



Canadian  
Electricity  
Association

Association  
canadienne  
de l'électricité



# Canada's Electricity Industry



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# The Canadian Electricity Association (CEA)

- Founded in 1891, the Canadian Electricity Association is the national forum and voice of the evolving electricity business in Canada.
- Mission Statement: A safe, secure, reliable, sustainable and competitively-priced supply of electricity is essential to Canada's prosperity.





# CEA's Corporate Utility Members



# CEA Corporate Partners Program Membership





## CEA MISSION STATEMENT

A safe, secure, reliable, sustainable and competitively priced supply of electricity is essential to Canada's prosperity. CEA is the voice of the Canadian electricity industry, promoting electricity as the critical enabler of the economy and Canadians' expectations for an enhanced quality of life.



# CEA Strategic Goals

**Infrastructure** – Ability to build needed electricity infrastructure, to meet growing demand and replace aging assets.

**Energy Efficiency** – Ability to provide options to customers to assist them in using electricity more efficiently, manage costs and minimize environmental impacts.

**Technology** – Ability to maximize and deploy leading-edge technologies.

**Regulation** – Need for more coordinated, effective and efficient regulatory regimes within and between governments, and more timely decisions.

**Environment** – Need for holistic approach and greater regulatory coherence on environmental issues.

**Security** – Need to ensure the long-term security, reliability and stability of the electricity system.

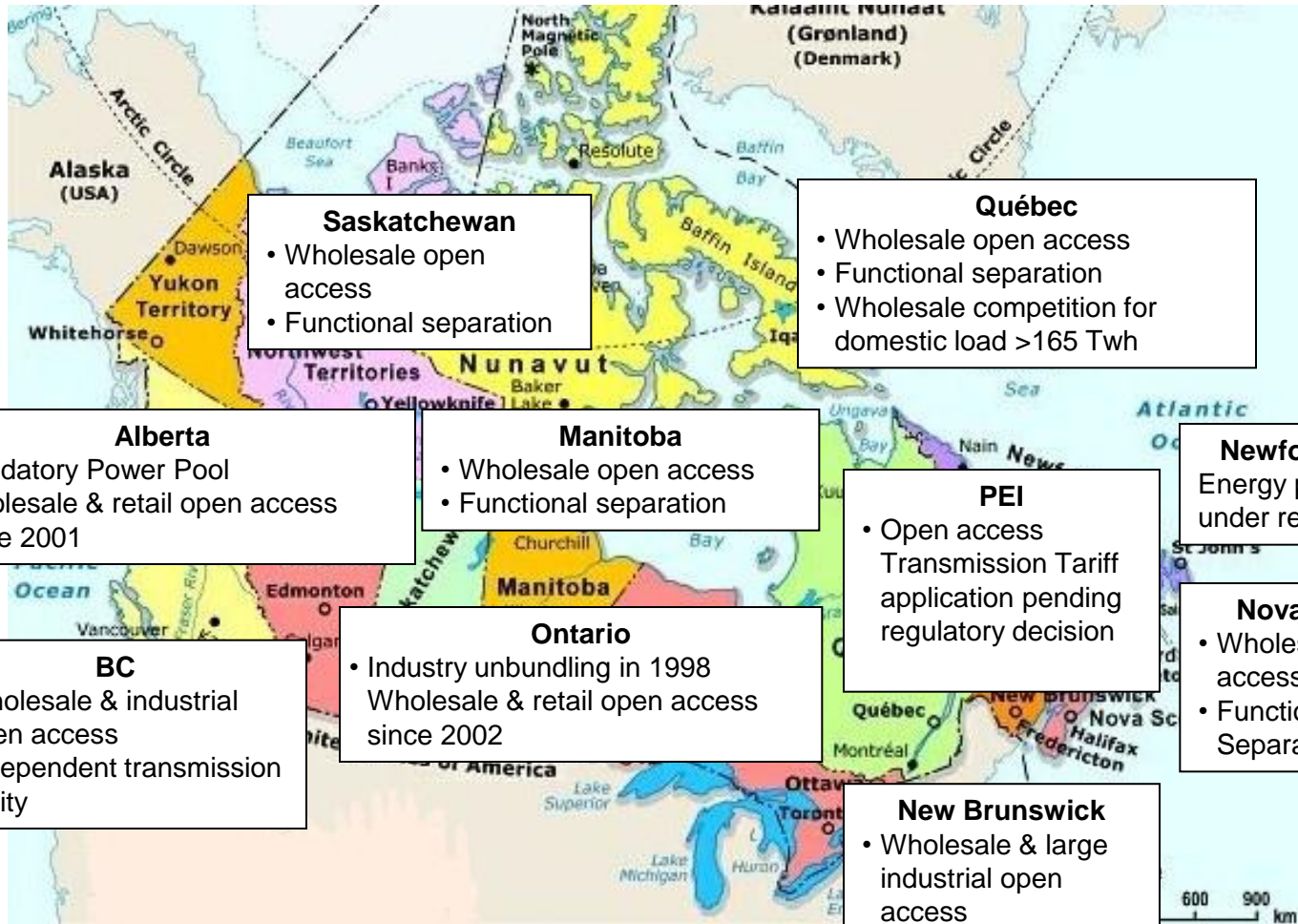


# Canada`s Multi-Jurisdictional Environment

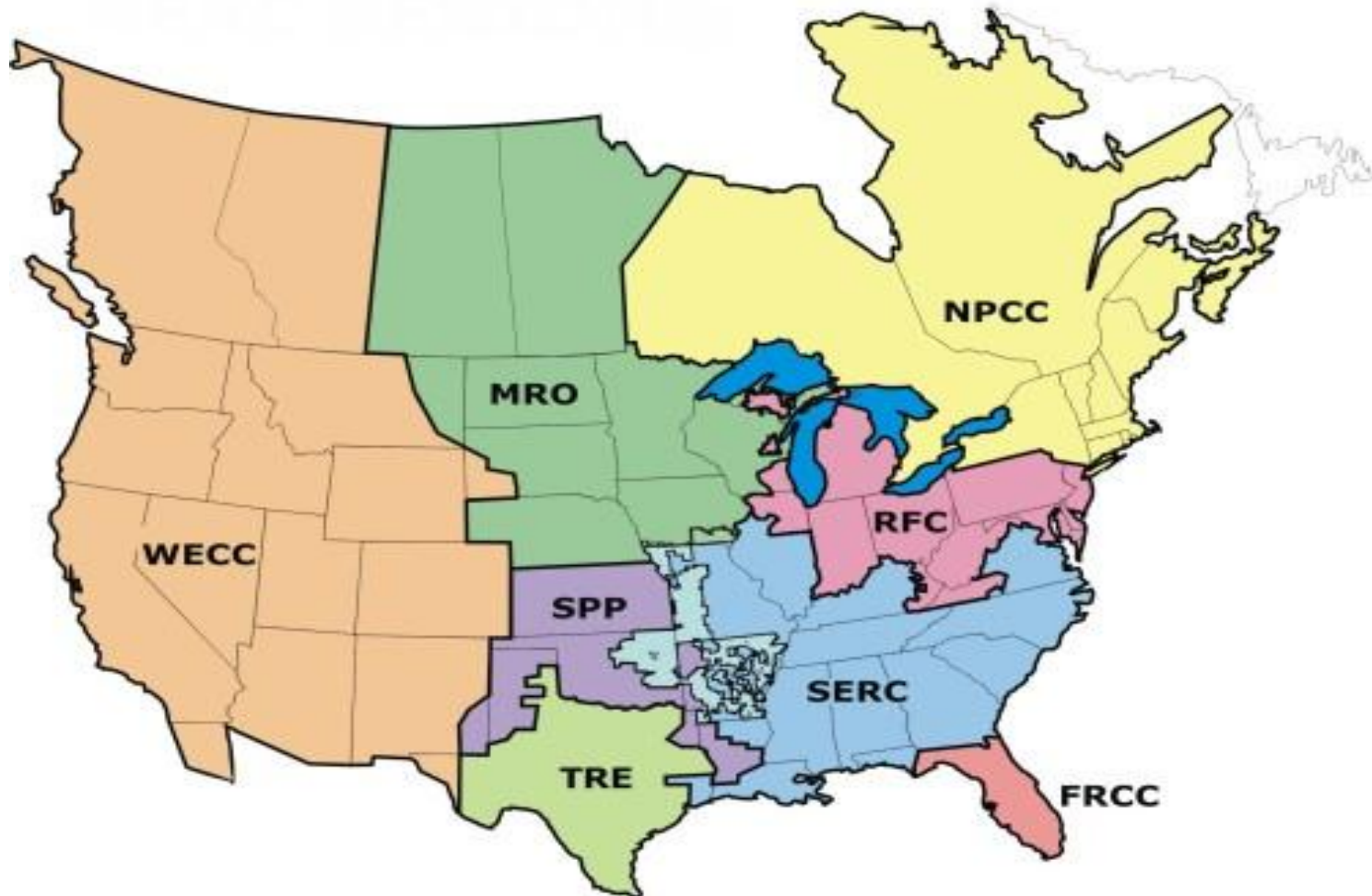
Jurisdictional Division of Responsibility	
Provincial/Territorial Governments	Federal Government
<ul style="list-style-type: none"> <li>▪ Resource management within provincial boundaries</li> <li>▪ Intra-provincial trade and commerce</li> <li>▪ Intra-provincial environmental impacts</li> <li>▪ Generation and transmission of electrical energy</li> <li>▪ Conservation and demand response policies</li> </ul>	<ul style="list-style-type: none"> <li>▪ Resource management on frontier lands</li> <li>▪ Nuclear safety</li> <li>▪ Inter-provincial and international trade</li> <li>▪ Trans-boundary environmental impacts</li> <li>▪ Environmental impacts where federal lands, investment or powers apply</li> <li>▪ Codes, standards and labeling relating to conservation and demand</li> <li>▪ Other policies of national interest</li> </ul>



# Canada's Market Structure

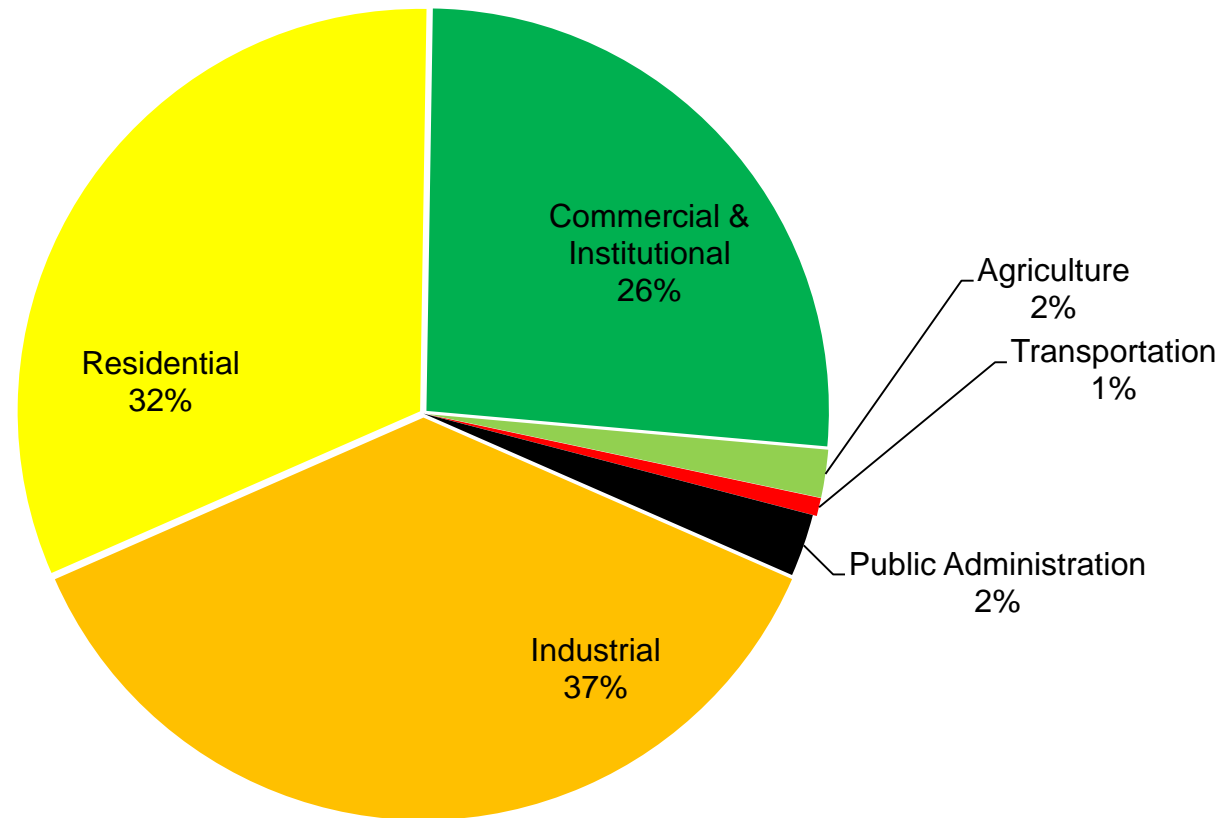


# North American Electric Reliability Corporation (NERC) Regions



# Electricity Demand in Canada by Sector, 2009

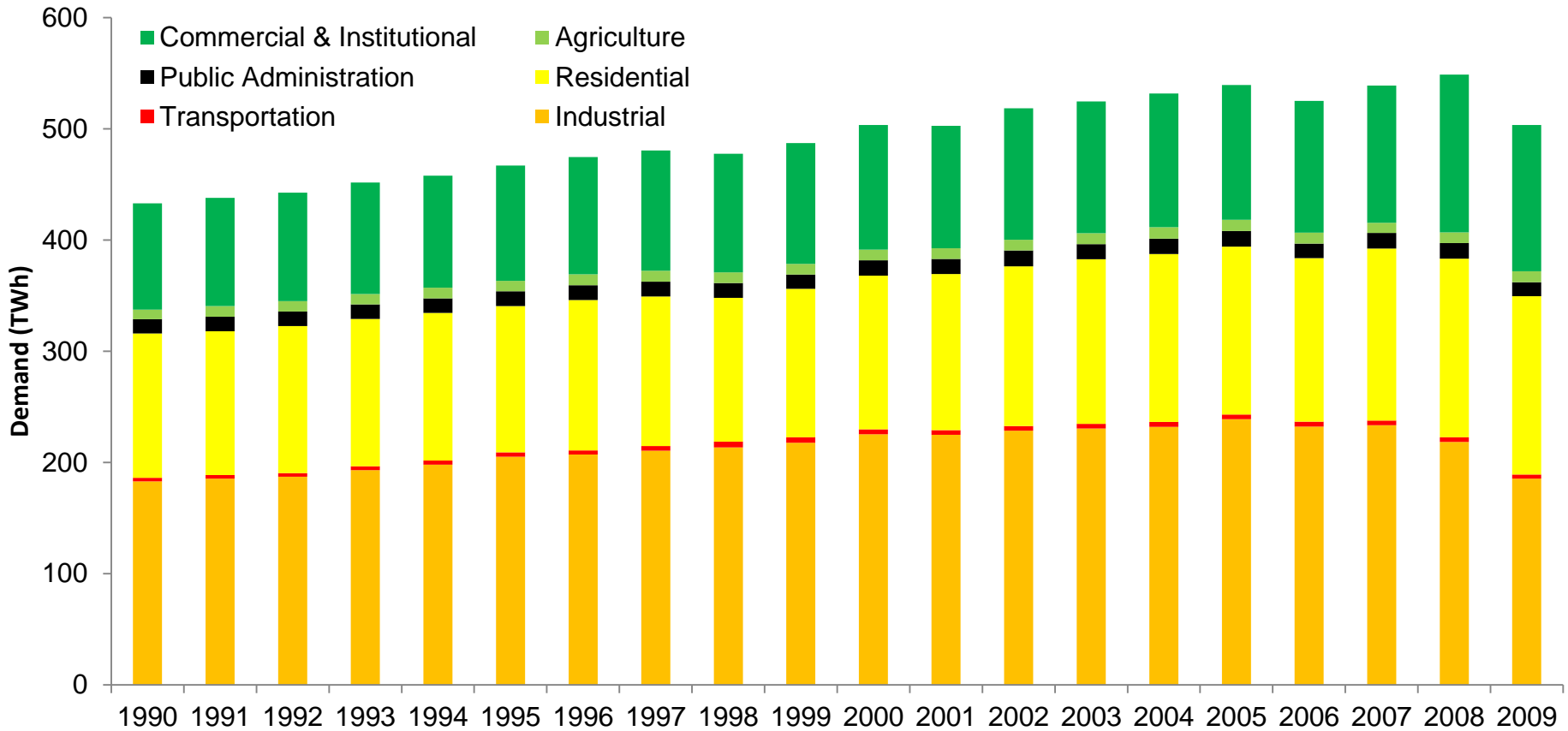
Total Electricity Demand in Canada, 2009 = 503.4 TWh



\*Numbers may not sum to 100 percent due to rounding  
Source: Statistics Canada, *Energy Statistics Handbook*, Q4:2009

# Electricity Demand in Canada by Sector, 1990 - 2009

Total Electricity Demand in Canada, 2009 = 503.4 TWh

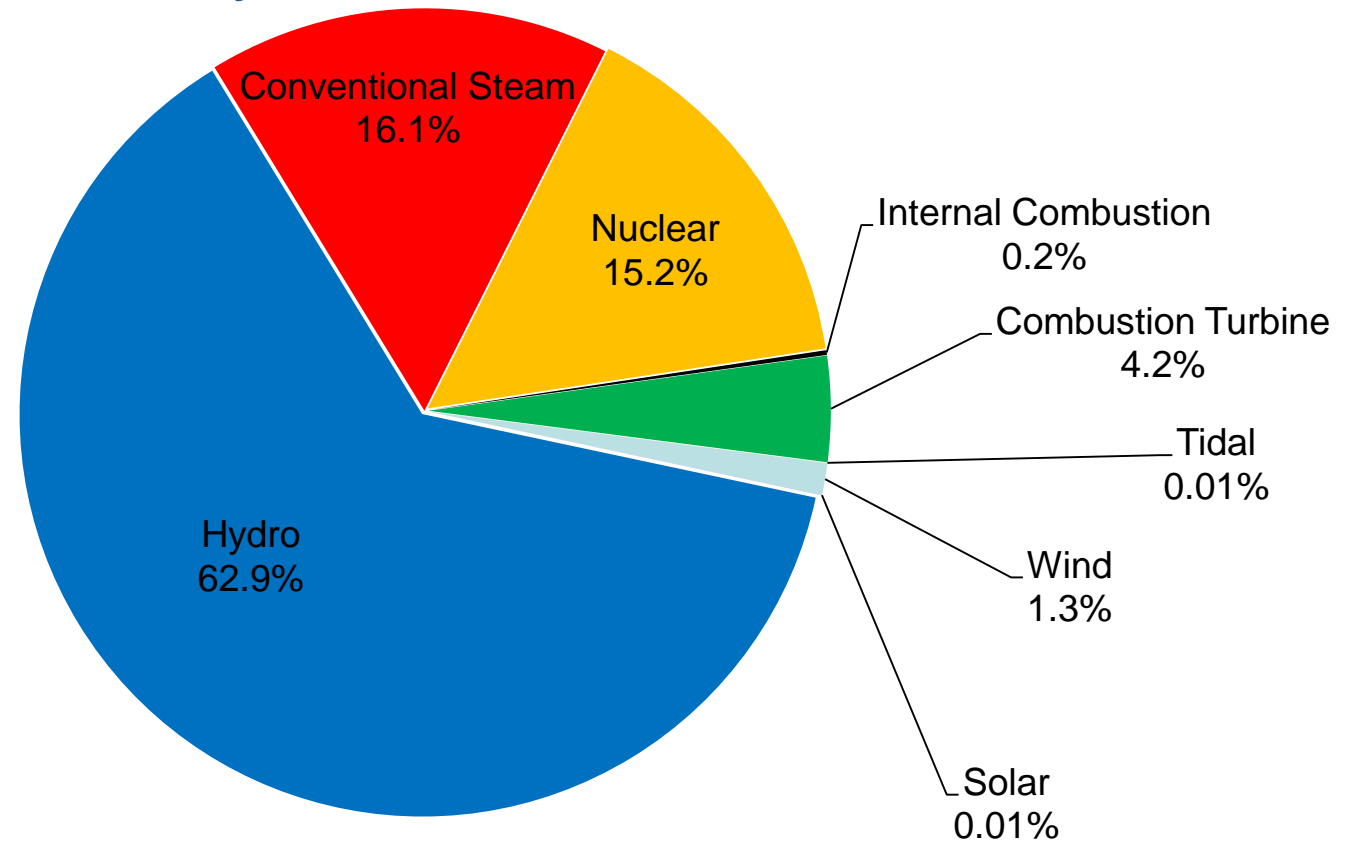


Source: Statistics Canada, *Energy Statistics Handbook*, Q4:2009



# Electricity Generation in Canada by Fuel Type, 2011

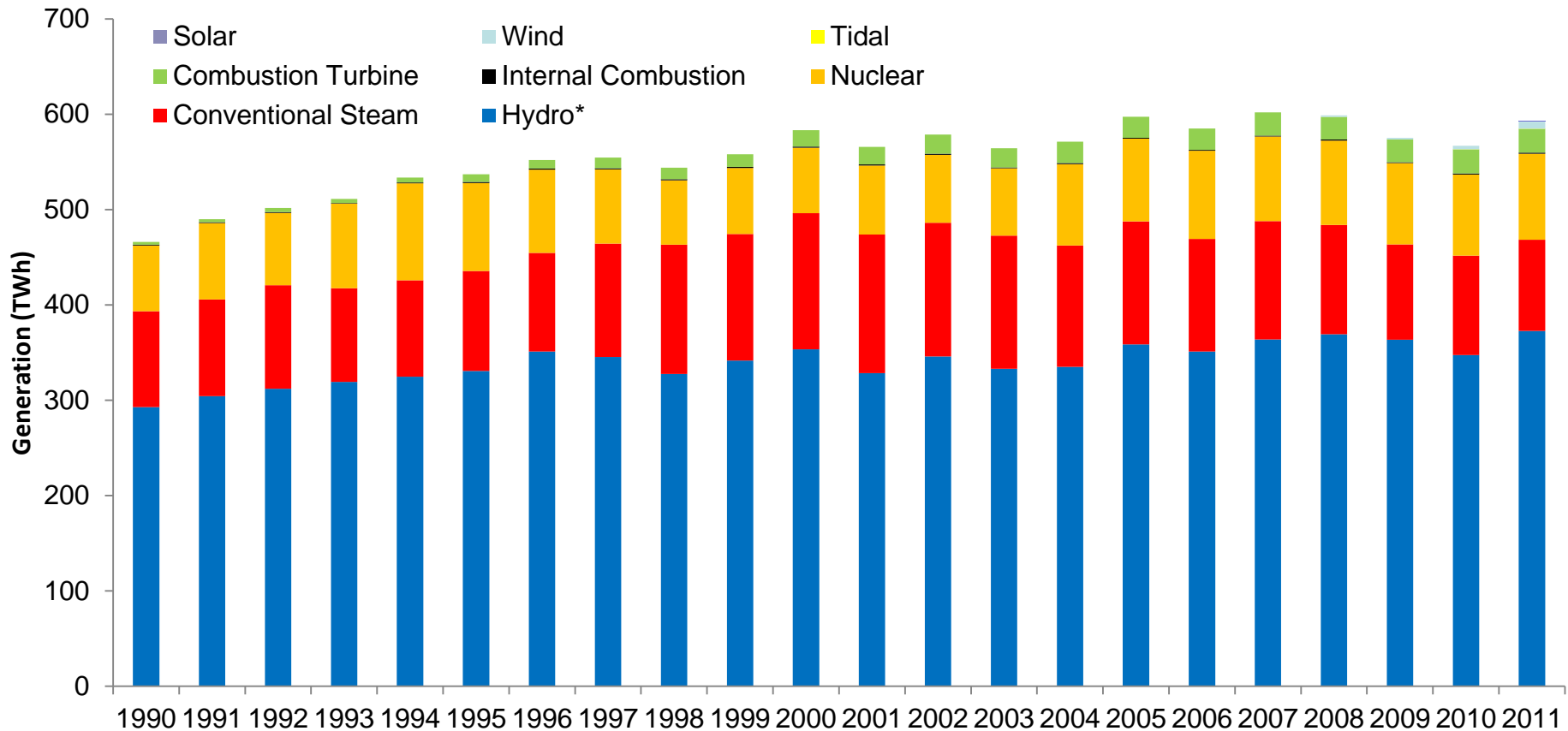
Total Electricity Demand in Canada, 2011 = 592.3 TWh



\*Numbers may not sum to 100 percent due to rounding.  
Source: Statistics Canada, *Survey 2151*, 2011  
Retrieved March 21, 2012

# Electricity Generation in Canada by Fuel Type, 1990 - 2011

Total Electricity Demand in Canada, 2011 = 592.3 TWh



\*Prior to 2008, wind and tidal generation are included in hydro.

Source: Statistics Canada, Survey 2151, 2011

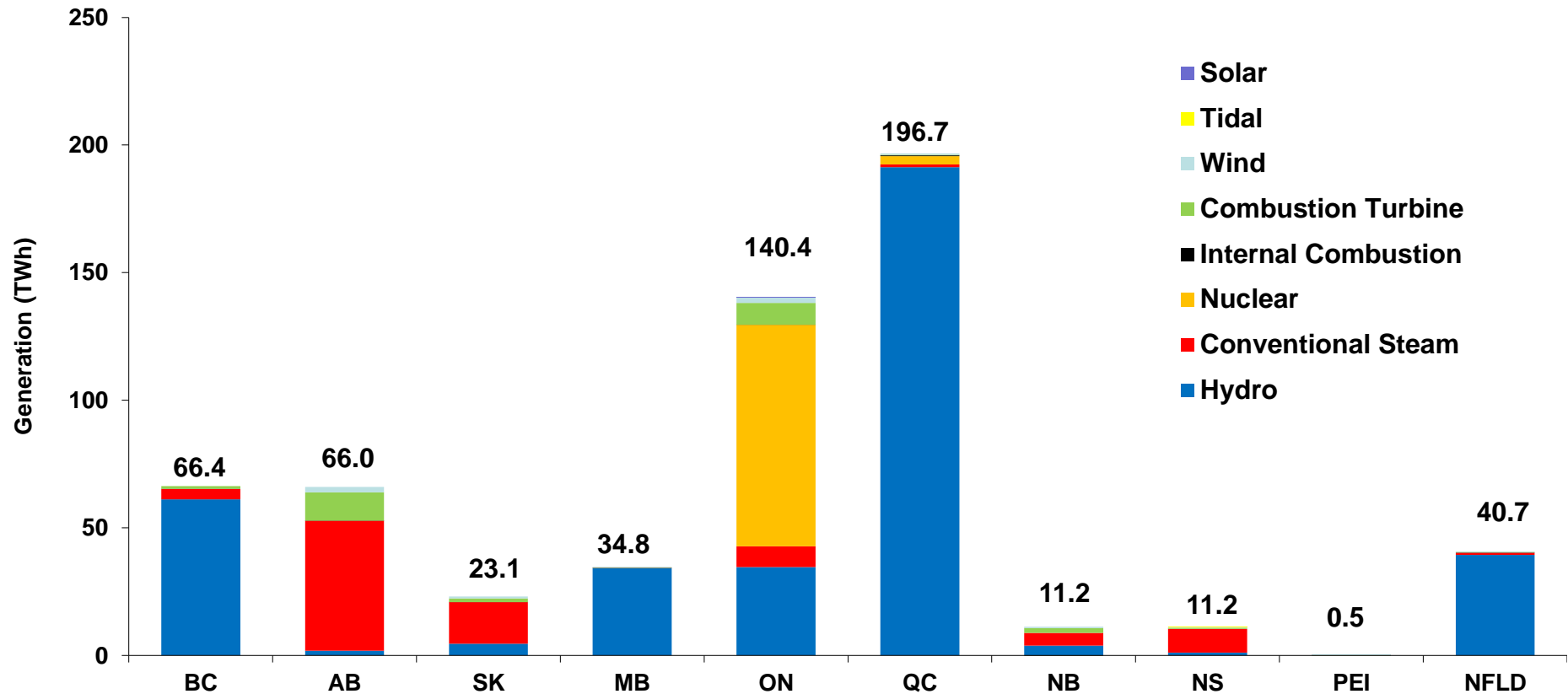
Retrieved March 21, 2012





# Electricity Generation in Canada by Province and Fuel Type, 2011

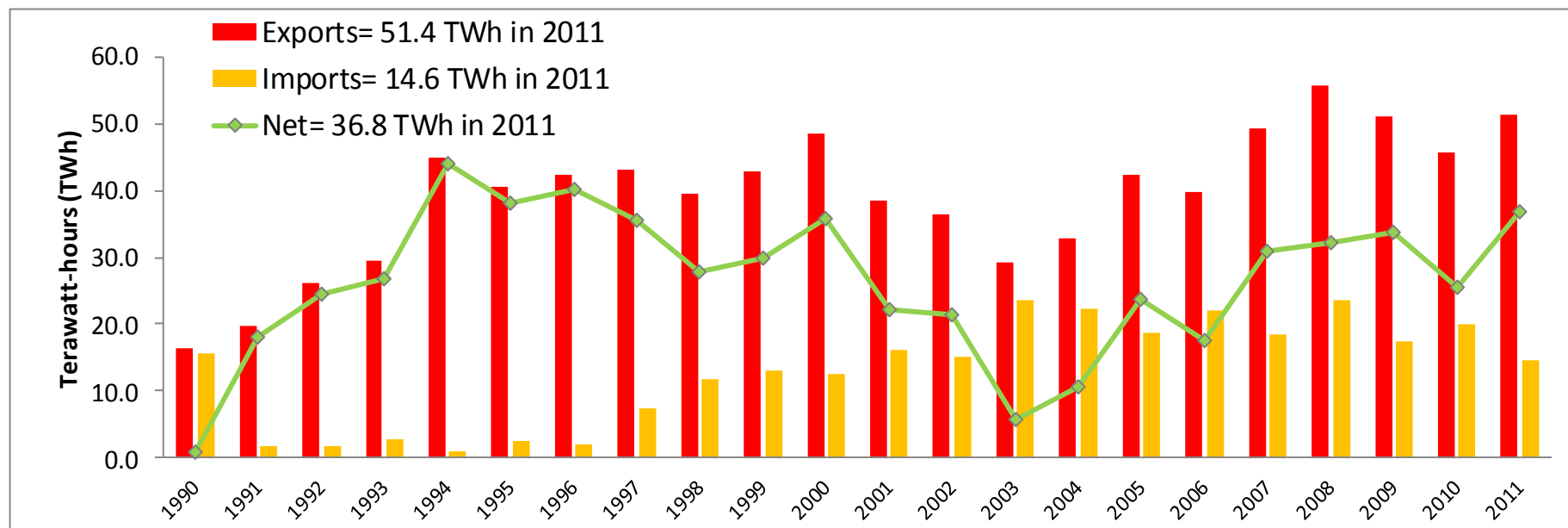
Total Electricity Demand in Canada, 2011 = 592.3 TWh



Source: Statistics Canada, Survey 2151, 2011. Retrieved March 21, 2012



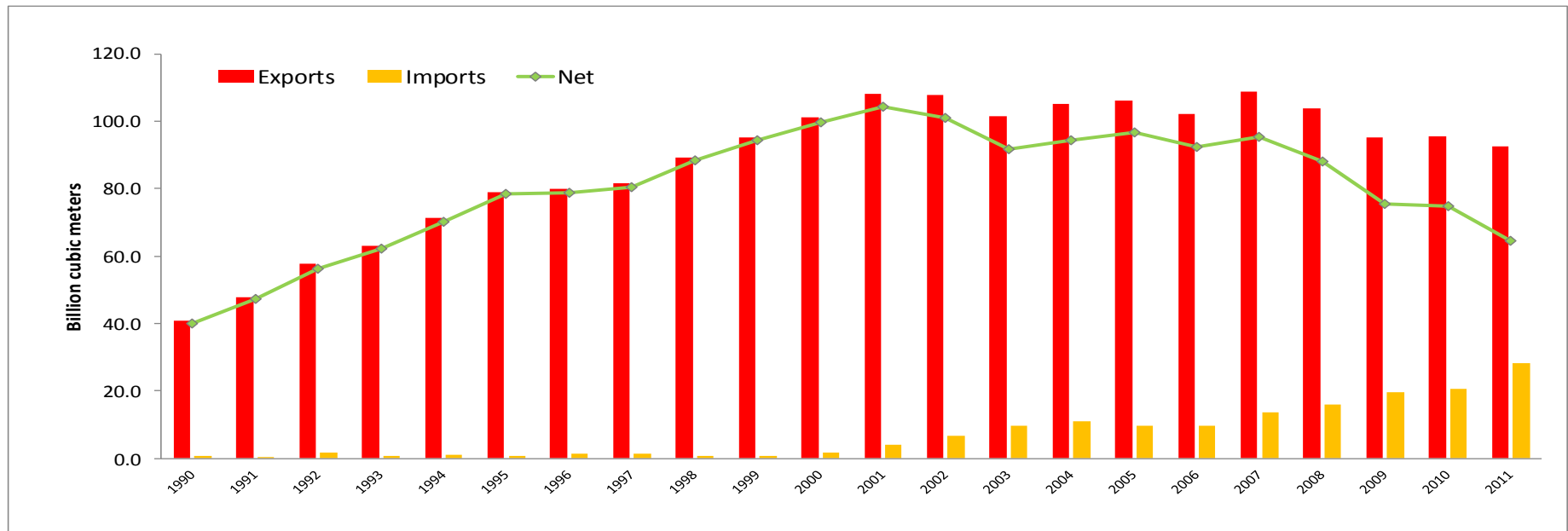
# Canada-U.S. Electricity Trade Volume, 1990 – 2011



Source: National Energy Board, *Electricity Exports and Imports, 2011*.  
Retrieved February 21, 2012



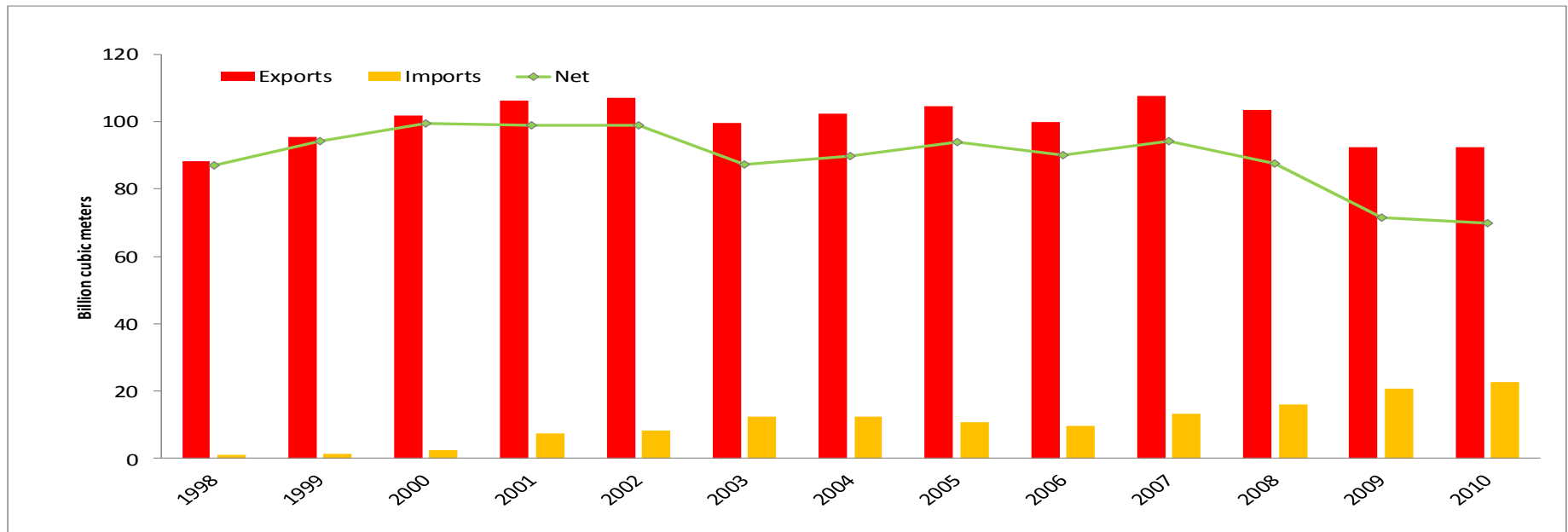
# Canada-U.S. Natural Gas Trade Volume, 1990 – 2011



Source: Statistics Canada, Natural Gas Exports and Imports, 2011  
Retrieved June 14, 2012



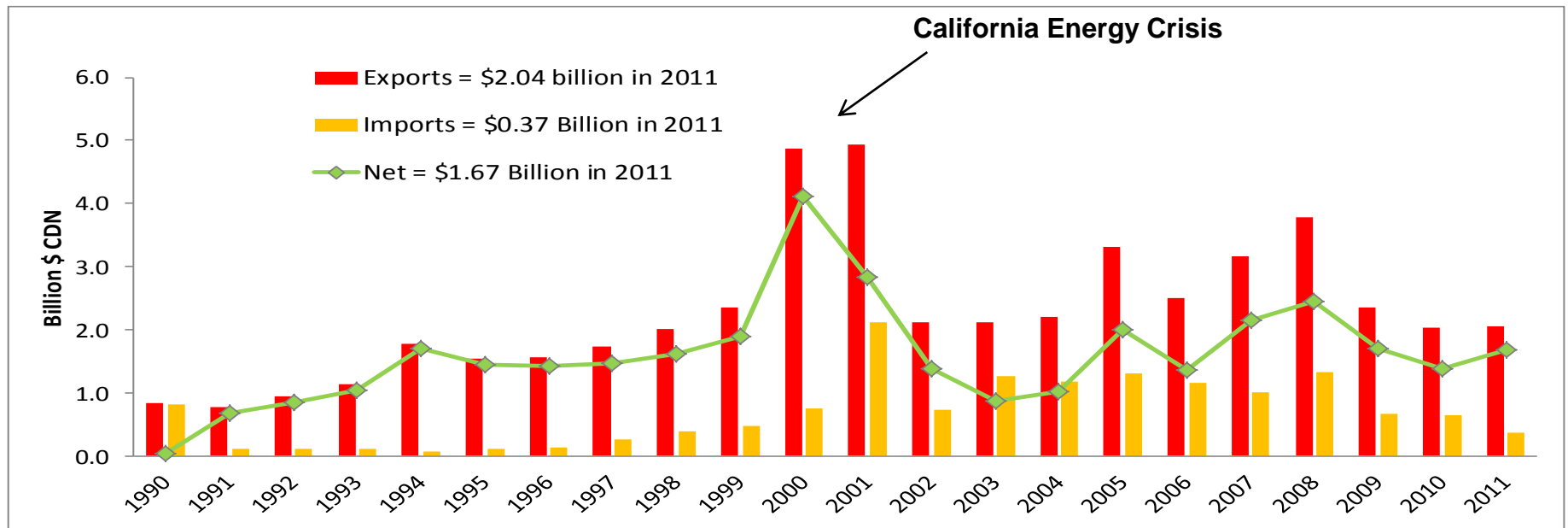
# Canada-U.S. Natural Gas Trade Volume, 1998 – 2010



Source: National Energy Board, 2010  
Retrieved June 19, 2012



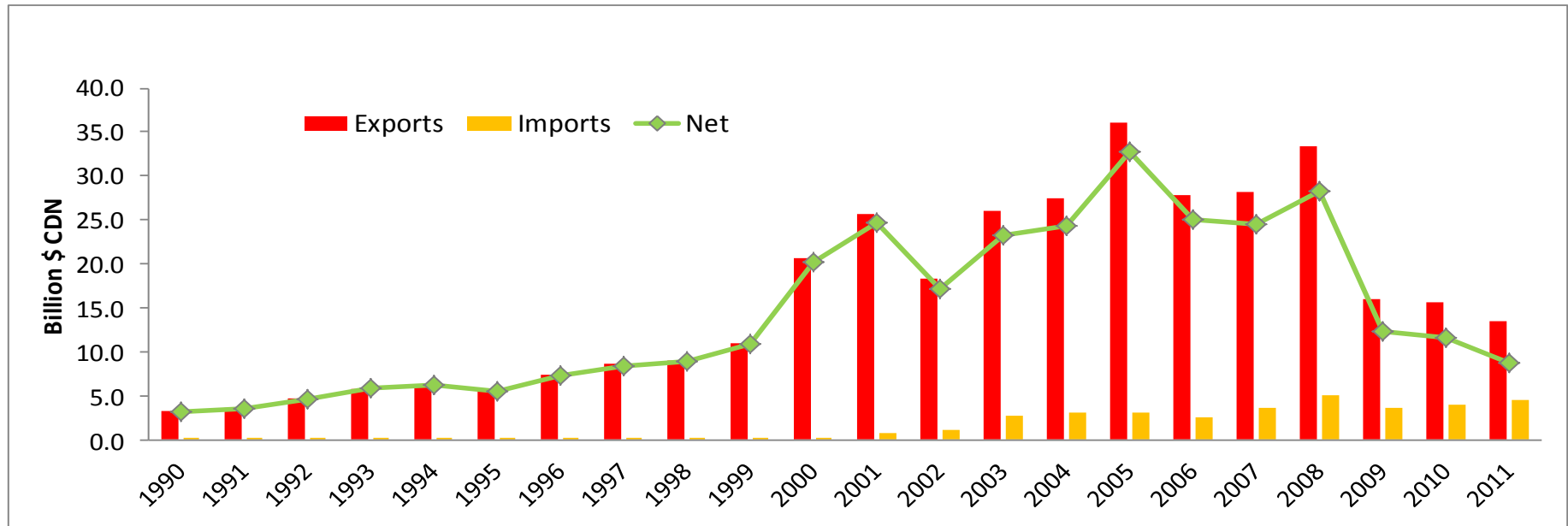
# Canada-U.S. Electricity Trade Revenue, 1990 – 2011



California Energy Crisis of 2000 and 2001 was the situation when California had a shortage of electricity  
 Source: National Energy Board, *Electricity Exports and Imports, 2011* Retrieved February 21, 2012



# Canada-U.S. Natural Gas Trade Revenue, 1990 – 2011

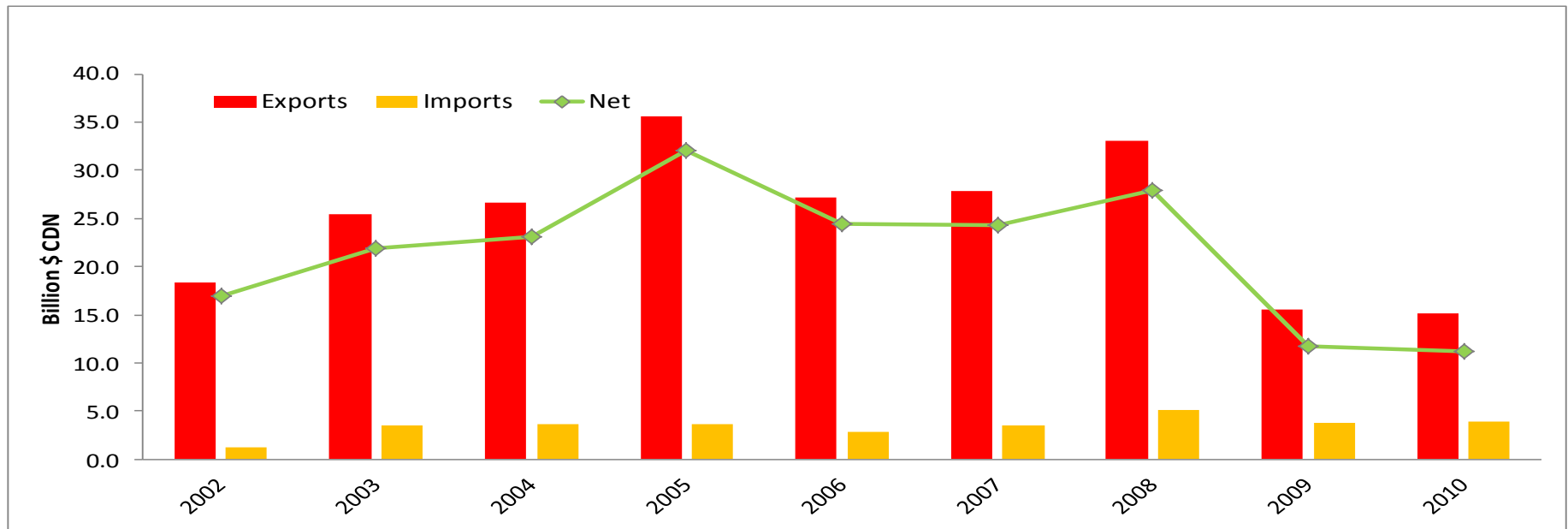


Source: Statistics Canada, Natural Gas Exports and Imports, 2011  
Retrieved June 14, 2012





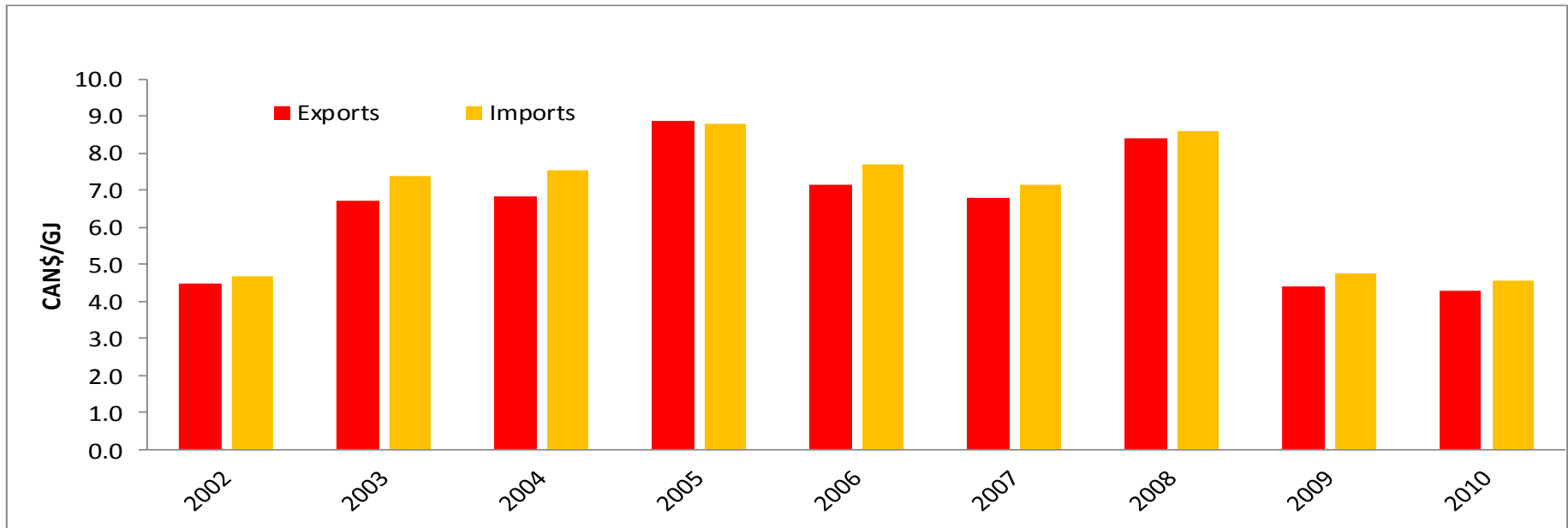
# Canada-U.S. Natural Gas Trade Revenue, 2002 – 2010



Source: National Energy Board, Natural Gas Exports and Imports, 2010  
Retrieved June 19, 2012



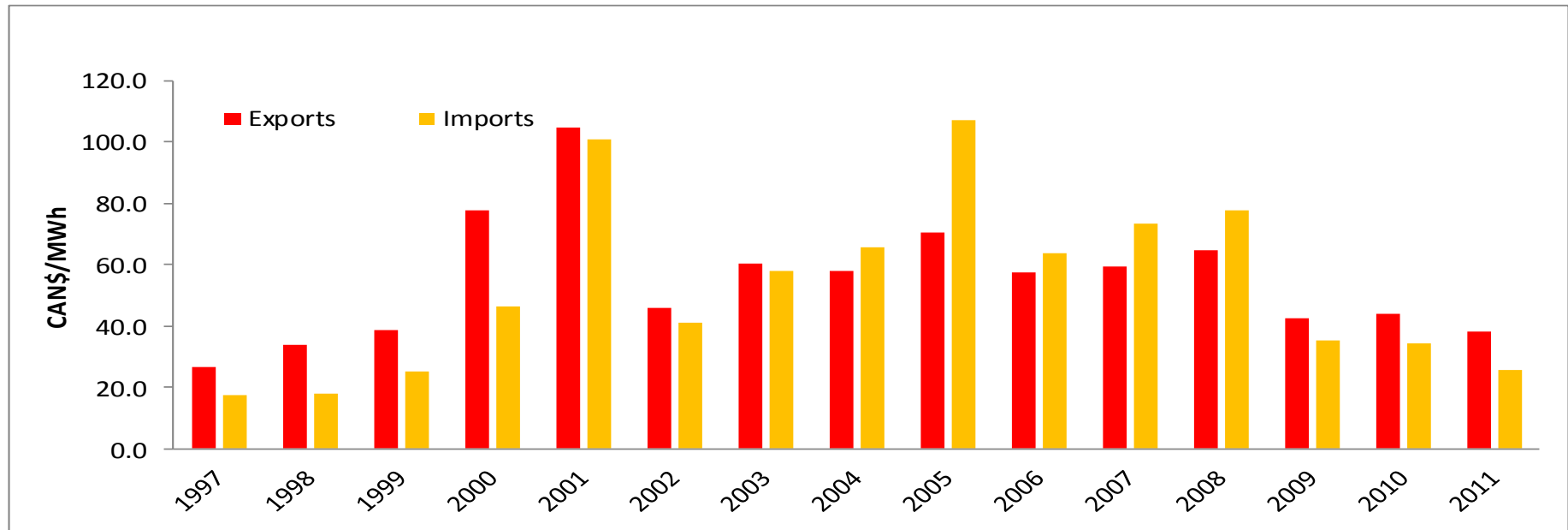
# Canada-U.S. Natural Gas Export/Import Prices, 2002 – 2010



Source: National Energy Board, 2010  
Retrieved June 15, 2012



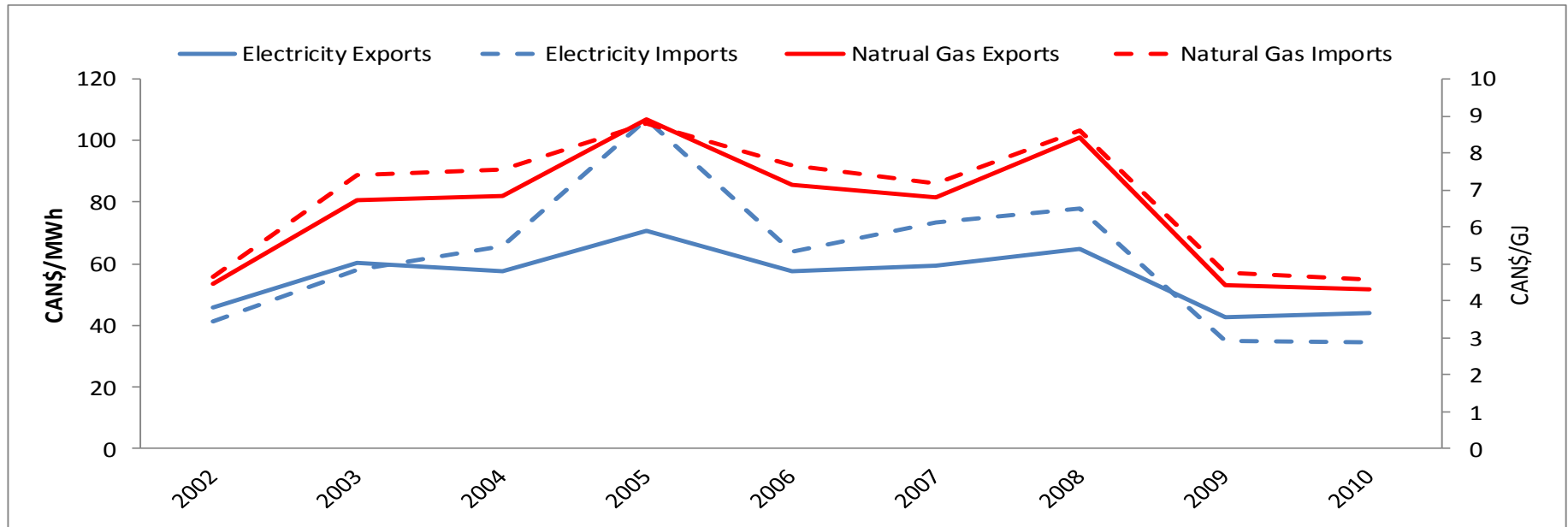
# Canada-U.S. Electricity Export/Import Prices, 1997 – 2011



Source: National Energy Board, 2011  
Retrieved June 15, 2012



# Canada-U.S. Natural Gas and Electricity Export/Import Price Comparison, 2002 – 2010



Source: National Energy Board, 2010  
Retrieved June 15, 2012

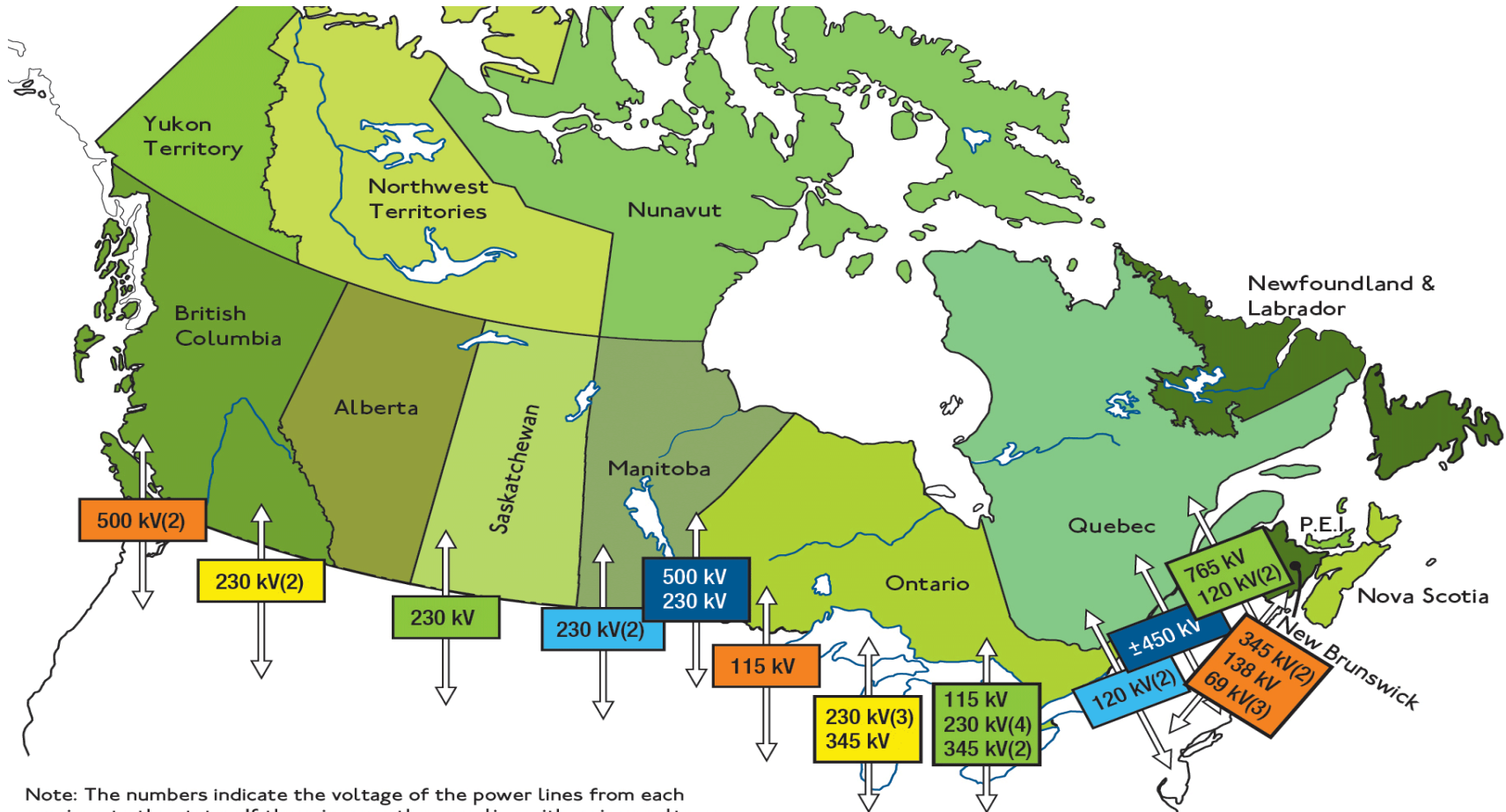


# Canada-U.S Electricity Trade – 2011 (GWh)



Source: National Energy Board – Electricity Imports and Exports

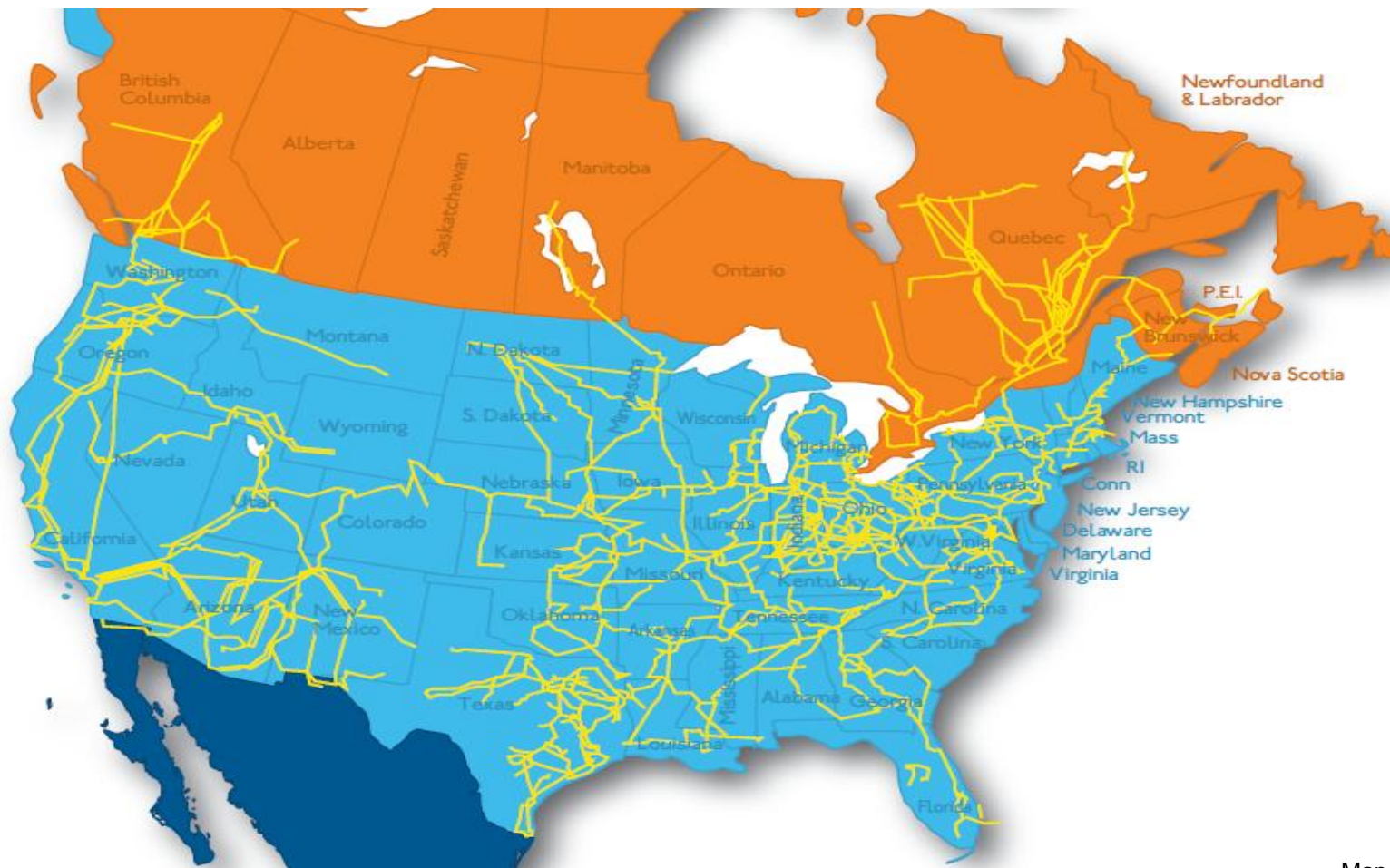
# Major Canada-U.S. Transmission Interconnections



Note: The numbers indicate the voltage of the power lines from each province to the states. If there is more than one line with a given voltage, the number of lines is indicated in parentheses.  
 Source: NEB, Canadian Electricity Association and Natural Resources Canada.

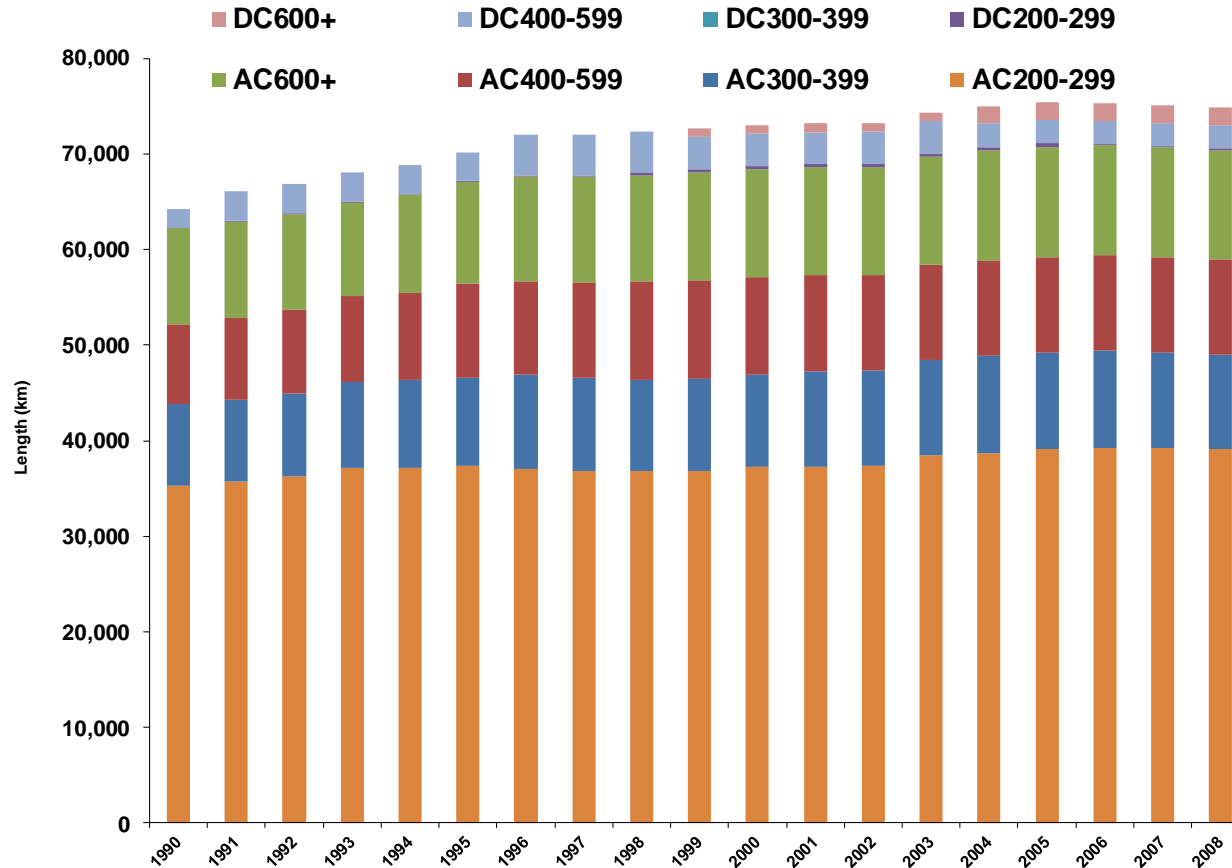


# Major Canada-U.S. Transmission Interconnections



Map copyright CEA.  
Lines shown are 345kV and above. There are numerous interconnections between Canada and the U.S. under 345KV that do not appear on this map.

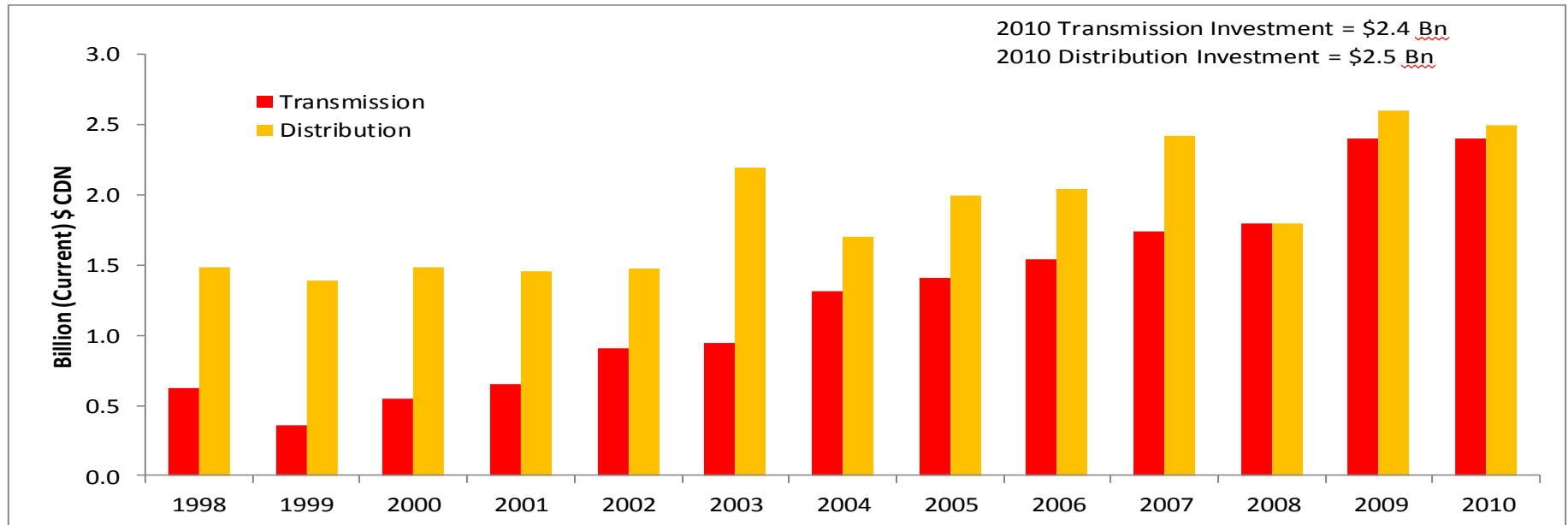
# Transmission Lines In Canada Length by Voltage, 1990 – 2008



Source: North American Electric Reliability Council (NERC)



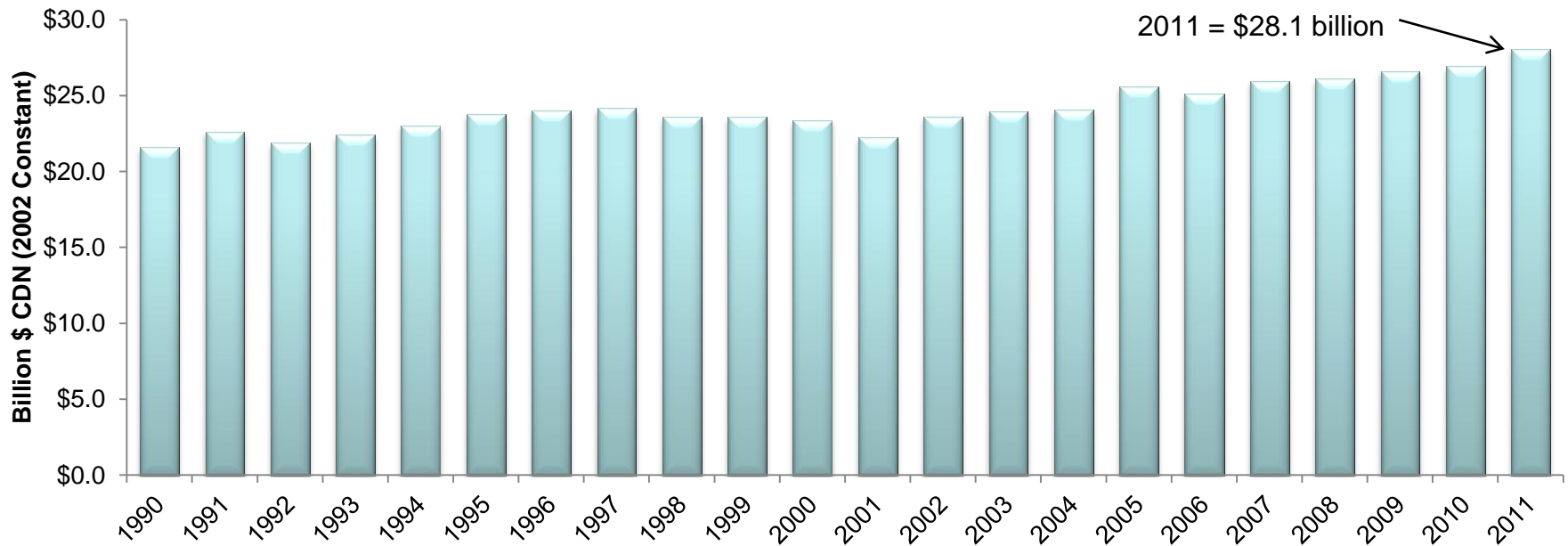
# Utility Investment in Canada's Transmission and Distribution Cable and Lines, 1998 – 2010



Source: Statistics Canada, *Survey 2803*, 2009  
 Source: CEA member reporting data for years 2008-2010, based on 2010 Sustainable Electricity Annual Report  
 Note: Statistics Canada and CEA member data combined



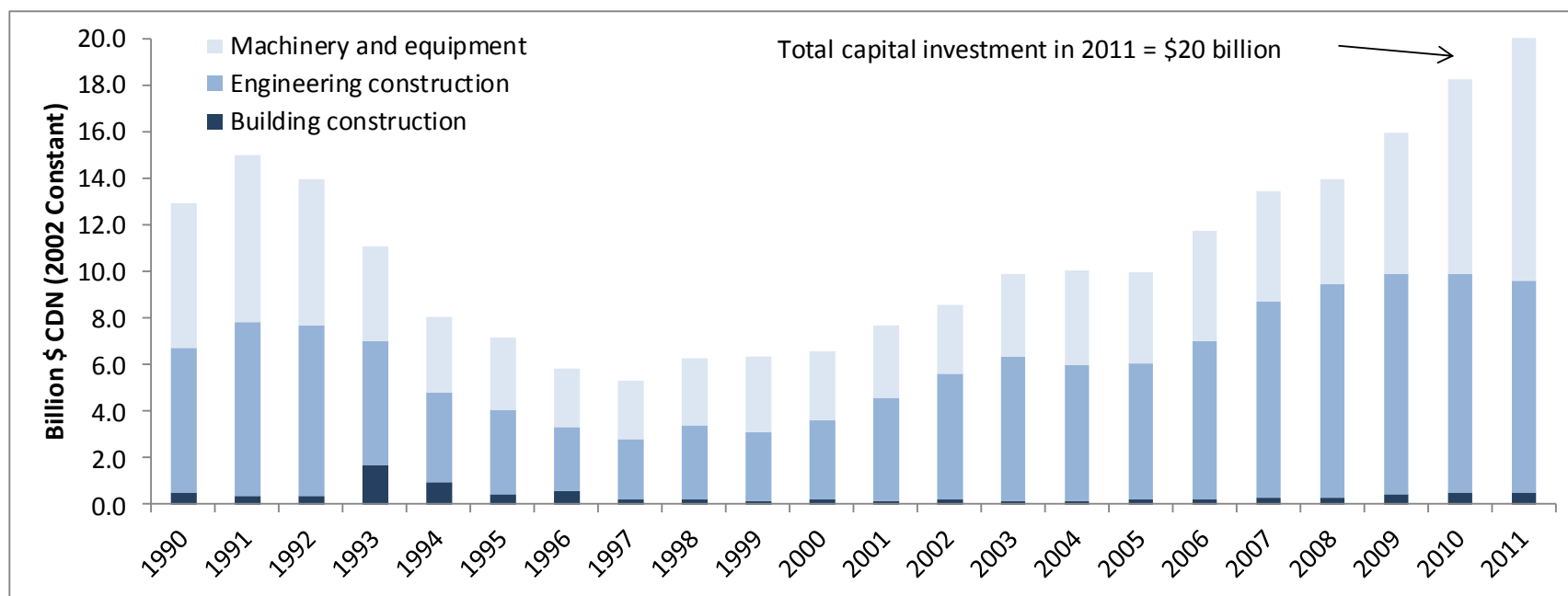
## Electric Power Generation, Transmission and Distribution Sector Contribution to Canada's GDP, 1990 – 2011 (billions of constant 2002 dollars)



Source: Statistics Canada, Survey 1301, 2011  
Retrieved March 2, 2012



## Capital Investment in Canada's Electric Power Sector, 1990 – 2011 (billions of constant 2002 dollars)

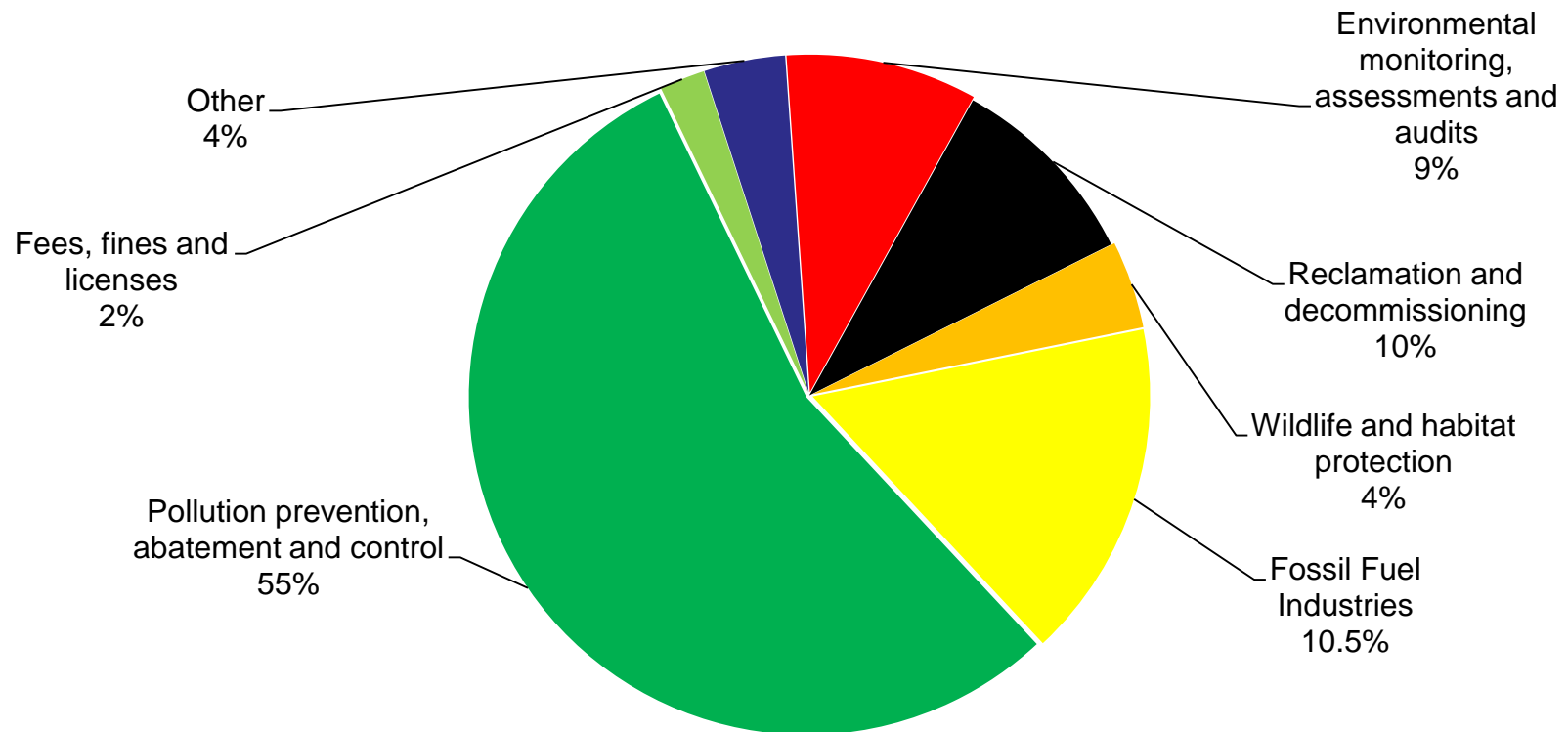


Source: Statistics Canada, *Survey 2820*, 2011  
Retrieved February 29, 2012



## Electric Sector Environmental Protection Expenditures by type, 2008

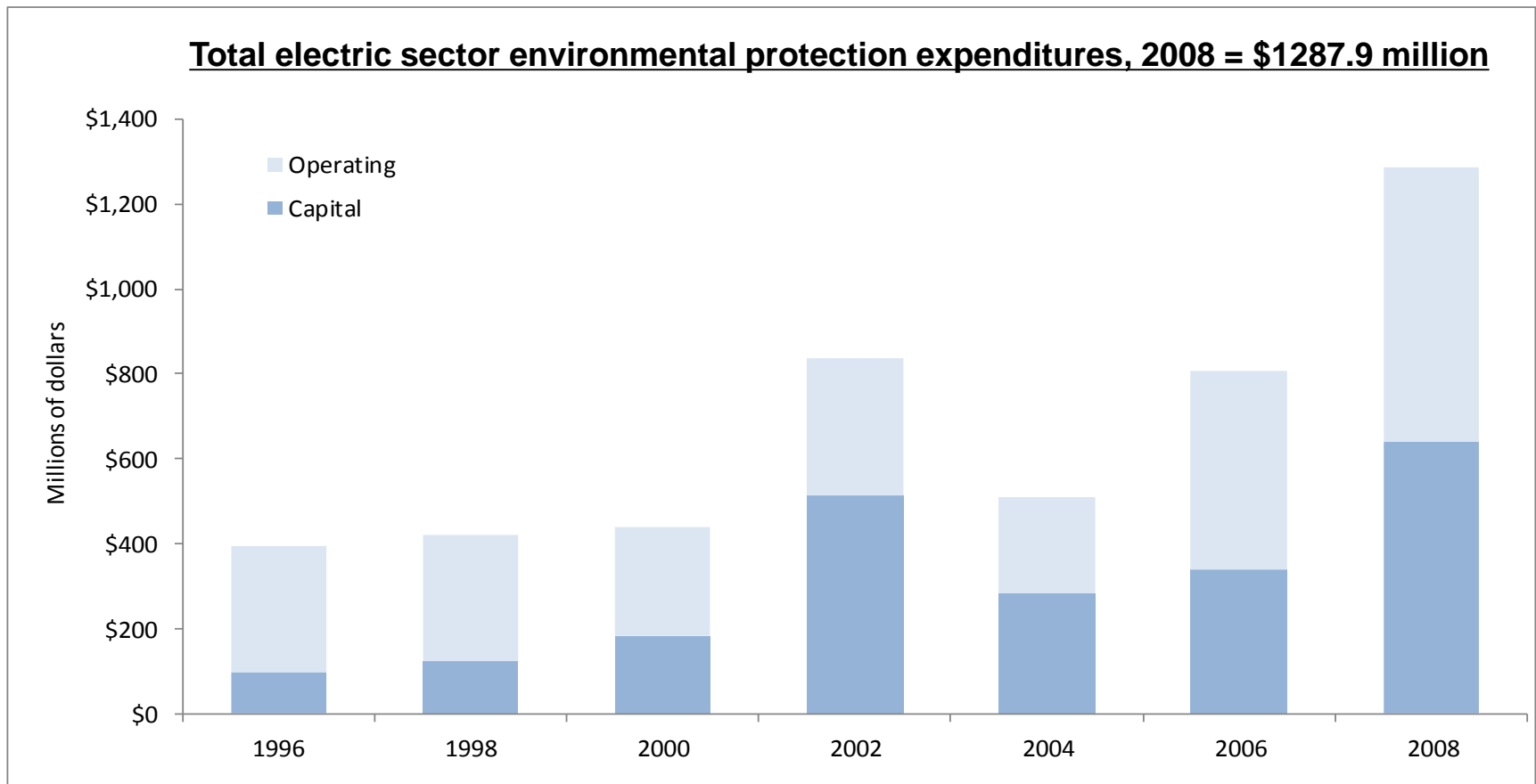
**Total electric sector environmental protection expenditures, 2008 = \$1287.9 million**



Source: Statistics Canada, *Environmental Protection Expenditures in the Business Sector, 2008*  
Retrieved February 16, 2012



## Environmental Protection Expenditures by the Electric Power Sector, 1996 – 2008

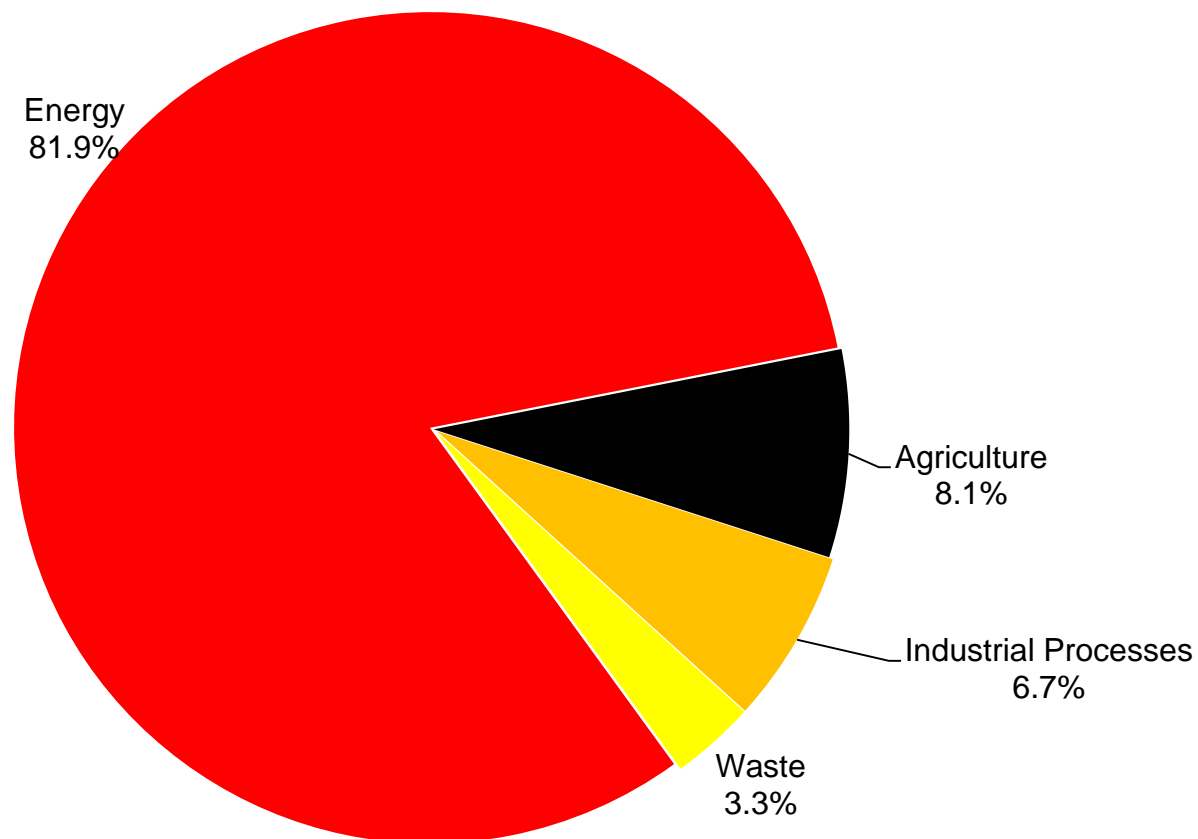


Source: Statistics Canada, *Environmental Protection Expenditures in the Business Sector*, 2008  
Retrieved February 16, 2012



## Greenhouse Gas (GHG) Emissions in Canada by Sector, 2009

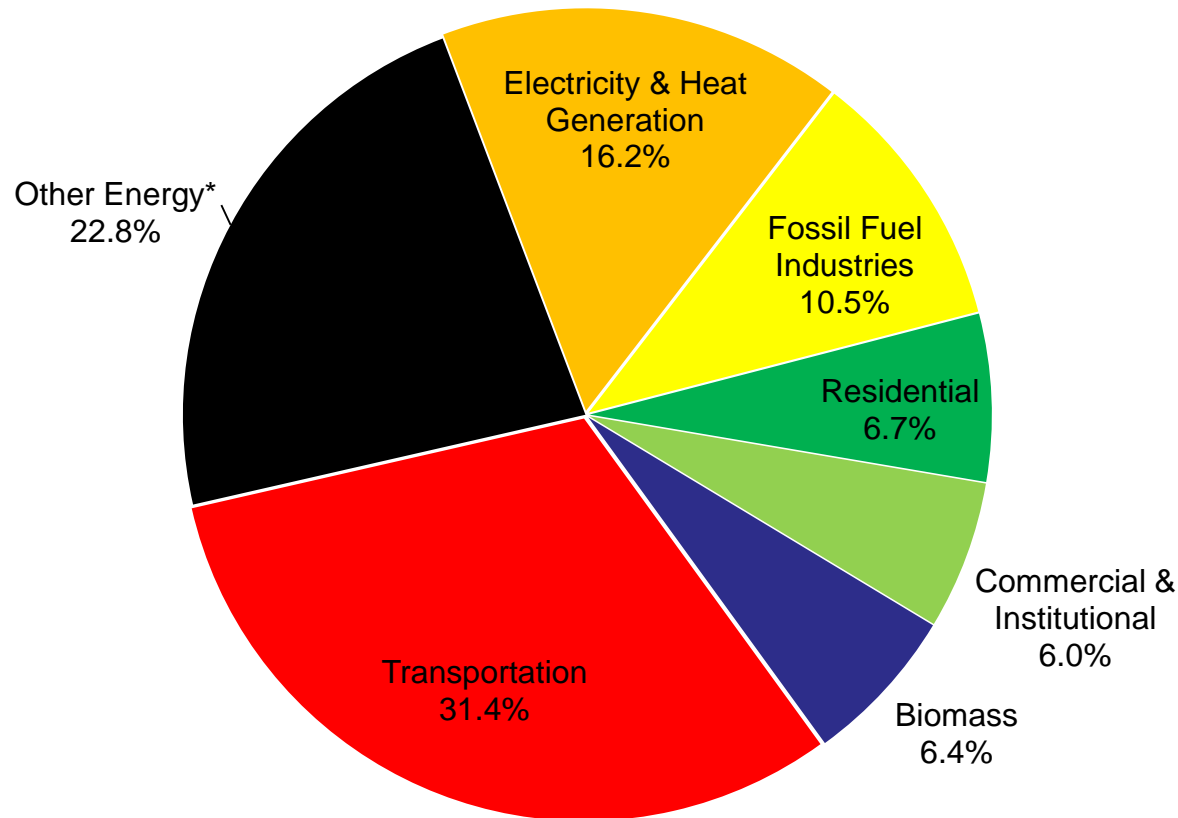
Total GHG Emissions in Canada, 2009 = 692 Megatonnes CO<sub>2</sub> Equivalent



Note: Emissions do not include the following sectors: land use change and forestry, solvent and other product use (negligible amounts) and biomass  
Source: UNFCCC, National Inventory Submission for Canada, for 2009,  
Report date: October 17, 2011

# Greenhouse Gas (GHG) Emissions in Canada for Energy Sector, 2009

**Total GHG Emissions in Canada, 2009 = 605 Megatonnes CO<sub>2</sub> Equivalent**



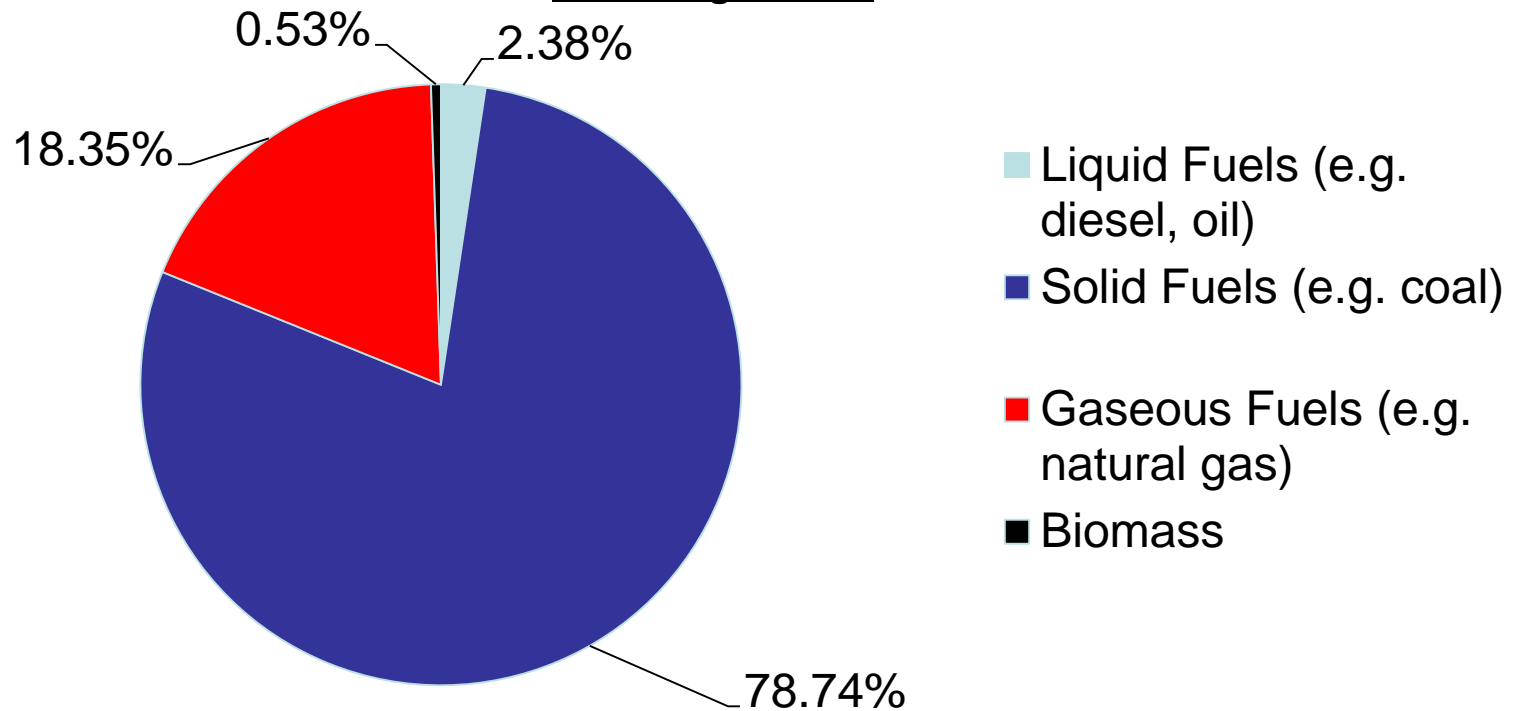
\*includes all the other energy sector emission sources, such as mining, manufacturing, and construction, fugitive sources and agriculture/forestry/fisheries

Note: Total energy emissions include emissions from biomass

Source: UNFCCC, National Inventory Submission for Canada, for 2009, Report dated October 17, 2011

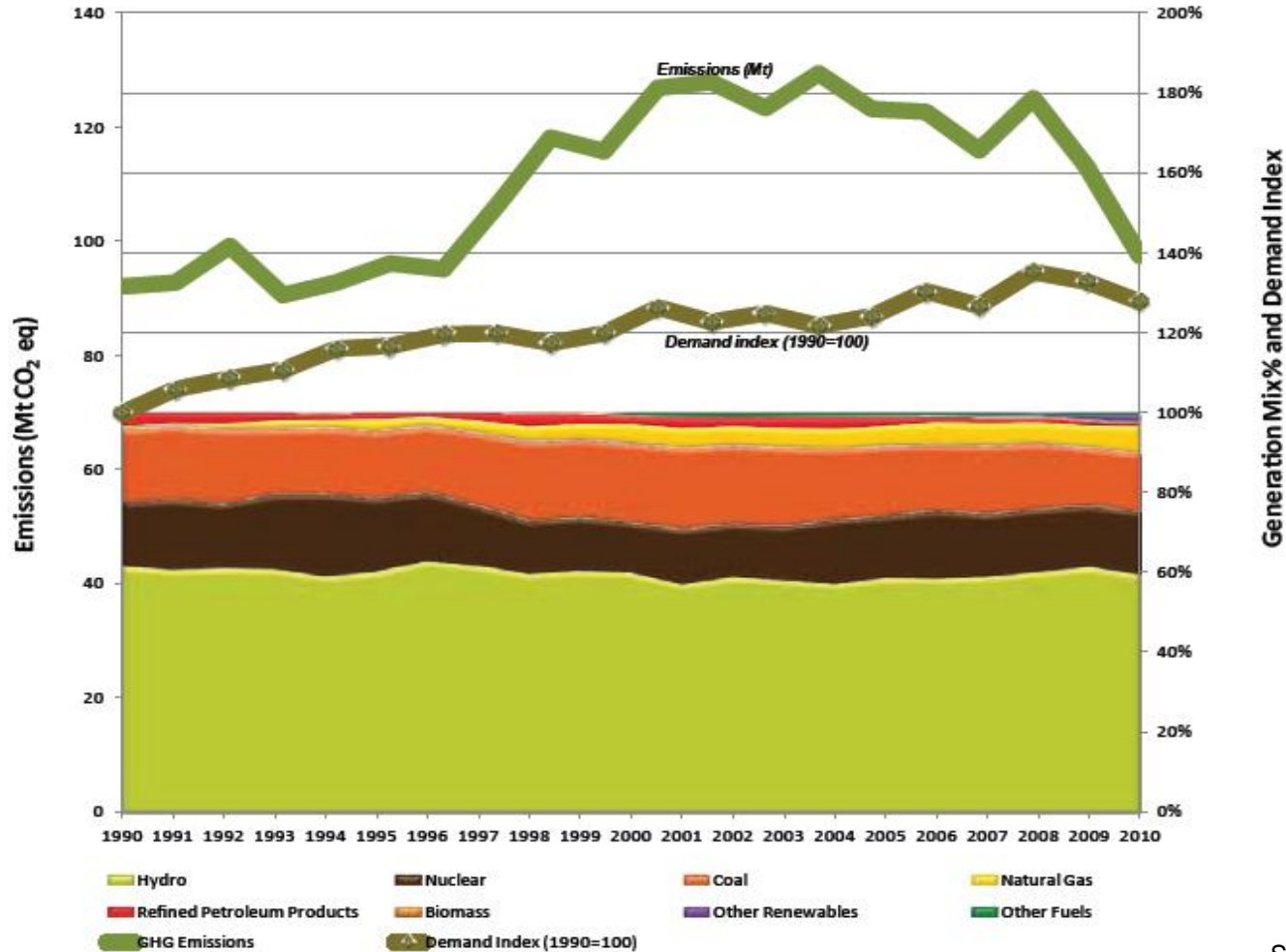
# CO<sub>2</sub> Emissions in Canada for Public Electricity and Heat Production Sector, 2010

**Total Public Electricity & Heat Sector CO<sub>2</sub> Emissions in Canada, 2010 = 100.5 Megatonnes**



Source: UNFCCC, National Inventory Submission for Canada, for 2010, Report dated April 11, 2012

# Utility-Generated Electricity by Source and GHG Emissions, 1990–2010



**Notes:**

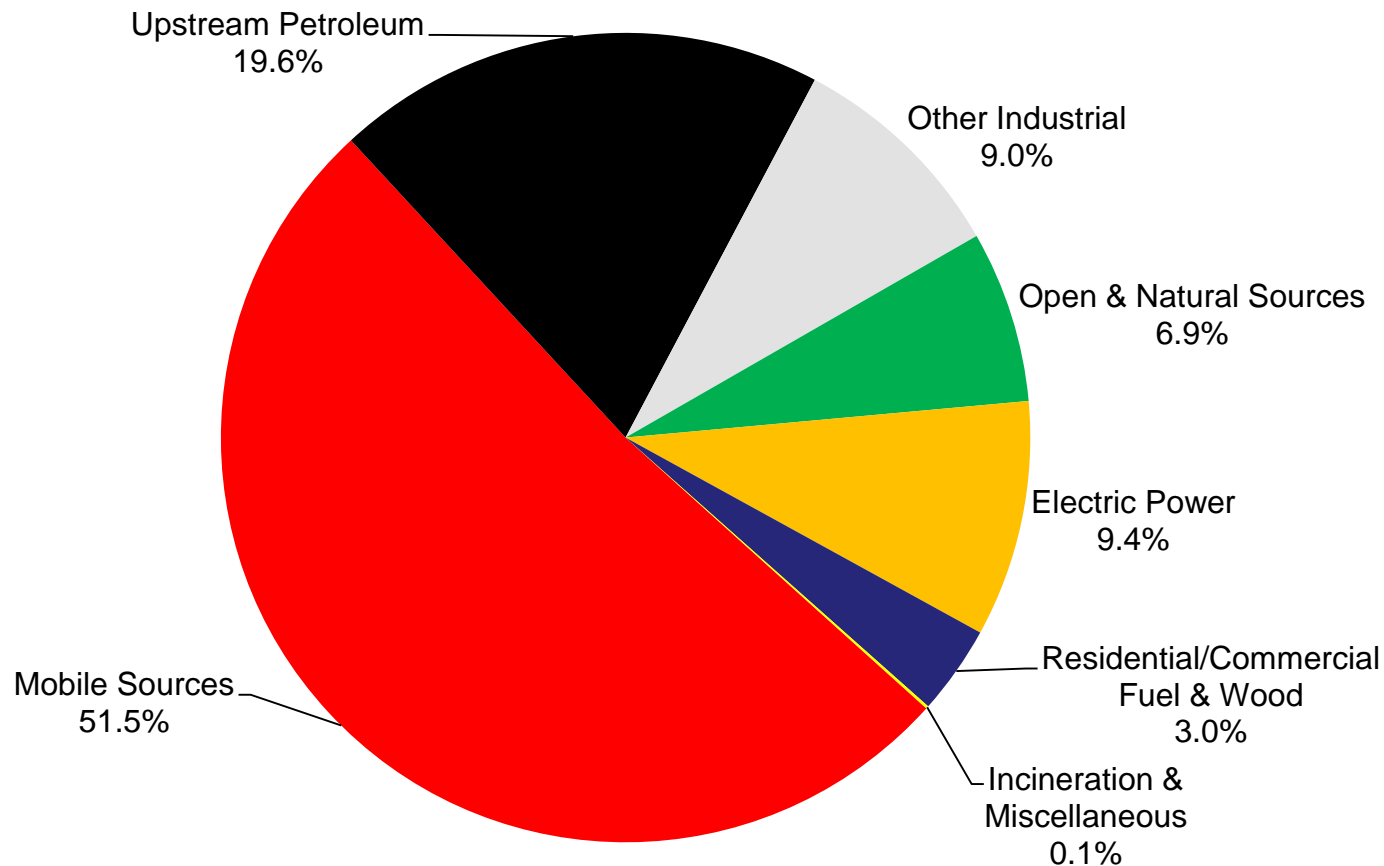
1. Generation statistics refer to utility-based generation only but contribute over 90% of the total supply.
2. Electricity emissions include only utility generation and do not include emissions associated with transmission.

Source: UNFCCC, National Inventory Report for Canada, for 2010, Report dated April 11, 2012



## Nitrogen Oxide (NO<sub>x</sub>) Emissions in Canada by Sources, 2010

**Total NO<sub>x</sub> Emissions in Canada, 2010 = 2,212 Kilotonnes**

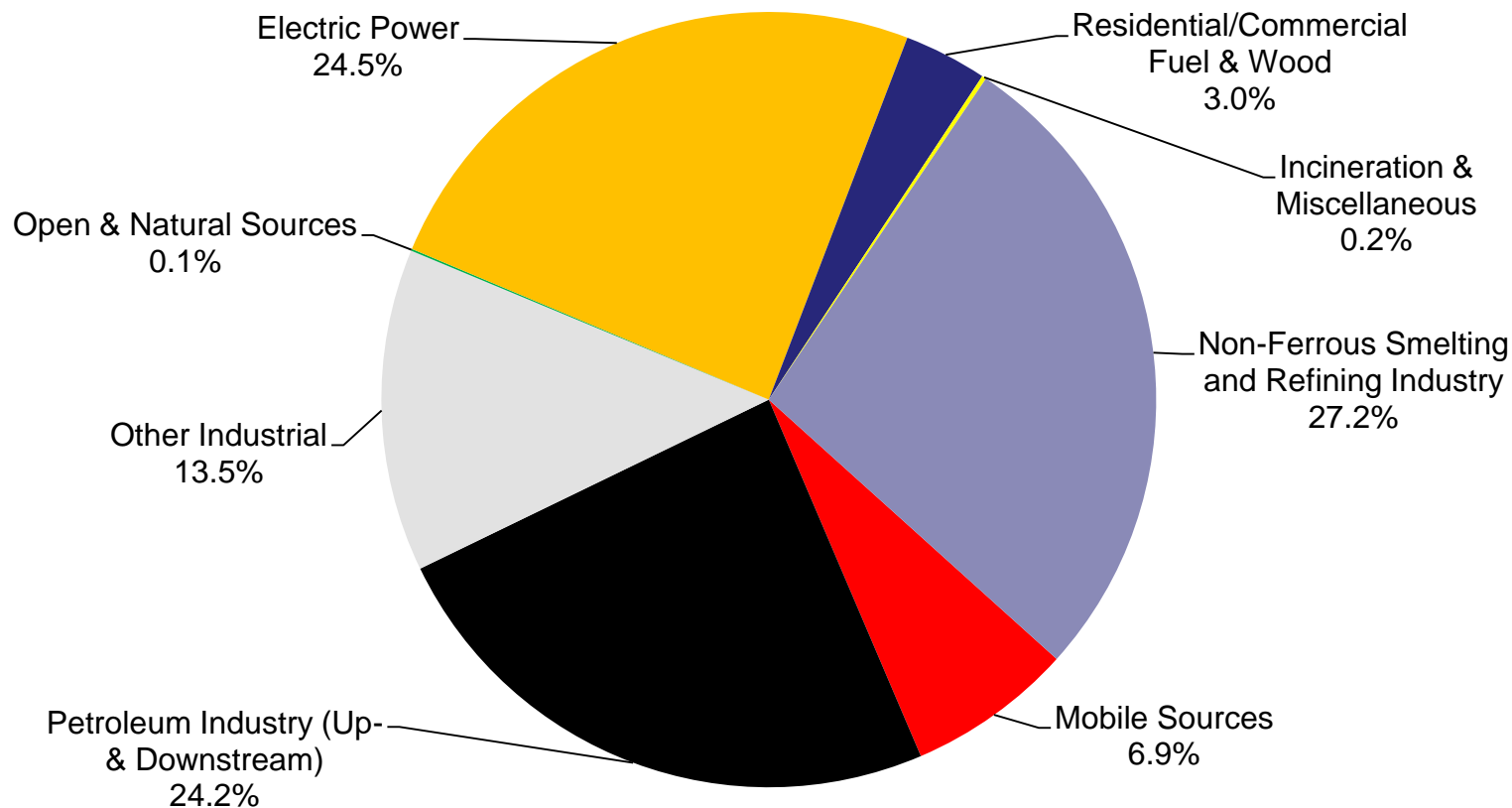


Source: Environment Canada, National Pollutant Release Inventory, 2010 Air pollutant emissions summary for Canada  
Retrieved February 24, 2012



## Sulphur Oxide (SO<sub>x</sub>) Emissions in Canada by Sources, 2010

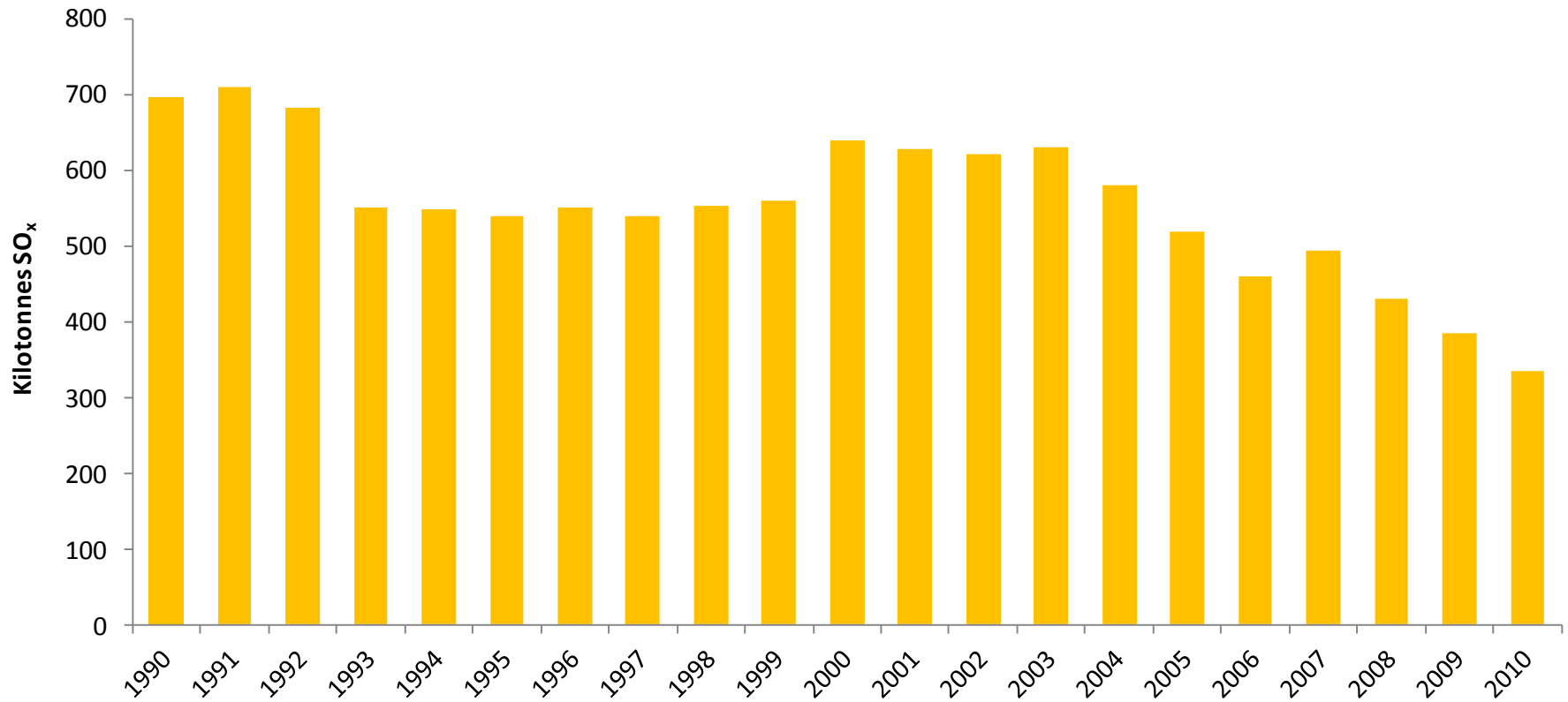
**Total SO<sub>x</sub> Emissions in Canada, 2010 = 1,371 Kilotonnes**



Source: Environment Canada, National Pollutant Release Inventory, 2010 Air pollutant emissions summary for Canada  
Retrieved February 24, 2012

## Electric Sector Sulphur Oxide (SO<sub>x</sub>) Emissions in Canada, 1990 - 2010

**Total Electric Sector SO<sub>x</sub> Emissions in Canada, 2010 = 335 Kilotonnes**

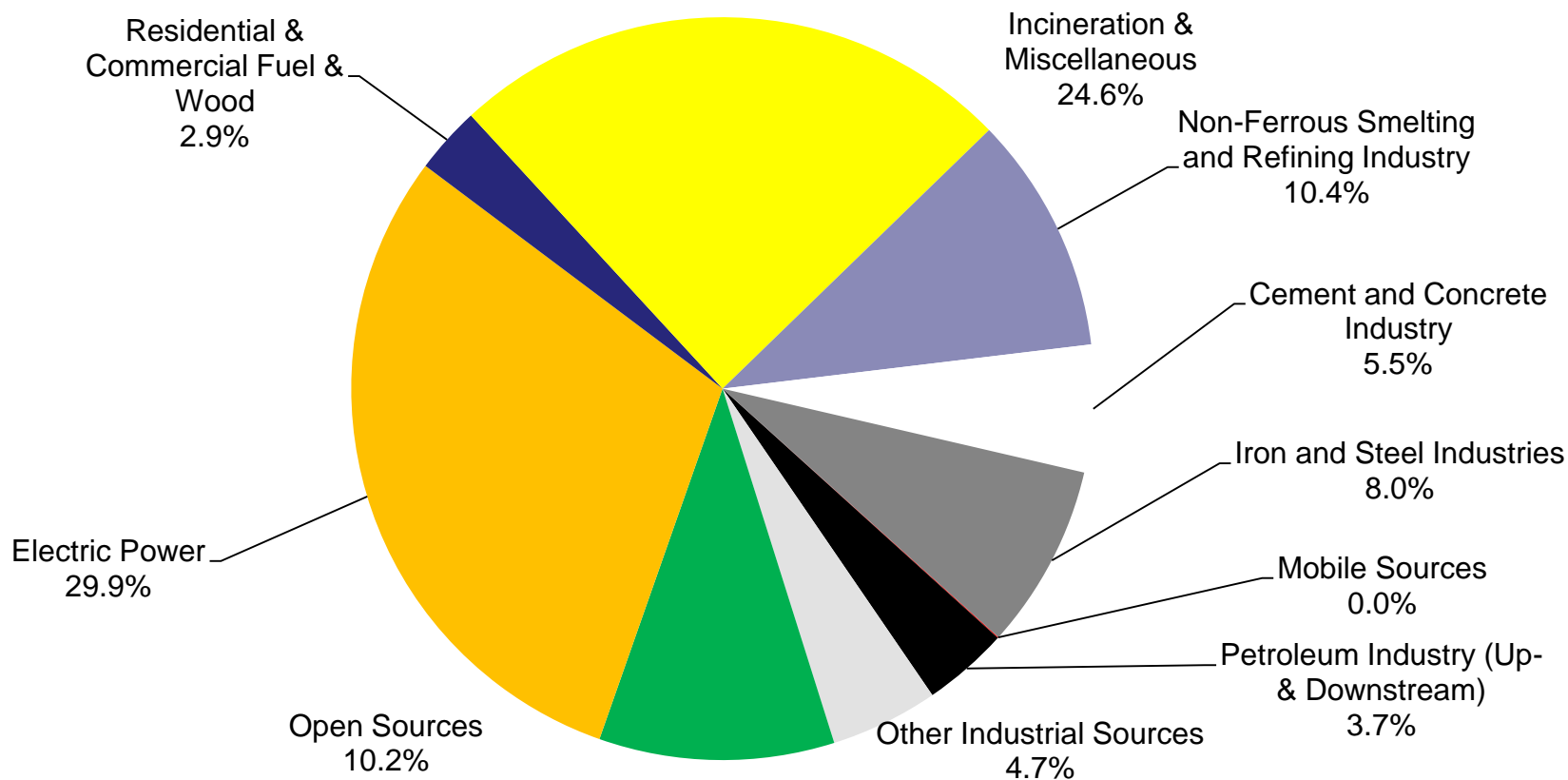


Source: Environment Canada, *National Pollutant Release Inventory (NPRI)* Retrieved June 19, 2012



## Mercury Emissions in Canada by Sources, 2010

**Total Mercury Emissions in Canada, 2010 = 5,222.1 Kilograms**

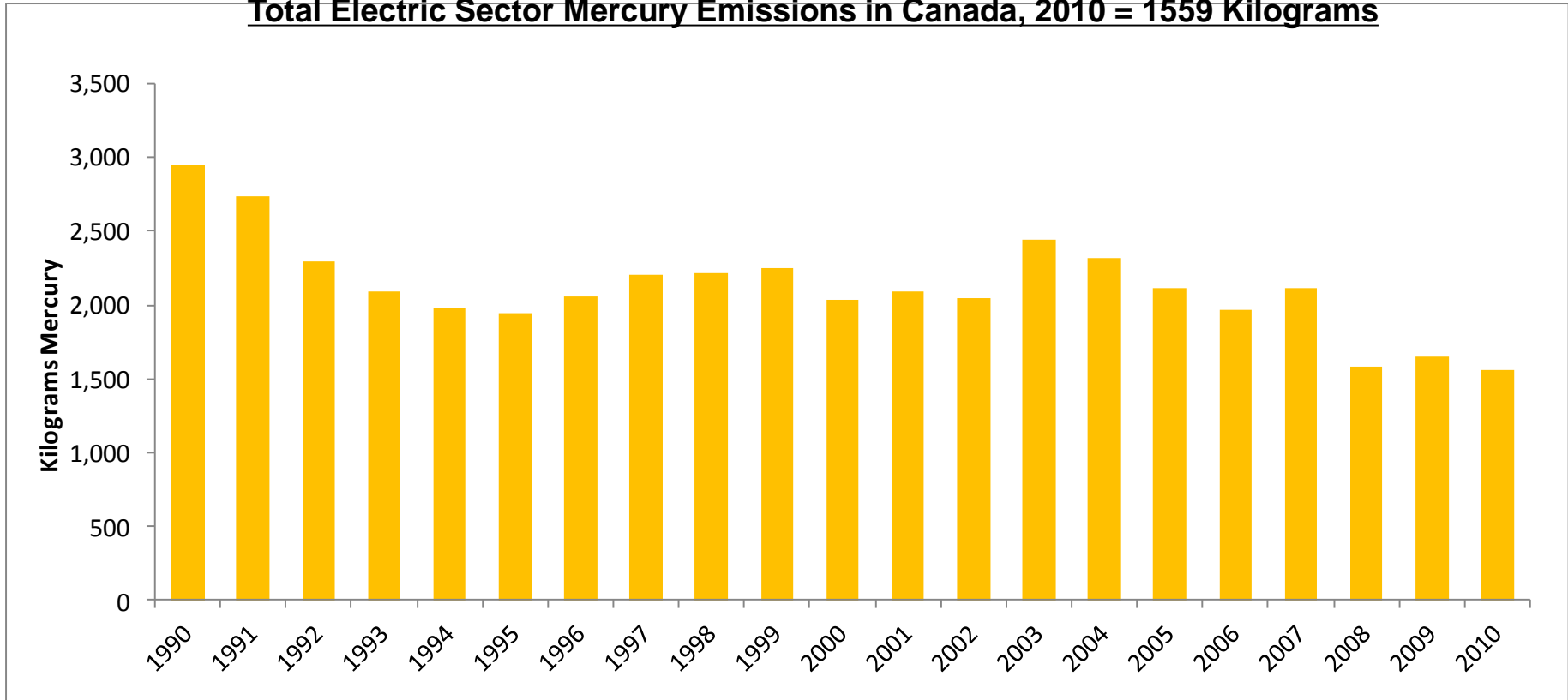


Source: Environment Canada, National Pollutant Release Inventory, 2010 Air pollutant emissions summary for Canada  
Retrieved June 19, 2012



# Electric Sector Mercury Emissions in Canada, 1990 - 2010

**Total Electric Sector Mercury Emissions in Canada, 2010 = 1559 Kilograms**

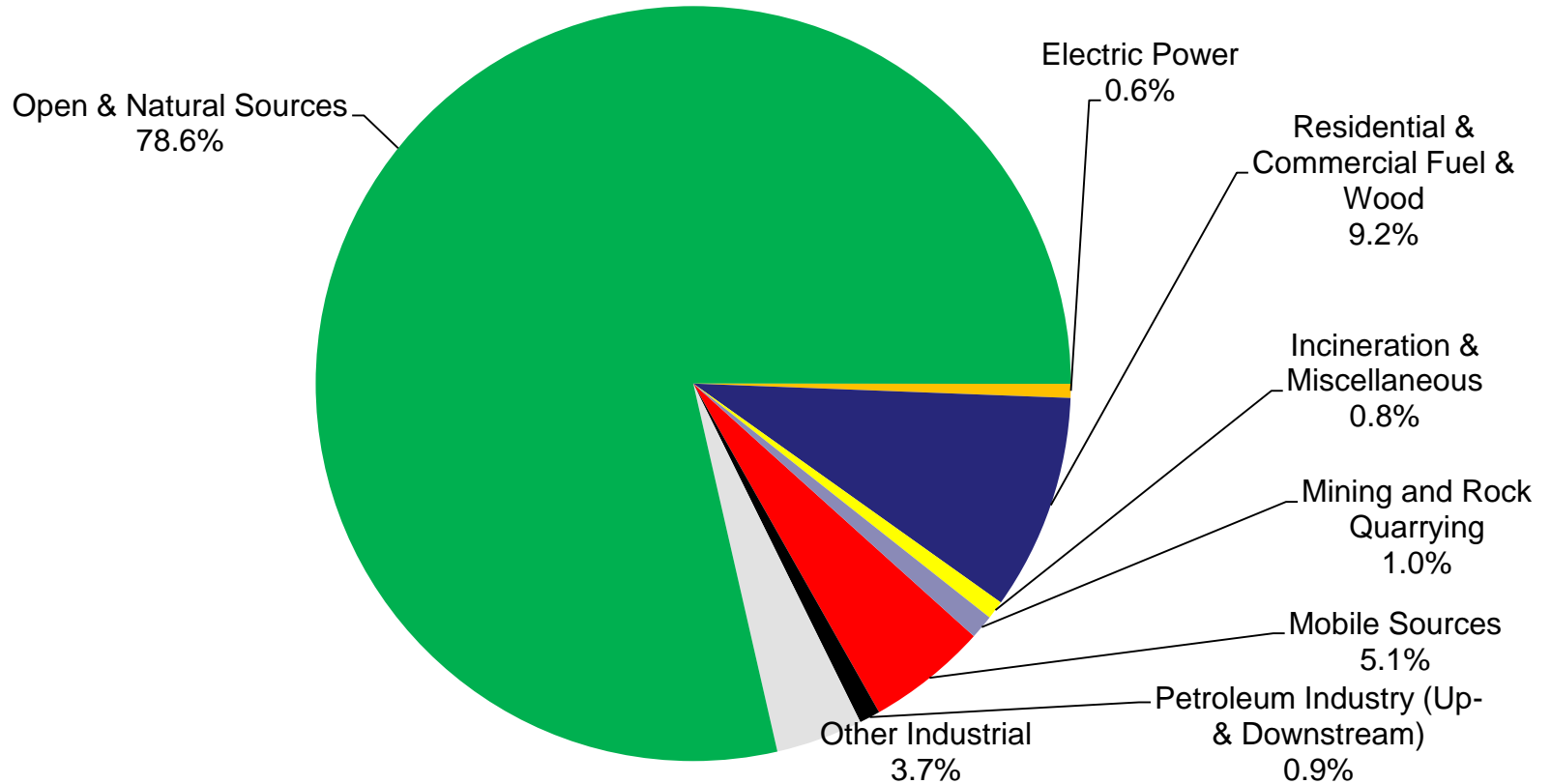


Source: Environment Canada, *National Pollutant Release Inventory (NPRI)*  
Retrieved on June 19, 2012



# Particulate Matter (PM<sub>2.5</sub>) Emissions in Canada by Sources, 2010

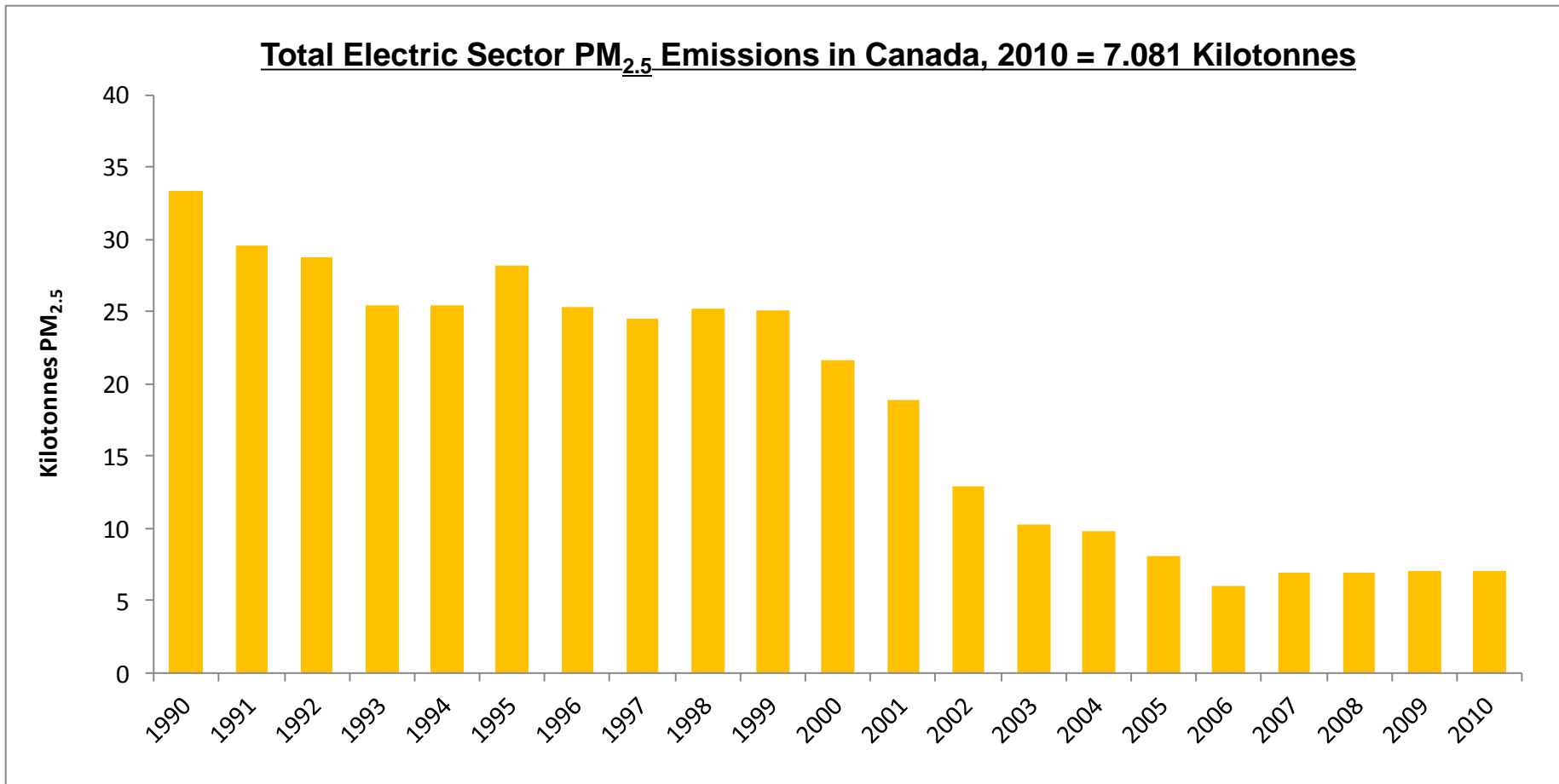
**Total PM<sub>2.5</sub> Emissions in Canada, 2010 = 1187.3 Kilotonnes**



Source: Environment Canada, National Pollutant Release Inventory, 2010 Air pollutant emissions summary for Canada  
Retrieved June 19, 2012



## Electric Sector Particulate Matter (PM) Emissions in Canada, 1990 - 2010

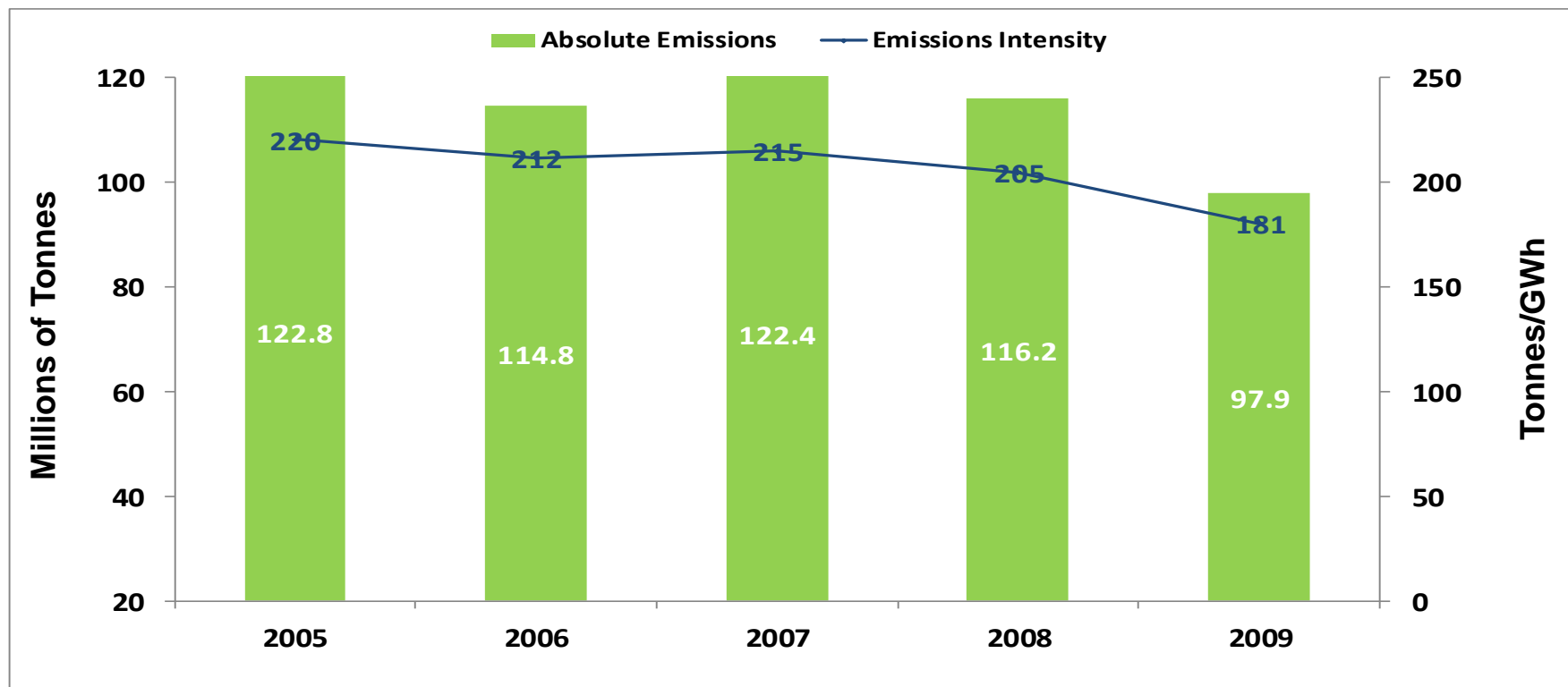


Source: Environment Canada, *National Pollutant Release Inventory (NPRI)*  
Retrieved on June 19, 2012

# 2009 CO<sub>2</sub> Electricity Emissions and Intensity in Canada

**97.9**  
 MT CO<sub>2</sub> e  
 Emissions

**181**  
 Tonnes/GWh CO<sub>2</sub> e  
 System Intensity

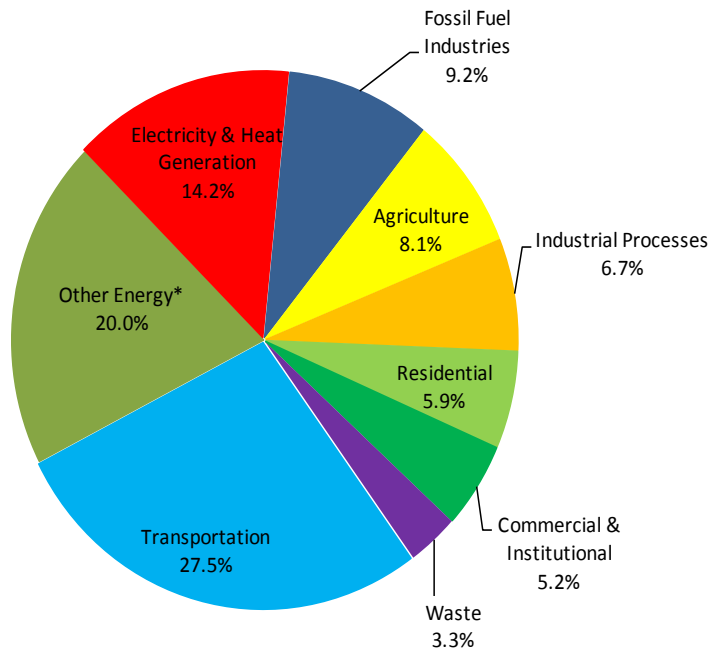


Source: National Inventory Report, 2009

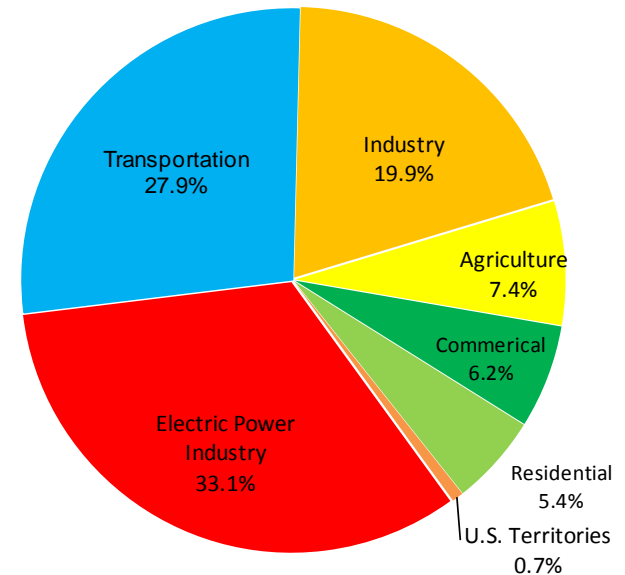


# Greenhouse Gas (GHG) Emissions in Canada and the US by Sector, 2009

Total GHG Emissions in Canada, 2009 = **692 Megatonnes CO<sub>2</sub> Equivalent**



Total GHG Emissions in US, 2009 = **6633.2 Megatonnes CO<sub>2</sub> Equivalent**



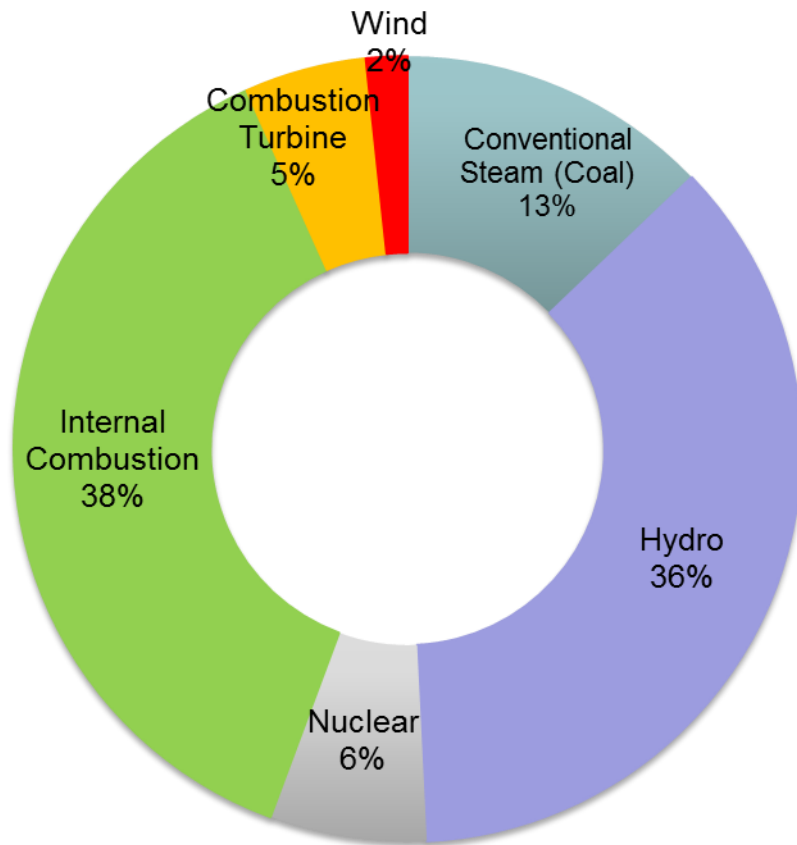
Source: Environment Canada, *National Inventory Report 1990 – 2008* and *US GHG Emissions and Sinks 2009*, retrieved March 9, 2012

\*includes all the other energy sector emission sources, such as mining, manufacturing, and construction, fugitive sources and agriculture/forestry/fisheries



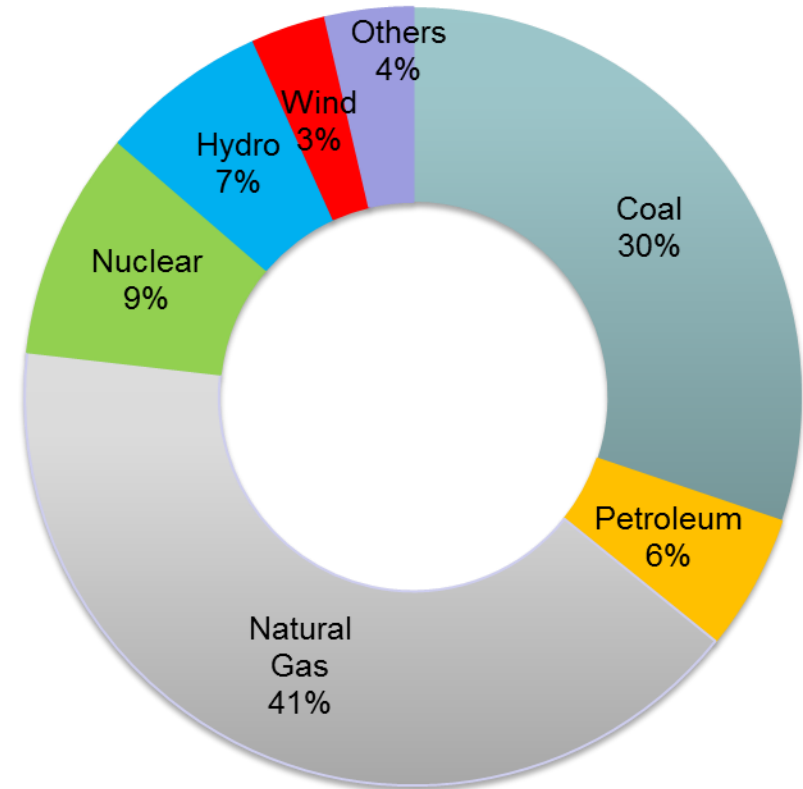
# Electricity Generating Capacity in the US and Canada by Fuel Type,<sup>1</sup> 2009

## Canada



Total Generating Capacity = 129 GW

## United States



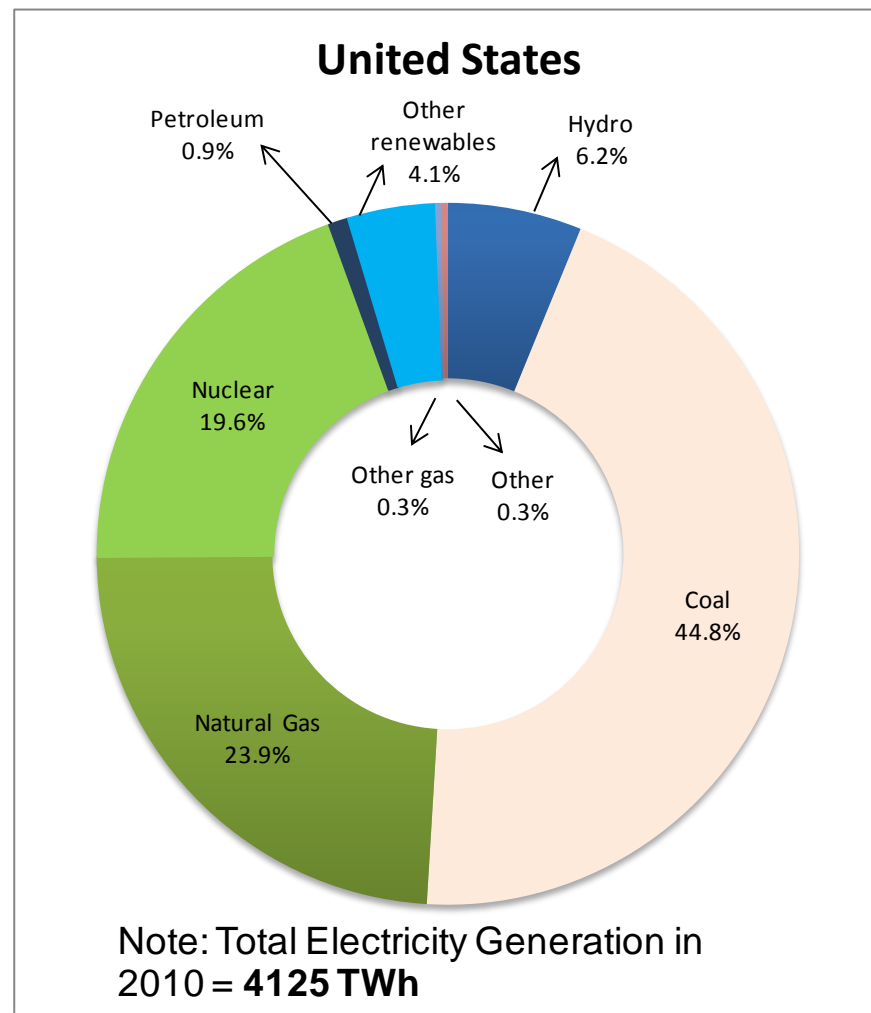
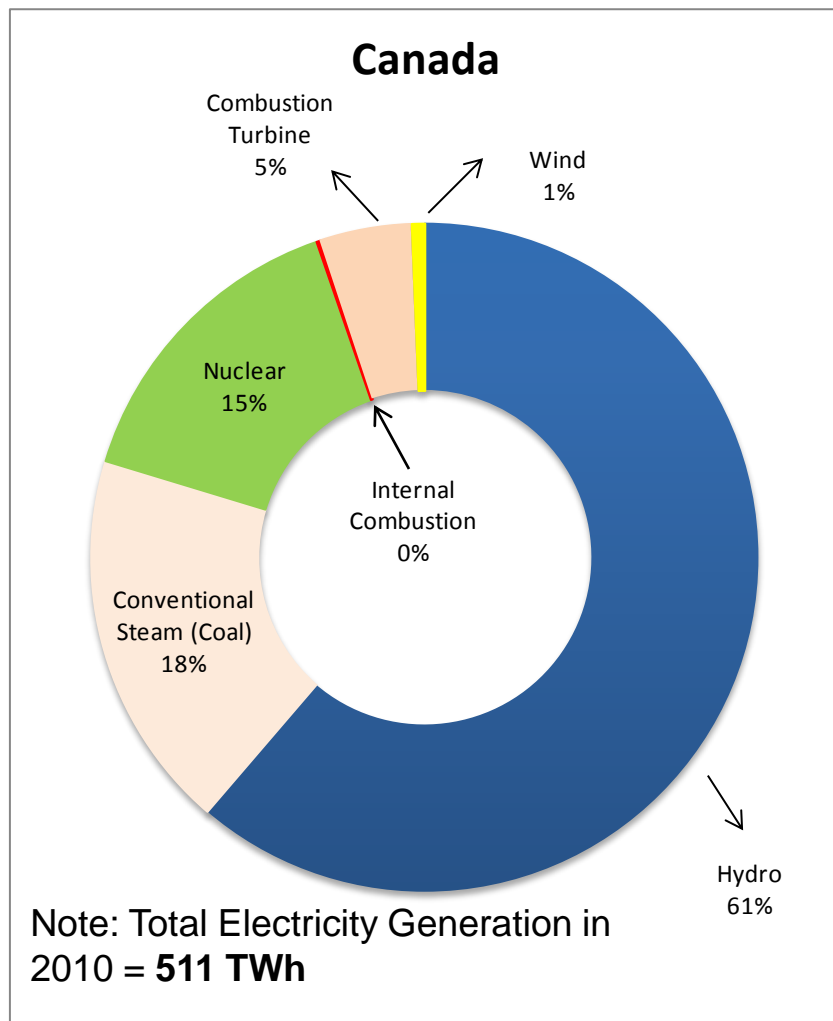
Total Generating Capacity = 1,121 GW

<sup>1</sup>Numbers may not sum to 100 percent due to rounding.  
Source: US Energy Information Administration, *Electric Power Monthly and Statistics Canada, Survey 2151, 2010*





## Electricity Generation in the US and Canada by Fuel Type,<sup>1</sup> 2010



## Building the Next Generation of Infrastructure: Capital Investment Requirements

**Total Canadian Electric Sector Investment Required by 2030 = \$CAN 293.8 Billion**

	(Billions of 2010 CDN dollars)			
	Generation	Transmission	Distribution	Total
<b>2010 – 2030</b>	195.7	35.8	62.3	293.8

Source: The Conference Board of Canada, Canada's Electricity Infrastructure, Building a Case for Investment, Report April 2011



## Active MPMO Electricity Sector Projects

MPMO Project Name	Description	Proponent	Project Type	Location
Bruce to Milton Transmission Reinforcement Project	500 kV line	Hydro One	Transmission	ON
Labrador - Island Transmission Link	1,100 km line	Nalcor Energy	Transmission	NL
Maritime Link Transmission	500-MW, +/- 200 to 250-kV HVDC & HVAC	ENL Maritime Link Inc.	Transmission	NL/NS
Keeyask Hydroelectric Generation	695 MW	Keeyask Hydropower Limited Partnership	Hydro	MB
Lower Churchill Hydroelectric Generation	3,074 MW	Nalcor Energy	Hydro	NL
Site C Clean Energy Hydroelectric Generation	1,100 MW	BC Hydro	Hydro	BC
Darlington New Nuclear Power Plant	Up to 4,800 MW	OPG	Nuclear	ON
Marten Ridge Wind Energy	80 MW	Premier Renewable Energy	Wind	BC
Mount MacDonald Wind Power	250 MW	Rupert Peace Power	Wind	BC
NaiKun Offshore Wind Energy	320 MW (off-shore)	NaiKun Wind Development	Wind	BC
Nicomén Wind Energy	70 MW	Premier Renewable Energy	Wind	BC
Trillium Offshore Wind Farm	414 MW	Trillium Power Wind Corporation	Wind	ON

Source: Major Projects Management Office, Project Tracker, retrieved February 29, 2012



## Active MPMO Electricity Sector Projects – indirect relevance

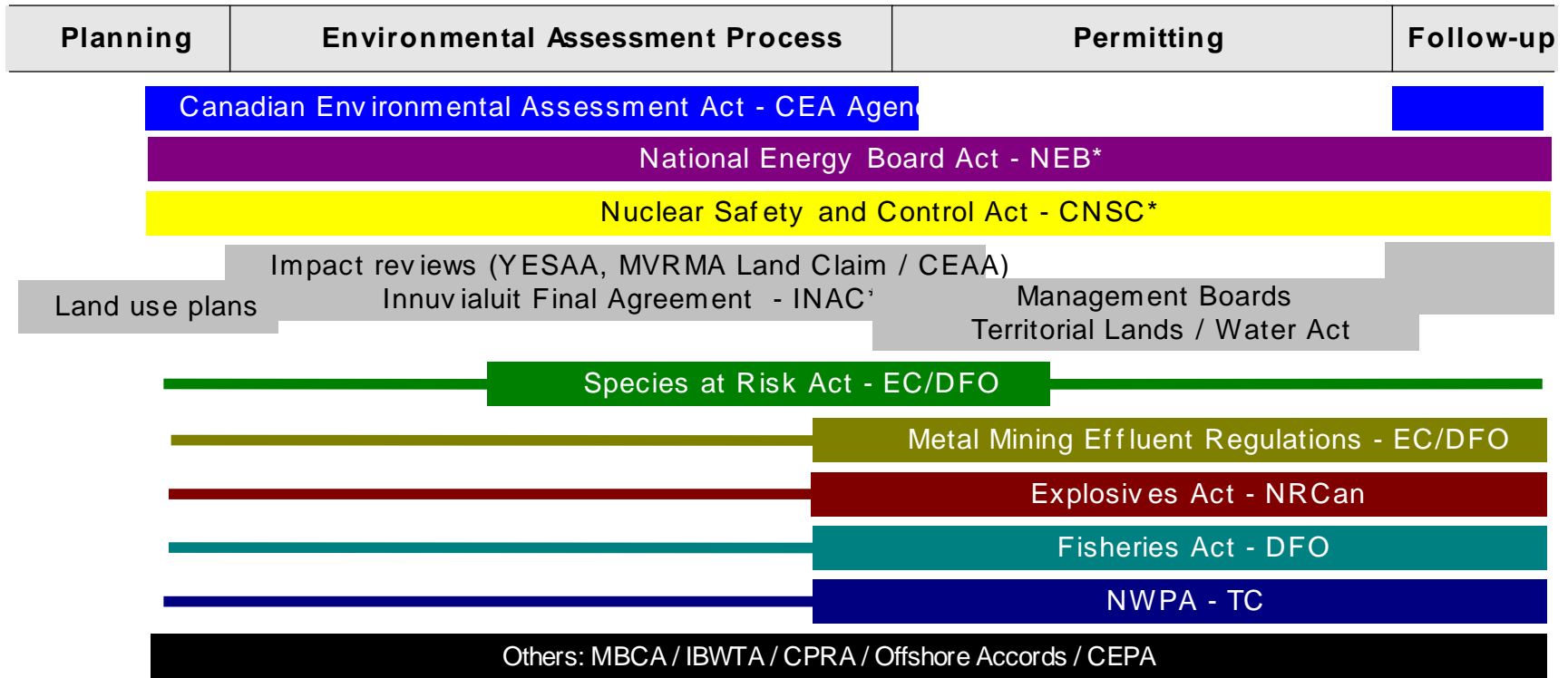
MPMO Project Name	Description	Proponent	Project Type	Location
Bow City Coal Mine and Power	2x 500 MW	Bow City Power Ltd.	Coal	AB
Deep Geological Depository	Waste Management	Ontario Power Generation	Nuclear	ON
Port Granby Long-Term Low-Level Radioactive Waste Management	Waste Management	Natural Resources Canada	Nuclear	ON
Port Hope Long-Term Low-Level Radioactive Waste Management	Waste Management	Natural Resource Canada	Nuclear	ON
Pointe du Bois Spillway Replacement	Spillways and earth, Dams	Manitoba Hydro	Hydro	MB

Note: indirect relevance refers to projects that are indirectly related to electricity generation and include infrastructure related activities, such as mining (of coal for power generation), waste management (of radioactive waste) and dam (re)construction

Source: Major Projects Management Office, Project Tracker, Retrieved February 29, 2012



# Canada's Regulatory Regime for Large Energy Projects



\*Permits required under other Acts trigger CEAA OGD participants

Illustrative – some components would not apply to same project

NWPA – Navigable Waters Protection Act / YESAA – Yukon Environmental and Socio-Economic Assessment Act

MVRMA – Mackenzie Valley Resource Management Act / MBCA - Migratory Birds Convention Act /

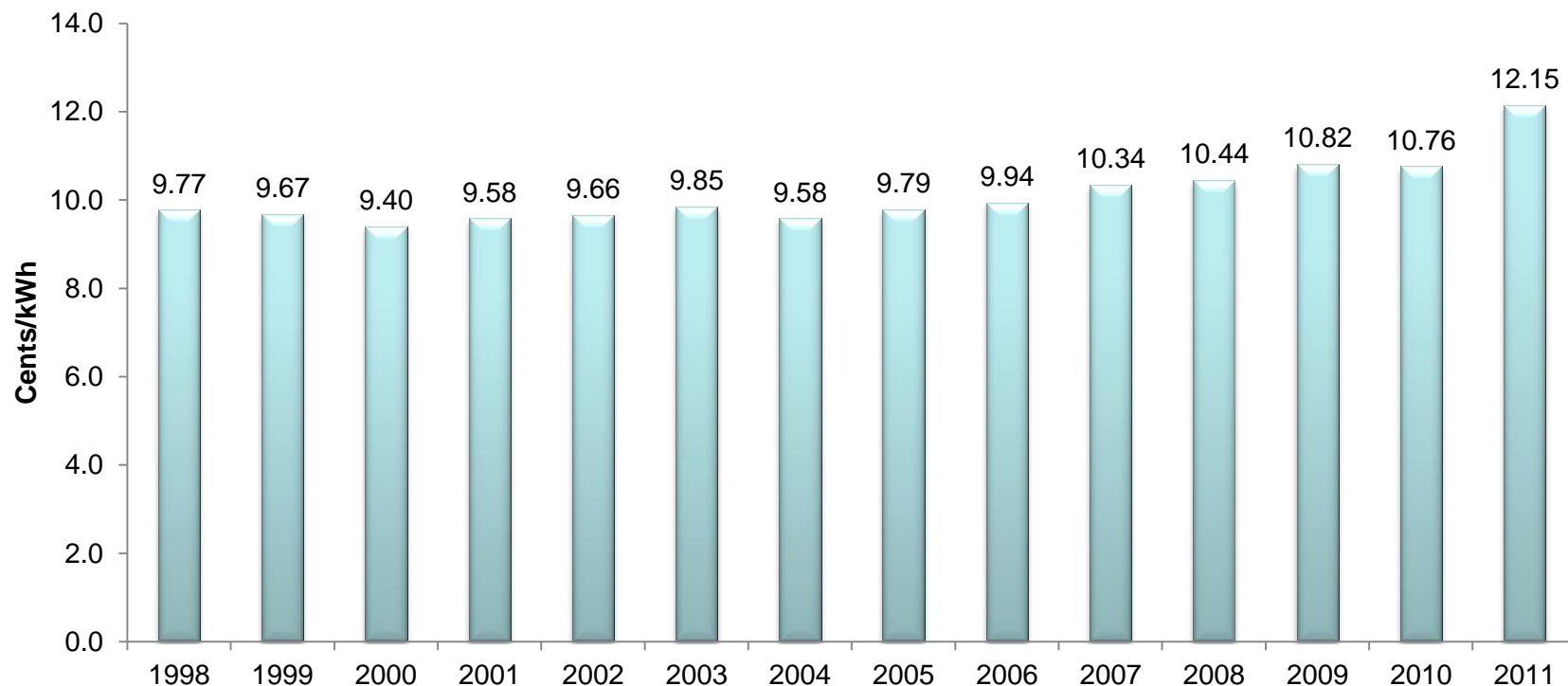
IBWTA – International Boundary Waters Treaty Act / CPRA – Canadian Petroleum Resource Act /

Offshore Accords – Canada - NS and NFLD Offshore Accords / CEPA – Canadian Environmental Protection Act

Source: Natural Resources Canada



## Average Residential Electricity Price in Canada, 1998 – 2011 (cents/kWh)



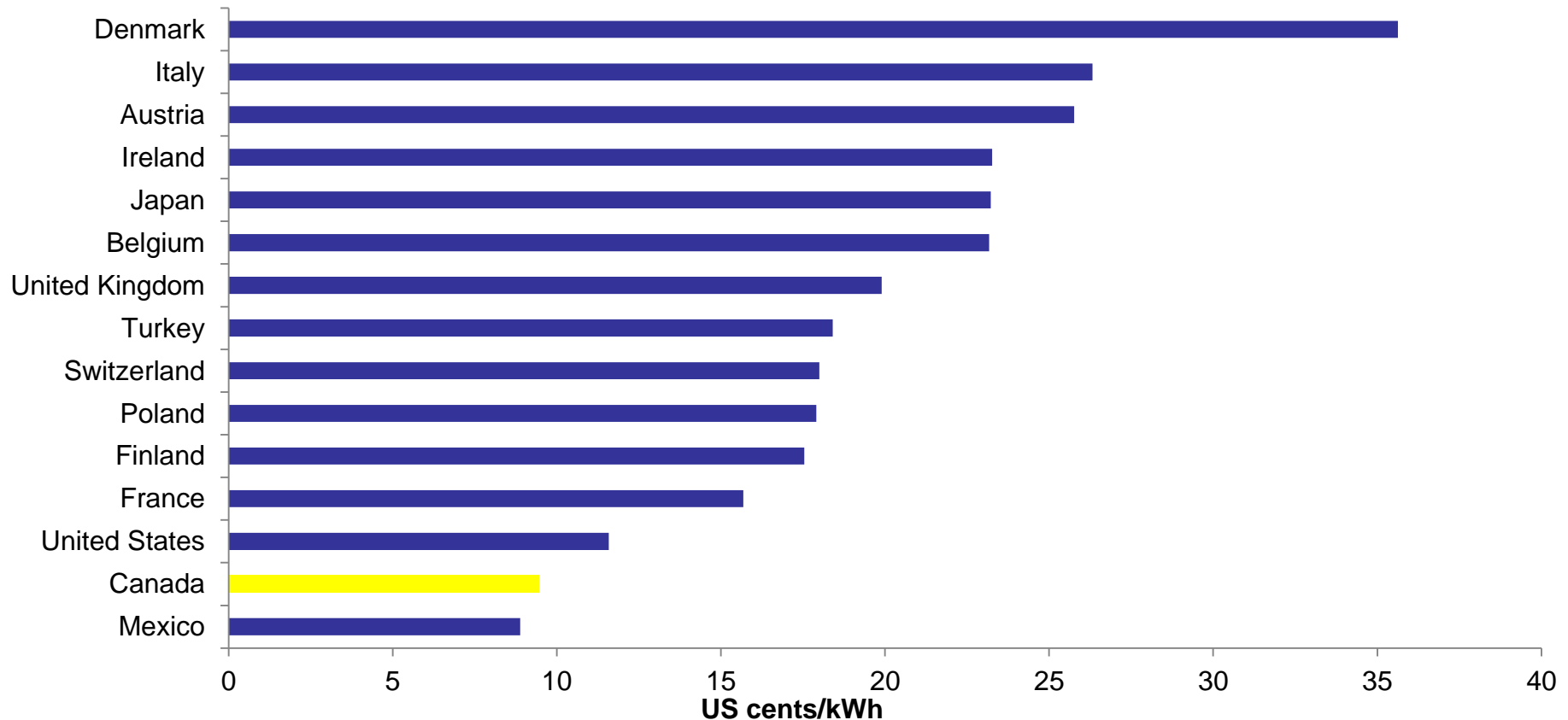
Source: Hydro Quebec, *Comparison of Electricity Prices in Major North American Cities*, 1998 – 2011, Retrieved February 15, 2012

Notes: Based on 1,000 kWh monthly consumption

Average electricity price is an average of 11 major Canadian cities for years 1998-2008 and an average of 12 major Canadian cities for years 2009-2011; and may not represent an exact national average.



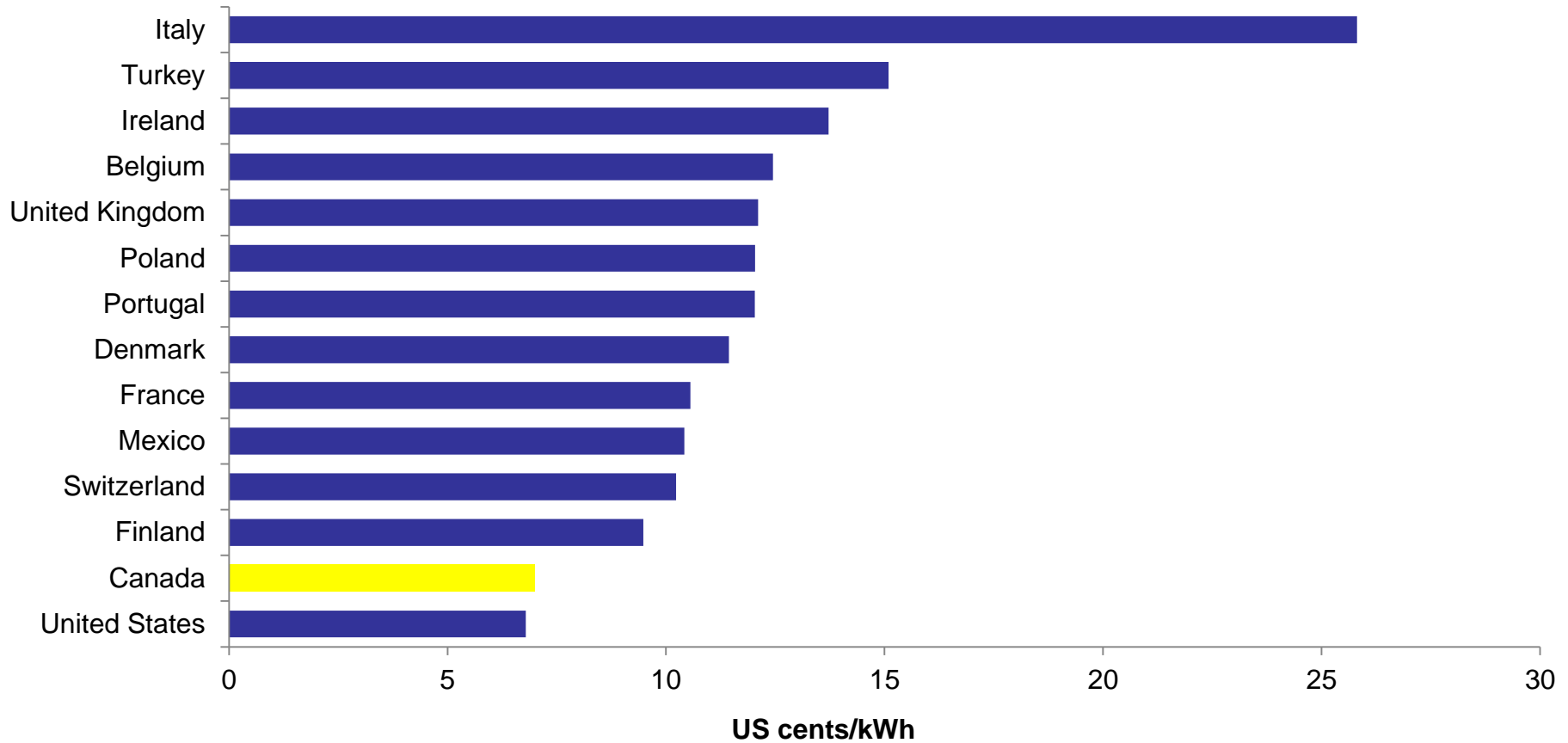
# Selected World Residential Electricity Prices, 2010



Source : International Energy Agency, *Key World Energy Statistics 2011 with 2010 data*

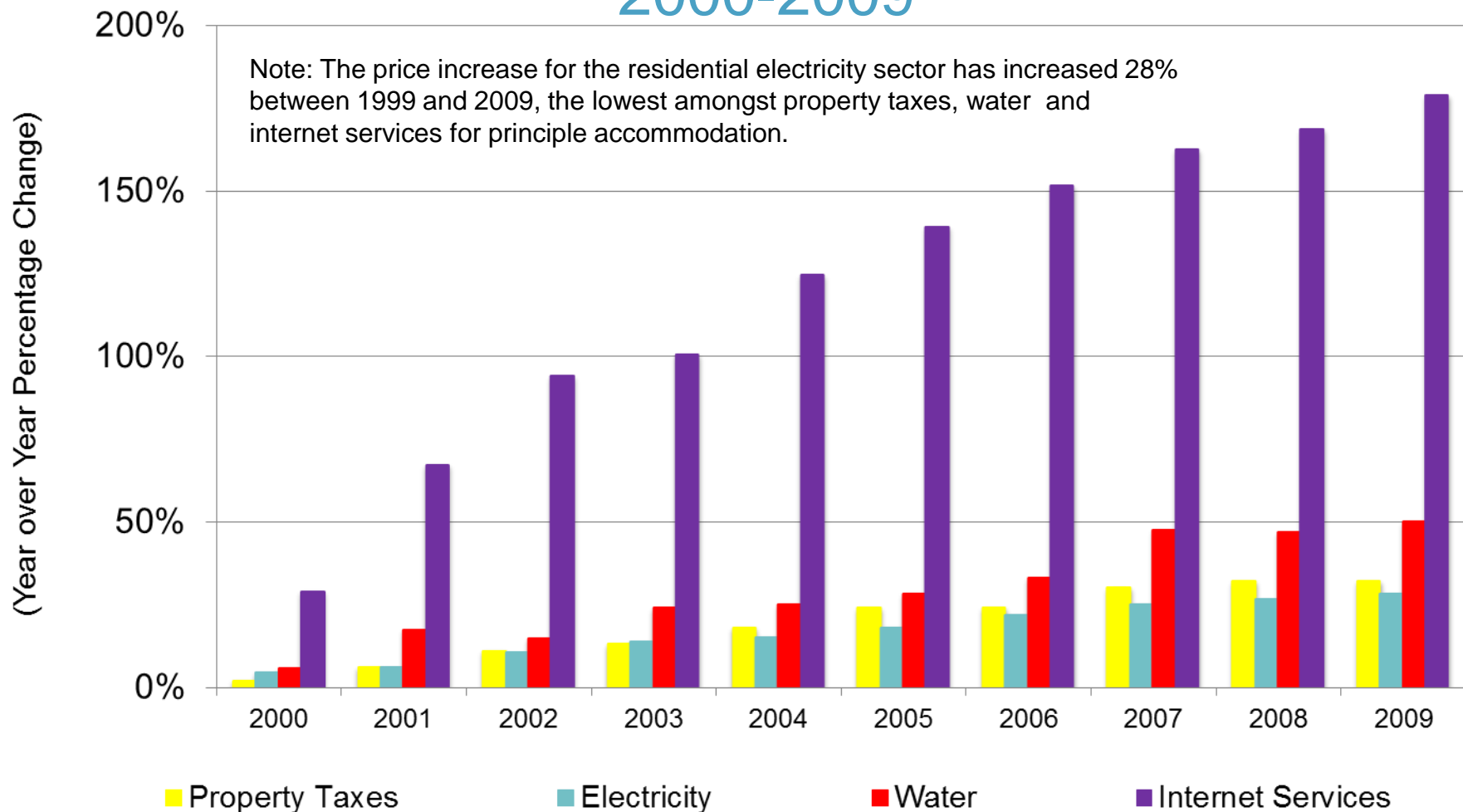


# Selected World Industrial Electricity Prices, 2010

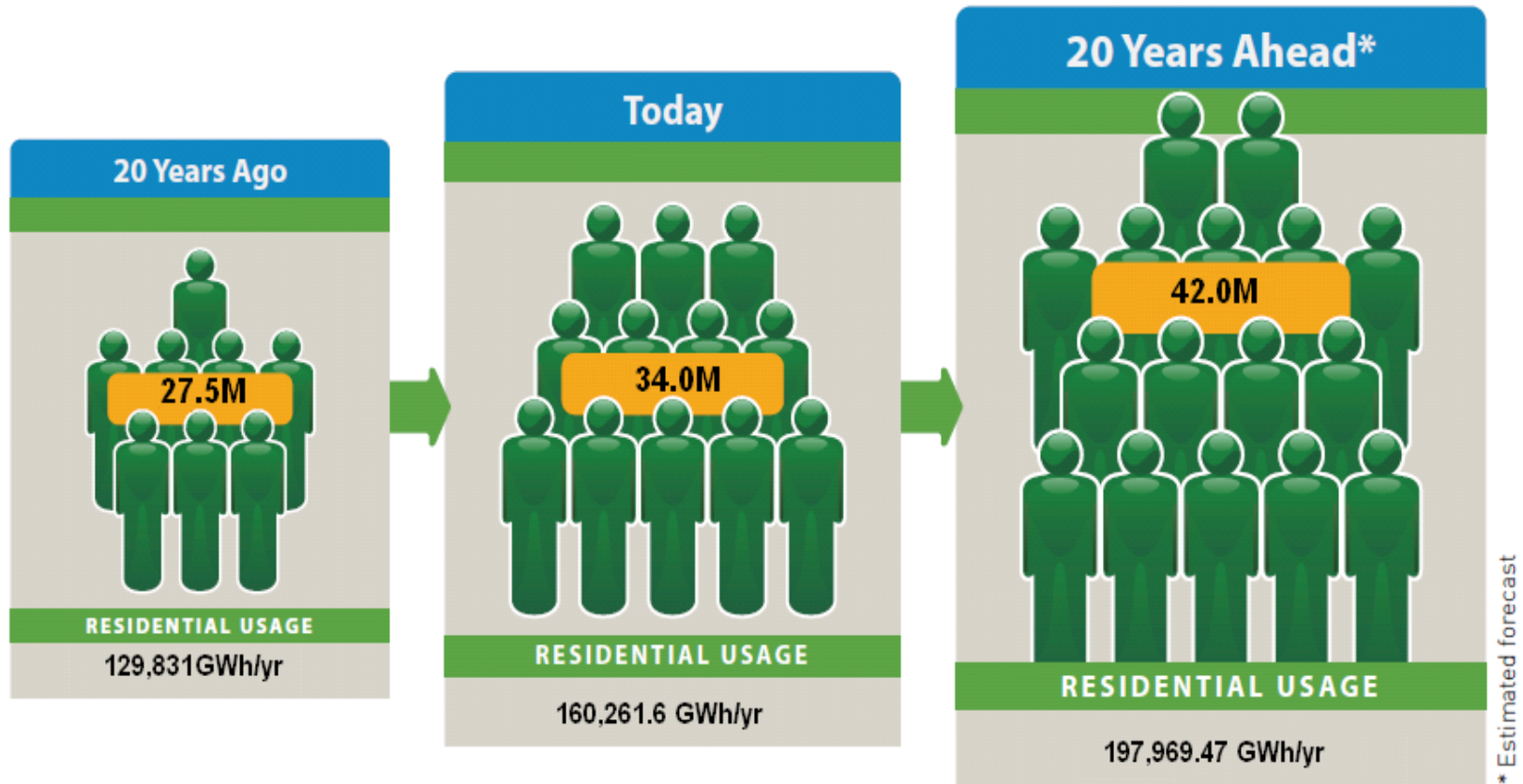


Source: International Energy Agency, *Key World Energy Statistics 2011*

# The Percentage Change in Household Expenditures 2000-2009



# Canada's Future Residential Electricity Needs



Reference: Graphics from BC Hydro: Lighting the Way. Estimates based on a business as usual scenario. Stats Canada Population Projections: Table 052-0005

## Low Emission and Sustainable Technologies Used for Electricity Generation in Canada

Resource	Advantages	Challenges
<b>Wind Power</b>	No fuel cost, no emissions or waste, renewable source of energy, commercially viable source of power	Less cost competitive than conventional energy source, variable energy resource, transmission issues, environmental concerns with regards to noise and interaction with birds, land use issues
<b>Small Hydro</b>	Low capital costs, many potential sites in Canada, well established technology, able to meet small incremental capacity needs, reduction in GHG emissions	Regulatory approval can be costly and time consuming, access to grid, local opposition to new development
<b>Biomass</b>	Uses landfill gas, wood pellets, and waste products to create electricity, reduces greenhouse gas, high availability of sites	High capital equipment and fuel costs; produces some emissions; access to transmission, competition for biomass materials use
<b>Geothermal Energy</b>	Reliable source of power, low fuel and operating costs, clean and renewable source of energy	High capital costs, connecting to the grid can be difficult, few potential sites in Canada
<b>Solar PV</b>	Reliable, renewable energy source with zero emissions and silent operation, fuel is free, suitable for areas where fossil fuels are expensive or where there is no connection to the grid	Restrictive and lack of grid connection for remote areas, not cost competitive, sun does not always shine and potential varies across regions
<b>Ocean Energy</b>	Costs are expected to decline as technology develops, intermittent, but predictable source of green energy	Potentially intrusive to marine life, investment is needed to promote research and development
<b>Clean Coal</b>	Highly efficient, potential for reduced greenhouse gas emissions	High capital costs, lengthy start-up period



# Canadian Electricity Statistics

## By the *Global* numbers...

- 5** Canada's world ranking in primary energy production (2008)
- 7** Canada's world ranking in primary energy consumption (2008)
- 22.4** Per cent of Canada's total exports that were energy related (2010)
- 3** Canada's ranking in Hydroelectricity generation (2009)

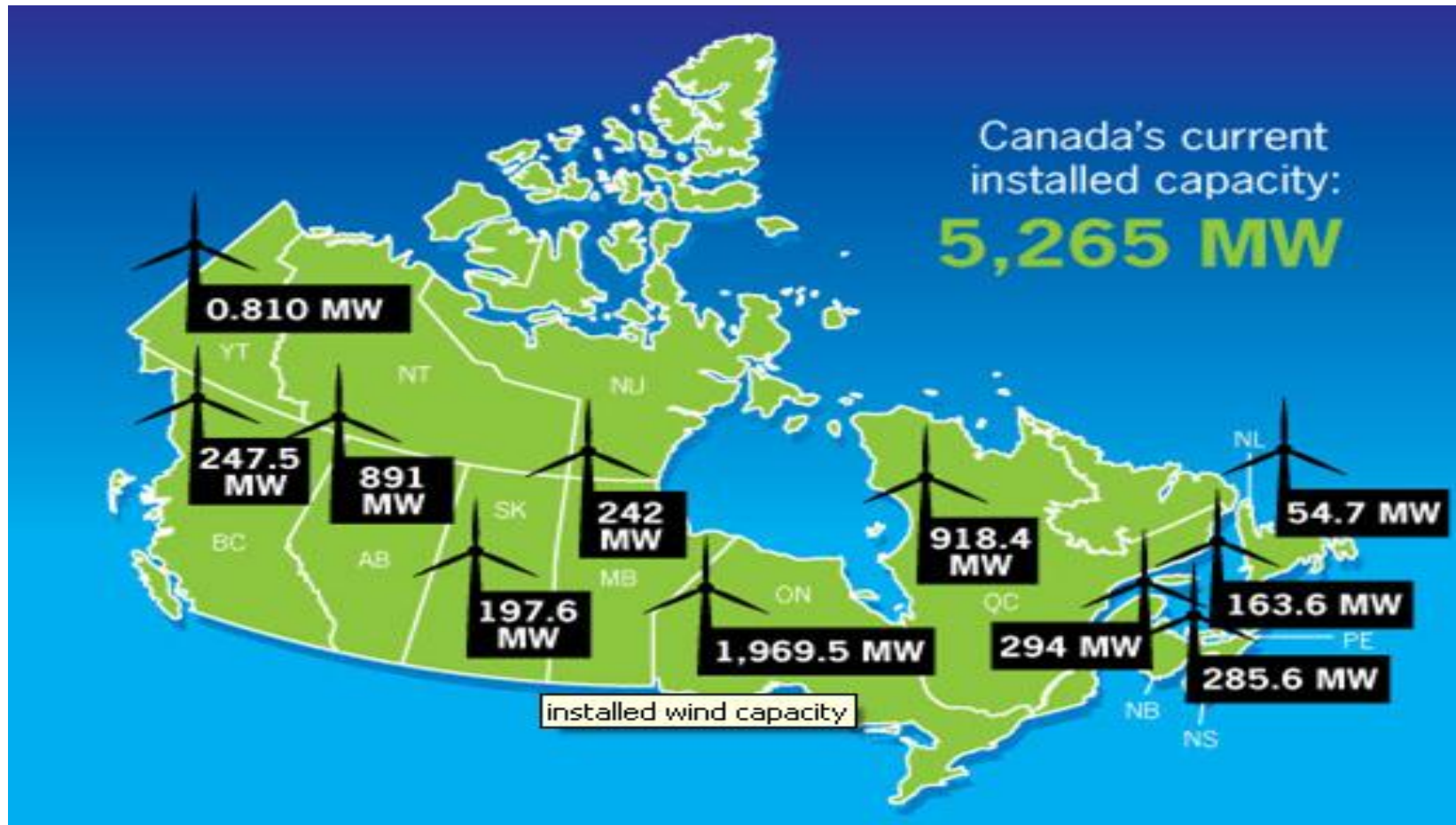
## By the *Domestic* numbers...

- 15.2** Per cent of Canada's electricity produced from nuclear generation (2011)
- 16.1** Per cent of Canada's electricity produced from thermal generation fired by coal (2011)
- 62.9** Per cent of Canada's electricity generated from hydropower (2011)
- 592.3** Terawatt-hours of total electricity generation (2011)





## Installed Wind Capacity in Canada as of December 2011



Source: Canadian Wind Energy Association, 2012, retrieved February 24, 2012



# Existing Coal Facilities in Canada – End of Life and Regulatory Shut Down

- Forthcoming





# Proposed Regulations to address GHG emissions from coal-fired electricity

- Will require all existing coal-fired electricity generation units to meet a carbon dioxide (CO<sub>2</sub>) emission standard of 375 tonnes per gigawatt-hour (GWh) upon reaching end of economic life (45 years).
- The proposed Regulations are to be promulgated under the Canadian Environmental Protection Act (CEPA) and are set to come into effect on July 1, 2015.
- Existing and new units may apply for a deferral in meeting the performance standard until January 1, 2025, if the technology for Carbon Capture and Storage (CCS) is incorporated.
- The regulation will be effective only if compliance is achievable.
- Compliance will contribute to clarity and stability for industry that will enable investment in electricity infrastructure to flow.
- Some jurisdictions will be more heavily impacted than others.



## The CEA Councils

- **Generation Council**
  - Develops and influences policy associated with investment in electricity generation infrastructure, as well as manages environmental and health impacts related to generation
- **Transmission Council**
  - Formulates positions on transmission, including cross border reliability, electric and magnetic fields and utility properties
- **Distribution Council**
  - Focuses on technological and regulatory developments associated with smart grid development and deployment, advanced meter performance, power quality issues, and national trends in provincial distribution utility regulation
- **Customer Council**
  - Seeks to increase the value of electricity service to Canadians
- **Power Marketers Council**
  - Promotes competitive and efficient electricity markets in Canada and the United States



## Energy Efficiency

- Commitment to sustainability through *efficient* production, delivery and use of energy, while promoting energy conservation and demand side management
- CEA's involvement in initiatives
  - Old refrigerator removal
  - Exchange programs to lower air conditioner levels during peak summer demand
  - Support for implementation of new technologies – smart meters for time-of-use pricing
- Promotion of conservation programs by CEA member utilities for their larger commercial, industrial and direct customers
- Demand Side Management
  - can be a least cost option,
  - postpones the development of new power plants,
  - improves energy efficiency
- Partnership among CEA, NRCan and utilities in promotion of ENERGY STAR qualified light fixtures

## Smart Grid

- A suite of information-based applications through increased automation of the electricity grid *and* the underlying automation and communication infrastructure itself
- Smart grid is posed to deliver grid resilience, environmental performance, and/or operational efficiencies
- Design and implementation of the smart grid integrated system aims to achieve desired customer priorities, interoperability with legacy infrastructure, and be appropriate for use with respect to geographical location and other needs
- Key characteristics or capabilities:
  - Demand response, facilitation of distributed generation, facilitation of electric vehicles, optimization of asset use, and problem detection and mitigation
  - Capabilities supported by development of hard infrastructure, soft infrastructure through stakeholder engagement
  - Expected results in new service offerings, reduced delivery charges, and faster response time
- Security, privacy, implementation cost, and stakeholder engagement requires *collaboration* among vendors, policy-makers, regulators and utilities





## Human Resources – Commitment by CEA member utilities

- Providing safe environment for general public as well as ensuring health and safety of employees and contractors in the workplace,
- Support a fair, respectful and diverse workplace for our employees and contractors, and investing in human resources
- Partnering with communities and stakeholders, communicating and engaging in a transparent and timely manner
- Engaging Aboriginal Communities while respecting their culture and traditions



## Economic Value

Economic Indicators for 2011	All Canadian Sectors Contribution	Canadian Electricity Sector Contribution
GDP (Millions chained 2002 dollars)	1,266,578	28,360.7
Merchandise Exports (dollars x 1,000,000)	456976.8	2,044.5
Merchandise Imports (dollars x 1,000,000)	455,577.8	371



## Electricity in Canada at a Glance

Indicator	Value
Total Generation in 2011 (Twh)	592.32
Total Demand in 2009 (Twh)	503.4
Average Price in 2011 (¢/kWh)	
Residential	12.15
Industrial	7.32
Canada – US trade volume in 2011 (Twh): exports/imports	51.4/14.6
Canada – US trade revenue in 2011 (billions \$): exports/imports	2.04/0.37
Capital Expenditure on New/Refurbished Infrastructure in 2010 (billion \$)	8.8
Environmental Expenditure in 2008 (million \$)	1287.9
GHG emissions from Public Electricity and Heat Production Sector (CO <sub>2</sub> , CH <sub>4</sub> and N <sub>2</sub> O eq. Mt)	98.1







## For More Information...

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