ENERGY DEVELOPMENT AND FUTURE OUTLOOK

for

Standing Senate Committee on Energy, the Environment and Natural Resources

by

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GROWTH IN GLOBAL DEMAND FOR ENERGY

- The International Energy Agency (IEA) based in Paris projects that global primary energy demand to increase by 1.7% pa from 2000 to 2030, reaching an annual level of 15.3 billion tonnes of oil equivalent. The increase will be equal to two thirds of current demand.
- Nearly 70% of the increase in world primary energy demand and almost all the growth in energy production between 2001 and 2030 will occur in developing countries and the transition economies. Energy investment needs will be greatest and increase most rapidly in those regions
- The world will remain heavily reliant on traditional forms of energy. Though renewables are expected to grow from a low base, they cannot displace fossil fuels as the over-riding source of energy in this time scale. Fossil fuels are expected to supply over 90% of global incremental energy demand through 2030.
- Gas consumption will double between 2000 and 2030 in view of its cost competitiveness, ample availability and environmental advantages.
- Oil will remain the largest fuel source with demand increasing by 1.6% pa. The worldwide global demand for oil has grown by 150% since 1965 and is projected to grow by 50% more in the next 20 years.

UNCONVENTIONAL SOURCES OF ENERGY

- The growth in global demand for oil comes at a time when the supply from relatively cheap conventional sources is declining, and reserves are not being replaced with new discoveries.
- The world has over twice as much supply of heavy oil and bitumen than it does conventional oil. Not including hydrocarbons in oil shale, it is estimated that there are 8-9 trillion barrels of heavy oil and bitumen in place worldwide, of which poten-

tially 900 billion barrels of oil are commercially exploitable with today's technology.

- Canada alone has 175 billion barrels of bitumen reserves that can be processed with today's technology, making it second only to Saudi Arabia in proven oil reserves in the world.
- Canada has one of the largest supplies of hydrocarbons in the world and is the 5th largest energy producer in the world (considering hydroelectric and nuclear along with fossil fuel production) and is a net exporter of energy. This exports of energy accounts for from 6 to 10 % of Canada's GDP.
- Most of the energy consumed in Canada comes from fossil fuels (oil: 32%, gas: 24% and coal: 13%).
- Canada also has huge coal resources. Nova Scotia, Saskatchewan and Alberta currently count on coal for 70% of their electricity needs. In Ontario, which relies on coal for 25% of its electrical power, the current government has committed to phasing out coal-fired electricity generation within three years. The lack of any obvious near-term solution in place for filling the gap and meeting new demand has caused dismay among major industrial power consumers in Ontario, who predict declines in industry competitiveness and an increased cost burden on homeowners.
- A basic technology does exist to produce electricity from coal and other low-value carbons with virtually no harm to the environment, and at the same time to create new value-added products from coal such as hydrogen, natural gas and feedstocks (raw materials) for the petrochemical industry. The challenge now is to finance the development of the alpha technology into robust, reliable, large-scale commercial applications.

"TECHNOLOGY OIL" – THE OIL SANDS AS A CASE STUDY

- The Canadian oil sands industry has had remarkable success in using technological innovations to spur major growth and create value from these vast resources. The oil sands represent an important case study for the breakthroughs that can culminate from aggressive public and private investments in research and development and field trials.
- The Athabasca is the single largest oil sands deposit, occurring from the surface to a depth of 750 m. In surface mining applications at depth of up to 100 m, new technologies include truck and shovel mining, cold-water extraction, slurry pipelining, mechanical separation and the potential recovery of by-products.
- In *in situ* operations in the Athabasca, Cold Lake, Peace River and Lloydminister deposits, commercial operations have emerged using cyclic steam stimulation, cold production, and steam assisted gravity drainage (SAGD). VAPEX, the solvent analogue to SAGD, is in the piloting phase.
- Significant advances have also been made in 'enabling' technologies such as horizontal well drilling, multilateral well technology, instrumentation, automation and

telemetry, 3-D and 4-D seismic, pumping systems for sand and fluids, and reservoir simulation and prediction techniques.

- These breakthroughs have been the culmination of **aggressive public and private investments in research and development and field trials**, and have led to a heavy oil and oil sands industry on the verge of a major growth period.
- Several factors have made investments in oil sands very attractive given world oil prices above about $25 U.S. per barrel WTI. There are no "finding costs" since the oil sands are well delineated. There is ready access to the largest market in the world, the U.S., via established pipelines. New technology has reduced operating costs by at least a factor of two.
- The current production of bitumen and synthetic crude oil from Alberta averages 1 million barrels a day and, by 2005, oil sands production is expected to represent 50% of Canada's total crude oil output, and 10% of North American production. Given existing and announced investments (over $50 billion U.S.) as well as projects under development, production is expected to triple to 3 million barrels per day by 2020.

OVERCOMING ECONOMIC AND ENVIRONMENTAL BARRIERS

- There is an increasing cost for natural gas, currently the fuel of choice for steam generation, upgrading, heat, and power. This comes at a time when natural gas supplies have reached their peak and are expected to decline. Currently oil sands operations consume 5% of Canada's natural gas supply. With growth in production and without fuel substitution, it is expected that oil sands operation will be using approximately 1 billion cubic feet of gas per day, or the major part of the Arctic gas expected to come to market over the next 10 years.
- There is a significant dependence on water used for thermal cooling in electricity generating plants such as coal fired, natural gas and nuclear and for oil and gas production from both conventional and unconventional resources. Although most of the water is recycled, there is still about 20% of potable make-up water that is required, and this creates concerns over the need for conservation and sustainability.
- The amount of energy required to produce a barrel of synthetic crude oil is about a third of the energy in a barrel of bitumen. This makes oil sands operations large single source emitters of greenhouse gases. The need to reduce CO_2 emissions, as concern about climate change grows and reduction targets come into effect; add considerable additional risks to investments.
- The investment costs and time to bring typical large projects such as clean coal plants and oil sands projects, into production is also a major risk. The cost of clean coal plant is approximately $1.5 billion for 500 MW plant and is about 30 to 50% higher than the cost of traditional coal burning. Typical oil sand mining, extraction and upgrading projects require about $4 billion investment to produce 100,000 barrels/day of high quality refinery ready synthetic crude oil.
- As production of upgraded oil increases, there is a strong potential for market limi-

tations for exported synthetic crude oil. This is because of the high aromatic content of the synthetic crude oil produced from bitumen, and U.S. refineries are currently not designed to mix more than 10 to 15% into their conventional crude supply to meet end product quality specification.

TECHNOLOGY INTEGRATION – THE KEY TO THE FUTURE

- There is a growing recognition that solutions to the pressing global energy needs and the challenges described above emerge when we understand the energy industry as one interconnected system, integrated horizontally along the various energy sources and vertically along the value chain.
- This integrated energy approach resists the temptation to argue for any one type of solution and assumes that no one single source of energy will be sufficient to meet world demand.
- A good example, of technology integration in the oil sands is the Opti-Nexen Long Lake project, which represents the future of Canadian oil sands expansion. This project uses SAGD technology to produce the bitumen, with the interesting feature that no natural gas is consumed to supply the high energy demand for steam injection and upgrading. Instead, the bitumen is deasphalted and the bottoms gasified to produce hydrogen for upgrading the deasphalted crude, steam for SAGD production, along with power and heat sufficient for all operations.

THE ENERGY INNOVATION NETWORK

- To address the challenges of ensuring an abundant supply of environmentally responsible energy, a process is well underway in Canada to construct a network organization and facilitate a long-term (20- to 25-year) effort to implement an integrated energy innovation strategy.
- This collaborative initiative (known as EnergyINet) is being built on the premise that strategic investment in a balanced portfolio of energy innovation – with a focus on common technology platforms and points of leverage across the portfolio – has the greatest potential for returns in economic, environmental, and social terms.
- Given the rich diversity of resources available in Canada and in other parts of the world, and the need to maintain a competitive energy supply while ensuring environmental protection, the best investment strategy appears to be at the forefront of shifts in energy systems:
    - From a reliance on conventional oil and gas recovery, to emerging unconventional sources such as oil sands and coal bed methane
    - From conventional coal burning to near-emission-free clean coal technology
    - From a relatively low to a much higher proportion of renewable and hydrogen energy options in the mix of energy production
    - From a focus on separate energy sources to an integrated energy system.

- The transformative strategy that is being implemented through EnergyINet speaks to an important scenario for the world's future energy economy. The goal is to highlight the innovation needed together with government policies and actions to stimulate such a transition and establish scenarios to inform priority areas for technology development.

INVESTING IN RESEARCH, TECHNOLOGY AND INNOVATION

- Energy is important to Canada because it sustains manufacturing jobs in Ontario, provides employment in Newfoundland and is a source of significant revenues that sustain our lifestyle across Canada. Our economies have been built on the presumption of relatively cheap and readily available energy. We are rapidly reaching an era where we would lose our natural global advantage to Europe and China and India – unless we are ready to act today.
- Canada has the potential to become the world's leading energy provider. We can provide clean energy technologies to the developing world. We can satisfy the energy needs of our neighbour to the South. We can continue to provide energy that sustains our agricultural, forestry and manufacturing sectors. All that is needed is the will and the willingness to invest in energy innovation.
- With current technologies, Canada will leave almost 40% of natural gas, 70% of conventional oil and 90% of oil sands resources in the ground, un-recovered. Informed industry leaders believe that with a renewed commitment to innovation, the recovery factor can be raised up to 72% for natural gas and 41% for conventional oil. According to the Alberta Department of Energy, this would add to our reserves about 5 billion barrels of conventional oil, 25 trillion cubic feet of conventional natural gas and 100 trillion cubic feet of unconventional gas. At today's prices of around C$40 per barrel and $5/MCF, this would generate an additional $825 billion wealth in Canada. During periods of energy shortages, prices could easily double. The upside potential of production from our heavier hydrocarbons, such as bitumen and coal, is even higher.
- That is why energy research and innovation is our key priority. Energy is also the engine of Alberta's economy. It accounts for approximately one-quarter of our Gross Domestic Product, one-third of the revenue allocated under Alberta's provincial budget and just over half the value of our province's total exports. Energy also employs – directly or indirectly – nearly one in every six workers in Alberta.
- The path from concept to commercialization is a long and arduous one – fraught with dead ends, pitfalls and the lack of staying power. Even the most promising technologies take fifteen to twenty-five years to commercialize. The best approach (proven in development of oil sands technology) is government-industry partnership to share resources and expertise, lower our risks and provide tools with which lead Canada to its destiny of being the world's leading supplier of clean energy in the twenty-first century.