

NSERC Investments

Electrical Energy Research



\$60 million

NSERC Investments in Electrical Energy Research (2009-10)

\$1 billion

Government of Canada Investments through NSERC (2009-10)

**NSERC Investments
in Electrical Energy
Research**

 **\$18 million** (2004-05)

 **\$40.9 million** (2009-10)

The Natural Sciences and Engineering Research Council (NSERC) is a federal agency that helps make Canada a country of discoverers and innovators for all Canadians. NSERC maximizes the value of the Government of Canada's investments in research by promoting **research-based innovation**, university-industry partnerships, and the **training of people** with scientific knowledge and business skills to create wealth from new discoveries in **science and engineering**.

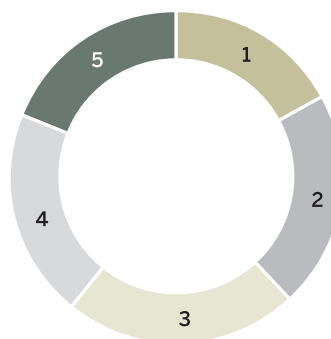
NSERC researchers help ensure a reliable supply of electricity for Canadians. Across the country, professors and students work with public utilities and the private sector to maximize the value of investments in all sources of new energy, including wind and solar. These collaborations help create innovative "smart" transmission grids that balance power inputs from many sources and improve the efficiency and reliability of power delivery. In the future, such systems may also be able to store electrical power and release it on demand.

\$795 million

NSERC Investments in All Priority Areas of Canada's S&T Strategy (2009-10)

Breakdown of Investments

- 1 | Health and Related Life Sciences and Technologies
21%
- 2 | Natural Resources and Energy
21%
- 3 | Information and Communications Technologies
20%
- 4 | Manufacturing
20%
- 5 | Environmental Science and Technologies
18%



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www.nserc-crsng.gc.ca

Electrical Energy Research



Impact and Investments

Campus a Test Bed for Smart Power Delivery

An intelligent microgrid being developed at the British Columbia Institute of Technology has become a test bed for technologies that produce smarter and more secure power systems.

The NSERC Smart Microgrid Network (NSMG-Net) is the first smart grid research network in Canada. Its participants include leading Canadian researchers from government research labs and universities across the country, working in close collaboration with partners in industry, provincial hydro utilities and governments. The initiative, led by British Columbia Institute of Technology electrical engineer **Hassan Farhangi**, involves installing smart meters, sensors and controls across the Burnaby campus. A key objective of creating these intelligent local microgrids is to balance supply and demand and integrate alternative energy sources. The project will provide the campus community with tools that tell users when the cheapest or cleanest power is available. NSERC and its partners are contributing **\$4.6 million** to the five-year initiative.

College Innovation Aids the Sustainable Energy Industry

Eastern Ontario is home to a burgeoning renewable energy industry. A contribution of \$2.3 million from NSERC over the next five years is allowing St. Lawrence College to expand its applied research activity so that students, instructors and university researchers can partner with local companies to deploy these sustainable energy technologies.

Many small and medium-sized enterprises in the renewable sector do not have the resources to conduct thorough research and development. The College's Sustainable Energy Applied Research Centre helps fill this gap by field testing new technologies and studying the efficiency of existing technologies. The partners also explore ways of integrating renewable energy sources—such as solar, geothermal, wind and biomass—with traditional generation and the existing power grid. This work will involve as many as 500 college students, enriching their experience and providing the sector with a highly skilled pool of workers.

482

NSERC-funded Professors

110

Industrial Partners

1,202

NSERC Awards to Students and Fellows

44

NSERC-supported Research Chairs

Did you know?

- An NSERC Industrial Research Chair partnership between the University of Manitoba, the Manitoba HVDC Research Centre and RTDS Technologies resulted in the commercialization of several of the most successful state-of-the-art simulation tools in the global power industry.
- Solar power in southeastern Ontario alone has the potential to produce almost the same amount of power as all the nuclear reactors in the United States. The findings come from studies led by mechanical engineer Joshua Pearce of the Queen's University Applied Sustainability Research Group.

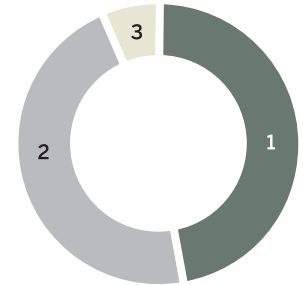
Electrical Energy Research



Preventing Blackouts

Trial and error is a great way to fine-tune complex systems. But a power grid delivering electricity to millions of people leaves no room for experiments. Aniruddha Gole is testing algorithms on a computer-simulated electrical grid to improve efficiency without putting systems at risk.

Dr. Gole is a professor of Electrical and Computer Engineering at the University of Manitoba and an NSERC Industrial Research Chair. By using the simulator, he can run an algorithm through the mock electricity grid, tweaking it until maximum efficiency is achieved. This allows electricity grid operators to squeeze more power out of the system without any risk of a catastrophic event. The research also ensures that automatic controllers throughout the network work in harmony, helping avoid system-wide blackouts, such as the one in August 2003 that affected much of eastern North America. Dr. Gole, who received **\$512,000** this year in funding from NSERC, earned an NSERC Synergy Prize in 2005 for his contributions towards making Manitoba an international leader in power system simulation. His research will further advance Canadian expertise and contribute new export opportunities.



Breakdown of Investments (2009-10)

- 1 | **\$25.2 million (61.6%)**
Wind, Solar and Alternative Systems
- 2 | **\$9.2 millions (22.6%)**
Hydroelectric Power, Electricity Distribution and Storage, and Power Systems
- 3 | **\$6.5 million (15.8%)**
Nuclear Power and Systems

The Capacity to Store

Our daily lives depend on power—to keep laptops running, create a flash from a digital camera and perhaps to help electric cars accelerate. Heather Andreas, a professor of chemistry at Dalhousie University, is researching the use of electrochemical capacitors (ECs) to meet this growing demand for stored electricity.

Anyone with a drawer full of used-up conventional batteries understands that these products have their limitations and produce waste. The advantage of using ECs is that they require very little maintenance and can be recharged millions of times before needing replacement. They are ideal for use with alternative energy sources and in remote locations. The major drawback is that ECs lose their charge over time, even if they are not being used. Dr. Andreas and her team are researching the reactions happening within the EC that steal the charge. She is also studying design factors that could allow for a larger charge to be stored and for a quicker release, boosting the electricity available to the device being powered. This research complements her involvement in the work of Dalhousie's Research in Energy, Advanced Materials and Sustainability (DREAMS) program—a **\$1.65-million** NSERC initiative led by colleague and battery pioneer **Jeff Dahn**. DREAMS supports the training of new researchers who can address important aspects of energy production, storage and sustainability.

Electrical Energy Research



The Power of Mathematics

Mathematical and engineering research is helping Quebec's economy take greater advantage of one its greatest natural assets—abundant hydro-electric potential.

Michel Gendreau, a professor at École Polytechnique de Montréal and an NSERC/Hydro-Québec Industrial Research Chair, is using data supplied by Hydro-Québec to study and understand uncertainties in both electrical generation and consumer demand. University researchers work side-by-side with Hydro-Québec employees to answer key questions identified by the company. Some of these challenges include uneven water flows at generating stations, equipment failures and fluctuations in demand. Applying computational methods, Gendreau suggests ideas for making the best use of dam systems and integrating wind turbines as an alternate source of power. The resulting software and new knowledge can also be applied to other sectors where managing a high level of uncertainty is a key business consideration. By using mathematical principles to study real-world data, the research can assist companies with key decisions that make better use of resources, contributing to a stronger economy and a higher quality of life for Canadians. NSERC and Hydro-Québec have committed **\$1.5 million** to the first five years of Gendreau's Chair program.

Sun Shines on Photovoltaics

The environmental benefits of solar power are creating a growing demand for the photovoltaic equipment that captures the Sun's energy. The NSERC Photovoltaic Innovation Network is accelerating research and development to allow more Canadian companies to capitalize on the domestic and international market for solar energy solutions.

The initiative engages 29 top scientists and engineers in the field of advanced solar cell research. Drawing this talent from 13 Canadian universities, the Network also has strong support from partners in the private and public sector. One idea Network researchers are exploring is the development of transparent solar cells, which could be used as windows that let in light while also producing energy. Led by McMaster University **Rafael Kleiman**, the Network will receive **\$5 million** from NSERC over five years. It expects to train almost 100 new researchers needed to fill positions in industry and academia. Research results will be publicly disseminated through a new Web site dedicated to public outreach in solar energy.

Some of NSERC's Partners in Electrical Energy Research

Alcan Cable
Alstom Canada Inc.
ARISE Technologies Corporation
ATCO Electric
Atomic Energy of Canada Limited
BC Hydro
Canadian Electricity Association
Canadian Wind Energy Association
CG Power Systems Canada Inc.
Cleanfield Energy Corp.
Hydro One Networks Inc.
Hydro-Québec
Manitoba Hydro
Matrix Energy Inc.
New Brunswick System Operator
Newfoundland and Labrador Hydro
Opsun Technologies Inc.
Powertech Labs Inc.
RTDS Technologies Inc.
SaskPower
SNC-Lavalin Inc.
Stantec Inc.
TechnoCentre éolien Gaspésie – les Îles
TransGrid Solutions Inc.
Tyco Electronics Canada Ltd.

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