



NUCLEAR FOR A
BETTER
TOMORROW

How nuclear science contributes directly and indirectly
to the United Nations Sustainable Development Goals



Just ahead of the world meeting on COP21, the United Nations laid out 17 Sustainable Development Goals (SDGs). These goals are designed to ensure the prosperity of developed countries and to improve living conditions in developing countries by 2030. Thanks to the work of nuclear science, we can help meet nine of these goals directly and the other eight indirectly.

From the food we eat to the water we drink to the energy we use, our lives have been made safer and healthier because of nuclear science and its innovative applications. This is nuclear's important, yet often forgotten, contribution to global sustainable development. The supporting facts are set out in this document.

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GOAL 2

ZERO HUNGER

The Food and Agricultural Organization (FAO) of the United Nations (UN) reports that up to 40 per cent of crops are lost annually because of disease and pests.

This loss can be alleviated with food irradiation, which kills bacteria, insects, and parasites that cause foodborne diseases. The World Health Organization (WHO), the FAO, and the International Atomic Energy Agency (IAEA) have reviewed accumulated data from about 50 years of research. They found that irradiated food is as safe as food preserved using other techniques, such as freezing or canning.

Many irradiators use cobalt-60 as the source of radiation. Cobalt-60, which is produced in CANDU reactors in Ontario, has a variety of medical, consumer, and industrial uses.

A nuclear science technique called crop mutation breeding is a proven, effective method for producing plants that are more resistant to the impacts of climate change. Another nuclear science process known as the sterile insect technique (SIT) has proven to be effective in eradicating crop-destroying pests without the use of pesticides, which are harmful to both humans and the environment.

Nuclear science can also detect micronutrient deficiencies, which helps hundreds of millions of children every year. The World Bank has highlighted the importance of nutrition for babies and children, pointing out that investments in nutrition can save one million lives and help to sustain 260 million more by preventing stunted growth and impaired brain development.



GOAL 3

GOOD HEALTH AND WELL-BEING

According to the World Nuclear Association, more than 40 million nuclear procedures are performed every year and the demand for radioisotopes is increasing by up to five per cent annually.

Diagnostic nuclear medicine is a critical component in diagnosing health problems related to the function of organs, tissues, or bones. Nuclear materials are also used in biotechnology for analyzing specific molecules inside the body to improve human health. They are an essential research component for chronic illnesses like AIDS and Alzheimer disease.

Radioisotopes are integral to nuclear medicine and the health-care system due to their ability to reveal and even treat various cancers, cardiovascular disease, tuberculosis and some infections. The nuclear by-product cobalt-60 can kill off harmful and deadly bacteria, making it an effective solution to sterilize medical equipment, such as syringes and catheters, to keep patients safe.



GOAL 6

CLEAN WATER AND SANITATION

Clean and available water supplies are critical to economic development and human health.

Nuclear reactors, in addition to providing electricity, can be a source of clean water for communities and countries in need. Small- and medium-sized reactors are suitable for desalinating seawater. Nuclear reactors produce tremendous heat that drives steam turbines to make electricity, and leftover heat can be used to boil ocean water. The steam that condenses is pure and clean, and the remaining salt can be returned to the ocean.

An example of a nuclear science technique that helps to clean water is the use of electron beams (ebeams) to break apart the chemical bonds of clothing dyes. This removes pollutants from textiles wastewater and allows recycling of the water for re-use.



GOAL 7

AFFORDABLE AND CLEAN ENERGY

Sustainable development is achievable only with access to clean, reliable and affordable energy. This energy is connected to all human activities and is the engine for economic sectors like agriculture, industry, commerce and transportation. Still, one billion people live without access to electricity.

Current projections by the IAEA forecast that energy demand will rise by an astonishing 60 to 100 per cent by 2030. If the world is to help lift people out of poverty and meet energy demands, then continued investment in low-cost, low-carbon nuclear energy is needed.

Over the last 30 years, Canada's nuclear reactor technology and uranium exports have contributed globally to the avoidance of at least one billion tonnes of CO₂ (in displacing fossil fuel sources) – a unique and ongoing contribution to global climate change mitigation that no other Canadian energy source can claim.



GOAL 9

INDUSTRY, INNOVATION AND INFRASTRUCTURE

The nuclear industry is pursuing innovative research and development. This includes more efficient fuels, new fuel cycles, Generation IV reactors, hydrogen fuels, small modular reactors (SMRs) and fusion energy.

An example of contribution to industry and infrastructure is nuclear non-destructive testing (NDT), a technique that helps make roads and air travel safer. NDT is a quality-assurance practice conducted on machines and materials to verify their structural integrity without causing any damage. One of the most common forms of NDT, industrial radiography, is used to inspect welds on pipes and vessels, and for security scanning (for example, of freight cargo or passenger luggage). Another form, neutron radiography, is used to inspect plastics rather than metal.



GOAL 13

CLIMATE ACTION

In 2018, the world hit a record high of 37.1 billion tonnes of airborne CO₂ emissions. The use of low-carbon energy sources help limit these emissions.

Nuclear power is the largest non-hydro source of clean energy worldwide, providing almost 12 per cent of global electricity. According to the Intergovernmental Panel on Climate Change, nuclear power produces a mere 16 g of CO₂ per kilowatt hour over its entire lifecycle, making it one of the cleanest forms of energy.

Globally, nuclear power avoids 2.5 billion tonnes of CO₂ emissions every year, equal to taking approximately half of the world's 520 million vehicles off the roads. A special report by the International Energy Agency in May 2019, titled "Nuclear Power in a Clean Energy System," states that "without additional nuclear, the clean energy transition becomes more difficult and more expensive – requiring \$1.6 trillion USD of additional investment in advanced economies over the next two decades."



GOAL 14

LIFE BELOW WATER

Ocean acidification is a change in the chemical composition of oceans due to an increase of CO₂. As excellent carbon sinks, oceans are estimated to have absorbed nearly half of all CO₂ emitted in the last two centuries.

Increasing amounts of CO₂ means less carbonate in the oceans. This carbonate is a fundamental building block for numerous marine organisms, including coral reefs and shellfish. An increase in ocean acidity corresponds to a decline in the shellfish that humans rely on for food.



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GOAL 15

LIFE ON LAND

Forests serve as a canopy for the habitat of numerous animal and plant species, and as natural carbon sinks, drawing in carbon and producing oxygen. Clear-cutting and other human activities can cause widespread damage to various ecosystems that call the forest their home.

A nuclear technique known as stable isotope addition is a valuable environmental risk assessment tool. These isotopes can identify various contaminants and thereby assist with forest monitoring and remediation.



GOAL 17

PARTNERSHIPS FOR THE GOALS

Partnerships are at the very core of our success in the nuclear industry. By combining the skills and expertise of various stakeholders in search of a common goal, the nuclear industry works collaboratively to find solutions to some of the world's most pressing problems. The global nuclear community has a long list of partnerships, including the FAO and WHO.

A key partnership in Canada is the Darlington and Bruce refurbishment projects, a collaborative effort between industry and the Government of Ontario. This effort will ensure the successful life extension of 10 reactors. The refurbishment project, which will last approximately 15 years, is creating thousands of jobs and extending the life of the reactors for another 30 years or more.



NUCLEAR CONTRIBUTES INDIRECTLY

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GOAL 1

NO POVERTY

According to the United Nations, nearly half of the world's population – more than 3 billion people – lives on less than \$2.50 per day. More than 1.3 billion people live in extreme poverty on less than \$1.25 per day.

As stated by the World Bank, poor people are more likely to remain poor if they stay unconnected. Without electricity, they must rely on polluting fuels for cooking, heating and lighting, and must spend much time collecting fuel to meet those basic needs.



GOAL 4

QUALITY EDUCATION



A quality education is necessary to raise the standard of living for people.

Electricity provided by nuclear improves economic conditions, which in turn improves living conditions and food access for the public. Well-nourished children learn more in school and are much more likely to become highly productive adults.

A country that has a nuclear industry requires high-level education and training for its citizens because it needs highly-skilled workers. Such a country creates nuclear science, medicine and engineering departments at its universities, colleges and trade schools.



GOAL 5

GENDER EQUALITY

Because of traditional gender-related social roles, energy poverty affects women more than men. When a household does not have access to electricity, work traditionally done by women is so time-consuming that it does not allow them to study or work outside the home. Nuclear energy can provide affordable, reliable, sustainable and modern energy, leading to an economy and workforce in which everyone can participate.





GOAL 8

DECENT WORK AND ECONOMIC GROWTH

Low-cost energy lowers the cost of business, spurs economic growth and increases wages.

Nuclear also creates decent work for people around the world. In Canada, nuclear is responsible for 76,000 direct and indirect jobs and adds \$17 billion per year to the Canadian GDP. These are high-skill, high-quality and high-pay jobs.



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GOAL 10

REDUCED INEQUALITIES

Like all forms of electricity, nuclear energy stimulates economic growth.

Nuclear facilities are typically outside cities and offer high-paying jobs and opportunities to people living in rural communities.

Marginalized populations and Indigenous communities are typically consulted before building facilities, and jobs are often created for those living in host communities.



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GOAL 11

SUSTAINABLE CITIES AND COMMUNITIES

Cities need to have proactive and environmentally sustainable plans to deal with the threat of climate change.

Nuclear reactors are well suited to powering large cities and industrial centres. They can provide emissions-free, large-scale power to replace dirty coal-fired plants. They create large amounts of clean energy with a small land footprint.

What's more, the energy generated from nuclear reactors can power clean public transportation. The electricity created to power electric vehicles is cleaner when it is supplied by a grid powered by nuclear than by a grid powered by fossil fuels.



GOAL 12

RESPONSIBLE CONSUMPTION AND PRODUCTION

Material requirements for nuclear energy are typically lower than for other energy sources. Because nuclear energy is efficient, nuclear reactors require little fuel. A single 20-gram uranium fuel pellet can produce the same amount of energy as 400 kilograms of coal, 410 litres of oil or 350 cubic metres of natural gas.

Nuclear has a small land footprint for the energy it produces. In addition, nuclear waste is strictly controlled and regulated. Every piece of waste is accounted for and monitored, unlike the fossil-fuel waste that is simply emitted into the atmosphere.



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GOAL 16

PEACE, JUSTICE AND STRONG INSTITUTIONS

Countries powered by nuclear energy are fundamentally safe and peaceful places to live, work and raise families. Nuclear energy is overseen globally by the IAEA, one of the most respected regulators in the world.



