

Small Modular Reactors (SMR)

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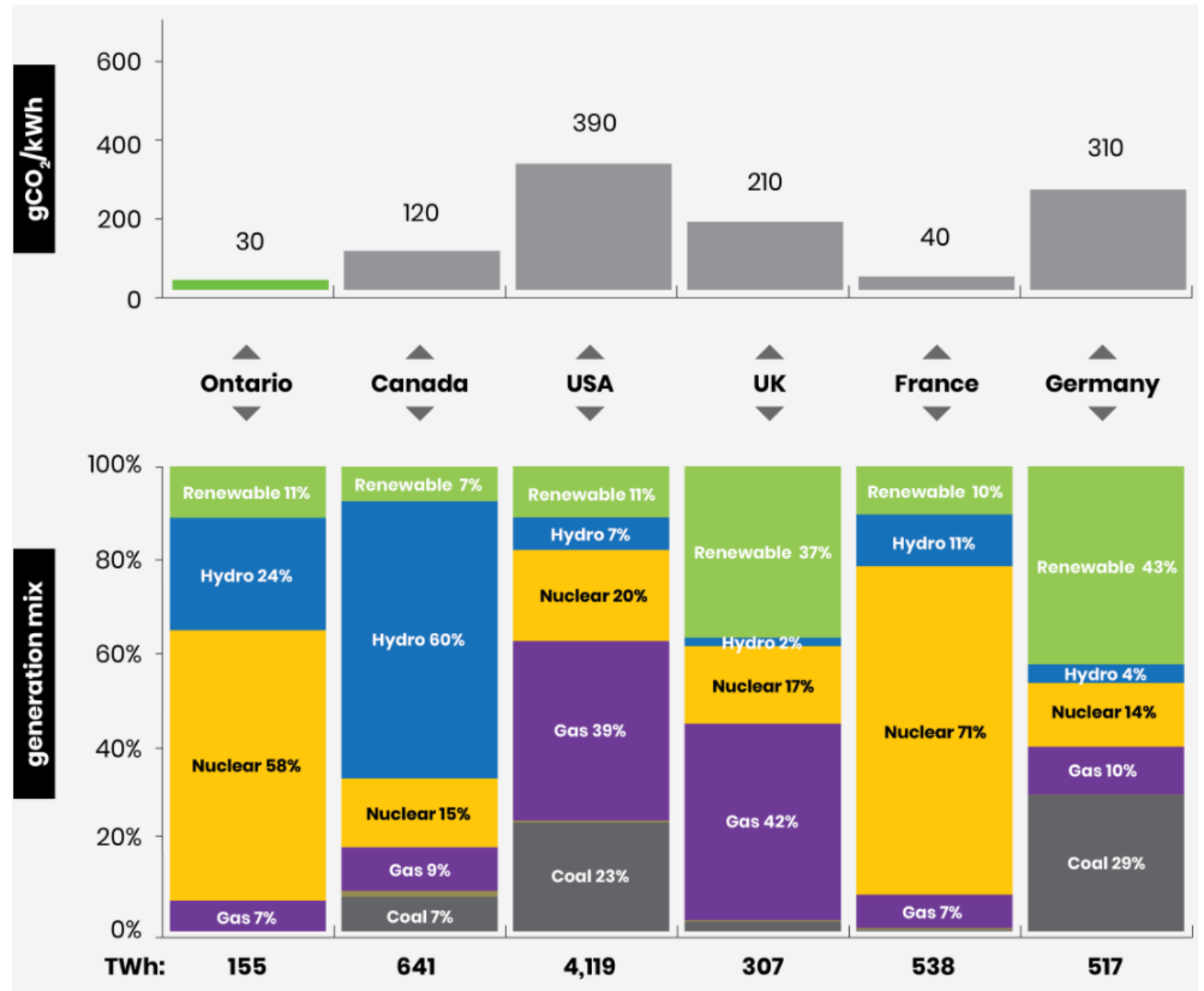
ONTARIO**POWER**
GENERATION

Deliver a world-class
SMR, together

Safety Moment



CO2 Emissions – Ontario vs World



Who is OPG?

Largest low-cost
power generator in
Ontario

100+ years of
operating experience

18,900+ MW
generating capacity

Industry innovator,
investor & leader

Facilitator of
electrification
infrastructure

PowerON
Energy Solutions
An OPG Company



2

Nuclear
Stations



2

Leased
Nuclear
Stations



2

Thermal
Stations



1

Solar
Facility



66

Canada
Hydroelectric
Stations



85

US
Hydroelectric
Stations



4

Atura Power
Combined
Cycle
Stations

Safe, clean, reliable



There is no greater priority than public and employee **safety**; it guides everything we do.



As a publically-owned generator, we strive to contribute to the **well-being of our communities**.



OPG's electricity is about **30 per cent less expensive** than the average of all other Ontario generators.



Helps **reduce overall cost of electricity** for Ontarians while our profits return to the Province.



OPG's Climate Change Action Plan



A net-zero carbon company by
2040

A net-zero carbon economy by
2050

There is no net-zero future without more non-emitting **nuclear generation** and there is no new nuclear without **First Nations support**

OPG Engagement with First Nations

\$56 million in Indigenous procurement and approximately \$20 million in distributions from our equity partnerships with Indigenous partners

Hired and secured placements for 24 skilled Indigenous employees through our Indigenous Opportunities Network (ION).

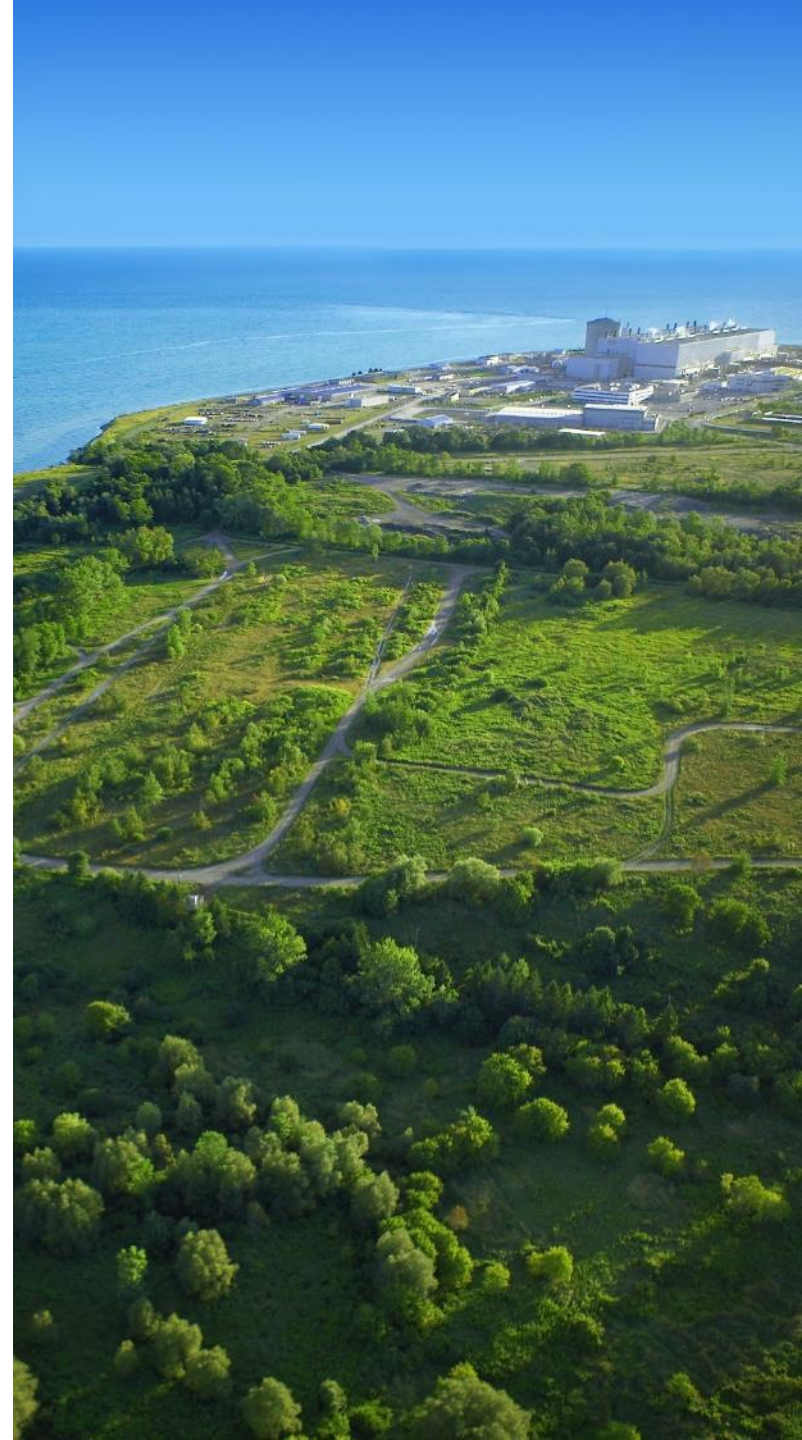
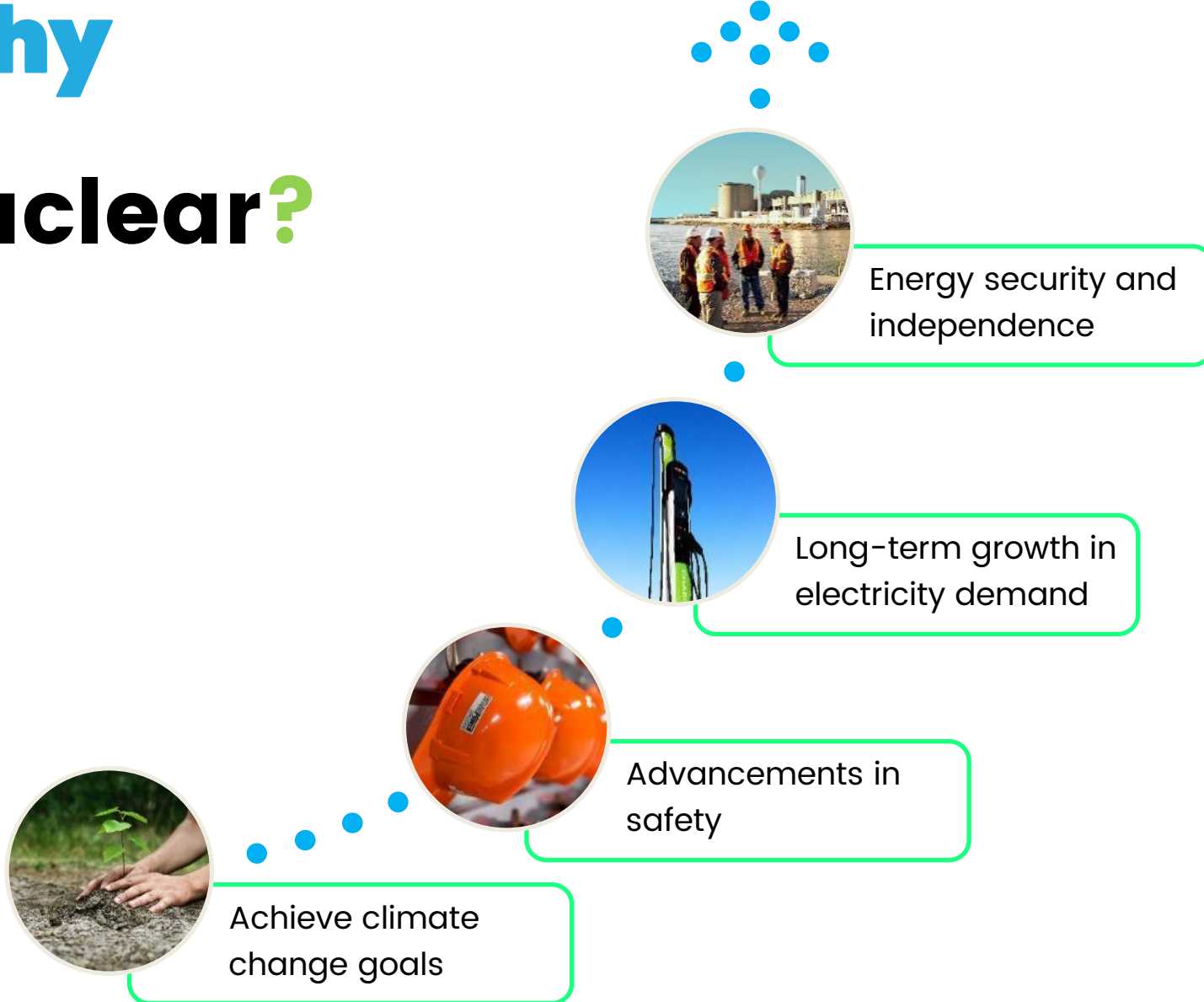
Incorporated RAP actions and commitments into People Leader annual performance plans.

Equity partnerships with indigenous communities on 3 hydro projects and 1 solar project, so far.

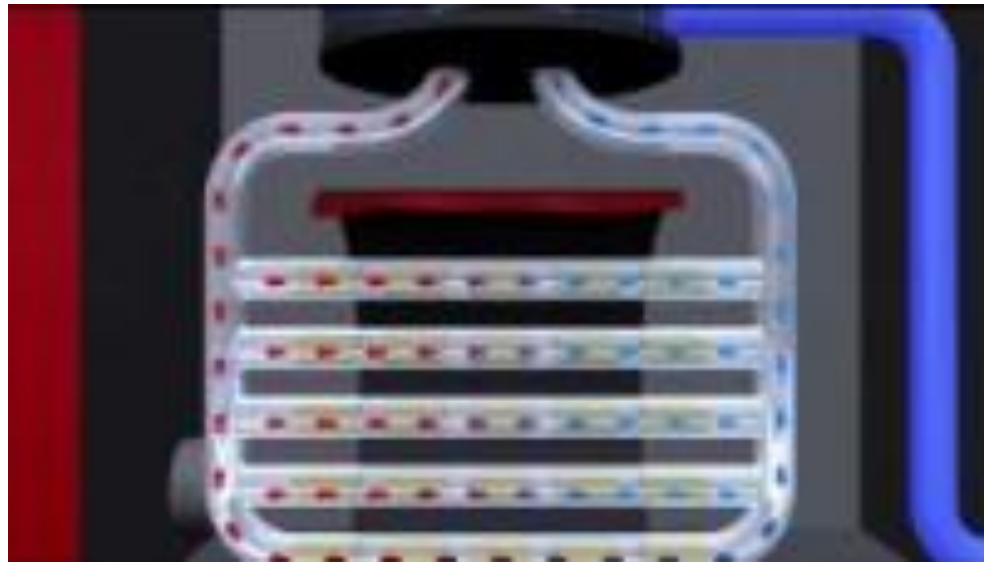
“Engage early, Engage often”



Why Nuclear?



What is nuclear energy ?



Small Modular Reactors

- SMRs are a type of advanced nuclear reactor, the **next evolution of nuclear energy**.
- Designed to be smaller in size than a traditional reactor, but also produce **safe, reliable, clean energy**.
- SMRs are a type of advanced nuclear reactor based on the **same science** as larger reactors:
 - Fission to create heat energy, for electricity or other heat applications (e.g. district heating, water desalination, hydrogen production, process steam)
- Same technology, **different applications** (e.g. on-grid, off-grid, advanced).
- **Based on technology** that has existed around the world for 50+ years.

**These three letters can
help solve climate change.**



Key Features & Benefits

Smaller physical size
and land footprint

Enhanced, inherent
safety features

Modular; components
factory constructed
and delivered to site

Reduced project
schedule and **cost**

Some can operate for
many years on initial
load of fuel

Ability to **integrate** with
other forms of energy
(i.e. **renewables**)

Some are designed for
off-grid locations

Scale to fit approach
as demand changes

Some generate **high
quality heat** for
industrial applications

Lower up-front capital
investment

Reactor Technologies

Water-Cooled Reactors

- Same fuel as large; same operating design

Non-Water-Cooled Reactors

- Salt-and-Sodium Cooled:
 - Still boiling water to create steam which spins a turbine to turn a generator
 - Liquid sodium is run through heat exchangers as the heat transfer medium
 - At higher temperature and lower pressure because sodium coolants expand less than water
 - High Assay Low Enriched Uranium (HALEU) (U-235 10-19%)
 - Refueled every ~20 years

- High Temperature Gas Cooled Reactors
 - Still boiling water to create steam which spins a turbine to turn a generator
 - Gas is compressed and run through heat exchangers
 - No water used for cooling, instead an inert gas (usually helium) is used as coolant and heat-transfer medium
 - At higher temperature and lower pressure because gas coolants expand less than water
 - HALEU fuel (U-235 10-19%)
 - Refueled every ~20 years

MMRs (Micro Modular Reactors)

- 1-5% size of a large-scale reactor
- Non-Water Cooled; eg Helium cooled
- Off-grid use; output of 1-10MWe
- Use HALEU fuel (U-235 10-19%)
- Refueled every ~20 years

Technology Developers

Water Cooled SMRs	Salt-and-Sodium Cooled SMRs	High temperature Gas Cooled SMRs	Micro Modular Reactors (MMRs)
GE-H BWRX-300	TerraPower	X-Energy	X-Energy
NuScale	Terrestrial Energy	General Atomics	Westinghouse (eVinci)
	ARC	Framatome	USNC

Water Cooled Reactor

GE Hitachi: BWRX-300

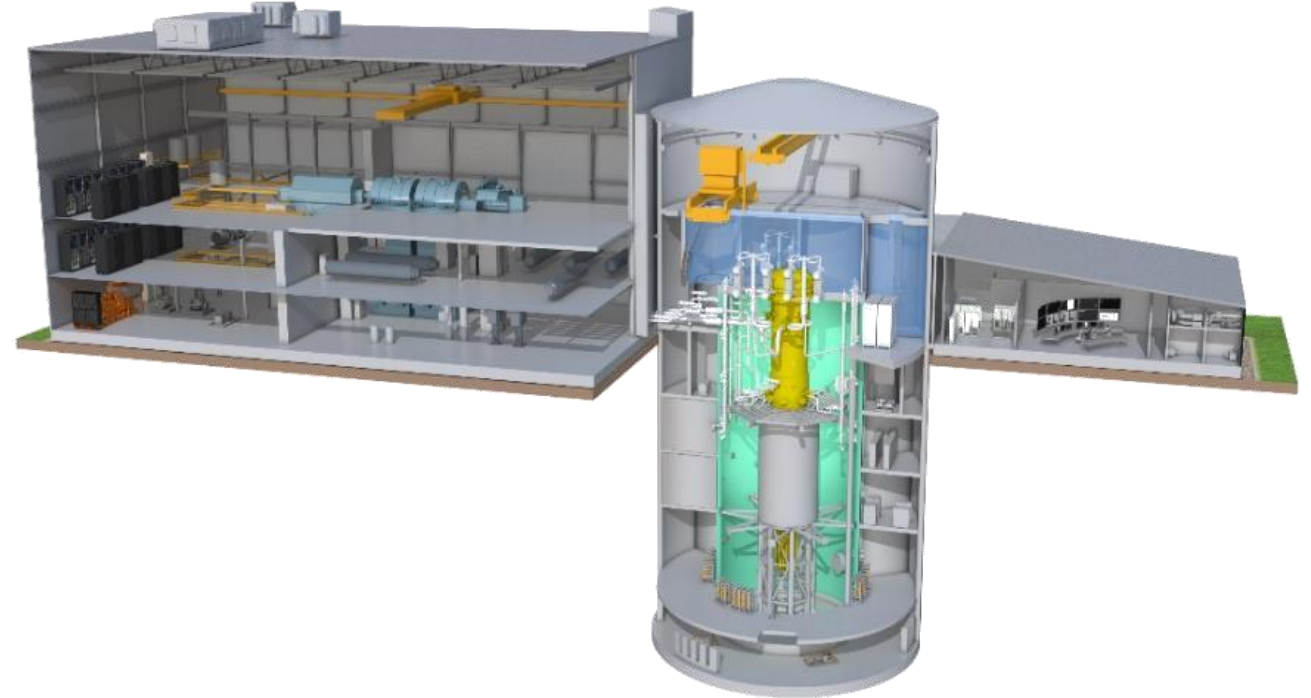
Designed for a 60-year operational life

~300MW(e) or
870MW(t)

Coolant & Moderator
= light water

Target use = baseload
electricity generation

GEH SMR Technologies Canada is the Canadian division of the world-leading provider of reactor technology and nuclear services.



HITACHI

A roadmap to Canada's **first Small** Modular Reactor

2021

2022

2024

2027



High Temperature Gas Cooled Reactors

X-Energy Xe-100



OPG and **X-energy (XE)** developed a framework agreement to evaluate opportunities to **deploy the Xe-100 for industrial applications** in Ontario, and support efforts to deploy across Canada.



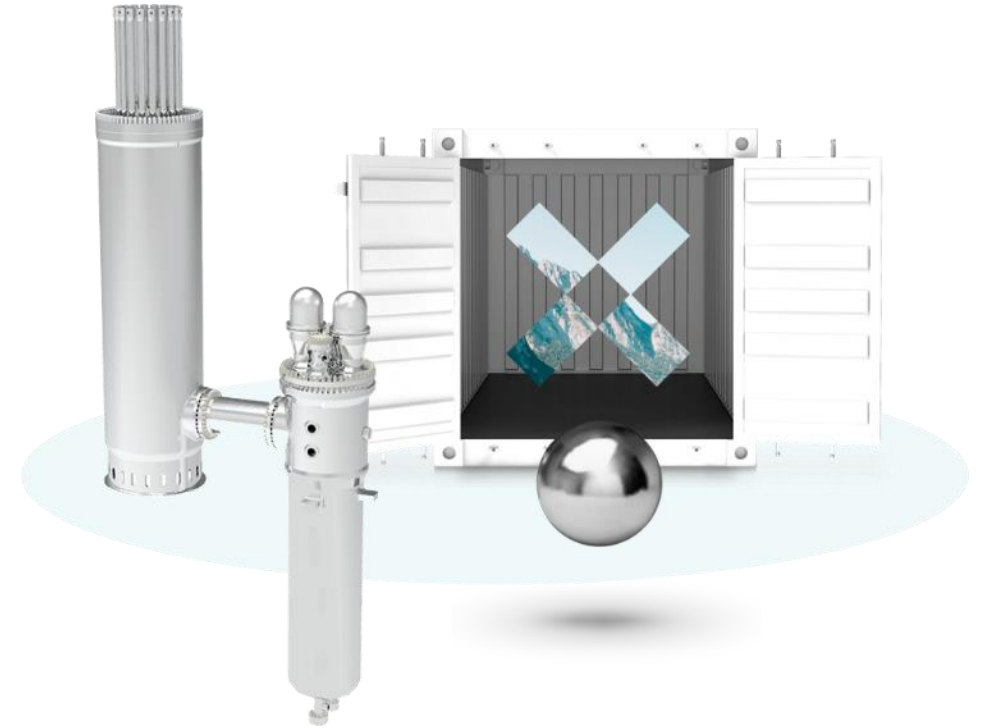
OPG has made an additional investment into **XE** to support further development.



The **Xe-100 builds and improves** on decades of high-temperature gas reactor research, development, and operating experience.



One Xe-100 unit can generate up to **80 MW of electricity** from **200 MW of thermal power**; support heavy industry including **oil sands operations** and **mining applications**.



[Xe-100 Explained](#)



off-grid MMRs

Global First Power Micro Modular Reactor



Demonstration project at the **Chalk River Laboratories** site; Ultra Safe Nuclear Corporation (USNC) designed **Micro Modular Reactor** (MMR).



Applied for a **Licence to Prepare Site** and **Environmental Assessment** (EA).



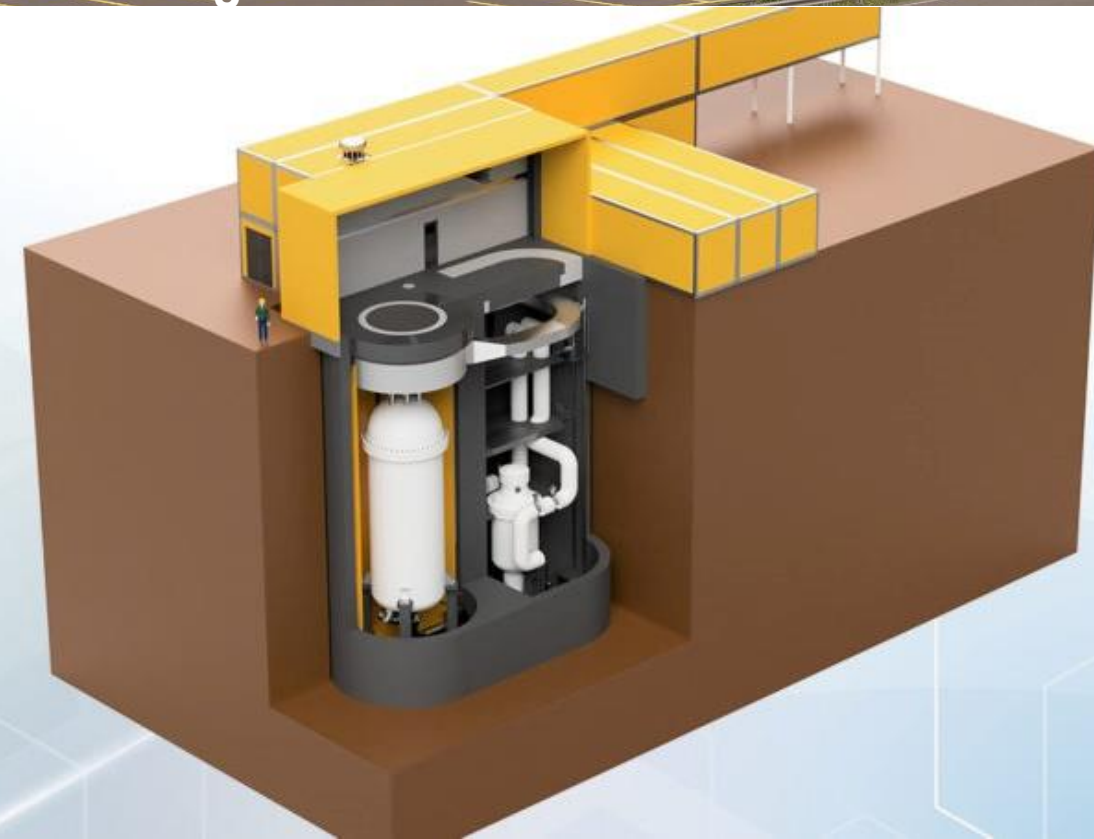
15 MW of heat energy (approx. 5 MW of electricity).



Lifespan anticipated to be **20 years**, after which the reactor will be decommissioned and the site restored.



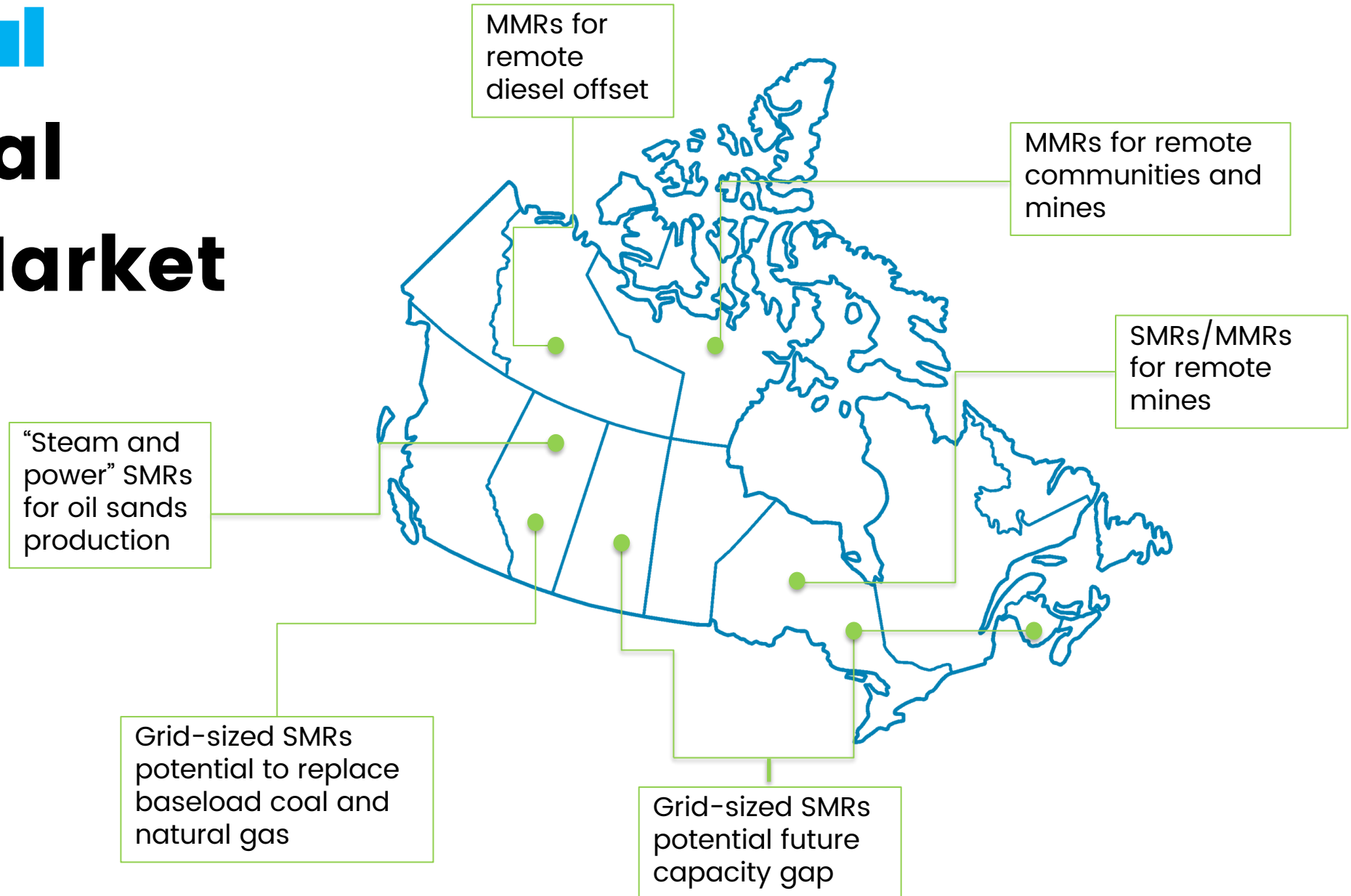
Rendering of the MMR® at Chalk River



National

Potential

SMRs Market



Resources

For more information:

1. OPG.com:
 1. Climate Change Action [Plan](#)
 2. Reconciliation Action [Plan](#)
 3. Darlington New Nuclear [Project](#)
2. International Atomic Energy Agency: [What are SMRs?](#)
3. Federal government resources:
 - i. SMR Roadmap: [Link](#)
 - ii. SMR Action Plan: [Link](#)





Electrifying life in
one generation.