

# Capacity Building and Nuclear Knowledge for Sustainable Energy Development

## Objective

*To support Member States in strengthening their capacities for formulating robust energy strategies, plans and programmes, and to improve their understanding of nuclear energy's contribution to facilitating the clean energy transition, combating climate change and achieving the SDGs. To support Member States in strengthening their capacities for establishing, managing and using their nuclear knowledge base and to foster international networking. To acquire, preserve and provide Member States with access to information in the area of nuclear science and technology and to facilitate sustainable information sharing among Member States.*

## Energy Modelling, Data and Capacity Building

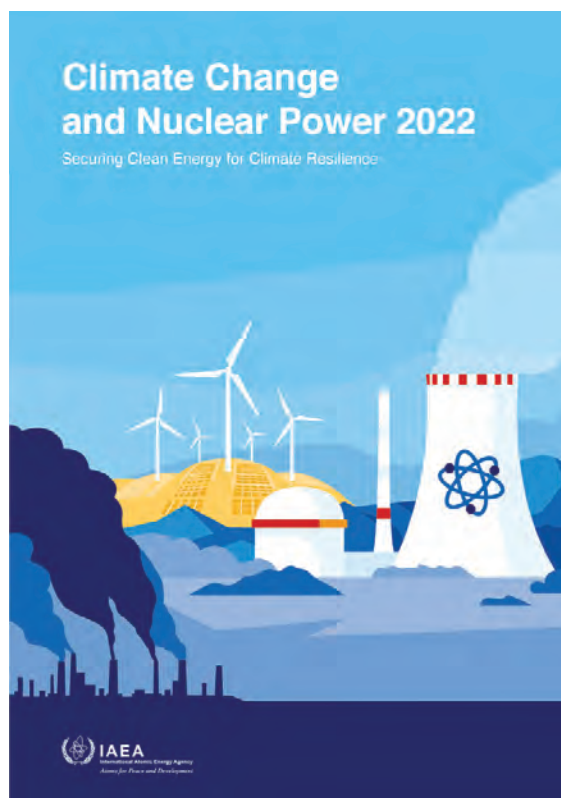
Planning for tomorrow's energy systems, whether at the national or at the regional scale, requires addressing multiple challenges, such as meeting energy demand as well as climate and sustainable development objectives, while considering the interlinkages between climate, land use, energy and water. The modelling support provided by the Agency to African Member States involved in the development of the Continental Power Systems Master Plan, Africa's future integrated electricity system, helped them in developing national energy strategies. Moreover, the Agency, the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific, and the Asian Development Bank made concerted efforts to showcase the Agency's energy planning support activities, resulting in renewed support being provided to Member States in the Asia-Pacific region.

An increasing number of Member States pledged to decarbonize fully by the middle of the century or thereafter. The Agency started to develop a dedicated analysis of the contribution of nuclear power technologies, including small modular reactors, to providing low carbon energy in energy supply scenarios.

## Energy Economy Environment (3E) Analysis

Ahead of COP27, the Agency published the 2022 edition of *Climate Change and Nuclear Power*, which examines, among other things, prospects for nuclear power deployment in Africa to address climate and economic development objectives; provides detailed analysis of the impact of climate change on nuclear power generation; and discusses nuclear power's contribution to the resilience of energy systems. Several of these topics were also discussed at the events held at the Agency's #Atoms4Climate pavilion at COP27.

A Workshop on the Economics of the Current Generation of Nuclear Power Plants, held virtually, and a Technical Meeting on Costing Approaches for Nuclear Infrastructure Development, hosted by the Czech Republic, promoted the understanding and development of cost analysis for nuclear projects. A Technical Meeting to Review and Finalize the IAEA Publication on Financing Nuclear Power Plants in Evolving Markets increased awareness of the available mechanisms and enabled the sharing of national experience.



*The Climate Change and Nuclear Power report has been published by the Agency since 2000. Building on energy statistics and climate change scenarios, the report outlines the potential contribution of nuclear power to a decarbonized, secure global energy system.*

Better understanding of the role of nuclear hydrogen in the clean energy transition was achieved through an International Workshop on the Role of Low Carbon Hydrogen for a Net Zero Energy System, organized with the International Energy Agency's Hydrogen Technology Collaboration Programme.

The Agency published *Alternative Commercialization Pathways for Fusion Energy Systems* (IAEA-TECDOC-1997), bringing together expert opinions from the diverse range of disciplines that are essential to fusion's commercial success. It highlights several critical aspects to consider for new pathways and sketches an outline of a road map for their development.

The Second IAEA Workshop on Fusion Enterprises, hosted virtually by the United Kingdom Atomic Energy Authority, discussed the market demands and commercialization opportunities for future fusion energy.

## Nuclear Knowledge Management

Three Technical Meetings on nuclear knowledge management supported professionals worldwide in maintaining and preserving the technical expertise and skills required for nuclear power programmes and other nuclear technologies.

The publication *Guide to Knowledge Management Strategies and Approaches in Nuclear Energy Organizations and Facilities* (IAEA Nuclear Energy Series No. NG-G-6.1) gives guidance on developing and implementing a strategic knowledge management programme as a proactive measure, to reduce the risk of knowledge loss and to provide safety and financial benefits.

The Agency also published *Mentoring and Coaching for Knowledge Management in Nuclear Organizations* (IAEA-TECDOC-1999), which highlights the importance of mentoring and coaching for knowledge transfer across the generations within the workforce.

The publication *Nuclear Educational Networks: Experience Gained and Lessons Learned* (IAEA-TECDOC-2007) provides the background, context and drivers for developing and promoting collaboration in nuclear educational networks, capturing best practices and mechanisms that can aid the establishment and operation of such networks.

International Nuclear Management Academy (INMA) review missions took place to review progress in developing the INMA programmes in the Czech Republic, the Republic of Korea, and the United States of America. The missions were conducted to evaluate the feasibility of implementing a nuclear technology management master's programme at selected universities.

The Agency re-designated the National Atomic Energy Commission of Argentina as a Collaborating Centre for human resources development in the area of nuclear science and nuclear technology and their applications.

The new digital Nuclear Knowledge Management Hub on the IAEA CONNECT platform continued to expand and showcase a wide range of online processes, methodologies and guidance for Member States across a broad spectrum of knowledge management and nuclear educational services.





## Nuclear Desalination Workshop Supports Water-scarce Jordan

Facing extreme water scarcity, Jordan turned to the Agency to learn more about seawater desalination using small modular reactors. The country, which is considering the introduction of nuclear power, requested support through the IAEA Platform on Small Modular Reactors and their Applications, which facilitates Member States' access to Agency support on all aspects of the development, deployment and oversight of such reactors.

The Agency organized a four-day workshop in November 2022 in the capital, Amman, where 18 participants from various Government ministries and the Jordan Atomic Energy Commission (JAEC) were given an overview of the technical and economic aspects of nuclear desalination technologies and systems, their coupling with small modular reactors, siting requirements, and the experience of Agency Member States with nuclear desalination. The workshop introduced the Agency's software tools for evaluating the performance and costs of desalination systems, using both membranes and distillation-based methods, coupled to nuclear reactors and to other energy sources. Participants also developed their own basic methodology for calculating the performance of NPPs coupled to a multi-effect distillation system.

As the second-most water-scarce country in the world, Jordan must develop desalination capabilities, Khaled Touqan, Chairman of the JAEC, remarked at the workshop. "The JAEC is now considering the deployment of SMR technology due to its load following power generation and cogeneration capabilities for a wider range of users and applications, enhanced safety features, and better economic affordability," he said, adding that "the unique features of SMRs are expected to affect siting considerations and environmental impact assessment."





Desalination plants require heat for distillation, or electrical/mechanical energy to power pumps that drive seawater through membranes. Currently, most of this energy is derived from fossil fuels, but nuclear desalination is a low carbon alternative that utilizes the electricity, and possibly also the heat, from nuclear plants.

“An increasing number of Agency Member States are expressing interest in using nuclear energy to address their water scarcity challenges,” said Francesco Ganda, who led the workshop and is Technical Lead for Non-Electric Applications in the Agency’s Department of Nuclear Energy. “The emergence of SMRs is offering more options to countries to use nuclear energy not only for power generation but also non-electric applications such as seawater desalination and for producing hydrogen, process heat for industry and heat for buildings.”

The feasibility of integrated nuclear desalination plants has been proven with over 150 reactor-years of experience, mainly in India, Japan and Kazakhstan. Aktau NPP in Kazakhstan, on the Caspian Sea, produced up to 135 MW(e) of electricity and 80 000 m<sup>3</sup> per day of potable water for 27 years until it was shut down in 1999. In Japan, several desalination facilities linked to nuclear reactors produce about 14 000 m<sup>3</sup> per day of potable water.

In southeast India, a demonstration plant producing a total of 6300 m<sup>3</sup> per day is coupled to the pressurized heavy water reactors at the Madras Atomic Power Station. This is the largest seawater desalination plant based on hybrid thermal and osmotic technology that uses low pressure steam from an NPP.

Jordan has worked closely with the Agency for more than a decade in developing the infrastructure for introducing nuclear power, including hosting INIR missions, most recently in 2014. The country has identified three possible sites for a future NPP, conducted feasibility studies for deploying some SMR designs, and prepared specifications for a bid invitation with support from Agency experts.



*Participants from Jordanian Government ministries and the JAEC performing a numerical exercise during the workshop, held in Jordan, which guided them to develop a simple computational model to evaluate the performance of desalination systems coupled to nuclear plants.*