Chinook Power Station

Federal Environmental Review

SaskWind submission

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Document Purpose

The proposed Chinook Power Station is a gas-fired electricity generating station with a combined capacity exceeding 200 megawatts. It is therefore a Designated Project for the purposes of the Canadian Environmental Assessment Act 2012 (CEAA). As such and in accordance with the Act, the Canadian Environmental Assessment Agency is seeking public comment as to whether a federal environmental assessment is required. This document contains SaskWind's response to that request.

4 November 2016

Summary of SaskWind submission

CEAA purpose is to protect the Canadian environment from significant adverse effects caused by Designated Projects. It places a duty on the Minister to ensure that protection through application of the Precautionary Principle. This states that where there are threats of serious or irreversible damage; lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Canada's ratification of the Paris Agreement signifies both that Climate Change poses a credible threat of serious damage and also that Canada is committed to concrete steps to address that threat. The question is therefore threefold: Does Chinook create '*significant adverse effects*'? Are '*cost effective measures*' available to prevent or mitigate them? Has SaskPower given due consideration to those alternatives prior to proposing Chinook?

GHGs. The annual GHG release from Chinook will be 1.04 million tonnes. This represents 6.8% of SaskPower's total 2015 GHG emissions or, at a 2022 carbon price of $50/tonne, a cost of $52-million annually. By definition any atmospheric emissions will have effects far from their point of origin and, specifically, on federal lands and lands outside of Saskatchewan. It is therefore reasonable to conclude that Chinook's expected GHG emissions are 'significant' within the context of the CEAA. Wind turbines emit no GHGs in operation.

Water. Chinook's annual cooling water consumption will be 36,500 m^3; a volume which would be sufficient to fill 15 Olympic-sized swimming pools. This volume of water, given Swift Current's semi-arid climate, is arguably significant. Wind turbines require no cooling water.

Wind economic feasibility. Wind energy costs are 60% lower today than six years ago. Wind turbines, given Saskatchewan's world-class wind resource, can generate zero-emission electricity at a cost which is directly competitive with natural gas-fired power stations such as Chinook. If a carbon price of $50/tonne, equivalent to $20/MWh, is included; wind is significantly cheaper than gas-fired power stations.

Wind technical feasibility. Chinook will at most generate 10% of Saskatchewan's total electricity (although 6% seems more likely). SaskPower implies that Chinook has to be built before wind energy, which currently supplies 2.9% of total electricity, can supply any more. There is, however, no evidence to support that position. The findings of numerous power system studies, together with the experience of multiple North American jurisdictions, demonstrate the additional fast-acting reserve, provided by Chinook, is not necessary for wind to meet 10%, or even 30%, of the province's power needs.

SaskPower consideration of alternatives. In the last ten years, the amount of Saskatchewan's electricity generated by wind turbines has remained unchanged at 2.9%. Although SaskPower states it has plans for the significant expansion of renewable energy; their actions in the last decade suggest otherwise. Their future plans are anyway not relevant to the evaluation of Chinook and, specifically, to whether SaskPower has given adequate consideration to other technically and economically feasible means of carrying out that project. The evidence, we would suggest, demonstrates they have not.

We have shown;

- Chinook creates significant adverse environmental effects;
- Alternative means of carrying out the Project are technically and economically feasible;
- These alternative means result in significantly reduced environmental effects;
- SaskPower has not given serious consideration to these alternative means.

Our view is, therefore, that a Federal Environmental Assessment of Chinook is required.

Additional information to support our position is contained in the following pages.

TABLE OF CONTENTS

1 THE PROJECT

The Chinook Power Station is a 350-megawatt combined cycle natural gas power station which SaskPower intends to build approximately 11 kilometres northwest of Swift Current. The project also includes a new 18-kilometre underground water pipeline from the South Hill Reservoir located within the city limits of Swift Current. The total project footprint will be 50 hectares.

SaskPower states the site selection process, which led it to settle on the current location for Chinook, was underway from 2012 to 2015.

2 PRINCIPLES OF SUSTAINABLE DEVELOPMENT

The Canadian Environmental Assessment Act (CEAA) states;

> *The Government of Canada, the Minister, the Agency, federal authorities and responsible authorities, must exercise their powers in a manner that protects the environment and human health and applies the precautionary principle.*
> *Section (4)(2) - Purposes*

The Precautionary Principle guides Canada's environmental policy and this is reflected in the Federal Sustainable Development Act (FSDA). Within the Act the precautionary principle is defined as;

> *Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*
> *FSDA Section 2 – Definitions*

3 THE CANADIAN ENVIRONMENTAL ASSESSMENT ACT, 2012

The purpose of the CEAA is;

> *To protect the components of the environment that are within the legislative authority of Parliament from significant adverse environmental effects caused by a designated project.*
> *Subsection 4(1)(a) – Purposes*

For the purpose of our submission, the relevant provisions of the Act are those which define a significant adverse environmental effect as;

> *A change that may be caused to the environment that would occur on federal lands (Subsection 5(1)(b)(i)) or…in a province other than the one in which the act or thing is done or where the physical activity, the designated project or the project (as defined in Section 66) is being carried out (Subsection 5(1)(b)(ii) or … outside Canada.*
> *Subsection 5(1)(b)(iii) – Environmental Effects*

> *A change that may be caused to …migratory birds as defined in subsection 2(1) of the Migratory Birds Convention Act, 1994 (Subsection 5(1)(a)(iii) and .. any other component of the environment set out in Schedule 2 (CEAA*
> *Subsection 5(1)(a)(iv) – Environmental Effects*

A change that may be caused to the following components of the environment … fish and fish habitat as defined in subsection 2(1) of the Fisheries Act…aquatic species as defined in subsection 2(1) of the Species at Risk Act…any other component of the environment set out in Schedule 2 Subsection 5(1)(a)(iv) – Environmental Effects

4 CARBON DIOXIDE AND CLIMATE CHANGE

4.1 Canada and International Obligations

Much could be written about climate change. It is, however, not the role of this submission to do so. May it suffice to point to the Paris Agreement: an international agreement within the United Nations Framework Convention on Climate Change (UNFCCC) dealing with GHG mitigation. The language of the Agreement was negotiated by representatives of 195 countries at the 21st Conference of the Parties (COP 21) of the UNFCCC in Paris and adopted by consensus on 12 December 2015. Canada is a signatory and ratified the Agreement on 5 October 2016. The Agreement has since been ratified by enough countries for it to enter into force and, as it would happen, it took effect today: the 4th November.

Signatory countries to the Paris Agreement, committed to reducing their emissions in accordance with their 'Intended Nationally Determined Contribution' (INDC). Canada's COP21 INDC states "*Canada intends to achieve an economy-wide target to reduce our greenhouse gas emissions by 30% below 2005 levels by 2030*". This represents a substantial reduction from Canada's business-as-usual emissions and, as noted in Canada's INDC, "*will require new policies in additional sectors and coordinated continental action*". On 3 October and in order to give effect to Canada's INDC commitment, the Federal Government announced a nationwide carbon tax starting at $10/tonne in 2018 and increasing by $10/tonne each year to $50/tonne in 2022.

4.2 Saskatchewan

Saskatchewan has the highest per capita carbon emissions of any province in Canada. Indeed, if Saskatchewan was a country, it would have the second highest per capita carbon emissions in the World[1]. It could therefore be argued that Saskatchewan has more of a duty than most to reduce those emissions.

It is therefore encouraging that Saskatchewan's '*Climate Change White Paper*', released by Premier Wall on Tuesday 18 October, noted (page 4);

There is no denying it. We have a problem; a problem that has to be solved for the sake of current and future generations. Climate change is real…. As we go about the business of feeding people and building an economy, we generate carbon and other gasses. That carbon causes the planet to warm, and the current rate of warming endangers our future.

We have to take steps now to limit climate change: this fact is indisputable.

One assumes that if the Premier says "*we have to take steps now*", he will be in favour of the steps we propose in this document to reduce carbon emissions at zero marginal cost to electricity consumers of Saskatchewan.

[1] SaskWind web site. '*Per capita GHG emissions by country (with Sask. shown for comparison)*'.

4.3 SaskPower

The Saskatchewan Power Corporation (SaskPower) is a 100% Crown-owned entity which has a de-facto monopoly on electricity generation in Saskatchewan. In 2015 SaskPower generated 23.7 TWh of electricity and, in the process, emitted 15.3 million tonnes of GHGs[2].

Per capita GHG emissions from electricity generation in Saskatchewan are, at 14.1 tonnes in 2014 (the most recent year for which Canada-wide data is available), the highest of any Canadian province[3]. The Canadian average in the same year was 2.4 tonnes.

These high emissions are the result of Saskatchewan's power generation mix which has historically been, and remains, heavily dependent on coal-and gas-fired capacity. In 2015 coal was the single largest source of provincial electricity generating 46% of the total. It was followed by natural gas with 34%. Only 17% of Saskatchewan electricity was generated by renewables (mainly hydro): this is the second lowest level in Canada ahead of only Alberta[4].

4.3.1 Investment in new generation

Since 2012 SaskPower has invested considerable sums in new electrical generation capacity: almost all of it fossil-fuel based. In 2013 it commissioned the $700-million, 260 MW North Battleford Combined Cycle natural gas plant. October 2014 saw commissioning of the $1.5-billion, 160 MW coal + CCS scheme at Boundary Dam in Estevan. In 2015 it commissioned the $525-million, 204 MW, Queen Elizabeth II gas-plant extension in Saskatoon. Now it intends to proceed with this $700-million, 350 MW, Chinook Combined Cycle natural gas facility in Swift Current. This represents a total of $3.5-billion of funds invested in, or committed to, 974 MW of new coal and gas capacity.

In the same period, i.e. since 2012, SaskPower has commissioned only two wind projects, with a combined cost of about $60-million and a capacity of 23.8MW. No new wind projects have been announced in that period: indeed one, the $355-million, 177 MW Chaplin Wind project, has recently been cancelled due to poor initial siting by SaskPower.

During the period 36 MW of new hydro-electric capacity was also commissioned.

4.3.2 2030 Renewable energy targets

The Chinook project summary notes;

> *SaskPower recently announced plans to double its renewable generation capacity from 25% today to up to 50% by 2030[5].*

This target was announced by Premier Wall in November 2015 only one day after a similar target was announced by Alberta. Although both announcements appear comparable – they were and are, substantially different.

Premier Wall's announcement was notable for not being accompanied by any publicly available policy analysis. In other words; it appeared to be little more than a political statement which was presumably intended, ahead of the COP21/Paris Agreement negotiations in

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[2] SaskPower *2015 Annual Report*. Page 59. '*Corporate Balanced Scorecard performance measure*'
[3] SaskWind website. '*Per capita power generation GHG emissions by Province. 2006-2014*'
[4] SaskWind website. '*Share of total 2015 electricity generated by renewables (by Canadian province)*.'
[5] SaskPower. '*The Chinook Power Station Project Summary*' (Section 2.1 '*Project's Context and Objectives*'). October 2016.

December and the Provincial elections in April, to deflect attention away from continued inaction by Saskatchewan on the climate file and to capture the 'green vote'.

Alberta's announcement, on the other hand, was backed by a comprehensive 100-page plan (the Climate Leadership Plan) which had been developed over a number of months after extensive consultation with the public, farmers and industry. It contained specific policy objectives, timelines and goals. The section of the Plan concerned with power generation was further enhanced, in September this year, when it was converted into clear, measurable and firm targets for renewables. Those targets were given further effect only yesterday when Alberta's Environment Secretary announced the province would soon table legislation spelling out details of the procurement program for the first 400 MW of wind capacity[6].

SaskPower's statement about doubling renewable generation capacity by 2030 is therefore encouraging but needs to be taken in light of their demonstrably poor track record with implementing non-hydro renewables. In the last three years, as noted in the previous section, SaskPower has built or awarded $3.7-billion of new generation capacity of which only $170-million (4.6%) was renewables and only $60-million (1.6%) was wind.

In the last ten years Saskatchewan's installed wind capacity has grown by 29%. The corresponding figures in Canada are 668%, the US: 542% and the World: 481%[7]. As a result, the amount of Saskatchewan's electricity generated by non-hydro renewables - almost all of which is by wind - has remained unchanged, at 2.9%, since 2006. Saskatchewan's endemic underperformance is neatly illustrated by this comparison of Saskatchewan with five leading US states.

SaskPower's renewable intentions are anyway not, as we will show in the following sections, directly relevant to consideration of the merits of the Chinook Power Station Project.

4.4 Chinook Power Station

The stated purpose of Chinook, which SaskPower intends will be completed by 2019, is;

> *To meet the growing demand for power in the province of Saskatchewan, provide replacement power for the retirement and/or refurbishment of conventional coal-fired generation units and allow for the integration of intermittent renewables[8].*

4.4.1 The Environment

SaskPower claims;

> *The Project is not anticipated to cause any changes in the environment that would adversely affect federal lands or land outside of Saskatchewan. The Project is a component of, and will contribute to, SaskPower's overall plan to reduce greenhouse gas and other air emissions[9].*

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[6] renews '*Alberta readies 400 MW green push*'. 3 November 2016
[7] SaskWind web site. '*Increase in installed wind capacity: SK, Canada, USA & the World. 2006-2015*'
[8] SaskPower. '*The Chinook Power Station Project Summary*' (Section 2.1 '*Project's Context and Objectives*'). October 2016.
[9] SaskPower '*The Chinook Power Station Project Summary*'. (Section 5.2.13 '*Environmental Effects to Components under Federal Jurisdiction'*.) October 2016

4.4.2 The need for Chinook

SaskPower claims;

> *to integrate these renewable supply options that are intermittent by nature, a back-up generation source is required to match electricity generation with electricity demand. Natural gas generation is an ideal candidate as it can quickly ramp up or down as the renewable generation output fluctuates*

and goes on;

> *Natural Gas is the only practical and economic option for integration of renewables in order to reach SaskPower's 40% emission reduction target by 2030*[10].

The conclusion, which is incorrect, does not logically follow from the premise which is anyway only partially true.

The Premise. A "*back-up generation source*" is not, as SaskPower implies, the only option to match generation with load. There are multiple non-generation options which can be implemented at significantly lower cost. These include renewable forecasting, more spatial diversity of wind/solar, grid friendly wind/solar, demand response/load management, ancillary services market, grid code changes, larger balancing areas, modified bulk power markets and more inter-regional transmission [11]. SaskPower provides no evidence it has seriously investigated any of these prior to proposing Chinook as a superior option.

The Conclusion. As noted above, neither natural gas, nor the Chinook Power Station, is the only "*practical and economic option*" for SaskPower to reach its 40% GHG reduction target. The implication that SaskPower's 2030 GHG reduction targets cannot be met unless Chinook is built by 2019 (SaskPower's targeted completion date) is flawed and not supported by the evidence.

4.4.3 Electricity generation

SaskPower has not provided a direct estimate of the annual generation of the facility. It does however expect it to have an operational capacity factor of 85%[12]. This seems unreasonably high and closer to what one would expect from baseload coal plants the average capacity factor of which, in 2015, was 82%. By way of comparison the average 2015 capacity factor of SaskPower's gas-fired generation fleet was 51.4%[13].

Regardless: a capacity factor of 85% implies annual generation of 2.6 TWh. Since SaskPower expects the plant to be commissioned in 2019, and given annual load growth of 2.5% from 23.7 TWh in 2015, the implication of an 85% capacity factor is the facility will supply 10% of 2019 Provincial electricity (26.2 TWh). If Chinook has a (more realistic) capacity factor of 51%, it will generate 1.6 TWh or 6% of provincial electricity.

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[10] SaskPower '*The Chinook Power Station Project Summary*'. (Section 2.1 '*Project's Context and Objectives*'.) October 2016

[11] GE Energy '*There is not a hard limit: Power grids can accommodate substantial levels of wind and solar power*'. Web site as at 1 November 2016

[12] SaskPower. '*The Chinook Power Station Project Summary*' (Section 2.7.1.3 '*Operation Emissions*'). October 2016.

[13] SaskPower *2015 Annual Report*. Page 152 '*Five-Year Generating and Operating Statistics*'

4.4.4 Carbon emissions

Emissions Factor. Annual GHG emissions of 1.04 million tonnes[14], given generation of 2.6 TWh, implies emissions of 400 kg/MWh. This is a logical number to use going forward since it correlates well with SaskPower's estimate of 370 to 420 kg/MWh[15].

Emissions avoided. SaskPower does not explicitly state what volume of emissions will be avoided annually by Chinook. It does however say;

> *The two coal units at SaskPower's Boundary Dam Power Station that are scheduled for retirement or retrofitting by the end of 2019 emit approximately 2.3 million tonnes of CO_2 annually to generate 280 MW. The Project will result in a greater generation output of 350 MW with a lower GHG footprint as indicated in Table 8[16].*

The implication of this statement is that Chinook will be displacing emissions from coal units. Given Chinook's annual GHG footprint, of 1.04 million tonnes, the logical conclusion is Chinook will avoid emissions of 1.26 million tonnes of GHG annually. This would, however, be incorrect.

As noted, Chinook will displace emissions from coal, meet load growth and provide additional reserve capacity. Chinook is therefore not replacing any specific power station and will instead be displacing emissions associated with an 'average' unit of electricity: in 2015 this was 650 kg/MWh[17]. This implies Chinook will avoid (650-400) kg/MWh * 2.6 TWh annually = 650,000 tonnes of GHGs annually.

5 WATER

The Chinook Power Station Project Summary does not contain details of the amount of water which will be used during operations. It does however note that treated, potable, water will be obtained from the City of Swift Current via an 18-kilometre water pipeline which will be capable of transporting "*a maximum of*" 100 US gallons (380 litres) per minute[18].

Without any additional information and assuming a reasonable safety margin in the design of the pipeline and also that the plant will only rarely operate at maximum, it would seem reasonable to assume the plant will require a continuous 70 litres per minute. Since no water is returned from the plant to the City of Swift Current, this equates to 100 cubic metres (m^3) of water daily; 36,500 m^3 every year or enough water to fill 15 Olympic swimming pools. This amount is approximately 1% of the total daily throughput of the City's water treatment facility[19].

The project proponents may consider this to be a negligible amount and, if so, that would explain why the environmental effects of this water requirement do not even merit a mention in the Chinook Project Summary. However; we believe it is noteworthy that Swift Current is designated as a cold semi-arid climate in accordance with the widely used Köppen climate classification scheme. Such a climate typically features hot (often exceptionally hot) and dry

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[14] SaskPower. '*The Chinook Power Station Project Summary*' (Table 8). October 2016.
[15] SaskPower. '*The Chinook Power Station Project Summary*' (Section 2.5: '*Processing*'). October 2016.
[16] SaskPower. '*The Chinook Power Station Project Summary*' (Section 2.7.1.3 '*Operation Emissions*'). October 2016.
[17] SaskPower *2015 Annual Report*. Page 59 '*Carbon Dioxide Equivalent emissions intensity*'
[18] SaskPower. '*The Chinook Power Station Project Summary*' (Table 5: '*Water Pipeline*'). October 2016.
[19] City of Swift Current – *Water Treatment*. Web site as at 1 November 2016

summers. One wonders if, in such a hot, dry summer, the 100 m^3 of water required daily by Chinook will be missed.

We will not consider water further in the remainder of our submission which is focussed on greenhouse gas emissions. However, and in closing this section, it is worth noting that wind turbines require no water for cooling, or any other purpose, during operations.

6 WIND ENERGY

6.1 Increased emissions from cycling of back-up capacity

Wind critics have posited that variable wind (and solar) energy causes significant additional emissions from fossil fuel power stations. They claim these emissions arise because dispatchable (fossil-fueled) generation capacity has to cycle more frequently (i.e. is exposed to more wear and tear) and/or has to run in inefficient stand-by mode due to increased variability of system net load. For moderate levels of wind penetration (less than 30%) These claims are not supported by analyses. Indeed, those same studies find that increased cycling emissions are negligible in comparison to the major GHG savings achieved when fossil fuel generators are displaced by renewables[20].

In the absence of evidence to the contrary; it therefore seems reasonable to assume that increased use of wind would lead to major reductions in GHG emissions from, and negligible marginal emissions due to increased cycling by, fossil fueled power stations.

The implication is that using wind energy, instead of the Chinook proposal, would save about one million tonnes of GHG emissions annually.

6.2 Economic feasibility

6.2.1 Wind energy and gas: the theory

Economics: While the cost of wind energy contracts is well known in Canada through the release of the results of competitive tenders; SaskPower does not release details of coal and gas contracts because it claims they are commercially confidential. Nonetheless multiple sources indicate that wind energy is currently extremely competitive vis-à-vis natural gas. Not least of the reasons for this is that Saskatchewan has one of the best wind resources in North America.

It can be difficult to compare the cost of different generators (such as wind energy and natural gas capacity) because they have different operating lives, fuel costs, maintenance cycles, O&M schedules etc. The Levelised Cost Of Electricity (LCOE) is a useful metric which addresses this because it represents the per MWh cost of building and operating a generating plant over an assumed financial life and duty cycle. In addition to capital costs, other key inputs are fuel costs, fixed and variable O&M costs, financing costs and an assumed utilization rate. It is of note that wind (and solar) have no fuel costs and very low O&M costs. For these and other reasons a simple, but erroneous, comparison of capital costs makes wind appear twice as expensive as gas. A more complex, but accurate, LCOE comparison shows otherwise.

[20] US Department of Energy: National Renewable Energy Laboratory '*The Western Wind and Solar Integration Study Phase 2: The Effects of Wind and Solar Power-Induced Cycling on Wear-and-Tear Costs and Emissions*.' September 2013

The US Government's annual LCOE[21] finds wind energy is now cost competitive with natural gas, significantly cheaper than nuclear and less than half the price of coal with carbon capture. The US Government's findings are confirmed by independent investment banks[22], and also by the rate at which new wind (and solar) energy is being installed in North America and globally[23,24].

Hedging gas volatility: One of the major, but lesser known, economic advantages of wind energy is that it provides a valuable hedge against gas price volatility[25]. In Saskatchewan, this effect is hidden – in other words fuel price volatility is not a cost carried by gas-fired power stations because pricing formulae, in Power Purchase Contracts between SaskPower and those generators, are structured such that any increases in feedstock prices are automatically passed through to final electricity customers. This means it is next to impossible to ascribe a hedge value to wind (or solar) power in Saskatchewan. Nonetheless that value is very real as illustrated by the experience of two of America's largest wind developers: one of which is owned by Warren Buffett's Berkshire Hathaway [26,27].

6.2.2 Wind energy and gas: the numbers

SaskPower estimates the capacity factor of Chinook will be 85%. This is twice that which can be achieved from wind turbines. As a result it would require about 700 MW of wind to generate the same amount of electricity as Chinook. Since the per MW capital cost of wind and gas is similar, about twice as much money would be required to replace Chinook ($700-million) with wind ($1,400-million).

However, and as noted, such a simple comparison would be inaccurate for determining the relative value of wind vs. natural gas. The reason is that capital cost is only one component which contributes to the eventual cost per unit of electricity paid by the final consumer. The aforementioned LCOE metric shows that wind and natural gas have very similar costs of around $70/MWh.

However, the Federal Government intends to introduce a carbon tax which will start at $10/tonne in 2018 and rise to $50/tonne in 2022. In other words, the Chinook Power Station, which SaskPower hopes to bring into service in 2019, would be exposed to a carbon price of $50/tonne for almost all of its operating life. Since Chinook will emit 400 kg/MWh of electricity generated, this translates into a carbon tax of $20/MWh. Under these conditions wind energy will produce electricity at a significantly lower cost than Chinook Power Station.

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[21] US Energy Information Administration. Annual Energy Outlook 2016. '*Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2016*'
[22] Lazard *Levelized Cost of Energy Analysis – Version 9.0*. November 2015
[23] US Energy Information Administration '*Wind adds the most electric generation capacity in 2015, followed by natural gas and solar'*. March 23 2016
[24] Bloomberg '*Wind and Solar Are Crushing Fossil Fuels: Record [Global] clean energy investment outpaces gas and coal 2 to 1.*'
[25] Ernest Orlando Lawrence Berkeley National Laboratory '*Revisiting the Long-Term Hedge Value of Wind Power in an Era of Low Natural Gas Prices*.' March 2013
[26] Bloomberg '*Wind Power Now Cheaper Than Natural Gas for Xcel, CEO Says'*. 23 October 2015
[27] MidAmerican Energy press release '*MidAmerican Energy moves forward with $3.6-billion investment in Wind XI project*.' 26 August 2016 CEO Bill Fehrman: "*Wind energy helps us keep prices stable and more affordable for customers*".

6.3 Technical feasibility

6.3.1 Wind energy and backup: the theory

Wind critics often state that every MW of wind capacity has to be backed up with one MW of 'base-load' capacity for those occasions when the wind is not blowing. While this argument is intuitively appealing; it is also incorrect and does not reflect the reality of the way in which modern, integrated, power systems operate. The reality is every form of traditional generation – nuclear, coal, gas, hydro – requires excess capacity to cope with peak load or backup capacity for those occasions when they are not required or are not operating for any of a number of reasons (maintenance, lack of fuel, unplanned outages, transmission failures etc).

By way of illustration: SaskPower's total installed generating capacity of 4,437 MW, generated 23.7 TWh of electricity in 2015. This is equivalent to saying that the entire 4,437 MW operated with a 61% capacity factor or, to put it another way, 2,700 MW (61%) of the total ran at full power all the time while the remaining 1,740 MW (39%) operated in backup mode for the entire period. The point is that every form of generation requires backup and there is no evidence to suggest, at a penetration level of less than 30%+, the backup needs of wind (or solar) are any different than for any other form of generation.

6.3.2 Wind energy and backup: the evidence

At the 2005 Gleneagles G8 Summit, the Paris-based International Energy Agency (IEA) was tasked with assessing the challenges of efficient integration of variable renewables (mainly wind and solar) in power systems. This marked the starting point for IEA analysis on the topic which culminated in February 2014 when the IEA presented '*The Power of Transformation – Wind, Sun and the Economics of Flexible Power Systems'*. The report draws on multiple international sources of practical experience and theoretical study. It is long (238 pages) and the following is from the Executive Summary;

> *Based on a thorough assessment of flexibility options currently available for VRE (Variable Renewable Energy) integration, a major finding of this publication is that large shares of VRE (up to 45% in annual generation) can be integrated without significantly increasing power system costs in the long run. However, cost-effective integration calls for a system-wide transformation. Moreover, each country may need to deal with different circumstances in achieving such a transformation.*

6.3.3 Canada's hidden advantage: Hydro-electric - the ideal wind complement

In 2015, hydro-electric power generated 60% of Canada's electricity; the third highest proportion in the world after Norway (95%) and Brazil (62%)[28]. This is relevant because hydro-electric power stations can be used to balance wind (and solar) variability at minimal cost. Indeed, GE Consulting completed the multi-year 'Pan-Canadian Wind Study' earlier this year and concluded;

> *The Canadian power system, with adequate transmission reinforcements and additional regulating reserves, will not have any significant operational issues if 35 percent of its electricity is provided by wind turbines[29].*

[28] BP *2016 Statistical Review of World Energy*
[29] GE Energy Consulting '*Pan-Canadian Wind Integration Study (PCWIS)*' October 14, 2016 (Rev 3)

It is worth noting that the study found the additional cost, of the aforementioned transmission reinforcements and regulating reserves, to be minimal.

Our province should therefore be looking to Manitoba's extensive hydro-electric resource, as is South and North Dakota, Wisconsin and Minnesota (CapX2020, Great Northern Transmission Line & Manitoba-Minnesota Transmission line), for balancing services for substantial wind capacities and certainly for much more than the 100 MW contemplated by SaskPower[30].

Wind energy currently generates 2.9% of Saskatchewan's electricity (an amount which has been unchanged in 10 years). Natural gas, as noted, generates 34% and the Chinook project would increase that to 44%. There is no technical reason why this much gas is required to support 2.9% electricity from wind or even ten times that much.

By way of illustration: Iowa, in the last 12 months, generated 35% of its electricity using wind energy. Over the same period coal generated 56%, natural gas: 4.2% and hydro: 1.5%[31].

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[30] CBC Manitoba '*Manitoba Hydro signs 20-year deal with SaskPower*'. September 14, 2015
[31] US Energy Information Administration – *Electric Power Monthly* & *Electricity Data Browser*