January 28, 2010

Standing Committee on Crown and Central Agencies
Inquiry into Growing Energy Needs of Saskatchewan
C/O Stacey Ursulescu, Committee Researcher
Room 7, Legislative Building
Regina, SK S4S 0B3

Dear Members of the Legislative Assembly,

We thank the provincial government for inviting the Regional Centre of Expertise (RCE) on Education for Sustainable Development in Saskatchewan to formally respond to the Standing Committee on Crown and Central Agencies and the "Committee inquiry on how to best meet Saskatchewan's growing demand for energy".

The Regional Centre of Expertise on Education for Sustainable Development in Saskatchewan (RCE Saskatchewan) is part of a United Nations University initiative to support the Decade on Education for Sustainable Development (2005-2014). RCE Saskatchewan seeks to transform education for sustainability in our region. The RCE focuses on research into formal, non-formal and informal learning methods to build capacity of Saskatchewan communities towards the goal of a sustainable future. The RCE currently has 179 members from across Saskatchewan. Further information can be found at www.saskrce.ca.

The RCE has seven main thematic areas in sustainable development that have been identified as priorities for our bioregion:

- Climate Change
- Health and healthy lifestyles
- Farming and Local Food Production, Consumption, and Waste Minimization
- Reconnecting to Natural Prairie Ecosystems
- Supporting and Bridging Cultures for Sustainable Living and Community
- Sustainable Infrastructure including Water and Energy
- Building Sustainable Communities

The recommendations “how to best meet Saskatchewan's growing demand for energy” will have a major impact on all of the aforementioned thematic areas.

The RCE also has two cross-cutting themes:

- Sustaining rural communities
- Regionally Appropriate Approaches for Education for Sustainable Development

A major emphasis of the RCE is supporting public awareness, one of the contexts of this report (Dahms *et al.*, 2008; Dahms *et al.*, 2009). The RCE would like to promote a broad public discussion on Saskatchewan's energy needs, in which citizen-based questions probe the energy issue from a long-term sustainability perspective. This type of inquiry requires answers and due public deliberation prior to engaging in long-term energy decisions. Some of the questions posed and observations made in this document are technical in nature, or involve risk assessment, while others relate to ethics and proper governance and accountability. In all cases, we try to address the question posed:

> *How should the Government best meet the growing energy needs of the province, in a manner than is safe, reliable and environmentally-sustainable, while meeting any current and expected Federal Environmental Standards and Regulations, and maintaining a focus on affordability for Saskatchewan residents today and into the future?*

This formal report was prepared with input from interested RCE members, and while it reflects the views of the contributors it does not necessarily represent the views of all RCE members and partner organizations. RCE members were invited to provide their expertise to this process, and this report reflects that input. We thank the Saskatchewan government for the opportunity to participate in this process, and encourage further public deliberation on this matter, with due weight being given to the public in any future decisions.

We look forward to meeting with you and the opportunity to share our ideas.

Sincerely,

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Major Contributors

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Mr. Douglas Casimel is a Saskatchewan citizen who is currently finishing his degree on Tourism Management, with a specialty in Aboriginal Ecotourism through Capilano University. For the past five years he has been independently researching and apprenticing methods to create sustainable housing.

Dr. Tanya Dahms is a physical biochemist with degrees from Waterloo and Ottawa Universities and postdoctoral fellowships from Purdue University and the National Research Council of Canada. She is currently an associate professor in the Department of Chemistry and Biochemistry at the University of Regina. Her research, funded by NSERC and the Canada Foundation for Innovation, extends to health and environmental applications.

Our primary answers to the question of how Government can best meet the energy needs of the province include: energy conservation, renewable energy generation, energy storage, and upgrading to smart-grid technology. The bases for each of these conclusions are outlined below.

Reducing Energy Consumption

One of the key issues facing the current generation is that human populations are approaching the carrying capacity of our planet. As such, the paradigms of perpetual population and economic growth have become obsolete as humanity comes to terms with its role in making the planet less and less hospitable for all life forms. It is not a reasonable option to return to earlier methods and standards of living, so the challenge with reference to energy is to develop ways to generate and use power without perpetually increasing resource use and waste while improving our quality of life. One key solution to this challenge is the emerging field of energy conservation.

Every dollar spent on conservation saves approximately five dollars in energy generation, representing a net economic gain. Furthermore, developments in this field provide ways for creative citizens to reduce their consumption without greatly changing their lifestyle. Reducing energy consumption in all forms could reverse (and at the very least slow down) the growth of energy use (see Appendix A).

Buildings are responsible for half of the world's greenhouse gas emissions every year (Hawthorne, 2009) and one third of material and energy flows world-wide (Klotz *et al.*, 2009). Documents such as the city of Portland's *Green Office* Guide (http://www.energyalternatives.ca/PDF/GreenOfficeGuide.pdf) and the *David Suzuki at Work toolkit* offer simple guidelines to streamline the workplace, and many aspects are also directly applicable to the home. In Australia, over 100 buildings in major cities will be upgraded so that owners can safeguard their profit margins against rising costs of traditional energy/heating/cooling sources (Taylor, 2009).

However, if we need to pursue energy savings on an individual basis our challenge then becomes one of education and motivation (Arbuthnott, 2008; Arbuthnott, 2009). How can the government offer incentives to citizens to promote energy conservation? Firstly, broad scale rural and urban education, including free workshops (Ioan *et al*., 2005), would be appropriate and could be facilitated by RCE members. Likely the most important incentive will be monetary and should include tax incentives (Hoffman and Henn, 2008). Minimally individuals should not be penalized for making changes that promote energy conversation including both provincial and municipal taxation policies. A provincial program to assess energy efficiency of existing buildings (Berning, 2008) and make improvements would provide jobs and stimulate the economy.

The use of active transportation and becoming "community-centric" to meet most needs (*e.g*. food, entertainment, resource-sharing, simple living) will further help to reduce energy consumption. This can be a challenge in Saskatchewan's smaller communities, but as the current provincial 'Food Miles' campaign (http://www.saskorganic.com/foodmiles/) illustrates, our citizens are capable of generating many creative solutions, especially given the richness of our agricultural resources. Collectively, we can make a big difference.

Sustainability is one of the goals in the new University of Regina strategic plan. In addition to education, the university is committed to developing and testing ways to reduce its energy consumption. Given this goal, it is likely that the university community, with its diverse range of knowledge and practice, will develop creative ways to encourage energy conservation, without losing capacity, over the next several years. This interest in sustainability is also shared by other RCE Saskatchewan higher education partners including the University of Saskatchewan, SIAST, Luther College, Campion College, First Nations University of Canada, Carleton Trail Regional College, and Cumberland College. Resources for networking and collaborative projects between higher education organizations on the topic of energy conservation have significant potential for advancing innovation for energy conservation in the province. Such innovation will have direct and indirect impacts on the economic, social, and ecological well-being of the province and its citizens.

Renewable Energy Generation

One of the most important lessons from nature is the role that biodiversity plays in ecosystem health, such that the greater the biodiversity, the greater the benefit to the ecosystem (Karjalainen *et al*., 2010; The 2010 International Year of Biodiversity). Monocultures are unheard of in nature, and even when imposed they are not sustainable over the long term without considerable environmental degradation. This lesson can also be applied to managing our energy needs. Specifically, no one energy source can meet our needs reliably and in a sustained manner, but a variety of different sources can provide both security and flexibility.

Saskatchewan is blessed with an abundance of renewable energy resources, in particular wind and sun, which are beginning to show strong global development. Renewable sources of energy have the potential to meet the province's growing energy needs in ways that are safe, reliable, and environmentally sustainable. With technological developments in the wind and solar power industries, the cost of such power generation becomes affordable within this decade. Researchers have analyzed the case of wind electricity in Spain, including environmental and socioeconomic benefits, realizing a net reduction in the retail electricity price for the consumer (Sáenz de Miera and del Rio González, 2008). Given Saskatchewan's renewable resources, provincial development of these technologies would provide Saskatchewan citizens and industries the opportunity to be world leaders in developing systems with world-wide economic and engineering appeal.

In considering solutions to impending energy crises, Jacobson (2009) considered impacts on water supply, land use, wildlife, resource availability, thermal pollution, water chemical pollution, nuclear proliferation, and under nutrition. He found that: "the use of wind, concentrated solar power, geothermal, tidal, solar-photovoltaics, wave, and hydro to provide electricity for battery-electric vehicles and hydrogen fuel cell vehicles and, by extension, electricity for the residential, industrial, and commercial sectors, will result in the most benefit among the options considered", whereas "coal with carbon capture and storage and nuclear offer less benefit thus represent an opportunity cost loss, and the biofuel options provide no certain benefit and the greatest negative impacts."

Opportunities and issues related to each of the potential sources of renewable energy to meet SK needs are discussed below.

Wind

In addition to energy conservation, the current most feasible technology is wind power. There is evidence that wind power has the smallest footprint based on a review and ranking of major proposed energy-related solutions to global warming, air pollution, and energy security (Jacobson, 2009). While, as critics have pointed out, the wind does not blow continuously in any one location, power production fluctuations can be mitigated by a distributed network across the entire province. Our current wind generation is limited to a small region in the southwest of the province, which exaggerates the unreliability of wind as a power source (Archer and Jacobson, 2007).

One of the problems associated with wind generation, already observed in Alberta and Manitoba (Baerwald and Barclay 2009, Willis personal communication), is the mortality of birds and especially bats. Bats, in particular appear to be actively attracted to turbines during their fall migration, potentially from long distances (Cryan and Barclay, 2009, Willis et al. 2009). Bat fatalities may result when bats are struck by turbine blades or suffer depressurization injuries (Baerwald et al., 2008). Fortunately, fatalities are most predominant when wind speeds are low. Therefore, simply turning off the turbines during fall migration (especially on low wind nights) or raising the cut-in speed of turbines (*e.g.* the wind speed required to start the blades spinning) could virtually eliminate bat mortality with potentially very small loss of revenue (Baerwald et al., 2009, Anderson, 2007). Similarly, loss could potentially be mitigated by planning turbine locations so as not to coincide with migration paths, and restricting height and rotor size (Barclay et al., 2007; Anderson, 2007). Noise issues can be solved by using electronic gearing systems for the turbines (Ackerman, 2005).

The downturn in the world economy makes this an optimal time for cost-effective large-scale expansion of wind power generation. Many jurisdictions such as Germany have extensive wind power installations despite the fact that their wind velocities are far inferior to that available in Saskatchewan. SaskPower could increase its wind power generation immediately, while optimizing local storage methods and/or investigating feasible methods for coordinated power production with Manitoba. Coal plants could be phased out as wind power production was integrated in a stable way to provide our base load needs.

Solar

Recent developments in solar power technology make this another attractive and affordable option. Saskatchewan is ideally situated to benefit from both the development and use of photovoltaics. The province should aim to install one or more solar panel on every commercial, government and residential building in Saskatchewan. Government retraining programs for unemployed workers would generate new professionals trained to install solar panels, ultimately boosting the economy (Collins, 2009). Once trained, solar installation specialists could update and extend their skills to solar panel repair and replacement.
The Saskatchewan Research Council has already initiated ***The Solar Heating Initiative for Today (SHIFT)***, providing monetary incentives and facilitation for the integration of solar energy for heating water and indoor air in relatively large facilities greater than three stories. (see http://www.src.sk.ca/html/research_technology/energy_conservation/solar_heating/index.cfm) Strategies learned from this project could be directly applied to Saskatchewan's residential sector.

Micro-Hydro

Currently hydro power accounts for the bulk of renewable energy generated in Canada. Small-scale, or micro-hydro, makes use of small rivers and is one of the most environmentally benign energy conversion options available, because unlike large-scale hydro power, it does not attempt to interfere significantly with river flows (Fraenkel *et al.*, 1991). Approximately 150 MW of power from small scale, low impact projects could be developed in northern SK. Such projects have been incredibly successful in British Columbia (Hydraulic Energy Group, 2008). In Saskatchewan, suitable areas for micro-hydro involve crown land and generally fall within First Nations traditional land use areas, offering a potential for stimulating First Nations' economies and improving living conditions in the north. Developing the use of technologies such as pumped storage and cogeneration (see below) could potentially deal with demand variability.

Biomass

Biomass conversion uses primary wood or agricultural products (virgin biomass) or their by-products (*e.g.* timber waste, agricultural harvest fiber by-product, livestock waste), considered "waste biomass", to produce energy (Wood and Layzell, 2003; Parker, 2002). Wood and Layzell (2003) state that "Agricultural activity in Canada produces millions of tons of biomass each year and has the potential to offer feed stocks for bio-energy and specific bio-products while improving the rural economy." Saskatchewan has the potential to produce hundreds of MW of power in forest-fringe and agricultural communities. The ability to use the "waste" products from other processes makes this a sustainably attractive and low-cost option. This renewable resource can be used to generate both heat and power. There is an emerging market for key biomass conversion technologies with CO_2 capture and sequestration, with the potential to achieve zero or negative carbon emissions (Faaij, 2006).

Co-generation

Co-generation is a thermodynamically efficient use of fuel. When electricity is produced independently, some energy is ultimately lost as heat, but cogeneration uses this thermal energy. Co-generation has low GHG emissions, eliminates waste and is capable of producing 100s of MW for industry, offering a cost-effective business model. Training in co-generation retrofitting would create jobs and economic activity distributed across the province. Co-generation has already been implemented at several sites in Saskatchewan.

Heating: Ground-source, Geothermal and Solar

One of the greatest challenges in Saskatchewan is heating the home and workplace. Electric heaters, furnace fans and other heating-related activities account for a significant portion of power consumption in the winter. The implementation of ground source heating (residential and business), geothermal (rural residential and business), and solar water heating/radiant floor heating (residential/business; Zhai et al, 2009), all with solar-driven pumps/fans, would go a long way to alleviate this need and free other sources for electrical generation. Geothermal heating would ultimately enhance the efficiency of biomass and gas power plants.

Nuclear Power is not a Renewable Energy Source

Nuclear power companies advertise nuclear energy as “part of the mix” for Saskatchewan’s energy needs, but as demonstrated in our brief for the UDP stakeholder consultation, nuclear energy is not an appropriate choice for Saskatchewan (see Appendix B). Since nuclear power is not a renewable resource, it will not be considered here.

Implementation

At the level of the producer, which could be citizens, co-operatives, communities or crown utility companies, two main policy mechanisms have emerged to encourage and promote the adoption of renewable energy sources and development, namely feed-in tariffs (FIT) and the renewable portfolio standard. FITs, having emerged as the superior choice (Fouquet and Johansson, 2008), are simply payments per kilowatt-hour for electricity generated by a renewable resource. The FIT, adopted over ten years ago by both Denmark and Germany, has made these two countries world leaders in renewable energy and brought them the closest to meeting their associated targets (Lipp, 2007). A similar FIT strategy was used in Spain (Sáenz de Miera and del Rio González, 2008). FIT generally has three key components including guaranteed grid access, long-term contracts for electricity producers, and purchase prices based on renewable energy generation cost (Klein *et al.* 2008). Under the FIT, regional or national electricity utilities are obligated to purchase renewable electricity, including that generated from renewable sources, such as solar thermal power, wind power, wave and tidal power, biomass, hydropower and geothermal power (Klein *et al.* 2008). The effectiveness of the implemented method can be assessed using standard methods (Roberts, 2006).

Base Load Power Renewable Energy Grids

The most widely used argument against converting to renewable energy sources is that any one renewable source is unable to meet the energy demands of a population (defined as a community or province) at any given time. It is true that each source of renewable energy has specific limitations. For instance, wind turbines cannot operate on still days, or at temperatures below -31° C, and solar power generation cannot operate on cloudy days and is less efficient on short winter days. However, these limitations can be easily dealt with by creating an energy platform that is interconnected and diverse, since not all sources share the same limitation and there may not be a specific weather-related limitation at all locations across the province at any given time. For instance, wind turbines and photovoltaics vary differently across the seasons, and thus together they represent a source of energy that is less variable than either on its own.

The reduction of transmission requirements by interconnecting of wind farms (and possibly other renewable sources) is a viable method to produce base load power (Archer and Jacobson, 2007). Ultimately, multiple renewable sources can make up the base load power. Relatively local, small-scale hydro and gas power stations could serve as quick response back-up to base load power mostly generated by solar and wind.

As well, Saskatchewan could coordinate wind production with Manitoba's large hydro production. Since our power grid is already tied into Manitoba’s grid, this proposal would have the advantage of requiring less additional transmission infrastructure development. In this way, our excess wind power could be exported to the latter jurisdiction when it was readily available here, thereby allowing Manitoba to save hydro power. Hydro power produced in Manitoba which is, in a sense, wasted on the production of base load power there could then be used to provide power in Saskatchewan when wind/solar are not available here.

Realistically, 30-40 % of the base load power could be generated by wind, 30-40 % by solar and 30-40% by biomass conversion. In the short-term, we can transition through natural gas fired cogeneration from coal with carbon capture and storage (Schulp *et al.*, 2008).

“Smart Grids”, Energy Distribution and Storage

Enhanced efficiency would immediately reduce demand for energy production in Saskatchewan. The Saskatchewan Environmental Society, in their October presentation, estimated that an investment in electrical efficiency could save up to 500 MW of electricity per year, and similarly SaskPower has estimated a potential 300 MW savings of power production over the next 20 years simply by managing demand.

Smart grids, as opposed to centralized grids for control and distribution, are collaborative network technology designed to decrease the discrepancy between peak and off-peak demand (Mayor *et al.*, 2009). Smart grids incorporate superconductive transmission lines that lead to less power loss (less resistance), as well as having the ability to integrate alternative sources of electricity such as solar and wind. A built-in intelligent monitoring system (Battaglini *et al.*, 2009) keeps track of all the electricity flowing into the system, and when power is most abundant (least expensive) a smart grid could turn on selected home appliances such as washing machines or factory processes during arbitrary off-peak hours. During peak hours (high demand), the smart grid could turn off selected appliances to reduce demand. SaskTel, as a leading innovator in the communications industry, could work with SaskPower to develop and implement such technology for Saskatchewan, and in collaboration with higher education organizations in the province. As such, the next generation of provincial employees would be well versed in the latest energy technologies, and students would be poised to enter the workforce in a changing economy.

One of the newer electric car designs (*e.g.* The Volt) comes equipped with batteries capable of both storing energy overnight and feeding back into the grid, a perfect complement to the smart grid technology. Electric cars are ideal for Saskatchewan, not suffering from the negative effects of the extreme cold – imagine not having to worry about starting your car in the morning!

Furthermore, the development of methods to store energy produced by wind would make it, by itself, a viable base load power source (Archer and Jacobson, 2007). Researchers from MIT (Kang and Ceder, 2009) have recently demonstrated the ability to store electrical energy at high charge and discharge rate that will enable hybrid and plug-in hybrid electric vehicles and provide back-up for wind and solar energy. Simpler methods include water pumping for subsequent turbine generation. Solutions such as pumped hydro, flow batteries, rechargeable batteries, compressed air, and hydrogen are being considered, and the development of such technology in Saskatchewan provides a great opportunity.

Farmers are particularly interested in the development opportunities represented by wind power, as this power source is particularly complementary with agriculture. Off-farm jobs in the construction and maintenance of wind turbines have the advantage of being geographically distributed, allowing farmers to continue working their land while increasing their off-farm income. Furthermore, the development of a geographically-distributed system of wind turbines would provide a means to revitalize rural communities. SaskPower could provide provincial leadership in developing this geographically-distributed system with its small-scale rural customers.

The combination of decentralized wind, solar and other renewable power sources with smart grid technology would have completely prevented the recent power loss many Saskatchewan communities experienced this past week as a result of the snow storm, significantly reducing the vulnerability of individuals and communities and costs associated with power loss.

Conclusion

RCE Saskatchewan is excited that the Saskatchewan government recognizes the need to transition energy production in the province from coal-fired plants. The gravity of climate change, if ignored, has the potential for dire consequences that relate to human safety, health, and food security, etc., with particularly damaging effects on our province. We are pleased that planning to reduce our carbon emissions, while protecting the production capacity and comfort of our citizens, is underway.

It is our belief that the best way to meet the goals of providing for the growing energy needs of the province in a safe, reliable, and environmentally sustainable manner is through a combination of reducing energy consumption, adding renewable energy generation capacity to our current grid, and an upgrade in the province's power distribution infrastructure to smart-grid technology.

Recommendations

1. **Energy Conservation**

a) Motivational: Government programs, tax incentives and education programs.
b) Technological: Development and implementation of smart grids.

2. **Renewable Energy**

a) Government-sponsored retraining programs in renewable energy.
b) Installation of widely-distributed wind farms (citizen, community, co-operative, crown)
c) Installation of one or more solar panels on every building in the province.
d) Incentives for the implementation of waste biomass generators
e) Establish provincial micro-hydro development policy for long-term implementation

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Appendix A
Simple household paths towards conservation

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For any household, little effort is required to achieve an energy savings of 50%. Many simple acts can be done with a minimal effort:

Lighting - Lighting is often one of the largest power consumers:

- Turn lights off when not in use and/or install timers/motion sensors.
- Use natural light during the day.
- Replace older incandescent fixtures with modern compact fluorescent ones.
- Light tubes (natural day lighting)

Phantom Loads - Phantom loads are appliances that use power all the time:

- Use power bars that have on/off switches for electronics (computer, stereo, TV/VCR), and turn it off when not in use
- Make sure wall cube transformers, that are often warm and wasting electricity, are off when not in use

Heating - Heating, especially in places like Saskatchewan, is often one of the largest electricity consumers.

- Insulate hot water tanks and use hot water wisely - the first hot water to reach the faucet heats up the water in the pipes, wasting that heat.
- Turn the thermostat down at night and when away from home. Installing a programmable thermostat will prevent waking up and coming home to a cold house.
- Install insulating curtains on windows for colder nighttimes.
- South-facing windows allow sun to heat homes during the day and solar heat sinks (cement, tiles, or other mass) radiate the heat during the evening.
- Inspect and resolve drafts around doors and windows.
- The furnace and hot water heaters should be serviced regularly so they will operate most efficiently.
- Close off rooms that are not in use, and block the registers to those rooms.
- Use high efficiency electric radiators to heat occupied rooms instead of heating the entire house.
- Add a solar-thermal hot water heating system for hot water and radiant heating.
- Better building envelopes
- Foil insulation added to thermal envelope.
- Infrared Thermal Imaging inspection: Shows hot and cold spots where more Insulation may be needed. (http://www.infraredvision.co.uk/pages/content.php?subID=37&catID=8)
- ICF Use of insulated concrete forms in construction (http://www.toolbase.org/Technology-Inventory/walls/Insulating-Concrete-Forms).
- SIPS (structurally insulated panels) (http://www.sips.org/content/about/index.cfm?pageId=7)

Appendix B
SK RCE Presentation to the UDP Stakeholders Meeting

RCE SASKATCHEWAN
REGIONAL CENTRE OF EXPERTISE ON EDUCATION FOR SUSTAINABLE DEVELOPMENT
REGIONAL CENTRE OF EXPERTISE ON EDUCATION FOR SUSTAINABLE DEVELOPMENT
ACKNOWLEDGED BY
UNITED NATIONS UNIVERSITY
www.saskrce.ca

June 18, 2009

Dear Mr. Perrins,

The Regional Centre of Expertise on Education for Sustainable Development in Saskatchewan (RCE Saskatchewan) is part of a United Nations University initiative to support the Decade on Education for Sustainable Development (2005-2014). RCE Saskatchewan seeks to transform education for sustainability in our region. The RCE focuses on research into formal, non-formal and informal learning methods to build capacity of Saskatchewan communities towards the goal of a sustainable future. The RCE currently has 179 members from across Saskatchewan. Further information can be found at www.saskrce.ca.

The RCE has six main thematic areas in sustainable development that have been identified as priorities for our bioregion:

Climate Change
Health and healthy lifestyles
Farming and Local Food Production, Consumption, and Waste Minimization
Reconnecting to Natural Prairie Ecosystems
Supporting and Bridging Cultures for Sustainable Living and Community
Sustainable Infrastructure including Water and Energy

The recommendations put forth in the UDP report will have a major impact on all of these thematic areas, and therefore the RCE will respond to the report in the context of these.

The RCE also has two cross-cutting themes:

- Sustaining rural communities
- Regionally Appropriate Approaches for Education for Sustainable Development

A major emphasis of the RCE is supporting public awareness, one of the contexts of this report. The RCE would like to promote a broad public discussion on the UDP report, and alternatives thereto, in which citizen-based questions probe the energy issue from a long-term sustainability perspective. This type of inquiry requires answers and due public deliberation prior to engaging in long-term energy decisions that are potentially irreversible and/or highly negative. Some of the questions posed and observations made in this document are technical in nature, or involve risk assessment, while others relate to ethics and proper governance and accountability. Here we directly engage the arguments being made by the UDP, question some of its underlying assumptions and the narrow mandate of the committee.

This formal report was prepared with input from interested RCE members, and while it reflects the views of the contributors it does not necessarily represent the views of all RCE members and partner organizations. RCE members were invited to provide their expertise to this process, and this report reflects that input. We thank the Saskatchewan government for the opportunity to participate in this process, and encourage further public deliberation on this matter, with due weight being given to the public in any future decisions.

Sincerely,

Dr. Tanya Dahms,
RCE Health Coordinator

Major Contributors

Dr. Katherine Arbuthnott is a cognitive psychologist with degrees from the University of Saskatchewan and with experience as a consumer scientist. She is currently a full professor at Campion College, University of Regina, Regina, SK, Canada. Her experimental research encompasses human attention and memory processes and is funded by the Natural Sciences and Research Council of Canada (NSERC). She also instructs a course on the psychology of environmental change.

Dr. Tanya Dahms is a physical biochemist with degrees from Waterloo and Ottawa Universities, and postdoctoral fellowships from Purdue University and the National Research Council of Canada. She is currently an associate professor in the Department of Chemistry and Biochemistry at the University of Regina. Her NSERC funded research extends to health and environmental applications.

Dr. Robert G. Petry is a published subatomic physicist with degrees from the University of Regina, the University of Saskatchewan, the University of Calgary, and Oxford University. He currently is an instructor in mathematics and science at SIAST.

Issues Related to the UDP Committee

An underlying concern regarding the UDP committee was that many of its members appear to have a vested interest in securing a nuclear reactor installation in Saskatchewan. Committee consensus bias and conflict of interest mean that the UDP report cannot be considered an independent assessment of nuclear issues in the province. Narrow concerns of individual committee members with a potential interest in securing contracts, academic funding, job security, etc., undermine the report's credibility and objectivity.

The UDP committee provides the public with the position of proponents of a nuclear reactor and its ancillary benefits; the report thereby sacrifices the public interest perspective. A review of membership of the committee reflects a committee composition designed to provide a coordinated message, and (as evidenced in the report) eliminate the presence of dissenting opinions on these controversial topics. In this day and age, it is surprising that the committee lacks a female voice (much less than 50% membership of the committee), nor does the committee include a local environmental or health expert (of which the province boasts many).

Further work needs to be done to provide the public with an objective assessment of the prospects of a nuclear reactor in the province. A committee appropriate for the task would be made up of members who, while having expertise, do not have a vested interest in the outcome of any decisions. This committee would produce a report that draws primarily from the current scholarly literature and other independent assessments. In short, proper protocols for generating proper public policy in the citizen interest do not seem to be being followed in the UDP process, which means the real work of assessing the prospects of a nuclear reactor for the province remains to be done.

<u>Recommendation:</u> **That an independent review of the prospects of a nuclear reactor for the province be developed using appropriate public policy guidelines and sustainable development principles. Further, we suggest that such a review panel be given an enhanced mandate: to examine all options to meet various predicted energy needs of the province over the next several decades.**

The Basic Assumption: Uranium Value Chain

The UDP report argues, from its very title and throughout the document that there is a "uranium value chain" that the province is not adequately exploiting. This questionable assumption suggests that since Saskatchewan is a uranium producer we should also be a consumer. The premise is based on the idea that using a source of energy locally has advantages based on the cost and energy of transporting raw material. This argument is false when applied to nuclear power.

As opposed to other sources of power there is no great cost in moving nuclear material given the amount of power produced by a small amount of uranium. Transportation costs of the raw material to the location where the power is needed are relatively negligible. There is no inherent reason nuclear power should be produced here or that we should enrich uranium simply based on local uranium mining. This claim underlying the report is unsubstantiated and goes unchallenged.

The committee itself found no gain in enriching uranium in Saskatchewan and Dr. Florizone (2009) used the above arguments as part of his case for not recommending local uranium enrichment.

Public Versus Private

The public policy decision at hand is whether to allow a private nuclear reactor to be built in the province, so this alone could have been the focus of study. The issue of building a nuclear reactor has sufficient complexity to be considered in and of itself, and its selection as a power source is unrelated to other aspects of uranium technology with which it is combined in the report. The UDP report would not have been commissioned if a nuclear reactor were not being considered.

Linking the disparate elements of the uranium industry (mining, upgrading, nuclear research, power production, etc.) in a single report is unwarranted and has undesirable consequences. By attempting to link these aspects of nuclear technology in a single report the proponents of a nuclear reactor cloud the issue of the potential for a reactor in Saskatchewan with ancillary issues which are largely unrelated. It presents the nuclear reactor option as part of a "balanced" recommendation where processing of uranium is rejected, as though something new has to be done, despite the fact that our existing uranium industry is stable.

Combining these various elements also has the adverse effect of characterizing opponents to a nuclear reactor as opponents to all aspects of the nuclear industry. While some opponents of a nuclear reactor would also be opposed to uranium mining, likely a significant fraction are not. It is unfair and unhelpful to frame the discussion as either pro-nuclear or anti-nuclear through the needless incorporation of other material. A decision to convey the issue in this way is misleading and is not indicative of sound public policy.

The UDP report suggests that Saskatchewan should have a nuclear reactor as "part of the mix" of its power production. More precisely the report recommends up to 3000MW of nuclear power production in Saskatchewan. With current generating capacity in Saskatchewan sitting at 3641MW the idea of a “mix” of power generation is a fallacy of the report. The scale of any current nuclear reactor exceeds the needs of our province.

The report seeks to alleviate the mismatch by suggesting that Alberta commercial and domestic markets will be a significant consumer of the power generated here. The need of an external market to justify a nuclear reactor is indicative of the imbalance between the power output of a nuclear reactor versus Saskatchewan's domestic requirements. Assuming the infrastructure would be built to allow the transfer of power produced by a single proposed nuclear installation to the users of the province, virtually 100% of the power requirements of the province would be supplied. This has profound economic implications and is discussed below.

Inefficiency Related to Redundancy

Any power source requires redundancy in the form of reserve power production to provide any security for those who require the power. The cost of this redundancy/reserve for many small scale power sources is manageable but becomes considerable if power is supplied from a single large source such as nuclear. For instance, a wind farm of 20 turbines would need 1 or 2 extra turbines to allow for scheduled maintenance. For a nuclear reactor, normally this redundancy would be accommodated by having a secondary reactor in case the first must be taken off-line. The report seems to suggest that new large coal plants could also provide this reserve. Since one of the main arguments in favour of nuclear power generation is that it would reduce the carbon production relative to coal-generated power, this weakens the nuclear power generation case. The scale of nuclear power production works against a jurisdiction such as Saskatchewan, where the cost of reserve power is high based on a small number of reactors. This is a primary reason that these locales do not opt for nuclear power production as is being put forward by the UDP.

If a province were to decide to adopt nuclear power, an ideal locale would be one in which there are many nuclear reactors, so that any single one can be brought down in the case of emergency/maintenance. As it stands Saskatchewan would be paying an extra 100% of the cost simply to provide redundant nuclear capacity.

Alternatively, if coal reserve power is built, the cost of the power redundancy required must be sufficient to effectively replace the nuclear reactor in the event that it is brought off-line. The coal option also suffers from the fact that it is proposed as infrastructure that would only presumably be used in emergency situations. The report suggests that reserve power supply could be provided by neighbouring jurisdictions with large infrastructure investment in the event of instantaneous failure. Once again, the scale of instantaneous failure of the power source means large scale capacity and transferability would have to be available from such a jurisdiction.

The UDP Report in the Context of RCE Thematic Areas

Climate Change

The UDP report acknowledges that:

> "many jurisdictions are shifting from traditional fossil fuel sources guided by global concern over the impact of carbon dioxide emissions on climate …"

RCE Saskatchewan is excited that the Saskatchewan government recognizes the gravity of climate change and, if ignored, the potential for dire consequences that relate to human safety, health, food security etc.

Addressing climate change in a sustainable manner, there is a need for conservation. Eventually, we will have to learn to live within our means. We need to use electric power more wisely. For example, why is it necessary for buildings to leave signs and other lights on all night when they are closed? This brings into question whether we need to produce a much greater capacity or not. A great deal of energy used in Saskatchewan relates to heating homes in the winter. Geothermal, ground source heating and solar water heating coupled with radiant flooring would go a long way to alleviate this problem. Saskatchewan has deep geothermal, solar, wind, and hydro potential, many of which have not been effectively harnessed at all. Several of these sources, especially wind and deep geothermal heat, require large scale public investment to be used efficiently and coordinated with other power resources in the province, making public power investment key to efficient implementation. There has never been a more important time for the public power company to be developing power generation.

How exactly has SaskPower calculated our projected increase in power consumption? In one argument, Dr. Florizone(1) pointed to the advent of electric cars as a potential source for increased power demand. However, new battery technology for electric cars provides a means of storage for renewable power sources, contributing to baseload power(2).

The statement that: "Nuclear power generates very low carbon emissions, on par with the cleanest forms of renewable energy", seems to be misleading since uranium mining operations and enrichment processes are energy (often coal and fossil fuel) intensive. This point does not capture the full nuclear power life cycle that still relies on traditional fossil fuel sources. The CO_2 cost of a nuclear power plant as a result of construction of new infrastructure with concrete is significant. The proposition to extend infrastructure (roads, etc.) into the north for exploration, mining and a nuclear power plant will pose a significant carbon emission cost. Has this been factored into the committee's equation?
Stanford University environmental engineering professor Mark Jacobson has calculated that wind power, by far, has the smallest footprint based on a review and ranking of major proposed energy-related solutions to global warming, air pollution mortality, and energy security. He considers other impacts of the proposed solutions, such as impacts on water supply, land use, wildlife, resource availability, thermal pollution, water chemical pollution, nuclear proliferation, and under nutrition(3).

In this article, he states that:
“the use of wind, concentrated solar power, geothermal, tidal, solar-photovoltaics, wave, and hydro to provide electricity for battery-electric vehicles and hydrogen fuel cell vehicles and, by extension, electricity for the residential, industrial, and commercial sectors, will result in the most benefit among the options considered. The combination of these technologies should be advanced as a solution to global warming, air pollution, and energy security. Coal with carbon capture and storage and nuclear offer less benefit thus represent an opportunity cost loss, and the biofuel options provide no certain benefit and the greatest negative impacts.”

One of the central arguments put forward in the UDP report for considering nuclear power generation is to reduce the province’s carbon emissions. As noted earlier, the report recommends that nuclear power generation be ‘part of the energy mix’ for Saskatchewan, recommending up to 3, 000 Mega Watts (MW) of nuclear power production. With current generating capacity in Saskatchewan sitting at 3, 641 MW the scale of any current nuclear reactor exceeds the needs of our province. This, in itself, is contrary to public policy goals with respect to climate change, because we aim to reduce our energy use to meet our needs at the minimal level, rather than to increase it. Adequate response to climate change requires global reduction in energy use and production.

The report seeks to alleviate the mismatch in production and need by suggesting that Alberta commercial (oil sands) and domestic markets will be a significant consumer of the power generated here. The idea of exporting to Alberta has the potential to generate revenue, however supporting the Alberta oil sands with nuclear power does not alleviate the carbon emissions issue, but rather compounds it. It costs approximately one barrel of oil (burning of fossil fuels) for every two recovered from the oil sands, and its reliance on natural gas is unsustainable. The extensive use of bitumen for upgrading and fuel appears at odds with Canada’s obligations under the Kyoto treaty. Söderbergh determined that “The future Canadian oil sands production cannot even compensate for the combined declining conventional oil production in Canada and the North Sea(4). The most optimistic scenario will not manage to compensate the decline by 2030. Canada’s oil sands resources cannot prevent a global peak oil scenario.” By all accounts, supporting this industry is an unsustainable action. The need for some external market to justify a nuclear reactor is indicative of the scale of power needs provided by reactors versus Saskatchewan's domestic requirements.

As a solution to climate change difficulties, nuclear power is less than ideal for Saskatchewan, both because providing reserve power would require either carbon-heavy coal plants, and/or the construction of an additional, otherwise unnecessary, nuclear plant. Further a nuclear option commits the province to generating more power than is necessary for our needs, working against conservation.

RCE Saskatchewan agrees with the UDP report that we need to move from coal-based power to some non-$C0_2$ source, be it nuclear, wind, solar, geothermal, etc. However the report also defies the global warming concern by suggesting that the reason we want to build nuclear reactors is to provide Alberta with up to four to five thousand MW of power, particularly for oil extraction from the tar sands. Putting aside the enormous loss of energy during transmission caused by producing nuclear energy in Saskatchewan when the power is to be used in Alberta, increasing our energy capacity to enable the continued expensive extraction of oil undermines any purported concern for global warming.

With 80% of a barrel of oil being used for power in one form or another, it makes more sense to use the power from a nuclear reactor directly where it is needed. For a case in which power needs to be more portable (e.g. cars) that power can be drawn from stationary energy sources. When one considers the energy lost in converting nuclear power to oil, and then transporting the oil to where the power is required (as opposed to just shipping the uranium there) the cost is staggering. Add to this the environmental costs of oil sands production and global warming due to the CO_2 produced by burning the oil, the proposal is on ethically questionable grounds.

As producers of uranium, Saskatchewan will continue to profit from this resource regardless of whether the power is used imprudently to extract oil or sensibly in reactors at the location that the power is actually needed. It is Alberta, not Saskatchewan that requires the power to maintain the large tar sands production. This seems to set aside the interests of this province's citizens to which the government is accountable in favour of external forces (e.g., residents of other provinces, private corporations). One should wonder why the people of Saskatchewan ought to be responsible for the transmission line upgrades, large maintenance costs and ultimately radioactive waste and decommissioning of nuclear reactors in order to support Alberta's oil industry; these costs should be internalized by oil companies operating in Alberta so that the true costs of oil sands production is reflected in the market price of the resulting oil products.

Finally the argument is made that one of the conditions making nuclear power an economically viable option is the looming imposition of carbon taxes. It is unclear why the proponents of the nuclear reactor believe that carbon taxes will not be applied to power sources used in the extraction of fossil fuels. As the goal of any carbon tax is to discourage the production and consumption of fossil fuels, it is not unlikely that discouraging such imprudent use of our limited nuclear resources in the fossil fuel power chain will also be discouraged through carbon taxes.

<u>Recommendation:</u> More thoroughly examine energy generation modalities and combinations thereof that would truly minimize carbon production.

Health and healthy lifestyles

The UDP report proposes that medical isotopes would offset the cost of its proposed program, approximately 1/3 the cost of the nuclear research reactor. Therefore, there is no net gain when one considers the production of radioisotopes. McGill University generated all of its radioisotopes using a cyclotron (non-nuclear particle accelerator), so it is not clear why we need a nuclear power plant or reactor to do so. The medical isotope issue is an emotional one for many people with its connection to cancer, but the large majority of isotopes are not used for cancer treatment, but rather for diagnosis. Further, alternatives to medical isotopes need to be explored. It is likely that the medical radioisotope shortage will be solved sooner rather than later, so any Saskatchewan build will be many years too late.

The UDP report does not adequately address or acknowledge the health and safety concerns associated with nuclear power generation and the storage of nuclear waste.
Health issues range from cancer risk by exposure to radio nucleotides to death by acute exposure.

We must consider contamination of a precious resource in SK, namely water. The UDP report states that “These bundles are then removed and stored in pools of water for a number of years”. Saskatchewan is an arid prairie province, where water is at a premium for human and agricultural purposes. With climate change, the volume of water flowing into the Saskatchewan Rivers from glacial and snow melt in the Rockies is projected to significantly diminish(5). Can we afford to divert water for power?

The UDP report downplays the danger of the nuclear waste that SK would be committing to store for 250 millennia: “During this time, the radioactivity of used fuel declines substantially – 10 years after being removed from the reactor, the radioactivity is approximately 1,000 times lower than it was initially.” This statement is misleading. Since radioactivity decays exponentially, there will be a steep decline in the first few years. However, a mixture of radionuclides (> 211), albeit with 1,000 times lower radioactivity that the original mixture, remains dangerous to human health(6). There is nothing sustainable about having to store waste for 250 millenia. Over such periods of time languages change beyond recognition, cities are lost and entire civilizations are forgotten(7). How then do we propose to safely store this material for such an extensive period of time?

The bioaccumulation of heavy metals and radioactive elements is well known(8), and uranium mining tailings and nuclear waste contribute to their production.

There is a certain amount of ambiguity in the report with statements like “variation of doses over time and by geography make it difficult to summarize the average dose to the public.”. A 1999 study(9) showed:
“Excess risk of leukemia mortality was, however, observed in the vicinity of the uranium-processing facilities in Andújar [RR, 1.30; 95% confidence interval, 1.03-1.64] and Ciudad Rodrigo (RR, 1.68; 95% confidence interval, 0.92-3.08). Excess risk of multiple myeloma mortality was found in the area surrounding the Zorita nuclear power plant … with proximity to an installation. … More specific studies are called for in areas near installations that have been fully operational for longer periods. In this connection, stress should be laid on the importance of using dosimetric information in all future studies.” The latter study did not detect an increase in childhood leukemia, but at least one study has detected increased incidence of childhood leukemia in close proximity to nuclear facilities(10-12)(13). Discrepancies between the German study and a British study are assessed in a recent review that is unable discern discrepancies between the studies(14). Another critical review indicates that leukemia incidence is higher at certain nuclear sites(13).

Dangers inherent to the mining industry, along with detrimental health effects that are increased by the mining of uranium in northern Saskatchewan are well documented.
A current (2009) study(15) follows up previous studies, with 15 additional years (1991-2005), showing that uranium miners from the US Colorado Plateau have both exposure to radon progeny and a higher risk of lung cancer:

> “For white miners, the standardized mortality ratio for lung cancer compared with the regional population was 3.99 (95% confidence interval: 3.43, 4.62) for the period 1991-2005. For American Indian miners, the lung cancer standardized mortality ratio was 3.27 (95% confidence interval: 2.19, 4.73). These standardized mortality ratios have not declined substantially since the 1980s.”

The UDP report again understates the risk from mining: “underground miners have a higher incidence of cancer than the public. Several other occupational exposures have shown similar results.”
However, uranium mining leads to other disease, and the study(15) further showed that:

> “Elevated mortality rates were observed from interstitial pulmonary fibrosis, multiple myeloma, and non-Hodgkin lymphoma. Significant trends were observed with increased radon exposure in silicosis and pulmonary fibrosis mortality and in the incidence of diabetes-related end-stage renal disease among white miners.”

If Saskatchewan were to retrain uranium miners to install and maintain solar panels, geothermal and wind generators, workers health profiles would improve dramatically, leading to a reduction in long-term health costs. The question of whether or not the renewable energy industry would be able to provide enough jobs for Saskatchewan workers is borne out by the statistics:
Germany currently employs approximately 250,000 people in the renewable sector, with a population of approximately 82 million, this represents roughly 0.3% of the population. Saskatchewan’s mining industry employs approximately 3000 people, roughly 0.3% of the population. Germany’s Deputy Environment minister, Astrid Klug, estimates that the number of “green jobs” will triple by 2020 and hit 900,000 by 2030, or over 1% of the population.

Recommendation: Consider the full, long-term, and potential consequences of UDP recommendations on Saskatchewan ecosystems and the health of all Saskatchewan residents, and weigh this with alternative solutions.

Farming and Local Food Production, Consumption, and Waste Minimization

Saskatchewan is the “bread basket” of Canada. Nuclear waste storage in SK poses a long-term threat to the agricultural sector and water security. The potential for ground water contamination and bioaccumulation, as noted above, threaten this sector.

The idea of building a large nuclear power plant on productive farm land, with a wide berth for safety issues, and taking that land out of food production is not desirable. Both agriculture and native prairie species can coexist with a wind turbine, but this is not so for a nuclear power plant that paves over arable land with concrete(3).

Renewable energy production would serve as an alternative for farmers with an often uncertain annual income, and equipment associated with alternatives such as wind and solar can co-exist with farming, as only small segments of land.

A large portion of the province is dedicated farm land. A particular concern for family farms is the danger of positioning a nuclear power plant over an aquifer that supplies rural residents and agricultural land. Ultimately this would contaminate agricultural produce. A further serious concern is the potential for large scale contamination of agricultural land in the event of a nuclear disaster.

A further issue is the removal of usable water from the system that can be used for more essential agricultural uses.

Reconnecting to Natural Prairie Ecosystems

Any radioactive material released into the environment will be bio-concentrated up the food chain from simple organisms to mammals. This will further endanger soil health (bacteria, fungi etc.), insects, plants, birds and mammals, all important to the future survival our natural prairie ecosystem.

Nuclear power to support oil sand extraction fundamentally undermines the preservation of natural prairie ecosystems, as evidenced by the large scale environmental disaster in Fort McMurray(16).

Supporting and Bridging Cultures for Sustainable Living and Community

Creating jobs only in one geographical area means that workers will have to travel and spend extended periods of time away from family, undermining sustainable living and community. On the contrary, renewable energy sources (wind, solar, geothermal) can be localized, house to house and town to town, with local construction, operators, and maintenance crews.

Sustainable Infrastructure including Water and Energy

Base Load Power

The UDP report dismisses most other power sources like wind or solar generation for their inability to produce reliable baseload power. While admittedly the wind does not blow continuously, such fluctuations in power production can be mitigated by a distributed network across our large province. Currently our wind generation is limited to a small region in the southwest of the province which exaggerates the unreliability of wind as a power source(2).

As well, Saskatchewan could coordinate wind production with Manitoba's large hydro production. Since our power grid is already tied into Manitoba’s grid, this proposal would have the advantage of requiring no additional transmission infrastructure development. In this way, our excess wind power could be exported to the latter jurisdiction when it was readily available here, thereby allowing Manitoba to save hydro power. Hydro power produced in Manitoba which is, in a sense, wasted on the production of baseload power there could then be used to provide power in Saskatchewan when wind was not available here.

Finally the storage of energy produced by wind to make it a viable base load power source should not be discounted. Physically, water can be pumped or gas compressed to be run through a turbine later. Chemical reactions such as electrolysis of water for storing energy could also be explored. The increased use of intermittent power sources around the world will see development in storage technologies which could be readily exploited when they become cost effective. Obviously, any of these alternatives have costs due to redundant turbines, transmission loss and power conversion, but they do make it possible technically for wind power to produce baseload power.

While these possibilities have in the past been discounted as too expensive by SaskPower, this has largely been in comparison with conventional coal. If the province is willing to pay what will likely be an order of magnitude increase in power rental costs to a private nuclear power company and pay substantial infrastructure costs to make nuclear power production possible, many alternatives such as wind and the infrastructure required to make it possible to provide baseload power then become viable.

The downturn in the world economy makes this an optimal time for cost-effective large-scale expansion of wind power generation. Many jurisdictions such as Germany (ref.) have extensive wind power installations despite the fact that their wind velocities are far inferior to that available here. SaskPower could increase its wind power generation now and subsequently look at feasible methods for coordinated power production with Manitoba or local storage. Coal plants could be phased out as wind power production was integrated in a stable way to provide our baseload needs.

Finally we note that while nuclear power suffers as coal does from not being able to be shut on and off quickly and thus limits such power produced to baseload, it does not follow that coal needs to be replaced by a power source with the same inherent limitations.

Sustaining Rural Communities

Putting all of our resources into one large project, a nuclear power plant, undermines local business, renewable energy production, and rural communities. Further, long-term sustainability, especially for rural communities, is supported by public rather than private ownership of energy generation. Only 10% of SaskPower's power is currently purchased from private sources, which typically deal in cogeneration or heat recovery projects integrated into existing privately owned industrial infrastructure. The remaining 90% comes from publicly owned power generation stations. The move to nuclear power providing between half and potentially all of Saskatchewan's power needs effectively means the wholesale privatization of power production in the province. The historical development of nuclear power in Ontario has seen the production of nuclear power moved from the public to private sphere. Even if the public AECL were to build a nuclear reactor in our province, the constant threat of its privatization means that such a nuclear reactor would likely end up in the hands of a private entity over the lifetime of the reactor. As such any nuclear power produced in Saskatchewan will likely be privately owned and controlled. It is remarkable that the UDP report makes no attempt to analyze the implications for the province to switch from publicly produced power accountable to citizens to privately produced power despite the profound implications this would have on the province.

The failure of private power production in other jurisdictions is largely due to power being a natural monopoly. In a private power market, transmission loss (see below)] and infrastructure limitations means a consumer of power purchases it from a relatively local power producer. This means that, even if a jurisdiction had a few power producing companies, they would likely control sufficient infrastructure in a regional base that a private monopoly would be effectively in place. The scale of power production by any proposed nuclear installation in Saskatchewan would mean a *de facto* private monopoly of power production.

After World War II, the move to bring electrification to the far reaches of this province by the state allowed not only the increased quality of life for particularly rural residents but also the potential for industrial development in diverse regions due to the availability of stable affordable power. While the claim in the UDP report is clearly made that commercial (i.e.

private) nuclear power will replace existing publicly owned coal plants, there seems to be no attempt to quantify the costs of providing a private company with an effective monopoly on power production in our province. Public power has historically served the province well and the onus is on proponents of nuclear power to argue why public power production should be abandoned. The loss of public power means that power production will no longer be geared to serve the needs of citizens and their development of this province, but rather the motive of private profit. There are many consequences to private power including the fact that profit motive necessarily works against energy conservation. The following itemizes some of these consequences:

1) Publicly owned power production provides basic economic infrastructure that bolsters our entire community within a global marketplace. Like Medicare, stable, cost-effective power production built in the interests of Saskatchewan residents rather than the profit of investors, gives our businesses a competitive edge in the global marketplace. Just as private health care means the unnecessary building of infrastructure, inflating of prices in a captive market, and locales being left out due to lack of profitability, similarly private power production transfers large sums of economic rent to private ownership, while increasing costs to the consumers of that energy. With public owernship of power production, the goal is to provide stable cost-effective power to meet local power needs, and allows long-term planning for a key basis of our economy. In addition, such planning is consistent with the goal of reducing energy use, a key goal with respect to climate change and global sustainability. Public power limits the need for redundant power production since competition is not required for manageable pricing. Ownership of power production means that our public power utility can actually plan the location of power production, ensuring both that the power produced is at its disposal and knowing the use to which that power will be put.

2) The lack of public ownership of power production, on the other hand, means that the state must encourage more private power to be produced than is actually required, because it does not have final say in how it is used. This scenario undermines the interests of conservation, and does not minimize our global carbon footprint. Efficiencies are also lost because SaskPower is not determining where these power sources will be placed, despite having to build the infrastructure to allow the power transfer. One can argue that the former may be mediated by long term power contracts with private producers, but this can be costly and SaskPower could end up buying unneeded private power. The recent economic problems in Ontario, for instance, have actually seen power consumption drop (~ 20%), and Ontario has recently unveiled a Green Energy and Green Economy Act (see http://www.thestar.com/business/article/649763). Unplanned energy production means consumers have to carry the cost of the unnecessary surplus power generation, transmission, and bureaucratic infrastructure.

3) As mentioned already, Saskatchewan would, as recommended in the UDP report, likely have to go ahead with building transmission lines able to accommodate the large scale sale of power to other jurisdictions such as Alberta. This means that in addition to having to pay the bill for infrastructure it does not use, Saskatchewan consumers will have to pay market prices for power, despite being the source of the energy. Indeed if the needs of the Saskatchewan power consumer were actually the priority, one would want to minimize the ability of private power to leave the province, not enable it.

Allowing a private nuclear reactor to have equal access to Saskatchewan and Alberta means we are vulnerable to the directions of Alberta markets. It is not impossible that a nuclear reactor may be built in Alberta that would have a clear advantage in providing domestic power and for the oil sands due to lower transmission costs, the provision of local jobs, etc. This would leave Saskatchewan having to support excess local capacity. Alternatively if the price of oil rises so that it is more lucrative to sell nuclear power to oil companies to process the oil sands, this could mean prohibitive pricing or power shortages for Saskatchewan consumers. The fact that oil companies have invested in the nuclear industry means that the power requirements of Saskatchewan consumers, not being the owners of the power produced, may have secondary importance. These problems are symptomatic of any government effectively renting something it could clearly own.

4) The technological complexity of a nuclear reactor (AECL has been trying to make replacement operational reactors for its 50 year old Chalk River isotope reactor for 20 years and has never succeeded), and the core role that such energy produced would eventually have in the overall power production of the province will be a disaster to public finances, especially given our small population base. The threat of a nuclear reactor going offline once the public and industry have begun to rely on its power means that the owners of the reactor can effectively charge whatever they want for it to be maintained.

For instance, a Bruce Power project to refurbish two reactors in Ontario is currently $350 million over budget. A "deal" struck with the Ontario provincial government for the project requires taxpayers to cover half the cost of budget overruns up to $3.05 billion. While the UDP report affirms that large scale public investment is routine in the nuclear industry, it unfortunately fails to tabulate such historical Canadian expenditures. If Saskatchewan were to rely on a large scale private power source like this, they would be obliged to similarly pay for whatever upgrades the private nuclear company deemed necessary in addition to our consumers paying power rates set by the private concerns for profit maximization.

5) Private nuclear, due to its decommissioning costs, creates added economic risk to this province. The province has already seen how the Gunnar and Laredo uranium mining and milling facilities in northern Saskatchewan were abandoned by the corporation who developed them. Forty years later the federal and provincial governments are largely picking up the 25 million dollar cost to clean up the sites, despite the fact that a separate company (Encana) actually currently owns the property. One of the basic principles of a private corporation is to minimize investor risk by allowing the entity to take profits when it can and, when its liabilities exceed its resources (for example GM) to declare bankruptcy. The private corporation is the antithesis of the way nuclear energy should be produced as the long term security, and safety issues are not important for an entity whose mandate is short term profit.

Transmission Costs

Transmission costs that arise from a centralized power source are particularly problematic for rural communities. While the scale of power produced by a nuclear reactor is difficult to reconcile with the power requirements of Saskatchewan, the cost in terms of transmission of power makes a single power source also difficult for our province. Any transfer of power over a transmission line loses power due to resistance. Furthermore, the more power transferred over a given line, the more substantial the line must be to carry it. Transferring power is conceptually like transferring water in a pipeline that leaks. Using this analogy, the shorter the distance for transfer means less power loss, and the smaller amount required for transfer means a smaller size pipe required.

For this reason, a nuclear plant is efficiently built near a large, power sync, which is typically heavy industry or a large population that can consume the energy. It is particularly useful and necessary for locations where other sources of power are unavailable. This is why nuclear power is desirable in southern Ontario. The situation in Saskatchewan is the exact opposite, where there are relatively minimal power consumption requirements over a very large area. Power produced over a diverse area minimizes transmission losses, while at the same time allows continued use of much of the existing transmission infrastructure. In other words, diversifying our energy production, rather than centralizing it, is central to effectively sustaining rural communities, at least with respect to their energy needs.

Requiring Saskatchewan citizens to fund inefficient power generation and transmission for our needs, conversely, puts strain on our ability to maintain diverse population density. Saskatchewan has favourable resources with respect to renewable energy sources, in particular wind, solar and deep geothermal which make regional energy production more realizable. To accommodate a single central source of power such as a nuclear reactor, the Saskatchewan power grid would also have to receive a large and costly overhaul. Imagine water being distributed to all people in the province over leaky pipes from a central source.

Furthermore if a significant amount of the new power is for export to Alberta the transmission lines for such large scale export of power would have to be built, likely at public expense. Currently Alberta is expecting the first phase of their power grid revamping to cost in excess of 8 billion dollars. David Erickson, president and interim CEO of the Alberta Electric System Operator has indicated that a key reason for the upgrade is to make it possible for private power generators to be able to sell power to locations outside Alberta. "What (an upgrade) allows generators to do is to access larger markets so that when there is surplus power in Alberta it can be shipped outside of Alberta and sold elsewhere" (see http://www.theglobeandmail.com/news/national/alberta-power-bills-to-get-a-jolt-due-to-transmission-upgrades/article1165580/). Of course this need not be surplus power - it permits power generators to command the highest price for power produced by playing off power customers, be they provincial power companies or industrial power consumers such as oil companies.

The UDP report similarly states that significant upgrades to our transmission infrastructure will be required to allow large scale power production facilities in Saskatchewan and to facilitate transmission of power to Alberta, though no attempt is made to quantify this cost despite the supposed economic analysis in support of the document. Given the great cost of building and maintaining infrastructure, and the energy lost transferring power over large distances, the economic argument for producing nuclear power in Saskatchewan for a conjectured 5000 MW Alberta market (4000 MW southern AB, 1000 MW for the oil sands), when it could be produced in Alberta itself at the locale the nuclear power is actually needed makes little sense. This rather obvious discrepancy undermines the credibility of the report.

Recommendation: That a review of the economic risks associated with privatizing power production, including case studies where this has been tried, be considered an essential part in any consideration of the procurement of a private nuclear reactor for the province.

Overall Sustainability

With Saskatchewan's uranium limited to an estimated 45 years, it is important to realize that this is a non-renewable resource. It is prudent that nuclear power production be done in such a way that it minimizes waste due to transmission and infrastructure cost.
Nuclear power is non-renewable and the mining and enrichment industries rely on non-renewable fossil fuels.

Water is a precious resource in Saskatchewan. Analysis of the impact of a nuclear power plant on water resources needs to be fully considered. For example, can we afford to divert water from the Saskatchewan river system to a nuclear power plant, when the province already faces potential long-term desertification?
One of the strongest arguments against nuclear power comes from a concern for sustainable economics, since nuclear power does not appear sustainable in this regard in Saskatchewan. It is comparatively expensive and we will run out of fuel. This means that current and future generations learn to overuse even more energy while we have nuclear power, then find we are without, just as we have done with oil.

Given the magnitude of a decision to build nuclear reactors to supply the future energy needs of Saskatchewan people for many years to come and the impact of such a decision in potentially limiting or foreclosing the pursuit of other provincial energy options (along with key decisions related to their ownership, management, and/or regulation), it is reasonable that such a decision would only be undertaken until after a party had received an electoral mandate to take such a direction. As the current nuclear power direction and current proposals being considered were not a focus of the provincial election in 2007, currently there is no electoral mandate for such a direction. Presumably key decisions and commitments in this regard will not be made until after a government receives such an electoral mandate from an informed population on this matter.

Recommendation: That the decision whether or not to expand nuclear development, and issues related to it, be based on solid science, sound economics, social justice, public awareness and electoral support, and environmental sustainability.

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