

Oil sands , Kyoto and the Nuclear Option (Rev. 1)

by

Gary D. Lewis

Preface:

This paper was written for an international and Canadian readership so please consider that some statements that are obvious to a Canadian may not be meaningful for a non Canadian. Other ideas presented can better be understood by Canadians. This paper has been revised from its original version in light of the publication of “Twilight in the Desert” by Matthew Simmons (Wiley Publishing) and “High Noon for Natural Gas” by Julian Darley (Chelsea Green Publishing). At the time this paper was being revised hurricane Katrina was hitting the southern US states. The content referencing hurricane Hugo was not changed to Katrina to reflect the issue of how hurricane’s have been known for some time to effect gas prices.

Author’s notes:

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Energy to make energy

Over the past few years there has been a continued debate on the issue of the Kyoto protocol. With the Canadian government's ratification of Kyoto and recently announced \$5 billion CO2 reduction initiative there is a concern about lost jobs here in Fort McMurray, Alberta, Canada.

It seems both environmentalists and industry is heading for more confrontation with more entrenchment on both sides and little room for compromise. Each side has its own statistics and line of experts that they can draw upon. One can only listen to the radio stations in Edmonton and Calgary regarding these issues.

I and a few others believe there is one possible solution to this dilemma where we can at least move in the direction of reducing CO2 emissions in accordance with Kyoto and not harm the gas and oil production in Alberta. In fact it will help the gas and oil industry in the long run.

One solution is to go to Nuclear Power for the support of the oil sands development.

The following are some good reasons to go to nuclear power in aid of oil production in the Fort McMurray Area. (In order of least to more importance.)

- Helps employ Saskatchewan uranium miners.
- Employment for Atomic Energy of Canada Limited (AECL) and all associated with the nuclear industry.
- Saves natural gas
- Kyoto compliance

There is one statistic that may have a dramatic effect on the whole oil sand industry that can be best illustrated by the following approximate equation.

$$\mathbf{1\ bbl\ (equivalent\ energy) = 2\ bbl\ oil\ (refined)}$$

1 barrel of equivalent oil of energy (**in the form of natural gas**) is needed to produce 2 barrels of refined oil.

This leads to the seemingly ironic conclusion that we presently need to burn fossil fuels (natural gas) in order to get to and process other fossil fuels just so we can burn them.

This is kind of crazy, economically and environmental when you really think about it.

There are other extraction methods (oil out of the sand) that are more energy intensive Such as “SAGD” mentioned later that makes the above equation closer to: (bbl is short for barrel =45 us gal)

1 bbl (equivalent energy) = 1 bbl oil (refined)

Or worse

Greater than 1 bbl of equivalent oil energy goes to produce 1 bbl of oil

There has been a misconception that the oil sands are a free energy source but the above equation contradicts that. (Ref. note 1.)

One statistic that people love to mention is the huge reserves of oil 1.7 trillion barrels of oil. But this statistic does not mention how much energy it takes to get it out of the ground upgrade it and into a pipeline.

The whole oil sand industry is in large part dependent on the value difference between the left hand side of the above equation and the right hand side. Because oil sand companies get more money for the refined sweet oil from the right side of the equation as opposed the cost of production from the left side, it follows the oil sand industry exists otherwise there would be no oil sand industry at all.

The oil Sands Industry uses 1 Billion standard cubic feet of natural gas per day.

Natural Gas Issue:

Nuclear power would conserve natural gas recourses in several ways such as.

- Reduce or eliminate natural gas consumption for the production of hot water in the separation process of extracting the oil from the sand. This can be accomplished using the waste heat from a nuclear plant.
- Reduce or eliminate the use of natural gas consumption for the production of electricity. The electrical energy would come from a nuclear plant.
- Reduce or eliminate the use of natural gas consumption for the heating of homes.

The use of electricity for the heating of homes and industry would come from nuclear power. The heating of homes by electricity can be done more efficiently than natural gas through the use of heat pumps. This would be like getting free energy. Manitoba Hydro and BC hydro is a great promoter of heat pumps for their conservation program.

(ref note 6.)

- Reduce or eliminate the present government energy subsidy to home owners. The Alberta provincial government can use these funds for much needed health care or infrastructure.

- The reduction in natural gas consumption used in the oil sand industries could displace the use of coal for the production of electricity in those areas where nuclear is not a politically correct option (not "yet" anyway) such as in California. This displacement has been done in Florida where an electrical utility switched from coal to natural gas for the environmental reason of cleaner air alone.
- The excess natural gas could be sold to the Americans.
- The excess natural gas could be sold to Ontario were the Ontario government has taken the bold step in committing to closing the coal fired plants by 2009. This is the displacement that has been done by a Florida utility (www.tecoenergy.com).
- Cleaner air will lower health care costs. In 2000, the Ontario Medical Association published a report which calculated that air pollution to which coal is the biggest contributor was causing \$10 billion in health-related costs and 1,900 premature deaths in Ontario per year.
- Global natural gas production will peak around 2020. (Ref. note 7).

Increased oil production

Oil sand production is dependent on the temperature of the hot water used to separate the oil from the sand. The higher the better, 80 deg. C gives better recovery of oil than 30 deg. C.

But the reason to keep the water temperature down is the cost of natural gas but also to keep carbon dioxide levels down. (ref note 1).

If nuclear power is used there is no reason to hold down water temperature because it produces no carbon dioxide. The only other reason to hold down water temperature is to save nuclear fuel. But because nuclear fuel represents a small portion of the total cost of a nuclear plant, it's more economical to run at higher temperatures and thereby produce more oil.

There are a number of web sights that can explain the cost of nuclear better than this paper can such as www.ecolo.org www.cna.ca and www.aecl.ca many others just follow the links.

It's important to state that there are two types of deposits of oil sand. One is close to the surface and the other is deeper where it is accessed by an "in-situ" process (in place).

One In-situ method is "SAGD" which stands for "Steam assisted gravity drainage" Where 2 pipes are used one over the other drilled deep into the oil deposit, steam is injected into the top pipe and the oil (bitumen) is drained and collected into a the second pipe below and is pumped to the surface. The steam is usually created from natural gas. Only about 10% (max) of the oil sands is accessible by surface mining the other 90% is accessible by the in-situ process.

Capping of Natural Gas wells

The Alberta Energy and Utilities Board (EUB) has made tough calls on the issue of gas vs. oil (or bitumen) in ordering the capping of 330 of the regions 938 wells that were considered to be a threat to extracting oil (bitumen). The reason for the threat is beyond the scope of this paper and can best be explained by the Alberta Energy and Utilities Board and or the oil sand producers.

In the words of a EUB spokesman Tom Neufield;

“This is the most significant energy conservation issue in the 75-year history of the board. The mandate of the EUB is to ensure that Alberta’s energy resources are conserved not wasted”. (Ref note.15)

The Mackenzie valley Pipe line.

Imperial Oil ltd. wishes to construct a pipe line from the Mackenzie delta to northern Alberta. This would supply the much needed natural gas for the North American market but especially for the oil sands industry. This is becoming a strategic issue especially in the light of the capping of natural gas wells.

First Nation Concerns

Lately a second Aboriginal group has filed suite to try to stop hearings into the proposed \$7 billion Mackenzie valley pipeline. Robert Freedman is the lawyer representing about 2,500 Dene Tha’ whose members are on several reserves in north-western Alberta, northern eastern British Columbia, and southern end of the North West Territories (NWT).

This is a very complex issue involving a number of parties, aboriginal groups, private companies, and the governments of Alberta, NWT, local native bands and federal authorities. It also involves treaty rights. Treaty No. 8. is of particular importance.

It’s important to note for non Canadians not familiar with Canadian constitutional law that the Canadian Supreme Court has upheld treaty rights starting in 1973 and with the repatriation of the constitution and entrenchment of the treaty rights in the constitution.

Therefore laws or regulations passed by any government may be deemed unconstitutional and may be subject to legal challenge.

I must defer to Mr. Freedman or any other lawyer familiar with this branch of law. It is important to note that Mr. Freedman has said that his clients are not apposed to development, but want a say and a share of benefits.

A good model to go by is the relationships that have been developed between First Nations and Governments in other parts of Canada. One good example is the Nisichawayasihk Cree Nation of northern Manitoba and Manitoba Hydro has reached an Agreement in the development of the Wuskwatim hydro project.

Environmentalist issue:

A report by Stephen Hazell of The Sierra Club of Canada states that the Sierra Club opposes the Mackenzie valley pipe line but they have stated that even if the project is approved at the end of the process and the Mackenzie valley pipe line goes forward then the Sierra Club argues that Canadian governments must among other things guarantee that natural gas will displace carbon-intensive fuels such as coal and oil and is not used to fuel expansion of tar sands development.

Even in Stephen Hazell's paper it is stated that the Mackenzie Gas Project "could release \$100 billion or more in committed capital spending on new and expanded tar sand mines." (Ref. note 16.) This figure is now at about \$60 billion. So this figure of \$100 billion is not out of the question. If the Sierra Club wishes to send all of the natural gas to the USA to aid the USA for conversion from Coal to Gas but does not have a plan in place to find a replacement for the natural gas needed for the processing of the oil sands, then this would effectively choke off all of the oil sands from its much needed natural gas energy supply. The whole idea that the oil sands industry would be "choked off" from the natural gas supply would be politically impossible to implement. It would be viewed by many here in Alberta as an economic disaster. Even if the Americans would gain this new large source of Natural Gas, they would lose out in much lower oil imports from Alberta and thereby really on even more imported oil from the middle east. The recommendation by the Sierra Club or by some of its members to choke off the oil sands industry without recommending an alternate energy source only alienates their cause in the eyes of the public. This in turn only marginalizes even further environmental groups like the Sierra Club, Green Peace and Friends of the Earth.

It's not just the marginalization that is happening but cynicism is starting to set in.

The Sierra Club is completely correct in wishing that all the available natural gas be sent south to convert the coal fired plants to natural gas in the US.

I support this idea completely.

However where we differ is in the solution, that being Nuclear Power.

My recommendation is to use nuclear power to supply this missing energy for the oil sand industry.

If nuclear power is not used to support the oil sands production then with a price of crude going to \$70 per barrel this would promote more oil sands development and therefore the size of this natural gas pipeline may enter Alberta's northern border will be large enough to carry the 1.2 billion cubic foot per day. However after the oil sand companies tap into this pipeline and use the majority share then by the time it gets to the USA border it would be the size of a soft drink straw.

All or most of the natural gas would be used for oil sands development.

The Sierra Club and other environmental groups are blinded by their own dogma against nuclear power. Cleaner air and lower CO₂ and SO₂ levels can be achieved. They must accept the conclusions that other environmentalist are coming to

“nuclear power is an option”.

Greenpeace Founder Patrick Moore Testified before the U.S. Congress on the Benefits of Nuclear Energy.

“I believe the majority of environmental activists, including those at Greenpeace, have now become so blinded by their extremist policies that they fail to consider the enormous and obvious benefits of harnessing nuclear power to meet and secure America’s growing energy needs. There is now a great deal of scientific evidence showing nuclear power to be an environmentally sound and safe choice. A doubling of nuclear energy production would make it possible to significantly reduce total GHG emissions nation-wide. In order to create a better environmental and energy secure future, the U.S. must once again renew its leadership in this area.” Patrick Moore

The Energy Information Administration of the US government has stated that the long term outlook for natural gas looks good. There maybe some short term supply issues but with the development of liquefied natural gas imports from various sources. The EIA has stated that the Mackenzie valley pipe line is a new source of natural gas for America.

I would strongly recommend to the EIA and any energy planners in the USA do not make the Mackenzie valley pipeline a part of any long range plan for natural gas supply. Most if not all of it will go to oil sands development.

The EIA and others can of course revise this plan if nuclear power is used either for oil sands development or a resurgence of nuclear power in the USA.

The Cost

It was the inexpensive and abundant natural gas available in the late 70's that "kick started" the whole oil sands industry.

The cost of natural gas has been increasing. So the left hand side of the above equation gets larger. But the right side of the equation gets larger too and at a faster rate with oil reaching a possible price of (some say) \$100.00 a bbl. This would only promote even more oil production development in the Middle East. Saudi Arabia and other countries are presently close to peak production.

There could be pressure put on Saudi Arabia by the US to add production capacity in order to stave off an "oil induced" recession. With the supply and demand principle this could mean a levelling of oil pricing.

With the cost of production in the middle east much lower than in Alberta the Saudi's can contribute to the world's oils supply faster and from newer sources especially from sour crude.

This increase of production from Saudi Arabia is now called into question in light of Matthew R. Simmons Book. "Twilight in the Desert". Mr. Simmons basically states that Saudi Arabia does not have the oil reserves it claims to have. The text under the main title on the cover of the book reads

"The Coming Saudi Oil Shock and the World Economy."

If this is true then this would undoubtedly put Alberta in the number 1 position for known oil reserves.

However one analyst stated on CBC radio on the morning of May 4th 2005 that oil could go back down to \$30.00 a barrel. This \$30.00 a barrel has been mentioned by other economists as well. It would be interesting if this analyst still holds that same view in light of Mr. Simmons book.

It has once been said that:

"Money is a coward".

With the capping of some natural gas wells and the delay of the Mackenzie valley pipe line will only make some investors balk, especially those willing to invest billions of dollars.

On the bright side most analysts agree that one can still make a profit even at \$30.00 a barrel (wishful thinking by oil consumers)

It has been said in the past that Saudi Arabia does not like too high oil prices because if it hurts economic development in those countries that show great potential for being new oil consumers such as India and China to mention a few. (Ref. note.5) Again in light of the book "Twilight in the Desert" do the Saudi's really want this.

The demographics of Saudi Arabia have changed drastically in the last 50 years.

What is needed in the oil sands industry is a need to be insulated from sudden increases in natural gas prices. A CEO of an oil sand company could be deeply concerned about a hurricane that hits the southern US because of the effect it has on natural gas prices.

This had happened in the past with hurricane Hugo. Hugo did have an effect on gas prices. California has an insatiable demand for energy and a number of natural gas fired plants are being built to meet the demand. This puts an even greater pressure on higher natural gas prices and gas reserves. This idea of being insulated from natural gas prices and its volatility is not a new idea.

The president of Opti Canada (an in-situ oil sand company) Syd Dykstra had said in an interview describing the process his company uses.

“Through the integrated project, we supply virtually all our own natural gas requirements. Natural gas prices go up and down.” “It’s cheaper depending on where the price is, but we’re insulated from those fluctuations.”

If Canadians accept the principal that gas prices will be based on a world or North American price, then we can expect no price fall with natural gas because of the demand for natural gas in the USA. If we have a regulated lower price just for the oil sand industry this would be like producing a false economy (Ref. note 4). Natural gas producers need to get full market value for their product.

Historically, there has been a close connection between natural gas and oil prices, though this has been disconnecting as the market for natural gas has developed. Therefore it is not easy to construct a price series for gas, unlike the situation with oil, which has well-developed markets in several places around the world.

I obtained price data from the Energy Information Agency (EIA), a branch of the Department of Energy in the USA. This shows the link between gas and oil prices in the USA, since 1972.

During the Seventies there was a strong correlation between the two prices. This has gradually been unravelling over the course of the Eighties and Nineties, as the following table shows, and during the Nineties the relationship appears to have broken down. What has been happening in the eighties and especially the nineties is that relative gas prices have been catching up on oil prices.

Table 1

Correlation Between Oil and Natural gas Prices in the USA, 1972 to 1997	
Period	Correlation coefficient
1972 – 1997	0.75
1972 – 1980	0.91
1980 – 1990	0.75
1990 – 1997	0.05
Source: Based on EIA data	

Table 2

Year	The coast ratio of 1 barrel of oil compared to 1000 cubic feet of natural gas
1972	19
1980	18
1990	13
1997	8

Source: Energy Information Administration, Annual Energy Review 1997, DOE/EIA-0384(97). (Washington, DC, July 1998). (Ref. note 13)

The figure for 1980 shows how inexpensive natural gas prices “kick started” the oil sands industry. The ratio of 18 to 1 looks a lot better than 8 to 1.

If one were to compare the calorific content of gas and oil (energy content), then gas has been historically under-priced. This produced the de-coupling of the price relationship. The natural gas price has been drifting up to a price that reflects more closely its relative calorific value. This is confirmed by the EIA figures. In terms of calorific value, crude oil was just over twice as expensive as gas in 1972. This gap has been on a downward trend, until the early Nineties, since then the price ratio has hovered around one, though with a fair amount of year-on-year variation. In other words, the relative price of the two fuels now roughly reflects their respective calorific values. This makes sense when one thinks about it.

This is what one would expect as the gas market has become more developed, with more suppliers and a wider range of users.

It is because of the above, that coal is looking more like an attractive alternative. (See “is coal an alternative?” heading) (Ref. note 12).

One way to insulate the oil sand industry from higher Natural Gas prices would be to go to Nuclear Power. The energy in the form of uranium would come from a secure source like Saskatchewan Canada.

Using nuclear power for the oil sands development is not a new idea. It was looked at before but it was the cheap natural gas in the early 80’s that did not make it an economical option. The economics of course has changed.

Canadian Energy

Cheap electrical power in Canada has been a major reason for our standard of living. Nickel production and aluminium production are heavily depended on cheap hydro electric power. It is the cheap power that allows those industries to prosper; unfortunately this is not the case in Alberta Canada. There is no cheap hydro electric power in Alberta.

In the case of a commodity such as nickel there is so much nickel in the Goro deposit in the south pacific (New Caledonia) that it could supply all of the world’s nickel production for the next several years.

The reason why this production has not displaced nickel production in Canada is because of cheap hydro electrical power in northern Manitoba (cheap hydro is INCO’s Ace card).

Canada has been for a long time the highest consumer of energy per capita then any other country.

An example of how a synergy happens with one industry and another as a result of inexpensive energy is the nickel concentrate that comes from Australia to the port in Montreal and then by rail to Winnipeg Manitoba and then north to Thompson. A very long way indeed. I understand that the unloading facilities in Montreal were already paid for in part by the aluminium smelters in Quebec to bring in the bauxite ore. The reason for the aluminium smelters in Quebec was as a result of Quebec's low cost Hydro power. So the employment that results in northern Manitoba is of course because of cheap power in Manitoba but also because of cheap power in Quebec.

With nuclear power oil sand companies could benefit from lower costs of purchased electrical energy and/or the oil sand companies would purchase not just the electrical power but purchase the hot water produced by the nuclear plant. This could lower electrical bills for the public because the purchase of the hot water could subsidize the cost of production of that electricity from a nuclear plant.

The Hydrogen economy

- A portion of the natural gas that would have been used for hot water production in the oil sands can then be used in the production of hydrogen.

The production of hydrogen is taking place currently in the oil sands industry and is used in their upgrade process.

Syncrude has announced the world's largest single train hydrogen plant with a capacity of 200 million standard cubic feet per day.

Most or all of this hydrogen production will be used in their UE1 program but just perhaps the technical expertise that is being developed can help kick start a new hydrogen economy. It's just a thought but excess hydrogen from facilities like these could be used for transportation in the form of hydrogen powered cars or fuel cells (Ref Note 9.)

- The steam that is required to produce the hydrogen from natural gas could come from a nuclear plant.
- Or electrical power generated from a nuclear plant could be used in the production of hydrogen through the electrolysis process. (Ref. note 8)
- Stored hydrogen can (and is) be used for backup power for telephone and computer backup systems. (Ref note 9)
- There was a wonderful program on public television regarding Hydrogen power narrated by the actor Alan Alda for Scientific American Frontiers. This program talked about the coming hydrogen economy. I was left with the question,

“Where will all of the Hydrogen come from”?

- Manitoba Hydro has great potential in developing hydro power in the north and sending this power to the USA. Michigan is a good destination point where the governor of that state has expressed a keen interest in developing a hydrogen economy there. (Ref. note 10)
- Hydrogen can be produced by the conversion from aluminium powder to aluminium oxide. The aluminium acts like an energy transfer media. The spent energy to form the aluminium oxide is sent back to its source, that is the aluminium smelter where the original electrical energy came from hopefully a non GHG source such as Hydro or nuclear or wind. I understand zinc can be used in the same way. (ref note 17)
- Rutgers University is developing nanotechnology that converts ammonia into Hydrogen with the ammonia coming from natural gas. The natural gas of course is the feed stock for Methanol production and ammonia production. It has been said that ammonia would make a good transfer media for hydrogen because of its solubility in water.
- The CEO of Ballard a maker of fuel cells stated.

“It’s not a question if we move to a hydrogen economy but when”.

Hydrogen from Nuclear

The problem of power generation has always been matching power output to demand. If for example you have 2 generators at 500Mw each and one is operating, that is just meeting the demand and with any slight increase in demand such as a person plugging in his toaster then the second 500Mw unit must come on line. This seems like a lot of extra power just for one toaster ☺

However if you have a nuclear reactor with all of its units running at full power 24hr per day 365 days per year (with some scheduled maintenance times). The power from this plant can then be split between the power grid and water electrolysis units that produce the hydrogen.

For example, at 2am in the morning most of the power generated would go to the water electrolysis because the demand from the grid is low.

During peak hours 100% of the power from the nuclear plant would go to the power grid with additional power from hydrogen fuel cells, using the hydrogen that was made earlier. Any excess hydrogen can go to power cars.

Because of the advances made in communications of today this is quite possible. Once sensors on the power grid sees an increase in power needs the electrolysis machines can be taken off line. And once the sensors see the nuclear plants cannot

meet the power needs during peak periods the fuel cells would come on line.

If the nuclear plant gets a good price for all the power it produces, no matter what time of day, then the capital cost for building the nuclear plant would be paid down that much faster. At a price of just .04 cents per Kwhr. Then for a 1000 Mw plant this would be $0.04 \times 1000 \times 1000 / \text{Mw} \times 24 \times 365 =$

\$350 million per year. The cost of the upgrading the nuclear plant and cost of the fuel cells and water electrolysis units could be paid for in 10 years.

- While producing hydrogen from electrolysis a by product would be the generation of heavy water with virtually no additional energy expenditure. This can be achieved by using AECL's CECE (Combined Electrolysis and Catalytic Exchange) technology. The production of the hydrogen can offset the cost of the heavy water. Or the end hydrogen user can sell the heavy water to the CANDU owner and there-by offset the cost of the hydrogen.
- Oxygen is a by-product of electrolysis that can be used for many industrial processes again offsetting the cost of production of hydrogen.
- South Korea and the United States will work together to develop a next-generation nuclear reactor that promises to produce large quantities of hydrogen at a low cost, South Korean officials said Wednesday Aug. 17th 2005. The joint project is expected to help South Korea to better prepare for the so-called hydrogen economy where hydrogen will become a major source of energy, according to the South Korean Ministry of Science and Economy.
<http://english.yna.co.kr/Engnews/20050817/440100000020050817150811E0.html>

Will Canada be left behind in pursuit of the hydrogen economy?

- Nuclear power can "kick start" this new Hydrogen economy just as cheap natural gas in the late 70's "kick started" the oil sand industry.

A Value added Economy:

There is a company in British Columbia, MethanX which had used natural gas as a feed stock for the production of methanol. This company has to go out of business resulting in the layoff of 127 employees caused by the high cost of natural gas. The associated ammonia plant will also close as a result. MethanX will produce methanol in other countries where they have long range contracts with natural gas suppliers. Methanol can be used as an energy source for fuel cells.

This shows in this case that natural gas had once had a value added feature where other products had been produced and where infrastructure had been built up around these value added products. It looks like natural gas is more valuable as an energy source than as a means of adding value in the production of new products.

Other countries add value and Canada imports them as finished products. This has been a long standing problem with the Canadian economy with the “hewers of wood and drawers of water” mentality.

Canadians may end up doing the same thing with uranium. Canada would sell uranium to China, Then China would add value in the form of manufactured goods and resell them back to Canadians. As well China has its eye on some Canadian mining companies not just the oil sands.

The Canadian pulp and paper and potash industries are value added parts of the economy that will be hurting with higher natural gas prices.

The whole value added portion of the economy is a complex issue.

Just perhaps, with nuclear power we could displace enough power in the production of oil from oil sands that natural gas prices will fall low enough to restart methanol plants like MethanX. There is a large domino effect that Canadians will be missing out on if natural gas prices remain high.

This is just a thought but if the methanol plant has gone out of business because of the high natural gas prices in BC, is it possible to open a methanol plant in the NWT at the source of the natural gas where the NWT government could negotiate a long term contract with companies like MethanX. The 127 jobs lost in BC would be re-gained in the NWT. This is the sustained development that the people in that area are looking for and not just the sort term construction job that the Mackenzie valley pipe line would give.

Making the Canadian economy a diverse economy by adding value to our natural resources may show signs of weakening. One sign of this weakening is the look at the recent relationship the Canadian dollar has with the energy (oil) sector as indicated by the comments of Marc Levesque, chief North American foreign exchange strategist at TD securities INC. He said the Canadian dollar has been moving almost tic-for-tic with oil in recent weeks, giving it almost “petro-currency” status. Marc Levesque goes on to say

“The correlation throughout the day is nothing short of stunning”.

Canadians have a habit of shooting themselves in the foot. We invent, design and develop great technology but we have this habit of not recognizing it or downplay its importance or sell it off. The I-MAX film format, computer graphics software like “Softimage”, the jetliner, the electron microscope,

Hydrofoil navy ships and of course the most notorious example is the Avro Arrow fighter plane. There is a danger that some future Canadian anti-nuclear government would kill off the Canadian CANDU reactor in the same way that Diefenbaker killed the Avro Arrow.

If the Koreans and the Americans are successful in developing a hydrogen producing technology from nuclear energy, will future Canadians find themselves purchasing hydrogen for their hydrogen power cars that are designed and built in America or Korea. Will this hydrogen be produced from a nuclear reactor designed in America built in Korea and installed in downtown Toronto?

But of course we Canadians would sell them the uranium. (“wowie woobteedoo”)

What’s next, we can sell to China the tree logs (with the bark still on) from the BC forests and they come back in the form of lumber (2 x 4’s and plywood)?

Kyoto

The oil sands are projected to be the largest single addition to Canada’s greenhouse gas emissions with 70 Million tonnes by 2010.

Scientist and environmentalist James Lovelock and author of the Gaia Hypothesis have a persuasive argument about global warming and the need to go to Nuclear Power. The web site www.ecolo.org has more on James Lovelock and www.oceansonline.com/gaiaho.htm has good info on Gaia.

When I was in Edmonton Alberta I was listening to a talk radio program. The topic was Kyoto and CO2 emissions. One caller said that “Carbon Dioxide is not a pollutant.” I thought that this was vary amusing because as James Lovelock states carbon dioxide is an essential part of Gaia, its just too much of it. (One can take morphine to kill the pain but just don’t too much of it.)

Because of nuclear this would result in lower CO2 emissions that are compatible with Kyoto. There would be a net decrease in CO2 emissions and therefore move toward the principles of Kyoto.

The oil sand production has a by-product called coke which is a coal like substance. Presently some of this coke is being used as a fuel to heat a coker along with natural gas. The coke as a fuel is a contributor to CO2 and some sulphur dioxide.

If there is trouble in securing a reliable source of energy for the oil sand processing then pressure to increase the percentage of coke used as a fuel would likely increase. This would happen as a result of too little or too expensive natural gas. Presently a good portion of the coke is stock piled. (but for how long)

Again this burning of coke could be eliminated by nuclear power. The heating of the coker can be done by electrical heaters (induction heaters could work well).

The Americans have not signed onto Kyoto but perhaps they can be onboard in a backdoor way. Perhaps Canadians can make a deal with our friends to the south.

One idea is that natural gas sold to the Americans used to replace coal fired plants could be sold but at a reduced price, or at market value with a rebate. This may not be possible because of NAFTA (North American free trade agreement). One fascinating idea is Canada could get carbon credits for decreased CO2 emissions and thereby approach their Kyoto commitments even though the CO2 is decreased by switching from coal to gas in the USA

(i.e. a CO2 emission is still a CO2 emission whether it be from a Canadian or USA plant).

We Canadians can claim this because the switch from coal to gas is as a result of increased exports of natural gas from Alberta, which was in turn caused by the construction of nuclear plants for the oil sands. This concept of cross border carbon credits could even apply to Japan because of their interest in oil sands development. JACOS (Japan Canada Oil Sands) is 50 km southwest of Fort McMurray.

So if nuclear power is used by JACOS either by buying the electrical power or waste heat from a nuclear reactor, would this mean a carbon credit is paid to Japan or Canada or both?

The same is true with France where there has been one of the last large investments of Dear Creek Energy Ltd. by Total SA for \$1.35 billion for a 84% working interest with 25% SAGD and 75% surface mining for a production estimate of 200,000 barrels per day by 2020. The French do not have this irrational fear of nuclear power that other countries have as indicated by their 78% of electric power coming from nuclear and the good use they make of this electricity by using heat pumps.

Many in the oil sand industry see the consumers of petroleum as the main producers of CO2 far from the producing areas of Alberta. Visions of people buying SUV's with horse power bragging rights comes to mind. Nuclear power can reduce CO2 at both ends of the same burning candle at the production end and at the consumer end.

The question remains, "Is Kyoto achievable?"

In the words of James Rajotte member of parliament and Conservative party industry critic in responding to the federal government's Kyoto Plan:

"I guess our biggest concern with the new plan on implementing Kyoto that was introduced in May is that it comes nowhere near meeting the targets that they've agreed to."

In the words of Jeremy Brown policy analyst with the Center for Studies in Risk and Environment at the Fraser Institute:

"The theory that Canada will be able to save its economy from the ravages of Kyoto simply by investing in alternative energy sources is a fallacy"

(I'm making the assumption that alternative energy sources are non-nuclear).

Mr. Brown goes on to say;

"So if we skew our energy costs, we can really change our competitiveness globally, especially if your major trading partner isn't doing the same thing. If the cost of energy goes up, suddenly places like China and India and other developing nations that aren't involved in Kyoto will become much more attractive because their production cost are just that much lower. So that's were we get into losing those 450,000 jobs."

Mr. Rajotte and Mr. Brown are both correct.

Nuclear power is the only option available that makes Kyoto achievable and at the same time diversifies the economy and makes it stronger.

Renewable vs. Non-renewable.

Wind Power

One day I read an e-mail news letter that announced a new coal fired thermo plant to be built in Brooks Alberta. This plant has 2 units each having a capacity of 500 Mw with one scheduled to come on line in 2005 and a second 500 Mw plant in 2006.

I found my self sitting there and staring at the computer monitor thinking to myself how this could happen. I looked at an Alberta map and saw that Brooks was in southern Alberta. So I said to myself

“I thought it was in southern Alberta where all these wind farms are.”

I thought that the number one mission for wind power was to prevent new CO2 producing power plants from being built. I then realized this did not happen in this case. Wind power did not stop the Brooks plant from being built. That is if there was sufficient on demand energy produced by wind farms in southern Alberta then there would be no need for the Brooks power plant.

In the news media on science programs etc. we see the skyline full of wind mills and extolling the virtues of clean renewable energy. I would admit to these virtues and I would be the first one to applaud at a ribbon cutting ceremony and would love to be the one throwing the switch connecting the wind generators to the grid (or better water electrolysis units). I wish god's speed for wind farms.

The Brooks coal plant would have never been built if the wind farm could have produced enough power.

Wind power was not able to produce the 1000 Mw required at demand times. With all of the wind farms in California they did not stop or fix the 2001 energy crisis Californians had to go through.

I have this vision in my head, seeing this film crew loading their cameras and equipment in a van and driving out to the wind farm south of Brooks in the Magrath area, taking videos and interviewing the operators of the wind farm and justly reporting the benefits of non green house gas producing power. It would be ironic that this video crew would travel north and pass and view the smoke stacks of Brooks power where one of the reporters would say

“Look at that old coal fired CO2 producing plant. Let's hope that wind power will replace it soon.”

That would be ironic because it's a BRAND NEW, CO2 and SO2 producing plant, and will be producing CO2 and SO2 for some time in the future.

In my opinion, if wind farms are to be build they should never be tied directly into

the power grid. Instead they (all of them) should go to water electrolysis for the production of Hydrogen.

The hydrogen can then be used for hydrogen power cars or stored and later converted back into electricity with fuel cells when the power is needed during peak hours then connected to the power grid. (Ref. note 8 &9)

One can ask the question:

“Can wind power supply the required energy to aid the oil sands production?”

At an energy requirement of 10GW (1 GW, giga watt = 1,000MW, mega watts) (the 10GW is the approximate low estimate amount of power needed for present day oil sand development)

For a wind mill costing 1 million dollars producing 2MW of energy at a wind velocity of 36 Km/hr. one would need \$5 billion dollars for the wind farm. That's 5000 (10,000/2) wind mills at \$1 million each.

This does not sound too bad. However this assumes the wind is blowing at a rate of 36 Km/hr. 24hr per day for 365 days per year, year after year.

The average wind speed in the Fort McMurray Area is about 10Km/hr. with the power output of a wind mill being proportional to the velocity cubed (V to the 3rd power) Then this 2Mw wind mill design would produce $(10^3/36^3)$ times less. (ie when the wind is 1/3rd less in speed it produces 1/27th the power). This would make the power output of this wind mill .0429Mw. Therefore Alberta would need 233,100 wind mills (10,000/.0429) at \$1,000,000 a piece resulting in the need to spend \$233.1 billion for the wind farm.

But the kicker here is this is at an average speed of 10Km/hr. in order to be effective the energy produced when the speed is above 10Km/hr one would need a storage system (hydrogen) in order to produce the energy and send it to the grid when the wind is blowing less than 10Km/hr.

This there-by making the \$233.1 billion look grossly inadequate. Just a thought but how many nuclear reactors can you buy from AECL with \$233.1 billion and how much energy can these reactors produce?

Germany is a heavy investor in wind power and is often quoted by Greenpeace and other environmental groups. However it should be realized that Germany is still a producer of nuclear power. Germany produced 157 billion kilowatt-hours of energy in 2003 with nuclear power (EIA data). and 30% of its electrical power came from nuclear in 1999.

Some plans in Germany still call for the elimination of nuclear power use by 2021. But has the German government made the same commitment that the Ontario government has made in shutting down all coal fired plants by 2009?

The Journey

One can think of a story of a man at the edge of a desert that he has to cross. The side that he is on has water but not renewable he needs to get to the other side of the desert in order to get to a renewable supply of water. But he is foolish and drinks too much too soon and wastes what he has. He realizes that he is getting low on water and starts his journey across the desert carrying what little water he has with him. Just before he gets to the other side he is on his back about to die of thirst. Just before he dies he thinks of all the water he once had many years before he started his journey.

And so we humans on this planet are in a similar situation we need to conserve the gas and even the coal for the long long journey ahead. We can not continue to consume the way we are. Global warming is like the desert and the desert is getting wider and wider. Yes it is true that the Holy Grail is renewable energy but there must be a transition period on the road in getting there.

If one is to use a non renewable energy source let it be nuclear because it does not produce carbon dioxide, carbon monoxide, nitrous oxide, particulates or sulphur dioxide that causes acid rain. (Ref. note 11)

Terrorist attack on a Nuclear site

I'm personally not worried about this in northern Alberta. A CF18 fighter is only seconds away from Cold Lake Alberta. I have confidence in Canada as a vital part of NORAD and can defend against a 9/11 type attack. Any questions about security can best be handled by the department of defence. If we are forced to change our energy policy because of mere speculation of a terrorist attack, then that would be falling into the terrorist game plan. Besides, what makes one think that the existing oil refineries and up graders are not on the some terrorist hit list.

Nuclear safety and Waste

In Canada the issue of nuclear waste is presently being handled by the Nuclear Waste Management Organization, visit www.nwmo.ca for more details. There are other web sites that can better explain this issue of safety such as www.ecolo.org or www.cna.ca and www.aecl.ca just to mention a few.

But for me it's surprisingly simple:

For the estimated 500 years the nuclear waste will be too radioactive to handle or even at 1 million years the emissions of carbon dioxide, carbon monoxide, sulphur dioxide and nitrous oxide by nuclear waste will be **Zero.**

The rest of the world will not say that the oil sands industry solved the nuclear waste issue because they did not use nuclear power. The issue of nuclear waste is here and can be handled in a responsible way.

Even if we wave a magic wand, where all of the power from the 436 nuclear reactors world wide will come from some new non CO2 producing source on demand we would still need to handle the present nuclear waste in a responsible way. This is being done already.

When we humans have destroyed the Florida everglades and all of the low lying cities like New York and the islands of the Maldives because of global warming, then the nuclear waste issue will seem like a vary small issue indeed. The issue of global warming maybe so great that we may need to access the nuclear waste for reprocessing for future energy use.

What worries me is the amount of cynicism that inevitably develops in people regarding justifying or rationalizing their actions. When the Florida everglades are underwater some people will say

“I could care less about some alligator in Florida”

or when the Maldives are underwater some will say:

“The people of the Maldives knew about global warming for some time.”

“They should have made preparations to evacuate years earlier.”

Is Coal an alternative?

With all of the above about natural gas, the forced capping of the wells and the Mackenzie valley pipe line stalled in court it is becoming clear to some, coal may be an option.

If coal would come north in large amounts to heat the water and generate the electricity this would mean an ecological disaster for all of northern Saskatchewan, Manitoba, the Canadian arctic and possibly Ontario.

There are approximately 100,000 lakes in northern Saskatchewan and Manitoba and about 200,000 lakes in Ontario. These lakes produce many jobs for commercial fishermen and is considered a part of the national identity by all Canadians. The aboriginal people of northern Canada who's lives have been affected by past and present development.

I can not speak for the aboriginals but I'm sure they would not trade the environment for brief prosperity. This, in part is an emotional point for me because my ex wife is a native Cree and is from northern Manitoba and I recall the hardship caused when development is not done in a responsible systematic way without the active involvement of first nations from the start. (e.g. Churchill River Diversion and the NFA northern flood agreement.)

The threat of acid rain killing off these lakes is too terrible to think of. Even if we were to think that all of this coal is clean coal "low sulphur content" the potential for harm is staggering. The amount of energy needed to replace the natural gas would be 10,000 Mw (10Gw) this would still result in Sulphur Dioxide released into the air (acid rain) It would be like having 10 Brook size power plants.

BC (British Columbia a province west of Alberta) has a coal industry that has been hurting because of decreased exports of coal to Japan as a result of Japan's switching to nuclear for its Kyoto commitments. So the coal industry has its eye on the oil sands of northern Alberta as a good customer for its coal. The coal industry knows that the huge investments in the Oil Sands require a long term know stable costs.

They (coal producers) know just as all of us that natural gas prices are uncertain for the long term especially its ratio with oil prices See table 1 above.

Jake Epp is the chairman of OPG (Ontario's Power Generation) said: "I know that province (Alberta) uses its cheap coal to make power and sells its gas elsewhere for higher returns", "This is a whole story Canada needs to understand".

Even if one could argue that Alberta is not exporting its natural gas but saving it for oil sands development one still reaches the conclusion that "Alberta" is saying;

"If no one else wants our coal then we might as well burn it ourselves".

I wish to congratulate Ontario for committing to closing down all its coal fired plants by 2009 (Ref. note 18). We, all of us from the first nations to the Manitoba and Saskatchewan fishermen to the tourist sites of northern Ontario must stop any thought of coal power plants being built in northern Alberta.

Action Plan : Nuclear for Ontario or Alberta

Ontario has been committed to no coal fired plants by 2009 (bravo!) and is looking at nuclear as an option because of the fluctuations in natural gas prices. If a reactor is built in Ontario then a demand for natural gas from Alberta would fall and no need to run the coal fired plants past 2009 as some would want. Also the gas consumers of Ontario would need to compete with America for natural gas if it were not built. The gas would flow to the highest bidder.

If however nuclear would come to Alberta then it could release more natural gas onto the market and possibly stabilize the price. This could delay new nuclear plants in Ontario. But the payoff would be greater in Alberta because it would help produce oil.

The percentage of oil produced for the Canadian market from Alberta is increasing and the rate would likely increase with nuclear power in Alberta.

Ontario can still build new nuclear plants but if this is tied to hydrogen production as stated above then this can only help the new hydrogen economy and the Canadian Auto industry as well. The by-product would be cleaner air and lower health care costs.

We need to go to Nuclear power for the oil sands industry the sooner the better. The amount of nuclear energy required to do this is awesome. Using the lowest calorific value for natural gas at just 900 BTU's /cubic foot this would require 10Gw (Giga watts of power) (or 10,000 Mw) of power.

Alberta could require the building of 16 reactors like Atomic Energy of Canada's ACR 700 or CANDU 6. These could be spaced throughout the oil sand deposits in northern Alberta to make use of the heat recovery from the steam turbines and would be great for the in-situ process for oil recovery. Even reactors like the AECL's SES10 slow poke reactor can help. The heating of water can be done with nuclear for the potash industry in Saskatchewan to save natural gas. AECL can have a reactor up and running in less than 5 years.

Just think how much CO2 these reactors can displace.

The start-up costs for these reactors can come in part from the \$5 billion federal governments Kyoto's initiative.

The Oil sand companies would have a predictable stable energy source not subject to market fluctuations or unexpected gas price increases (i.e. hurricanes in the Caribbean remember Hugo).

Edmonton and Calgary will benefit from lower electrical and heating bills because the waste heat purchased by the oil companies would subsidize the cost of the electricity.

The natural gas that is saved from the oil sands could be used for hydrogen, methanol or ammonia production.

Our American friends to the south can benefit from a new source of natural gas. Imagine a small American child suffering from asthma can breathe easier because a US utility switched from coal to natural gas. (remember the Florida utility). Many people in the Canadian province of Ontario would agree.

And as a tribute to professor and environmentalist James Lovelock and I'm sure he would agree,

Gaia will be healthier too.

Reference:

Note 1.

There has been some very good advances in the in this area in the above equation when in 1982 there was about 2 million Btu's of energy used for 1 barrel of oil. Where due to efforts have decreased and is planed to decrease more. Visit Sycrude's web site www.mysyncrude.com for more info.

Note. 2

The demand for energy in the US is so great that a saw mill in the province of British Columbia can make more profit by selling its own hydro power to the US, than use the power to run the mill. (There-by laying off Canadians that work at the mill).

Note. 3

It is unlikely to happen that cheap oil would come back. If we do produce so much oil that it starts to effect market share for Saudi Arabia, then there could be a backlash. That is OPEC could over produce in order to keep market share. A low cost producer such as Saudi Arabia will always gain market share over the higher cost producer (oil sands) if supply meets demand is met by the low cost producers. I think we here in Alberta do not have to worry about this. At the time of this writing US president Gorge Bush has met with the Saudi's where news reports has stated there is planned increase in oil production by the Saudis in the future.

Note. 4

There was a case before the fall of the communism in Poland where the price of bread was subsidized so much, that hog farmers would at times buy all of the bread from the local bakery. Then they would take it back to their farms and feed it to their hogs leaving the local people without bread if they didn't get to the bakery before the farmers did. The excellent book by James Walsh book "The \$10 billion Jolt" (Silver Lake Publishing of Los Angeles.) is a good example of how a false economy can and does happen please read paragraph 1, 2 and 3 on page 226. Please read page 231.

Note. 5

This was stated on CNBC program in a resent interview with the Saudi oil minister.

Note. 6

A heat pump is something like a refrigerator run backwards a heat source that can come from underground or lake bottom or a nuclear cooling pond where heat can be pumped into your home. For more information on heat pumps visit www.heatpumpcentre.org .

Note. 7

From the book The Hydrogen Economy by Jeremy Rifkin (page 169). This makes a good read.

Note. 8

A Canadian company, Stuart energy systems (recently acquired by Hydrogenics) visit www.hydrogenics.com for more details.

Note. 9

Ford's ICE engine is a good example. Visit <http://www.ford.com/en/innovation/engineFuelTechnology/hydrogenInternalCombustion.html> for more info.

There is a good article on Ford's hybrid and Hydrogen vehicles in the February 05 issue of Machine Design Visit www.machinedesign.com

Ballard is a leader in fuel cells visit www.ballard.com for more info.

Note. 10

Ford and BP this year also announced a major initiative aimed at moving the US even closer to a Hydrogen economy. Ford plans to produce up to 30 more hydrogen-powered vehicles, while BP will build a network of fuelling stations in California, Florida and Michigan to support them.

Note. 11

Some may dispute the definition of non-renewable when it comes to Nuclear because of the breeder reactor design (next generation).

Note. 12

Please read James Walsh book "The \$10 billion Jolt" page 96 2nd paragraph. (Silver Lake Publishing of Los Angeles.)

Note. 13

Please read James Walsh book "The \$10 billion Jolt" page 233 6th paragraph. (Silver Lake Publishing of Los Angeles.)

Note 14.

When I was in college in the early 70's one of the students designed and built a wind mill that would turn an old car generator. It was quite primitive by today's standards but it showed the interest that students had in the area of clean air long before we all knew the word "Kyoto". This wind mill was to go on the roof of Algonquin Collage in Ottawa but ended up at the professor's cottage ☺

Note 15.

Info from publication "extracting energy" (winter 2004). This publication is available from the "Discovery Center" in Fort McMurray Alberta. For more info visit www.eub.gov.ab.ca

Note 16.

From EA Reporter issue 10 spring 2005.

Note.17

Checkout web site www.hydrogenpowerinc.com
for hydrogen from aluminium as energy transfer media.

Note.18

The planned closing of all of Ontario's coal plants will start soon $\frac{3}{4}$ will be out of service
by 2007 and the remainder by 2009.

Related Web pages:

Company web sites

www.suncor.com	www.syncrude.com
www.albiansands.ca	www.cnrl.com
www.uts.ca	www.truenorthenergy.com
www.petro-canada.ca/oilsandsand	www.jacos.com
www.longlake.ca	
www.opticanada.com	
www.nexeninc.com	
www.devonenergy.com	
www.synenco.com	www.huskyenergy.ca
www.imperialoil.com	www.dearcreekenergy.com
www.encana.com	
www.conocophillips.com	
www.shell.ca	
www.deercreekenergy.com	
www.methanex.com	

Government web sites and energy web sites

www.eub.gov.ab.ca	Alberta energy board
www.oilsandsdiscovery.com	educational center
www.fortmcmurraytourism.com	for tourism
www.woodbuffalo.ab.ca	for local government
www.woodbuffalo.net	for labour market
www.ceaa-aacee.ga.ca	Canadian Environmental Assessment Agency
www.acr-alberta.com	Alberta Chamber of Resources
www.ceri.ca	Canadian Energy research institute
www.peakoil.net	The association for the study of peak oil and gas
www.energy.ca	Energy council of Canada
www.centreforenergy.com	Energy info center
www.eia.doe.gov	USA energy information agency branch of Dept. of Energy
www.energy.gov.on.ca	Ontario government energy (for coal policy).
www.nrcan-nrcan.gc.ca	Natural Resources Canada

Pipelines

www.enbridge.com	Hydrogen web pages
www.pembina.com	www.ballard.com
www.terasen.com	www.hydrogenics.com
	www.hydrogenpowerinc.com

Nuclear power
www.ecolo.org
www.cna.ca
www.aecl.ca
www.nwmo.ca
www.nei.org

Environment:
www.oceansonline.com
www.mackenziewild.ca
www.greenpeace.ca
www.sierraclub.ca
www.bigskyco2.org
www.greenfacts.org

Books

“High noon for Natural Gas”

www.chelseagreen.com/2004/items/highnoon

“The end of oil”

http://www.alibris.com/search/search.cfm?S=R&qwork=7989028&qsort=p&siteID=Pw2LQAj_zJk-kkQNqhwUS2K5DzMFVmA7xg

“Twilight in the Desert”

<http://ca.wiley.com/WileyCDA/WileyTitle/productCd-047173876X.html>

“The \$10 billion Jolt”

http://www.silverlakepub.com/catalog/product_info.php?products_id=108

“The Hydrogen economy”

<http://www.amazon.com/exec/obidos/tg/detail/-/1585421936/104-1611306-5293548?v=glance>

Magazine Articles

“Generating Hydrogen with Nanotubes”

By Sandia National Laboratory

From Machine Design April 14, 2005 page 46

“Heading toward the hydrogen economy”

By Paul Dvorak

Machine Design Sept. 16, 2004 page 92

“Power Plant takes on a new meaning”

By Lawrence Kren

Machine design Sept. 16, 2004 page 100

“Automakers drive toward a hydrogen powered future”

Edited by Sherri Carmody

By: Research and Advanced Engineering Team

Ford Motor Co. Dearborn Mich.

Machine Design Feb. 17, 2005 page 110