Transforming Saskatchewan's Electrical Future

PART TWO

Using Electricity More Efficiently

By Mark Bigland-Pritchard

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This paper is written as part of an ongoing project, Green Energy Project Saskatchewan. GEPS is a civil society group, established to research the conversion of Saskatchewan's electricity grid to sustainable options by the earliest possible date.

Basic principles of compassion and justice demand that we move rapidly to phase out fossil fuel usage. We owe this to all actual and potential victims of climate change, locally, nationally and globally, in our generation and in generations to come.

Concern for the welfare of the human species, and a respect for the earth and all of its natural systems, drive us instead to find energy policy options based on:

- Efficient use of resources.
- Renewable energy, using continuous natural cycles rather than finite resources.
- Technical viability, with the best available scientific and technological methods brought to bear on both innovative and traditional choices.
- Recognition and respect for the rights of indigenous people at home and low-income people worldwide.
- A preference for options which are either already cost-effective or can become cost-effective through inexpensive programmes of support within about a decade.
- Minimization of negative environmental impacts and respect for ecosystems.
- Optimization of opportunities for local social and economic development.

More information on GEPS and sustainable energy practices can be found at *http://greenenergysask.ca*

About the Author

Mark Bigland-Pritchard operates as a consultant in energy, environmental assessment, green building and architectural physics through his company, Low Energy Design Ltd. His background includes two engineering degrees, a PhD on energy performance and moisture risk in strawbale construction, several years of teaching energy studies at the Open University and the University of Sheffield (in Britain), and a diverse range of consultancy work in the public, private and voluntary sectors, spread over two decades and three continents. He is currently a director of the Saskatchewan chapter of the Canada Green Building Council.

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Transforming Saskatchewan's Electrical Future

Using Electricity More Efficiently

The first paper[1] in this series noted the considerable potential of efficiency measures, combined with renewable sources (and short-term "stop-gap" options such as natural gas), to move Saskatchewan's electricity generation regime decisively in the direction of economic, environmental and social sustainability. This paper looks in more detail at the role of energy efficiency and conservation.

Given that, compared to new generation of any sort, such measures typically have a low (or even beneficial) environmental impact, a low financial cost, and positive social benefits, we believe that a sane electrical power procurement policy will nearly always prioritize efficiency and conservation over all other options. This is well articulated in the (US) federal NorthWest Power Act of 1980,[2] which establishes the Pacific Northwest Electric Power and Conservation Planning Council and requires it to produce regular upgrades of its "regional conservation and electric power plan". The legislation includes the following stipulation:

> *839b(e)(1). The plan shall, as provided in this paragraph, give priority to resources which the Council determines to be cost-effective.* ***Priority shall be given: first, to conservation; second, to renewable resources; third, to generating resources utilizing waste heat or generating resources of high fuel conversion efficiency; and fourth, to all other resources.***

[emphasis added]

Definition of Terms

While there is often some overlap of meaning among some of the terms we will be using in this paper, some definitions are helpful:

Energy efficiency: providing the same services, or the same quantity of product, using less energy.

Energy conservation: meeting our needs in different ways so as to reduce energy consumption.

To take an example: A corporation needs regular meetings between executives at its Saskatoon and Regina offices. At present these executives do this by meeting face-to-face in one or other of the locations. Successive efficiency measures might be (i) to travel by car instead of flying, (ii) to carpool instead of driving individually, (iii) to use a Toyota Prius instead of a typical SUV, (iv) to take the bus. A possible conservation measure would be to meet by video conference instead of face-to-face.

Or, to take another example more relevant to our main focus of electricity consumption: A business wants to save money on its electricity bills by reducing its air-conditioning consumption. Efficiency savings could be made by replacing the old SEER[3] 10 air-conditioner with state-of-the-art SEER 22 equipment, thus more than halving energy consumption for the same cooling effect. Conservation measures could range from resetting the thermostat to reduce air-conditioner operation, to making more effective use of shading and ventilation, to strategic planting of deciduous trees or plants on the south side of the building, to planning better thermal design into the next building refurbishment so as to eliminate the need for air-conditioning altogether.

For industrial processes, where the goal is to meet targets for the amount of product sold (whether that is a primary resource or a manufactured item), efficiency is more immediately relevant than conservation. For electricity use in buildings, however, both are of importance.

Load management (demand response): A major concern for all electrical utility companies is peak load — i.e. the maximum demand for electricity within their area of operation during the year. (In Saskatchewan this currently happens during a cold winter day, although there is also a smaller peak in the summer.[4]) This determines the amount of generating capacity which they need to either operate themselves or else access through contracts with other operators. Load management is the reduction of electricity demand during periods of peak power consumption or high prices (often the two coincide, or can be made to coincide by careful tariff structure design), with the purpose of reducing the capacity requirement. Load management programmes rely on a variety of means to encourage customers to reduce their demand, for example, interruptible load tariffs, time-of-use rates, real-time pricing, direct load control, and voluntary demand-response programmes. Load management efforts may save some energy and kilowatt-hours (kWh), but mostly they save capacity and kilowatts. The potential options for load management programmes will become steadily greater as "smart grid" technology is introduced and further developed.

Demand side management (DSM) is a term encompassing any measures sponsored, funded and/or implemented by electric utilities or government authorities, which modify end-use electrical consumption. This may be thought of in two categories — (i) measures to reduce overall consumption through efficiency and conservation, and (ii) load management measures to reduce peak power consumption. Efficiency/conservation measures will also reduce peak power, but load management measures will not necessarily have much impact on overall consumption. A balanced DSM package will include effective measures in both categories: often these can be mutually reinforcing. DSM measures may include targeted funding of better equipment and processes, their direct provision at discount prices by the authority, or arrangement of favourable loan terms for the purchase of larger items. It may also include taxation or regulatory exclusion of wasteful equipment and processes.

Smart grid is not a precisely-defined term, as technological change is still ongoing and new strategies are being developed. However, it is used to refer to modern methods of making the grid more responsive, and is associated with strategies which use technological options such as increased connectivity, greater automation, load control switches, phasor measurement units, smart meters and price signalling.

How Does DSM Save Money?

For a society with our present electrical consumption patterns, there is a wide range of efficiency and conservation measures which will yield a faster return on investment than any type of new power generation capacity. Even if the utility provider were to pay the entire cost of efficiency savings (which is surely unfair), it is likely that it would benefit from the transaction through reduction of the need for investment in new power stations.

Savings occur in three areas:

1. The utility provider saves by reducing its required investment in new generating capacity, and by reducing operation, maintenance and fuel costs. Because of the lower costs to the utility provider, any financial support which it gives for its consumers' purchase of energy-efficient equipment should be seen as investment rather than subsidy.
2. The customer saves through lower electricity consumption. The annual cost to the consumer is the cost per kilowatt-hour multiplied by the number of kilowatt-hours consumed per year. Hence, even if the unit cost of electricity were to rise, it is still possible to make overall savings through reducing the number of units of electricity used.
3. By encouraging investment in ever more energy-efficient equipment and methods, economies of scale are created for the most efficient products, taking them from a niche market into the mainstream and enabling future savings. The US federal Energy Policy Act of 2005 included tax incentives for air-conditioners, with the threshold efficiency level set such that only 10 of over 100,000 products on the market qualified. By the following year, 15% of air-conditioner replacement sales in California qualified.[5] Wherever there has been a significant drop in the price of compact fluorescent lighting, a rapid increase in sales has followed, enabling further price reductions. (The same trend may be predicted for LED lighting in the next few years.) Ambitious measures — whether financial incentives or legislated minimum standards — can yield meaningful savings within a few months followed by a larger effect growing on the scale of a decade until the formerly leading-edge technology becomes the new norm. For many technologies, steadily more ambitious incentives would be able to drive such improvements over several decades.

Where Would the Savings be Made?

First we should identify where and how much electricity is consumed. SaskPower offers the following breakdown:[6]

Sector	2009		Predicted 2019	
Power account (potash, oil/gas pipelines, steel, chemicals, oil refining/upgrading, northern mining)	6995.1 GWh	(34.5%)	13363.9 GWh	(46.8%)
Oilfield	2755.0 GWh	(13.6%)	3511.7 GWh	(12.3%)
Commercial	3274.5 GWh	(16.1%)	3603.6 GWh	(12.6%)
Residential	2779.4 GWh	(13.7%)	3272.1 GWh	(11.5%)
Farm	1256.4 GWh	(6.2%)	1221.9 GWh	(4.3%)
Reseller (cities of Saskatoon and Swift Current)[7]	1288.0 GWh	(6.3%)	1380.7 GWh	(4.8%)
SaskPower internal	115.0 GWh	(0.6%)	117.8 GWh	(0.4%)
Transmission losses	1808.5 GWh	(8.9%)	2065.8 GWh	(7.2%)
Total	20301.9 GWh		28567.5 GWh	

The 2019 figures are of course projected: with a good DSM programme these will be significantly lower. Clearly SaskPower is expecting massive industrial expansion (power account, oilfield), especially in extractive industries, so energy efficiency programmes should be focussed particularly in this area. However buildings (commercial, residential, reseller) should not be disregarded — there are substantial savings to be made through technological improvement. It is useful to look separately at these two areas. Remarks made in both categories will also be relevant to the third main area, agriculture.

Industry

Industrial savings are possible through use of more efficient equipment — pumps, fans, compressors, motors, drives, conveyor belts, etc.

Where electricity is used for industrial heating — as is the norm particularly for high temperature processes such as steel production — heat recovery can provide massive savings. This may be of one of two types — recuperators are usually more suitable for continuous processes, and regenerators for batch processes.

Frequently in industrial processes, electricity use represents one of a number of interrelated energy flows, which should be analyzed in tandem using well-established engineering methodologies such as pinch analysis[8] — while this may or may not result in lower electricity use, there is generally scope for it to significantly reduce overall energy requirements by rationalizing heating loads. Such techniques are now widely used in the chemical industry; other industries would benefit from their introduction. It is good practice to revisit this analysis every decade or so, to see if new savings can be made by taking advantage of technological advances in heat exchangers, etc.

This integrated approach to industrial energy flows will result in automatic consideration of combined heat and power (cogeneration) systems, such as are already in operation at the Cory potash plant and the Meridian oil refinery. Urban-based industry could, with logistical support from government, begin to sell heat to local consumers as well as power to the grid — numerous good examples of this already exist in Europe.[9] Some processes, however, produce excess heat at too high a temperature for easy use in space or water heating: this should be seen as a valuable resource rather than an inconvenient waste stream — one of several potential uses would be pre-heating of turbine steam to increase the efficiency with which on-site electricity is generated.

Wherever electrical equipment makes substantial use of inductive or capacitive components — for example induction coils in motors — current and voltage get out of phase with each other and the available power declines by a ratio known as the power factor.[10] It is usually sufficient to put current and voltage back in phase (and so restore the power factor to 1.0) by means of switched banks of capacitors, though in some cases more sophisticated electronic methods are necessary.

Good maintenance is vital to the practice of energy efficiency. A striking example is that of pneumatic power systems, where air leakage can result in very substantial excess electrical consumption at the compressors.

Industrial efficiency measures are not limited to raising and maintaining the efficiency of equipment. Processes can be streamlined to avoid excess use of materials — excess materials usually means excess energy consumption. Use of recycled materials can reduce the energy requirements in certain industries (e.g. manufacture of glass, aluminium and steel).

Adoption of plant-wide energy management standards and optimization techniques can reveal further opportunities for savings. For example, while it is an improvement to replace an inefficient pump with an efficient one of the same size, it is even better to substitute it with one of optimum (probably smaller) size. A recent UN report puts the case in more general terms:

> *There is little benefit in producing compressed air, steam, or pumped fluids efficiently only to over supply plant requirements by a significant margin or to waste the energized medium through leaks or restrictions in the distribution system. System energy efficiency requires attention to the entire system.*[11]

The authors of this report go on to warn that:

> *The presence of energy-efficient components, while important, provides no assurance that an industrial system will be energy-efficient. Misapplication of energy-efficient equipment (such as variable speed drives) in these systems is common. System optimization requires taking a step back to determine what work (process temperature maintained, production task performed, etc.) needs to be performed. Only when these objectives have been identified can analysis be conducted to determine how best to achieve them in the most energy-efficient and cost-effective manner.*[12]

Buildings

In buildings, substantial efficiency savings are again frequently possible through replacement of equipment, including refrigerators, freezers, washing machines, electronic equipment, etc. Furnace fan motors should typically be direct current models.

A major component in building electrical consumption — often, especially in offices, the largest component — is lighting. A number of efficiency and conservation elements are applicable, preferably as a package wherever this is possible:

- Natural daylight is preferable to artificial light for reasons of human comfort (and office worker productivity) as well as conservation. This has implications both for the way that new buildings are designed and the way that existing ones are used.
- Lighting types vary considerably in the amount of light which they can produce from a given number of watts of power — for example, an old-fashioned tungsten incandescent bulb requires about five times the power to produce the same light level as a compact fluorescent bulb. More efficient designs of fluorescent lighting are still being developed, and technological improvements are especially rapid with LED (light emitting diode) lighting. Another useful feature of LED lighting is that it is directional: no energy is wasted shining light on the ceiling.

- The design of lighting systems often requires more care. Professional lighting engineers recommend relatively low but uniform levels of lighting throughout the majority of office space, with higher levels only in the small areas where visual tasks are actually performed. Those responsible for office planning are frequently not aware of such recommendations and so design inefficient systems.
- Introduction of lighting controls — including electronic dimmers, occupancy sensors, etc. — can make a significant difference to total consumption.

Another large energy consumer in many buildings — particularly offices but also some homes — is air-conditioning. Good building design can often eliminate the need in Saskatchewan, through appropriate use of shading and ventilation. However, a building where substantial amounts of heat and/or moisture are generated — for example through banks of IT equipment or by certain types of food processing — will need some cooling and/or dehumidification in the summer months. In these cases, it is still good practice to pursue the conservation options first, and then opt for the most efficient unit of a size appropriate to manage the residual cooling or dehumidifying load.

Surprisingly large amounts of electricity are consumed by a variety of appliances when they are switched off at the unit or on standby — notably electronic equipment and kitchen appliances. These “phantom loads” or “plug loads” can be avoided by unplugging the appliance or by making use of a power bar with a switch.

The most appropriate energy efficiency measures will vary from one building to another and from one industrial site to another. In many cases a professional energy manager can provide useful guidance. This is of particular value in assessment of the complex systems typical in large industrial installations.

What Are the Barriers?

- **Financial.** Clearly, energy efficiency measures of most types require some upfront financial investment. Savings are of course subsequently made through lower utility bills; however, the payback time may sometimes be prohibitively long. Key factors affecting the payback time include the unit cost of electricity (particularly low for heavy industry in Saskatchewan, thus extending the payback time) and the interest rate for any loans.
- **Educational.** Installers and operators are frequently not aware of the possibilities, and do not have a sense of the savings which are possible.
- **Organizational.** Many corporations do not employ an energy manager, and others do not give this post the seniority required for it to be taken seriously by top management.
- **Cultural.** There is frequently greater trust in familiar products of low efficiency than in newer, more efficient options.
- **The Jevons paradox (also known as the kickback effect).** By reducing overall cost, energy efficiency gives the user more disposable income, some of which may be used in new consumption of electricity. Measures are therefore often necessary to set limits on the degree of financial savings made by any group of consumers.

A complete strategy for efficiency and conservation will address all of these issues, through a mix of fiscal, educational and logistical measures.

What Specific Measures Could SaskPower or the Provincial Government Pursue?

Efficiency depends to some extent on individual choice and on corporate policy. But it also depends on public policy geared to removal of the barriers noted above. Some options include:

- Make such amendments to SaskPower's charter as are necessary to make efficiency in energy use a core function of the organization. Wording similar to that of the NorthWest Power Act quoted on page 3 above could provide a useful model in drafting such changes.
- Raise rates for heavy industrial users. These corporations currently pay about half as much per unit as domestic or commercial customers. This is not just an issue of justice (should low-income households be in effect subsidizing wealthy corporations?) but also necessary to incentivize corporations to pursue efficiency seriously. A particular aspect of this issue is further discussed below.

- Work with banks and credit unions to establish a low-interest loan system for energy efficiency improvements.
- Establish a "feebate" scheme for each industrial sector, whereby more profligate users of energy (per unit of production) are charged an additional fee, which is passed on to more efficient users as a rebate. The result of such a scheme should be to create competition within each sector to drive down unnecessary energy costs. Feebates should only be implemented on a sector-by-sector basis because of wide differences in energy requirements from one process to another.
- Prioritize the shift to a "smart grid". This would open up more opportunities for load management. It would also enable a scheme such as is currently being operated, at net economic benefit, in Vermont. When a major piece of electrical equipment fails in that state, the information systems recording the relevant customer account flag up an unusual event. A frequent outcome is that, after some discussion of requirements, an Efficiency Vermont employee will arrange for the customer to receive the currently most energy-efficient suitable replacement model at a discounted price. The utility companies benefit through avoidance of new investment, and the customer benefits through lower utility bills.
- Provide incentives for industrial combined heat and power.
- Require any company putting forward new proposals for industrial development to meet stringent minimum efficiency standards in their design.
- The provincial government should possess, and should be prepared to use, reserve powers to block projects which cannot be developed without large scale expenditure on new generating capacity and a substantial and enduring increase in greenhouse gas emissions. Instead of welcoming all new industry whatever the human and environmental cost, government should be seeking an enduring prosperity based on industries and businesses whose impact is small or even beneficial.
- Establish training courses at SIAST in energy efficiency for all relevant trades.

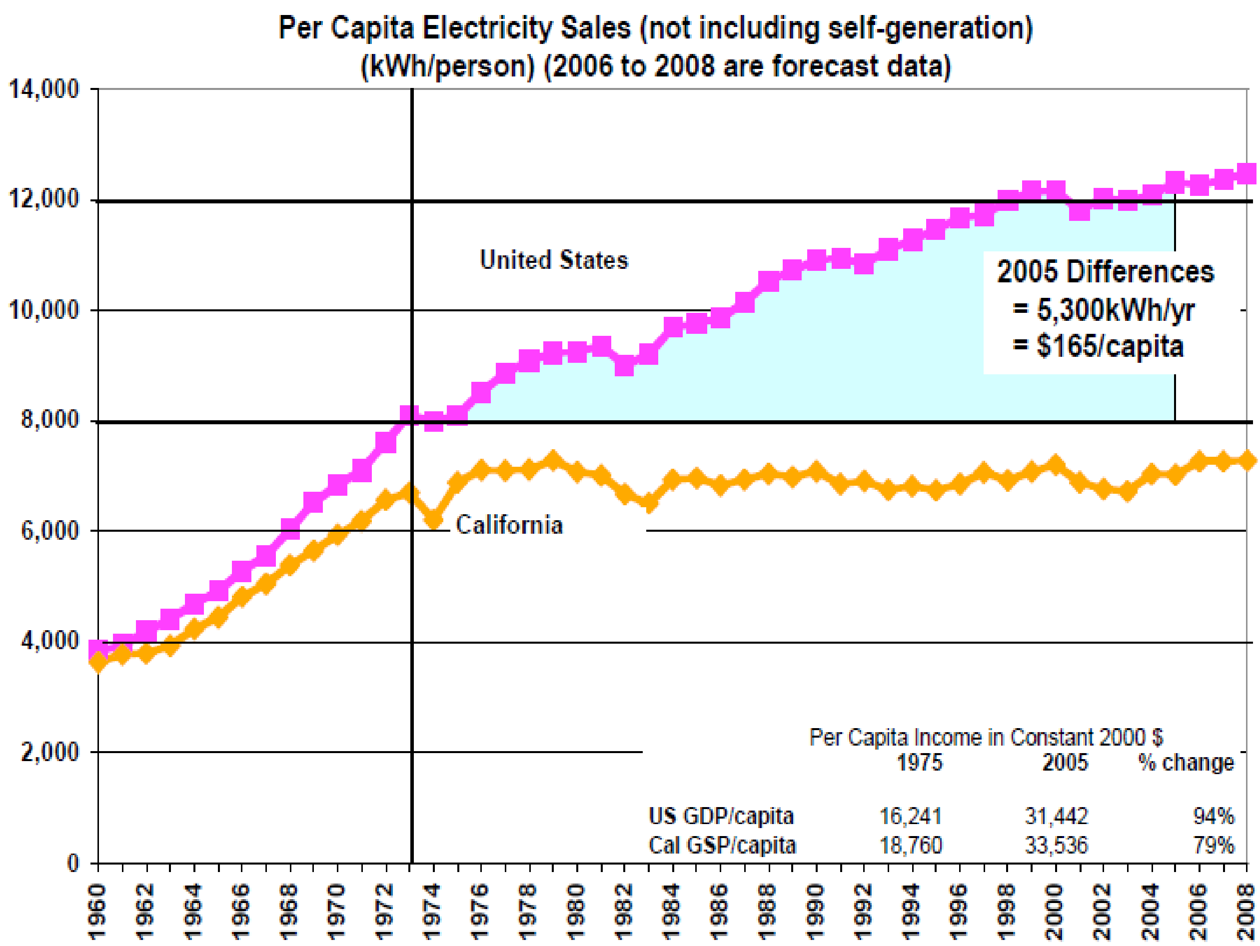
Additionally, it should be noted that the projected rapid increase in electricity (and other energy) consumption is a function of the economic development strategy pursued by governments of both main political parties. The province's high-consumption high-greenhouse-gas-emissions economy is in large part a result of a political choice to opt for heavy dependence on extractive industries. A future government with a commitment to industrial diversification, especially around the emerging green economy, could curtail some of the side-effects which make the present path fundamentally unsustainable, and enable prosperity based on lower consumption and lower emissions.

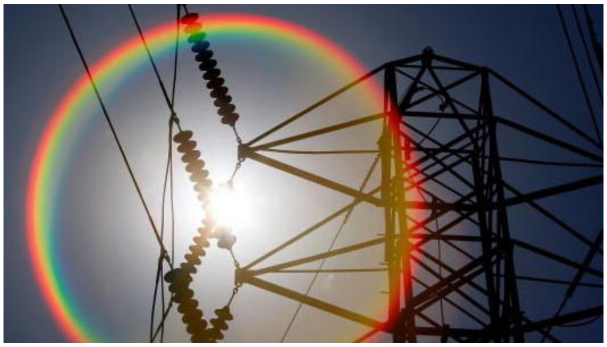
What Level of Savings is Achievable?

The potential for substantial savings over an extended period of time in a modern economy is shown clearly by the example of California. The state introduced DSM measures in 1974 in response to the 1973 "oil crisis". Since then, the per capita electricity consumption has remained steady while that in the USA as a whole has risen by over 50%. This is shown in Figure 1 below. During that time, inflation-adjusted Californian income per capita has risen by 79%, and a whole new industrial sector of global importance — the IT and computing industry — has been created largely as a result of the work of start-up businesses and research institutes within the state, and has become a major source of economic prosperity in the state.

While California's somewhat different electricity usage pattern (less heavy industry, more light industry, more building usage) means that direct comparisons with Saskatchewan are difficult, it nevertheless uses electricity in the same appliances — lights, fans, pumps, motors, etc.

Figure 1: Changes in per capita electricity usage in California and in the United States as a whole. Source: Rosenfeld (2008)[13]





A 2006 study by Marbek and Jaccard & Associates for the Canadian Gas Association identified electricity savings potential by 2025 in Canada of about 23% for the residential sector, 44% for commercial buildings and 86% in the industrial sector.[14] The model used, however, assumes that no savings per unit output are possible in the mining industries which dominate Saskatchewan consumption. The figures which Marbek and Jaccard arrive at for Saskatchewan are consequently 28%, 24% and a disappointing 10%. For the Saskatchewan economy this represents roughly 17% saving over the time period, or about 0.8% per year. This is substantially higher than the 0.3% per annum target set by SaskPower for this period. However, it still significantly underestimates the true potential for savings. In particular, the zero mining savings assumption does not reflect technical reality and needs to be revisited. As we will see below in the case of potash, there are both substantial variations in energy intensity among mines and significant opportunities for efficiency savings in the technology used. The equipment used is mostly not unique to the industry — there are just as many opportunities here as in above-ground manufacturing for saving through high-efficiency hardware, better process integration, better maintenance schedules, etc. Like most of the industries strongly represented in Saskatchewan, mining does not have a particularly strong efficiency culture, and so it is to be expected that there is significant room for improvement given appropriate incentives from the provincial government and the electrical utility.

The level of savings possible is largely dependent on the commitment of the utility provider to the DSM process. This area of SaskPower's business has been poorly resourced in the past, but with a higher priority within the organization it would be possible for DSM staff to aim for and hit more ambitious targets. With stronger policies and enhanced staffing, there is no reason why SaskPower should not increase its DSM annual savings target from 0.3% to at least 1%[15] — a figure which is commonly seen as the North American norm and is regularly exceeded by several jurisdictions. California has averaged about 1.4% savings per year over the nearly 40 years of its DSM policy. A 1% per annum figure would amount to a reduction of the 2019 projected total consumption by about 2000 GWh.

Savings in the Potash Industry?

Saskatchewan's large industrial energy consumption is in a relatively small range of industries — oil and gas (field operations, pipelines, refining and upgrading), potash mining, mineral mining (uranium, gold, diamonds, rare earths, etc.), steel making and chemicals. Of these the oil and gas industry is the largest energy consumer, followed by potash mining.

In 2003, NRCan published a study on energy consumption in the potash industry.[16] Electrical power is used for powering mining machines, hoisting, conveying, ventilation, lighting, dewatering, mill operations, tailings management and office/administration facilities. Among underground mines in Canada (all but one of which are in Saskatchewan), electricity consumption was found to vary widely, from 92 to 155 kWh per tonne potassium oxide equivalent, with an average of 120 kWh/te K_2Oe. Many factors may affect this figure — the age of plant and equipment, the type and design of equipment for each operation, the dewatering requirements, the underground distance to the mine face, any specific operational requirements, the level of production, the degree of process integration, etc. Several of these may be addressed by efficiency measures, though others cannot be.

The British potash industry is finding scope for greater efficiency. Cleveland Potash operates Britain's only potash mine at Boulby, in the northeast of England; since early 2006 they have been subject to the UK's Climate Change Levy on specially negotiated terms. (The CCL is a tax and rebate measure applied to heavy industry and negotiated on a sector-by-sector basis.) The company committed to increase energy efficiency (compared to at 2001 base) by 2.8% by the end of 2006, by 4% by 2008, and by 10% by 2010.[17] A partial energy analysis of the plant, conducted in 2002,[18] identified significant possible savings with a short financial payback time, through better electronic control of drier temperature, optimal washing of centrifuges, and variable speed motors on the drier extract fans. The consultant responsible for this analysis also trained in-house staff so that further savings could be sought and found.

Without deeper investigation, it is not possible to give a figure for the efficiency savings possible in the Saskatchewan potash industry, nor to identify specific measures to achieve them. However, there is every reason to believe — contrary to the assumptions in the Marbek/Jaccard model — that non-trivial savings are possible.

The Effect of Perverse Subsidies: A Current Example

In November 2008, BHP Billiton published on the web their application to the Saskatchewan Ministry of the Environment for permission to open a massive new potash mine, to be known as Jansen Lake, to the east of the existing PCS development in the Lanigan area.[19] It is to their credit that they should make their proposal readily available to the public in such detail: not all applicants for a licence do so.

However, in terms of energy efficiency, the new proposal does not look so good. The intensity of electricity use, at 101 kWh per tonne of potassium oxide equivalent, is slightly better than the average for existing potash mines, but significantly less good than the best in the NRCan study mentioned above. In terms of both gas usage and total energy consumption, the mine would come out worse than the present average if implemented as proposed.

Because of the size of the mine — about twice that of the largest existing installation — its electricity consumption is projected at an immense 512 GWh/yr. This rate of consumption is about 2.5% of the province's current total.

To accommodate this (and other large proposals) and stay within accepted safety margins, SaskPower would need to build new capacity. According to SaskPower's lengthy submission in October 2009 to the provincial legislature's Standing Committee on Crown and Central Agencies,[20] it would not be able to produce power from that new capacity from any source at less than 6 cents/kWh — and given their current choices it would most likely be at least 8 cents/kWh. This is the (levelized) busbar cost — i.e. it doesn't include the cost of transmission, distribution, losses, administration or profit — so a realistic break-even price would be several cents higher.

At SaskPower's current business rates,[21] which provide a substantial rebate for any use above 15.5 MWh/month, the mine would pay for electricity at an average of just over 5.6 cents/kWh. To this needs to be added a peak demand charge, which, given the continuous nature of the mining operation, would probably not exceed 2 cents/kWh.

From these calculations it is apparent that BHP Billiton would not only be requiring SaskPower to invest in new generating capacity, but receiving power at a price lower than the cost of providing it to the Jansen mine.

Put another way, the ordinary householders of Saskatchewan would be subsidizing BHP Billiton.

This example has been chosen simply because the data are available. No doubt similar calculations could be carried out for other large industrial proposals. Because electricity is available to such large operations at such a low price, they have little incentive to pursue efficiency and conservation, thus creating a triple burden — to the people of Saskatchewan in compensatory higher electricity prices, to the utility company in the cost of the new generating capacity required to meet their demands, and to the whole world in increased emissions of greenhouse gases.

The Way Forward

A concerted effort to encourage efficiency and conservation, especially in industry, will instead have multiple benefits — to the people of Saskatchewan in lower total electricity bills, to SaskPower in avoidance of expenditure on new capacity, and to the world as a whole in reduction of greenhouse gas emissions. Adoption of these measures will also benefit industry by encouraging practices and habits that will lead to long-term cost savings. Implementing the specific measures identified on pages 9 and 10 as a package is a high priority, as it is a critical step toward creating a self-reinforcing culture of efficiency in Saskatchewan.

To ensure this cultural shift occurs genuine commitments by the provincial government and SaskPower are required. As government implements the policy recommendations made in this paper, it will be fulfilling its most fundamental mandate of protection: protecting the environment for future generations, protecting vulnerable citizens from high electrical costs, and protecting our resources for future use as corporations reduce unit costs of production.

Endnotes

1 Bigland-Pritchard, Mark and Prebble, Peter (2010:Apr), Transforming Saskatchewan's Electrical Future pt 1: Sustainability is achievable, but how do we get there?, CCPA Saskatchewan, Regina SK

2 Pacific Northwest Electric Power Planning and Conservation Act (a.k.a. Northwest Power Act): 16 United States Code Chapter 12H (1994 & Supp. I 1995). Act of Dec. 5, 1980, 94 Stat. 2697. Public Law No. 96-501, S. 885. May be downloaded from *http://www.nwcouncil.org/library/poweract/default.htm* (last accessed 2010:Aug:09)

The federal agency created by the act operates in the states of Washington, Oregon and Idaho, western Montana, and those parts of other states which lie within the Columbia River drainage basin.

3 SEER stands for Seasonal Energy Efficiency Ratio, and is the standard North American measure of the energy performance of an air conditioning unit. It is defined as the ratio of the cooling effect in Btu/hr to the power input in watts, averaged over a standard year (for a standard reference climate with an average summer temperature of 28°C). [Outside of North America, consistent units are used for power — i.e. both the cooling effect and the power input are measured in watts. Hence manufacturers from outside of North America will instead quote the seasonal average cooling coefficient of performance, or COPc(seasonal). To obtain SEER from COPc(seasonal), multiply by 3.415.]

4 In 2009, the SaskPower winter peak was 3231 MW, the summer peak was 2773 MW, the annual average load was 2042 MW, and the minimum load was 1561 MW. All figures net of line losses, and taken or calculated from: SaskPower (2010), Securing Tomorrow's Energy Begins Today: SaskPower Annual Report 2009.

5 Goldstein, David B (2009), Invisible Energy: Strategies to rescue the economy and save the planet, Bay Tree Publishing, Point Richmond, California

6 SaskPower (2009:Sep), 2009 Load Forecast

7 Swift Current Light and Power provides electricity to the City of Swift Current: *http://www.city.swift-current.sk.ca/city_hall.php?name=Sections&op=viewarticle&artid=136*. Saskatoon Light and Power provides electricity to more than half of the city of Saskatoon: *http://www.saskatoon.ca/DEPARTMENTS/Utility%20Services/Saskatoon%20Light%20and%20Power/Pages/default.aspx*. Both utilities purchase power primarily from SaskPower and use their own distribution systems to route it to their customers.

8 For a basic description, see the wikipedia entry at *http://en.wikipedia.org/wiki/Pinch_analysis*

A more technical introduction may be found in many engineering textbooks: for example, Eastop, T.D. and Croft, D.R. (1990), *Energy Efficiency for Engineers and Technologists*, Longman, Harlow, England, chapter 6, pp 203-246.

9 An example in the English-speaking world is the use of the municipal refuse incinerator in Sheffield, England for production of both electricity and district heating. Electricity is sold direct to the grid; the district heating network consists of a network of heavily insulated underground hot water pipes serving many of the businesses and institutions in the city's downtown core as well as some more distant housing estates. Instead of running

their own furnaces or boilers, these customers extract heat from the network by means of metered heat exchanger units. Further details at *http://www.veoliaenvironmentalservices.co.uk/sheffield/pages/district.asp* (last accessed 2010:Aug:11)

10 For more technical detail on power factors, see the wikipedia entry at *http://en.wikipedia.org/wiki/Power_factor*

11 McKane, Aimee; Price, Lynn and de la Rue du Can, Stephane (2007:May), Policies for Promoting Industrial Energy Efficiency in Developing Countries and Transition Economies, United Nations Industrial Development Organization. Citation from p21. Available online at: *http://industrial-energy.lbl.gov/files/industrial-energy/active/0/ind.energy_efficiency_65693_CSD15_SideEvent_IndustrialEnergyEfficiency.pdf* (last accessed 2010:Aug:09)

12 Ibid, p21

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14 Marbek (2006:May), Demand-Side Management Potential in Canada: Energy Efficiency Study. Available for download from *http://www.electricity.ca/resources/reports-and-documents/policy-statements-and-briefs.php* (last accessed 2010:Aug:12)

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21 The relevant SaskPower rate structure is listed at *http://www.saskpower.com/customer_service/rates/supplied_transformation/*