

climate change

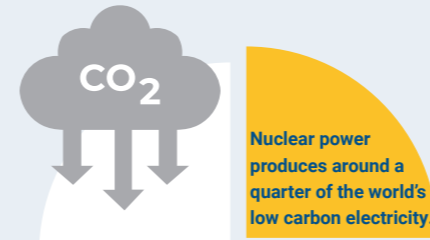
How nuclear science and technology enables sustainable development in a climate-stressed world

food Nuclear and related techniques support the development of sustainable agrifood systems that are more climate resilient.

Climate change is profoundly reshaping ecosystems and threatening food and water security. Globally, agrifood systems are under strain, while freshwater resources are shrinking. The natural environment, including the oceans, is under threat.

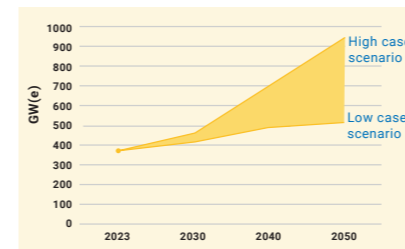
Nuclear science and technology can help countries continue their progress towards sustainable development by addressing many of the unprecedented challenges the world faces today.

energy Nuclear energy plays a key role in reducing greenhouse gas emissions and strengthening energy security.



It enhances development as part of a just energy transition by providing jobs and other economic benefits to local communities, expanding access to electricity for sustainable development.

IAEA nuclear capacity projections to 2050



Global nuclear capacity could more than double by 2050. To achieve net zero goals, financial investments in expanding nuclear capacity will need to increase from US \$50 billion – the annual average from the last 5 years – to US \$125 billion, annually.

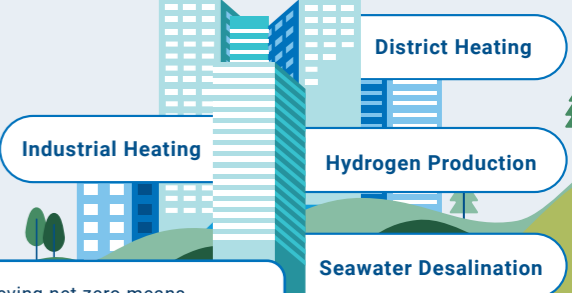
The net zero transition requires all clean energy sources to work together to meet energy demand. Nuclear adds the needed stability to clean energy systems for renewables, such as solar and wind, to fully flourish.

Following the momentum from the historic inclusion of nuclear energy in the Global Stocktake at COP28, world leaders gathered in Brussels in March 2024 at the first ever Nuclear Energy Summit, co-organized by the IAEA in Belgium.

Nuclear power can support affordable, low carbon electricity generation by helping to integrate large shares of variable renewables in a cost efficient way.

Nuclear power plants are all-weather sources of reliable energy that can serve as the backbone of clean energy systems 24/7.

Achieving net zero means decarbonizing not only electricity but also industry, transport and other sectors. Nuclear power also supports non-electric applications.



Nuclear techniques provide reliable methods for tracing, quantifying and understanding emissions.

Pakistan has developed climate-resilient varieties of pulses through plant breeding, which has doubled its yield by hectare, boosting food security and economic stability.

Plant mutation breeding accelerates the natural mutation process in plants, producing new varieties with improved quality, higher yields and resistance to climate change.

Food irradiation extends the shelf life of food, helps prevent the spread of pests and diseases and facilitates international trade.

By using nuclear technologies, like the Cosmic Ray Neutron Sensor, and isotopic techniques for water-saving irrigation, specific water quantities can be given to crops, greatly reducing water use.

Nuclear techniques enable the accurate tracking of nutrients from fertilizers to plants, providing farmers with critical data.

Nuclear techniques provide solutions to diagnose, monitor, prevent and tackle transboundary animal and zoonotic diseases.

In Benin, farmers' use of integrated soil fertility management practices have increased yields while saving fertilizer, hence reducing GHG emissions.

Countries are using nuclear science and techniques to enhance food and water security, protect the environment, produce clean energy and develop strategies to minimize harm to fragile coastal and marine ecosystems.

The IAEA is helping countries realize the vast potential of nuclear science and technology, from supporting the introduction of clean nuclear energy to researching climate resilient agrifood systems in partnership with the United Nations Food and Agriculture Organization.

Nuclear techniques can help countries monitor and assess environmental changes, meaning they can understand ecosystem processes, enabling science-based policies that can provide resilient solutions in adapting to climate change.

water

Nuclear technology provides key insights on the water cycle, empowering communities to achieve sustainable water management.

ocean

Nuclear technology makes a difference in better understanding the impacts of climate change in coastal and marine ecosystems and countering the loss of biodiversity.



Scientists around the world track raindrops and use big data to improve water supply.



Scientists in Europe and Central Asia have worked together to determine the status of freshwater resources in rivers, aquifers and glaciers.

Climate change is shrinking glaciers globally, reducing future meltwater availability for downstream communities. Isotope hydrology helps track freshwater contributions to downstream ecosystems.



From the Andes to the Himalayas, scientists are tracking the consequences of glacier retreat.

Climate change is affecting the source, distribution and intensity of precipitation worldwide and the occurrence of snow. These changes can lead to increased incidences of floods and droughts.



Scientists in the Sahel region are using isotopic techniques to study groundwater quality and recharge rates, helping to guide sustainable water management.

Climate change is altering river flow patterns. Isotope hydrology can identify the origin of river water and assess its quality to better manage river health.

Groundwater recharge and availability is increasingly affected by changes in precipitation.

Samples of water that can be analysed with nuclear techniques

Isotopes are like the fingerprints of water. Isotopic hydrology offers a unique and powerful tool to determine the age, source, quality and movement of water resources – key information that is not available through any other means.



The IAEA supports countries to track shared ocean issues and to standardize the collection of data.

Learn more about how countries in Latin America and the Caribbean are working together through the REMARCO network.

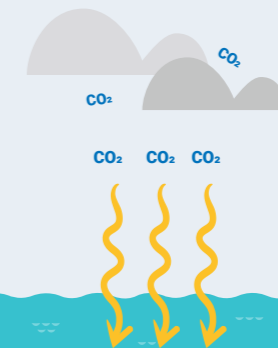


Scientists at the IAEA prepare samples as part of blue carbon research.



Researchers at the IAEA are studying the effects of ocean acidification and other environmental stressors on marine organisms.

Blue carbon ecosystems capture CO₂ emissions, acting as a nature-based solution to mitigate climate change. Nuclear and related techniques help to assess the absorption capacities of these ecosystems.



The ocean absorbs CO₂, causing ocean acidification, affecting marine life and the livelihoods of up to 3 billion people who depend on the ocean.



Increasing global temperatures and human activities have led to an increase in harmful algal blooms, which are poisonous to human and marine lives. The IAEA builds national capacity to use radioligand receptor binding assays, a nuclear technique, to detect them.

The IAEA uses nuclear and isotopic techniques to gain a better understanding of the impact that microplastics have on marine ecosystems, and to evaluate any additional contamination risks from associated pollutants.

Infographic: A. Vargas, R.Kenn/IAEA