



**NATURAL RESOURCES CANADA - INVENTIVE BY NATURE**

# **Innovation and Energy Technology in Canada**

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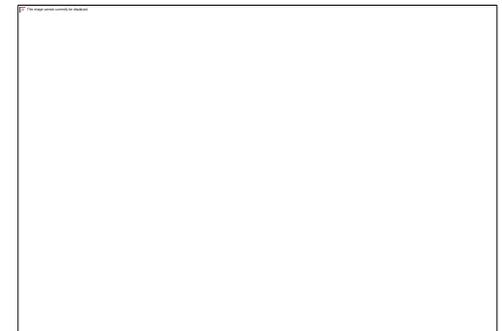
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Canada

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# Overview of Natural Resources Canada

- A science and technology leader in the fields of **energy, forestry and mining.**
- Canada's **abundant natural resources**
  - 5<sup>th</sup> largest crude oil and gas producer and 3<sup>rd</sup> largest proven oil reserves
  - 4<sup>th</sup> largest in natural gas production
  - 3<sup>rd</sup> largest in hydro production
  - Vast renewable and clean energy potential (wind, biomass, solar, marine, geothermal)
- Major projects underway or planned over the next 10 years estimate **investments** of some **\$650B**
- Three strategic portfolios: unconventional oil & gas, clean electricity, end use applications



# Canada's clean energy tech landscape

- Major investments in energy technologies since 2006
  - \$1.1B invested by the Government since 2006 has leveraged an additional \$4.4B from partners (e.g. growth in green infrastructure development, energy efficiency, clean energy technologies and cleaner fuels)
- World leader in Carbon Capture and Storage
  - Over \$1.8B government investments - 4 large-scale projects (1 in operation and 3 under construction)
  - Requirement for CCS at coal-fired power plants by 2025
- Renewable energy increasing
  - Various regions attractive for solar, onshore wind energy developers
  - Bioenergy contributes 4% energy supply
- *Sustainable Development Technology Canada* brings new technologies closer to commercialization
  - Government investment of \$923M

Canada has strategic advantages in key technology clusters:

- 1 Unconventional oil & gas
- 2 Next generation transportation
- 3 Energy efficiency
- 4 Distributed power generation
- 5 Longer term R&D opportunities



# CanmetENERGY laboratories conduct leading energy R&D

CanmetENERGY scientists are internationally-recognized experts in key energy R&D domains.



## Areas of Focus:

- Oil sands & heavy oil processes (incl. tailings, water management, upgrading, and future fuels and emissions)
- Shale resources
- Oil spills

Devon



## Areas of Focus:

- Buildings energy efficiency
- Industrial processes
- Energy solutions for Northern & remote communities
- Integration of renewable & distributed energy resources

Varennes



## Areas of Focus:

- Clean fossil energy
- Buildings & communities energy efficiency
- Industrial processes
- Bioenergy
- Renewables

Ottawa



# Unconventional Oil & Gas

- **Environmental impacts** - Air & water quality, oil spill response, land reclamation, tailings
- **Hydrocarbon recovery and conversion** - Non-aqueous extraction, partial upgrading, refining, future fuels
- **Shale gas / oil** - Resources characterization, groundwater, hydrofracturing, wellbore integrity, seismicity studies, improved oil and gas recovery in low permeability reservoirs
- **Upgrading intermediate feedstocks** - Producing “drop in” fuels which are fully compatible with current commercial transportation fuel, upgrading biomass pyrolysis oils (bio-oils) into refinery feedstocks for coprocessing applications with petroleum distillates

## International Examples:

- NAMA project on Flaring & Venting mitigation and Energy Efficiency with Colombia’s Ecopetrol and Mexico’s PEMEX
- Ongoing pilot plant operation on testing partial upgrading using supercritical water with Japan



# Clean Electricity

- **Clean Fossil Fuels** - Clean coal, Carbon Capture & Storage technologies
- **Renewables** - Solar thermal, photovoltaics, wind technology for cold climates, marine renewable energy, wind-diesel systems, tidal stream energy, river current, bioenergy & biofuels
- **Biomass Fast Pyrolysis** - Bio-oils for heat and power, deriving high value green products from bio-oils
- **Smart grids** - Integration of renewable & distributed energy resources , transmission & distribution, micro-grids, energy storage

## International Examples:

- Modeling clean coal technology to assist designing of the GreenGen 250MW gasifier in China
- Building Integrated PV / Thermal systems with South Korea



# End Use applications

- **Buildings and Communities** - Net zero energy buildings, advanced mechanical systems, renewables integration, smart energy networks
- **Intelligent Buildings & Building Recommissioning** - Seasonal heat storage, building diagnostics and simulation, ejector-based mechanical systems, refrigeration systems
- **Industrial Processes and Industrial Systems Optimization** - Biorefinery, minimizing waste heat, converting waste heat to power, capture and utilization of waste heat within complex processes, efficient refrigeration applications
- **Transportation** - Electric Vehicle technologies, novel emission control systems for natural gas vehicles

## International Examples:

- Use of Canadian wood products and construction methods; energy efficient and renewable energy technologies in Tianjin eco-city, China
- Building and housing energy simulation research with the US to increase the energy efficiency of buildings



# Forms of Collaboration for Discussion

- Sharing of research data / samples on subjects of mutual interest
- Sharing the development and/or utilization of specialized pilot-scale research facilities and modeling capabilities
- Cooperation under international environmental, clean energy technology, or sustainable development partnerships
- Personnel exchange



## **For further information please contact:**

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