

Leading the way to a bright energy future

Terrestrial Energy's IMSR400 Economic Benefit Assessment

October 2021



HATCH

Disclaimer

This slide deck has been prepared by Hatch Ltd. for the use of Terrestrial Energy to provide an assessment of the economic impact for Terrestrial Energy's small modular reactor power plant (IMSR400) in Ontario.

The analysis and observations presented in this document are based on information provided by Terrestrial Energy, which has not been verified by Hatch. Any statement in relation to the cost estimates and the resulting economic impacts are based on the capital cost estimates dated June 17, 2021. Any subsequent changes to the capital cost estimates may cause the impacts to be different from those reported here.

All dollar values are in 2021 Canadian dollars, unless otherwise specified.



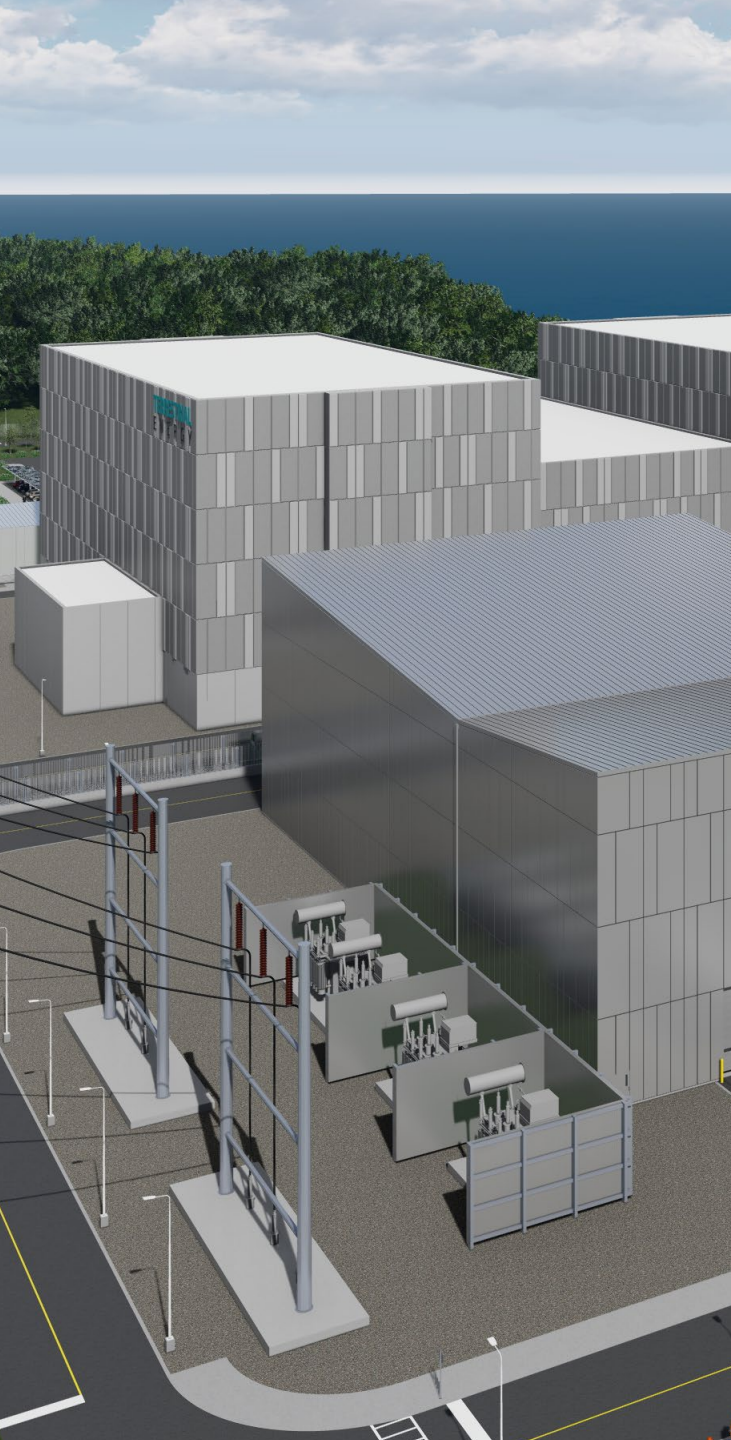
Table of Contents

Executive Summary	4
Introduction and Background	16
Catalytic Impacts	20
Broader Benefits of the IMSR	31
Economic Impact Results	40
Appendix	46



Executive Summary





Project background

To meet the growing demand for clean energy, Ontario Power Generation (OPG) is exploring innovative and emissions free energy options that are safe, reliable, and cost competitive.

One such option is the Darlington New Nuclear Project (DNNP). As part of the DNNP, OPG plans to deploy a grid-scale small modular reactor power plant (SMR). Just like traditional large-scale reactors, SMRs offer reliable, safe, zero-carbon electricity. However, unlike today's nuclear power plants, they are smaller in size and output, and promise to be easier to construct and finance.

Terrestrial Energy's IMSR400 is one of three SMR power plant technologies selected by OPG for further consideration by the DNNP. Based on the current deployment schedule, the DNNP will be one of the first SMR power plants to be deployed both in North America and globally.

The IMSR400 power plant has the potential to generate electric power more efficiently than SMRs that use conventional (water-moderated and water-cooled) technology. This is achieved through the use of molten salt technology which allows for higher temperature of operation and higher power conversion efficiency (thermal efficiency) than conventional reactor technology. Terrestrial Energy's Canadian pedigree will give Canadian and Ontario industries a strategic position within the global SMR technology supplier market generating significant benefits over many decades.

The design, construction, ongoing operations, and eventual decommissioning of the IMSR400 for the DNNP will support significant economic benefits locally for Ontario and nationally as the spending ripples through the Canadian economy.

Within this document, the economic, R&D, industry and other benefits that would arise due to IMSR400 related activities are critically analyzed and presented.

An IMSR400 at Darlington would provide significant, high impact economic benefits to Canada over many decades

- According to Terrestrial Energy, the IMSR400 will deliver up to a 50% improvement in cost-efficiency of electricity generation over an SMR employing Generation III technology and will provide compelling, cost-competitive energy options for global clean energy supply in a competitive timeframe at a time of escalating need.
- This improved efficiency together with an innovative design, smaller scale, and use of modular techniques promises to make the IMSR400 more affordable, easier to construct and finance and its electric power more cost competitive than traditional nuclear power plants. Furthermore the IMSR400's 580 °C thermal energy supply provides a thermal energy alternative to fossil fuel combustion for many industrial production processes including natural resource extraction. Such direct applications with a Generation III SMR are limited due to their lower operating temperatures (approximately 280 °C).
- The unique pairing of the IMSR400, an SMR technology with compelling economic benefits developed in Canada by a Canadian company, with an initial deployment as part of the DNNP would provide Canadian and Ontario industries with a unique opportunity and a highly strategic position within the global SMR supplier market. This has the potential to generate new Canadian supply chain and export opportunities extending well beyond Darlington.
- The design, construction, ongoing operations, and eventual decommissioning of the IMSR400 at Darlington will support significant economic benefits locally for Ontario and nationally as the spending ripples through the economy.

Key benefits

Economic impacts

The GDP, employment, wages and salaries associated with the design, construction, operation, and decommissioning of the IMSR400 at Darlington.

Catalytic Impacts

Broader benefits to the Canadian Economy, including:

- Increased exports
- First mover advantages
- R&D spill over impacts

Catalytic impacts

In addition to the economic and fiscal impacts associated with the design, construction, and operation of the IMSR400 plant at Darlington, the technology underlying the IMSR400 will deliver highly compelling economic impacts across the Canadian economy. The catalytic impacts include:

“Terrestrial Energy operates the largest SMR technology development project in Canada, and its success will have a strong positive impact on the OCNI’s many member companies.”

Dr. Ron Oberth

President and CEO Organization of Canadian Nuclear Industries (OCNI)

Increased exports	First mover advantages	R&D spillover impacts
The IMSR is a Canadian technology that draws heavily on Ontario’s internationally recognized high-quality nuclear supply chain. This uniquely and strategically positions Canadian and Ontario industries within the global technology supplier market. This has the potential to provide Canadian nuclear technology manufacturers with new supply chain opportunities as the global market for Generation IV power plant technology such as the IMSR400 expands.	The development of the IMSR400 will require several components with nascent supply chains requiring significant expansion to meet the demands of a widescale rollout of IMSR plants. If Canada were to become a first mover with both the development and deployment of SMR plants, which would be the case with the IMSR400 plant, Ontario will be positioned to become home to these expanding industries.	Terrestrial Energy will invest an additional \$395 million in the development of the first generation of IMSR400 and further capital to develop the next generations of IMSR power plants including those supporting hydrogen production. This spending has the potential to generate significant spillover impacts as some of the knowledge gained may boost the productivity achieved by other sectors of the Canadian economy.

Catalytic impact summary

Terrestrial Energy has developed estimates of two SMR rollout scenarios – “Baseline” and “IMSR Green Energy Transition” – with SMR new build amounts ranging from 360 to 4,600 IMSR plants over the 2025 to 2050 period. The Baseline scenario assumes that SMRs play a leading role in the replacement of existing nuclear generating capacity with a modest expansion of nuclear energy use overall. The IMSR Green Energy Transition scenario assumes that SMRs play a major role in the replacement of existing fossil fuel capacity to enable countries to achieve their net-zero energy goals.

By supplying materials and equipment as well as raw materials for other manufacturers, Canada’s economy would benefit from the construction of plants deployed elsewhere in Canada, in the U.S., and abroad. The design and engineering of each IMSR plant as well as the manufacturing and supply of the reactor and the associated components are areas where Canada would likely have a competitive advantage and be able to capture a large portion of future international spending.

The development of the IMSR will include several components with nascent supply chains requiring significant expansion to meet the demands of a domestic and international rollout of IMSR plants. The manufacturing of the uranium fuel is one area where Canada has the potential to be a “first-mover”.

SMR power plant economics will drive energy market share and deployment rates. Terrestrial Energy’s IMSR400, based on Generation IV molten salt reactor technology, supports continued carbon-free energy deployment by providing enhanced power generating efficiency when compared to SMRs using conventional reactor technologies, supporting the IMSR’s compelling economic case. The ability of the IMSR to provide high-temperature heat positions it as a carbon-free thermal energy alternative to fossil fuels for many industries.



“Terrestrial Energy is on a clear path to market, and its IMSR® Generation IV advanced nuclear technology has tremendous market potential.”

Andreas Hefter
Vice President Nuclear Energy of KSB

* The roll out scenarios assume that each plant is a single reactor plant that has the capacity to generate 195 MWe.

Catalytic impact summary - Baseline

The catalytic impacts from the Baseline scenario have the potential to generate annual economic impacts for the Canadian economy of a scale that represents a major industrial opportunity. The table to the right presents the direct impacts along with the total economic impacts. The direct impacts include impacts in the design and engineering, reactor manufacturing, and uranium mining and fuel manufacturing sectors, while the total impacts are the sum of the direct, indirect, and induced impacts and provides a measure of total impact on the Canadian economy.

The direct annual impacts under the Baseline scenario will generate an average of \$1.0 billion of GDP and directly employ 5,200 individuals in the engineering, reactor manufacturing, and uranium mining and fuel manufacturing sectors annually. The total annual impacts (direct + indirect + induced) include \$2.0 billion in GDP and 12,900 jobs per year.

To help put the impacts into perspective, the direct and total employment and GDP impacts were compared to other sectors of the Canadian economy. In terms of GDP, the direct GDP impacts are smaller than the semiconductor sector, while the total GDP impacts are 43% and 37% the size of the forestry and logging and motor vehicle manufacturing sectors, respectively. The total employment impacts are greater than the employment impacts of the petroleum refining sector and are behind the semiconductor manufacturing sector.



GDP (\$B)



Employment (jobs)

Annual Catalytic Impacts - IMSR Baseline Scenario

	Direct	Total	Direct	Total
Design and Engineering	\$0.3	\$0.5	1,600	3,800
Reactor	\$0.2	\$0.4	1,500	3,400
Fuel Spending	\$0.5	\$1.0	2,100	5,700
Total	\$1.0	\$2.0	5,200	12,900

Sector Comparisons (Direct Annual Impacts) - IMSR Baseline Scenario

Semiconductor
manufacturing
\$1.5



Semiconductor
manufacturing
15,800

Forestry
and logging
\$4.6



Forestry
and logging
25,220

Motor Vehicle
Manufacturing
\$5.4



Motor Vehicle
Manufacturing
38,900

Petroleum refining
\$9.4



Petroleum refining
8,500

Catalytic impact summary - IMSR Green Energy Transition

The catalytic impacts from the IMSR Green Energy Transition scenario have the potential to generate far greater annual economic impacts for the Canadian economy. The table to the right presents the direct impacts along with the total economic impacts. The direct impacts include impacts in the design and engineering, reactor manufacturing, and uranium mining and fuel manufacturing sectors, while the total impacts are the sum of the direct, indirect, and induced impacts.

The direct impacts under the IMSR Green Energy Transition scenario will generate an average of \$12.5 billion of GDP and directly employ 65,500 individuals in the engineering, reactor manufacturing, and uranium mining and fuel manufacturing sectors annually. The total impacts (direct + indirect + induced) includes \$25.8 billion in GDP and 170,600 jobs per year.

To help put the impacts into perspective, the direct and total employment and GDP impacts were compared to other sectors of the Canadian economy. From an employment perspective, the direct impacts fall between the oil and gas extraction sector and the electric power generation and transmission sector, and the total employment impacts are behind the non-residential construction sector. From a GDP perspective, the direct impacts are greater than the motor vehicle manufacturing and oil and gas extraction sector and the total GDP impacts are greater than the non-residential construction sector.



GDP (\$B)







Employment (jobs)

Annual Catalytic Impacts - IMSR Green Energy Transition

	Direct	Total	Direct	Total
Design and Engineering	\$3.9	\$7.0	20,100	48,800
Reactor	\$2.6	\$5.7	19,000	43,900
Fuel Spending	\$6.0	\$13.1	26,400	77,900
Total	\$12.5	\$25.8	65,500	170,600

Sector Comparisons (Direct Annual Impacts) - IMSR Green Energy Transition

Motor Vehicle Manufacturing		Motor Vehicle Manufacturing
\$5.4		38,900
Oil and Gas Extraction		Oil and Gas Extraction
\$9.4		61,200
Non-Residential Construction		Non-Residential Construction
\$24.7		198,700
Electric Power Generation and Transmission		Electric Power Generation and Transmission
\$37.5		90,690

Additional benefits of the IMSR400

In addition to the economic benefits noted in this report, the following benefits of the IMSR400 have been reviewed with Terrestrial Energy.

Canadian Technology – Terrestrial Energy is headquartered in Oakville, Ontario, making the IMSR400 the only Canadian SMR technology under consideration by OPG for the DNNP.

Climate Change and Canada's Net-Zero Goals – With flexibility for both electric and thermal power provision, the IMSR400 can form part of the solution to Canada's net-zero goal formalized by the Canadian Net-Zero Emissions Accountability Act.

Meeting Global Demand for Energy Production – Terrestrial Energy's IMSR400 promises to produce high-grade, cost-competitive thermal energy and electric power from its adoption of molten salt Generation IV technology and has the potential to be a clean alternative to fossil fuel combustion for a range of applications.

Long Term and Sustained Economic Benefit – Over the estimated 56-year operating life of the plant, an IMSR400 installation at Darlington will generate nearly \$6.6 billion of total GDP for the Ontario economy and \$7.9 billion in total GDP for Canada.

Indigenous and Community Investment – Terrestrial Energy is a growing Canadian company with deep roots in Ontario and a commitment to growing its Indigenous programs nationally. Terrestrial Energy will continue building meaningful relationships with Indigenous communities.

Direct employment, training and community investment

– Terrestrial Energy has already created more than 110 direct jobs and has committed to the federal government to create more than 180 direct jobs and more than 50 national co-op positions to support the development of its IMSR power plant.

Engineering Partners' Indigenous Inclusion Program

– In addition to their supplier and construction partners, Terrestrial Energy's engineering partners also have advanced programs in place.

Business and Technical Acumen – Terrestrial Energy benefits from expert engineers with Canadian market expertise. Its directors, advisors and management team have world leading business, nuclear energy and policies experiences.



Hatch assessed the economic impacts of the design, construction, and operations of an IMSR400 at Darlington

The total economic impact of Terrestrial Energy's IMSR400 plant at Darlington is presented for two phases :

- Design and construction
- Annual operations

The following economic impacts were estimated

- **Direct Impacts** – the economic activity associated with the design, construction, and operation, of the IMSR400 at Darlington.
- **Indirect Impacts** – the economic activity supported down the supply chain.
- **Induced Impacts** – the economic activity supported by spending of the wages and salaries paid to the direct and indirect employees in the wider economy.

The analysis presented here has relied on a cost estimate developed by Hatch, AECON, and the Terrestrial Energy team dated June 2021. The economic impact estimates were developed through a combination of Statistics Canada's input-output data and Hatch's economic modeling.

All dollar values reported throughout the report are in 2021-dollars and are undiscounted unless otherwise noted.

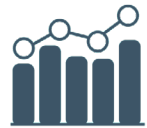
Design and Construction

- \$2.8 billion in total spending
- 87% of spending at Ontario suppliers and 91% at Canadian suppliers

Ongoing Operations

- \$71.8 million of spending per year
- 73% of spending at Ontario suppliers and 82% at Canadian suppliers

The design and construction of the IMSR400 at Darlington is expected to create over \$3.0 billion in GDP and over 18,900 job-years during the design and construction phases for the Canadian economy



GDP (\$M)



Employment

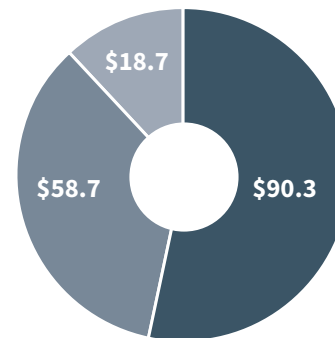
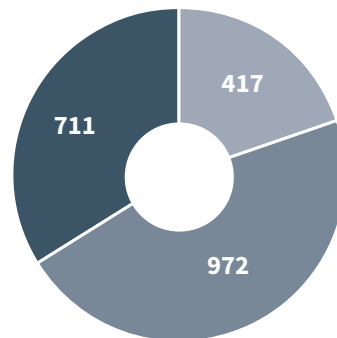
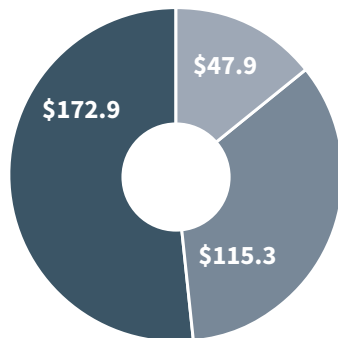


Wages and Salaries (\$M)



Fiscal Impacts (\$M)

\$3,023.8	18,900 (job-years)	\$1,509.6	\$606.8	Total (undiscounted)
\$336.0	2,100 (jobs)	\$167.7	\$67.4	Average Annual



● Direct
● Indirect
● Induced

Total project spending
\$2.8B

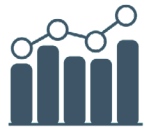
Spending at Ontario Suppliers
87%

Spending at Canadian Suppliers
91%

Spending outside of Canada
9%



Operation of the IMSR400 at Darlington will generate over \$80 million in GDP and 580 jobs annually for the Canadian economy



GDP (\$M)

\$4,519.7

\$80.7



Employment

28,690 (job-years)

580 (jobs)



Wages and Salaries (\$M)

\$2,263.1

\$40.4



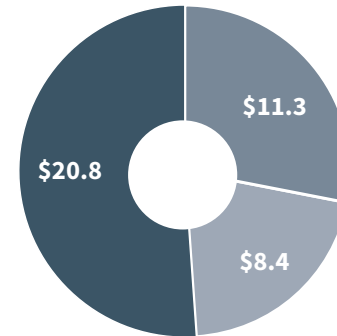
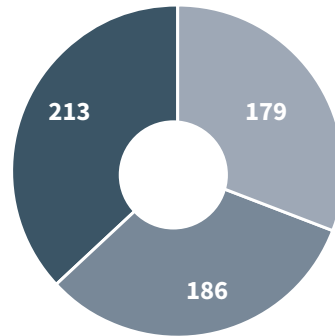
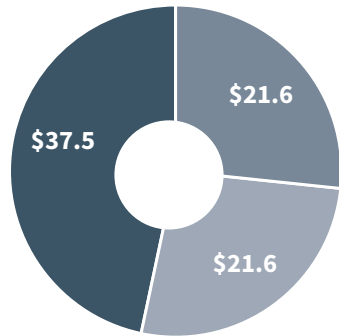
Fiscal Impacts (\$M)

\$722.5

\$12.9

Operating Life
(undiscounted)

Average Annual



● Direct
● Indirect
● Induced

**Annual
Spending**

\$71.8m

**Spending at
Ontario Suppliers**

73%

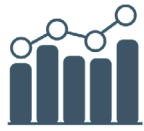
**Spending at
Canadian Suppliers**

82%

**Spending outside
of Canada**

18%

The design, construction, operation, and decommissioning of the IMSR400 at Darlington will generate nearly \$6.6 billion in GDP in Ontario and \$7.9 billion in GDP for the Canadian economy over its 80-year life-cycle



GDP (\$M)



Employment (job-years)



Wages and Salaries (\$M)



Fiscal Impacts (\$M)

Ontario Benefits

(Undiscounted)

\$6,608.4

48,000

\$3,646.8

\$1,127.2

(Discounted at 3.5%)

\$3,373.7

48,000

\$1,784.1

\$584.3

Canada Benefits

(Undiscounted)

\$7,887.9

54,150

\$3,956.4

\$1,405.2

(Discounted at 3.5%)

\$3,890.3

54,150

\$1,951.2

\$725.7

80 years includes 4 years of design and engineering, 5 years of construction, 56 years of operations, and 15 years for decommissioning

Introduction and Background



Project background

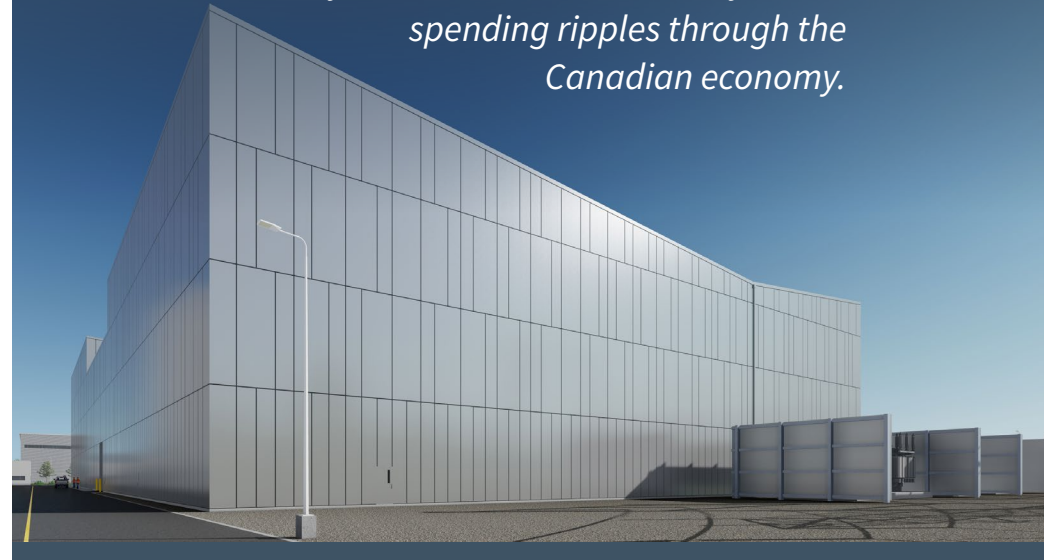
To meet the growing demand for clean energy, Ontario Power Generation (OPG) is exploring innovative and emissions-free energy options that are safe, reliable, and cost competitive.

One such option is the Darlington New Nuclear Project (DNNP). As part of the DNNP, OPG plans to deploy a grid-scale small modular nuclear reactor (SMR). Just like traditional large-scale reactors, SMRs offer reliable, safe, zero-carbon electricity. However, unlike traditional reactors, they are smaller in size and output which makes SMR plants less expensive, easier to finance and construct than conventional nuclear power plants. This avoids the project and commercial complexities of traditional nuclear plants which are large in scale, complex to construct, and have higher financial risk by both relative and absolute measures.

Terrestrial Energy's IMSR400 is one of three SMR power plant technologies selected by OPG for further consideration for the DNNP – two use Generation IV reactor technologies (including the IMSR400) and one uses Generation III technology ("conventional").

According to Terrestrial Energy, the IMSR400 will deliver up to a 50% improvement in electrical generating efficiency over an SMR employing Generation III technology and will provide compelling, cost-competitive energy options for global clean energy supply in a compelling timeframe at a time of escalating need.

The design, construction, ongoing operations, and eventual decommissioning of the IMSR400 at DNNP will support significant economic benefits locally for Ontario and nationally as the spending ripples through the Canadian economy.



"Terrestrial Energy's IMSR® technology has great potential for producing more affordable and versatile carbon-free energy over a range of applications."

Timothy O'Connor
Chief Generation Officer Xcel Energy

About the IMSR400

The IMSR400 is a 390 MWe small modular molten salt fueled reactor. It uses Generation IV reactor technology to create a low-cost and commercially innovative and elegant solution to the world's increasing clean power needs.

Affordable – While conventional (water-moderated and water-cooled) large (1 GWe) nuclear power plants typically have a \$15B+ upfront cost and are difficult to finance, the IMSR400 has a less than \$3B upfront cost and a smaller and more capital efficient design.

Superior electric power generating efficiency – The IMSR400's innovative coolant, a molten salt as opposed to water, permits high temperature operation. Assuming a baseline ~30% net thermal efficiency for conventional power reactor technologies, the IMSR400's 44% net thermal efficiency represents a nearly 50% improvement in this key metric. If you assume a similar overall capital cost between nuclear fission technologies, this improvement in thermal efficiency represents a corresponding improvement in the relative capital efficiency of the IMSR400 power plant.

Non-pressurized operation – The IMSR400's low-pressure operation avoids the considerable engineering complexity and costs of pressurized SMR alternatives, making the IMSR significantly less expensive, easier to operate, as well as simplifying the nuclear licensing process.

Modular approach for fast and simple construction – Fast modular construction using modules manufactured in factories and transported by truck or rail for on-site assembly allows for construction of an IMSR400 power plant in five years, under half the time required for conventional nuclear power plants.

Proven technology – According to Terrestrial Energy, the IMSR400 incorporates and improves upon many aspects of already proven Molten Salt Reactor technology developed over many decades. This reduces the investment risk and first-of-a-kind (FOAK) risk as it is an improvement on existing and proven technology.

Resilient and clean energy – IMSR400 power plants have among the lowest environmental impacts of clean energy technologies today, with a virtually emission-free life cycle basis. Carbon tax costs will become economically significant as the world moves towards a carbon zero future. Use of commercially available and abundant uranium at “current” assay enrichment levels ensures sustainability and fuel supply security.

The use of molten salt Generation IV technology with its high thermal efficiency, application of an innovative design, smaller scale, and use of modular techniques, makes the IMSR400 technology cheaper, easier to construct, and less risky than conventional nuclear power plants. This avoids the project and commercial complexities of traditional nuclear plants which are large in scale, complex to construct, have higher financial risk by both relative and absolute measure, all of which makes them expensive and difficult if not impossible to finance without sovereign support.

The IMSR400 is a unique opportunity for Canada

The DNNP plant will be one of the first commercial SMRs in the world, serving as a reference plant for future SMR deployments. Follow-on deployments, both in Canada and internationally, will catalyze a tremendous first-mover advantage to the SMR technology selected for the DNNP.

The IMSR400's commercial advantages give it a consequential and important role in meeting the global demand for clean energy production. Concurrently, the Canadian pedigree of the IMSR400 will give Canadian and Ontario industries a unique strategic position within the global technology supplier market. This has the potential to generate new Canadian supply chains and export opportunities extending well beyond Darlington.

The extent to which Canada and Ontario are able to capture the catalytic benefits will depend on the SMR technology chosen for the DNNP – the catalytic benefits are unlikely for a SMR technology developed outside of Canada as they will accrue instead to the country-of-origin of the SMR technology selected. When developing a new nuclear power plant technology, the technology developer is likely to work with its local supply chain to develop the proprietary technology and to continue to work with those same suppliers as the technology is rolled out. The home market preference is amplified by country-level industrial policy, which tends to support domestic SMR technology.

The IMSR400 is a born and bred Canadian power plant design and technology. Terrestrial Energy has extensively engaged the Canadian nuclear supply chain to assist in its development. This uniquely positions the Canadian supply chain to play a key role in the development of IMSR400 plants domestically and internationally.

As a Canadian company, Terrestrial Energy has made a commitment since 2012 to maximize their sourcing from the Canadian supply chain for the DNNP project, and all other plants, both domestic and international.

TERRESTRIAL
ENERGY



HATCH