ANNUAL REPORT

2024-2025

CanmetENERGY in Varennes

A Government of Canada clean energy research centre

Natural Resources Canada
Ressources naturelles Canada

Canada

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Message from the **Director General**

In 2023, greenhouse gas (GHG) emissions in Canada totalled 694 Mt CO_2 eq., representing a 0.9% decrease compared to 2022 and an 8.5% decrease compared to 2005. We still have five years to reach our target of reducing emissions by 40–45% compared with 2005. The energy sector accounts for the bulk (81%) of Canada's GHG emissions.[1]

At first glance, the implementation of climate strategies such as emissions reduction, adaptation, resilience and green financing can have various positive or negative effects on resolving the trilemma[2] of achieving energy security, energy equity and environmental sustainability for all Canadians. For example, the use of renewable energies, which are more costly but necessary to reduce emissions, may be detrimental to energy equity, but can be made possible thanks to green financing.

Rather than dealing with one or other dimension of the same problem, we need to adopt a holistic and creative approach, combining geopolitical, economic, societal, regulatory and technological issues, in an increasingly dynamic regional and global context.

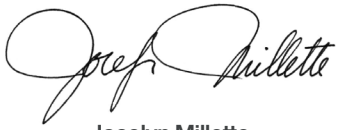
Research and development (R&D) players in energy science and technology, such as our laboratory, need to understand and anticipate this constantly changing environment if they are to develop the technologies and knowledge needed to help all players in this ecosystem make informed decisions and understand the effects of these decisions. This is the environment in which we are positioning ourselves, in collaboration with our partners, to create and materialize value today, while planning and preparing the science of tomorrow.

The 2024–2025 period was year two of our five-year scientific plan (2023–2028). We have continued our work to increase the production of renewable energy in electricity grids, in a context of massive electrification of fossil fuels, which will require 1.6 to 2.1 times more electricity and 2.2 to 3.4 times more installed capacity.[3] Since energy efficiency remains one of the main levers for reducing GHG emissions, we have continued our work in the fields of industrial processes and buildings. Our work on CO_2 capture, utilization and storage (CCUS) and on clean fuels is aimed at reducing GHG emissions in applications that are difficult to electrify or decarbonize.

We are working at the technology as well as the national value chain levels, training highly qualified personnel,[4] producing scientific papers, contributing to the development of codes and standards, transferring our technologies and knowledge to Canadian industry, producing and disseminating tools and software, modelling major Canadian energy systems and supporting the establishment of government policies and programs.

The R&D infrastructure modernization and development projects launched in 2024–2025 will continue this year and in subsequent years, and will help increase our microgrid and high-performance computing capacities. The succession plan launched this year will be enhanced by an innovation plan designed to identify the areas of scientific expertise required for the short, medium, and long-term development of our human resources.

Please review the results of this year's activities on the following pages, and contact us if you require further information or would like to work with the centre.



Jocelyn Millette
Director General

1 https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/sources-sinks-executive-summary-2025.html
2 https://www.worldenergy.org/transition-toolkit/world-energy-trilemma-framework
3 Caroline Lee, Jason Dion and Christiana Guertin. 2022. *Bigger, Cleaner, Smarter: Pathways for Aligning Canadian Electricity Systems with Net Zero.* Canadian Climate Institute.
4 Students represent 10% of our payroll.

Looking Forward to a Green Future

Although our scientific plan extends to 2028, we are adapting our activities to changing needs and the evolving Canadian context. In addition to the 13 projects funded by the Program of Energy Research and Development (PERD) and the Energy Innovation Program (EIP), projects involving CCUS, hydrogen and clean fuels have been added. Also of note are projects carried out in collaboration with the forest sector, the Treasury Board Secretariat (Greening Government Operations) and the Department of National Defence. All these projects are coordinated around a common vision and mission, with competent, interrelated teams, so that Canada becomes "an energy superpower in both clean and conventional energies."[5]

In the years to come, we will:

- continue to work on technology and knowledge development and study and improve transfer mechanisms to deliver results throughout our five-year plan, helping the beneficiaries of our activities make "no-regrets" decisions more quickly, while avoiding stranded assets;
- upgrade our test and development facilities, including our electrical and thermal microgrid to around 250 kWe, our high-performance computing capabilities to support artificial intelligence (AI) applications, and our air-to-air, air-to-water, geothermal and cold-climate heat pump installations;
- leverage our energy system modelling capabilities to help reduce GHG emissions and support energy security and prosperity at the community, provincial, and national levels;
- ensure internal and external training and scientific succession in key areas so that we can fulfill our mandate. This 5-, 10- and 15-year innovation plan will be based on forecasting exercises and consultations with the scientific community, with the aim of forecasting changes in the social, economic and geopolitical environment over the coming years.

We are well aware of the magnitude of the task ahead, and are open to work with organizations that share our mission.

5 Mandate Letter | Prime Minister of Canada

Who **We Are**

Clean Energy | Research | Innovation | Leadership

The **CanmetENERGY in Varennes (CEV) research centre**, located on Montreal's south shore, is part of Natural Resources Canada's Energy Efficiency and Technology Sector (EETS).

With over 180 researchers, engineers, technologists, managers and support staff, we lead research and development (R&D) activities and deliver programs aimed at developing clean and efficient science and technology for a low-carbon future.

We collaborate with partners from non-governmental organizations, academia, industry, and all levels of government.

We strive to put science at the service of all Canadians.

Our **Values**

At the core of our decisions and actions lie the excellence and scope of our work, the accountability of public funds and resources, great and efficient teamwork, as well as the well-being, development and motivation of our employees. We value diversity within our team for a healthy, respectful, inclusive and creative work environment.

Our Impact and **Scientific Productivity**

We use several means to communicate and disseminate our science. The results of our R&D activities are namely:

- Presented in international conferences
- Published in reports and scientific journals
- Integrated in several codes and standards
- Included in new patented technologies
- Taught in university courses, workshops and training sessions
- Highlighted in posters, videos, brochures and other promotional material
- Deployed in our software tools, federal government facilities, and remote communities not connected to the power grid
- Shared in television reports, radio interviews, articles published on the Natural Resources Canada website, and posts on our social media platforms

Our work is focused on a successful energy transition and the achievement of GHG emissions reduction targets. Our science and conclusive data enable us to:

- Support government policy decision-making
- Develop national strategies and guidelines
- Provide technical expertise to public deployment programs
- Foster technological innovation in Canada's various sectors

Our Areas **of Activity**

Our facilities are equipped to develop, test and demonstrate clean energy solutions in real-world conditions to enhance their market uptake. Our activities and expertise in various sectors include:

BUILDINGS	INDUSTRIAL SYSTEMS OPTIMIZATION	RENEWABLE ENERGY INTEGRATION	RETScreen
Renewable heating and cooling systems	Eco-efficient processes for deep decarbonization	Transition to high renewable integration on the grid	RETScreen Expert
Intelligent buildings operation	Advanced biorefinery processes and decision support systems	Smart grid and microgrid control for resilient power systems	RETScreen Innovation Lab
Energy systems for northern and remote infrastructures	Artificial intelligence for energy-efficient process industry	Smart cities and communities	RETScreen Data Onboarding
Greening Government services and expertise	Training in energy optimization and data analytics	Distributed energy resource assessment and technology	RETScreen Capacity Building

Structure & **Annual Budget**

SOURCE OF FUNDS

$18.1M
NRCan Research and Development Programs

$3.1M
Other Government Departments (OGDs)

$1.7M
Vote-Netted Revenue (VNR)

$5.6M
Core Budget (A-Base)

DISTRIBUTION OF FUNDS

R&D PROGRAMS	STRATEGIC & OPERATIONAL	DEPLOYMENT
Buildings 25 employees $4.4M	**Science Impact Unit** 4 employees $0.5M	**RETScreen** 23 employees $2.8M
Industry 43 employees $4.6M	**Scientific Outreach** 4 employees $0.2M	**Greening Government Operations (Buildings division)** 10 employees $1.8M
Renewable Energy Integration 40 employees $4.6M	**Operations** 21 employees $4.8M	**Energy Systems for Northern & Remote Infrastructures (Buildings division)** 9 employees $2.8M
Test Benches 8 employees $1.9M		

In millions of dollars, including salaries, benefits, operations, and maintenance.
Excludes student salaries of $0.9M. Full-time equivalent (FTE).

Overview of our science and technology activities carried out during the 2024-2025 fiscal year

BUILDINGS

Our Buildings division carries out R&D activities and deploys energy efficiency, renewable energy integration and smart electrification solutions and technologies for the decarbonization of buildings. Our activities aim to support Canada in achieving its GHG emissions reduction targets to achieve net-zero emissions by 2050.

Renewable Heating and Cooling

Accelerating heat pump adoption

Heat pumps play a vital role in building electrification and heating decarbonization. **Techno-economic simulation studies on cold-climate air-source heat pumps** in the Canadian residential sector were conducted to identify adoption barriers, quantify regional benefits and develop strategies to increase their uptake. We collaborate with the Office of Energy Efficiency (OEE) on initiatives to promote the adoption of air-source and ground-source heat pumps in commercial and institutional buildings. We have developed recommendations for sizing cold-climate heat pumps in the residential sector across all Canadian regions.

KEY OUTCOMES

The **techno-economic simulation studies** informed the **requirements of the Canadian Greener Homes Initiative and a heat pump sizing guide**. The studies also enhanced understanding of the increase in electricity demand, addressing questions about other aspects of decarbonization. A two-year project with the OEE is underway to increase heat pump penetration in commercial and institutional buildings, evaluating the technical and economic potential of cold-climate air-to-air heat pumps in rooftop units and updating design guides and training materials for ground-source heat pumps.

CO_2 heat pump with ejector

Transcritical CO_2 heat pumps are **increasingly used in a variety of heating and cooling applications in buildings**. Integrating a two-phase ejector as an expander improves the performance of a heat pump, especially at low-source temperatures. The ejector is a simple device with no moving parts, which allows high pressure to entrain and compress a lower pressure stream.

KEY OUTCOMES

Ongoing experimental work has quantified ejector benefits for multiple heating applications requiring different temperatures, such as space heating with radiant floor systems (25°C to 37°C), low-temperature hydronic loops (37°C to 50°C) and domestic hot water production (50°C to 60°C). Measured benefits include performance increases (up to 18%) and capacity increases (up to 20%). Operational and control knowledge has been developed to **maximize gains**. Our team of experts **assists Canadian CO_2 system manufacturers in enhancing competitiveness** by offering more efficient CO_2 systems.

CO_2 thermal network

The CO_2 Thermal Network developed by CEV is **expected to greatly improve the way thermal energy is used, recovered and distributed** in commercial and institutional buildings. This innovative technology comprises a single pipe that circulates two-phase (liquid-vapor) CO_2 as a heat carrier fluid. Heat pumps connected to the CO_2 loop provide heating or cooling to the different zones of a building or building cluster.

KEY OUTCOMES

Ongoing experimental work **has developed and tested control sequences crucial** for achieving targeted performances. Discussions are underway with Canadian companies interested in commercializing the technology, which is patented in Canada and the United States.

Highlights

› Our team, in collaboration with other federal entities, successfully implemented a high-temperature heat pump in a forestry building in Quebec City. This is the first project of its kind in a federal building. The project serves as a technology showcase with significant reproducibility potential.

New research activity

› A new project aimed at **improving the energy efficiency of federal urban energy systems** will be funded starting in 2025 by the Greening Government Fund—an initiative that supports the greening of federal operations. Control strategies to optimize steam pressure in systems equipped with natural gas boilers, thereby reducing fuel consumption and GHG emissions, will be developed under this project.

CO_2 vertical thermosiphon to extract ground heat

This passive technology is particularly interesting for **improving building heating efficiency and maintain permafrost under buildings in northern remote communities**.

KEY OUTCOMES

Test bench results have **validated the simulation models** and **confirmed the potential applications of this technology**, particularly regarding permafrost maintenance with heat recovery to preheat supply air for building ventilation. A collaboration with Université Laval's Centre for Northern Studies (CEN) has been established and is aimed at conducting a demonstration project in a new building of the CEN in Northern Quebec.

High temperature heat pump for building retrofit

Many buildings in Canada's building inventory use a high-temperature (80-90 °C). Existing, new and emerging heat pump technologies that make it possible to achieve these temperatures in a cascade system or by using heat waste offer a **solution for the electrification of these buildings**.

KEY OUTCOMES

A high-temperature heat pump demonstration project is underway in an NRCan building. The technology was previously tested in our facilities. The project is part of a **technology showcase** and will **support the market entry of Canadian equipment manufacturers** we assist in their technological development.

Heat pumps combined with thermal storage

Integrated heat pump and thermal storage solutions for buildings enable **storing excess thermal energy provided by the heat pump** during low building load periods, **then using the stored energy to supplement or entirely replace heat pump operation** during peak periods. Benefits include increased building flexibility to reduce electricity consumption during peak periods, reduction (and in some cases, elimination) of auxiliary heating systems using fossil fuels or less efficient electric baseboards and, lastly, reduction of investment required for upgrading building electrical infrastructure.

KEY OUTCOMES

Work in this new research area has made it possible to **evaluate, through modeling and simulation, heat pump solutions** using phase change materials as thermal storage units. A test bench is under development to test these solutions.

Data-Driven Building Operation **for Increased Energy Efficiency, Flexibility and Resiliency**

Advanced controls to reduce energy consumption and GHG emissions and improve energy flexibility

Supervisory control strategies based on simplified energy models have been developed to reduce **natural gas consumption in buildings** heated by natural gas and electricity. Results will be presented at CISBAT 2025: The Built Environment in Transition.

Operational data-driven controls have been developed **to enable central cooling systems to dynamically adapt** to building cooling demands to minimize electricity consumption. Results will be presented at COBEE 2025: Conference on Building Energy and Environment.

In collaboration with Polytechnique Montréal, control strategies have been developed and simulated for a portfolio of 2,400 residential buildings **to reduce peak heating-related demand**. Results were presented at eSim 2024, a conferenced organized by the International Building Performance Simulation Association.

KEY OUTCOMES

Heating energy costs are reduced by 22% and GHG emissions by 73%, without compromising thermal comfort. Electricity consumption of central cooling systems is reduced by 19%. Furthermore, residential building heating-related peak demand is reduced by 15% to 25%.

Deployment and dissemination of knowledge

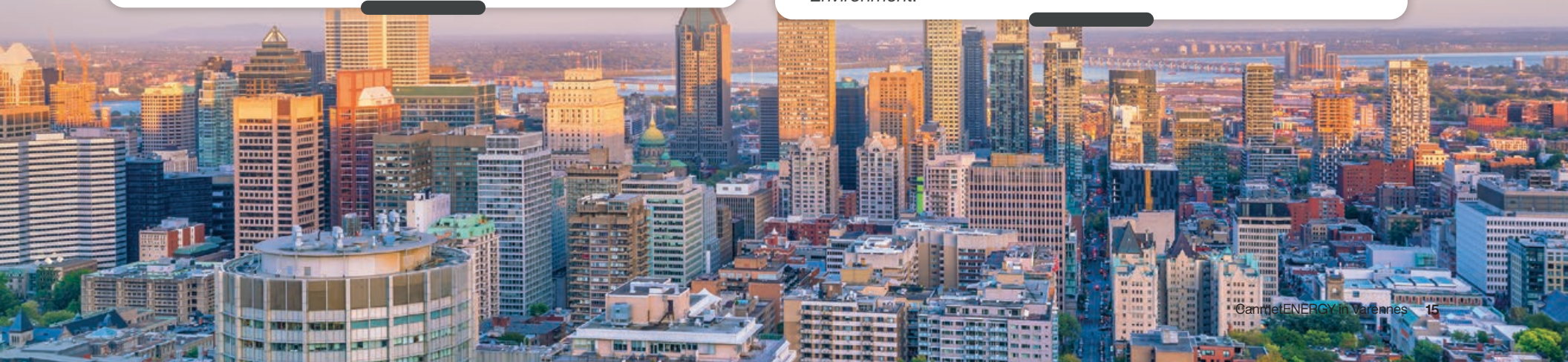
An advisory committee composed of private sector companies was formed to **accelerate the adoption of products developed by the Smart Buildings team** and thereby increase the impact of knowledge developed through our R&D projects.

Members of the Buildings division granted an interview to Voir vert magazine about the **role of artificial intelligence in the energy transition of buildings**.

At the 5-in-5 event organized by the *Réseau Énergie et Bâtiments*, members of the division **presented the CanmetENERGY in Varennes research** on energy flexibility in residential communities and energy efficiency in commercial and institutional buildings.

KEY OUTCOMES

- Simplified software tools have been developed to facilitate the reduction of GHG emissions from heating systems equipped with electric or natural gas boilers. These tools have been transferred to private sector partners for evaluation and proposals for improvement.
- A scientific article emphasizing the importance of selecting appropriate evaluation methods for energy savings resulting from the implementation of new control strategies has been published in the journal *Building and Environment*.



Reducing Diesel Dependence of **Remote Infrastructures**

Operational energy efficiency – NATO Science for Peace and Security Project

The benefits of reducing diesel dependence in military camps extend beyond GHG emission reductions. They include enhanced resilience, reduced fuel convoy requirements and, potentially, faster mission execution.

A project funded under NATO's Science for Peace and Security Program has been initiated to **develop tools and demonstrate their energy efficiency in deployed camp scenarios**. This three-year project also assists Ukraine in developing optimization tools to rebuild and enhance the resilience of its national electricity grid. It is a collaborative effort involving Canada, Belgium, Denmark, France, Lithuania, the Netherlands, Slovenia, Ukraine, the United Kingdom and the United States.

KEY OUTCOMES

The project will explore opportunities to improve interoperability among allies by demonstrating methods to **reduce emissions associated with diesel in deployment operations**. The project began in February 2025 and is funded for three years.

Low power energy solutions for remote surveillance

This project demonstrated that a **direct methanol fuel cell** with solar photovoltaics, a battery energy storage and a wind system had the **capability of operating autonomously** through the polar night in the Arctic.

KEY OUTCOMES

The results **advanced scientific efforts in the field of power generation and sustainment in the Arctic**. Operating through the polar night was never demonstrated and accomplished before using this type of system, which now provides a new option.

Energy efficiency assessments for the Royal Canadian Navy

Several studies were conducted to **improve the operational effectiveness of the Royal Canadian Navy platforms**. The project is conducted in collaboration with Defence Research and Development Canada (DRDC) – Atlantic and the National Research Council Canada (NRC).

KEY OUTCOMES

An energy audit was performed on the Halifax-class combat ship of the Royal Canadian Navy and, for the first time, a detailed dataset on the destination of major electrical flows was collected. Data analysis led to the **development of an energy model** to formulate energy efficiency recommendations aimed at **reducing fuel consumption and improving decision-making**. Various ships have also been selected for evaluating electrification potential.

Greening **Government Operations**

CanmetENERGY in Varennes (CEV) and the Office of Energy Efficiency (OEE) are mandated by the Centre for Greening Government (CGG) of the Treasury Board of Canada Secretariat (TBS) to **provide support to federal departments in achieving the GHG emissions reduction targets** set by the Greening Government Strategy. These support services are provided as part of Greening Government Operations. In 2024-2025, our centre contributed to this program in several ways, namely by:

- **supporting twelve departments, agencies and Crown corporations in their decarbonization process**, including through energy performance contracts and existing building commissioning (CxBE) projects, or to assess or determine energy efficiency and GHG emissions reduction measures;
- **developing and implementing tools and guides** in collaboration with the OEE, including fact sheets, brochures, videos, templates and web content covering various aspects of CxBE;
- **exploring various avenues that will enable CEV to demonstrate leadership in energy management and GHG emissions reduction**, including initiating the implementation of Standard ISO 50001 under the OEE's ISO 50001 READY program, evaluating various projects to achieve carbon neutrality and launching fault detection and diagnostics (FDD) activities as part of deploying an advanced software solution;
- securing funding from the Greening Government Fund to develop an assessment tool that defines an **index reflecting a building's readiness for electrification**, in collaboration with Parks Canada;
- **Facilitating the adoption of various approaches and technologies** through conferences, interviews, university training, and participation in technical committees, standards development, and TBS-CGG working groups.

Highlights

- Supporting a GHG emissions reduction opportunity for NRCan's ARMCO building: replacing end-of-life standard ventilation units with units equipped with heat pumps
- Participating in the ASHRAE working group on building decarbonization for the development of a guide titled *Decarbonizing Building Thermal Systems: A How-to Guide for Heat Pump Systems and Beyond*
- Interviews for *Voir* vert magazine focusing on the continuous evolution of building intelligence and how to fully leverage it, as well as on cold-climate heat pumps and models for the commercial market
- Presentation on CxBE at the National Conference on Building and Facility Operations (NCBFO)

INDUSTRIAL SYSTEMS OPTIMIZATION (ISO)

Our division offers a broad range of expertise and is uniquely positioned to tackle complex problems related to large-scale energy systems optimization. We provide Canada's energy-intensive industrial sectors with holistic system design tools and knowledge to improve their global efficiency, increase their competitiveness and reduce their environmental footprint.

Carbon **capture, utilization and storage (CCUS)**

National CCUS Assessment Framework

The product of a collaboration with CanmetENERGY in Ottawa and different Canadian stakeholders, this decision-support platform **helps governments and industry improve their planning of CCUS projects**. The platform considers costs and technological performance across the entire CO_2 value chain, including capture, transportation and storage, as well as the impact of policy decisions.

KEY OUTCOMES

A cutting-edge CCUS value chain optimization model was developed to identify cost-effective plans for connecting CO_2 emitters with storage reservoirs using pipelines, ships, trains and trucks. This multimodal model enabled a preliminary **strategic assessment of CCUS in Eastern Canada** (Ontario, Quebec and the Atlantic provinces), considering 70 major industrial emitters, promising storage sites and multimodal CO_2 transportation options. Many stakeholders in CCUS planning requested applications tailored to their provincial context.

Advanced CCUS technologies and systems

High-performance carbon capture technologies that reduce energy consumption and costs are critical for the large-scale deployment of CCUS. Advanced process designs that combine efficient solvents with innovative equipment and process configurations aim to **significantly improve energy and mass transfer while lowering costs**.

KEY OUTCOMES

Our studies confirmed that certain solvents, such as piperazine (PZ), and new process configurations, like Lean Vapor Compression and Stripper Overhead Compression, can reduce energy consumption and cost by up to 20% compared to monoethanolamine (MEA) carbon capture. Integrating **high-temperature heat pumps** (HTHP) and **mechanical vapor compression** (MVR) further improves energy efficiency through waste heat recovery, eliminating the need for external steam. **Rotary packed bed** (RPB) absorbers and strippers significantly reduce both the capture unit's footprint and the amount of solvent required.

Carbon Capture Modeling and Costing Tool

Our team is developing a decision support tool to quickly and accurately **predict the design, performance and cost of different carbon capture technologies** across a wide range of flue gas conditions and capture rates, applicable to most industrial and power plant settings.

KEY OUTCOMES

Process models, including flue gas conditioning, CO_2 separation and compression, were developed using Aspen Engineering Suite for two amines-, cryogenic-, membrane- and enzymatic-based capture technologies. Validated with literature/vendor data, these models were run tens of thousands of times across diverse flue gas conditions. The resulting datasets **trained powerful machine learning (ML) models** with prediction errors under 5% for key design parameters. The capture cost was calculated for 180 industrial facilities emitting over 300,000 tonnes of CO_2 annually across multiple sectors, contributing to **Canada's first nationwide CCUS study**.

Industrial Decarbonization **Powered by Artificial Intelligence (AI)**

AI-based carbon capture process design acceleration and optimization

An AI-assisted approach using causal incremental reinforcement learning (CIRL) has been developed to **optimize chemical process design**. This method integrates an intelligent agent with process simulators to guide and accelerate multi-objective design optimization.

KEY OUTCOMES

The approach was successfully tested on a representative MEA absorption-based carbon capture process, achieving 8% cost reduction compared to standard design methods. It also enhances the scalability of decarbonization technologies, **supporting broader adoption for climate change mitigation**.

Enhanced predictive modeling of materials and products for decarbonization applications

A novel modeling methodology using an ensemble of ML techniques and available datasets was developed to **predict novel material and product properties**.

KEY OUTCOMES

The developed ensemble model **outperformed the best-performing individual ML model by 10%**, achieving 99% accuracy in predicting the Hansen Solubility Parameters (HSP) of lignin using SMILES codes. This methodology can be applied to various chemical analytics beyond HSP prediction.

Advanced modeling for enhanced forest yield prediction

A **forest yield prediction model** using Polygon Generation (PG) and Deep Learning (DL) techniques was developed. The model integrates harvester data, satellite & ALS metrics and weather conditions.

KEY OUTCOMES

Applied to different ecoregions in New Brunswick, the model improved forest yield prediction by 17% compared to available models, achieving 76% accuracy and demonstrating its potential to **improve forest value chain sustainability**.

Improved forest biomass inventory estimation tool

An advanced deep neural network-based tool was developed to more **accurately estimate forest biomass attributes**.

KEY OUTCOMES

The tool allowed a 22% improvement in tree biomass estimation (R^2 increased from 0.63 to 0.76) and enhanced tree species identification by 38% (accuracy increased from 45% to 62%) compared to most popular tools. This tool will enable **more accurate forest value chain planning**.

Powerful decision support tool for log transportation scheduling and routing

State-of-the-art models and algorithms were developed for **a decision support tool to optimize log truck routing and scheduling** in wood supply allocation and transportation.

KEY OUTCOMES

The tool was successfully applied to a large Canadian forest company's transportation network, **achieving a 20-30% reduction potential in GHG emissions** across different scheduling horizons.

Clean Fuels

Integrated Biorefineries Mission Innovation: bio-SAF production

A collaborative project between Canada and Brazil established a methodology for harmonizing the techno-economic assessment and calculation of carbon intensity to produce bio-based sustainable aviation fuels (bio-SAFs). The project considers regional specificities relating to the type of biomass, supply and distribution logistics, and country-specific operating costs.

KEY OUTCOMES

A daily production of 2,000 barrels of bio-SAF was set for benchmarking performance indicators. Five harmonized indicators were defined: thermal efficiency, return on energy investment, minimum selling price, carbon intensity and the GHG emissions abatement cost. The regions with abundant and diversified biomass sources and low-carbon electricity are better positioned to produce bio-SAF.

Hybrid production of sustainable aviation fuels (SAFs): an innovative approach

This approach, validated for a case study in Quebec, combines biomass gasification (490,000 dry tonnes/year), water-gas shift reactions and Fischer-Tropsch synthesis to produce bio-SAF and downstream upgrading with CO_2 recovery to produce e-SAFs. It addresses the challenges of limited biomass availability and the need for low-carbon, scalable and flexible SAF production.

KEY OUTCOMES

The biomass gasification produced 2,176 barrels of bio-SAF per day, as well as 913 barrels of renewable naphtha and additional electricity. Flue gases contain 1,136 tonnes of biogenic CO_2 per day. Hybrid bio-SAF and e-SAF production, with a CO_2 capture rate of 95%, enabled an additional 2,000 barrels of e-SAF daily, which represents a 92% increase in production over the bio-SAF pathway alone. This process also produced an additional 717 barrels of naphtha per day.

Awards, Agreements and **Knowledge Dissemination**

- Obtained a two-year CIFAR AI Catalyst Grant in partnership with AMII (Alberta Machine Intelligence Institute) to work on accelerating the design of catalytic materials and CO_2 conversion processes.
- Active member in the Quantum-Sustainability Working Group and at the AI for Climate Change Working Group.
- Participation and representation at the IEA IETS, IEA Bioenergy and Hydrogen Technology Collaboration Programs Tasks (IEA-IETS Tasks XI, XVIII, XVII and XXI, and IEA-Bioenergy Tasks 39, 42 and 43).

Hydrogen

Techno-economic assessment of hydrogen production

In collaboration with CanmetENERGY in Devon, four hydrogen production pathways were analyzed: methane pyrolysis, steam methane reforming (SMR) with and without CO_2 capture and storage, alkaline electrolysis and solid oxide electrolysis. The study examined the GHG abatement cost and hydrogen selling price in Alberta, Quebec and Ontario.

KEY OUTCOMES

SMR, a technologically mature process, has the lowest capital cost at$6.3/kg H_2, compared to $9.5/kg H_2 for methane pyrolysis and $11.3/kg H_2 for electrolysis. The viability **of electrolysis technologies** depends on investments and electricity prices, which account for 70-82% of operating costs. In Alberta, production costs range from $9.9/kg to $12.3/kg H_2. In Quebec, it ranges from $4.9/kg to $6.4/kg H_2. Despite its lower cost, SMR remains the least environmentally sustainable option.

Harmonized life cycle assessment (LCA) for hydrogen carbon intensity

The methodology developed through a collaboration with the National Research Council (NRC) and the CanmetENERGY centre in Devon ensures consistency in scope, inventory criteria and data quality. Six hydrogen production pathways were compared against the Clean Hydrogen Investment Tax Credit thresholds.

KEY OUTCOMES

The carbon intensities of alkaline electrolysis (1.2 kg CO_{2eq}/kg H_2) and PEM electrolysis (1.3 kg CO_{2eq}/kg H_2) in Quebec meet the threshold of 0.75-2 kg CO_{2eq}/kg H_2, qualifying for a 25% tax credit. In Alberta, autothermal reforming (4.4 kg CO_{2eq}/kg H_2) and steam methane reforming (10.1 kg CO_{2eq}/kg H_2, or 4.9 with capture) exceed this threshold. Biomass gasification with carbon capture (0.3 kg CO_{2eq}/kg H_2) could qualify for up to a 40% tax credit.

Multicriteria analysis tool for green hydrogen

A multicriteria analysis tool was developed to prioritize the use of green hydrogen in the industrial sector. The key criteria considered include greenhouse gas (GHG) reduction per unit of energy input, energy penalty, the availability of alternative solutions to hydrogen and technical and economic factors.

KEY OUTCOMES

The replacement of grey hydrogen in refineries, diesel in heavy trucks and reforming gas in steel plants were among the applications studied. Only a limited number of applications offer GHG reduction potential comparable to direct electrification. In low-carbon intensity grids, direct electrification applications offer GHG reductions from 200 to 500 CO_{2eq}/MWh, compared to 120 to 300 CO_{2eq}/MWh for green hydrogen decarbonization projects.

A Partnership for **Improved Decarbonization**

Collaboration agreement with the Quebec provincial government

We have maintained a fruitful collaboration on energy transition and decarbonization with the Quebec government for over a decade. A new partnership agreement has been signed for the 2024-2028 period, allowing us to continue developing tools and knowledge to facilitate the achievement of Quebec's decarbonization goals.

KEY OUTCOMES

This partnership will support the development of detailed energy inventories for the province's major industrial sectors, enabling a clearer understanding of energy consumption patterns. It will also facilitate the establishment of decarbonization scenarios, the estimation of the potential for electrification and bioenergy uses in the industrial sector as well as the assessment of opportunities for green hydrogen utilization to further advance the province's energy transition efforts.

Industrial Decarbonization

Pulp and paper sector

KraftSIM was launched on NRCan's website in 2024, showcasing high-efficiency technologies for energy-intensive pulp and paper (P&P) subprocesses. These technologies **lead to fossil fuels and biomass savings as well as emission reductions**. The platform models various decarbonization and production diversification pathways.

KEY OUTCOMES

Ten new technologies were integrated into a representative Canadian Kraft mill. KraftSIM was upgraded to include a condensing turbine, improved white liquor chemistry control, black liquor and biomass gasification for NH_3 production and calcium looping for CO_2 capture. Upcoming additions for 2025-2026 include amine-based carbon capture, methanol production from gasified black liquor and biomass and methanol production from contaminated condensates. KraftSIM is currently in use by several Canadian mills and research centers.

Electrification of industrial processes

The **electrification opportunities were analyzed and characterized by their technological maturity** in the sectors of pulp and paper, refineries, steel plants, aluminum smelters, alumina production, cement, whitewash, iron ore extraction and pelletizing, as well as gold and silver mining. These sectors generate 99 megatonnes (MT) of GHG emissions annually, from their use of electricity, biomass, fossil fuels and industrial processes.

KEY OUTCOMES

These opportunities **could reduce fossil fuel consumption by 710 PJ/year and GHG by 40 MT of CO_2/year**. They would require an additional 50 TWh of electricity per year. Taking only mature technologies into account, the reduction would equal 435 PJ/year and 23.5 MT of CO_2 emissions/year, for an additional 28 TWh of electricity.

Iron and steel sector

Traditional and emerging steel production pathways have been modeled to assess their energy demand and GHG emissions. A techno-economic viability analysis has helped **identify optimal strategies for achieving carbon neutrality in the Canadian steel sector**.

KEY OUTCOMES

This work has determined the electricity, biomass, hydrogen and carbon capture and storage (CCS) requirements for **achieving carbon neutrality across different production pathways**. It has also estimated the potential carbon customs tariffs on Canadian steel exports to Europe based on electricity grid carbon intensity, production processes, product type and carbon footprint.

In collaboration with CanmetENERGY in Ottawa, Corem and the Thermochemical Computation Centre (CRCT) at Polytechnique Montreal, decarbonization solutions tailored to Canadian steel plants are being studied. Corem is providing experimental validation by exploring the integration of greener fuels, such as hydrogen, in iron oxide reduction.

KEY OUTCOMES

Industrial unit modeling and simulation using globally recognized thermodynamic databases for metallurgical processes. The replacement of natural gas with hydrogen, alongside process optimization efforts, can significantly reduce GHG emissions in steel production, while avoiding major process modifications. An analysis of biomass integration is planned for 2025.

Decision Support Tools and Methodologies

Role of biorefineries in industrial decarbonization

Biorefineries transform biomass into biofuels, bioproducts and bioenergy. They reduce fossil fuel reliance, cut GHG emissions and support a circular economy by valorizing residues. The I-BIOREF software now integrates CO_2 capture, storage and valorization, by specifying the biogenic and non-biogenic emissions.

KEY OUTCOMES

Three case studies analyzed renewable diesel and SAF production, incorporating low-carbon H_2 production technologies and CO_2 valorization. The calculation of their carbon intensity and other findings were presented at the Integrated Biorefineries Mission Innovation and the BBEST & IEA Bioenergy international conference (Brazil, October 2024).

Arbitrage of limited renewable resources – system-level modeling

The limited availability of renewable resources forces us to prioritize their use where they offer maximum benefits and where there are no better alternatives. **System-level modeling techniques and multicriteria decision-making tools** are needed to develop robust decarbonization pathways, policies and programs.

KEY OUTCOMES

Improved technology models were incorporated into report “Pathways for a net-zero Canada”, by the Trottier Energy Institute (IET). The third edition of the IET Energy Outlook predicts an increase in biomass utilization for biochar and biocarbon production, generating negative emissions. These models have been adapted to assess electrification potential and identify the most promising hydrogen application in industry.

Software Solutions **Developed by Our Team**

EXPLORE
Multivariate data analysis for process optimization

I-BIOREF
Assessment of the techno-economic, environmental and socio-economic performance of the sustainability and circularity of industrial biorefineries

INTEGRATION
Heat recovery optimization in industrial processes

COGEN
Modeling to improve the profitability of cogeneration systems

KraftSIM
CADSIM simulation for the assessment of new technologies in kraft processes

Free download online ›

RENEWABLE ENERGY INTEGRATION (REI)

Our R&D activities aim to improve access to renewable and clean electricity for Canadians while recognizing sustainability, reliability, safety and affordability objectives. Our mandate is well aligned with the Government of Canada's commitments to achieving net-zero emissions in all sectors of the economy by 2050.

Renewable Energy and **Smart Grid Resources and Devices**

Our team assesses the performance of distributed energy resources (DER) and related standards to address issues related to the impact on electric grids of variable renewable energy and the increasing demand for electricity. Through our work, we evaluate and model the performance of both existing and novel solar photovoltaic (PV)-related technologies and power conversion equipment (inverters). In addition to this work, design guidelines and gaps in performance and safety are also addressed.

Standards related to PV/BIPV technologies and to inverters

This project focuses on the adoption and maintenance of standards related to PV and building-integrated photovoltaics (BIPV) technologies and to inverters through various standard committees, such as the CSA Group's standard committees. Our involvement contributes to the coordinated **development of DER products and system standards, guides and codes** in Canada.

KEY OUTCOMES

CanmetENERGY chaired the working group dealing with the adoption of the international BIPV standards IEC 63092-1 and -2 on building integrated PV modules and systems in Canada. As a result, the first Canadian standards on BIPV were published in October 2024 (CSA C22.2 No. 63092-1:24 and -2:24). CanmetENERGY also contributed to the BIPV design guidelines published by the IEA PVPS Task 15, incorporating two Canadian case studies and facilitating its release as open source. Finally, we also chaired the adoption of the new edition of standard CAN/CSA-IEC 61215 on PV module design qualification. This standard ensures that PV modules can **withstand Canadian weather conditions**. It also **safeguards the quality of PV modules sold in Canada**. The standard is now available on CSA's webstore.

Assessment of the photovoltaics potential of the Canadian building stock

This project focuses on assessing the potential of photovoltaics on rooftops in Canada. Using a new statistical method developed by our researchers, a detailed analysis of 11 Canadian municipalities was conducted, leveraging high-quality LiDAR and building footprint data. The method was applied to the stock of residential, commercial and institutional buildings in Canada and can be used, for example, in net-zero pathway studies.

KEY OUTCOMES

Since CanmetENERGY **published the report entitled "Assessing the photovoltaic potential of the Canadian building stock"** in January 2024, detailed data for municipalities has been made available. The results were presented to multiple internal and external audiences, such as Canadian energy modellers and technical experts of the IEA PVPS Task 16. The report indicates a potential of up to 300 GW for rooftop PV, which is roughly double the total electric power capacity of Canada's generation fleet, suggesting that rooftop PV could **play a significant role in Canada's energy transition**. Our researchers are making advancement in assessing to which extent this potential could be realized, considering financial criteria and market adoption as well as the ability of electricity grids to host this capacity.

Conferences **& Events**

- Participated in and contributed to two conferences held by the Energy Modeling Hub (EMH) by presenting on two different panels related to 1) rooftop PV potential in Atlantic Canada and 2) distribution system planning. A poster on pulp mill demand flexibility modeling for a capacity expansion model was also presented. The EMH facilitates the collaboration of Canadian modellers and accelerates the acquisition of knowledge related to net-zero modeling and analysis.
- Participated in the 2024 Annual Conference of the IEEE Industrial Electronics Society in Chicago. Our centre contributed to the main program by giving a presentation on inverter modeling and grid code testing as part of the panel “The role of real-time, multi-fidelity, and hardware-in-the-loop simulations for accelerating renewable energy integration.”

Improving Technology-Grid Interface and Interoperability **to Support Grid Modernization**

This project focuses on bridging the gaps in terms of integration and connections between grid-edge technologies (e.g., flexible loads) and the grid itself. It focuses on three main R&D areas: facilitation of connections between inverters and the grid, development of methods for DER control and aggregation as well as mapping and advancement of grid integration standards.

Advanced controllers to harness the flexibility of residential space heating

Building a grid capable of integrating large amounts of variable renewable energy (VRE) resources necessitates greater flexibility. This project aims to harness the full flexibility potential of residential space heating by controlling electric baseboard heaters. It includes the design of advanced controllers and the development of a testing environment to test those controllers. By shifting the electricity demand associated with space heating during certain periods, the strain on the electricity grid can be reduced.

KEY OUTCOMES

Based on previous studies related to controlling electric baseboard heaters with external partners, our team developed an advanced controller that optimizes the setpoint schedule of specific thermal zones using smart thermostat historical data. The main advantage of this optimization-based controller is that it can be adapted to fulfill different grid objectives.

Variable Renewable Energy (VRE) Resources and **Electrified Grid-Active Neighbourhoods, Communities and Cities**

This project focuses on strategies to allow operation of distribution grids with a large penetration of VRE. It is based on these main areas of R&D: the amount of VRE that a distribution grid can accommodate (i.e., hosting capacity); the management, control and protection for the distribution grid and microgrids; and the pathways for both net-zero remote communities and distribution grid modernization.

Distribution system hosting capacity

This project focuses on hosting capacity, defined as the additional amount of DERs and loads that a distribution system can accommodate without requiring infrastructure upgrades. It investigates the assessment methods and their standardization as well as short term approaches to **increase the hosting capacity through resource and load management**.

KEY OUTCOMES

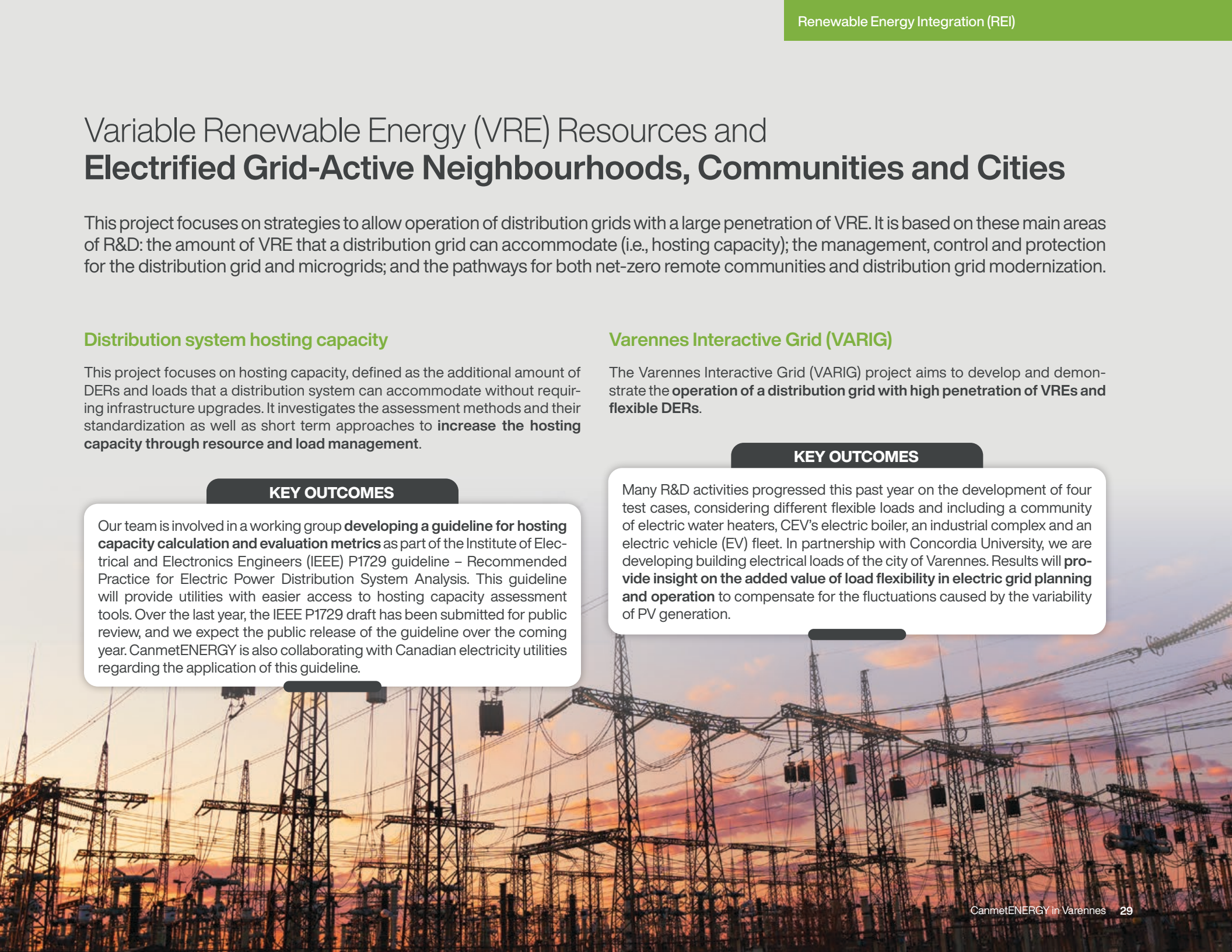
Our team is involved in a working group **developing a guideline for hosting capacity calculation and evaluation metrics** as part of the Institute of Electrical and Electronics Engineers (IEEE) P1729 guideline – Recommended Practice for Electric Power Distribution System Analysis. This guideline will provide utilities with easier access to hosting capacity assessment tools. Over the last year, the IEEE P1729 draft has been submitted for public review, and we expect the public release of the guideline over the coming year. CanmetENERGY is also collaborating with Canadian electricity utilities regarding the application of this guideline.

Varennes Interactive Grid (VARIG)

The Varennes Interactive Grid (VARIG) project aims to develop and demonstrate the **operation of a distribution grid with high penetration of VREs and flexible DERs**.

KEY OUTCOMES

Many R&D activities progressed this past year on the development of four test cases, considering different flexible loads and including a community of electric water heaters, CEV's electric boiler, an industrial complex and an electric vehicle (EV) fleet. In partnership with Concordia University, we are developing building electrical loads of the city of Varennes. Results will **provide insight on the added value of load flexibility in electric grid planning and operation** to compensate for the fluctuations caused by the variability of PV generation.



Low-Carbon Regional and National Electric Grids and Energy Systems

This project fosters the **development of zero-carbon systems** at the provincial, territorial and national levels. It has three main areas: bulk system stability while integrating large numbers of DERs and inverter-based resources; planning and operation to support electrification and DER opportunities in a new grid paradigm; and Canadian pathways for grid modernization.

This work aims to develop methods and models for improving regional stability, strategies for system operation and planning to support electrification and flexibility while weighing new cooperative roles for transmission and distribution system operators and grid modernization pathways and scenarios.

Modeling electric grid planning and production

This project focuses on building electric grid planning and production cost models. Through the development of a national grid and regional models, CanmetENERGY is able to **identify the least-cost mix of generation and transmission capacity investment scenarios** for the future Canadian electric grid.

KEY OUTCOMES

Internal modeling capacity to evaluate bulk electric power system pathways is being built with the development of a national grid and regional models in the open-source tool Python for Power System Analysis (PyPSA). This modeling capacity is being used to **provide science-based advice to evaluate the feasibility of future electric grid scenarios** for different provinces. This year, the grid modeling of Atlantic provinces supported the advancement of major projects led by policymakers. Our modeling capacity was also recognized by key actors during the Energy Modeling Hub (EMH) 2024 winter conference, where we presented our PyPSA-Canada national grid model and compared our results with those of other groups in Canada during EMH's multi-model comparison forum.

Integrated energy systems planning

This project focuses on bridging knowledge gaps on the effective integration of industry and building technologies into the electric grid by using CanmetENERGY's multisectoral expertise. Through energy modeling activities, this initiative seeks to tackle complex research and policy questions that each group could not address independently, enabling CEV to **take a holistic approach to cross-sectoral decarbonization challenges**.

KEY OUTCOMES

This modeling capacity is being used to develop solution pathways that create value and a sustainable energy future. Through a collaborative project between the industry and the renewable energy integration groups, the flexibility of a pulp and paper facility was integrated into a bulk electric system model. This activity showed that **integrating industrial demand flexibility into grid planning leads to less investment in grid infrastructure requirements**, supporting a more affordable energy transition.

Smart Renewables Electrification Systems (SRES)

This project aims to assess the capacity of various technologies to provide grid services and their impact on the grid infrastructure. By assessing the performance as well as the flexibility potential of technologies and identifying knowledge gaps on the effective integration of these technologies into grid systems, SRES provides guidance to policymakers on **effective grid modernization pathways to achieve net-zero targets**.

Technology assessment for grid modernization

Information and data analysis focuses on analyzing the information gathered through literature reviews and data acquisition to study the system's performance and operation and then determining what information gaps still exist per technology. This work aims to **determine the impact, the performance and the long-term viability of any grid services that were provided** and, if no grid services were provided, to study the potential for the system to provide grid services.

KEY OUTCOMES

Through literature review, our project **assessed PV technology and inverter-based resource research needs for grid support**. The grid-support assessment for PV and IBRs was classified in different categories, such as grid operation, stability and protection, and by grid services. These questions were analyzed according to internal expertise and each question was prioritized based on the importance and urgency, which may affect the grid in the short or long term. Our team is continuing its work to provide recommendations and potential solutions in due course.

A Policymaker's Feedback **on Our Work:**

"CanmetENERGY helped us better understand utilities feedback. The team provided contextualized utility concerns regarding policy and regulations and provided us targeted advice."

–Julia McNally
Director Climate Action
Toronto Hydro

RETScreen

Our RETScreen division develops and deploys the world-leading **RETScreen Clean Energy Management Software** platform, which enables low-cost energy planning, implementation, monitoring and reporting for buildings, factories, fleets and power plants around the world.

The division undertakes **several workstreams to advance NRCan's corporate mandate** to ensure Canada's abundant natural resources are developed sustainably, competitively and inclusively. These workstreams include:

- the **RETScreen Innovation Lab**, which collaborates with government and multilateral organizations to co-fund and develop advanced versions of the RETScreen software,
- the **RETScreen Data Onboarding service**, which delivers onboarding services on a cost-recovery basis, helping large public enterprise customers with their facility-level and portfolio-wide deployment of the platform, and
- the **RETScreen Capacity Building program**, which helps improve the knowledge, skills and capabilities of the 900,000+ energy, facility and sustainability professionals located around the world who use the RETScreen software.

Here are some of the key highlights of the workstreams during the 2024-2025 fiscal –year:

RETScreen **Innovation Lab**

Version 9.2 of the RETScreen Software was released. This updated version includes the following new features:

Benchmark and Feasibility Analysis Modules

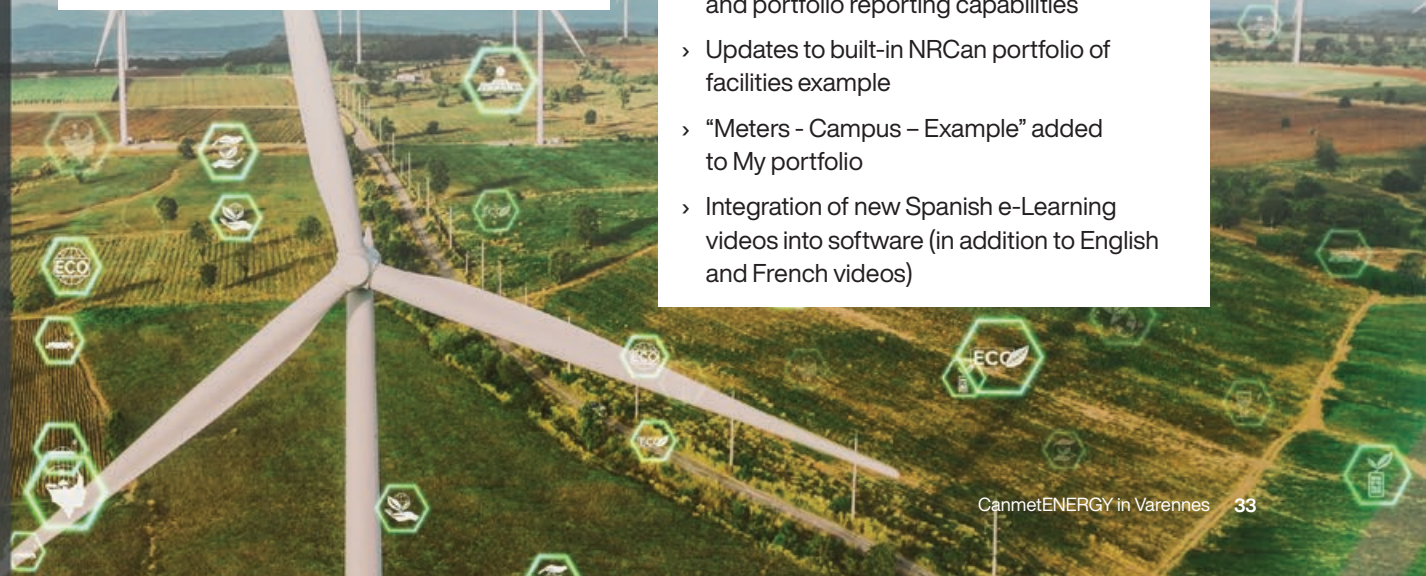
- Several more deep emission reduction archetypes incorporating artificial intelligence (e.g., for restaurants, hotels, retail stores, greenhouses, etc.)
- 4 archetypes for data centres
- Information Technology (IT) equipment energy model
- Peak shaving and renewables added to electricity storage models
- Advanced version of electricity rate calculator
- Currency switch for fuel and electricity rate database
- Updates to built-in Varennes individual facility example

Performance Analysis Module

- Phase 1 of new ongoing commissioning tool – annual and monthly bulletins
- Direct automated data connectors for *Energy Star® Portfolio Manager®*
- New custom database tool, including templates for fleet inventory, greenhouse gas inventory, IT equipment inventory and refrigerant inventory

Portfolio Analysis and All Modules

- Scaling for Net Zero Planning (NZP) Tool and hot climate model improvements
- Energy Management Information System (EMIS) meter management (tree structure) and portfolio reporting capabilities
- Updates to built-in NRCan portfolio of facilities example
- "Meters - Campus – Example" added to My portfolio
- Integration of new Spanish e-Learning videos into software (in addition to English and French videos)



Members of the RETScreen team received an **NRCan DEPARTMENTAL MERIT AWARD** ("Behind-the-Scenes" Category).

The RETScreen Division was commissioned by the Department of National Defence (DND) to help create a strategic-level 2050 Carbon Neutral Portfolio Plan for all 8,000+ DND existing military facilities across Canada using the RETScreen Clean Energy Management Software platform. This award recognizes this outstanding accomplishment.

RETScreen **Data Onboarding**

The annual Government of Canada's Greenhouse Gas Emissions Inventory, prepared by the Treasury Board of Canada Secretariat (TBS) with the support of the RETScreen Team in Varennes, uses the RETScreen Software to **report on GHG emissions from federal facilities and conventional fleet operations** (Scope 1 & 2 emissions) and from air travel (Scope 3). This reporting now also includes water consumption, waste production and refrigerant tracking on a pilot basis.

Supported other cost-recovery enterprise customers in implementing and maintaining RETScreen portfolios:

- Global Affairs Canada (GAC) – **300+ facilities (e.g., embassies and consulates)** at foreign missions
- Natural Resources Canada (NRCan) – **29 facilities**
- Canadian Space Agency (CSA) – **15 facilities**

Provided ongoing cost-recovery support to the DND to implement and maintain a RETScreen portfolio, with **8,000+ military facilities**. This work includes the completion and dissemination of the extensive portfolio-wide feasibility analysis for DND: ***2050 Carbon Neutral Portfolio Plan: Canada's Department of National Defence (DND)***.

Provided ongoing technical support to numerous energy, facility and sustainability managers at public sector enterprises who use RETScreen for **portfolio-wide energy and GHG management for thousands of facilities** located across Canada and around the world.

RETScreen **Capacity Building**

Undertook **outreach activity efforts with various key stakeholders** to encourage a continued software download rate at 40,000+/year and to further build the capacity of the 900,000+ RETScreen users across Canada and around the world.

Coordinated **activities with the RETScreen trainers' network**, including the delivery of multiple online training webinars and in-person workshops, in Canada and around the world, focused on various customer segments for the RETScreen software (e.g., primary and secondary schools, municipalities, healthcare, clean power generation, etc.).

Provided in-depth technical support to subscribing customers and engaged high value potential customers on an ongoing basis to ensure **continuous capacity building of key users**.

Supported Housing, Infrastructure and Communities Canada's (HICC) $2B Green and Inclusive Community Buildings (GICB) Program in **reviewing numerous funding applications** submitted to GICB via the RETScreen Software.

Targeted outreach activities, including sending **regular email bulletins** to 150,000+ newsletter subscribers and producing **many new training videos in Spanish**.

40,000+
Continued software download rate, per year

150,000+
Email newsletter subscribers

900,000+
RETScreen users across Canada and around the world


SOURCE

Our support teams offer a wide range of expertise and are of valuable service to our divisions tasked with implementing R&D programs

Operations

Our Operations team supports the delivery of interdependent and national programs by our Centre and its S&T partners. This team is comprised of the following three subgroups:

Engineering & Technical Services | Infrastructure Management | Business Office

Areas of Expertise

- Design and construction of test benches and prototypes for applied science
- Design, construction and delivery of external projects with partners
- Maintenance of test benches and scientific R&D facilities in our pilot pants
- Calibration of scientific measuring instruments
- Technical support for researchers and engineers
- Building maintenance, upkeep and improvement
- Physical security of the premises
- Information technology and management
- Shipping and receiving of goods
- Human resources
- Contracts and finance
- Risk and emergency management

Highlights

- Managed the electrical installation of the microgrid
- Upgraded pilot plants to accommodate future projects
- Reorganized workspaces to accommodate new mechanical and electrical workshops
- Dismantled obsolete projects and test benches
- Delivered new geothermal and CO_2 heat pump test benches
- Delivered a hybrid energy project for the Arctic with interdepartmental and external partners
- Provided technical support for our scientific projects and prototypes at end sites across Canada
- Standardized our automated and human-machine interface systems to collect scientific data in our databases
- Improved and modified workspaces for a hybrid work environment with a focus on ergonomics and the practical needs of employees
- Repaired or replaced several critical building equipment items such as humidifiers, sump pumps, heating pumps, ventilation systems, etc.
- Managed building condition report initiated by Real Property
- Fully migrated the team's files to MS365 and increased use of Planner and Project for project management
- Supported R&D groups for data migration to MS365
- Migrated multiple servers to a newer version of Windows Server
- Developed a tool for archiving valuable documents
- Verified the compliance of building equipment and protection systems

Science Impact Unit

Within the Director General's office is the Science Impact Unit (SIU), composed of science, policy, commerce and engineering experts that provide scientific and corporate support to the research groups in their strategic planning to maximize the impact of research results. The SIU achieves this role by conducting strategic foresight and developing value propositions for our S&T activities. It also provides advice, coordination and administrative oversight on NRCan agreements developed by our researchers.

Highlights

- Finalised both the 2023-28+ Science Plan for the centre, built on the value propositions of R&D investments.
- Established an internal innovation planning working group to identify the innovative energy technologies and trends that are most relevant to the 2035 – 2050 time horizon to better situate future research.
- Assisted researchers in structuring contractual R&D and revenue generation agreements and MOUs with the private sector, universities, international institutions and other government departments.
- Liaised regularly with the Office of the Chief Scientist on departmental science planning activities.
- Participating in a pilot project on using foresight on energy-related R&D activities.
- Represented CEV in various departmental working groups, such as:
  - Departmental Science Impact & Technology Transfer Working Group
  - NRCan's International Science, Technology and Innovation Interest Group (STIIG)
  - NRCan's Clean Energy Ministerial Planning Working Group
  - Working group with CanmetMATERIALS and the IPD about standardizing research impact measurements.
- Led NRCan's Foresight Community of Practice (CoP) to develop a strategy for the future of the CoP on how to increase its profile within NRCan.
- Collaboration with the Strategic Policy and Innovation Sector and the Office of the Chief Scientist to improve strategic foresight capacity across the department.
- Developed a project tracking directory to monitor the status of IPs to be registered or renewed, and diffusion strategies to be developed or refined.
- Led the mapping of the stakeholder ecosystem for/with the Industrial Systems Optimization Industry group to develop appropriate outreach actions.
- Contributed to the mapping of the Greening Government Operations ecosystem in order to align the development of the next funding application with the needs and interests of the different ecosystem actors.
- Reviewed the challenges and the best practices in supporting technology and knowledge transfer.

Scientific Outreach

Our Scientific Outreach team provides strategic communication advisory services and puts in place actions towards promoting CEV's science and research. The team helps our scientific divisions maximize the impact of their R&D activities, while offering assistance with knowledge and technology transfer.

Areas of Expertise

- Advice on strategic communications for CEV's different divisions
- Development of communication products
- Management of social network platforms
- Dissemination of science and technology
- Arrangements for activities related to media relations
- Translation and revision
- Graphic design, photography and videography
- Document formatting
- Coordination of visits and corporate events

Highlights

- Revision, translation and layout of the GHG Emissions Reduction Audit Guide for the Greening Government Operations team
- Development of an outreach strategy for the launch of the new EBCx site, purposed for commissioning existing buildings
- Production of a series of staff video portraits to value the diversity of the occupations and careers at the Centre
- Development of a communication plan tailored to the needs of the Industrial Systems Optimization division
- Design and production of visual aids (brochure and poster) for PaperWeek
- Creation of an occupations guide for CanmetENERGY in Varennes
- Reinforcement of the Centre's digital presence on LinkedIn and Instagram
- Representation of the Centre at a career event at Polytechnique Montreal
- Photo and video support during internal, external and international events
- Production of visual content to support the collaboration between the Buildings division and the Department of National Defence (DND)
- Development of eLearning course for DND
- Design of a poster for the test benches

79
documents translated and reviewed

341
postings to our social networking sites

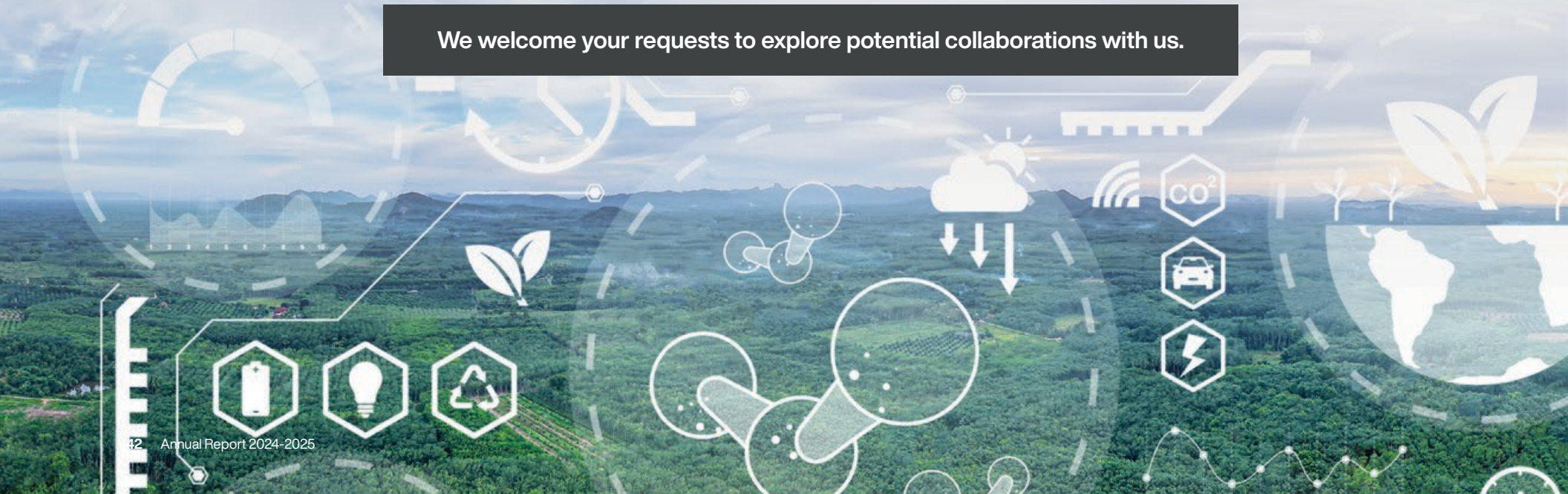
20+
projects (guides, brochures, leaflets, documents, reports) achieved

How to **Collaborate**

CanmetENERGY is open to collaborate with external partners so long as these arrangements provide a win-win outcomes to both parties and helps CEV advance its research mandates. Collaborations with the private sector are specifically designed to share the costs, risks and benefits of joint initiatives, while at the same time increasing the involvement of the clients being served and enhancing the general level of goodwill with all parties. There are different types of arrangements under which universities, industry and companies could collaborate with CanmetENERGY. They include:

- **Formal agreements** or revenue generation contracts, such as Memorandums of Understanding, Task-Shared Agreements, R&D Umbrella Agreements, Non-Disclosure Agreements, and other arrangements that clearly define the roles, responsibilities and timelines and ensure a clear understanding of the scope of the collaboration.
- **Informal partnerships** that can be more flexible and less formal, such as access and use of CEV's testing facilities, co-supervision of post-graduate level students for practical training and appointment of our researchers to adjunct professorship positions at selected universities.
- **Service arrangements** to procure required services to effectively deliver on scientific and corporate mandates and to communicate research results to the public.

We welcome your requests to explore potential collaborations with us.



Some of **Our Collaborators**

Federal & Provincial Governments | Crown Corporations

- Hydro Québec
- Infrastructure Canada
- TORONTO HYDRO
- National Defence / Défense nationale
- ieso — Connecting Today. Powering Tomorrow.
- Global Affairs Canada / Affaires mondiales Canada
- Québec
- Canadian Forest Service / Service canadien des forêts
- Canada CNRC·NRC
- Canadian Space Agency / Agence spatiale canadienne
- Treasury Board of Canada Secretariat / Secrétariat du Conseil du Trésor du Canada

Universities

- POLYTECHNIQUE MONTRÉAL — WORLD-CLASS ENGINEERING
- Université Concordia University
- UdS Université de Sherbrooke
- University of Waterloo

Private Companies

- BGI
- COPELAND
- CEPTEK
- EMERSON
- evapco LMP
- OPAL-RT
- RioTinto
- TOROMONT CIMCO
- zeroc

Agencies | Associations | Organizations

- CSA GROUP™
- NASA
- IEEE
- Carrefour de modélisation énergétique | Energy Modelling Hub
- ISGAN — International Smart Grid Action Network
- NATO OTAN
- IEA PVPS
- iets — Industrial Energy-Related Technologies and Systems

Clean Energy | Research | Innovation | Leadership

Science at the service of all Canadians

Visit our website