



# **Nuclear Energy in Canada**

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## Role of Government

- Minister of Natural Resources responsible for Atomic Energy of Canada Ltd., Canadian Nuclear Safety Commission
- Nuclear constitutionally federal jurisdiction
- Federal responsibilities include:
  - Regulation (*Nuclear Safety and Control Act*)
  - Nuclear Research and Development (*Nuclear Energy Act*)
  - Nuclear Non-proliferation (NPT, IAEA obligations)
  - Waste (*Nuclear Fuel Waste Act*)
  - Liability (*Nuclear Liability Act*)
- Electricity generation provincial jurisdiction



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# Canadian Energy Policy

- Canadian energy policy addresses a number of goals:
  - Energy supply security
  - Ensuring Canadian productivity and competitiveness
  - Addressing air quality, climate change objectives
  - Fostering innovation
- Canada's energy policy is built on:
  - A diversified energy mix
  - A sustainable development approach
  - Open markets
  - Respect for provincial, territorial jurisdiction



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# Structure of the Canadian Nuclear Industry

Canada has a full-spectrum nuclear industry

- Uranium
- Nuclear Utilities
- Reactor Design and Nuclear R&D
- Engineering, Manufacturing and Supply
- Medical and industrial applications
- Academic Institutions - Research Reactors



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# Canada's Major Nuclear Facilities





## Nuclear Energy in Canada

- Canada has over 50 years of experience in nuclear power
- Canada a major producer of uranium
- 22 reactors installed; unique CANDU technology
- 15% of Canada's electricity (50% in Ontario, 30% in New Brunswick and 3% in Quebec)
- Consistent improvements in reactor performance
- Decisions to refurbish, life-extend reactors
- Government investing in nuclear R&D (Nuclear Laboratory, Advanced CANDU Reactor (ACR), Generation IV)





# Impact of Canada's Nuclear Energy Program

## Security of supply:

- Nuclear energy provides baseload power in Canada's industrial heartland

## Economics

- Production value \$5B/year  
(including Uranium and Electricity)
- Exports \$1.2B/year
- Employment 30,000

## Air quality:

- Displaces coal-fired generation, a major source of poor air quality

## Climate Change

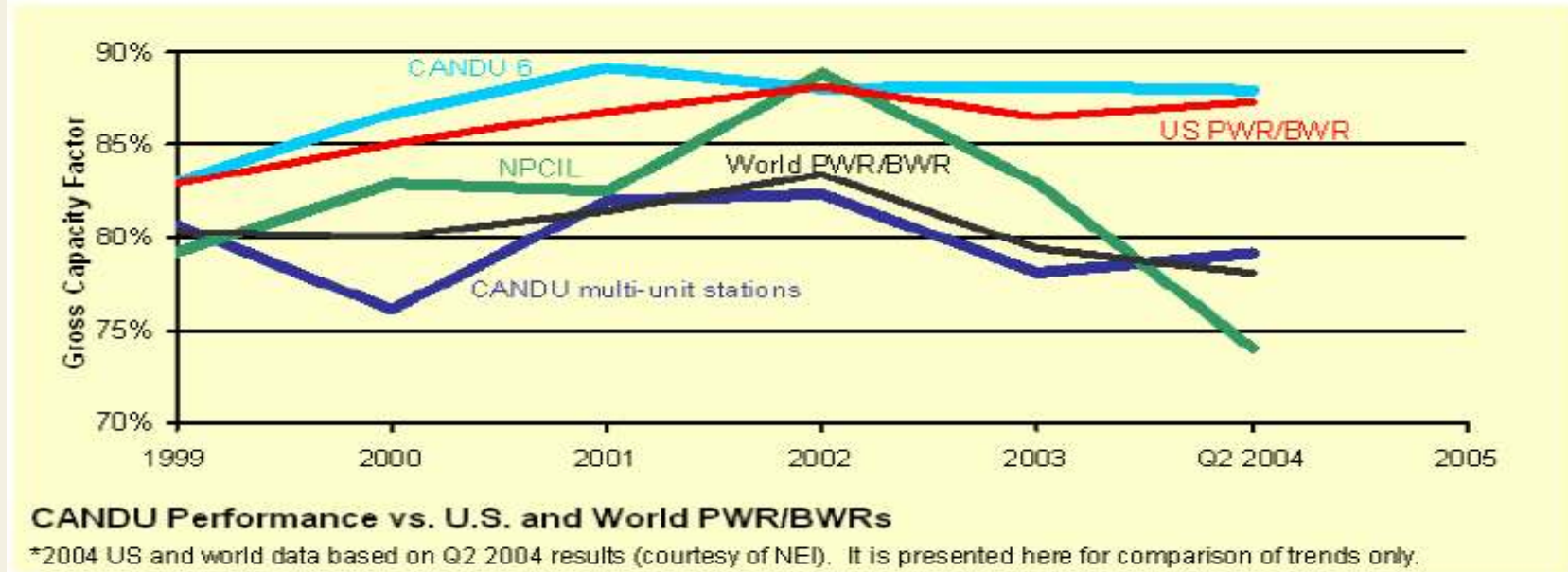
- Prevents annual GHG emissions equivalent to 40Mt (gas) to 80Mt (coal)





# CANDU Performance

## CANDU/PHWR Performance Trends (1999 – Q2 2004)



Mid-year 12-month rolling average

Source: COGNizant Newsletter, Volume 9, Issue 10, November 2004



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## CANDU Nuclear Reactor Performance December 2004

Reactor	In Service	Capacity (MW)	Performance In 2004 (%)	Lifetime Performance (%)
Point Lepreau	1983	680	77.5	82.7
Gentilly 2	1983	675	87.8	79.3
Wolsong 1	1983	679	90.3	86
Wolsong 2	1997	700	94.9	92.6
Wolsong 3	1998	700	96.4	93.9
Wolsong 4	1999	700	97.4	96.4
Embalse	1984	648	86.1	84.8
Cernavoda 1	1996	706	89.7	86.8
Qinshan 4	2002	700	77.3	84.2
Qinshan 5	2003	700	94	87.8
Pickering 4	1973	542	72.2	67
Pickering 5	1983	540	92.5	74.3
Pickering 6	1984	540	61.5	77.6
Pickering 7	1985	540	69.2	79.3
Pickering 8	1986	540	55.5	75.8
Bruce 3	1978	805	76.1	53.9
Bruce 4	1979	805	81.9	51.8
Bruce 5	1985	840	85	82.6
Bruce 6	1984	840	75.7	79.4
Bruce 7	1986	840	92.7	83.1
Bruce 8	1987	840	82.3	80.2
Darlington 1	1992	935	72.8	82.1
Darlington 2	1990	935	92	73.3
Darlington 3	1993	935	85.8	84.4
Darlington 4	1993	935	95.1	84.4
<b>Total/Average</b>		<b>16 900</b>	<b>83.3</b>	<b>80.1</b>

*COG CANDU/PHWR Performance Indicators, December 2004*



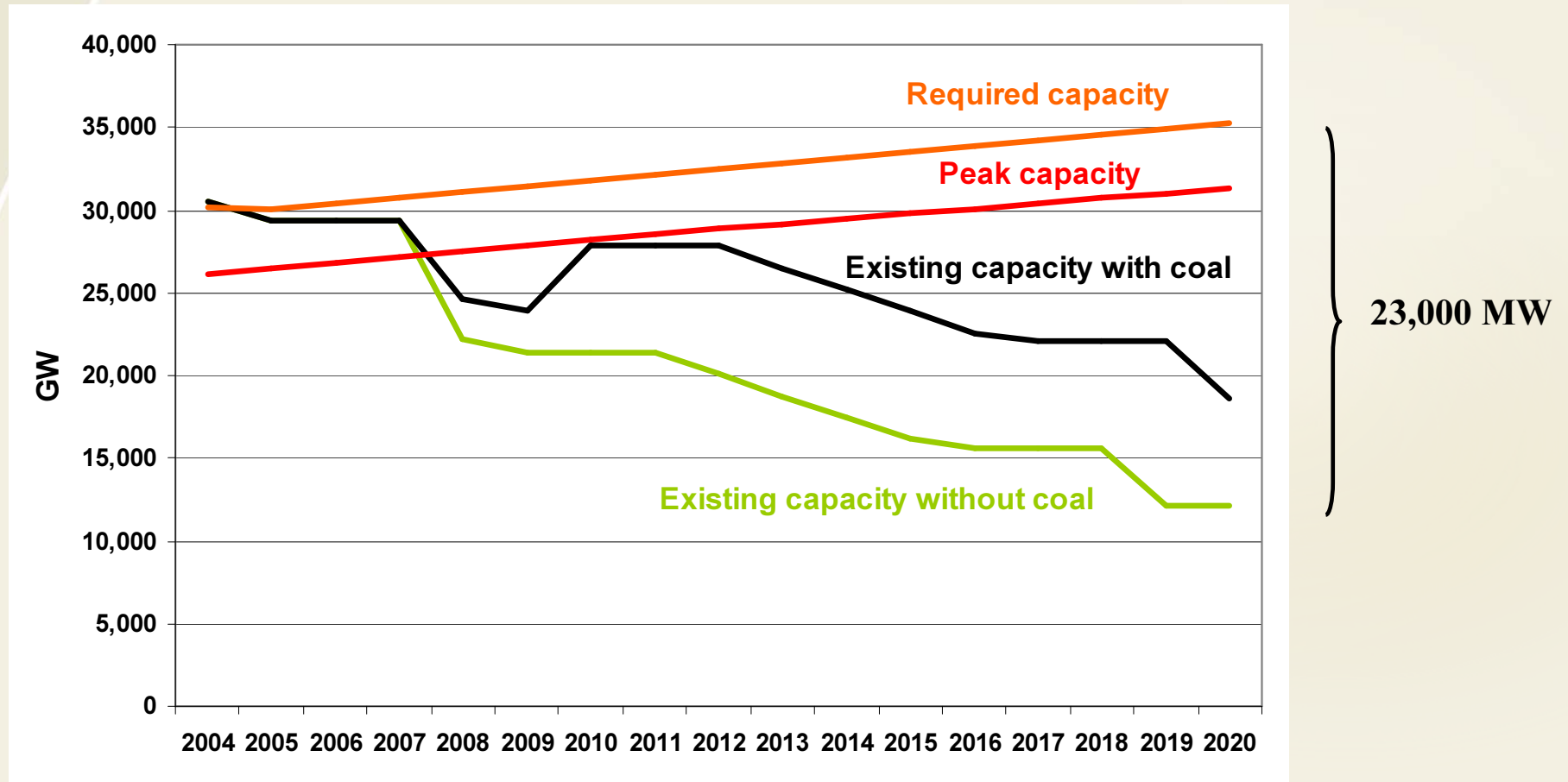
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# Potential Ontario Gap



Source Data: Ontario Ministry of Energy; National Energy Roundtable  
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## Domestic Market

- Refurbishment Decisions
  - Point Lepreau
  - Bruce A (4 units)
  - Others decisions to come
  - Utility investments announced in 2005: about \$6B CDN
  
- Opportunities for new nuclear
  - Ontario supply mix being studied by the Ontario Power Authority
  - Longer term possibilities, e.g., oil sands
  - Linked to long-term technologies (hydrogen production)





## International Market

- Uranium
- Isotopes
- CANDU 6 units: Korea (4), China (2), Romania (2) and Argentina (1)
- Refurbishment of existing units (Wolsong 1 and Embalse)
- Potential for new reactor sales (CANDU 6 & ACR)





# Outlook for Nuclear Energy

- We are witnessing a noticeable turn-around
- Forecasts show new baseload will be needed in Canada
- Baseload options limited in Ontario (few remaining hydro projects and coal phase-out policy)
- There are challenges as we move forward:
  - Aging R&D infrastructure and investment in R&D
  - Innovative solutions and partnerships needed to finance new reactor construction
  - Regulatory considerations, long lead times for approvals
  - Maintaining and developing skilled workforce





## Closing Remarks

- Nuclear energy remains an important option for meeting Canada's future energy needs as well as meeting our air quality and climate change objectives.



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