



Canadian Nuclear Association

Canadian Nuclear Energy: Role and Future

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Relations*

Canadian Nuclear Association

Hydropower and the Economy:

Powering for Growth

Ottawa, Ontario

November 4, 2009

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Nuclear: A Clean - Energy

To meet the vast global need for electricity, hydrogen and safe water, nuclear energy is being recognized as a “green” energy source.



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Nuclear Energy Drivers

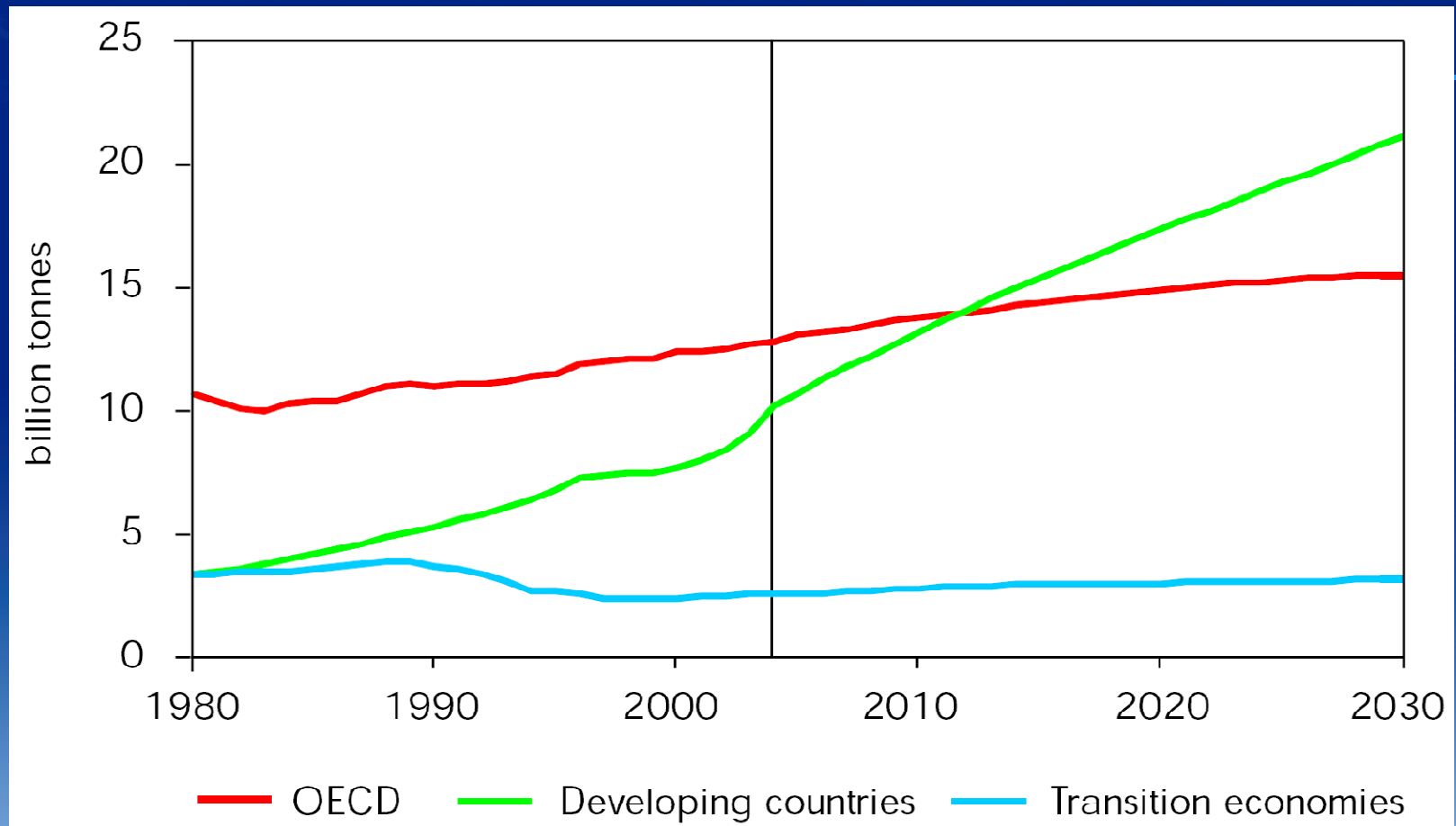
- Population growth in developing countries
- Economic growth
- Energy security and supply
- Technology change
- Clean air
- Climate change/CO2 emissions
- Sustainable development



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Global CO₂ Emissions Increasing



China has overtaken the United States as the world's biggest CO₂ emitter before 2010.

Source: IEA World Energy Outlook 2006



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The Technology Challenge



Vehicles: Efficiency, Bio-fuels, Hydrogen Fuel Cells



Zero Net Emission Bldgs., Industrial Efficiency, CHP



The ACR-1000: Generation III+
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No single technology or policy can do it all

Different

- regions
- markets
- scale-up requirements
- infrastructures
- resources
- preferences
- technology timing



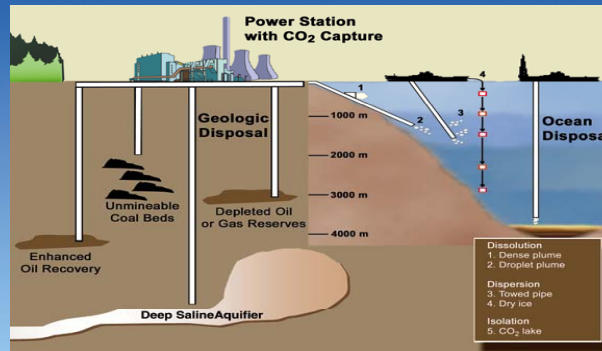
Renewable Energy Technologies



Bio-Fuels and Power



Advanced Power Grids



Carbon (CO₂) Sequestration

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Environmental Performance

Nuclear power means low carbon emissions:

Coal	975 g/kWh
LNG Thermal	608 g/kWh
LNG Combined Cycle	519 g/kWh
Solar PV	53 g/kWh
Wind	29 g/kWh
Nuclear	22 g/kWh
Hydroelectric	19 g/kWh

Source: Japanese Central Research Institute, 2002



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Environmentalist speak out



*Patrick Moore
Environmentalist Founder of
Greenpeace*

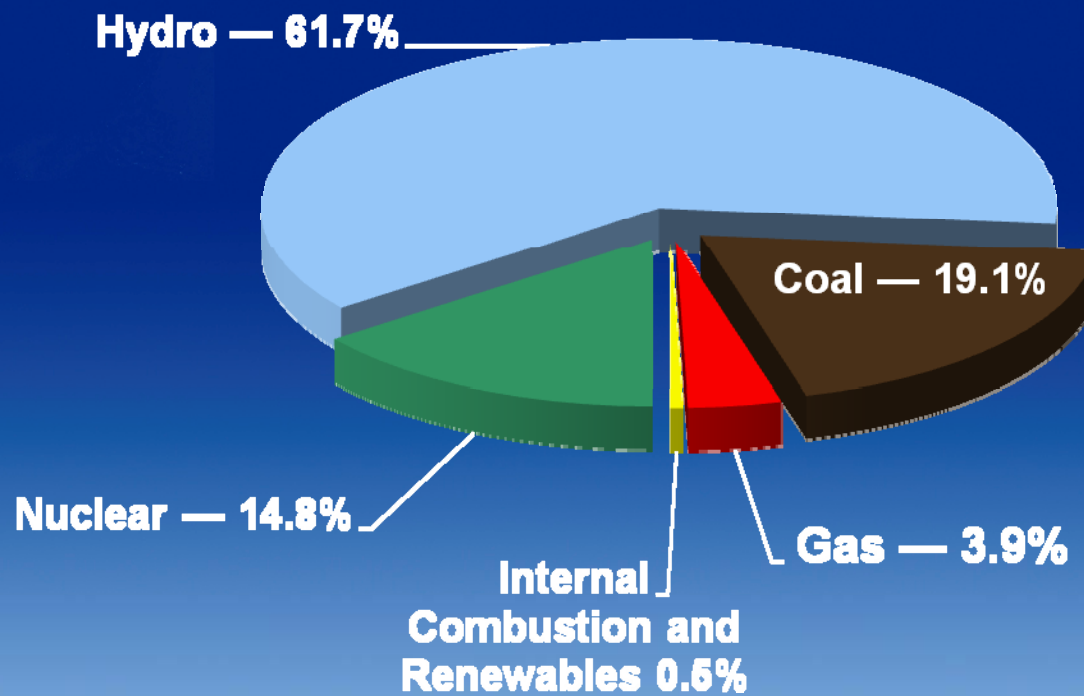
“Environmental activists, notably Greenpeace and Friends of the Earth, continue to lobby against clean nuclear energy. We can agree renewable energies, such as wind, geothermal and hydro are part of the solution. But nuclear energy is the only non-greenhouse gas emitting power source that can effectively replace fossil fuels and satisfy global demand”



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Electricity Sources in Canada (2008)



Source: Natural Resources Canada (NRCAN, 2009)



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Canada's Nuclear Industry

- 61 years in nuclear; Nobel Prize in Physics — 1994 NRC Dr. Bert Brockhouse
- 47 years – generating electricity from 22 CANDU nuclear plants
- 2008 – nuclear generated 14.8% of Canada's electricity - Ontario (53%) Québec (3%) and New Brunswick (6.1%*- under refurbishment normally provides approx 30% of NB's power)
- October 2009, 17 reactors in service, 3 reactors being refurbished - Bruce A – Units 1 & 2 and 1 – Point Lepreau, N.B.
- 2 reactors being placed in safe storage -Pickering A - Units 2 & 3



Gentilly, QC



Bruce, ON



Pt. Lepreau,
NB



Pickering,
ON



Darlington,
ON



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Canada Is the World's Leader in Uranium

- Canada is the world's largest producer of natural uranium, providing 21% of total world production from Saskatchewan in 2008
- Saskatchewan's uranium reserves contain about 4 times more energy than all known Canadian conventional oil reserves (not including Athabasca tar sands)
- The two biggest deposits are at Saskatchewan's McArthur River and Cigar Lake and are the world's richest, with average ore grades more than 100 times the global average for uranium mines
- McArthur River and Cigar Lake contain energy equivalent to 15 billion barrels of oil or 4 billion tonnes of coal
- Electricity generated from Canadian uranium worldwide avoids 700 million tonnes of CO₂ emissions annually



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Advancing Global Health

- In 1951 the first two cancer-treatment machines using Cobalt 60 (radioisotopes) were built in Canada
- There are 20 million medical diagnostic procedures using radioisotopes in North America each year
- Over half of the worlds medical isotopes are produced by Ottawa's MDS Nordion
- MDS Nordion supplies 60% of the world demand for Cobalt 60 used for cancer treatment, sterilization and food irradiation
- Canadian produced medical isotopes are used in 60,000 medical procedures per day worldwide, 5,000 in Canada



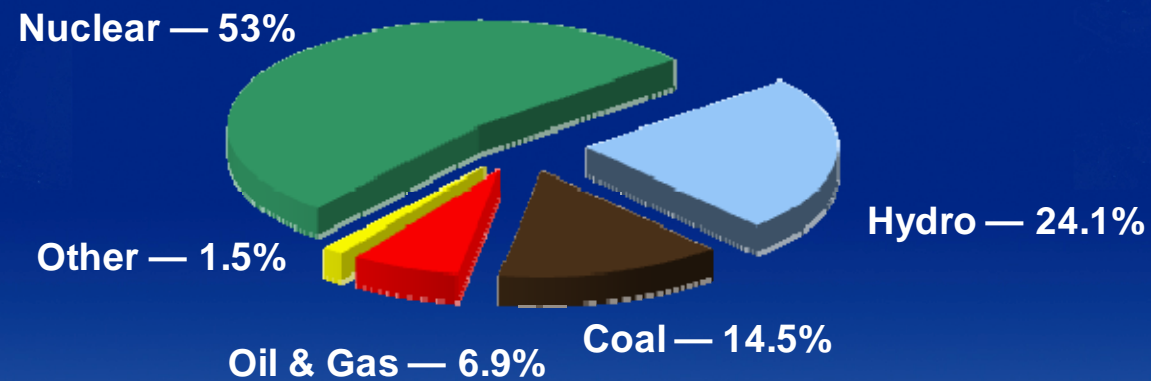
Source: MDS Nordion, 2006



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2008 Ontario Electricity Generation by Fuel type (TWh)



- Nuclear — 84.4 TWh
- Hydro — 38.3 TWh
- Coal — 23.2 TWh
- Oil & Gas — 11 TWh
- Other — 2.4 TWh

IESO- Market Information Services, January 12, 2009

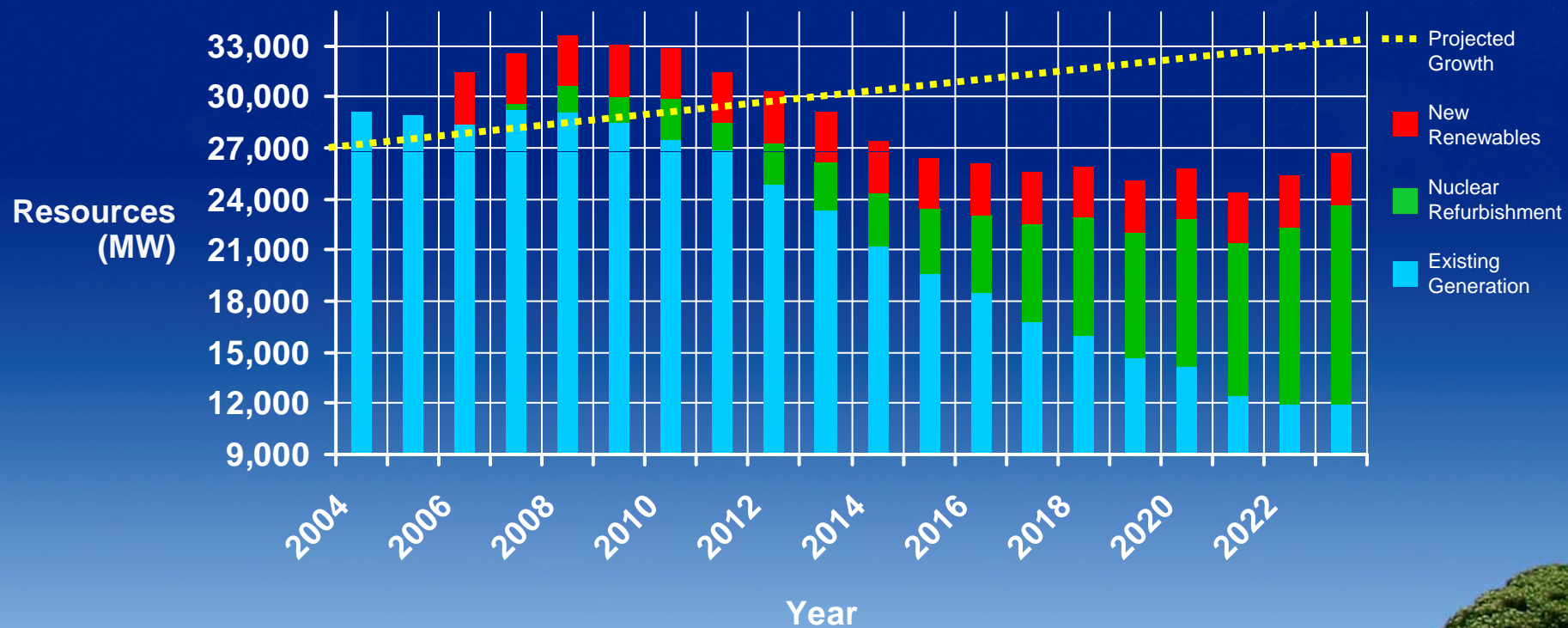


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Renewables Insufficient

Renewable Potential added to Nuclear Refurbishment



Source: Independent Electricity System Operator (IESO), 2004



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Bruce Power - Refurbishment and New Build

- Bruce Power is located in Ontario and is the only private sector nuclear operator with eight units, the second largest nuclear power station in the world
- Bruce is currently refurbishing Bruce A Units 1 & 2 with a return to service date by 2010-2011
- Bruce is evaluating building new nuclear plants in Ontario, Saskatchewan and Alberta



Source: Bruce Power, 2008



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New Nuclear Construction

- June 2008 – The Government of Ontario selected the Darlington site (near Toronto, Ontario) as the location to build two new nuclear reactors
- June 2009 - Government of Ontario announced a delay in the procurement process to select a vendor for the new reactors (AECL, Westinghouse and AREVA were under consideration)



Photograph of Darlington Station.

Source: OPG



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Nuclear Refurbishment and New Build in New Brunswick and Quebec

- March 31, 2008 – New Brunswick Power began refurbishing the Point Lepreau reactor to extend the stations life to 2032
- In 2008 New Brunswick Power also begins investigating the building of 1 or 2 new units at Point Lepreau
- Hydro-Québec made the decision in 2008 to refurbish Gentilly-2 in Quebec to extend the stations life to 2035. Refurbishment to begin 2011-2012



Point Lepreau



Gentilly-2



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Alberta

- Nuclear energy is being promoted as a non-emitting electricity generator for Alberta's oil sands operations
- Nuclear would be a substitute for natural gas saving this premium fuel for uses in transportation, home heating, as a chemical or export
- March 2008 – Bruce Power begins the process to consider new nuclear in Alberta west of the town of Peace River



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Saskatchewan

- In May 2008, the Government of Saskatchewan began to express strong interest in building a nuclear reactor and becoming more involved beyond the uranium mining industry
- Saskatchewan uranium reserves contain about four times more energy than all known conventional oil reserves (not including the Athabasca tar sands)
- There is ample uranium in the world to fuel nuclear power plants today and in the future. Higher uranium prices will encourage investment and exploration



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Economic Profile of the Canadian Nuclear industry

- Nuclear energy is a \$6.6 billion/year industry in Canada
- Nuclear generates \$1.5 billion in federal and provincial revenues through taxes
- 150 firms, 21,000 direct jobs, 10,000 indirect jobs (contractors) and 40,000 spin-off jobs
- 5,000 jobs from uranium exports
- 1.2 billion in exports
- GDP generated by investment of two CANDU 6 reactors is \$5.973 billion

Source: CERI 2008



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Nuclear Safety

- Not one single fatality has resulted from radiation exposure at a nuclear power plant in Canada
- Improved performance
- Effective regulation — Canadian Nuclear Safety Commission, headquartered in Ottawa
- International peer review “International Atomic Energy Agency”



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Adaptive Phase Management For Long-term Care of Canada's Used Nuclear Fuel

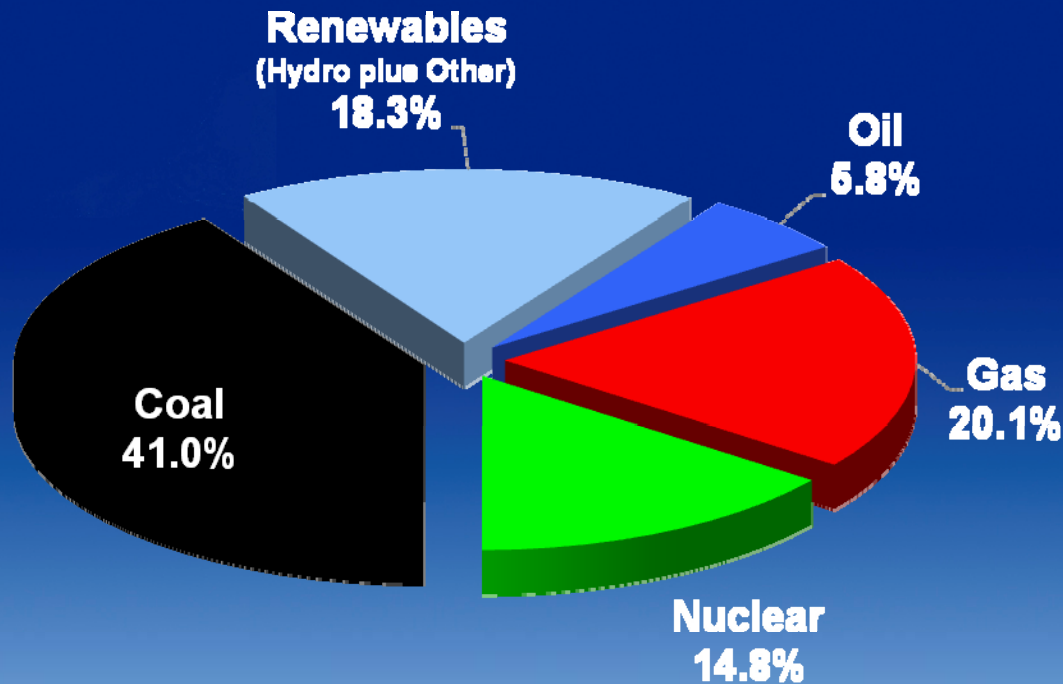
- June 2007 – Federal Government supports the Nuclear Waste Management Organization's proposal for Adaptive Phase Management for long-term management of used fuel
- Centralized containment and isolation in deep geological repository. Suitable rock (Canadian Shield & Ordovician sedimentary rock)
- Optional shallow underground storage facility while developing deep geological repository
- Continuous monitoring and potential for retrieval
- NWMO is now beginning to seek a site for the repository and a willing host community



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Global Electricity Generation



Nuclear power produces almost 15% of global electricity and is the world's fourth largest source of electricity.

436 Operable Reactors
48 Under Construction
133 Planned
282 Proposed

Source: OECD/IEA Key World Statistics, (2008)



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In Summary, Nuclear Power

- Globally, 2 to 3 billion tonnes of CO₂ per year are avoided by nuclear generation
- In Canada, the use of CANDU reactors has avoided 1.4 billion tonnes of emissions since 1972



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