

INNOVATIVE CLEAN ENERGY (ICE) FUND

Performance Report 2017 - 2023

Programs and Initiatives Approved by Fiscal Year



Nano One Materials

Table of Contents

What is ICE Fund	03
Our Story in Numbers	04
2017/2018 Projects	05
2018/2019 Projects	21
2019/2020 Projects	30
2020/2021 Projects	38
2021/2022 Projects	40
2022/2023 Projects	46
Contingencies 22/23	48
SDTC Joint Call	54

What is the ICE Fund?

The Innovative Clean Energy (ICE) Fund is a Special Account, funded through a levy on certain energy sales, designed to support the Province's energy, economic, environmental and greenhouse gas reduction priorities, and to advance BC.'s clean energy sector.

Since 2008, the ICE Fund has committed over \$110 million to support pre-commercial clean energy technology projects, clean energy vehicles, research and development, and energy efficiency programs.

Successful ICE Fund partnerships have included universities, First Nations, municipalities and many emerging clean tech companies across British Columbia. Technology demonstrations have included bioenergy, solar, ocean tidal, geo-exchange, desalination, energy management, smart grid and waste-to-energy.

The ICE Fund often partners with other funds to co-fund projects that advance BC.'s clean energy sector and reduce greenhouse gas emissions.

Our Story in Numbers: 2017/18 to 2022/23 Projects



**67 PROJECTS
FUNDED**

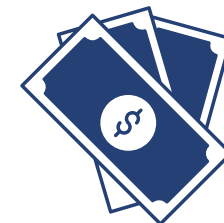


**52 ORGANIZATIONS
FUNDED**



**TOTAL ICE FUND
CONTRIBUTION
\$62,019,137**

**\$386,000,000
ESTIMATED
PROJECT VALUE**



2017/2018 Projects

Pilot Facility for Scale Up & Testing of Carbon Capture and Conversion Technologies

Organization: CMC Research Institute (CCCI)

ICE Fund Contribution: \$84,972

Other Contributors:

NRCan Contribution: \$950,000

Project Cost: \$2,265,000

Partners: Natural Resources Canada, BC Research Institute, UBC



Project Highlight:

The Carbon Capture and Conversion Institute (CCCI) is a collaborative venture between CMC Research Institutes and BC Research Inc. This alliance creates a unique ecosystem of experts and equipment that is unparalleled in Canada. Funding to the CMC Research Institutes supported the CCCI in operating a multi-purpose scale-up and piloting facility. The facility supports researchers and technology developers from academia and industry (particularly Small and Medium Enterprises), in accelerating the development, validation and prototyping of novel carbon capture and conversion technologies. The facility is located on Mitchell Island in Richmond BC and is unique in its synergistic and system engineering approach to developing the most efficient solutions to mitigate GHG emissions from a broad range of industrial processes.

Project Status/Update: Completed in May 2020. ICE Funds were used to purchase analytical equipment to support CCCI's new facility in Richmond BC. The project entailed the design & engineering phase and installation & commissioning phase of the facility.

Energy Step Code Local Government Best Practices Guide

Organization: City of Surrey, Energy Efficiency Branch

ICE Fund Contribution: \$30,000

Partners: BC Building Safety and Standards Branch, BC Hydro, and the Greater Vancouver Home Builders' Association



Project Highlight:

The project supported the development of the BC Energy Step Code Local Government Best Practices Guide. The Guide is a detailed manual for local government staff to use to help them understand and apply the BC Energy Step Code in their communities. Although local government staff will be the Guide's primary audience, it is expected that it will also be an important resource for other stakeholders involved in BC's new construction building sector (e.g., builders, developers, trade associations and realtors).

Project Status/Update:

Completed in September 2017.

Current version of the guide available here:

https://energystepcode.ca/app/uploads/sites/257/2019/08/BCEnergyStepCode_GuideDigital_v02July2019.pdf

Envision 2017 Conference

Organization: University of Victoria

ICE Fund Contribution: \$25,000

Event Sponsors: Pacific Institute for Climate Solutions, University of Victoria Engineering Department, BC Government, University of Victoria Alumni, Carbon Engineering



Project Highlight:

The IESVic EnVision 2017 conference was held in April 2017 at the University of Victoria. This was IESVic's fourth biannual conference, which had the objective of building a strong community around IESVic by introducing highly relevant topics of long-term importance and providing a venue to explore these. The 2017 topic was 'Decarbonizing Energy and Environment' which looked at technology and policy options for stabilizing global temperature increase due to greenhouse gas emissions following the signing of the UNFCCC Paris Agreement. in 2016. Presentations were made by 30 speakers over the two days, with topics ranging from policy development to climate geoengineering.

Project Status/Update: Event took place in May 2017.

Smart Drive Challenge

Organization: Scout Environmental

ICE Fund Contribution: \$50,000

Other Contributors:

Other Government Contribution: \$74,000

Project Cost: \$195,603

Funding Partners: Canadian Fuels Association, NRCan, Nova Scotia Connect2

Supporting Partners: Alberta Motor Association (AB), Capital Regional District (BC), Clean Air Hamilton (ON), Clean Foundation (NS), City of Edmonton (AB), Cowichan Valley Regional District (BC), Smart Commute (ON)

Project Status/Update:

Completed in March 2018. The Smart Drive Challenge resulted in 503 registrants. The program resulted in participants pledging to drive more efficiently and an increased use of other modes of transportation. The results of the program will likely lead to GHG and fuel emission reductions with all other factors being equal.

Project Highlight:

Expanding on the 2016 pilot success, Scout Environmental ran a larger version of their Smart Drive Challenge (SDC) commuter engagement program in fall 2017. This data-driven program is designed to engage, educate and challenge commuters to drive better (more efficiently) and drive less (shift to other modes of transportation). The project's objective was to reduce participants' fuel use and related GHG emissions by at least 15%. This is achieved by improving participant fuel efficiency (L/KM travelled) and reducing vehicle kilometers travelled.



scout
ENVIRONMENTAL

Building Sector Energy and Costing Tool

Organization: Regenerative Application Inc

ICE Fund Contribution: \$125,000

Other Contributors:

NRCan Contribution: \$200,000

BC Housing Contribution: \$50,000

BC Hydro Contribution: \$30,000

Project Highlight:

This Project's purpose was to provide improved energy and costing data to BC's new home construction market and policy makers throughout the province who are interested in promoting the construction of cost-competitive, high efficiency homes. The Province and Project Partners developed a dynamic tool that will quickly assist key user groups to identify different cost-effective combinations of measures that can be used to build energy efficient new single-detached, semi-detached, and various forms of attached homes (Part 9 residential buildings) in British Columbia.

Project Status/Update: Completed in August 2018.

Energy Advisor Employment

Organization: Building Owners and Managers Association (BOMA)

ICE Fund Contribution: \$300,000

Project Highlight:

The ICE Fund's contribution ran over three years to fund a new full-time BOMA BC Energy Advisor (BEA) position. The BEA assists owners and managers of existing class B and C buildings in BC to identify and develop business cases for energy conservation measures, as well as provide support to identify energy conservation products, technologies and qualified contractors for implementation of projects.

Project Status/Update: Completed in July 2020.



Building Owners and Managers
Association of British Columbia

High Performance Building Training Fund

Organization: FortisBC

ICE Fund Contribution: \$50,000

Other Contributors:

BC Hydro Contribution: \$30,000

BC Housing Contribution: \$10,000

Project Highlight:

This project aimed to accelerate and expand the dissemination of super-efficient construction concepts to building professionals. Subsidizing the cost of high-performance builder training for initiatives such as, but not limited to, BC Housing's Build Smart with Energy Step Code, the Community Energy Association's Workshops for Buildings and Building Officials, and Canadian Home Builders Association (CHBA) Net Zero Energy (NZE) design and construction courses. The courses provided designers, developers, contractors, and educators with the skills required to construct buildings that meet the Energy Step Code for new Part 9 residential buildings.

Project Status/Update: Completed December 2018.

Air Source Heat Pump Installation Study

Organization: FortisBC

ICE Fund Contribution: \$50,000

Other Contributors:

BC Hydro Contribution: \$10,000

Project Highlight:

The project carried out a study on the practices used to install air source heat pumps in BC's residential sector. The project partners wanted to understand current best installation practices, the quality of installations, and to identify best installation practices to ensure optimal performance of heat pumps installed in the province.

Project Status/Update: Completed June 2018.



Illustrated Guides for BC Energy Step Code

Organization: BC Housing

ICE Fund Contribution: \$25,000

Other Contributors:

BC Hydro Contribution: \$40,000

City of Vancouver Contribution: \$40,000

City of New Westminster: \$15,000

BC Office of Housing and Construction Standards: \$30,000

FortisBC: \$30,000

Project Cost: \$216,635



BC HOUSING

Project Highlight:

Project developed the following illustrated guides:

- Design Guide to the BC Energy Step Code
- Builder's Guide to the BC Energy Step Code – Lower Steps portion

The two guides developed as part of this Project will help builders, designers, developers and building owners identify and adopt cost-effective paths to high energy efficiency, and ensure smooth uptake of the BC Energy Step Code and the City of Vancouver's Green Buildings Policy for Rezoning.

Project Status/Update: Completed in March 2018.

BC Bioenergy Strategy

Organization: BC Bioenergy Network Association

ICE Fund Contribution: \$1,600,000



Project Highlight:

Part A of project aimed to renew the BC Bioenergy Strategy and set strategic policies and actions for the future of bioenergy in BC as a part of the Energy Roadmap process (\$250,000).

Part B of this project was to support techno-economic analysis for energy efficient pump technology to assist with decarbonizing BC industrial processes, reducing the carbon footprint of co-processing biofuels and study applications in the pulp and paper and municipal wastewater sectors (\$50,000).

Part C of this project targeted the BC-SMART multi-stakeholder initiative for the development of a decarbonization of transportation “Strategy for the Marine, Aviation, Rail and Trucking” sectors. The decarbonization of transportation requires a multi-faceted and integrated approach across a number of different fuel and infrastructure pathways (\$1,000,000).

Part D of this project was designed to deliver a Decarbonized Energy Research Partnership between universities, institutes and research councils to focus work on decarbonization strategies at the direction of the province. In partnership with the Ministry, BCBN enabled a collaboration amongst BC.’s research intensive universities and other research institutes (\$300,000).

Project Status/Update: Part B of this project was complete, the remaining components of this project were partially completed.

National Industrial Symbiosis Program: Canada Pilot

Organization: Light House Sustainable Building Centre Society

ICE Fund Contribution: \$10,000

Other Contributors:

Western Economic Diversification Contribution: \$700,000

Partners: Western Economic Diversification, Ministry of Agriculture, Ministry of Municipal Affairs and Housing, BC Innovation Council, Metro Vancouver, City of Surrey, City of New Westminster



Project Highlight:

Light House Sustainable Building Centre Society piloted the National Industrial Symbiosis Program (NISP) in Metro Vancouver, British Columbia and Edmonton, Alberta. The NISP pilot entailed delivering workshops to participating businesses facilitated by regional NISP practitioners. The intent of the pilot was to demonstrate the NISP model in Western Canada to position the program for nation-wide adoption. Project activities include training regional NISP practitioners, delivering facilitated workshops, developing post-workshop symbiotic connections, marketing the program, analyzing pilot outcomes, and reporting on recommendations for future implementation.

Project Status/Update: Completed in April 2019.

Stage 2: Technology Formulation and Preliminary Design of a Tri-Generation Pyrolysis Platform for Low-Cost Green Hydrogen Production

Organization: Ekona Power Inc

ICE Fund Contribution: \$500,000

Project Cost: \$1,000,000

Funding Partners: EVOK



Project Highlight:

Ekona's Tri-generation Pyrolysis (TGP) solution uniquely integrates pyrolysis and direct carbon fuel cell (DCFC) technology into a novel architecture that produces green hydrogen from natural gas for applications such as heavy oil upgrading, oil refining, ammonia production, chemical plants, natural gas pipeline network injection and emerging hydrogen energy markets.

The main objective for this project was to de-risk the TGP solution concept and create a preliminary process design, with aim to support the next-stage TGP prototype development and testing.

Project Status/Update: The Project was completed on schedule in December 2018. Key deliverables that were met include:

- 3rd party validated preliminary design
- IP licenses and patents secured
- Technology formulation meets CRD
- Business model shows venture return

Community Energy Leadership Program (CELP)

Organization: Fraser Basin Council

ICE Fund Contribution: \$1,000,000

Partners: Local governments and First Nations in BC,
Other provincial ministries, BC utilities, Federal Government funders.

Project Highlight:

Round 4 of Funding Intakes:

Funding for CELP was established through the Innovative Clean Energy (ICE) Fund.

The Community Energy Leadership Program (CELP) invested in community projects throughout the province. The primary purposes of CELP are to: support communities in implementing their climate action goals; reduce greenhouse gas emissions; increase energy efficiency; and support the development of vibrant and resilient communities.

These innovative community energy projects are creating jobs, supporting regional, economic, and social development opportunities, reducing greenhouse gas emissions, reducing energy costs, and improving energy conservation and overall community sustainability.

Project Status/Update: Completed in June 2021.



Techno-Economic Study of CleanBerry Solutions' CO2 Sequestration Technology

Organizations: Global Energy Horizons
ICE Fund Contribution: \$150,000



Project Highlight:

Global Energy Horizons believes that the CleanBerry Process has the potential to become economically sustainable, to be implemented within a relatively short timeframe; and to have the capability to capture and store CO₂ on a scale that will make a real difference. The CleanBerry Process can contribute to achieving a low-carbon economy that is essential for a sustainable long-term solution to the global warming challenge. As an added benefit, the CleanBerry Process can access currently unusable water resources, and convert these to accessible clean water.

Global Energy Horizons believes the CleanBerry Process can create a commercially viable carbon capture and storage business that will integrate enhanced gas recovery and clean energy, as well as water production, into one sustainable and environmentally responsible business.

The Techno-Economic study is required as a first stage to move from a conceptual phase into detailed engineering and design, and ultimately a pilot project. A regional assessment is required to determine options for the location of a pilot project and the identification of potential stakeholders.

Project Status/Update: Completed in March 2018, the study determined that there does not appear to be any major technology uncertainties that would prevent the CleanBerry process from going forward, at least from a surface operations perspective.

Metro Vancouver Advanced Biofuel Pilot Facility

Organization: Greater Vancouver Sewage and Drainage District

ICE Fund Contribution: \$750,000

Project Cost: \$28,650,000

Partners: Parkland Fuel Corporation



metrovancouver

Project Highlight:

The project is to design, fabricate, install, and test for at least one year, a technology called Hydrothermal Liquefaction (HTL) that can transform wastewater treatment plants into biocrude production facilities. Metro Vancouver's Annacis Island Wastewater Treatment Plant in Delta will host the world's first HTL demonstration facility that uses wastewater biomass as the renewable feedstock and converts it into a biocrude that will be refined into low carbon transportation fuels by project partner, Parkland Fuel Corporation at its Burnaby refinery.

Project Status/Update: The project is ongoing and has seen an additional \$9.29 million from the capital budget to top up funding.

Feasibility Study and Assessment of Centralized Renewable Hydrogen Production in BC Followed by a Pilot Plant Development

Organization: ITM Power

ICE Fund Contribution: \$230,000

Partners: Ministry of Jobs, Trade and Technology, BC Hydro, Mitsui & Co., Chiyoda Corporation



Project Highlight:

The purpose of this study was to examine the technical and economic feasibility of building a centralized hydrogen production plant in BC powered by clean electricity. The hydrogen would be converted into a liquid organic hydrogen carrier (LOHC) for export to Asia and California for energy use, and also used in BC for transportation and/or industrial use. The project was split into two phases:

- Phase One: the collection of the necessary information as the inputs for the feasibility study
- Phase Two: to undertake an economic and environmental evaluation for the potential of a business opportunity in British Columbia.

Project Status/Update: Completed in March 2019, the study highlighted a number of attractive opportunities which provide the basis for BC to leverage its vast renewable electricity generation capacity to become a world leader in the production and export of renewable electrolytic hydrogen whilst providing socio-economic benefits including business development and job growth for local communities including the First Nations people.

The results of the study will be used by ITM Power, Mitsui & Co. and Chiyoda Corporation to consider the installation of a facility in BC which has the potential to be the world's largest hydrogen production facility.

NZER Building Demonstration Program

Organization: Integral Group Consulting

ICE Fund Contribution: \$1,000,000

Other Contributors:

NRCan Contribution: \$1,154,000



Project Highlight:

The BC Net-Zero Energy Ready (NZER) Building Demonstration Program consisted of a design competition with incentive funds awarded for the construction of NZER buildings. Intake for the program will occur via a single call for proposals in 2018 for mid-rise and high-rise residential, commercial office and institutional buildings. A Project Selection Jury consisting of building sector experts will be convened to judge submissions based on criteria that favor low-cost and reproducible designs. Incentives will be provided to developers of selected projects to cover a portion of the cost of energy studies and construction. A condition of the incentives will be the collection and dissemination of building costing and performance data.

Project Status/Update: Completed in April 2023.

EV Charging Analysis for BC

Organization: FleetCarma

ICE Fund Contribution: \$75,000

Project Cost: \$154,600

Funding Partner: BC Hydro \$79,600

Project Highlight:

The Electric Vehicle Charging Analysis for BC represented one of a suite of programs and projects funded under the Province's Clean Energy Vehicle (CEV) Program. The CEV Program is designed to reduce barriers to the adoption of CEVs to realize both their environmental and economic benefits. The CEV Program has been highly successful in starting the transition to a transportation system that is powered by clean energy. The CEV Program goal was to achieve 5% of new vehicles purchased in British Columbia being clean energy vehicles by 2020.

Project Status/Update: Completed in June 2021.

2018/2019 Projects



Building Energy Labelling Platform Assessment

Organization: Pembina Institute

ICE Fund Contribution: \$20,000

Other Contributors:

NRCan Contribution: \$25,000

Partners: BC Hydro, NRCan

Project Highlight:

The purpose of the Project was to evaluate options for a building energy labelling program in BC. The output of the Project was an assessment of the effectiveness, gaps and trade-offs of different labelling platforms for small residential, non-residential and multi-unit residential buildings. Key objectives include: (1) gathering research and expert advice on effectiveness of different energy assessment methods and labelling platforms; (2) assessing the pros and cons of the different models reviewed; and (3) clarifying opportunities and gaps for adopting similar approaches in BC.

Project Status/Update: Completed in March 2019.

First Nations Home EnergySave: Retrofit Pilot

Organization: Fraser Basin Council

ICE Fund Contribution: \$276,000 (2016 initiative)

Multi-Year Agreement:

\$50,000 Fiscal Year 2016/17

\$50,000 Fiscal Year 2017/18

\$122,000 Fiscal Year 2018/19

\$54,000 Fiscal Year 2019/20



Project Highlight:

Based on the success of the First Nations Home EnergySave: Retrofit Pilot to date, the Ministry is taking advantage of an opportunity to add additional funding to extend the Program and to gain additional benefits. Specifically, these benefits were:

- Completing additional energy efficiency upgrades in First Nation communities.
- Enhancing First Nations energy efficiency knowledge and skills through hands on workshops.
- Building capacity with First Nation community energy champions using a nationally recognized training program (20/20 Catalyst Program).

Project Status/Update: Completed in March 2021.

Designing Climate Resilient Multi-Unit Residential Buildings

Organization: University of British Columbia

ICE Fund Contribution: \$10,000

Partners: BC Hydro, BC Housing, Fraser Health Authority, City of Vancouver, City of New Westminster, City of North Vancouver.

Project Highlight:

Project aimed to develop a methodology for generating weather files for different Intergovernmental Panel on Climate Change (IPCC) scenarios applied to climate zone 4 in BC. UBC then undertook an evaluation of the impact of these scenarios on energy, greenhouse gas (GHG) emissions and thermal comfort in multifamily building archetypes. The project also assessed cost-effective design measures for climate-resilient multifamily buildings and investigate heat-pump strategies that provided integrated heating and cooling.

Project Status/Update: Completed in June 2019.



THE UNIVERSITY
OF BRITISH COLUMBIA

Retrofit Code Supply Chain Study

Organization: Vancouver Economic Commission

ICE Fund Contribution: \$15,900

Project Cost: \$59,678

Partners: City of Vancouver (co-funders)



Project Highlight:

Undertook secondary and primary research to estimate the potential economic and supply chain impacts (both positive and negative) from the adoption of a retrofit building code in BC.

A focus of the research strove to answer key guiding questions related to the impact of a retrofit policy on industry and skilled workers:

- How many and what types of businesses will be impacted (both positively and negatively) by a retrofit code (by sector and sub-sector)?
- How many jobs will be impacted by a retrofit code?
- Who represents these companies and skilled workers at present?
- What types of skills are expected to grow in demand, based on the need to work with new and different technologies and the range of required services?
- Where does current supply chain capacity exist for both services and local products and technologies (e.g., heating and cooling, building envelope technologies, etc.) and where are the gaps?
- What priority actions and/or considerations should be taken into account in order to develop an industry transition roadmap to support the businesses and skilled workers likely to be most impacted by a retrofit code?

Project Status/Update: Completed in September 2019.

Energy Use Intensity Targets for NZER MURBS

Organization: Vancouver Regional Construction Association

ICE Fund Contribution: \$20,000

Other Contributors:

NRCan Contribution: \$45,000

City of Vancouver Contribution: \$45,000

BC Hydro Contribution: \$20,000

Additional Partner: Passive House International

Project Highlight:

Vancouver Regional Construction Association conducted a research project on energy-use intensity (EUI) targets for net-zero-energy ready (NZER) high-rise multi-unit residential buildings (MURBs). The project used design challenges, modelled energy use outcomes, and equipment availability encountered by actual high-rise MURB projects in Canada that meet the Passive House Standard to inform practical EUI targets for buildings of this form.

Project Status/Update: Completed in March 2019.

VRCA

Project CO₂MENT

Organization: Inventys (Svante)
ICE Fund Contribution: \$150,000
Project Cost: \$5,575,000
Partners: LafargeHolcim, Total

Svante

Project Highlight:

Svante has developed a next generation post-combustion carbon capture technology based on solid adsorption. The VeloxoTherm™ system has the potential to be a game changer within this market because of its modular fabrication, small footprint, and low capital cost compared to traditional solvent-based carbon capture processes.

Svante demonstrated its CO₂ capture system on Lafarge's Richmond cement plant at a pilot scale of 1 tonne per day (TPD). The captured purified CO₂ will be liquefied and then used to produce new products and economic opportunities. Developing and demonstrating a customized-for-cement version of its carbon capture technology at pilot scale supports the development of CO₂ conversion technologies such as low-carbon transportation fuels and CO₂ injected concrete and fly ash.

Project Status/Update: Project was completed in 2020. Svante completed the design, construction, and installation of the 1TPD Capture Plant in November 2020. During this stage, Lafarge had a catastrophic event that has shut down the cement plant until March 2021. Svante has initiated completing commissioning with simulated flue gas and plans to start testing with real flue gas upon cement plant start-up.

Cold Climate Heat Pump Field Study

Organization: FortisBC

ICE Fund Contribution: \$30,000

Partners: NRCan, BC Hydro

Project Highlight:

Fortis carried out a field study to monitor the performance of cold climate heat pumps (CCHP) in BC.'s residential sector.

The study provided data and feedback including:

- the feasibility of cold climate heat pumps for use as a primary heating system in residential homes throughout BC.
- the energy savings of CCHP in locations across BC.
- the economic savings of CCHP in locations across BC.
- guidance for consumers and installers on CCHP performance.
- recommendations for how current and future rebate programs can be designed to encourage CCHP installations throughout BC.; and
- a baseline study on CCHP performance to support future policy work, regulation, training and capacity building initiatives by government and utilities.

Project Status/Update: Completed in April 2020.

High Performance Builder Training Fund

Organization: FortisBC

ICE Fund Contribution: \$199,100

Other Contributors:

BC Hydro Contribution: \$130,000

BC Housing Contribution: \$10,000

Project Cost: \$369,100

Partners: BC Hydro, BC Housing

Project Highlight:

To accelerate and expand the dissemination of super-efficient construction concepts to building professionals. Done by subsidizing the cost of high performance builder training, making training accessible in multiple languages, and undertaking information sharing initiatives such as, but not limited to, Energy Advisor Net-Zero Program Mentoring Support, Multilingual Air-tightness Training, and the sharing of informational training media on air-tightness best practices in Part 3 construction.

Project Status/Update: Completed in March 2020.



Pembina Clean Future Forum

Organization: Pembina Institute for Appropriate Development

ICE Fund Contribution: \$5,000

Project Highlight:

The Pembina Institute hosted a conference, Clean Future Forum on February 28, 2019 at the Pinnacle Marriott, in Vancouver, BC. The Clean Future Forum brought leaders from the business, government, and non-profit sectors together to craft a bold vision for BC.'s low-carbon future.

Participants will explore the challenges and opportunities in transitioning BC.'s energy system to one that is increasingly clean and consistent with our climate commitments. The forum aimed to support the next stages of this process by tackling the tough questions needed to inform BC.'s climate and energy planning.

Project Status/Update: Event took place on February 28, 2019.

Energy Connections 2018

Organization: BC Sustainable Energy Association

ICE Fund Contribution: \$2,500

Event Sponsors: BCIT, BC Real Estate Foundation, HES PV, Bullfrog Power, Greener Print

Project Highlight:

The BC Sustainable Energy Association (BCSEA) hosted its third annual conference, Energy Connections 2018 on September 15, 2018, at the BC. Institute of Technology in Burnaby, BC.

Energy Connections 2018 brought together and engaged driven and knowledgeable citizens and members of industry, government and academics to discuss the latest innovations and issues in clean transportation. With innovations in technology and a strong push for a low carbon economy, the event addressed one of the largest sources of air pollution and greenhouse gas emissions in British Columbia and find sustainable solutions for our transportation industry.

Project Status/Update: Event took place on September 15, 2018.

Stage 3 of Prototype Tri-Generation Pyrolysis Platform

Organization: Ekona Power Inc

ICE Fund Contribution: \$400,000

Other Contributors:

NGIF Contribution: \$100,000

Project Cost: \$1,500,000

Partners: Suncor, Evok Innovations, NGIF



Project Highlight:

Ekona's Tri-generation Pyrolysis (TGP) solution uniquely integrates pyrolysis and direct carbon fuel cell (DCFC) technology into a novel architecture that produces green hydrogen from natural gas for applications such as heavy oil upgrading, oil refining, ammonia production, chemical plants, natural gas pipeline network injection and emerging hydrogen energy markets. In addition, the TGP process generates high-value by-products (zero-emission baseload electricity and process heat), which supplement the revenues from hydrogen production and enhance plant economics. Pure CO₂ produced by the DCFC is easily sequestered or utilized.

Stage 3 of Ekona's project was the Pulse Pyrolizer Development/Validation and DCFC Design.

Project Status/Update: Completed in June 2020.

2019/2020 Projects



High Performance Building Collaboration

Organization: BC Hydro

ICE Fund Contribution: \$85,000

Project Highlight:

The Province co-funded the development of community demand-side management (DSM) studies, building energy tools, and strategies to support the Province's energy efficiency and decarbonization objectives for the built environment. This collaboration included four workstreams: (a) assessing DSM potential in Indigenous Non-Integrated Areas (NIA); (b) developing a user guide for the ASHRAE 100 building retrofit standard in order to support the development of building codes for existing buildings; (c) studying options for mandatory energy efficiency labelling for commercial buildings; and (d) creating a roadmap for the electrification of buildings.

Project Status/Update: Completed in March 2021.

Home Retrofit Database and Decision Support Tool

Organization: City of Vancouver

ICE Fund Contribution: \$100,000

Project Cost: \$510,000

Partners: BC Hydro, CityGreen, NRCan

Project Highlight:

The City of Vancouver developed the COV Home Retrofit Database and Decision Support Tool. The Project included two interrelated components: (1) the development of a comprehensive COV low-rise housing stock database using existing tax assessment, energy assessment, city permit, and other reliable datasets, to inform policy and program development in COV; and (2) the development of an online home energy and greenhouse gas (GHG) emission rating and retrofit decision assistance tool utilizing the housing stock database.

Project Status/Update: Completed in March 2022.

LCFS Technology Pathways

Organization: S&T Squared
ICE Fund Contribution: \$15,000

Project Highlight:

The purpose of this agreement was to expand the GHGenius Microsoft Excel workbook as required to be able to complete lifecycle assessments of different electricity and heat generation technology pathways in an off-grid setting, and to develop "default" estimates of the carbon intensity and energy efficiency of known technology pathways

Project Status/Update: Completed in June 2020.

Envision 2019 Conference

Organization: University of Victoria
ICE Fund Contribution: \$15,000

Project Highlight:

Event through IESVic, focused on energy system transformation has potential to generate exciting new linkages for research and development both in BC and the rest of Canada.

Approximately 150-175 attendees drawn from academic, industry and government from across Canada participated.

Project Status/Update: Event took place May 2-3, 2019.



Energy Connections 2019

Organization: BCSEA

ICE Fund Contribution: \$2,500

Project Highlight:

The event brought together policy makers, researchers, innovation leaders, educators, and industry experts to connect, collaborate and engage for the progress of BC's sustainable energy solutions. The Ministry's sponsorship of this event assisted BCSEA in achieving:

- A well-rounded program providing current and accurate information for attendees.
- The opportunity for over 150 attendees, speakers and volunteers interested in clean transportation technology, economics and policy to network and potentially develop new, or improve current initiatives.
- An overall increased awareness of the BCSEA, enabling the organization to remain as a leader in facilitating the transition to a low carbon economy in BC.

Project Status/Update: Event took place on Sept 20, 2019.



Biofuels Workshops

Organization: University of British Columbia

ICE Fund Contribution: \$10,000

Project Highlight:

The theme of the advanced biofuels workshops was "Pathways to Market". The workshops explored strategies for facilitating large-scale supply of biological feedstocks and overcoming barriers to technology demonstration and commercial scale production of fungible biofuels.

Project Status/Update: Workshop took place May 30-31, 2019.



Stage 4 Prototype Development and Testing of a Tri-Generation Pyrolysis Platform for Low-Cost Blue Hydrogen Production

Organization: Ekona Power Inc

ICE Fund Contribution: \$375,000

Partners: Evok Innovations, Suncor, Cenovus, National Research Council-IRAP, Natural Resources Canada-BESC.



Project Highlight:

Ekona's Tri-generation Pyrolysis (TGP) solution uniquely integrates pyrolysis and direct carbon fuel cell (DCFC) technology into a novel architecture that produces green hydrogen from natural gas for applications such as heavy oil upgrading, oil refining, ammonia production, chemical plants, natural gas pipeline network injection and emerging hydrogen energy markets. In addition, the TGP process generates high-value by-products (zero-emission baseload electricity and process heat), which supplement the revenues from hydrogen production and enhance plant economics. Pure CO₂ produced by the DCFC is easily sequestered or utilized.

In Stage 4 of this project, Ekona conducted ongoing proof-of-concept testing to validate design assumptions, explore operational trade-offs and inform Ekona's scale-up design of the prototype PMP reactor and DCFC unit cell.

Project Status/Update: Completed in March 2021.

Advancing Heavy Duty Fueling for Gaseous Hydrogen Vehicles

Organization: Powertech Labs Inc

ICE Fund Contribution: \$125,000

Project Cost: \$528,248

Partners: Toyota, New Flyer, Hexagon, Ballard

The logo for Powertech, with 'Power' in blue and 'tech' in green.

Project Highlight:

Powertech aims to remove barriers to the deployment of hydrogen refueling infrastructure by advancing two critical technical requirements for the large-scale decarbonization of Canada's transportation sector - (1) hydrogen fueling testing facilities and (2) fueling infrastructure design and standards.

Before this project there was no testing facility available anywhere in the world that can support high-flow pneumatic hydrogen gas cycle testing for component and fuel systems for medium/heavy duty hydrogen fuel cell electric vehicles (FCEVs). The development of a testing facility for medium and heavy-duty FCEVs, fuel systems and components would substantially advance the FCEV bus and truck market. At the same time, the development of a 350-bar medium/heavy-duty hydrogen fueling protocol and dispenser design will promote infrastructure development.

The project goals aligned with the current direction of the FCEV industry, which is focused on increasing the pace of the rollout of FCEV trucks and buses. Vehicle manufacturers are in need of testing facilities and fueling station infrastructure to support this rollout. Powertech is in a unique position to support these industry needs, given its extensive experience in both dispensing and testing of hydrogen, plus its existing light-duty fast-fill testing facilities and 350/700 bar light-duty dispenser designs.

Project Status/Update: Completed in March 2021. Powertech is able to test large tanks used for heavy duty fuel systems.

Evaluating the Carbon Intensity of an Electrified Autonomous Labour Force

Organization: Sanctuary AI
ICE Fund Contribution: \$28,000



Project Highlight:

Sanctuary AI aimed to quantify the energy savings and reduction in carbon emissions that will result from the development of an electrified, autonomous workforce.

Energy intensity per work activity/task: An autonomous, electrified workforce may have a dramatically lower carbon impact on a productivity basis vs. a human workforce. Potential energy savings could arise for an electrified worker as it would not have to commute, consume food/water, produce waste, require a heated building, require standard lighting and could amortize the electricity costs over a 24/7 work schedule. This is likely a very significant difference in carbon intensity on an individual worker basis but could be extremely large when scaled across a larger workforce.

Project Status/Update: Completed in November 2020, Sanctuary AI determined that the introduction of robots to electrify a workforce resulting in significant reduction of GHG emissions, ranging for 22-58%. The largest impact can be seen at Remote Industrial Work Sites, where workers fly-on and fly-out on rotation. By partially switching over to an electrified workforce, regions in which electricity grids are clean, such as BC, Ontario, Quebec, Washington, Oregon and California, saw much larger impacts – up to 94%.

Cleanberry Pilot Plant Pemberton BC

Site Preliminary Evaluation

Organization: Global Energy Horizons

ICE Fund Contribution: \$40,000



Project Highlight:

Global Energy Horizon's core technology (CleanBerry) lies in the sequestration of carbon dioxide, from point sources, into deep saline aquifers, using the energy trapped in those aquifers as the energy source for running the process, and the potential co-production of electrical power and fresh water for export.

This project aimed to determine the feasibility of installing a hydrogen production facility, integrated to the CleanBerry carbon capture and storage process, in the Meager Creek geothermal area in Pemberton, British Columbia. The subsequent demonstration facility would supply hydrogen to a small growing local market and the Resort Municipality of Whistler, BC. to help the municipality meet its objective of being carbon neutral by 2030.

The project aimed to determine the cost associated with:

- the basic engineering package for an integrated hydrogen production facility, using steam methane reformer technology, and the novel CleanBerry carbon capture and storage process
- a Class 3 cost estimate for the complete installation of the process plants in Meager Creek (BC), including the associated costs for bringing natural gas into the site and hydrogen transportation to end users.

Project Status/Update: Completed in June 2020, the project has shown the benefits and feasibility of the integrated process.

2020/2021 Projects

Development of Draft Pan-Canadian Roadmap to Zero Net Carbon by 2050

Organization: Institute for Breakthrough Technology

ICE Fund Contribution: \$20,000

Partners: Pembina Institute



Project Highlight:

The Institute for Breakthrough Technology and its project partner, the Pembina Institute produced a draft pan Canadian roadmap to zero net carbon emissions by 2050 by identifying leading net zero energy pathways based on reduction in carbon intensity and economic costs of CO² averted.

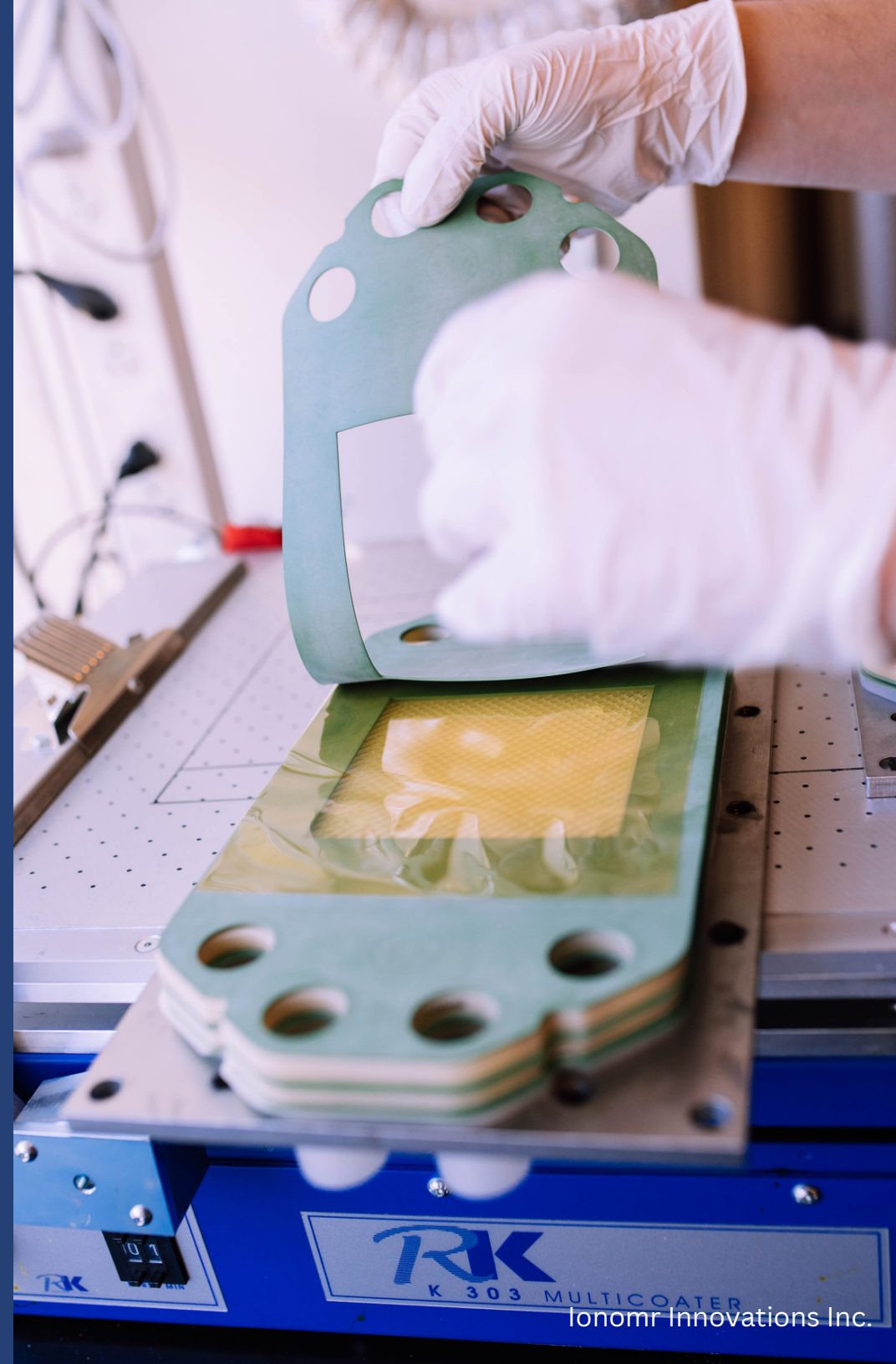
The intent of Phase 1 was to present the roadmap documents to senior federal government decision makers and other interested stakeholders in late 2021, to enable development of and support for achieving Canada's goal of Net Zero Carbon Emissions by 2050.

Concurrently, for information purposes only, the joint team identified the scope, workplan and budget for a larger program (Phase 2) that will provide at a minimum:

- Stakeholder engagement to validate the assumptions in the Draft Documents
- Detailed and definitive completion of the Draft Documents
- An assessment of regional implications
- Relevant policy recommendations

Project Status/Update: Completed in October 2021.

2021/2022 Projects



Funding to support the creation of the Centre for Innovation and Clean Energy (CICE)

Organization: Centre for Innovation and Clean Energy

ICE Fund Contribution: \$75,000 (originally \$25,000)



Project Highlight:

Funding to support a contractor to establish the BC Centre for Innovation and Clean Energy (CICE)

The Contractor must provide Strategic Advice and deliverables by:

- Reviewing Centre Business Plan and advise on how to translate high level content in to the first Strategic Plan for the Centre.
- Reviewing constating documents and advise on how to operationalize governance framework.
- Considering industry and low carbon technology stakeholders during the pre-incorporation period and provide consultation plan to Ministry for early engagement post incorporation with specific emphasis on stakeholders related to the “initial focus areas” for project funding.
- Developing initial considerations for a provincial and federal stakeholder map that identifies low carbon technology development organizations and their respective mandates.
 - Advising on where the Centre should fit within the low carbon technology ecosystem to ensure it adds value and does not compete unnecessarily with existing organizations.
 - Identifying short list of key strategic partners the Centre should prioritize building relationships during initial start-up.
- Developing an outline for a Membership recruitment strategy for Class A, Class B and Associate members based on the stakeholder map.

Project Status/Update: Completed in November 2021.

BC Hydrogen Blending Study and Technical Assessment for Enbridge-FortisBC-PNG

Organization: Enbridge

ICE Fund Contribution: \$5,000,000

Partners: Enbridge Inc, FortisBC, PNG



Project Highlight:

Enbridge, together with FortisBC Energy Inc. and Pacific Northern Gas Ltd. will undertake an assessment of blending hydrogen into their natural gas assets in British Columbia representing an entire value chain approach (gathering, transmission and distribution and end users). This feasibility assessment referred is required to lay the groundwork for safe and effective hydrogen blending, transportation, and export.

Each partner will undertake separate detailed engineering assessments of their respective pipeline systems to determine the feasibility of injecting hydrogen with the goal of creating a hydrogen deployment strategy and standard for their share of BC. gas supply chain. Given the unique aspects of their respective pipeline systems, each partner, will manage their own engineering assessment under the umbrella of the Project.

The Project will assess the hydrogen compatibility of the existing transmission, intermediate and distribution delivery networks and customers' end use equipment, processes, systems, and applications, and identify specific upgrades and other activities required for the system to continue to operate safely and reliably in the targeted hydrogen blending service.

The assessment will also identify gaps in knowledge which will provide input for research and innovation activities, as well as inform modifications to existing codes and standards. The results of the assessment will likely be confirmed through pilot projects.

Project Status/Update: Final hydrogen blending assessment is scheduled to be completed by 2025. PNG has withdrawn from the project.

Supporting for the Continuing Development of the Pacific Regional Institute for Marine Energy Discovery (PRIMED)

Organization: University of Victoria PRIMED

ICE Fund Contribution: \$300,000



Project Highlight:

PRIMED is a research lab hosted by the Institute for Integrated Energy Systems of Victoria, in the engineering department at the University of Victoria, which has been engaged in marine renewable energy (MRE) research for nearly 20 years. PRIMED is recognized as a marine commercialization centre that enables off-grid coastal communities and industries that are pursuing MRE alternatives to diesel fueled energy generation.

The Financial Contribution will be used by the UVic, in collaboration with the Ministry, to evolve the capacity of PRIMED to use its human, computational and capital resources to: advance the understanding of wave, tidal and offshore wind resources for energy conversion; create the economic foundation for a provincial marine energy sector; attract federal investment; and stimulate job creation in the value chain of technology and service companies that comprise British Columbia's (BC) ocean industries.

Over the term of this Agreement, UVic will collaborate with the Ministry to seek funding and logistics support to augment PRIMED's resources so that it can fully support the economic development of British Columbia's marine energy value chain, commercialization of marine energy technologies; and continue to provide marine renewable energy advice and support to BC coastal communities.

Project Status/Update: Project is scheduled to be completed in 2024.

Pre-Front End Engineering and Design Study for the Merritt Electrofuels Project Plant

Organization: Huron Clean Energy

ICE Fund Contribution: \$2,000,000

Project Cost: \$9,640,000

Partners: Oxy Low Carbon Ventures, Carbon Engineering,
Upper Nicola First Nations



Project Highlight:

Huron, together with its partner Oxy Low Carbon Ventures (OLCV), is seeking to build a first-of-a-kind commercial scale Direct Air Capture / Synthetic Fuels Plant to be built in partnership with the Upper Nicola First Nation near Merritt, British Columbia. The project is known as the Merritt Electrofuels Project.

Huron and OLCV will finance, design, build and operate this plant which will use carbon dioxide captured from the atmosphere and hydroelectricity purchased from BC Hydro to convert into near net zero synthetic fuels capable of being used as standard diesel, marine and aviation fuels on a “drop in” compatible basis. The plant will utilize Carbon Engineering’s (CE’s) Direct Air Capture and AIR TO FUELS™ technologies, together with third party technology partners for the balance of the plant, to produce these low-carbon fuels. Huron has an exclusive licensing arrangement with Carbon Engineering for Canada and an equity partnership and land lease arrangement for the site with the Upper Nicola First Nation.

Project Status/Update: Completed in June 2022.

Hydrogen Strategy Implementation Year 1

Organization: Centre for Innovation and Clean Energy (CICE)

ICE Fund Contribution: \$998,000

Project Highlight:

As part of the strategy of implementing the BC Hydrogen Strategy, funding was provided to CICE for the following four studies: Hydrogen Production Carbon Intensity Threshold Study; a Vancouver Region focused Hydrogen Investment Blueprint; a Regulatory Mapping Study; and a Carbon Capture and Storage BC Atlas. Completing these four studies will be of importance to move the province towards achieving its emission reduction targets as mandated under the Climate Change Accountability Act, including 40% emission reductions by 2030, 60% by 2040, and 80% by 2050 from 2007 levels.

Project Status/Update:

Completed in March 2023.



GLOBE Series 2022

Organization: Accelerating Sustainability Events Management Inc.

ICE Fund Contribution: \$5,000

Project Highlight:

The GLOBE forum is hosted in Vancouver, BC, every two years and draws the best and brightest of the international sustainable business community, making it an unsurpassed forum for learning and networking.

ICE Funding went to the GLOBE event organizer for the upcoming Destination Net Zero (DNZ) events - a three-event series culminating in GLOBE Forum 2022, the largest and longest-running sustainability conference in North America.

Project Status/Update: Event took place on October 26 & 27, 2021.

2022/2023 Projects



Hydrogen Strategy Implementation Year 2

Organization: Fraser Basin Council, BC First Nation Energy and Mining Society and City of Prince George.

ICE Fund Contribution: \$1,000,000

Other Contributors:

Fraser Basin Council Society: \$600,000

BC First Nation Energy and Mining Society: \$250,000

City of Prince George: \$150,000

Project Highlight:

As part of the plan of implementing the BC. Hydrogen Strategy, the Ministry of Energy, Mines and Low Carbon Innovation is financially contributing to the development of three hydrogen projects below:

Project 1 – Hydrogen Education and Marketing Materials

·Conduct market research to inform the development of a hydrogen safety curriculum and educational and marketing materials for target audiences that will have a specific awareness and educational campaign in Northern BC. to support communities and local industry.

Project 2 – Hydrogen in End-of-Line Communities Study

·Identify potential energy constraints for end-of-line communities, explore community interest in hydrogen, and complete a case study to examine the potential for hydrogen in various communities.

Project 3 – Hydrogen Labour and Skills Development Analysis Report

·Gap analysis to identify resources needed for hydrogen labour and skills development in BC. and relevant capacity building tools to support this development.

Project Status/Update: Projects are expected to be completed by 2024.

Contingencies 22/23

Specific funding from the Province administered by the ICE Fund in 22/23

BC Net Zero Innovation Network

Organization: Foresight Cleantech
ICE Fund Contribution: \$2,326,000
Partners: PacifiCan



Project Highlight:

Foresight will develop a series of thematic clusters throughout BC. called the BC Net Zero Innovation Network (BC NZIN) as a platform for cluster development to support cleantech innovators and adopters to compete, access capital and attract talent to grow faster, scale their ventures and get products to market. In addition, the initiative intends to advance regionally dispersed inclusive economic growth opportunities and de-risk investment decisions that support net-zero and environmental goals at the provincial and federal levels.

Project Status/Update: Project is scheduled to be completed in 2025. Foresight's BC Net Zero Innovation Network has established four sectors: Forest Bioeconomy, Mining, Transportation, Water.

Centre for Ocean Applied Sustainable Technologies (COAST)

Organization: YYJ Prosperity Association

ICE Fund Contribution: \$2,000,000

Partners: PacifiCan



Project Highlight:

The South Island Prosperity Partnership's (SIPP)'s Centre for Ocean Applied Sustainable Technologies (COAST) initiative will serve as a catalyst and cluster facilitator for the Blue Economy. The Blue Economy is a concept that seeks to promote economic growth, social inclusion and the preservation of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas. COAST is filling a gap in the west coast's ocean and marine industry as there is a need for a catalyst for innovation and solutions in the local market to act as a conduit to connect large industry players like shipping, shipbuilding and defense/aerospace, to the emerging technologies, like start-ups, small and medium enterprises (SMEs) and nascent research.

COAST will bring together key ecosystem partners including SMEs, customers, academia, partners, and innovators in the oceans sector, and will focus on clean energy, industrial decarbonization, GHG reductions, and net zero emissions via enabling technology adoption in these areas to solve industry challenges in the oceans sector.

Project Status/Update: Project is scheduled to be completed in 2026.

BC Pilot H2 Truck Project

Organization: HTEC

ICE Fund Contribution: \$16,474,000

Project Cost: \$21,400,000



Project Highlight:

The scope of the Project includes upgrading a hydrogen fueling station in Tsawwassen BC, the procurement and deployment of six prototype heavy-duty hydrogen fuel cell electric (HFCE) trucks and upgrading a hydrogen safe maintenance bay at a local facility. These vehicles will be demonstrated over a one-year period in order to validate their performance capabilities ahead of a large-scale deployment program.

The project will assist HTEC in advancing the H200 Gateway Program to bring hydrogen at scale to the heavy-duty trucking market in BC, including both fueling infrastructure and vehicles. The BC Pilot H2 Truck Project implements a pilot project in Metro Vancouver that will allow the HTEC team to test and validate the trucks and fueling infrastructure in real world operating conditions.

Project Status/Update: Project is scheduled to be completed in 2026.

Blind Channel Test Centre

Organization: University of Victoria PRIMED

ICE Fund Contribution: \$2,000,000

Funding Partners: PacifiCan, NRCan



Project Highlight:

PRIMED is a research lab hosted by the Institute for Integrated Energy Systems of Victoria, in the engineering department at the University of Victoria, which has been engaged in marine renewable energy (MRE) research for nearly 20 years. PRIMED is recognized as a marine commercialization center that enables off-grid coastal communities and industries that are pursuing MRE alternatives to diesel fueled energy generation.

The purpose of this project is to support the development of the Blind Channel Test Centre which will serve as an Integrated Test Centre to help coastal communities transition from fossil-derived diesel to community-owned renewables. The project will consist of multiple tidal turbines (deployed at different times) and other renewable energy technologies to understand the nature and variability of the resource or how the technology will perform in the west coast of Canada's operating conditions, being one of the most energetic tidal and wave climates in the world.

Project Status/Update: Project is scheduled to be completed in 2024.

SeaSense: Maritime Protection Using Zero Emission Autonomous Vessels, AI and Advanced Sensors

Organization: Open Ocean Robotics

ICE Fund Contribution: \$700,000

Project Cost: \$7,413,192

Partners: Just Innovation Inc, SMRU Consulting, Bamfield Marine Sciences Centre, SDTC



Project Highlight:

The scope of the Project is for Open Ocean Robotics to develop solar-powered un-crewed surface vehicles (USVs) which can be used autonomously and deployed to continuously monitor risks to marine life and marine security.

Open Ocean Robotics is developing two USV products called the Data Explorer and Data Voyager. The Data Explorer is a more compact vessel that is fully solar-powered and meant for non-stop ocean voyages up to 30-60 days. The Data Voyager is a larger USV designed to have more space and power for sensors.

The Province's contribution will support the construction of four Data Explorer USVs and one larger Data Voyager USV. In addition, Open Ocean Robotics will design and build a command-and-control portal for customers, improve visual and acoustic detection algorithms and develop adaptive routing algorithms.

Project Status/Update: Project is scheduled to be completed in 2024.

SDTC Joint Call

In March 2017, Sustainable Development Technologies Canada (SDTC) and the ICE Fund entered into a three-year, \$40 million partnership for the development of pre-commercial clean-energy projects and technologies focused on the reduction of GHG emissions. Both SDTC the ICE Fund have completed their \$20 million commitments, funding the following projects.



SUSTAINABLE DEVELOPMENT
TECHNOLOGY CANADA



Ministry of
Energy, Mines and
Low Carbon Innovation

Clir Renewables

ICE Fund Contribution: \$1,494,000

SDTC Contribution: \$1,494,000

Project Cost: \$8,800,000

Project Highlight: Software to increase energy production at windfarms. The project involves developing and demonstrating Clir's automated windfarm software optimization suite. Clir Renewables estimates it can improve power production at a facility by 2% to 5%

Project Status/Update: Completed in April 2021. Clir has developed a renewable energy performance management automated analysis system to improve wind farm operations. The objective of the Project is to provide tools to separate all the issues that impact the performance of wind turbines, giving wind farm owners' clear and actionable directions to improve the performance of their assets.

This Final Environmental Benefits Report was developed by SAISS Consulting Group (SAISS) on behalf of Clir. The goal of the Project was to both automate a manual wind farm analysis system, and to create a robust set of case studies showing improvements across many different turbine types and wind farms. During the Project, Clir has demonstrated their software in 92 Wind Farms around the world and provided improved achievements in 72 farms of 92. The Annual Energy Production (AEP)-gains reported range from 0.06% up to 9.18%.



Consolidated Biofuels

ICE Fund Contribution: \$875,200
SDTC Contribution: \$933,000
Project Cost: \$3,680,000

Project Highlight:

Consolidated Biofuels planned to construct and commission a 20 tonne/day polyol production plant at the existing plant facility located in Delta, BC. This plant will demonstrate the economic viability of the process for producing Liprol 260 to be sold at a favorable price compared to equivalent petrochemical polyols.

Project Status/Update: Pivoted during the pandemic to make hand sanitizer. Project was closed out before completion.



D-Wave

ICE Fund Contribution: \$2,000,000
SDTC Contribution: \$20,500,000
Project Cost: \$99,799,885

Project Highlight:

The D-Wave project planned to accelerate the development of a Next-Generation Quantum Computer. D-Wave Systems is the world's first quantum computing company and leads in development and delivery of quantum computing systems and software. Quantum computers decouple operational performance from power usage, and as a result, D-Wave computers power consumption required for equivalent results on hard problems is orders of magnitude less than large classical supercomputers.

Project Status/Update: Completed in November 2020, meeting all project objectives. Beta products were released at the end of this project and preparing for initial customer validation.



MineSense Technologies Ltd.

ICE Fund Contribution: \$2,000,000

SDTC Contribution: \$2,000,000

Project Cost: \$16,200,000

Partners: SDTC



Project Highlight:

This project aimed to continue developing and subsequently validating the MineSense's Smart SmartOre product family technologies – 3 hardware models (SmartShovel™, SmartUG™ and SmartConvey™) and the corresponding data management and analytics platform, SmartOre. The Recipient conducted challenging Environment Trials and Durability Installations on the SmartShovel and SmartUG products and one production trial on the SmartConvey product.

MineSense built off a successful previous SDTC project, which developed a scalable digital sensing platform that gives the mine equipment operator a real-time estimate of the ore grade at the point of extraction. This enables mines to optimize metal recovery while reducing carbon dioxide emissions, consumption of processing materials, energy, water, and reagents throughout the ore extraction process.

The ICE funding will help the MineSense promote and sell its scalable digital-sensing platform. The platform gives mine equipment operators a real-time estimate of the ore grade at the point of extraction and enables mines to optimize metal recovery. The predictive on-bucket technology is being demonstrated on wire-rope shovels at the Highland Valley Copper Mine

Project Status/Update: Completed in 2021, MineSense technology is now commercialized and operational in 3 mines in BC and one in South America. During 2021, MineSense began working on a service centre in Chile which will help expand business in South America. MineSense continues to work on their suite of products to help benefit mining operations.

Ionomr Innovations Inc.

ICE Fund Contribution: \$2,357,000

SDTC Contribution: \$2,357,000

Project Cost: \$8,700,000

Project Highlight:

This project was to develop alkaline anion-exchange membranes, creating a platform for efficient and cost-effective clean energy generation, storage and advanced wastewater treatment. Ionomr's membranes can be used across the clean tech sector and have significant environmental and economic advantage

Project Status/Update: Completed in September 2020. At the completion of this project Ionomr established a pilot-scale facility able to produce their aemion polymer membranes.



Arbios Biotech (Canfor)

ICE Fund Contribution: \$2,000,000

SDTC Contribution: \$13,048,000

Project Cost: \$80,757,010

Project Highlight:

Project that will convert forestry byproduct and wood waste to renewable energy for the company's Prince George kraft pulp mill business. Once successfully demonstrated in BC., the technology will then be licensed for Canadian and international use to help reach climate sustainability goals globally.

Project Status/Update: Project is scheduled to be completed 2023.



Nano One Materials

ICE Fund Contribution: \$3,033,000
SDTC Contribution: \$5,000,000
Project Cost: \$14,755,566

Project Highlight:

The Project design is based on Nano One's reactor-dryer-calcinator process, which is based on crystal nucleation in an aqueous solution at mild temperature, pH and ambient pressure.

The intent of the Project is to enable Nano One to pursue improvements to its materials performance; process optimization and third-party validation; and, to allow for testing of LFP and high nickel NMC to demonstrate its patented processing technologies for high performance energy storage materials used in lithium-ion batteries.

Project Status/Update: Nano One completed their project on schedule. They now have a commercialization hub in Quebec with their head office and innovation hub in Burnaby, BC.



RecycleSmart

ICE Fund Contribution: \$606,161
SDTC Contribution: \$1,760,576
Project Cost: \$5,386,352

Project Highlight:

Project to develop a multi sensor-driven cloud-based system that gathers data from commercial and industrial waste and recycling bins. The project will provide analysis to optimize roadside recycling service.

Project Status/Update: Project was completed in April 2022 and RecycleSmart's prototype was built and tested as planned.



Cryologistics Refrigeration Technologies

ICE Fund Contribution: \$1,439,000
SDTC Contribution: \$2,205,000
Project Cost: \$7,568,555

Project Highlight:

This is a project to develop a carbon dioxide refrigeration technology to reduce emissions in the high-value cold freight transportation sector. This technology uses liquid carbon dioxide to provide controlled cooling power within an insulated pallet container and will replace diesel refrigeration units, resulting in emission reductions, waste reductions and cost savings for high-value products, such as pharmaceuticals and seafood.

Project Status/Update: Project was completed in June 2023. Technology demonstration projects took place in British Columbia, Alberta, and Ontario throughout the duration of the project, deploying prototype units deployed at Cold Star Solutions Inc., Rosenau Transport Ltd., Wallace and Carey Inc., Federated Co-operative Ltd., TransCold Distribution Ltd., and Grimshaw Trucking LP.



Advanced Intelligent Systems

ICE Fund Contribution: \$950,000
SDTC Contribution: \$2,240,000
Project Cost: \$5,617,356

Project Highlight: This project aimed to create an electric autonomous outdoor cart puller to transport empty or loaded carts within the outdoor environment of a nursery or similar setting. The project involved the design, build and testing of three evaluation prototypes and one verification prototype as well as the development and implementation of the AIS Internet of Things Box and AIS Connect systems. The prototypes will be created in sequence, each time building on the learnings from the previous prototypes.

Project Status/Update: Advanced Intelligent Systems was not able to complete the project and it was terminated by SDTC and the ICE Fund in 2022.



ADVANCED INTELLIGENT SYSTEMS

Pani Energy Inc.

ICE Fund Contribution: \$837,800

SDTC Contribution: \$2,800,000

Project Cost: \$7,660,321



Project Highlight:

During the Project, the technology developed (Pani Digital) will be demonstrated at eight sites across Canada, the United States and Asia. Pani will lead technology development, implementation, and support while consortium partners, Aqualyng and AV Cell (Aditya Birla), will be participating as demonstration hosts.

The Project consists of three main activities:

- Core technology development (specifically the development of an onboarding process and the improvement of the forecasting, analytics, and optimization features of the software)
- On-site integration at water treatment facilities (this will provide the necessary data and experience to easily integrate data from facilities into Pani's system)
- ROI validation (to create case studies to better communicate value proposition to potential customers)

Pani anticipates creating 27 jobs in the near term and through the project, including a mixture of STEM, marketing, sales and administrative roles. In addition, building on this project Pani has initiated research and development activity with the University of British Columbia (UBC), and with local water and waste-water utilities in Nanaimo and the Capital Regional District.

Project Status/Update: Project is scheduled to be completed in 2024.

Miru Smart Technologies

ICE Fund Contribution: \$300,000
SDTC Contribution: \$4,585,978
Project Cost: \$12,296,411



Project Highlight:

Miru is developing next-generation electrochromic window technologies to provide functional, affordable, and energy-efficient dynamic window solutions to the residential and commercial building markets. HVAC (heating, ventilating, and air conditioning) and lighting in buildings account for up to 40% of global primary energy consumption, and up to half of this energy can be lost through windows. This energy loss results in both greenhouse gas emissions and high costs for building owners. Electrochromic windows are a type of “smart” window where tint can be electrically controlled and can address this energy inefficiency.

Miru will scale up the technology from current smaller prototype samples (12”x12”) by building out a pilot line capable of building insulated glazing units (2’x5’) for use in windows that utilizes Miru’s patented technology. The Project will also allow for development of precursor solutions that will allow for changes in window appearance and performance while enabling a solid-state material stack versus liquid or polymer electrolytes that will be used initially.

The funding will help the company build out a scaled-up pilot line in order to optimize the process technology, develop new innovative material stacks, perform reliability/durability testing and prove the technology out for their own manufacturing (or via joint venture) and/or licensing to existing insulated glazing unit manufacturers.

Project Status/Update: Project is scheduled to be completed in 2024.

Ecoation Innovation

ICE Fund Contribution: \$200,000

SDTC Contribution: \$6,417,804

Project Cost: \$17,944,393



Project Highlight:

Ecoation's proprietary OKO and IRIS robots use sensors and cameras for data capture. The OKO is mounted on a scout-driven cart whereas the IRIS robot provides independent data acquisition of in-row data acquisition by working autonomously. The Ecoation platform consists of the aforementioned robots and Software-as-a-Service (SaaS) to provide full functionality for integrated pest management, crop work quality check and yield assessment.

The Project will demonstrate the technology platform's 'Find' capabilities at two different tomato greenhouses in Delta, British Columbia and Leamington, Ontario and collect data that is needed for enhancing the machine learning function of the platform. This includes measuring and documenting the impact of this new approach to crop production, reduction of pesticide and fertilizer use, as well as impacts on the emission of biological volatile organic compounds (BVOCs) and greenhouse gases (GHGs). In addition, Ecoation will also expand the capabilities of their technology platform to enable a full Farming as a Service (FaaS) solution - a complete "find and fix" system to address anomalies in the greenhouse environment and respond with a holistic diagnostic, prescription, and treatment approach.

Project Status/Update: Project is scheduled to be completed in late 2023.

Terramera

ICE Fund Contribution: \$1,000,000
SDTC Contribution: \$7,946,010
Project Cost: \$25,000,000

Project Highlight:

Terramera will develop a low-cost soil carbon surveying technology that integrates hyperspectral, aerial, and on-ground sensing tools with other data sources. This will provide a standard for consistent soil carbon quantification across Canada, opening a new and stable market for nature-based soil carbon credits and allowing farmers to be incentivized for the carbon they sequester.

Project Status/Update: Project is scheduled to be completed in 2024.



Axine Water

ICE Fund Contribution: \$1,000,000
SDTC Contribution: \$6,220,000
Project Cost: \$17,079,375

Project Highlight:

Axine Water is developing their second-generation wastewater treatment system which include step change improvements in hardware and software aspects of the system.

The key hardware element is a new reactor configuration in which multiple reactor groups, each containing a unique electrode type, is used to treat different parts of a treatment curve, as opposed to the first generation configuration in which only reactors with single electrode type are used to treat the entire stream.

The key software element involves new sensors and data analytics which can be used to generate system control responses.

Project Status/Update: Project is scheduled to be completed in 2024.



Open Ocean Robotics

Organization: Open Ocean Robotics

ICE Fund Contribution: \$800,000 in 21/22, \$250,000 in 22/23

SDTC Contribution: \$2,820,000

Project Cost: \$7,413,192

Project includes \$700,000 in contingency funding



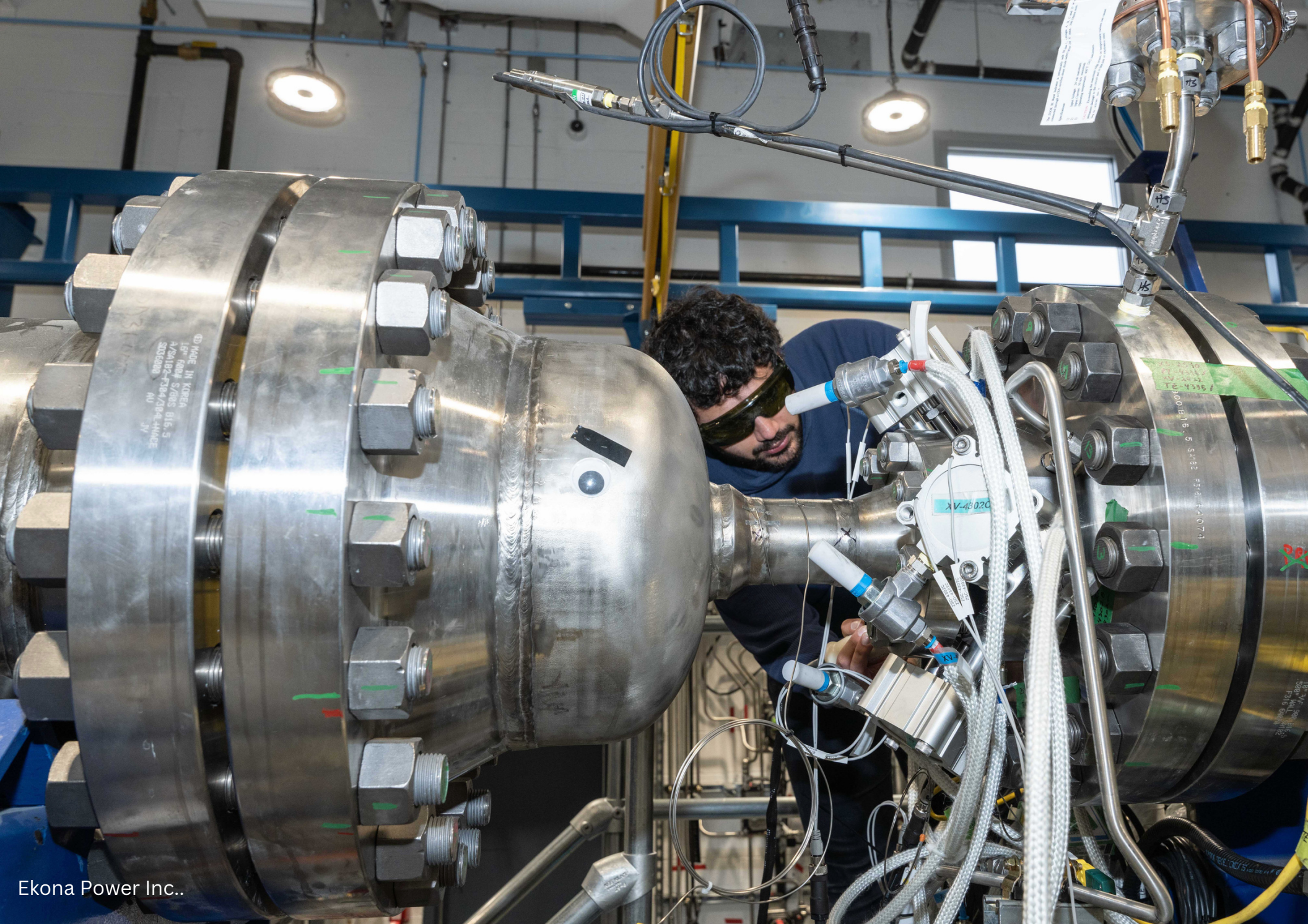
Project Highlight:

The scope of the Project is for Open Ocean Robotics to develop solar-powered un-crewed surface vehicles (USVs) which can be used autonomously and deployed to continuously monitor risks to marine life and marine security.

Open Ocean Robotics is developing two USV products called the Data Xplorer and Data Voyager. The Data Xplorer is a more compact vessel that is fully solar-powered and meant for non-stop ocean voyages up to 30-60 days. The Data Voyager is a larger USV designed to have more space and power for sensors.

The Province's contribution will support the construction of four Data Xplorer USVs and one larger Data Voyager USV. In addition, Open Ocean Robotics will design and build a command-and-control portal for customers, improve visual and acoustic detection algorithms and develop adaptive routing algorithms.

Project Status/Update: Project is scheduled to be completed in 2024.



Ekona Power Inc..



Ministry of
Energy, Mines and
Low Carbon Innovation

Contact Us: icfund@gov.bc.ca