Fuel Cycle and the Environment

Eng. Ayelén Giomi
Nuclear safety and environment area manager
July, 2024

Fuel Cycle and the Environment in Argentina

- 2 CENTRALES NUCLEARES DE POTENCIA EN CONSTRUCCIÓN
- 1 PLANTA DE ENRIQUECIMIENTO DE URANIO
- 8 ÁREAS DE RESTITUCIÓN AMBIENTAL
- 5 ACELERADORES DE PARTÍCULAS PARA INVESTIGACIÓN
- 2 CENTRALES NUCLEARES DE POTENCIA EN OPERACIÓN
- 3 INSTITUTOS DE FORMACIÓN ACADÉMICA
- 9 LOCACIONES CON ACTIVIDAD MINERA
- 5 ACELERADORES DE PARTÍCULAS PARA PRODUCCIÓN DE RADIOISÓTOPOS
- 1 PLANTA DE PURIFICACIÓN DE URANIO
- 3 CENTROS ATÓMICOS
- 4 CENTROS DE MEDICINA NUCLEAR
- 1 POLO TECNOLÓGICO
- 1 PLANTA INDUSTRIAL DE AGUA PESADA
- 6 REACTORES DE INVESTIGACIÓN
- 2 CENTROS DE MEDICINA NUCLEAR EN CONSTRUCCIÓN
- 1 FÁBRICA DE COMBUSTIBLES NUCLEARES
- 4 PLANTAS DE IRRADIACIÓN PARA USOS INDUSTRIALES
- 1 COMPLEJO MINERO FABRIL
- 4 REGIONALES: CENTRO, NOROESTE, CUYO, PATAGONIA
- 339 INSTALACIONES CON APLICACIONES INDUSTRIALES

Fuel Cycle and the Environment in Argentina

Comisión Nacional de Energía Atómica

Open Nuclear Fuel Cycle

Front end for the cycle

Uranium Raw Material: Exploration

Mining

Milling – conversion Raw material production

DIOXITEK

Nuclear fuel fabrication

CONUAR

Combustibles Nucleares Argentinos

Nuclear Reactor– Nuclear fission

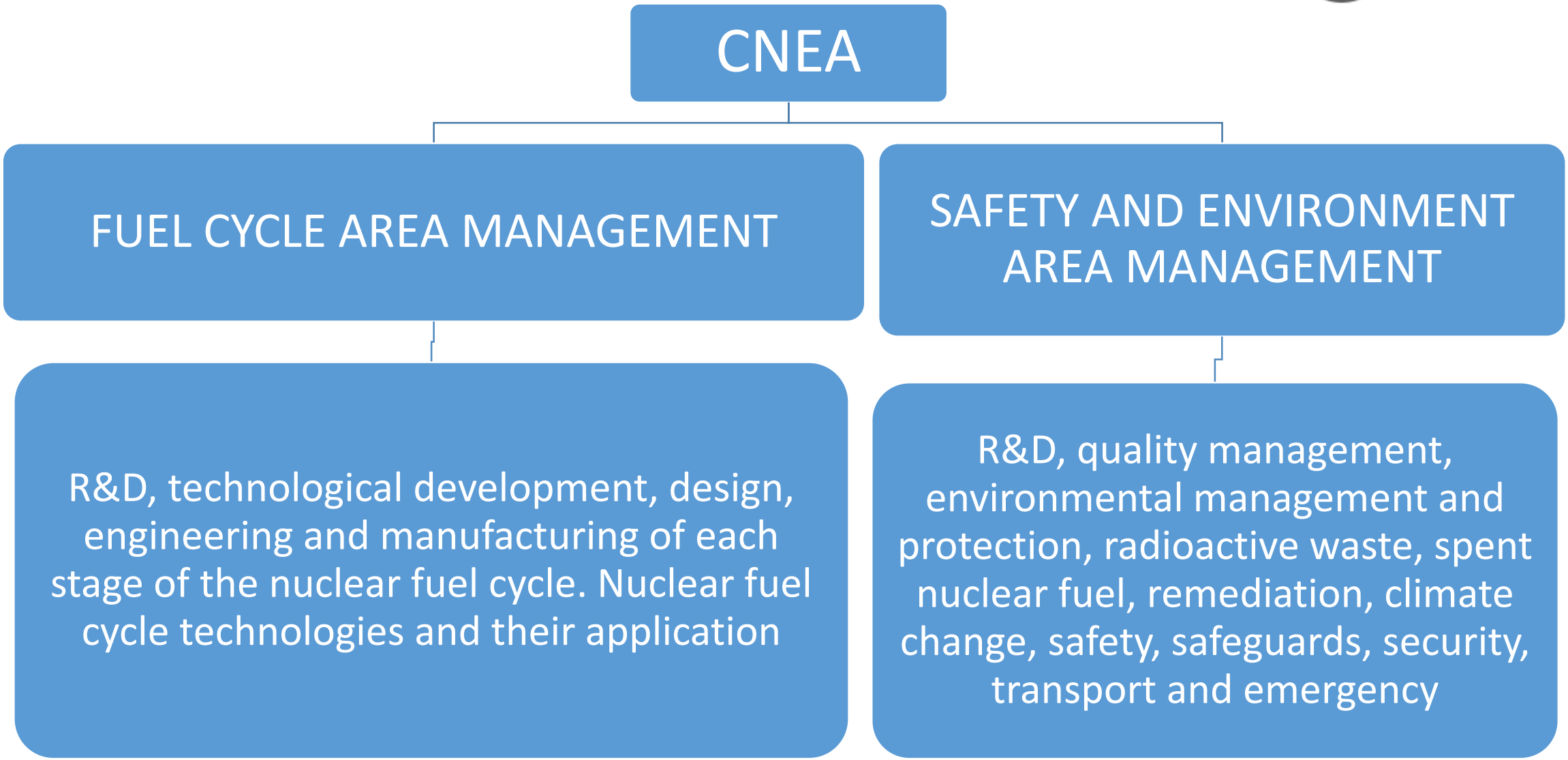
NA·SA

Back end for the cycle

Radioactive waste and spent fuel management

Fuel Cycle and the Environment: Organizational Structure

Comisión Nacional de Energía Atómica



Fuel Cycle and the Environment: CNEA and Companies

Fuel Cycle and the Environment: Legal Framework

Comisión Nacional de Energía Atómica

Leyes de Presupuestos Mínimos	Ley 25612	Gestión Integral de Residuos Industriales y de Actividades de Servicio	ver
Leyes de Presupuestos Mínimos	Ley 25670	Presupuestos Mínimos para la Gestión y Eliminación de PCB.	ver
Leyes de Presupuestos Mínimos	Ley 25675	Ley General del Ambiente	ver
Biodiversidad	Ley 25679	Declara de interés nacional la cría del denominado ñandú petiso o choiqué (Pterocnemiapennatapennnata), y del choiqué cordillerano o suri (Pterocnemiapennatagarleppi).	ver
Leyes de Presupuestos Mínimos	Ley 25688	Régimen de Gestión Ambiental de Aguas	ver

National, provincial and municipal Standards

CNEA´s Environmental Policy

Fuel Cycle and the Environment: Uranium prospecting and exploration

The exploration are carried out in compliance with Law No. 24,585/95 referring to Environmental Protection for Mining Activity. In addition, all provincial and municipal regulations are taken into account.

The information provided is supported by the monitoring and the baseline environmental in compliance with national, provincial and local regulations.

Los Gigantes

Sierra Pintada

Fuel Cycle and the Environment: Milling-Conversion

Comisión Nacional de Energía Atómica

The Uranium Dioxide Industrial Plant produce UO_2 through a chemical physical purification and conversion process.

Its production is achieved through processes that turn the raw material into a product to be used as nuclear fuel in the Argentine NPPs.

The main objective is to produce electricity.

Environmental Management System

DIOXITEK
Dioxitek S.A.

Fuel Cycle and the Environment: Nuclear Power Plants

Comisión Nacional de Energía Atómica

EMBALSE

EMBALSE
PHWR - 648 MWe
Operating Since 1984
Life Extension
2016 ~ 2018
the plant brought its reactor to critical on January 4th, 2019

ATUCHA site

ATUCHA II
PHWR
745 Mwe
In operation since 2016

ATUCHA I
PHWR
357 MWe
In Operation Since 1974

ATUCHA III (HPR-1000)
PHWR - 745 MWe

CAREM 25 MWe
CNEA Design –
Under Construction

Fuel Cycle and the Environment: Responsibilities

Comisión Nacional de Energía Atómica

Radioactive waste generators

Comisión Nacional de Energía Atómica | CONUAR | NA-SA | DIOXITEK | **Other users**

Regulatory Body

arn

PNGRR

Radioactive waste manager

Comisión Nacional de Energía Atómica

Fuel Cycle and the Environment: Spent Fuel Management

Comisión Nacional de Energía Atómica

Embalse Nuclear Power Plant (CNE): Storage Pool

Embalse Nuclear Power Plant (CNE): Storage Silos (ASECQ)

Fuel Cycle and the Environment: Spent fuel management
The Dry Storage Facility for CNA I´s Spent Fuel (ASECQ- I)

The facility has been operational since 2022. In December 2023, 603 SF were transfered.

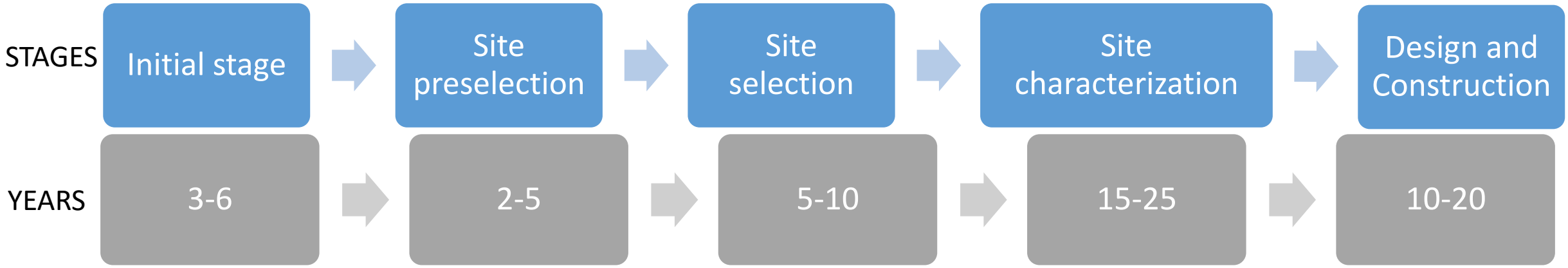
A new SF Dry Storage Facility (ASECQ II) is in proccess.

Fuel Cycle and the Environment: Final Disposal

Comisión Nacional de Energía Atómica

Argentina has a preliminary CONFINAR-GEO project.

The aim is the final disposal of medium and high-level radioactive waste.



Fuel Cycle and the Environment: CNE´s Life Extension

Comisión Nacional de Energía Atómica

The CNE's spent fuel storage system in silos has been in operation since 1993.

As of early 2020, 280 silos have been built and a further 32 silos are planned to be built by 2024.

CNE has a project to build new storage deposits for radioactive waste.

Fuel Cycle and the Environment: Atomic Centers and sites

Comisión Nacional de Energía Atómica

Bariloche Nuclear Research Center (Río Negro)

Ezeiza Nuclear Research Center (Buenos Aires)

Pilcaniyeu Technological Center (Río Negro)

Constituyentes Nuclear Research Center (Buenos Aires)

Fuel Cycle and the Environment: Research Reactors Irradiated Fuel Storage Facility

Comisión Nacional de Energía Atómica

Successful transfer of RA-3 research reactor spent fuels to the Research Reactors Irradiated Fuel Storage Facility (FACIRI).

This task was finished on 21st March 2019.

Fuel Cycle and the Environment: CNEA sites

Comisión Nacional de Energía Atómica

Procedure

↓

Environmental Monitoring Plan

↓

Environmental Monitoring Program

↓

Environmental sampling

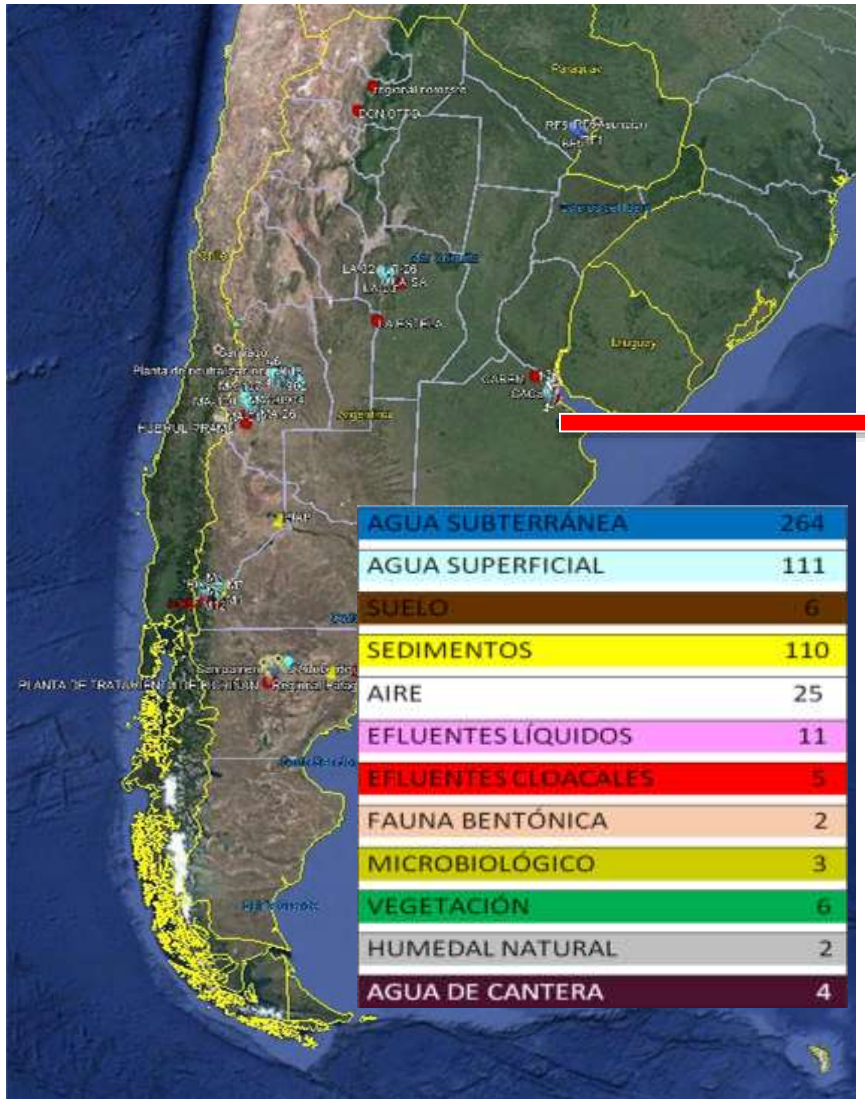
The activities in CNEA sites are:

- Managment: headquarters.
- R&D and innovation and production activities (Atomic Center): Ezeiza, Constituyentes and Bariloche.
- Development activities: Pilcaniyeu y Lima.
- Exploration of raw materials activities: Mendoza, Trelew, Cerro Solo, Salta y Córdoba.
- Raw material production activities: San Rafael.
- Uranium mining remediation activities : Malargüe, Córdoba, Los Gigantes, Tonco, La Estela, Los Colorados, Pichiñan (Chubut) y Huemul.

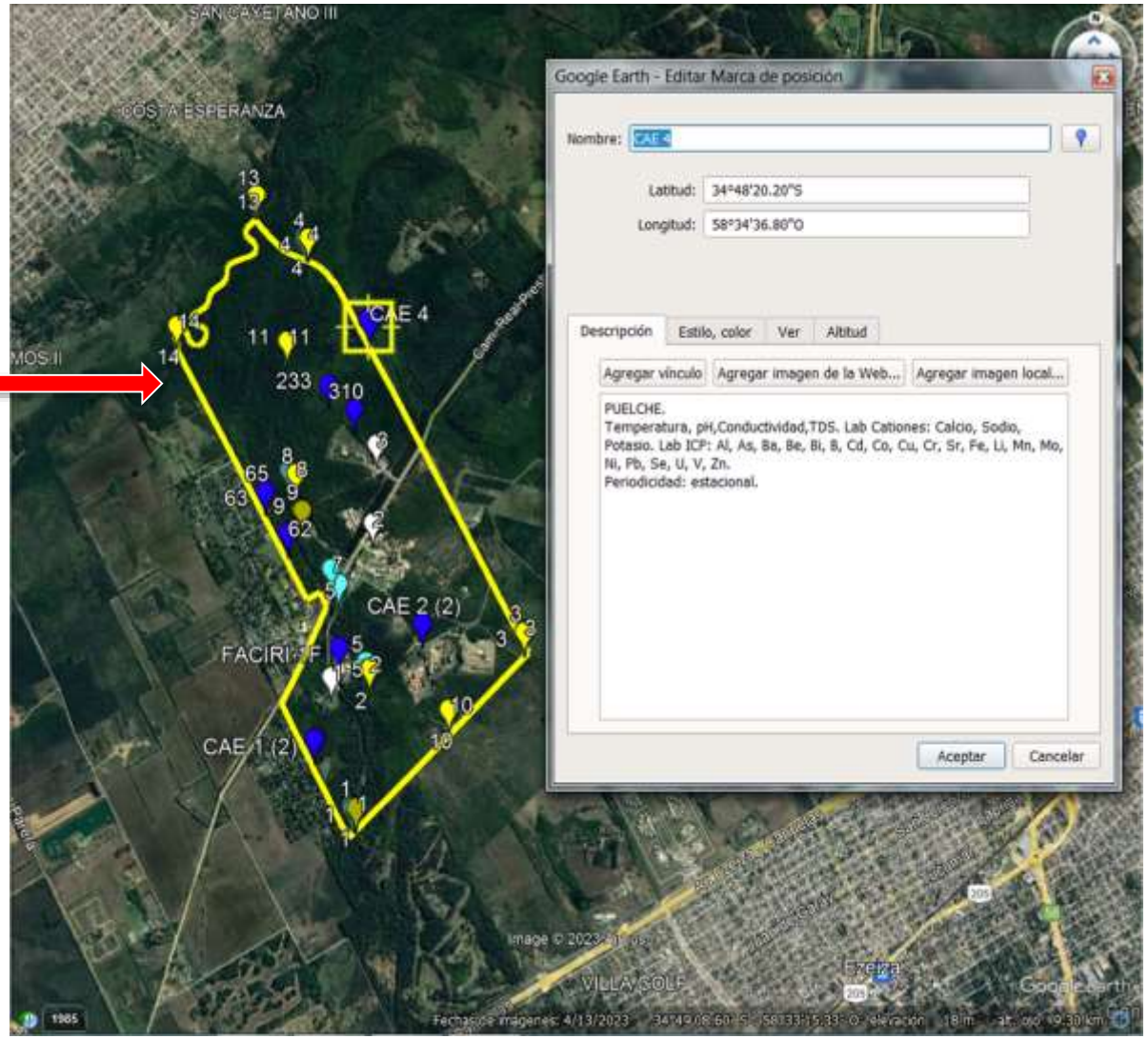
1. Sede Central (CABA)
2. Ezeiza (Ezeiza, Bs. As.)
3. Constituyentes (San Martín, Bs. As.)
4. Lima (Zárate, Bs. As.)
5. Bariloche (Bariloche, Río Negro)
6. Pilcaniyeu (Río Negro)
7. Córdoba (Córdoba, Córdoba)
8. Los Gigantes (Córdoba)
9. Mendoza (Godoy Cruz, Mendoza)
10. San Rafael (San Rafael, Mendoza)
11. Malargüe (Malargüe, Mendoza)
12. Huemul (Mendoza)
13. La Estela (San Luis)
14. Los Colorados (La Rioja)
15. Salta (Salta, Salta)
16. Tonco (Salta)
17. Trelew (Trelew, Chubut)
18. Cerro Solo (Chubut)
19. Chubut – PRAMU

Fuel Cycle and the Environment: Ezeiza monitoring network

Comisión Nacional de Energía Atómica



Environmental matrices are monitored with their corresponding parameter and frequency .



Fuel Cycle and the Environment: Uranium mining and milling sites

Comisión Nacional de Energía Atómica

- Malargüe (Mendoza)
- Huemul (Mendoza)
- Córdoba (Córdoba)
- Los Gigantes (Córdoba)
- Pichiñan (Chubut)
- Tonco (Salta)
- La Estela (San Luis)
- Los Colorados (La Rioja)


Huemul


Tonco


Los Colorados


Pichiñán


La Estela

San Rafael

Malargüe: Remediation project finished in 2017

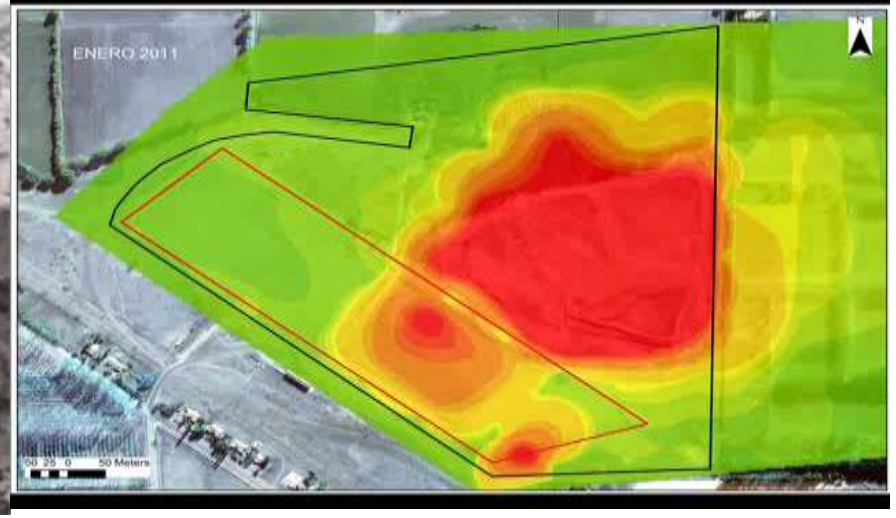
Fuel Cycle and the Environment: Malargüe Remediation

- Decommissioning facilities
- Underground drainage construction
- Encapsulation consisted of a containment cell for the ore tailings
- Tailings encapsulation management
- Decontamination and rehabilitation of the area

Fuel Cycle and the Environment: Malargüe Remediation

Comisión Nacional de Energía Atómica

The aim of the tailings encapsulation was to isolate them from the environment.



Fuel Cycle and the Environment: Energy transition

Comisión Nacional de Energía Atómica

CNEA is committed with the environment within all Nuclear Fuel Cycle stages.

However, some challenges remain, like the role of Nuclear Fuel Cycle in the clean energy transition.

The Nuclear Fuel Cycle provide about a third of the world's total carbon pollution -free electricity (CFE).

Climate change is the greatest environmental challenge of our time.

Source	CO_2 [Tn/GWh]*
Coal	1100
Natural gas (cogeneration)	650
Natural gas (combined cycle)	450
Biomass	50
Solar	40
Hydraulics	20
Nuclear	5
Wind	4

*Full Nuclear Fuel Cycle [Spain Nuclear Foro]

Fuel Cycle and the Environment: Energy transition

The area occupied by energy sources is an important variable for the environmental impact reduction, as it is scarce and expensive.

NPPs use small areas in relation to other technologies.

TECHNOLOGY	Area [Km^2/MWe]*
Nuclear	1-4
Solar	20-50
Wind	50-150
Biomass	4000-6000

*Equivalent to 1000 MWe of installed power per year

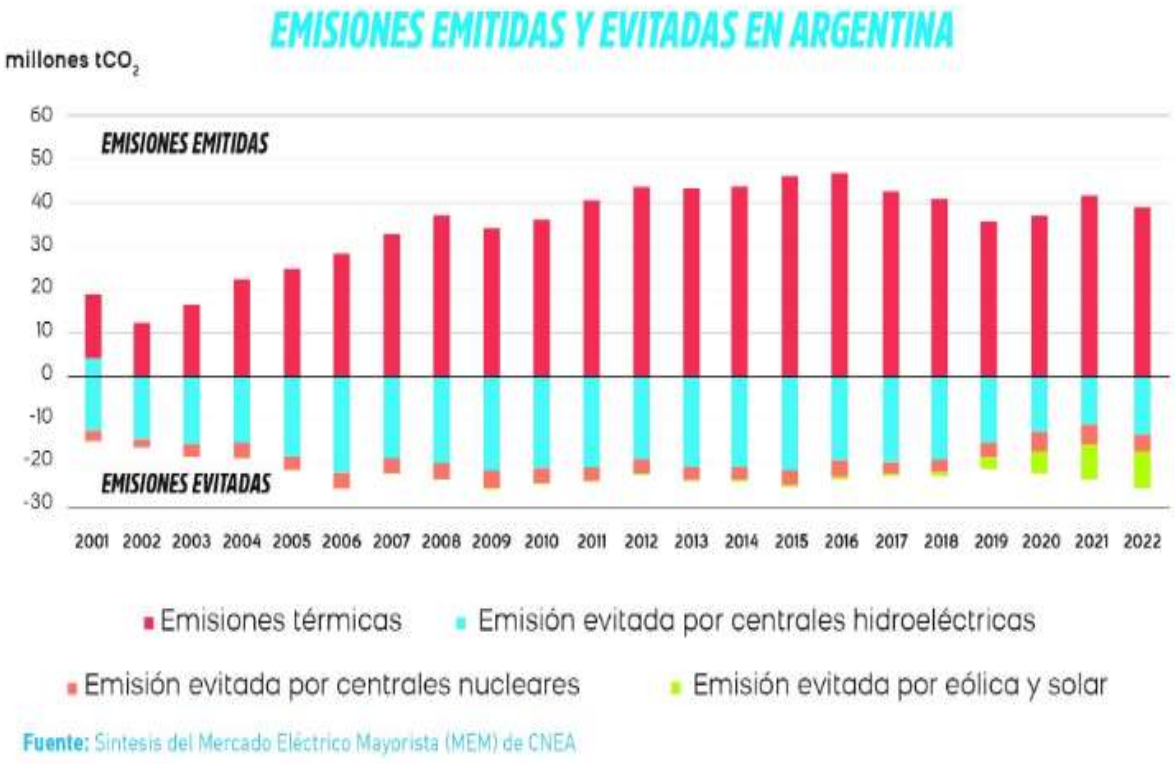
Fuel Cycle and the Environment: Energy transition

Comisión Nacional de Energía Atómica

Energies Diversification have reduced not only GHG emissions, but also the dependence on fossil fuels.

Nuclear energy began in 1974 with CNA I. This was the first nuclear power plant in Argentina and in Latin America.

The three nuclear power plants allow us **to avoid around 5 million tons of CO_2 per year,** which is equivalent to the emissions generated by ***one million cars per year.***



Fuel Cycle and the Environment: Projects Under Development

Comisión Nacional de Energía Atómica

RA-10: Multipurpose Research Reactor	CAREM 25 – SMR Argentine reactor	Long Term Operation CNA I	4th NPP
			
Research reactor (30 MW), open pool, to produce Mo-99 weekly, Low enriched uranium plates fuel, production: >2000 Ci/w. The objective is provide an irradiation facility for testing NPP fuel and cold and thermal neutron beams for basic research and technology (LAHN project).	PWR type (32 MWe) with passive safety systems, integrated Primary System, natural circulation, self-pressurized and enriched UO_2 fuel (3,1 and 1,8%).	Since 2008, Nucleoeléctrica has been executing the Atucha I Life Extension Project (stage A). Planned outage in 2024, for an estimated time of 2 years. This will allow it to extend its operation for an additional twenty-four years at full power.	The Argentine Republic is devoted to the negotiation with the PRC for the construction of an HPR-1000 Nuclear Power Plant. The CNEA is under negotiations regarding the Technology Transfer Contract for the nuclear fuel assemblies of the future reactor to be built in Argentina.

Fuel Cycle and the Environment: Energy transition

Comisión Nacional de Energía Atómica

Nuclear energy can contribute to reduce 20% of GHG emissions in the global electrical system by 2050.

The net generation of Argentine nuclear power plants during 2021 allowed savings of 4.7 million tons of CO_2. This is equivalent to the residential energy consumption of more than 7 million people.

NPPs are constant and stable and **do not depend on seasonal or climatic factors** and are key to face **climate change** and on the path towards the clean energy transition.

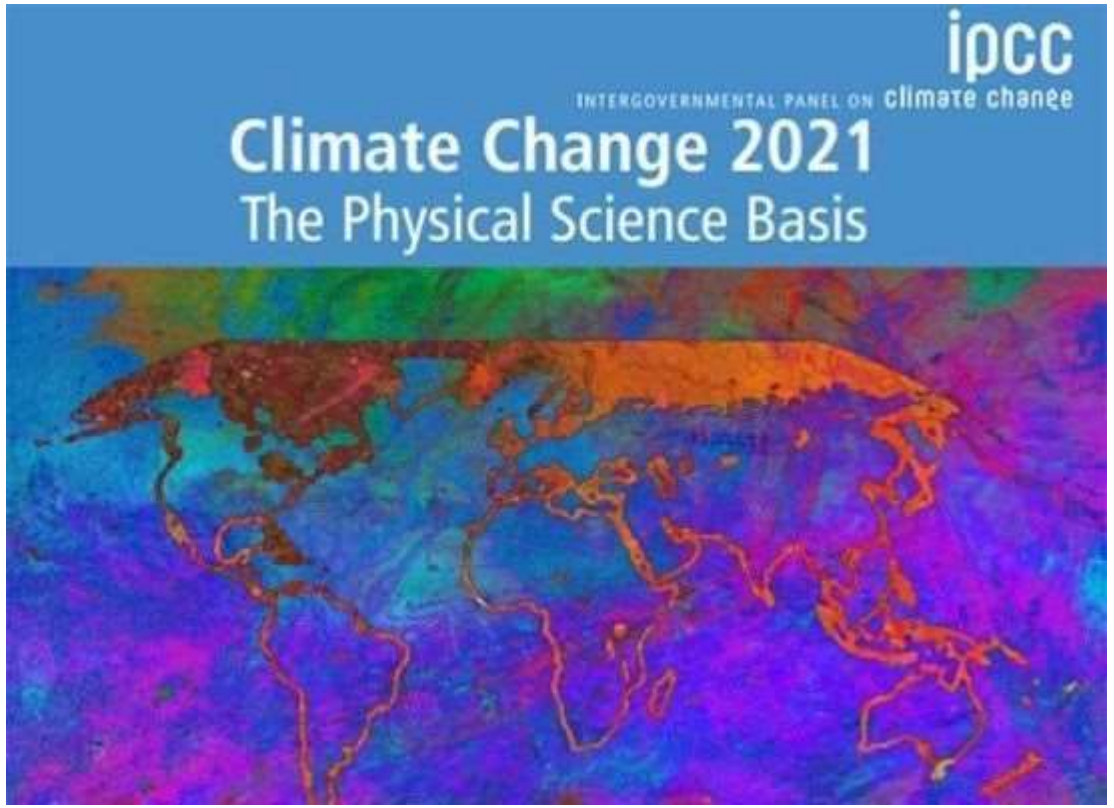
Fuel Cycle and the Environment: Energy transition

Comisión Nacional de Energía Atómica

According to IPCC report, NPPs do not produce CO_2 emissions. In their full cycle they discharge 12 g CO_2/kWh, similar to those of wind energy and lower than those of other renewable technologies.

Therefore, they have an essential role in limiting global warming to 1.5ºC.

It is recommended to measure GHG emissions throughout the cycle.



Fuel Cycle and the Environment: Challenges and opportunities

Comisión Nacional de Energía Atómica

CHALLENGES:

- Quantifying emissions at each stage of the nuclear fuel cycle
- The need to move towards an clean energy transition in Argentina
- Demonstrate the importance of nuclear energy to face climate change, and therefore gain public approval for future developments.
- Count with repositories for low, medium and high level waste.

OPPORTUNITIES

- Develop early warnings, which are fundamental for anticipating and reducing the impacts of extreme events.
- In practically all the major economies there are iniciatives for building new governing bodies or extending the life of those that already exist.

Fuel Cycle and the Environment: Conclusion

Comisión Nacional de Energía Atómica

- Achieving decarbonization by 2050 is essential for the future of the planet. It is important to count with all low carbon technologies and to dismiss none of them.
- Nuclear energy and its fuel cycle is a clean and safe technology that can contribute significantly to reduce the emission of Greenhouse Gases (GHG) in Argentina and all around the world.
- Argentina has been greatly committed to reduce impacts on the environment related to the nuclear fuel cycle, but some challenges remain.
- Nuclear has been generating clean energy for more than forty years.
- Projects under development will contribute with the clean energy transition.
- Nuclear energy is an essential technology in the clean energy transition and to face the climate change.

Thank you

ayelengiomi@cnea.gob.ar

Comisión Nacional
de Energía Atómica