analysis suggests that buyback of water-use rights (e.g. to maintain environmental flows) is more cost effective in enhancing water-use efficiency than subsidies to upgrade irrigation infrastructure (Wittwer, 2012). Existing irrigation capacity should be used more efficiently before constructing new irrigation reservoirs, as foreseen in the National Irrigation Plan.[33]

Decoupling agricultural support from production

Agricultural support in the form of transfers to farmers, as measured by the OECD Producer Support Estimate (PSE), has declined significantly since 2000 (Figure 5.10).[34] Chile is now among the OECD member countries with the lowest level of such support. PSE averaged 3% of gross farm receipts between 2013 and 2014, compared to an OECD average of about 18% and to about 18% in Colombia, 12% in Mexico and 4% in Brazil. Chile has reduced its potentially most distorting support (based on output and variable input use – without input constraints), which accounted for 28% of PSE in 2012-14. Transfers to farmers mostly target small-scale agriculture and indigenous farmers, aim to improve productivity and competiveness, and create almost no market distortions (OECD, 2015a).

Yet over 90% of transfers to farmers are linked to input use (Figure 5.10). In other words, they reduce the cost of capital and other purchased inputs. This indirectly encourages agricultural production and increases risk of overuse or misuse of inputs such as pesticides and fertilisers, with potentially negative environmental impact. These subsidies include support to investment in on-farm irrigation systems, which can harm

Figure 5.10. **Support to agricultural producers has dropped, but it is linked to input use**



*A/An/R/I: Area/animal numbers/receipts/income criteria

Source: OECD (2015), "Producer and Consumer Support Estimates", *OECD Agriculture statistics* (database).

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aquatic biodiversity and ecosystems (as discussed above). Chile would benefit from systematically assessing the effectiveness of these budgetary allocations against their socio-economic objectives and potential environmental impact.

Promoting organic farming

Organic agricultural production has expanded markedly in Chile since the early 2000s, accompanied by a national certification system and the National Commission of Organic Agriculture. Chile also introduced a certification system for sustainable wineries in 2012 (Box 5.9). However, in 2013, organic agricultural land still amounted to a negligible share of total agricultural land (0.15%, or 0.6% if wild collection and other non-agricultural land is included).[35] Organic exports amounted to USD 178 million in 2013 (FiBL and IFOAM, 2015); the domestic market demand is relatively small, but growing. The number of certified organic producers (446) is significantly below that of regional peers with a similar size of organic agricultural land, such as Colombia (4 700) or Bolivia (9 800).

Box 5.9. **Sustainable practices in Chile's wine industry**

Wine is one of Chile's key agricultural exports, with production concentrated in the biodiversity-rich central Mediterranean climate regions. The wine industry is particularly vulnerable to climate change and its expected impact on water availability (Box 4.4). Chile's wineries are already moving in the direction of more sustainable practices, and working with universities to innovate. The industry aims to position itself as an international leader in sustainability by 2020. Chile established a certification system for sustainable wineries in 2012, which uses a variety of environmental and social criteria such as methods for soil protection, water use, energy use, recycling and pesticide use. Forty-six Chilean wineries are listed as sustainable. Emiliana, for example, has organic vineyards that incorporate a number of environmentally-beneficial practices such as the use of compost instead of synthetic fertiliser, biological corridors for native trees and flowers, cover crops to prevent soil erosion and chickens as a natural form of pest control.

In 2008, the Chilean Institute of Ecology and Biodiversity started an initiative to demonstrate the compatibility of biodiversity conservation and growth of Chile's wine industry. It is developing research capacity regarding the industry's susceptibility to climate change; proposing improvements in the design of vineyards and management practices; improving knowledge dissemination in both industry and society; promoting creation of protected areas within the territory of the vineyards; and developing an international network of scientists and winemakers from other water-scarce wine-producing regions such as California, South Africa and Australia. The programme has led to the conservation of more than 11 000 ha of land.

Source: Wines of Chile (2012a, 2012b, 2012c); MMA (2014a); Emiliana (2015).

6.2. Forestry

Forestry is a major economic sector in Chile, contributing 5.2% to national exports in 2013, the third highest value in the OECD after Finland (13.5%) and Sweden (6.3%) (OECD, 2015c).[36] The Chilean forest industry is centred in territories that are traditionally Mapuche, and environmental concerns have long been a source of conflict with indigenous communities. Expansion of pine and eucalyptus plantations, which cover vast tracts of land and absorb significant groundwater, has sparked violent conflict in the Araucanía region of southern Chile (Miroff, 2014).

The forestry industry has reduced its consumption of native wood significantly in the last 20 years, but direct consumption of native tree species (e.g. firewood collection for domestic heating) has almost doubled (MMA, 2014a). Chile's forest products sector has increasingly certified its production processes to conform to market demand and trade agreements (CBD, 2015). At least 70% of plantation companies affiliated with the trade association qualify for the Forest Stewardship Council (FSC) certification, and the FSC-certified forest area has increased more than five-fold since 2010 (FAO, 2015). In addition, Chile's forestry industry has used some national sustainable forestry labels such as Certfor, Marcha Blanca and Sello Verde. The forestry industry (including pulp and paper and wooden furniture) has also established eight Clean Production Agreements that include targets for reducing liquid industrial waste and management plans for solid industrial waste (MMA, 2014a; see also Chapter 2).

The 2008 Native Forest Recovery and Forestry Promotion Law created a financial incentive for the protection and preservation of native forests, in addition to supporting economic activities focused on timber and non-timber production. The law also created a Conservation Fund to promote management, conservation, restoration and research on native forest ecosystems.

At the same time, Chile has long subsidised afforestation and forest plantation (Decree Law 701/1974 and its amendments). While these subsidies can contribute to increasing carbon sequestration capacity (Chapter 4), they may have encouraged replacing native forests by plantations with exotic species. In addition, the level of subsidies for native forests is well below that for tree planting, thus creating few incentives to bid for native forest subsidies (CONAF, 2013). The tree plantation subsidy programme ended in 2012, but is expected to be renewed. In designing the new programme, Chile should rebalance the incentives, traditionally in favour of forest plantation, and carefully assess costs, benefits and trade-offs between carbon sequestration and biodiversity objectives.

6.3. Fishing and aquaculture

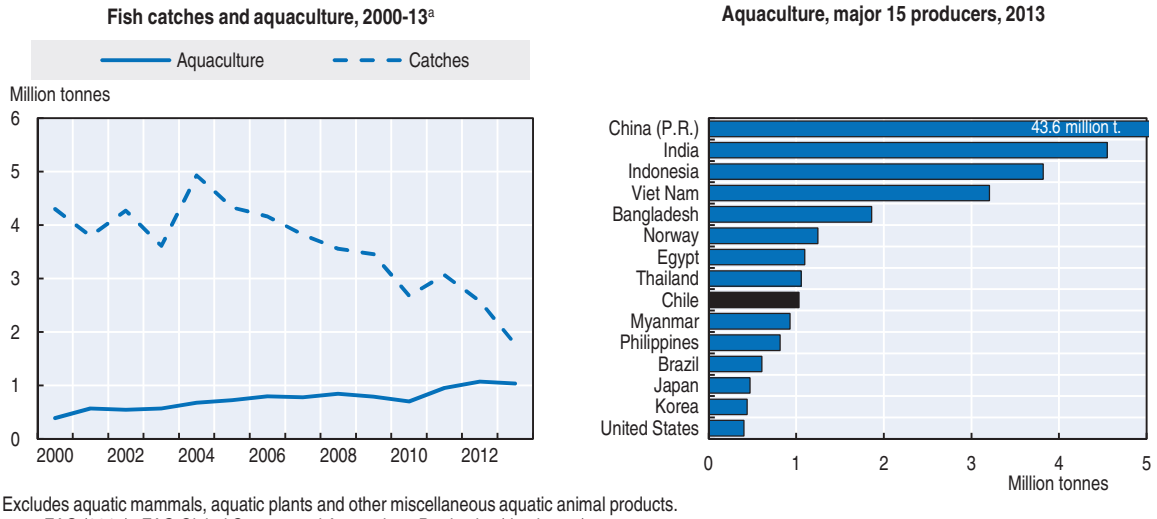
Fishing

Chile is among the world's major producers and exporters of fish products. In 2013, it had the 12th largest commercial fish catch in the world, accounting for 2% of global catches. Fish catches from large industrial operators have dramatically declined since 2000, in part due to critically low fish stocks and overexploitation of some species (e.g. horse mackerel and anchovy).[37] Despite the growth of the artisanal fishery, overall fish captures have more than halved since 2000 (Figure 5.11).

Chile has established over 700 Areas of Management and Exploitation of Benthic Resources (AMERBs) to help sustainably manage its fisheries. Through the areas, exclusive rights are assigned to organisations of artisanal fishers. Studies have shown the number of species in managed areas is much higher than those in open access fisheries. The management plans in the AMERBs are developed in participation with communities and fishers through joint workshops (MMA, 2014a).

Following severe depletion of its fish stock, Chile introduced a quota system in 2001, which helped reduce fishing (Figure 5.11). Global catch quotas are usually distributed between the industrial and small-scale sectors. A transferable quota licence (TQL) system covers industrial fisheries, with duration of the quotas normally of 20 years. The TQLs corresponds to a percentage of the industrial quota, so its amount might change from one

Figure 5.11. **Fish catches have declined, while aquaculture has expanded**



a) Excludes aquatic mammals, aquatic plants and other miscellaneous aquatic animal products.
Source: FAO (2015), *FAO Global Capture and Aquaculture Production* (databases).

StatLink http://dx.doi.org/10.1787/888933388744

year to another (OECD, 2015c). This is an advantage, as it will give the permit holders an incentive to argue for the global catch limit to be set at sustainable levels – in order to preserve their value. In cases of non-compliance, where permit holders overfish, a significant fine is applied; the excess amount fished is deducted from next year's permit.

In 2013, the Law on Fishing and Aquaculture was amended to recover fishing grounds and enhance the sector's sustainability. It shifted the basis for fishing quotas from economic and social considerations to scientific and technical factors (MMA, 2014a). The new law introduced concepts such as the precautionary principle and ecosystem approaches. It includes new definitions and classifications for assessing and measuring the availability of fishery resources and incorporates international sustainability management standards (e.g. biological reference points and maximum sustainable yield), which set the maximum catch that a resource can be subject to without affecting its medium- and long-term sustainability. The law requires conservation measures for vulnerable marine ecosystems, management plans for resources with closed access and recovery plans for overexploited and depleted fisheries. It also adjusted the tradable quota system, establishing new controls for larger vessels and reserving the first nautical mile from shore exclusively for smaller vessels (less than 15 m in length) (OECD, 2015c).

In addition, a new tax on fisheries extraction rights was introduced in 2014, based on the quota size of each industrial operator. Such a tax should help secure a part of the resource rents related to fish stocks for society as a whole. The small-scale sector is not subject to the tax, but the fishers have to pay a permit for each registered vessel, which increases with the size of the vessel.

Chile provides modest support to fisheries, totalling approximately USD 90 million in 2012 (OECD, 2015c). It gives less than 5% as grants for vessel construction, modernisation and equipment. In addition, diesel used for powering vessels benefits from a tax credit. While these measures may encourage fishing and pressure on fish stocks, if the total catches of the transferable quota system are being respected, fish stocks should not be affected.

Aquaculture

Chile is among the world's biggest producers in aquaculture (Figure 5.11). Fish production from aquaculture almost tripled over 2000-12. Although it dropped between 2008 and 2010 due to a salmon virus crisis,[38] it amounted to nearly one-third of total fish production in 2014. The effluent, pesticides and medicines flowing from the fish farms are a major source of pollution of, and pressure on, inland waters, estuaries and marine ecosystems (MMA, 2014a).

Since the salmon virus crisis, the government has promoted diversification of aquaculture. At the same time, industry has reduced density of farms and relocated operations to new areas with better ventilation and depth (OECD, 2015c). Certification of salmon production centres to international Best Aquaculture Practices (BAP) has increased. Fisheries legislation is also being amended to limit emissions of solid and liquid waste from aquaculture.

Limited financial and human resources to enforce regulation and monitoring of aquaculture impacts on ecosystems and aquatic species still pose a challenge (MMA, 2014a). By 2013, 1 300 violations were detected in the fisheries sector, and 215 in the aquaculture sector, but enforcement capacity for fisheries and aquaculture remains weak (MMA, 2014a).

6.4. Tourism

Tourism is an important and growing source of foreign income in Chile. The tourism sector represents Chile's fourth largest export sector, with about 4.5 million foreign visitors in 2015 (Subsecretaría de Turismo, 2015). Many of Chile's forests, glaciers, mountains and lakes have high recreational and scenic value. More than three-quarters of foreign tourists are drawn to Chile because of its natural environment and wide variety of ecosystems (Government of Chile, 2014).

Since many natural attractions are in protected areas, tourism presents an opportunity to raise awareness and support for conservation, as well as financing for biodiversity protection in Chile. As noted in Section 5, Chile raised USD 10 million in 2012 through access fees and concessions (including for ecotourism). The number of national and international visitors to protected areas grew by 38% between 2010 and 2014. One in three Chileans reportedly visit one of the country's protected areas at least once a year (MMA, 2015). One study showed that divers in Chile were willing to pay up to USD 65 extra for more biodiverse marine sites (MMA, 2014a). However, tourism can also be a potential threat to biodiversity conservation efforts if not managed carefully, while environmental degradation can reduce the attractiveness of tourist destinations.

For most of the 2000s, there has been limited recognition of the economic potential of sustainable tourism and a lack of policy co-ordination (OECD and LEED, 2014). Sustainability, however, is one of five pillars in the Tourism Strategy for 2012-20 and the government launched an action plan for sustainable tourism in protected areas for 2014-18. The 2010 Tourism Law contains a regulation specific to the granting of concessions for private tourism activities in protected areas (MMA, 2014a). New Sustainable Distinction Systems for Chilean Tourist Accommodation and Destinations have also been created based on global sustainable criteria suggested by the World Tourism Organization, which include economic, environmental and social components (OECD and LEED, 2014).[39] The government created a technical board to address areas with tension between tourism development and sustainability objectives. It defines criteria to establish limits of acceptable change for specific tourist destinations in the country.

6.5. Mining

The mining industry is a pillar of the Chilean economy (Chapter 1). Excessive extraction of groundwater, soil and water contamination and hazardous waste represent the mining sector's greatest risks to biodiversity in Chile. Mining development is expected to continue to be a source of environmental conflict, as a result of disputes over land and water. Twenty of 30 cases of environmental conflict documented in Chile are linked to mining activities (Segall, 2014).[40]

Excessive groundwater use threatens to dry out wetlands, which are the habitats and feeding grounds of species such as the Andean flamingo. Dust from mining can also cause Andean glaciers – a precious freshwater source – to melt faster (SDSG, 2010). The mining industry has responded to the worsening water scarcity with greater water-use efficiency and a massive increase in seawater use (Chapters 1 and 3).[41] Most improvements have, however, been in large-scale mining projects. Water needs for mining are expected to rise by 40% over 2014-25 due to rising production and declining ore grades.[42] Seawater use is projected to expand massively, with the supply of seawater used in copper mining expected to increase from 16% to 36% between 2014 and 2025 (Cochilco, 2014a, 2014b). An increase of this magnitude would sharply expand energy needs; it may also alter salt concentrations and chemical compositions at discharge sites, with unknown impacts on ecosystems and biodiversity.

Tailings ponds (where hazardous mining waste is stockpiled) present a significant risk to human health and ecosystems in regions prone to earthquake, landslides and heavy rains.[43] Large volumes of tailings (containing chemicals and heavy metals) have contaminated soil, surface water and groundwater (Jarroud, 2015). However, data on soil and water contamination from mining activities are limited. While Chile restricts the disposal of mining waste at sea, tailings have been discarded into the Pacific Ocean off the Chilean coast, with potential negative impacts on marine biodiversity.

Chile has made progress in surveying abandoned and/or inactive mine sites. The 2012 Mine Closure Law requires all new mines to get approval for end-of-life closure plans. This is an important step to prevent creation of abandoned mine sites in the future. However, it does not apply to the over 650 already abandoned mining sites, which have no decontamination plans. Imposing decontamination fees on hazardous industrial installations could help raise the necessary funding for remediation (Chapter 1; Box 2.1). Information on small-scale mining operations and their impact is insufficient. The government subsidises small-scale mining, which encourages exploitation of natural resources, increases the risk of pollution of water table and affects biodiversity.

As with other major projects, mining projects undergo an EIA. Between 2000 and 2015, nearly 11% of all projects that underwent an EIA related to mining activities (SEIA, 2015).[44] In the context of the EIA, some mining companies have compensated the biodiversity loss at the mining site with conservation projects at other locations (Box 5.10). In 2013, the Iquique region conducted a biodiversity offset pilot in the mining sector. These initiatives should be further encouraged, as they can help better engage mining companies in addressing social and environmental concerns arising from their projects. The EIA process should ensure that species and ecosystems in water-scarce regions are adequately considered in project licensing.

Box 5.10. **Biodiversity offset in the mining sector**

In late 2015, Antofagasta Minerals submitted a revised EIA for its multi-million dollar copper mine in the central-northern Coquimbo region that proposed a biodiversity offset. The proposal is to spend USD 43 million to support conservation and reforestation efforts in other areas impacted by mining operations, instead of the local area which the company says is too arid to support certain plant species. One of the proposed areas for conservation is on the coast of Chile.

Source: Abarca (2015).

7. Biodiversity and climate change

In addition to the impact on water availability, climate change can negatively impact biodiversity as the pace of change exceeds species' ability to adapt (Chapter 4). Areas of particular vulnerability include the regions between the Coquimbo and Los Lagos regions (MMA, 2014a). Increases in the mean sea level will also impact Chile's marine ecosystems, with an estimated 20 cm to 25 cm increase along the coast of Chile by 2100.

AGRIMED (2013) concluded the speed of adaptation of plant and animal communities in Chile is incompatible with the speed at which climate change is projected to continue. IEB (2010) assessed the climate change impact on eight sites in the high Andean wetlands in northern Chile. The study forecast a loss of the stability and ecological functionality of the ecosystems and a reduction in the projected distribution of most species under exam. In 2014, to improve understanding of climate change impact on biodiversity, Chile started developing a biodiversity monitoring network in the context of climate change.[45]

In 2014, the Council of Ministers for Sustainability approved a Climate Change Adaptation Plan for Biodiversity, as part of the national adaptation strategy (Chapter 4). The plan considers 50 measures focused on research and development of ecosystem management capacities, information and environmental awareness, the promotion of sustainable farming practices, consideration of the biodiversity objectives in territorial planning and strengthening of the National System of Protected Areas. Biodiversity considerations are also incorporated into the sectoral climate change adaptation plans for fishing and aquaculture, and forestry and agriculture.[46] As Chapter 4 discusses, the combination of a national strategy and a series of sectoral plans makes the treatment of cross-cutting risks challenging in practice.

Chile's policy of encouraging conservation of native vegetation and afforestation can bring climate change mitigation and biodiversity co-benefits (Section 6.2). As indicated in Section 1.1, forest cover has considerably increased. However, the effectiveness of these measures in supporting both climate and biodiversity objectives has not been formally evaluated, and plantation of exotic tree species threaten biodiversity. Chile is at the early stages of a National Climate Change and Vegetation Resource Strategy to help meet its climate-related commitment to restore 1 000 km^2 of degraded and deforested land (Chapter 4). Chile is also a part of the REDD+ mechanism (Reducing Emissions from Deforestation and Forest Degradation), with leadership by CONAF (MMA, 2014a).[47] As of September 2015, Chile was preparing for full participation in the REDD+ programme (CONAF and FCPF, 2015). A reference emission level for payments under REDD+, required by the 2013 Warsaw Framework, is expected to be completed in 2016.

Recommendations on biodiversity conservation and sustainable use

Knowledge base and evaluation

- Accelerate efforts to build the knowledge base on the status and trends of biodiversity, including classification of species and assessment of the status of terrestrial, inland water and marine ecosystems; further engage academic and research centres in filling knowledge gaps and support policy development.
- Conduct a national ecosystem assessment at the earliest opportunity to improve knowledge of the values of biodiversity and ecosystem services and of the costs associated with their loss; ensure the values of ecosystem services are integrated into national accounts, as well as policy design and evaluation.

Governance and policy framework

- Approve the proposed legislation creating the Biodiversity and Protected Areas Service and accelerate its implementation; ensure the proposed service has adequate financial and human resources to fulfil its mandate.
- Reinitiate institutional and policy reforms to implement integrated watershed management that would bring together water quantity and quality planning and regulation.
- Ratify and implement the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS).
- Improve participation of NGOs, local governments and indigenous communities at all stages of biodiversity policy development and implementation to build trust and enlist a broader set of resources for executing action plans.

Protected areas

- Focus investment in protected areas on increasing the representativeness of priority ecoregions and the protection of the coasts and marine areas of continental Chile, and on conserving the habitats and nesting grounds of priority species.
- Accelerate the development and update of the management plans for all protected areas, and systematically review their implementation; ensure that the plans set clear priorities, targets and progress indicators.
- Develop and implement a strategy to encourage private conservation initiatives through carefully designed incentives (e.g. incentives for donations of land in priority areas to the protected area system; contracts with landowners); bring private conservation initiatives into the national system of protected areas; and support financing management plans and protection activities.

Economic instruments

- Further expand the use of economic instruments to encourage biodiversity conservation and sustainable use, raise additional revenue and leverage private sector investment; in particular, consider introducing water effluent charges, taxes on fertilisers and pesticides, and payments for ecosystem services programmes; expand the use of biodiversity offsets.

Mainstreaming

- Systematically integrate biodiversity conservation objectives into land-use planning, marine planning and sectoral policies; further mainstream biodiversity considerations into project and plans appraisal mechanisms, such as EIA and SEA.

Recommendations on biodiversity conservation and sustainable use *(cont.)*

- Expand efforts to increase water use efficiency in all economic sectors, particularly in agriculture and mining; systematically monitor freshwater abstraction and the use of desalinated seawater to prevent negative impacts on water ecosystems.
- Systematically assess the impacts of subsidies for irrigation and small-scale mining on groundwater recharge, biodiversity and ecosystems, with a view to reforming these subsidies; decouple agricultural support from input use and the expansion of agricultural land, to ensure the protection of sensitive ecosystems.
- Review the incentives for afforestation and native forest protection, and carefully assess costs, benefits and trade-offs between carbon sequestration and biodiversity objectives.

Notes

1. The Chilean matorral and Valdivian temperate rainforest ecoregions are estimated to hold nearly 2 000 endemic plant species and at least 26 endemic animals, with endemism levels of 90% and 70% respectively.
2. The Tropical Andes Hotspot covers the Andes Mountains of Venezuela, Colombia, Ecuador, Peru, Bolivia and the northern tropical portions within Argentina and Chile. It contains about one-sixth of all plant life in the world and has the largest variety of amphibian, bird and mammal species and second largest reptile diversity (CEPF, 2015).
3. For example, the area of avocado plantation has tripled and that of vineyards has doubled over the last 20 years.
4. Eight of these ecosystems are vulnerable due to having lost more than 50% of native biota coverage and eight are considered endangered due to having lost more than 70% of coverage between 1992 and 2012.
5. The Central Chilean coast has been particularly affected, with a loss of native forest of 26% between 1992 and 2012 in the coastal area of the Maule and Bío Bío regions, mainly due to the establishment of new plantation forests (MMA, 2014a).
6. For example, eucalyptus trees require significant amounts of water, which can be challenging in water-scarce regions. There is a negative correlation between plantation forests of eucalyptus and radiata pine and water flow (Lara et al., 2010).
7. The 2015 Ocean Health Index assessed countries across ten goals, with half of the score based on present status and half based on the likely future status resulting from trends, pressures, policies and other factors.
8. However, the index only assesses the health of mangroves, seagrass, salt marsh, tropical coral reefs, soft bottom subtidal habitats and sea ice. Country scores are not penalised for lack of data.
9. Algae blooms and phytotoxins have increased in certain regions such as in Region VII (Lake Vichuquén and connected Torca lagoon and Llico estuary).
10. For example, crop farming and intensive livestock husbandry have led to high concentrations of nitrates in tributaries of Bío Bío river and in Rapel river (Chile's second longest and third largest river, respectively).
11. This excludes wetlands on the oceanic islands and meadows and bogs in southernmost Chile.
12. These include the espinillo, lantana, common cane, pomacea snail, rainbow trout, brown trout, carp, mosquito fish, red-eared slider, goat, red deer, boar, cat, rabbit, mink, European rabbit and rodent.
13. The General Water Directorate (DGA) of the Ministry of Public Works is in charge of water allocation issues; the Superintendence of Water Services regulates water supply and sanitation services; the Ministry of Health regulates water quality and pollution; irrigation is governed by the Ministry of Agriculture; and the Ministry of Environment is responsible for the well-being of ecosystems and species.
14. The committee, created in 2005, includes CONAF, the National Museum of Natural History, the Agriculture and Livestock Service, SERNAPESCA, the Undersecretary for Fishing and Aquaculture,

and the Ministry for the Environment, as well as three representatives from the Chilean Science Academy, three from universities and three from the agriculture, forestry and fishing sectors.

15. Chile is also a party to the Inter-American Convention for the Protection of Flora, Fauna and Natural Scenic Beauties, the Protocol for the Conservation and Management of Protected Marine and Coastal Areas of the South-East Pacific, and the Convention concerning the Protection of World Cultural and Natural Heritage.

16. The plans cover 17 flora and 14 fauna species, including the hummingbird of Arica, the little tern, the ruddy-headed goose, Darwin's fox, several amphibians and five cactus species (CBD, 2015).

17. CONAF developed a National Wetlands Conservation Programme in 2010 for protected areas. In 2013, they performed 64 actions in 76 continental areas and on Easter Island. They also developed an Andean Wetlands Regional Strategy in 2005, with representatives from academia, NGOs and ten mining companies. The strategy focuses on biological and water resource monitoring, resource protection, and land-use planning and local development (MMA, 2014a).

18. Under the Chile-US partnership, protected areas in the two countries are matched, supporting information exchange, technical visits, internships and other beneficial initiatives. For example, the US Glacier Bay National Park and Reserve and Chile's Francisco Coloane Marine Park in the Strait of Magellan were twinned, allowing scientific co-operation in studying the population of humpback whales and strategies to protect the species in shipping lanes (MMA, 2014a).

19. These include agreements for the conservation of the huemul deer, the canquén colorado, the High Andean flamingos, vicuña, Andean cat, suri, guanaco, Andean chinchilla, horned tagua and queñoa (polylepis).

20. Secondary water quality standards regulate biological contamination, nutrient levels (nitrogen, phosphorus), heavy metals, and toxic contaminants (phenols, polycyclic aromatic hydrocarbons, organic halogen compounds and some pesticides).

21. Minimum ecological flows aim to preserve the hydrological and ecological functions of rivers, e.g. by preventing rivers from drying up or significantly altering their physical regimes. The minimum ecological flow was set at 10% to 20% of the annual average flow rate in 2005, and replaced in 2014 by a more flexible 50% of monthly river flow rates, while the 20% cap has remained.

22. The recommendation included a menu of options such as fees, charges and environmental taxes; payments for ecosystem services; assignment of well-defined property rights; reform or removal of harmful subsidies; and environmental funds and public financing.

23. Official protected areas refer to those areas administered by public institutions, including CONAF, SERNAPESCA and MMA. They include national parks, national reserves, nature sanctuaries, natural monuments, marine reserves, marine parks and multiple use marine coastal protected areas. The government estimated the total area under some form of protection is broader and reaches almost 40% of the territory.

24. The SNASPE includes national parks, national reserves and natural monuments.

25. There are an additional 64 initiatives not yet surveyed and characterised.

26. The Chilean matorral ecoregion extends over about 148 000 km^2, of which slightly more than 1 760 km^2 are covered by official protected areas and 261 km^2 by private protected areas; the Valdivian temperate rainforest ecoregion extends over about 200 300 km^2, of which nearly 38 000 km^2 lie within official protected areas and nearly 4 900 km^2 are under private protection initiatives.

27. For example, the World Wildlife Fund for Nature (WWF) Chile developed a planning tool for marine ecosystem conservation actions in southern Chile and a plan for the conservation of Valdivian temperate rainforests. An agreement between the NGO TNC, Austral University and forestry company Masisa was established to restore native forest in the Valdivian Coastal Reserve (MMA, 2014a).

28. Chile's beekeeping industry has about 500 000 hives, providing pollinating services to fruit producers and producing honey. Honey is now the main primary livestock product exported by Chile (MMA, 2014a).

29. Risk assessments led to restricting the use of pesticides belonging to the neonicotinoid family in the EU as from end-2013.

30. The grants can reach up to 70-90% of the total cost of the project, depending on the type of farmer who applies, with a higher percentage for the most vulnerable farmers.

31. Modern irrigation includes drip irrigation as well as furrow, sprinkler and pivot irrigation.

32. In the late 2000s, Chile's water application rate was 15.2 megalitres per hectare of irrigated land, the third highest, after Japan and Korea, among the OECD member countries with irrigation area larger than 5% of total agricultural area.

33. The National Irrigation Plan foresees expanding irrigated area by 55%, or 600 000 ha, by 2022.

34. Agricultural support is defined as the annual monetary value of gross transfers to agriculture from consumers and taxpayers, arising from government policies that support agriculture. The Percentage Producer Support Estimate (%PSE) represents policy transfers to agricultural producers individually, measured at the farm gate and expressed as a share of gross farm receipts. Transfers included in the PSE are composed of market price support, budgetary payments and the cost of revenue foregone by the government and other economic agents. They require that an individual farmer takes actions to produce goods or services, to use factors of production, or to be defined as an eligible farming enterprise or farmer, to receive the transfer.

35. Main organic crops are berries, grapes, fruit and olives.

36. Chile is one of Latin America's largest producers of pulp and cellulose (Segall, 2014). Chile's forests are an important source of timber, pellets, firewood, biofuel and other forest products.

37. Declining fish catches have also been related to the El Niño phenomenon, whose effect on sea temperature impacts fisheries destined for fish meal, as well as to the 2010 earthquake and tsunami, which caused considerable losses in processing plants.

38. A case of "infectious salmon anaemia" infected and killed millions of salmon. It resulted in a collapse of the sector and the loss of more than 13 000 jobs.

39. The Sub-secretariat of Tourism has identified three local destinations for the distinction system: Easter Island; the Cajon de Maipo (near Santiago) and Lake Llanquihue (Los Lagos region) (OECD and LEED, 2014).

40. For example, Codelco's Andina 244 expansion close to Santiago is raising concerns about impacts to glaciers that form part of the watershed providing drinking water to 6 million people (Segall, 2014). Opposition to the Pascua Lama mining project by neighbouring communities concerned about water use and damage to glaciers led to works being halted (OCMAL, 2015).

41. Between 2009 and 2014, freshwater consumption in the mining sector increased by only 4%, while use of seawater increased almost ten-fold.

42. Lower ore grades make the extraction and processing of copper more difficult and typically lead to increased use of chemicals, water and energy per produced tonne.

43. The 2010 earthquake caused the collapse of one abandoned tailings pond onto a family that was unaware of the risk. In March 2015, heavy rains in the northern Atacama desert region stirred up heavy metals in abandoned ponds.

44. Of these projects, 68% were approved, 3% were rejected and the remaining were revoked, judged non-admissible, withdrawn or not rated.

45. The project benefits of the financial and technical assistance of the UNFCCC Climate Technology Centre and Network and the Tropical Agricultural Research and Higher Education Center.

46. The Climate Change Adaptation Plan for Forestry and Agriculture includes 21 measures mainly focused on water management, research, information and capacity building, risk management and agricultural insurance and forestry management. The Climate Change Adaptation Plan for Fisheries and Aquaculture includes 29 measures to be implemented by the Sub-secretariat for Fisheries and Aquaculture under the Ministry of Economy, Promotion and Tourism.

47. The REDD+ initiative under the UN Framework Convention on Climate Change provides a mechanism to finance projects that reduce deforestation and forest degradation, thereby contributing to both climate change mitigation and biodiversity objectives.

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