

Canada's Nuclear Future

Q&A with Canada's Nuclear Experts

Industry experts Tracy Primeau, Darryl Spector, and Lisa McBride discuss diversity, reconciliation, and innovation within Canada's nuclear energy industry.

To read the full discussion, visit innovatingcanada.ca.

TRACY PRIMEAU

Past Shift Manager, Bruce Power & Board Member, Women in Nuclear Canada

What is a challenge in your career that you've faced as a woman and how did you overcome it?

Women weren't allowed to work in nuclear plants until the 1980s. I worked with an authorized nuclear operator who refused to have women on his unit and a shift manager who refused to have women on his crew.

I was the first woman to ever enter the control room as an authorized nuclear operator at Bruce A Nuclear Generating Station. When I got there, I brought some colour — my work boots were pink, my nails were always done, and I had a little heel in my boot. I came to the understanding that there's no fitting in, you can only be yourself. As long as you have integrity and you remain true to yourself, you'll be fine.

How can leaders in Canada's nuclear energy industry respect and advance reconciliation with Indigenous communities?

In my opinion, economic reconciliation is where we make the biggest difference. Additionally, collaborating and partnering with a First Nations community where everyone is committed and everyone benefits is another great way to work on reconciliation. A subset of collaboration is employment. Set a target or create a program where you aim to hire a certain percentage of Indigenous employees by a certain time.

This should be embedded in every part of your company — it can't just be the Indigenous Relations or HR team that's thinking about this. Collaborating with Indigenous communities should be on your mind in everything you do.



DARRYL SPECTOR

President, Promotion & Board Chair, Skills Ontario

What emerging trends and innovations in Canada's nuclear industry are you most excited about?

Likely the least appreciated, but the most relevant to the everyday public, are the profound advancements in the area of nuclear medicine. Canada is quickly becoming a global leader in the adoption and large scale-up production of critical, life-saving radiopharmaceutical medical isotopes for both diagnostic and therapeutic benefits.

Another is the advancements in the area of small modular reactors (SMRs). In the past decade, we've seen exponential advancements in the development of commercially-viable and scalable deployment cases for SMRs around the world. Additionally, Canada's licensing framework to enable the development of a prudent and rigorous framework is seen globally as being industry-leading, which has attracted the focus of many internationally-based SMR players, in addition to homegrown initiatives.

What recent achievements in the nuclear space should Canada be proud of?

Canada is an admired and respected player on the global stage amongst every major jurisdiction in terms of our culture, safety record, performance record, technology adoption, and workforce. Leaders from the Canadian nuclear industry are in demand and are often sought after globally. Additionally, our fleet of nuclear reactors continues to achieve world-leading performance records, and we boast the world's largest operating nuclear utility site at Bruce Power.

The life-extension programs currently underway at Bruce Power and Ontario Power Generation are the largest green infrastructure projects in the nation, and we're quickly becoming a global champion in the medical isotope space. We need to take far more credit for our amazing accomplishments, but we don't to the degree that we should. And what is more Canadian than that? Steady, reliable, respected, and modest — it's the Canadian way!

LISA MCBRIDE

Country Leader of Small Modular Reactors, GE Hitachi Nuclear Energy & President, Women in Nuclear Canada

Why is Canada's nuclear energy industry more important than ever right now?

Nuclear energy is clean, safe, and reliable energy that's helping us to meet our net-zero goals, and there's no way that we can get to net-zero without nuclear energy. To me, getting to net-zero is about leveraging all types of clean energy generation to hit these decarbonization goals, and that includes nuclear.

Aside from the benefits of clean energy, how is Canada's nuclear industry making a major contribution to our economy and society?

In Canada, we have the full fuel cycle — everything from mining to nuclear energy to research and development in waste and decommissioning. If we look at that from a contribution perspective, we employ more than 76,000

people in this industry. We make a major contribution to the economy — our impact is \$17 billion a year to the Canadian GDP from the nuclear energy industry. Not to mention the valuable contribution from medical isotope production.

What advice can you offer to women looking to pursue a career in the nuclear industry?

The nuclear industry is innovative, dynamic, and exciting, and there are opportunities in almost everything to do with nuclear. And this industry needs all voices — it needs diversity and women in order to leverage what diversity truly means to a business. I want women to know that there are a lot of growth opportunities and different career opportunities in this industry, and that if they apply themselves, the sky is the limit.



Delivering Nuclear Power to Achieve a Sustainable Environment

Since its formation in 1998, the World Nuclear Transport Institute has developed practices to safely, securely, reliably, and efficiently transport radioactive materials.

Captain Simon Chaplin, Maritime and Security Specialist, World Nuclear Transport Institute

More recently, the World Nuclear Transport Institute (WNTI) scope has broadened to have demonstrable alignment to sustainability. New and novel work in support of transportable nuclear power plants, with their various applications, clearly shows WNTI members' commitment to contribute to the nuclear industry goal of being central to a net-zero carbon future," says Martin Porter, Secretary General at the WNTI.

The 2050 net-zero emissions target cannot be met without nuclear power. Transportable nuclear power plants, including those being developed by WNTI members, will be an essential element in providing green energy to all communities.

The nuclear renaissance

Large-scale nuclear sites provide power to large populations. However, remote regions cannot be served unless hundreds of miles of power

cables are installed. Often, these remote locations use fossil fuels to generate power.

Clearly, there's a need for small-scale nuclear, called small modular reactors (SMRs), that can serve remote regions or specific industrial applications.

Rapid deployment and disaster relief

Factory-built, using cost-saving modular production methods, SMRs are then delivered to the site of operation for assembly.

SMRs have many uses:

1. Electricity generation
2. Production of green hydrogen
3. Heating for communities
4. Industrial heating for steel, paper, and cement production
5. Sea water desalination to produce clean drinking water
6. Disaster relief

Green energy — using less space and no waste

Some SMRs use molten salt reactors (MSRs), incorporating safety by design. These cannot melt down as the already-molten nuclear material inside will simply solidify into rock if the reactor encounters a problem. This material cannot be used to make nuclear weapons.

Unlike solar and wind power, SMRs don't need much space, often being sited on floating barges, making them ideal for small island states where there's a demand for sustainable, green energy.

Supporting transportation

Transporting SMRs requires careful planning to ensure that the public, environment, and nuclear material are protected. The WNTI is committed to supporting this work.



Captain Simon Chaplin
Maritime & Security Specialist, World Nuclear Transport Institute



Martin Porter
Secretary General, World Nuclear Transport Institute

Find out more at wnti.co.uk.

This article was sponsored by the World Nuclear Transport Institute.





PHOTOS COURTESY OF NWMO

An Innovative and Collaborative Approach to Dealing with Nuclear Waste

The Nuclear Waste Management Organization is taking an innovative, industry-leading approach to the safe, long-term management of nuclear waste.

Tania Amardeil

Nuclear fuel has powered Canadian communities for decades. As a low-carbon energy source, it's increasingly being sought by governments to help fight climate change — the Government of Canada has made it clear that there's no credible path to net-zero energy by 2050 without nuclear in the mix.

Yet whenever the topic of nuclear comes up, someone inevitably asks about the “problem” of waste. The reality is that all energy sources create waste. Fossil fuels enter the atmosphere and industrial waste goes to landfill. In fact, nuclear is the only energy industry that manages its waste throughout its entire lifecycle.

While once thought of as a barrier, today managing that waste is an industry success story. Nuclear waste is safely stored now and there's international scientific consensus about how to safely manage it over the very long term.

Investing in our future

The Nuclear Waste Management Organization (NWMO) is responsible for implementing Canada's plan for the safe, long-term management of used nuclear fuel. Headed by Laurie Swami, one of only three women CEOs in the Canadian nuclear industry, the NWMO is planning to build a deep geological repository that uses a series of engineered and natural barriers to contain and isolate used nuclear fuel. While used nuclear fuel is currently being safely stored at above-ground facilities, this approach is widely recognized as being inappropriate over the long term.

“Canada's plan solves the problem today, instead of passing it on to future generations,”

says Swami. “This is one of the key priorities we hear from Canadians and Indigenous peoples when seeking input on our work.”

Canada's plan represents a \$26-billion environmental infrastructure project over its 150-year lifecycle. That means investments across the country, including significant contributions in the siting areas, as well as many high-value jobs in the short term and into the next century.

A progressive approach to partnership

One of the NWMO's key commitments is that it will only proceed in an area with informed and willing hosts, where the municipality, First Nation and Métis communities, and others in the area are working together to implement Canada's plan.

“We've only worked in regions where a community voluntarily expressed interest in exploring their potential to host the project,” says Swami. “Twenty-two communities raised their hands. It was nothing short of extraordinary.”

Through progressive social and technical studies, that list was narrowed down to the Ignace area and South Bruce, both in Ontario. The NWMO expects to select a site in 2023. By actively collaborating with local leaders and interested citizens, the NWMO is taking an industry-leading, consent-based approach to exploring partnerships and willingness.

Building a foundation of respect

Innovation is truly at the core of the NWMO's work. The organization is using best-in-class environmental practices and Indigenous knowledge to ensure that the project protects people and the environment, essentially indefinitely. And by

interweaving cutting-edge western science with Indigenous knowledge, the project is setting new standards for research, community engagement, and Indigenous collaboration.

“Listening to Indigenous peoples has always been key to our work, and in 2019 we took an important step forward by formalizing our reconciliation policy,” says Swami.



Canada's plan solves the problem today, instead of passing it on to future generations.

Laurie Swami, President & CEO, Nuclear Waste Management Organization

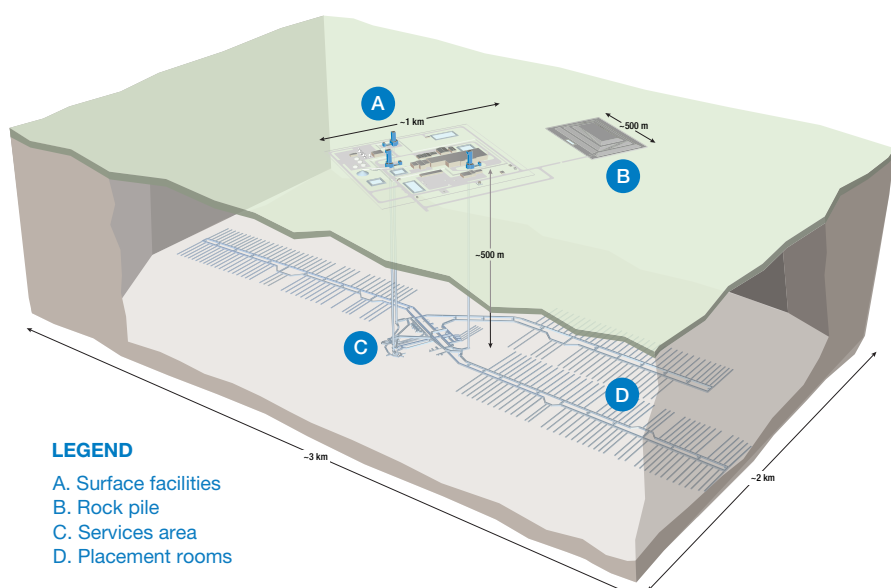
That meant developing an annual implementation plan to measure and publicly report on its reconciliation journey, which is building a foundation of recognition and respect through ongoing educational opportunities. The NWMO continues to travel this path with Indigenous peoples, with strong guidance from a Council of Elders and Youth.

Now, based on its experience implementing Canada's plan, the NWMO has been asked by the federal government to develop an integrated strategy that addresses any remaining gaps in plans for other radioactive waste streams — specifically, some of Canada's low- and intermediate-level radioactive waste. While this waste is all safely managed today, some of it still requires plans for the very long term.

The NWMO is breaking new ground, both figuratively and literally, and playing a vital role in environmental stewardship. It's exciting to see such a world-leading example right here in Canada. 🌱

To learn more about the NWMO's latest initiatives, visit www.nwmo.ca.

This article was sponsored by the **Nuclear Waste Management Organization.**



LEGEND
 A. Surface facilities
 B. Rock pile
 C. Services area
 D. Placement rooms

This diagram shows a conceptual layout for the surface facilities, and the underground services area and placement rooms in the deep geological repository in a site with sedimentary rock. The design will continue to become more detailed as the project progresses.

Participate in our survey on the **Integrated Strategy for Radioactive Waste**

<https://radwasteplanning.ca/>



nwmo

Creating a Cleaner and Greener Future with the Power of Nuclear Energy

Innovation and leadership in the nuclear sector from companies like Hatch are fuelling hope for a carbon-free future.

Tania Amardeil

One of the biggest problems our planet is facing today is climate change. Canada's government has committed to reducing our greenhouse gas emissions dramatically, and we're steadily transitioning to a low-carbon economy. Fuelling this shift is the energy industry, and nuclear energy is leading the way.

We've all heard that nuclear energy is a sustainable, reliable, and clean energy source, but what is it, exactly? "We use the natural aspects and properties of uranium," explains Amar Jolly, a professional engineer and Global Director of Nuclear at Hatch, a global engineering, project management, and professional services firm headquartered in Mississauga, Ont. "We know from physics that if you put uranium in a certain configuration, it produces heat. We exploit that property to extract energy."

Nuclear is a highly creative way of producing energy. It's also extremely efficient. "The energy density of uranium is incredible," says Jolly. "A 20-gram pellet of uranium is equivalent to 400 kilograms of coal or 400 litres of oil."

Creating clean energy for the future

Hatch's expertise spans all facets of the nuclear industry, from uranium mining and processing, fuel fabrication, and operational support of existing facilities to new nuclear builds and the development of emerging technologies and innovative solutions for things like nuclear waste management and long-term storage. The company is proud to be known as



As global energy consumption continues to increase, a sustainable energy mix is the only solution.

nuclear experts leading the way in innovation in Canada and abroad.

"Nuclear aligns with our values," says Jolly. "We're very much committed to a sustainable future and to making the world a better place via positive change."

Hatch is also a leader in partnering to develop, license, and implement small modular reactors (SMRs) — an emerging class of nuclear reactors designed to be built in smaller modules that produce less power than a conventional nuclear power plant. Their mass production makes them more economical, and their smaller size helps

bring nuclear power to remote and isolated communities, industrial applications, and as a replacement for carbon-intensive forms of energy generation.

Embracing nuclear sustainability

Nuclear is a sustainable option when it comes to power generation, and the team at Hatch believes it should be a go-to as we move forward to a cleaner, greener future.

"As global energy consumption continues to increase, a sustainable energy mix is the only solution," says Jolly. "That is, new nuclear fission and fusion reactors complemented by other clean sources of energy."

Nuclear provides clean, reliable, base-load power — meaning it can run all the time. And the deployment of the flexible new SMRs extends the possibilities of nuclear immensely. Nuclear operations account for and safely manage all of their components, fuel, spent fuel, and by-products. Emerging technologies can utilize spent fuel for further energy extraction. "It's a closed loop, which lends itself to true sustainability," says Jolly.

"Canada is at the forefront of leading the transition to a low-carbon world with nuclear," adds Jolly. "We need everybody's support and involvement to stay in the lead." 🍀



Learn more about Hatch's leadership in the nuclear space at hatch.com.

This article was sponsored by Hatch.

HATCH

How One Company is Helping Canada Lead the Energy Transition

Cutting-edge innovations by nuclear energy leader GE Hitachi Nuclear Energy power up Canada's leadership in carbon-free technology.

Ken Donohue

Climate change is an urgent global priority, and nuclear energy will play a major role in helping Canada and the rest of the world reach its net-zero carbon emissions goals. GE Hitachi Nuclear Energy (GEH), which has more than six decades of experience designing and deploying nuclear reactor technologies, is delivering game-changing innovation with the introduction of its small modular reactor (SMR).

This technology has the potential for a wide range of applications including the generation of non-emitting reliable electricity, process heat, hydrogen production and powering remote communities. Several provinces are actively pursuing SMRs, and the first one in Canada could be operational in as early as 2028.

"We're very excited about the potential of these reactors because the modular design allows for faster construction schedules through advancements in fabrication," says Lisa McBride, Canada SMR Country Leader GEH. "The speed in which we can get to market enables large-scale deployment in a time that is meaningful for attaining our climate goals."

Clean energy: helping power the world

Canada has long been a global leader in nuclear research and technology and in exporting reactor systems, but the world is at an energy turning point. Countries rec-

ognize the need for safe, clean, and reliable sources of energy that are flexible to meet diverse needs. "While Ontario and Canada are poised to support the development and deployment of SMRs, the bigger opportunity is for Canada to support the world's energy transition," says McBride. "With our nuclear operating expertise and infrastructure project experience, Canada is well-positioned to become a carbon-free technology export powerhouse."

The federal government estimates that the global SMR market will be worth \$150 billion annually by 2040. PwC estimates that each made-in-Canada SMR deployed globally will generate approximately \$98 million in GDP for Canada and more than \$45 million in total tax revenue through the purchase of nuclear fuel, machinery, and equipment.

Modular reactors: next-generation technology

Innovative SMR technology includes designs that have a combination of features that address public concerns about cost and safety. In addition, the various designs consider the needs of residents, whether in dense cities and suburban areas or in rural areas and remote areas with no access to an electric grid.

SMRs are also designed to be passively safe, utilizing natural circulation and passive cooling systems to cool themselves without power or operator action for extended periods.



With our nuclear operating expertise and infrastructure project experience, Canada is well-positioned to become a carbon-free technology export powerhouse.

McBride adds that now is the time to work with partners in government, industry, and academia who think globally to seize the opportunity that's waiting. GEH is a leader in scaling energy innovation globally — GE technology generates 30 percent of the world's power — and by supporting SMRs, we can play a key role in reinvigorating Canada's post-COVID manufacturing economy.

"The nuclear future is bright for Canada, and especially Ontario," says McBride. "Advancements of time-tested nuclear technologies are poised to bring new levels of affordable, carbon-free, and reliable energy to our homes, industries, and commercial buildings." 🍀



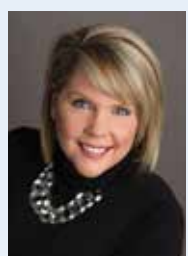
Nuclear energy is critical to achieving Canada's net-zero decarbonization goals. Find out how GE Hitachi Nuclear Energy is leading the way. Visit nuclear.gepower.com.

This article was sponsored by GE Hitachi Nuclear Energy.

GE HITACHI



Amar Jolly
Global Director of Nuclear,
Hatch



Lisa McBride
Country Leader,
Small Modular
Reactors,
GE Hitachi