In the Red:
The Green Behind Nuclear Power

By Heath Packman

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About the Author

Heath Packman holds degrees from the University of Regina in Economics and History. A writer and researcher of public policy, Heath spent six years working alongside the key Ministers of the Calvert administration in the Ministries of Industry, Finance, and Advanced Education and Training.

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Introduction

In December of 2009, the Saskatchewan government — following extensive consultations through the Perrins' Commision — announced that they would not pursue the construction of a nuclear reactor in the province. The primary factor motivating the government's decision was the uncertainty of cost in the development of nuclear power. Energy and Resources Minister Bill Boyd, evaluating the economic case for nuclear power, stated that "worries about the impact nuclear power generation would have on consumers' power bills was a chief factor in the Saskatchewan Party government's decision."[1] In an interview with the *Saskatoon Star-Phoenix*, Premier Wall observed that the cost of upgrading the province's transmission system to accommodate the large scale of a reactor, the uncertainty around the ability to export power and the relative cost advantage of natural gas had all contributed to the government's concern with the cost of nuclear power.[2]

Despite the government's concern over the costs, Saskatchewan's business community — led by the Saskatchewan Chamber of Commerce — remains fully committed to the development of nuclear power in the province and continues to campaign on its behalf. Speaking for the Chamber, Steve McLellan argued that the government had not based its decision on "good economics," but had rather succumbed to fears of nuclear power's expense without taking into account future carbon taxes and "escalating infrastructure costs for any type of new power supply."[3]

With the release of *In the Red: The Green Behind Nuclear Power*, the Saskatchewan Office of the Canadian Centre for Policy Alternatives hopes to add some clarity to the argument over the true costs of pursuing nuclear power in our province. Throughout this study, Heath Packman endeavours to critically assess the merits of the business case for nuclear power in the province, taking into account a myriad of economic factors that have rarely been considered in public debates over the costs of nuclear energy. Through this careful analysis, Packman concludes that the province can ill-afford the economic costs associated with the construction of a nuclear reactor. We at the Saskatchewan Office of the CCPA trust that the arguments made within this report will further bolster the case for the development of clean, safe and sustainable power generation as a means to secure Saskatchewan's future energy needs.

Simon Enoch
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In the Red: The Green Behind Nuclear Power

The importance of reductions in greenhouse gas emissions, and in carbon dioxide levels has become a major public policy issue. Although nuclear power remains a controversial topic, the enticement of a reliable source of baseline power with low carbon emissions is intriguing. This has allowed the nuclear industry to rebrand itself as a solution to global warming. However, the promise of cheap, reliable power remains ever illusive. Nuclear power has never stood on its own economic legs and has always relied upon generous public subsidies, tax concessions and government guarantees. Nuclear facilities are wildly capital intensive and construction is extremely complex so delays greatly add to the cost long before any revenue is generated. For more than 50 years nuclear advocates have consistently over-promised and under-delivered. Nuclear advocates continue to propose that governments should provide massive subsidies to nuclear construction, provide unlimited liability insurance, and assume most of the decommissioning costs rather than furthering gains in new renewable technologies and industries of the future. The opportunity cost of throwing vast sums of public money into nuclear power is too great since the technology has yet to demonstrate a solid return on investment and that more economically feasible solutions can be found in other technologies and sources of energy.

Despite this record, here in Saskatchewan the argument has been made that nuclear power can be a cost-effective form of future power generation for the province. In the following pages, the economic case for nuclear power in Saskatchewan will be critically assessed, with a thorough examination of the key players and potential economic costs involved. With a clear idea of all the costs that nuclear power entails, we can then determine whether the construction of a nuclear reactor here in Saskatchewan can be considered a prudent energy option for the future.

The Players

While certain provinces own their nuclear power plants, Bruce Power has become the first private nuclear generating company in Canada and it has made clear its desire to bring nuclear power to Saskatchewan. Bruce Power's opportunity to construct a nuclear reactor in the province came on October 20, 2008, when the Saskatchewan government announced the creation of the Uranium Development Partnership (UDP).[4] According to the government news release, the UDP's mandate was to "identify, evaluate and make recommendations on Saskatchewan-based, value added opportunities in the uranium industry."[5] The UDP report states that initial construction expenses are one of the major capital costs of building a nuclear power plant. History has often shown these projects are capital intensive and notorious for construction delays and cost overruns.[6]

On March 31, 2009 the UDP submitted their recommendations including one supportive of nuclear power as a solution to Saskatchewan's future energy needs. In spite of the fact that most members of the UDP panel either work for or are strong advocates of the nuclear power industry, the final report notes no nuclear project in Canada has gone forward without significant public investment.[7] Citing cost as the primary concern, the Saskatchewan government announced at the end of 2009 it had opted not to participate in the construction of a nuclear reactor.[8] Therefore if Bruce Power wants to pursue construction of a nuclear reactor, it would have to do so without the province as a key financial backer.

Bruce Power is Canada's only private nuclear generator and the only company currently interested in building a nuclear reactor in Saskatchewan. The company was formed in May of 2001 and includes TransCanada, Cameco, Borealis Infrastructure Management, the Power Workers' Union and the Society of Energy Professionals as its investors.[9] TransCanada is a leader in development of North America's energy infrastructure. The company has a pipeline network which runs through Canada, the United States and Mexico providing energy throughout the continent. TransCanada currently holds 31.6 per cent of Bruce Power.[10]

Cameco is another shareholder in Bruce Power. The company is one of the world's largest uranium producers responsible for over 15 per cent of global uranium production. Cameco's expertise is in uranium mining but it is also active in the enrichment process, providing fuel for the nuclear power cycle. The company is headquartered in Saskatchewan and has a 31.6 per cent direct interest in Bruce Power.[11]

Borealis Infrastructure Management is a group of investment professionals that invest and manage large-scale infrastructure assets. With the financial backing and resources of one of the largest public pension plans in Canada, the Ontario Municipal Employee Retirement System, Borealis Infrastructure is provided with stable capital and the ability to take a long-term approach on all of its investments.[12] Through these achievements Borealis has a 31.6 per cent share in the Bruce Power Partnership.[13] The Power Workers' Union (PWU) is another shareholder. The PWU represents employees with expertise in electricity generation transmission, distribution, regulations, research and development. In total it holds a four percent investment in Bruce Power.[14] The Society of Energy Professionals represents more than 7,000 professional employees in the electricity industry in Ontario. Its members include engineers, scientists, supervisors, and finance specialists.[15] As of 2002 the Society of Energy Professionals holds a 1.2 per cent interest in the Bruce Power Partnership.[16]

The Infrastructure

A major consideration for the future is our province's aging energy infrastructure. The majority of Saskatchewan's electrical infrastructure was built 30-50 years ago.[17] These vital systems require constant upgrades, replacement and expansion. Over 60 per cent of our current energy generation capacity is derived from fossil fuels (chiefly coal and natural gas).[18] With new environmental regulations being drafted by the federal government, SaskPower believes the continued reliance on fossil fuels as a major source for power generation will become impracticable.[19] New regulations will also carry with them reductions in GHG emissions, sulfur dioxide content, nitrogen oxides, mercury and particulates.[20]

SaskPower has calculated the estimated cost to rebuild, replace, or acquire 4,100 megawatts (MW) in generation and transmission infrastructure by 2030 will be $1.8 billion and can be achieved in three stages:[21]

- 2009-2014 – supply requirement of 1,091 MW
- 2015-2022 – supply requirement of 1,017 MW
- 2023-2032 – supply requirement of 1,985 MW[22]

SaskPower points out that demand has grown by an average of 1.3 per cent per year over the last decade.[23] If forecasts provided to SaskPower by their large-scale industrial and commercial customers are accurate, by 2019 the system peak will increase by 1,104 MW to 4,318 MW, an average growth of over 110 MW or 3 per cent per year.[24]

In order to meet these targets current conservation projects are expected to deliver 100 MW of savings by 2017.[25] SaskPower also estimates 10-15 per cent of energy savings can be found in the industrial market, 50-60 per cent from the commercial market, and 30-35 per cent from the residential market.[26] SaskPower has also begun to meet these needs through a 20 year agreement to purchase 261 MW of power from Northland Power once its newly constructed natural gas-fired plant is completed.[27] Manitoba and Saskatchewan are also working to increase the number of megawatts they are able to exchange with a goal of reaching 250 MW (currently the two provinces can exchange about 100 MW).[28] This agreement will strengthen the grid between the two provinces and increase the possibility of more green energy because it spreads out the financial risk of power generation like wind power and could lead to the extension of a national or continental grid.[29]

As stated earlier, these increases in capacity will have to be met with decreases in emissions. Policy makers in some provinces have proposed carbon taxes, cap and trade, or hybrid systems as a way to reduce greenhouse gas emissions. The use of market mechanisms to foster environmental sustainability is not foreign to Saskatchewan. The creation of SARCAN in 1988 to recycle used beverage containers has prevented 4.3 billion beverage containers from being dumped in the environment.[30] A review of SARCAN's environmental impact shows recycling in 2008-2009 generated energy savings of 240,511 MW and was responsible for the removal of 47,816 tonnes of carbon dioxide.[31] These benefits are in conjunction with the added economic benefits of local employment and the sale of recycled materials.

According to the Pembina Institute (August 2009), Saskatchewan is responsible for 9 per cent of Canada's overall emissions, but contains only 3 per cent of the national population.[32] If carbon taxes, cap and trade, or a hybrid system were to be introduced it is believed the impact to

Saskatchewan's economy would be a total of 2.8 per cent in overall GDP growth between 2010 and 2020. Essentially this would cost the province 0.28 per cent of future economic growth for a decade.[33] Saskatchewan has indicated it will comply with the federal government's reduction targets but will not impose a tax that will hinder the province's competitiveness and investment climate.[34] The provincial government in late 2009 introduced its own plan for a 20 per cent reduction of greenhouse gas emissions by 2020. Operating within the framework to meet national emissions targets, the Premier favours a "cap and research" or "cap and cut" plan through the use of renewable energy, carbon sequestration, clean coal technology, and conservation.[35] It is this point nuclear power advocates seize on because a new reactor would purportedly reduce greenhouse gas emissions, meet climate change targets, and generate a reliable supply of baseline power.[36]

It should be understood that advocates of emission reductions do not believe regulations need be punitive. In fact many environmental advocates point to these changes as opportunities that will create new markets for carbon trading and technologies that can be marketed and harvested for their benefits.[37] A recent report released by the TD Bank Financial Group shows the policy and regulatory actions likely required to achieve the federal government's goal to lower GHG emissions by 20 per cent from 2006 levels by 2020. The report also considers the requirements to reach a more ambitious target of lowering emissions by 25 per cent as proposed by the Pembina Institute and David Suzuki Foundation through a cap and trade system, carbon tax, or hybrid of the two. The modeling in the report by M.K. Jaccard and Associates (MKJA) further shows that implementation of nuclear power causes little to no reduction in GHG emissions.[38] When conducting a deeper review of the numbers, the report also indicates the projected cumulative economic growth between 2010 and 2020 in Saskatchewan will be 26 per cent if no actions are taken to reduce emissions.[39] With the full implementation of either the Federal Government (20 per cent) or Pembina Institute/David Suzuki Foundation (25 per cent) emission reductions the province of Saskatchewan will see cumulative economic growth between 20 and 24 per cent respectively in the next decade. Keep in mind these are future projections and the difference is between 2 and 6 per cent depending on if Saskatchewan follows the federal government or Pembina Institute/David Suzuki Foundation plans.[40] TD Bank does not deny these changes can have a negative impact on the provincial economies of energy rich provinces and acknowledges carbon producer provinces will bear a greater burden.[41] However, TD Bank also says there is optimism to think these impacts could be the effect of an economy in transition rather than a punitive regulatory regime.[42] Herein lies the opportunity for Saskatchewan.

A further look at the TD report shows in order to reach a 20 or 25 per cent reduction in GHG emissions both strategies are significantly reliant upon carbon capture and storage. While the province may be reluctant to discuss GHG reductions due to its effect on the economy, it is quite enthusiastic to participate in carbon capture and storage. The provincial and federal government announced in spring 2008 they would collaborate to develop the world's first and largest commercial-scale carbon capture and storage demonstration project.[43] This was broadened in 2009 by a memorandum of understanding with the state of Montana to develop an international carbon capture and storage project.[44] Secondly, nothing stops the province from exceeding its targets through using carbon sequestration, other technologies or opportunities. The GLOBE Foundation, a Vancouver based not-for-profit organization, conducts research to suggest practical business-oriented solutions to current ecological problems.[45] Their research demonstrates the green economy could be an engine of

growth for the B.C. economy generating more than $27 billion by 2020.[46] According to the GLOBE Foundation the green economy currently contributes $18.3 billion to the B.C. economy, representing 166,000 full-time equivalent jobs (equal to 7.2 per cent of total provincial employment) and $15.3 billion to provincial GDP (equal to 10.2 per cent of total provincial GDP).[47] Saskatchewan generates almost 10 per cent of its overall power through renewable energy and in the next decade it is likely that will increase.[48] Saskatchewan certainly benefits from having the energy sector in the province, but head offices and their jobs continue to remain outside the province. If a similar potential for growth exists in Saskatchewan, investments and incentives in new technologies could be the catalyst for the creation of new energy companies in a greener economy.[49]

Integral to any expansion of energy production is the transmission system and infrastructure. Saskatchewan is in a unique position since the province owns its own power distribution and transmission system — SaskPower. Between 2009 and 2018, SaskPower plans to invest more than $8 billion in the provincial electrical system through upgrades and expansion.[50] If a nuclear power plant were to be constructed in the province, the question must be asked who would be financially responsible for the maintenance and upkeep of its power distribution system? With the provincial government already having a large investment in power distribution, Bruce Power has made it clear it expects there to be a substantial public commitment if nuclear power generation were to go forward in Saskatchewan. In Ontario, the provincial government paid $650 million in order to connect the Bruce Power plant to the Ontario power grid.[51] "The nuclear power company needs stability through a reactor's life and that requires a government backed entity to partner with Bruce Power," Bruce Power Vice-President Dwight Millet told the Greater Saskatoon Chamber of Commerce in the summer of 2009. Millet further added, "We are looking for certainty from your government that if we build a plant there will be a market to sell the electricity. At some stage, we need that kind of agreement."[52]

The Saskatchewan Party government has consistently stated it will not pursue nuclear power in the province if there is not a strong private case to do so. However, Millet's statements combined with Bruce Power's unwillingness to invest any of its own money in a nuclear reactor would appear to bring into question the economic viability of such a project. While it is not uncommon for business leaders to indicate privately or publicly what they need in order to be profitable, it is hard to understand why the public is beholden to them in order to make their business profitable if the technology is as proven and reliable as the nuclear industry regularly claims.

The Economics

Further complicating the matter, major shareholders in Bruce Power have seen their own share prices plummet beginning in the fall of 2008. Below are the stock price values of TransCanada and Cameco on the TSX between December 1, 2007 and December 1, 2009. As can be seen in the chart, at the start of 2008 TransCanada was over $40 per share on the TSX but only a year later its price struggled to stay above $30 per share. Although TransCanada's share price improved to $34 per share, this is still 15 per cent less than the share price two years ago.

TransCanada Share Price: December 2007 - 2009

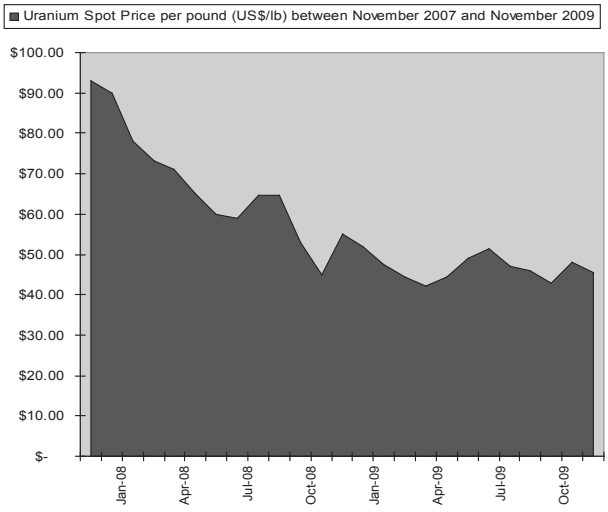
Cameco, Bruce Power's second largest shareholder, has witnessed an even more dramatic decline in share price. Prior to the market meltdown in the autumn of 2008, Cameco's stock had experienced two separate stock splits while the price of uranium remained high. However, in the autumn of 2008 its share price began to decline, a review of Cameco's stock price shows that between December 1, 2007, and December 1, 2009 Cameco's stock price reached a high of almost $45 and a low of near $15. Since then, its share price has rebounded but it is still around 25 per cent below where Cameco shares were just two years ago.

Shortfalls of this nature could significantly affect the capital flow of a company and, faced with these further current challenges, it is likely the companies that hold large shares in Bruce Power are re-evaluating their priorities. With a decrease in stock value and the amount of capital these companies can hold or can borrow greatly diminished, the question of who will actually pay for the construction costs and potential overruns of a nuclear power plant in Saskatchewan becomes even more prevalent.[53]

Cameco Share Price: December 2007 - 2009

At the same time, the spot price of uranium is a further cost consideration. Uranium is after all the fuel source for nuclear power generation and any fluctuation in its price is sure to affect the viability of any nuclear project. Two years ago, the spot price of uranium peaked close to $100 US/lb as seen in data provided from Cameco's own website,[54] and at this price it was easier to see the argument for constructing a nuclear reactor. A low American dollar combined with a relatively high price for uranium meant companies like Cameco had more available capital to invest in various long term projects. A decrease in the value of the spot price of uranium by 50 per cent and a fluctuation in the value of the American dollar versus the Canadian dollar by almost 25 per cent[55] would seriously affect the likelihood of Cameco's ability to invest in a long term nuclear project.

As a way to offset these costs, members of the business community have suggested Saskatchewan would be able to export its surplus power to our neighbouring provinces and the United States.[56] In addition to Alberta and Manitoba it is conceivable that our American neighbours would be interested in our surplus power. However, the



potential export market for Saskatchewan nuclear power should be scrutinized. For instance, the province of Alberta has 11,500 MW of reliable power, and a peak demand of 9,800 MW.[57] Currently the province of Alberta is planning a $14 billion investment in new electrical transmission lines in order to improve their infrastructure and export one per cent of their power to the United States. But there are criticisms that the investment into transmission lines is for the exporting of power to the United States rather than retaining it for domestic shortfalls. The

UDP made twenty recommendations, among them that Saskatchewan should aim to have 45 per cent of our energy needs met by nuclear power by 2020. This will require the production of 3000 MW of electricity and will require that 1800 MW be exported or wasted but to date there does not appear to be a customer to accept this surplus power.

David Erickson, Chair of the Alberta Electric System Operator points out British Columbia, Washington, and Oregon currently have an abundant supply largely of cheap green hydro-electricity. As a major producer of hydro power, Manitoba is already a net exporter of electricity through its membership in the Midwest ISO (Independent Transmission System Operator), an organization whose mandate is to ensure the reliable operation and access to 93,600 miles of interconnected, high-voltage power lines in 13 U.S. states and the province of Manitoba. Members of the Midwest ISO include Saskatchewan's neighbours Montana and Minnesota. The Midwest ISO also manages one of the world's largest energy markets, clearing nearly $41 billion in energy transactions annually. A review of the monthly electricity exports and imports from the National Energy Board show Saskatchewan exported electricity to only Indiana and North Dakota between January and February of 2009.[58] The SaskPower Annual Report from 2008 demonstrates SaskPower's sales of exported electricity decreased from 851 GWh (gigawatt hour) in 2007 to 409 GWh in 2008. This represents a loss of 442 GWh.[59] SaskPower expresses a GWh as being equivalent to the energy consumed by 125 typical houses in one year.[60] Looking at these numbers, when you multiply the 442 GWh loss in 2008 by the number of typical households that consume one GWh, you get a total of 55,250 households. According to a neighbourhood profile of Regina published in 2004, the city has 71,720 households.[61] Therefore the decrease in power consumption is almost equal to the total number of households in one of the province's more densely populated centres. While it is fair to say that as the economy grows so will demand for energy, this undermines the view that there is a critical shortage of power in Saskatchewan.

In Ontario the nuclear industry continues to lobby government for two new reactors saying they are needed in order to keep the lights on. However, over the summer of 2009, Ontario paid power companies to consume surplus energy from its own reactors and exported power to foreign and domestic consumers. To further complicate matters, Ontario's Independent Electricity System Operator predicts electricity demand will continue to drop even as the economy recovers.[62]

Under the regulated utility monopoly that Saskatchewan currently operates, the risks associated with capital constructions costs, operation, price of fuel, and other factors are borne by the consumers rather than suppliers. Large capital costs and long construction periods also mean it is a long time before a return on investment (ROI) by investors is realized. In a liberalized electricity market, such as the United States, these risks are borne by operators, energy suppliers, and their competitors as they compete for business from consumers leading to a significantly different evaluation of the economics of nuclear power plants.

Without the encumbrances of competition, the monopolist provider, (i.e. SaskPower), is able to guarantee output requirements into the future since its consumer demand is guaranteed. This provides a fair bit of stability since SaskPower knows it will always be able to count on a certain threshold of customers. Due to the large upfront investment and capital intensive nature of a nuclear plant, revolving private capital would be challenging to secure. But once these initial infrastructure costs are paid, a nuclear power plant does have among the lowest operating costs, which has always been the mantra of its supporters.[63] It is the initial sticker shock that makes nuclear power investment so risk adverse.

What further confuses people is these initial costs are not always a total "all in" amount. An August of 2007 study done by the Massachusetts Institute of Technology (MIT) demonstrated this stark difference. In their analysis MIT pointed to a story from Reuter's news service that indicated NRG Energy would be building two 1,350 MW reactors at a cost of between $6 and $7 billion, or $2,200 - $2,600 kilowatts per hour (kWh) of capacity in Texas. In contrast, the *St. Petersburg Times* reported Florida Power & Light was planning on constructing two 1,100 MW reactors. The reported cost would be between $12 and $18 billion, or between $5,500 - $8,200 kWh of capacity. The difference between these two costs is the Texas NRG Plant only accounts for the "overnight" costs — the costs of all parts and labour required over several years of construction represented in current dollars, but not additional costs. The figure reported by the *St. Petersburg Times* includes these same costs, but went further to illustrate the investments needed in transmission system upgrades. It is important to know when looking at these costs, that sometimes these estimates are only the overnight costs. The estimate from Florida Power & Light includes the effect of inflation on the total project, the investment needed over the whole construction period, the charges made to cover the utility's cost of capital during the period of construction, and the costs to finance the capital needed. These are not represented in the Texas NRG Plant estimates and in no way represent an attempt by anyone to conceal what the true price is. However, care must be taken to ensure an accurate picture is represented when reporting and reviewing these costs so that proper comparative analysis can be done.

Despite the difference in scale when compared to Saskatchewan, Ontario just went through a cost-benefit analysis on nuclear power and has decided to put its plans on hold. What makes Ontario interesting is that the province already relies upon nuclear energy to supplement some of its energy requirements so there would not be the additional costs of upgrading of transmission lines, as is the case in Saskatchewan. What is also curious is in 2005 the Ontario Power Authority began drafting a long-term electricity plan based on the premise that nuclear costs would be low, and demand would be high.[64] In 2007, the Ontario Power Authority based its plan on a price of $2,900 kWh — a cost of $7 billion for the project at Darlington. During hearings of the Ontario Energy Board in summer of 2008, it was revealed anything higher than $3,600 kWh would be too expensive when compared to alternatives, such as natural gas.[65] Since then, Ontario has suspended their interest in pursuing reactor construction at the Darlington site based on costs that have increased by a factor of three, and seen electricity demand decrease over a four year period.[66] It was reported in the *Toronto Star* on July 14, 2009 that the only bid they received, compliant to their fiscal constraints, came from Atomic Energy of Canada Limited (AECL). AECL based its construction costs on two 1,200 MW Advanced Candu Reactors. The estimated cost would have been an astonishing $10,800 kWh.[67] In their proposal, the cost of construction of two next-generation Candu reactors at Darlington was projected to eclipse the total Ontario nuclear power budget for two decades at $26 billion. On June 29, 2009 Ontario Energy Minister George Smitherman responded that his government was suspending the competitive process for the purchase of new reactors in Ontario highlighting the cost as a major reason for his decision.[68]

As stated earlier, there are other players in the global nuclear power industry, each with their own talents and access to proprietary technology, but what remains a constant is the high capital cost investment. AREVA's proposal required a commitment from the province of Ontario of $23.6 billion. It was comprised of two 1,600 MW reactors at $7.8 billion, the remainder of the plant targeted at a cost of $15.8 billion. While their bid is lower, its conclusions are based

on a similar estimate AREVA provided for a plant proposed in Maryland.[69] When looking at these costs it is hard to justify an argument for a nuclear reactor when faced with the growing number of cheaper alternatives that can be brought on stream more quickly and affordably. This is the argument put forward by Shawn-Patrick Stensil, nuclear researcher at Greenpeace Canada. "This whole renaissance in nuclear was built on the premise of cheap reactors," states Stensil, "and that's what they haven't been able to deliver."[70] The Ontario Power Authority reached a similar conclusion when it concluded in the summer of 2008 that nuclear power had exceeded the threshold where it is no longer considered a cost-effective energy option.[71]

An economic construct done by Craig A. Severance in 2009 tries to pinpoint and itemize a full analysis of the capital costs. This calculation accounts for both the overnight costs and those that become part of the capital costs. Keep in mind this is a multi-year construction project so the cost of interest during the construction is a component as is inflation, supply of materials needed and the upgrading of transmission lines. Some utilities will charge a financing cost to ratepayers during the construction period in order to make ends meet rather than deferring costs to the future. In this scenario it is estimated the capital costs will be $10,553 kW.[72] For further validation, one only needs to review studies done by Standard & Poor's or Moody's who have also submitted analysis with similar results. In the spring of 2007, Standard & Poor's published a report on coal, gas, nuclear, and wind costs and their competitiveness with carbon taxes factored in. They estimated the capital cost for a new nuclear reactor was the most expensive ($4,000 kWh) when compared to new coal ($2,438 kWh), natural gas ($700 kWh), wind ($1,700 kWh), solar ($4,000 kWh), and biomass ($2,500 kWh) electricity construction.[73] Standard & Poors also demonstrated the cost of variable operations and maintenance. Solar ($30 MWh) was the most expensive, followed by nuclear ($7 MWh), natural gas and coal ($2 MWh) and then wind ($0 MWh). Finally, when comparing the fixed operations and maintenance the front-runner was nuclear ($100 kW-year), followed by coal ($45 kW-year), solar ($33 Kw-year), wind ($25 kW-year), and natural gas ($20 kW-year).[74]

In October of the same year Moody's Investment Service released their estimates for the total capital cost construction of a new reactor to be $5,000-$6,000 kWh.[75] Those estimates were revised in another release in May 2008 pegging the total capital cost for a new reactor at $7,500 kWh.[76] However these total capital costs can be converted into a "mortgage payment" spread over the number of kWhs generated in order to express the total capital cost component in kWh, essentially the way it is represented on our utility bills. When figuring out this amount they discovered the cost to be $0.22 kWh ($US). The additional operating costs such as those associated with the fuel cycle, maintenance of the fuel, property taxes, decommissioning and waste costs reserve, total $0.08 kWh ($US) and proves once the capital costs are extracted out the operating costs make nuclear more affordable.[77] The final sum illustrates what the total generation costs of a reactor would look like, and the answer is $0.30 kWh ($US),[78] but that is the amount just to pay for the facility and does not include profit. Any company, no matter private or public, is entitled to earn some profit so let us increase that to $0.32-$0.34 kWh since it's certain investors will want to recoup and earn a return on investment for this project. To put this in perspective, current residential customers witnessed increased electricity rates of 13.3 per cent in May 2009 to $0.1022 per kWh[79] with an expected further increase in August of 2010.[80] Let us all remember the public's natural response to any utility rate increase. The radio is crammed with outraged individuals, newspapers are riddled with stories and angry ratepayers write letters to the editor. So the difference here is a variance

of $0.22-$0.25 kWh and would effectively triple residential customer utility rates. This, by any measure, is neither economically competitive nor advantageous.

One of the advantages of doing business in Saskatchewan is the low cost of its utilities. An increase by a factor of three in cost would be catastrophic to Saskatchewan's economy. While this cost would not be introduced overnight, but in stages, it would seriously erode the buying power of many households, halt business expansions and handicap growth and investment. Ironically one industry that would certainly be affected in a negative way would be the mining industry since a great deal of their cost is in the usage of electricity.[81] Given an increase by three-fold of electricity rates, the effect on uranium and potash mining would be dire. A privately owned and built reactor would have to sell its power at this higher price to SaskPower, which would have to pass this increased price onto corporate and residential consumers. The government could choose to subsidize these costs but that is not only a poor public policy decision, it also creates a false economy that eventually will not be able to sustain itself. Furthermore, with electricity being produced at upwards of $0.30 kWh, it is unlikely any of our neighbours would be willing to pay this kind of price when there is plenty of cheap hydro power being exported from Manitoba. So would they be interested in electricity from Saskatchewan at three times its current price? It is certainly unlikely they would desire electricity three times the price of anywhere else.

In conclusion, the impetus should be to build a sustainable energy economy, one that is not only cost-effective but also adaptive to our energy needs. We need a solution that can come on stream quickly rather than take a decade to build. While nuclear projects do generate a great deal of power, they take at least a decade to implement from the drawing board to supplying the grid. Modern economies rely on a mixture of sources for their energy needs and some of these include nuclear, but none of them rely solely on nuclear. Geography also limits where a nuclear plant can go since they must have access to a freshwater source and transmission lines.[82]

Despite the emotion and passion swirling around nuclear power, these are multi-billion dollar investments requiring a serious long term financial commitment. This fact is not meant to dissuade anyone from these investments, but instead meant to bring clarity to the issue and serve as a counterweight to those arguing in favour of nuclear power as a cheap and reliable power source with low greenhouse gas emissions. It must be realized with any public policy decision taken on by a government, regardless of political stripe, nuclear power facilities are capital intensive. In order to provide an effective cost comparison to other methods of power generation, construction timelines and availability of labour and materials must be looked at. Costs of regular maintenance, storage of waste, decommissioning and cleanup should be factored in. With these costs included, it is fair for supporters to integrate into their arguments the benefits of reduced greenhouse gas emissions and potential carbon emissions trading credits. If the economic merits of a nuclear reactor can be demonstrated, then it may be worth pursuing. However, with more environmentally friendly power available for import from other jurisdictions and at as little as a third of the price of nuclear, the pursuit of nuclear energy in Saskatchewan continues to be hard to justify.

Appendix
Uranium Development Partnership Panel Membership

This panel consisted of the following members:

- Dr. Richard Florizone, Chair Vice President of Finance and Resources at the University of Saskatchewan.
- Ray Ahenakew, President of the Saskatchewan Indian Institute of Technology; Keith Brown represented the Saskatchewan Chamber of Commerce. (The Chamber itself has been a longtime supporter of nuclear reactor construction in Saskatchewan.)
- Neil Collins, a SaskPower employee, currently serves as the business manager of the International Brotherhood of Electrical Workers Local 2067. On April 9, 2009 IBEW Local 2067 signed a letter of agreement with Bruce Power in support of the further development of a nuclear option in Saskatchewan.
- Allan Earle, President of the Saskatchewan Urban Municipalities Association.
- Jerry Grandey, President and CEO of Cameco.
- Jim Hallick, Vice-president of the Saskatchewan Association of Rural Municipalities.
- Duncan Hawthorne, President and CEO of Bruce Power and serves as Chair of the Canadian Nuclear Association.
- Armand Laferrere, President and CEO of AREVA Canada.
- Dr. Patrick Moore, co-founder of Greenpeace and a former President of Greenpeace Canada. He has renounced his earlier opposition to nuclear power and is now a strong advocate.
- Alex Pourbaix, President – Energy, TransCanada Corporation.
- Dr. Edward Mathie, Professor of Nuclear Physics at the University of Regina. He is a member of the Canadian Association of Physicists, the Canadian Institute of Particle Physics and the Canadian Institute of Nuclear Physics.

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