



Nuclear Science and Technology for Climate Change Mitigation, Adaptation and Monitoring



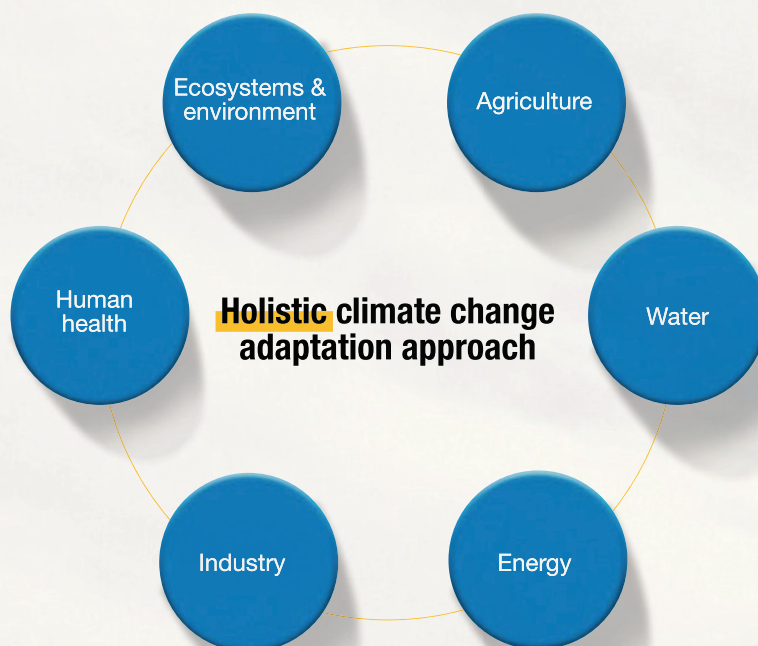
IAEA

International Atomic Energy Agency
Atoms for Peace and Development

Climate change is one of the biggest challenges affecting use nuclear science and technology to combat climate ch

The challenge of climate change

Climate change is a key global challenge. To achieve the Paris Agreement goals, countries have committed themselves to mitigate climate change by reducing greenhouse gas (GHG) emissions, and to take measures to adapt to climate change.



What does the IAEA offer?

To address climate change, multiple interrelated sectors must be taken into account, including energy, agriculture, water, industry, human health, ecosystems, and the environment. The International Atomic Energy Agency (IAEA) has long standing experience and unique expertise in supporting these sectors through the safe and peaceful application of nuclear science and technology. The IAEA also supports Member States in their use of nuclear power as a low carbon source of energy and in applying nuclear technologies to support climate adaptation in various sectors or in monitoring GHG emissions, ocean acidification and threats to ecosystems.

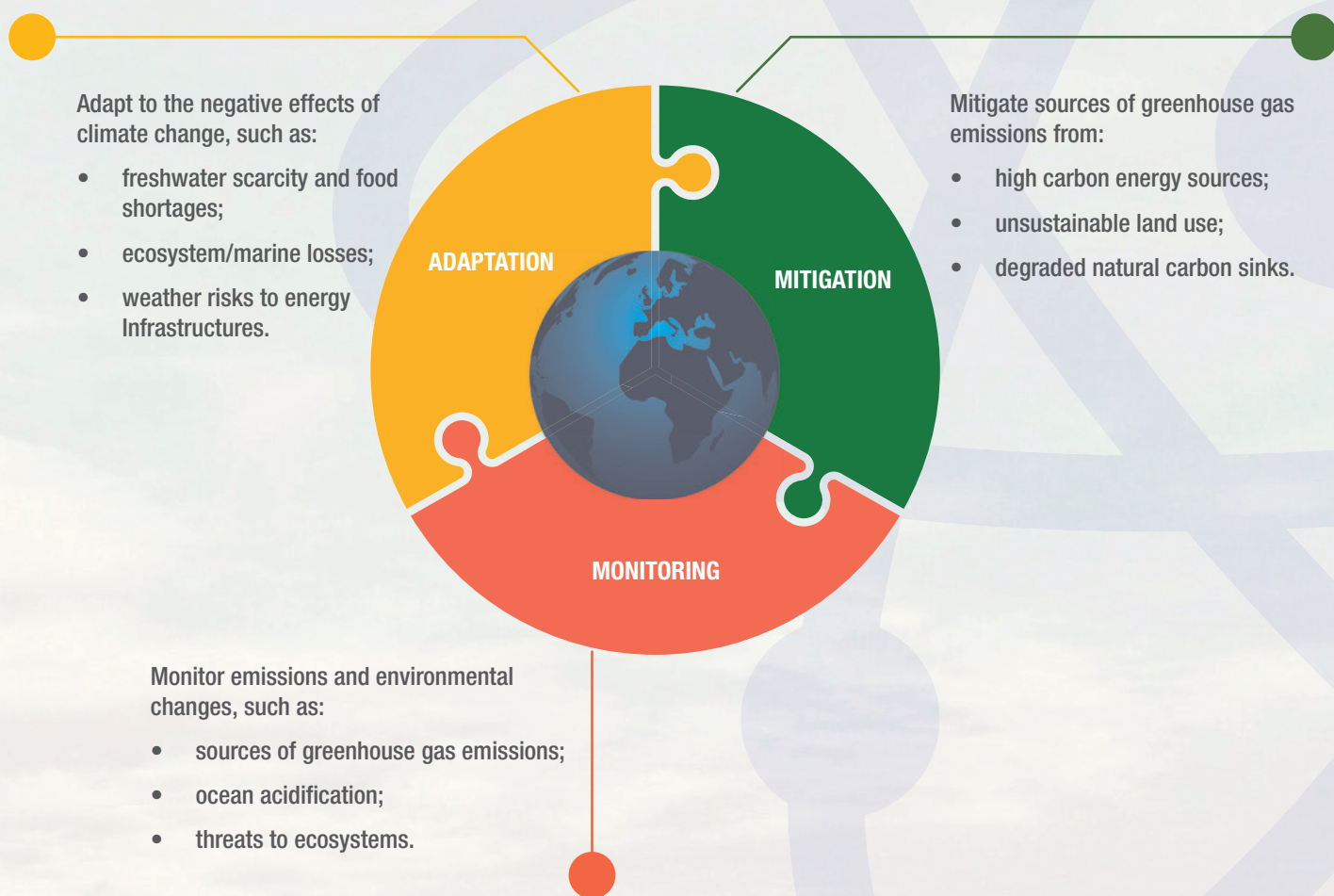
Safe, secure nuclear energy, in combination with renewable energy sources and other low carbon options, can be a key component of decarbonized, sustainable energy systems. By ensuring a steady stream of reliable electricity, flexible enough to meet fluctuating demand, nuclear power supports the integration of the expected large shares of renewable generation. The IAEA assists countries who decide to opt for nuclear energy to meet their climate objectives and supports the safe extension of the operational lifetimes of existing nuclear power plants in order to maintain low carbon generating capacity. Electricity generation from nuclear will need to double by 2050 to achieve net zero emissions, according to the International Energy Agency (IEA).

*the planet and humanity. The IAEA helps countries
ange.*

In addition, nuclear technologies and techniques complement conventional climate adaptation and climate science technologies and approaches. The IAEA contributes its expertise to climate adaptation in six thematic areas: climate smart agriculture, sustainable water resource management, ocean change and marine ecosystems, sustainable land management, food production systems, and analysis and measurement of GHG emissions.

Contributing to the attainment of the Sustainable Development Goals

Nuclear science and technology offer an important contribution to the achievement of the United Nations Sustainable Development Goals (SDGs). Working in cooperation with other United Nations organizations and academic partners, the IAEA helps countries to address climate change challenges in the context of the SDG framework, addressing, among others, SDG 2 (zero hunger), SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 13 (climate action), SDG 14 (life below water), SDG 15 (life on land) and SDG 17 (partnerships for the goals).



NUCLEAR ENERGY FOR NET ZERO





Moving away from coal

1. Moving away from coal

Nuclear power is a suitable replacement for coal-fired power plants for low emissions electricity generation, and can substitute coal-fired boilers for district heating and industry.

Nuclear power is a significant driver of economic growth, generating jobs in many economic sectors, and enabling a just transition away from coal.



Nuclear-renewables systems including hydrogen

2. Nuclear-renewables systems including hydrogen

Nuclear power can form an ideal partnership with renewables by helping lower the costs of the overall electricity generating system, by providing dispatchable power and reducing the need for grid expansions and storage.

Nuclear energy can provide low carbon heat and can be used to produce hydrogen for hard-to-abate sectors via both established and emerging production processes.



Affordability, resilience and security of energy supply

3. Affordability, resilience and security of energy supply

Energy system resilience relies on the robustness of individual generation technologies, the grid infrastructure and demand side management. Net zero emission systems need built-in climate resiliency to guarantee the security of energy supply. Nuclear energy provides this climate-resilience to energy systems, and can ensure an affordable, safe, secure and reliable energy supply.

The nuclear sector is well prepared to face the challenges posed by climate change, and has developed specific adaptation measures to mitigate the risks of more frequent and more extreme weather events.



Nuclear technology and sustainable development

4. Nuclear technology and sustainable development

Nuclear energy can provide developing countries with reliable electricity supply to support socio-economic development and industrialization, and help meet their sustainable development and climate goals. Nuclear power in particular contributes directly to four SDGs (7, 8, 13, 17): energy, economic growth, climate action and fostering partnerships.



Nuclear energy investment for a sustainable post-COVID world

5. Nuclear energy investment for a sustainable post-COVID world

Investment in nuclear power is among the most effective actions for a sustainable post-COVID economic recovery, as well as the transition to a resilient net zero energy system.

Mobilizing investments in sustainable energy requires a consistent, technology-neutral policy framework, including objective criteria for climate investments, to address barriers and enable access to financing for countries wishing to invest in nuclear power programmes.

**NUCLEAR SCIENCE
AND TECHNOLOGY
FOR CLIMATE CHANGE
MITIGATION, ADAPTATION
AND MONITORING**





Climate smart agriculture

1. Climate smart agriculture

Nuclear science and technology is used to assess the impacts of climate change on food and agriculture. It contributes to the development of climate-smart agricultural practices. Nuclear technology is used to monitor agrochemical inputs to improve food safety, and to support the development of innovative land and water management packages, with improved soil and nutrient management practices and water use efficiency. It is also used to enhance carbon sequestration.



Sustainable water management

2. Sustainable water resource management

Isotopic hydrology is used to understand the water cycle, from precipitation, to surface water and groundwater. This provides countries with vital data on the age, quality and source region of their water resources, critical information needed to answer essential questions on how much water they have, and how long it will last. Isoscapes, which show how water isotopes vary spatially and temporally, offer climate snapshots that support better understanding of climate change, enable reconstruction of the paleoclimate at various timescales, and modelling of future impacts. This information enables resource managers to strengthen national water security and resilience planning.



Blue carbon and ocean acidification

3. Addressing blue carbon and ocean acidification

Nuclear techniques provide insights into the role of marine ecosystems as a nature-based solution to absorb carbon dioxide emissions. They support understanding of the consequences of climate change on coastal and marine ecosystems, including monitoring and assessment of contaminants in seafood, and offer the ability to address potential biological effects under projected ocean acidification scenarios. Nuclear science and technology also provide the tools for the development and successful implementation of solutions to address and minimize the negative effects of pollutants such as plastic.



Sustainable land management

4. Sustainable land management

Sustainable management of agricultural land is fundamental to global food security, especially in the face of climate change and increasingly erratic weather. Nuclear techniques are used to assess climate change impacts on soil health and land degradation, and to maximize livestock feeding while minimizing greenhouse gas emissions. Insights from nuclear technology support the development of sustainable management practices that contribute to increasing global agricultural production and food security while conserving natural resources.



Food production systems

5. Food production systems

Nuclear techniques such as mutation breeding are used to develop improved drought and heat-tolerant crop varieties, and to enhance existing genetic resistance in crops to transboundary plant diseases. Nuclear techniques are also used to control insect pests and diseases, to strengthen post-harvest food safety and trade and reduce food waste, and to monitor residues and contaminants in food. The IAEA also supports the development of nuclear and genomic data tools that enable breeders and farmers to identify and select superior (both genotypically and phenotypically) sires for animal breeding and reproduction.



Analysis of GHG emissions

6. Analysis and measurement of GHG emissions

Nuclear techniques offer substantial advantages over conventional techniques for the precise analysis and measurement of GHG emissions, including from crop and livestock production. The IAEA also provides standards for the calibration of carbon isotope ratios, ensuring comparability of data used for climate change monitoring.

How we deliver

The IAEA fosters the efficient, safe, secure and sustainable use of nuclear power by supporting existing and new nuclear programmes around the world, catalysing innovation and building capacity in energy planning, analysis, and nuclear information and knowledge management.

The IAEA also carries out climate adaptation and climate monitoring activities, for example through research in its own laboratories and through extended networks of research institutions, academia and reference laboratories. Once vetted, relevant nuclear technologies and techniques are transferred to countries, especially developing countries, through the IAEA technical cooperation programme. The TC programme is the IAEA's primary mechanism for helping countries address key development priorities.

Over the past decade, the IAEA has supported almost 500 projects related to climate change adaptation in more than 100 countries around the world, disbursing over €110 million in support.

Looking forward

The IAEA aims to contribute to climate change adaptation efforts through research and technical cooperation in nuclear science and technology. Its work in the six thematic areas of climate change adaptation contributes to the achievement of global climate goals.

Join us

The IAEA looks forward to strengthening and establishing partnerships to support Member States towards the achievement of the SDGs and the implementation of the Paris agreement in areas such as energy, sustainable land use, climate smart agriculture, food production systems, analysis of GHG emissions, water management, and oceans and coastal protection.

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INTERNATIONAL ATOMIC ENERGY AGENCY

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