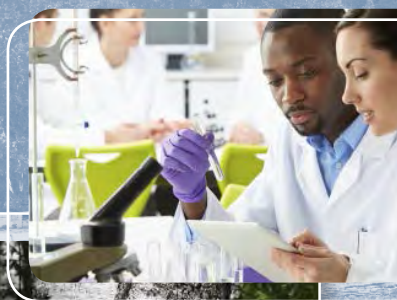
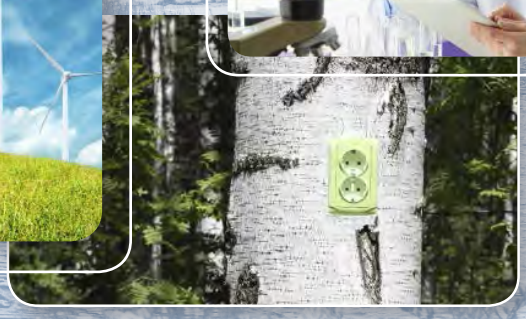
Annex A:
Compendium on Energy Technology Innovation in Canada

Energy and Mines Ministers' Conference

Sudbury, Ontario
August 2014





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IMPORTANT

It is important for each jurisdiction to review their entries to ensure that appropriate significant initiatives/actions on energy technology innovation will be included in the final Compendium.

Should you require any further information, please contact Claude Gauvin, Director, Energy Technology Policy, Natural Resources Canada, at claude.gauvin@nrcan-rncan.gc.ca.

Aussi disponible en français sous le titre : Annexe A : Recueil de l'innovation en matière de technologie énergétique au Canada

This document is the annex for: Mobilizing Canada's Energy Advantage: Leveraging Energy Technology Innovation and Efficiency to Drive Competitiveness and Future Prosperity

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Government of Canada

Canada's energy research, development and demonstration (RD&D) framework integrates the diversity of Canada's resource base, the various provincial priorities and jurisdictions, and the need to prioritise support for promising opportunities with limited funding.

The establishment of priorities and policy setting is a result of communication and collaboration between parties at all levels of the public/private sphere and fluctuates in relation to developments across the Canadian energy sector.

Federal involvement is aimed primarily at enhancing the competitiveness of Canada's natural resource sectors; developing and promoting Canadian scientific and technology capabilities; participating in the development and application of codes and standards; and operating laboratories and other facilities for research. It reduces the risks and costs of individual firms for pre-commercial technology development and provides capacity, expertise, targeted investment and brings together key players to share risks and move new technologies through the innovation chain, from initial concept to commercial application.

In addition to carrying out RD&D in federal laboratories and providing funding for external research, the Government of Canada also acts as a leader, co-ordinator and facilitator of RD&D collaboration with all stakeholders and complements the efforts of the provinces, industry and academia. These roles are accomplished through a number of federal programs across a broad range of departmental mandates and are led by Natural Resources Canada, which is the primary center of expertise and funding provider for energy RD&D in Canada.

- **Natural Resources Canada**
- **National Research Council**
- **Sustainable Development Technology Canada**
- **Atomic Energy Canada Limited**
- **Natural Sciences and Engineering Research Council of Canada**
- **Environment Canada**
- **Finance Canada**
- **Western Economic Diversification**
- **Canada Mortgage and Housing Corporation**

Natural Resources Canada

Program of Energy Research and Development (PERD)

Direct investment: Research, development and demonstration

Description	The Program of Energy Research and Development (PERD) is a federal, interdepartmental program led by Natural Resources Canada (NRCan). PERD funds research and development designed to ensure a sustainable energy future for Canada in the best interests of both our economy and our environment. PERD is managed by the Office of Energy R&D (OERD) of Natural Resources Canada and is the only interdepartmental energy R&D program. PERD funding is aimed at developing new knowledge and advancing technological solutions in aid of regulatory development, codes and standards and public good to ensure the safety and security of energy supply in Canada. Today, it can be described in terms of three characteristics: it is long-term; it is needs-driven; and it is interdepartmental. PERD is about creating knowledge: it provides a foundation for short-term, focused technology development programs as well as generating new knowledge to support codes, standards and regulations that are necessary to address barriers to the adoption of clean energy technologies. PERD funds projects spanning the range of fundamental R&D to pre-demonstration R&D, with a principal focus on applied R&D, in three thematic energy technology areas: • **fossil fuels**: oil sands, frontier oil and gas, pipelines, clean coal and carbon capture and storage • **renewables and clean electricity**: renewables, smart grid, storage, bioenergy, and Generation-IV Nuclear (to be phased out in 2015–16) • **end use**: built environment, industry and transportation
Timeframe	PERD is an ongoing funding program.
Eligible recipients	PERD only provides funding to federal departments and agencies. It is not a general funding or grant program for companies, associations or individuals. 13 federal departments and agencies participate in PERD on an ongoing or opportunity basis: • Aboriginal Affairs and Northern Development Canada • Agriculture and Agri-Food Canada • Atomic Energy of Canada Limited • Canada Mortgage and Housing Corporation • Environment Canada • Fisheries and Oceans Canada

	• Health Canada • Industry Canada • National Defence • National Research Council Canada • Natural Resources Canada • Public Works and Government Services Canada • Transport Canada
Achieved/expected results	PERD funding has contributed to many successes and significant developments, including: • Drake Landing Solar Community, Okotoks, Alberta – an innovative solar thermal seasonal borehole storage system for space heating; it is expected that solar energy will provide over 90 percent of space heating requirements for 52 homes leading to reductions of up to five tonnes of greenhouse gas (GHG) emissions per home (won the Energy Globe Foundation's Golden Energy Globe World Award for 2011) • the development of technology roadmaps, e.g. o Canadian Marine Renewable Energy Technology Roadmap o Clean Coal Technology Roadmap o Electric Vehicle Technology Roadmap for Canada • pipeline corrosion research work, which showed that diluted bitumen (dilbit) is no more corrosive than conventional crude oil under pipeline operating conditions • paraffinic solvent froth treatment, a revolutionary new technology for recovering high-quality bitumen from mined oil sands • early support for the development of the Ballard fuel cell and the Hydrogenics fuel cell • support for codes and standards, e.g. o Canadian Hydrogen Installation Code (covering different types of hydrogen installations), published in January 2007, making Canada the first country in the world to adopt such a code o publication of two national standards and one section of the installation code governing the interconnection of distributed power sources with the electrical grid, now part of the Canadian Electrical Code o publication of five international standards, adapted for Canadian use, on aspects of wind turbines, to support regulatory frameworks and facilitate commercial transactions o contribution on the standardization of protocols for measurement of strength and toughness of pipe welds to the American Welding Society (AWS) as part of *Standard Methods for Mechanical Testing of Welds*

	○ assessment of mercury baseline emissions from Canadian coal-fired power plants in support of emission regulations ○ developing the scientific basis for regulation of fine particulate matter from Canadian coal-fired power plants, including the development and standardization of sampling and characterization methodologies
Other	Recipient science-based departments and agencies (SBDAs) are expected to leverage PERD funds with their own A-base and are encouraged to partner with the private sector, universities, non-governmental organizations, provincial and municipal governments and research organizations. PERD projects typically average $1.50 to $2.00 for each $1 of PERD funding. PERD-funded projects have also led to projects on shorter-term initiatives. For example, PERD work undertaken by Environment Canada on wind modelling led to the large T&I initiative on the Wind Atlas. It also provided the foundation for the work done on the wind forecasting tools that have since been funded by PERD, CEF and ecoEII as they have advanced. In some instances PERD work has led to multiple linkages. For example, the PERD hydro program spawned the Very Low Head concept through collaboration with French partners. The project was then funded by T&I, returned to PERD for further development, then funded under the Canada–U.S.–Mexico Security and Prosperity Partnership initiative for cold climate engineering, and then demonstrated under ecoEII.
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ecoENERGY Innovation Initiative (ecoEII)

Direct investment: Research, development and demonstration

Description	The ecoENERGY Innovation Initiative (ecoEII) received funding in Budget 2011, the Next Phase of Canada's Economic Action Plan, for a comprehensive suite of research and development (R&D) and demonstration projects. The program's objective is to support energy technology innovation to produce and use energy in a cleaner and more efficient way. This initiative is a key component of the Government of Canada's actions to achieve real emissions reductions, while maintaining Canada's economic advantage and its ability to create jobs for Canadians. The ecoEII is providing $268 million over five years (2011–12 to 2015–16) to fund clean energy research, development, and demonstration (RD&D) activities to support energy technology innovation to produce and use energy more cleanly and efficiently. The ecoEII supports the following technology cluster in the outlined areas of the innovation spectrum: • **Unconventional oil and gas:** Support to enhance Canada's ability to develop important resources (i.e. oil sands, shale gas, gas hydrates), improve efficiencies and reduce environmental impacts. Key areas of focus will include tailings, water and feasibility of unconventional gas. • **Next generation transportation:** Support to conduct R&D focused on improving the efficiency of vehicles and to advance the electrification of transportation. • **Energy efficiency technologies:** Support to advance next-generation technologies and analytical models to scale up energy-efficiency solutions from individual buildings to the community level, facilitating low-carbon solutions in industrial processes and improving the performance and efficiency of vehicles and transportation systems. • **Distributed power generation:** Support to advance projects supporting clean electricity generation (e.g. smart grid and smart power distribution, the integration of renewable sources of electricity, renewable energy generation and energy storage). • **Technologies with potential longer-term impact:** Support to provide funding towards the development of scientific knowledge and technologies necessary to accelerate the development of advanced bioenergy, advance R&D in carbon capture and storage, and Canada's commitments to Generation-IV nuclear research.
Timeframe	The ecoEII has seven major components: 1) quick-start one-year internal R&D projects conducted by federal researchers in the first year (2011–12)

	2) internal R&D projects conducted by federal researchers over the four remaining years of the program (2012–13 to 2015–16), some of which are follow-on projects from the first year 3) external R&D projects conducted by external recipients over four years (2012–13 to 2015–16). 4) external demonstration projects conducted by external recipients over four years (2012–13 to 2015–16) 5) research conducted by university researchers in support of Canada's next-generation nuclear technology, jointly funded by NRCan and NSERC over four years (2011–12 to 2014–15) 6) the Canada–Israel Energy Science and Technology Fund, which will fund collaborative R&D projects, involving both Canadian and Israeli companies and other partners, to spur the development of innovative energy technologies and processes to enable the responsible development of unconventional oil and gas resources, including applications to address environmental challenges, over four years (2012–16). 7) research component on rare earth elements used in the production of clean energy technologies, over three years (2011–14)
Eligible recipients	For the program's external R&D and demonstration components, the following are eligible recipients: companies, utilities, Canadian academic institutions, industry associations, First Nations, research institutions, standards organizations, not-for-profit organizations, municipalities, and provincial, territorial, regional and municipal governments and agencies. For the program's internal R&D components, the following are eligible: federal researchers and research organizations.
Achieved/expected results	Successful calls for proposals were held in 2011–12 for all components resulting in a 10 times oversubscription, with the program receiving over 1100 proposals requesting $2.5 billion in funding. The program selected to support 289 projects, as follows: • 192 internal R&D projects, in the key priority areas, conducted by federal researchers, supporting new knowledge creation, advancement in the area of new product development, and support for new policies, regulations, and codes and standards, including research on rare earth elements used in the production of clean energy technologies • 44 external R&D projects, in the key priority areas, conducted by external recipients, to advance their R&D initiatives • 8 joint R&D projects funded under the Canada–Israel Energy Science and Technology Fund • 18 external demonstration projects conducted by external recipients

	• 27 university-led projects in support of development of next-generation nuclear technology The ecoEII is being implemented. Examples of short-term deliverables include: • One hundred and thirteen Track A R&D projects leveraging $5 million in additional funding from partners have been completed. • The Oil Sands Tailings Technology Deployment Roadmap has been completed in partnership with Alberta Innovates and the Oil Sands Tailings Consortium. • The report on Assessment of Solar Thermal Seasonal Storage (potential) in Canada was completed.
Other	The external component includes the $5 million Canada–Israel Energy Science and Technology Fund, announced by NRCan Minister Oliver in October 2012 and delivered via the Canada–Israel Industrial R&D Foundation. Two calls for proposals have been issued to date and are expected to result in the selection of eight R&D projects in which Canadian companies will collaborate with Israeli stakeholders to advance clean energy R&D, primarily in the area of unconventional oil and gas. For more information, please go to: ciirdf.ca.
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Clean Energy Fund (CEF)

Direct investment: Research, development and demonstration

Description	The Clean Energy Fund (CEF) program was a component of Canada's Economic Action Plan announced in Budget 2009. The program objectives are to support the development and demonstration of the new cutting-edge energy technologies that are essential for reducing greenhouse gas (GHG) emissions and other air emissions in energy production, transmission, distribution and use. The initial budget was $1 billion to be spent from 2009–10 to 2013–14 but the funding was reduced by $205 million in Budget 2010. The total budget was further reduced as proponents cancelled their projects. The program was designed with three components: • $150.3 million to support two large-scale carbon capture and storage (CCS) demonstration projects • $117.5 million for smaller-scale, clean and renewable energy technology demonstration projects • $26.9 million for a 1.5 year R&D component at Natural Resources Canada (NRCan) The CEF supports the following technology cluster in the outlined areas of the innovation spectrum: • Unconventional oil and gas: Support for development of new technologies to address the environmental challenges facing oil sands production and the conversion of bitumen, including issues of tailings ponds, water and natural gas use. • Next generation transportation: Support for hydrogen and fuel cells technology development for transportation and stationary applications. • Energy efficiency technologies: Support new concepts in integrating renewable energy technologies into the built environment, as well as reducing electrical peak demands, in the context of the drive towards net-zero buildings and communities and the particular needs of rural and remote communities. • Distributed power generation: Support for development of renewable and non-emitting energy technologies (e.g. marine, biomass, wind and solar energy) and their increased integration into Canada's electricity system including for remote communities, using smart technologies and systems, and for addressing the impact on power supply for the deployment of plug-in hybrid electric vehicles. • Technologies with potential longer-term impact: Support for development of technologies to lower CO_2 capture costs and increase knowledge on CO_2 storage; bio-based energy systems such as anaerobic digestion; production and utilization of renewable natural gas; and short-rotation plantation/agroforestry energy systems.

Timeframe	April 2009 to October 2016
Eligible recipients	For-profit and non-profit organizations legally incorporated or registered in Canada, including electrical and gas utilities, industry associations and research associations, Canadian academic institutions, and Canadian provincial, territorial, regional and municipal governments and their departments and agencies.
Achieved/expected results	The program has funded two large-scale CCS demonstration projects and 18 smaller-scale clean and renewable energy demonstration projects of a wide variety of technologies. The CEF has provided $150.3 million in funding to the following large-scale CCS demonstration projects: • **Shell Quest** project is expected to capture 1.1 million tonnes (MT) CO_2 per year for 25 years (an expected reduction of 27 MT over 25 years), representing a reduction of one-third of the CO_2 emissions for the Shell Scotford Upgrader (oil sands) or five percent for 2020 projected total oil sands upgrading emissions in Alberta. • **Enhance's Alberta Carbon Trunk Line** project is building CCS infrastructure consisting of a pipeline and enhanced oil recovery (EOR) storage infrastructure that will be able to transport and utilize up to 14.6 MT per year of CO_2, representing six percent of Alberta's total GHG emissions. In the first phase of the project (funded by the CEF), up to 1.8 MT per year will be captured from two sources: 0.6 MT per year from the Agrium fertilizer plant and1.2 MT per year from the North West Redwater Partnership's Sturgeon Refinery, the world's first refinery to incorporate CO_2 capture into its design. Leverage for large-scale CCS demonstration projects is expected to far exceed the objective at 16:1. Both projects are expected to start operation in 2015. The learnings from these projects have been instrumental in the development of Alberta's Regulatory Framework Assessment, which was a comprehensive review of that province's CCS regulations, and federal GHG regulations for new coal-fired electricity published in 2012. The CEF is providing funding support to 18 small-scale clean and renewable energy projects in the following technology priority areas: bioenergy, buildings/community energy systems, smart grids, hybrid systems/geothermal, marine/hydro, wind and energy storage.

	Out of 18 projects, the following progression along the innovation spectrum has been achieved: • Ten technologies have now been demonstrated that surpass the currently best commercially-available technologies. • Ten technologies moved from research to development. • Five technologies moved from development to demonstration. Leverage for the 18 small-scale clean and renewable energy demonstration projects is expected to exceed the matching leveraging objective at 2:1. Several of the small-scale projects, such as the Harvest Power Waste to Energy and the PowerShift Atlantic project are attracting international attention. These two projects have been recognized by KPMG as in the top 100 infrastructure projects worldwide in 2012. In addition, 56 internal R&D projects, led by federal research organizations, were carried out in collaboration with industry, universities and provinces. These activities expanded existing and created new research capacity and innovation networks across Canada.
Other	A unique aspect of the CEF program is that a five-year reporting period is required for each project contribution agreement. This reporting mechanism will enable NRCan to track technology deployment and hopefully replication for the small-scale demonstration projects and the continued performance of the large-scale CCS projects.
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CanmetENERGY

Expertise in energy technology research, development, and demonstration

Description	Natural Resources Canada's CanmetENERGY reseach centres, located in Ottawa, Ontario; Varennes, Quebec; and, Devon, Alberta, are the Government of Canada's leading performer of energy research and development. With over 420 scientists, engineers and technicians and more than 100 years of experience, these are Canada's knowledge centres for scientific expertise on clean energy technologies. CanmetENERGY works to find solutions to improve competitiveness, reduce greenhouse gas (GHG) emissions and air pollutants by developing new knowledge and technologies through research, development and demonstration (RD&D) activities. CanmetENERGY advances sustainable and responsible resource development of Canada's energy resources by providing expert scientific and technological knowledge and by working in partnership with all levels of government, universities, research institutes, the private sector and international organizations.
Research Priorities	CanmetENERGY is developing the next generation of clean energy technologies through a combination of in-house expertise combined with strategic partnerships across the Canadian energy innovation landscape. Specifically: CanmetENERGY-Ottawa works in the fields of clean energy supply from fossil fuel and renewable sources, energy management and advanced end-use technologies and processes. Key areas of focus include reducing costs, reducing emissions and improving technology performance. The centre houses pilot-scale facilities to help accelerate the advancement of clean energy technologies throughout the innovation cycle, from the initial research stage through to commercialization. CanmetENERGY-Varennes leads on programs in buildings and communities, renewables, industrial processes and manages the world-leading RETScreen International Clean Energy Decision Support Centre. The centre also designs and implements clean energy solutions and builds on knowledge that helps produce and use energy in ways that are more efficient and sustainable. Analytical laboratories and pilot plants are equipped to develop, test and demonstrate clean energy solutions in real-world conditions through R&D agreements, research consortiums or collaborations on demonstration projects. CanmetENERGY- Devon focuses on the development of step-changing innovations for cleaner fossil fuels and related environmental technologies, making bitumen and oil and gas a cleaner energy option for Canada. The facility has expertise in extraction and tailings, water management, multiphase systems, bioprocessing, oil sands, upgrading oil sands and heavy oil, and future fuels and emissions.

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Forest Innovation Program (FIP)

Direct investment: Research, development and demonstration

Development of standards and regulations

Description	Under Budget 2012, the federal government invested $105 million over two years to support Canada's forest sector. The funding is targeted at fostering innovation and expanding market opportunities for the sector. Additional funding of $92 million over two years was announced under Budget 2013 to further support market diversification and forest sector innovation. This funding is available until March 31, 2016. The goal of the Forest Innovation Program (FIP) is to support research, development and technology transfer activities in Canada's forest sector. Together, these activities will help the sector pursue its ongoing transformation through the adoption of emerging technologies ready for commercialization. The FIP will generate and advance high-value products and processes for commercialization in the forest industry (including bioenergy and energy-efficiency technologies) and is helping to position Canada as a global leader in several technology areas. The FIP includes support for FPInnovations, Canada's world-recognized forest sector research organization, as well as the Canadian Wood Fibre Centre. The FIP also includes support for the development of both international and national standards for cellulose nanomaterials. • Energy efficiency technologies (~$4.7 million over three years) – Technology development and demonstration: To enhance the energy efficiency of forest industry facilities and operations. • Distributed power generation (~$1.3 million over three years) – Technology development and demonstration: To advance the development and demonstration of forest-based bioenergy facilities. • Technologies with potential longer-term impact (~$11.3 million over three years) – Technology development: To support the transformation of the forest sector toward bioeconomy applications, including the development of integrated biorefineries for the production of biochemicals, biocomposites and next-generation wood products.
Timeframe	April 2013 to March 2016

Eligible recipients	The primary recipient of contributions under the Transformative Technologies (TT) element of the FIP is FPInnovations. Should the program determine that partners other than FPInnovations are needed to achieve the stated outcomes of the FIP, funding can be made available to: • universities, colleges, and other academic institutions • provinces • enterprises that harvest forest products in Canada or that produce forest products and that have existing forest product manufacturing facilities (for example, pulp, paper or lumber mills) located in Canada • enterprises that supply materials, products or services to forest products enterprises defined above • other not-for-profit institutions such as research, associations and standards organizations
Achieved/expected results	Over the long term, the FIP will contribute to the adoption of forest products, processes and technology innovations by industry. • Five case studies completed by 2016 that demonstrate the positive economic impact of forest product, process and technology innovations adopted by Canada's forest sector • One new product innovation adopted by the Canadian forest sector by 2016 • Five new forest process and technology innovations adopted by the Canadian forest sector by 2016 • Ten forest technologies/processes/products ready for implementation by March 31, 2016 • An average of 50 science-based research/technical reports produced per year demonstrating that the attributes of forest products are supported by science-based evidence • a framework to coordinate forest bio-refinery activities through the support of R&D laboratory work undertaken by NRCan's CanmetENERGY laboratories in collaboration with FPInnovations
Other	• FPInnovations, the largest public/private forest sector research organization in the world, receives funding from the Canadian Forest Service, provinces and industry. As such, the research agenda of this organization is collaboratively determined. FPInnovations is world-recognized as a best practice for industrial innovation systems. • CFS participates in the Forest Innovation by Research and Education (FIBRE) Partners Committee to help to optimize the efficiency and effectiveness of academic research within the forest sector innovation system. FIBRE is an umbrella organization that links eight forest R&D

	networks at universities across the country. FIBRE members are recognized as important contributors to the development of innovative forest sector technologies as well as the highly-trained personnel essential for the commercial deployment of these technologies.
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Forest Research Institutes Initiative (FRII)

Direct investment: Research, development and demonstration

Description	The goal of the Forest Research Institutes Initiative (FRII) is to support pre-competitive research in Canada and will be conducted by FPInnovations. Investments will reflect federal objectives such as forest sustainability, improved environmental performance through the adoption of new technologies and forestry practices, sector competitiveness and access to international markets. More specifically, priorities include: enhancing productivity; reducing costs of production; maintaining and improving market access; growing opportunities for value-added products; cutting energy consumption while advancing non-fossil fuel options (e.g. biomass); and improving environmental performance through new processes and technologies. Over the long term, outputs of the FRII are expected to contribute to: • increased competitiveness of the Canadian forest sector (product and process innovation, value-added product development, maximized economic fibre yield) • improved environmental performance from Canadian forest and forest product operations • enhanced market access for Canadian forest products in world markets (reduction of non-tariff trade barriers) • improved national and international perception of Canadian forest practices • improved forest workplace health and safety practices The main technology area is: • **Energy efficiency technologies** ($460K) – Technology development and demonstration: To enhance the energy efficiency of forest industry facilities and operations.
Timeframe	April 2013 to March 2015
Eligible recipients	The only eligible recipient of contributions under the Forest Research Institutes Initiative (FRII) is FPInnovations.
Achieved/expected results	The expected outcome of the FRII is the generation of new knowledge through research and development to enable Canadian forest operators and wood product manufacturers to enhance productivity, reduce production costs, maintain and improve market access, reduce energy consumption and improve environmental performance.

	Deliverables, though highly variable from one project to another, may include: • scientific, industrial or popular publications • available new or improved technologies, processes, or methods of operating • industrial implantation of a new technology or approach • changes to codes or standards relating to the use of wood
Other	FPInnovations, the largest public/private forest sector research organization in the world receives funding from CFS, provinces and industry. As such, the research agenda of this organization is collaboratively determined. FPInnovations is world-recognized as a best practice for industrial innovation systems.
Key contact	Darcie Booth Acting Director General Policy, Economics and Industry Branch, Natural Resources Canada E-mail: Darcie.Booth@nrcan-rncan.gc.ca Telephone: 613-947-7400

Investments in Forest Industry Transformation (IFIT)

Direct investment: research, development and demonstration

Description	The Investments in Forest Industry Transformation (IFIT) program was created in 2010 to support Canada's forest sector in becoming more economically competitive and environmentally sustainable. This $100 million, 4-year initiative targeted investments for the commercialization of innovative technologies and processes to support forest industry transformation and ensure a more prosperous future from a more diversified portfolio of products and markets. The renewal of IFIT was announced in the February 2014 Budget, under the Economic Action Plan 2014, with an additional $90.4 million over four years for the program. This continued commitment will help bring the next wave of innovation to market and will solidify Canada's position as a leader in forest industry transformation.
Timeframe	April 2010 to March 2014 with a renewed time frame of April 2014 to March 2018
Eligible recipients	Eligible recipients are companies that produce forest products (products made from/with wood fibre) with existing manufacturing facilities located in Canada (i.e. open or closed pulp, paper, panelboard or engineered wood products mills).
Achieved/expected results	IFIT addresses a critical need for capital investment in new technologies. The program's two calls for proposals produced 107 unique applications demonstrating the sector's great appetite for transformative projects. To date, IFIT has supported 14 world- and Canadian-first technologies in several provinces across a range of forest subsectors and businesses. These projects aim to "de-risk" new technologies and encourage broader adoption of the technologies across the industry. As a whole, the innovative products and processes advanced by IFIT are technically and financially viable, generating over $60 million per year in new revenues to firms and supporting over 2400 jobs across the forest sector, including rural and Aboriginal communities. While the IFIT program funds a maximum of 50 percent of project costs, the average contribution is nearly 35 percent. As such, this initiative has leveraged significant funding from industry, provincial governments and other stakeholders for the implementation of first-in-kind forest sector technologies in facilities across the country. IFIT's outcomes will continue to include: • new or increased production of bioenergy, biomaterials and biochemicals as well as next-generation building products by the forest sector

	• increased deployment of first-in-Canada applications of innovative technologies (with preference given to Canadian technologies) or new applications of existing technologies not traditionally applied in the forest sector • the creation of innovative partnerships with sectors and stakeholders that are not traditional forest sector partners, thus leading to new business models for the forest sector
Other	• A number of projects are implementing technologies to produce renewable energy. For example, a lumber mill in British Columbia has installed an organic rankine cycle system to generate electricity using biomass-derived waste heat, and a pulp mill in Alberta is implementing an innovative anaerobic hybrid digester technology to generate bioenergy from pulp mill effluent. Together these mills are also increasing green electricity production in Canada. • IFIT has established strong working relationships with many of its provincial counterparts over the past four years and through these connections created unique co-funding partnerships. Both FIP and IFIT have successfully collaborated with the Centre de recherche industrielle du Québec and Ontario's Centre for Research and Innovation in the Bio-economy and have implemented joint projects. • Intellectual property management has been another important component of a number of projects. In one case, it was possible for the IP rights associated with a project to rest with a research organization while the company implementing the project was granted an exclusive licence for a set period of time, after which the technology would be made available to other companies in the sector. This provided the company implementing the project with an incentive to take on project risk, as they are able to capture first-mover advantage, but still increased the public benefit associated with the project as the technology becomes available across the sector once the time-limited licence expires.
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Aboriginal Forestry Initiative (AFI)

Direct investment: research, development and demonstration

Collaboration

Description	The Aboriginal Forestry Initiative (AFI) represents a Government of Canada approach to foster enhanced Aboriginal participation in the competitive and sustainable transformation of Canada's forest sector. The AFI is supported by Aboriginal Affairs and Northern Development Canada and the Canadian Forest Service within Natural Resources Canada and works with other federal departments through the Strategic Partnerships Initiative. The AFI supports the Government of Canada's Framework for Aboriginal Economic Development. With a focus on economic development, the AFI empowers Aboriginal entrepreneurs in the forest sector by serving as a knowledge centre for Aboriginal forestry and forest sector innovation and to facilitate knowledge exchange and coordination of federal and other supports to Aboriginal forestry projects and partnerships. The AFI focuses its resources on Aboriginal forestry projects that are acting on an immediate economic development opportunity, have potential for regional-scale economic development, and appeal to multiple partners/funding agencies. The projects that AFI supports deliver significant economic impacts in the forest sector to multiple Aboriginal communities. They are designed to benefit Aboriginal groups and organizations in areas such as business development, business revenue and employment. The AFI focuses investment on three key subsector activities: biomass and bioenergy research, development and production; forestry services that fill identified service gaps or niches; and development of value-added forest products. • **Energy efficiency technologies:** The total funding amount was not allocated by technology type for this initiative. Nor are technologies the focus of the initiative. • **Distributed power generation** ($2 million) – AFI has identified bioenergy as a priority area and has supported feasibility, technical and biomass supply studies related to forest-based bioenergy projects across the country. • **Technologies with potential longer-term impact:** N/A

Timeframe	April 2011 to March 2014 A new version of the program is currently in development for 2014–15
Eligible recipients	Eligible participants are Aboriginal communities, associations, industries and entrepreneurs who have a focus on economic development in forestry. The focus of the AFI going forward will be in the development and support of communities and businesses involved in the bioenergy economy and participation in forest opportunities related to major resources projects.
Achieved/expected results	The Aboriginal Forestry Initiative is supporting the forest sector by financing business plans, feasibility, training and entrepreneurship development projects with the aim of helping entrepreneurs to competitively engage in markets, spreading benefits across communities and organizations and to other partners. Activities involve optimizing the use of forest tenure or wood supply to develop innovative value-added forest products, competing in new markets with innovative forest products and services for government and industry. AFI also supports Aboriginal communities in developing feasibility and technical studies related to forest-based bioenergy production and distribution. To date, the AFI has invested over $5 million in 39 projects which includes $2 million to five bioenergy projects. These projects include the: • development of forest inventories and management of the resource to enable the installation of efficient biomass systems in communities across the Northwest Territories • Whitesand First Nation's continued advancement in environmental and engineering planning for a 3 MW biomass-fired combined heat and power plant and a 180 tonne/day wood pellet mill. The power plant aims to feed electricity to three remote communities that are currently powered by diesel generators In the coming year, the AFI will continue to support a diversity of approaches to supporting or advancing regional-scale bio-economic and bioenergy development in Northern and remote communities.
Other	• Northwest Territories Bioenergy Initiative – The main goal of this project is to support wood chip, pellet and other forest products harvest in the NWT for the biomass industry. The project includes a South Slave Lake Forest Resource Assessment for most of the productive forest areas and community engagement and consultation. Through an ILA for delivery of funds via CanNor, AFI invested $1.2 million between 2012 and 2014. • Whitesand First Nation – Community Sustainability Initiative – Bioenergy – Whitesand First Nation is partnered with Great Northern BioEnergy (private firm) and Wawasum Group LP to train new staff and pool their respective wood pellet production to secure large long-term commercial

	contracts with European wood pellet buyers that neither partner could secure individually. Canada's (AFI's) contribution to the project in 2012–13 and 2013–2014 was $642,158. • **Sagatay: A Brighter Horizon Forest Products and Energy Manufacturing Training Project** – In preparation for the start-up of a 3 MW combined heat and power plant (as presented in the Whitesand First Nation – Community Sustainability Initiative – Bioenergy project), Whitesand First Nation is conducting training around facility operation and biomass harvesting and hauling activities. Canada's (AFI's) contribution to the project in 2012–13 was $25,000. • **Winnipeg River Integrated Wood and Biomass Project –** In order to utilize the former Tembec Pine Falls wood supply, AFI supported planning to help First Nations engage in stewardship of a wood supply agreement by establishing a joint venture company. This First Nations partnership will be the foundation for their partnership with Manitoba Model Forest, Prendiville, Ainsworth Energy Co. Ltd., and other possible partners. This project assessed the training needs of the community and supported a scoping/marketing study of the cross laminate timber facility. AFI has contributed $58,000 since 2012. • **Bioenergy and lumber production facility** – This project with the Innu Mishtuk Limited Partnership was for the establishment of a sawmill producing random length kiln-dried lumber and wood chip plant processing debarked roundwood into wood chips for supply to industrial/utility bioenergy markets in Europe. AFI contributed $35,000 towards the project in 2011–12 to facilitate a feasibility study on product development.
Key contact	Darcie Booth Acting Director General Policy, Economics and Industry Branch, Natural Resources Canada E-mail: Darcie.Booth@nrcan-rncan.gc.ca Telephone: 613-947-7400 nrcan.gc.ca/forests/federal-programs/13125

Sustainable Development Technology Canada

SD Tech Fund™

Direct investment: technology demonstration

Description	The SD Tech Fund™ has received federal funding through several successive conditional grants, which are subject to a funding agreement that sets the terms and conditions. The latest federal funding announcement was $325 million in Budget 2013, bringing the total to $915 million for the SD Tech Fund™. The purpose of the SD Tech Fund™ is threefold: a) to provide financial support for the late-stage development and pre-commercial demonstration of technology solutions that address climate change, air quality, clean water, and clean soil b) to foster and encourage innovative collaboration and partnering amongst diverse entities in the private sector and in academic and not-for-profit organizations to channel and strengthen the Canadian capacity to develop and demonstrate sustainable development technologies c) to ensure timely diffusion by the funded recipient of the sustainable development technologies in relevant market sectors throughout Canada SD Tech Fund™ support is focused primarily on small-scale technology demonstrations in the following areas: • Responsible resource development: Mitigate environmental impacts associated with Canada's natural resource sector through technologies in the oil and gas, mining, and forestry sectors. • Next generation transportation: Technologies related to next-generation vehicles having reduced emissions and higher energy efficiency, with a focus on freight transportation. • Resource and energy efficiency: Technologies that encourage energy efficiency in buildings and industrial processes, with a focus on industrial water use efficiency. • Clean energy: Technologies that enable clean energy production, distributed power generation and energy storage as well as technologies related to carbon capture and storage, integrated energy systems and biorefinery/biochemical production. • Agriculture: Technologies that increase yield and improve temperature and drought resistance of agricultural crops, mitigate land-use changes and biodiversity loss and diversify farm incomes. • Northern and remote communities: Innovative technologies and solutions for self-sufficiency in smaller communities, such as food security, heavy-lift transportation, small-scale renewable energy and microgrid applications.

Timeframe	Original agreement signed in March 2001, latest agreement ending on December 31, 2017 (new FA5 under negotiation)
Eligible recipients	To be considered for Sustainable Development Technology Canada (SDTC) funding, applicants should have expertise in sustainable development technology and be part of a project consortium that meets one of the following three descriptions: 1) a for-profit corporation, a partnership, a limited partnership or a business trust that has entered into a contract relating to the execution of the applicant's project with one or more of the following legal entities: o another corporation o a partnership, a limited partnership or a business trust that has expertise in sustainable development technology o a university, college or other provincially accredited post-secondary educational institution o a research institute o an individual who has expertise in sustainable development technology o a not-for-profit corporation, with one of its purposes being to undertake, fund or otherwise support the development or demonstration of sustainable Development technology 2) same as above, except a for-profit corporation, a partnership, a limited partnership or a business trust that has entered instead into a collaborative arrangement with one or more of the legal entities listed above to apply jointly to SDTC for funding to carry out the applicant's proposed project 3) a not-for-profit corporation, with one of its purposes being to undertake or fund the development or demonstration of sustainable development technology
Achieved/expected results	As of June 2014, the SD Tech Fund™ has received 2,556 applications for funding through 24 rounds of funding, involving 8,214 entities as project consortia members. The total funding requested amounts to $6.5 billion. As of June 2013, SDTC has contributed $684 million towards a portfolio of 269 SD Tech Fund™ projects. These projects have leveraged $1.8 billion from project consortia members, for a total portfolio value of $2.5 billion (total eligible project costs). In addition, 57 companies into which SDTC has invested $185 million have raised $2.5 billion in follow-on financing from the private sector in the past eight years. 56 percent of follow-on funding comes from sources outside of

	Canada, particularly the United States (42 percent), as well as Europe (8 percent). SDTC's website (www.sdtc.ca) provides the names of consortium members for each project. It also provides data on the funding from "other government and academia" for each project.
Other	To identify investment priorities for development and demonstration of clean technologies, SDTC has developed five SD Business Case™ reports, which provide strategic insights into specific economic sectors. Combining comprehensive stakeholder input with objective SDTC analysis, these reports present a vision of Canada's future potential and investment opportunities in the technology areas under study. One specific example under Clean Conventional Fuels is the oil and gas report that focuses on the upstream portion of the market (from extraction to the refinery). An example under Renewable Fuels is the biofuels report that addresses promising investments in the development of second-generation technology to enable the use of alternative, higher-revenue generating feedstocks. SD Business Case™ reports can be found on the SDTC website www.sdtc.ca under the "Knowledge Centre" tab. In addition, the SD Natural Gas Fund™ supports the development and demonstration of new downstream natural gas technologies by bringing together contributions from the Canadian Gas Association's members through their Energy Technology Innovation Canada Initiative to match contributions from SDTC's SD Tech Fund™, up to a combined total of $30 million over three years.
Key contact(s)	Jon Flemming, VP – Public Affairs E-mail: j.flemming@sdtc.ca

NextGen Biofuels Fund™

Direct investment: technology demonstration funding

Description	Budget 2007 announced a conditional grant of federal funding to establish the NextGen Biofuels Fund™, subject to a funding agreement that sets the terms and conditions separate from the SD Tech Fund ™. The purpose of the NextGen Biofuels Fund™ is to: • facilitate the establishment of first-of-kind large demonstration-scale facilities for the production of next-generation renewable fuels and co-products • improve the sustainable development impacts arising from the production and use of renewable fuels in Canada • encourage retention and growth of technology expertise and innovation capacity for the production of next-generation renewable fuels in Canada For the past several years, the next-generation renewable fuel industry has endeavoured to overcome technology and financial hurdles and is slowly progressing towards commercial roll-out. The NextGen Biofuels Fund™ primarily supports technology demonstrations under • **Technologies with potential longer-term impact –** Technology demonstration o Support for first-of-kind facilities that primarily produce a biofuel (ethanol or biodiesel) using next-generation processes at a commercial-scale demonstration. Eligible projects must be located in Canada and use feedstocks that are, or could be, representative of Canadian biomass. The project proponents must have completed a pre-commercial pilot-scale demonstration of the technology that has run on a continuous or semi-continuous basis and successfully validated technical efficacy.
Timeframe	September 2007 to April 2017 (for disbursement of funds to recipients)
Eligible recipients	To be considered for the NextGen Biofuels Fund™, applicants must have legal capacity in Canada, access to expertise in next-generation renewable fuels production pathways, and must meet one of the following four descriptions: (a) for-profit corporation (b) partnership (c) limited partnership (d) business trust

Achieved/expected results	As of the end of December 31, 2013, two Applications for Funding (AFF) were actively progressing under the NGBF Project Assurance Process (PAP). Total project costs pertaining to the two active AFF's amounted to $512.3 million with estimated NextGen Biofuels Fund™ funding totalling $177.8 million. Six Indications of Interest (IOI) were received in 2013 that represent NextGen Biofuels Fund™ applicants. Related total project costs of the eight IOI's on hand in 2013 amounted to $1.3 billion.
Key contact(s)	Jon Flemming, VP – Public Affairs E-mail: j.flemming@sdtc.ca

National Research Council Canada

Energy Production and Mining

Direct investment: technology development and demonstration

Description	Under this initiative the National Research Council Canada (NRC) works with energy and mining production companies and their supply chains with impacts in improved global competitiveness and increased employment. It has a number of objectives, principal among them being 1) reducing the cost of grid storage by up to 50 percent 2) developing waste biomass and municipal solid waste (MSW) as an energy source for stationary power production particularly to displace diesel use in remote and off-grid communities and industrial sites 3) rendering separation processes and comminution in mining more energy efficient 4) reducing water consumption in mining thereby reducing the energy requirements for separation, drying and tailings ponds management. Under Energy Production and Mining, NRC focuses its efforts under the following technology areas: • Unconventional oil and gas ($10 million) – Technology development and demonstration: support for development of more effective tailings treatment technologies and for improved recovery strategies and processes for bitumen upgrading. • Energy efficiency technologies ($10 million) – Technology development and demonstration: Support for development of energy-efficient separation technologies and comminution. • Distributed power generation ($20 million) – Technology development and demonstration: Support for biomass waste-to-energy for power production to reduce the costs of energy supply in remote/off-grid communities and industry by 20 percent and development of energy storage technologies for grid reliability and smart grid applications leading to cost reductions by 50 percent. • Technologies with potential longer-term impact ($2 million) – Technology development and demonstration: Support for development of hydrogen/fuel cell (as part of energy storage for grid applications). These outcomes should be realized within the next six to ten years through an overall government investment of approximately $40 million. This will be matched by industry investment of about $80 million for a total of about $120 million.
Timeframe	6 to 10 years

Eligible recipients	NRC is the sole recipient. NRC's clients are companies in the mining, oil and gas and environment sectors as well as utilities and independent power producers and their supply chains. NRC works with the spectrum of renewable and emerging energy technology developers, including bioenergy, wind, solar, hydrogen, fuel cells and batteries. NRC also collaborates on research, testing and demonstration activities with government departments and agencies to support the development of public policy and regulations.
Other	NRC innovation initiatives have the overarching goal of economic development and wealth creation for Canada and involve significant collaboration with industry throughout the value and supply chain, as well as other government departments, to achieve these outcomes.
Key contact	Andrew Reynolds General Manager Energy, Mining and Environment E-mail: Andy.Reynolds@nrc-cnrc.gc.ca Telephone: 604-221-3024 nrc-cnrc.gc.ca/eng/rd/eme/index.html

Construction

Direct investment: technology development and demonstration

Development and implementation of standards and regulations

Collaboration

Description	NRC Construction works with firms in Canada's construction value chain to support innovation of building products, systems and services that are deployed domestically and internationally. It provides research- and technology- based solutions and services to accelerate commercialization of construction products and services that achieve higher-performing buildings and infrastructure. It integrates multi-disciplinary technical expertise and national facilities; national services for performance assessment and validation for building products and systems; and leadership and operation of Canada's National Model Building Codes, including the National Energy Code for Buildings. Jointly with Natural Resources Canada and Canada Mortgage and Housing Corporation (CMHC), NRC operates the Canadian Centre for Housing Technologies, a unique facility that evaluates and deploys energy-efficient technologies. NRC Construction will deliver the following energy-related outcomes via programs: 1) improved building regulations and solutions to reduce compliance costs and de-risk building designs; this also includes the National Energy Code for Buildings that established the minimum level of energy efficiency for buildings in Canada, and energy requirements for houses 2) validated energy retrofit technologies and decision-making tools for commercial and institutional buildings; 3) innovative bio-based building products that reduce raw materials and energy consumption, including insulation materials The activities are focused in the following technology areas: • Energy efficiency technologies ($31 million) – Technology development and demonstration: Support for improvements in indoor air quality delivered with reduced energy consumption, through technologies and validation for contaminant reduction, air cleaning and ventilation. This includes supports for energy-efficient building environmental control systems for LED lighting and HVAC; ultra-high efficiency thermal insulations for wall and roof systems; novel glazing films and coatings to control solar load; and innovative recycled, composite and bio-based building materials and products, including insulation materials.

	• **Distributed power generation** ($3 million) – Technology development: Support for the development of roof-integrated photovoltaic material with improved durability and efficiency (20 years and 12 percent, respectively) and building-level electro-chemical storage technologies for load-leveling as well as improved value from photovoltaic (PV) systems. • **Technologies with potential longer-term impact** ($2 million) – Technology development and demonstration: Support for development of hydrogen/fuel cell (as part of energy storage for grid applications). These outcomes should be realized within the next three to ten years through an overall government investment of about $34 million. This will be matched by industry investment of about $80 million for a total of approximately $114 million.
Eligible recipients	NRC is the sole recipient.
Other	NRC innovation initiatives have the overarching goal of economic development and wealth creation for Canada and involve significant collaboration with industry throughout the value and supply chain, as well as other government departments, to achieve these outcomes.
Key contact	Dr. Morad Atif General Manager Construction E-mail: Morad.Atif@nrc-cnrc.gc.ca Telephone: 613-993-2443 nrc-cnrc.gc.ca/eng/rd/construction/index.html

Aerospace

Direct investment: technology development and demonstration

Description	NRC Aerospace (Aero) objectives are focused on research and technology development programs in six areas crucial to the Canadian aerospace sector's overall competitiveness: 1) future aircraft development 2) cabin and cockpit technology 3) aircraft icing 4) high-TRL technology and process development 5) air defence technologies 6) UAS civil certification and applications While its program investment objectives are multi-faceted, Aero has concrete goals related to energy innovation in the aerospace sector. Increasing aircraft fuel efficiency by 25 percent is one of the key goals under the Aeronautics for the 21st Century (AERO21) program. NRC is investing about $32 million, and the industry is leveraging the government investment with approximately $79 million over eight years. In addition, through the Civil Unmanned Aircraft Systems (CivUAS) program, a Technology Demonstrator program will be carried out to demonstrate the benefits of using UAS to carry out close inspections of power lines and pipelines. The total NRC Civil UAS program cost will be approximately $22.5 million over five years, of which about $10.2 million is NRC investment and about $12.3 million is external revenue. Under its Aeronautical Product Development Technologies (APDT) program, Aero supports the technology development of advanced industrial gas turbine combustion systems for original equipment manufacturers through its high-pressure combustion test facilities. Industry is supporting this effort with approximately $4 million per year. In addition, AERO also supports EME in exploiting gas turbine technologies for advancing stationary applications using waste biomass and MSW (under the Energy Production and Mining initiative). The activities are focused in the following technology areas: • Next generation transportation ($4 million) – Technology development and demonstration: Support for development of processes and technologies focused on increasing fuel efficiency and reduced engine emissions. • Distributed power generation: Technology development and demonstration: Support for the development advanced gas turbines engineered for biofuel applications (see Energy Production and Mining).

	• **Technologies with potential longer-term impact** ($4 million): Technology development and demonstration: Support for development of advanced syngas combustion technologies. These outcomes should be realized within the next three to ten years through an overall government investment of about $34 million. This will be matched by industry investment of about $80 million for a total of approximately $114 million.
Eligible recipients	NRC is the sole recipient.
Other	NRC innovation initiatives have the overarching goal of economic development and wealth creation for Canada and involve significant collaboration with industry throughout the value and supply chain, as well as other government departments, to achieve these outcomes.
Key contact	Jerzy P Komorowski General Manager Aerospace E-mail: Jerzy.Komorowski@nrc-cnrc.gc.ca Telephone: 613-993-0141 nrc-cnrc.gc.ca/eng/rd/aerospace/index.html

Automotive and Surface Transportation

Direct investment: technology development and demonstration

Description	NRC-Automotive and Surface Transportation (AST) works with Canadian companies to deliver cost-effective technology solutions to meet aggressive fuel-efficiency and emission-reduction targets (US CAFE standards for the automotive industry and the upcoming equivalent Canadian regulations) and to deliver cost savings for the transportation sector and for public-sector organizations in terms of fuel, maintenance and repair savings. These solutions include lightweighting parts structures, enhanced aerodynamic design, energy-efficient powertrains and power management tools. Solutions to implement those strategies for internal combustion engine (ICE)-based vehicles will be required in the short term, whereas increasing degrees of electrification will be required to reach the 2025 fuel economy targets. AST has three relevant programs with the following targeted outcomes: 1) reduce average fuel consumption of light-duty vehicles from 9.8L/100 km to 5.6L/100 km 2) reduce vehicle weight by at least 10 percent using aluminum intensive solutions for light-, medium- and heavy-duty vehicles 3) produce fuel savings of $165M and greenhouse gas (GHG) reductions of 325 000 tonnes (CO_2) for heavy-duty long-haul truck and intercity bus fleet operators by the deployment of energy management systems and improved aerodynamics. The activities are focused in the following technology areas: • Next generation transportation ($45 million) – Technology development and demonstration: Support for development of technologies that will lead to lower-cost electric motors, and Li-ion batteries as well as development of low-friction materials for moving components in powertrains and advanced after-treatment solutions of alternative fuels. Other activities are focused on the development of technologies for manufacturing of composite structures and parts for lightweight designs, engine idling technologies, intelligent power management systems, technologies for drag reduction for light and heavy vehicles, and other manufacturing technologies. • Technologies with potential longer-term impact ($5 million) – Technology development and demonstration: Support for development of low-cost manufacturing technologies for hydrogen/fuel cell vehicles and for auxiliary power units. These outcomes should be realized within the next six to ten years with the help of government investment of about $40 million matched with industry co-investment of $67 million.

Eligible recipients	NRC is the sole recipient.
Achieved/expected results	Please see the program description.
Other	NRC innovation initiatives have the overarching goal of economic development and wealth creation for Canada and involve significant collaboration with industry throughout the value and supply chain, as well as other government departments, to achieve these outcomes.
Key contact	Dr. Michel M Dumoulin General Manager Automotive and Surface Transportation E-mail: Michel.Dumoulin@nrc-cnrc.gc.ca Telephone: 450-641-5181 nrc-cnrc.gc.ca/eng/rd/ast/index.html

Ocean, Coastal and River Engineering

Direct investment: Technology development and demonstration

Description	NRC is supporting three themes under this initiative: 1) The NRC Arctic program will be the Government's catalyst in developing engineering technologies to ensure sustainable, low-impact resource development of the Arctic while increasing the quality of life of northerners. Efforts in this program will: a. reduce design ice loads for oil and gas platforms in the Arctic by 40 percent b. increase the detection of oil under ice and forecasting its location c. decrease the number of ice-related Arctic shipping incidents and structural damage by 50 percent d. optimize route planning in ice and ice management to increase operational windows and efficiencies e. increase survivability of personnel in emergencies by a factor of five and increase the life expectancy of Arctic infrastructure by 100 percent f. significantly reduce the operational costs of homes in the Arctic 2) The second theme focuses on increasing the commercial viability of Canadian marine renewable energy (MRE) technologies and projects (for extracting useful energy from ocean waves and water currents in Canadian rivers and coastal waters) and unconventional hydropower. The goal of this effort is to reduce typical MRE project costs by 10 percent and advance two wave and two hydrokinetic technologies from an immature to a mature stage. 3) Marine Vehicles program will address the priority challenges of the Canadian marine transportation industry, frontier oil and gas industry, and the Canadian shipbuilding and ship design industry. The needs have been identified as: a. reducing the cost of marine transportation operations (fuel costs) b. increased operability for Arctic and offshore exploration and production c. reducing the cost of vessel design, increasing vessel design capacity in Canada and designing for efficient vessel operations. NRC will develop technical solutions to address these needs that will be brought to industry through commercialization partners or by NRC as technical service

	NRC investment in the above-mentioned themes is $26 million over the next five to ten years. The activities are focused in the following technology areas: • **Unconventional oil and gas**: Technology development and demonstration: Support for development of technologies for oil spill detection, for forecasting and clean-up under Arctic conditions, for emission (CO_2, NO_x, SO_x) reduction in ships, for reduced ice loads on offshore oil and gas exploration and development platforms in Arctic conditions, and other. • **Energy efficiency technologies:** Technology development and demonstration: Support for development of technologies for reliable water supply and energy-efficient houses in the Arctic. • **Next generation transportation:** Technology development and demonstration: Support for development of improved ship designs and technologies for more efficient operations. • **Distributed power generation**: Technology development and demonstration: Support for development of improved assessment and mapping of unconventional hydropower resources. • **Technologies with potential longer-term impact:** Technology development: Support for development of marine energy technologies and advance two-wave and two hydrokinetic technologies from an immature to a mature stage.
Eligible recipients	NRC is the sole recipient.
Achieved/expected results	Please see the program description.
Other	NRC innovation initiatives have the overarching goal of economic development and wealth creation for Canada and involve significant collaboration with industry throughout the value and supply chain, as well as other government departments, to achieve these outcomes.
Key contact	Terry Lindstrom General Manager Ocean, Coastal and River Engineering E-mail: Terry.Lindstrom@nrc-cnrc.gc.ca Telephone: 613-993-2417 nrc-cnrc.gc.ca/eng/rd/ocre/index.html

Environment and Sustainability and Aquatic and Crop Resource Development

Direct investment: Technology development and demonstration

Description	Environment and Sustainability and Aquatic and Crop Resources initiatives share many synergies and are complementary to NRC's efforts under Energy Production and Mining. Under the Environment and Sustainability initiative, NRC's Algal Carbon Conversion (ACC) Flagship will provide Canadian industry with a cost-competitive, value-generating solution to divert CO_2 emissions into algal biomass, which can then be processed into biofuels and other marketable products. The flagship initiative represents an opportunity to address the environmental, energy and economic issues associated with industrial emissions by exploring how CO_2 emissions can be sustainably and profitably converted by algae into valuable products, without displacing food crop resources. The primary objective of the ACC Flagship is for NRC and its partners to establish a pilot-scale algal biorefinery at an industrial site. Government investment of about $45 million over the next five years will be matched by industry investment of approximately $12 million. The major final outcome, expected to be realized in fifty years, is diversion of 20 percent of 2010 Canadian carbon dioxide emissions. NRC's Aquatic and Crop Resource Development (ACRD) portfolio works directly with small to large Canadian companies to realize technological advances with aquatic and crop resources destined for natural health products, foods and beverages, fibres, bioenergy, bioremediation, bio-based chemicals and other bioproduct sectors. The research and technology development efforts span the entire value chain. NRC collaborates with companies from the seed technology and microalgae growth stage through to pre-clinical trials and quality assurance/quality control processes for their products. NRC is considered a valued partner to industry, particularly for Canadian companies developing functional ingredients for natural health products (NHPs), bio-based chemicals, improved varieties of wheat and solutions for capturing CO_2 through algal carbon conversion. The activities are focused in the following technology areas: • Unconventional oil and gas ($5 million to $10 million) – Technology development: Support for development of smart bio-chemicals (surfactants) for enhanced oil recovery. • Technologies with potential longer-term impact ($1 million to $2 million) – Technology development: Support for development of technologies for processing of seed oil products and waste streams.

Eligible recipients	NRC is the sole recipient.
Achieved/expected results	Please see the program description.
Other	NRC innovation initiatives have the overarching goal of economic development and wealth creation for Canada and involve significant collaboration with industry throughout the value and supply chain, as well as other government departments, to achieve these outcomes.
Key contact	Denise LeBlanc, General Manager Aquatic and Crop Resource Development E-mail: Denise.LeBlanc@nrc-cnrc.gc.ca Telephone: 902-426-2496 nrc-cnrc.gc.ca/eng/rd/aquatic/index.html

Measurement Science and Standards, Information and Communication Technologies, and Disruptive Energy Technologies

Direct investment: Technology development and demonstration

Description	Measurement Science and Standards, Information and Communication Technologies, and Disruptive Energy Technologies all focus on the development of advanced measuring and monitoring technologies offering high-potential energy savings. Accurate measurement underpins industrial success across all sectors of the economy. NRC's Measurement Science and Standards meets this demand with world-class facilities, technologies and staff, tackling challenges in innovation and providing first-rate metrology capabilities. Relevant to energy innovation, NRC works with Canadian and international power generation and distribution companies to calibrate power transformers, cables and sources to enable an efficient power grid and anticipates environmental sustainability metrology issues associated with energy innovation, such as the emission of black carbon, a climate forcer with air quality and health effects impacts. The government investment in these areas is $3 million annually. NRC Information and Communications Technologies program focuses on development of high-power, high-efficiency, high-frequency electronic devices that have the potential to create enormous energy savings. In particular, three sectors have been identified as being strong receptors for this technology, namely the communications, automotive and photovoltaic switching sectors. The APC program works with telecommunication companies to develop photonic technologies that increase data transmission capacity, reduce cost, and reduce network power consumption (and hence operating cost and environmental impact). Ongoing adoption of photonics technologies and improvements in device efficiency are driven in part by the need to reduce power consumption. Optical data transmission consumes far less power than traditional copper wire links, and this is driving the ongoing replacement of copper with optics in data centres and supercomputers throughout the world. This initiative is currently engaged with three industry clients in collaborative research projects in the silicon photonics area, with a cumulative project value exceeding $1.5 million. The Disruptive Energy Technologies program focuses on two themes: development of cost effective electrical energy capture and storage technologies, and development of fiber optic Bragg grating sensors and instrumentation that are operational within the harsh environments of integrated gasification combined cycle (IGCC) power plants. NRC is investing about $15 million over five to ten years.

	The activities are focused in the following technology areas: • **Next generation transportation** ($1.2 million) – Technology development: Support for development of improved measurement of black carbon emissions from advanced fossil fuel-efficient engine technologies, including those operating on biofuels and from next-generation aircraft engines, including those operating on biofuels. • **Distributed power generation** ($1.8 million) – Technology development and demonstration: Support for calibrations of high-voltage, high-current power transformers, cables, sources and field measurements of cable degradation to establish efficiency of grid system and assess innovative smart-grid technologies.
Eligible recipients	NRC is the sole recipient.
Achieved/expected results	Please see the program description.
Other	NRC innovation initiatives have the overarching goal of economic development and wealth creation for Canada and involve significant collaboration with industry throughout the value and supply chain, as well as other government departments, to achieve these outcomes.
Key contact	Dr. Alan Steele, General Manager Measurement Science and Standards E-mail: Alan.Steele@nrc-cnrc.gc.ca Telephone: 613-993-9384 nrc-cnrc.gc.ca/eng/rd/mss/index.html François Cordeau, General Manager Information and Communications Technologies E-mail: Francois.Cordeau@nrc-cnrc.gc.ca Telephone: 613-993-4444 nrc-cnrc.gc.ca/eng/rd/ict/index.html Dr. Duncan Stewart, General Manager Disruptive Energy Technologies E-mail: Duncan.Stewart@nrc-cnrc.gc.ca Telephone: 613-990-0915 nrc-cnrc.gc.ca/eng/rd/security/index.html

Industrial Research Assistance Program (IRAP)

Incentives and financing: technology development and demonstration

Description	For over 60 years, the National Research Council of Canada Industrial Research Assistance Program (NRC-IRAP) has been stimulating wealth creation for Canada through technological innovation. This is largely accomplished by providing technology assistance to small and medium-sized enterprises at all stages of the innovation process, to build their innovation capacity. The program's strategic objectives are to: • provide support to small and medium-sized enterprises in Canada in the development and commercialization of technologies • collaborate in initiatives within regional and national organizations that support the development and commercialization of technologies by small and medium-sized enterprises The activities are focused in the following technology areas: • Unconventional oil and gas: $12 million over the past five years for this technology cluster. • Next generation transportation: $38.5 million over the past five years for this technology cluster. • Energy efficiency technologies: $9.5 million over the past five years for this technology cluster. • Distributed power generation: $11 million over the past five years for this technology cluster. • Technologies with potential longer-term impact: $9.5 million over the past five years for this technology cluster.
Timeframe	NRC-IRAP does not target specific sectors but its contribution to any given sector can be determined by summing activity against relevant NAICS codes. Using this approach, NRC-IRAP has contributed more than $84 million over the past five years to innovation related to energy technologies.
Achieved/expected results	Please see the program description.
Other	NRC's innovation initiatives have the overarching goal of economic development and wealth creation for Canada and involve significant collaboration with industry throughout the value and supply chain, as well as other government departments, to achieve these outcomes.

Key contact	Bogdan Ciobanu Vice-President Industrial Research Assistance Program E-mail: bogdan.ciobanu@nrc-cnrc.gc.ca Telephone: 613-993-0695 nrc-cnrc.gc.ca/eng/irap/index.html

Atomic Energy Canada Limited

Generation IV Nuclear Technologies Development

Direct investment: Research, development and demonstration

Collaboration: Enhancing international and national collaborations

Description	The Generation IV International Forum (GIF) is focused on developing nuclear technologies that will be predicated on four goals: sustainability, economics, safety and reliability, and proliferation resistance and physical protection. The objectives of the Generation-IV national program are to: • broaden Canadian expertise (i.e. universities, industry and national laboratories) in advanced reactor technologies • participate in international R&D efforts and learn more about initiatives in other countries • coordinate domestic expertise and facilitate partnering within Canada and abroad • leverage existing Canadian R&D efforts • influence multi-lateral R&D in accordance with Canadian needs and requirements • attract and train highly-qualified professionals to work in nuclear- and energy-related positions within Canada • position Canadian companies to benefit from, and engage in, future market opportunities Research and development for Generation-IV nuclear systems builds upon the existing Canadian nuclear science and technology base established over the last five decades. Atomic Energy Canada Limited's (AECL's) concept of a Generation-IV reactor is based on the supercritical water-cooled reactor (SCWR). The SCWR is the most natural evolution of Canada's CANDU technology. AECL is also pursuing development of technology for producing hydrogen from water using high-temperature Generation-IV nuclear reactors. All research and development work under this program is highly leveraged through collaborations with international organizations through GIF agreements and with over 20 Canadian universities and other federal laboratories. The activities of this program largely fall under: • Technologies with potential longer-term impact ($8 million) – Technology development: Support for the projects focused on development of the SCWR concept and nuclear hydrogen production technologies. In addition to this amount, about $3.5 million from the Program on Energy Research and Development (PERD) and the ecoENERGY Innovation Initiative (ecoEII) is provided to support these activities.

Timeframe	April 2012 to March 2016
Eligible recipients	This AECL program supports the R&D activities of the AECL laboratories.
Achieved/expected results	A significant output of this program would be a concept of Generation-IV nuclear reactor that is more reliable, efficient, economic, safe and sustainable compared to the current-generation reactors. The concept will be reviewed and validated by international experts. The program is also helping train highly-qualified people through university research, many of whom have already been employed in Canada's nuclear sector. It is expected that some of the outputs from this program (for example high-temperature, corrosion-resistant materials) could be applicable beyond the nuclear industry.
Other	The program is highly leveraged through collaborations with international nuclear organizations under the auspices of the Generation-IV International Forum. Currently, collaborations exist with organizations from France, Japan, China, Russia, the USA, South Korea and several European members of the European Atomic Energy Community (EURATOM). AECL also collaborates with over 20 universities in Canada as well with the universities abroad. Within Canada, AECL also collaborates with Natural Resources Canada's CanmetENERGY and National Research Council laboratories.
Key contact	Dr. Robert A. Speranzini General Manager CANDU Technology Development E-mail: speranzinir@aecl.ca Telephone: 613-584-3311 aecl.ca/en/home/science-technology/energy.aspx

Natural Sciences and Engineering Research Council of Canada

Collaborative Research and Development (CRD) Grants

Description	Collaborative R&D Grants support well-defined projects undertaken by university researchers and their private-sector partners. Direct project costs are shared by the industrial partner(s) and NSERC. CRD projects can be at any point in the R&D spectrum that is consistent with the university's research, training, and technology transfer mandate. These grants can support research projects in all areas of natural science and engineering. With respect to energy-related research, the following areas, and many more, are eligible: • Unconventional oil and gas • Next generation transportation • Energy efficiency technologies • Distributed power generation • Technologies with potential for a longer-term impact
Timeframe	Projects may range from one year to five years in duration, but most awards are for two or three years.
Eligible recipients	Eligible academic researchers Although NSERC will only match the industrial contributions under this program, provincial and federal departments are often partners in these projects, along with industry.
Achieved/expected results	CRD Grants are intended to give companies that operate from a Canadian base access to the unique knowledge, expertise and educational resources available at Canadian post-secondary institutions and to train students in essential technical skills required by industry. The mutually beneficial collaborations are expected to result in industrial and/or economic benefits to Canada.
Key contact	Anne-Marie Thompson Director, Energy, Environment and Resources Division National Sciences and Engineering Research Council of Canada Telephone: 613-943-7651 Email: Anne-Marie.Thompson@nserc-crsng.gc.ca nserc-crsng.gc.ca

Industrial Research Chair (IRC) Grant

Description	The objective of the Natural Sciences and Engineering Research Council of Canada (NSERC) Industrial Research Chair (IRC) Grant is to assist universities in pursuing new directions, or in building on existing strengths, in an area of science and engineering of interest to industry. These grants provide salary support for the Chairholder and funding for a major research program. These grants can support research in all areas of natural science and engineering including, but not limited to, the following: • Unconventional oil and gas • Renewable energy • Next generation transportation • Energy efficiency technologies • Distributed power generation • Technologies with potential for a longer-term impact
Timeframe	Five years (renewable)
Eligible recipients	Eligible academic researchers Although NSERC will only match the industrial contributions under this program, provincial and federal departments are often partners in these Chairs, along with industry.
Achieved/expected results	Assist universities in pursuing new directions, or in building on existing strengths, in an area of science and engineering of interest and benefit to industry.
Key contact	Anne-Marie Thompson Director, Energy, Environment and Resources Division National Sciences and Engineering Research Council of Canada Telephone: 613-943-7651 Email: Anne-Marie.Thompson@nserc-crsng.gc.ca nserc-crsng.gc.ca

Strategic Project Grants

Description	The goal of Strategic Project Grants (SPG) is to increase research and training in targeted areas that could strongly enhance Canada's economy, society and/or environment within the next 10 years. Under this program, NSERC is currently funding research in four targeted areas including "Natural Resources and Energy". A detailed description of this strategic target area can be found on our website but a few topic areas (under energy) are listed below as examples. The activities are focused in the following technology areas: • Cleaner fossil fuels (including unconventional oil and gas) • Renewable energy • Energy use (including energy-efficiency technologies) • Energy systems (including distributed power generation) • Energy technologies with potential for a longer-term impact
Timeframe	Strategic Project Grants provide support for one- to three-year projects
Eligible recipients	Eligible academic researchers
Achieved/expected results	Increase research and training in targeted areas that could strongly enhance Canada's economy, society and/or environment within the next 10 years.
Key contact	Anne-Marie Thompson Director, Energy, Environment and Resources Division National Sciences and Engineering Research Council of Canada Telephone: (613) 943-7651 Email: Anne-Marie.Thompson@nserc-crsng.gc.ca nserc-crsng.gc.ca

Environment Canada

Environmental Technology Verification (ETV) Program

Direct investment: Market-ready technologies

Development and implementation of standards and regulations

Description	Established in 1997 by Environment Canada, the Environmental Technology Verification (ETV) program validates the performance claims of environmental technologies, processes and products that are commercially available through qualified third parties. Technology developers and users alike can use the ETV program to enhance technology credibility and reduce procurement risk, respectively. ETV verifications are based on test data generated by test protocols. The program is currently focusing its activities on four priority sectors: energy, water, soil and air. The main objective of Canada's ETV program is to promote the advancement and deployment of clean technologies by: • differentiating a technology from the competition, thereby providing a company with a distinct market advantage • providing a specific and precise performance claim of the technology, presented in an easily understood format to facilitate adoption • generating credibility with prospective buyers and reducing their perceived procurement risk • expediting permitting and approvals for the use of the technology • supporting the patenting process, by providing verified claims • increasing national and international market recognition Through this work, the ETV program encourages faster and more widespread adoption of technologies to solve environmental challenges while also helping to build the capacity of clean technology developers, entrepreneurs and companies. The requirement process of the ETV program is generic; therefore it applies to any environmental sectors indicated above such as water, air emissions, residual wastes, energy, etc. The verification process under the ETV program costs between $10,000 to $20,000 depending on the complexity of the technology and the quality of data available.
Timeframe	Depending on the availability and quality of data, the verification can take two months and up to six months if additional testing is required.

Eligible recipients	Any user, developer, regulator or other party that would like to verify the environmental performance of a technology can apply voluntarily to the program.
Achieved/expected results	Environment Canada manages the Canadian ETV program through the provision of oversight and the coordination of activities with other government jurisdictions. In this respect, Environment Canada is coordinating work between ETV and Natural Resources Canada on an EMMC-approved technology verification for the Green Mining Initiative (GMI). This verification activity is elaborated below in the "Collaboration" section. In addition, Environment Canada officials are participating in the ETV International Working Group (IWG), which is composed of members from the United States, the European Union, the Philippines and the Republic of Korea, with the objective of developing an international ISO standard for ETV. The IWG is working towards international recognition to ensure that a technology verified in one member country will be accepted as verified in other member countries. International recognition presents opportunities to: • facilitate recognition of environmental technologies and their capabilities across jurisdictions • foster mutual recognition of verification certifications and accreditation of verification entities • enable the sharing of test methods and protocols Environment Canada is the Chair of the ISO Technical Working Group for the development of the ISO standard on ETV. The future ISO-ETV standard (ISO 14034) will support the move towards mutual recognition of ETV and will ensure the credibility of the ETV process while increasing the visibility and awareness of ETV globally. Based on ISO guidelines and timeline, the development of ISO 14034 should be completed within three years.
Other	Although the ETV program commonly targets environmental technology developers, the success of the ETV program is closely linked to the acceptance, application and implementation of this process by specific jurisdictions (i.e. municipalities, provincial and federal governments). Therefore, an ETV pilot project was initiated with Canmet MNING to verify an environmental technology under the Green Mining Initiative (see above). As well, an Agreement in Principle was signed between Globe Performance Solutions, third-party Delivery Agent of the ETV program, and the Bureau de normalisation du Québec for the acceptance and reciprocity of verification results of waste water and clean water environmental technologies. Discussions are ongoing with other stakeholders to repeat those types of successful agreements. The main challenge related to the ETV program is the cost incurred by the applicant. The cost of a verification ($10,000 to $20,000) could be significant for a small or medium-sized enterprise (SME), even more if additional testing is

	required which is usually paid by the SME. Although that certification of a technology's environmental performance has key benefits for an SME, the cost of the process might be a significant obstacle for a company. However, it is expected that an ISO-ETV standard would have a major impact on the demand of the ETV program in Canada, considering the recognition an ISO standard would garner in the Canadian market and internationally.
Key contact	The Canadian ETV program is being delivered by GLOBE Performance Solutions under a license agreement with Environment Canada. Paul Jiapizian Manager Horizontal Programs Section, Environment Canada Email: paul.jiapizian@ec.gc.ca Telephone: 819-953-0602

Finance Canada

Scientific Research and Experimental Development (SR&ED)

Incentives and financing

Description	The Scientific Research and Experimental Development (SR&ED) Program is a federal tax incentive program, administered by the Canada Revenue Agency, that encourages Canadian businesses to conduct research and development (R&D) in Canada. It is the largest single source of federal government support for business R&D. The SR&ED tax incentive program has two components: 1. An income tax deduction, which allows immediate expensing of all eligible expenditures. Eligible expenditures include most of the costs that are directly related to SR&ED, including salary and wages, materials, overhead, and contracts. 2. An investment tax credit in respect of eligible expenses: • The general rate is 15 percent. • An enhanced rate of 35 percent is provided to small and medium-sized Canadian-controlled private corporations (CCPCs) on their first $3 million per year of eligible expenditures. • Unused credits earned in a year are generally fully refundable for small and medium-sized CCPCs on their first $3 million of current expenditures. • Unused credits can be carried back three years and forward twenty years. The SR&ED tax incentive program is available to all taxpayers in all sectors of the economy.
Timeframe	Ongoing
Eligible recipients	The SR&ED incentive is available to any taxpayer carrying on a business in Canada. A taxpayer is considered to be a person, which can be an individual, a corporation or a trust. Even though a partnership is not a person for tax purposes, a partner's income from a partnership is calculated as if the partnership were a person.
Achieved/expected results	The SR&ED Program encourages Canadian businesses of all sizes and in all sectors to conduct R&D in Canada that will lead to new, improved or technologically advanced products or processes.
Key contact	Nicolas Blouin Tax Policy Branch Department of Finance Telephone: 613-992-0960

Venture Capital Action Plan (VCAP)

Incentives and financing

Description	The Government of Canada is seeking to create a vibrant private sector-led venture capital sector to ensure that innovative high-growth Canadian firms have access to the capital and resources they need to grow and create value-added jobs. In January 2013, the Prime Minister announced the Venture Capital Action Plan (VCAP), a comprehensive strategy for deploying $400 million in new capital. This includes $350 million made available by the Government to help establish or recapitalize up to four large-scale private sector-led funds of funds, in partnership with institutions and corporate investors as well as interested provinces. The funds of funds to be established under the VCAP are expected to attract about $1 billion in non-federal investments. The funds of funds are expected to focus on high-growth sectors where Canadian firms have existing strengths, such as cleantech and energy technologies, as well as information and communication technologies and the life sciences. The objective of the VCAP is to reinvigorate the venture capital ecosystem and to improve access to venture capital financing by high-growth companies so that they have the capital they need to create jobs and growth.
Timeframe	7 to 10 years
Eligible recipients	Venture capital funds and high-growth firms
Achieved/expected results	The Government is currently in the process of implementing the Venture Capital Action Plan (VCAP). This is a long-term strategy that will take time before showing results. As the Action Plan rolls out, the Government will be tracking the impact of the VCAP investments on the performance of the underlying firms that received capital under the plan.
Other	In January 2014, the Government announced the initial closing of the Northleaf Venture Catalyst Fund, the first fund of funds to be established under the VCAP. The fund of funds was co-sponsored by the Governments of Canada and Ontario and has $217.5 million in initial commitments, of which $145 million is from institutional and corporate investors, and $36.3 million is from each of the Governments of Canada and Ontario. The Fund has an overall target size of $300 million. The Government is proceeding towards the establishment of the three remaining funds of funds.

Key contact(s)	Alison Nankivell Vice President, Venture Capital Action Plan Business Development Bank of Canada Email: Alison.Nankivell@bdc.ca Telephone: 613-947-9165 bdc.ca

Western Economic Diversification

Western Innovation Initiative (WINN)

Description	The Western Diversification Program (WDP) is the main program through which Western Economic Diversification makes strategic investments in initiatives that enhance and strengthen the economy of Western Canada. Contributions made through the program are towards projects that support the development and diversification of the western Canadian economy and activities where economic and/or employment benefits accrue primarily in Western Canada. Program objectives include: • knowledge translated into new products and services and into new ways of designing, producing or marketing existing products or services for public and private markets, through innovation • enhanced business productivity and competitiveness, trade and investment attraction and penetration of western Canadian technologies, services and value-added products into international markets, access to risk capital and business services for SMEs • economic development and diversification in communities to sustain their economies and adjust to changing and challenging economic circumstances • undertaking research and analysis required to inform policy and program decisions In terms of innovation-related projects, some basic research capacity in the past has been supported through WDP, however, the majority of funding is focused towards technology development, technology demonstration (small- and large-scale), and technology deployment as well as post-commercialization activities such as market penetration. The activities are focused in the following areas: • Unconventional oil and gas – Support for research improvements to extraction and treatment of waste by-products in the oil sands industry and for technology development to reduce maintenance in the oil sands sector. • Next generation transportation – Support to attract foreign investment and increase exports in the hydrogen and fuel cell sector • Distributed power generation – Support to develop small-scale and off-grid renewable power generation technologies and demonstrate a biomass fueled district heating system in an urban location. • Technology with potential longer-term impact – Support for the validation of the economic and environmental benefits of biochar technology and for developing camelina and carinata into crops for industrial applications.

Timeframe	Ongoing
Eligible recipients	Funding is primarily provided to not-for-profit organizations such as industry associations, post-secondary institutions, Indian bands (as represented by their Chief and Council), provincial or municipal governments, agencies and Crown corporations.

Canada Mortgage and Housing Corporation

Housing Research, Demonstration and Information Dissemination

Collaboration and information sharing

Description	One of Canada Mortgage and Housing Corporation's (CMHC's) key objectives is to promote and contribute to informed housing decisions and to a stable, competitive and innovative housing system. A strategic priority for CMHC under this objective is to undertake comprehensive, timely and relevant research and information transfer activities to enable Canadian consumers and the housing sector to make informed decisions. This research improves the understanding of current and future housing challenges in Canada and informs the development of housing-related policy. More informed housing decisions on the part of individual Canadians and the housing industry and wider adoption of best practices lead to increased market efficiency and foster innovation in areas such as sustainable housing. CMHC undertakes technical research to build industry capacity and promote consumer knowledge, awareness and acceptance of best practices and technologies to advance the sustainability of new and existing housing throughout Canada, including in the North. The Corporation also supports information transfer activities, including demonstration projects, web-based information, seminars, workshops, presentations and other outreach activities. An expected outcome of CMHC's research is the reduction of greenhouse gas emissions attributable to the residential sector through improved performance of new and existing homes. CMHC contributes approximately $500,000 in grants and contributions annually for sustainable housing-related research activities through Part IX funding. The activities are focused on: Energy efficiency technologies and practices – Technology development and demonstration activities to advance affordable and sustainable housing more broadly in the housing sector, including the North.
Timeframe	Ongoing
Eligible recipients	External research contractors, universities, research centres within other government departments, collaborative research projects with other housing stakeholders including housing agencies

Achieved/expected results	Consumers, the housing industry, stakeholders and policy makers have access to timely and relevant information on housing. Indirectly measured by take-up of, and satisfaction with, CMHC's information products in 2013: • Nearly 2.1 million housing information products were downloaded or distributed. • Sixty-eight percent of recipients of newly published Research Highlights found them useful. • Eighty-eight percent of recipients of About Your House publications found them useful. • There were more than 7.6 million visits to CMHC's website, with each visitor averaging more than five minutes per visit.
Other	Eleven demonstration projects designed to showcase technologies that result in highly energy-efficient housing were constructed under the EQuilibrium™ Sustainable Housing Demonstration Initiative between 2007 and 2014. Post-occupancy monitoring demonstrates that these homes are some of the most energy-efficient homes constructed in Canada. EQuilibrium™ homes can attain a 60 percent to 92 percent improvement in energy performance compared to conventional new construction, a 43 percent to 88 percent improvement in energy performance compared to the current R-2000 standard (a benchmark for energy-efficient housing) and an 80 percent improvement in energy performance for the EQuilibrium™ retrofit project, compared to a similar existing 1950s-era conventional house. Further, 68 percent of the industry participants of the EQuilibrium™ Housing Forum held in Vancouver in 2012 indicated that they were very likely to incorporate the knowledge gained and lessons learned from the four EQuilibrium™ projects presented at the two-day forum in their future construction projects. To address the unique and challenging housing needs in northern communities, CMHC works closely with northern housing providers through the Northern Sustainable Housing Initiative. Demonstration projects in Dawson, Yukon; Inuvik, Northwest Territories; and Arviat, Nunavut showcase four homes that were designed and built to demonstrate high levels of energy efficiency and cultural appropriateness. Some of the homes involve "flex"features that support accessibility for occupants and/or visitors, and adaptability to changing needs. Community members were highly engaged in the design of these demonstration projects.
Key contact	Duncan Hill Sustainable Housing Policy and Research

Province of British Columbia

In 2005, an Alternative Energy and Power Technology Task Force was appointed by the Premier to develop an implementation plan for British Columbia's Alternative Energy and Power Technology Strategy. The Task Force focused on the need for solutions to provincial energy challenges and identifying market opportunities where British Columbia has a competitive advantage to lead the world in sustainable environmental management.

A final report was submitted to Government in March 2006. Report recommendations were considered in support of developing The BC Energy Plan: A Vision for Clean Energy Leadership. A key recommendation of the Task Force was that the province facilitate greater commercialization within the sustainable energy sector through the creation of a "provincially-led fund or resource pool for sustainable energy projects" that can also be used to leverage matching federal contributions.

In response, within the BC Energy Plan, Government committed to the creation of an Innovative Clean Energy (ICE) Fund. The resulting ICE Fund Special Account is a legislated funding tool designed to support Government's energy and environmental priorities and advance British Columbia's clean energy sector.

To date, the ICE Fund has been used primarily to bridge capital funding gaps in the deployment of pre-commercial clean energy technology projects in communities throughout British Columbia.

Funding for the Special Account comes via a 0.4 percent levy applied to specific "energy products", including natural gas, fuel oil used for the purposes of heating, cooling or raising steam (kerosene excluded), and propane in a vaporized form. The levy now generates approximately $6.5 million to $7 million a year.

Innovative Clean Energy Fund: Direct investment for development, demonstration and deployment of clean energy technologies

Innovative Clean Energy (ICE) Fund

Direct investment: Technology demonstration

Description	The current focus of the Innovative Clean Energy (ICE) Fund has been to accelerate the development of new energy technologies that have the potential to solve real, everyday energy and environmental issues and create significant socio-economic benefits for all British Columbians. The ICE Fund: • addresses specific British Columbia energy and environmental problems that have been identified by government • showcases British Columbia's technologies that have a strong potential for international market demand because they solve problems that exist both in British Columbia and other jurisdictions • supports pre-commercial energy technology that is new, or commercial technologies not currently used in British Columbia • demonstrates the commercial viability of new energy technologies Under legislation, the Minister responsible for the ICE Fund may pay money out of the Special Account for projects, programs or initiatives that will (1) address specific British Columbia energy issues or related environmental issues that have been identified by the government, and (2) do one or more of the following: • support the development or adoption of pre-commercial clean energy technologies, or of clean energy technologies not currently used in British Columbia • reduce the environmental impact of the use, production, generation, storage, transmission, delivery, provision or conversion of energy • demonstrate or promote British Columbia clean energy technologies that have good potential for market demand in other jurisdictions • reduce the cost or improve the reliability of clean energy sources or associated technology • support energy efficiency or conservation The main areas of technology are: • Unconventional oil and gas, e.g. multi-stage hydraulic fracturing, water treatment, pipelines, air quality, land remediation, bitumen upgrading. Enabled by ICE Fund Legislation, but no projects at this time. • Next generation transportation, e.g. electric vehicle (EV) technologies, light-weight materials, advanced fossil fuel-efficient engine technologies, EV infrastructure, advanced train aircraft systems, natural gas fleet.

	Development of technology to convert softwood residues to ethanol for use as low-carbon transportation fuel and commercialization of electric vehicle technology, including plug-ins, hybrids and fuel cells. • **Energy efficiency technologies**, e.g. energy-efficient and novel technologies for buildings, energy-efficient technologies for water use, advanced lighting. Commercialization of energy-efficient materials advanced heating, lighting and cooling technology, and electricity self-generation for "net-zero energy" residential, commercial and institutional buildings and remote, First Nations and/or off-grid communities. • **Distributed power generation**, e.g. unconventional hydro, biomass combined heat and power (CHP), waste-to-energy, solar, smart grid. Production of clean electricity/energy using biomass and/or municipal solid waste and other clean or renewable energy resources. • **Technologies with potential longer-term impact**, e.g. carbon capture and storage, hydrogen fuel cell systems, biorefinery and biofuels. Capture and storage of carbon dioxide and other greenhouse gases from oil refineries, natural gas processing plants and thermal electricity generation facilities.
Timeframe	The ICE Fund was created in 2007 and has no defined end-date. The ICE Fund was intended to be a "living" program that would be responsive to Government's changing economic and environmental priorities for British Columbia's energy sector.
Eligible recipients	Eligible proponents include: • local governments (municipalities and regional districts) • school boards • hospitals • First Nations • not-for-profit societies that are registered under the *Society Act* • post-secondary institutions • Crown corporations • public utilities • British Columbia-based companies registered under the *Business Corporations Act* or companies registered under the *Canada Business Corporations Act*.
Achieved/expected results	• Of 62 approved projects, 29 projects are complete, 9 projects are under way, 6 are seeking partners or additional project funding, 8 projects have withdrawn and 10 projects have had their funding rescinded. • Completed projects have created 575 construction jobs and 207 ongoing jobs; projects under way are expected to create 182 construction jobs and 100 ongoing jobs when completed. • In the four funding rounds conducted by the ICE Fund between 2007 and 2010, 241 applications were received proposing projects worth over $2.6 billion.

	• First Call for Applications: 15 projects with a combined project value of $78.7 million were approved to receive $24.43 million. • The Second (Rural) Call for Applications: 19 projects with a combined project value of over $96 million were approved to receive $22.68 million. • Call for Liquid Fuels from Biomass: eight projects with a combined value over $100 million were approved to receive $10 million. • Third (2010 Showcase) Call for Applications: 20 projects with a combined value of $167.21 million were approved to receive $20.71 million.
Key contact	Irene Wingfield A/Senior Program Manager E-mail: irene.wingfield@gov.bc.ca Telephone: 250-387-2883 empr.gov.bc.ca/EAED/ICEFund/Pages/CurrentCall.aspx

Province of Alberta

Key policy frameworks supporting energy technology innovation in Alberta include, but are not limited to:

1. Provincial Energy Strategy – Identifies innovation, inclusive of the entire spectrum of research from fundamental to pre-commercial demonstration, as a driver to three outcomes:
   - clean energy production
   - wise energy use
   - sustained economic prosperity
2. Responsible Actions – Includes the stated strategy to increase long-term and stable investments in research, promote world-class innovation, leverage technology to address development of the resource, and proactively address environmental challenges.
3. Climate Change Strategy – Innovation is the mechanism described to expand our use of alternative sources of energy, as well as reduce greenhouse gas (GHG) emissions produced from more traditional energy sources like oil and gas.
4. Land-Use Framework – Innovation is key to balancing the many interests that compete for Alberta's land, water and air resources. Information technology development is needed for improved monitoring, evaluation and management.
5. Alberta's Water Research and Innovation Strategy – A framework guiding Alberta's research and innovation system, focused on actions to address key Alberta priorities in responding to challenges faced by Alberta's water resource system, supporting Water for Life.

Alberta Innovates Energy and Environment Solutions: Direct Investment in basic research, technology development and demonstration

Alberta Innovates Technology Futures: Direct investment in basic research, technology development and demonstration

Campus Alberta Innovation Program Chairs: Direct investment for basic research in universities

Alberta's Climate Change and Emissions Management Corporation: Direct investment for technology development and demonstration focused on GHG emission reductions

Carbon Capture and Storage: Direct investment for demonstration of two large-scale projects

Innovation Energy Technologies Programs: Direct investment for technology development and demonstration

Alberta Innovates Energy and Environment Solutions

Direct investment: Basic research, technology development and demonstration

Description	Alberta Innovates Energy and Environment Solutions (AI-EES) is focused on energy technologies, water and environmental management, and renewables and emerging resources. AI-EES funds research and does not conduct research. AI-EES acts as a project manager for many of the projects it initiates. In 2012–13, AI-EES invested $13.8 million across 98 projects. Other parties often provide funding through participation agreements, and all invested parties share results equally. Partnerships with industry, other governments, agencies and universities result in an average leverage factor of 3:1. AI-EES also acts as a manager for projects funded through the Climate Change and Emissions Management Corporation (CCEMC). The main areas of technology are: • Unconventional oil and gas, e.g. multi-stage hydraulic fracturing, water treatment, pipelines, air quality, land remediation, bitumen upgrading. • Energy efficiency technologies, e.g. energy-efficient and novel technologies for buildings, energy-efficient technologies for water use, advanced lighting. • Distributed power generation, e.g. unconventional hydro, biomass combined heat and power (CHP), waste-to-energy, solar, smart grid. • Technologies with potential longer-term impact, e.g. carbon capture and storage, hydrogen fuel cell systems, biorefinery and biofuels.
Timeframe	Investments are ongoing and technology timeframes vary.
Eligible recipients	Funding recipients and collaborators include industry, academic institutions, governments (federal, provincial, municipal), other government agencies (Alberta Innovates Corporations), non-governmental research entities (e.g. Petroleum Technology Alliance of Canada) and other non-governmental organizations (e.g. Canadian Geothermal Energy Association).
Achieved/expected results	Strengthening Alberta's research and innovation capacity with the ultimate objective of developing cleaner energy, reducing environmental impacts and better managing Alberta's water resources. AI-EES' core business is to position Alberta to achieve superior environmental performance while growing and diversifying the energy economy through research and technology development.

Key contact	Edmonton Office 1800 Phipps McKinnon Building 10020 – 101A Avenue Edmonton, AB T5J 3G2 Telephone: 403-297-7089 ai-ees.ca

Alberta Innovates Technology Futures

Direct investment: Basic research, technology development and demonstration

Description	Objectives include: • supporting research and innovation activities directed at the growth and development of technology-based sectors, including: the commercialization of technology, the provision of business and technical services, and initiatives that encourage a strong science, technology and entrepreneurial culture in Alberta • helping technical industries find solutions, develop products and move technologies to market • enhancing the technical capacity within Alberta's high-tech companies • facilitating access to the strengths of key partners that help support commercialization and grow new ventures • investing in and attracting research and entrepreneurial talent who can support priorities, such as nanotechnology, information communications technologies and genomics Alberta Innovates Technology Futures (AI-TF) has three operational divisions: the Applied Research Centres; Business Innovation Services; and the Innovates Centre of Research Excellence. The Government of Alberta provides budget, in a range of a hundred million dollars, to support the work of the three operational divisions The Applied Research Centres provide research and development services to Alberta's leading economic sectors, primarily on a fee-for-service basis, enhancing business competitiveness, accelerating the commercialization of new technologies, and building commerce. Relevant portfolios include Heavy Oil and Oil Sands, Clean Energy, Ecosystem Management and Environmental Monitoring, Environmental Analytical Services, Geosciences and CO_2 Storage, Land and Water Management, Wildlife Ecology, Advanced Materials, Industrial Sensors Technologies, Drilling and Completions, Production, and Pipelines. Business Innovation Services helps move technology to market through programs enhancing product commercialization, technology transfer and technology development. The Innovates Centre of Research Excellence (iCORE) attracts top talent to Alberta to create multi-disciplinary, collaborative research capabilities in the platform technologies of Information and Communication Technology, Nanotechnology, Omics and other relevant areas of science and engineering. iCORE's funding mechanisms include research chairs and scholarships.

	The main areas of technology are: • **Unconventional oil and gas**, e.g. multi-stage hydraulic fracturing, water treatment, pipelines, air quality, land remediation, bitumen upgrading. • **Energy efficiency technologies**, e.g. energy-efficient and novel technologies for buildings, energy-efficient technologies for water use, advanced lighting. • **Distributed power generation**, e.g. unconventional hydro, biomass combined heat and power (CHP), waste-to-energy, solar, smart grid. • **Technologies with potential longer-term impact**, e.g. carbon capture and storage, hydrogen fuel cell systems, biorefinery and biofuels.
Timeframe	Investments are ongoing and technology timeframes vary.
Eligible recipients	Grants awarded address the product and market development and commercialization needs of industry, post-secondary institutions and other research performers. Funding also supports other regional delivery providers, encouraging a pan-Alberta approach to commercialization and accelerated growth within technology-based organizations and networks. The Applied Research Centres under AI-TF are also the recipients of government funds. In 2011–12, fees-for-service from industry accounted for 36 percent of AI-TF's revenue.
Achieved/expected results	Expected results include: • facilitating the commercial use of new technologies • developing new knowledge-based industry clusters • encouraging an entrepreneurial culture in Alberta In 2012–13, AI-TF supported 900 companies through Applied Research Centres; AI-TF's services generated revenue of $61.1 million. AI-TF also receives a core grant from the Government of Alberta, in the order of $82.5 million for 2012–13. Of this amount, $54.8 million was used to make awards, and the remainder was used to support commercialization, technology transfer, strategic programs and investment in capital equipment. Recipients include the 245 companies through Business Innovation Services and 10 post-secondary institutions through iCORE.

Key contact	250 Karl Clark Road Edmonton, AB, T6N 1E4 Canada E-mail: referral@albertainnovates.ca Telephone: 780-450-5454 albertatechfutures.ca/Corporate/AboutTechFutures.aspx

Campus Alberta Innovation Program Chairs

Direct investment: Basic research

Description	The Campus Alberta Innovation Program Chairs (CAIP) are part of the Government of Alberta's Campus Alberta initiative. The program is designed to recruit new research leaders to Alberta in specific areas. The Chairs are aligned with the four strategic priority areas of the Alberta Innovates Corporations and Alberta Innovation and Advanced Education: Energy and Environment, Food and Nutrition, Neuroscience/Prions, and Water. There are currently five CAIP chairs appointed in energy-related research areas at Campus Alberta institutions. Five chairs in the theme of Energy and the Environment will enhance Alberta's innovation potential at the intersection of geosciences, biology and biotechnology, and material sciences. Six chairs in Water will focus on environmental sustainability and quality for watersheds, aquatic ecosystems, aquatic organisms and water throughout the province. • The chairs will be supported for a total of seven years after which they may be transitioned to university operating budgets. • All chairholders will be recruited from outside the province such that there are no internal appointments or recruitments between institutions. • The four universities will work together to recruit chairholders within a priority area who have complementary research areas (i.e. no significant overlap) and which build on existing institutional strengths. • Chairholders will be encouraged to work with individuals in similar fields at the other Alberta universities as appropriate and this may be through cross appointments or adjunct appointments, but these are not required. • The value of the awards is chair-specific, varying from approximately $300,000 to $650,000 per year for seven years. The main areas of technology are: • Unconventional oil and gas, e.g. multi-stage hydraulic fracturing, water treatment, pipelines, air quality, land remediation, bitumen upgrading. • Energy efficiency technologies, e.g. energy-efficient and novel technologies for buildings, energy-efficient technologies for water use, advanced lighting. • Distributed power generation, e.g. unconventional hydro, biomass combined heat and power (CHP), waste-to-energy, solar, smart grid. • Technologies with potential longer-term impact, e.g. carbon capture and storage, hydrogen fuel cell systems, biorefinery and biofuels.

Timeframe	The five Energy and Environment chairs and the six Water chairs were awarded one-time funding for seven years since 2011–12. The beginning of the funding cycle varies depending on the commencement dates of each chair.
Eligible recipients	Academia. Alberta's four Comprehensive Academic and Research Intensive (CARI) institutions: Athabasca University, University of Alberta (U of A), University of Calgary (U of C), and University of Lethbridge (U of L).
Achieved/expected results	Technical, focused capacity-building is expected in the following areas of study: CAIP: Energy and the Environment – These five chairs represent investment in Reservoir Biogeoscience (two chairs: molecular/microbial processes to extract energy supplies and subsequent application/innovations in specialty chemical production, biosensors, and antibiotics), Enhanced Geothermal Energy Systems, Interfacial Polymer Engineering for Oilsands Processing, and Terrestrial Ecosystems Remote Sensing. CAIP: Water – These six chairs will be united by the two major themes: managing and protecting watersheds (major river systems and aquatic ecosystems of the prairie, parkland, mountains and boreal forest) and applied technology (in relation to water policies, impacts of human activities on the water quantity and quality in watersheds, and aquatic ecosystems in order to identify deterrents to a sustainable water supply).
Key contact	Steve Vossos, Director, Research Capacity Planning E-mail: steve.vossos@gov.ab.ca Telephone: 780-427-6022 campusalbertainnovatesprogram.ca/index.html

Alberta's Climate Change and Emissions Management Corporation

Direct investment: Technology development and demonstration

Description	Objective:
	Establish or participate in funding initiatives that reduce greenhouse gas (GHG) emissions and improve our ability to adapt to climate change.
	Targets include:
	• achieving actual and sustainable reductions in GHG emissions and facilitating climate change adaptation by stimulating transformative change through investments in:
	  ○ conserving and using energy efficiently
	  ○ implementing carbon capture and storage
	  ○ greening energy production
	Climate Change and Emissions Management Corporation (CCEMC) is a not-for-profit organization responsible for funding projects aligned with Alberta's Climate Change Strategy. Program money is collected under the Specified Gas Emitters Regulation. Companies that emit more than 100 000 metric tonnes of carbon dioxide equivalent per year must reduce emissions intensity by 12 percent below their 2004–05 baseline intensity. Organizations that are unable to meet their targets may, among other options, pay $15 into the Climate Change and Emissions Management Fund for every tonne they exceed the allocated limit. The CCEMC receives money from the Climate Change and Emissions Management Fund and directs it towards innovative projects that will reduce GHG emissions.
	As of December 2013, the CCEMC had announced $212.8 million in funding for a total of 51 clean technology projects (these projects have a total value of more than $1.57 billion). In addition, the CCEMC is supporting three adaptation projects and has initiated a partnership with Alberta Innovates-Bio Solutions to address emissions from biological sources. Every year, the CCEMC invites new projects through an Expression of Interest.
	The main areas of technology are:
	• Unconventional oil and gas, e.g. multi-stage hydraulic fracturing, water treatment, pipelines, air quality, land remediation, bitumen upgrading.
	• Energy efficiency technologies, e.g. energy-efficient and novel technologies for buildings, energy-efficient technologies for water use, advanced lighting.
	• Distributed power generation, e.g. unconventional hydro, biomass combined heat and power (CHP), waste-to-energy, solar, smart grid.
	• Technologies with potential longer-term impact, e.g. carbon capture and storage, hydrogen fuel cell systems, biorefinery and biofuels.

Timeframe	Project timelines vary. Reduction targets have been set for different priority areas (see Targets above).
Eligible recipients	Funding recipients and collaborators may include any combination of industry, academic institutions, governments (federal, provincial, municipal), other government agencies (Alberta Innovates Corporations), non-governmental research entities and other non-governmental organizations.
Achieved/expected results	The following emissions reductions are targeted: • conserving and using energy efficiently (emissions target of 24 MT by 2050) • implementing carbon capture and storage (CCS) (emissions target of 139 MT by 2050) • greening energy production (emissions target of 37 MT by 2050)
Key contact	Climate Change and Emissions Management (CCEMC) Corporation Email: info@ccemc.ca Telephone: 780-417-1920 ccemc.ca

Carbon Capture and Storage

Direct investment: Technology demonstration

Description	Objective: Balancing the economic benefits that our province receives from the development of its resources and our responsibility to reduce greenhouse gas (GHG) emissions. Target: Reducing Alberta's GHG emissions by 2.76 million tonnes annually beginning in 2015. The Government of Alberta has committed $1.3 billion over 15 years to fund two large-scale carbon capture and storage (CCS) projects, both proposed to help reduce the CO_2 emissions from oil sands refining: the Alberta Carbon Trunk Line and the Quest Project. These projects will reduce Alberta's GHG emissions by 2.76 million tonnes annually starting in 2015. That's the equivalent of taking 550,000 Alberta vehicles off the road. The main areas of technology are: • **Technologies with potential longer-term impact**, e.g. carbon capture and storage, hydrogen fuel cell systems, biorefinery and biofuels.
Timeframe	Funding timeframe: • Alberta Carbon Trunk Line: provincial funding of $495 million over 15 years • Quest Project: provincial funding of $745 million over 15 years
Eligible recipients	• Alberta Carbon Trunk Line: Enhance Energy, Northwest Upgrading and Agrium • Quest Project: Shell Canada Limited, Chevron Canada Limited and Marathon Oil Canada Corporation
Achieved/expected results	The two projects will reduce Alberta's GHG emissions by 2.76 million tonnes annually beginning in 2015, equivalent of taking 550,000 Alberta vehicles off the road. Alberta's investment will also help make CCS technologies more accessible.
Key contact	Darryl Seehagel Sustainable Energy Branch Telephone: 780-643-1609 solutionsstarthere.ca

Innovative Energy Technologies Programs

Direct investment: Technology development and demonstration

Description	Objectives include: • increasing the recovery from oil and gas deposits resulting in incremental production and royalties • finding a flexible, commercial and technical solution to the gas-over-bitumen issue that will allow efficient and orderly production of both resources • improving the recovery of bitumen resources by in-situ technologies • improving recovery of natural gas from coal seams • disseminating technology and information developed through the projects supported by this program. The Innovation Energy Technologies Programs (IETP) is a $200 million commitment by the Alberta government to provide royalty credits to operators of pilot and demonstration projects that use innovative technologies to increase recoveries and encourage responsible development of oil and gas reserves. To date, the program has committed just over $170 million in funding to 40 innovative projects.
Timeframe	Investments are ongoing and technology timeframes vary.
Eligible recipients	Industry, technology providers. Successful applicants receive a transferable royalty credit at the lesser of $10 million or 30 percent of a project's approved costs.
Achieved/expected results	Successful technologies supported by this program have enhanced resource recovery and it is estimated that royalties from this incremental production have offset program costs (certainty in attribution of technological development is difficult but is based on base case vs. incremental and total case production simulations as well as royalty forecasts and decline analysis).
Key contact	Martin Mader Energy Technical Services Branch Telephone: 780-644-3150 energy.alberta.ca/768.asp

Province of Saskatchewan

Saskatchewan Plan for Growth

Advancing Saskatchewan's natural resource strengths, particularly through innovation, to build the next economy

Saskatchewan Petroleum Research Incentive: Direct investment for technology development and demonstration of new technologies in the oil and gas sector

Saskatchewan Petroleum Research Incentive

Direct investment: Technology development and demonstration

Description	The Saskatchewan Petroleum Research Incentive provides a 30 percent royalty/tax credit for eligible projects related to enhanced oil recovery pilot projects and demonstrations of new technology in the oil and gas sector. The main areas of technology are: • **Unconventional oil and gas**
Timeframe	$30 million in royalty/tax credits are available for the 2010–15 time period.
Eligible recipients	Eligible applicants are oil and gas operators (royalty payers).
Achieved/expected results	$9.8 million has been allocated for five projects.
Key contact	Howard Loseth, Director Energy Development and Climate Change, Ministry of the Economy Telephone: 306-787-3379 E-mail: howard.loseth@gov.sk.ca

Province of Manitoba

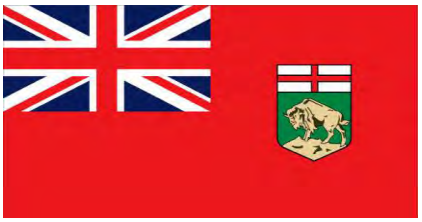
The key overall policy framework is Manitoba's Clean Energy Strategy, released in December 2012. This strategy has five main actions, building new hydro-electric generation; leading on energy efficiency; keeping consumer rates low; growing other renewables; and fossil-fuel freedom.

Several additional frameworks are relevant and dovetail in terms of directions.

TomorrowNow is a broad environmental strategy released in 2012. It emphasizes the environmental-innovation driver, in particular greenhouse gas emissions.

The Manitoba Bioproducts Strategy was released in 2011. It includes biofuels and biomass for heat and is consistent with the innovation drivers of reducing fossil fuels and enhancing the environment.

Manitoba has a more general Innovation Strategy, which is also consistent.



Geothermal, Heat Pumps, Biomass For Heating, Biofuels, and Renewable Energy Products: Incentives and financing supporting the development and adoption of clean energy technologies

Standard Business Assistance Programs

Research and Development Tax Credit: Incentives supporting innovation

Geothermal, Heat Pumps, Biomass for Heating, Biofuels and Renewable Energy Products

Incentives and financing

Description	Manitoba has incentives in four main areas: geothermal heat pumps, biomass for heating, biofuels, and financing for companies providing renewable energy products/services. The main areas of technology are: • Unconventional oil and gas, e.g. multi-stage hydraulic fracturing, water treatment, pipelines, air quality, land remediation, bitumen upgrading. • Next generation transportation, e.g. electric vehicle (EV) technologies, light-weight materials, advanced fossil fuel-efficient engine technologies, EV infrastructure, advanced train aircraft systems, natural gas fleet. • Energy efficiency technologies, e.g. energy-efficient and novel technologies for buildings, energy-efficient technologies for water use, advanced lighting. • Distributed power generation, e.g. unconventional hydro, biomass combined heat and power (CHP), waste-to-energy, solar, smart grid. • Technologies with potential longer-term impact, e.g. carbon capture and storage, hydrogen fuel cell systems, biorefinery and biofuels.
Timeframe	At least five years in each case.
Eligible recipients	Eligible applicants in these cases are respectively: property owners/consumers and production companies.
Achieved/expected results	The anticipated results in all cases are increases in implementation of cost-effective clean-energy or energy-efficiency products and services into the market. This embraces a need for innovation.
Other	Experience with incentive/financing programs indicated that there is never one standard approach to succeed in moving forward a policy objective. Individual energy opportunities need to be carefully reviewed in the context of the existing situation in order to best fit suitable mechanisms.
Key contact	Jim Crone Executive Director Energy Telephone: 204-945-1874 E-mail: jcrone@gov.mb.ca Manitoba Geothermal Energy Incentive Program: manitoba.ca/iem/energy/geothermal/incentives.html

	Manitoba Biomass Energy Support Program: gov.mb.ca/agriculture/innovation-and-research/biomass-energy-support-program.html Manitoba Ethanol Program: manitoba.ca/iem/energy/biofuels/ethanol/index.html Manitoba Energy Jobs Fund: http://news.gov.mb.ca/news/?item=13912 Manitoba Hydro Power Smart Program Suite: hydro.mb.ca/savings_rebates_loans.shtml

Standard Business Assistance Programs

Direct investment: Technology development

Description	Standard business assistance programs (called CSBs) have been employed by companies involved in energy innovation. The main areas of technology are: • **Unconventional oil and gas**, e.g. multi-stage hydraulic fracturing, water treatment, pipelines, air quality, land remediation, bitumen upgrading. • **Next generation transportation**, e.g. electric vehicle (EV) technologies, light-weight materials, advanced fossil fuel-efficient engine technologies, EV infrastructure, advanced train aircraft systems, natural gas fleet. • **Energy efficiency technologies**, e.g. energy-efficient and novel technologies for buildings, energy-efficient technologies for water use, advanced lighting. • **Distributed power generation**, e.g. unconventional hydro, biomass combined heat and power (CHP), waste-to-energy, solar, smart grid. • **Technologies with potential longer-term impact**, e.g. carbon capture and storage, hydrogen fuel cell systems, biorefinery and biofuels.
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Other	Experience with incentive/financing programs indicated that there is never one standard approach to succeed in moving forward a policy objective. Individual energy opportunities need to be carefully reviewed in the context of the existing situation in order to best fit suitable mechanisms.
Key contact	Jim Crone Executive Director Energy Tel: 204-945-1874 Email: jcrone@gov.mb.ca

Research and Development Tax Credit

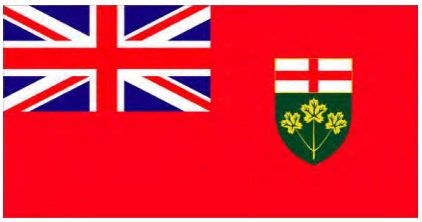
Tax incentives

Description	Manitoba also has a research and development (R&D) tax credit that dovetails with the federal SR&ED tax credit, but not energy-specific. The main areas of technology are: • **Unconventional oil and gas**, e.g. multi-stage hydraulic fracturing, water treatment, pipelines, air quality, land remediation, bitumen upgrading. • **Next generation transportation**, e.g. electric vehicle (EV) technologies, light-weight materials, advanced fossil fuel-efficient engine technologies, EV infrastructure, advanced train aircraft systems, natural gas fleet. • **Energy efficiency technologies**, e.g. energy-efficient and novel technologies for buildings, energy-efficient technologies for water use, advanced lighting. • **Distributed power generation**, e.g. unconventional hydro, biomass combined heat and power (CHP), waste-to-energy, solar, smart grid. • **Technologies with potential longer-term impact**, e.g. carbon capture and storage, hydrogen fuel cell systems, biorefinery and biofuels.
Timeframe	At least five years in each case.
Eligible recipients	Eligible applicants in these cases are respectively: property owners/consumers and production companies.
Achieved/expected results	The anticipated results in all cases are increases in implementation of cost-effective clean-energy or energy-efficiency products and services into the market. This embraces a need for innovation.
Other	Experience with incentive/financing programs indicated that there is never one standard approach to succeed in moving forward a policy objective. Individual energy opportunities need to be carefully reviewed in the context of the existing situation in order to best fit suitable mechanisms.
Key contact	Jim Crone Executive Director Energy Tel: 204-945-1874 Email: jcrone@gov.mb.ca

Province of Ontario

Ontario's 2013 Long-Term Energy Plan sets the policy framework to enable the continued delivery of a cost-effective, reliable and clean energy supply and to support energy innovation and the adoption of new technologies.

Ontario has undertaken a number of initiatives to encourage energy innovation. These initiatives are building a thriving smart grid ecosystem that can lead to innovation that both enhances the grid's operation and improves asset management to help mitigate system and customer costs.



The Advanced Energy Centre: Collaboration to promote commercialization as well as domestic and international market growth for SMEs from Ontario and Canada

The Smart Grid Fund: Direct investment for technology development and demonstration to advance smart grids in Ontario

The Innovation Demonstration Fund: Direct investment for clean energy technology demonstration

The Advanced Energy Centre

Collaboration

Description	The Advanced Energy Centre is a new partnership between the public and private sectors and the MaRS Discovery District that will drive economic growth and sustainable job creation. The goal of the Centre is to unite industry partners with utility and government representatives to consolidate and extend Ontario's early lead in next-generation energy technologies by capturing new domestic markets and transforming these local successes into international market opportunities. The Centre was formally launched on February 28, 2014, and founding corporate partners Siemens and Capgemini are already forging partnerships with the community of innovative energy technology small and medium-sized enterprises (SMEs) to develop comprehensive "solutions-based" products that can compete and win in the global market. The Centre's primary action is driving commercialization and domestic and international market growth for SMEs from Ontario. It does this by working to unlock domestic markets for new Canadian energy innovations that drive efficiency and cost savings. A good example of such innovative and cost-effective conservation programs is the Ontario Green Button initiative, a program launched by the Ministry of Energy and MaRS Discovery District that gives consumers greater visibility and control over their energy usage and that paves the way for an ecosystem of Ontario-based energy data analytics companies to drive market-based savings. The Centre builds on these successes to assist Ontario's energy entrepreneurs and developers to deploy these solutions globally through a solutions-based approach and international alliances driven through the Centre's corporate partners. The Centre will initially focus on four projects: • Energy Conservation through Data (Green Button) – Facilitating wider adoption of Green Button to drive energy conservation. • Future Value from Ontario's Energy Data System – The MDM/R roadmap project was formed to identify opportunities to derive additional value from the investments already made in the province's smart metering infrastructure. • Energy Storage for Regional Planning – The purpose of this project is to better understand and predict the systemic costs and benefits of deploying energy storage systems on Ontario's transmission and distribution network. • LDC Innovation Prioritization for Long Term Energy Planning – Using a methodology created by Siemens, it helps utilities to understand, sequence and plan how they will improve network operations through the use of smart grid technologies, how they can build and operate networks that enable and leverage new smart grid resources (such as distributed generation and energy storage), and how they can better manage both assets and customer service through the use of smart grid technologies.

Timeframe	The Advanced Energy Centre was created as a public-private partnership with an initial three-year business plan. During this time, the Centre will prove its value in the market and provide value to both the public and private sector. The actions of the Centre are immediate and will aim for tangible market impact within this window.
Eligible recipients	The Advanced Energy Centre is a public-private partnership based at the MaRS Discovery District, a non-profit organization that provides services to all SMEs in the market. Partners of the Centre do not apply; rather, the Centre works collaboratively with the broader set of market actors to determine which actions it will take and how it will generate the most beneficial outcomes for the broader energy innovation ecosystem.
Achieved/expected results	The Advanced Energy Centre was launched by Ontario Premier Kathleen Wynne on February 28, 2014. More information on the Centre's first six months of operation will be available by August 2014 at the time of the Energy and Mines Ministers' Conference.
Key contact	Ian Philp, Director of Operations E-mail: iphilp@marsdd.com marsdd.com/systems-change/advanced-energy-centre/ news.ontario.ca/opo/en/2014/02/ontario-supporting-energy-innovation.html marsdd.com/newsreleases/ontario-premier-announces-new-advanced-energy-centre-based-at-mars/

Smart Grid Fund

Direct investment: Technology development and demonstration

Description	The Smart Grid Fund (SGF) is a $50 million technology development and demonstration fund designed to advance smart grids in Ontario, encourage economic development and reduce the risk and uncertainty in electricity sector investments. A 2010 Directive to the Ontario Energy Board provides guidance on how to encourage smart grid development in local distribution companies (LDCs) and what the objectives of that development should be. Ontario's smart grid objectives are:
	• customer control:
	  ○ access
	  ○ visibility
	  ○ control
	  ○ participation in renewable generation
	  ○ customer choice
	  ○ education
	• power system flexibility:
	  ○ distributed renewable generation
	  ○ visibility
	  ○ control and automation
	  ○ quality
	• adaptive infrastructure
	  ○ flexibility
	  ○ forward compatibility
	  ○ encourage innovation
	  ○ maintain pulse on innovation
	The Government's policy objectives for pursuing this course of action are: efficiency, customer value, co-ordination, interoperability, security, privacy, safety, economic development, environmental benefits and reliability.
	The first round of SGF projects cover technology areas such as grid automation, data management, distributed energy resources and "behind the meter" (advanced thermostats and software) technologies. For the second round, technology areas covered expanded to include microgrids, storage and electric vehicles.
	• Next generation transportation – Projects supporting electric vehicle (EV) integration are supported through the program. This could include projects that test consumer usage of EVs, billing systems that account for

	EV battery usage as storage when not in use, and monitoring the impact of EV use, such as recharging the battery, on local distribution systems and/or within a microgrid context. • **Energy efficiency technologies** – Testing and demonstration of innovative thermostat systems for both residential and commercial/industrial applications are part of the mix of SGF supported projects. There are also grid-focused projects demonstrating efficiencies for the grid system that can be achieved through grid automation and supporting software solutions. • **Distributed power generation** – Renewables, such as solar and wind installations for example, and their impact on the distribution system are included in the range of projects supported through the Fund. Some of these projects are focused on the integration of distributed power generation (DG) within the context of a microgrid system.
Timeframe	The SGF was announced in the 2009 Ontario Budget and officially launched in 2011. Its latest call for applications closed on September 6, 2013. In the 2013 Long-Term Energy Plan, the Government indicated its intention to seek to expand the SGF to build on its previous success.
Eligible recipients	• Business organizations • Universities and colleges • Regional or municipal government agencies • Non-governmental organizations
Achieved/expected results	The SGF is in the midst of supporting 26 projects, representing over $150 million in electricity sector investment and over 900 jobs. These projects involve collaborations with prominent academic/research institutions and Ontario utilities. All projects supported by the SGF are under way; however, some are expected to be completed in 2014. The Ministry looks forward to discussing their results in the near future.
Key contact	Usman Syed Senior Manager Smart Grid and Network Policy. E-mail: Usman.syed@ontario.ca Telephone: 416-325-6651 Mike Smith Senior Advisor Smart Grid and Network Policy E-mail: Mike.smith@ontario.ca Telephone: 416-314-3650 energy.gov.on.ca/en/smart-grid-fund/

Innovation Demonstration Fund

Direct investment: Technology demonstration

Description	The Innovation Demonstration Fund (IDF) was established as part of the government's $24 million Ideas to Market Strategy in the 2006 Budget to address a need in Ontario's economy by providing financial assistance to companies demonstrating risky clean technologies. In recognition of its value to the clean technology/alternative energy industry, the program has received additional funding and has invested $94.8 million in 41 projects. The IDF program focuses on clean technologies in the areas of environmental, alternative energy, bio-products, hydrogen and other globally significant clean technologies at the pilot stage of development. The IDF is designed to help clean technology companies in their efforts to commercialize innovative technologies in Ontario by mitigating the risk of projects with significant pilot-scale technical hurdles. The IDF provides financial support, typically as a forgivable loan, to companies looking to commercialize new technologies by supporting pilot-scale technology demonstration of clean technologies projects that have both a high potential environmental and commercial impact. Examples of IDF supported technologies include: water treatment and remediation technologies, energy-efficient technologies for water use, waste-to-energy technologies, and solar and biofuels technologies.
Timeframe	The IDF began accepting applications in 2006; however, the program is currently paused pending a review of business support programs.
Eligible recipients	Ontario-based companies
Achieved/expected results	The IDF has supported 41 projects, which will contribute to a total of $337.8 million in high-value investment (from all sources) in the province. If these projects are successful, it is expected that over 4,150 jobs will be created.
Key contact	David B. Meyer Manager Capital Programs Ministry of Research and Innovation Ministry of Economic Development, Trade and Employment Commercialization Branch E-mail: david.b.meyer@ontario.ca Telephone: 416-325-4899 ontario.ca/business-and-economy/funding-clean-tech-projects

Province of Quebec

The **Politique nationale de la recherche et de l'innovation 2014–2019** (PNRI 2014–19) introduces measures that will be carried out by the Government of Quebec in the coming years to promote research and development as well as technology innovation. Several of these measures will target energy innovation. The PNRI identifies seven strategic priority areas, including renewable energy resources and transportation electrification, in order to promote further cooperation between various research and innovation system components in Quebec.

The **Transportation Electrification Strategy 2013–2017** also introduces several measures to encourage innovation in this area, including the establishment of a world-class research and advanced technology institute: the Institut du transport électrique.

The **Climate Change Action Plan 2013–2020** (CCAP 2013–20) provides significant funding to support research and development, demonstration and commercialization of greenhouse gas emission-reducing technologies (including energy technologies) and to help adopt new technologies.

Technoclimat 2.0: Direct investment in the development and demonstration of new technologies or innovative processes related to energy efficiency, emerging energy resources and greenhouse gas (GHG) emission reduction

Energy Innovation Assistance Program: Direct investment in the development and demonstration of new technologies or innovative processes related to energy efficiency or emerging energy resources

Technoclimat 2.0

Direct investment: Technology development and demonstration

Description	Technoclimat 2.0 is a program aimed at promoting the development of new technologies or innovative processes related to energy efficiency, emerging energy resources and greenhouse gas emission reduction. It provides financial support to project proponents involved in various stages of the innovation chain. Technoclimat 2.0 integrates the objectives of two former programs: the Green Technologies Demonstration Program (Technoclimat), which is aimed at reducing greenhouse gas emissions, and the Energy Innovation Assistance Program (PAIE). The program also provides increased financial assistance compared to the two previous programs. Technology areas: • Next generation transportation – e.g. electric (road, rail, marine), hydrogen vehicles, natural gas vehicles, etc. • Energy efficiency technologies – e.g. heat recovery devices, combustion control systems, etc. • Distributed power generation – e.g. wind, wave, low-head hydro, solar, biomethanation, etc. • Technologies with potential longer-term impact – e.g. hydrogen cell, lithium battery, bioenergy, heat storage, etc.
Timeframe	Technoclimat • Start: Spring 2008 • End: 2012 The program ended December 31, 2012. No new applications have since been approved. Ongoing projects will continue. Technoclimat 2.0 • Start: Fall 2013 • End: Indeterminate. The government may end the program at any time.
Eligible recipients	Technoclimat 2.0: Any legal entity with a location in Quebec seeking to develop, adapt, use or commercialize a new technology or innovative process related to energy efficiency, emerging energy resources or greenhouse gas emission reduction.

Achieved/expected results	Technoclimat (as at December 31, 2012): • Approved projects: 35 • Financial aid allocated: $50 million Technoclimat 2.0: • Results to come (program launched in fall 2013)
Key contacts	Caroline Davoine Director, Transportation, Industry and Technological Innovation Sectors Kathleen Gauvin Program Officer, Technological Innovation Geneviève St-Arnaud Program Officer, Technological Innovation http://efficaciteenergetique.mrn.gouv.qc.ca/clientele-affaires/technoclimat/

Energy Innovation Assistance Program (PAIE)

Direct investment: Technology development and demonstration

Description	The Energy Innovation Assistance Program provides financial aid for the development of new technologies or innovative processes related to energy efficiency or emerging energy resources. Technology areas: • **Next generation transportation –** e.g. electric (road, rail, marine), hydrogen vehicles, natural gas vehicles, etc. • **Energy efficiency technologies** – e.g. heat recovery devices, combustion control systems, etc. • **Distributed power generation** – e.g. wind, wave, low-head hydro, solar, biomethanation, etc. • **Technologies with potential longer-term impact –** e.g. hydrogen cell, lithium battery, bioenergy, heat storage, etc.
Timeframe	Start: fall 2009 End: fall 2013 The program ended with the launch of Technoclimat 2.0. Ongoing projects will continue.
Eligible recipients	Any individual, company, government or non-governmental agency with a location in Quebec.
Achieved/expected results	• Approved projects: 72 • Financial aid allocated: $13 million
Other	Please indicate the lessons learned, collaborations, challenges or any other information that may be important for this action or leverage.
Key contacts	Caroline Davoine Director, Transportation, Industry and Technological Innovation sectors Kathleen Gauvin Program Officer, Technological Innovation Geneviève St-Arnaud Program Officer, Technological Innovation http://efficaciteenergetique.mrn.gouv.qc.ca/clientele-affaires/technoclimat/

Province of New Brunswick

Key policy frameworks supporting energy innovation in New Brunswick include, but are not limited to:

1. The New Brunswick Energy Blueprint – The New Brunswick Energy Blueprint identifies innovation in Smart Grid Technologies as well as energy sector research and development. The drivers for these actions are:
   - low and stable energy prices
   - energy security
   - reliability of the electrical system
   - environmental responsibility

   In addition, energy-related research and development activities in New Brunswick focus on how residents, business and industry can reduce their use of energy through improved product standards and building codes; emerging energy efficiency and smart grid technologies; and cogeneration and district heating systems.

2. The New Brunswick Oil and Natural Gas Blueprint – The New Brunswick Oil and Gas Blueprint identified innovation in the oil and natural gas sector and supporting industries as a key driver for economic development through the oil and gas sector.

PowerShift Atlantic: Basic research and technology demonstration of more economical integration of wind energy into the grid

Wood-Based Biomass Energy: Resource and technology assessment of regional biomass practices

New Brunswick Energy Institute: Fostering collaboration and information dissemination

PowerShift Atlantic

Direct investment: Basic research and technology demonstration

Description	The purpose of this research is to determine if load shifting can provide for more economical integration of wind rather than expensive supply-side options such as fossil fuel. Up to 1200 Maritime customers (mostly residential and commercial) will participate in the pilot project. The main area of technology is: • Distributed power generation
Timeframe	The demonstration phase will be complete on September 30, 2014. A business case and final report will follow.
Eligible recipients	N/A – this is not a funding program but rather a onetime funding for a specific project.
Achieved/expected results	The PowerShift Atlantic initiative will drive development and implementation of smart grid and energy-efficiency technologies into homes and businesses. Smart grid innovation will enable consumers to better manage energy consumption and allow our energy-dependent business sectors to be more competitive.
Key contact	Norma McCarthy Customer Engagement PowerShift Atlantic E-mail: nmccarthy@nbpower.com powershiftatlantic.com/index.html

Wood-Based Biomass Energy

Resource and technology assessment

Description	The Department of Energy and Mines continues to identify and assess regional biomass best practices, including small-scale district energy applications, and their applicability to New Brunswick. Working with the pellet industry to identify barriers to further development and explore new economic opportunities within the province is an important component of the work at the department. The main area of technology is: • **Distributed power generation**
Timeframe	This action item will be completed in 2014.
Eligible recipients	N/A
Key contact	Heather Quinn Acting Director of Energy – Department of Energy and Mines Telephone: 506-658-3180 E-mail: Heather.Quinn@gnb.ca

New Brunswick Energy Institute

Fostering collaboration and information dissemination

Description	The New Brunswick Energy Institute's mandate is to serve as an advisory body to the provincial government and to the people of New Brunswick and to review and assess the environmental, social, economic and health issues relating to energy extraction, development or production within New Brunswick by ensuring credible, evidence-based research. The main area of technology is: • **Unconventional oil and gas**
Timeframe	Ongoing
Eligible recipients	N/A
Achieved/expected results	The creation of the Energy Institute will ensure a more factual, science-based dialogue as New Brunswick expands the development of its oil and gas industry. An important role of the institute will be to communicate its findings to the public, thereby ensuring factual and unbiased information is available to all New Brunswickers.
Key contact	Annie Daigle, M.Sc. Executive Director New Brunswick Energy Institute Telephone: 506-455-3232 http://nbenergyinstitute.ca

Province of Nova Scotia

Nova Scotia's key strategies related to energy technology innovation include:

- Nova Scotia's *Environmental Goals and Sustainable Prosperity Act* (EGSPA)
- Nova Scotia's 2009 energy strategy, Toward a Greener Future
- Nova Scotia's Marine Renewable Energy Strategy
- Nova Scotia's Renewable Electricity Plan
- Nova Scotia's Climate Change Action Plan, Toward a Greener Future
- Nova Scotia's Sustainable Transportation Strategy, Choose How You Move

The main driver for these strategies is highlighted in the *Environmental Goals and Sustainable Prosperity Act* which states that the environment and the economy are inextricably linked: economic prosperity cannot happen without environmental sustainability. For this reason Nova Scotia is taking bold steps to transform our electricity sector from coal to renewables, investing significantly in energy efficiency, and pursuing innovative emerging technologies such as marine renewables.

Offshore Energy Research Association of Nova Scotia: Direct investment for offshore energy and environmental research and development

Renewable Electricity Regulations: Development of standards and regulations for feed-in tariffs

Statement of Best Practices: Development of regulations for the construction, installation, operation and decommission of in-stream tidal energy projects

Feed-in Tariffs: Incentives and financing

The Fundy Ocean Research Center for Energy: Infrastructure investment for research centre for in-stream tidal energy

Offshore Energy Research Association

Direct investment: Basic research

Description	The Offshore Energy Research Association of Nova Scotia (OERA) is an independent, not-for-profit organization that funds and facilitates collaborative offshore energy and environmental research and development including examination of renewable energy resources and their interaction with the marine environment. Its mission is to lead environmental, renewable and geoscience energy research that enables the sustainable development of Nova Scotia energy resources through strategic partnerships with academia, government and industry. The main area of technology is: • **Technologies with potential longer-term impact**
Timeframe	Ongoing
Eligible recipients	OERA funds, primarily, academic research; however, it does fund private industry to conduct certain research projects such as strategic environmental assessments.
Achieved/expected results	OERA is currently funding an economic impact study for the tidal energy sector in Nova Scotia, Atlantic Canada and nationally. It has recently entered into a memorandum of understanding with the Province of Nova Scotia and the United Kingdom's Technology Strategy Board to fund environmental monitoring technology projects. There are a variety of ongoing research projects funded by OERA.
Key contact	Sandra Farwell Director Sustainable and Renewable Energy, Nova Scotia Department of Energy Telephone: 506-424-1700 oera.ca

Renewable Electricity Regulations

Development and implementation of standards and regulations

Description	The Renewable Electricity Regulations, under the *Electricity Act*, outline the process that small- and large-scale tidal energy developers may undergo in order to receive a feed-in tariff for the power they produce incidental to the testing/demonstration of their devices. The Regulations also outline the review process for these applications to the Government. The main area of technology is: • **Technologies with potential longer-term impact**
Timeframe	2011–14 (It is expected that the majority of feed-in tariffs will be allocated by mid-2014.)
Eligible recipients	Regulations apply to Community Feed-in Tariff (COMFIT) and Developmental Tidal Array Feed-in Tariff applicants. It commits various provincial departments to the review of the submitted applications through a One Window Committee process.
Achieved/expected results	Five COMFIT approvals have been awarded and the Developmental Tidal Array Feed-in Tariff will be opened to four berth holders at Nova Scotia's Fundy Ocean Research Center for Energy (FORCE).
Key contact	Sandra Farwell Director Sustainable and Renewable Energy, Nova Scotia Department of Energy Telephone: 506-424-1700 novascotia.ca/energy

Statement of Best Practices

Development and implementation of standards and regulations

Description	Currently under development, the Statement will outline best practices for industry to follow in the construction, installation, operation and decommission of in-stream tidal energy projects. The main area of technology is: • **Technologies with potential longer-term impact**
Timeframe	2014 completion
Eligible recipients	The Statement will apply to all project developers in Nova Scotia. Other jurisdictions may choose, however, to adopt the Statement as a code of practice.
Achieved/expected results	N/A
Key contact	Sandra Farwell Director Sustainable and Renewable Energy Nova Scotia Department of Energy Telephone: 506-424-1700 novascotia.ca/energy

Feed-in Tariffs

Incentives and financing

Description	There are feed-in tariffs in Nova Scotia: Community Feed-in Tariff (COMFIT) and Developmental Tidal Array Feed-in Tariff. Feed-in tariffs (FITs) provide developers a guaranteed price per kilowatt-hour for the power they produce incidental to the testing/demonstration of their devices. The main area of technology is: • **Technologies with potential longer-term impact**
Timeframe	2011–14: Province awards of FITs to developers 2015–35: the first devices to be deployed that will receive a FIT are expected in 2015; the term of the Power Purchase Agreement between the developers and the utility, Nova Scotia Power Inc. is approximately 20 years.
Eligible recipients	Industry. FITs for small-scale developers, through the Community Feed-in Tariff (COMFIT) Program, require that the projects must be community-owned. There are no eligibility restrictions for Developmental Tidal Array Feed-in Tariff applicants.
Achieved/expected results	Five COMFIT approvals have been awarded and the Developmental Tidal Array Feed-in Tariff will be opened to four berth holders at Nova Scotia's Fundy Ocean Research Center for Energy (FORCE). The province has committed to limiting the Developmental Tidal Array Feed-in Tariff to a total impact of two percent of electricity rates; therefore, anticipating 15 to 20 megawatts of power supplied at the FIT rate in the near term. The COMFIT Program has natural limits due to the fact it requires projects to be distribution-connected.
Key contact	Sandra Farwell Director Sustainable and Renewable Energy Nova Scotia Department of Energy Telephone: 506-424-1700 novascotia.ca/energy

The Fundy Ocean Research Center for Energy (FORCE)

Infrastructure investment

Description	The Fundy Ocean Research Center for Energy (FORCE) is Canada's leading research centre for in-stream tidal energy, located in the Bay of Fundy, Nova Scotia. FORCE works with developers, regulators and researchers to study the potential for tidal turbines to operate within the Bay of Fundy environment. FORCE provides a shared observation facility, submarine cables, grid connection and environmental monitoring at its pre-approved test site. FORCE receives funding support from the Government of Canada, the Province of Nova Scotia, Encana Corporation and participating private-sector project developers. The main area of technology is: • Technologies with potential longer-term impact
Timeframe	FORCE was established in 2009, and the first in-stream tidal energy device was deployed and recovered 2009–10. Since this time, significant enabling mechanisms (such as infrastructure upgrades) and research have been ongoing. The next round of deployments is expected in 2015.
Eligible recipients	FORCE is a non-profit entity. Its Board of Directors consists of representatives of each of its four private-sector developers, a representative from the Province of Nova Scotia, an academic representative and independents. The berth holders at FORCE are not restricted on the basis of ownership and are selected through a competitive procurement process by the Province of Nova Scotia.
Achieved/expected results	Significant enabling mechanisms (such as infrastructure upgrades, subsea cable deployments) and research have been ongoing since FORCE's inception in 2009. The next round of deployments (at each of the four berths) is expected in 2015. The province expects 15 to 20 megawatts of power to be produced at the FORCE facility in the next five to six years. It is expected that these projects will result in economic opportunities for Nova Scotia's supply chain.
Key contact	Sandra Farwell Director Sustainable and Renewable Energy Nova Scotia Department of Energy Telephone: 506-424-1700 fundyforce.ca

Province of Newfoundland and Labrador

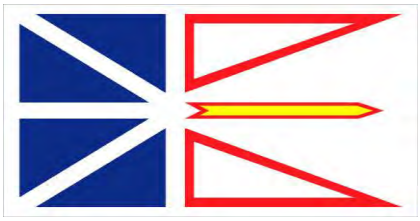
All aspects of Newfoundland and Labrador's future energy sector development are guided by the province's Energy Plan which was released in 2007 with $35 million over five years set aside for implementation. A key pillar of this energy plan is energy innovation and research and development (R&D).

The province is fortunate to be home to several world-class research, development and innovation facilities. These include "Centres of Excellence" at Memorial University, College of the North Atlantic, the Marine Institute and Sir Wilfred Grenfell College. This has led to Newfoundland and Labrador establishing itself as an acknowledged world leader in marine science and ocean technology

The Centre for Marine Compressed Natural Gas, the world's first research and development centre for large-scale compressed natural gas (CNG) transportation, is also based in the province. In addition, the Government of Newfoundland and Labrador is a funding partner in Petroleum Research Atlantic Canada (PRAC).

Another important element of the province's research and development success is found in the Atlantic Accord legislation which provides for prescribed levels of local spending on research and development by offshore operators in the province and authorizes the Canada-Newfoundland and Labrador Offshore Petroleum Board to issue guidelines with respect to such spending.

Finally, the province released a broad-based Innovation Strategy in 2006. This ultimately led to the establishment of the Research and Development Corporation. The principles were further embedded in the Energy Plan in 2007 which set aside $5 million to provide detailed advice and recommendations on planning, implementing and financing energy innovation. This investment has been used to pursue a strategic, coordinated approach to energy innovation focusing on areas of competitive advantage, create an Energy Innovation Roadmap, leverage existing strengths and energy expertise at the Centres of Excellence, and address a lack of venture capital and other funding required to move ideas into implementation.



Research and Development Guidelines: Development and implementation of standards and regulations for offshore hydrocarbon extraction

Research and Development Corporation: Collaboration

Energy Innovation Roadmap

Research and Development Guidelines

Development and implementation of standards and regulations

Description	A regulatory requirement that companies extracting hydrocarbons in the Newfoundland offshore area invest prescribed levels of funding in local research and development. The main area of technology is: • **Technologies with potential longer-term impact**
Timeframe	Long-term
Eligible recipients	N/A
Achieved/expected results	Has led to a significant enhancement in research and development spending in the province, particularly in focused areas of enhanced oil recovery and harsh environment technologies.
Key contact	Paul Morris Assistant Deputy Minister, Energy Policy Government of Newfoundland and Labrador Telephone: 709-729-1406 Email: pmorris@gov.nl.ca

Research & Development Corporation (RDC)

Collaboration

Description	An arms-length provincial Crown corporation established in 2008 to improve research and development in Newfoundland and Labrador. The Research & Development Corporation (RDC) was created in response to the need for increased investment in research and development in Newfoundland and Labrador and recognizing that increased R&D activities will play a major role in driving innovation, creating wealth and increasing economic growth in Newfoundland and Labrador for future generations. RDC works with business, academic and government partners to improve Newfoundland and Labrador's research and development performance. Since its launch, RDC has received an annual budget from the provincial legislature dedicated to R&D funding programs. One of RDC's major focus areas is capitalizing on the province's harsh environment. The main area of technology is: • Technologies with potential longer-term impact
Timeframe	Medium term
Eligible recipients	N/A
Achieved/expected results	To date, RDC has committed to invest $23.95 million in 67 energy R&D projects. These investments are in areas of competitive advantage with strong potential for economic return, notably in Arctic and harsh environment projects. Each dollar invested is leveraging $3 from other sources.
Key contact	Paul Morris Assistant Deputy Minister, Energy Policy Government of Newfoundland and Labrador Telephone: 709-729-1406 Email: pmorris@gov.nl.ca

Energy Innovation Roadmap

Collaboration

Description	The Energy Innovation Roadmap identifies future energy innovation needs and defines a series of possible paths to achieve those specific objectives. The main area of technology is: • **Technologies with potential longer-term impact**
Timeframe	Medium to long-term
Eligible recipients	N/A
Achieved/expected results	As part of the road map process, key areas of technology and innovation advantage were evaluated, with four priority areas being identified in oil and gas, onshore wind, transmission and remote energy. A second phase saw a combined onshore wind/transmission in harsh environments roadmap completed with other roadmaps expected to be undertaken in the future.
Key contact	Paul Morris Assistant Deputy Minister, Energy Policy Government of Newfoundland and Labrador Telephone: 709-729-1406 Email: pmorris@gov.nl.ca

Yukon

Energy Strategy for Yukon (2009)

Yukon Government Climate Change Action Plan (2009)

Micro-generation Policy (2013)

Yukon Development Corporation: Infrastructure development

Yukon Development Corporation

Infrastructure investment

Description	The Yukon government has made direct contributions to electricity infrastructure development, including: • an increase in capacity at the existing Mayo hydroelectric facility • the connection of the northern and southern power grids into one integrated system • an increase in capacity at the existing Aishihik hydroelectric facility The main area of technology is: • **Distributed power generation**
Timeframe	Construction of Mayo B began in June 2010. In December 2011 it was tied into Yukon's integrated transmission grid and is now providing clean and renewable electricity to Yukoners. In June 2011, Stage 2 of the Carmacks to Stewart Crossing transmission line was completed, linking the northern and southern Yukon transmission systems. In December 2011, Yukon Energy Corporation added a seven-megawatt hydro generator to the Aishihik hydro facility, which increased plant efficiency during periods of low demand as well as providing greater hydro production during periods of high demand. This new unit will save $1 million or more per year in diesel costs and will reduce greenhouse gas emissions by an estimated 3800 tonnes annually. Yukon's micro-generation policy began taking applications from individuals and businesses in spring 2014; the first grid-connected projects are expected to be contributing to Yukon's electricity supply by fall 2014.
Eligible recipients	The electricity infrastructure projects were completed by the Crown-owned Yukon Energy Corporation. Eligible micro-generation participants include all Yukon residential and commercial electricity consumers served by Yukon's two utilities: the Yukon Electrical Company Limited and Yukon Energy Corporation.
Achieved/expected results	The expansions to the Mayo hydro facility will contribute firm capacity of 10 MW, increase in annual generation by 36 GWh, and reduce annual greenhouse gas emissions by 25 000 tonnes. The expansion of the Aishihik hydroelectric plant adds 10 MW of firm capacity and five GWh of energy to the Yukon grid, and reduces greenhouse gas emissions by up to 3800 tonnes.

	The completion of the Carmacks-Stewart transmission project provides greater flexibility in supplying electricity to most of Yukon's communities. The micro-generation policy makes it possible for individual Yukon residential and commercial electricity customers to offset some or all of their electricity consumption and to contribute their excess supply to the grid.
Key contact	Mayo B, Carmacks-Stewart Transmission Line, Aishihik #3 – Janet Patterson, Yukon Energy Corporation Micro-generation policy – Sean MacKinnon, Yukon Energy, Mines and Resources

Northwest Territories

Northwest Territories Energy Action Plan

The Northwest Territories (NWT) Energy Action Plan provides the overall policy framework guiding energy decisions in the NWT as well as a detailed three-year plan on Government of NWT (GNWT) investments in energy. Displacing imported diesel and increasing the amount of local and renewable energy we use are the key goals of the Energy Plan. Energy conservation and efficiency, including public incentives, is a key focus of investment in the NWT. Investments in innovation are generally focused on the areas of biomass and solar.

Biomass Energy Strategy

The NWT Biomass Energy Strategy outlines the GNWT approach to encouraging further development of biomass energy in the NWT. Programs are now in place to support biomass development and community-led biomass projects. A key role for the GNWT has been the installation of a number of wood-pellet boilers in GNWT assets in a number of communities throughout the NWT.

Solar Energy Strategy

The Solar Energy Strategy provides the framework for encouraging greater use of solar and less reliance on diesel fuel in NWT communities. Many areas in the NWT (the land of the midnight sun) have more solar on an annual basis than parts of southern Canada and locations where solar is prevalent in Europe, such as Germany. The solar strategy establishes an ambitious target of supplying up to 20 percent of the average electricity load in 25 NWT "diesel" communities with solar.

Biomass Systems: Infrastructure investment for the adoption of emerging or proven technologies to the unique environment and circumstances in the North

Solar energy: Incentives and financing to promote the growth of solar energy technology in the North

Biomass Systems

Infrastructure investment

Description	As noted above, the GNWT does not have the resources to engage in substantial research or technology development initiatives. The focus is on applying emerging or proven technologies to the unique environment and circumstances in the north. The GNWT is making biomass an integral part of the NWT energy mix by installing a number of commercial-sized wood pellet boilers, spurring the development of a local industry. This work has helped create consumer confidence in pellet technology and has spurred a competitive market for wood pellet fuels, products and services. Through the projects and programs listed below, and other, the GNWT realizes a 40 percent cost savings and the level of GNWT investment has spurred substantial growth in the local industry. Many businesses are now investing in their own boilers. This support has helped to make the NWT a national leader in the deployment and use of wood pellet boilers. Combined heat and power, boilers using locally sourced biomass (i.e. wood chips) and the development of a local wood pellet producer are the next areas of biomass expected to evolve in the NWT. The main areas of technology are: • Energy efficiency technologies • Distributed power generation
Timeframe	Ongoing
Eligible recipients	Residents, businesses, communities
Achieved/expected results	Examples of biomass projects and programs: • Wood-Pellet Boiler for the Prince of Wales Northern Heritage Centre The installation of a 500 kW wood-pellet boiler will cost an estimated $650,000. The project will displace 185,000 litres of heating oil annually and reduce heating costs by 34 percent, generating annual savings of $50,000. The project's payback period is 13 years with a 492 tonne annual reduction in greenhouse gas emissions. • Wood-Pellet Boiler for the Yellowknife Airport Terminal Building The wood-pellet boiler to be installed at the Terminal Building will cost $750,000. It is estimated to displace 320,000 litres of propane annually, generating annual savings of $80,000 and a payback period of 9.4 years. Greenhouse gas emissions would be reduced by 477 tonnes annually.

	• **Funding for Biomass Systems** This funding is used to support small-scale biomass heating projects. Communities are eligible for 50 percent of project costs to a maximum of $50,000. Businesses can receive up to one-third of costs to a maximum of $15,000. Residents are eligible for one-third of costs to a maximum of $5,000. These biomass projects are administered through program guidelines established under the Alternative Energy Technology Program.
Key contact	Dave Nightingale Director Energy Policy and Planning, Industry, Tourism and Investment Telephone: 867-920-3274 E-mail: Dave_Nightingale@gov.nt.ca enr.gov.nt.ca/_live/documents/content/Biomass_Energy_Strategy_2012–2015.pdf pws.gov.nt.ca/pdf/publications/PWS_Energy_Conservation_Projects_2012–13.pdf

Solar Energy

Incentives and financing / direct investment

Description	In addition to developing a 104 kW solar installation in Fort Simpson, the GNWT has developed a number of incentive programs to promote the growth of solar technology in the north. In December 2013, a contract was awarded for the Colville Lake solar project to install 50 kW of solar photovoltaic (PV) generation as the first phase of a solar-battery-diesel hybrid system being built to offset diesel in this community. The Colville Lake project is the first high-penetration solar-battery-diesel project for the NWT. This utility-scale demonstration project allows the utility to refine the technological challenges of installing a hybrid system in a community without road access. For residents living in Colville Lake, shutting the noisy power plant down for a few hours in the summer will be something to celebrate. The potential to replicate this project in other "diesel" communities will depend on the success of this demonstration project. The main areas of technology are: • **Energy efficiency technologies** • **Distributed power generation**
Timeframe	Two years
Eligible recipients	Communities
Achieved/expected results	To date, funding has been provided through the Alternative Energy Technologies Program to support solar energy systems under five kW in the communities of Behchokö, Edzo, Wekweètì, Gamètì, Whatì, Nahanni Butte, Fort Simpson, Fort Good Hope, Paulatuk and Sachs Harbour.
Key contact	Dave Nightingale Director Energy Policy and Planning, Industry, Tourism and Investment Telephone: 867-920-3274 E-mail: Dave_Nightingale@gov.nt.ca enr.gov.nt.ca/_live/documents/content/Solar_Energy_Strategy_2012–2017.pdf