Republic of Chile

International Atomic Energy Agency

Country Programme Framework

2026–2032

This Country Programme Framework for the Republic of Chile (2026 – 2032) has been signed on behalf of the Government of the Republic of Chile and the International Atomic Energy Agency

On behalf of the Government	**On behalf of the International Atomic Energy Agency**
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List of Abbreviations

Chilean Institutions and Agencies

Abbreviation	Name
ACHIPIA	Chilean Agency for Food Safety and Quality
ANI	National Intelligence Agency
ANID	National Research and Development Agency
CCHEN	Chilean Nuclear Energy Commission
CIREN	Natural Resources Information Center
CNCR	National Center for Conservation and Restoration
CNE	National Energy Commission
CONAF	National Forestry Corporation
CONSER	Radiological Emergency Safety Commission
CPC	Confederation of Production and Commerce
DGA	General Water Directorate
DIMA	Directorate for the Environment and Ocean Affairs
DIRECTEMAR	General Directorate of Maritime Territory and Merchant Marine
DISNR	Nuclear and Radiological Safety Division (CCHEN)
EPR	Emergency Preparedness and Response
EPRIMS	Emergency Preparedness and Response Information
INACH	Chilean Antarctic Institute
INCANCER	National Cancer Institute
INDAP	Agricultural Development Institute
INFOR	Forestry Institute
INIA	Agricultural Research Institute
INTA	Institute of Nutrition and Food Technology
IRMIS	International Radiation Monitoring Information System
ISP	Institute of Public Health
JUNAEB	National Board for School Assistance and Scholarships
MINAGRI	Ministry of Agriculture
MMEG	Ministry of Women and Gender Equality
MINDEF	Ministry of Defense
MININ	Ministry of the Interior
MINREL	Ministry of Foreign Affairs
MINSAL	Ministry of Health
MINSEG	Ministry of Public Security
MMA	Ministry of the Environment
NDT	Non-Destructive Testing
OCC	Climate Change Office
ODEPA	Office of Agricultural Studies and Policies

ONEMI	National Emergency Office
PDI	Investigative Police of Chile
PER	Regional Energy Plan
SERNAPESCA	National Fisheries and Aquaculture Service
SAG	Agricultural and Livestock Service
SML	Legal Medical Service
SNA	National Agricultural Society

International Organizations and Frameworks

Abbreviation	Name
CPF	Country Programme Framework
CRP	Coordinated Research Project
ECLAC	Economic Commission for Latin America and the Caribbean
FAO	Food and Agriculture Organization (United Nations)
GICNT	Global Initiative to Combat Nuclear Terrorism
IAEA	International Atomic Energy Agency
IDB	Inter-American Development Bank
INSSP	Integrated Nuclear Security Support Plan
INSSERV	International Nuclear Security Advisory Service
IPPAS	International Physical Protection Advisory Service
IRPA	International Radiation Protection Association
ME	Member State
NPC	National Participation Costs
NSNS	Nuclear Safety and Nuclear Security (IAEA)
OECD	Organization for Economic Cooperation and Development
PCT	Technical Cooperation Program
SDG	Sustainable Development Goal
SIT	Sterile Insect Technique
TC	Technical Cooperation
TCF	Technical Cooperation Fund
UN	United Nations Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNS	United Nations System
UNSDCF	United Nations Sustainable Development Cooperation Framework
WHO	World Health Organization

EXECUTIVE SUMMARY

This Country Programme Framework (CPF) for 2026-2032 provides the strategic orientation for Chile's cooperation with the International Atomic Energy Agency (IAEA). It identifies the national development priorities where nuclear science and technology can offer high-impact, evidence-based solutions and establishes the basis for the programming of Technical Cooperation (TC) activities during the next three TC cycles.

Developed jointly by the Government of Chile and the IAEA, this framework aligns with the UNSDCF 2023-2026 and the 2030 Agenda. It focuses on six priority areas where nuclear technology delivers specific added value:

1. Nuclear Safety and Security: Strengthening regulatory independence and emergency preparedness.

2. Food and Agriculture: Enhancing climate resilience, pest control (SIT), and food authenticity.

3. Health and Nutrition: Aligning with the Rays of Hope initiative to expand cancer care and nutritional monitoring.

4. Water and Environment: Using isotopic techniques for water security and Antarctic preservation (NUTEC Plastics).

5. Energy and Industry: Supporting energy planning, lithium sustainability, and mining traceability.

6. Heritage preservation and structural safety: Supporting culture and infrastructure.

The expected results will directly contribute to SDGs 2, 3, 5, 6, 7, 9, 13, 14, 15, and 17, with gender equality mainstreamed as a cross-cutting priority.

This CPF is a flexible programming instrument. It allows for the incorporation of emerging national priorities and new initiatives at any stage of implementation, ensuring continued alignment with Chile's development agenda and the evolving needs of beneficiary institutions.

1. INTRODUCTION

The CPF for 2026-2032 defines Chile's priority areas for cooperation with the IAEA and serves as the strategic reference for planning, implementing and reviewing TC activities. Its purpose is to ensure that future programmes are fully aligned with national development policies, sectoral strategies, the UNSDCF 2023-2026 and Chile's commitments under the 2030 Agenda.

The CPF was developed jointly by the Government of Chile, under the leadership of the CCHEN and the IAEA. The process drew on lessons learned from the 2020-2025 CPF cycle and involved consultations with national authorities, technical institutions, research centres, universities and other stakeholders contributing to the identification of priority thematic areas and expected outcomes. Gender-balanced participation was encouraged throughout the process, ensuring that diverse institutional perspectives and expertise informed the formulation of the CPF.

Based on this collaborative approach, six strategic thematic areas were identified as the focus for the 2026–2032 period: Nuclear and Radiation Safety and Security; Food and Agriculture; Health and Nutrition; Water and Environment; Energy and Industry; and Industrial Applications. These areas represent the intersections where national needs, scientific capacity and the potential of nuclear technologies converge to support sustainable socioeconomic development.

The CPF builds on the achievements of previous cooperation cycles and provides a coherent framework to guide future assistance, promoting the peaceful, safe and effective use of nuclear science and technology for national benefit.

2. SITUATION ANALYSIS

2.1. OVERALL SITUATION ANALYSIS

This Country Programme Framework (CPF) for the period 2026-2032 is based on a comprehensive analysis of the current situation in Chile, with the aim of identifying priority areas for development where technical cooperation from the International Atomic Energy Agency (IAEA) can make a substantial and strategic contribution.

These priorities were defined through a process of analysis that considered the intersection of several key reference frameworks: the public policies and sectoral strategies that guide national development; the current United Nations Sustainable Development Cooperation Framework, which articulates the work of the UN system in the country; and Chile's commitment to the 2032 Agenda and its Sustainable Development Goals (SDGs). This approach ensures that the CPF not only responds to immediate needs but also serves as a tool aligned with the country's long-term development vision.

Figure No. 1 Basis for the development of the Country Programme Framework CPF Chile 2026-2032.

2.1.1. NATIONAL PRIORITIES

The main national development plans and priorities that were considered in defining the priorities for technical cooperation activities with the IAEA in this CPF are presented below.

2.1.2. MCNUDS CHILE 2023-2026 PRIORITIES

The MCNUDS[1] signed by Chile in April 2023 identifies the cooperation that the United Nations System (UNS) will provide to the country in the coming years to achieve sustainable development, within the framework of the 2030 Agenda[2] , which proposes 17 SDGs for the period, with the four strategic priorities indicated in the table below.

Table No. 1: MCNUDS-Chile Strategic Priorities.

Strategic priority	Concept	[3]Related SDGs
PE1: Substantive equality in access to economic, social, cultural, and environmental rights	Chile is moving towards a welfare state, focused on providing and guaranteeing universal social rights in critical areas, as well as adopting public programs aimed at closing gaps and inequalities.	1, 2, 3, 4, 5, 6, 8, 10, 11, 16
PE2: Strengthened democratic institutions and security for a new inclusive social contract	Chile is strengthening its democratic institutions, with a focus on human rights, transparency, decentralization, and citizen participation, guaranteeing security, access to justice, and effective representation of the country's diversity.	5, 10, 11, 16, 17

[1] United Nations Cooperation Framework for Sustainable Development in Chile 2023-2026 (MCNUDS)https://chile.un.org/sites/default/files/2023-05/VERSI%C3%93N%20FINAL_MDC_2023-2026_web_23mayo.pdf

[2] Chile Agenda 2030 http://www.chileagenda2030.gob.cl

[3] Sustainable Development Goals - UN 2030 Agenda; 2015 https://www.un.org/sustainabledevelopment/es/sustainable-development-goals/

Strategic priority	Concept	[3]Related SDGs
PE3: A sustainable, inclusive, and resilient development model to address the climate crisis, biodiversity loss, and pollution	Chile is promoting a new development model that responds to the climate crisis, fosters productive diversification, innovation, and ecological transition, with a focus on territories, MSMEs, and cooperatives, integrating environmental sustainability with social justice.	1, 2, 7, 8, 9, 10, 12, 13, 14, 15, 17
PE4: Gender balance	Chile is moving towards an inclusive society, free from violence and discrimination against women and diversity, promoting gender balance as a cross-cutting priority of the State, with an intersectional approach and coordination in policies, programs, and budgets to guarantee rights and autonomy.	5, 10, 16

2.1.3. NATIONAL DEVELOPMENT POLICIES, STRATEGIES, AND PLANS

Chile's national development priorities are informed by key strategic frameworks, including the Long-Term Climate Strategy 2050, the Climate Change Framework Law, the National Energy Policy, the National Mining Policy 2050, the National Water Strategy, the National Food Security Strategy, the National Disaster Risk Reduction Policy and major health sector plans such as the National Cancer Plan. Additional sectoral policies on gender equality, innovation, biodiversity and cultural heritage also contribute to national planning.

2.1.4. IAEA TECHNICAL COOPERATION. MAIN AREAS OF SUPPORT AND KEY ACHIEVEMENTS OF PAST TC

IAEA technical cooperation has been a fundamental pillar in the development of Chile's nuclear and radiological capabilities. The Technical Cooperation Program has been key in building physical infrastructure and advanced human capital, supporting scientific and technological development for the country. In the most recent cycles, and in response to national priorities and global challenges.

Chile has received significant support from the IAEA in nuclear and radiological safety and security, including EPR to strengthen its national architecture, developing technical and human capacities in agencies such as the CCHEN, MINSAL, and ISP. Support services have been enhanced, including laboratories, radiochemistry, hospital radiopharmacy, and capacities in radiodiagnostics, nuclear medicine, and medical and biological dosimetry. Of particular note is the successful removal and shipment to Germany of 31 discarded Cobalt-60 sources, described as the largest of its kind by the recycling company *Gamma Service Recycling*.

The National Nuclear and Radiological Emergency Plan was also drawn up and approved, and national capacities for preparedness and response to emergencies of this type have been strengthened with technical support from the IAEA. In the field of agriculture, technical cooperation has focused on the application of isotopic and related techniques in agricultural studies, with a view to improving soil management in the face of inappropriate practices such as overexploitation, water scarcity, and excessive use of agrochemicals, which cause erosion and pollution. Through the SIRSD program, large areas of degraded land were recovered, and the use of nuclear methodologies improved water and soil quality diagnostics, promoting sustainable agricultural practices.

In addition, with technical cooperation from the IAEA, the National Zoonosis Laboratory was strengthened in biosafety and transboundary diseases, and support was provided to small farmers, addressing contaminants, good agricultural practices, and toxicology. In the food sector, food safety,

quality, and authenticity, which are fundamental aspects for public health and exports, have been addressed. Irradiation technology has been used to extend the shelf life of food and eliminate pathogens and quarantine pests. Progress has also been made on a national system to verify food authenticity, using an EA-IRMS spectrometer at the CCHEN to analyze products such as honey, wine, and seafood.

IAEA support in the field of health has been important in strengthening the production of radiopharmaceuticals, ensuring their quality under international standards, and consolidating capacities in nuclear medicine and radiation protection in medical applications. Training for professionals in new radiotherapy technologies has been promoted to improve treatments and reduce adverse effects on patients. Also noteworthy is the incorporation of NephroCam equipment at the MATER Children's Renal Corporation, which has strengthened early diagnosis in children, positioning the country as a regional benchmark.

With regard to water and the environment, the IAEA has supported the application of nuclear and isotopic techniques in water quality assessment and sustainable water resource management, including the study of contaminants in surface, groundwater, and marine waters. Noteworthy are participation in the IAEA and WMO GNIP network, which generates precipitation data for hydrogeological and climate change studies; the establishment of a genomics laboratory in Concepción to improve forest species in the face of climate change using nuclear techniques, with relevant results in hormesis and mutation induction; and the consolidation of a national cooperation network for plant breeding by mutagenesis, coordinating capacities between research institutions. Progress has also been made in the characterization of aquifers, recharge areas, and groundwater sustainability. With regard to coastal areas, capacities have been developed to study microplastics and marine toxins, actively contributing to the REMARCO regional platform.

Furthermore, within the framework of the Memorandum of Understanding signed with the IAEA, an important initiative led by the Chilean Antarctic Institute is being developed to strengthen the protection of the Antarctic environment. In the field of energy, through the Chilean Nuclear Energy Commission, Chile has maintained its commitment to preserving technical capabilities and up-to-date knowledge in this area, with support from the IAEA. In the industrial sector, especially in mining, capacities have been strengthened in the use of radiotracer techniques to optimize hydrometallurgical processes, making Chile a regional benchmark in this application.

In addition, Chile requested IAEA support to modernize the instrumentation of the Chilean Research Reactor RECH-1 reactor through a co-financing scheme to expand its capabilities, including its use in techniques such as neutron imaging, applied to the inspection of internal structures in industrial and heritage objects.

Thanks to the consolidation of these capacities, the IAEA's contribution has diversified and deepened. Significant progress has been made in areas of national interest such as nuclear medicine, where cancer diagnosis and treatment have been improved; agriculture, with the implementation of techniques to optimize resource use and control pests; and industry, improving the competitiveness of sectors such as mining. At the same time, the national safety and security architecture has been systematically strengthened, with progress in the modernization of regulations, the training of State agencies, and the strengthening of the radiologically safe operation of medical and industrial facilities throughout the country.

2.1.5. Priorities according to Country Profile Framework 2026-2032

Thematic areas according to CPF for 2026-2032

The thematic areas adopted for the period 2026-2032 are as follows:

- **TA1:** Nuclear and Radiation Safety and Security
- **TA2:** Food and agriculture
- **TA3:** Health and nutrition
- **TA4:** Water and environment
- **TA5:** Energy and industry
- **TA6:** Non-Destructive Testing Applications

For each of these thematic areas, a situation analysis was carried out based on national development plans and priorities and experience gained from IAEA TC. These analyses, presented in sections 2.2 to 2.7, conclude with a brief statement of results and corresponding outputs.

2.1.6. Nuclear knowledge management

Nuclear knowledge management is cross-cutting, strategic and enabling pillar for the sustainable and safe development of all nuclear and radiological applications. International experience confirms that, in such a specialized and dynamic field, the ability to systematically create, preserve, transfer, and apply knowledge is essential for innovation, safety, and operational continuity. Faced with challenges such as generational change and rapid technological evolution, proactive knowledge management becomes indispensable.

Since the 2014 cycle, Chile has recognized this need and has been implementing various initiatives to develop and safeguard its human and intellectual capital in the nuclear field, with the valuable support of IAEA technical cooperation programs. The country has participated in projects such as RLA0057 "Improving education, training, outreach, and knowledge management in the nuclear field" and RLA0065 "Promoting the implementation of knowledge management in nuclear organizations and strengthening nuclear education." In the latter, the IAEA supported, among other things, the holding of the "Third International Symposium on Nuclear Education, Training, Dissemination and Knowledge Management" (July 2022), which was organized by the Latin American Network for Education and Training in Nuclear Technology (LANENT), of which the country is a member. In addition, the Regional Course on Nuclear Knowledge Management (Latin America) was held in parallel with the LANENT symposium. It is also worth noting that a KMAV (Level 2) expert mission on knowledge management and human resource development took place in the country during the period. Its purpose was to examine knowledge management practices in the institution and provide advice for their improvement.

For the period 2026-2032, this topic is not conceived as an isolated thematic area, but as a cross-cutting and fundamental component that ensures the long-term viability of the projects and capacities developed in each of the six strategic areas of this Country Programme Framework. Continuity of efforts in training, capacity building, mentoring, and the creation of knowledge networks will be crucial to the success and sustainability of the entire cooperation program.

2.1.7. Country vulnerabilities due to climate change

Chile meets seven of the nine vulnerability criteria of the UNFCCC. The structural 'mega drought' and extreme weather events necessitate the use of nuclear techniques for water resource management, climate-smart agriculture, and environmental monitoring, directly informing the prioritization of Thematic Areas 2 and 4.

2.1.8. GENDER SITUATION IN CHILE AND RELATED COMMITMENTS

Chile has made progress in gender balance over the last decade, driven by social movements and a growing recognition of the need to close structural gaps.

Chile continues to advance gender equality, although gaps persist in labour participation, care responsibilities, political representation and STEM careers. These challenges are addressed through national frameworks such as the National Equality Policy 2018-2030, the National Support and Care Policy, the National Women's Health Programme and the Gender Policy in Science, Technology, Innovation and Knowledge. Chile also upholds its international commitments under CEDAW, the Beijing Platform for Action and SDG 5, and gender equality remains a cross-cutting priority of the UNSDCF 2023-2026.

2.1.9 ASSUMPTIONS AND RISKS

The expected results and outputs are also subject to internal and external factors beyond the control of the management team, which could affect the progress of the planned program. In this regard, the proposed program was developed based on certain assumptions, which, in general terms, include the following:

- The design of this CPF assumes that the key actors involved in this CPF will continue to participate at the level necessary to ensure the effective implementation of this instrument.
- There is sufficient availability of qualified personnel for training.
- There is ongoing support from the government, maintaining the prioritization of the areas identified.
- The necessary legal framework is in place.
- The required funds are available.

The CPF also takes into account possible factors that are beyond the direct control of the program management team, which could lead to future situations that hinder the achievement of the expected results and outputs. These factors, identified as general risks, include the following:

- Changes in national policies or priorities.
- Failure of stakeholders (mainly government institutions) to participate.
- Insufficient financial resources.
- Interference due to emergencies or natural disasters.
- Political interference that distorts priorities.
- Inadequate coordination between key actors.
- Insufficient number of qualified personnel to provide training.

2.2. LEGAL FRAMEWORK

Chile is a party to the main international instruments governing nuclear safety and security, namely: Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; Convention on Nuclear Safety, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, the Convention on the Physical Protection of Nuclear Material and its Amendment

Chile has expressed a political commitment to the Code of Conduct on the Safety and Security of Radioactive Sources and two Guidance documents on the Import and Export of Radioactive Sources, and has notified the IAEA of its commitment to implement the Guidelines on the Management of Disused Radioactive Sources.

Two regulatory bodies have been established for the regulatory control of facilities and activities. On the one hand, the Ministry of Health, through its 16 Regional Secretariats, is responsible for the authorization and inspection of facilities that use Category 2 and 3 radioactive sources as provided for in Article 7 of Decree No. 133, and for activities related to them. On the other hand, the Chilean Nuclear Energy Commission is responsible for the authorization and inspection of nuclear facilities and facilities that use Category 1 radioactive sources s, as provided for in Article 7 of Decree No. 133, and for activities related to them.

CCHEN is the State institution that is responsible for research, development, and application of nuclear energy, as well as its regulation, control, and oversight, providing technological and research and development services to sectors outside the country that contribute effectively to knowledge in science and technology, the well-being and safety of people, and the protection of the environment. The main objective of the CCHEN is to advise the Supreme Government on all matters related to the peaceful use of nuclear science and technology.

In terms of regulation and in accordance with current national legislation (Law N° 18302 on Nuclear Safety), the CCHEN is the competent authority for nuclear facilities and first-category radioactive facilities. As such, the CCHEN—and the Ministry of Energy, where appropriate—is the body responsible for regulating, supervising, controlling, and monitoring activities related to the peaceful uses of nuclear energy and other facilities and nuclear substances and radioactive materials used therein, as well as their transport. It is also the body responsible for issuing regulations concerning radioactive facilities. (Article 67°). Notwithstanding the above, regulations on radiation protection and authorizations relating to radioactive facilities shall be signed jointly by the Ministers of Energy and Health.

With regard to authorizations, the CCHEN grants licenses for the siting, construction, commissioning, operation, and definitive closure, as applicable, of nuclear facilities and first-category radioactive facilities (as defined in D.S. °. 133 of 1984, of the Ministry of Health), as well as to the personnel operating them; it grants authorizations for the transport, storage, transfer, import, and export of radioactive materials and equipment associated with the aforementioned facilities.

The Ministry of Health is responsible for the control of second and third category radioactive facilities. The Health Authority Law (Law No.° 19937, enacted in 2004 and effective as of January 1, 2005) assigns the role and functions of Regional Health Authority to the Regional Ministerial Secretary of Health. Thus, the sixteen Regional Ministerial Secretaries of Health throughout the country have the status of regulatory authority for second and third category radioactive facilities and/or equipment and for authorizing the import or export of radioactive sources.

Then, according to Article 4 of Law No. 18302, the Ministry of Energy is responsible for authorizing, by supreme decree, nuclear power plants, enrichment plants, reprocessing plants, and permanent storage facilities for radioactive waste.

Chile does not have a national safety policy and strategy, nor does it have a national policy and strategy for the safe decommissioning of facilities, the safe management and disposal of radioactive waste, and the safe management of spent fuel. The legal, and regulatory framework for safety is based on Law No. 18302, the Nuclear Safety Law, Decree with Force of Law No. 725, the Health Code, and the following decrees:

- Decree No. 133 of 1984, of the Ministry of Health, Regulations on authorizations for radioactive facilities or equipment that generates ionizing radiation, personnel working in such facilities or operating such equipment, and other related activities.
- Decree No. 3 of 1985, Ministry of Health, Regulations on Radiation Protection for Radioactive Facilities.
- Decree No. 12 of 1985, Ministry of Mining, Regulations for the safe transport of radioactive materials.
- Decree No. 647 of 2015, of the Ministry of the Interior, creating the Radiological Emergency Safety Commission.

As regards national policies and strategies for the upcoming period of 2023-2026, CCHEN aims at promoting the establishment of national policy and strategy for:

- nuclear safety and the management of the associated risks associated with facilities and activities, based on a graded approach in accordance with the national reality.
- safe management of spent fuel and radioactive waste, taking into account the characteristics and volume of fuel and waste generated in the country.

With regard to preparedness and response to radiological or nuclear emergencies, the country developed a National Nuclear and Radiological Emergency Plan, with the support of the IAEA. The plan was approved in 2022. Its purpose is to ensure a coordinated and effective response to emergency situations, minimizing the risks and damage that may arise, while complying with Chile's international commitments in this area. The Plan is aligned with the IAEA General Safety Requirements No. GSR Part 7: Preparedness and Response for a Nuclear or Radiological Emergency, and is based on Law No. 21364, which establishes the National Disaster Prevention and Response System (SINAPRED).

In this context, the National Disaster Prevention and Response Service (SENAPRED) has been operational in the country since 2023, replacing the former National Emergency Office (ONEMI) and constituting a new institutional framework for risk management. This service is responsible for the overall coordination of emergencies, in close collaboration with the relevant technical agencies. In the event of a nuclear or radiological emergency, technical leadership falls to the relevant regulatory authority: CCHEN for nuclear facilities and first-category radioactive facilities, and the Regional Ministerial Secretariats (SEREMI) of the Ministry of Health (MINSAL) for facilities using Category 2 and 3 facilities.

In addition, in 2024, the Emergency Protocol for Nuclear and Radiological Events between SENAPRED and CCHEN was approved by Exempt Resolution No. 375. Its purpose is to establish mechanisms for coordination, communication, and information exchange between both institutions in order to ensure a timely response to nuclear or radiological emergencies, facilitating preventive and response actions that protect life, health, the environment, and public and private property against these threats.

As for the Radiological Emergency Safety Commission (CONSER), created by Decree No. 647/2015 of the Ministry of the Interior, its activities resumed in 2024 after being suspended since the COVID-19

pandemic in 2020. CONSER is a permanent presidential technical advisory body with interministerial and intersectoral representation, composed of 18 institutions. Its objectives are to propose measures to strengthen national capacities to jointly address the different stages of an event that poses a threat to physical, nuclear, and radiological safety; provide advice for adequate intersectoral coordination; and suggest actions for the dissemination of knowledge and international standards on nuclear and radiological safety.

Recently, CONSER has focused its efforts on reforming its internal regulations and updating the contact points of its member institutions. As part of this process, training activities for its members in emergency preparedness and response are being strengthened, especially considering the staff turnover that has affected many of the institutions involved.

Chile has benefited from the IAEA legislative assistance for the development of a comprehensive nuclear legislation. Through the IAEA Legislative Assistance Programme, the IAEA can provide further assistance, as needed.

2.2.1. Progress in the 2020-2025 period

In the 2020-2025 period, Chile continued to make progress on the initiatives presented in its CPF, including the start of operations at a centralized storage facility for low- and medium-level radioactive waste generated in the country; the response to radiological emergencies; improving the physical protection system for nuclear and radioactive materials and associated facilities; and generally strengthening the safety and security infrastructure at the national level. International cooperation has played a key role in these advances, contributing to projects, programs, systems, expert missions, technical meetings, training activities, and equipment donations, among others. Progress has been reflected mainly in the following areas:

1. Development of a regulatory framework for the regulation and control of facilities and activities.

a) Publication of nine resolutions approving regulatory provisions:

During 2020-2025, Chile strengthened its regulatory framework through the issuance of nine new regulatory instruments. These included updated requirements for authorization procedures and operator qualifications, classification criteria for nuclear and radioactive facilities, inspection guidelines for high-risk installations and safety standards for radiography, nuclear medicine laboratories, cyclotron facilities and CCHEN-operated installations, as well as a protocol for reporting abnormal events. Collectively, these measures modernized the national system for regulatory control of activities involving ionizing radiation.

b) Leadership and management for safety:

- Progress has been made in restructuring the regulatory body, incorporating provisions into CCHEN's internal procedures for non-intervention in regulatory decisions proposed by the Nuclear and Radiological Safety Division.
- Documented processes have been incorporated into the Nuclear and Radiological Safety Division's Quality Manual, which includes the processes of inspection, facility evaluation, personnel evaluation, regulations, technical report of findings, transparency, customer service, tasks, summaries, purchases, and internal management. This manual is in the final stages of review.
- The regulatory process management platform was updated. The new version includes verification of the consistency of regulatory control.

- Progress was made on the risk monitoring system for nuclear and radioactive facilities within a nuclear facility, focusing on the performance of the regulatory function.
- To promote a safety culture, projects have been carried out to assess the safety culture of the operator and the regulator, in addition to safety culture training workshops (CDC).
- Standards have been developed for the main nuclear and radioactive practices within a nuclear facility and for first-class practices (TSA1), which indicate the obligation to ensure occupational exposure control. The update to standard 015/2019 was presented.
- The requirement for minimum training in practices of regulatory interest was incorporated into the regulations.
- The requirement for safety assessments and the mandatory licensing of modifications was incorporated into the regulations.

c) Regulations under development:

There are currently nine regulatory proposals under review, which are detailed below:

- Regulation on Radioisotope Production and Handling.
- Cargo Inspection Standard.
- Basic Criteria for Radiation Protection.
- Regulation on Requirements for Radioactive Waste Management.
- Regulation on Constraints in Category 1 Facilities.
- Basic nuclear safety content.
- Contents of reactor safety reports.
- Criteria for the evaluation of the aging of research reactors.
- Contents of the emergency plan for research reactors.

2.2.2. Strengthening the National Infrastructure for Radiation Protection

The regulatory framework for occupational radiation protection has been maintained, with responsibilities assigned to the regulatory body, employers, authorized parties, and workers, and requirements for dose limitation, including monitoring and recording.

The technical standards approved for the period 2020-2025 incorporate the responsibilities of importers, companies providing import-export services, maintenance companies, and radiation protection operators and officers. These standards also establish the optimization of occupational exposure, the content of the operating report, and radiation safety, with a risk analysis of the facility.

A technical service capacity for personal dosimetry that meets national needs is maintained. These services must be authorized by the Ministry of Health following a favorable technical report from the Public Health Institute.

National technical equipment calibration services are maintained and must be referred to the Designated Institute for Ionizing Radiation of the National Metrology Network, under the responsibility of the Chilean Nuclear Energy Commission.

National initiatives in medical applications of ionizing radiation are guided by the National Cancer Plan 2018-2028 and the updated documents: National Cancer Plan 2022-2027, Adult Action Plan 2022-2027, and National Plan for Childhood and Adolescent Cancer 2023-2028.
In the period 2020-2025, the following came into force:

- Technical quality standard for mammography (2021).
- Technical quality guidelines for nuclear medicine equipment (2021).
- Technical guide for computed tomography (2024).

- Technical bases for the quality assessment program in radiotherapy (2021).
- Protocol for the evaluation of workplaces with exposure to ionizing radiation associated with the use of mammography equipment (2022).
- Requirements guide for equipment and technical infrastructure in radiotherapy facilities (2023).

2.2.3. Radiation Safety Information Management System (RASIMS) and Emergency Preparedness and Response Information Management System (EPRIMS)

Information on the current status of the country, for each TSA in RASIMS, needs to be updated by each counterpart. In summary, the following can be noted for each TSA:

- TSA1 – Regulatory infrastructure: the area has an appropriate level of development in the country and in its management system. Work needs to be done on the effective independence of the regulatory body.
- TSA2 – Radiation protection in occupational exposure: also shows satisfactory national development, with gaps in training and assessment of occupational exposure situations, protection of workers in emergency situations, and in existing exposure situations.
- TSA3 – Radiological protection in medical exposure: although the health sector applies good hospital practices, there is a need for explicit requirements for the qualification of medical personnel in aspects of radiation safety. It also includes standards for the justification and optimization of diagnosis and interventional radiology.
- TSA4 – Radiological protection of the public and the environment: shows a satisfactory level, but there are gaps in existing exposure situations, storage, and acceptance criteria for radioactive waste.
- TSA6 – Education and training in radiation safety, transport, and waste management: shows a low level of development; there are gaps in the requirements for personnel providing expert advice on radiation safety and protection, in the definition of the requirements for regulatory body personnel, and in the verification of education and training requirements in all facilities and activities in the country.
- TSA7 – Transport safety: The transport regulations need to be updated and requirements for authorizing transport companies need to be defined.

Regarding TSA5 – Emergency Preparedness and Response – information on the current status of the country needs to be updated by the counterpart in EPRIMS, in accordance with the EPRIMS recommendations (valid for five years).

Within the period of this CPF, it is expected that the information on all TSAs will be completed so that the IAEA's comments can be used to improve the regulatory framework (TSA1) as well as the other Safety Thematic Areas (TSAs). In addition to the above, Chile intends to increase the degree of implementation of several RASIMS and EPRIMS performance indicators, with the support of the IAEA's PCT, including the following:

- Given that the CCHEN is incorporating most of the relevant recommendations of the IRRS mission, it is expected that the degree of implementation of RASIMS performance indicators associated with Regulatory Infrastructure (TSA1) will increase.
- Through the implementation of project CHI 9024 (launched in 2020), it is expected to increase the degree of implementation of performance indicators associated with Occupational Radiation Protection (TSA2), Radiation Protection in Medical Exposure (TSA3), and Radiation Protection of the Public and the Environment (TSA4).

Furthermore, in line with these efforts, Chile will continue to complete the relevant information to keep up to date with the IAEA's RASIMS, as a means of recording achievements and evaluating the

effectiveness of actions and progress made. The information in RASIMS will be updated by the relevant national counterparts and endorsed by the national RASIMS coordinator.

2.2.4. Recent IAEA Missions to Assess Nuclear and Radiation Safety and Security in Chile

In the period 2020-2025, work has continued on the recommendations of the latest IAEA missions:

- Occupational Radiation Protection Appraisal Service (ORPAS), carried out in November 2017.
- Integrated Regulatory Review Service (IRRS), carried out in January 2018.

As a result of these missions, Chile received observations, recommendations, and suggestions indicating where improvements are necessary or desirable to continue strengthening its performance in radiation and nuclear safety. The corresponding improvement actions are currently being developed through the definition and implementation of the relevant action plans.

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE (ORPAS)

Progress was made in establishing requirements in current regulations on the submission of an Annual Safety Report for nuclear and radioactive facilities, defining the minimum content. Progress will be made in completing the recommendations regarding:

- Assessment of occupational doses in medical and industrial facilities.
- Assessment of the 24 points of the GSR-4 guide for each of the participating facilities, obtaining satisfactory results on the most important points related to radiation protection.
- Identification of facilities, the vast majority of which have radiation monitoring programs. Some of them also have safety assessments; a call was made to work on issues related to radiation safety culture.

INTEGRATED REGULATORY REVIEW SERVICE (IRRS)

The main challenge identified by the mission for the regulatory body remains the lack of effective independence of the two competent authorities.

Complete the regulatory framework for nuclear and radiation safety, which has progressed annually, with projects under review for subsequent publication.

It is expected that a mission will be requested to the IAEA in the future to review the progress and recommendations of the mission.

2.2.5. National Initiatives Under Development

During the 2020–2025 period, three national projects have been implemented—CHI9024, CHI9025, and CHI9026—with the general objective of reducing risks for both the public and occupationally exposed individuals by strengthening the country's technical, regulatory, and operational capacities in radiological and nuclear safety. These projects have been oriented towards minimising the inherent risks associated with the peaceful use of nuclear technology in Chile. This effort, developed throughout the various technical cooperation cycles and always aligned with the international standards of the IAEA, has been fundamental in protecting both the public and occupationally exposed personnel. Its approach is comprehensive, seeking to contribute to the protection of patients and workers, the strengthening of safety management systems, and the development of a radiological safety culture in the country.

Support is currently being provided for the strengthening of support services, the updating of regulations applicable to the health sector, the recovery of the Radioisotope Production Plant, and improvements in protocols associated with legal requirements and in the management of radiological safety, including safety assessments in facilities and services. Capacities in radiodiagnostics and nuclear medicine are also being reinforced. Support continues for the safe and sustainable operation of nuclear facilities, the evaluation of radiochemical processes, the strengthening of hospital radiopharmacy, and the production of radioisotopes in reactors. Important recommendations have been received and human resources have been strengthened through expert missions and other initiatives in areas such as neutron activation analysis, strategies for radioactive waste management, and various improvements related to the RECH-1 reactor, including thermal and neutronic analysis models, as well as the evaluation, inspection, and review of systems, among others. Furthermore, a project is in the design stage that contemplates further progress in strengthening the national infrastructure for nuclear and radiological safety, addressing regulatory and normative aspects, occupational radiological protection, medical applications, protection of the public and the environment, as well as prevention and response to radiological and nuclear emergencies.

Ensuring the safe use of radiation sources and nuclear technology requires a competent workforce, built and maintained sustainably. Chile will continue its efforts to develop a national strategy for education and training in radiation safety. With regard to the establishment of national policies and strategies for the period 2023-2026, CCHEN has set itself the following objectives:

- Promote the establishment of a national policy and strategy for nuclear and radiological safety and the management of the associated risks associated with facilities and activities, based on a graduated approach in accordance with the national reality.
- Promote the establishment of a national policy and strategy on the safe management of spent fuel and radioactive waste, taking into account the characteristics and volume of fuel and waste generated in the country.

With regard to pending legislation, the following may be mentioned:

- Draft law creating the Strategic Trade Commission and regulating the export of dual-use and defense materials and other materials specified therein (Bulletin 14773-02).
- Draft law establishing a Framework Law on Sectoral Authorizations and introducing amendments to the legal bodies indicated therein (Bulletin 16566-03).

2.2.6. PARTNERS AND STAKEHOLDERS

PARTNERS

- United States Department of Energy (US-DOE).
- Ministry of Social Development.
- International Radiation Protection Association (IRPA).
- Radiation Protection Societies.
- Ibero-American Forum of Regulatory Agencies for Radiological and Nuclear Safety (FORO).
- Latin American Network for the Optimization of Occupational Radiation (REPROLAM).
- European Radiation Dosimetry Group (EURADOS).
- Commission on Radiological Emergency Preparedness (CONSER).

STAKEHOLDERS

- Ministry of Health, Ministry of the Environment, CONSER, radiological and nuclear facilities of technical and scientific support organizations.
- Chilean Society for Radiological Protection.
- Chilean Institute of Public Health.
- Laboratories, hospitals.

- Organizations in the areas of development projects in this subject area.

From the analysis conducted in this section, the following key areas for improvement have been identified

- The legal and regulatory framework for nuclear and radiological safety in transport and waste management needs to be updated in accordance with the latest IAEA safety standards, reflecting progress beyond the 2020–2023 assessment.
- A plan for the establishment of an independent national regulatory authority should be developed and implemented.
- The occupational radiation protection program in end-user facilities, along with the capacity of technical service organizations, requires further strengthening.
- A national policy on nuclear and radiological safety and waste management needs to be developed and implemented gradually.
- A national plan for risk management in nuclear and radioactive facilities should be designed, including systematic monitoring and analysis.
- Internal capacity-building initiatives within the regulatory body should be reinforced through a progressive approach.
- Institutional processes require improvement to strengthen the provision of knowledge, technologies, products, and services to society.
- Nuclear safety and security, including emergency preparedness and response, as well as the adoption of new technologies, should be further developed.
- Infrastructure, inspection systems, and process optimization need to be enhanced through a phased approach.
- A comprehensive work plan should be established and implemented collaboratively with stakeholders, regulated entities, academic institutions, suppliers, transporters, and international partners.

2.2.7. Expected Outcomes

Strengthened national nuclear and radiation safety infrastructure, including regulatory functions, technical capacities and emergency preparedness, across institutions in Chile.

2.3. Food and Agriculture

Chile's agriculture and food sectors are strategic for domestic supply and export competitiveness and remain highly vulnerable to climate variability, water scarcity and pest pressures. National frameworks, including INDAP's Strategy 2023-2030 and the Food Security and Sovereignty approach, prioritise sustainable production, climate adaptation, food safety and innovation. These priorities create clear entry points for nuclear and isotopic applications in pest control, soil and water management, crop improvement and food authenticity.

Chile's policy framework (including the Food Security and Sovereignty Strategy, the Climate Change Adaptation Plan for the Forestry and Agricultural Sector, the National Food Safety and Quality Policy)

prioritises climate-resilient production, water management, food safety and innovation. These areas align with IAEA support in nuclear-based soil and water management, plant mutation breeding, SIT and food safety and authenticity.

Chile's agriculture is increasingly affected by water scarcity, soil degradation, shifting pest and disease patterns and reduced crop resilience linked to climate change. Against this background, Chile is interested in technical cooperation related to nuclear and isotopic techniques which offer tools to support climate-smart agriculture by improving soil and water management, enhancing crop adaptability, strengthening pest control and supporting food safety and authenticity systems. Chile is piloting the implementation of a preventive Sterile Insect Technique (SIT) approach against the Mediterranean fruit fly in their pest free areas. This technology allow a preventive response to potential outbreaks in the pest free areas, where historically they are prone to occur.

2.3.1. Pest control using SIT

Compared to the use of insecticides, the Sterile Insect Technique (SIT) is an environmentally sustainable solution, as it has no harmful effects on public health. In 2017, the Chilean government inaugurated a new fruit fly irradiator in Arica. At that time, the CPIE was producing 1.144 billion sterile male insect pupae annually, used mainly in Arica and some municipalities in the Metropolitan Region.[4] Under the current fruit fly campaign being carried out by the Agricultural and Livestock Service (SAG) in Renca, Cerro Navia, and Quinta Normal, the number of sterile flying males released in the metropolitan area will increase to approximately five million, to be released twice a week.[5]

Currently, the IAEA continues to support Chile in developing this technique for various applications. For example, in a continuous effort to strengthen the use of SIT, the ARCAL RLA5092 project entitled "Strengthening regional capacity for the adoption of the sterile insect technique as a component of mosquito control programs" seeks to reduce the incidence of diseases caused by the *Aedes aegypti* mosquito, including SIT in integrated pest management. Chile hopes to have the capacity to prioritize the continued application of SIT for specific priority species and regions that pose the greatest risk, within the overall objective of reducing high-impact pests. It is important that the IAEA, together with FAO, continue to support the use of SIT against fruit fly pests, the development of this technology against other invasive species pests, and its adoption to optimize insect pest management.

2.3.2. Optimization of agrochemical use in forestry and agricultural production

Improving nutrient-use efficiency and soil fertility is a national priority due to water scarcity and the need to increase sustainable production. Nuclear and isotopic techniques provide unique tools to assess fertiliser efficiency, optimise nutrient management and support climate-smart agriculture. Chile seeks continued IAEA support to strengthen laboratory capacities and expand the use of these techniques in priority crops.

2.3.3. Adaptation of Plant Species to Climate Change

Climate change is affecting crop productivity and forest species, increasing demand for resilient varieties. Chile has strengthened mutation-breeding capacities but requires continued support to scale applications, improve screening methods and expand collaboration networks. Nuclear techniques remain essential for developing drought-, salt- and pest-resistant plant varieties.

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[4] https://www.sag.gob.cl/noticias/ministro-de-agricultura-y-director-del-sag-inauguraron-nuevo-irradiador-para-mosca-de-la-fruta-en-arica

[5] http://www.sag.cl/noticias/sag-comienza-liberacion-de-insecto-esteril-de-mosca-de-la-fruta-en-region-metropolitana

2.3.4. Animal Production and Health

There are four areas of interest of Chile in the animal production and health, as follows:

i) Animal health: Development and upgrade of capacities in the use of nuclear and nuclear-related technologies for the detection, characterization, and monitoring of animal diseases, zoonotic diseases, and antibiotic resistance. This component should cover the use of serological and molecular tools for disease detection, support advanced methods for pathogen detection and characterization, application of irradiation techniques for the production of safe and effective vaccines against animal pathogens, as well as support the implementation and maintenance of international standards in the relevant field (primarily ISO 17025). Targets are priority transboundary animal diseases of the Member State as well as those with zoonotic impact.

ii) Animal reproduction: Support in the programs for the establishment or upgrade of nuclear and nuclear-related technologies for the improvement of animal production through improved animal genetics and animal breeding (priority on artificial insemination of animals).

iii) Animal nutrition: The use of nuclear and nuclear-related technologies for the improvement of utilisation of locally available resources for sustainable animal nutrition and production. The priority is focused on evaluation of alternative and non-conventional non-human edible feed resources for sustainable livestock feeding strategies with reduced greenhouse gas emission potential.

iv) Animal genetics: Use molecular techniques to improve the productive performances of the local livestock and, where feasible, the genetic resistance towards some livestock diseases.

(ii) and (iii) could be approached in the context of sustainable livestock breeding and feeding strategies that optimize production, maintain biodiversity, and mitigate the impact of livestock rearing on climate change.

These four areas are aligned with Zoonotic Disease Integrated Action (ZODIAC), which is the IAEA's flagship initiative to address zoonotic diseases to safeguard human and animal health.

2.3.5. Traceability and Authenticity: Food Fraud and Origin

Ensuring food authenticity is a strategic priority for Chile's export-oriented economy. Isotopic techniques provide reliable tools to verify origin and detect adulteration. National TC projects have established initial analytical capacities, but further strengthening is required to consolidate a national food authenticity system and expand methodologies across priority food matrices. In particular, two initiatives have been implemented at the national level. The first project, CHI5053 "National reference system for verifying the authenticity and determining the origin of food using nuclear isotopic techniques," was implemented during the 2022-2023 cycle. Likewise, in the 2024-2025 cycle, project CHI5056, "Strengthening the national system for verifying the authenticity and determining the origin of food," is currently underway.

Due to climate change and the resulting increase in the adulteration of certain foods, Chile needs to continue with a plan to strengthen the capacities already acquired in order to move towards the consolidation of the national food authenticity system.

2.3.6. Food Safety

Chile is strengthening its national food-safety system through new regulatory frameworks and quality policies. Nuclear and isotopic techniques support the detection of contaminants and residues,

contributing to national monitoring systems. Continued participation in IAEA regional initiatives will help harmonise standards, expand analytical capacities and support the implementation of the new National Food Safety and Quality Policy.

In recent decades, the Chilean government has promoted various food programs. In the last five years, the country has introduced a comprehensive package of policies that play a fundamental role in the food and nutritional security of the population. In the field of food security, this includes Law 20.606 on the Nutritional Composition of Foods and Advertising, and the Ministry of Health's National Food and Nutrition Policy.[6][7]

New and ongoing projects with the IAEA include project RLA5080, "Strengthening regional collaboration among official laboratories to address emerging challenges to food safety," and RLA5081, "Improving regional testing capabilities and residue/contaminant monitoring programs in food using nuclear/isotopic and complementary techniques"; RLA5082 "Strengthening food security through efficient pest management schemes that implement the sterile insect technique as a control method"; and INT5154 "Improving food security through the creation of an interregional network that produces reliable scientific data using nuclear and isotopic techniques."

2.3.7. PARTNERS AND STAKEHOLDERS

- Ministry of Agriculture (MINAGRI)
- National Agricultural Society
- Agricultural and Livestock Service (SAG)
- Office of Agricultural Studies and Policies (ODEPA)
- Agricultural Development Institute (INDAP)
- Forestry Institute (INFOR)
- Agricultural Research Institute (INIA)
- Natural Resources Information Center (CIREN)
- Universities
- Producers (Beekeeping Network, Chile Oliva)
- Ministry of Health (MINSAL)
- Public Health Institute (ISP)
- Chilean Agency for Food Safety and Quality (ACHIPIA)
- Chile Alimentos
- Center for Advanced Studies in Fruit Growing
- National Seed Producers Association
- Center for Processed Food Studies

2.3.8. EXPECTED OUTCOME

Strengthened national capacities in agricultural, food safety and animal health institutions to apply nuclear and nuclear-related techniques for climate-resilient production, improved diagnostics and enhanced value-chain integrity across Chile.

2.4. HEALTH AND NUTRITION

The importance of health in national strategic objectives is reflected in a series of actions, public policies, strategies, and plans developed by the country. In particular, the National Health Strategy 2021-2030,

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[6] Library of Congress: Law 21489 on the Promotion, Protection, and Development of Beekeeping. https://www.bcn.cl/leychile/navegar?idNorma=1182623

[7] National Food Safety and Quality Policy 2025-2035. Draft for Public Consultation. https://www.achipia.gob.cl/politica-de-inocuidad-y-calidad-de-los-alimentos/

developed by the Ministry of Health to achieve the 2030 Health Goals, includes the National Cancer Law, the National Cancer Plan 2018-2028, the Explicit Health Guarantees (GES), and the 2018 National Food and Nutrition Policy.

Non-communicable diseases (NCDs) remain the main cause of morbidity and mortality in Chile, accounting for around 60% of all deaths. Cardiovascular diseases, cancer, diabetes and chronic respiratory conditions are priority areas in national health strategies and public health plans and will continue to drive demand for early diagnosis, quality treatment and long-term follow-up. This epidemiological profile underlines the importance of strengthening nuclear medicine, radiotherapy and related applications in cancer care and NCD management.

Cancer is the second leading cause of death in Chile and the leading cause of premature death. Currently, cancer incidence is around 60,000 patients per year, with a mortality rate close to 50%. By 2045, 110,000 new cases are projected, representing an 83% increase in incidence. The main types of cancer—prostate (12.3%), colorectal (11.1%), and breast (10.1%)—are responsible for the majority of deaths, followed by gallbladder and stomach cancer (9.7%) and lung cancer (7.3%). In women, cervical and breast cancer are responsible for the greatest number of years of healthy life lost (11.2 and 10.2, respectively). Lung and prostate cancer rates have not changed significantly in the last decade, and only colorectal cancer rates have increased steadily during this period.

Overweight, obesity and nutrition-related non-communicable diseases represent a major challenge for Chile. National surveys show that a large majority of adults and a growing share of children live with excess weight, with higher prevalence among low-income and less-educated groups. These patterns increase the risk of diabetes and other NCDs and place additional pressure on the health system. The National Food and Nutrition Policy, together with regulatory and intersectoral initiatives, seeks to address malnutrition in all its forms by improving food environments and promoting healthier diets. This framework provides a favorable basis for applying nuclear and isotopic techniques to generate robust evidence on body composition, dietary patterns, and the effectiveness of nutrition interventions aligned with national health targets to 2030.

The National Food and Nutrition Policy and related instruments, including Law 20.606 on the Nutritional Composition of Foods and Advertising, school-based nutrition measures and intersectoral initiatives such as "Choose to Live Healthy", seek to address malnutrition in all its forms by improving food environments and promoting healthier diets. This policy framework provides a favorable basis for using nuclear and isotopic techniques to generate robust data on body composition, dietary patterns and the impact of nutrition interventions, in line with national health targets to 2030.

Chile has progressively strengthened its legal and institutional framework for organ, tissue and cell donation and transplantation, including presumed consent legislation, technical standards for tissue procurement and processing, the establishment of a National Tissue Bank and a network-based model to ensure tissue availability across the country. The National Health Strategy to 2030 aims to increase safe and equitable access to clinical-grade tissues, which creates a clear demand for irradiation technologies and quality-assured processes supported by IAEA technical cooperation. Furthermore, the development of tissue- and cell-based products and biomaterials for advanced medical therapies through radiation-assisted processing represents a highly relevant area, as irradiation technologies enable sterilization, functionalization, and quality assurance required for clinical applications.

In this context, nuclear and radiological technologies can make a significant contribution to national health goals, particularly in cancer diagnosis and treatment, nutritional assessment and monitoring, and safe processing of human tissues. The following subsections summarize the country's situation and recent IAEA technical cooperation activities in these areas.

2.4.1. Diagnosis and Treatment of Cancer treatment

The achievements of recent years, resulting from the IAEA's technical cooperation program in the application of nuclear technology to health, have focused on strengthening quality assurance, improving and maintaining the production capacities of radiopharmaceuticals, nuclear medicine and medical radiation protection, allowing their use in sustainable scenarios.

In fact, the IAEA is currently developing Mission IMPACT 2025, which aims to assess Chile's situation and needs in terms of comprehensive cancer control, from prevention to palliative care. The results are expected to be delivered by the end of 2025. Some of the key initiatives that have emerged in the development of the mission include:

- Expansion and decentralization of radiotherapy services.
- Strengthening of nuclear medicine and diagnostic imaging techniques (PET/CT, SPECT/CT).
- Development of national radiopharmacies and regulatory frameworks.
- Capacity building in radiation safety and quality assurance.
- Integration of nuclear techniques in cancer diagnosis and treatment (e.g., theranostics).
- Strengthening of integration and coordination with key institutions for the development of nuclear medicine, such as: CCHEN-MINSAL-ISP.

To maintain current and future radiopharmaceutical production capacity, it has been necessary to implement regulations that ensure compliance with Good Manufacturing Practices (GMP). In recent cycles, regional and national projects have facilitated the implementation of these requirements through courses, workshops, professional training, and expert assistance.

The sustainability of the 18/9 MeV IBA cyclotron and RECH-1 research nuclear reactor, located at the La Reina Nuclear Center in Santiago, along with a second operational cyclotron, also installed in Santiago by a private company, are critical for maintaining the technological supply of radiopharmaceuticals. National technical cooperation projects promoted by the IAEA have enabled the technological modernization of critical equipment and components of the cyclotron and RECH-1 at CCHEN, laying the foundation for the safe, sustainable, and reliable production of radiopharmaceuticals in the country.

Previously, IAEA technical cooperation has supported the adoption of advanced radiotherapy and nuclear medicine techniques and strengthened human resources in radiation oncology, medical physics and radiology. Training initiatives, including specialised postgraduate programmes, have helped improve the quality and safety of radiotherapy (e.g. IMRT, VMAT, HDR brachytherapy, IGRT) and contribute to more effective, less toxic cancer treatment across the country and the region.
Among the recent projects supported by IAEA are RLA6085 "Strengthening the capacities of cyclotron/positron emission tomography centers in the region"; RLA 6090 "Strengthening the management of radiotherapy for the treatment of cervical cancer in Latin America and the Caribbean"; RLA6091 "Strengthening the capacities of medical physicists to improve the quality and safety of medical practices"; RLA6092 "Strengthening the use of advanced techniques and hypofractionation schemes in radiotherapy in the countries of the region"; RLA6093 "Strengthening regional capacities for the use of nuclear medicine techniques in a multimodal cardio -oncological approach in cancer patients"; RLA6082 "Strengthening regional capacities in the provision of quality radiotherapy services." and CHI6022 "Strengthening the applications of single-photon emission computed tomography/computed tomography and positron emission tomography/computed tomography for the diagnosis and treatment of patients."

Also noteworthy in this new cycle is the project to strengthen national capacities for the manufacture of lyophilized radiopharmaceuticals, with the aim of improving production capacities, expanding the range of radiopharmaceuticals, and facilitating the national distribution of radiopharmaceutical kits, thus promoting equitable access to cancer diagnosis and treatment technologies.

2.4.2. NUTRITIONAL ASSESSMENT AND MONITORING

To better define and characterise healthy growth and nutrition, indicators such as body composition provide essential information on metabolic responses to malnutrition and the risk of obesity and nutrition-related NCDs. Stable isotope techniques offer accurate and standardised methods for assessing body composition and nutrient absorption in infants, children and adults.

Chile faces a high burden of disease attributable to malnutrition in all its forms, and national health targets for 2030 include reducing obesity in adults and school-aged children and improving dietary patterns. Nuclear and isotopic techniques can generate robust data to guide nutrition policies and programmes, refine targeting of interventions and monitor their impact, thereby supporting evidence-based decision-making in this area. Chile requests IAEA support to further develop these capacities.

2.4.3. EQUITABLE ACCESS TO CLINICAL GRADE TISSUES AND CELLS

Irradiation technologies are widely used in tissue and cell banks to inactivate pathogenic microorganisms and ensure the biosafety and quality of human tissues for clinical use. In line with international strategies on donation and transplantation (Global strategy on donation and transplantation of cells, tissues and organs, GAFTT-WHO) and SDG 3, Chile has launched its first national project on tissue activities (CHI1020), aimed at strengthening capacities for the generation and use of clinical-grade radio-sterilized tissues for the treatment of conditions with high impact on health and quality of life.

At the national level, the National Health Strategy 2030 explicitly recognizes the need to strengthen the therapeutic use of human tissues, highlighting the importance of increasing the availability, traceability, and quality of tissues processed in the country. The goal for 2030 is to increase tissue availability and improve their safe use for therapeutic purposes, promoting a regulated and coordinated system at the national level, thereby contributing to a more efficient and reliable national network for tissue access. This health priority reinforces the relevance of using irradiation technologies as a fundamental tool to ensure sterility, biosafety, and traceability in tissue procurement and processing, contributing to a more efficient and reliable network of tissue banks in the country. To increase the availability of clinical-grade tissues, technical cooperation with the IAEA for the 2026-2032 cycle in this area will focus on improving the standardization of procedures, quality assurance in human tissue generation, improve irradiation process, and strengthening national capacities for the development of new therapeutic processes and products.

In addition to their well-established role in ensuring the biosafety of biological products such as human tissues and blood components used in transfusion medicine, irradiation technologies also enable new developments in cell therapy, regenerative medicine, and tissue engineering applications, such as the generation of functionalized biomaterials, personalized scaffolds, and the preparation of cells for advanced therapies. Strengthening national technological and innovation capacities in this field is therefore essential to address emerging public-sector challenges related to the generation of functional tissues and to promote equitable access to advanced therapeutic strategies.

2.4.4. PARTNERS AND STAKEHOLDERS

- Ministry of Health (MINSAL)
- Chilean Society of Oncology (SCC)
- National Cancer Institute (INCANCER)

- Cancer Chile Foundation
- Institute of Radiomedicine (IRAM)
- Hospitals, clinics, diagnostic centers
- Public Health Institute (ISP)
- National Health Fund (FONASA)
- National Coordination for Donation, Procurement and Transplantation of Organs, Tissues and Cells
- National Tissue Bank
- Chilean Society of Hematology
- Chilean Society of Transfusion Medicine
- Institute of Nutrition and Food Technology (INTA)
- National Board for School Assistance and Scholarships (JUNAEB)
- Universities or other research centers

International:

- International Atomic Energy Agency (IAEA)
- Regional Cooperation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL)

2.4.5. Expected Outcome

Strengthened national capacities in health, nutrition and tissue-banking institutions to apply nuclear and nuclear-related techniques for cancer management, nutritional assessment and safe tissue processing across Chile.

2.5. Water and environment

Chile's environmental governance has strengthened over the past decade, supported by the Ministry of Environment and the 2022 Framework Law on Climate Change, which commits the country to greenhouse gas neutrality by 2050 and introduces basin-level water resource planning. Persistent water scarcity, ecosystem vulnerability and climate-driven hydrological stress require improved monitoring of groundwater, surface water, soils, air, marine systems, marine systems, and transitional continent-ocean environments. Due to its geographic position, from north to south, Chile presents a gradient of ecosystems, including the Atacama Desert and the Andean salt flats, fragile systems due to water stress and anthropogenic impact. Central and Southern Chile continue with unique terrestrial and marine ecosystems, due to their rainfall, vegetation, and environmental composition (soils, continental and marine water, and air). In the southernmost part of the country lies the increasingly well-known Patagonian ecosystem, which, like the Antarctic system, still has a significant environmental information gap. These priorities create clear entry points for nuclear and isotopic techniques in pollution tracing, water-source identification, basin management and environmental diagnostics.

Chile faces one of the most severe and prolonged droughts on record. Over 12 years of below-average rainfall have left 76% of the territory in water scarcity, with significant aquifer depletion and 110 basins where demand exceeds natural recharge. These conditions increase reliance on groundwater and require improved tools to characterise water sources, recharge zones and pollution pathways—areas where isotope hydrology provides critical value.

The aforementioned impact on aquifers and wells reflects the fact that Chile faced the Megadrought by increasing groundwater exploitation. This has led to greater dependence on groundwater resources, which has reduced underground storage and natural springs, affecting various dependent ecosystems such as lagoons and wetlands throughout the country.

Chile's water challenges align with SDG 6 on clean water and sanitation, particularly regarding water quality, efficient use and protection of water-related ecosystems.The Framework Law on Climate Change[8] also refers in Title II to climate change management instruments, which, regarding the Mitigation Goal (Article 4), states that "greenhouse gas neutrality shall be achieved no later than 2050. This goal will be evaluated every five years by the Ministry of the Environment, in accordance with the instruments established in this law." Title III also refers to the Emission of Greenhouse Gases, which will be regulated over time through normative processes aimed at establishing the maximum permitted levels of these variables. One of the objectives in this area is to achieve zero emissions by 2050 and thus advance with the agreements reached at the 2018 Paris Convention.

Among the current normative processes is the one for copper smelters and arsenic emitting sources, led by the Ministry of the Environment since 2013[9], and the current process for primary arsenic quality initiated in 2020[10]; and currently under review. It should be noted that the first air quality standard for arsenic was enacted in 2025. It establishes a maximum of 2 ng/m³ as the annual standard, benefiting several cities in the country where smelters operate[1111].

In addition to the above, there is the decarbonisation draft plan[12], led by the Ministry of Energy, consisting of the development of a plan to 2030 for the decarbonisation of the country's energy matrix and the retirement and conversion of coal-fired power plants. The Plan is divided into three main axes: i) Modernisation of the Grid and the Electricity Market, and infrastructure, ii) Thermoelectric Reconversion and Transition Fuel; and iii) Just Energy Transition and Communities. One of the topics in the second axis relates to enabling conditions and goals such as climate and environmental management. Axis No. 3 addresses topics such as environmental and social standards and citizen involvement, social justice, and shared benefits.

This is consistent with SDG No. 7[13], Affordable and Clean Energy, which aims to ensure access to affordable, reliable, sustainable and modern energy for all. This SDG proposes 5 targets, of which No. 7.a states "By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology."

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[8] Ley 21455. Ley Marco de Cambio Climático. Ministerio del Medio Ambiente

[9] D. 28, 2013. Decreto N° 28 del Ministerio del Medio Ambiente, Establece Norma de Emisión para fundiciones de cobre y fuentes emisoras de As, Fecha de Publicación en el Diario Oficial: 30 de julio de 2013. Biblioteca del Congreso Nacional de Chile, BCN. https://www.bcn.cl/leychile/navegar?idNorma=1057059

[10] R.S Ex. 1136, 2020. Resolución Exenta N° 1136 del Ministerio del Medio Ambiente, Da Inicio a la Elaboración Del Anteproyecto De La Norma Primaria De Calidad Del Aire Para Arsénico, Fecha de Publicación en el Diario Oficial: 2 de noviembre del 2020. Biblioteca del Congreso Nacional de Chile, BCN. https://bcn.cl/2mi18

[11] Decreto 9 (2024). Establece norma primaria de calidad de aire para arsénico. Ministerio de Medio Ambiente. MMA (2023). Anteproyecto de Norma primaria de calidad del aire para arsénico. Recuperado el 8 de septiembre de 2024. https://bcn.cl/3su4y

[12] Plan de Descarbonización, Ministerio de Energía, https://energia.gob.cl/panel/plan-de-descarbonizacion

[13] Objetivos de Desarrollo Sostenible 7: Energía asequible y no contaminante, https://www.un.org/sustainabledevelopment/es/energy/

Air pollution is also considered in SDG No. 11[14] Sustainable Cities and Communities, which aims to "Make cities and human settlements inclusive, safe, resilient and sustainable." The 10 targets set here include No. 11.6, which addresses the challenge of air pollution: "By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management." Target 11.a proposes to "Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning."

Chile's soils and ecosystems are affected by both natural and anthropogenic contamination, including arsenic, cadmium and other metals associated with mining, geological formations and agricultural practices. These pollutants affect soils, groundwater, food safety and public health. Significant gaps remain in environmental baselines and pollution-source identification. Nuclear and isotopic techniques offer essential tools for tracing contaminants, characterizing soil dynamics and supporting evidence-based regulation.

Chile faces increasing microplastic pollution affecting soils, rivers and marine environments in the different ecosystems found from north to south and in southern territory. Current national studies are limited to polymer identification, leaving major gaps in tracing sources and understanding ecological impacts. Nuclear and isotopic techniques (such as Raman spectroscopy and isotopic ratio analysis) enable advanced source attribution and monitoring, providing strategic value for national surveillance systems. Given that mining activities can have a significant impact on the environment, we are interested in the potential risk posed by both naturally occurring radioactive material (NORM) and technologically enhanced NORM (TENORM). It is expected that some activities will be developed in the country to understand the situation, complemented by TC requests. Subsequently, a review of the corresponding regulatory framework can be carried out.

The conditions described above assign special importance to the capabilities of nuclear and isotopic technology, in which the IAEA can significantly contribute to improving these conditions. This can be achieved by increasing knowledge for the assessment of the quality and availability of surface and groundwater, evaluating the environmental quality of soils, air, marine environments and ecosystems in general, which are the prioritised topics for this CPF. Regarding each of the topics identified in this analysis, some of the current or recent IAEA TC activities are included below.

2.5.1. ASSESSMENT OF WATER QUALITY AND MANAGEMENT WITH A BASIN APPROACH

Chile faces increasing pressure on freshwater resources due to climate variability, groundwater depletion and growing contamination from agricultural and industrial activities. Significant gaps remain in identifying recharge zones, understanding groundwater dynamics and tracing sources of pollutants. National institutions (including DGA, SERNAGEOMIN and CCHEN) require strengthened isotope hydrology capacities to support basin-scale assessments, aquifer sustainability planning and evidence-based regulation.

Updating and increasing knowledge about the quality and availability of the country's water sources, in a context of climate change, is vital for both the lives of the inhabitants and the country's economy, due to the impact of water on various productive sectors, located from north to south. For this reason, it is also necessary to establish and evaluate different scenarios that allow for the identification of water recharge zones, classify the quality of the waters, their use, and thus prioritise their consumption. To this is added the contamination of groundwater storage by agricultural activity, which is very depleted, so managed recharge must be considered as a possible solution. Due to the

[14] Objetivos de Desarrollo Sostenible 11: Ciudades y Comunidades Sostenibles, https://www.un.org/sustainabledevelopment/es/cities/

above, both for determining the origin of certain contaminants, as well as for delimiting recharge zones, the application of environmental isotopes and radioisotopes is necessary.

2.5.2. Assessment of quality and mitigation measures for contaminated soils

Chile's soils throughout the different ecosystems are affected by heavy metal contamination from mining, agriculture and naturally enriched geological formations, with consequences for food safety, groundwater quality and public health. Significant gaps persist in establishing soil baselines, identifying contaminant sources and assessing exposure pathways. Nuclear and related techniques (such as neutron activation analysis and radionuclide-based tracing) provide essential analytical capacity for source attribution, monitoring and the development of evidence-based remediation strategies. Strengthening national institutions, including SERNAGEOMIN, environmental authorities and research centres, is required to establish systematic soil surveillance and support regulatory decision-making.

2.5.3. Atmospheric Pollution

Chile faces significant air-quality challenges, particularly in mining regions where particulate matter from tailings and industrial emissions affects urban and peri-urban populations. National authorities require improved capacity to distinguish between local, regional and mining-related pollution sources. Nuclear analytical techniques, for example elemental and isotopic fingerprinting, provide reliable tools for source apportionment and for supporting air-quality management and emission-control policies. Strengthening institutional capabilities in this area would enable more accurate monitoring and evidence-based mitigation strategies.

2.5.4. Management of Marine and Coastal Environments

Chile faces growing microplastic pollution in coastal waters, sediments and soils, yet national studies remain limited to basic polymer identification and do not address source attribution or contamination pathways. These analytical gaps affect environmental authorities and marine-dependent economic sectors. CCHEN holds comparative advantages for applying nuclear and isotopic techniques that enable source tracing and advanced monitoring, providing a critical basis for a future national surveillance system.

2.5.5. Vulnerable Ecosystems

Beyond continental and coastal environments, Chile's environmental agenda also includes its diverse vulnerable ecosystems. In the far south of the country are the Antarctic and Patagonian ecosystems. After that, southern and central Chile. Finally, the north of the country encompasses the Atacama Desert and salt flats, with a large concentration of lithium, among other fragile ecosystems, which are increasingly affected by human activity despite their geographic isolation. All of these ecosystems are increasingly affected by plastic pollution, which threatens continental and marine life and ecological balance. Addressing this challenge requires strengthening analytical and technical capacities, training researchers, and improving infrastructure through advanced nuclear techniques that allow for more precise detection.

Various environmental studies conducted in the country, across its ecosystems, have demonstrated levels of contamination by metals and metalloids, as well as emerging pollutants such as microplastics. Further research in this area requires a specialized laboratory. In 2024, the Memorandum of Understanding (MoU NUTEC Plastics) and the MoU for Cooperation in the area of Nuclear Technology

Applications in the Sustainable Mining Industry and Lithium Energy Applications were signed. In addition, a series of technical cooperation projects related to environmental issues with the IAEA are aimed at promoting scientific cooperation on microplastic pollution.

2.5.6. Partners and Stakeholders

- Ministry of the Environment (MMA)
- General Water Directorate (DGA)
- Water Scenarios 2030
- National Irrigation Commission (CNR)
- Council for Sustainable Development of Chile
- National Fisheries and Aquaculture Service (SERNAPESCA)
- Directorate General of the Maritime Territory and Merchant Marine (DIRECTEMAR)
- Marine and Coastal Research Institute
- Marine Toxins Laboratory, University of Chile
- Universities, higher education centres (Environmental Chemistry, Faculty of Sciences; Geology, University of Chile; Geology, Universidad Mayor). Doctorates in Water Resources and Environmental Sciences at the University of Concepción.
- National Geology and Mining Service (Sernageomin).
- Chilean Antarctic Institute

2.5.7. Expected Outcome

Strengthened national institutional capacities to apply nuclear and isotopic techniques for environmental monitoring, pollution source attribution and ecosystem assessment across Chile.

2.6. Energy

Chile is pursuing a long-term transition toward a reliable, affordable and low-emission energy system, in line with its 2050 Energy Policy and climate commitments under the 2030 Agenda. Rapid growth of non-conventional renewable energy, especially solar and wind, has increased the share of clean generation but also introduced challenges of intermittency, grid stability and regional transmission, reinforcing the need for secure, dispatchable low-carbon options and integrated energy planning.

At the same time, Chile's economy relies on energy-intensive strategic sectors, particularly mining, and holds around one-third of global lithium reserves, positioning the country as a key player in energy storage value chains. This creates both economic opportunities and pressures to improve process efficiency, environmental performance and traceability across the lithium and copper industries, including higher value-added stages such as purification, characterization and certification of products.

Nuclear science and technology can support these priorities by strengthening national analytical and modelling capacities for integrated energy planning, advanced characterization of materials and lithium products, process optimization and environmental monitoring in the energy and mining sectors. This thematic area therefore focuses on three interconnected pillars: (i) integrated energy planning, including analysis of the potential role of modern nuclear energy in a low-carbon system; (ii) development of a sustainable, high-value lithium industry supported by nuclear analytical techniques; and (iii) more sustainable mining and industrial processes enabled by advanced nuclear applications.

2.6.1. Energy Planning

Chile's energy system is undergoing rapid transformation, driven by high penetration of solar and wind generation, increasing climate-related water stress and growing variability in electricity supply. These trends create structural challenges for grid stability, long-term decarbonization and energy security, particularly in a system where renewable generation depends heavily on climatic conditions. National institutions require strengthened analytical, regulatory and human-resource capacities to evaluate complementary low-carbon technologies and to integrate them into long-term planning frameworks. Nuclear science and IAEA technical cooperation can support Chile in areas such as system modelling, regulatory development, environmental assessment and workforce training.

Strategic Vision and Objectives

Chile's long-term energy policy recognizes the need for a diversified, low-carbon electricity system capable of maintaining stability despite high renewable penetration and growing climate-related water stress. National institutions require strengthened analytical, regulatory and technical capacities to evaluate the potential role of advanced nuclear technologies within integrated energy planning frameworks. Support from the IAEA is relevant for system modelling, regulatory preparedness, environmental assessment and development of specialized human resources.Chile's energy transition is challenged by high variability of renewable generation, climate-driven water stress affecting hydroelectric output, and increasing system curtailment. National authorities require stronger analytical, regulatory and technical capacities to assess low-carbon baseload options, including advanced nuclear technologies, within integrated long-term energy planning.

Existing institutions (particularly the Ministry of Energy, CNE, SEC and CCHEN) need enhanced capabilities in system modelling, regulatory assessment, environmental evaluation and human-resource development to support evidence-based decision-making. IAEA support is relevant for capacity building, regulatory readiness and evaluation of emerging nuclear technologies.

2.6.2. Stakeholders and Beneficiaries

The strategic incorporation of nuclear energy into Chile's energy matrix requires broad inter-institutional coordination involving multiple actors from the public, private, academic, regulatory, and international spheres.

First, the Ministry of Energy plays a central role in the country's energy planning and in defining public policies that integrate low-emission technologies, such as nuclear energy. The Chilean Nuclear Energy Commission is the main national technical body in the nuclear field. It has a proven track record in regulation, radiation safety, human capital training, and international cooperation.

For their part, the National Energy Commission (CNE) and the Superintendency of Electricity and Fuels (SEC) are responsible for regulatory design and oversight of the energy sector.

The academic and scientific system also plays a fundamental role. Universities and research centers, such as the Pontificia Universidad Católica de Chile, the Universidad de Chile, and the Universidad Técnica Federico Santa María, among others, contribute to the training of specialized professionals, applied research.

Finally, international cooperation with the International Atomic Energy Agency (IAEA) strengthens Chile's integration into global networks.

2.6.4. LITHIUM: ITS APPLICATION IN STORAGE AND IN THE ENERGY GENERATION OF THE FUTURE

CURRENT SITUATION AND FUTURE OUTLOOK

Chile has approximately 36% of the world's lithium reserves, giving it a strategic position in the global energy transition. This element is essential both for energy storage, through lithium-ion batteries, and for the development of nuclear fusion energy, where it is used in the production of tritium.

Currently, the Chilean lithium value chain is mainly concentrated in the extraction phase, with efforts still in their infancy to move towards stages with greater added value, such as purification, transformation, and certification. The future vision envisages a traceable, environmentally sustainable lithium- industry backed by national scientific and technological capabilities.

In this context, the IAEA's Technical Cooperation Program can play a decisive role in strengthening new methodologies for purifying and obtaining lithium salts, as well as supporting the development of the country's analytical capabilities through cleaner and more competitive processes using nuclear tools such as neutron activation, spectrometry, and isotopic tracers.

TRENDS, DATA, AND RISKS

Current methods of extraction in salt flats raise significant environmental concerns, particularly regarding intensive water use and ecosystem disruption. This calls for the development of cleaner technologies and effective environmental monitoring, where nuclear tools could also be particularly useful for characterizing, monitoring, and improving these processes.

PREVIOUS ACHIEVEMENTS AND KEY INSTITUTIONS

CCHEN has established basic analytical capabilities related to lithium characterization, but these require further strengthening to support national needs in certification, traceability and environmental monitoring in line with Chile's emerging lithium strategy.

2.6.5. STAKEHOLDERS AND BENEFICIARIES

Among the main national actors are the Ministry of Mining and Corfo, which are responsible for coordinating the implementation of the National Lithium Strategy and promoting the development of a technological and industrial value chain. Production companies such as SQM, Albemarle, and Codelco-Litio are also key players.

At the international level, the United Nations Industrial Development Organization (UNIDO) and the World Bank are strategic partners for technical cooperation and financing of projects aimed at the sustainable valorization of lithium.

RELEVANT INITIATIVES AND ALLIANCES

Chile is promoting the creation of a state-owned lithium consortium to add value to the production chain and ensure public governance of this resource.

2.6.7. Sustainable Mining and Advanced Characterization with Nuclear Technologies

Chile's mining sector faces increasing pressure to improve sustainability, traceability and environmental performance. Nuclear analytical techniques can support advanced characterization and monitoring.

Strategic vision and objectives

The main strategic objective of this area is to contribute to a structural transformation of Chilean mining by integrating nuclear tools to improve material traceability, process efficiency, and the certification of environmental and quality standards. It also seeks to strengthen national capacities in advanced characterization and environmental monitoring.

This thematic area is aligned with the Sustainable Development Goals: SDG 9 "Promote industrial innovation," SDG 12 "Promote sustainable production and consumption patterns," and SDG 13 "Combat climate change."It responds to key national policies: the National Lithium Strategy and the National Mining Policy 2050.

Trends, data, and risks

The global mining industry faces growing demands for environmental sustainability, material traceability, and energy efficiency. At the same time, social pressure for more responsible mining and international competition for high-value markets are driving the need to incorporate advanced technologies.

Chile has established experience in applying nuclear analytical techniques to mining and materials characterization, but institutional and laboratory capacities require further strengthening to meet emerging needs for traceability, certification, and environmental monitoring.

2.6.8. Partners and Stakeholders

The main beneficiaries of this thematic area include the Ministry of Mining, geological services, public and private mining companies, universities, and applied research centers. In addition, accredited laboratories and certification bodies may benefit from the development of advanced analytical capabilities.

Relevant initiatives and partnerships

Coordination with national programmes on sustainable mining, environmental monitoring, and industrial innovation provides a basis for integrating nuclear-based analytical tools. Engagement with regional cooperation mechanisms and national public-private platforms will support the development of traceable, certified and environmentally responsible mining processes.

2.6.9. Expected Outcome

Strengthened national analytical, technical and institutional capacities to apply nuclear and nuclear-related techniques for integrated energy planning, sustainable lithium development, and improved traceability, quality assurance and environmental monitoring in Chile's energy and mining sectors.

2.7 Industrial Applications

Chile is developing non-destructive testing (NDT) applications for cultural heritage preservation and disaster risk management, where national capacities remain limited but nuclear and radiation-based techniques can provide significant added value.

2.7.1. Preservation of Cultural Heritage

The preservation of cultural heritage requires the participation of various disciplines, according to the problems to be addressed. Two priority aspects have been identified for the conservation of the country's material memory: on the one hand, the control of biodeterioration, and in particular pest management; and on the other hand, the preservation of built heritage, which is at permanent risk in the context of a seismic country.

The control of biodeterioration and pest management is a problem that affects a large percentage of national cultural assets. By applying cutting-edge science and technology, such as ionisation, biodeterioration and pests can be combated without leaving residues, ensuring the permanence of heritage objects for future generations. This constitutes a safe and effective technique that allows for the safeguarding of the national heritage and the memory of a country, which is an act of care and social and cultural responsibility. To this end, the country has initiated a highly relevant line of work, which involves the use of non-destructive testing with ionising technologies on built heritage, training technical teams for the control of biodeterioration.

2.7.2. Disaster Risk Management (DRM)

In 2019, the Subregional Centre for Non-Destructive Testing was established at CCHEN, oriented towards the inspection of civil and industrial structures to determine their structural integrity following emergencies caused by disasters. This centre constitutes a subregional initiative that uses non-destructive techniques to characterize the state and physical properties of structures without damaging them, supporting the structural assessment of buildings, bridges, and others—a preventive task of primary relevance in a seismic country such as ours.

2.7.3 Partners and Stakeholders

National:

- National Cultural Heritage Service (SERPAT)
- National Centre for Conservation and Restoration (CNCR)
- National Museums (MNBA, MNHN)
- Local Museums
- National Library
- National Archive
- National Sub-directorate of Museums
- Regional Directorates of SERPAT
- University of Chile (Faculty of Arts and FACSO)
- Finis Terrae University
- Durabillity
- SI3
- National Standardisation Institute (INN)

International:

- International Atomic Energy Agency (IAEA)

- Regional Cooperation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL)

2.7.4 Expected Outcome

Strengthened national capabilities to apply non-destructive nuclear techniques for the preservation of cultural heritage and for preventive and post-event structural assessment in disaster risk management.

3. Results Matrix

Thematic Area No. 1: Nuclear and Radiation Safety and Nuclear Security				
Outcome	**Baseline**	**Indicators**	**Means of Verification**	**Assumptions and Risks**
Strengthened national nuclear and radiation safety infrastructure, including regulatory functions, technical capacities and emergency preparedness, across institutions in Chile.	• No independent nuclear regulatory authority; regulatory functions are divided between CCHEN and MINSAL. • Implementation of recommendations from IRRS (2018), ORPAS (2017) and INSSP (2019) is partial; several actions remain pending. • RASIMS maturity levels across several Thematic Safety Areas are incomplete; multiple TSA modules have not been updated. • EPRIMS entries indicate partial integration of national EPR arrangements with SINAPRED. • Technical support services for dosimetry, calibration, and occupational radiation protection operate with limited capacity. • Safety culture and systematic internal assessment in end-user facilities are not yet consistently implemented.	• % of priority recommendations from IRRS (2018), ORPAS (2017) and INSSP (2019) implemented by 2032. • # of priority recommendations from IRRS, ORPAS and INSSP remaining open • % of Thematic Safety Area (TSA) modules fully completed and validated in RASIMS by 2032. • % of national EPR arrangements fully reflected and updated in EPRIMS by 2032. • Level of formal coordination between EPR arrangements and SINAPRED (Not established / Partially established / Fully established) by 2032. • # of technical support services (dosimetry, calibration, ORP) meeting IAEA-referenced operational requirements by 2032. • % of end-user facilities covered by qualified technical support services by 2032. • % of end-user facilities implementing documented safety	• IAEA mission reports and follow-up reports (IRRS, ORPAS, INSSP, EPREV, advisory missions). • National action plans developed in response to IAEA missions and official progress reports on their implementation. • RASIMS records and maturity level updates. • EPRIMS entries and updates. • Official legal and regulatory documents submitted to or reviewed with IAEA support (draft laws, regulations, regulatory procedures). • IAEA TC project reports, including progress reports and completion reports. • Training records, participant lists and post-training evaluation reports. • National emergency preparedness and response plans updated with IAEA technical input. • Records of national exercises and drills conducted with IAEA methodological support. • Official correspondence and endorsements from the IAEA	Assumptions Sustained government commitment to strengthening nuclear and radiation safety and nuclear security, including continued engagement with the IAEA. Political willingness to advance legal and institutional reforms, including progress toward establishing an independent nuclear regulatory authority. Continued cooperation and coordination among CCHEN, MINSAL, emergency authorities and other relevant national institutions. Availability of qualified national counterparts to absorb IAEA technical assistance and participate in missions, training and follow-up actions. Continued access to IAEA technical cooperation resources, advisory services and peer review mechanisms. Functioning national emergency management system (SINAPRED) capable of integrating nuclear and

		culture and internal self-assessment processes by 2032.	confirming milestones achieved (missions completed, plans validated, tools operational).	radiological preparedness arrangements. Risks Delays or stagnation in legislative and institutional reforms affecting regulatory independence. Insufficient national financial or human resources to implement IAEA recommendations and action plans. Limited institutional capacity to systematically update and maintain RASIMS and EPRIMS information. Weak inter-institutional coordination, particularly between regulatory, health and emergency response authorities. High staff turnover in key institutions, leading to loss of institutional memory and reduced sustainability of capacity-building efforts. Competing national priorities that may reduce attention to nuclear and radiation safety and emergency preparedness. Delays in follow-up or postponement of IAEA missions due to external factors.	
Outputs	**Time periods (Future TC cycle)**	**Relevant national counterparts**	**Approximate cost € (A)**	**Estimated Available Resources € (B)**	**Resources to be identified/mobilized € (A-B)**
National legal and regulatory instruments	2026-2032	CCHEN MINSAL	560,000	254,000	306,000

for nuclear and radiation safety and security reviewed and updated in line with IAEA safety standards and mission recommendations.					
Plan to implement an Independent National Regulatory Authority in the country developed.	2026-2032	CCHEN MINSAL Ministry of Energy	280,000	127,000	153,000
National programmes and procedures for occupational radiation protection, technical support services and emergency preparedness and response reviewed and strengthened.	2026-2032	CCHEN MINSAL CONSER Facilities participating in ORPAS-2017	1,120,000	508,000	612,000
Preparedness and response capacity for nuclear and radiological emergencies strengthened.	2026-2032	CCHEN MINSAL CONSER First Responders National Disaster Disaster Prevention and Response System (SINAPRED)	840,000	381,000	459,000
			Subtotal		
			y approximate cost € (A)	**ly available resources Estimated € (B)**	**resources to be identified/mobilized € (A-B)**
			2,800,000	**1,270,000**	**1,530,000**

Thematic Area No. 2: Agriculture and Food

Outcome	Baseline	Indicators	Means of Verification	Assumptions and Risks
Strengthened national capacities in agricultural, food safety and animal health	• Application of nuclear and nuclear-related techniques in agriculture, food safety and animal health is fragmented and limited to	• % of priority agricultural and agroforestry production systems applying nuclear or nuclear-related techniques for pest control, soil	Figures corresponding to yield and area cultivated with plant species Publications (scientific and outreach) reporting on improvements in species adaptability	Assumptions National agricultural, food safety and animal health institutions remain committed to applying nuclear and nuclear-related techniques as part of

institutions to apply nuclear and nuclear-related techniques for climate-resilient production, improved diagnostics and enhanced value-chain integrity across Chile.	selected crops, regions and institutions, with uneven national coverage. • SIT, isotope-based fertilizer optimization, mutation breeding and food authenticity techniques are applied on a pilot or partial scale, without systematic integration into national production and control systems. • Small agricultural farmers (AFC) and indigenous farmers have limited access to nuclear-based technologies for climate-resilient production and pest, soil and water management. • National capacities for food authenticity, traceability, contaminant detection and residue analysis exist but remain insufficiently harmonized and scaled to support domestic control and export requirements. • Institutional capacities for animal health diagnostics, zoonotic disease control and productivity enhancement using nuclear techniques are present but require strengthening to address climate-related and emerging risks nationwide.	fertility or water-use efficiency, by 2032. • # of national agricultural, food safety and animal health institutions applying nuclear or nuclear-related techniques supported through IAEA by 2032. • % of priority food products monitored using nuclear or isotopic techniques for food safety, authenticity or residue control, by 2032. • # of priority crop and forestry species integrated into national climate adaptation or breeding programmes using nuclear techniques, by 2032. • # of national animal health laboratories applying nuclear or nuclear-related diagnostic techniques, by 2032. • % of supported small agricultural farmers (AFC) and indigenous farmers benefiting from nuclear technique-based interventions delivered through national institutions, by 2032.	Records of origin assessment. Methodologies and techniques developed for the detection of food fraud. • National agricultural pest surveillance and SIT monitoring reports (SAG / INIA) • Official agricultural production and yield statistics (ODEPA / INIA) • National laboratory reports applying nuclear and isotopic techniques in agriculture and food safety • Food authenticity and traceability assessment records (ACHIPIA / CCHEN / accredited labs) • National food safety inspection and contaminant monitoring reports (MINSAL / ISP) • Veterinary disease surveillance and diagnostic reports (SAG / INIA) • TC project progress and completion reports	climate adaptation, food safety and productivity policies. Inter-institutional coordination among MINAGRI, SAG, INIA, MINSAL, ACHIPIA and CCHEN is sustained throughout the CPF period. Farmers, producers and veterinary services continue to participate in surveillance, diagnostic and control programmes supported by nuclear techniques. Regulatory and policy frameworks continue to support the use of nuclear and isotopic applications in agriculture, food safety and animal health. Risks Increased frequency and severity of climate extremes (droughts, floods, pest outbreaks) may reduce the effectiveness of productivity-oriented interventions. Limited human and laboratory capacities at national and sub-national levels may constrain uptake and sustained use of nuclear techniques. Fragmented data systems and weak integration between agriculture, food safety and animal health institutions may limit evidence-based decision-making. Financial constraints or shifts in national budget priorities may affect implementation of agreed activities. Market and trade disruptions may affect incentives for producers to adopt food

				authenticity, traceability and safety measures.	
	Food safety needs to be improved. Percentage of food products and food-s approved in terms of quality and absence of contaminants, for the whole country.	• Percentage increase in food products approved in terms of safety and absence of food hazards, for the entire country by 2032 • Percentage increase in food products approved in terms of export standards by 2032	Food safety monitoring records: • According to species and regions of priority interest • For domestic production and export	Different organizations working in a coordinated manner to address national needs.	
Outputs	**Time periods (Future TC cycle)**	**Relevant national counterparts**	**Approximate cost € (A)**	**Estimated available resources € (B)**	**Resources to be identified/mobilized € (A-B)**
National capacity to apply nuclear and nuclear-related techniques for climate-resilient crop and forestry production (including pest management, inputs optimization and varietal improvement) in priority regions, strengthened.	2026-2032	Ministry of Agriculture (INIA, SAG, INDAP) Chilean Nuclear Energy Commission (CCHEN) National Agricultural Society Universities	€148.571	€40.857	€107.714
National capacity to assess food authenticity, traceability, contaminants and residues in priority food products using nuclear and isotopic techniques, strengthened.	2026-2032	Office of Agricultural Studies and Policies (ODEPA) Chilean Nuclear Energy Commission (CCHEN) Institute for Agricultural Development (INDAP) Agricultural Research Institute (INIA) Agricultural and Livestock Service (SAG) Food Safety Agency (ACHIPIA) Universities National Association of Manufacturers and Importers of Agricultural Phytosanitary Products (AFIPA) National Agricultural Society	€148.571	€40.857	€107.714

National veterinary capacity to prevent, detect and control priority animal and zoonotic diseases (including AMR-related surveillance where relevant) using nuclear and nuclear-related techniques, strengthened.	2026-2032	Forestry Institute (INFOR) Chilean Nuclear Energy Commission (CCHEN) Agricultural Research Institute (INIA) Natural Resources Information Center (CIREN) Universities Regional Research, Development, and Technology Transfer Centers (CEAF, CEAP, CETA) ANPROS	€148.571	€40.857	€107.714
National capacity to apply nuclear techniques in animal reproduction, nutrition and genetics to improve livestock productivity and resilience, strengthened.	2026-2032	Ministry of Health (MINSAL) Ministry of Agriculture (MINAGRI) Food Safety Agency (ACHIPIA) Chilean Nuclear Energy Commission (CCHEN) Producers Public Health Institute (ISP) Beekeepers Association Chile Alimentos	€148.571	€40.857	€107.714
	2026-2032	Ministry of Health (MINSAL) Public Health Institute (ISP) Chilean Nuclear Energy Commission (CCHEN) Food Safety Agency (ACHIPIA)	€148.571	€40.857	€107.714
	2026-2032	Ministry of Health (MINSAL) Ministry of Agriculture (MINAGRI) Producers Universities Agricultural Research Institute (INIA) Chilean Nuclear Energy Commission (CCHEN) Agricultural and Livestock Service (SAG)	€148.571	€40.857	€107.714
	2025-2032	Ministry of Health (MINSAL) Ministry of Agriculture (MINAGRI) Producers Universities Agricultural Research Institute (INIA) Chilean Nuclear Energy Commission (CCHEN) Agricultural and Livestock Service (SAG)	€148.571	€40.857	€107.714
			Subtotal		

			Approximate cost € (A)	Estimated Available Resources € (B)	Resources to be identified/mobilized € (A-B)
			€1.040.000	**€286.000**	**€754.000**

Thematic Area No.: 3 Health and Nutrition

Outcomes	Baseline	Indicators	Means of Verification	Assumptions and Risks
Strengthened national capacities in health, nutrition and tissue-banking activity to apply nuclear and nuclear-related techniques for cancer management, nutritional assessment and safe tissue processing and advanced therapies development across Chile.	• Non-communicable diseases, including cancer, remain the leading cause of morbidity and mortality in Chile, accounting for around 60% of all deaths and generating sustained demand for early diagnosis and quality treatment. • National capacities in nuclear medicine, radiotherapy and radiopharmaceutical production exist but remain unevenly distributed and require further strengthening to ensure quality, sustainability and equitable access. • Overweight, obesity and nutrition-related non-communicable diseases affect a large majority of the population, while systematic use of nuclear and isotopic techniques for nutritional assessment and monitoring is still limited. • A national legal and institutional framework for organ, tissue and cell donation is in place, but	• % of cancer patients diagnosed at early stages using nuclear medicine techniques in Chile by 2032. • % of diagnostic radiology and radiotherapy facilities operating with quality assurance systems aligned with IAEA standards in Chile by 2032. • % of clinical-grade human tissues processed using irradiation technologies in compliance with national and international standards in Chile by 2032. • % of priority population groups covered by nutritional assessment programmes using stable isotope techniques in Chile by 2032. • # of patients treated with radiosterilized tissues in Chile by 2032. • # of national laboratories applying irradiation technologies for the development of tissue/cell-based products and biomaterials by 2032.	• Results of surveys on the quality of care provided to patients. • Quality assurance system records. • IAEA training records. The necessary human, financial, and equipment resources are available. The commitment of the key stakeholders remains. There is agreement among the actors involved to proceed with the activities according to the established program. The government continues to prioritize cancer diagnosis and treatment, equitable and timely access to biosafe cells and tissues, and nutrition. Availability of funds • Records of nutritional assessments carried out at the national level on priority interest groups. • Reports on recommendations implemented by decision-makers • National cancer registry and Ministry of Health reports on cancer	Assumptions Continued government prioritization of cancer control, nutrition and tissue transplantation under the National Health Strategy 2021–2030. Sustained institutional commitment of MINSAL, ISP, CCHEN and national health services to apply nuclear and nuclear-related techniques. Availability of qualified human resources and continued engagement with IAEA technical cooperation. Updating decrees, regulations and technical guidelines by establishing working groups for the harmonization and coordination of regulatory frameworks. Risks Uneven regional access to nuclear medicine, radiotherapy services and radiopharmaceuticals. Gaps in quality assurance and radiation protection practices in diagnostic and therapeutic services.

	capacities for irradiation-based processing and quality-assured supply of clinical-grade tissues need further development to meet national targets. • Conditions related to chronic non-communicable diseases and severe injuries have a substantial impact on vulnerable segments of the population, while national capacity to apply irradiation technologies for the development of advanced therapy products remains limited.		staging at diagnosis, including nuclear medicine procedures. • IAEA mission reports (e.g. QUATRO, IMRT audits), national regulatory inspection reports and facility QA documentation. • National Tissue Bank records and regulatory reports on irradiated tissues processed in compliance with approved standards. • Official reports from national nutrition and health surveys and institutional records documenting the use of stable isotope techniques for nutritional assessment.	Limited human and financial capacity to expand and sustain nuclear medicine, nutrition and tissue-banking services nationwide.	
	It is necessary to harmonize, integrate and reach consensus on health and nuclear regulations among the related institutions, in order to strengthen regulatory capacities.	• Updating decrees, regulations, and rules related to nuclear and radiological safety. • Establishing ministerial technical working groups for the harmonization and coordination of regulation and rules applied to nuclear medicine.	• Registration of new regulations and rules related to the scope of action.		
Outputs	**Time periods (Future TC cycle)**	**Relevant national counterparts**	**Approximate Cost € (A)**	**Estimated available resources € (B)**	**Resources to be identified/mobilized € (A-B)**
National capacity for cancer diagnosis and treatment strengthened through the application of nuclear medicine, radiotherapy and quality assurance practices.	2026-2032	Ministry of Health (MINSAL) Public Health Institute (ISP) Chilean Nuclear Energy Commission (CCHEN) Chilean Cancer Society (SCC) National Cancer Institute (INCANCER) Cancer Chile Foundation Institute of Radiomedicine (IRAM) Hospitals, clinics, diagnostic centers	€173.333	€47.667	€125.667
Radiopharmaceutical production and supply capacities strengthened to support equitable	2026-2032	Ministry of Health (MINSAL) Public Health Institute (ISP) Chilean Nuclear Energy Commission (CCHEN)	€173.333	€47.667	€125.66

access to nuclear medicine services across regions.		Chilean Society of Oncology (SCC) National Cancer Institute (INCANCER) Cancer Chile Foundation Institute of Radiomedicine (IRAM) Hospitals, Clinics			
National capacity for nutritional assessment and monitoring strengthened through the use of stable isotope techniques to support evidence-based nutrition policies.	2026-2032	Ministry of Health (MINSAL) Institute of Nutrition and Food Technology (INTA) National Board for School Assistance and Scholarships (JUNAEB) Chilean Nuclear Energy Commission (CCHEN) Universities or other research centers	€173.333	€47.667	€125.66
National capacity for safe processing and use of clinical-grade human tissues strengthened through irradiation technologies and quality-assured procedures.	2026-2032	Ministry of Health (MINSAL) National Tissue Bank National Coordination for Donation, Procurement and Transplation of Organs, Tissues and Cells Chilean Nuclear Energy Commission (CCHEN) Hospitals anc Clinics	€173.333	€47.667	€125.66
National capacity to develop advanced therapy products through the application of irradiation technologies.	2026-2032	Chilean Nuclear Energy Commission (CCHEN) Ministry of Health (MINSAL) National Tissue Bank National Coordination for Donation, Procurement and Transplation of Organs, Tissues and Cells Public Health Institute (ISP) Universities or other research centers	€173.333	€47.667	€125.66
	2026-2032		€173.333	€47.667	€125.66
			Subtotal		
			Approximate cost € (A)	**Estimated Available Resources € (B)**	**Resources to be identified/mobilized € (A-B)**

Thematic Area No.: 4 Water and Environment

Outcomes	Baseline	Indicators	Means of verification	Assumptions and Risks
Strengthened national institutional capacities to apply nuclear and isotopic techniques for environmental monitoring, pollution source attribution and ecosystem assessment across Chile and impact of contaminated environments on public health.	Isotope hydrology is not yet routinely used in basin assessments and Strategic Water Resources Plans. Groundwater and surface water stress persists, and national capacity to identify recharge zones and pollution pathways using isotopes remains limited. Soil and air contamination baselines, source attribution (metals/metalloids, PM) and its impact on the public health are incomplete and not consistently supported by nuclear analytical techniques. Microplastics monitoring is limited, and national capacity for source attribution and pathway analysis remains insufficient. The capacity to monitor pollutants in vulnerable ecosystems (such as Antarctica and salt flats, among others) is in an initial stage and requires specialized laboratory capacity, trained personnel and sustained coordination.	# of river basins with water availability, quality and pollution-source assessments conducted using nuclear and isotopic techniques by 2032. # of critical areas with soil, air quality baselines and its impact on public health, established using nuclear and isotopic techniques by 2032. # of coastal and marine areas with sediment quality pollution-source and its local productivity impact assessments, conducted using nuclear and isotopic techniques by 2032. # of Vulnerable Ecosystem (such as Antarctica and salt flats, among others) monitoring programmes applying nuclear and isotopic techniques for microplastics and contaminant analysis by 2032.	Official technical reports and databases of basin-level water assessments produced by DGA, MMA, CCHEN and partner institutions applying nuclear and isotopic techniques. Validated soil and air quality baseline and the population affected, reports for critical areas issued by environmental authorities and research institutions using nuclear and isotopic methods. Published assessment reports or official technical documents on marine and coastal sediment quality, pollution-source attribution and productivity impact, using nuclear and isotopic techniques. Program reports, laboratory records, and scientific results that document the application of nuclear and isotopic techniques in the monitoring of microplastics and pollutants in vulnerable ecosystems (such as Antarctica and salt flats, among others).	Assumptions Continued political priority for environmental protection, water security and climate change adaptation at national and basin levels. Sustained institutional engagement of MMA, DGA, CCHEN and sectoral authorities in basin-based and environmental monitoring processes. Availability of minimum technical staff and institutional capacity to absorb IAEA-provided methodologies and training. Willingness of national institutions to integrate nuclear and isotopic techniques into existing monitoring and planning frameworks. Risks Shifts in government priorities or delays in implementation of Strategic Water Resources Plans at basin level. Increased frequency of extreme climatic events (droughts, floods) disrupting field measurements and monitoring activities. Insufficient or delayed national funding affecting continuity of environmental monitoring programmes. Regulatory or institutional fragmentation limiting effective use of generated data for decision-making.

Outputs	Time periods (Future TC cycle)	Relevant national counterparts	Approximate cost € (A)	Estimated Available Resources € (B)	Resources to be identified/mobilized € (A-B)
Institutional and technical capacities strengthened to apply isotope hydrology and related nuclear techniques for basin-level water resources assessment and pollution source attribution.	2026-2032	Ministry of the Environment (MMA), General Water Directorate (DGA), Chilean Nuclear Energy Commission (CCHEN), Water Scenarios 2030, National Irrigation Commission (CNR), Associated Universities (Universidad de Concepción, Universidad Mayor, Universidad de Chile)	400.000,00 €	100.000,00 €	300.000,00 €
National capacities strengthened for the establishment of environmental baselines and source attribution of soil and air contamination using nuclear and related analytical techniques.	2026-2032	Ministry of the Environment (MMA), Council for Sustainable Development of Chile, Chilean Nuclear Energy Commission (CCHEN), Faculty of Sciences, University of Chile	240.000,00 €	40.000,00 €	200.000,00 €
Capacities enhanced for the assessment of marine and coastal sediments and pollution pathways using nuclear and isotopic techniques to support ecosystem management.	2026-2032	SERNAPESCA, DIRECTEMAR, Chilean Nuclear Energy Commission (CCHEN), Fisheries Development Institute, Marine and Coastal Research Institute, Universidad Católica del Norte, Millennium Institute of Oceanography (Universidad de Concepción), Pontificia Universidad Católica de Valparaíso (PUCV) School of Marine Sciences, Marine Toxins Laboratory, U. de Chile, Universidad Austral, Universidad de Los Lagos	400.000,00 €	100.000,00 €	300.000,00 €
National technical and analytical capacities strengthened for monitoring microplastics and	2026-2032	Chilean Antarctic Institute (INACH), Chilean Nuclear Energy Commission (CCHEN), Marine Toxins Laboratory, U. de Chile, Ministry of the Environment.	440.800,00 €	340.800,00 €	100.000,00 €

emerging contaminants in vulnerable ecosystems (such Antartic and salt flats, among others) using nuclear and related techniques.					
			Subtotal		
			Approximate Cost € (A)	Estimated Available Resources € (B)	Resources to be identified/mobilized € (A-B)
			1.480.800,00 €	**580.800,00 €**	**900.000,00 €**

Thematic Area No. 5: Energy

Outcomes	• Baseline	Indicators	Means of verification	Assumptions and Risks

Strengthened national analytical, technical and institutional capacities to apply nuclear and nuclear-related techniques for integrated energy planning, sustainable lithium development, and improved traceability, quality assurance and environmental monitoring in Chile's energy and mining sectors.	• Nuclear energy is not yet integrated into national energy planning, and institutional capacities to assess advanced nuclear technologies (e.g. SMRs) remain limited. • National analytical and technological capacities to support a sustainable, high-value lithium value chain (including purification, characterization and isotope-related studies) are still at an early stage. • Application of nuclear techniques for traceability, quality assurance and environmental monitoring in mining and industrial processes is limited in scale and coverage. • Ageing infrastructure of the RECH-1 research reactor constrains the expansion of nuclear analytical services, applied research and specialized human-capital training for energy and industrial applications.	% of national energy planning and feasibility analyses that integrate nuclear or nuclear-related technical inputs (including SMRs) by 2032. # of national institutions applying nuclear or nuclear-related analytical techniques for lithium characterization, purification or isotope analysis by 2032. # of national laboratories providing accredited nuclear analytical services for mining and lithium traceability and quality assurance by 2032. % of priority mining and lithium production processes supported by nuclear techniques for environmental monitoring, traceability or quality control by 2032.	• Approved national energy planning and feasibility study reports • Official CCHEN and partner laboratory technical reports and records • Accreditation and certification documentation of nuclear analytical services • Environmental monitoring and quality-control reports from mining and lithium operations	**Assumption:** Cooperation with IAEA and investment in R&D. **Risk:** Resistance to change from strategic actors and international industry competition. **Assumption:** International partnerships remain active. **Risk**: Low prioritization within national funding schemes. **Assumption:** Modernization with IAEA support (ARCAL RLA1012). **Risk:** Obsolescence of RECH-1. **Assumption:** Financing secured. Assumptions Continued government commitment to energy transition, decarbonization and sustainable mining under Energy Policy 2050 and National Mining Policy 2050. Sustained institutional engagement of CCHEN, energy and mining authorities, academia and industry. Continued technical cooperation and advisory support from the IAEA.
				Availability of qualified technical staff to absorb and apply nuclear analytical techniques. Risks Limited political or social consensus on the role of nuclear technologies in the energy transition.

				Insufficient or delayed public funding for infrastructure upgrades and laboratory modernization. Technological obsolescence of existing nuclear infrastructure if modernization is delayed. Market or regulatory pressures in the lithium and mining sectors limiting uptake of advanced analytical and traceability techniques.		
Outputs	**Time periods (Future TC cycle)**	**Relevant national counterparts**	**Approximate cost € (A)**		**Estimated Available Resources € (B)**	**Resources to be identified/mobilized € (A-B)**
Integrated analytical and institutional capacities strengthened to support long-term	2026-2032	Ministry of Energy, CCHEN, IAEA, universities (PUC, University of Chile).	100.000 €		10.000 €	90.000 €

energy planning, including assessment of advanced nuclear technologies as low-carbon complementary options.					
National capacities strengthened for sustainable and traceable lithium production, through the application of nuclear analytical techniques for characterization, quality assurance and certification.	2026-2032	Ministry of Mining, CORFO, Ministry of Finance, CCHEN	100.000 €	33.000 €	67.000 €
Analytical capacities strengthened for sustainable mining and industrial processes, using nuclear techniques to improve material traceability, process efficiency and environmental monitoring.	2026-2032	CCHEN, ITER, Ministry of Science, IAEA	115.535 €	38.000 €	77.535 €
National nuclear research infrastructure sustainably strengthened and utilized, including the RECH-1 reactor, to	2026-2032	Ministry of Science, CCHEN, universities, IAEA	115.535 €	15.000 €	100.535 €

support analytical services, training and applied R&D for energy and industry.					
	2026-2032	CCHEN, INN, Mining Companies, CORFO, IAEA, Codelco, SQM.	165.000 €	40.000 €	125.000 €
	2026-2032	CCHEN, IAEA (ARCAL RLA1012), IDIEM, Ministry of Health.	155.000 €	45.000 €	110.000 €
	2026-2032	CCHEN, IAEA, Ministry of Science, Mining Companies, National Cultural Heritage Service - National Center for Conservation and Restoration	155.000 €	35.000 €	120.000 €
	2026-2032	CCHEN, IAEA	160.000 €	35.000 €	125.000 €
	2026-2032	CCHEN, IAEA, Ministry of Health, Ministry of Science, National Geology and Mining Service, Industrial and Mining Companies.	120.000 €	35.000 €	85.000 €
			Subtotal		
			Approximate cost € (A)	**Estimated available resources € (B)**	**Resources to be identified/mobilized € (A-B)**
			1.186.070 €	**286.000 €**	**900.070 €**

Thematic Area No. 6: *Non-Destructive Testing Applications*				
Outcomes	**Baseline**	**Indicators**	**Means of verification**	**Assumptions and Risks**

Strengthened national capabilities to apply non-destructive nuclear techniques for the preservation of cultural heritage and for preventive and post-event structural assessment in disaster risk management.	Existing NDT and irradiation capacities are concentrated at CCHEN, with limited geographic coverage and no formalised national programme for cultural heritage preservation and disaster risk management. Applications of non-destructive nuclear techniques in cultural heritage preservation remain ad hoc, with no consolidated national protocols for biodeterioration control, pest management or assessment of built heritage. Disaster risk management institutions lack systematic access to nuclear-based NDT tools and standardised procedures for preventive and post-event structural assessment. Human resource capacities and interinstitutional coordination for NDT applications are incipient, relying mainly on project-based cooperation and short-term training activities.	Existence and level of implementation of a national programme for the application of NDT and irradiation techniques in cultural heritage preservation and disaster risk management. Number of projects or training activities conducted by the Subregional NDT Centre focused on cultural heritage or disaster risk management. Existence of a formalised national programme for the application of nuclear non-destructive testing and irradiation techniques in cultural heritage preservation and disaster risk management, by 2032 (Yes/No). # of nationally approved protocols for the application of nuclear non-destructive testing and irradiation techniques in cultural heritage preservation, by 2032. # of disaster risk management institutions with regular access to nuclear-based non-destructive testing services and standardised procedures for preventive and post-event structural assessment, by 2032. # of trained professionals and formal interinstitutional cooperation arrangements supporting nuclear non-destructive testing applications in cultural heritage preservation and disaster risk management, by 2032.	Official government or CCHEN documents approving or establishing a national programme for nuclear non-destructive testing applications. Approved national guidelines, technical protocols or standard operating procedures issued by CCHEN, CNCR, SERPAT or relevant authorities. Institutional agreements, service records and annual reports from disaster risk management institutions and CCHEN documenting access to NDT services. Training records, certificates, participant lists, signed cooperation agreements or memoranda of understanding between participating institutions.	Institutional will and access to sustained financing Effective interinstitutional coordination. Availability of technical and human resources Regional logistics and infrastructure secured Assumptions Continued institutional commitment from cultural heritage and disaster risk management authorities to use nuclear-based NDT solutions. Sustained availability of CCHEN technical infrastructure and expert staff for NDT and irradiation services. Ongoing cooperation with the IAEA and ARCAL to support capacity building, training and technology transfer. Risks Changes in institutional priorities or leadership reducing demand for NDT applications in heritage and DRM. Obsolescence or insufficient maintenance of specialised

				NDT and irradiation equipment. Logistical and operational constraints limiting deployment of NDT teams to remote regions or post-disaster sites.

Establish a national and international cooperation network	Ad hoc and non-systematic cooperation	Number of current international agreements and projects		Political will and continuity in strategic alliances	
Outputs	**Time periods (Future TC cycle)**	**Relevant national counterparts**	**Approximate cost € (A)**	**Estimated Available Resources € (B)**	**Resources to be identified/mobilized € (A-B)**
Standardised national protocols and operational arrangements for the application of nuclear-based NDT techniques in cultural heritage preservation and disaster risk management established.	2026-2032	CCHEN, CNCR, MOP, INN, IAEA, ARCAL, SERPAT	150.000 €	50.000 €	100.000 €
Institutional and human capacities of cultural heritage and disaster risk management authorities strengthened for the systematic use of nuclear-based NDT techniques.	2026-2032	CCHEN, CNCR, National Cultural Heritage Service (SERPAT), National Sub-directorate of Museums, National Historical Museum, National Museum of Fine Arts, Natural History Museum of Valparaíso, National Library, National Archive.	170.000 €	56.667 €	113.333 €
National and international cooperation mechanisms consolidated to support sustainable application of nuclear-based NDT technologies in heritage preservation and DRM.	2026-2032	CCHEN, CNCR, SERPAT, Universities (University of Chile, Finis Terrae University), INN.	100.000 €	33.333 €	66.667 €
	2026-2032	Public, private companies (Durabillity, SI3).	173.500 €	57.833 €	115.667 €

	2026-2032	CCHEN, CNCR, SENAPRED, Serpat.	250.000 €	83.333 €	166.667 €
	2026-2032	CCHEN, MINREL, ANID, OIEA, ARCAL.	50.000 €	20.000,00 €	30.000 €
			Approximate cost € (A)	**Estimated available resources € (B)**	**Resources to be identified/mobilized € (A-B)**
			893.500,00 €	**301.167 €**	**592.333 €**

3.1. SUMMARY TABLE OF RESOURCES

Thematic Area	Approximate Cost in € (A)	Estimated resources* available in € (B)	Resources to be identified/mobilized in € (A-B)	
Thematic Area No. 1: Nuclear and Radiation Safety and Security	2.800.000	1.270.000	1.530.000	(+)
Thematic Area No. 2: Agriculture and Food	1.040.000	286.000	754.000	(+)
Thematic Area No. 3: Health and Nutrition	1.040.000	286.000	754.000	(+)
Thematic Area No.: 4 Water and Environment	1.480.800	580.800	900.000	(+)
Thematic Area No.: 5 Energy and Industry	1.186.070	286.000	900.070	(+)
Thematic Area No: 6 Non-Destructive Testing Applications	893.500	301.167	592.330	
	Total estimated overall cost for CPF	**Total estimated resources* available for CPF**	**Total resources to be identified/mobilized**	
	8.440.370 €	***3.009.967 €***	***5.430.400 €***	*(=)*
	Estimated government cost sharing (included in the above total of resources* available -B)		*20000*	
	Other estimated extrabudgetary contributions from donors/partners who have expressed interest (included in the above total of resources* available - B)		*0*	
	Estimated in-kind contributions from the Government and other partners/donors that have expressed interest (included in the above total of resources available - B)**		*2000*	

(*)-The above stated figures are indicative. Signing of the CPF does not commit to funding of the CPF implementation by the Member State or the IAEA, nor does it suggest the expectation of continued levels of Agency funding. The main purpose is to assist planning and prioritization of the Country Programme Framework.

(**)-This estimate should reflect the total estimated value (in Euros) of in-kind contributions provided by the Member State to carry out the planned programme (in-kind examples: time of staff, infrastructure, materials, equipment, repairs, construction work, sampling costs, shipment costs, etc.)

4. PROGRAM IMPLEMENTATION AND RELATED SUPPORT

4.1 COORDINATION OF THE COUNTRY PROGRAMME FRAMEWORK (CPF)

The process of preparing this Country Programme Framework (CPF) was coordinated and led by the Chilean Nuclear Energy Commission, as the institution hosting the NLO office, and the Program Management Officer (PMO) in the Division for Latin America and the Caribbean of the IAEA's Department of Technical Cooperation. The process was led by the CCHEN Office of Strategic Alliances and International Relations.

As a first step, an internal CCHEN working group was formed for each of the six thematic areas, and a team leader was appointed to carry out the update for each thematic area. This team of professionals produced a first draft of the document, which was submitted to the IAEA for comments.

In a second stage, relevant external actors from industry, academia, and the public sector were identified who could contribute their vision of the various priority issues. To gather their inputs, two contextualization meetings were held to explain the relevance of the MPN and what was required of them for the updating process. Subsequently, they were assigned to different thematic teams and virtual spaces for dialogue and joint participation were created.

Throughout this participatory phase, a gender perspective was actively incorporated. Guidance was sought from the Ministry of Women and Gender Equality (MMEG) on how to integrate this approach across all stages of the process. Accordingly, gender advisors from different ministries and MMEG specialists in specific topics were invited to take part, and balanced participation was actively promoted in every dialogue instance.

Finally, a workshop was held where all the actors gathered in person to consolidate the contributions for each thematic area. These inputs were compiled and, together with the comments received from the IAEA, were integrated into a second version of the document, which was then submitted to the IAEA for final evaluation.

On behalf of the IAEA, the PMO coordinated the relevant contributions from the IAEA's technical departments.

4.2 FUTURE REVIEW OF THE CPF

If required, future reviews of the progress and development of activities under this CPF will be carried out before the end of the next TC cycle, i.e., at the end of 2027.

The experience gained from these reviews will serve to provide better guidance in the formulation of new project proposals for the next cycle of the TC program. In this regard, the review will include, among other actions, the following:

- Evaluate the overall performance of the projects with respect to the CPF. Identify the strengths and weaknesses of their implementation.
- Evaluate the results and lessons learned in the implementation of the projects, as a reference for other similar initiatives that the IAEA may consider supporting in the future.

- Make proposals and recommendations on the future implementation of projects that could be included in the CPF and make adjustments to the CPF to improve the achievement of the objectives to be attained.
- Extract lessons learned and best practices, including possible updates in priority areas for future programming.

With regard to the documents that have been used as references for the development of this CPF, if any of them become obsolete before the end of this CPF, their subsequent editions will be reviewed and incorporated, as appropriate, during the CPF review process.

In addition, since the CPF is designed as a flexible tool that adapts to changing circumstances, it may be updated as the need arises, for example, to adapt to changes in national priorities, to address unplanned problems, or to incorporate lessons learned for program improvement. Any significant changes (positive or negative) that have affected the program will also be considered.

The review will be led by the Program Management Officer (PMO) in the Division for Latin America and the Caribbean of the IAEA's Department of Technical Cooperation and the NLO in the Chilean Nuclear Energy Commission. The final review and update of the next CPF will be carried out no later than early 2030, one year before the expiration of this CPF.

4.3 Coordination with partners

Chile has been a member of the United Nations since 1945 and, as such, adopted the 2030 Agenda with its 17 Sustainable Development Goals (SDGs). To implement this Agenda, Chile created the "National Council for the Implementation of the 2030 Agenda for Sustainable Development (SDGs)" through Decree No. 49 of the Ministry of Foreign Affairs. It is composed of the Ministry of Foreign Affairs, which chairs it, the Ministry of Economy, Development and Tourism, the Ministry of Social Development, and the Ministry of the Environment. This Council has set the following six SDGs as priorities for this year: No. 4 (quality education), No. 8 (decent work and economic growth), No. 10 (reduced inequalities), No. 13 (climate action), No. 16 (peace, justice, and strong institutions), and No. 17 (partnerships for the goals).

The partnership between Chile and the UN is guided by the United Nations Sustainable Development Cooperation Framework (UNCDF), a national strategic planning instrument that brings together agreements between the United Nations System and the Government of Chile. Its latest version was signed in 2023.

This CPF has been developed on the basis of national strategic priorities, to which the IAEA's TC program can make a significant contribution. In addition, a number of regional frameworks, policies, and agreements were taken into account, such as the ARCAL Regional Strategic Profile and international agreements, for example in the field of climate change, with United Nations agencies such as FAO, WHO, ECLAC, etc. For its part, the IAEA is part of the United Nations country team as a non-resident agency and has worked with United Nations organizations in the implementation of previous TC programs.

With regard to donor countries or agencies and partners that assist Chile in its development activities relevant to the implementation of the TC program proposed under this CPF, mention may be made of the US Department of Energy (DOE), the Global Initiative to Combat Nuclear Terrorism (GICNT), and the International Center for Theoretical Physics (ICTP), among others. The main key partners for the implementation of the program proposed under this CPF have been identified. At the national level, these are the ministries of Health, Energy, Agriculture, and the Environment. At the international level,

they are organizations of the United Nations system, donor countries, and agencies. The planned projects will be implemented in universities, technology centers, laboratories, and institutes.

Chile is participating in eight IAEA coordinated research projects (CRP). The Agricultural Research Institute (INIA) is participating in a project to analyze nitrogen isotope enrichment to estimate the efficiency of nitrogen use by dairy cows in temperate pastoral systems to mitigate greenhouse gas emissions. The Fruit Development Foundation is participating in a project related to the sterile insect technique and post-irradiated pupae that breed *Lobesia botrana* and another project related to the control of *Drosophila suzukii* in cherry orchards; the Faculty of Veterinary and Animal Sciences of the University of Chile is participating in a project to evaluate beta-lactam residues in broiler chickens; the Faculty of Medicine of the Universidad de Chile with a project on iron absorption and loss in conditions of low to moderate chronic inflammation; the Universidad Andrés Bello with a project on the characterization and quantification of water resources in north-central Chile; the Universidad de Mule with a project on the deployment of hybrid nuclear-renewable systems for a deep decarbonization of the Chilean energy matrix; and the Chilean Nuclear Energy Commission with a project on the environmental impact assessment of radionuclide transfer from soil to crops in arid and semi-arid regions of Chile.

ANNEX 1 PARTNERSHIP MATRIX

Thematic Area	Practical result in the national plan or sectoral strategy	Practical results of the CPF	Link to the SDGs	Link to the practical results of the UNSCP	Relevant partners
Nuclear and Radiation Safety and Nuclear Security	[National Nuclear and Radiological Emergency Plan 2022]: Ensures a coordinated and effective response to emergency situations, minimizing risks to public health and the environment . [Strategic objectives of CCHEN] Promotes the establishment of a national policy and strategy for nuclear safety, risk management, and safe management of radioactive waste . [National Cancer Plan 2018-2028]: Ensures quality and safety in the use of ionizing radiation for medical diagnosis and treatment.	Strengthened national nuclear and radiation safety infrastructure, including regulatory functions, technical capacities, and emergency preparedness across institutions in Chile . Progress toward the establishment of an independent national regulatory authority and updated legal frameworks.	SDGs 3, 9, 16 and 17	Strategic Priority 2: Strengthened democratic institutions and security for a new inclusive social contract . Directly related to: Outcome 2.1: Guarantee of civil and political rights, transparency, and effective institutions (focus on regulatory independence and security). Strategic Priority 1: Substantive equality in access to rights (Health safety)	**National:** Chilean Nuclear Energy Commission (CCHEN) Ministry of Health (MINSAL) Ministry of Energy Ministry of the Interior / CONSER (Radiological Emergency Safety Commission) SENAPRED (National Disaster Prevention and Response Service) Public Health Institute (ISP) **International:** IAEA US Department of Energy (US-DOE) Ibero-American Forum of Radiological and Nuclear Safety Agencies (FORO) International Radiation Protection Association (IRPA)
Food and Agriculture	Ref [2]: Promotes adaptation to mitigate climate impact on the forestry and agricultural sector, in line with [1]. Ref [15]: Protects food	Increased food availability and improved agroforestry capacity development in the country by 2032.	SDGs 2, 12, 13, and 15.	Strategic Priority 3: Sustainable, inclusive, and resilient development model to address the climate crisis, biodiversity loss, and pollution. Directly related to: Outcome 3.1: Sustainable, inclusive and	**National:** Ministry of Agriculture (MINAGRI) National Agricultural Society Agricultural and Livestock Service (SAG) Office of Agricultural Studies and Policies (ODEPA) Agricultural Development Institute (INDAP)

Thematic Area	Practical result in the national plan or sectoral strategy	Practical results of the CPF	Link to the SDGs	Link to the practical results of the UNSCP	Relevant partners
	heritage and promotes healthy diets and food safety. Ref [16]: Strengthen smallholder and indigenous farming and the rural sector. Ref [17]: Consolidation as an effective tool for food control and quality. Ref [35]: Seeks to ensure food safety.			resilient production and consumption, with a just socio-ecological transition, decent work, economic diversification and financing. Outcome 3.2: Sustainable use of natural resources, restoration and conservation of ecosystems and biodiversity. Effect 3.3: Climate change adaptation and mitigation, resilience, and disaster and emergency management.	Forestry Institute (INFOR) Agricultural Research Institute (INIA) Natural Resources Information Center (CIREN) Universities Producers (Beekeeping Network, Chile Oliva) Ministry of Health (MINSAL) Public Health Institute (ISP) Food Safety Agency (ACHIPIA) Chile Foods Center for Advanced Studies in Fruit Growing National Association of Seed Producers Center for Processed Food Studies **International** Food and Agriculture Organization of the United Nations (FAO) Inter-American Development Bank (IDB)
Health and Nutrition	Ref [8]: Seeks to improve access to health services. Ref [13]: Guides health policy, including the National Cancer Plans ( ) 2022-2027/2028. Ref [14]: Promotes comprehensive women's health. Ref [17]: Establishes principles for adequate and safe nutrition. Ref [18]: Addresses child health and nutrition.	Improved health and nutrition for the population by 2032.	SDGs 2 and 3.	Strategic Priority 1: Substantive equality in access to and enjoyment of economic, social, cultural, and environmental rights (DESCA). Directly related to: Effect 1.4: High-quality, sustainable, and resilient public education, food, and health systems.	**National** Ministry of Health (MINSAL) Chilean Cancer Society (SCC) National Cancer Institute (INCANCER) Chilean Cancer Foundation Institute of Radiomedicine (IRAM) Hospitals, Clinics, Diagnostic Centers Public Health Institute (ISP) National Health Fund National Coordination of Donation, Procurement, and Transplantation of Organs, Tissues and Cells National Tissue Bank Chilean Society of Hematology Chilean Society of Transfusion Medicine Institute of Nutrition and Food Technology (INTA) National Board for School Assistance and Scholarships (JUNAEB) Universities or other research centers

Thematic Area	Practical result in the national plan or sectoral strategy	Practical results of the CPF	Link to the SDGs	Link to the practical results of the UNSCP	Relevant partners
	Ref [20]: Strengthens the care system and access to support.				Ministry of Science, Technology, Knowledge and Innovation **International** International Atomic Energy Agency (IAEA) World Health Organization (WHO) Pan American Health Organization (PAHO/WHO) Food and Agriculture Organization of the United Nations (FAO)
Water and Environment	Ref [1]: Guides long-term climate action. Ref [2]: Seeks GHG neutrality by 2050 and climate adaptation, proposing Strategic Water Resource Plans. Ref [6]: Provides infrastructure to address water challenges and meet demand. Ref [7]: Strengthens environmental risk management. Ref [30]: Protects and manages biodiversity. Ref [33]: Addresses marine pollution.	By 2032, increase knowledge generation on the availability, management, and use of surface and groundwater resources, using a watershed approach, as well as increase knowledge on soil quality, air quality, coastal marine environments, and the impact of polluted environments on public health.	SDGs 3, 6, 7, 11, 12, 14, and 15.	Strategic Priority 3: Sustainable, inclusive, and resilient development model to address the climate crisis, biodiversity loss, and pollution. Directly related to: Effect 3.1: Sustainable, inclusive, and resilient production and consumption, with a just socio-ecological transition, decent work, economic diversification, and financing. Outcome 3.2: Sustainable use of natural resources, restoration and conservation of ecosystems and biodiversity. Effect 3.3: Climate change adaptation and mitigation, resilience, and disaster and emergency management.	**National:** Ministry of the Environment (MMA) General Water Directorate (DGA) 2030 Water Scenarios National Irrigation Commission (CNR) Chilean Sustainable Development Council SERNAPESCA DIRECTEMAR Marine and Coastal Research Institute Marine Toxins Laboratory, University of Chile Universities, higher education centers National Geology and Mining Service (Sernageomin) Fisheries Development Institute Millennium Oceanographic Institute, University of Concepción School of Marine Sciences, Pontifical Catholic University of Valparaíso

Thematic Area	Practical result in the national plan or sectoral strategy	Practical results of the CPF	Link to the SDGs	Link to the practical results of the UNSCP	Relevant partners
Energy	Ref [3]: Promotes the development of clean energy sources. Ref [4]: Guides the reduction of emissions in the energy matrix. Ref [21]: Establishes the framework for nuclear development in the country. Ref [24]: Seeks a reliable, inclusive, competitive, and sustainable energy sector. Ref [25]: Promotes efficiency, technological research and innovation, and environmental traceability in mining. [27]: Promotes R&D in the sector.	Diversification of the energy matrix with nuclear energy and NCRE. Sustainable lithium extraction processes. Nuclear techniques in mining. Modernization of the RECH reactor.	SDGs 7, 9, 12, and 13.	Strategic Priority 3: Sustainable, inclusive, and resilient development model to address the climate crisis, biodiversity loss, and pollution. Directly related to: Outcome 3.1: Sustainable, inclusive and resilient production and consumption, with a just socio-ecological transition, decent work, economic diversification and financing. Outcome 3.2: Sustainable use of natural resources, restoration and conservation of ecosystems and biodiversity. Effect 3.3: Climate change adaptation and mitigation, resilience, and disaster and emergency management.	**National:** Ministry of Energy Chilean Nuclear Energy Commission (CCHEN) National Electricity Coordinator National Energy Commission (CNE) Superintendency of Electricity and Fuels (SEC) Ministry of Mining CORFO National Institute of Standardization (INN) of Chile National Customs Service SQM Albemarle CODELCO-Lithium Universities and research centers Ministry of Science, Technology, Knowledge and Innovation Research and Development and Innovation in Structures and Materials (IDIEM) Directorate of Scientific and Technological Research (DICTUC), Pontificia Universidad Católica de Chile Private energy sector **International** International Energy Agency (IEA) Latin American Energy Organization (OLADE) Economic Commission for Latin America and the Caribbean (ECLAC) United Nations Industrial Development Organization (UNIDO) World Bank ITER
Industrial Applications	It strengthens disaster risk management, prioritising the inspection of civil and industrial structures to	Capabilities in the application of non-	SDGs 9, 11, 13 and 17.	Strategic Priority 2: Strengthened democratic institutions and security for a new inclusive social contract.	National: • Chilean Nuclear Energy Commission (CCHEN)

Thematic Area	Practical result in the national plan or sectoral strategy	Practical results of the CPF	Link to the SDGs	Link to the practical results of the UNSCP	Relevant partners
	assess their structural integrity. It strengthens the comprehensive development of research, protection, and conservation actions for cultural and natural heritage. It seeks the coordination and articulation of state initiatives related to the management of cultural heritage, recognising it as a public good.	destructive testing techniques in the preservation of cultural heritage and in the application of preventive protocols for disaster risk management, implemented.		Directly related to: Effect 2.1: Guarantee of civil and political rights, and strengthening of mechanisms for dialogue and participation. Strategic Priority 3: A sustainable, inclusive, and resilient development model to address the climate crisis, biodiversity loss, and pollution. Directly related to: Effect 3.3: Adaptation and mitigation to climate change, resilience, and disaster and emergency management.	• National Centre for Conservation and Restoration (CNCR) • National Disaster Prevention and Response Service (SENAPRED) • National Cultural Heritage Service (SERPAT) • Ministry of Cultures, Arts and Heritage • National Museums (MNBA, MNHN) • Local Museums • National Library • National Archive • Universities (U. of Chile, U. Finis Terrae) • National Standardisation Institute (INN) • Durability • SI3 <u>International:</u> • International Atomic Energy Agency (IAEA) • Regional Cooperation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL)

ANNEX 2 LIST OF PARTICIPATING INSTITUTIONS

Institutions	Roles and Responsibilities in the Nuclear and Radiological Field
Nuclear and Radioactive Facilities in the Country	Operate ionizing radiation applications in health or industry. Comply with requirements of the Competent Authority (CCHEN or MINSAL).
State agencies that play a role in the National Civil Protection System and State Intelligence System agencies: CONSER	Participate in the prevention, preparation, and response to nuclear and radiological emergencies and physical security events. Coordinate through CONSER or other agencies.
Regulatory agencies: CCHEN, MINSAL, SAG, ISP, SERNAPESCA, DGA, SEC, CNE, Sernageomin, among others.	They oversee and control legislation and regulations applicable to different subject areas.
State Sectoral Agencies:	They lead sustainable development and the creation of public policies. They generate basic information for decision-making and actions within the scope of their sectoral powers.
Ministry of Social Development, National Agency for Research and Development (ANID)	Possible sources of national funding for capacity-building projects.
Universities, technological institutes, and study centers	Participate in research, development, and application projects for nuclear and related technologies. Reflect impact on the dissemination and transfer of information and technology.
Health centers and educational centers related to medical physics	Establish links between academic education and clinical training in medical physics specialties (diagnostic radiology, nuclear medicine, radiotherapy), contributing to the safety and quality of radiotherapy.
Hospitals, clinics, and other health centers	They apply nuclear techniques in healthcare. They implement public health policies and access to services.
Societies, foundations, cooperatives, and consultants: SCC, Fundación Cáncer Chile, SNA, among others.	Apply the results of technical cooperation projects in the areas of development of the thematic areas.
International agencies: FAO, WHO, ECLAC, among others.	They establish cooperation with organizations to carry out specific programs and implement actions and challenges in thematic areas.

ANNEX 3 LEGAL FRAMEWORK AND TREATIES RELATED TO THE IAEA

LAWS – DECREES

The national legal framework governing nuclear activities in Chile is grounded in the Nuclear Safety Law (No. 18302) and the organic laws establishing the Chilean Nuclear Energy Commission and the Ministry of Energy. This legislative foundation is operationalized through a comprehensive set of Supreme Decrees that enforce specific regulations for radiation protection, physical security, and the safe transport of radioactive materials, defining the regulatory competencies of the competent authorities as detailed below.

Law No. 16319: Creates the Chilean Nuclear Energy Commission.
Decree Law No. 1557: Amends the Organic Law of the Chilean Nuclear Energy Commission and establishes rules on operating contracts.
Law No. 18302 (amended by Laws No. 18,730 and No. 19,825 and Law No. 20402): Nuclear Safety Law
Supreme Decree No. 133: Approves regulations on authorizations for radioactive facilities or ionizing radiation-generating equipment, personnel working in such facilities or operating such equipment, and other related activities.
Supreme Decree No. 87: Approves regulations on the physical protection of nuclear facilities and materials.
Supreme Decree No. 3: Approves regulations on radiation protection for radioactive facilities.
Supreme Decree No. 12: Approves regulations for the safe transport of radioactive materials.
Decree No. 82: Approves regulations for the physical protection of radioactive materials in first-category radioactive facilities.
Law N° 19937: Health Authority Law
Law No. 20402, Date of Promulgation: November 25, 2009, Date of Publication: December 3, 2009. Creates the Ministry of Energy, establishing amendments to DL No. 2,224 of 1978 and other legal bodies. The amendments "to other legal bodies" that affect the Chilean Nuclear Energy Commission are found in: Article 4.- Law No. 16319, Organic Law of the Chilean Nuclear Energy Commission, is amended as follows: 1. In the third paragraph of Article 1, the word "Mining" is replaced by "Energy." 2. In paragraph b) of the third section of Article 9, replace the word "Mining" with "Energy." Article 5 - In Law No. 18302, Nuclear Safety Law, the word "Mining" is replaced by "Energy" in all provisions where it appears.

TREATIES UNDER THE AUSPICES OF THE IAEA

IAEA Acronym	Title	In force	Status
P&I	Agreement on the Privileges and Immunities of the IAEA	1987-12-08	Accepted: 1987-12-08
VC	Vienna Convention on Civil Liability for Nuclear Damage	1990-02-23	Signed: 1988-08-18 Ratified: November 23, 1989
VC/OP	Optional Protocol on the Compulsory Settlement of Disputes		Non-party
CPPNM	Convention on the Physical Protection of Nuclear Material.	1994-05-27	Accessed: 1994-04-27
CPPNM/A	Amendment to the Convention on the Physical Protection of Nuclear Material	2016-05-08	Accepted: 2009-03-12
NOT	Convention on Early Notification of a Nuclear Accident.	2005-12-15	Signed: 1986-09-26 Ratified: 2005-11-15
ASSIST	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	2004-10-23	Signed: 1986-09-26 Ratified: 2004-09-22
JP	Joint Protocol on the Application of the Vienna Convention and the Paris Convention	1992-04-27	Signed: 1988-09-21 Ratification: 1989-11-23
NS	Convention on Nuclear Safety	1997-03-20	Signed: 1994-09-20 Ratified: 1996-12-20
RADW	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management	2011-12-25	Accessed: 2011-09-26
PVC	Protocol Amending the Vienna Convention on Civil Liability for Nuclear Damage		Non-party
SUPP	Convention on Supplementary Compensation for Nuclear Damage		Non-party

TECHNICAL COOPERATION AGREEMENTS

Acronym IAEA	Title	In Force	Status
RSA	Revised Supplementary Agreement on the Provision of Technical Assistance by the IAEA (RSA)	1980-08-29	Signed: 1980-08-29
RCA	Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and		Non-party

Acronym IAEA	Title	In Force	Status
	Technology, 2017		
AFRA	African Regional Cooperation Agreement for Research, Development and Training in Nuclear Science and Technology (AFRA) - Fifth Extension		Non-party
ARCAL	Agreement to further extend the Cooperation for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL)	2020-09-05	acceptance: 2020-08-11
ARASIA	Cooperation Agreement for Arab States in Asia for Research, Development and Training Related to Nuclear Science and Technology (ARASIA) - First Extension		Non-party

SAFEGUARDS AGREEMENTS

Reg. No	Title	In force	Status
1661	Agreement between the Republic of Chile and the IAEA for the application of safeguards in connection with the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Tlatelolco)	1995-04-05	Signed: 1995-04-05
1762	Additional Protocol to the Agreement between the Republic of Chile and the IAEA for the application of safeguards in connection with the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean.	2003-11-03	Signed: 2002-09-19

MoUs

Date	Instrument	Objective
April 2024	Memorandum of Understanding between the International Atomic Energy Agency and the Republic of Chile on Cooperation in the Area of Nuclear Technology for Plastic Pollution Control (NUTEC Plastics).	The objective of this MoU is to set forth the framework for non-exclusive cooperation between the Parties in the area of NUClear TEChnology for Plastic Pollution Control (NUTEC Plastics). The Parties have identified the following activities in which cooperation may be pursued, subject to the Parties' respective mandates, governing regulations, rules, policies, and procedures: 1. Technical collaboration through the organization of Chilean expert missions and educational and training activities necessary to take samples, analyse and generate the necessary knowledge and data on the situation of microplastics in Antarctica. 2. Collaboration in the organization of special logistical arrangements necessary for providing

		access to scientific experts to remote locations in Antarctica. 3. Transfer of technical assistance, equipment, and nuclear technology, with the understanding that the Government of Chile may designate recipient institution(s). 4. Exchange and promotion of information, including publications and best practices in the area of cooperation, in accordance with norms and legal framework of each of the Parties.
April 2024	Practical Arrangements between the International Atomic Energy Agency and Chilean Nuclear Energy Commission on Cooperation in the Area of Nuclear Technology Applications in the Sustainable Mining Industry and Lithium Applications in Nuclear Energy.	The objective of these Practical Arrangements is to set forth the framework for non-exclusive cooperation between the Parties in the area of nuclear technology applications in the sustainable mining industry and lithium applications in nuclear energy. The Parties have identified the following activities in which cooperation may be pursued, subject to the Parties' respective mandates, governing regulations, rules, policies and procedures: 1. Technical collaboration in research of lithium applications in nuclear energy. 2. Transfer of technical assistance, equipment and nuclear technology, to strengthen Chilean capabilities in the sustainable mining industry. 3. Exchange and dissemination of unclassified information, including publications and best practices to promote regional cooperation.

APPENDIX 4 INFORMATION ON THE ACHIEVEMENTS OF PREVIOUS TC PROGRAMS

Chile signed the Supplementary Technical Cooperation Agreement with the Agency in 1980. In the early years and until the beginning of the 1990s, the assistance received enabled the establishment of infrastructure and human resources training in the nuclear field in the country. Since 1980, various national institutions have participated in technical cooperation projects. In the early years, IAEA technical assistance focused on developing infrastructure, both physical and human resources, in universities and research centers, including the CCHEN. This generated the capacity to acquire competitive technologies, which was the focus of the second phase of what became known as the IAEA Technical Cooperation Program.

In line with subsequent strategies established for technical cooperation, Chile addressed problems with a significant economic and social impact in sectors relevant to its development, such as health (quality control in imaging and mammography), agriculture (fertilizers, pesticides), industry, mining (copper mining), fishing (red tide, product exports), water resources, and the environment. In recent years, emphasis has been placed on the Sustainable Development Goals, in which nuclear science and technology can play an important role, for example, in climate change mitigation and adaptation, human health, and water resources, among others.

The CCHEN has promoted a series of fundamental projects aimed at strengthening national capacities in essential areas of nuclear science and technology. These projects have been developed in different cycles, each with a specific focus on improving infrastructure, human resources training, and the implementation of advanced technologies in Chile. Four lines of work are currently underway: contributing to the strengthening of strategic water resource management plans (SWRP) for aquifers; strengthening capacities to establish internationally harmonized methods for determining the traceability of the origin and confirming the identification of microplastics using nuclear techniques; contributing to improving the value of organic agricultural products produced by small and medium-sized producers; and strengthening national capacities within the framework of the NUTEC Memorandum of Understanding signed by Chile and the IAEA, which focuses on research and monitoring of microplastics in Antarctica.

Noteworthy assistance received from the IAEA, parallel to technical cooperation projects, occurred in the context of the COVID-19 pandemic, through the delivery of four (4) complete diagnostic kits to Chilean laboratories. The beneficiary institutions are as follows: 1.- Claudio Vicuña Hospital in Valparaíso; 2.- Dr. Augusto Riffart Hospital in Castro; 3.- Santa Cruz Hospital in Santa Cruz; 4.- Veterinary Laboratory of the Agricultural and Livestock Service. The estimated final cost of the equipment provided is EUR 540,000 (including equipment, kits, and shipping). The extra-budgetary funds come from the United States (1) and Takeda (3). In addition, national laboratories actively participated in the series of webinars offered by the IAEA to support laboratories in the diagnosis of COVID-19.

In 2023, through national projects, the IAEA supported the acquisition of important equipment, such as genotyping equipment, gas chromatographs and peripherals for the headspace analyzer of the mass spectrometer for food authenticity, and a microbeta system for marine toxin detection capabilities. In addition to the above, it is important to highlight the modernization of the RECH- 1 research reactor, which will expand its capabilities, at a cost of EUR 1,000,000, with Chile contributing EUR 260,000 under a government co-financing scheme.

In addition to the funds allocated to the Technical Cooperation Program, the IAEA provided extraordinary support for:

- A radiation monitoring system, worth EUR 56,000, to strengthen the technological and physical aspects relevant to the safe operation of the RECH-1 research reactor.
- Equipment for the supply of liquid nitrogen, worth EUR 156,600, essential for the operational continuity of radiation protection services.
- A dosimetry system for the postal audit program, worth EUR 40,000.
- In addition, extraordinary additional support is being provided for the purchase of a microscope, worth EUR 300,000, which will support various areas of the CCHEN, including materials characterization, organic chemistry, biology, and microbiology, as well as the study of microplastics.

In general terms, the areas of the Technical Cooperation Program that have had the greatest impact in the country include the following:

Thematic area	Results of past technical cooperation	Key partners and counterparts
Safety and security	The National Technical Cooperation Program permanently includes projects on strengthening the national nuclear and radiological safety infrastructure, which focus on minimizing the risks inherent in activities related to the radiological and nuclear field in Chile. This effort has been developed in the various technical cooperation cycles, always in line with IAEA international standards, and has been fundamental in protecting both the public and occupationally exposed workers. In the field of nuclear and radiation safety and security, the PNCT has supported the strengthening of the national architecture, developing capacities for the safe operation of medical and industrial facilities, advancing regulation, and training human resources in relevant state agencies. In the area of radiation protection, a large number of human resources have been strengthened and specialized equipment relevant to radiation safety has been incorporated in the country, mainly from CCHEN, MINSAL, and ISP. Highlights from the last period include the updating of radiation protection regulations, the strengthening of support services, dosimetry calibration laboratories and capacities in radiodiagnostics, nuclear medicine and medical and biological dosimetry, the evaluation of radiochemical processes, and the reinforcement of hospital radiopharmacy. In 2023, the operation to remove 31 discarded Cobalt-60 sources was successfully completed, within the framework of the IAEA project "Improving Nuclear Safety through the Sustainable Management of Sealed Radiation Sources." The process included two campaigns, coordinated with other government agencies to ensure the country's safety and security. Seventeen sources were shipped in 2022 and the rest in 2023. Each campaign involved the preparation of packages, transport, and shipment to Germany to Gamma Service Recycling, a company specializing in recycling, which described this operation as the largest project ever carried out in this field. In the area of radiological emergency preparedness and response, with IAEA support, the country developed a National Nuclear and Radiological Emergency Plan, approved in 2022, in line with IAEA Safety Standard General Safety Requirements No. GSR Part 7: Preparedness and Response for a Nuclear or Radiological Emergency. In addition, since 2023, the National Service for Disaster Prevention and Response (SENAPRED) has been operational, emerging as a new institutional framework replacing the National Emergency Office (ONEMI). For a nuclear or radiological emergency, technical command is under the responsibility of the relevant regulatory authority. That is, the CCHEN for first-category nuclear and radioactive facilities, and the MINSAL for other radioactive facilities, as indicated in	**National:** Members of CONSER Ministry of the Interior Ministry of Public Security Carabineros de Chile (Chilean National Police) Investigative Police (PDI) National Emergency Office National Intelligence Agency (ANI) National Customs Service Ministry of National Defense Ministry of Foreign Affairs Legal Medical Institute Chilean Nuclear Energy Commission (CCHEN) Ministry of Health, Ministry of Transportation and Telecommunications General Directorate of Civil Aeronautics General Directorate of Maritime Territory and Merchant Marine General Directorate of National Mobilization Ministry of the Environment Chilean Army Chilean Society for Radiological Protection Ministry of Energy **International** IRPA FORO GICNT

Thematic area	Results of past technical cooperation	Key partners and counterparts
	Annex 3. The Radiological Emergency Safety Commission (CONSER), an interministerial commission that advises the president on nuclear and radiological safety and security, brings together state authorities in these areas to propose measures to strengthen capacities, improve coordination between sectors, and disseminate international best practices. In this area, the support provided by the IAEA Technical Cooperation Program has been very important in strengthening the capacities of its members.	

Thematic area	Results of past technical cooperation	Key partners and counterparts
Food and Agriculture	In the period 2020-2025, progress was made in the area of food fraud to establish a national reference system for verifying the authenticity and determining the origin of food, including the acquisition of an isotope ratio mass spectrometer (EA-IRMS) for the CCHEN to measure the isotopic signature of different food matrices such as honey, wine, seafood, and beverages, in order to confirm their authenticity, at a cost of EUR 200,000.00. Another area addressed with the Agricultural and Livestock Service has been to strengthen the National Zoonosis Laboratory in the area of biosafety for the control and prevention of transboundary diseases. To this end, a diagnosis of the laboratory's current capacity gaps will be carried out, with a technical report, and human resources trained in transboundary diseases will be provided. Organic agricultural production by small and medium-sized producers has also been strengthened through the training of technical teams that provide assistance to these farmers. Issues such as toxicology, contaminants in agriculture, food safety, and good agricultural practices were addressed to support small producers in facing environmental challenges, and international partnerships were promoted to strengthen local capacities.	**National:** Ministry of Agriculture Agricultural and Livestock Service (SAG) Forestry Institute (INFOR) Office of Agricultural Studies and Policies (ODEPA) Chilean Agency for Food Safety and Quality (ACHIPIA) Agricultural Development Institute (INDAP) Agricultural Research Institute (INIA) Natural Resources Information Center (CIREN) Chilean Nuclear Energy Commission (CCHEN) National Agricultural Society Fruit Development Foundation Universities Technological Institutes Agricultural associations Agricultural and forestry producers Production companies **International:** FAO UN Environment Entomology Research Unit USDA/ APHIS California, USA.
Health and Nutrition	Recent achievements in the application of nuclear technology in health, resulting from the IAEA's technical cooperation program, have focused on strengthening quality assurance, improving and maintaining capacities for the production of radiopharmaceuticals, nuclear medicine and radiation protection for medical use, enabling their use in sustainable scenarios. In the period 2020-2025, an important milestone is the commissioning of the NephroCam equipment at the Diagnostic Center in the municipality of San Miguel of the MATER Children's Renal Corporation. This equipment provides unique information that is often not possible to obtain through other imaging procedures. Its approximate cost is EUR 120,000. The improvement in early diagnosis provided by this non-profit corporation to low-income children throughout Chile are achievements that position	Ministry of Health Public Health Institute Chilean Nuclear Energy Commission (CCHEN) Chilean Cancer Society National Cancer Institute Cancer Chile Foundation Institute of Radiomedicine Institute of Nutrition and Food Technology (INTA) National Board for School Assistance and Scholarships (JUNAEB) Hospitals, Clinics Universities or other

Thematic area	Results of past technical cooperation	Key partners and counterparts
	the country as a benchmark on the continent in nuclear medicine and kidney research, constituting a major contribution to the country. In another line of work, the challenge of contributing to equitable, timely, and safe access to biological tissues for the treatment of injuries and non-communicable diseases is being addressed through capacity building for tissue irradiation, the implementation of good practices, and compliance with international quality standards applicable to clinical production. The Chilean Nuclear Energy Commission (CCHEN), the National Tissue Bank, and the National Coordination of Organ and Tissue Donation, Procurement, and Transplantation of the Ministry of Health are participating in the initiative. Beneficiaries include GES and non-GES patients, as well as health professionals. In 2024, the CCHEN inaugurated the National Tissue Bank, which will enable the country to provide radiosterilized, clinical-grade tissues for the treatment of pathologies.	Research Centers WHO PAHO UN Environment
Water and Environment	In 2022, a genomics laboratory was launched to improve climate-resilient tree species through mutation at the Concepción headquarters of the INFOR research institute, part of the Ministry of Agriculture. The initiative was developed under the project "Use of nuclear techniques to improve the adaptation and productivity of forest species to climate change," which aimed to improve the productivity and adaptation of forest species to climate change through nuclear plant breeding techniques. Radiation trials were conducted, achieving significant results in hormesis and mutation induction, and outreach activities were carried out with broad stakeholder participation. Along the same lines, a project continued on strengthening the national cooperation network for the use of nuclear techniques in plant breeding programs, whose main achievement was to consolidate a national cooperation network between research institutions, facilitating the coordination of capacities, the exchange of experiences, and the coordination of activities related to plant breeding by mutagenesis. This network has been key to strengthening national knowledge in this strategic area. In another line of work, progress has also been made in the application of isotopic techniques to characterize recharge zones in aquifers, identify sources of contamination, estimate flow rates and dynamics, and calculate mass balances, as well as in sampling wells of different depths, with an emphasis on assessing the age and sustainability of groundwater. In addition, scientific collaboration with experts from Argentina, Switzerland, and international networks was strengthened. With regard to coastal pollution in Chile, capacities were strengthened to quantify microplastics, assess emerging	General Water Directorate (DGA) Chilean Nuclear Energy Commission (CCHEN) Universities, higher education centers Relevant research institutes Universities World Meteorological Organization. National Institute of Statistics (INE), Environmental Isotope Laboratories Health and mining companies

Thematic area	Results of past technical cooperation	Key partners and counterparts
	marine toxins, and promote community participation. New equipment was installed with technical training, information on microplastics and toxins on beaches was generated, and links were established with local communities, municipal authorities, and naval personnel. In addition, the project was presented to the IAEA, highlighting its contribution to the REMARCO regional platform, which is used as a reference for its program on plastic pollution. Another line of action worth highlighting is the protection of the Antarctic environment, addressed through the *Capacity Building* project, with hopes for a national project in the next period. The initiative is part of the Memorandum of Understanding signed in April 2024 with the IAEA and includes training for personnel and equipment for the Chilean Antarctic Institute.	
Energy and industry	Chile requested assistance from the IAEA to modernize the instrumentation of the RECH-1 research reactor in order to expand its capabilities. This upgrade is valued at €1,000,000, of which Chile contributed €260,000 under a government co-financing scheme. Among the expanded uses is the improvement of neutron imaging, a technique similar to X-ray radiography, which allows the internal structure of manufactured objects, such as cultural heritage items, to be identified.	Ministry of Energy Undersecretary of Energy National Electricity Coordinator National Energy Commission Chilean Nuclear Energy Commission (CCHEN) Industry associations Universities and educational institutions. Universities, CODELCO, CCHEN Mining companies
Non-Destructive Testing Applications	New thematic area	New thematic area

A relevant aspect of the Technical Cooperation Program is capacity building through scholarships, scientific visits, workshops, training courses, and expert visits, which have benefited the country. In turn, the country's capacities have been recognized by the IAEA and in the region by the growing number of foreign scholarship holders and scientific visits to Chile, and by missions of Chilean experts, especially to countries in the region.

Furthermore, Chile has actively participated in regional projects that are part of the technical cooperation cycles of the Regional Agreement for Cooperation in the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL), which bases its actions on the support received from the International Atomic Energy Agency, but also on South-South cooperation among member countries.

The IAEA's contribution to technical cooperation activities has enabled the country to implement various projects that are relevant to its development. The following tables show the contributions received by Chile for the period January 2020 to December 2024.

Contributions for Technical Cooperation Activities January 2020 to December 2024

Year	FCT					
	Contribution ($	Commitment ($)	Paid ($)	Installment (EUR)	Commitment (EUR)	Paid (EUR)
2015	0	0	0	224,048	231,010	231,010
2016	0	0	0	271,104	280,244	279,994
2017	0	0	0	326,074	326,074	326,074
2018	0	0	0	328,954	328,954	328,954
2019	0	0	0	330,874	0	330,874
2020				345,199		345,199 (payment in 2022)
2021				351,067		0
2022				357,014		0
2023				378,491		0
2024				387,840		0
2025				395,920		0
Total	0	0	0	1,481,054	1,166,282	1,166,032

From 2011 to 2013, 50% of the FCT target quota was invoiced in EUR and 50% in USD
*From 2014, the FCT target quota was invoiced solely in EUR.

Year ($)	, extra-budgetary funds ($)		n support in kind ($)	n extra-budgetary funds (EUR)		support in kind (EUR)
	Extra-budgetary ($)	Cost shared by the Government ($)		Extra-budgetary (EUR)	Government cost sharing (EUR)	
2015				9,040	27,211	16,600
2016				14,548		5,800
2017				8,610		3,000
2018				8,640		4,800
2019	-	-	-	-	-	-
2020						
2021						
2022						
2023						
2024						
2025						
Total	0	0	0	40,838	27,211	30,200

* For extra-budgetary and in-kind contributions, amounts are only available the following year

With regard to technical cooperation projects approved for the country during the same period, their financing can be seen in the following table:

Period: 2020 to 2025.
Approved and granted assistance

Year	Approved assistance from the CTA **	Assistance granted from all sources	TOTAL

	Amount (EUR)	% Region	FCT (EUR)	Extra-budgetary (EUR)	UNDP (EUR)	In kind (EUR)	
2015	333,500	1.0	280,441				280,441
2016	372,900	0.8	659,929				659,929
2017	427,880	1.0	419,454				419,454
2018	642,966	1.3	422,650				422,650
2019							
2020							
2021							
2022							
2023							
2024							
2025							
Total							

* Attendance figures are only available the following year.

** As reported for national projects in the Board document.