OECD Environmental Performance Reviews

CHILE

2024

OECD

OECD Environmental Performance Reviews: Chile 2024

Please cite this publication as:
OECD (2024), *OECD Environmental Performance Reviews: Chile 2024*, OECD Environmental Performance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/5bc65d36-en.

ISBN 978-92-64-37918-3 (print)
ISBN 978-92-64-73497-5 (PDF)
ISBN 978-92-64-53977-8 (HTML)
ISBN 978-92-64-35013-7 (epub)

OECD Environmental Performance Reviews
ISSN 1990-0104 (print)
ISSN 1990-0090 (online)

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Foreword

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

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

This is the third EPR of Chile. It examines the country's environmental performance since 2016. Progress in achieving domestic objectives and international commitments provides the basis for assessing Chile'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 grateful to Chile's Ministry of Environment for providing information and comments, organising the review mission (27-30 June 2023) and virtual policy mission (10 November 2023), as well as for facilitating contacts inside and outside government institutions. Thanks are also due to all government ministries and agencies, as well as non-governmental organisations, that participated in the missions and provided information or comments.

The participation in the review of the representatives of the two examining countries, Francisco Aleza Enciso (Spain) and Sharon Sagi-Ben Moshe (Israel), is also gratefully acknowledged.

The authors of this report are Sho Yamasaki and Maria Adelaida Rojas Lleras (Chapter 1) and Kathleen Dominique (Chapter 2) of the OECD Environment Directorate. Kathleen Dominique co-ordinated the review. Nathalie Girouard provided oversight. Maria Adelaida Rojas Lleras provided statistical support. Lydia Servant provided administrative support. Mark Foss copy-edited the report. Natasha Cline-Thomas provided communications support. Preparation of this report also benefited from inputs and comments from Marta Arbinolo, Carla Bertuzzi, Helene Bombrun, Ivana Capozza, Joseph Cordonnier, Olivia Cuq, Assia Elgouacem, Guillaume Gruère, Marijn Korndewal, Britta Labuhn, Xavier Leflaive, Eugene Mazur, Sarah Miet, Mauro Migotto, Rodrigo Pizarro, Mariana Prats, Mikaela Rambali, Claudia Ramirez, Adolfo Rodriguez-Vargas, Oriana Romano, Andres Sanabria, Juan Vazquez Zamora, Julia Wanjiru, Pinhas Zamorano and Frédérique Zegel of the OECD Secretariat.

The OECD Working Party on Environmental Performance discussed the draft Environmental Performance Review of Chile at its meeting on 23 January 2024 and approved the Assessment and Recommendations.

Table of contents

Figures

Boxes

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Reader's guide

Signs

The following signs are used in figures and tables:

– : nil or negligible

. : decimal point

Country aggregates

OECD Europe: This zone includes all European member countries of the OECD, i.e. Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye 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, Colombia, Costa Rica, Israel*, Japan, Korea, Mexico, New Zealand and the United States. Country aggregates may include Secretariat estimates

Currency

Monetary unit: Chilean Peso (CLP)

In 2023, USD 1 = CLP 796

In 2022, USD 1 = CLP 873

Cut-off date

This report is based on information and data available up to 30 November 2023.

Indicators

Internationally-comparable indicators presented in the OECD Environment at a Glance online platform support the analysis. They should be read in conjunction with this report.

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Basic statistics of Chile

2022 or latest available year (OECD values in parentheses)[a]

PEOPLE AND SOCIETY					
Population (million)	19.83		Population density per km^2	26	(36.5)
Share of population by type of region:			Population compound annual growth rate, latest 5 years	1.5	(0.5)
Predominantly urban (%)	50	(49)	Income inequality (Gini coefficient)	0.45	(0.33)
Intermediate (%)	16	(28)	Poverty rate (% of pop. with less than 50% median income)	17	(11)
Rural (%)	34	(23)	Life expectancy	81	(80)
ECONOMY AND EXTERNAL ACCOUNTS					
Total GDP (National currency, billion)	262 593		Imports of goods and services (% of GDP)	39	(30)
Total GDP (USD, billion, current prices and PPPs)	592		Main exports (% of total merchandise exports)		
GDP compound annual real growth rate, latest 5 years	2.4	(1.7)	Ores, slag and ash	27	
GDP per capita (1 000 USD current PPPs)	30	(54)	Copper and articles thereof	22	
Value added shares (%)			Inorganic chemicals; organic and inorganic compounds of precious metals	11	
Agriculture	4	(2)	Main imports (% of total merchandise imports)		
Industry including construction	35	(24)	Mineral fuels, mineral oils and products of their distillation	22	
Services	61	(74)	Vehicles; other than railway or tramway rolling stock	11	
Exports of goods and services (% of GDP)	36	(30)	Nuclear reactors, boilers, machinery, mechanical appliances	10	
GENERAL GOVERNMENT Percentage of GDP					
Expenditure	34	(46)	Education expenditure	4	(5.2)
Revenue	27	(39)	Health expenditure	5.8	(7.6)
Gross financial debt	41	(121)	Environment protection expenditure	0.15	(0.75)
Fiscal balance	-7	(-8)	Environmental taxes: (% of GDP)	1.0	(1.4)
			(% of total tax revenue)	4.6	(4.6)
LABOUR MARKET, SKILLS AND INNOVATION					
Unemployment rate (% of civilian labour force)	7.9	(5.0)	Patent applications in environment-related technologies (% of all technologies, average of latest 3 years [b]	18	(11)
Tertiary educational attainment of 25-64 year-olds (%)	31	(40)	Environmental management	11	(3)
Gross expenditure on R&D, % of GDP	0.3	(2.7)	Climate change mitigation technologies	13	(10)
			Climate change adaptation technologies	8	(1)
ENVIRONMENT					
Energy intensity: TES per capita (toe/cap.)	1.89	(3.75)	Passenger cars stock (vehicles/100 inhabitants)	21	(50)
TES per GDP (toe/1 000 USD, 2015 PPPs)	0.08	(0.09)	SDG 6.4.2 Water stress (freshwater withdrawal as % of available freshwater resources)	9	(21)
Renewables (% of TES)	27	(12)	Public water supply per capita (million m^3)	91	(95)
Carbon intensity (energy-related CO_2):			Municipal waste per capita, (kg/capita)	461	(534)
Emissions per capita (t/cap.)	4.2	(8.4)	Material productivity (USD, 2015 PPPs/DMC, kg)	0.4	2.45
Emissions per GDP (t/1 000 USD, 2015 PPP)	0.2	(0.2)	Land area (1 000 km^2)	744	
GHG intensity: [c]			% of arable land and permanent crops	2	(11)
Emissions per capita (t/cap.)	5.43	(10.86)	% of permanent meadows and pastures	12	(23)
Emissions per GDP (t/1 000 USD, 2015 PPP)	0.26	(0.25)	% of forest area	25	(33)
Mean population exposure to air pollution ($PM_{2.5}$), µg/m^3	23.68	(13.93)	% of other land (built-up and other land)	61	(33)

a) Values earlier than 2017 are not taken into consideration. OECD value: where the OECD aggregate is not provided in the source database, a simple OECD average of the latest available data is calculated where data exist for a significant number of countries.
b) Higher-value inventions that have sought 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/OECD, EUROSTAT and the World Bank.

Executive summary

Chile made a major step-change in climate policy and needs ambitious action to meet targets

Chile significantly raised its climate ambition with the enactment of the Framework Law on Climate Change (FLCC) in 2022. The law sets a binding national target to reach net zero by 2050. However, greenhouse gas (GHG) emissions rose significantly in 2010-19 and are not projected to peak before 2025. Ambitious actions to reduce GHG emissions are required. These include clarifying sectoral and regional plans, pursuing the plan to close all coal-fired plants by 2040 and boosting renewable energy generation. The transport and building sectors need more stringent climate targets to spur further investments in sustainable public transportation as well as electrification of vehicles and building heating systems.

Chile is highly exposed and vulnerable to the impacts of climate change. The country has made great strides in developing localised climate risk mapping and analysing socio-economic vulnerability. However, lack of financial resources and capacity impedes progress on climate adaptation. The successful implementation of adaptation measures requires strengthening co-ordination across administrative levels and building capacity.

Air pollution remains a serious public heath challenge

Major air pollutant emissions declined, but $PM_{2.5}$ concentrations remain among the highest in the OECD and far exceed World Health Organisation guidelines, posing significant health risks to 98.6% of the population. Regional disparities in air pollution levels are stark, with northern regions experiencing the highest levels of SO_2 and NO_x emissions from industrial sources, while central and southern regions suffer from concerningly elevated $PM_{2.5}$ concentrations, largely due to residential wood burning for heating and road transport. Improved monitoring of air quality has enabled the creation of effective decontamination plans. However, the country needs to transition to a more proactive approach, prioritising preventive and abatement-driven policies.

Waste management relies heavily on landfilling

Chile made progress in waste management by implementing several extended producer responsibility schemes and enacting the Single-use Plastics Law. Still, the waste management system remains inefficient, with over 90% of municipal waste landfilled. Significant challenges remain in diverting organic waste from landfills and improving recycling, which stands at a mere 1%. Long-term investment in waste management infrastructure and decisive actions to discourage landfilling are needed. Approving the bill for the valorisation of organic waste would be a positive step forward.

Chile made major strides on biodiversity conservation

The Law for Nature and the Biodiversity and Protected Areas Service (SBAP) approved in 2023 represent major breakthroughs. With 44% of its exclusive economic zone and 22% of its land area protected, the country is on track to meet it 30x30 targets. It is one of the few countries in the Latin America and Caribbean (LAC) region that has increased its forest cover. Still, pressures from invasive species, land-use change, and unsustainable fishing practices persist. By strengthening natural capital valuation and establishing biodiversity baselines, Chile can effectively scale up payment for ecosystem services schemes. Achieving biodiversity goals requires prioritising investment in research and data collection, securing adequate funding, and establishing a dedicated workforce.

Environmental institutions were strengthened, but are under-resourced

Major developments include the ratification of the Escazú Agreement, enactment of the FLCC and creation of the SBAP. At the same time, the government faces acute capacity challenges in terms of human and financial resources to reach environmental objectives. There is significant room to improve Environmental Impact Assessment by strengthening the technical quality of assessments and ensuring safeguards against political influence. This is increasingly important in the context of major new projects, such as green hydrogen and lithium production.

Compliance monitoring expanded with new technology, but is still under-resourced. The Environmental Superintendence's (SMA's) use of remote compliance checks has effectively increased the coverage of checks at low cost and improved compliance through behavioural change. However, to the extent environmental impact mitigation measures concern the competence of sectoral ministries, the SMA does not monitor compliance directly in some cases. The SMA should be further strengthened towards integrated compliance monitoring, with sufficient resources to conduct it.

The green tax reform should be pursued

Chile made progress in using economic instruments for environmental objectives through the green tax reform, including the establishment of the carbon tax (USD 5 per tonne of CO_2) and the carbon offsetting system. While Chile ranks among the highest in LAC countries for average effective carbon rates, it is well below other OECD countries. An increase in the carbon tax rate would better reflect the social costs of pollution. There are further opportunities to consider environmentally related taxes and charges, such as a landfill levy. Transportation-related taxes need to be rationalised by eliminating exemptions (e.g., cargo transport). Revenue generated from mining royalties could be secured for environmental purposes, in particular to address legacy pollution (e.g., abandoned mines).

The severe and deepening water crisis spurs increasing social conflicts

Pressure on freshwater resources has intensified over time. The country has been facing a "megadrought" for the past 14 years. Demand for groundwater exceeds sustainable supply in most regions. Water quality is a major concern, with urban and industrial wastewater, fish farming, agriculture and mining the main sources of water pollution. Emergency measures are inadequate to manage water resources sustainably. Expanding new sources of supply, such as desalination and wastewater reuse, has considerable potential. However, Chile should also introduce demand management measures, improve water use efficiency, and ensure a robust and flexible water allocation system, including to address the impacts of climate change.

Water allocation reform and improved water quality are urgently needed

The 2022 reform to the Water Code was a positive step forward by enshrining the priority of water supply for human use and introducing time-bound concessions for new water rights. However, issues related to existing water rights (defined as private property, allocated free of charge and granted in perpetuity) and over-allocation are unresolved and environmental flows are not secured. More comprehensive reforms of water allocation should be pursued to provide more flexibility to adjust the amount of water abstracted in line with sustainable supply.

Water quality standards are incomplete and wastewater discharge standards should be more stringent. Environmental water quality standards cover only a fraction of Chile's water bodies. Their development should be accelerated with a focus on priority basins. The coverage of wastewater discharge standards remains patchy and outdated. There are no specific standards and regulations for agricultural wastewater sources, including aquaculture. Requiring nutrient removal in wastewater treatment would reduce excessive nutrient discharge into receiving water bodies, and thus eutrophication.

The use of economic instruments for water management is limited. There are no abstraction charges for use of water resources. Wastewater effluents, pesticides and fertilisers are not taxed or charged. Introducing abstraction charges and taxes on water pollutants would better reflect the value of water and apply the polluter pays and beneficiary pays principles. Chile could also explore a broader suite of approaches to scale up financing for water-related investments, such as use of proceeds bonds, payments for ecosystem services and public-private partnerships.

Establishing river basin pilots is a positive step to strengthen water governance

The institutional landscape for water management in Chile is one of the fragmented in the OECD. The establishment of pilot organisations for river basin governance in 16 basins seeks to redress this fragmentation by anchoring activities at the basin scale. Chile is also making important progress on river basin planning with Strategic Water Resources Management Plans for all basins. Strengthening co-ordination and establishing a central governmental authority for water management would help align of all agents intervening in water management, across all levels, as well as stakeholders.

Assessment and recommendations

The Assessment and Recommendations present the main findings of the OECD Environmental Performance Review of Chile. They identify 36 recommendations to help the country make further progress towards its environmental objectives and international commitments. The OECD Working Party on Environmental Performance discussed and approved the Assessment and Recommendations on 23 January 2024.

1. Towards sustainable development

Addressing key environmental challenges

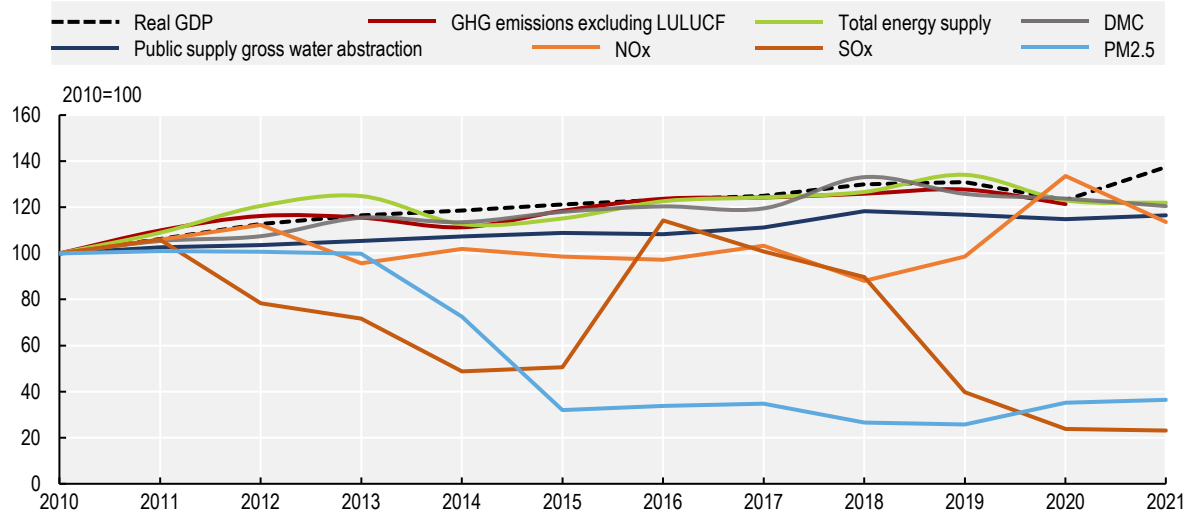
Decoupling of environmental pressures from economic growth is limited in Chile

Chile is a medium-sized country with an open, export-oriented economy. Natural resources have been a pillar of the economy, such as extraction and processing of minerals, forestry and fisheries. Except for the period of the COVID-19 pandemic, the country showed continuous economic growth over the last decade (3.0% annual real gross domestic product (GDP) growth on average over 2010-19). The economic recovery from the pandemic in Chile has been more rapid than in most other OECD countries. However, since 2021, global supply constraints and the Russian war of aggression on Ukraine have fuelled price inflation. After tighter fiscal and monetary policies to rebalance the economy, data suggest that GDP did not grow in 2023 but is projected to grow by 1.8% in 2024 and pick up to 2.1% in 2025 (OECD, 2023[1]).

Chile has not managed to decouple a number of environmental pressures from economic growth since 2010 (Figure 1). Nitrogen oxide (NO_x) emissions declined until 2018, but then increased mainly driven by industrial combustion. Greenhouse gas (GHG) emissions, total energy supply and domestic material consumption (DMC) have risen at the same pace as the economy, highlighting the need for further efforts to decouple these pressures from economic growth. Water abstractions for public water supply continue to rise, albeit more slowly than economic growth. Emissions of sulphur oxide (SO_x) and fine particulates ($PM_{2.5}$) declined significantly since 2010, a positive development.

Figure 1. Chile has not decoupled several environmental pressures from economic growth

Decoupling trends, Chile, 2010-21



Note: GDP = gross domestic product. GHGs = greenhouse gases. LULUCF = land use, land-use change and forestry. DMC = domestic material consumption. SOx = sulphur oxides. NOx = nitrogen oxides. $PM_{2.5}$ = fine particulates. SO_X as SO_2 (sulphur dioxide) and NOx as NO_2 (nitrogen dioxide).

Source: SNI Chile (2022), Inventario Nacional de Gases a Efecto Invernadero Chile 1990-2020 [National Greenhouse Gas Inventory Chile 1990-2020]; RETC, *Emisiones al Aire de Transporte en Ruta 2010-21* [On-Road Transport Air Emissions 2010-21]; IEA (2023), IEA World Energy Statistics and Balances (database); OECD (2022), OECD Economic Outlook (database); OECD (2023), Environment Statistics (database).

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Building resilience to climate change impacts faces major funding and capacity gaps

Chile is highly exposed and vulnerable to the impacts of climate change. Nearly one third of the territory is exposed to at least two climate-related hazards, mainly heat stress and flooding. Extreme heat affected 25.7% of the population over 2018-22 on average (Maes et al., 2022[2]). Flood risk is dispersed across the country and prominent along the central coast. The country is also severely affected by drought and wildfire risk, with wide-ranging impacts on water supply, agriculture and ecosystems. For example, following the 2017 wildfires, nearly 40% of critically endangered habitats in Chile were significantly damaged (OECD, 2023[3]).

Progress on climate change adaptation varies significantly across sectors. The National Plan for Adaptation to Climate Change of 2014 established plans for nine sectors.[1] The tourism sector has shown the slowest progress with only 25% of planned actions achieved by 2021, mainly due to limited financial resources and capacity. Lack of financial strategies also impedes progress of planned adaptation actions (Ministry of Finance and Green Climate Fund, 2021[4]). The successful implementation of adaptation measures requires to further strengthen co-ordination across administrative levels, build capacity at sub-national level, and encourage public-private collaboration.

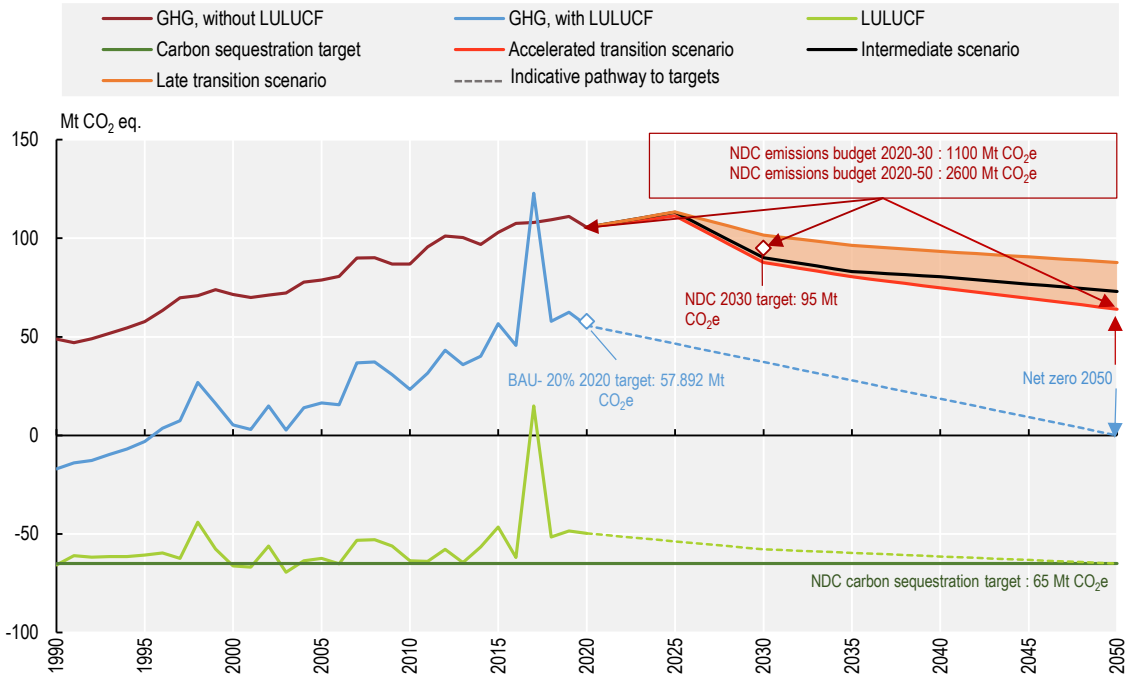
Chile has made great strides towards developing localised climate risk mapping. The Climate Risk Atlas (ARCLIM) platform, launched in 2020, provides climate risk indicators and visualisation of current and projected climate risks at the communal scale. Unlike many other OECD countries, Chile also analyses socio-economic vulnerability of different population groups to relevant climate risks. Moreover, the country is developing further tools to monitor and assess progress of adaptation policy implementation for better decision making.

Chile achieved a major step-change in the legal framework for climate action, although emissions continued to rise

Chile's GHG emissions rose significantly in 2010-19 (Figure 2), mainly driven by CO_2 emissions generated by fossil fuel burning (MMA, 2022[5]). GHG emissions decreased in 2020 due to the COVID-19 pandemic, which enabled the country to meet its 2020 target.[2] Energy industries are the largest source of GHG emissions followed by transport, accounting for 28% and 25% of emissions in 2020, respectively. Electricity supply accounted for more than 90% of GHG emissions from energy industries over 2010-20. Land use, land-use change and forestry (LULUCF) have consistently contributed to sequester carbon except for 2017, when Chile experienced devastating wildfires.

Figure 2. Chile aims for net zero by 2050, while GHG emissions continued to rise

Historical GHG emissions, targets, projections and indicative pathways to targets, 1990-2050



Note: BAU = business as usual. CO_2e = carbon dioxide equivalent. GHGs = greenhouse gases. LULUCF = land use, land-use change and forestry. NAMAs = nationally appropriate mitigation actions. NDC = nationally determined contribution. NDC targets are based on total GHG emissions excluding LULUCF. Chile presents specific targets for LULUCF additionally. Chile proposed to undertake NAMAs to achieve a 20% reduction in GHG emissions (including LULUCF) from BAU levels by 2020. The 2020 GHG emissions target was an estimated 122 Mt CO_2e, excluding emissions and sinks from LULUCF. The transition scenarios reflect sectoral budgets needed to meet targets but are not projections of emissions based on current policies.

Source: SNI Chile (2022), *Inventario Nacional de Gases a Efecto Invernadero Chile 1990-2020* [National Greenhouse Gas Inventory Chile 1990-2020]; Gobierno de Chile (2022), 5to Informe Bienal de Actualización ante la Convención Marco de las Naciones Unidas sobre Cambio Climático [5th Biennial Update Report to the United Nations Framework Convention on Climate Change].

StatLink https://stat.link/jdl9oc

Chile made substantial progress on the legal and policy framework for climate change through a joint effort across ministries. The Framework Law on Climate Change (FLCC) promulgated in 2022 creates the legal framework to address climate change mitigation and adaptation. It establishes a binding national goal to reach net zero by 2050, which implies the need to reduce gross GHG emissions by approximately 40% from 2020 to 2050. Chile also set long-term and increasingly ambitious climate change mitigation objectives in the Long-Term Climate Strategy (ECLP), submitted in 2021. The strategy defines a national GHG emissions budget for 2030 and 2050 and emission budgets for relevant sectors. Sectoral and regional plans will support achievement of the ECLP horizontally (across ministries) and vertically (across levels of government). There is a requirement to review progress implementing these plans and update ambition every five years[3] so that the country can course-correct efforts to achieve the net-zero goal by 2050.

Chile must implement the climate law with a whole-of-government approach

Chile is not on track to achieve national targets for GHG emissions. Ambitious actions will be needed to ensure achievement of both 2030 and 2050 targets (Valdés et al., 2023[6]) (Benavides et al., 2021[7]). Important challenges remain in the implementation of the FLCC. Sectoral and regional plans are under

development and must be completed by 2025. They need to clarify concrete measures and policies to peak GHG emissions before 2025, and to meet the 2030[4] and 2050 targets. Measures defined in sectoral and regional plans must be supported by a portfolio of investments with sufficient financing.

Moreover, the successful implementation of the climate law requires the strengthening of technical capacity at national and sub-national levels. There is a need for increased collection and analysis of data, development of indicators and reporting, and improved monitoring, reporting and verification (MRV) systems to track and evaluate policies and to course-correct as needed. Implementation also requires deployment of professionals with relevant expertise in both national and sub-national institutions.

Decarbonisation of the energy sector requires swift coal phase-out and expansion of renewables

The energy sector is expected to contribute the most to GHG emission reductions in the coming decade. Chile aims to close all coal-fired plants by 2040. This original timetable has been modified several times and brought forward, with the aim to close more than half of coal-fired plants by 2025. As of November 2023, 8 out of 28 coal-fired plants operating in 2019 have been retired (22.5% reduction in terms of total capacity).

The other key policy is to promote renewable energy, notably solar and wind. Chile aims to achieve 80% of electricity generation from renewables in 2030 (an increase from 55% in 2022) and 100% from renewables and other energy sources with carbon capture[5] by 2050. These targets should be legally binding, as was the case for 2025 target for renewables, which has already been achieved. A major bottleneck for greater uptake of renewables is the lack of transmission lines, notably in the north, but these are under development. Lack of transmission lines caused the significant curtailment of generated renewable energy (up to 290 gigawatt hours of solar- and wind-generated energy were not used in 2022). Energy efficiency is expected to contribute to 7% of cumulative reductions in GHG emissions by 2050, with the 2021 Energy Efficiency Law as the main legal framework.

Chile established the National Green Hydrogen Strategy in 2020 to develop a competitive hydrogen industry. The country's extraordinary renewable energy potential with relative cost competitiveness compared to other countries makes it well placed to become a major producer and exporter of green hydrogen. Green hydrogen and its derivatives are not only a potential solution to store and transport electricity from renewable sources, they can also decarbonise hard-to-abate sectors such as heavy industry and cargo transport. Green hydrogen is expected to contribute to 21% of the emission reductions required for net zero in Chile. This is significantly higher than its expected contribution in the IEA's net-zero emission scenario (4%) (IEA, 2023[8]).

Transport and building sectors should have more stringent climate targets

The transport sector has rising energy consumption and slow uptake of electric vehicles (EVs). The GHG emissions scenario based on sectoral budgets allows emissions to increase the most in the transport sector compared to other sectors from 2020 to 2030. Swift transition to low carbon mobility requires further investments in sustainable public transportation. Another key sectoral measure is the ban of sales of combustion engine vehicles by 2035, with a goal and action plan to achieve a higher share of EVs. However, EV uptake is impeded by limited public charging infrastructure, with only up to 750 public units as of November 2023. Minimum energy efficiency standards for light-duty vehicles will be in force from 2024. Given that the trucks and buses contributed to more than 60% of land transport GHG emissions in 2019, further green tax reform, energy efficiency standards and investment in electrification of these vehicles as well as the use of hydrogen are crucial.

In the building sector, electrification of heating for residential, public and commercial building is a key sectoral mitigation measure. Other key measures include establishing solar thermal systems, energy rating

of existing homes and thermal overhaul in vulnerable homes, which also address air pollution linked to energy poverty. The GHG emission reduction target aims for all new buildings to be “zero net energy consumption” by 2050, but the timeframe for this target should be accelerated. The target for existing buildings is even weaker, aiming for 10% to meet a specific standard for thermal regulation by 2050. In Chile, the LULUCF sector absorbed 47% of gross GHG emissions in 2020. The country's forest land increased by 2.9% from 2016 to 2020. The ECLP further aims to restore 200 000 hectares of forests by 2030; nevertheless, wildfire risk poses a continuing challenge.

Air pollution, linked to energy poverty, is a major public health challenge

Despite some improvements, air pollution remains a significant public health challenge. Chile made significant progress in reducing sulphur dioxide (SO_2) emissions, primarily from stationary sources. However, emissions of other air pollutants, such as nitrogen oxides (NO_x) and fine particulates ($PM_{2.5}$) have been rising recently (OECD, 2023[9]). Regional disparities in air pollution levels are stark, with northern regions experiencing the highest levels of SO_2 and NO_x emissions from industrial sources (e.g. copper smelters, thermoelectric power plants), while central and southern regions suffer from concerningly elevated $PM_{2.5}$ concentrations, largely due to residential wood burning for heating and road transport (OECD, 2020[10]).

Chile has taken some positive steps to address air pollution, including the Environmental Regulation Programmes (PRAs) and Environmental Prevention and/or Decontamination Plans (PPDAs) and the green tax emission-intensity criterion for PM, NO_x, SO_2, and CO_2. These measures have contributed to a decline in the average age of vehicles in Chile, attributed to the increasing popularity of new fuel-efficient models. However, the adoption of the EURO VI standard for new light-duty vehicles may have a short-term effect on fleet renewal rates (4.4% in 2021), particularly in northern regions where the purchase of used vehicles is more pronounced (average vehicle age 13.4 years) (De Vicente, 2022[11]).

To further improve air quality and public health, emissions from vehicles already in circulation (5.98 million in 2021) need to be reduced. This can be done by expanding the coverage of the green tax to CO emissions, implementing a comprehensive fleet-renewal management program mandating regular emissions testing, and higher registration fees for older and more polluting vehicles. To mitigate the potential negative impacts of these policies on low-income households and promote social equity, Chile should simultaneously invest in more accessible and sustainable public transportation in all regions. Additionally, by aligning air quality standards with WHO guidelines and concurrently increasing funding for PPDAs, Chile can facilitate timely declaration of saturated or latent zones and prompt implementation of mitigation measures such as diesel bans in urban areas and declaration of low-emission zones for densely populated centres.

High levels of multidimensional poverty, thermally inefficient buildings and weak electricity accessibility exacerbate air pollution, especially in central and southern Chile. The Heater Replacement Programme to enhance energy efficiency upgrades to curb air pollution from residential wood burning along with building thermal retrofitting and housing energy performance labelling are welcome. However, achieving significant progress in reducing energy demand, air pollution, and GHG emissions necessitates sustained and intensified efforts mainly to broaden the accessibility to affordable and sustainable energy for heating. Cultural barriers impede the widespread adoption of cleaner cooking and heating systems. Reinforced environmental awareness campaigns could play a pivotal role in catalysing the transition towards cleaner technologies.

Chile forges ahead with biodiversity conservation amid management and data challenges

Chile is well-positioned to achieve the Kunming-Montreal Global Biodiversity Framework targets. It is one of the few countries in the LAC region, along with Costa Rica and Uruguay, that has increased its forest cover (OECD et al., 2022[12]). Chile has already protected 44% of its exclusive economic zone (EEZ) and has made significant progress in expanding its terrestrial protected areas, reaching 22% of its land area.[6] The country is committed to further growing its protected areas network, specifically in vulnerable and underrepresented ecosystems to meet the 30x30 targets.

However, challenges remain in increasing protected areas management effectiveness (CBD, 2021[13]) and reducing threats from invasive species and human activities, such as wildfires and salmon farming within and near protected areas. Chile should further develop biodiversity-positive nature-based solutions to combat desertification, promote sustainable land use, and enhance climate change adaptation (Dussarrat et al., 2022[14]). Additionally, peatland and wetland conservation can further bolster Chile's climate change mitigation efforts (Hoyos-Santillan et al., 2021[15]).

After more than a decade of deliberation, the Law for Nature was promulgated in June 2023, marking a significant step towards reinforcing biodiversity protection and conservation in Chile. However, the implementation of this ground-breaking legislation is expected to be a protracted endeavour, with a projected full operationalisation in 2027. The law introduces several instruments to support biodiversity conservation within and beyond protected areas. These include the Biodiversity and Protected Areas Service (SBAP), approved in August 2023, the National Biodiversity Fund, and the establishment of retribution programmes for ecosystem services (BCN, 2023[16]). These reforms are accompanied by an expansion of the workforce exclusively dedicated to biodiversity conservation, underscoring the critical need for sustained funding and skilled personnel to effectively implement biodiversity conservation measures.

Chile’s progress in implementing payment for ecosystem services (PES) pilots in various regions holds promise for a national PES program. However, to fully scale up PES initiatives and integrate nature and biodiversity into sustainable public and private decision-making, the country needs to strengthen natural capital valuation methods and foster stakeholder engagement. This can be achieved through the Natural Capital Committee (NCC), established in January 2023, which is tasked with developing methodologies for measuring and valuing natural capital and ecosystem services. The development of public baselines of natural capital and ecosystem services, as exemplified by the efforts in the Magallanes region, will further enhance Chile's ability to incorporate ecosystem, species, and genetic diversity into national accounts and its effective mainstreaming into national planning and environmental impact assessments.

To support NCC efforts, Chile must bolster its biodiversity data collection and accessibility. The country’s *Sistema de Información y Monitoreo de Biodiversidad* (SIMBIO) provides a centralised platform for storing, managing and accessing biodiversity data. However, to fully realise its potential, SIMBIO should be enriched with indicators to monitor temporal and spatial dynamics, as well as progress towards conservation targets. Improving coordination among stakeholders through a biodiversity data network would streamline data exchange and integration across disparate databases and institutions. This would also lead to more reliable and consistent biodiversity information, favouring informed decision-making across sectors. Engaging the public in biodiversity data management and utilisation can foster greater awareness and support for conservation efforts.

Waste management requires urgent and transformative actions towards a circular economy

Chile landfills a higher percentage of its municipal solid waste (92%) than any other OECD country, although it generates less waste per capita (406 kg versus 534 kg in 2020) (OECD, 2022[17]). The entry

into force of extended producer responsibility (EPR) schemes in early 2023 and the enactment of the Single-use Plastic Law in 2022 will help the country reduce plastic generation and promote recycling of major waste streamlines (e.g. packaging, batteries and tyres). The expected promulgation of the decree establishing EPR for waste electrical and electronic equipment (WEEE) in 2024 represents a significant step towards a circular economy. Nevertheless, given their designation as priority products, it is crucial to accelerate the implementation of EPR schemes for textiles and fishing nets, which are still in their early stages of development.

The approval and implementation of the bill for the valorisation of organic waste is strongly encouraged. This bill represents a significant step forward in promoting organic waste reduction and strengthening differentiated waste management practices at the territorial level. To further enhance its effectiveness, the proposed mandate on recovery of organic and other separated waste should be accompanied by the introduction of economic instruments, such as a landfill tax (OECD, 2019[18]).This would help Chile discourage the use of environmentally harmful waste disposal practices, promote sustainable waste treatment methods and meet its ambitious waste management goals of 66% organic waste recovery rate by 2040 and 40% recycling rate by 2030.

Despite high waste collection coverage (99% in urban areas and 73.4% in rural areas) (SUBDERE, 2019[19]), municipal solid waste collection infrastructure faces two interconnected challenges: financial sustainability and promoting behaviour change. Currently, many municipalities lack the resources to manage waste due to sanitation fee exemptions, as established by the Municipal Revenue Law, and unclear tariffs. These make it difficult to ensure cost recovery and implement the polluter pays principle through pay-as-you-throw schemes (CSP and MMA, 2020[20]). The absence of substantial technical and financial support to municipalities impedes progress towards achieving national waste management goals.

Chile faces a pressing need to devise a comprehensive long-term investment strategy that prioritises waste separation and recovery infrastructure while simultaneously tackling the modernisation of landfill facilities with stringent environmental standards as they are nearing their end of life (Pelayo Díaz and Linazasoro Espinoza, 2020[21]). This is compounded by the lack of defined ceilings in the Regional Contingency Support Fund, which only allocated 15% of its 2023 budget to waste management, primarily for waste disposal, with less focus on collection, transfer, and recovery. Moreover, to foster waste reduction and recycling initiatives, Chile should make environmental awareness campaigns more accessible and tailored to specific community needs (Rodríguez Salas and Trebilcock, 2020[22]).

Improving environmental governance and management

Significant progress was made in strengthening environmental institutions

Significant progress was made to strengthen the environmental institutional framework. The most prominent development was approval of the SBAP in 2023, as recommended in the previous review. Another major development was ratification in 2022 of the Escazú Regional Agreement on Access to Information, Public Participation and Access to Justice in Environmental Matters in LAC countries. Under the Escazú Agreement, Chile is working to promote access to information, public participation and justice in environmental matters, including through the Just Socio-Ecological Transition Office established in 2022. The Inter-Ministerial Committees for Just Socio-ecological Transition and for Just Water Transition were established in the same year. They function as horizontal co-ordination mechanisms for respective matters, alongside the Council of Ministers for Sustainability and Climate Change.

Further decentralisation is needed to empower local environmental services

Chile has been one of the most centralised countries in the OECD. While regional and provincial administrations have some territorial planning responsibilities, they play a minor role in environmental management. Limited institutional autonomy in municipalities has continued since the last review, with limited competences at local level to set more stringent environmental standards than national level. Local authorities also have little fiscal autonomy and lack financial resources for environmental services. The MMA is legally obliged to work with local authorities for environmental matters.

A stronger push towards decentralisation was reflected in the "Stronger Regions" bill submitted to Congress in 2023 (Government of Chile, 2023[23]). The bill aims to empower regions by granting greater autonomy to regional governments to design mechanisms to generate their own income, and use of resources according to the needs of the area. Moreover, the bill proposes a new Permanent Fund for Inter-regional Equity, which aims to reduce the financing gaps between regions. The Mining Royalty Law enacted in 2023 will also strengthen local financing, by creating a flat-rate value-added tax, and three community funds to distribute collected revenue to regions and municipalities.

Progress on environmental quality and emission standards stalled, and the liability regime for environmental damage is still weak

Despite recommendations of the 2016 Environmental Performance Review, progress on strengthening both environmental quality and emission standards has been limited. Chile has quality standards on air and water and emission standards on air, noise, soil and water pollution in force. However, Chile lacks standards on soil (currently under development), and standards for water are incomplete (Chapter 2) (Carrasco, Benítez and Cañas, 2023[24]). Since 2016, some emission standards for stationary sources were added or updated, including ones for odours and arsenic.

There is no legal regime in Chile related to remediation of contaminated land (BCN, 2023[25]) and no specific agency responsible for the investigation and clean-up of those sites, despite a recommendation in the last review. In 2022, a total of 10 253 soils were identified with potential presence of contaminants nationwide, particularly in mining regions. For abandoned mining sites, Chile has made no significant progress since the last review. The 2012 Mine Closure Law requires all new mines to get approval for end-of-life closure plans with guarantees for the full present value of closure cost. However, the law does not apply to already abandoned mining sites. For those sites, limited financing of decontamination activities comes from the state budget, which is not in line with the polluter pays principle.

A sustainable funding solution is necessary for remediation of abandoned mining sites. One possibility would be to create a fund from mining royalties dedicated to clean up legacy land and water pollution. A share of extraordinary revenues due to the high price of lithium could be earmarked for remediation purposes. Another possibility is to impose decontamination fees on hazardous industrial installations and earmark the revenue for such fund.

Environmental impact assessment needs better technical criteria for decision-making and broader, early citizen participation

There is significant room to improve environmental impact assessment (EIA) in Chile. Although a full EIA is required in the case of a potential risk to public health or the environment, most projects (94% in 2022) undergo a simpler environmental impact declaration (DIA). The project owner, rather than an independent party, judges the project entry category (full EIA or DIA). A validation of this screening is incomplete due to limited oversight capacity. Such a validation process is important to ensure that the screening process is not used as a loophole to avoid a full EIA.

Even in a full EIA, the System of Environmental Impact Assessment still does not require evaluation of alternative scenarios. Institutional safeguards against political influence are insufficient (Chile Transparente, 2021[26]). The risk of political influence undermines environmental protection and generates uncertainty that can discourage future investment. Reinforcing the technical quality of EIAs without political influence is increasingly important in the context of the development of major new projects, such as green hydrogen and lithium production. A reform of the Law 19.300 General Bases of the Environment is expected to strengthen the technical quality of EIAs. Additional challenges relate to the asymmetry of information between project owners and citizens, ensuring citizen participation at the early stages of the process and integrating climate change into environmental assessments.

Compliance monitoring expanded with new technology but is still under-resourced

The Environmental Superintendence (SMA) recently started remote mass control to check compliance resulting in the number of checks more than doubling between 2017 and 2022. This allowed some 1 700 additional checks on the salmon industry using satellite images and large data sets, achieving more than 95% coverage in this area. Remote compliance checks have been effective to increase the coverage of checks at low cost and improve compliance through behavioural change of the industry given the high probability of detection of non-compliance.

Chile's highly centralised compliance service exerts pressure on the capacity of the SMA. The management of minor local complaints should be decentralised to minimise the burden on the SMA. There is currently an initiative to modify the Organic Law of the SMA, aiming to grant greater investigative powers to the SMA, streamline compliance procedures and increase incentives for compliance, a welcome development.

To the extent environmental impact mitigation measures concern the competence of sectoral ministries, the SMA does not monitor compliance directly in some cases[7]. Instead, the SMA co-ordinates with sectoral ministries – sharing control tasks with other services through agreements with different sectoral agencies. While there is a standardised procedure for compliance checks, the arrangements may undermine the enforceability of permit conditions compared to integrated monitoring compliance on a cross-media basis. The key bottleneck to integrated compliance monitoring is a lack of regional resources for compliance monitoring. The SMA should be further strengthened towards integrated compliance monitoring, with sufficient resources to conduct it.

Enforcement has been strengthened by broadening criminal liability

Chile has ramped up efforts to address environmental violations and broadened criminal liability. In 2023, Congress approved a law enabling criminal sanctions for environmental violations. It criminalises certain activities without environmental permit, non-compliance with environmental standards and other activities that damage protected ecosystems. Similarly, amendments to the Organic Law of the SMA incorporate new articles that penalise activities such as maliciously dividing projects into smaller ones to avoid the full EIA (Hilgers, Vial and Gutierrez, 2023[27]).

Enhancing policy coherence for green growth

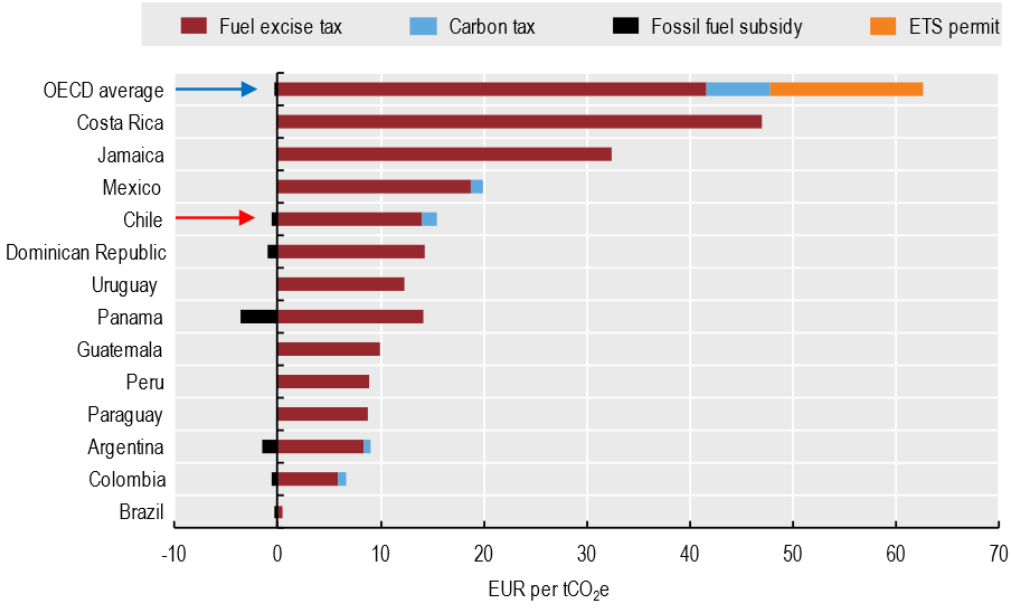
Chile should continue the reform on green tax and electricity price-setting mechanism

Chile showed some progress in greening the tax system. As part of the green tax reform, a carbon tax of USD 5 per tonne of CO_2 emissions applies for stationary sources since 2017. The tax does not apply to emitting sources primarily based on biomass energy. With the carbon tax, Chile achieved 55.6% of GHG

emissions being subject to a positive net effective carbon rate in 2021 (the highest coverage in LAC countries) (OECD, 2023[28]). While Chile ranks among the highest in LAC countries for average effective carbon rates, it was well below other OECD countries in 2021 (Figure 3). Since 2022, the carbon tax applies to large emitters[8], without exclusion of any sector.

Figure 3. Carbon pricing in Chile is relatively high compared to LAC countries but lower than in other OECD countries

Net effective carbon rates in selected LAC countries and OECD average, 2021



Note: ETS = emissions trading system. Fossil fuel subsidy refers to budgetary transfers that decrease pre-tax prices for domestic fossil fuel use. ETS coverage estimates are based on the OECD's (2021), Effective Carbon Rates 2021, with adjustments to account for recent coverage changes.
Source: OECD (2022), *Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action*, OECD Series on Carbon Pricing and Energy Taxation, OECD Publishing, Paris.

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A carbon offset system came into force in February 2023, including GHGs and local pollutants $PM_{2.5}$, NO_x and SO_2. This system can pave the way for a more sophisticated market that allows flexibility in emissions reductions by offsetting tax liability with projects that reduce emissions directly.

Future efforts in carbon pricing should concentrate on establishing a gradual timeline towards higher levels of the carbon tax rate. The government has put forward a revision of the current tax, including increasing the rate, as part of its fiscal reforms. An increase in the rate would better reflect the social costs of pollution. However, such reforms are still in the technical design phase. Higher carbon prices are crucial to spur the needed shifts towards cleaner energy to meet climate objectives.

The electricity price-setting mechanism in the Chilean electricity market needs to be changed for carbon pricing to work effectively. The variable costs of electricity generation plants determine wholesale electricity prices and the order of dispatch. However in Chile, the full amount of the carbon tax is not included in the variable costs, which creates economic distortions in the power sector. Without revisiting this design issue, carbon pricing will not be effective at incentivising the transition towards renewables.

Several of the last review's recommendations on energy and vehicle taxes have not been implemented. For instance, there is still a wide gap in tax rates between petrol and diesel. Sectoral fuel tax exemptions applying to large-size cargo transport in trucks, and diesel used in off-road vehicles, still exist in the form of tax refunds. Taxes on motor vehicles exempt commercial vehicles and are linked not only to the fuel efficiency and emissions but also to the vehicle price, which is not related to environmental damages. Further reforms should address these outstanding issues, in addition to raising both vehicle tax rates and annual registration fees depending on vehicle types (e.g. age, emission levels) to discourage purchase and use of highly polluting vehicles.

Fiscal cost of support to fossil fuels increased due to the global supply disruptions

The fiscal cost of support to fossil fuels in Chile more than tripled over 2016-22, reaching approximately USD 2.6 billion in 2022. This substantial increase was primarily driven by the Stabilisation Mechanism of Fuel Prices (*Mecanismo de Estabilización de Precios de los Combustibles,* MEPCO), which accounted for about USD 2.4 billion in 2022. MEPCO aims to reduce international oil and gas price fluctuations for domestic consumers through adjustments in specific taxes on transport fuels. MEPCO's limit has expanded in recent years to counteract the pandemic's adverse economic impact, as well as the rising international price of oil and gas arising from the Russian war of aggression in Ukraine. Prior to 2021 and in the first half of 2023, MEPCO effectively stabilised prices without significantly subsiding fossil fuel consumption. During the initial seven months of 2023, MEPCO facilitated the collection of an additional USD 0.7 billion in taxes on fossil fuels. However, it is crucial for long-term sustainability that such a mechanism remains neutral to avoid inadvertently providing support for fossil fuels.

Periods of high and volatile fossil fuel prices highlight the benefits of the clean energy transition. Support measures to fossil fuels weaken incentives to switch to alternative sources of energy. They also use public funds that could be spent on clean energy transitions (IEA, 2023[29]). The long-term focus should be on building resilience and investing in the clean energy transition with emergency relief phased out eventually. Social benefit schemes need to be well-targeted to the vulnerable population who are hardest hit.

Environmental expenditure trends need to be systematically identified with meaningful categorisation by domain

Chilean central government expenditure on environmental protection stayed around 0.1% of GDP (0.35-0.40% of total governmental expenditure) over 2012-21, lower than the OECD average (0.6% of GDP in 2020). The last review recommended continuing systematic surveys on environmental expenditures with expanded coverage for private sector and sub-national levels. However, progress has been limited (e.g. pilot studies, or initial study started, but data not processed yet).

The public environmental expenditure study using Classification of Activities and Expenditures for Environmental Protection (CEPA) or other equivalent classifications has not been conducted since the 2015 survey. This makes it hard to understand the environmental expenditure trends and identify gaps. There are other efforts to identify public investment in environmental protection, in particular for climate change. However, these approaches are not comprehensive enough to understand expenditure trends by domain.

Chile leads the GSSS bond market in the region to mobilise private sector investment

Chile has been at the vanguard of leveraging capital markets for sustainable growth, which has allowed a broadening of the investor base. The country has issued green, social, sustainability, and sustainability-linked (GSSS) bonds since 2019. They constitute approximately 30% of the sovereign debt stock, with half of them linked to social initiatives. Green bonds make up around one-fourth of that GSSS bonds issuance (OECD, 2022[30]). Chile has the LAC region's largest GSSS bond market at USD

43.2 billion in cumulative issuance as of July 2023. Chile issued the world's first sovereign sustainability-linked bonds in March 2022, a USD 2 billion issuance. The two key performance indicators are GHG emissions reduction and the scale-up of non-conventional renewable energy (NCRE) generation. A failure to meet these performance indicators would trigger a coupon penalty for these bonds.

Green hydrogen attracts national attention, but must ensure safety, social and environmental considerations

The development of the hydrogen industry needs careful consideration across multiple aspects. Safety is critical for all stakeholders, notably for new, less experienced companies. EIA and permitting processes are increasingly important to ensure safe operation by those players as well as larger operators. Land-use planning for siting production facilities needs to consider appropriate safety distances from communities and biodiversity hotspots. More broadly, the government should employ the precautionary principle for using technology with considerable uncertainties related to its safety (OECD, 2023[31]).

Environmental impacts of hydrogen production, such as on water scarcity and biodiversity, are diverse across regions. Water is needed to produce hydrogen, and further water consumption in the area with high solar energy potential such as the north can exacerbate water scarcity. To address this issue, desalination technology will be required to provide water for hydrogen production, while its environmental impacts (e.g. brine) need to be managed. Development of facilities in open spaces, such as in the southern area of the country in Magallanes, can exert pressures on local biodiversity including birds and marine ecosystems. This highlights the importance of a territorial approach to strategic energy planning and to address distinct environmental impacts in each region.

Intensifying production of lithium must address social and environmental impacts

High global demand and elevated prices of critical minerals for the global energy transition provide historic opportunities to Chile, which has almost half of the world's lithium reserves. However, lithium mining can exacerbate water scarcity, while chemical waste can contaminate soil and water. Chile must address the social and environmental impacts of intensifying lithium production. The development threatens the wetlands in Chilean Andes, which support the fragile salt flat ecosystem (Blair, Balcázar and Barandiarán, 2022[32]).

The National Lithium Strategy, developed in 2023, aims to create a network of protected Andean salt flats. It aims to protect at least 30% of these areas by 2030. A new regulatory framework for lithium production is under development with a focus on minimising local freshwater consumption. Hydrogeological and biodiversity baselines must be established before lithium production to measure the impact of the production activity on salt flats.

These measures are critical for sustainable production of lithium. If not well-managed, lithium mining in particular regions, such as the Salar de Atacama, may also deepen historical inequalities and negatively impact Indigenous Andean territories (Jerez, Garcés and Torres, 2021[33]). Lack of transparency and access to key information for local citizens can contribute to procedural injustice, while new job opportunities are not well distributed among the population in the region.

The Just Socio-Ecological Transition needs well-targeted policies to address social inequalities and environmental injustice

Environmental injustice is a historical and growing concern in Chile. Local populations in areas referred to as "overburdened zones" face various environmental burdens caused by industrialisation. Projects in high demand for global and domestic clean energy transitions, namely hydrogen, lithium and copper production as well as renewable energy projects, can increase local environmental concerns in affected regions, if not

well managed. Screening and mapping tools can be a powerful means to help identify communities with environmental justice concerns and inform targeted actions. Chile should strengthen the evidence base to spur its efforts on environmental justice.

Chile has a bold commitment to the Just Socio-Ecological Transition. Putting it into practice will require strategic and targeted policies to address inequality and social impacts. For instance, phasing out coal-fired power plants has raised some concerns about impact on employment. The consequences of the carbon tax are heterogeneous across households with different incomes and consumption patterns. Without further policy measures, the proposed increases in the carbon tax rate can have regressive distributional outcomes, given that lower income households spend a larger share of their budget on energy. The potential effects of a higher carbon tax on low-income households could be mitigated through well-targeted transfers. Introduction of redistribution mechanisms can also help so that revenues generated from carbon tax are used to provide such transfers.

Recommendations on sustainable development

Climate change and air pollution

- Pursue comprehensive and timely implementation of the Framework Law on Climate Change with a whole-of-government approach to mainstream climate change in relevant sectors; clarify sectoral and regional plans with a coherent policy mix to put GHG emissions on the pathway to net zero; align the portfolio of investments with the planned measures; strengthen the MRV system; deploy sufficient technical capacity at national and sub-national levels.
- Swiftly complete the closure of remaining coal-fired plants with a stepwise plan and clear timeline, mindful of the just transition; make renewable energy targets legally binding; accelerate integration of renewable sources into the electric grid; establish a gradual timeline towards higher levels and wider scope of carbon tax to better reflect the social cost of carbon; revisit the electricity price-setting mechanism to reflect the carbon tax in order to incentivise the transition towards renewables.
- Set more stringent GHG emission targets for the transportation sector; expand investment in sustainable public transportation and improve its accessibility, efficiency, and coverage in urban areas with a specific focus on small- and medium-sized cities; promote investment in electrification of vehicles as well as EV-charging infrastructure, in collaboration with local authorities.
- Pursue more stringent targets for GHG emission reduction for buildings, including those for energy efficiency and distributed power generation to address energy poverty; expedite initiatives to improve building thermal performance and broaden access to affordable and sustainable energy-efficiency upgrades for households and major public and commercial building; enhance public awareness to reduce residential wood burning-related pollution.
- Enhance vertical and horizontal co-ordination on climate change adaptation plans, informed by climate risk assessments; develop financing strategies and strengthen capacities of sub-national governments to manage climate-related risks and enhance resilience; pursue the development of indicators to monitor progress.

Biodiversity, waste and circular economy

- Allocate sufficient resources to meet conservation goals and ensure the effective implementation of the Law for Nature; complete management effectiveness assessments for protected areas; improve biodiversity data management; establish robust baselines of natural capital and ecosystem services to incorporate biodiversity into national accounts and develop a national PES scheme; review and phase-out harmful incentives that undermine biodiversity conservation; prioritise biodiversity-positive nature-based solutions.
- Accelerate the implementation of new EPR schemes; establish specific regulations for construction waste; approve and promptly implement the bill for the valorisation of organic waste; strengthen use of economic instruments such as a landfill tax.
- Modernise landfill facilities with more stringent environmental standards; devise a comprehensive long-term investment strategy for waste separation and treatment infrastructure; review and implement transparent sanitation tariff schemes to achieve cost-recovery while ensuring affordability.

Environmental governance and management

- Ensure authorities deploy sufficient resources to successfully implement environmental commitments and overcome capacity challenges for implementation.

- Further pursue decentralisation of environmental institutions and management to empower regions to deliver environmental services tailored to their challenges and needs with adequate resources and necessary capacity building; adopt the Stronger Regions bill to promote regional financial autonomy in line with regions' responsibilities.
- Introduce a strict liability regime for future damage to the land and ecosystem; develop and implement environmental remediation standards and plans, notably for soil contamination; establish a financing mechanism (e.g. remediation fund) for clean-up activities of past pollution, such as abandoned mining sites.
- Strengthen the technical quality of EIA by creating safeguards against political influence and improving the capacity of the Environmental Assessment Service to obtain and review project information with sufficient resources to digitise the EIA process and produce reliable public databases; reinforce the validation process to ensure the screening for project entry into the SEIA is done properly; guarantee meaningful public participation, notably by Indigenous communities, in early stages of the process; incorporate climate change into EIA and SEA to enhance resilience in territorial and infrastructure planning.
- Reinforce the SMA's institutional capacity with sufficient resources and ensure the involvement of SMA inspectors in assuring compliance with sector-specific environmental permits; decentralise local complaints management; strengthen compliance monitoring and enforcement activities through technology and data analytic tools; reinforce the legal basis to improve the effectiveness of compliance enforcement and SMA's sanctioning powers.

Policy coherence for green growth

- Pursue the green tax reform: phase out the fuel tax refund for large-size cargo transport and diesel used by off-road vehicles; reduce the petrol-diesel tax gap; increase the vehicle tax rate and broaden its coverage to commercial vehicles; expand coverage of tax to mitigate CO emissions; tighten emissions and energy efficiency standards for all vehicles; increase the cost of owning and operating older and more polluting vehicles (e.g. through higher vehicle registration fees).
- Identify public environmental expenditure trends with meaningful classification by environmental domains such as CEPA classification, through systematic surveys or budget-tagging, to inform relevant budgeting and environmental policy decision making.
- Ensure safety, social and environmental considerations are taken into account in green hydrogen production supported by robust scientific evidence; adopt the precautionary principle in decisions related to safety risk across the value chain (e.g. producers, transporters, and users); ensure appropriate regulatory framework, permitting and land-use planning with a territorial approach.
- Protect water resources and ecosystems, notably the salt flats, in the context of lithium production: strengthen and implement a new regulatory framework, including measures to achieve the biodiversity protection goal; advance scientific research and establish environmental baselines with necessary financing support.
- Facilitate access to better-targeted social assistance programme, including for areas called "overburdened zones", to support the Just Socio-Ecological Transition; enrich dataset and mapping tools to identify vulnerable communities facing disparate pollution burdens and inform actions to advance environmental justice.

2. Water management and policies

Water resources status and trends

Chile faces a severe and deepening water crisis resulting in increasing social conflicts

Chile's freshwater resources, as well as major economic and population centres, are unevenly distributed across the country, resulting in stark contrasts with respect to availability and quality of water. The country's distinct geography and climate variability across the territory add to the challenges for water management. The climate varies from the driest region in the world, including the Atacama Desert, to a humid climate and numerous glaciers in the south. Water scarcity is acute in the arid north, where most of the water-intensive mining activities occur. It is also a major challenge in central Chile, where agricultural production and population centres are concentrated. The country has about 1 250 rivers that flow from the mountains to the sea, with 101 hydrological basins, creating a complex, interconnected water system to manage.

The management of water resources has important economic, environmental and social consequences for the country. Chile continues to be a major producer and exporter of minerals and is pursuing ambitious investments in green hydrogen and lithium production. Chile also aims to become a global agricultural and food production power. All these activities depend on a secure supply of water and increasing demand will compound water stress. Hydropower accounts for around 20% of electricity supply, although recurring drought has contributed to the decreasing share of hydropower in power generation.

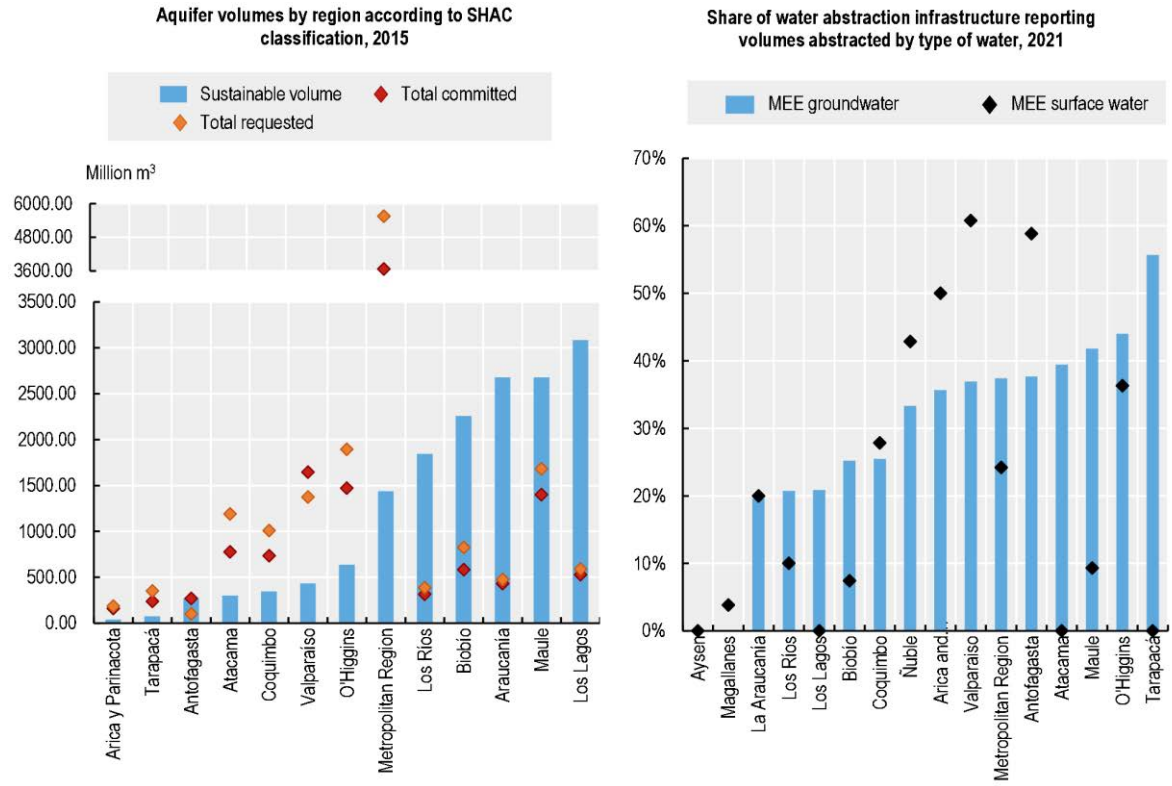
Chile faces extreme water stress and ranks 16th among 164 countries for baseline water stress (Kuzma, Saccoccia and Chertock, 2023[34]). The pressures on water resources are growing due to rising demand, pollution, and declining, more erratic and unpredictable supply due to over-allocation of water resources, drought and climate change. The result is growing competition for water and increasing social conflicts, including with Indigenous communities. Significant drivers of disputes relate to property rights and the environment, regularisation of water rights, and overexploitation and uncontrolled use of groundwater (Donoso, 2021[35]).

The availability of freshwater resources is sharply declining

Pressure on freshwater resources has intensified over time, resulting in acute declines in availability. Chile is facing a "megadrought", which has been ongoing for 14 years. Drought risk is high or very high in multiple provinces across the country. River flows are generally below 2015-20 averages. The situation is especially acute in central and northern Chile. For example, the Bio Bío River in central Chile has experienced declining flows. It is the second largest, has the highest hydroelectric potential and has been characterised as the most economically important river in the country. Water levels in many dam reservoirs are declining; in Lake Laja dam, for example, levels are far below capacity. This dam is a critical source of hydroelectricity and irrigation, and among the reservoirs with multi-year storage. As such, it serves as a "reserve battery" for the entire national grid. Growing uncertainty related to the quantity and quality of surface water has translated to intensifying pressures on groundwater.

Demand for groundwater exceeds sustainable levels of supply in most regions (Figure 4). As of 2015, total volume of known allocated water rights for groundwater abstraction was greater than sustainable supply, resulting in over-allocation of these resources. Limited monitoring and reporting impede a comprehensive understanding of total freshwater abstractions for surface water and groundwater. Less than half of registered infrastructure works for water abstraction are reporting volumes abstracted in the Directorate General for Water (DGA) system for Monitoring Effective Extractions; some are not reporting at all (Figure 4).

Figure 4. Groundwater demand exceeds supply in most regions, while less than half of abstraction works are monitored



Note: Left panel: SHAC = sector hidrogeológico de aprovechamiento común (hydrogeological sector of common use), a body of groundwater that can be defined and managed as a unit. Sustainable volume: annual amount of water associated with the recharge of the aquifer. Total committed: amount of water that corresponds to all constituted and recognised water rights. Total requested: annual amount of water that corresponds to all applications for water rights, both resolved and pending. Data are underestimated.
Right panel: MEE = monitoring effective extractions. Data are available as of May 2023. Values are provisional. Total works reporting considered works reporting online. Regions of Aysen and Magallanes are not registered for groundwater.
Source: DGA(2016), *Atlas del Agua* [Water Atlas], Chapter 4, pg.116; SINIA (2023), *Monitoreo de Extracciones Efectivas* [Monitoring of Effective Withdrawals].

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Overall, agriculture is the major water user in Chile, but mining accounts for a large share of abstractions in certain regions

Overall, agriculture remains the major user of freshwater resources, accounting for around 72% of estimated demand, with industrial and municipal use accounting for relatively minor shares. Relative to water use for service-based activities and industrial activities, water used for agriculture is much less efficient when measured in terms of the value added in USD per volume of water used (in cubic metres).

National averages of water use mask critical variations across the territory. For example, whereas mining accounts for a relatively minor share of total abstractions, it accounts for a considerable share in the north of the country. In the Antofagasta Region (II), for example, mining accounts for nearly half of total consumptive use, contributing to depletion of non-renewable groundwater resources (Acosta, 2018[36]). Mining activities rely substantially on groundwater, although the share of non-conventional water supplies (e.g. desalination) has increased over time. Lithium-rich brines are also an issue for water management, given their ambiguous legal status. As they may be considered as an ore deposit, the DGA cannot manage

them as water resources. The pressures on water resources from lithium mining are already acute in the Atacama basin and will extend to other regions as lithium extraction ramps up.

Water pollution is a major issue in Chile and not sufficiently monitored

Urban and industrial wastewater, along with fish farming, agriculture and mining, are the main sources of water pollution in Chile. Energy, fishing and aquaculture produce the largest shares of industrial wastewater. From 2013, the total volume of industrial wastewater increased until 2017, then declined somewhat and remained broadly steady through 2021.

A significant share of wastewater discharges goes directly into the ocean, while inland discharges are predominant in the Metropolitan region. It is estimated that over 60% of industrial discharges flow into sewerage networks and combine with domestic sewage, which is treated by wastewater treatment plants before discharge. The remaining 40% of industrial discharges is either deposited in river basins and irrigation channels or discharged to the soil or directly into the ocean without adequate treatment (OECD, 2017[37]). This is especially concerning in regions where water is scarce and low or non-existent levels of water flows restrict the capacity of water bodies to dilute acidity, hazardous chemicals and heavy metals.

Incomplete data and monitoring of surface and ground water quality, including a lack of key environmental indicators such as nitrogen and phosphorus balances, impede a comprehensive assessment of water pollution. Based on available data, chlorides (and related substances) accounted for the largest share (45%) of pollutants in water in 2020, with sulfates and sulfides accounting for around 34%. Diffuse pollution from agriculture is a concern, with high levels of nitrates and pesticides observed in surface water. Mining and other industrial activities, mainly in northern and central Chile, are also major sources of pollution. This makes heavy metal contamination a serious concern and challenge to drinking water supply and irrigation (Vega, Lizama and Pastén, 2018[38]).

Chile is taking steps to adapt to the impacts of climate change on water resources

Climate change impacts on the hydrological cycle and rising temperatures exacerbate water-related risks and generate uncertainty about future water availability. Climate impacts amplify seasonal variation in runoff and increasing flooding from heavy precipitation. In the arid north, there is high uncertainty about projected changes in precipitation. For central Chile, declining snowpack is expected to reduce runoff by up to 40%. In the southernmost regions, less runoff is projected due to decreased rainfall. Shrinking glaciers and the melting of ice is projected to accelerate in the far southern basins, resulting in a higher average runoff each year. Sea-level rise is expected to reduce groundwater recharge and increase salinisation of aquifers (Vicuña et al., 2021[39]).

Chile has taken important steps to better understand the impacts of climate change on water resources and integrate water into adaptation planning. The Ministry of Environment's Atlas of Climate Risks provides information on projected climate change impacts and related risks. It includes a Water Resources module that details the projected impacts of climate, vulnerabilities and adaptive capacity at a granular spatial scale across the country. A Water Resources Climate Change Adaptation Plan mandated in the Framework Law on Climate Change is under preparation. The plan will consider measures to reduce climate risk and for disaster risk management to address floods, mudslides and other extreme events related to water resources. It considers nature-based solutions, which can enhance climate resilience, support water management goals (for both quality and quantity) and provide broader benefits for ecosystems and biodiversity cost effectively (OECD, 2020[40]).

The Chilean population enjoys high levels of access to drinking water and sanitation, although disparities in rural areas remain

Chile has achieved close to universal access to safely managed drinking water and a relatively high share of access to safely managed sanitation services. Access to both drinking water and sanitation services (WSS) improved between 2010 and 2020, from 96% to 99% for drinking water and from 63% to 78.6% for sanitation. The share of the population with access to WSS services in Chile is the highest in Latin America and the Caribbean (LAC) and broadly in line with OECD averages.

Private operators regulated by the government deliver WSS services in urban areas of Chile. This approach has spurred investments in WSS and has been largely successful in delivering nearly universal access to reliable, financially sustainable urban WSS services. Still, the share of non-revenue water from urban public water supply (around 30%) is relatively high. For wastewater treatment, more than two-thirds of wastewater receives at least secondary treatment. The share of primary treatment hovered just over 20% during 2010-18. Challenges to confront include the need to reduce non-revenue water, expand tertiary treatment of wastewater and enhance resilience to climate change impacts.

As in many countries, Chile has notable urban-rural disparities in WSS services. The limited coverage of sewerage and wastewater treatment is a major issue. Many rural systems fail to meet quality standards. In northern and central Chile, domestic water supply often competes with other uses, causing resort to high-cost and inefficient emergency solutions (e.g. cistern trucks and desalination of brackish rivers). The number of WSS systems serving rural populations has increased by 35% between 2010 and 2022. Expansion of the service network continues, with plans to build some 25 water and sanitation systems annually. Nevertheless, there have been no effective mechanisms, including reliable sources of financing and technical capacity, to ensure proper operation and maintenance.

Timely and effective implementation of the November 2020 Law on Rural Sanitary Services, would provide a much stronger basis for the reliable delivery of rural WSS to communities. Robust economic regulation for rural WSS can set performance standards for service provision, monitor and incentivise performance, as well as assess development plans for expanding and maintaining service provision.

Institutional arrangements for water governance

Establishing river basin pilots is a positive step to address fragmented water governance

The institutional landscape for water management is one of the most centralised and, at the same time, fragmented in the OECD. A striking feature of the Chilean water management model has been the absence of integrated basin governance systems. In that context, Water Users Organisations (WUOs) have acquired the experience and social acceptance to manage water resources. However, they typically focus on managing irrigation activities related to a specific river, or section of a river, without control over all rivers and tributaries that form a basin (OECD, 2017[41]). There is limited consideration for the need for conjunctive management of surface water and groundwater.

The establishment of pilot organisations for river basin governance in 16 basins seeks to redress the fragmented nature of water management by anchoring activities at the basin scale and promoting decentralised decision making. The pilots also aim to expand the range of stakeholders involved in water management, beyond the remit and focus of the Monitoring Boards in place in several basins. This is a welcome step. To promote basin-scale governance effectively, river basin organisations will need clear decision-making authority and adequate human and financial resources. In the context of decentralisation, the roles of the national, regional and local authorities need to be clearly defined. A bill to formalise the

establishment of basin-scale governance organisations, is pending. This bill should be a priority, to provide a legal framework to establish river basin authorities. It should be part of a broader strategy to establish autonomous bodies, with clear planning and management functions and the requisite human and financial resources to perform them.

At the same time, Chile is making important progress on river basin planning. The 2022 reform of the Water Code requires each of the basins to have a Strategic Plan for Water Resources in Basins (PERHC). They aim to be comprehensive with improved design that can better inform basin-level decision making and strengthen co-ordination with other government plans. However, the development of these plans will require significant resources and technical capacity. Further, the plans are only indicative and not required by statute to be implemented. The regulation setting out the procedures to prepare, review and update the plans, and ensure public participation was approved by the Comptroller General of the Republic in January 2024. The regulation specifies the creation of "Strategic Water Resources Tables" in each basin to engage all relevant actors in the elaboration of the PERHC.

Chile lacks an integrated national authority to make strategic decisions for the water sector based on professional and technical recommendations. Efforts to improve co-ordination of water management, including establishment of basin-scale governance and the Inter-Ministerial Committee on Just Water Transition created in 2022, are important developments. Still, these efforts are insufficient to advance the alignment and co-ordination of all agents intervening in water management at all levels, as well as stakeholders.

Water policies, financing and investment

Chile must continue to reform its allocation arrangements to put water management on a sustainable footing

Water resource allocation is a fundamental issue for Chile to ensure the sustainable management of water resources. The legacy of water allocation in Chile presents a particularly challenging context. The 1981 Water Code established the system for allocation and use of water resources based on tradeable water use rights (*derechos de aprovechamiento de aguas*, DAAs). Water resources are legally defined as "national property for public use", while rights to use water are defined as private property, allocated free of charge and granted in perpetuity. In many cases, water rights are freely tradeable, without prior authorisation or consideration of third-party impacts. While other countries have recognised private property rights to water and water markets, none has done so in such a deregulated and unconditional way as Chile. The State's limited authority to regulate these rights and a lack of transparency of the water market has led to over-allocation and extreme concentration of water rights, overexploitation of some water bodies and drinking water shortages in some communities. The situation has fuelled conflicts among water users.

In April 2022, a major reform to the Water Code was enacted (Law 21.435). This helped bring the allocation regime a step closer towards good international practice, but serious challenges remain. Two major changes are fundamental. First, the law enshrines the priority of supply for human consumption, sanitation and subsistence domestic use both in the granting and in the exercise of water use rights. The law recognises access to water and sanitation as an essential and inalienable human right and that water is a national good for public use. Second, it defines water use rights as a real right over waters, allowing temporary use and enjoyment of them, in accordance with the rules, requirements and limitations prescribed by the Water Code. Thus, under the reform, new water rights are temporary and granted through a concession.

However, issues related to existing water rights and over-allocation in some basins and aquifers are unresolved. For example, minimum ecological flows must be established for the preservation of nature, considering the ecological conditions for each surface water body. These minimum ecological flows must be considered in the granting of new water rights. However, this is insufficient to ensure minimum ecological flows in the case of water rights already granted and to restore deteriorated freshwater ecosystems in over-exploited basins.

The number of registered rights allocated in the past decade has nearly doubled. Moreover, a significant number of water rights are not registered in the DGA's Public Water Cadastre, impeding a comprehensive and accurate understanding of allocated water resources. Critically, the 2022 reform of the Water Code establishes that water rights not registered in the Water Property Registry at the time of the law's enactment must be registered by 6 April 2025. After the deadline, unregistered water rights will expire. Registered water rights are projected to triple by the deadline, reaching more than 300 000.

DGA methods to determine the water available for allocation can underestimate variability and the impact of long-term trends, including climate change (Barría et al., 2019[42]). In addition to revising methodologies to inform water allocation decisions, the DGA could consider defining water rights as a share (percentage) of available resources rather than as an absolute volume of water that can be abstracted. This provides more flexibility over the course of the concession to adjust the amount of water that can be abstracted in line with availability. This approach can more equitably share the risk of scarcity across users. The OECD *Health Check for Water Resources Allocation* can guide a comprehensive review of allocation arrangements and bring the system more in line with best international practices (OECD, 2015[43]).

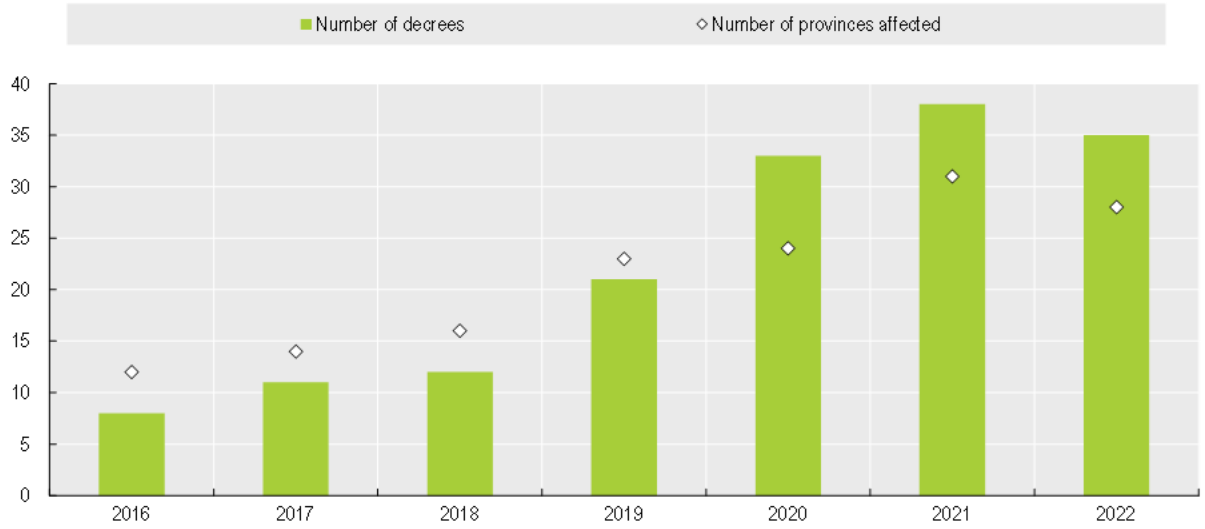
Emergency measures are inadequate to manage Chile's water resources sustainably

As water scarcity becomes more common across the country and water shortages more persistent, current emergency measures will not be sufficient to deal with the "new normal". Historically, Chile has addressed scarcity issues by increasing supply (Donoso, 2021[35]). The Drought Plan launched in 2021 focused on promoting investments in desalination, modernisation of irrigation (including construction plans for 26 reservoirs) and rural drinking water. Expanding new sources of supply, such as desalination and wastewater reuse, has considerable potential. However, Chile should also introduce demand management measures, improve water use efficiency, and ensure a robust and flexible water allocation system. These should be fundamental pillars of Chile's strategy to manage water resources over the long term, including addressing the impacts of climate change.

The DGA has been granted the power to curtail the exercise of water rights and the granting of new water rights when the sustainability of the water resource is threatened. The President can declare water scarcity zones in the event of a severe drought at the request of the DGA. The number of decrees designating scarcity zones has risen from 8 to 35 between 2016 and 2022, impacting half of Chile's 56 provinces in 2022 (Figure 5). As of 2022, multiple water scarcity zones were concentrated in population centres.

Figure 5. Rising number of scarcity zones reflects extraordinary drought conditions

Number of decrees declaring scarcity zones and number of provinces affected



Note: Water scarcity zones can be decreed in those areas with an extraordinary drought, defined according to hydrometeorological criteria (i.e. based on data on precipitation, river flows, reservoir volumes and aquifer conditions). A decree of water scarcity zones is made by region and can encompass multiple provinces and municipalities.
Source: DGA (2023), Planilla Decretos Zonas de Escasez Hídrica (2008-2023) [Water Scarcity Zones Decree Spreadsheet (2008-2023)] (accessed 17 August 2023), https://dga.mop.gob.cl/administracionrecursoshidricos/decretosZonasEscasez/Paginas/default.aspx.

StatLink https://stat.link/arqlxz

Water quality standards cover only a fraction of Chile's water bodies

The development and implementation of water quality standards in Chile remain incomplete and require further updating to achieve improved water quality. There are only six secondary environmental quality standards (NSCAs) (focused on the preservation of aquatic ecosystems) out of 101 basins. Another eight environmental quality standards are under development. The approach to developing these environmental quality standards is complex and slow with dedicated human resources severely limited. Chile should accelerate development of secondary standards for water quality. A standard list of basic water quality parameters could be defined for the national territory to simplify the process. Implementation of measures towards achieving the national secondary standards could initially focus on priority basins with the most pressure on water quality and the greatest potential net benefits to society from improved water quality. Additional parameters could be defined for individual basins depending on hydrological considerations and specific pressures.

Wastewater discharge standards should be more stringent and cover more sectors

The coverage of wastewater discharge standards remains patchy and some of them have not been updated in the past two decades. Emission standards cover some, but not all, regulated pollutants and only selected activities and sectors. There are no specific standards and regulations for agricultural wastewater sources, including aquaculture. Wastewater discharge standards are disconnected from environmental quality standards for water bodies.

The ongoing reform of discharge standards for surface waters aims to increase their stringency for certain water bodies but does not consider requirements (in terms of parameters or limits) that make the use of

tertiary treatment necessary to comply with the standard. Requiring nutrient removal in wastewater treatment would reduce excessive nutrient discharge into receiving water bodies, and thus eutrophication (Vega, Lizama and Pastén, 2018[44]). As a complement to improved wastewater treatment, Chile could also consider nature-based solutions, such as restoration or construction of wetlands and buffer zones, as a cost-effective approach to improve water quality.

Given the constraints related to water availability, Chile has recognised the need to promote reuse of treated wastewater ("grey" water) for industrial or agricultural activities. A few projects are being considered, although they remain at early stages. A law (21.075) regulating the collection, reuse and disposal of grey water was passed in 2018. However, the Ministry of Health has not yet formalised the corresponding regulations. A modification of the law was approved by Congress in October 2023, which expands the use of grey water to forestry and agriculture.

Legislation does not define who owns the rights to waters discharged through wastewater treatment plants into surface waters. A clear legal and regulatory framework is needed, with well-defined quality parameters and a robust monitoring system for treated effluent to be used for irrigation or other purposes. This is an important prerequisite to stimulate demand for and to promote development of wastewater reuse in Chile.

The remediation of contamination is a looming challenge, one the regulatory framework is inadequate to address. The Ministry of Environment and the DGA have made significant regulatory efforts to prevent future contamination, but there are no national efforts to identify, assess and remediate contaminated sites. Better water quality monitoring is a prerequisite to identify damages and remediation needs. Pollution Prevention and Decontamination Plans (PPDAs) can only be developed after violation of an environmental standard. These plans may employ emission standards, tradeable emission permits, emission taxes or user fees to promote environmental improvements (Melo and Perez, 2018[45]). However, the lack of secondary environmental standards for water quality directly impedes development of PPDAs for affected water bodies.

Lack of comprehensive data and systematic monitoring impedes sustainable water management

Chile has a range of disparate information sources and data platforms to inform management of water resources. Still, a number of information and data gaps exist, including in spatial coverage of the quantity and quality of surface water, groundwater and ecosystems, and monitoring frequency. There is an absence of research and monitoring of emerging contaminants (including pharmaceuticals, cosmetic and personal care products) (National Water Board, 2022[46]). The DGA's system for Monitoring Effective Extractions reveals important gaps in reporting of abstractions. Building on the various data and information sources available, Chile would benefit from a centralised platform for water quality and quantity management. Such a platform would provide a more coherent and comprehensive source of key information to support efforts to monitor water resources and inform policy and planning.

Chile has robust tariffs for urban WSS, but should better leverage economic instruments for water management

Chile is a leader in the LAC region in effective economic regulation of urban WSS (Fernandez, Saravia Matus and Gil, 2021[47]). Tariffs for drinking water and sewerage are charged at a uniform rate per cubic metre across all users and are adjusted for inflation. A variable portion of the water tariff is adjusted seasonally, with a higher value during the peak summer period, reflecting the scarcity value of the resource. The peak seasonal rate contributes to managing demand to avoid reaching the capacity limits of the water distribution network. There is also an additional charge for overconsumption of drinking water. Overall, water tariffs in Santiago are generally lower than in other major cities in the region, while fully recovering operational costs and part of capital investment costs.

The use of broader economic instruments for water management in Chile is limited. There are no abstraction charges for use of water resources. To address speculation and hoarding of water rights, the 2005 Water Code reform introduced a non-use tariff for unused water rights. Wastewater effluents, pesticides and fertilisers are not taxed or charged. The previous review recommended such economic instruments for water management, but there has not been progress on this front.

Chile should explore a broader suite of financing options for water-related investments

Water-related investments account for a considerable and increasing share of investments by the Ministry of Public Works, reaching nearly 20% in 2021. Investments in rural drinking water and sanitation have increased by more than fourfold between 2010-21 – an important step towards closing the water services and sanitation gap for rural communities.

Until recently, long-term planning for water infrastructure investments in Chile has been lacking; projects have been developed independently, without co-ordination at basin level. In a positive step, the Water Infrastructure Plan sets out a long-term vision from 2020 to 2050 with an emphasis on flexible infrastructure planning and adaptive design to address future priorities in the context of uncertainty. A strategic planning approach should consider a range of diverse investments, including nature-based solutions, over multiple future scenarios and evaluate options relative to stakeholder-defined goals (Brown, Boltz and Dominique, 2022[48]).

More than one-third of General Services Support to agriculture over 2010-21 targeted water infrastructure (OECD, 2022[49]). The National Irrigation Commission manages a cost-share grant programme to support small- and medium-scale initiatives for irrigation development and management. Small and medium landowners can complement their investments in irrigation and drainage projects for community or individual works with public grants. While irrigation efficiency has improved, the return flows of water to groundwater and surface water sources have declined (Anríquez and Melo, 2018[50]). In Chile's allocation system, water saved from more efficient irrigation reverts to the water rights holder. This may encourage an increase in total area irrigated rather than contribute to overall water availability. Chile should review and assess the efficiency of investments for irrigation, their impact on groundwater recharge and ecosystems, and the possibility of implementing systems to return water flows to basins, in line with the national water management framework.

New sources of supply to address scarcity, such as desalination and wastewater reuse, have large investment needs. The question of how to finance them and who should bear the cost must be addressed. Chile's experience with public-private partnerships (PPPs) for water infrastructure has been limited to date. Two desalination plants are indicated in the PPP Infrastructure Plan 2022-26. PPPs for water infrastructure could be further explored drawing on lessons from other OECD countries.

Chile could also explore a broader suite of approaches to scale up financing for water-related investments, tailoring financing approaches with the risk-return profile of investments. Use of proceeds bonds (e.g. "green bonds" or sustainability-linked bonds) for water investments have potential. These could build on Chile's considerable experience with such bonds for other climate- and environment-related investments. Payment for ecosystem services could incentivise improved water management in basins, an instrument that has been widely used in LAC and the OECD (Leflaive, Dominique and Alaerts, 2022[51]).

Recommendations on water management

Institutional arrangements, planning and information

- Establish a central governmental authority to regulate, plan, develop, conserve and protect water resources and provide holistic, overall water and wastewater management with clearly defined roles and responsibilities at all levels of governance (national, regional, river basin and local).
- Strengthen inter-ministerial efforts to further advance the alignment and co-ordination of all agents intervening in water management at all levels, as well as stakeholders, to lay the groundwork for a central government authority on water.
- Prioritise the approval of the bill for the formalisation of basin-scale governance to establish river basin authorities with clear planning and management functions and the requisite human and financial resources to perform them; drawing on lessons from pilots, expand basin-scale governance across the country, corresponding to relevant hydrological boundaries.
- Ensure adequate resources and technical capacity to develop and implement Strategic Water Resources Management Plans, in close collaboration with relevant basin-level authorities and stakeholders; consider making the implementation of plans, at least certain provisions, legally binding; ensure meaningful early engagement of stakeholders, including extending the timeframe for participation.
- Establish a centralised information system for water quality and quantity management to provide a coherent and more comprehensive source of information to support water management.
- Strengthen monitoring and enforcement of water abstractions and water quality.

Water supply and sanitation

- Reduce non-revenue water and enhance resilience to climate change impacts in urban WSS by integrating climate risk and vulnerability assessments into infrastructure planning.
- Advance tertiary wastewater treatment (including nutrient removal), with stricter regulations for discharges into water bodies at risk of eutrophication.
- Accelerate implementation of the Law on Rural Sanitary Services to build technical and financial capacity of rural WSS delivery; improve efficiency of investments to expand access to rural WSS.

Water policies and allocation arrangements

- Further pursue a comprehensive reform of water allocation arrangements to address over-use and over-allocation of resources; revise methodologies to inform water allocation decisions to better account for variability and climate change impacts; consider defining water rights as a share of available resources; adopt effective and harmonised methodologies for minimum environmental flows and ensure they are enforced.
- Update water quality standards; accelerate the development of secondary standards for water quality focusing on priority basins; simply the process by defining a standard list of basic water quality parameters for the national territory, with additional parameters tailored to specific basins and protected areas; develop and implement PPDAs for impacted water bodies; strengthen water quality monitoring; develop a Substances Watch list for contaminants of emerging concern.
- Adopt more stringent wastewater discharge standards, broaden their coverage to other key sources of pollution through the development of specific emissions standards for productive sectors, notably agriculture, including aquaculture, among others; make an explicit link between discharge standards and secondary water quality standards.

- Formalise a clear legal and regulatory framework on the collection, reuse, disposal and monitoring of grey water defining health and environmental criteria and clarifying ownership rights to discharged wastewater.
- Strengthen regulations associated with the extraction and desalination of seawater, including the management of environmental impacts such as the disposal of brine.
- Pursue nature-based solutions to promote resilient water management, ecosystems protection and provide flexibility in adapting to climate change, including managing climate-related risks such as floods, droughts and wildfires.

Economic instruments and financing for water management

- Introduce economic instruments for water management (e.g. abstraction charges, taxes on water effluents, pesticides and fertilisers) to better apply the polluter pays principle and the beneficiary pays principle.
- Review and evaluate efficiency of investments for irrigation and their impact on groundwater recharge and ecosystems.
- Examine a broader suite of approaches to scale up financing for water-related investments, including PPPs, use of proceeds bonds and payment for ecosystem services.

References

Acosta, O. (2018), "Water and mining", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing, Cham. [36]

Anríquez, G. and O. Melo (2018), "The socio-economic context of Chilean water consumption and water markets growth: 1985-2015", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing, Cham. [50]

Barría, P. et al. (2019), "Anthropocene and streamflow: Long-term perspective of streamflow variability and water rights", *Elementa: Science of the Anthropocene*, Vol. 7, https://doi.org/10.1525/elementa.340. [42]

BCN (2023), *LEY 21600: Crea el Servicio de Biodiversidad y Áreas Protegidas y el Sistema Nacional de Áreas Protegidas, [LAW 21600: Creates the Biodiversity and Protected Areas Service and the National System of Protected Areas]*, Biblioteca del Congreso Nacional de Chile, https://www.bcn.cl/leychile/navegar?idNorma=1195666 (accessed on 2 October 2023). [16]

BCN (2023), *Ley Chile - Ministerio del Medio Ambiente, [Chile Law - Ministry of Environment]*, webpage, https://www.bcn.cl/leychile/consulta/listado_n_sel?comp=&agr=1020&_grupo_aporte=&sub=&npagina=1&itemsporpagina=10&totalitems=21 (accessed on 8 August 2023). [25]

Benavides, C. et al. (2021), *Options to Achieve Carbon Neutrality in Chile: An Assessment Under Uncertainty*, Inter-American Development Bank, Washington, https://doi.org/10.18235/0003527. [7]

Blair, J., R. Balcázar and J. Barandiarán (2022), *Exhausted: How we can stop lithium mining from depleting water resources, draining wetlands and harming communities in South America*, Natural Resources Defence Council, https://www.nrdc.org/resources/exhausted-how-we-can-stop-lithium-mining-depleting-water-resources-draining-wetlands-and (accessed on 21 November 2023). [32]

Brown, C., F. Boltz and K. Dominique (2022), "Strategic Investment Pathways for resilient water systems", *OECD Environment Working Papers*, No. 202, OECD Publishing, Paris, https://doi.org/10.1787/9afacd7f-en. [48]

Carrasco, E., R. Benítez and E. Cañas (2023), *The Environment and Climate Change Law Review: Chile*, n-Depth: Environment and Climate Change Law, Lexology, https://thelawreviews.co.uk/title/the-environment-and-climate-change-law-review/chile. [24]

CBD (2021), *Aichi Biodiversity Target 11 Country Dossier: Chile*, Convention on Biological Diversity. [13]

Chile Transparente (2021), *Corruption Risks in the Award of Mining Concessions and Environmental Permits: the Case of Chile*, Chile Transparente, https://www.chiletransparente.cl/wp-content/files_mf/1634296005Chile_Report_vF_web1.pdf (accessed on 2 August 2023). [26]

CSP and MMA (2020), *Análisis Sobre el Esquema Tarifario Establecido en la Recolección Municipal de Residuos, [Analysis of the established Municipal Waste Collection Tariff Scheme]*, Centro de Sistemas Públicos (CSP), Universidad de Chile. [20]

De Vicente, A. (2022), *Euro 6: la estricta norma de emisiones que comienza a regir para los vehículos livianos y medianos en Chile, [Euro 6: the strict emissions standard that begins to apply to light and medium-sized vehicles in Chile]*, 29 September, Reporte Minero & Energético, https://www.reporteminero.cl/noticia/noticias/2022/09/norma-euro-6-chile (accessed on 6 September 2023). [11]

Donoso, G. (2021), "Economics of water resources", in Fernández, B. and J. Gironás (eds.), *Water Resources in Chile*, Springer International Publishing, Cham. [35]

Dussarrat, T. et al. (2022), "Predictive metabolomics of multiple Atacama plant species unveils a core set of generic metabolites for extreme climate resilience", *New Phytologist*, Vol. 234/5, pp. 1614-1628, https://doi.org/10.1111/nph.18095. [14]

Fernandez, D., S. Saravia Matus and M. Gil (2021), *Regulatory and Tariff Policies in the Drinking Water and Sanitation Sector in Latin America and the Caribbean*, UN ECLAC, Santiago. [47]

Government of Chile (2023), *Stronger Regions: President Boric announces bill for the decentralization of Chile*, 27 April, Press Release, Government of Chile. [23]

Hilgers, M., S. Vial and J. Gutierrez (2023), *Chile: Economic and environmental crimes to be sanctioned in new law*, Baker McKenzie blog, http://www.globalcompliancenews.com/2023/06/01/https-insightplus-bakermckenzie-com-bm-environment-climate-change_1-chile-economic-and-environmental-crimes-to-be-sanctioned-in-new-law_05242023 (accessed on 8 August 2023). [27]

Hoyos-Santillan, J. et al. (2021), "Diversifying Chile's climate action away from industrial plantations", *Environmental Science & Policy*, Vol. 124, pp. 85-89. [15]

IEA (2023), *Fossil Fuels Consumption Subsidies 2022*, IEA, Paris, https://www.iea.org/reports/fossil-fuels-consumption-subsidies-2022 (accessed on 22 August 2023). [29]

IEA (2023), *Net Zero Roadmap A Global Pathway to Keep the 1.5 °C Goal in Reach*, IEA, Paris, https://iea.blob.core.windows.net/assets/6d4dda5b-be1b-4011-9dad-49c56cdf69d1/NetZeroRoadmap_AGlobalPathwaytoKeepthe1.5CGoalinReach-2023Update.pdf (accessed on 19 October 2023). [8]

Jerez, B., I. Garcés and R. Torres (2021), "Lithium extractivism and water injustices in the Salar de Atacama, Chile: The colonial shadow of green electromobility", *Political Geography*, Vol. 87, https://www.sciencedirect.com/science/article/pii/S0962629821000421 (accessed on 30 August 2023). [33]

Kuzma, S., L. Saccoccia and M. Chertock (2023), *25 Countries, Housing One-quarter of the Population, Face Extremely High Water Stress*, World Resources Institute, Washington, DC. [34]

Leflaive, X., K. Dominique and G. Alaerts (2022), *Financing Investment in Water Security: Recent Developments and Perspectives*, Elsevier, https://doi.org/10.1016/C2019-0-03290-6. [51]

Maes, M. et al. (2022), "Monitoring exposure to climate-related hazards : Indicator methodology and key results", *OECD Environment Working Papers*, No. No. 201, OECD Publishing, Paris, https://doi.org/10.1787/da074cb6-en (accessed on 21 September 2023). [2]

Melo, O. and J. Perez (2018), "Water quality policy", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing, Cham. [45]

Ministry of Finance and Green Climate Fund (2021), *Readiness proposal - Update of the National Climate Change Adaptation Plan (NAP) in Chile*, https://www.greenclimate.fund/sites/default/files/document/adaptation-plan-update-chile-fao_0.pdf. [4]

MMA (2022), *5th Biennial Update Report under the United Nations Framework Convention on Climate Change*, https://unfccc.int/sites/default/files/resource/5IBA_Executive%20summary.pdf (accessed on 10 May 2023). [5]

National Water Board (2022), *Final Report*, National Water Board, Santiago. [46]

OECD (2023), *Air and climate: Air emissions by source*, Environment Statistics (database), https://doi.org/10.1787/c4e073d8-en. [9]

OECD (2023), *Chile*, OECD Economic Outlook, Volume 2023 Issue 1, OECD Publishing, Paris, https://doi.org/10.1787/7a5f73ce-en (accessed on 15 December 2023). [1]

OECD (2023), *Effective Carbon Rates 2023: Pricing Greenhouse Gas Emissions through Taxes and Emissions Trading*, OECD Publishing, Paris, https://doi.org/10.1787/b84d5b36-en (accessed on 20 December 2023). [28]

OECD (2023), *Taming Wildfires in the Context of Climate Change*, OECD Publishing, Paris, https://doi.org/10.1787/dd00c367-en. [3]

OECD (2023), *Understanding and Applying the Precautionary Principle in the Energy Transition*, OECD Publishing, Paris, https://doi.org/10.1787/5b14362c-en (accessed on 29 August 2023). [31]

OECD (2022), *Agricultural support (indicator)*, (database), https://doi.org/10.1787/6ea85c58-en (accessed on 22 September 2023). [49]

OECD (2022), *Municipal waste - Generation and Treatment*, Environment Statistics (database), https://doi.org/10.1787/data-00601-en. [17]

OECD (2022), *OECD Economic Surveys: Chile 2022*, OECD Publishing, Paris, https://doi.org/10.1787/311ec37e-en. [30]

OECD (2020), *Environmental Risks and Health: Exposure to Air Pollution*, Environment Statistics (database), https://doi.org/10.1787/e12b7dd9-en. [10]

OECD (2020), "Nature-based solutions for adapting to water-related climate risks", *OECD Environment Policy Papers*, No. 21, OECD Publishing, Paris, https://doi.org/10.1787/2257873d-en. [40]

OECD (2019), *Waste Management and the Circular Economy in Selected OECD Countries: Evidence from Environmental Performance Reviews*, OECD Environmental Performance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/9789264309395-en. [18]

OECD (2017), *Diffuse Pollution, Degraded Waters: Emerging Policy Solutions*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/9789264269064-en. [37]

OECD (2017), "The governance of water infrastructure in Chile", in *Gaps and Governance Standards of Public Infrastructure in Chile*, OECD Publishing, Paris, https://doi.org/10.1787/9789264278875-7-en. [41]

OECD (2015), *Water Resources Allocation: Sharing Risks and Opportunities*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/9789264229631-en. [43]

OECD et al. (2022), *Latin American Economic Outlook 2022: Towards a Green and Just Transition*, OECD Publishing, Paris, https://doi.org/10.1787/3d5554fc-en. [12]

Pelayo Díaz, C. and I. Linazasoro Espinoza (2020), "The climatic impact of garbage: Legal analysis of solid waste,recovery and landfill mining", *Revista de Derecho Ambiental(Chile)* 14, pp. 71-95, https://doi.org/10.5354/0719-4633.2020.54151. [21]

Rodríguez Salas, A. and M. Trebilcock (2020), *Desigualdades Territoriales y Comportamiento Ecológico: Determinantes del Hábito de Reciclaje en Chile y sus Barreras, [Territorial Inequalities and Ecological Behavior: Determinants of Recycling Habits in Chile and their Barriers]*, Universidad Alberto Hurtado, Facultad de Ciencias Sociales. [22]

SUBDERE (2019), *Diagnóstico de la Situación por Comuna y por Región en Materia de RSD y Asimilables, [Diagnosis of the Situation by Commune and Region regarding MSW and Assimilables]*, Programa Nacional de Residuos Sólidos. [19]

Valdés, J. et al. (2023), *Greenhouse Gas mitigation beyond the Nationally Determined Contributions in Chile: an assessment of alternatives*, Environmental Defense Fund, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4481537 (accessed on 2 August 2023). [6]

Vega, A., K. Lizama and P. Pastén (2018), "Water quality: Trends and challenges", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing, Cham. [38]

Vega, A., K. Lizama and P. Pastén (2018), “Water Quality: Trends and Challenges”, in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing, Cham. [44]

Vicuña, S. et al. (2021), “Impacts of climate change on water resources in Chile”, in Fernández, B. and J. Gironás (eds.), *Water Resources in Chile*, Springer International Publishing, Cham. [39]

Notes

[1] Twelve sectors are included in the FLCC: Forestry and Agriculture; Biodiversity; Fisheries and Aquaculture; Health; Infrastructure Services; Cities; Energy; Tourism; Coastal areas; Water resources (under development); Mining; and Transport.

[2] The target of reducing GHG emissions by 20% by 2020 compared to business as usual (BAU) emissions projected since 2007.

[3] ECLP must be fully updated every ten years and partially every five years to incorporate the new NDC. Sectoral plans will be reviewed and updated every five years.

[4] Targets are not to exceed 1 100 million tonnes of carbon dioxide equivalent (tCO_2e) between 2020 and 2030, and to reach a GHG emissions level of 95 million tCO_2e excluding the LULUCF sector by 2030.

[5] This is referred to as a “low-emission energy” in the target stated by the Chilean authority.

[6] Data from Chile come from SIMBIO National Registry of Protected Areas. They differ slightly from data reported in the database of OECD Environment Statistics, which show 41.1% of the exclusive economic zone and 20.5% of terrestrial area covered by protected areas in 2022.

[7] Although, permits (RCAs) proscribe environmental impact mitigation measures, including those related to sector-specific issues.

[8] Large emitters are those whose emissions are 100 or more tonnes per year of particulate matter, or 25 000 or more tonnes of CO_2 per year. If either of these two thresholds is equalled or exceeded, the regulated source must pay for the total emissions of the pollutants concerned.

Annex 1. Actions taken to implement selected recommendations from the 2016 OECD Environmental Performance Review of Chile

Recommendations	Actions taken
Chapter 1. Towards sustainable development	
Addressing key environmental challenges	
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.	Greenhouse gas (GHG) emissions decreased in 2020 due to the COVID-19 pandemic, which enabled the country to meet its 2020 target. The Framework Law on Climate Change (FLCC) was promulgated in 2022. The Long-Term Climate Strategy (ECLP) was submitted to the UNFCCC in 2021, which functions as a roadmap to achieve the NDC target for 2030 and net zero by 2050, comprising more than 400 transition goals to reduce emissions. The strategy defines a national GHG emissions budget for 2030 and 2050 and emission budgets for seven ministries. Sectoral and regional plans to support achievement of the ECLP are still under development.
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.	The Climate Risk Atlas (ARCLIM) platform, launched in 2020, provides climate-risk indicators and visualisation of current and projected climate risks at the communal scale. The platform supports the design of public policies, the implementation of measures and their evaluation. In addition, in 2019, the COP25 Scientific Committee was created, which later became the Scientific Committee on Climate Change. The committee provides scientific evidence for decision making.
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.	The implementation of the national adaptation plans (PNACC) of 2014 and sectoral adaptation plans is monitored on a yearly basis by the Ministry of Environment (MMA). In addition, the FLCC mandates development of the National Climate Change Action Report every two years to monitor and report on progress. The ECLP aims to implement a monitoring, reporting and verification system within the framework of the updated PNACC (expected in 2024). Chile is developing further tools to monitor and assess progress of adaptation policy implementation for better decision making. This development of vulnerability and adaptation indicators is expected to be completed by 2030.
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).	The ECLP defines a national GHG emissions budget for 2030 and 2050 and emission budgets for seven ministries. Chile established a mechanism to review progress and update ambition, which enables it to course-correct efforts to achieve the net-zero goal by 2050. For instance, the ECLP must be fully updated every ten years and partially every five years to incorporate the new NDC. Sectoral plans will be reviewed and updated every five years. Sectoral and regional plans to support achievement of the ECLP are under development.
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.	Since 2016, 10 new saturated and/or latent zones for $PM_{2.5}$, PM_{10} and SO_2 have been established, bringing the total number of PPDAs to 21, covering 16 urban and 5 mining areas. These PPDAs were developed through a collaborative process involving government agencies, non-governmental organisations, academia, municipalities and civil society organisations. Additionally, four PPDAs are under review and five are in preparation or approvals. Further improvements in air quality monitoring will help determine areas that do not comply with air quality standards and enable the development of corresponding PPDAs. The Superintendency of the Environment (SMA) has augmented its supervisory and enforcement capabilities to uphold air quality regulations. PPDAs have led to implementation of the Euro VI entry standard, stricter emission control measures for diesel and petrol, and sustainable housing initiatives.

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.	The Law for Nature, which creates the Biodiversity and Protected Areas Service (SBAP), was approved in June 2023 and is expected to be fully in force by 2027. The approval of this law will increase the budget for environmental institutions by almost 58%, promote private participation in the management of protected areas and double the number of park rangers.
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.	Chile has adopted a new planning methodology for terrestrial protected areas based on the Conservation Measures Partnership, which focuses on identifying threats, prioritising strategies, setting specific objectives and establishing progress indicators. This methodology has been used to develop 10 management plans since 2017, and an additional 28 plans are in development. Chile has implemented four Ecosystem-Based Management Plans. In 2022, Sernapesca updated its Guide to Marine Parks and Reserves.
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.	In 2017, Law 20.283 on the recovery of native forests and forest development provided landowners with the legal framework to conserve their land in perpetuity, ensuring its long-term protection and biodiversity value. The National Forestry Corporation (CONAF) actively supports establishment of private conservation and has developed a methodology to assess the environmental value of properties and their conservation potential. The enactment of the Law for Nature introduces a comprehensive framework for biodiversity protection, encompassing various actions and instruments to promote private conservation initiatives and integrate them into the national system of protected areas.
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.	In 2019, the UN REDD programme financed projects that support payment for ecosystem services (PES). CONAF has implemented five pilot projects for the territorial implementation of PES models. The Law for Nature promotes use of economic instruments to increase financing for the conservation of biodiversity and ecosystem services. This includes contracts for PES, enabling the possibility to develop a national PES scheme. There are no specific taxes on fertilisers and pesticides. On the contrary, to counter the effects of global supply disruptions, subsidies were implemented.
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.	Species classification and reclassification have advanced significantly since 2016. The creation of *Sistema de Información y Monitoreo de Biodiversidad* (SIMBIO) in December 2021 allows advancement in biodiversity documentation and monitoring. The Scientific Committee on Climate Change (2019) established the Biodiversity Table, which has produced nine comprehensive reports from 2019 to 2021.
Adopt the draft waste framework law at the earliest opportunity and implement extended producer responsibility schemes for key types of environmentally harmful products.	Law 20.920 (*REP Law*), approved in 2020, established extended producer responsibility schemes for priority products: tyres; containers and packaging; oils and lubricants; electrical and electronic equipment; and batteries. Decrees implementing the *REP LAW* for oils and lubricants, electrical and electronic equipment, fishing nets and textiles are under preparation.
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.	The *REP Law* created the Recycling Fund to finance projects, programmes and actions to prevent waste generation and promote reuse, recycling and other municipal waste recovery initiatives. In 2021, the National Organic Waste Strategy established a comprehensive plan to address the growing challenge of organic waste management. It set ambitious recovery targets (66% of organic waste by 2040), emphasising the need for efficient collection, composting and anaerobic digestion processes. A bill to further promote the valorisation of organic waste and strengthen planning and governance of waste management is under discussion. Implementation of incentives to discourage waste generation and landfilling is pending.
Improving environmental governance and management	
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.	Progress on strengthening environmental standards has been limited. Since 2016, some emission standards for stationary sources were added or updated, including for odours and arsenic. However, the country lacks environmental quality standards on soil (under development) and standards for water resources are incomplete. There is no implementation of 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.	Evaluation of alternative scenarios is not required in the environmental impact assessment (EIA) process. Under the Escazú Agreement, the Environmental Assessment Service strives to ensure access to information and improve citizen participation. The Service publishes guidance and conducts training courses. However, citizen participation needs to improve further, notably through participation of Indigenous peoples and ensuring public participation at the early stages of the process.
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.	SMA compliance monitoring has been strengthened mainly through incorporation of remote monitoring. This has contributed to greater geographic coverage of compliance monitoring, notably in the fishery sector. However, the SMA does not monitor compliance directly in some cases, to the extent environmental impact mitigation measures concern the competence of sectoral ministries. Instead, the SMA co-ordinates with sectoral ministries by sharing control tasks through agreements. In 2023, Congress passed a law enabling criminal sanctions for environmental violations. The law modifies the Penal Code, introducing an article "Crimes against the environment", which criminalises certain activities. Similarly, amendments to the Organic Law of the SMA incorporate new articles that penalise activities such as maliciously dividing projects into smaller ones to avoid the full EIA process.
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.	In October 2022, MINREL's Decree promulgated the Escazú Agreement, which promotes the rights of access to environmental information, public participation in environmental decision-making processes, and access to justice in environmental matters. Daily air quality forecasts with restriction and prohibition measures, community alerts and citizen education programmes have been developed since 2016 through the management of PPDAs. Moreover, the *Registro de Emisions y Transferencia de Contaminates (RETC)* provides a comprehensive repository of pollutant emissions information. The creation of SIMBIO in 2021 advanced biodiversity documentation and monitoring efforts, providing a central platform for accessing and managing data across various administrative levels. Chile updated the National Water Balance in 2017 and has several other data and information systems on hydrological systems. Still, a number of information and data gaps on water allocation and quality remain.
Enhancing policy coherence for green growth	
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.	A corrective tax bill is pending. The bill aims to increase the tax on diesel to narrow the petrol-diesel tax gap.
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.	Since 2017, a green tax for stationary sources has taxed emissions of CO_2 (carbon tax, at USD 5 per tonne of CO_2), as well as local pollutants. Facilities that operate based on non-conventional renewable generation whose primary source is biomass are exempt from the carbon tax, although the tax for local pollutants applies. The government has put forward a revision of the current tax, including increasing the rate, as part of its fiscal reforms. However, such reforms are still in the technical design phase. Since 2022, the carbon tax applies to large emitters (those whose emissions are 100 or more tonnes per year of particulate matter, or 25 000 or more tonnes of CO_2 per year), without exclusion of any sector. The full amount of the carbon tax is not included in the variable costs of electricity generation plants, which determine wholesale electricity prices and the order of dispatch. This creates economic distortions in the power sector and needs to be changed for carbon pricing to work effectively.
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.	A carbon offsetting system came into force in February 2023. It provides the possibility to offset CO_2 emissions with government-certified GHG abatement certificates. This system covers both CO_2 and local pollutants PM, SO_2 and NO_x. This system can pave the way for a more sophisticated market that allows flexibility in emissions reductions by offsetting tax liability with projects that reduce emissions directly.

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.	There have been no reforms or modifications to the tax on the first sale of vehicles since its creation.
Ensure that major investment programmes systematically consider environmental and climate objectives, include sustainability criteria to guide implementation and indicators to monitor environmental impacts.	The strategic environmental assessment guide to incorporate climate change into territorial planning was established in 2023. The FLCC mandates the use of the guide. An update on the current regulations of the Environment Assessment Service to make it coherent with the FLCC is pending.
Chapter 2. Water management and policies	
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.	Since 2019, the Directorate General for Water has developed Strategic Water Management Plans (PEGHs) describing key characteristics of basins and actions to address management gaps. The reform of the Water Code (Law 21.435) defines new water rights as temporary and granted through a concession, a step towards better managing risk of scarcity. The reform also advanced basin-level planning by requiring a Strategic Plan for Water Resources in Basins (PERHC) for each of the 101 basins. A Water Resources Climate Change Adaptation Plan mandated in the FLCC is under preparation. The MMA's Atlas of Climate Risks provides information on projected climate change impacts and related risks.
Reinitiate institutional and policy reforms to implement integrated watershed management that would bring together water quantity and quality planning and regulation	Basin-level planning by requiring a PERHC for each of the 101 basins will incorporate water quantity and quality aspects of water management. Pilot organisations in 16 river basins aim to establish river basin governance at the relevant hydrological scale.
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.	The reform of the Water Code (Law 21.435) included several elements to strengthen water allocation. Notably, the reform: • enshrined the priority of water supply for human consumption, sanitation and subsistence in the granting and exercise of water use rights • declared groundwater as a national asset for public use • established that water rights not registered in the Water Property Registry at the time of the law's enactment must be registered by 6 April 2025. After the deadline, unregistered water rights will expire. A bill to amend the Criminal Code to increase penalties for crimes of illegal water abstraction is pending.
Develop a strategy to address over-allocation in basins and aquifers where water-use rights exceed the sustainable capacity of the water body.	PERHCs must have a recovery plan for aquifers whose sustainability, in terms of quantity and physicochemical quality, is affected. The reform of the Water Code authorises the DGA to curtail the exercise of water rights due to the non-effective use of the resource or if the sustainability of the water resource is threatened. A declaration of exhaustion of natural sources (article 282) prohibits the granting of new water rights in sources of surface water (rivers, lakes, lagoons). There have been 15 such declarations to date and the DGA projects at least 50 new declarations by 2025. In cases of non-effective use, DDAs for consumptive uses expire in five years; for non-consumptive uses they expire in ten years.
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.	Eight secondary environmental quality standards (NSCAs) are under development. The DGA has expanded its network of water quality monitoring stations, covering 77% of basins. Still, a comprehensive and integrated monitoring network is lacking.
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.	Investments in rural drinking water and sanitation (WSS) increased more than fourfold between 2010-21. The number of WSS systems serving rural populations increased by 35% between 2010-22 as a result of an investment programme led by the Ministry of Public Works and implemented by the Directorate of Hydraulic Works.

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.	Pending.
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.	Irrigation efficiency has improved, although the return flows of water to groundwater and surface water sources have declined. Water saved from improvements in irrigation efficiency reverts to the water rights holder. Less than half of registered infrastructure works for water abstraction are reporting volumes abstracted in the DGA's system for Monitoring Effective Extractions; some are not reporting at all.

Source: OECD Secretariat based on country submission and findings of the 2024 Environmental Performance Review.

1 Towards sustainable development

This chapter examines progress towards sustainable development in Chile. It examines how Chile has fared with key environmental targets related to climate change, air pollution, waste management and biodiversity. It assesses the environmental effectiveness and economic efficiency of the environmental policy mix, including regulatory and voluntary instruments; fiscal and economic instruments; and public and private investment in environment-related infrastructure. Finally, it examines the interaction between the environment and other policy areas, such as greening the system of taxes and charges, and investments that promote environmentally friendly and socially inclusive growth.

1.1. Addressing key environmental challenges

Chile is a medium-sized country with an open, export-oriented economy. Except for the period of the COVID-19 pandemic, the country showed continuous economic growth over the last decade. Over 2010-19, gross domestic product (GDP) grew on average by 3.0% annually (Figure 1). This has helped improve citizens' well-being and reduce poverty, but inequality remains high (section 1.3.3). GDP per capita reached USD 30 000 current PPPs in 2022. This is well below the OECD average (USD 54 000 current PPPs) but highest in the region of Latin America and the Caribbean (LAC) (OECD, 2023[1]).

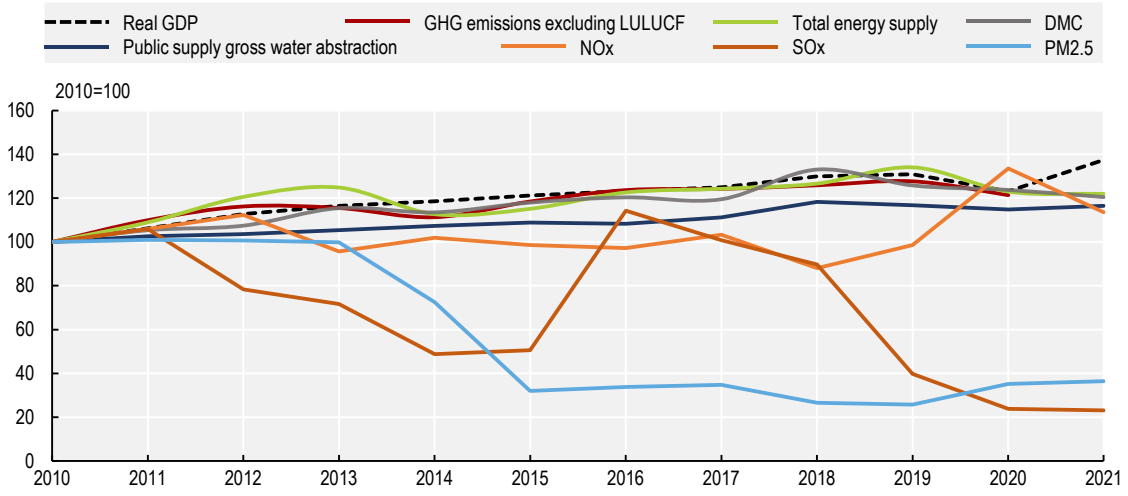
Chile's economic growth is anticipated to slow. The economic downturn caused by the pandemic resulted in a GDP contraction of -6.2% in 2020. In 2021, the economy recovered (+11.9%) more rapidly than in most OECD countries (+5.6%), buoyed by exceptionally strong policy support and a well-organised vaccination roll-out. Expansionary fiscal policy in 2021, global supply constraints and the Russian war of aggression in Ukraine have fuelled price inflation. After tighter fiscal and monetary policies to rebalance the economy, data suggest that GDP did not grow in 2023 but is projected to grow by 1.8% in 2024 and pick up to 2.1% in 2025 (OECD, 2023[2]).

Natural resources, such as extraction and processing of minerals, forestry and fisheries, have been a pillar of the economy. Chile has one of the largest reserves in the world of the critical minerals necessary for the energy transition, such as copper and lithium. The population is increasing by around 1.3% each year, faster than the OECD average. While population density is relatively low, more than 80% of Chile's population is concentrated in urban areas (OECD, 2023[1]). Chile's unique geography, with desert in the north, mountainous terrain throughout the country and glaciers in the south, results in high demographic and economic concentrations.

Chile has not decoupled a number of environmental pressures from economic growth since 2010, except in 2021 when the country had an exceptional economic recovery (Figure 1). Nitrogen oxide (NO_x) emissions declined until 2018, but then increased, mainly driven by industrial combustion. Greenhouse gas (GHG) emissions, total energy supply and domestic material consumption (DMC) have risen at the same pace as the economy. This highlights the need for further efforts to decouple these pressures from economic growth. Water abstractions for public water supply continue to rise, albeit more slowly than economic growth. Emissions of sulphur oxide (SO_x) and fine particulate matter ($PM_{2.5}$) declined significantly since 2010, a positive development (section 1.1.2).

Figure 1.1. Chile has not decoupled several environmental pressures from economic growth

Decoupling trends, Chile, 2010-21



Note: GDP = gross domestic product. GHGs = greenhouse gases. LULUCF = land use, land-use change and forestry. DMC = domestic material consumption. SOx = sulphur oxides. NOx = nitrogen oxides. $PM_{2.5}$ = fine particulates. SO_X as SO_2 (sulphur dioxide) and NOx as NO_2 (nitrogen dioxide).

Source: SNI Chile (2022), Inventario Nacional de Gases a Efecto Invernadero Chile 1990-2020 [National Greenhouse Gas Inventory Chile 1990-2020]; RETC, *Emisiones al Aire deTransporte en Ruta 2010-21* [On-Road Transport Air Emissions 2010-21]; IEA (2023), IEA World Energy Statistics and Balances (database); OECD (2022), OECD Economic Outlook (database); OECD (2023), Environment Statistics (database).

StatLink https://stat.link/k3zt9x

1.1.1. Progress towards climate targets

Building resilience to climate change impacts faces major funding and capacity gaps

Chile is highly exposed and vulnerable to the impacts of climate change (Ministry of Finance and Green Climate Fund, 2021[3]). Nearly one-third of the territory is exposed to at least two climate-related hazards, mainly heat stress and flooding.[1] A quarter of the population was exposed to extreme heat over 2018-22 on average. Higher risk of heatwaves exists in the north (Figure 1.2), while flood risk is dispersed across the country, notably along the central coast. Cropland soil moisture declined by 2.1% in 2022, while Chile has experienced a drastic decrease in average annual precipitation (the second largest decrease in OECD LAC countries), compared to 1981-2010 (Maes et al., 2022[4]). The country is also severely affected by drought and wildfire risk, with wide-ranging impacts on water supply, agriculture and ecosystems. For example, following the 2017 wildfires, nearly 40% of critically endangered habitats in Chile were significantly damaged (OECD, 2023[5]).

Figure 1.2. Increasing risk related to heatwaves is acute in the north

Variation in the risk of health and human well-being impacts from heatwaves between historical (1980-2010) and future scenarios (2035-65 under RCP 8.5)

Note: The map represents the variation in the risk of heat-related health impacts (mortality and morbidity) between historical and future periods for cities over 50 000 inhabitants. The risk assessment solely considers change in risk only considers the projected increase in heatwaves, under future climate scenarios (2035-2065 under the RCP 8.5 scenario) and historical sensitivity and resilience factors. The index does not represent the likelihood of impacts, but rather identifies communes that are more likely to suffer adverse impacts associated with heat waves. The index encompasses a range of -1 (lower risk) to 1 (higher risk). Environmental Thermal Discomfort represents the degree of satisfaction of the population in open spaces, especially in parks, squares and streets due to heat and humidity in the summer months.
Source: MMA (2020), Atlas de Riesgos Climáticos: Salud y Bienestar Humano [Climate Risk Atlas: Health and Human Well-being],https://arclim.mma.gob.cl/; Biblioteca del Congreso Nacional de Chile, Información Territorial, Mapas vectoriales: Mapoteca (accessed 3 August 2023), www.bcn.cl/siit/mapas_vectoriales/index_html.

Progress on climate change adaptation varies significantly by sector. The National Plan for Adaptation to Climate Change (PNACC) of 2014 established adaptation plans for nine relevant sectors.[2] The PNACC set guidelines for monitoring and evaluation in each sector. The adaptation plan for fishery and aquaculture adopts a systemic approach to increase resilience of marine ecosystems and coastal communities (OECD et al., 2022[6]); almost 80% of planned actions were achieved by 2021. Progress was slowest in the tourism sector at 25%, mainly due to limited financial resources and capacity for vulnerability assessment studies.

Lack of a clear financing strategy impedes progress on planned adaptation actions (Ministry of Finance and Green Climate Fund, 2021[3]). Chile recognises the need for climate adaptation financing instruments but has not responded with commensurate resources. The PNACC will be updated by 2024, covering additional sectors (mining, coastal zones and transport). The updated plan needs to strengthen governance and institutional co-ordination for adaptation planning and develop financing strategies. It should also promote a participatory process for vulnerable stakeholders and adaptation strategies for different climate scenarios in territorial planning (section 1.2.2).

Chile has made great strides towards developing localised climate risk mapping. The Climate Risk Atlas (ARCLIM) platform launched in 2020 provides climate-risk indicators and visualisation of current and projected climate risks at the communal scale[3] (MMA, 2020[7]). Unlike many other OECD countries, the country also analyses socio-economic vulnerability of different population groups to relevant climate risks. Moreover, the country is developing further tools to monitor and assess progress on adaptation. The development of vulnerability and adaptation indicators is expected to be completed by 2030.

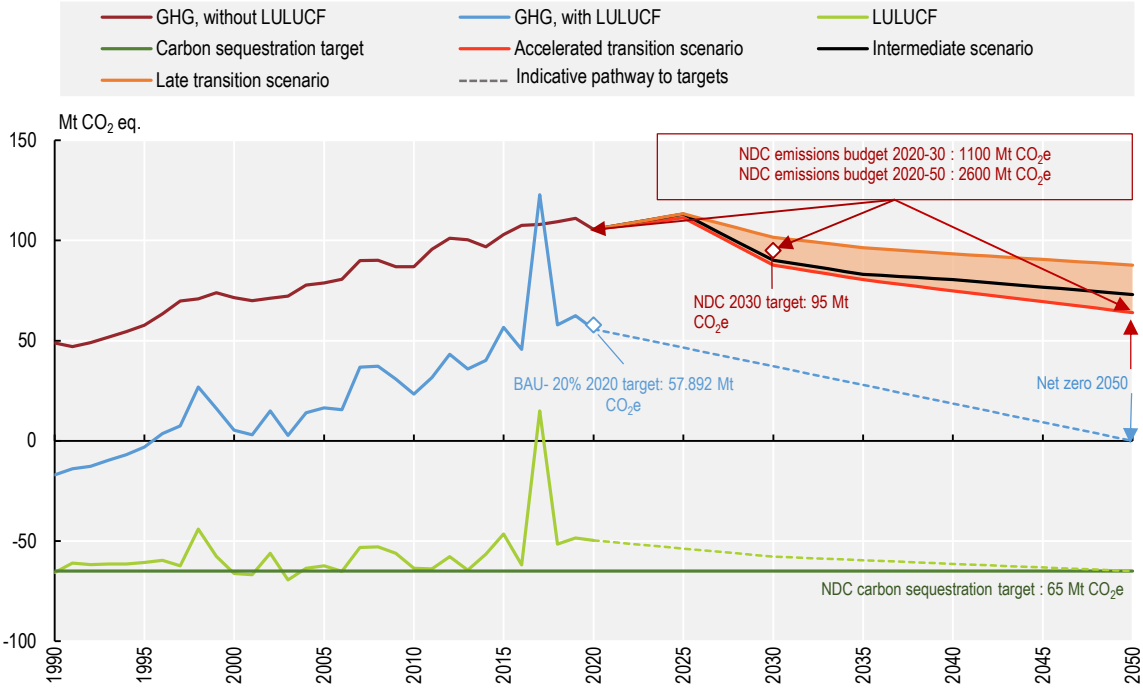
Chile achieved a major step-change in the legal framework for climate action, but the challenge lies in implementation

Chile's GHG emissions rose significantly in 2010-19 (Figure 1.3), mainly driven by CO_2 emissions generated by fossil fuel burning (MMA, 2022[8]). GHG emissions decreased in 2020 due to the COVID-19 pandemic, which enabled the country to meet its 2020 target.[4] Land use, land-use change and forestry

(LULUCF) has consistently contributed to sequester carbon except for 2017, when Chile experienced devastating wildfires.

Figure 1.3. Chile aims for net zero by 2050, while GHG emissions continued to rise

Historical GHG emissions, targets, projections and indicative pathways to targets, 1990-2050



Note: BAU = business as usual. CO_2e = carbon dioxide equivalent. GHGs = greenhouse gases. LULUCF = land use, land-use change and forestry. NAMAs = nationally appropriate mitigation actions. NDC = nationally determined contribution. NDC targets are based on total GHG emissions excluding LULUCF. Chile proposed to undertake NAMAs to achieve a 20% reduction in GHG emissions (including LULUCF) from BAU levels by 2020. The 2020 GHG emissions target was an estimated 122 Mt CO_2e, excluding emissions and sinks from LULUCF. The transition scenarios reflect sectoral budgets needed to meet targets.
Source: SNI Chile (2022), Inventario Nacional de Gases a Efecto Invernadero Chile 1990-2020 [National Greenhouse Gas Inventory Chile 1990-2020]; Gobierno de Chile (2022), 5to Informe Bienal de Actualización ante la Convención Marco de las Naciones Unidas sobre Cambio Climático [5th Biennial Update Report to the United Nations Framework Convention on Climate Change].

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Since the last review in 2016, Chile has made substantial progress on the legal and policy framework for climate change through a joint effort across ministries. Most prominently, the Framework Law on Climate Change (FLCC) was promulgated in 2022 by the president and 15 ministries.[5] It creates the legal framework to address climate change mitigation and adaptation, consistent with international commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. The law establishes a binding national goal to reach net zero by 2050, which implies the need to reduce gross GHG emissions by approximately 40% from 2020 to 2050.

Chile also set long-term and increasingly ambitious climate change mitigation objectives. The Long-Term Climate Strategy (ECLP) was submitted to the UNFCCC in 2021 (Chile was the first LAC country to present such a strategy). It functions as a roadmap to achieve net zero by 2050, comprising more than 400 transition goals to reduce emissions (Government of Chile, 2021[9]). The strategy defines a national GHG emissions budget for 2030 and 2050 and emission budgets for seven ministries. Sectoral and regional

plans are under development.[6] These will support achievement of the ECLP horizontally (across ministries) and vertically (across levels of government).

For the strategy and plans, Chile established a requirement to review progress and update ambition, which will allow it to course-correct efforts to achieve the net-zero goal by 2050. The ECLP must be fully updated every ten years and partially every five years to incorporate the new Nationally Determined Contribution (NDC). Sectoral plans will be reviewed and updated every five years.

Although the legal framework has been strengthened, important challenges remain in its implementation. Chile is not on track to achieve national targets for GHG emissions. There is a lack of clarity about concrete measures in sectoral and regional plans to peak GHG emissions before 2025, and to meet the NDC target of 2030[7] and the net-zero goal by 2050. Analyses suggest that ambitious actions will be needed to ensure achievement of both 2030 and 2050 targets (Benavides et al., 2021[10]; Valdés et al., 2023[11]). Implementation of the climate law requires a whole-of-government approach with each relevant sector designing and implementing the necessary policy instruments to achieve climate targets. The government needs to swiftly clarify a coherent policy mix (e.g. economic, regulatory and information-based instruments) and concrete measures to meet targets. At the same time, measures defined in sectoral and regional plans must be supported by a portfolio of investments with sufficient financing, to ensure measures yield expected impacts.

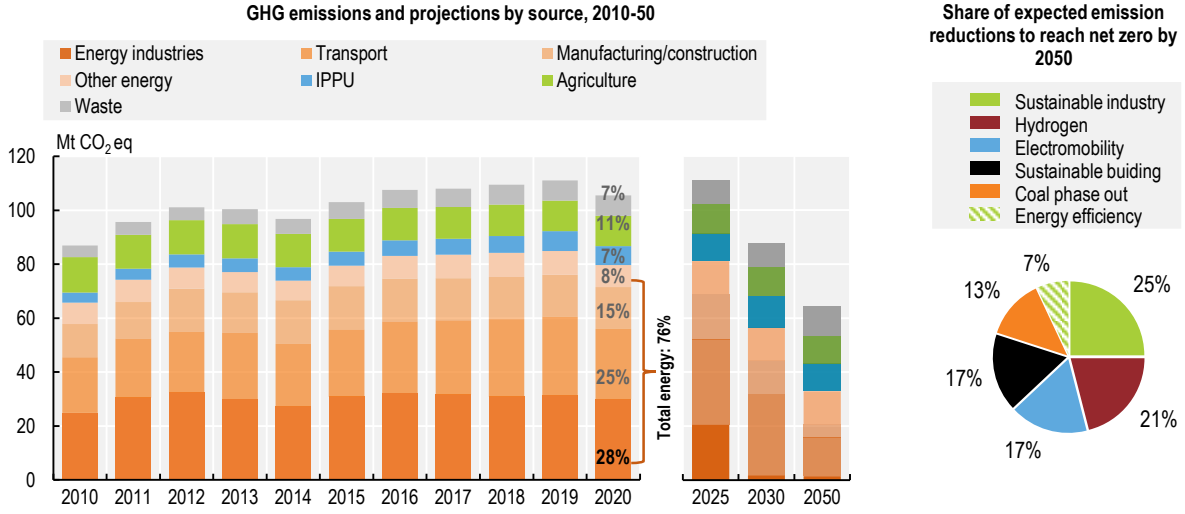
Moreover, the successful implementation of the climate law requires strengthened technical capacity at national and subnational levels. There is a need for increased collection and analysis of data, development of indicators, and improved monitoring, reporting and verification systems to track and evaluate policies and course-correct plans as needed. Implementation also requires deployment of professionals with relevant expertise in both national and regional institutions.

Trends and mitigation policies in key sectors

Energy industries are the largest GHG emitter; coal phase-out, carbon tax and renewables expansion are key for decarbonisation

Energy industries are the largest source of GHG emissions followed by transport, accounting for 28% and 25% of emissions in 2020, respectively (Figure 1.4). Electricity supply accounted for more than 90% of GHG emissions from energy industries over 2010-20. Reduction of GHG emissions from electricity supply is crucial to meet national goals, notably the 2030 NDC target, while the contribution of other sectors to emissions reduction is expected to be limited by 2030. The Ministry of Energy has the largest role in design and implementation of climate change mitigation measures. Measures are integrated into the National Energy Policy (PEN).

Figure 1.4. Energy industries and transport generate more than half of total GHG emissions



Note: IPPU = industrial processes and products use. From 2010, electricity production accounted for more than 90% of total energy industries emissions. Other energy sources include sectors such as: residential, commercial, agriculture, solid fuels, oil, natural gas and unspecified sectors. GHG emissions projections are based on the accelerated scenario presented under Chile's NDCs. Right panel: GHG emissions reduction considers mitigation interventions between 2017 and 2050.

Source: SNI Chile (2022), Inventario Nacional de Gases a Efecto Invernadero Chile 1990-2020 [National Greenhouse Gas Inventory Chile 1990-2020]; Gobierno de Chile (2022), 5to Informe Bienal de Actualización ante la Convención Marco de las Naciones Unidas sobre Cambio Climático [5th Biennial Update Report to the United Nations Framework Convention on Climate Change].

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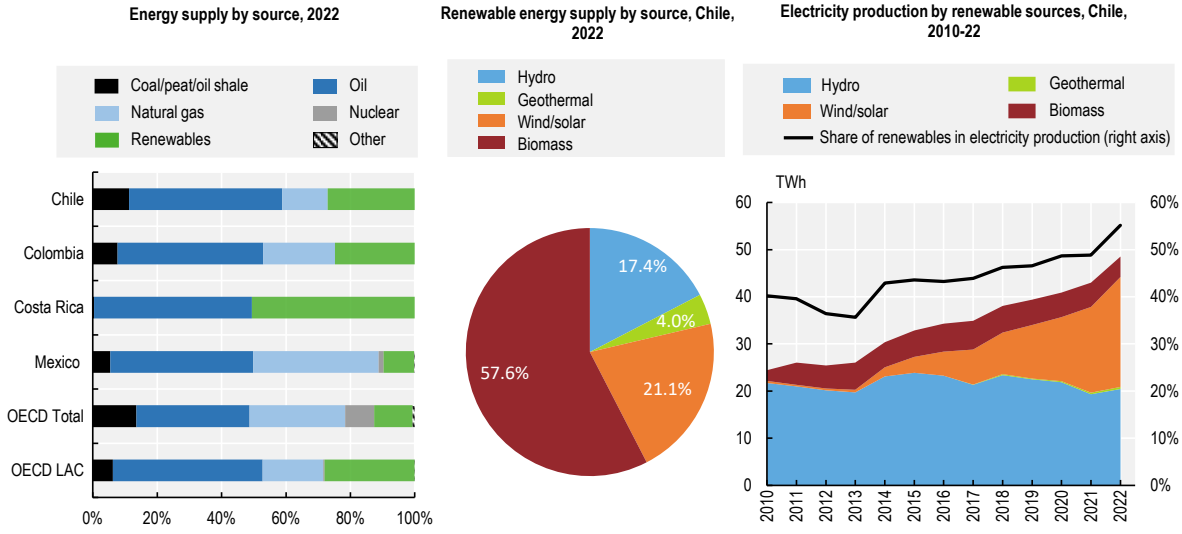
The coal phase-out plan, established in 2019 as a key sectoral mitigation policy, aims to close all coal-fired plants in Chile by 2040. This original timetable has been modified several times and brought forward, with the aim to close more than half of coal-fired plants by 2025. As of November 2023, 8 out of 28 plants operating in 2019 were closed (22.5% reduction in terms of total capacity[8]). The phase-out of coal-fired plants is essential to reduce energy-related GHG emissions. The Just and Sustainable Transition Strategy for the energy sector focuses on challenges related to the coal phase-out, such as the impact on employment, but will later serve as a basis for other transitions (MMA, 2022[8]).

The other key policy is the promotion of renewable energy. The ECLP set an ambitious goal of converting 70% of total energy supply to renewables by 2030. In 2022, the share of renewables was 27% (Figure 1.5), which is higher than the OECD average (12%). Biomass is broadly used (mainly for heating), accounting for 57.6% of renewables in total energy supply in 2022 (section 1.1.2). Still, Chile's dependency on coal, peat and oil shale (11%) is highest among OECD LAC countries.

For electricity generation, the share of renewables rose from 40% in 2010 to 55% in 2022 (Figure 1.5). This was driven chiefly by increases in wind and solar (26% share of electricity generation in 2022), which are relatively cost competitive compared to other sources. Chile achieved the 2025 target of 20% of its electricity generation to come from non-conventional renewable energy sources[9] ahead of schedule. The updated PEN aims to achieve 80% of electricity generation from renewables in 2030 and 100% from renewables and other energy sources with the carbon capture[10] by 2050 (Government of Chile, 2021[12]). However, unlike the previous 2025 target, these targets are not legally binding.

Figure 1.5. Despite rapid expansion of renewables, Chile still relies heavily on fossil fuels



Note: Total primary energy supply excludes electricity trade. OECD LAC average includes Chile, Colombia, Costa Rica and Mexico.
Source: IEA (2021), "World energy statistics", *IEA World Energy Statistics and Balances* (database).

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A major bottleneck for greater uptake of renewables is the lack of transmission lines, notably in the north, but these are under development. Green hydrogen is also expected to contribute as a means of transmission and storage of electricity (section 1.3.2). Energy efficiency is expected to contribute to 7% of cumulative reductions in GHG emission by 2050 (Figure 1.4), backed by the 2021 Energy Efficiency Law as the main legal framework.

Rising energy consumption in transport with slow uptake of electric vehicles and incomplete green tax reform make it challenging to reach the GHG reduction target

Transport is the second largest contributor to GHG emissions in Chile with an increasing trend, dropping only in 2020 due to the pandemic (Figure 1.4). Up to 90% of sectoral GHG emissions came from land transport in 2019, where trucks and buses contributed more than 60% in 2019 (MMA, 2023[13]). The sector accounted for about one-third of Chile's total final energy consumption in 2020, with consumption rising 35% over 2010-19 (IEA, 2021[14]). This increasing trend makes it challenging to reach the sectoral target of reducing transport-related GHG emissions by 40% by 2050 compared to 2018 levels. Moreover, the GHG emissions scenarios based on sectoral budgets allow emissions to increase the most in the transport sector compared to other sectors from 2020 to 2030.

The most prominent actions include investment in public transportation to improve accessibility, efficiency and coverage in urban areas (section 1.3.2), as well as electrification of taxis, buses and commercial vehicles. Santiago made progress in the electrification of buses, and the country intends to electrify all its buses by 2040 and all public transport by 2050. The Green Hydrogen Strategy emphasises decarbonisation in the transport sector to replace diesel in motor uses of industry and mining, as well as cargo vehicles. Comprehensive green tax reform is critical to incentivise the transition towards low-carbon transportation, notably for those off-road and cargo vehicles. However, it remains incomplete despite recommendations in the last review (section 1.3.1).

The other key measure is the ban of sales of combustion engine vehicles by 2035, announced by the National Electromobility Strategy in 2021 (Government of Chile, 2021[15]). The strategy sets out a goal and

action plan to achieve a 40% share of electric passenger vehicles by 2050. These measures will accelerate the transition towards low-carbon transportation, complementing the minimum energy efficiency standards for light-duty vehicles starting in 2024.[11] The share of electric vehicles (EVs) in new sales increased only marginally, moving from less than 0.1% in 2016 to 0.5% in 2022, and their share on the road was below 0.1% in 2022 (IEA, 2023[16]). EV uptake is impeded by both its high price and limited public charging infrastructure, with only up to 750 public charging units as of November 2023. The Electromobility Roadmap presented in 2023 commits to develop a master plan to address this infrastructure gap. Local authorities should have a greater role in transport decisions, in collaboration with the national government.

Industry and mining are the largest energy consumers, with policy focus on use of low-carbon sources and process electrification

Industry and mining are the largest consumers of energy, accounting for 38% of all use in 2020, with levels rising by 18% over 2010-20 (IEA, 2021[14]). The country sets the ambitious target of reducing GHG emissions from industry and mining by 70% by 2050 compared to 2018 levels. To that end, its most prominent policy is the use of solar energy for heat generation in industry. According to the PEN, at least 90% of energy for heating in industry must come from low-carbon sources,[12] such as solar, by 2050. Electrification of machine drives in industry and mining is expected to help this transition, further incentivised by the carbon tax (section 1.3.1).

Various initiatives support decarbonisation of the mining sector, such as the incorporation of renewable energy. These are especially encouraged in areas not yet connected to the grid, where renewables-based electricity would otherwise be wasted, such as the north (section 1.3.2). Chilean mining is making significant progress in the use of renewable energy, such as solar. Already in 2021, renewable energy[13] accounted for 44% of mining electricity consumption, and by 2025 it is expected to exceed 60% (MMA, 2022[8]). The National Mining Policy 2050 sets various goals for the industry.[14] In line with a recommendation in the last review, energy management is incorporated into medium-sized mining operations through co-operation agreements. The Energy Efficiency in Mining Project, implemented in 2019, includes technical advice to companies, development of events and training, and a learning network.

GHG emissions from buildings remain stagnant; decarbonisation of heating is needed with more ambitious targets for buildings

GHG emissions from the building sector have not changed much over 2016-20. Buildings accounted for almost a quarter of final energy consumption in 2020 (IEA, 2021[14]), with a significant share from heating. Electrification of heating for residential, public and commercial building is a key sectoral mitigation measure. Chile targets to increase the share of electricity-based heating systems to more than 57% in houses and to 70% in apartment buildings by 2050 (Government of Chile, 2020[17]). Other key measures include establishing solar thermal systems, energy rating of existing homes and thermal overhaul in vulnerable homes (section 1.3.3).

There has been some progress in the construction sector, such as the update of the National Sustainable Construction Strategy and completion of the National Strategy for Carbon Footprint in Construction (MMA, 2022[8]). The Energy Efficiency Law established that buildings must have an energy rating before they are commercialised. The PEN established targets for all new buildings to be “zero net energy consumption” by 2050 (by 2030 for new public buildings); the timeframe to reach targets could be reconsidered with the aim to accelerate progress. The target for existing building is even weaker, aiming for 10% of existing homes to have a specific standard for thermal regulation by 2050. Increasing ambition in energy efficiency along with distributed power generation would help reduce GHG emissions, as well as energy poverty, which also contributes to air pollution (section 1.1.2).

Agriculture GHG emissions are declining, while LULUCF contributes as a carbon sink

Agriculture represented 11% of total GHG emissions in 2020 (Figure 1.4). This is the only sector that has reduced its GHG emission over the last decade (14% decrease over 2010-20). Chile has among the lowest GHG emissions intensity of agricultural output across OECD countries and has no agricultural-specific mitigation target (OECD, 2022[18]). Agricultural emissions in Chile were mainly driven by emissions from enteric fermentation and soil. In line with the ECLP, the Ministry of Agriculture implemented mitigation initiatives such as the efficient use of fertilisers and sustainability standards with mitigation actions for three agri-food subsectors (dairy, poultry and pork). The initiatives also include soil management practices that capture carbon (OECD, 2022[18]).

In Chile, the LULUCF sector absorbed 47% of gross GHG emissions in 2020 (Figure 1.3). Forest land represented 24.7% of Chile's land area in 2021; this increased by 3.5% since 2016. One of the instruments developed to meet the NDC goal is the National Strategy for Climate Change and Vegetation Resources (ENCCRV). It is led by the Ministry of Agriculture through the National Forest Corporation (CONAF). Since 2016, the ENCCRV has been the main tool to contribute to climate targets, leveraging international support (Ministry of Agriculture and CONAF, 2019[19]).

The ECLP further aims to restore 200 000 hectares (ha) of forests by 2030.[15] Wildfire risk poses challenges for climate mitigation, with 12% of forests (average over 2016-20) in areas at risk of burning. In summer 2023, the worst period in history, more than 400 000 ha burned. By 2025, a part of the ENCCRV, CONAF plans to establish the results-based payment schemes for environmental services, contributing to GHG emissions reduction or capture.

1.1.2. Atmospheric emissions and air quality

Despite some improvements in the last decade, air pollution remains a significant public health challenge, particularly in the northern and central regions. Chile has made progress in reducing emissions of fine particulates (PM_{10}) and sulphur dioxide (SO_2), declining by 3% and 80%, respectively, between 2016 and 2021. However, despite an overall decoupling from economic growth since 2010, other pollutants, such as $PM_{2.5}$, nitrogen oxides (NO_x), non-methane volatile organic compounds and carbon monoxide (CO), increased between 2016 and 2021 (by 8%, 17%, 21% and 25%, respectively) (Figure 1.6). This is due to a combination of factors, including continued reliance on fossil fuels for electricity generation, carbon-based transportation and growing industrial activity.

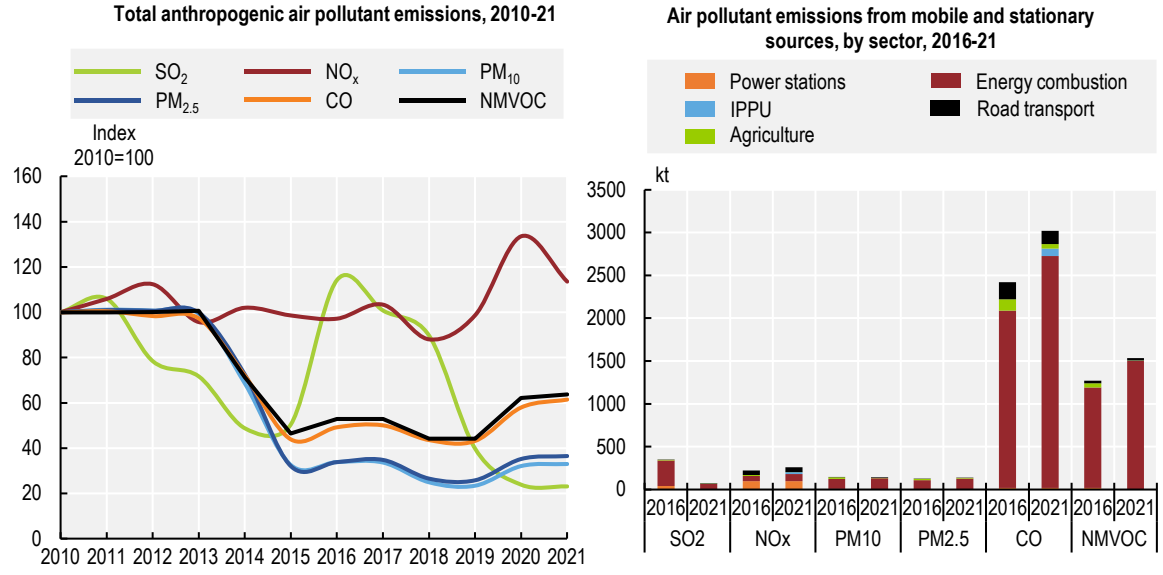
Regional disparities in air pollution levels are evident across the country. Northern regions experience the highest levels of SO_2 and NO_x emissions from industrial sources (e.g. copper smelters, thermoelectric power plants). Meanwhile, central and southern regions suffer from concerningly elevated $PM_{2.5}$ concentrations, largely due to residential wood burning for heating and road transport.

Chile has made significant progress in regulating air pollutants through Law 20.780, which established taxes (the “green tax”) on emissions from mobile (NO_x) and stationary sources (PM, SO_2, and CO_2). This has led to a 22% decrease in taxable PM emissions since 2017. Technological challenges, however, have limited the decline of NO_x and SO_2 emissions, particularly from thermoelectric power plants (MMA, 2021[20]). To address this, the tax adopted an emissions-intensity criterion in 2020 with a threshold of 25 kilotonnes (kt) of CO_2 or 100 t of PM per year (section 1.3.1). Expanding the green tax to CO emissions is also advisable, as they represent three-fifths of total air pollutant emissions in the country.

Chile is the first country in the LAC region to incorporate the EURO VI emissions standards for new light-duty vehicles, which is expected to reduce $PM_{2.5}$ and NO_x emissions by 51% and 55%, respectively, by 2030. However, it may lead to a slower fleet renewal rate (4.4% in 2021), mainly in northern regions with high average vehicle age (13.4 year in 2021) and a prevalence to buy used vehicles (De Vicente, 2022[21]). To address this and reduce emissions from vehicles in circulation (5.98 million in 2021), Chile should introduce a comprehensive fleet-renewal strategy that enforces mandatory periodic emissions

testing, while providing incentives (e.g. higher registration fees for older and more polluting vehicles) and support for transitioning to vehicles with lower impact on the environment. At the same time, it should invest in public transportation (mass and active), while enhancing accessibility, coverage, efficiency and affordability. This would help alleviate the potentially adverse effect of tighter standards and higher fees on low-income households and avoid exacerbating inequality.

Figure 1.6. Chile has made notable progress to reduce air pollutant emissions, but challenges remain



Note: SO_2 = sulphur dioxide. NO_x = nitrogen oxides. PM = fine particulates. CO = carbon monoxide. NMVOC = non-methane volatile organic compounds. IPPU = industrial processes and product use. NO_x as NO_2 (nitrogen dioxide). Emissions from road transport are estimated only for certain cities and do not consider natural dust emissions.
Source: OECD (2023), "Air emissions by source", *Environment Statistics* (database). RETC (2023), *Emisiones al Aire de Transporte en Ruta* 2010-21 [On-Road Transport Air Emissions 2010-21].

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Chile has implemented Environmental Regulation Programmes (PRAs) since 2016. However, its annual average $PM_{2.5}$ concentrations – 23 micrograms per cubic metre (µg/m³) – remain among the highest in the OECD and considerably above the 5 µg/m³ World Health Organisation (WHO) guideline (OECD, 2020[22]). This exposure to harmful $PM_{2.5}$ levels affect 98.6% of the population, higher than the LAC average of 95.4% and the OECD average of 61% (OECD, 2022[23]), posing substantial health risks and costing 3.4% of GDP (IHME, 2022[24]). The number of critical air pollution episodes[16] has declined. However, they remain common, especially in southern regions (SINIA, 2022[25]) where wood burning is exacerbated by multidimensional poverty (MDSF, 2023[26]), thermally inefficient housing and weak electricity accessibility (MinEnergia, 2023[27]). Additionally, by aligning air quality standards[17] with WHO guidelines and concurrently increasing funding for PPDAs, Chile can facilitate timely declaration of saturated or latent zones.[18] It could also enable implementation of mitigation measures such as diesel bans in urban areas and declaration of low-emission zones for densely populated centres.

In a welcome step, the Ministry of Environment (MMA) and Ministry of Housing and Urbanism (MINVU) have made efforts to enhance energy efficiency upgrades to curb air pollution from residential wood burning, along with building thermal retrofitting and housing energy performance labelling. The Heater Replacement Program (PRC) is a promising solution, subsidising replacement of outdated heaters with

more efficient models. In 2015-21, this programme delivered 62 000 devices; it is expected to replace 198 000 by 2030 (MMA, 2021[20]). However, resources should be allocated to more efficient pellet, kerosene vented or electric heaters (Mardones, 2021[28]).

Chile should expand retrofitting efforts to major public and commercial buildings and further encourage implementation of renewable energy technologies and electric heating systems. This will help reduce energy demand and air emissions (section 1.1.1). Providing financial assistance to building owners, especially low-income households, is also encouraged. This could include extending eligibility for PPDA grants, preferential loans and tax incentives for energy-efficient building materials and technologies (Simon et al., 2023[29]) to make affordable and sustainable energy for heating more accessible. Cultural barriers impede the widespread adoption of cleaner cooking and heating systems, which could be addressed effectively through intensified environmental awareness campaigns.

Additionally, Chile has made progress in the generation of higher quality information on air pollution with the National Air Quality Information System (SINCA) and the Pollutant Release and Transfer Register (RETC*)*. SINCA is a network of air quality monitoring stations (84 in 2020) used for real-time monitoring of atmospheric pollutants. However, regulations are advancing faster than the generation and availability of information. This jeopardises the design of effective public policies as lack of data impedes understanding of the full impact of different measures to reduce air pollution.

1.1.3. Progress towards biodiversity targets

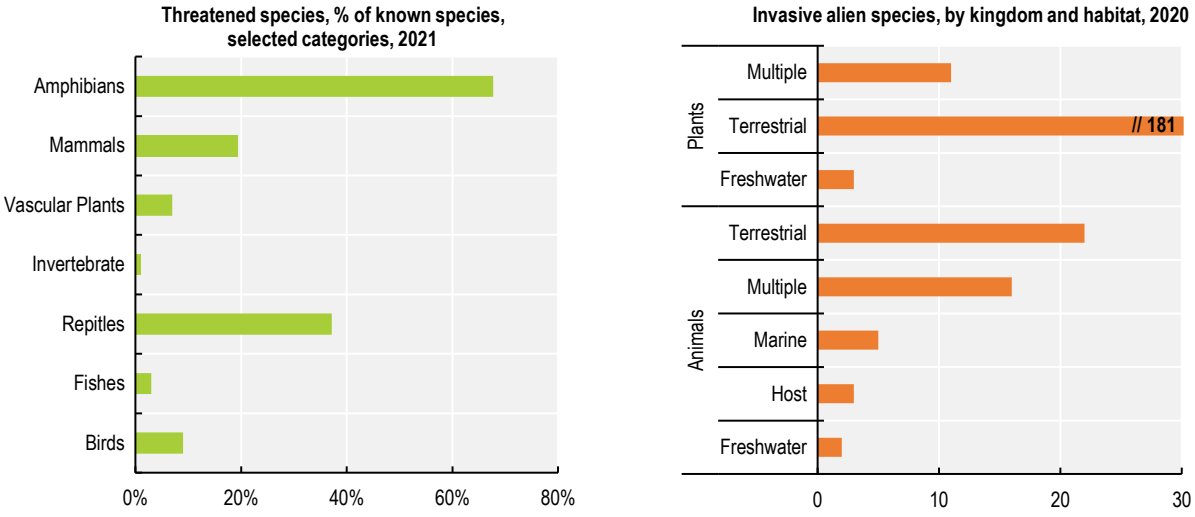
Chile is a biodiverse country with around 30 000 species. Of these, 25% are endemic, including more than 40% of plants. The central and southern zones are considered a global biodiversity hotspot and among the most threatened. Approximately 4% of known native species are classified as threatened. This is lower than Costa Rica (7%) and Mexico (5%) but higher than Colombia (2%) (OECD, 2023[30]). Amphibians are the most threatened species (68%), followed by reptiles (37%) and mammals (19.5%) (Figure 1.7). Over half (14 of 27) of fisheries or fishing operations face overexploitation, which represents 58% of the 19 species that make up these fisheries (SINIA, 2022[25]). Without additional control measures, invasive alien species (Figure 1.7) could cost the country USD 90 million a year and up to USD 2 billion over the next decades by harming biodiversity and productive sectors (Araos et al., 2020[31]).[19]

Salmon farming has posed a persistent threat to biodiversity and ecosystems within and near protected areas. In response, Chile recently required management plans of all concessions within protected areas to align with conservation objectives. Additionally, it prohibited sectoral concessions for the commercial exploitation of natural resources in virgin region reserves, national parks and natural monuments. To mitigate aquaculture's impact on marine protected areas effectively, Chile should enhance hydrobiological data collection and establish a rigorous monitoring and reporting framework to assess concession compliance (Schönsteiner et al., 2021[32]). Furthermore, a phase-out approach to salmon farming within protected areas is recommended.

Chile has emerged as a leading example in the LAC region, among the few countries (along with Costa Rica and Uruguay) to increase its forest cover, mainly through privately owned plantations (EFI, 2019[33]; OECD, 2022[23]) but at the expense of native forests (LIttle C., 2023[34]), creating trade-offs between afforestation and biodiversity objectives. Land-use change, such as the conversion of forest lands to agricultural use, mining, urban and infrastructure development, continue to exert intense pressure on terrestrial ecosystems. Despite the encouraging 14% decrease in forest fires in Chile in the 2020-21 season, human actions and climate change remain perilous threats to ecosystems (SINIA, 2022[25]). Leveraging the resilience of its unique biodiversity, particularly in the Atacama Desert, Chile can develop and implement biodiversity-positive nature-based solutions to combat desertification, promote sustainable land use and strengthen climate change adaptation (Dussarrat et al., 2022[35]). Additionally, the enhancement of peatland and wetland conservation can further bolster Chile's climate change mitigation efforts (Hoyos-Santillan et al., 2021[36]) (section 1.1.1).

Chile has made significant progress in expanding protected areas. Chile has already protected 44% of its exclusive economic zone (EEZ) and has made significant progress in expanding its terrestrial protected areas, reaching 22% of its land area.[20] This makes it a leader among OECD and LAC countries. However, more efforts are needed to meet the 30x30 targets and adequately represent all biomes. To that end, under its NDC (Government of Chile, 2020[37]), Chile has committed to expanding its protected areas, with a special focus on vulnerable and underrepresented ecosystems, to meet 30x30 targets. The National Lithium Strategy (Box 1.2) aims to expand the protection of salt flats, home to an exceptional microbial and avian biodiversity, from 7.8% to at least 30% of these ecosystems under protection.

Figure 1.7. More than two-thirds of amphibians are threatened, while invasive species represent a significant pressure to terrestrial ecosystems



Note: Known species refer to native species only. Multiple habitats for animals include brackish, marine, freshwater and biological host. Multiple habitats for plants include freshwater and terrestrial habitats. Biological host could include a host plant or host animal (e.g. in the cases of parasites).
Source: OECD (2023), "Threatened species", *Environment Statistics* (database); GRIIS (2020), Global Register of Introduced and Invasive Species (database).

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However, challenges persist in enhancing the management effectiveness of protected areas. Only 28.6% of terrestrial and 0.1% of marine protected areas have completed management effectiveness assessments (MEAs), falling short of the 60% target (CBD, 2021[38]). Completing MEAs will aid in achieving Chile's NDC commitment to implement management plans, including climate change adaptation measures, for all marine protected areas established by 2030 and foster replication of successful management practices.

After more than a decade of deliberation, the Law for Nature was promulgated in June 2023, marking a significant step towards reinforcing biodiversity protection and conservation in Chile. However, the full implementation of this groundbreaking legislation is expected to be a lengthy process, with full operationalisation anticipated in 2027. The law introduces a comprehensive package of instruments to support biodiversity conservation within and beyond protected areas. These include establishment of the Biodiversity and Protected Areas Service (SBAP), approved in August 2023, which oversees biodiversity monitoring in protected areas and other ecoregions of high biodiversity value. Additionally, the law mandates the implementation of several conservation management tools, including the National Biodiversity Fund, sustainable certification and eco-labelling, a biodiversity and ecosystem services certification system, contracts for remuneration of ecosystem services, cleaner production agreements,

proposal of environmental criteria in sectoral subsidies and grants, and the Real Right of Conservation (Derecho Real de Conservación)[21] (BCN, 2023[39]).

Alongside these reforms, Chile has committed to a dedicated workforce and funding expansion for biodiversity conservation. This highlights the critical need for sustained funding and skilled personnel to implement biodiversity services effectively, encompassing research, protected area management and infrastructure development. To ensure these efforts translate into concrete outcomes and achieve their full potential, Chile should enhance transparency and granularity of biodiversity-related expenditure (section 1.3.2), enabling stakeholders to track progress and hold decision-makers accountable.

Chile's progress in implementing payment for ecosystem services (PES) pilots in various regions holds promise for a national PES programme. However, to fully scale up PES initiatives and integrate nature and biodiversity into sustainable public and private decision-making, the country needs to strengthen natural capital valuation methods and foster stakeholder engagement. This can be achieved through the Natural Capital Committee (NCC), established in January 2023, which is tasked with developing methodologies for measuring and valuing natural capital and ecosystem services. The development of public baselines of natural capital and ecosystem services will further enhance Chile's ability to incorporate ecosystem, species and genetic diversity into national accounts and its effective mainstreaming into national planning and environmental impact assessments (EIAs) (section 1.2.2).

Fulfilling this objective requires sustained investment in biodiversity information and data collection, alongside enhanced dissemination and accessibility. Chile's *Sistema de Información y Monitoreo de Biodiversidad* (SIMBIO) serves as a valuable centralised platform for storing, managing and accessing biodiversity data. Yet, it could be further enriched with indicators monitoring temporal and spatial dynamics, as well as progress towards conservation targets. Additionally, fostering co-ordination among stakeholders through a biodiversity data network would streamline data exchange and integration across disparate databases and institutions. Engaging the public in biodiversity data management and use can foster greater awareness and support for conservation efforts.

1.1.4. Waste management and circular economy

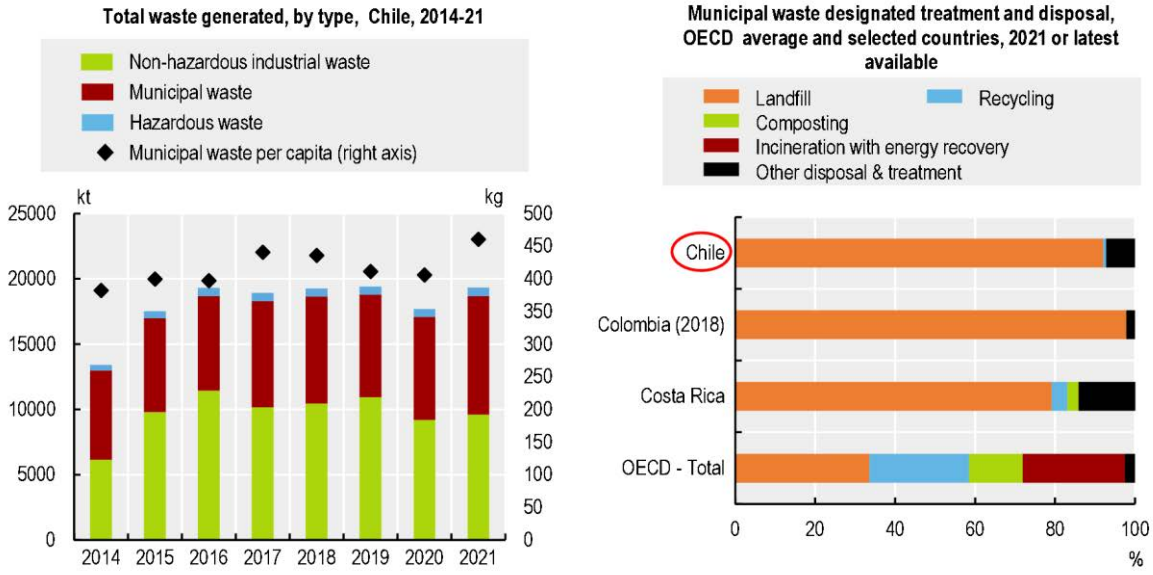
Chile landfills 92% of its municipal solid waste, one of the highest percentages among OECD countries, although it generates less waste per capita (406 kg vs. 534 kg in 2020). This represents a decrease from the past decade when the country landfilled an average of nearly 100% of its waste. National waste generation has remained stable between 2016 and 2021, at around 19 Mt per year. Waste is predominantly non-hazardous (97%) (Figure 1.8, left panel). By implementing the National Waste Declaration System (SINADER) and linking it to the single window system of the RETC, Chile has improved its waste information over the past seven years. This has allowed the country to better understand its waste generation and management challenges, as well as develop more effective policies and programmes.

Chile has taken several steps to reduce waste generation and promote recycling. In 2016, Congress passed Law 20.920 (the REP law) with entry into force in 2023. The law establishes extended producer responsibility (EPR) schemes for a variety of products, including packaging, batteries, and tyres. It has also set fundamental principles such as polluter pays, gradualism, hierarchy of waste management practices, traceability and transparency (IEA, 2022[40]) for the aforementioned waste streams. The promulgation of a decree regulating waste oil and waste from electrical and electronic equipment through EPRs is expected in 2024. Given the designation of textiles and fishing nets as priority products, Chile needs to accelerate EPR schemes for them. The enactment of the Single-use Plastics Law in 2022 is also a step forward in reducing plastic consumption and encouraging its reuse and recycling.

Despite high waste collection services coverage (99.2% in urban areas and 73.4% in rural areas) (SUBDERE, 2018[41]), Chile's municipal solid waste (MSW) collection system faces two major interconnected challenges: financial sustainability and behavioural change. One-third of municipalities do

not have a substantial waste recovery budget (ECLAC, 2019[42]). Even those that do cannot afford proper waste collection due to extensive sanitation fee exemptions and unclear tariffs. These factors impede cost recovery and the implementation of incentive-based systems aligned with the polluter pays principle, such as pay-as-you-throw schemes (CSP and MMA, 2020[43]). As a result, municipalities must often subsidise sanitation services, with low-income municipalities allocating a bigger proportion of their resources.

Figure 1.8. Major efforts are needed to increase municipal waste recovery



Note: Municipal waste is defined as waste collected and treated by or for municipalities. The definition excludes waste from municipal sewage networks and treatment, as well as waste from construction and demolition activities. Other disposal and treatment include incineration without energy recovery, refuse derived fuel, waste used for backfilling, process loss from mechanical biological treatment facilities, incinerator bottom ash sent for recycling and metals from incineration sent for recycling.
Source: OECD (2023), "Municipal waste, generation and treatment", *OECD Environment Statistics* (database).

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The country has taken some steps to address these challenges, such as establishing the Recycling Fund to support EPR schemes and finance projects that reduce waste generation and promote its recovery (IEA, 2022[40]). However, the budget allocated to this fund has been declining (359.1 million pesos in 2017 vs. 233.7 million pesos in 2022) (BCN, 2023[44]). Furthermore, the absence of a comprehensive, long-term investment strategy that prioritises waste separation and recovery infrastructure, coupled with the concurrent need to enhance technical assistance for municipalities, hinders progress towards achieving waste management goals. This is compounded by the lack of defined ceilings in the Regional Contingency Support Fund, which only allocated 15% of its 2023 budget to waste management, primarily for waste disposal, with less focus on collection, transfer and recovery.

Chile's waste disposal infrastructure faces significant challenges. More than one-third (34%) of disposal sites have reached the end of their operational lifespan. Yet they continue to receive approximately one-third of the country's MSW (Pelayo Díaz and Linazasoro Espinoza, 2020[45]). This poses a significant public health concern.

In addition to modernising landfill facilities with stringent standards, Chile should reduce organic waste generation and disposal in landfills, considering that it represents 58% of total MSW generated (MMA, 2021[46]). This includes approving and implementing bill for the valorisation of organic waste, which

mandates the recovery of organic and other separated waste. It should also consider a landfill tax akin to those in other OECD countries such as Israel, Norway and several EU member states (OECD, 2019[47]). These measures would discourage environmentally harmful waste disposal and promote sustainable waste treatment. Further, they would align Chile's waste management strategies with its NDC National Organic Waste Strategy (ENRO) and the Roadmap for a Circular Chile (2021) goals. These aim to achieve a 66% organic waste recovery rate by 2040 and a 40% recycling rate by 2030.

Chile has one of the lowest MSW recovery rates among OECD countries, recovering only about 1% (Figure 1.8, right panel). Most waste recovered in Chile is glass, paper and cardboard. Typically, municipalities use green points (69%) and clean points (47%)[22] (ECLAC, 2019[42]) to ensure waste recovery. However, house-to-house segregated collection is prevalent in municipalities with superior recycling performance (Peró et al., 2022[48]).

Further expanding recovery infrastructure is crucial for promoting segregated waste collection. Since clean points only accept completely washed and unlabelled products, green points would help gradually raise awareness about waste separation and recycling. Although 75% of municipalities have recycling awareness campaigns (ECLAC, 2019[42]), Chile should tailor them to specific community needs. Such a process should consider demographics, socio-economic status, and available waste collection and recovery infrastructure (Rodríguez Salas and Trebilcock, 2020[49]). This will help the country promote waste prevention and recycling, while reducing capacity and financing needs for waste management (Pelayo Díaz and Linazasoro Espinoza, 2020[45]).

1.2. Improving environmental governance and management

1.2.1. Institutional framework for environmental governance

Key progress made in strengthening environmental institutions

The core national institutional structure for environment has remained in place since the last review. The MMA is responsible for policy design and information management in all environmental domains. The Environmental Assessment Service, a decentralised technical agency under the MMA at the regional level, administers the System of Environmental Impact Assessment (SEIA). The Environmental Superintendence (SMA) monitors and enforces compliance with respect to activities and projects subject to the SEIA or covered by Pollution Prevention and Decontamination Plans (PPDAs), environmental quality or emission standards. Three environmental courts in Chile, which review administrative resolutions and decisions of environmental legal disputes, have strengthened access of citizens to environmental justice. The first two courts started operation in 2013 and the most recent opened in 2017.

Institutional arrangements for environmental management in Chile have been strengthened with the approval of the SBAP and the FLCC. The climate law formalises the Inter-Ministerial Technical Team on Climate Change and Regional Climate Change Committees. The Council of Ministers for Sustainability and Climate Change functions as the main horizontal co-ordination mechanism for environmental matters, including climate change. The National Council for the Implementation of the 2030 Agenda for Sustainable Development co-ordinates implementation and monitoring of the SDGs (Government of Chile, 2023[50]).

Other key developments relate to efforts to address the Just Transition, represented by the ratification of the Escazú Agreement: Regional Agreement on Access to Information, Public Participation and Access to Justice in Environmental Matters in LAC countries (section 1.1.3). Chile and Costa Rica co-chaired negotiation of the agreement. The MMA created the Just Socio-Ecological Transition Office in 2022 to tackle the climate, ecological and inequality crisis. It incorporates social and environmental justice at the local level, mainly focusing on extractive industries (section 1.3.3). In the same year, the Inter-Ministerial

Committee for Just Socio-Ecological Transition, as well as the Inter-Ministerial Committee for Just Water Transition, were established to advise the president on Just Transition issues in each domain.

Local governments still have little autonomy, calling for greater decentralisation

Chile has been one of the most centralised countries in the OECD, with a four-tier government system composed of the national level, regions, provinces and municipalities. While regional and provincial administrations have some territorial planning responsibilities, they play a minor role in environmental management. Since the last review, institutional autonomy in municipalities has remained limited, including their ability to set more stringent environmental standards than national level. Municipalities also have little fiscal autonomy and lack financial resources for environmental services.

The MMA is legally obliged to work with local authorities through collaborative agreements for environmental matters. It does this via its local branch office of the Environmental Regional Secretariat. These national institutions in the regions play an important role in planning and monitoring environment-related policies, but their institutional capacity at the regional level needs to be improved.

A stronger push towards decentralisation was reflected in the "Stronger Regions" bill submitted to Congress in 2023 (Government of Chile, 2023[51]). The bill aims to empower regions by granting regional governments more autonomy to design mechanism to generate their own income and use resources according to their needs. This progress builds on the change in 2021 to establish elections for regional governors rather than selection by presidential appointment. Moreover, the bill proposes a new Permanent Fund for Inter-regional Equity, which aims to reduce financing gaps between regions. The Mining Royalty Law enacted in 2023 will also strengthen local financing by creating a flat-rate value-added tax and three new funds[23] to distribute collected revenue to regions and municipalities (section 1.3.1).

1.2.2. Regulatory framework for environmental management

There has been limited progress on environmental quality and emission standards

Despite recommendations of the last review, progress on strengthening both environmental quality and emission standards has been limited. To date, Chile enforces 21 quality standards on air and water, and 37 emission standards on air, noise, soil and water pollution (BCN, 2023[52]). However, the Chilean regime lacks environmental quality standards on soil (under development[24]), and standards for water resources are incomplete (Chapter 2) (Carrasco, Benítez and Cañas, 2023[53]). Since 2016, some emission standards for stationary sources were added or updated, including for odours and arsenic. However, despite recommendations in the last review, there is no implementation of technique-based emission/effluent limit values[25] for large high-risk industrial installations or sector-specific emission and effluent standards for facilities with lower environmental impact (OECD/ECLAC, 2016[54]).

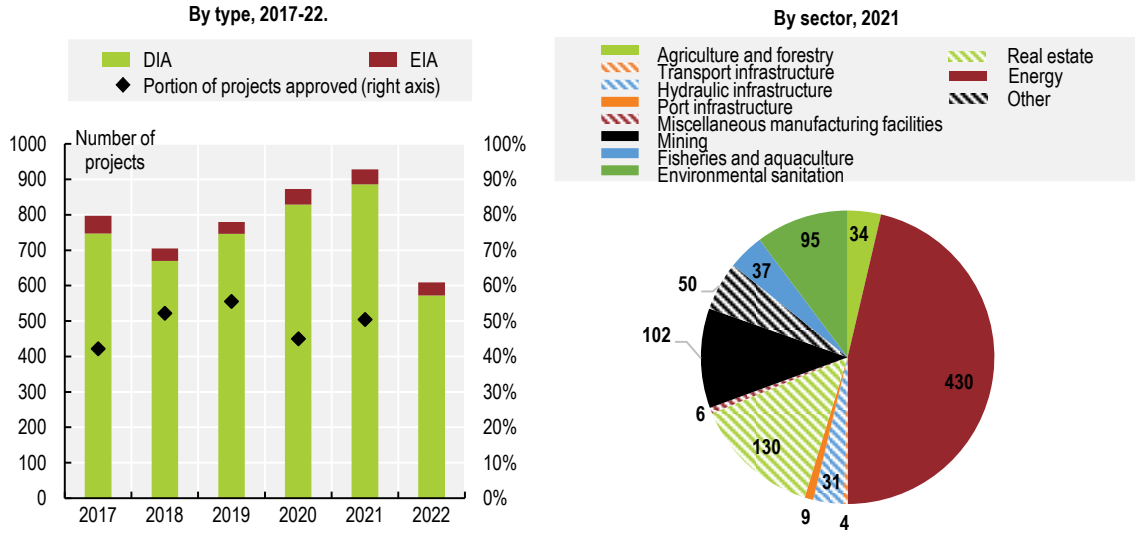
Environmental impact assessment needs to further strengthen its technical criteria

EIA is carried out through the SEIA. The project entry to the system is either through full EIA or a simpler environmental impact declaration (DIA). A full EIA is required for projects with a potential risk to public health or the environment. Even in a full EIA, however, the SEIA does not require evaluation of alternative scenarios, a limitation yet to be addressed since the previous review. Each approved project receives a resolution of environmental qualification (RCA), equivalent to an environmental permit, and a consolidated evaluation report. These are available to the public. Similar to the emission/effluent limit values, there is no implementation of technique-based RCAs. On average, a full EIA takes 25 months; a DIA only 10. In 2022, 37 full EIAs were conducted and 572 DIAs submitted, approximately 6% and 94% of all the procedures, respectively (Figure 1.9). The project owner, rather than an independent party, judges the project entry category (full EIA or DIA). A validation of this screening is incomplete due to limited oversight

capacity. Such a validation process is important to ensure the screening process is not used as a loophole to avoid a full EIA (and thus the need for a permit and eventual monitoring). The poor quality of entries by project owners, such as missing information, often causes delays.

Figure 1.9. Most environmental impact assessments are conducted via the simplified version

Projects entered into the System of Environmental Impact Assessment



Note: DIA = environmental impact declaration. EIA = environmental impact assessment. Data as of 2 June 2023. Right panel: Other sector includes equipment related projects.
Source: SEA, Información de Proyectos Ingresados al SEIA, Reportes Estadísticos Mensuales de Proyectos en el SEIA. [SEA, Information on Projects Submitted to the SEIA, Monthly Statistical Reports on Projects in the SEIA].

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There is significant room to improve the EIA process. Institutional safeguards against political influence, for example, are insufficient (Chile Transparente, 2021[55]). The final approval of an EIA lies with a political committee (ministers, regional), which does not give full confidence that clear and technical criteria guide decisions. The risk of political influence undermines environmental protection and also generates uncertainty that can discourage future investment. A reform on Law 19.300 General Bases of the Environment is expected to remove political influence and strengthen the technical quality of the EIA.

Another key issue is asymmetry of information between project owners and citizens. The process relies heavily on project owners for information provision, while communities lack technical tools and financial support to engage effectively (Chile Transparente, 2021[55]). Modernising the EIA process with the further use of technology (e.g. digitalisation of the EIA process) and production of reliable public databases can improve the quality of information in EIAs and reduce information asymmetry.

Under the Escazú Agreement, the Environmental Assessment Service strives to ensure access to information and improve citizen participation. This needs to happen in the early stages of the process before the evaluation, to allow scope to influence projects at the design stage. Citizen participation needs to improve further, notably through participation of Indigenous peoples. Over 2013-19, the Environmental Assessment Service registered 55 projects that included consultations with Indigenous communities, with the largest number in energy (54.5%) and mining (29.1%). However, many challenges remain for Indigenous populations, notably in rural areas, to access information related to EIAs and to understand the

processes so they can participate effectively (Reperger, 2021[56]). Moreover, only projects that conduct full EIAs are subject to consultation, representing only a small fraction of all projects.

Strategic environmental assessment has improved but needs further incorporation of climate change

Strategic environmental assessment (SEA) incorporates environmental considerations into the process of formulating policies and plans of a general regulatory nature, as well as their substantial modifications. The body responsible for the respective policy or plan triggers the SEA process, while the MMA guides and collaborates on the technical aspects.

According to the Environmental Quality Law, all territorial development plans are subject to SEA. As recommended in the last review, there has been some progress to improve the SEA process in communal regulatory plans, such as publication of the MINVU Manual. While the MMA provides the generic framework through the SEA Orientation Guide, this new manual addresses SEA application and methodology for urban planning. Still, the number of plans submitted to the SEA has declined slightly since the last review; Communal Regulatory Plans account for most submissions.

Climate change needs to be incorporated into environmental assessments. Use of a guide to incorporate climate change into SEA, created in 2023, was mandated by the FLCC. However, an update is pending on the regulations of the Environment Assessment Service to make it coherent with the FLCC. Notably, the EIA and SEA should consider climate change impacts systematically to enhance resilience in territorial and infrastructure planning.

1.2.3. Compliance assurance

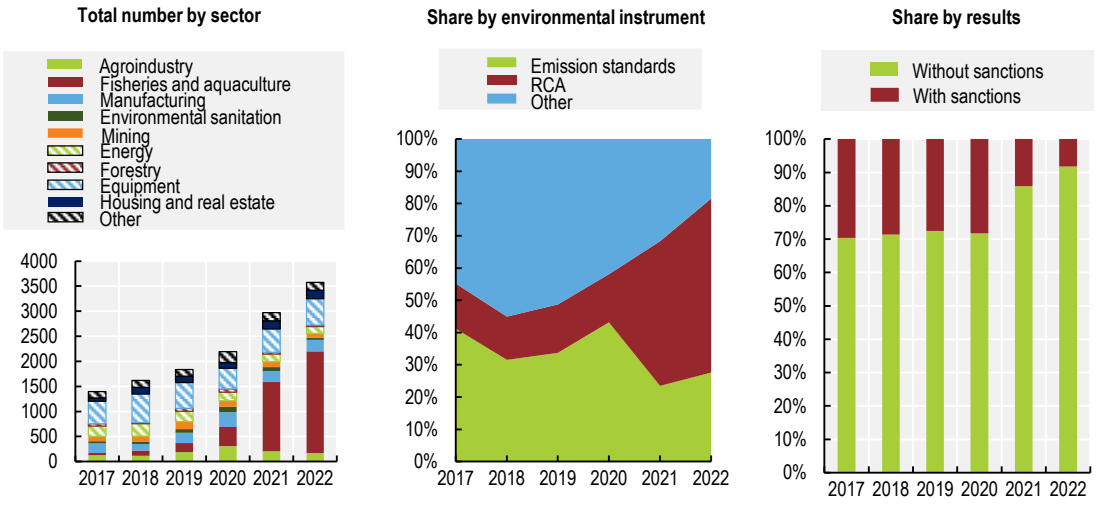
Compliance monitoring expanded with new technology but is still under-resourced

The SMA is exclusively responsible for executing, organising and co-ordinating the compliance monitoring and supervision of environmental permits, Environmental Quality Standards (NCA), Emission Standards (NE) and all other environmental instruments established by law. The law empowers the SMA to impose sanctions, force closure of a project or revoke an environmental permit. Through an open portal, the SMA publishes its control programmes in the fields of RCA, PPDA, NCA and NE, as well as compliance programmes. The Organic Law of the SMA will be modified to grant greater investigative powers to the SMA, streamline compliance procedures and increase incentives for compliance.[26]

To reinforce its monitoring capacity, the SMA recently started implementing remote mass control. This new technology contributed to a significant increase in compliance checks, which more than doubled from 1 395 in 2017 to 3 573 in 2022 (Figure 1.10). It allowed some 1 700 extra checks of the salmon industry using satellite images and large data-sets, achieving more than 95% coverage in this area. Meanwhile, the share of compliance checks that result in sanctions decreased from approximately 30% in 2017 to 8% in 2022. This remote compliance check has been effective to increase coverage of inspections at a low cost and compliance[27] through behavioural change as industry actors know they will almost certainly be monitored.

Figure 1.10. Compliance checks more than doubled from 2017 to 2022

Compliance checks, 2017-22



Note: RCA = Resolutions of Environmental Qualification. Values correspond only to files considered as finalised. Some compliance check processes ended without findings and those with findings merited a sanctioning process. "Other sectors" include but are not limited to port, hydraulic and transport infrastructure, storage and transportation, and technical environmental audit bodies (ETFAs). "Other instruments" include Quality Norms (NC), Prevention and/or Atmospheric Decontamination Plans (PPDA), circumvention of the SEIA (SRCA), Environmental Law, Pollutant Release and Transfer Register (RETC) regulations.
Source: Sistema Nacional de Información de Fiscalización Ambiental (SNIFA) (2023), Estadísticas, [National Environmental Control Information System, Statistics] https://snifa.sma.gob.cl/Estadisticas.

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In 2022, the SMA audited 3 382 units, representing 18.2% coverage out of 18 587 auditable units identified. This number includes on-site compliance checks and remote compliance checks. The number of environmental complaints per year tripled from 1 870 in 2020 to over 5 700 in 2021. The increase was mainly driven by claims related to environmental noise through the newly implemented citizen portal. Addressing minor complaints should be decentralised to local authorities to minimise the burden on the SMA's capacity.

Since the last review, the number of penalty procedures initiated by the SMA has steadily increased. More than 650 fines were issued over 2016-22 (amounting to USD 125 million). The fine depends on several aggravating and attenuating factors, including the economic benefit incurred as a result of non-compliance. There have been recent cases of severe sanctions imposed on industry. In 2018, the SMA made the historic decision to permanently close the Pascua Lama mining project – part of the Canadian company Barrick Gold – after confirming a series of violations.

Despite the recommendation in the last review, the SMA does not monitor compliance directly in some cases (to the extent environmental impact mitigation measures concern the competence of sectoral ministries).[28] The SMA directly monitors compliance only for projects that went through the full EIA process. For other projects, the SMA co-ordinates with sectoral ministries. While compliance checks follow a standard procedure, arrangements may undermine the enforceability of permit conditions compared to integrated monitoring of compliance on a cross-media basis. The key bottleneck to the integrated compliance monitoring is a lack of regional resources for compliance monitoring (only about four people per region in 2023). For instance, the SMA in Antofagasta lacks around ten officials to meet the monitoring needs of mining operations in the region. The SMA should be further strengthened to support integrated compliance monitoring, with sufficient resources to conduct it.

The SMA reinforced its compliance promotion agenda since the last review. For example, the SMA issued guidelines on compliance programmes for different types of infractions. The audit division and the regional offices have set public-private meetings and workshops continuously.

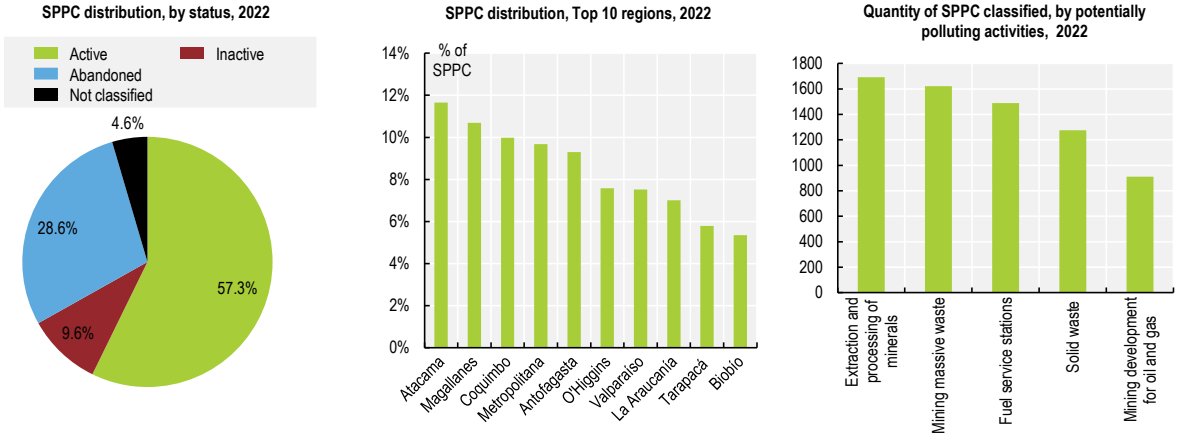
Enforcement capacity has been strengthened by broadening the criminal liability

In 2023, Congress passed a law enabling criminal sanctions for environmental violations, as recommended in the last review. The law modifies the Penal Code, introducing an article "Crimes against the environment" which criminalises certain activities[29] without environmental permits, non-compliance with environmental standards and other activities that damage protected ecosystems. These violations entail penalties of imprisonment of up to ten years, in addition to mandatory fines. Similarly, amendments to the Organic Law of the SMA incorporate new articles that penalise activities such as maliciously dividing projects into smaller ones to avoid the full EIA process and submitting false information to the SMA to obtain permits (Hilgers, Vial and Gutierrez, 2023[57]).

Liability regime for environmental damage is still weak with the limited progress

Despite the recommendation in the last review, there is no legal regime in Chile related to remediation of contaminated land (BCN, 2023[52]). Enforceable legal requirements, such as soil quality standards (under development), are critical to establish responsibilities and deter future environmental damages. In 2022, 10 253 soils[30] were identified nationwide with the potential presence of contaminants, particularly in mining regions (MMA, 2023[58]). Chile has a National Cadastre of Soils with Potential Presence of Contaminants (SPPC), which identifies soils that may have contaminants based on past or present industrial activities. Out of SPPCs identified, 57% are active and 29% are abandoned (Figure 1.11).

Figure 1.11. Soils with potential presence of contaminants are dominant in mining regions



Note: SPPC = Soils with Potential Presence of Contaminants. Right panel: Minerals included are copper, silver, gold, molybdenum, steel, iron and lead.
Source: IdeAmbiente (2022), *Informe Final: Actualización del Catastro Nacional de Suelos con Potencial Presencia de Contaminantes* [Final Report: Updating of the National Cadastre of Soils with Potential Contaminant Presence].

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Chile has made no significant progress on abandoned mining sites since the last review. No specific agency is responsible for investigation and clean-up of contaminated sites. The 2012 Mine Closure Law requires all new mines to get approval for end-of-life closure plans with guarantees for the full present value of closure cost. However, the law does not apply to already abandoned mining sites. For those sites,

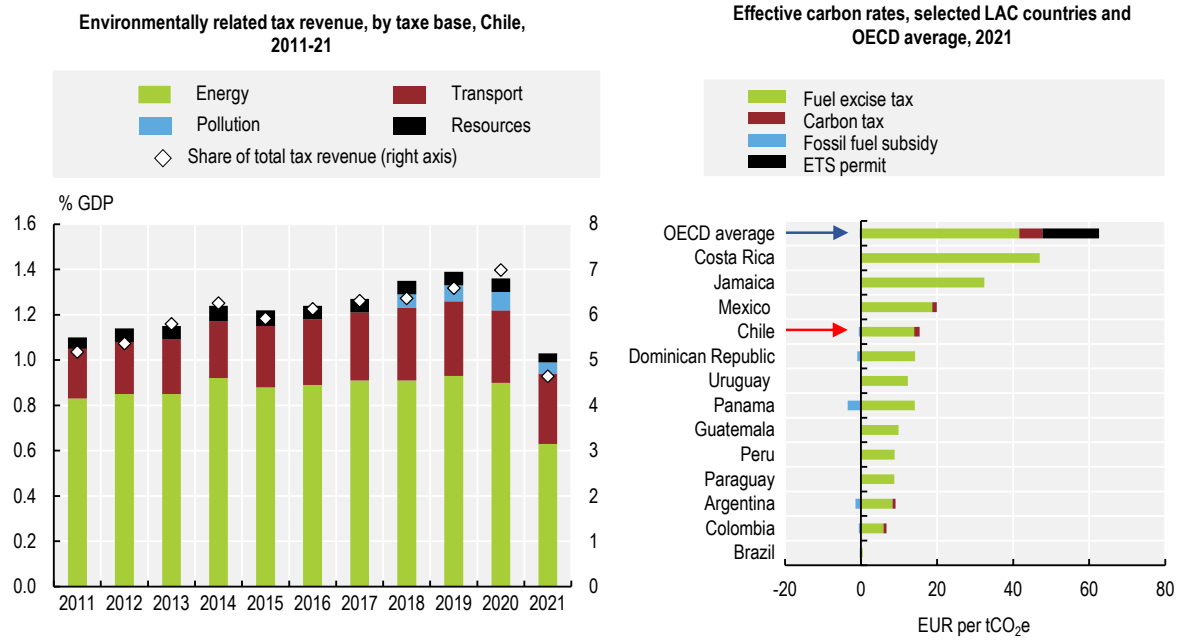
limited financing of decontamination activities comes from the state budget, not in line with the polluter pays principle. A sustainable funding solution is necessary to address this. One possibility would be to create a fund from mining royalties dedicated to clean up legacy land and water pollution (section 1.3.1). A share of extraordinary revenues due to the high price of lithium could be earmarked for remediation (section 1.3.2). Another possibility is to impose decontamination fees on hazardous industrial installations and earmark the revenue for a remediation fund.

1.3. Enhancing policy coherence for green growth

1.3.1. Greening the system of taxes and charges

In 2021, the Chilean government collected around USD 3.3 billion of environmental tax revenue, representing 1.0% of GDP and 4.6% of total government revenue from taxes and social contributions (Figure 1.12). The share of GDP is lower than the OECD average (1.4%), while the share of total tax revenue is the same (4.6%). Both shares showed a gradual increase from 2011 to 2020 but dropped in 2021 due to a decline in tax revenues from energy, driven mainly by reduced electricity demand during the pandemic.

Figure 1.12. Environmentally related tax revenue grew faster than GDP, while average effective carbon rates in Chile are low by OECD standards



Note: ETS = Emissions Trading System. Resources include mining patents for extraction and exploitation but exclude revenues from the specific tax on mining. Fossil fuel subsidy refers to budgetary transfers that decrease pre-tax prices for domestic fossil fuel use. ETS coverage estimates are based on OECD (2021), Effective Carbon Rates 2021, with adjustments to account for recent coverage changes.
Source: OECD (2022), Environmentally related tax revenue, *OECD Environment Statistics* (database). OECD (2022), *Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action*, OECD Series on Carbon Pricing and Energy Taxation, OECD Publishing, Paris.

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Taxes on energy use

Similar to most OECD countries, taxes on energy use in Chile generate the largest amount of revenues (73% in 2020) from environmentally related taxes. In terms of effective carbon rates, as of 2021, Chile ranked among the highest in LAC but well below the OECD average (Figure 1.12).

A carbon tax was implemented, but its rate is too low

Since 2017, a green tax for stationary sources has taxed emissions of CO_2 (carbon tax) at the rate of USD 5 per tonne of CO_2, as well as local pollutants. The carbon tax covered 32.5% of GHG emissions in CO_2 equivalent (CO_2e) in 2021. This contributed to 55.6% of GHG emissions being subject to a positive net effective carbon rate (the highest coverage in LAC countries) (OECD, 2023[59]). The rate for local pollutants PM, SO_2 and NO_x is calculated using specific local information related to the population affected by each facility's industrial activities. The green tax applies to facilities of which the total thermal power capacity of boilers and turbines is at least 50 megawatts (MWt).[31] Since 2022, the tax applies to the so-called "large emitters",[32] without exclusion of any sector.

Future efforts in carbon pricing should establish a gradual timeline to increase the tax rate. The government has put forward a revision of the current, including increasing the rate, tax as part of its fiscal reforms. An increase in the rate would better reflect the social cost of pollution. However, such reforms are still in the technical design phase. Higher carbon prices are crucial to spur the needed shifts towards cleaner energy to meet climate objectives.

The electricity price-setting mechanism in the Chilean electricity market needs to be changed for carbon pricing to work effectively. The variable costs of electricity generation plants determine wholesale electricity prices and the order of dispatch. However, in Chile, the full amount of the carbon tax is not included in the variable costs, which creates economic distortions in the power sector. Moreover, renewables-based power generators sometimes compensate carbon tax on fossil fuel-based power generators.[33] Without revisiting this design issue, carbon pricing will not be effective at incentivising the transition towards renewables.

A carbon offsetting system was established, and a "cap and tax" system is planned

The green tax reform introduced a carbon offsetting system that came into force in February 2023.[34] The reform provides the possibility to offset CO_2 emissions with government-certified GHG abatement certificates. It will reduce the tax burden on "claimants" through the incentive to develop projects to reduce or capture emissions by "bidders". The carbon tax would then apply only to the remaining emissions. This system covers both CO_2 and local pollutants PM, SO_2 and NO_x. It can pave the way for a more sophisticated carbon market that allows flexibility in emissions reductions by offsetting tax liability with projects that reduce emissions directly.

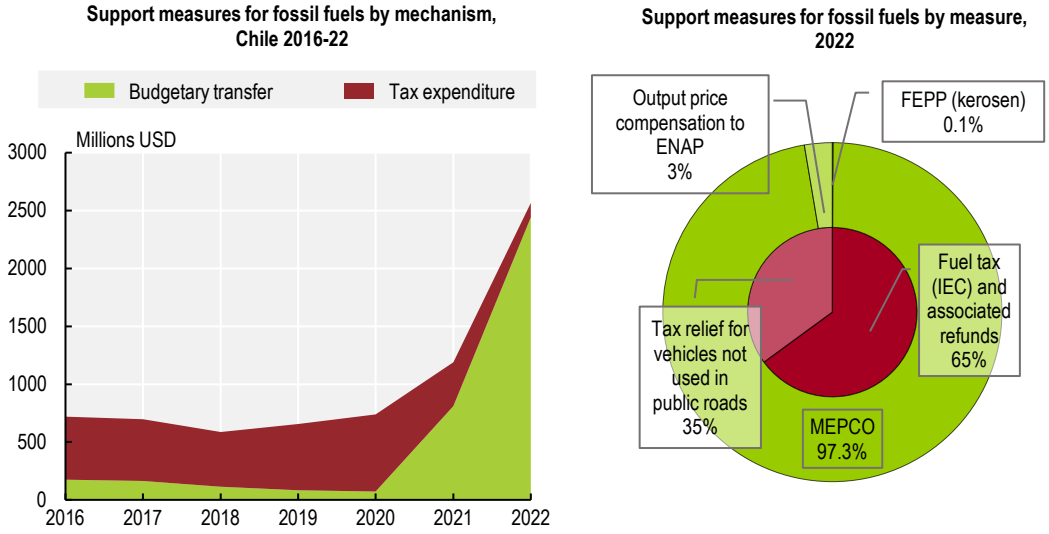
Chile does not operate an emissions trading system (ETS) for GHG emissions. As a first step towards the potential ETS, a "cap and tax" is expected to be included as part of the green fiscal reform, following the example of Canadian Output-Based Pricing System Regulations. In this "cap and tax" system, companies with emissions above benchmarks (emissions per product unit) will have to either pay the carbon tax or compensate through offsets. Companies with emissions lower than the benchmarks will be able to issue a certificate that can be sold in the market. The current carbon tax rate, however, limits these certificates to abatement efforts whose cost is below USD 5 per tonne of CO_2.

Fiscal cost of support to fossil fuels increased due to global supply disruptions

The fiscal cost of support to fossil fuels in Chile was estimated at USD 2.57 billion in 2022 (Figure 1.13). The support has more than tripled from 2016 to 2022, mainly driven by the change in budgetary transfers (USD 2.44 billion in 2022), of which the Stabilisation Mechanism of Fuel Prices (Mecanismo de

Estabilización de Precios de los Combustibles, MEPCO) accounts for approximately 97%. The remaining support relates to tax expenditures (USD 0.12 billion in 2022), of which refunds to the fuel tax are the majority.

Figure 1.13. MEPCO budgetary transfers are rising alongside the global supply disruptions



Note: ENAP = Empresa Nacional del Petróleo. FEPP = Fondo de Estabilización de Precios del Pétroleo. IEC = Impuesto Especifico a los Combustibles. MEPCO = Mecanismo de Estabilización de Precios de los Combustibles. Data for 2022 are preliminary and may contain OECD-generated estimates. Fiscal cost of support measures for fossil fuels are based on information reported by countries through official documentation. Tax expenditures are estimates of revenue that is foregone due to a particular feature of the tax system that reduces or postpones tax payments (relative to a jurisdiction's benchmark tax system) to the benefit of fossil fuels' producers or users. Support measures for fossil fuels are included in the Inventory without reference to their economic or environmental effects.
Source: OECD (2023), "OECD Inventory of support measures for fossil fuels", Environment Statistics (database).

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MEPCO aims to reduce international oil and gas price fluctuations for domestic consumers through adjustments in specific taxes on transport fuels, reducing revenue when international prices are above domestic prices and vice versa.[35] It replaced all previous stabilisation mechanisms,[36] except the Petroleum Price Stabilisation Fund (FEPP). Since 2011, the FEPP has applied only to domestic use of kerosene, which is widely used for heating.

In recent years, MEPCO's limit has expanded to counteract the pandemic's adverse economic impact, as well as the rising international price of kerosene and crude oil arising from the Russian war of aggression in Ukraine. The government doubled the amounts for MEPCO from around USD 750 million in 2020 to USD 1.5 billion in 2021. This rose to USD 3 billion in 2022 but dropped to USD 1.5 billion before 2023. Prior to 2021 and in the first half of 2023, MEPCO effectively stabilised prices without significantly subsidising fossil fuel consumption. During the initial seven months of 2023, when international oil prices were below local prices, MEPCO facilitated the collection of an additional USD 0.7 billion in taxes on fossil fuels. However, it is crucial for long term sustainability that such a mechanism remains neutral to avoid inadvertently providing support for fossil fuels.

Periods of high and volatile fossil fuel prices highlight the benefits of the clean energy transitions. However, support measures to fossil fuels weaken incentives to switch to alternative sources of energy. They also use public funds that could be spent on clean energy transitions (IEA, 2023[60]). The long-term focus should be on building resilience and investing in the clean energy transition with emergency relief phased out

eventually. Social benefit schemes need to be well-targeted to the vulnerable population who are hardest hit (section 1.3.3).

Transport-related taxes show a wide gap between diesel and petrol, the removal of exemptions is still pending

Fuel excise taxes have been in place since 1986 and apply exclusively to motor vehicle fuels. They set a base component, to which a "variable component" is added or subtracted according to MEPCO. Despite recommendations in the last review, there is still a wide gap in rates between petrol (6.0 UTM/m^3 [37]) and diesel (1.5 UTM/m^3 [38]) for the base component. The corrective tax bill to narrow this gap is pending.

Despite recommendations in the last review, sectoral exemptions still exist through tax refunds. These exemptions apply to large-size cargo transport in trucks,[39] and diesel used in off-road vehicles.[40] These tax refunds effectively subsidise transport externalities. Moreover, fuels from the air, sea and rail transport sectors are fully exempt from fuel excise taxes.

Taxes on the purchase of motor vehicles exempt commercial vehicles. They are linked not only to fuel efficiency and emissions but also to vehicle price, weakening application of the polluter pays principle. Higher vehicle tax rates and broadened coverage through removal of exemptions are being discussed. Further green tax reforms should address these outstanding issues. In addition, they should raise both vehicle tax rates and annual registration fees depending on vehicle types (e.g. age, emission levels) to discourage purchase and use of highly polluting vehicles.

Taxes on natural resources could contribute to environmental remediation

Taxes on renewable natural resources include those on fishery and forestry. Transferable fishing quotas are used to regulate exploitation of fish stocks. In 2014, Chile also introduced a tax on fisheries extraction rights. Chile has actively participated in efforts to eliminate subsidies to illegal, unreported and unregulated fishing and harmful subsidies to fishing that contribute to overfishing and overcapacity (OECD, 2022[61]).

Chile's support to farmers is among the lowest of OECD countries at 2.7% of gross farm incomes in 2019-21, down from 7.3% in 2000-02 (OECD, 2022[18]). Since Chile reduced its tariff-based border protection at the beginning of the 2000s, agricultural support creates limited distortions to the markets, with almost no market price support to the sector. The Incentive System for the Agri-environmental Sustainability of Agricultural Soils Program provides supports for fertilisers, but this is limited.

Taxes on non-renewable natural resources include those for mining. A tax on mining patents has long been in place, but accounts for a negligible share of environmentally related tax revenue. A special tax on mining[41] has also been in place since 2006, as a royalty on profits.

Chile enacted a bill to modify the special tax on mining in 2023. It will create a flat-rate, value-added tax of 1% for large-scale mining, and modify tax rates to 8-26% on the operating margin of large copper mining companies. The law will also create three community funds to distribute collected revenue to the general budget of regions and municipalities (Ministry of Finance, 2023[62]). This could contribute to environmental remediation if the revenue is earmarked for such purposes. For lithium, two current Special Lithium Operation Contracts are subject to the payment of commissions. In 2023, the government announced the National Lithium Strategy, which ensures the state's participation in lithium revenue streams (section 1.3.2).

1.3.2. Investing in the environment to promote green growth

Environmental expenditure trends need to be systematically identified with meaningful categorisation by domain

Chilean central government expenditure on environmental protection remained around 0.35-0.40% of total governmental expenditure over 2012-21 (DIPRES, 2022[63]). This is merely 0.1% of GDP, lower than the OECD average (0.6% in 2020). Chile's Budget Office (DIPRES) makes data available for only three types of environmental expenditures: Pollution reduction, Biological and landscape diversity protection, and Others.

The last review recommended continuing systematic surveys on environmental expenditures with expanded coverage for private sector and sub-national levels. However, such progress has been limited (e.g. pilot studies, or a study that has not yet processed data). The public environmental expenditure study using Classification of Activities and Expenditures for Environmental Protection (CEPA) or any other equivalent classification has not been conducted since the 2015 survey. This makes it hard to understand environmental expenditure trends and to identify gaps. In 2015, the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) supported the study on the expenses across all the relevant ministries, but this surveying methodology was not institutionalised.

It is critical to conduct systematic surveys or establish environmental expenditure-tagging procedures as part of regular budgeting cycles, with meaningful classification by environmental domains. Other efforts can identify public investment in environmental protection, in particular for climate change. However, these approaches are not comprehensive enough to understand expenditure trends by domain. One such effort is the integrated form of public expenditure study by the MMA in collaboration with the United Nations. The other effort is the collaboration agreement by the Ministry of Finance and the United Nations. It showed that government spending on climate-related investments has increased from 0.01% to 0.11% of GDP over 2016-22, representing on average 0.33% of total governmental expenditure (DIPRES, 2023[64]).

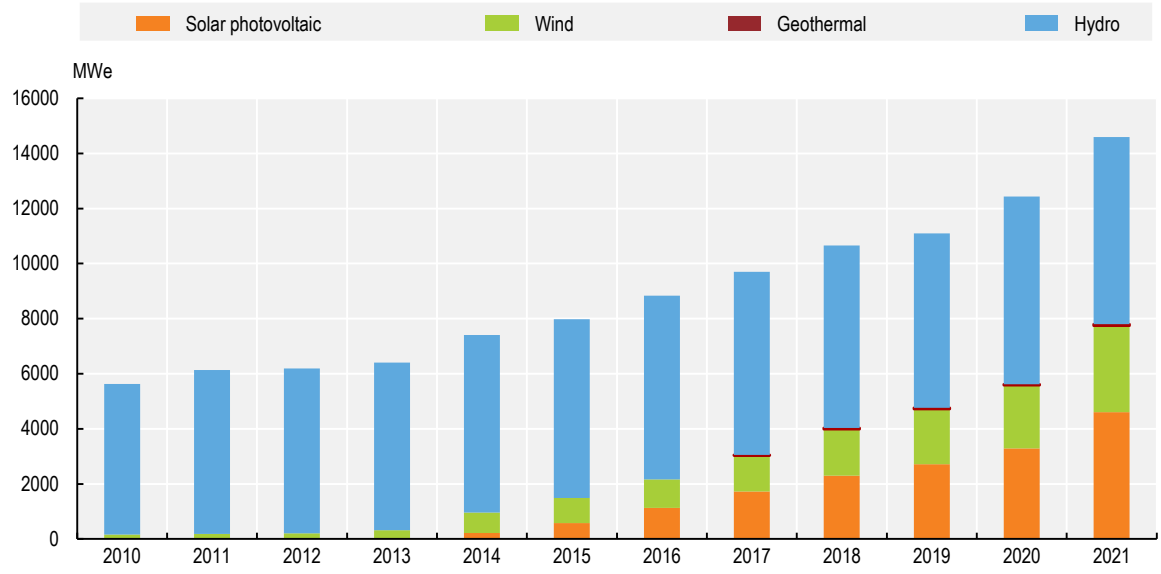
Renewable energy and energy efficiency

Renewable electricity generation capacity grew rapidly, and more investments in transmission and storage infrastructures are needed

Chile accelerated its investment on renewable energy to meet national climate goals. Installed capacity of electricity generation by solar and wind energy has been rising significantly in recent years (Figure 1.14). In LAC countries, Chile is leading the way in the integration of utility-scale renewable energy projects for mining activity, such as Antofagasta's wind power and Compañía de Acero del Pacífico's solar projects (OECD et al., 2022[6]). Chile can further leverage its unique potential in the generation of electricity from renewables. Solar radiation in the country's desert north is among the highest on Earth, while the best onshore wind resources in the world are concentrated in the south (OECD, 2022[65]).

Figure 1.14. Chile has increasingly expanded solar and wind electricity generation capacity

Total renewable electricity generation capacity in Chile, 2010-21



Source: IEA (2023), *IEA Electricity Information Statistics* (database).

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Sufficient investment in transmission and storage infrastructure is critical for a transition towards renewables. Those infrastructures are required to transport the electricity generated by renewables in north and south to the central area with high energy consumption in Chile. However, lack of transmission lines caused the significant curtailment of generated renewable energy. For instance, up to 290 gigawatt (GW) hours of solar- and wind-generated energy were not used in 2022. It also led to electricity price disparities between supply and consumption areas.

The Kimal-Lo Aguirre transmission line is to be operationalised by 2030 to avoid wasting renewable energy in the north. In 2023, the "Energy Transition: Electric Transmission as an enabling sector" bill was submitted to Congress. It aims to accelerate participation of renewables in the energy matrix through efficient development of transmission works (e.g. improve performance of tender processes) and promotion of storage. Further integration of electricity market should be promoted by expanding transmission lines. This would reduce regional price disparities in electricity, boost renewables investment and lower the overall cost of electricity (Gonzales, Ito and Reguant, 2023[66]).

Green hydrogen attracts national attention but must ensure safety and social considerations

The National Green Hydrogen Strategy was established in 2020 to develop a competitive hydrogen industry in Chile (Box 1.1). Chile's extraordinary renewable energy potential with relative cost competitiveness positions it to become a major producer and exporter of green hydrogen.[42] Green hydrogen and its derivatives[43] are a potential solution to store and transport electricity from renewable sources. Further, they can also decarbonise hard-to-abate sectors such as heavy industry and cargo transport. Green hydrogen is expected to contribute 21% of emission reductions required for net zero by 2050. This is significantly higher than its expected contribution in the IEA's net-zero emission scenario (4%) (IEA, 2023[67]).

Box 1.1. National Green Hydrogen Strategy

Chile launched its Green Hydrogen Strategy in 2020. The strategy targets a 5 GW electrolysis capacity by 2025 and aims to become a world leader in production of green hydrogen by 2030 with the world's cheapest hydrogen production. In this way, Chile hopes to become one of the world's top three hydrogen exporters by 2040. Since 2022, the Committee for the Development of the Green Hydrogen Industry has brought together more than ten ministries to implement the strategy through co-ordinated actions. It addresses issues of local demand, land use planning, project financing and development, permits and potential risks.

Chile and Germany have already published roadmaps to develop their domestic markets and look to co-operate with other countries. Chile's strategy focuses on promoting co-operation among industry, academia and technical centres. It encourages the public and private sectors to build research and development roadmaps to solve local implementation challenges.

Source: (Ministry of Energy, 2020[68]), (OECD et al., 2022[6]).

Development of the hydrogen industry needs careful considerations across multiple aspects. Safety is critical for all stakeholders, notably for new, less experienced companies. EIA and permitting processes are increasingly important to ensure safe operation by those players, as well as larger operators. Land-use planning for siting production facilities need to consider appropriate safety distances from communities and biodiversity hotspots. More broadly, the government should employ the precautionary principle for using technology with considerable uncertainties related to its safety (OECD, 2023[69]).

Environmental impacts of hydrogen production, such as on water scarcity and biodiversity, are diverse across regions, requiring a territorial approach. Water is needed to produce hydrogen; further water consumption in areas with high solar energy potential such as Antofagasta in the north can exacerbate water scarcity (Chapter 2). To address this issue, desalination technology will be required to provide water for hydrogen production, and its environmental impacts (e.g. brine) will need to be managed.[44] Development of facilities in open spaces, such as the southern area of the country in Magallanes, can exert pressures on local biodiversity. There are growing concerns about impacts on bird migration routes and alteration of marine-coastal edges. Strategic energy planning of regions needs to be submitted to SEA to ensure incorporation of appropriate environmental considerations. To minimise trade-offs between renewable energy development and biodiversity goals, the government needs to systematically address both climate and biodiversity objectives throughout electricity planning and policy (OECD, 2024[70]).

Energy efficiency investments focus mainly on the building sector

The Ministry of Energy invests in several initiatives for improving energy efficiency. Of its 2022 budget for energy efficiency (CLP 7.8 billion), the building sector accounts for approximately half (CLP 4.2 billion). This sector budget includes the "Better School" programme, which aims to improve energy efficiency in 100 Chilean schools through better thermal conditioning. For the appliance sector, minimum energy performance standards and energy efficiency labels promote energy efficiency for light bulbs, refrigerators, motors and air conditioners.

Low-carbon transport investments focus on electrification of vehicles and railways

Investment in electrification of mobility has been expanding in Chile. Direct subsidies to encourage electrification of regional buses reached a budget of CLP 976 billion for 2022. In 2021, the public transport system in Santiago introduced electric and low-emission buses, making it one of the cities with the highest

percentage of electrical fleet in the LAC region. The Mi Taxi Eléctrico programme, also launched in 2021, helps owners of taxis and buses to switch to EVs (Mi Taxi Eléctrico, 2023[71]).

Various investment initiatives promote alternatives to car use in Chile. The Ministry of Transport and Telecommunications invests approximately USD 1 million annually for bicycle lanes and for the design of specific projects to promote sustainable transportation. For the sustainable mobility infrastructure, almost USD 7 billion is invested to extend metro lines over 70 km, projected in 2022 (Metro de Santiago, 2022[72]).

Lithium mining is intensifying for the green transition, raising environmental concerns

High global demand and elevated prices of critical minerals in the global energy transition provide historic opportunities to Chile, which has almost half of the world's lithium reserves. The global demand for lithium is expected to grow over fifteenfold from 2020 to 2040, mainly driven by increasing demand for EVs and storage use (IEA, 2022[73]). The National Lithium Strategy was developed in 2023 (Box 1.2). Under this strategy, the state will lead development of the lithium industry with support from the private sector.

Box 1.2. National Lithium Strategy

Chile launched a National Lithium Strategy in 2023, led by the Corporation for the Promotion of Production (CORFO). With the involvement of relevant ministries, including Mining, Finance, Economy and Environment, the strategy promotes fiscal, social and environmental sustainability, and the state's participation in lithium revenue streams. It also aims to foster public-private partnerships co-ordinated by the new state-owned National Lithium Company.

The strategy will develop a new institutional framework for lithium production in salt flats and update regulations, with a focus on minimising local freshwater consumption and promoting renewable energy. The unique wetlands in Chilean Andes, which contribute to fragile salt flat ecosystems and provide a carbon sink, are threatened. To safeguard the ecosystems, the strategy will create a network of protected Andean salt flats to protect at least 30% of these areas by 2030 (7.8% in 2023), in line with the international target of the CBD. The strategy also specifies the need to develop hydrogeological and biodiversity baselines with scientific research to understand the impacts of production. Finally, it highlights the need to engage stakeholders, notably local communities and Indigenous peoples.

Source: (Government of Chile, 2023[74]).

Chile leads the GSSS bond market in the region to mobilise private sector investment

Chile has been at the vanguard of leveraging capital markets for sustainable growth, which has broadened the investor base. The country has issued green, social, sustainability and sustainability-linked (GSSS) bonds since 2019. They constitute approximately 30% of the sovereign debt stock, with half of them linked to social initiatives. Green bonds make up around one-fourth of the GSSS bonds issuance (OECD, 2022[65]). Chile has the LAC region's largest GSSS bond market at USD 20.9 billion in cumulative issuance in 2021,[45] (OECD et al., 2022[6]). Chile issued the world's first sovereign sustainability-linked bonds in March 2022 (USD 2 billion). The two key performance indicators are GHG emissions reduction and the scale-up of non-conventional renewable energy (NCRE) generation. For instance, a failure to meet the targets would trigger a coupon penalty for these bonds (Ministry of Finance, 2023[75]).

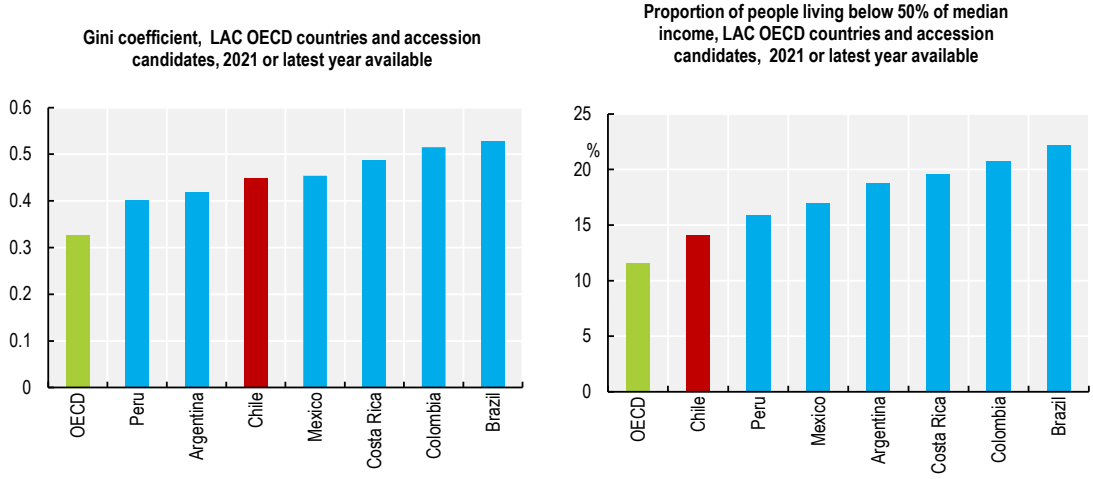
Various initiatives for a national taxonomy for sustainable finance are under development. Chile has created a roadmap for a national taxonomy, focusing on key economic sectors. These include the high-emitting sectors of construction, energy, transport and mining (Climate Bonds Initiative, 2021[76]).

1.3.3. Social and distributional impacts of environmental policy

The COVID-19 pandemic reversed gains in reducing poverty and inequality

Income inequality and poverty in Chile remain high compared to other OECD countries, but lower than in other countries in the region (Figure 1.15). Chile has made remarkable progress in improving social outcomes, with the poverty rate of around 30% in 2006 decreasing to below 14% after 2015. However, the COVID-19 pandemic reversed this trend, leading to an unemployment rate of 10.7% in 2020 (from a low of 6.1% in 2013); this gradually decreased to 8.8% in 2021. Job quality also deteriorated during this period. Self-employment, which is mostly informal, grew more strongly (on average, at 3.8% per year). Meanwhile, salaried employment grew by less than half in the same period (1.6%) (OECD, 2022[65]). Informal workers tend to have lower and more unstable incomes.

Figure 1.15. Income inequality and poverty in Chile are relatively low in the LAC region but high by OECD standards



Note: For the right panel, the OECD average excludes Iceland, Israel, Japan, Korea and New Zealand.
Source: World Bank, WDI; OECD (2023), "Income distribution", *OECD Social and Welfare Statistics* (database).

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Disparities in environmental burdens is a historical and growing concern in Chile

Vulnerable populations face distinct environmental burdens in Chile. For instance, a major air pollution source is home heating with wood combustion by stoves, which are widely used by low-income households (section 1.1.2). Local population in areas referred to as "overburdened zones" (Box 1.3) face disparate environmental burdens caused by industrialisation. In Patagonia, industrial salmon farming exerted pressures on local environment and Indigenous peoples (section 1.1.3).

Box 1.3. Overburdened zones

In the 1980s, the newly adopted Constitution reinforced an economic development model based on the exploitation and export of natural resources. Given their high concentration of polluting activities, five coastal areas designated to be industrialising regions, became known as “overburdened zones”. In these zones, environmental damage is compounded by social inequalities. Industrial activities such as coal-fired power stations, stockage of toxic waste, petrol refineries and copper-processing only marginally benefit local communities. However, they have led to severe health damages and contaminated air, land and water. These densely industrialised areas also feature high rates of poverty and unemployment.

Source: (Ortúzar, 2019[77]), (Allain, 2020[78]).

Projects in high demand for global and domestic clean energy transitions, namely hydrogen, lithium and copper production as well as renewable energy, increase local environmental concerns such as water scarcity and pollution in affected region, if not managed properly. Chemical waste from lithium production can contaminate soil and water. Lithium mining in particular regions, such as the Salar de Atacama, may also deepen historical inequalities and negatively impact Indigenous Andean territories (Jerez, Garcés and Torres, 2021[79]). Lack of transparency and access to key information for local citizens can contribute to procedural injustice, while new job opportunities are not well distributed among the population in the region.

The Just Socio-Ecological Transition needs well-targeted policy for social assistance

Chile has a bold commitment to the Just Socio-Ecological Transition, but putting it into practice will require strategic and targeted policies to address inequality and social impacts. Phasing out coal-fired power plants has raised some concerns about impact on employment. While coal phase-out is expected to add around 25 000 jobs by 2030 across the country (Feng et al., 2023[80]), unemployment in affected communities needs to be addressed. Support for reskilling, such as providing occupational training, can be helpful. The consequences of a carbon tax are heterogeneous across households with different incomes and consumption patterns. Without further measures, the increased carbon tax will disproportionately affect low-income households, given that they spend a larger share of their budget on energy. This potential impact could be mitigated through well-targeted transfers. Introduction of redistribution mechanisms can also help so that revenues generated from carbon tax are used to provide such transfers.

Chile’s social assistance programmes are considered fragmented with low coverage and benefit levels (OECD, 2022[65]). With its focus on poverty, Chile has performed better than other LAC countries on social programmes. More than 95% of social assistance spending to reduce poverty and vulnerability is channelled through cash transfer programmes. The number of families receiving income support has increased in the last two decades. However, the main cash transfer programmes have not reached all those in need. Coverage reached 30.7% in 2017 for the main social assistance programmes, but only 51% of households in poverty were receiving at least one type of income support (OECD, 2022[65]). Moreover, some high-income households were receiving cash transfers to the detriment of public spending efficiency. Well-targeted polices for social assistance require investments in better data collection.

In addition, screening and mapping tools can be a powerful means to identify communities with environmental justice concerns and inform targeted actions. Chile should strengthen the evidence base to better understand the types of communities facing disparate pollution burdens and use this to spur efforts on environmental justice. For instance, the United States has developed an EJ screening and mapping tool called “EJ Screen”. This tool provides a nationally consistent dataset and approach for combining environmental and demographic indicators to consider EJ issues. These tools can facilitate assessment of

cumulative exposures and impacts, serving as an important starting point for more context-specific, local-level policy decisions (OECD, 2023[81]).

References

Allain, M. (2020), *Chile: the Social Crisis is Also an Environmental One*, webpage, https://noria-research.com/chile-the-social-crisis/ (accessed on 30 August 2023). [78]

Araos, A. et al. (2020), "Estimated economic impacts of seven invasive alien species in Chile", *Human Dimensions of Wildlife*, Vol. 25/4, pp. 398-403, https://doi.org/10.1080/10871209.2020.1740837. [31]

BCN (2023), *LEY 21600: Crea el Servicio de Biodiversidad y Áreas Protegidas y el Sistema Nacional de Áreas Protegidas, [LAW 21600: Creates the Biodiversity and Protected Areas Service and the National System of Protected Areas]*, Biblioteca del Congreso Nacional de Chile, https://www.bcn.cl/leychile/navegar?idNorma=1195666 (accessed on 2 October 2023). [39]

BCN (2023), *Ley Chile - Ministerio del Medio Ambiente, [Chile Law - Ministry of Environment]*, webpage, https://www.bcn.cl/leychile/consulta/listado_n_sel?comp=&agr=1020&_grupo_aporte=&sub=&npagina=1&itemsporpagina=10&totalitems=21 (accessed on 8 August 2023). [52]

BCN (2023), *Presupuesto de la Nación: Subsecretaría del Medio Ambiente, [National Budget: Undersecretariat of the Environment]*, Biblioteca Nacional del Congreso de Chile, https://www.bcn.cl/presupuesto/periodo/2023/partida/25/capitulo/01/programa/01/subtitulo/24/item/03/asignacion/017 (accessed on 2 October 2023). [44]

Benavides, C. et al. (2021), *Options to Achieve Carbon Neutrality in Chile: An Assessment Under Uncertainty*, Inter-American Development Bank, Washington, https://doi.org/10.18235/0003527. [10]

Carrasco, E., R. Benítez and E. Cañas (2023), "The Environment and Climate Change Law Review: Chile", in *Environment and Climate Change Law*, In-Depth: Environment and Climate Change Law, Lexology, https://thelawreviews.co.uk/title/the-environment-and-climate-change-law-review/chile. [53]

CBD (2021), *Aichi Biodiversity Target 11 Country Dossier : Chile*, Convention on Biological Diversity. [38]

Chile Transparente (2021), *Corruption Risks in the Award of Mining Concessions and Environmental Permits: the Case of Chile*, Chile Transparente, https://www.chiletransparente.cl/wp-content/files_mf/1634296005Chile_Report_vF_web1.pdf. [55]

Climate Bonds Initiative (2021), *Latin America & Caribbean: State of the market*, Climate Bonds Initiative, https://www.climatebonds.net/files/reports/cbi_lac_2020_04e.pdf. [76]

CSP and MMA (2020), *Análisis Sobre el Esquema Tarifario Establecido en la Recolección Municipal de Residuos, [Analysis of the established Municipal Waste Collection Tariff Scheme]*, Centro de Sistemas Públicos (CSP), Universidad de Chile. [43]

De Vicente, A. (2022), *Euro 6: la estricta norma de emisiones que comienza a regir para los vehículos livianos y medianos en Chile, [Euro 6: the strict emissions standard that begins to apply to light and medium-sized vehicles in Chile]*, 29 September, Reporte Minero & Energético, https://www.reporteminero.cl/noticia/noticias/2022/09/norma-euro-6-chile (accessed on 6 September 2023). [21]

Defense, I. (ed.) (2019), "Sacrifice Zones: The injustice of living in an unhealthy environment", *Interamerican Association for Environmental Defense*, ADIDA blog, https://aida-americas.org/en/blog/sacrifice-zones-the-injustice-of-living-in-an-unhealthy-environment (accessed on 30 August 2023). [77]

DIPRES (2023), *Gastio Presupuestario en Inversión Pública en Materias Relativas a cambio Climático: Año 2022, [Budgetary Expenditure on Public Investment in Climate Change-Related Matters: Year 2022]*, Dirección de Presupuestos de Chile, https://www.dipres.gob.cl/598/articles-316674_doc_pdf.pdf. [64]

DIPRES (2022), *Estadísticas de las Finanzas Públicas 2012-202, [Public Finance Statistics 2012-202]*, Dirección de Presupuestos de Chile, https://www.dipres.gob.cl/598/articles-274905_doc_pdf.pdf. [63]

Dussarrat, T. et al. (2022), "Predictive metabolomics of multiple Atacama plant species unveils a core set of generic metabolites for extreme climate resilience", *New Phytologist*, Vol. 234/5, pp. 1614-1628, https://doi.org/10.1111/nph.18095. [35]

ECLAC (2019), *Encuesta a Municipios Sobre Gestión de Residuos Sólidos Domiciliarios [Survey of Municipalities on Household Solid Waste Management]*, ECLAC. [42]

EFI (2019), *Planted Forest: The Big Opportunity for Forest Recovery in Chile and Uruguay*, European Forest Institute. [33]

Feng, K. et al. (2023), "National and local labor impacts of coal phase-out scenarios in Chile", *Journal of Cleaner Production*, Vol. 414, https://doi.org/10.1016/J.JCLEPRO.2023.137399. [80]

Finance, M. (ed.) (2023), *Chile's Sustainability Linked Bond Report 2023*. [75]

Gonzales, L., K. Ito and M. Reguant (2023), *Market integration and the expansion of renewable energy: Evidence from Chile*, 23 January, VoxDev, https://voxdev.org/topic/energy-environment/market-integration-and-expansion-renewable-energy-evidence-chile (accessed on 28 August 2023). [66]

Government of Chile (2023), *National Lithium Strategy*, Government of Chile, https://s3.amazonaws.com/gobcl-prod/public_files/Campa%C3%B1as/Litio-por-Chile/Estrategia-Nacional-del-litio-EN.pdf. [74]

Government of Chile (2023), *Stronger Regions: President Boric announces bill for the decentralization of Chile*, 27 April, Press Release, Government of Chile, https://www.gob.cl/en/news/stronger-regions-president-boric-announces-bill-decentralization-chile/. [51]

Government of Chile (2023), *The National Council for the Implementation of the 2030 Agenda for Sustainable Development*, webpage, https://www.chileagenda2030.gob.cl/Agenda%202030/sobre-agenda/consejo-nacional-2030/1# (accessed on 2 June 2023). [50]

Government of Chile (2021), *Estrategia Climática de Largo Plazo de Chile: Camino a la Carbono Neutralidad y Resilencia a Más Tardar al 2050, [Chile's Long-Term Climate Strategy: Towards Carbon Neutrality and Resilience no Later than 2050]*, Government of Chile, https://cambioclimatico.mma.gob.cl/wp-content/uploads/2021/11/ECLP-LIVIANO.pdf. [9]

Government of Chile (2021), *Minister Jobet announces 66 measures to guide the development of Chile's energy sector over the next decades*, 21 October, Press Release, Government of Chile, https://www.gob.cl/en/news/minister-jobet-announces-66-measures-to-guide-the-development-of-chiles-energy-sector-over-the-next-decades/ (accessed on 25 July 2023). [12]

Government of Chile (2021), *National Electromobility Strategy Launch: Government announces that only electric vehicles will be sold in Chile by 2035*, 18 October, Press Release, Government of Chile, https://www.gob.cl/en/news/national-electromobility-strategy-launch-government-announces-only-electric-vehicles-will-be-sold-chile-2035/ (accessed on 16 June 2023). [15]

Government of Chile (2020), *Chile's Nationally Determined Contribution*, Government of Chile. [37]

Government of Chile (2020), *Green growth opportunities for the decarbonization goal for Chile*, Government of Chile, https://documents1.worldbank.org/curated/en/968161596832092399/pdf/Green-Growth-Opportunities-for-the-Decarbonization-Goal-for-Chile-Report-on-the-Macroeconomic-Effects-of-Implementing-Climate-Change-Mitigation-Policies-in-Chile-2020.pdf. [17]

Hilgers, M., S. Vial and J. Gutierrez (2023), *Chile: Economic and environmental crimes to be sanctioned in new law*, Baker McKenzie blog, https://www.globalcompliancenews.com/2023/06/01/https-insightplus-bakermckenzie-com-bm-environment-climate-change_1-chile-economic-and-environmental-crimes-to-be-sanctioned-in-new-law_05242023/ (accessed on 8 August 2023). [57]

Hoyos-Santillan, J. et al. (2021), "Diversifying Chile's climate action away from industrial plantations", *Environmental Science & Policy*, Vol. 124, pp. 85-89. [36]

IEA (2023), *Fossil Fuels Consumption Subsidies 2022*, IEA, Paris, https://www.iea.org/reports/fossil-fuels-consumption-subsidies-2022. [60]

IEA (2023), *Global EV Data Explorer – Data Tools*, (database), https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer (accessed on 20 June 2023). [16]

IEA (2023), *Net Zero Roadmap A Global Pathway to Keep the 1.5 °C Goal in Reach*, IEA, Paris, https://iea.blob.core.windows.net/assets/6d4dda5b-be1b-4011-9dad-49c56cdf69d1/NetZeroRoadmap_AGlobalPathwaytoKeepthe1.5CGoalinReach-2023Update.pdf (accessed on 19 October 2023). [67]

IEA (2022), *Law 20920. Establishment of a framework for waste management, extended producer responsibility and recycling.*, https://www.iea.org/policies/16005-law-20920-establishment-of-a-framework-for-waste-management-extended-producer-responsibility-and-recycling (accessed on 19 June 2023). [40]

IEA (2022), *The Role of Critical Minerals in Clean Energy Transitions*, IEA, Paris, http://www.iea.org/t&c/ (accessed on 22 November 2022). [73]

IEA (2021), *World energy statistics, IEA World Energy Statistics and Balances (database)*. [14]

IHME (2022), *Global Burden of Disease (GBD)*, https://www.healthdata.org (accessed on 9 October 2023). [24]

Jerez, B., I. Garcés and R. Torres (2021), "Lithium extractivism and water injustices in the Salar de Atacama, Chile: The colonial shadow of green electromobility", *Political Geography*, Vol. 87, https://www.sciencedirect.com/science/article/pii/S0962629821000421 (accessed on 30 August 2023). [79]

LIttle C., C. (2023), *Otro Marco Forestal: del 701 a Territorios Multifuncionales, [Another Forestry Framework: from 701 to Multifunctional Territories]*, CIPER. [34]

Maes, M. et al. (2022), "Monitoring exposure to climate-related hazards : Indicator methodology and key results"*, OECD Environment Working Papers*, No. No. 201, OECD Publishing, Paris, https://doi.org/10.1787/da074cb6-en (accessed on 21 September 2023). [4]

Mardones, C. (2021), "Ex-post evaluation and cost-benefit analysis of a heater replacement program implemented in southern Chile", *Energy*, Vol. 227, https://doi.org/10.1016/j.energy.2021.120484. [28]

MDSF (2023), *Baja la pobreza por ingresos y la pobreza multidimensional en Chile [Income poverty and multidimensional poverty fall in Chile]*, 27 July, Noticias, Ministerio de Desarrollo Social y Familia de Chile. [26]

Metro de Santiago (2022), *Memoria Integrada Contenidos, [Integrated Report Contents]*. [72]

Mi Taxi Eléctrico (2023), *Programa Mi Taxi Eléctrico [My Electric Taxi Program]*, https://mitaxielectrico.cl/ (accessed on 13 June 2023). [71]

MinEnergia (2023), *Plataforma de Indicadores de Pobreza Energética [Energy Poverty Indicators Platform]*, https://vipe.minenergia.cl/ (accessed on 2 October 2023). [27]

Ministry of Agriculture and CONAF (2019), *The National Strategy for Climate Change and Vegetation Resources (ENCCRV)*, https://www.enccrv.cl/ (accessed on 21 September 2023). [19]

Ministry of Energy (2020), *National Green Hydrogen Strategy*, https://energia.gob.cl/sites/default/files/national_green_hydrogen_strategy_-_chile.pdf. [68]

Ministry of Finance (2023), *Royalty Minero: Comisión de Minería y Energía Arueba Proyecto Tras Indicaciones del Ejecutivo que Aumentan los Recursos a Regiones y Municipios del País*, [Mining Royalty: Mining and Energy Commission approves project after indications from the Executive that increase resources to regions and municipalities of the country], https://www.hacienda.cl/noticias-y-eventos/noticias/comision-mineria-senado-aprueba-royalty (accessed on 22 August 2023). [62]

Ministry of Finance and Green Climate Fund (2021), *Readiness proposal - Update of the National Climate Change Adaptation Plan (NAP) in Chile*, https://www.greenclimate.fund/sites/default/files/document/adaptation-plan-update-chile-fao_0.pdf. [3]

MMA (2023), *Informe del Inventario Nacional de Chile 2022: Inventario Nacional de Gases de Efecto Invernadero y Otros Contaminantes Climáticos 1990-2020*, [Chile 2022 National Inventory Report: National Inventory of Greenhouse Gases and Other Climate Pollutants 1990-2020], Ministry of the Environment, https://snichile.mma.gob.cl/wp-content/uploads/2023/04/2022_IIN_CL.pdf (accessed on 9 October 2023). [13]

MMA (2023), *Seremi del Medio Ambiente presenta estudio de Suelos con Potencial Presencia de Contaminantes, [Seremi del Medio Ambiente presents study of Soils with Potential Contaminant Presence]*, 20 April, Ministry of the Environment, https://mma.gob.cl/seremi-del-medio-ambiente-presenta-estudio-de-suelos-con-potencial-presencia-de-contaminantes/ (accessed on 3 June 2023). [58]

MMA (2022), *5th Biennial Update Report under the United Nations Framework Convention on Climate Change*, https://unfccc.int/sites/default/files/resource/5IBA_Executive%20summary.pdf (accessed on 10 May 2023). [8]

MMA (2021), *Estrategia Nacional de Residuos Orgánicos Chile 2040, [National Organic Waste Strategy Chile 2040]*. [46]

MMA (2021), *Informe del Estado del Medio Ambiente: Calidad del Aire [State of the Environment Report: Air Quality]*. [20]

MMA (2020), *Atlas of Climate Risks for Chile*, https://arclim.mma.gob.cl/ (accessed on 27 July 2023). [7]

OECD (2024), *Mainstreaming Biodiversity into Renewable Power Infrastructure*, OECD Publishing, Paris. [70]

OECD (2023), *Biodiversity*, Environment Statistics (database), https://doi.org/10.1787/data-00605-en. [30]

OECD (2023), "Chile", in *OECD Economic Outlook, Volume 2023 Issue 1 - Chile*, OECD Publishing, Paris, https://doi.org/10.1787/ce188438-en (accessed on 15 December 2023). [2]

OECD (2023), "Chile", in *Environment at a Glance Indicators*, OECD Publishing, Paris, https://doi.org/10.1787/ac4b8b89-en (accessed on 20 June 2023). [1]

OECD (2023), *Effective Carbon Rates 2023: Pricing Greenhouse Gas Emissions through Taxes and Emissions Trading*, OECD Publishing, Paris, https://doi.org/10.1787/b84d5b36-en. [59]

OECD (2023), *OECD Environmental Performance Reviews: United States 2023*, OECD Publishing, Paris, https://doi.org/10.1787/47675117-en. [81]

OECD (2023), *Taming Wildfires in the Context of Climate Change*, OECD Publishing, Paris, https://doi.org/10.1787/dd00c367-en. [5]

OECD (2023), *Understanding and Applying the Precautionary Principle in the Energy Transition*, OECD Publishing, Paris, https://doi.org/10.1787/5b14362c-en. [69]

OECD (2022), *Agricultural Policy Monitoring and Evaluation 2022: Reforming Agricultural Policies for Climate Change Mitigation*, OECD Publishing, Paris, https://doi.org/10.1787/7f4542bf-en. [18]

OECD (2022), *Latin American Economic Outlook 2022: Towards a Green and Just Transition*, OECD Publishing, Paris, https://doi.org/10.1787/3d5554fc-en. [23]

OECD (2022), *OECD Economic Surveys: Chile 2022*, OECD Publishing, Paris, https://doi.org/10.1787/311ec37e-en (accessed on 5 May 2023). [65]

OECD (2022), *OECD Review of Fisheries 2022*, OECD Publishing, Paris, https://doi.org/10.1787/9c3ad238-en. [61]

OECD (2020), *Environmental Risks and Health, Exposure to Air Pollution, Environment Statistics (database)*, https://doi.org/10.1787/e12b7dd9-en. [22]

OECD (2019), *Waste Management and the Circular Economy in Selected OECD Countries: Evidence from Environmental Performance Reviews*, OECD Environmental Performance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/9789264309395-en. [47]

OECD/ECLAC (2016), *OECD Environmental Performance Reviews: Chile 2016*, OECD Environmental Performance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/9789264252615-en. [54]

OECD et al. (2022), *Latin American Economic Outlook 2022: Towards a Green and Just Transition*, OECD Publishing, Paris, https://doi.org/10.1787/3d5554fc-en. [6]

Pelayo Díaz, C. and I. Linazasoro Espinoza (2020), "The climatic impact of garbage: Legal analysis of solid waste,recovery and landfill mining", *Revista de Derecho Ambiental(Chile)* 14, pp. 71-95, https://doi.org/10.5354/0719-4633.2020.54151. [45]

Peró, J. et al. (2022), *Informe de Recuperación y Valorización de Materiales Reciclables y Compostables por Comuna [Recyclable and Compostable Materials Recovery and Valorization Report by Commune]*, KYKLOS. [48]

Reperger, S. (2021), *Miradas para la Inclusión: Participación Ciudadana de Grupos Excluidos, [Perspectives for Inclusion: Citizen Participation of Excluded Groups]*, Fundación Friedrich Ebert, https://library.fes.de/pdf-files/bueros/chile/17716.pdf (accessed on 18 September 2023). [56]

Rodríguez Salas, A. and M. Trebilcock (2020), *Desigualdades Territoriales y Comportamiento Ecológico: Determinantes del Hábito de Reciclaje en Chile y sus Barreras, [Territorial Inequalities and Ecological Behavior: Determinants of Recycling Habits in Chile and their Barriers]*, Universidad Alberto Hurtado, Facultad de Ciencias Sociales. [49]

Schönsteiner, J. et al. (2021), *Regulations Applicable to the Salmon Industry in Chile: Gaps with International Environmental Standards, Labor and Human Rights*, Instituto Danés de Derechos Humanos, ASDI, Fondo Nacionnal de Desarrollo Científico y Tecnológico, https://derechoshumanos.udp.cl/publicacion/normativa-aplicable-a-la-industria-del-salmon-en-. [32]

Simon, F. et al. (2023), "Toward sustainability and resilience in Chilean cities: Lessons and recommendations for air, water, and soil issues", *Heliyon*, Vol. 9/7, https://doi.org/10.1016/j.heliyon.2023.e18191. [29]

SINIA (2022), *Reporte del Estado del Medio Ambiente 2022, [State of the Environment Report 2022]*. [25]

SUBDERE (2018), *Diagnóstico de la Situación por Comuna y por Región en Materia de RSD y Asimilables, [Diagnosis of the Situation by Commune and Region regarding MSW and Assimilables]*, Programa Nacional de Residuos Sólidos. [41]

Valdés, J. et al. (2023), "Greenhouse Gas mitigation beyond the Nationally Determined Contributions in Chile: an assessment of alternatives", *Economics Discussion Paper Series*, No. EDF EDP 23, Environmental Defense Fund, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4481537 (accessed on 2 August 2023). [11]

Notes

[1] Six hazards are considered: heat stress, cold stress, wildfire, wind threats, and river and coastal flooding.

[2] Twelve sectors are included in the FLCC: Forestry and Agriculture; Biodiversity; Fisheries and Aquaculture; Health; Infrastructure Services; Cities; Energy; Tourism; Coastal areas; Water resources (under development); Mining; and Transport.

[3] Regionalised data with resolution of 5 km.

[4] The target of reducing GHG emissions by 20% by 2020 compared to business as usual (BAU) emissions projected since 2007.

[5] Ministries of Environment; Interior and Public Security; External Relations; Defence; Hacienda; Economy; Education; Public Works; Health; Housing and Urbanism; Agriculture; Mining; Transport and Telecommunications; Energy; and Science, Technology, Knowledge and Innovation.

[6] The maximum period of preparation for the regional action plan is three years from the date of enactment of the FLCC.

[7] Targets are not to exceed 1 100 million tonnes of carbon dioxide equivalent (tCO_2e) between 2020 and 2030, and to reach a GHG emissions level of 95 million tCO2e excluding the land use, land-use change and forestry sector by 2030.

[8] In 2019, 28 coal-fired plants were in operation, with a total capacity of 5 529 megawatts. As of November 2023, eight plants closed with a total capacity of 1 189 megawatts.

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

[10] This is referred to as "low-emission energy" in the target stated by the Chilean authority.

[11] Importers or representatives of each light-duty vehicle brand marketed in Chile must meet these standards under Energy Efficiency Law. The standards are planned to start for medium-duty vehicles in 2026 and for heavy-duty vehicles in 2028.

[12] This includes solar systems (thermal, heat pumps), non-traditional biomass boilers (pellets, chips, waste), hydrogen combustions, electricity in the proportion of renewable generation, among others.

[13] Excluding conventional renewable energy such as large-scale hydroelectric energy.

[14] i) operate zero-emission fleets at large mining companies by 2030; ii) reduce CO_2 equivalent emissions from large-scale mining operations by at least 50% by 2030, achieving net zero by 2040; iii) ensure that the mining sector is powered at 90% by renewable energy sources by 2030 and 100% by 2050.

[15] ECLP also has the target for landscape restoration: 1 million ha by 2030, and 2.5 million ha by 2050.

[16] Critical episodes are declared based on data provided by a statistical daily air quality forecast model, with the aim of indicating a high risk of exposure to atmospheric pollutants. These episodes are classified as alert, pre-emergency, and emergency. Daily $PM_{2.5}$ concentration values are established in three ranges: 80-109 µg/m³, 110-169 µg/m³, and 170 µg/m³ or higher, respectively. Only in areas where there are prevention and/or environmental decontamination plans can the existence of a critical episode be confirmed.

[17] Primary air quality standards are environmental quality standards that aim to protect human health within, given a concentration level that represents an acceptable risk.

[18] A latent zone is one in which the measurement of the concentration of pollutants in the air, water, or soil is between 80% and 100% of the value of the respective environmental quality standard. A saturated zone is one in which one or more environmental quality standards are exceeded.

[19] The estimates represent a minimum floor of foregone benefits, so in no case can these results be used as an absolute economic value. Economic impacts are estimated for seven invasive alien species in Chile: beaver (Castor canadensis), rabbit (Oryctolagus cuniculus), wild boar (Sus scrofa), American mink (Neovison vison), yellow jacket (Vespula germanica), blackberry (Rubus spp.), and ulex (Ulex europaeus). The direct and indirect impacts considered are on livestock and agricultural production, forest plantations, components of biodiversity, wood and viti/viniculture production, loss of forest biomass, repair of road infrastructure, potential cost in fire control, decrease in carbon sequestration and resources allocated for species control and research.

[20] At the national level, MMA uses SIMBIO, https://simbio.mma.gob.cl/AreaProtegida/IndexDesignaciones/1161, as a source of georeferencing for marine protected areas. The official figure from the General Directorate of the Maritime Territory (DIRECTEMAR -SHOA) for EEZ is 3,402,990 km2. Data differ slightly from data reported in the *OECD Environment Statistics* database, which shows 41.1% of exclusive economic zone and 20.5% of terrestrial area covered by protected areas in 2022.

[21] Real Rights for Conservation are agreements between landowners and conservation organisations. The landowner retains the ownership but agrees to certain restriction on usages. These restrictions can help protect wildlife, water quality, or other natural resources, while allowing a sustainable use of the land.

[22] Clean Point: These are fixed facilities located in public places, designed to receive waste selectively from the public, for storage, possible pre-treatment and shipment to collection centres or disposal facilities. Green Point: These are one or more mobile containers located in places of use or public access designed to receive specific waste from the public, for storage and shipment to recovery or disposal facilities.

[23] The mining communes fund; the regional fund for productivity and development; and the support fund for territorial equity.

[24] RE 309/2023 begins preparation of the preliminary draft of the Environmental Quality Primary Standard for soils.

[25] For example, Germany and Austria have some standards closely linked to best available techniques.

[26] The initiative comprises six pillars, which include: improve reporting times; simplify the sanctioning process; provide greater mechanisms to encourage compliance; and increase maximum penalties.

[27] The number of non-compliance incidents in the salmon industry decreased from 38 in 2020 to 8 in 2023.

[28] However, RCAs proscribe environmental impact mitigation measures, including those related to sector-specific issues.

[29] i) discharge polluting substances into marine or inland water; ii) extract continental waters, whether surface or subway, or maritime waters; iii) dump or deposit polluting substances in the soil or subsoil, continental or maritime; iv) dump soil or other solids into wetlands; v) extract components from the soil or subsoil; vi) release polluting substances into the air.

[30] The regions with the most SPPCs are Atacama (1 195), Magallanes (1 096), Coquimbo (1 024), Metropolitana (992) and Antofagasta (953).

[31] Facilities that operate based on non-conventional renewable generation whose primary source is biomass are exempt from the carbon tax, although the tax for local pollutants applies.

[32] Large emitters are those whose emissions are 100 or more tonnes per year of particulate matter, or 25 000 or more tonnes of CO_2 per year. If either of these two thresholds is equalled or exceeded, the regulated source must pay for the total emissions of the pollutants concerned. The set of affected establishments include electricity generation, fishing, pulp/paper, agriculture, wood and mining sector in 2022.

[33] This is the case if the variable cost (including carbon tax portion) of fossil fuels-based power generators is larger than the market spot price of electricity. The compensation by renewables-based power generators is proportional to their electricity withdrawals.

[34] It begins to apply to 2023 emissions that will be reported in 2024.

[35] Petrol, diesel, liquefied and compressed natural gas.

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

[37] Equivalent to USD 208.0/tCO_2e.

[38] Equivalent to USD 44.1/tCO_2e.

[39] With a gross vehicle weight equal to or greater than 3 860 kg.

[40] This includes exporters and construction companies for the IEC diesel when it has not been earmarked for motor vehicles that travel on streets, roads and public roads in general.

[41] The specific tax on mining falls outside the OECD's definition of environmentally related taxes as it is more a tax on profits than on extracted minerals.

[42] Hydrogen produced by the electrolysis of water, using renewable electricity.

[43] They include ammonia, methanol and electrofuels.

[44] As of November 2023, Congress was reviewing a bill that requires usage of desalination technology for hydrogen production and regulates its environmental impacts.

[45] As of July 2023, the cumulative issuance reached approximately USD 43.2 billion in Chile.

2 Water management and policies

The management of water resources has important economic, environmental and social consequences for Chile. This chapter examines pressures and trends related to the country's water resources, focusing on water quantity and quality, the impact of climate change, and the state of water and sanitation services. It subsequently analyses water strategies, river basin plans, and institutional arrangements. The chapter concludes with a discussion of policy instruments such as water allocation, water quality standards and regulations, data and information, economic instruments, and finance and investment for infrastructure. Throughout the chapter, good practices in other OECD member countries, such as Israel and Spain, are highlighted.

2.1 Pressures, state and trends

2.1.1 Water quantity

Chile's freshwater resources are unevenly distributed across the country, resulting in stark contrasts for water availability and quality. The country's distinct geography and climate variability across the territory add to the challenges for water management. Chile has the world's longest national mountain ridge and shoreline, which provides a high potential for hydropower. The climate varies from the driest region in the world, including the Atacama Desert, to numerous glaciers and a humid climate in the south. The country has about 1 250 rivers that flow from the mountains to the sea. Its 101 hydrological basins, including many small-scale basins, create a complex, interconnected water system.

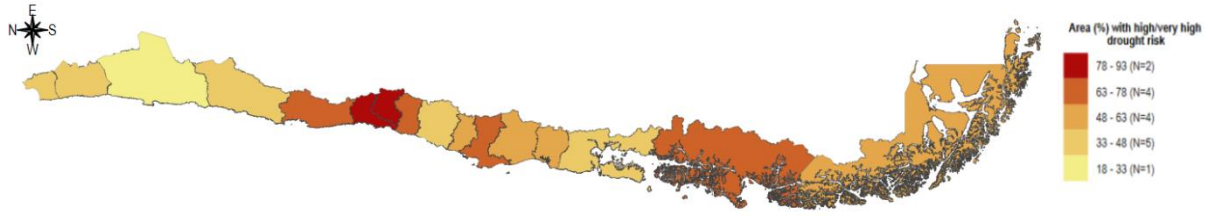
Water scarcity is acute in the arid north, where most of the water-intensive mining activities occur. It is a major challenge in central Chile, where agricultural production and population centres are concentrated. Pressures on water resources are growing due to various factors: rising demand; pollution; and declining, more erratic and unpredictable supply due to the over-allocation of water resources, drought and climate change. The impact of climate change on the hydrological cycle and rising temperatures generate considerable uncertainty about future water availability and demand.

The management of water resources has important economic, environmental and social consequences for the country. Chile aims to become a global agricultural and food production power. In the context of the global transition to net zero, by 2040, demand for Chile's main minerals – copper and lithium – is projected to nearly double and increase tenfold, respectively (OECD, 2023[1]). Chile is also pursuing ambitious investments in green hydrogen. All these activities depend on the secure supply of water. Intensifying pressures on available water resources have resulted in growing competition for water among industry, agriculture, energy production, public water supply and ecosystems. This, in turn, has resulted in social conflicts, including with Indigenous communities. The competition for water has amplified the number of conflicts and their extent across the national territory. Significant drivers of disputes relate to property rights and the environment, regularisation of water rights, and overexploitation and uncontrolled use of groundwater (Donoso, 2021[2]).

The availability of freshwater resources is sharply declining

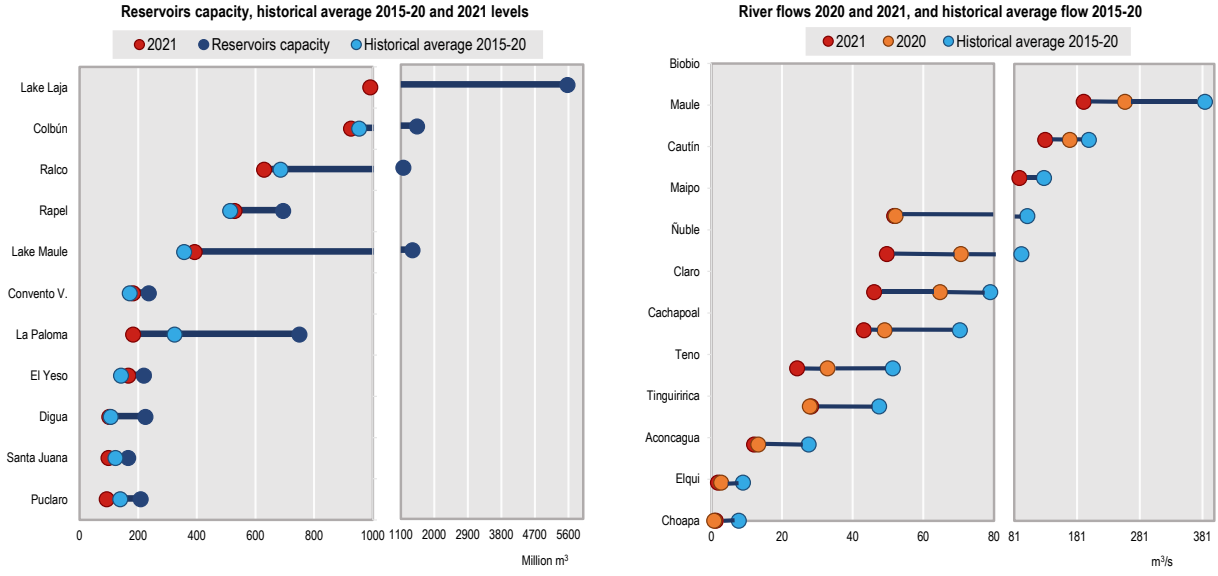
Chile faces extreme water stress and ranks 16th among 164 countries for baseline water stress (Kuzma, Saccoccia and Chertock, 2023[3]). Pressure on freshwater resources has intensified over time, resulting in acute declines in availability. Chile has been facing a "megadrought" for 14 years. Drought risk is high or very high in multiple provinces across the country (Figure 2.1). River flows are generally below 2015-20 averages. The situation is especially acute in northern and central Chile. For example, the Bio Bío River in central Chile has experienced declining flows. It is the second largest river, with the highest hydropower potential. As such, it has been characterised as the most economically important river in the country. Water levels in many dam reservoirs are declining; in Lake Laja, for example, levels are far below capacity (Figure 2.2). This dam is a critical source of hydroelectricity and irrigation and among the reservoirs with the capacity for multi-year storage. It serves as a "reserve battery" for the entire national grid (Bauer, 2013[4]).

Figure 2.1. Multiple provinces are at high or very high risk of drought



Note: The drought risk index is a combined index that integrates indicators of meteorological drought, measured through the Standardized Precipitation Index, and agricultural drought, estimated through the Normalized Difference Vegetation Index.
Source: CONAF (2021), Actualización a Escala Nacional de los Mapas de Desertificación, Degradación de las Tierras y Sequía de Chile, [National Scale Update of the Desertification, Land Degradation and Drought Maps of Chile].

Figure 2.2. The availability of freshwater resources is sharply declining



Source: SINIA (2022), Medio ambiente y el impacto de la actividad antrópica: Aguas Continentales [Environment and the impact of anthropogenic activity: Inland Waters], Reporte del Estado del Medio Ambiente Chile 2022 [State of the Environment Report Chile 2022].

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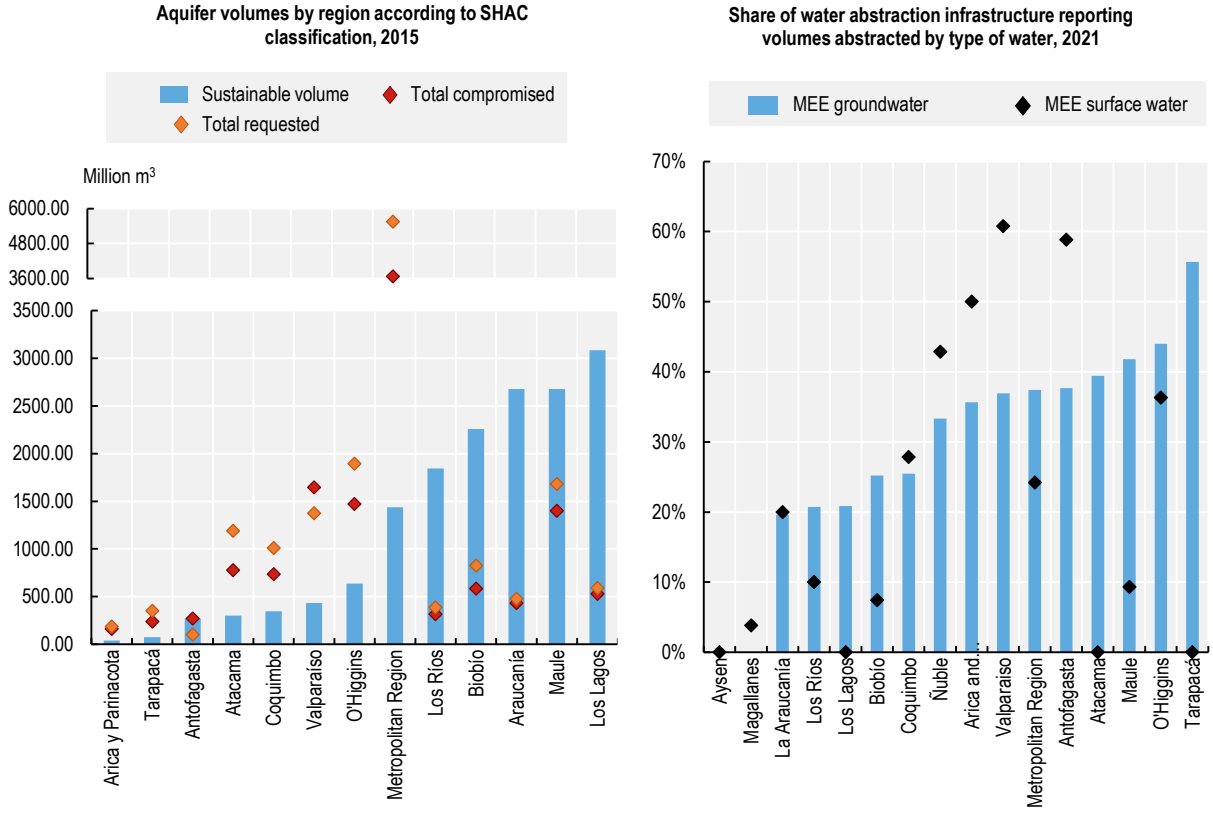
Growing uncertainty related to surface water supply has translated into intensifying pressures on groundwater. Demand for groundwater exceeds sustainable levels of supply in most regions (Figure 2.3). As of 2015, total volume of known allocated water rights for groundwater abstraction was greater than sustainable supply, resulting in over-allocation of these resources. Limited monitoring and reporting impede a comprehensive understanding of total freshwater abstractions for surface water and groundwater. Less than half of registered infrastructure works for water abstraction are reporting volumes abstracted in the Directorate General for Water (DGA) system for Monitoring Effective Extractions; some are not reporting at all (Figure 2.3).

Figure 2.3. Groundwater demand exceeds supply in most regions, while less than half of abstraction works are monitored



Note: Left panel: SHAC = sector hidrogeológico de aprovechamiento común (hydrogeological sector of common use), a body of groundwater that can be defined and managed as a unit. Sustainable volume: annual amount of water associated with the recharge of the aquifer. Total committed: amount of water that corresponds to all constituted and recognised water rights. Total requested: annual amount of water that corresponds to all applications for water rights, both resolved and pending. Data are underestimated.
Right panel: MEE = monitoring effective extractions. Data are available as of May 2023. Values are provisional. Total works reporting considered works reporting on line. Regions of Aysen and Magallenes are not registered for groundwater.
Source: DGA (2016), *Atlas del Agua,* [Water Atlas], Chapter 4, pg.116; SINIA (2023), *Monitoreo de Extracciones Efectivas* [Monitoring of Effective Withdrawals].

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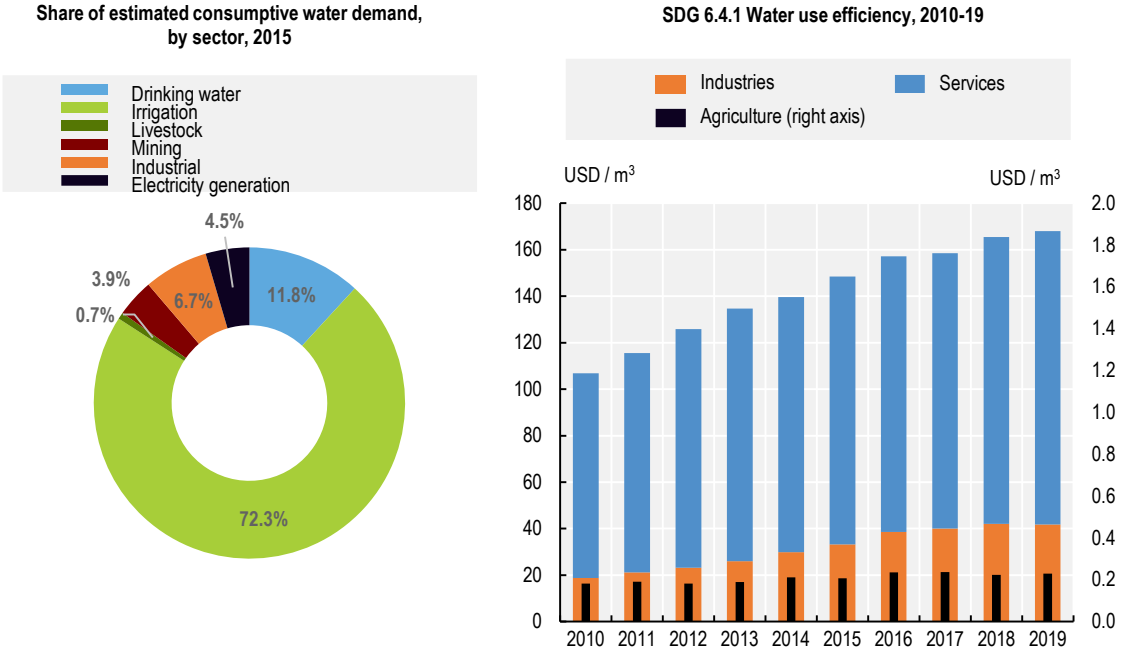
Overall, agriculture remains the major user of freshwater resources, accounting for around 72% of estimated consumptive water demand, with industrial and municipal use accounting for minor shares (Figure 2.4). Hydropower was the second-largest energy source in power generation after coal, accounting for 20% of electricity supply in 2022. This share varies significantly year-on-year, depending on hydrological conditions; although recurring drought conditions have contributed to the generally declining share of hydropower in power generation. Environmental concerns have slowed developments of new hydropower plants, but multiple plants are still being developed (IEA, 2018[5]). Green hydrogen projects are expected to increase water demand, although these will be required to use desalinated water. In northern and central Chile, due to drought conditions and a lack of secure water rights, domestic water supply often competes with other uses. This leads to high-cost and inefficient emergency solutions (e.g. cistern trucks and desalination of brackish rivers).

Relative to water use for service-based activities and industrial activities, water used for agriculture is much less efficient. Water use efficiency of service-based activities and industrial activities has increased significantly over 2010-19, while water use efficiency in agriculture has increased only slightly (Figure 2.4).

Figure 2.4. Agriculture accounts for the largest share of water withdrawals and is less economically efficient than other water uses



Note: Water demand for electricity generation can be categorised into two types: non-consumptive (hydroelectric power plants) and consumptive (thermal power plants utilising water for cooling systems). Indicator for target 6.4.1. "Change in water use efficiency over time", UN Sustainable Development Goals.
Source: DGA (2017), Estimación de la Demanda Actual, Proyecciones Futuras y Caracterización de la Calidad de los Recursos Hídricos en Chile [Estimation of Current Demand, Future Projections and Characterisation of the Quality of Water Resources in Chile], Volume II, Table 27.1.1. Food and Agriculture Organization (2021), SDG Indicators, FAOSTAT (database).

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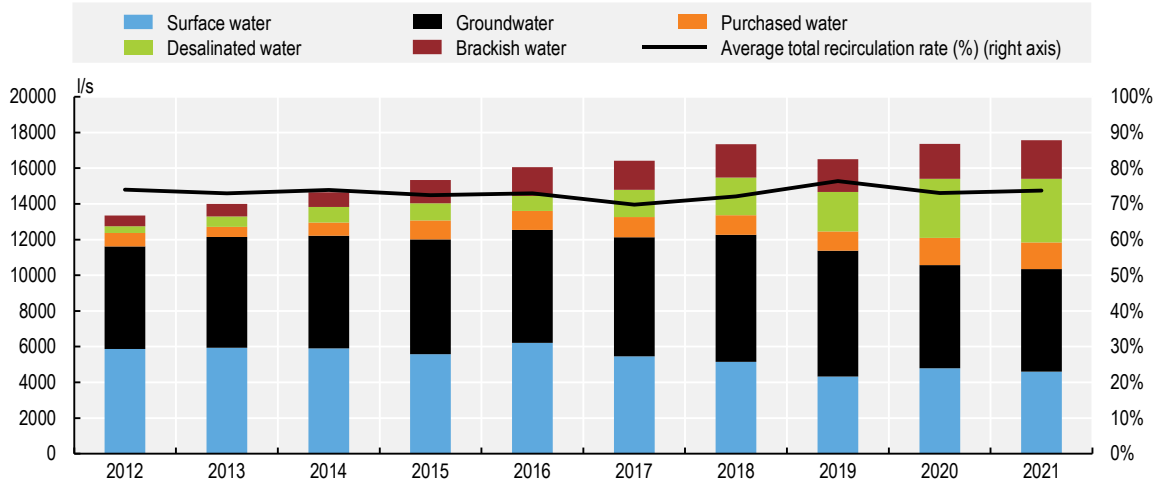
National averages of water use mask critical variations across the territory. Whereas mining accounts for a relatively small share of total abstractions, it represents a considerable share in the arid north. For example, in Antofagasta, the world's leading copper and second largest lithium-producing region, mining accounts for nearly half of total consumptive use, contributing to depletion of non-renewable groundwater resources (Acosta, 2018[6]). Mining activities rely substantially on groundwater, although the share of non-conventional water supplies (e.g. desalination) has increased over time (Figure 2.5).

Figure 2.5. Water consumption for copper mining has increased steadily

Water abstraction and circularity rate in copper mining, by source, 2012-21



Source: COCHILCO (2022), Anuario de Estadísticas del Cobre y otros Minerales 2002-21 [Yearbook of Statistics on Copper and Other Minerals 2002-21].

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Box 2.1. Increasing lithium production presents challenges for water management

In the context of the global transition to net zero, demand for lithium is projected to increase tenfold by 2040. In Chile, lithium is produced from brines; the process involves the evaporation of water over long periods. The Atacama Salt Flat in Antofagasta is the site of Chile's two largest lithium mines. This area is one of the world's driest regions and also the location of internationally recognised wetlands and nationally protected areas whose boundaries often overlap with salt flats.

Water evaporation from the brines results in fresh (or brackish) groundwater flowing into the salt flats, replacing the evaporated water. This may decrease freshwater availability for ecosystems, as well as for other uses, including for drinking water supply. Lithium-rich brines are managed as a mining resource, with the impacts on the environment managed through environmental permits.

The pressures on water resources from lithium mining are already acute in the Atacama basin, where the lithium industry is the main abstractor of water. Lithium mining and processing also puts pressure on water quality, though extensive assessments of the extent of contamination and impacts are lacking. Pressures will extend to other regions where lithium extraction ramps up. Use of desalinated water for mining operations is already on the rise. However, it must be transported long distances from the coast to altitudes of up to 3 000 m above sea level, an energy-intensive process. In addition to relying on non-conventional sources, water use efficiency will need to improve. The impact on fragile salt flat ecosystems and wetlands must also be managed carefully.

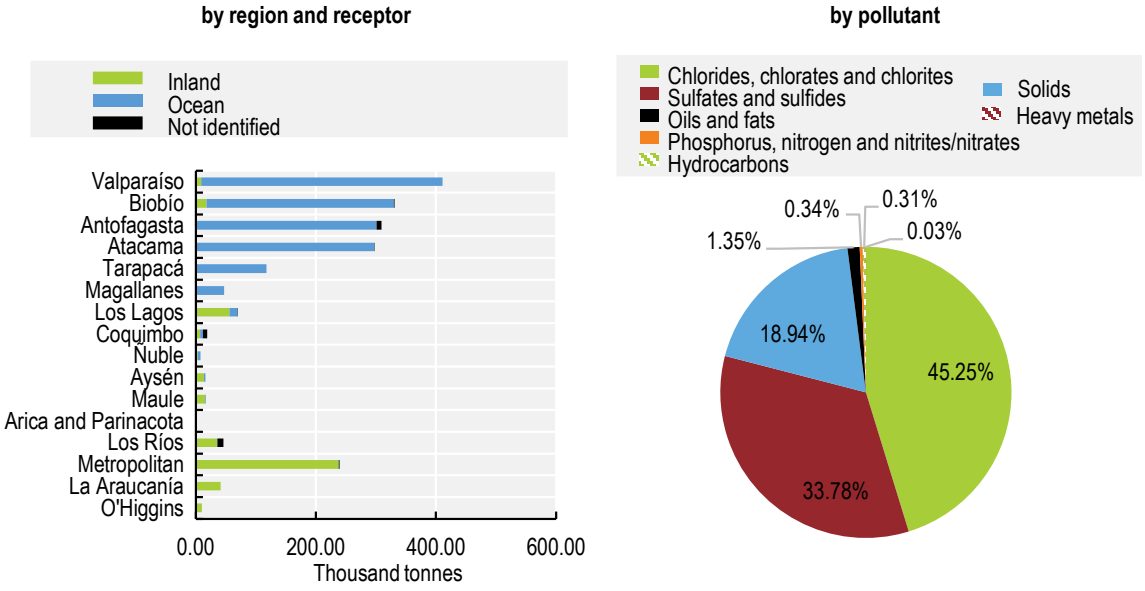
Source: (Blair, Balcázar and Barandiarán, 2022[7]; OECD, 2023[1]).

2.1.2 Water quality

Urban and industrial wastewater, along with fish farming, agriculture and mining, are the main sources of water pollution in Chile. Energy, fishing and aquaculture produce the largest shares of industrial wastewater. Discharges from mining, port and transport infrastructure, and manufacturing also contribute to water pollution. A significant share of wastewater discharges goes directly into the ocean, while inland discharges are predominant in the Metropolitan region. All or nearly all of wastewater discharges are released into the ocean in the regions of Atacama, Arica and Parinacota, Tarapacá, Valparaiso, Antofagasta, Bio Bío and Magallanes and Antártica Chilena (Figure 2.6).

Figure 2.6. Urban and industrial wastewater and fish farming are main sources of water pollution

Pollution emissions to water bodies, 2020



Note: Panel A: The region Arica and Parinacota pollutant emissions to water correspond to 577.74 tonnes in oceans.
Source: SINIA (2022), Medio ambiente y el impacto de la actividad antrópica : Contaminación [Environment and the impact of anthropogenic activity : Pollution], Reporte del Estado del Medio Ambiente 2022 [State of the Environment Report 2022].

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Incomplete data and monitoring of surface water and groundwater quality impede a comprehensive assessment of water pollution in Chile. Based on available data, chlorides (and related substances) accounted for the largest share (45%) of pollutants in water in 2020 with sulfates and sulfides accounting for around 34% (Figure 2.6). Diffuse pollution from agriculture is also a concern, with high levels of nitrates and pesticides observed in surface water. Monitoring the extent of the problem is difficult, as key environmental indicators such as nitrogen and phosphorus balances are lacking (OECD, 2022[8]).

In addition to agriculture, mining and other industrial activities, mainly in northern and central Chile, are major sources of pollution. This makes heavy metal contamination a serious concern and challenge for drinking water supply and irrigation (Vega, Lizama and Pastén, 2018[9]). It is estimated that more than 60% of industrial discharges flow into sewerage networks and combine with domestic sewage, which is treated by wastewater treatment plants before discharge. The remaining 40% of industrial discharges is either deposited in river basins and irrigation channels, or discharged to the soil or directly into the ocean, without adequate treatment (OECD, 2017[10]). This is especially concerning in regions where water is scarce and

low or non-existent levels of water flows restrict the capacity of water bodies to dilute acidity, hazardous chemicals and heavy metals.

2.1.3 Water management in the context of climate change

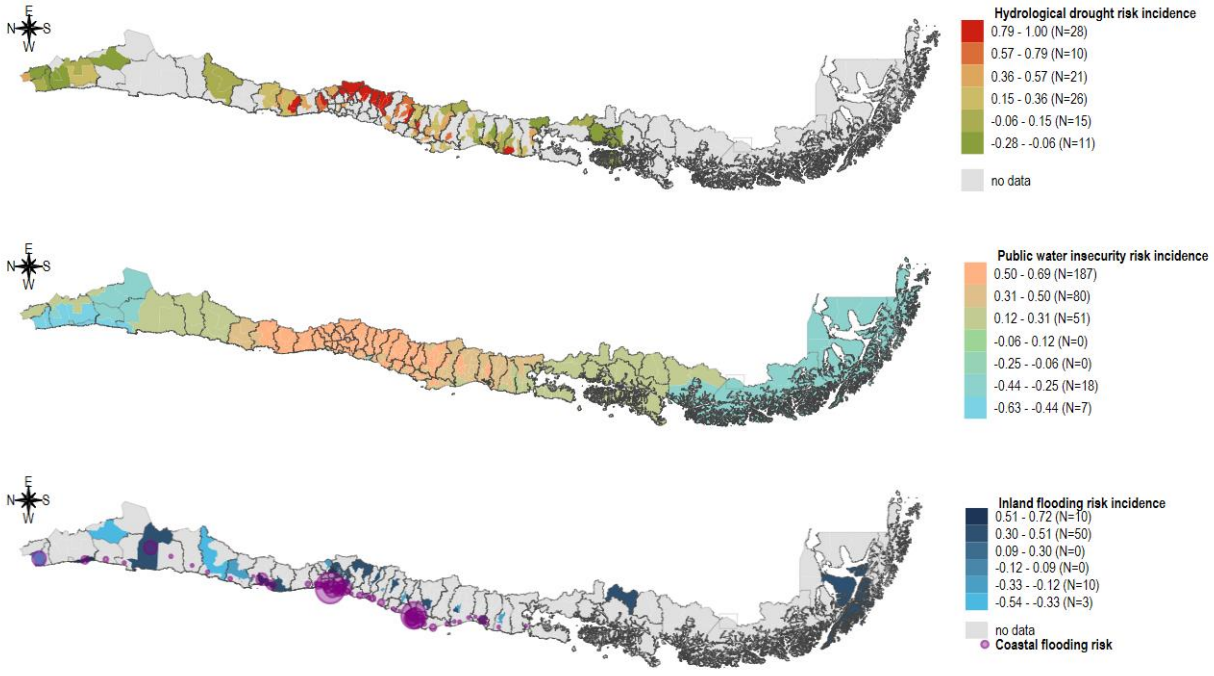
The impact of climate change on the hydrological cycle and rising temperatures exacerbate water-related risks with diverse impacts across the territory. Climate change also generates uncertainty about future water availability and greater frequency and intensity of extreme events. Climate impacts amplify seasonal variation in runoff and increase flooding from heavy precipitation. In the arid north, there is high uncertainty about projected changes in precipitation. For central Chile, declining snowpack is expected to reduce runoff by up to 40%. In the southernmost regions, less runoff is projected due to decreased rainfall. Shrinking glaciers and the melting of ice are projected to accelerate in the far southern basins, resulting in a higher average runoff each year. Sea-level rise is expected to reduce groundwater recharge and increase salinisation (Vicuna et al., 2021[11]).

The Ministry of Environment (MMA) has developed an Atlas of Climate Risks (ARClim) to provide information on projected climate change impacts and related risks. It includes a water resources module that details the projected impacts of climate, vulnerabilities and adaptive capacity at a granular spatial scale across the country. This is a valuable initiative to inform climate adaptation and sustainable water resources management. Figure 2.7 illustrates the variation in several key risks related to climate change and their dispersion across the territory.

A Water Resources Climate Change Adaptation Plan mandated in the Framework Law on Climate Change is under preparation. The plan will consider measures to reduce climate risk and for disaster risk management, to address floods, mudslides and other extreme events related to water resources. The plan considers nature-based solutions. Research and experience with nature-based solutions attest to their capacity to deliver multiple benefits for water management, climate adaptation and biodiversity cost effectively (OECD, 2020[12]). They can also contribute to managing uncertainty related to climate change by avoiding or delaying lock-in to capital-intensive grey infrastructure, allowing for flexibility to adapt to changing circumstances (OECD, 2013[13]).

Figure 2.7. Projected variation in water-related risks due to climate change

Variation in risks related to hydrological droughts, public water insecurity and flooding between historical (1980-2010) and future scenarios (2035-65 under RCP8.5)



Notes: Hydrological drought risk incidence (provincial level): hydrological drought is defined as the condition of extreme deficit water storage and flows in the river basin with respect to historical conditions (1980-2010); future scenarios consider 2035-65 under RCP8.5. The severity of a drought is characterised by its magnitude and frequency. The risk index considers hazard, exposure and vulnerability. Higher risks are reflected by higher demand than supply in areas with extremely low flows and limited resilience. Risk to public water security: meteorological drought is defined by the precipitation deficit. The map displays the impact of climate change, as expressed in the incidence of drought and potential evapotranspiration, on public water supply (urban and rural). It represents which municipalities are more likely to experience adverse health and well-being impacts associated with water insecurity under historical and/or future climatic (hazards), social and institutional conditions (exposure and resilience). Data at the municipal level are limited to the information available in the 2018 National Water Balance

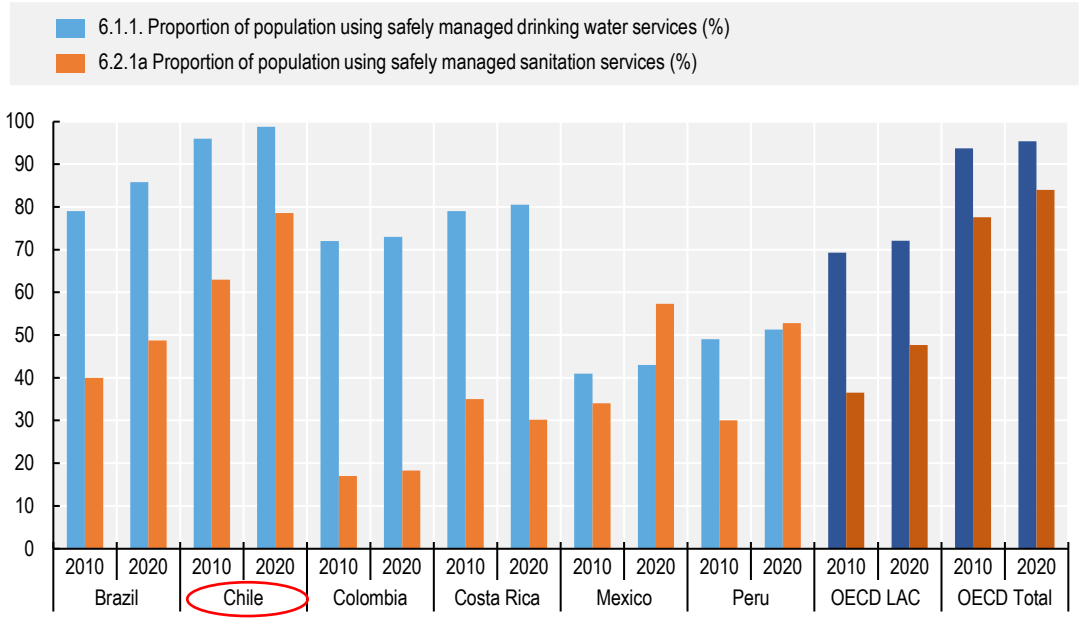
Source: MMA (2020), *Atlas de Riesgos Climáticos: Recursos Hídricos [Atlas of Climatic Risks: Water Resources]*, arclim.mma.gob.cl; Biblioteca del Congreso Nacional de Chile, Información Territorial, Mapas vectoriales: Mapoteca [Library of the National Congress of Chile, Territorial Information, Vectorial Maps: Map Collection], www.bcn.cl/siit/mapas_vectoriales/index_html (accessed 3 August 2023).

2.1.4 Water supply and sanitation services

Chile has achieved close to universal access to safely managed drinking water and a relatively high share of access to safely managed sanitation services (Figure 2.8). Access to both drinking water and sanitation services (WSS) improved between 2010 and 2020, from 96% to 99% for drinking water and from 63% to 79% for sanitation. The share of the population with access to WSS services in Chile is the highest in the Latin America and Caribbean (LAC) region (74% for drinking water and 46% for sanitation in LAC). This is broadly in line with OECD averages, although access to sanitation remains below the OECD average of 84%.

Figure 2.8. Chile has achieved nearly universal access to drinking water and relatively high levels of access to sanitation in urban areas

Progress assessment of SDG 6 “Clean water and sanitation”, selected LAC countries and OECD average, 2010-20



Note: Indicator 6.1.1 refers to the population supplied with intra-domiciliary water from an aqueduct; Indicator 6.2.1a refers to the population that lives in dwellings with a sanitary service connection to sewage or septic tank. OECD LAC averages includes OECD members (i.e. Chile, Colombia, Costa Rica and Mexico) and candidates for accension (i.e. Brazil and Peru).
Source: WHO/UNICEF (2021), Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.

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Private operators regulated and supervised by the government deliver WSS services in urban areas of Chile. Private operators have 30-year concession contracts, with the infrastructure owned by the state. The privatisation of the sector is credited with spurring significant investment in wastewater treatment, with a rapid increase of coverage from zero to universal in a span of roughly 15 years. This approach has been largely successful in delivering nearly universal access to reliable, financially sustainable urban WSS services. Still, the share (around 30%) of non-revenue water from urban public water supply is relatively high. Challenges include the need to reduce non-revenue water, expand tertiary wastewater treatment and enhance resilience to climate change impacts.

For wastewater treatment, more than two-thirds of wastewater receives at least secondary treatment. The share of primary treatment hovered at just over 20% from 2010 to 2018. Maritime outfalls, located mainly in coastal cities in the north, account for 11.6% of the total number of wastewater treatment systems (Molinos-Senante, 2018[14]). These rely on dilution in the ocean rather than removal of pollutants from wastewater, and hence are not effective wastewater treatment systems. Nutrient removal in wastewater treatment plants is necessary to avoid excessive nutrient discharge into receiving water bodies. This is common practice in many OECD countries but limited in Chile (Vega, Lizama and Pastén, 2018[9]). Excessive nutrient discharges contribute to eutrophication of water bodies.

Despite overall high rates of access to WSS, there are important urban-rural disparities in Chile, as in many countries. About 2 million people have access to drinking water through rural water systems, which

are managed by communities via committees or co-operatives. The number of WSS systems serving rural populations increased by 35% between 2010 and 2022 as a result of an investment programme led by the Ministry of Public Works (MOP) and implemented by the Directorate of Hydraulic Works. Expansion of the service network continues, with plans to build some 25 water and sanitation systems annually.

The quality of drinking water and limited coverage of sewerage and wastewater in rural systems are major issues. Many rural systems fail to meet quality standards. There have been no effective mechanisms, including reliable sources of financing and technical capacity, to ensure proper operation and maintenance. Technical capacity of community water organisations is limited. Municipalities are responsible for grants to vulnerable households and often do not manage the funds properly.

The Law on Rural Sanitary Services (20 998) came into force in November 2020. In a positive development, it established a regulatory framework for rural WSS covering such key areas as tariff setting, inspection and registration of operators. However, implementation has been delayed, due in part to the COVID-19 pandemic. Effective and timely implementation of the law would provide a much stronger basis for reliable delivery of rural WSS to communities. Robust economic regulation for rural WSS can set performance standards for service provision, monitor and incentivise performance, and assess development plans for expanding and maintaining service provision.

2.2 Water strategies and basin plans

The Strategic Plan "2030 Water and Sanitation Agenda" developed in 2019 under the Superintendency of Sanitation Services (SISS) under the MOP articulated the main strategic objectives for water management. This plan spurred development of Strategic Water Management Plans (PEGHs). These describe the general characteristics of the basins (water quantity, environmental quality, climate change and governance), identify gaps and evaluate actions to address these gaps. In 2019-20, basins with the most information available and the most acute water issues were prioritised.[1] By 2022, PEGHs covered 48 basins.

More recently, the National Just Water Transition Strategy (2022-26) set out a national agenda for systematic reform of water governance and management in Chile, in line with the objectives of the Socio-ecological Just Transition. It sets out a comprehensive agenda across main thematic areas: i) water for human needs, including the human right to water; ii) multi-purpose water infrastructures for water security; iii) strong public institutions and stakeholder participation at national- and river-basin level; and (iv) safeguarding water for ecosystems.

The approach reflects a needed step-change in water management with an emphasis on stronger inter-ministerial co-ordination, basin-level governance and action to ensure water resources are managed in the public interest, including protection of freshwater ecosystems. The Programme for Results, developed by the MOP and MMA with the World Bank, supports Chile's Just Water Transition. It emphasises supporting river basin governance, strengthening rural WSS and enhancing resilience to climate change through water management, including nature-based solutions.

The 2022 reform of the Water Code advanced basin-level planning by requiring a Strategic Plan for Water Resources in Basins (PERHC) for all basins. The plans should be publicly available, reviewed every five years and updated every ten years. The 2022 Framework Law on Climate Change (FLCC) (Article 13) requires certain factors in the plans, such as the characterisation of water risks and socio-economic factors in line with the principle of equity and climate justice. The FLCC also requires the MOP to enact a regulation for the elaboration, updating and revision of the plans, as well as monitoring and reporting, and public participation. The regulation was approved by the Comptroller General of the Republic in January 2024. The regulation specifies the creation of "Strategic Water Resources Tables" in each basin to engage all relevant actors in the elaboration of the PERHC.

The PERHCs will use the PEGHs already developed as an input, along with other available information. The PERHCs require more comprehensive information and address some limitations of the PEGHs. This includes improving hydrological and hydrogeological modelling to inform decision making at the relevant spatial scale and to incorporate information on water use rights. The plans must include a recovery plan for impacted aquifers in terms of both the quantity and quality of resources. The evaluation of measures for each basin should include the costs and benefits of different alternatives. Co-ordination with other government plans and regulations will be strengthened, notably the National Plan for Adaptation to Climate Change.

The development of PEHRCs for all basins can support more integrated planning and policy decisions. They aim to be comprehensive with improved design that can better inform basin-level decision making and strengthen co-ordination with other government plans. However, the plans will require significant resources and technical capacity. Further, they are only indicative and not required by statute. Chile should assess whether plans, at least certain provisions, should be legally binding. Moreover, the period for public participation should be extended beyond the 60 days minimum foreseen in the FLCC.

2.3 Institutional arrangements for water management

Water governance in Chile is complex and fragmented, involving over 40 water-related institutions delivering over 100 functions at different scales. The institutional landscape for water management is one of the most centralised and, at the same time, fragmented in the OECD, with limited prerogatives at the subnational level (OECD, 2017[15]). A striking feature of the Chilean water management model has been the absence to date of integrated basin governance systems. In the absence of river basin governance, Water Users Organisations (WUOs) have acquired the experience and social acceptance to manage water resources. However, they typically focus on irrigation related to a specific river, or section of a river, without control over all rivers and tributaries that form a basin. There is limited co-ordination with other groundwater users, resulting in the neglect of hydrological interconnections between the river and the aquifers (OECD, 2017[15]).

The establishment of pilot organisations for river basin governance in 16 basins seeks to redress the fragmented nature of water management by anchoring activities at the basin scale and promoting decentralised decision making. In a welcome step, these pilots also aim to expand the range of stakeholders in water management beyond the remit and focus of the Monitoring Boards in place in several basins.

To promote basin-scale governance effectively, river basin organisations will need clear decision-making competencies and adequate human and financial resources. In the context of decentralisation, the roles of the national, regional and local authorities need to be clearly defined. In Chile, regional governments do not have direct competences in water management, although they do have responsibility for territorial planning. A bill to formalise establishment of basin-scale governance organisations is pending. This bill should be a priority to provide a legal framework to establish river basin governance. Further, it should be part of a broader strategy to establish autonomous bodies with clear planning and management functions and the requisite human and financial resources to perform them (Box 2.2).

Box 2.2. River basin governance: An example from Spain

The spatial scope of water management and hydrological planning in Spain is the river basin district. Water policy competences (hydrological planning, granting of water use rights, protection and management of the public water domain, water quality control, design and implementation of main water infrastructure) are attributed to the state level in river basins that exceed the territorial scope of a single Autonomous Community, and are attributed to the Autonomous Communities in basins that are entirely within their territory.

River basin organisations (RBOs) were created in 1926 and have been operating uninterruptedly up to the present day. Attached for strategic and administrative management purposes to the Ministry for the Ecological Transition and the Demographic Challenge, they are public law entities with their own legal personality and assets, which provide water management services with functional, economic and financial autonomy.

The ministry submits the hydrological plans proposed by each RBO and the National Hydrological Plan to the government for approval. It also has competence over the granting of water use rights by means of infrastructure of general interest, infrastructure for water supply, treatment and desalination that concern the territory of more than one autonomous community, and any other action that is declared to be of general interest by a law.

RBOs in Spain have the following functional structure:

- Governing bodies: The president, appointed by the government, exercises the highest managerial and executive functions of the RBO, and the Governing Board.
- Management bodies: the Users' Assembly, the Discharge Commission, the Exploitation Boards and the Works Boards. Through the full participation of water users, the Exploitation Boards and the Users' Assembly co-ordinate operation of the hydraulic works and water resources in the basin. The Discharge Commission collaborates with the president of the RBO in determining the appropriate regime for the exploitation of reservoirs and aquifers in the basin.
- Participation and planning body: the Water Council of the River Basin District promotes information sharing, public consultation and active participation in the hydrological planning process and proposes to the government, through the ministry, the hydrological plan for the basin and its subsequent revisions.
- Co-operation body: the Committee of Competent Authorities ensures proper co-operation in the implementation of water protection regulations. It involves the state, regional and local public administrations and has a key role in the elaboration, co-ordination and implementation of the measures of the hydrological plans for fulfilment of environmental objectives.
- Technical support: Several technical support offices equipped with human and material resources provide technical functions for each RBO and its functional bodies.

The model of water management and governance in Spain, through RBOs, is a good example of the application of the OECD Council Recommendation on Water and the OECD Principles on Water Governance. It ensures an allocation of water resources based on long-term basin-wide water management plans, considering availability and the criteria of use efficiency, general utility and productivity. The approach promotes integrated management of surface water and groundwater resources, with the participation of all stakeholders, especially users. Finally, it encourages implementation of public policy measures adapted to local conditions.

Source: Government of Spain (1988), Royal Decree 927/1988 on the Regulation of Public Water Administration, www.boe.es/buscar/act.php?id=BOE-A-1988-20883.

The Inter-Ministerial Committee on Just Water Transition (CITHJ), chaired by the MMA, was created in 2022 to provide a co-ordination platform among the six ministries[2] with competence in water management.

It develops short, medium and long-term roadmaps to address the water crisis and define immediate actions.

Chile lacks an integrated national authority to make strategic decisions for the water sector based on professional and technical recommendations. Efforts to improve co-ordination on water management are important developments. Still, these efforts are insufficient to advance the alignment and co-ordination of all agents intervening in water management at all levels, as well as stakeholders. Chile should thus establish a central governmental authority to regulate, plan, develop, conserve and protect water resources and provide holistic management for water and wastewater. Select examples from OECD and partner countries are highlighted in Box 2.3.

Box 2.3. National water authorities: Examples from OECD and partner countries

Institutional arrangements to manage water resources vary widely in OECD and partner countries. Responsibilities for water policy and management are primarily defined by specific water and environmental laws but may also be enshrined in the national Constitution. Nearly all OECD countries involve both central and subnational governments in water policy design, planning and management. As a good practice for water governance, "form should follow function" in the design of institutional arrangements. There should be a clear understanding of objectives and clarity on roles and responsibilities at all levels of governance (national, regional, local, river basin).

Select examples of national water agencies are illustrated below:

- Israel's Water Authority: Established in 2006 with an amendment to the Water Law, the Water Authority is the governmental body authorised to govern all aspects relating to the water and sewage sector in Israel, including its management, planning, development, operation and regulation. The main goal of the Water Authority is to enable regular and reliable supply of water to all water consumers in the required quality and quantity, at reasonable prices, while preserving the water sources for future generations.
- Brazil's National Water Agency (*Agência Nacional de Águas* [ANA]): Created in 2000, ANA provides a qualified and stable institution to facilitate forward-looking reforms of water management in Brazil. Both a regulatory and an executive agency, ANA combines the high standards and hierarchical position of a regulator at the federal level and the capacity for on-the-ground action as the executive authority for federal rivers (to oversee licences for water uses and collect water charges). It has strong technical capacity and serves as a trusted partner to co-ordinate water resources management with state water agencies and river basin agencies.
- Peru's National Water Authority (*Autoridad Nacional del Agua* [ANA]): Created in 2008, ANA serves as the governing body of Peru's National Water Resources Management System. It is the highest technical and regulatory authority on water resources in the country with its own budget and legal status. It elaborates, manages, executes and supervises the National Water Resources Policy and Strategy, promulgates regulations and establishes procedures for integrated water management (for both surface water and groundwater). It also helps co-ordinate a number of public entities related to water resources management with ANA.

Source: (OECD, 2015[16]; OECD, 2021[17]).

2.4 Policy instruments for water management

2.4.1 Water allocation

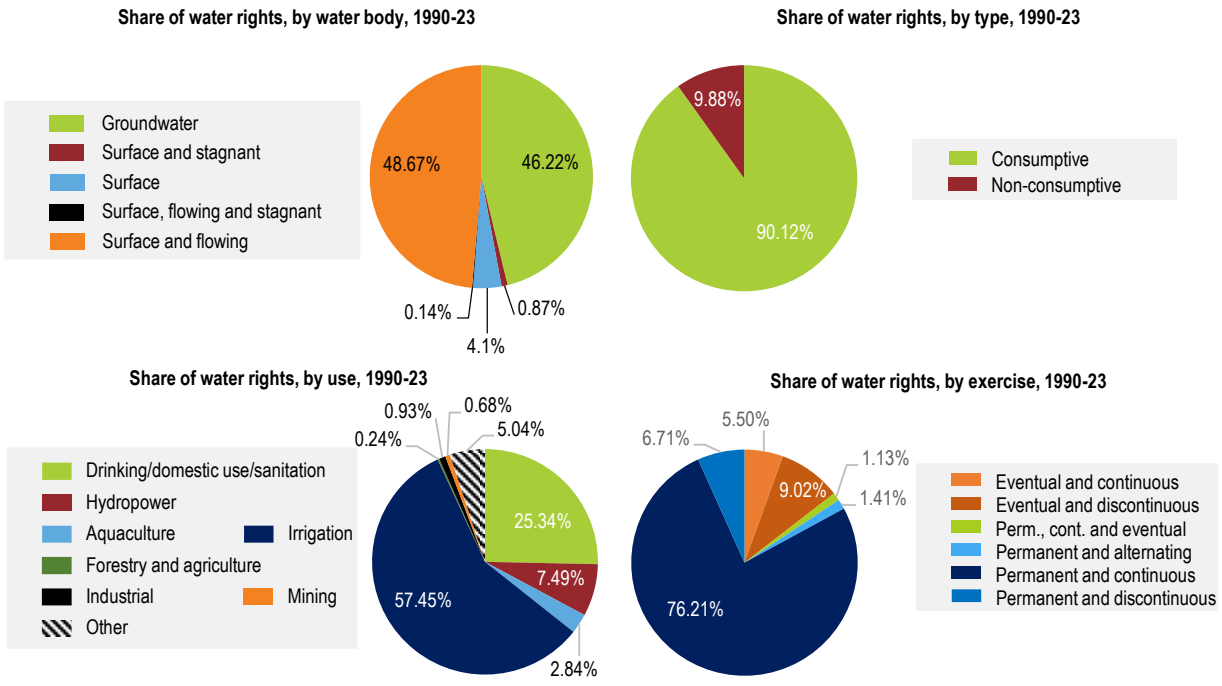
Water resource allocation is a fundamental issue for Chile to ensure the sustainable management of water resources. The legacy of water allocation in Chile presents a challenging context, unique in international experience. The 1981 Water Code established the system for allocation and use of water resources based on tradeable water use rights (*derechos de aprovechamiento de aguas*, DAAs). Water resources are legally defined as "national property for public use", while rights to use water are defined as private property, allocated free of charge and granted in perpetuity. They are separate from land ownership. In many cases, water rights are freely tradeable, without prior authorisation or consideration of third-party impacts (OECD, 2015[18]). While other countries have recognised private property rights to water and water markets, none has done so in such a deregulated and unconditional way as Chile (Bauer, 2013[4]).

The state's limited authority to regulate these rights and lack of transparency of the water market 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. Most water market transactions are among agricultural users. The wide range of prices for water trades reflect the influence of the individual bargaining power of buyers and sellers (Hearne, 2018[19]). 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 remained.

In April 2022, major reforms to the Water Code (Law 21.435) helped bring the allocation regime closer in line with good international practice, but serious challenges remain. Two major changes are fundamental. First, the law enshrines the priority of supply for human consumption, sanitation and subsistence domestic use both in the granting and in the exercise of water use rights. The reform recognises access to water and sanitation as an essential and inalienable human right and that water is a national good for public use. Second, it defines water use rights as a real right over waters allowing temporary use and enjoyment of them, in accordance with the rules, requirements and limitations prescribed by the Water Code. The law replaces the concept of owner (*dueño*) of the rights of use by that of holder (*titular*) of such rights. Groundwater is declared as a national asset for public use under the new law, without prejudice to the owner of land in the aquifer's domain. It is prohibited to grant water rights in glaciers and in protected areas, such as national parks, national reserves, reserves of virgin regions, natural monuments, nature sanctuaries and wetlands of national importance.

The DGA's Public Water Cadastre records registered water rights and approved requests related to the transfer of rights and changes in the collection and supply point. Figure 2.9 provides an overview of the water rights registered over 1990-23 by type of water body, type (consumptive or non-consumptive), use and conditions of exercising the right (occasional, permanent, etc.). The number of registered water rights allocated in Chile has nearly doubled in the past decade. In several instances, more than 100 water rights in the Public Water Cadastre were allocated to a specific user in the same year and in the same basin for consumptive rights for irrigation.

Figure 2.9. Most water rights in Chile are permanent, continuous rights allocated to irrigation



Note: "Other water uses" includes but is not limited to medical purposes, observation and analysis. "Consumptive rights" entitle the holder to consume the water in its entirety in any activity. "Non-consumptive rights" allow use of water without consuming it and require it to be returned in the same quality and quantity, and in a timely fashion. Water rights attributed between 1990 and 2023 were considered. Values are cumulative for the whole period. Bottom right panel: occasional and alternating, permanent alternating and provisional, and permanent discontinuous and provisional rights represented around 0.02% of attributed water rights for the considered time period.
Source: DGA (2023), Derechos de aprovechamiento de aguas registrados en DGA, Consolidado Nacional [Water Use Rights Registered in DGA, National Consolidation].

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Moreover, a significant number of water rights are not registered in the Cadastre, impeding a comprehensive and accurate understanding of allocated water resources. Critically, the 2022 reform of the Water Code establishes that water rights not registered in the Water Property Registry at the time of the law's enactment must be registered by 6 April 2025.[3] After the deadline, unregistered water rights will expire. Registered water rights are projected to triple by the deadline, reaching more than 300 000. The DGA's Inspection Department monitors abstractions, but its capacity is limited. Penalties exist for illegal abstraction and may constitute a crime. The Senate is discussing a bill to amend the Criminal Code to increase penalties for crimes of illegal water abstraction.

Under the new reform, new water rights are temporary and granted through a concession. The duration of 30 years is contingent on the availability of water resources and the sustainable use of groundwater. DGA methods to determine water availability for allocation are highly sensitive to the period of time used for the analysis. This can lead to underestimating the variability of resources available and the impact of long-term trends, including climate change (Barría et al., 2019[20]). In addition to revising methodologies to inform water allocation decisions, the DGA could consider establishing new water rights as a share (percentage) of available resources rather than as an absolute volume of water that can be abstracted. This provides more flexibility over the course of the concession to adjust the amount of water that can be abstracted in line with availability. This approach can more equitably share the risk of scarcity across users. The OECD

Health Check for Water Resources Allocation can guide review of allocation arrangements and bring the system more in line with good international practices (OECD, 2015[18]).

Minimum ecological flow requirements must be established for the preservation of nature, considering the ecological conditions for each surface water body. In an important development, these minimum ecological flows must be considered in the granting of new water rights. However, this is not sufficient to ensure minimum ecological flows in the case of water rights already granted or restore deterioration of freshwater ecosystems in over-exploited basins. Further, the DGA may allocate water rights to ensure minimum ecological flows and ecosystem preservation. An environmental impact assessment would evaluate the potential for water rights to be incompatible with minimum environmental flows. However, the DGA and the System of Environmental Impact Assessment use different methodologies to assess minimum ecological flows. Amendments to the Water Code (article 129 bis) in July 2023 specify that a regulation to be signed by the Ministers of the Environment and Public Works will set out new criteria for establishing minimum ecological flows. This is an important opportunity to define and consistently apply a robust and harmonised method to establish and enforce minimum ecological flows. Box 2.4 summarises the example of establishing minimum ecological flows in Spain.

Box 2.4. Ecological flow regime: An example from Spain

The natural flows of many rivers in Spain are altered by infrastructures (storage reservoirs), diversion for water use and other causes. A regime of ecological flows facilitates compliance with environmental objectives, seeking to reduce the pressure from alteration of natural flows. In this way, it replicates the functions of the natural regime in each river.

Spain has made significant progress in this respect and has established ecological flow regimes for all water bodies:

- minimum flows under hydrological normality, with a distribution of temporal values over the year
- minimum flows under a situation of prolonged drought
- maximum flows, with a distribution of temporary values, which are established in river sections affected upstream by the existence of a reservoir, and where it is necessary to limit them for environmental reasons
- generating flows, which is a regime of artificial floods in highly altered river sections, and which simulates in some way the effect of high natural river flows
- rates of change, where the rate of rise or fall of flow is limited in river sections affected upstream by regulating infrastructure.

The regime of ecological flows is included in the Hydrological Plan of each river basin district. As such, it is a prior restriction on water use (legally binding), both for new water use rights granted after approval of the plan and for those already in existence. It respects only the priority of use for water supply for human consumption. Plans also consider the environmental needs of important wetlands.

Ecological flows are set up in accordance with the Hydrological Planning Regulation and the Hydrological Planning Instruction. They are calculated through technical studies based on hydrological and hydro-biological (habitat availability) methods. Their compatibility with water uses is analysed through modelling studies of the availability of the water resource and the alternatives for its management in order to satisfy water demands.

The proposed environmental flow regime is subject to public consultation and active participation by water stakeholders. This takes place within the framework of public participation for the preparation and approval of the Hydrological Plan of each river basin (or its periodic revisions). If the environmental flow regime affects pre-existing water use rights, its establishment and implementation may include, in addition to public consultation, an agreement phase with stakeholders.

Source: Government of Spain (2007), Decree 907/2007 Regulation on Hydrological Planning, www.boe.es/eli/es/rd/2007/07/06/907/con; Ministry of Environment, Rural and Marine Environment (2008), Hydrological Planning Instruction (revised 29 December 2016), www.boe.es/buscar/pdf/2008/BOE-A-2008-15340-consolidado.pdf.

The DGA has the power to curtail the exercise of water rights due to the non-effective use of the resource or if the sustainability of the water resource is threatened. A declaration of exhaustion of natural sources (article 282) prohibits the granting of new water rights in sources of surface water (rivers, lakes, lagoons). There have been 15 such declarations to date. The DGA expects some 50 areas will be declared depleted by 2025. In cases of non-effective use, DDAs for consumptive uses expire in five years; for non-consumptive uses, they expire in ten years.

The DGA can declare “restriction areas” and “prohibition zones” for new exploitations. Declarations of restriction areas (articles 65 and 66) apply to groundwater when there is a risk of serious depletion of an

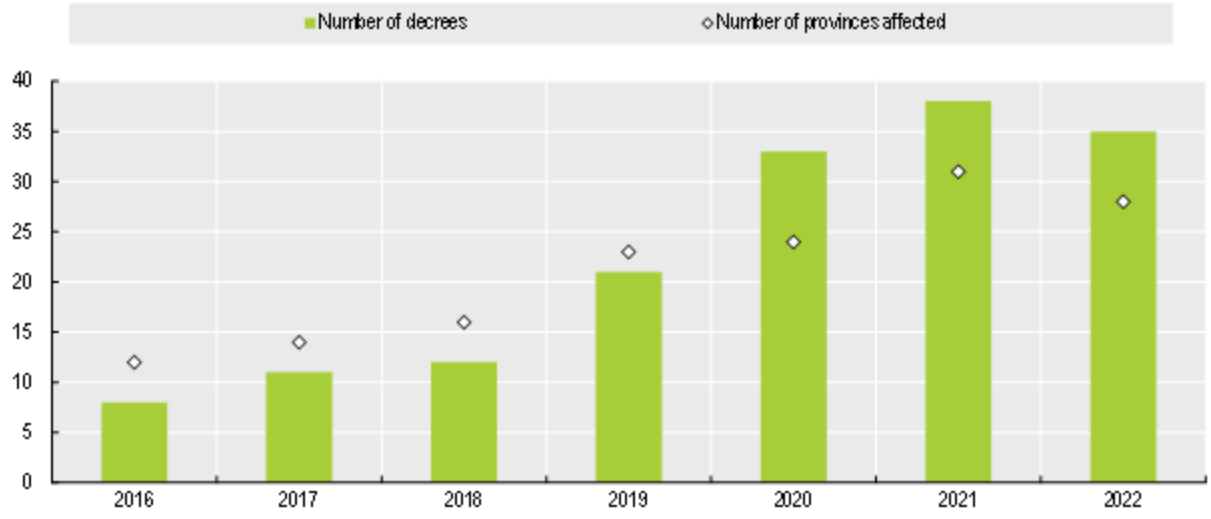
aquifer or its sustainability. Prohibition zones (articles 63, 64 and 67) are designated when the sum of existing water rights compromises the availability of resources determined in a technical study. In such cases, water rights holders must install and maintain systems to measure flows, volumes abstracted and transmit this information to the DGA.

As of May 2023, preventive measures for excessive allocation of DAAs covered 31% of the national territory. In all, 102 hydrogeological sectors (83 598 km^2) of common use had been decreed as prohibition zones, and 98 as restriction areas (71 214 km^2). These measures seek to prevent the depletion of basins and aquifers and allow the DGA to take specific actions, such as the formation of WUOs. The DGA's Effective Extraction Control System applies to both groundwater and surface water.

The president can declare water scarcity zones in the event of a severe drought, at the request of the DGA. The 2022 reform of the Water Code reinforces this power. Scarcity zones can be declared for up to one year, with successive extensions possible. Such a declaration requires the responsible authority to present an agreement for the redistribution of water within 15 calendar days. The number of decrees designating scarcity zones rose from 8 to 35 between 2016 and 2022, affecting half of Chile's 56 provinces in 2022 (Figure 2.10). As of 2022, multiple water scarcity zones were concentrated in population centres (Figure 2.11).

Figure 2.10. Rising number of scarcity zones reflects extraordinary drought conditions

Number of decrees declaring scarcity zones and number of provinces affected



Note: Water scarcity zones can be decreed in those areas with an extraordinary drought, defined according to hydrometeorological criteria (i.e. based on data on precipitation, river flows, reservoir volumes and aquifer conditions). Regions decree water scarcity zones, which can encompass multiple provinces and municipalities.
Source: DGA (2023), Planilla Decretos Zonas de Escasez Hídrica (2008-2023) [Water Scarcity Zones Decree Spreadsheet (2008-2023)] https://dga.mop.gob.cl/administracionrecursoshidricos/decretosZonasEscasez/Paginas/default.aspx (accessed 17 August 2023).

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Figure 2.11. Concentration of multiple water scarcity zones in population centres

Number of declared water scarcity zones, by province, 2022

Source: DGA (2023), Planilla Decretos Zonas de Escasez Hídrica [Water Shortage Zone Decree Spreadsheet] (2008-2023), https://dga.mop.gob.cl/administracionrecursoshidricos/decretosZonasEscasez/Paginas/default.aspx (accessed 17 August 2023); Biblioteca del Congreso Nacional de Chile, Información Territorial, Mapas vectoriales: Mapoteca [Library of the National Congress of Chile, Territorial Information, Vectorial Maps: Map Collection], Mapas vectoriales — (bcn.cl) (accessed 3 August 2023).

As water scarcity becomes more common and water shortages more persistent, emergency measures will be insufficient to deal with conditions that have become the "new normal". Historically, Chile has addressed scarcity issues by increasing supply (Donoso, 2021[2]). The Drought Plan launched in 2021 focused on promoting investments in desalination, modernisation of irrigation (including construction plans for 26 reservoirs) and rural drinking water. Expanding new sources of supply, such as desalination and wastewater reuse, have considerable potential. However, Chile should also introduce demand management measures, improve water use efficiency, and ensure a robust and flexible water allocation system. Key lessons from allocation reforms in OECD and partner countries are summarised in Box 2.5. These should be fundamental pillars of Chile's strategy to manage water resources over the long term, including addressing the impacts of climate change.

Box 2.5. Water allocation reforms: Lessons from OECD and partner countries

Reforming water allocation arrangements can be contentious and institutional path dependency can raise the costs of making allocation more flexible. A number of OECD and partner countries have pursued or are pursuing such reforms to improve the sustainable management of water resources; adapt to current and future water challenges; and facilitate water allocation to higher value uses, including for ecosystem services. A review of ten OECD and partner countries' experience with allocation reforms provides some lessons learnt.

- **Making the case for reform.** Water reforms may be driven by an accumulation of pressures over time or spurred by a "trigger event", such as a severe drought. Concerns about water scarcity and insufficient water for ecosystems are often key factors. Water reforms can also emerge from broader political reforms or social movements outside of the water sector, such as efforts to improve economic efficiency (e.g. Australia, Israel) or equity in the distribution of resources (e.g. South Africa). Well-documented evidence of the limitations of allocation arrangements to address current and future pressures can demonstrate the value of reform (e.g. England and Wales). The perceived shortcomings of the water allocation system strongly shape reform options (e.g. Alberta, Canada, England and Wales, France, South Africa).
- **Water allocation reform is an iterative process that extends over many years, even decades.** This has been the case in the Murray-Darling Basin, Australia; the Yellow River Basin, People's Republic of China; and South Africa, where allocation reforms have spanned decades. This is also the case in Chile, with periodic, often incremental, reforms to the 1981 Water Code over the past 40 years.
- **Effective and meaningful stakeholder engagement facilitates allocation reform.** Experiences from Israel, Alberta, Canada, England and Wales, New Mexico, the United States and South Africa attest to the importance of stakeholder engagement to achieve credible and lasting reforms. Case studies also illustrate the wide range of opportunities to engage stakeholders effectively throughout the process.
- **Negotiating accompanying measures and balancing divergent interests is essential.** Measures to mitigate the negative impacts of reforms can facilitate progress. For example, water rights users can be compensated for reductions to these rights (e.g. Australia) or an interim period can allow adjustment to new allocation measures (e.g. prices, change in rights). Finding compromise on contentious issues is needed, such as determining the appropriate level of water pricing for irrigation (e.g. Israel) or government support to financing water infrastructure (e.g. France). In some contexts, a powerful central authority can play an essential role in resolving disputes.

Source: (OECD, 2015[18]).

2.4.2 Water quality standards and regulations

The implementation of water quality standards in Chile remains incomplete and requires further development and updating. Drinking water must comply with 43 quality parameters related to the presence of chemicals and metals; turbidity; the presence of microorganisms; physical characteristics; and the absence of bacteria. There are two primary environmental quality standards for water (NPCAs) (focused on protecting human health). These have not been implemented to date. Of the 101 basins, only 6 have secondary environmental quality standards[4] (NSCAs) (focused on the preservation of aquatic

ecosystems). These secondary standards are local in nature, each with its own parameters and maximum values of pollutant concentrations tailored to the context of the freshwater system.

A further eight NSCAs are under development. The approach to developing these environmental quality standards is complex and slow; dedicated human resources are limited. Economic costs and benefits are analysed to develop water quality and emission standards. While this is a good practice, the methodologies typically applied often fail to capture important non-market benefits, such as improved ecosystem services. Chile should accelerate development of secondary standards for water quality. A standard list of basic water quality parameters could be defined for the national territory to simplify the process. Implementation of measures towards achieving the national secondary standards could initially focus on priority basins with the most pressure on water quality and the greatest potential net benefits to society from improved water quality. Additional parameters could be defined for individual basins depending on hydrological considerations, ecological considerations and specific pressures. In addition, Chile could consider developing a water quality Watch List to improve information on substances of greatest concern in view of possible future setting of environmental quality standards.

Chile has several water quality monitoring instruments. The DGA's network of 1 523 monitoring stations covers 78 of the 101 basins (77%). This is an improvement from the 829 stations in 2014 where only 61% of basins were actively monitored (Vega, Lizama and Pastén, 2018[9]). Despite advances in recent years, water quality monitoring is fragmented across different institutions. The frequency of sampling should be increased. The lack of a comprehensive and integrated monitoring network, and insufficient data, impede decision making and policy development to improve water quality.

The coverage of wastewater discharge standards remains patchy and standards are outdated. There are three main standards: sewage (DS 609/1998), surface waters (DS 90/2000) and groundwater (DS 46/2006). These discharge standards have not been updated in the past two decades, although they are under review. Emission standards cover some, but not all, regulated pollutants and only selected activities and sectors. There are no specific standards and regulations for agricultural wastewater sources, including aquaculture.

Wastewater discharge standards do not define the scope of primary, secondary or tertiary treatment. Tertiary wastewater treatment is not required to comply with discharge standards, as secondary treatment (mostly activated sludge) is sufficient. The reform of DS 90/2000 increases the stringency of discharge standards for certain surface water bodies. However, it does not consider parameters or limits that require tertiary treatment to comply with the standard. Requiring the nutrient removal in wastewater treatment would reduce excessive nutrient discharge into receiving water bodies, and thus eutrophication (Vega, Lizama and Pastén, 2018[9]).

There are no specific standards and regulations for agricultural wastewater sources (including aquaculture). Wastewater discharge standards are completely disconnected from environmental quality standards for water bodies. Chile should pursue more stringent wastewater discharge standards, broaden their coverage to other key sources of pollution (notably agriculture, aquaculture and mining) and link explicitly to secondary water quality standards, as is common practice in most OECD countries. As a complement to improved wastewater treatment, Chile could also consider nature-based solutions, such as restoration or construction of wetlands and buffer zones, as a cost-effective approach to improve water quality.

Given the constraints related to water availability, Chile has recognised the need to promote reuse of treated wastewater ("grey" water) for industrial or agricultural activities. It is considering a few projects, but they remain at early stages. Chile passed a law (21.075) regulating the collection, reuse and disposal of grey water in 2018. However, the Ministry of Health has not yet formalised the corresponding regulation. Congress approved modification of the law in October 2023, which expands the use of grey water to forestry and agriculture.

Legislation does not define who owns the rights to waters discharged through wastewater treatment plants into surface waters or reused for irrigation. A clear legal and regulatory framework is needed. It should establish well-defined quality parameters and a robust monitoring system for treated effluent to be used for irrigation or other purposes. This is an important prerequisite to stimulate demand for and promote development of wastewater reuse in Chile. Moreover, environmental flows should be set particularly in sub-basins and aquifers that rely on treated wastewater discharges to maintain a minimum flow or recharge.

The remediation of contamination is a looming challenge, one the regulatory framework is inadequate to address. The MMA and the DGA have made significant regulatory efforts to prevent future contamination, but there are no national efforts to identify, assess and remediate contaminated sites. Better water quality monitoring is a prerequisite to identify damages and remediation needs. Pollution Prevention and Decontamination Plans (PPDAs) can only be developed after violation of an environmental standard. These plans may employ emission standards, tradeable emission permits, emission taxes or user fees to promote environmental improvements (Melo and Perez, 2018[21]). However, lack of secondary environmental standards for water quality directly impedes development of PPDAs for affected water bodies.

As a complement to substance-by-substance water quality monitoring, Chile could make better use of non-targeted or effect-based techniques. Isotopes and bioanalytical methods, for example, could vastly improve water quality management (Brack et al., 2019[22]; OECD, 2023[23]). Effect-based methods can screen potentially harmful pollution and contamination hotspots, including pollution by mixtures of chemicals and chemicals that are not regularly monitored. This would seem appropriate considering both the wide range of pollutants (from agriculture, mining or urban wastewater) affecting freshwater quality in Chile and the lagging standards for water quality and monitoring. Isotopes can trace the pollution source. Such methods may seem advanced, particularly since routine water quality monitoring system is still in development. However, their ability to screen water quality risks can help prioritise monitoring and establish secondary water quality standards for national and basin-specific substances. Nevertheless, these methods cannot replace the need to collect detailed information on the composition and characteristics of the specific pollutants on the site and the extent of the contamination, which are required for risk assessment and the preparation of remediation plans for contaminated sites.

2.4.3 Data and information

Chile has a range of disparate information sources and data platforms to inform management of water resources. A number of tools exist, notably the National Water Balance (updated in 2017); the Online Hydrometric System to capture satellite data on meteorological and hydrological conditions; the National Water Bank – a repository of data used to produce official hydrological statistics; the National Institution of Statistics' database with key datasets on water; the National Inventory of Wetlands; and the Atlas of Climate Risks.

Still, a number of information and data gaps have been identified, including in spatial coverage of the quantity and quality of surface water, groundwater and ecosystems, and monitoring frequency and coverage (National Water Board, 2022[24]). Challenges related to accurately monitoring water abstractions and water quality data are especially acute. Information on water quality is fragmented across different institutions; water quality information on specific impacts from activities of national interest, such as diffuse pollution sources and aquaculture, is lacking; available information on water quality is also insufficiently disseminated. There is an absence of research on, and monitoring of, emerging contaminants (including pharmaceuticals, cosmetics and personal care products) (National Water Board, 2022[24]). In addition, there are long time lags between DGA sampling of water quality and reporting.

A reference centre for water quality is absent, creating a challenge to reconcile disparate analyses by different laboratories and monitoring campaigns. There is a lack of reliable data on water use rights. For

the provision of drinking water services, SISS has established information protocols that private companies use to report data. Nevertheless, capacity to validate the information provided is lacking.

Building on the various data and information sources available, Chile would benefit from a centralised platform for water quality and quantity management. Such a platform would provide a coherent and more comprehensive source of key information to support efforts to monitor water resources and inform policy and planning.

2.4.4 Economic instruments for water management and WSS

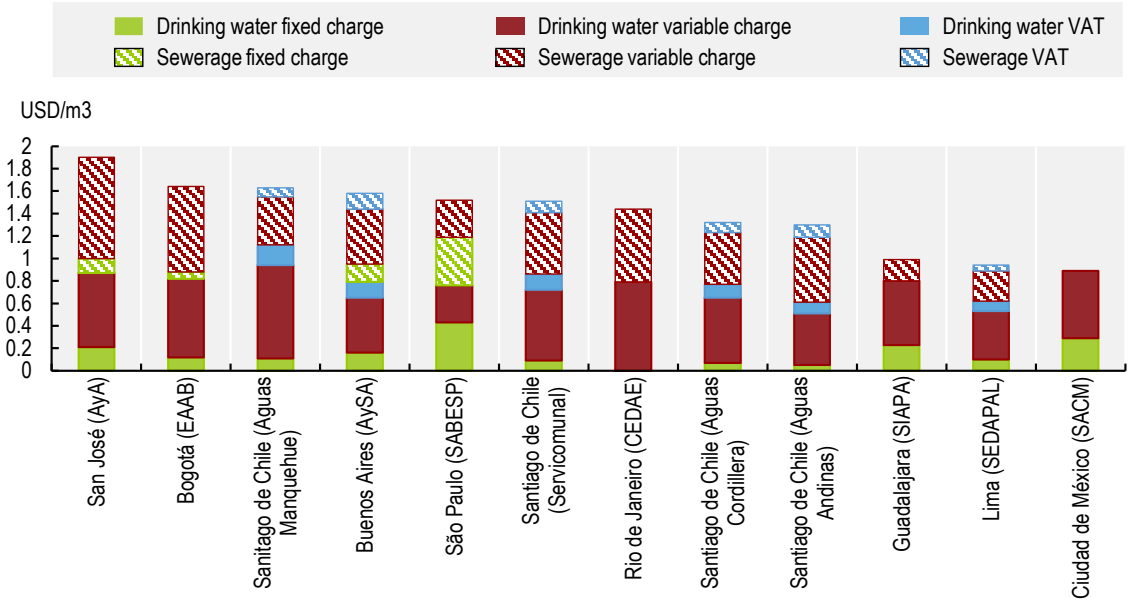
The use of economic instruments for water management in Chile is limited. There is untapped potential to better apply the polluter pays principle and the beneficiary pays principle. There are no abstraction charges for the use of water resources. Pricing water via abstraction charges can generate revenue that could support water management, internalise negative externalities associated with water abstractions and send a price signal to users to discourage inefficient and low-value water uses (OECD, 2015[18]). The 2005 reform to the Water Code introduced a non-use tariff for unused water to address speculation and hoarding of water rights, which is mainly an issue for non-consumptive rights (for hydropower). Once the water use right is determined to be "unused", the tariff is levied based on a system of escalating charges (OECD, 2015[18]). Water effluents, pesticides and fertilisers are not taxed or charged. The previous review recommended such economic instruments for water management, but there has been no progress on this front.

Chile is a leader in the LAC region in the effective implementation of economic regulation of urban WSS services (Fernandez, Saravia Matus and Gil, 2021[25]). Tariffs for drinking water and sewerage are charged at a uniform rate per cubic metre across all users and adjusted for inflation. There are no block tariffs. A fixed charge is also applied, regardless of consumption levels (Fernandez, Saravia Matus and Gil, 2021[25]). The variable portion of the tariff is adjusted seasonally, with a higher value during the peak summer period (1 December to 31 March), reflecting the scarcity value of the resource. The peak seasonal rate contributes to managing demand to avoid reaching the capacity limits of the water distribution network. Overconsumption of drinking water triggers an additional charge; if use exceeds a threshold of 40 cubic metres (m^3)/month during this period, the unit price is more than doubled (Andres et al., 2021[26]). Overall, water tariffs in Santiago are generally lower than in other major cities in the region, while fully recovering costs (Figure 2.12).

Tariff levels are based on marginal investment costs. Eligible low-income households receive a direct subsidy to cover part or all of the cost of up to 15 m^3/month of potable water and sewerage (Fernandez, Saravia Matus and Gil, 2021[25]). In rural areas, water tariffs are often too low to recover operational and maintenance costs. As a result, infrastructure has deteriorated over time. From 2024, SISS will be responsible for calculating tariffs for rural services. Tariffs should aim to recover operation and maintenance costs of service provision, with targeted support for low-income households to address affordability issues.

Figure 2.12. Water tariffs in Santiago are generally lower than in other major cities in LAC, while fully recovering costs

Monthly drinking water and sewerage tariffs for 15 m^3, major LAC cities, latest available year



Note: Values for Mexico City are underestimated since only data for drinking water services are available.
Source: World Bank (2023), IBNET.

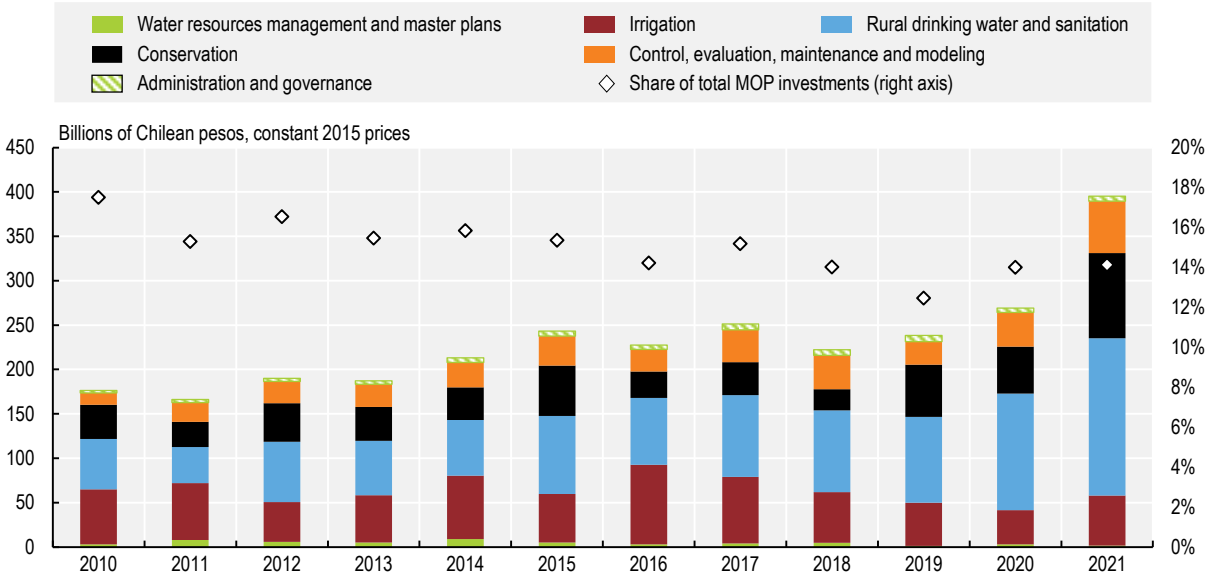
StatLink https://stat.link/095l3h

2.4.5 Finance and investment in water infrastructure

Water-related investments account for a considerable and increasing share of investments by the MOP, reaching nearly 20% in 2021 (Figure 2.13). Investments in rural drinking water and sanitation increased more than fourfold between 2010-21 – an important step towards closing the WSS gap for rural communities.

Figure 2.13. Investments in rural drinking water and sanitation have increased significantly

Investments by the Ministry of Public Works related to water, by programme, 2010-21



Note: The authors have grouped investment subcategories into general categories.
Source: MOP (2022), Inversión Histórica MOP.

StatLink https://stat.link/flpsq2

Chile has achieved financial sustainability for water services in all its urban areas for over two decades, with tariffs the main source of primary financing for the sector (Fernandez, Saravia Matus and Gil, 2021[25]). Aguas Andinas, a publicly traded company, serves a population of 8.5 million in Santiago de Chile, with 100% coverage for drinking water and over 98% in treated sewerage. In rural areas, community organisations operate services with financial support from the national government (Fernandez, Saravia Matus and Gil, 2021[25]).

Until recently, long-term planning for water infrastructure investments in Chile has been lacking; projects have been developed independently, without co-ordination at basin level. In a positive step, the Water Infrastructure Plan sets out a long-term vision from 2020 to 2050 with emphasis on flexible infrastructure planning and adaptive design to address emerging priorities. A strategic and long-term approach to water infrastructure investments is critical, given they tend to be capital-intensive and long-lived. Ideally, planning for water-related investments should be robust to known hazards and flexible to adapt to future conditions. It should consider a range of diverse investments, including nature-based solutions, over multiple future scenarios and evaluate options relative to stakeholder-defined goals (Brown, Boltz and Dominique, 2022[27]).

New sources of supply to address scarcity, such as desalination and wastewater reuse, require large investments. Chile needs to address how to finance them and who should bear the cost. To date, Chile's experience with public-private partnerships (PPPs) for water infrastructure has been limited. The PPP Infrastructure Plan 2022-26 indicates an investment of USD 449 million in two desalination plants. PPPs for water infrastructure could be further explored, drawing on lessons from other OECD countries. Box 2.6 highlights how Spain and Israel set up a legal and regulatory framework.

Box 2.6. Legal and regulatory framework for wastewater reuse: Examples from Israel and Spain

The use of non-conventional resources (wastewater reuse and desalination) has reached significant levels in Israel and Spain. In Israel, more than 500 million cubic metres (MCM) of raw sewage is collected per year, of which 93% is treated and 85% is reused for agriculture. In Spain, wastewater reuse has reached around 400 MCM in volume and is mainly used for agriculture. Water reuse is concentrated in areas with the greatest natural resources deficit and highest volume of wastewater generated.

In Israel, wastewater reuse follows several policy principles, established by the Water Authority. These include: (i) the full use of wastewater to minimise disposal to the environment; (ii) economic efficiency reflecting that different qualities are used appropriately, subject to agricultural, health and ecological limitations; and (iii) fairness so that sewerage producers are responsible for treatment and purification, reclaimed water users are responsible for usage systems and the government participates in financing external costs.

Public Health Regulations established in 2010 are designed to protect public health, prevent contamination of water sources from wastewater and effluent, allow reuse of effluent as a source of water, protect the environment, including ecosystems and biological diversity, the soil and agricultural crops. In 2011, the Water Authority published rules that give water and sewerage companies tools to monitor the quality of industrial wastewater discharged into system and charge additional sewage rates for these discharges in accordance with the provisions of the tariffs rules. These rules implement the polluter pays principle when the factories are obliged to pay for the additional treatment costs and the damages caused as a result of the industrial wastewater discharged into the sewage system.

In Spain, the use of reclaimed water is a private use of the public water domain. The right is granted by administrative concession, with project competition of potentially interested parties. The river basin authority must permit production of reclaimed water from wastewater, subject to a binding report from health authorities. The quality requirements for reclaimed water are laid down in national and EU legislation. The producer of reclaimed water and the concessionaire of its subsequent use are responsible, respectively, for its production and for its use in accordance with a risk management plan. The authorisation of the plan, implementation and compliance monitoring requires co-ordination of competent water, health, agriculture and environmental authorities.

In Spain, public administrations may use economic instruments to promote water reuse by granting direct public aid to the concessionaire of reclaimed water (user), or indirect public aid through an exemption from the water use tariff. This tariff helps pay for the availability or use of water, as well as for the deterioration of its quality. It is generally paid by all beneficiaries of water infrastructure that is totally or partially financed by the state. As a condition for granting public aid, the total or partial substitution of a surface water or groundwater abstraction concession by reclaimed water must help achieve environmental objectives of the natural water bodies concerned or optimise water resource management. Compliance with this condition is determined in the hydrological plans of each river basin.

Source: Submissions from Israel and Spain.

Chile could also explore a broader suite of approaches to scale up financing for water-related investments, tailoring financing approaches with the risk-return profile of investments (OECD, 2021[28]). Use of proceeds bonds (e.g. “green bonds” or sustainability-linked bonds) for water investments have potential, building on Chile’s considerable experience with such bonds for other climate- and environment-related investments (Chapter 1). Payment for ecosystem services (PES) could be used to incentivise improved water management in basins and financing for water resources management. PES have been widely used for water management in LAC and OECD, with a number of successful examples (Leflaive, Dominique and Alaerts, 2022[29]).

Irrigation subsidies

In Chile, around 49% of agricultural land is irrigated (Instituto Nacional de Estadísticas, 2022[30]). It accounts for more than 80% of the country's agricultural exports, notably fruit-export crops (Martin and Saavedra, 2018[31]). Exports have been the main driver of growth in the agricultural sector, increasing at a rate of 10% per year over 2008-18 (Anríquez and Melo, 2018[32]).

More than one-third of General Services Support to agriculture over 2010-21 targeted water infrastructure (OECD, 2022[33]). The National Irrigation Commission manages a cost-share grant programme to support small and medium-scale initiatives for irrigation development and management. Small and medium-sized landowners can complement their investments in irrigation and drainage projects for community or individual works with public grants. Small producers who benefit from the Agricultural Development Institute can receive financing of up to 90%, and small farmer organisations up to 70% of total costs (Panez, Roose and Faúndez, 2020[34]). About 23 000 farmers have benefited from the programme, which helped develop irrigation on 200 000 ha, including a growing number of small farmers over time. The programme also enabled 500 000 beneficiaries to shift to pressurised irrigation, representing a total area of 325 000 ha (Gruère, Ashley and Cadilhon, 2018[35]).

While irrigation efficiency has improved, the return flows of water to groundwater and surface water sources have declined (Anríquez and Melo, 2018[32]). In Chile's allocation system, water saved from improvements in irrigation efficiency reverts to the water rights holder. This may encourage an increase in total area irrigated rather than contribute to overall water availability. The previous review recommended assessing impacts of subsidies for irrigation and small-scale mining on groundwater recharge, biodiversity and ecosystems. However, this is still pending. Chile should review and assess the efficiency of irrigation investments and their impact on groundwater recharge and ecosystems. It should also explore the possibility of implementing systems to return water flows to basins, in line with the national water management framework.

References

Acosta, O. (2018), "Water and mining", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing. [6]

Andres, L. et al. (2021), *Troubled Tariffs: Revisiting Water Pricing for Affordable and Sustainable Water Services*, World Bank, Washington, DC. [26]

Anríquez, G. and O. Melo (2018), "The socio-economic context of Chilean water consumption and water markets growth: 1985-2015", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing. [32]

Barría, P. et al. (2019), "Anthropocene and streamflow: Long-term perspective of streamflow variability and water rights", *Elementa: Science of the Anthropocene*, Vol. 7, https://doi.org/10.1525/elementa.340. [20]

Bauer, C. (2013), "The experience of water markets and the market model in Chile", in Maestu, J. (ed.), *Water Trading and Global Water Scarcity: International Experiences*, RFF Press, New York. [4]

Blair, J., R. Balcázar and J. Barandiarán (2022), "Exhausted: How we can stop lithium mining from depleting water resources, draining wetlands and harming communities in South America", *Report*, Natural Resources Defence Council, Washington, DC, https://www.nrdc.org/resources/exhausted-how-we-can-stop-lithium-mining-depleting-water-resources-draining-wetlands-and. [7]

Brack, W. et al. (2019), "Effect-based methods are key. The European Collaborative Project SOLUTIONS recommends integrating effect-based methods for diagnosis and monitoring of water quality", *Environmental Sciences Europe*, Vol. 31/1, https://doi.org/10.1186/s12302-019-0192-2. [22]

Brown, C., F. Boltz and K. Dominique (2022), "Strategic Investment Pathways for resilient water systems", *OECD Environment Working Papers*, No. 202, OECD Publishing, Paris, https://doi.org/10.1787/9afacd7f-en. [27]

Donoso, G. (2021), "Economics of water resources", in Fernández, B. and J. Gironás (eds.), *Water Resources in Chile*, Springer International Publishing. [2]

Fernandez, D., S. Saravia Matus and M. Gil (2021), *Regulatory and Tariff Policies in the Drinking Water and Sanitation Sector in Latin America and the Caribbean*, UN ECLAC, Santiago. [25]

Gruère, G., C. Ashley and J. Cadilhon (2018), "Reforming water policies in agriculture: Lessons from past reforms", *OECD Food, Agriculture and Fisheries Papers*, No. 113, OECD Publishing, Paris, https://doi.org/10.1787/1826beee-en. [35]

Hearne, R. (2018), "Water markets", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing. [19]

IEA (2018), *Energy Policies Beyond IEA Countries: Chile 2018 Review*, International Energy Agency, Paris. [5]

Instituto Nacional de Estadísticas (2022), *Censo Nacional Agropecuario y Forestal*, [Final Results, National Graphs. 04 Area under irrigation and unirrigated land], Instituto Nacional de Estadísticas. [30]

Kuzma, S., L. Saccoccia and M. Chertock (2023), *25 Countries, Housing One-quarter of the Population, Face Extremely High Water Stress*, World Resources Institute, Washington, DC. [3]

Leflaive, X., K. Dominique and G. Alaerts (2022), *Financing Investment in Water Security: Recent Developments and Perspectives*, Elsevier, https://doi.org/10.1016/C2019-0-03290-6. [29]

Martin, F. and F. Saavedra (2018), "Irrigated agriculture", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing. [31]

Melo, O. and J. Perez (2018), "Water quality policy", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing. [21]

Molinos-Senante, M. (2018), "Urban water management", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing. [14]

National Water Board (2022), *National Water Board Final Report*, National Water Board, Santiago. [24]

OECD (2023), *Endocrine Disrupting Chemicals in Freshwater: Monitoring and Regulating Water Quality*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/5696d960-en. [23]

OECD (2023), *Mining Regions and Cities in the Region of Antogafasta, Chile: Towards a Regional Mining Strategy*, OECD Rural Studies, OECD Publishing, Paris, https://doi.org/10.1787/336e2d2f-en. [1]

OECD (2022), *Agricultural Policy Monitoring and Evaluation 2022: Reforming Agricultural Policies for Climate Change Mitigation*, OECD Publishing, Paris, https://doi.org/10.1787/7f4542bf-en. [8]

OECD (2022), *Agricultural support (indicator)*, https://doi.org/10.1787/6ea85c58-en (accessed on 2023). [33]

OECD (2021), *Financing a Water Secure Future*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/a2ecb261-en. [28]

OECD (2021), *Water Governance in Peru*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/568847b5-en. [17]

OECD (2020), "Nature-based solutions for adapting to water-related climate risks", *OECD Environment Policy Papers*, No. 21, OECD Publishing, Paris, https://doi.org/10.1787/2257873d-en. [12]

OECD (2017), *Diffuse Pollution, Degraded Waters: Emerging Policy Solutions*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/9789264269064-en. [10]

OECD (2017), "The governance of water infrastructure in Chile", in *Gaps and Governance Standards of Public Infrastructure in Chile: Infrastructure Governance Review*, OECD Publishing, Paris, https://doi.org/10.1787/9789264278875-en. [15]

OECD (2015), *Water Resources Allocation: Sharing Risks and Opportunities*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/9789264229631-en. [18]

OECD (2015), *Water Resources Governance in Brazil*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/9789264238121-en. [16]

OECD (2013), *Water and Climate Change Adaptation Policies to Navigate Uncharted Waters*, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/9789264200449-en. [13]

Panez, A., I. Roose and R. Faúndez (2020), "Agribusiness facing Its limits: The re-design of neoliberalization strategies in the exporting agriculture sector in Chile", *Land*, Vol. 9/3, p. 66, https://doi.org/10.3390/LAND9030066. [34]

Vega, A., K. Lizama and P. Pastén (2018), "Water quality: Trends and challenges", in Donoso, G. (ed.), *Water Policy in Chile*, Springer International Publishing. [9]

Vicuna, S. et al. (2021), "Impacts of climate change on water resources in Chile", in Fernández, B. and J. Gironás (eds.), *Water Resources in Chile*, Springer International Publishing. [11]

Notes

[1] Copiapó and Huasco rivers (Atacama region); Elqui, Limarí, Choapa, and Quilimarí (Coquimbo); Ligua, Petorca and Aconcagua (Valparaíso); and Maule (Maule).

[2] Ministries of Environment, Public Works, Energy, Agriculture, Mining and Science, Technology, Knowledge and Innovation.

[3] Small agricultural producers have five years (dating from enactment of the law) to register their water rights.

[4] Secondary standards are in place for Serrano, Maipo, Biobío and Valdivia basins, and for the Villarrica and Llanquihue lakes.

OECD Environmental Performance Reviews

CHILE

Chile has made important strides on its environmental agenda in recent years with the passage of the Framework Law on Climate Change, the establishment of the Biodiversity and Protected Areas Service and the ratification of the Escazú Agreement. However, the country has made limited progress in decoupling environmental pressures from economic growth. Greenhouse gas emissions have continued to rise and the country is not on track to reach its legally binding target of net zero by 2050. Chile is well-positioned to achieve its targets for biodiversity, while air pollution remains a serious public health challenge and waste management relies heavily on landfilling. Chile is facing a severe and deepening water crisis that requires concerted action to improve water allocation and water quality, and to strengthen water governance. The review provides 36 recommendations to help Chile improve its environmental performance, with a special focus on water management and policies.

This is the third *Environmental Performance Review* of Chile. It provides an independent, evidence-based evaluation of the country's environmental performance since the previous review in 2016.

PRINT ISBN 978-92-64-37918-3
PDF ISBN 978-92-64-73497-5

2024