Nuclear Perspectives in Latin America

- **Outline**
  - **Brazil**
  - **Argentina**
  - **Mexico**
  - **Chile**
  - **Other Countries**
  - **Perspectives**

Brazil Nuclear Energy Program

- Next steps: PDE 2031 and PNE 2050
- PDE 2031 – Program for 10 years
- PNE 2050 – Program for 30 years
- New changes in the Nuclear Regulation
  - A ENBPar
  - The separation of CNEN - ANSN – National Authority for Nuclear Security
  - Changes in the Future - Constitutional Amendment
  - Resumption of Angra 3
  - Acceleration of the critical line of the work

National Energy Plan – PDE 2031 & PNE 2050

Nuclear energy in Brazil will involve investments of US$ 27 billion

The government plans to achieve an installed nuclear power capacity of between 8 and 10 Gigawatts in the next 30 years

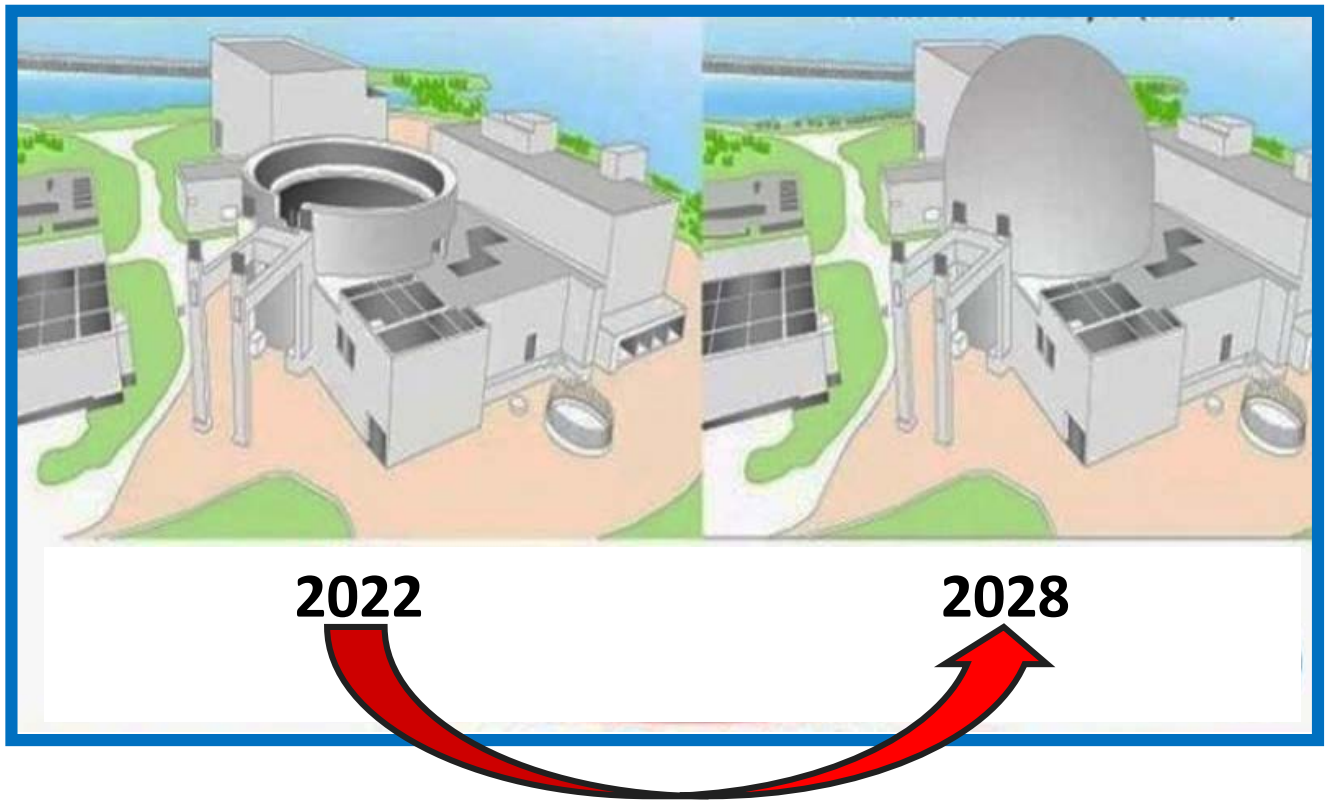
The PDE 2031 has the following energy policy guideline:

- **Inclusion of a new 1,000 MW Nuclear plant in the region**

Brazil´s Short term PROJECTS

- ✓ **Construction of Angra III**
  - ✓ **Acceleration of the critical path for the construction of Angra III**
  - ✓ **EPC Contract**
- ✓ **EPC Contract**
- ✓ **Angra III commercial operation - 2028**
- ✓ **Life span of Angra I - 2024 (20 years)- 2045**
- ✓ **Life span of Angra iI - 2040 (20 years) - 2060**

Finishing Angra 3

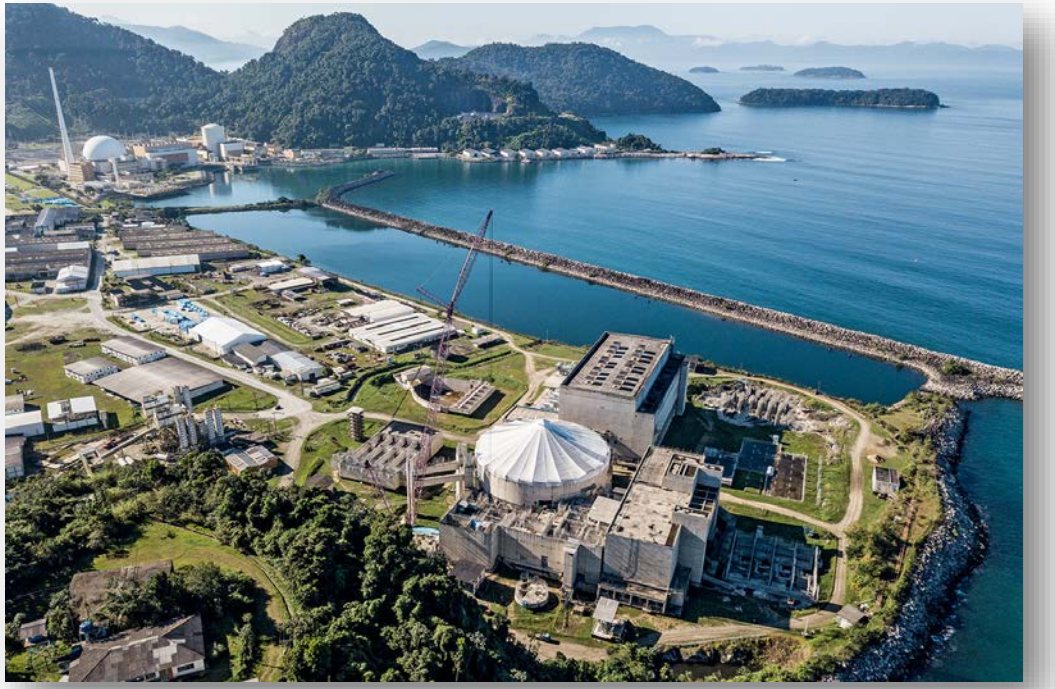


- Eletronuclear and its parent company ENBPar will comply with the Critical Line Acceleration Program
- Part of Finalizing with EPC and Final Equipment and System Aquisition
- investment plan for the period 2022-2028 – US$ 3 billions
- designed to preserve the schedule of works.
- The goal is:
  - Start EPC - February 2024
  - COD - June 2028

Angra I and II NPP

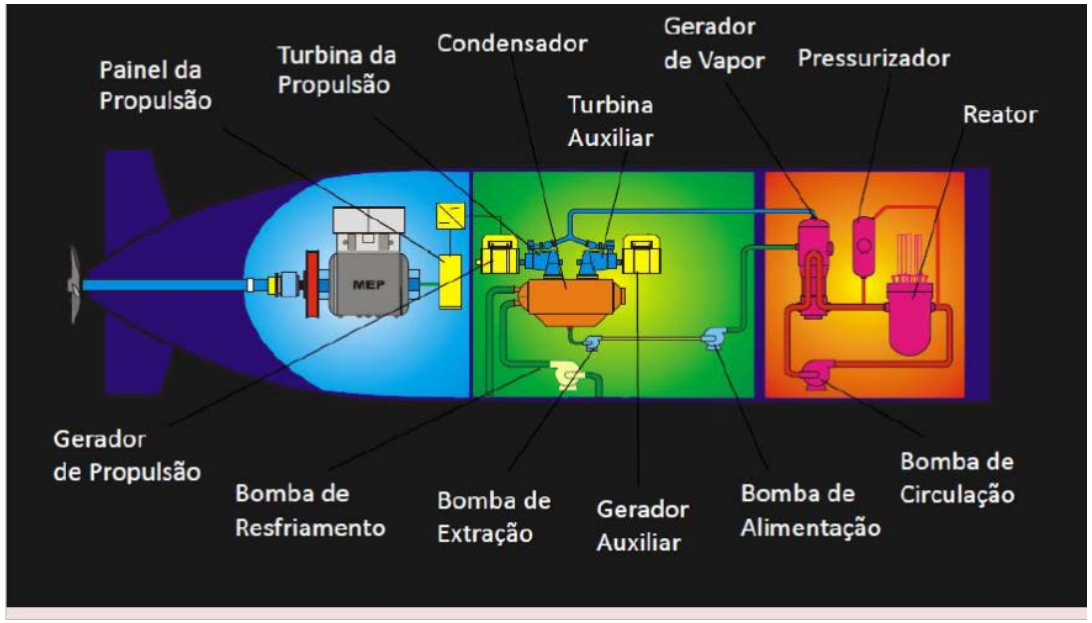
Status of Angra 3 Construction

- ✓ **67.26% of civil works have already been carried out**
- ✓ **The overall physical progress of the enterprise, considering all other disciplines involved, is 65.29%**
- ✓ **The investment already made is around US$ 1.6 billion**
- ✓ **Estimated resources for completion are approximately US$ 3.013 billion - funding by ENBPar**



Navy Program – Nuclear Defense Submarine

Schematic Plant



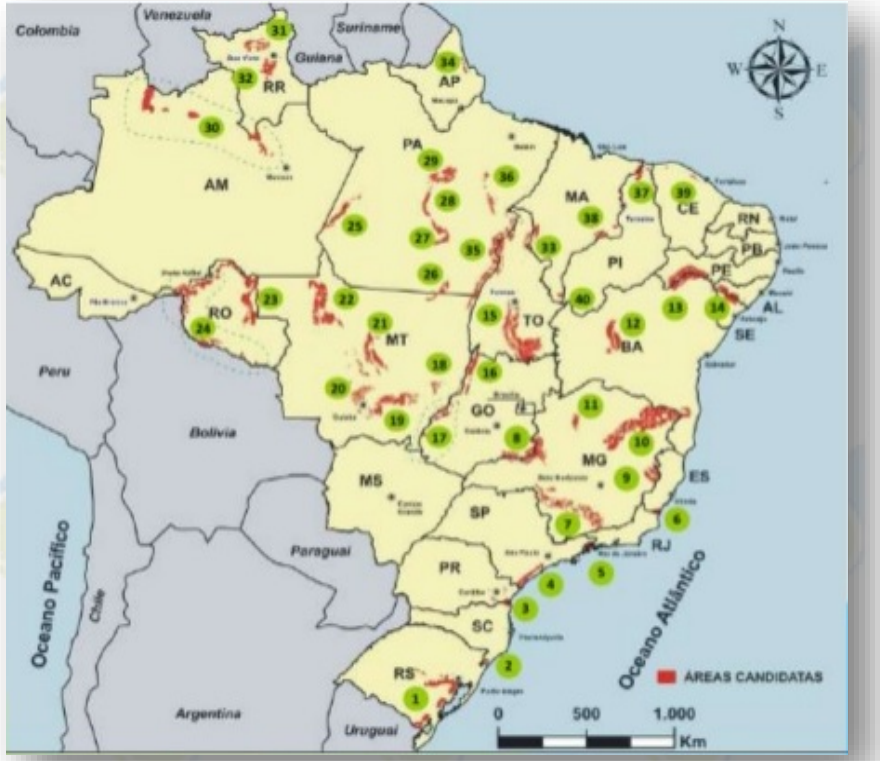
Main Topics

- Huge human resource formation
- Spin off of Technology
- Depend on the government funds
- Planning for 2032
- More than 2000 staff

[installed nuclear power capacity between 8 and 10 Gigawatts over the next 30 years]

implementation of Small Modular Reactors - SMR

Localization Study of New Nuclear Sites

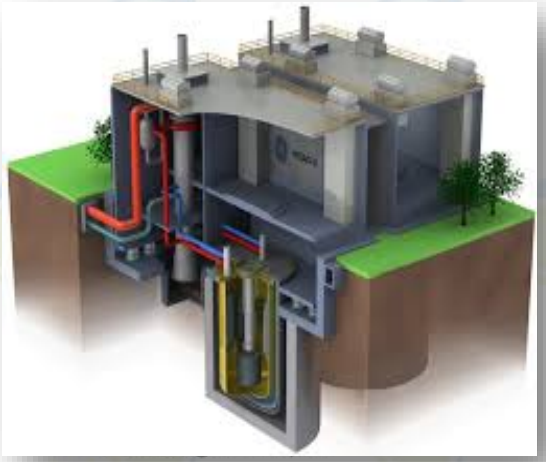


Location of New Sites - Candidate Areas
(Source: Eletronuclear)

EPR Project
(Source: Framatom)

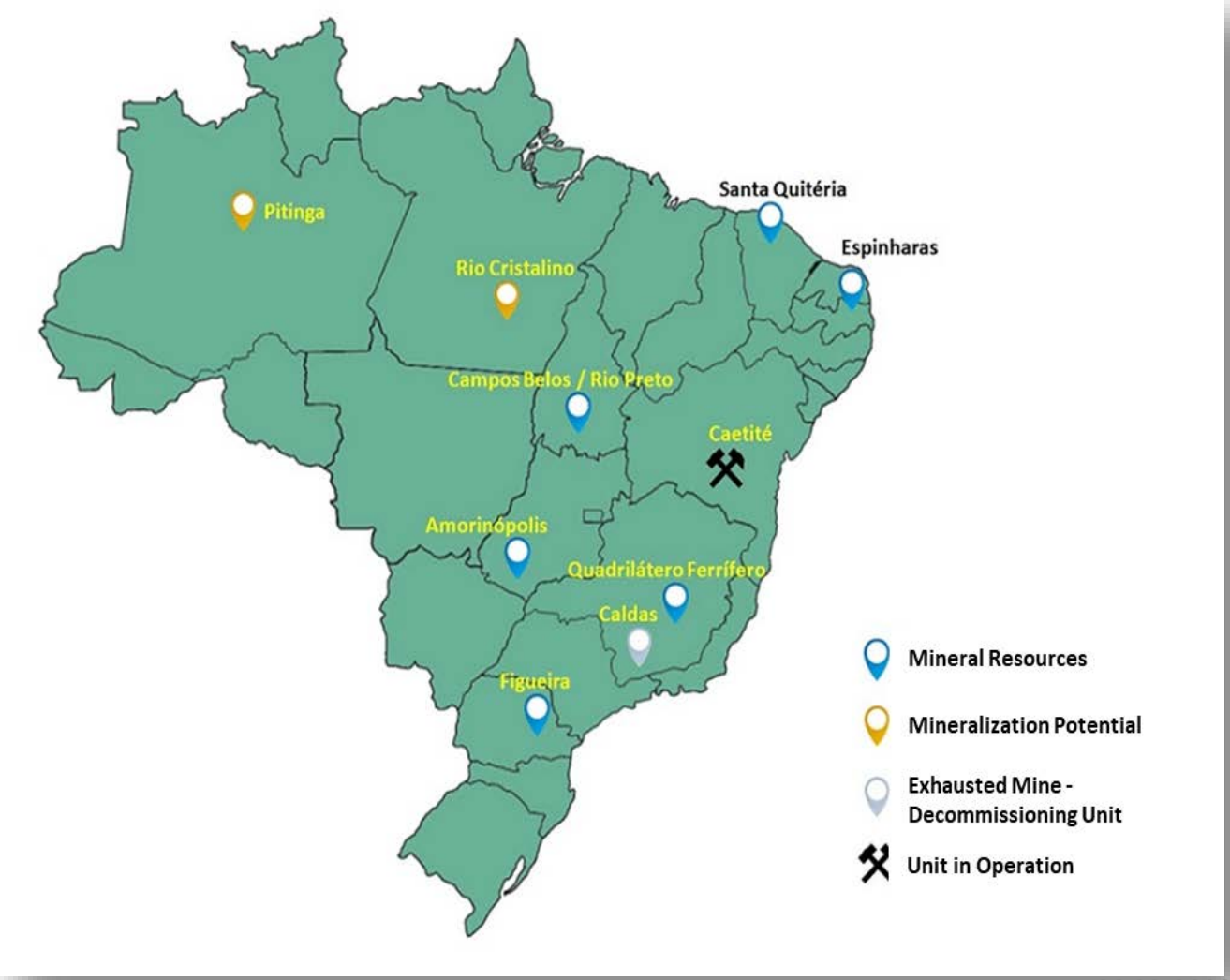
AP1000 Project
(Source: Westinghouse)

A Cutaway of the Reactor Building SMR design
(Source: NuScale)



A cutaway of the PRISM design

Projects for Uranium Production



- Brazilian mineral resources evolved from 9,400 ton (1975) to the current amount of 244,788 ton of U_3O_8
- can be expanded with new research and mineral research since only 33% of the national territory was researched
- The northern region of the country has the potential to house more than 300,000 tons of Uranium
-

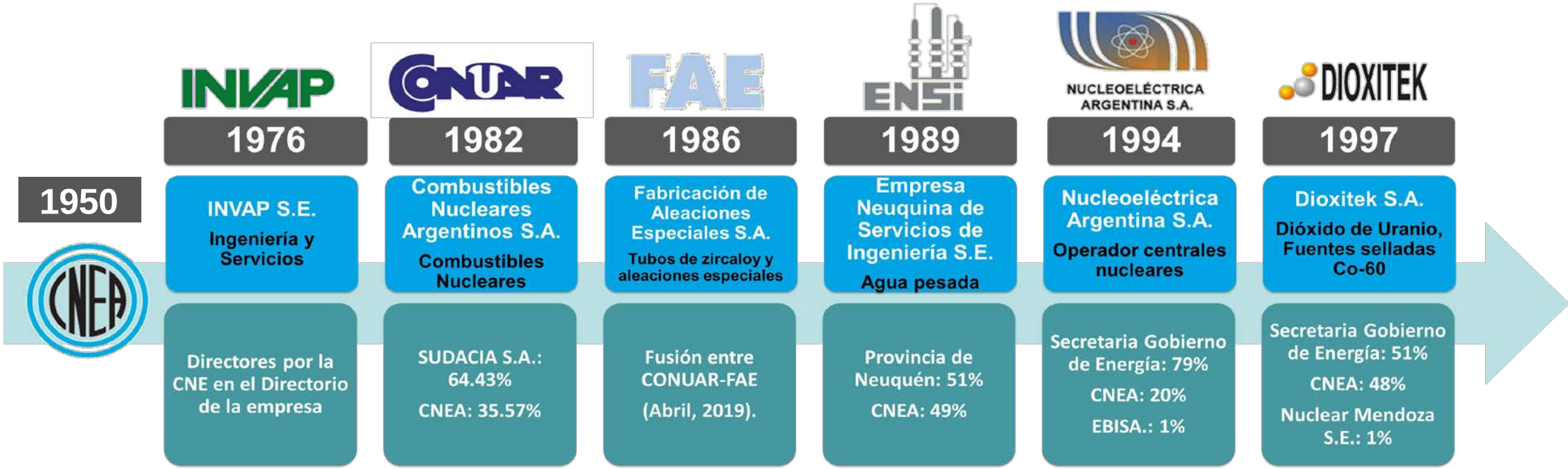
Small Modular Reactors

- **Brazil has an advanced nuclear technological development;**
- **Help to mastery of the nuclear fuel cycle;**
- **Possibility to leverage the nuclear production chain;**
- **Leveraging the technological development of other Programs (Medicine, Nuclear Application, Navy, etc.);**
- **Multiple application potential**
  - **Remote and off-grid region**
  - **Application in National Integrated System**
  - **Desalination**
  - **Hydrogen Production**
  - **Industrial Purposes**
  - **Green hydrogen production & synthetic fuel**
- **Other applications**

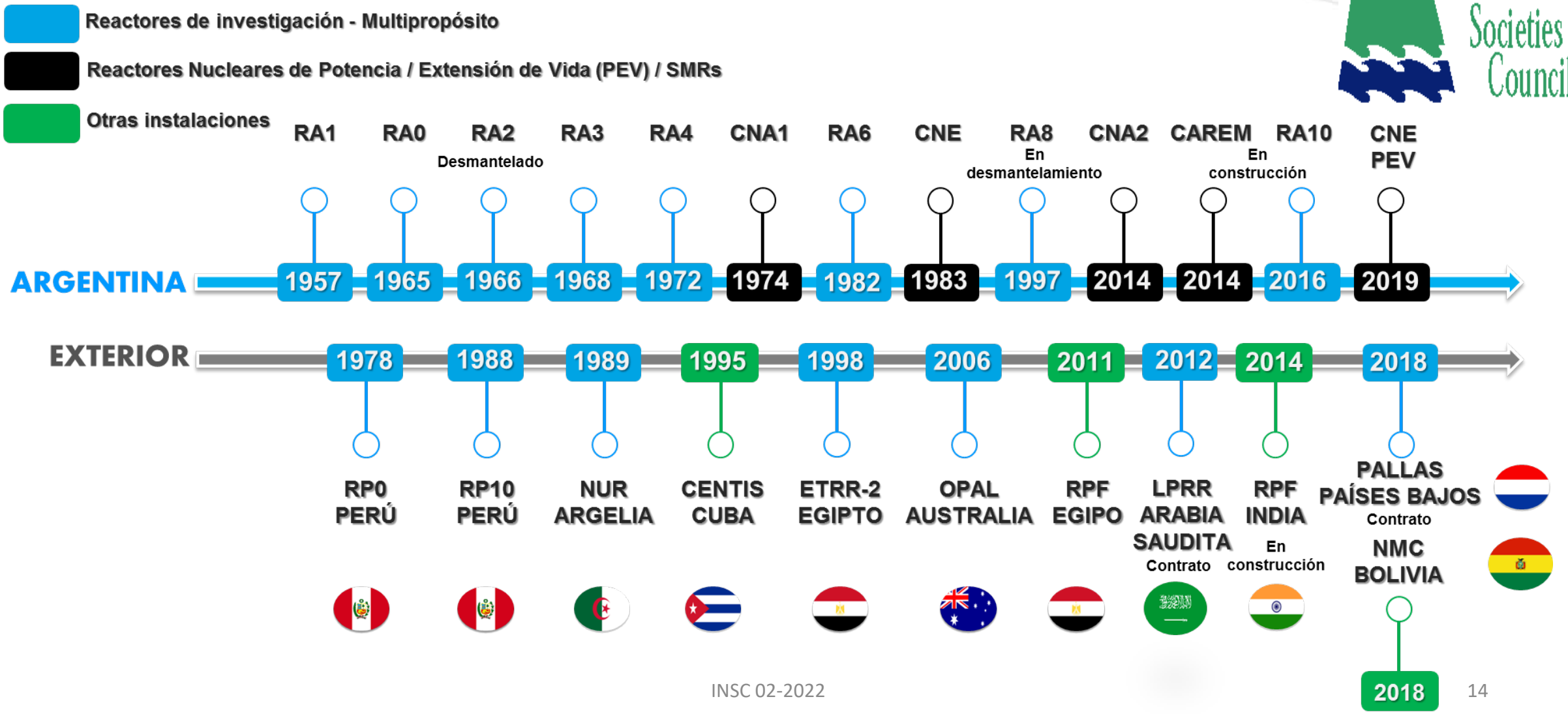
Argentina Nuclear Energy Program

- Development of nuclear technology and its fuel cycle;
- Basic and applied research;
- Nuclear technology in medical applications, food irradiation and environmental protection;
- Human resources training.

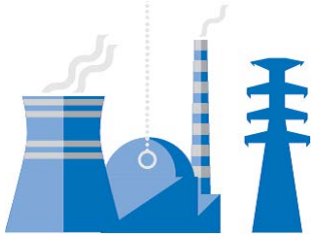
Associated Industries and Institutions



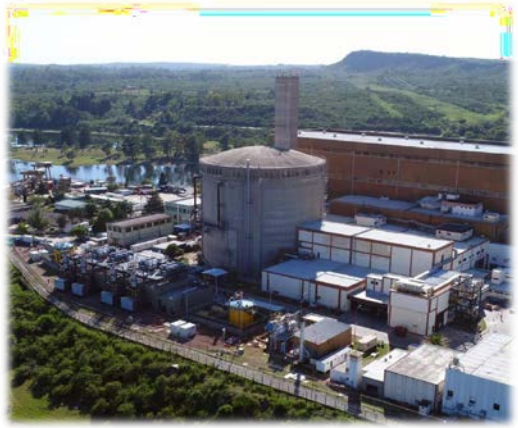
Argentian Relevant Nuclear Projects



The ARGENTINE REPUBLIC designs, builds and operates nuclear power plants, while facing a process of construction of a Small Modular Reactor (SMR) of entirely national design and develops negotiations with the People's Republic of China for the construction of a Nuclear Power Plant of HPR-1000 technology.

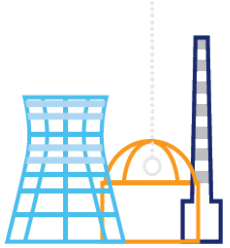


3 NUCLEAR POWER PLANTS IN OPERATION
TOTAL INSTALLED CAPACITY 1763 MWe

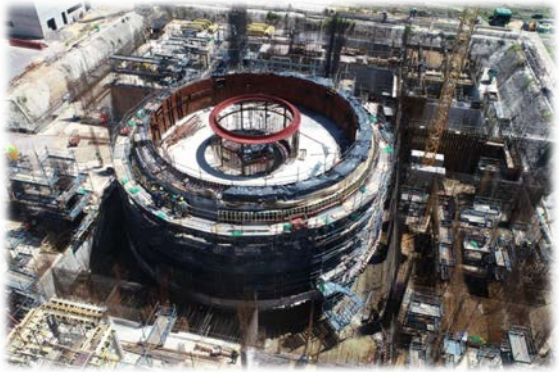


ATUCHA 1
First nuclear power plant in Latin America (362 Mwe)
ATUCHA 2
Commissioning in 2014 (745 Mwe)

EMBALSE
En 2019 culmiRESERVOIR
In 2019, the life extension tasks were completed, allowing it to operate for 30 more years (656 Mwe)..



1 CAREM NUCLEAR POWER PLANT UNDER CONSTRUCTION (SMR)



1 NUCLEAR POWER PLANT UNDER NEGOTIATION

ARGENTINA MAIN ON GOING PROJECTS

CAREM 25

RA-10

Futura Central Nuclear

Uranium enrichment

Environmental restitution

Nuclear medicine

CAREN 25 and Multipurpouse RA 10

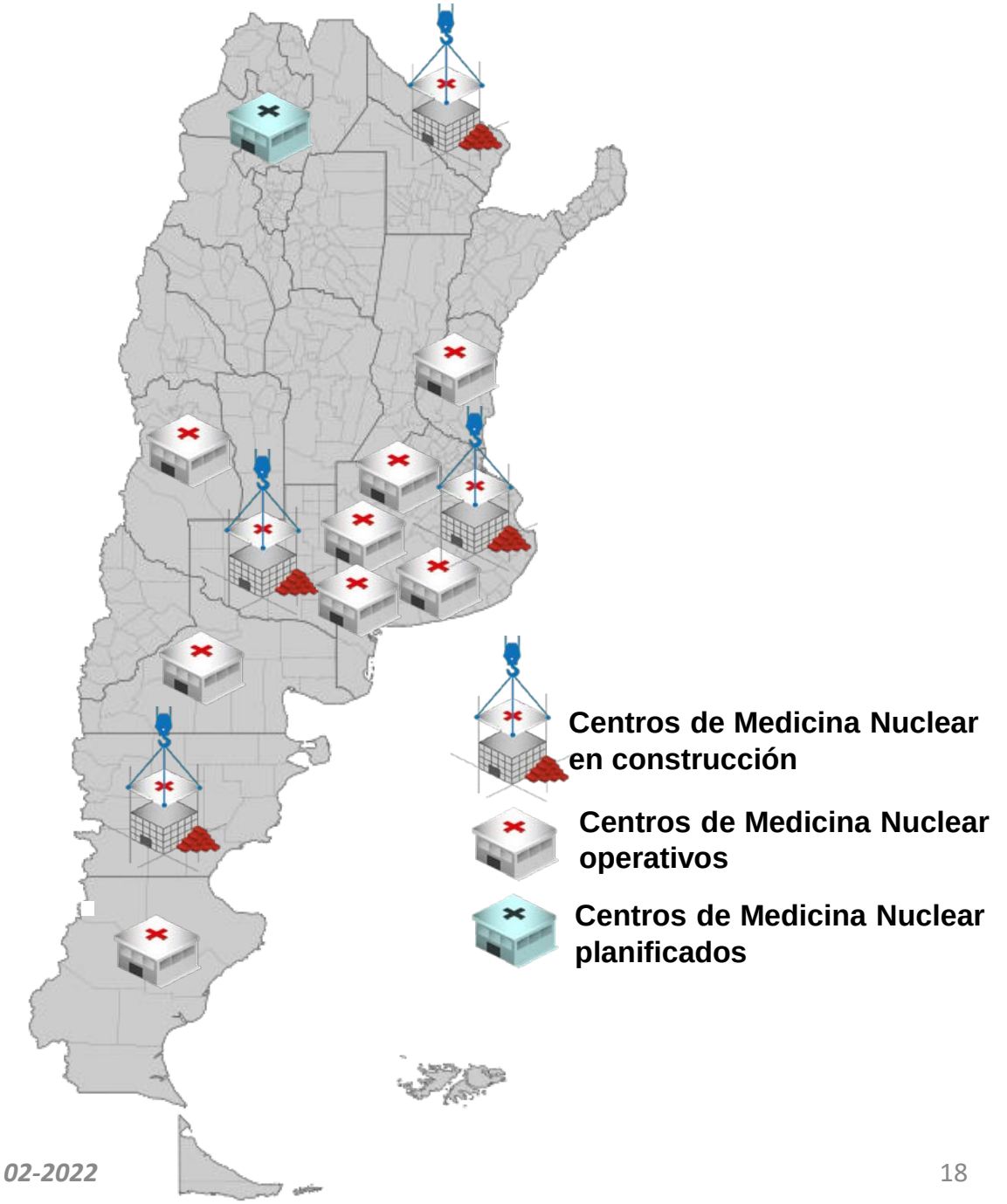
- Main features
- Tipo PWR
- Electrical power : 32 MW
- Heating capacity : 100 MW
- Integrated Primary System
- Natural circulation
- Autopresurizado
- Fuel: Enriched UO2 (3.1 and 1.8%)
- Passive safety systems
- 18-month operating cycle
-

NUCLEAR MEDICINE

National Atomic Energy Commission (CNEA) pays special attention to Health field, strongly supporting scientific development linked to nuclear medicine.

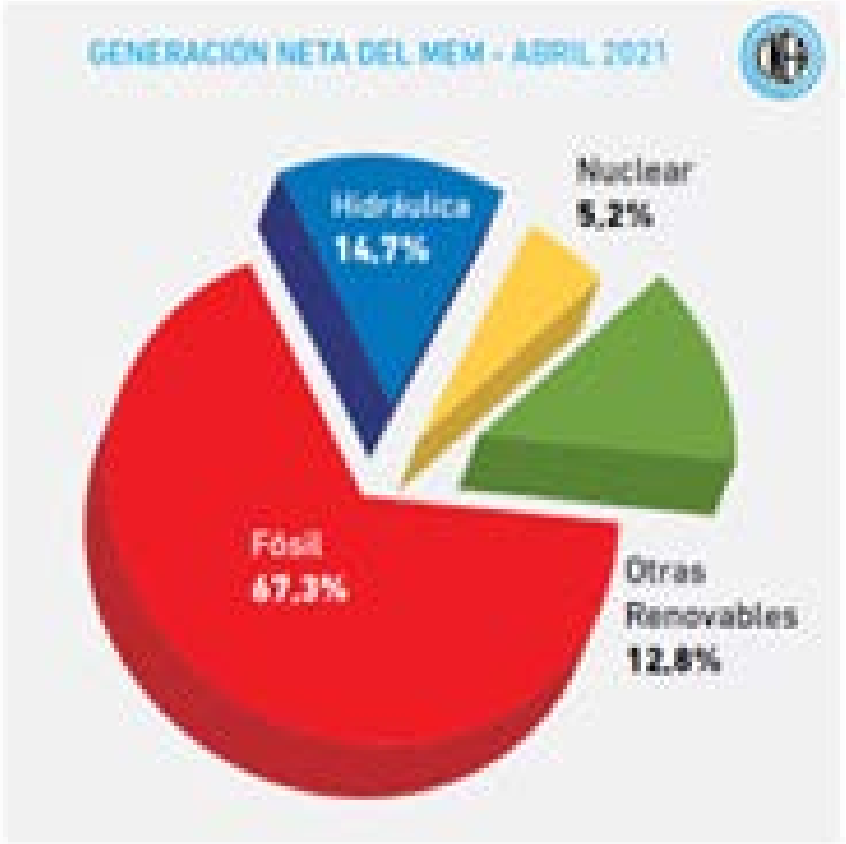
Synergies are generated between the production of radioisotopes, R+D, infrastructure and the staff of experts and technicians.

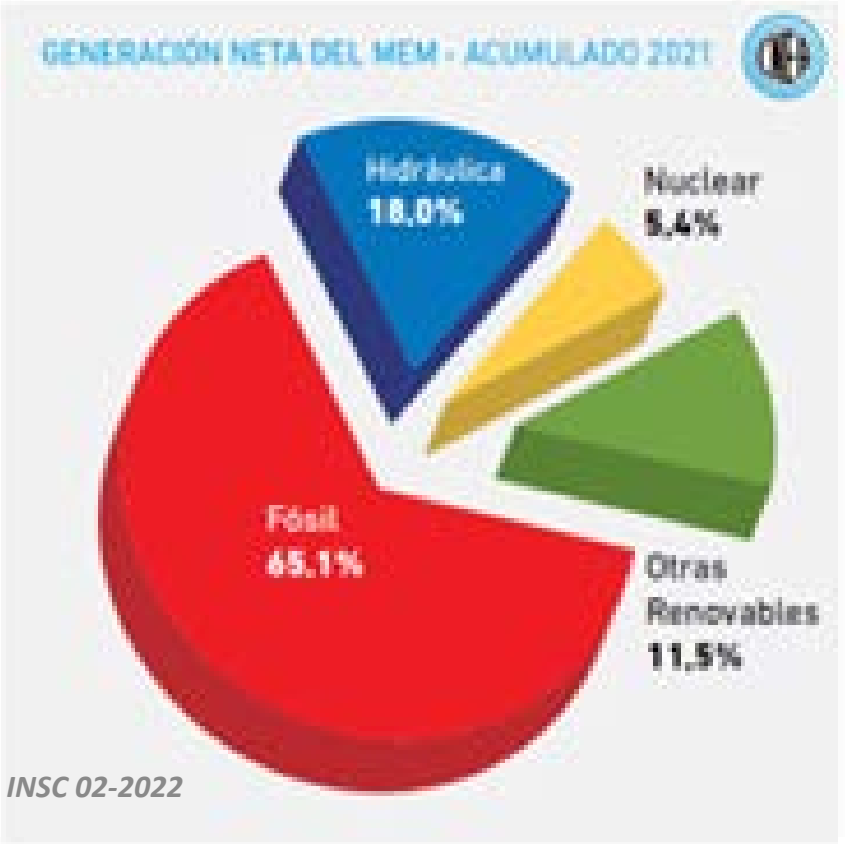
The CNEA is responsible for the coordination of Nuclear Medicine and Radiotherapy Centers, updating the equipment of existing ones – associated with the National Health System – and leading the construction and acquisition of new centers throughout the country.



Energy Matrix

GENERACIÓN ENERGÉTICA ARGENTINA





Mexico Nuclear Energy Program

- In Mexico, the Laguna Verde Nuclear Power Plant (CNLV) has been operating since 1990 (Unit 1) and since 1995 (Unit 2). These reactors are boiling water type (BWR) manufactured by General Electric.
- Both Units have gone through two processes of increasing power, narrow (5%) and extended (120%). In June 2018, the National Commission for Nuclear Safety and Safeguards (CNSNS) granted the license to operate up to 120% of the originally licensed power (1931Mwt).
- In June 2020, Unit 1 was granted the renewal of its license to operate for 30 more years. The license renewal of Unit 2 is in process.

LAW FOR THE USE OF RENEWABLE ENERGIES AND THE FINANCING OF THE ENERGY TRANSITION

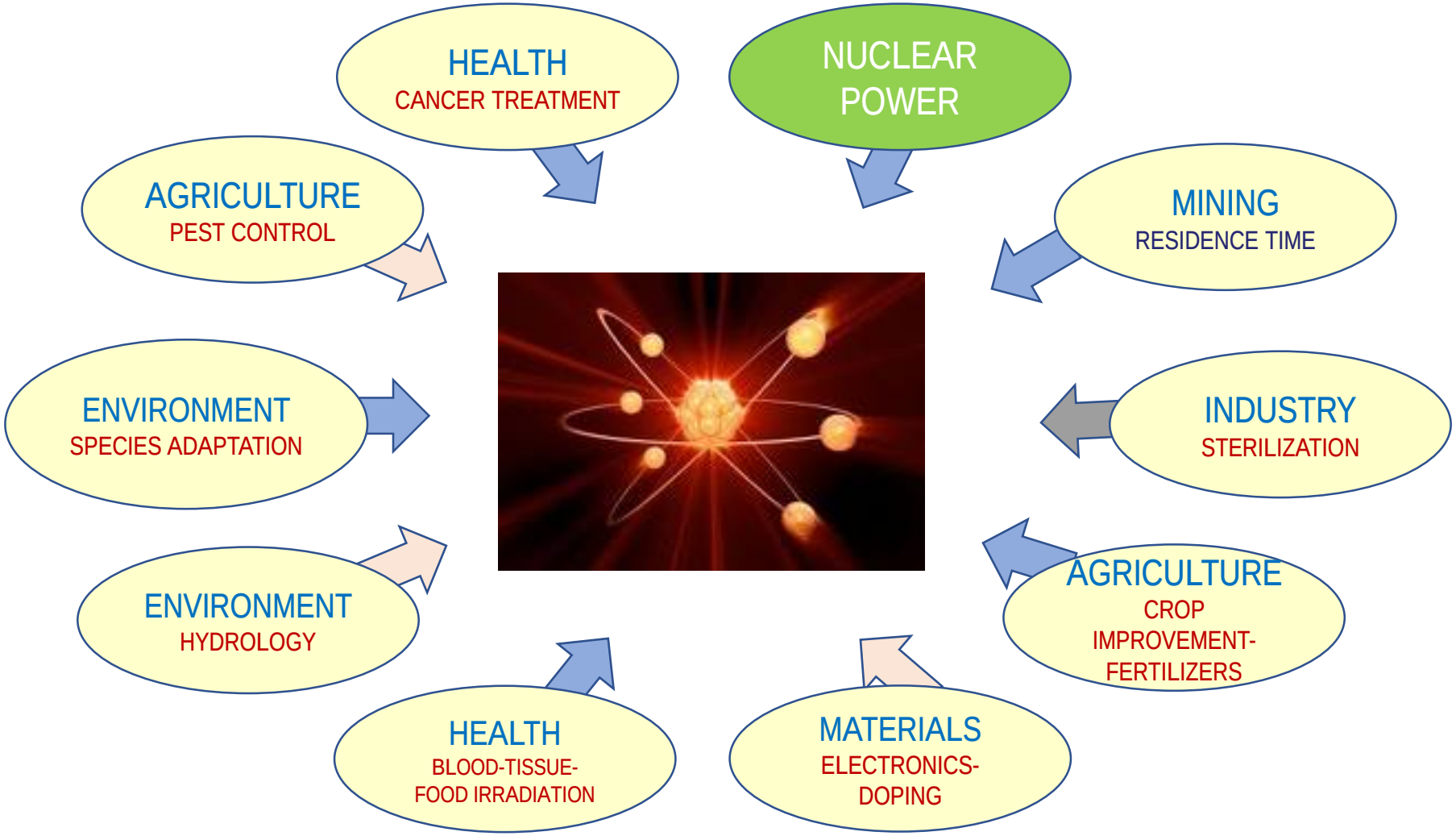
- Second transitory: increase the percentage of non-fossil energies in the portfolio of primary energy sources for electricity generation by at least 35% by 2024, 40% by 2035 and 50% by 2050.

System (PRODESEN) 2022-2036 Program for the Development of the National Electric

- It is the instrument that details the annual planning of the National Electric System with a fifteen-year horizon and that specifies the national energy policy on electricity.
- In light of this document, two projects have been contemplated that would expand the installed nuclear capacity in the country:
- Consider incorporating into the national electricity system an SMR with the ability to desalinate seawater
- Add two more units in Laguna Verde (Unit 3 and Unit 4)

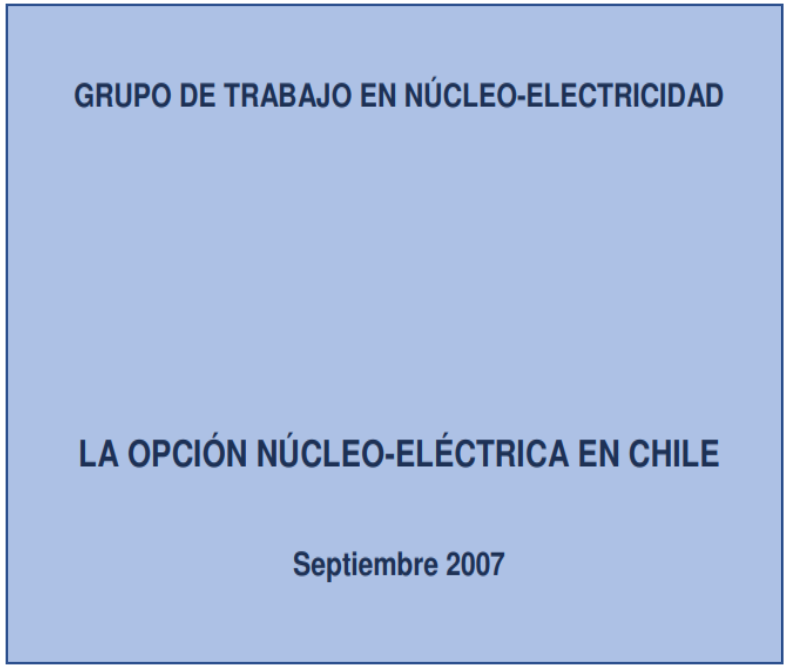
CHILE Nuclear Energy Program

Nuclear applications

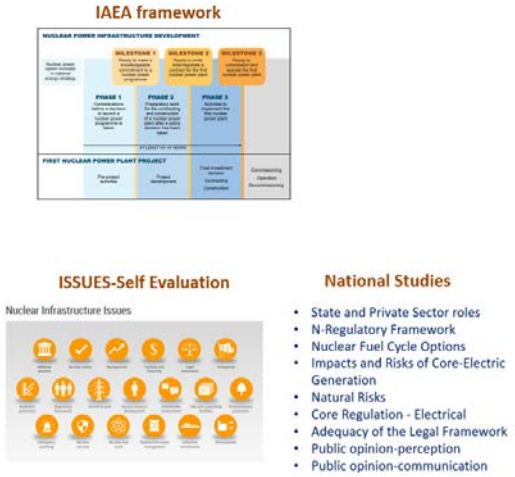


Considering Nuclear Power……

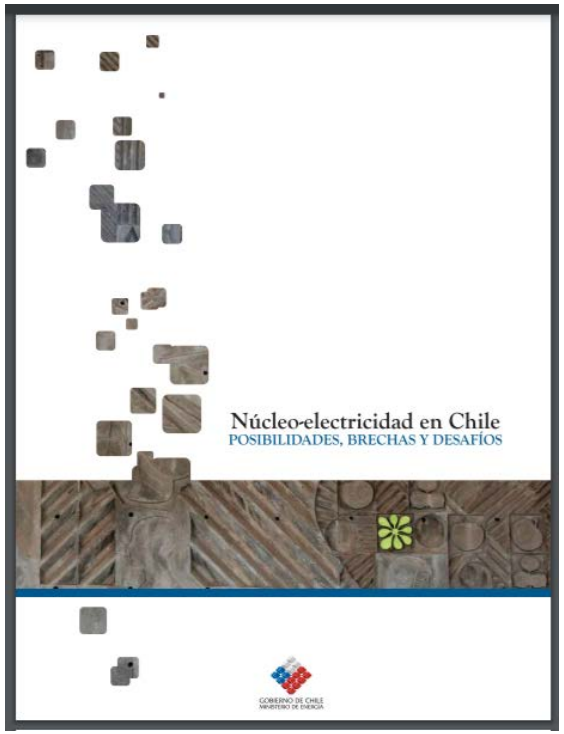
First Report-2008



Nuclear energy is not a disposable option and could contribute to the security of electricity supply

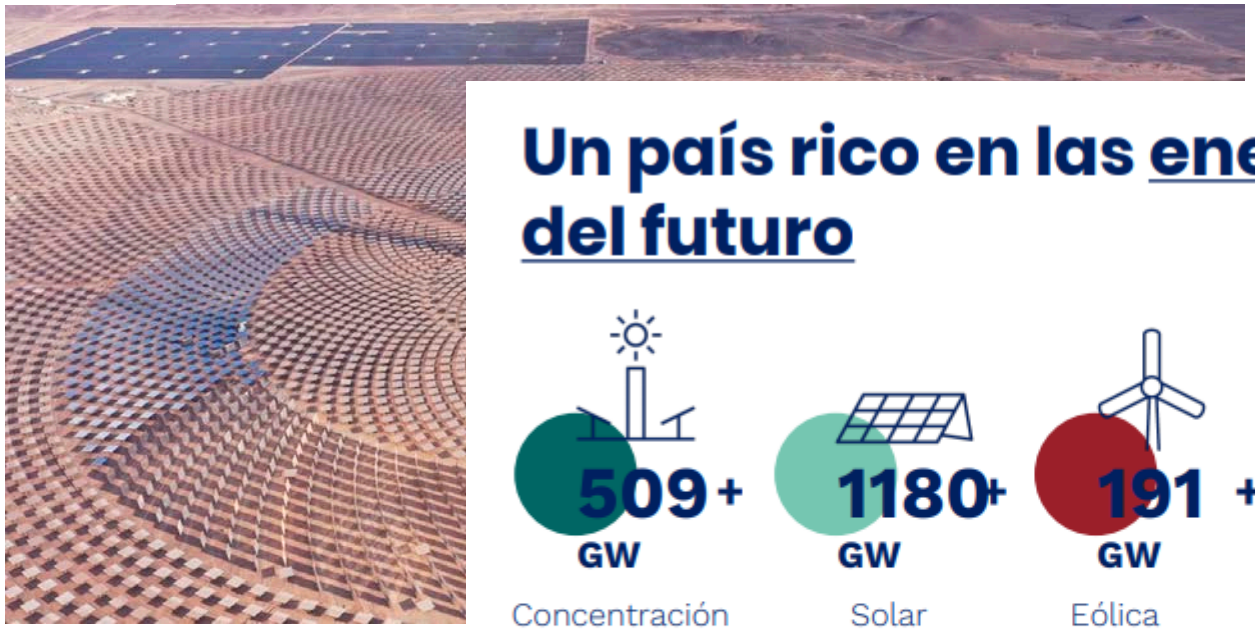


Final Report-2010



The nuclear option for electricity generation is experiencing a renaissance in the world. The projected evolution of the national energy sector indicates that Chile -in the most probable scenarios- will require nuclear energy at mid-2020s, to support meeting its economic efficiency targets, security of supply and prices, as well as environmental sustainability.

Renewable energy growth in Chile



Un país rico en las energías del futuro

509+ GW	1180+ GW	191 GW	+ 6 GW
Concentración solar de potencia	Solar fotovoltaica	Eólica *on-shore*	Hidroeléctrica de pasada

1.800+ GW

de potencial energético renovable

que equivalen a 70 veces la demanda de Chile

Summary status for States in Latin America

Tlatelolco, CSA and AP in force	Tlatelolco, CSA, w/o AP in force	Tlatelolco, CSA with Mod. SQP and AP in force	Tlatelolco, CSA with Mod. SQP, w/o AP in force	Tlatelolco, CSA with SQP and AP in force	Tlatelolco, CSA with SQP, w/o AP in force
CHILE	ARGENTINA	ECUADOR	BAHAMAS		BELIZE
COLOMBIA	BRAZIL	NICARAGUA			BOLIVIA
CUBA	VENEZUELA	DOMINICAN REPUBLIC			GRENADA
JAMAICA		COSTA RICA			GUYANA
PERU		GUATEMALA			ST LUCIA
URUGUAY		PANAMA			ST VINCENT & THE GRENADINES
MEXICO		ANTIGUA & BARBUDA			SURINAME
		HONDURAS			TRINIDAD & TOBAGO
		DOMINICA			BARBADOS
		EL SALVADOR			
		PARAGUAY			
		HAITI			
		ST KITTS & NEVIS			

Conclusions for Nuclear in LATAM

- **Argentina, Brazil and Mexico will continue to increase the Nucler Energy option;**
- **Goals to increase the Clean Energy will help;**
- **The renewables, Solar and Wind, are Strong Competitors;**
- **The Matrix Mix needs balance with intermitent and base load energy;**
- **SMR can play a important role and change for some countries;**
  - **Create Nuclear Knowledge**
- **Nuclear Medicine and Applications are expected to have a Strong increase;**
- **Nuclear Culture and Human Resources should be looked thru different approaches.**

Nuclear Societies in Latin America

- **Brazil – ABEN / ABDAN**
- **Argentina - AATN**
- **Mexico - SNM**
- **Chile - CHNS**
- **Other Countries – Peru, Cuba, Colombia**
- **Latin America – LAS/ANS – WIN - IYNC**

Thank you

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