

Energy Research & Development Expenditures by Area of Technology, 2009

Reporting unit name and address

Confidential when completed.

Si vous préférez ce questionnaire en français, veuillez nous appeler au 1-877-992-3999.

Please correct contact information as required.

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INFORMATION FOR RESPONDENTS

Survey objective

This survey collects data which are essential to assure the availability of pertinent statistical information to monitor science and technology related activities in Canada and to support the development of science and technology policy. Your data will be used, for instance, by the Office of Energy Research and Development (OERD) at Natural Resources Canada to plan and evaluate energy research and development programs. The results of this survey will be published in “**Industrial Research and Development**” (Cat. No. 88-202-XIE).

Confidentiality

The *Statistics Act* protects the confidentiality of information collected by Statistics Canada.

Data-sharing Agreements

To reduce respondent burden, Statistics Canada has entered into data-sharing agreements with provincial and territorial statistical agencies and other government organizations, which must keep the data confidential and use them only for statistical purposes.

Information on confidentiality and data-sharing agreements can be found on page 5 of this questionnaire.

Reporting period and coverage

This questionnaire should be completed for the **fiscal year ending in 2009**. This report should exclude foreign operations. Please report all currency amounts in thousands of **Canadian dollars**.

Data Linkage

To enhance the data from this survey, Statistics Canada may combine information from the Research and Development in Canadian Industry Survey with the information your organization provided on the Energy R&D Expenditures by Area of Technology Survey, if applicable, and with information from other surveys or from administrative sources.

Fax or other electronic transmission disclosure

Statistic Canada advises you that there could be a risk of disclosure during facsimile or other electronic transmission. However, upon receipt, Statistics Canada will provide the guaranteed level of protection afforded all information collected under the authority of the *Statistics Act*.

For further information, please see the **Guide** at the end of this questionnaire.

Please return the completed questionnaire within 30 days of receipt.

DEFINITION

For the purpose of this questionnaire, R&D is given the same definition as that provided in the **GUIDE** with the following qualifications intended to restrict the response to energy:

- (i) **Energy R&D is undertaken to achieve economic, environmental, security, safety and/or social objectives. It is aimed at increasing the supply of energy (e.g. energy crops); increasing the efficiency with which it is used in production and conversion processes (e.g. processing oil sands, manufacturing biofuel, generating electricity) and in end-use sectors (e.g. vehicle efficiency); and/or reducing or avoiding energy-related emissions in those sectors, etc.. It includes advances that contribute to scientific knowledge as well as those leading to the commercial technologies.**
- (ii) **Excludes R&D on socio-economics, environmental protection (i.e. non-energy related), safety and resource assessment.**

**FISCAL YEAR
ENDING IN 2009**

From: ⁰²⁰¹ Year Month Day To: ⁰²⁰⁴ Year Month Day

In 2009, did this reporting unit perform or fund any energy R&D, as defined above?

- ⁰³⁰¹ Yes ► Please estimate the approximate expenditures for the items 1 to 8, complete certification and return with the **completed** main "Research and Development in Canadian Industry" (blue) questionnaire. Include all current and capital expenditures.
- No ► Please complete certification (on page 4) and return this report along with the **completed** main "Research and Development in Canadian Industry" (blue) questionnaire

Energy R&D by area of technology (see definition sheet)	2009 Expenditures on energy R&D done within this reporting unit				2009 Energy R&D payments outside Canada ⁴
	Self-funded ¹	Government co-funded ²	Other co-funding ³	Total	
(CAN\$ thousands)					
1. Fossil Fuels					
a) Crude oils and natural gas:					
i) Exploration	4101 \$,000	4111 \$,000	4121 \$,000	4131 \$,000	4141 \$,000
ii) Production (including enhanced recovery) and storage	4102 \$,000	4112 \$,000	4122 \$,000	4132 \$,000	4142 \$,000
b) Oil sands and heavy crude oil: Surface and sub-surface production and separation of bitumen, tailings management					
	4103 \$,000	4113 \$,000	4123 \$,000	4133 \$,000	4143 \$,000
c) Refining, Processing and Upgrading	4104 \$,000	4114 \$,000	4124 \$,000	4134 \$,000	4144 \$,000
d) Coal production, preparation and processing	4105 \$,000	4115 \$,000	4125 \$,000	4135 \$,000	4145 \$,000
e) Transportation of fossil fuels	4106 \$,000	4116 \$,000	4126 \$,000	4136 \$,000	4146 \$,000
2. Renewable energy resources					
a) Solar:					
i) Photovoltaics	1001 \$,000	1011 \$,000	1021 \$,000	1031 \$,000	1041 \$,000
ii) Thermal-power and high-temperature applications	1101 \$,000	1111 \$,000	1121 \$,000	1131 \$,000	1141 \$,000
iii) Heating and cooling	1102 \$,000	1112 \$,000	1122 \$,000	1132 \$,000	1142 \$,000
b) Wind energy	1004 \$,000	1014 \$,000	1024 \$,000	1034 \$,000	1044 \$,000
c) Bio-energy:					
i) Biomass production and transport	1103 \$,000	1113 \$,000	1123 \$,000	1133 \$,000	1143 \$,000
ii) Conversion to transportation fuel	1104 \$,000	1114 \$,000	1124 \$,000	1134 \$,000	1144 \$,000
iii) Conversion to heat and electricity	1105 \$,000	1115 \$,000	1125 \$,000	1135 \$,000	1145 \$,000
iv) Other bio-energy	1106 \$,000	1116 \$,000	1126 \$,000	1136 \$,000	1146 \$,000
d) Hydro:					
i) Small < 10Mw	1005 \$,000	1015 \$,000	1025 \$,000	1035 \$,000	1045 \$,000
ii) Large > 10Mw	1006 \$,000	1016 \$,000	1026 \$,000	1036 \$,000	1046 \$,000
e) Other renewable energy (including ocean and geothermal)	1007 \$,000	1017 \$,000	1027 \$,000	1037 \$,000	1047 \$,000

Energy R&D by area of technology (see definition sheet)	2009 Expenditures on energy R&D done within this reporting unit				2009 Energy R&D payments outside Canada ⁴
	Self-funded ¹	Government co-funded ²	Other co-funding ³	Total	
	(CAN\$ thousands)				
3. Nuclear fission and fusion					
a) Exploration, mining and preparation, tailings management	5003 \$,000	5013 \$,000	5023 \$,000	5033 \$,000	5043 \$,000
b) Nuclear reactors	5004 \$,000	5014 \$,000	5024 \$,000	5034 \$,000	5044 \$,000
c) Other fission	5005 \$,000	5015 \$,000	5025 \$,000	5035 \$,000	5045 \$,000
d) Fusion	5006 \$,000	5016 \$,000	5026 \$,000	5036 \$,000	5046 \$,000
4. Electric power					
a) Generation in utility sector	9001 \$,000	9011 \$,000	9021 \$,000	9031 \$,000	9041 \$,000
b) Combine heat and power in industry, buildings	9002 \$,000	9012 \$,000	9022 \$,000	9032 \$,000	9042 \$,000
c) Electricity transmission, distribution and storage	9003 \$,000	9013 \$,000	9023 \$,000	9033 \$,000	9043 \$,000
5. Hydrogen and fuel cells					
a) Hydrogen production for process applications	9101 \$,000	9111 \$,000	9121 \$,000	9131 \$,000	9141 \$,000
b) Hydrogen production for transportation applications	9102 \$,000	9112 \$,000	9122 \$,000	9132 \$,000	9142 \$,000
c) Hydrogen transport and storage	9103 \$,000	9113 \$,000	9123 \$,000	9133 \$,000	9143 \$,000
d) Other hydrogen	9104 \$,000	9114 \$,000	9124 \$,000	9134 \$,000	9144 \$,000
e) Fuel cells					
i) Stationary	9105 \$,000	9115 \$,000	9125 \$,000	9135 \$,000	9145 \$,000
ii) Mobile	9106 \$,000	9116 \$,000	9126 \$,000	9136 \$,000	9146 \$,000
6. Energy efficiency					
a) Industry	3005 \$,000	3015 \$,000	3025 \$,000	3035 \$,000	3045 \$,000
b) Residential, institutional and commercial	3001 \$,000	3011 \$,000	3021 \$,000	3031 \$,000	3041 \$,000
c) Transportation	3002 \$,000	3012 \$,000	3022 \$,000	3032 \$,000	3042 \$,000
d) Other	3004 \$,000	3014 \$,000	3024 \$,000	3034 \$,000	3044 \$,000
7. Other technologies					
a) Carbon capture, transport and storage related to:					
i) Fossil fuel production and processing	6005 \$,000	6015 \$,000	6025 \$,000	6035 \$,000	6045 \$,000
ii) Electric power production	6006 \$,000	6016 \$,000	6026 \$,000	6036 \$,000	6046 \$,000
iii) Industry in end use sector (i.e. excludes 7a(i) and 7a(ii))	6007 \$,000	6017 \$,000	6027 \$,000	6037 \$,000	6047 \$,000
b) Energy system analysis	6001 \$,000	6011 \$,000	6021 \$,000	6031 \$,000	6041 \$,000
c) Other	6008 \$,000	6018 \$,000	6028 \$,000	6038 \$,000	6048 \$,000
8. Non-energy R&D					
	7001 \$,000	7011 \$,000	7021 \$,000	7031 \$,000	7041 \$,000
9. Total energy and non-energy R&D	8001 \$,000	8011 \$,000 ⁵	8021 \$,000	8031 \$,000 ⁶	8041 \$,000 ⁷

1. Self-funded: Total investment in energy R&D including that which is eligible for income tax purposes (re. Scientific Research and Experimental Development Program), as well as other if applicable to energy R&D (i.e. land, buildings) and for which data is available.
2. Government co-funded: Co-funding (associated with "Self-funded") from federal, provincial and municipal government sources provided through contracts, grants and contributions. Excludes indirect government support provided through tax credits.
3. Other co-funded: Canadian non-government co-funding (excluding co-funding identified through other reporting units) plus co-funding from foreign sources (government, non-government, private sector) provided it is expended in Canada and data is available.
4. Energy R&D Payments Outside Canada: Amount of "Self" funding (as defined above) expended outside of Canada, where data is available.
5. Should equal total federal and provincial funding.
6. Should equal the 2009 total expenditures of question 9 on main "Research and Development in Canadian Industry" (blue) questionnaire (question 3 if on a Non-profit Institute questionnaire).
7. Should equal the 2009 R&D payments outside Canada on main "Research and Development in Canadian Industry" (blue) questionnaire.

Confidentiality

Your answers are confidential.

Statistics Canada is prohibited by law from releasing any information it collects which would identify a person, business, or organization, unless consent has been given by the respondent or as permitted by the *Statistics Act*. The confidentiality provisions of the *Statistics Act* are not affected by either the *Access to Information Act* or any other legislation. Therefore, for example, the Canada Revenue Agency cannot access identifiable survey records from Statistics Canada.

Information from this survey will be used for statistical purposes only and will be published in an aggregate form only.

Data-sharing Agreements

To reduce respondent burden, Statistics Canada has entered into data-sharing agreements with provincial and territorial statistical agencies and other government organizations, who must keep the data confidential and use them only for statistical purposes. Statistics Canada will only share data from this survey with those organizations that have demonstrated a requirement to use the data.

Section 11 of the *Statistics Act* provides for the sharing of information with provincial and territorial statistical agencies that meet certain conditions. These agencies must have the legislative authority to collect the same information, on a mandatory basis, and the legislation must provide substantially the same provisions for confidentiality and penalties for disclosure of confidential information as the *Statistics Act*. Because these agencies have the legal authority to compel businesses to provide the same information, consent is not requested and businesses may not object to the sharing of the data.

For this survey, there are **Section 11** agreements with the provincial and territorial statistical agencies of Newfoundland and Labrador, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, and the Yukon.

The shared data will be limited to business establishments located within the jurisdiction of the respective province or territory.

Section 12 of the *Statistics Act* provides for the sharing of information with federal, provincial or territorial government organizations. Under **Section 12**, you may refuse to share your information with any of these organizations by writing a letter of objection to the Chief Statistician and returning it with the completed questionnaire. Please specify the organizations with which you do not want to share your data.

For this survey, there is a **Section 12** agreement with the statistical agencies of Prince Edward Island, the Northwest Territories and Nunavut as well as with the Office of Energy Research and Development (OERD) of Natural Resources Canada.

For agreements with provincial and territorial government organizations, the shared data will be limited to information pertaining to business establishments located within the jurisdiction of the respective province or territory.

Definitions below correspond to the area of technology items listed in the table.

1. Fossil Fuels

a) Crude oils and natural gas

- i) **Exploration:** includes development of advanced exploration methods (geophysical, geochemical, seismic, magnetic) for on-shore and off-shore prospecting;
- ii) **Production (including enhanced recovery) and storage:** includes on-shore and off-shore deep drilling equipment and techniques for conventional oil and gas; secondary and tertiary recovery of oil and gas; hydro fracturing techniques; processing and cleaning of raw product; storage on remote platforms (e.g. Arctic, offshore); safety aspects of offshore platforms;

b) Oil sands and heavy crude oils

- i) **Surface and sub-surface production and separation of the bitumen, tailings management:** includes surface and in-situ production (e.g. SAGD); tailings management;

- c) **Refining, Processing and Upgrading:** includes processing of natural gas to pipeline specifications, and refining of conventional crude oils to refined petroleum products (RPPs), and the upgrading of bitumen and heavy oils either to synthetic crude oil or to RPPs. Upgrading may be done at an oil sands plant, regional merchant upgraders or integrated into a refinery producing RPPs;

- d) **Coal production, separation and processing:** includes coal, lignite and peat exploration; deposit evaluation techniques; mining techniques; separation techniques; coking and blending; other processing such as coal to liquids, underground (in-situ) gasification;
- e) **Transportation of fossil fuels:** includes transport of gaseous, liquid and solid hydrocarbons via pipelines (land and submarine) and their network evaluation; safety aspects of LNG transport and storage.

2. Renewable energy resources

a) Solar

- i) **Photovoltaics:** includes solar cell development; PV module development; PV-inverter development; building-integrated PV-modules; PV-system development; other.;
- ii) **Thermal power and high-temperature applications:** includes solar chemistry; concentrating collector development; solar thermal power plants; high-temperature applications for heat and power;
- iii) **Heating and cooling:** includes daylighting; passive and active solar heating and cooling; collector development; hot water preparation; combined-space heating; solar architecture; solar drying; solar-assisted ventilation; swimming pool heating; low-temperature process heating; other.

- b) **Wind energy:** includes technology development, such as blades, turbines, converters structures; system integration; other.

c) Bio-energy

- i) **Biomass production/supply and transport:** includes improvement of energy crops; research on bio-energy production potential and associated land-use effects; transport as bio-solids, bio-liquids, biogas and bio-derived energy products (e.g. ethanol, biodiesel); compacting and baling; other.;
- ii) **Conversion to fuels:** includes conventional bio-fuels; cellulose-derived alcohols; biomass gas-to-liquids; other energy-related products and by-products;
- iii) **Conversion to heat and electricity:** includes bio-based heat, electricity and combined heat and power (CHP), excluding multifiring with fossil fuels;

d) Hydro

- i) **Small < 10MW:** includes plants with capacity of below 10 MW;
- ii) **Large > 10MW:** includes plants with capacity of 10 MW and above.
- e) **Other renewable energy:** includes hot dry rock; hydro-thermal; geothermal heat applications (including agriculture); tidal power; wave energy; ocean current power; ocean thermal power; other.

3. Nuclear fission and fusion

- a) **Exploration, mining and preparation, tailings management:** includes development of advanced exploration methods (geophysical, geochemical) for prospecting; ore surface and in-situ production; uranium and thorium extraction and conversion; enrichment; handling of tailings and remediation;
- b) **Nuclear reactors:** includes nuclear reactors of all types and related system components;
- c) **Other fission:** nuclear safety; environmental protection (emission reduction or avoidance); radiation protection and decommissioning of power plants and related nuclear fuel cycle installations; nuclear waste treatment, disposal and storage; fissile material recycling; fissile materials control; transport of radioactive materials;
- d) **Fusion:** includes all types (e.g.: magnetic confinement; laser applications).

4. Electric Power

- a) **Generation in utility sector:** includes conventional and non-conventional technology (e.g.: pulverised coal; fluidised bed; gasification-combined cycle; supercritical); re-powering, retrofitting, life extensions and upgrading of power plants; generators and components; super-conductivity; magneto hydrodynamic; dry cooling towers; co-firing (e.g.: with biomass); air and thermal pollution reduction or avoidance; flue gas cleanup (excluding CO₂ removal); CHP (combined heat and power) not covered elsewhere;
- b) **Combined heat and power in industry, buildings:** includes industrial applications; small scale applications for buildings;

- c) **Electricity transmission, distribution and storage:** includes solid state power electronics, load management and control systems, network problems, super-conducting cables, AC and DC high voltage cables, HVDC transmission; other transmission and distribution related to integrating distributed and intermittent generating sources into networks; all storage (e.g.: batteries, hydro reservoirs, fly wheels); other.

5. Hydrogen and fuel cells

- a) **Hydrogen production for process applications;**
- b) **Hydrogen production for transportation applications;**
- c) **Hydrogen transport and storage;**
- d) **Other hydrogen:** includes end uses (e.g.: combustion); other infrastructure and systems R&D (refuelling stations);
- e) **Fuel cells**
 - i) **Stationary:** for electricity generation, other stationary end-use;
 - ii) **Mobile:** includes portable applications.

6. Energy efficiency

- a) **Industry:** includes reduction of energy consumption through improved use of energy and/or reduction or avoidance of air and other emissions related to the use of energy in industrial systems and processes (excluding bio-energy-related) through the development of new techniques, new processes and new equipment; other;
- b) **Residential and commercial:** includes space heating and cooling, ventilation and lighting control systems other than solar technologies; low energy housing design and performance other than solar technologies; new insulation and building materials; thermal performance of buildings, domestic appliances; other;
- c) **Transportation:** includes analysis and optimisation of energy consumption in the transport sector; efficiency improvements in light-duty vehicles, heavy-duty vehicles, non-road vehicles; public transport systems; engine-fuel optimisation; use of alternative fuels (liquid and gaseous, other than hydrogen); fuel additives; diesel engines; stirling motors, electric cars, hybrid cars; includes air emission reduction; other;
- d) **Other:** includes waste heat utilisation (heat maps, process integration, total energy systems, low temperature thermodynamic cycles); district heating; heat pump development; reduction of energy consumption in the agricultural sector.

7. Other technologies

- a) **Carbon capture, transport and storage related to:**
 - i) **Fossil fuel production and processing;**
 - ii) **Electric power production;**
 - iii) **Industry in the end-use sector, such a steel production, manufacturing, etc. (i.e. excludes 7a(i) and 7a (ii)).**
- b) **energy system analysis:** includes system analysis related to energy R&D not covered elsewhere; sociological, economical and environmental impact of energy which are not specifically related to one technology area listed in the sections above;
- c) **other:** includes energy technology information dissemination; studies not related to a specific technology area listed above.

Please return the completed questionnaire within 30 days of receipt.

If you are unable to do so, please inform us of the expected completion date. If you receive more than one copy of this survey questionnaire for the same business, please complete one and attach and return the duplicate(s). If you require assistance in the completion of this questionnaire or have any questions regarding the survey please address all enquiries to:

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Thank you for your co-operation.