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The Emerging Big Picture: The External Factors Influencing the Canadian Nuclear Industry

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Introduction

- **The Current State of Affairs**
- **The Boundaries**
- **The Big Picture Issue**

No new nuclear capacity is being planned in North America. The current contribution of about 20% of total electricity production from nuclear plants will inevitably decline over the next twenty years, unless new plants are built.

There is "great uncertainty" about the future of existing plants.

An era of cheap electricity, driven by low natural gas prices and the expansion of coal-fired plants, is at hand. Most of the concern is now focused on "stranded assets" in the new, deregulated world. Among the assets that may be "uneconomic" are recently-built nuclear plants.

Environmental uncertainty is growing in all directions - GHG as a threat to the world's climate, capacity to handle nuclear waste, operations of current facilities.

The Boundaries

In this presentation, the boundaries will be restricted to North America - US and Canada, with the possible inclusion of Mexico when we discuss electricity.

Discussions of uranium markets, fossil fuels, environmental issues, etc. should be, of course, on a global basis.

The Big Picture Issue

Will there be any nuclear generation of electricity in 25-50 years in North America?

The US story: "No new nuclear units are expected to become operable by 2015, because natural gas and coal-fired plants are more economical." EIA-1997, p.52

50 units retire by 2015 (38% of current nuclear capacity). This cuts nuclear generation to 10% of the total from 20%.

A similar pattern will merge in Canada unless new nuclear plants are scheduled (25% to 15%)

Economic Driving Forces

- **Low Inflation**
- **High Real Interest Rates**
- **Slower Growth in North America**
- **Rising Environmental Concerns**
- **Deregulation of Almost Everything**

Low Inflation

Requires stable or declining nominal prices. Management mistakes are much more visible.

High Real Interest Rates

Kept high in order to keep inflation low. Acts to discourage long-term investments, shortens horizon for planners, investors, and governments. Large capital-intensive facilities can be a relative disadvantage.

Slower Growth in North America

Reduces cash flows, raises premium for good management decisions, need for excess capacity reduced, longer lead times for new capacities.

Rising Environmental Concerns

"The other [the anti-nuclear lobby], surely, has to accept that by abolishing nuclear energy tomorrow, one cannot un-invent it and forget about the problems of waste, spent fuel and the concomitant dangers of nuclear terrorism. Acting like the proverbial ostrich may be good for the ego but not for the environment. " [Beck, p. 110]

Deregulation of Almost Everything

Markets for electricity, other energy forms, deregulation of transportation, communications, etc. All that matters is the "price".

Sector-specific Factors

- **Demand for Electricity**
- **Alternative Supplies**
- **The Cost of Energy**
- **Deregulation of the North American Electricity Markets**
- **Privatization of Electric Utilities**
- **Safety Factors**

Demand for Electricity

Preferred fuel for many purposes, unique for others. Likely to grow more rapidly than other fuel types, and only slightly less rapidly than overall economic growth.

Alternative Supplies

With low natural gas prices, co-gen is attractive (low capital costs and high proportion of fuel costs). Similarly, coal where local emissions are not a problem remains a cost-effective generation fuel. High fixed cost facilities (hydro and nuclear) are less attractive since high real interest rates are a dominant influence on power costs.

The Cost of Energy

Base case view of only modest relative price increases through 2015. Sensitivity to OPEC price shock should not be discounted.

Deregulation of the North American Electricity Markets

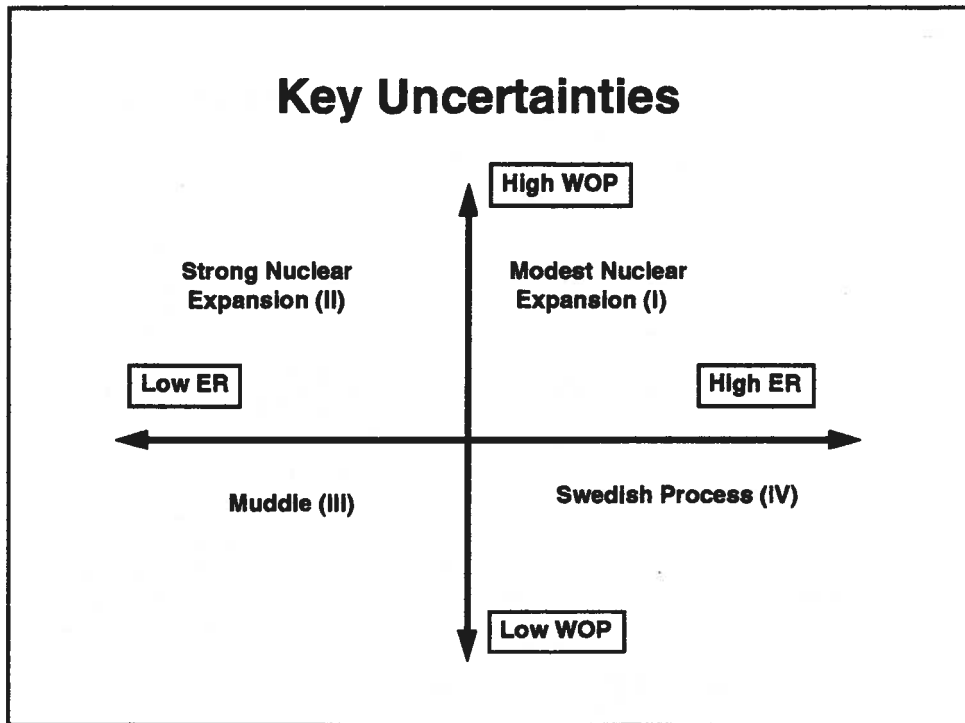
It is happening. Price is all that matters. But are there widening spreads between the costs of short-term power and long-term commitments?

Privatization of Electric Utilities

Separable issue, but likely to be linked among some groups.

Safety Factors:

Safe Mining of Nuclear Fuels, Safe Operation of Nuclear-fueled Power Plants, Disposition of Plutonium and other Military Waste, Safe Long-term Storage of Nuclear Wastes from Generating Plants



Two key Uncertainties

- World Oil Prices (WOP) and other energy prices
- Environmental Risk Assessment (ER) - real and perceived

Expand Nuclear Capacity - High WOP

- For Canadian Needs Only (I) High ER

Replace existing plants and add additional base plants as needed to maintain optimal mix.

- For North American Demand (II) Low ER

Add additional nuclear plants to serve the NA market, or bring on earlier new capacity ultimately slated for the Canadian market.

Muddle - Do Nothing Until? (III) Low WOP, Low ER

No new nuclear plants, no closedowns until necessary, new supplies from cheapest source at the time (likely NG).

The Swedish Process(IV) Low WOP, High ER

Actively de-commission plants before their useful life has been completed. Substitute with other forms of electricity generation.

Expand Nuclear Capacity (I & II)

- **For Canadian Needs Only**
- **For North American Demand**
- **Higher fossil-fuel prices**
- **Perceived risks of nuclear fuels lowered**
- **Demand for electricity grows**
- **New capacity put in place in Canada with US electricity market also served**
- **Scale depends on US actions re nuclear supplies**

Higher fossil-fuel prices could come from a rise in **OPEC** prices, pushing up petroleum prices and therefore competing fuels. The other source could arise from **social pricing** of coal, oil, and natural gas, reflecting the full costs to society of acid rain, greenhouse gases, and other environmental consequences.

A "clean" end-use fuel, with the capacity to use it as a point-source for heating and hot water, lead to increased substitution away from oil and natural gas. Computerization, the electric car, and multi-media entertainment penetrate much more rapidly than assumed.

Successful implementation of long-term storage of spent fuel and the prompt fixing of FSU nuclear reactors avoids another Chernobyl occurrence, allowing the public support for nuclear generation to be rebuilt. Sufficient uranium supplies are available and waste facilities can be expanded in a timely fashion.

Muddle - Do Nothing Until? (III)

- **Continuing relatively low fossil-fuel prices**
- **No environmental actions re GHG**
- **Temporary storage of nuclear fuel continues**
- **No nuclear disasters in FSU, but ...**
- **Natural gas generators becoming widely disbursed, with some actually making use of waste heat**
- **Existing nuclear capacity phased out in US and Canada**

Although this scenario might be thought of as a transition from one to another scenario, it essentially reflects the setting of the last ten years.

Continuation in this mode leads eventually to the nuclear generating capacity disappearing as existing plants reach their planned lives.

Darlington in Canada and Watts Bar I in the US are the last two facilities to close around 2035.

The “Swedish” Process (IV)

- **Heightened concerns about nuclear safety lead to an earlier phase-out of nuclear generation facilities**
- **FSU reactor leaks lead to hysteria about nuclear risks**
- **Pace of phase-out conditioned only by the availability of alternative power options**
- **NEB directs Canadian natural gas to domestic generation use as a priority before exports**
- **All Canadian nuclear facilities closed by 2010**

One of the major constraints to a rapid phaseout of nuclear generation is the need to replace the capacity with a fossil-fuel or other source of electricity. In Canada, as part of the response, more rapid development of the remaining large hydro sites in Labrador, Quebec, Manitoba, and BC could be undertaken.

But this may not be enough. Gas exports to the US are expected to grow rapidly, with much of this fuel destined to the generation of electricity. If Canadian needs are more pressing, then the NEB could limit gas exports. (If some believe that this can not be done under NAFTA, then perhaps we should sort this issue out, before there is a 50% increase in NG exports!)

It should be noted that gas-fired electricity generation is expected to grow quite rapidly in the “muddle-case” in Canada, increasing its share from 3% to 10% by 2020.

In this case a share of 30% by 2010 would be required, less whatever can be provided incrementally from coal, hydro, and other sources.

Using Scenarios

- **Dealing with Uncertainties - GHG, temporary storage, permanent disposal, OPEC prices**
- **Discuss scenarios - develop several others**
- **What do you need to know?**
- **Discussion of scenarios does not require that anyone “believe” in a view.**
- **Rather it is a process of “holding a thought” and understanding its implications**

Dealing with uncertainties

Environmental uncertainty - GHG, operations of plants, “temporary” storage

Supply Price Uncertainty - OPEC

Nuclear Waste Uncertainty - Long-term disposal

“..scenarios are a set of reasonably plausible, but structurally different futures. They are conceived through a process of causal, rather than probabalistic thinking ...” (Kees van der Heijden, p.29)

What are some other scenarios?

Is there a technological breakthrough that transforms nuclear generation? “Inherently safe” or “forgiving” cycles? [Beck, p.104]

Can storage and safety be handled in a more acceptable manner?

Once you have the scenarios at hand then they can drive the search for options, the development of strategies, and the on-going strategic conversations that are so important to the success of a modern organization.