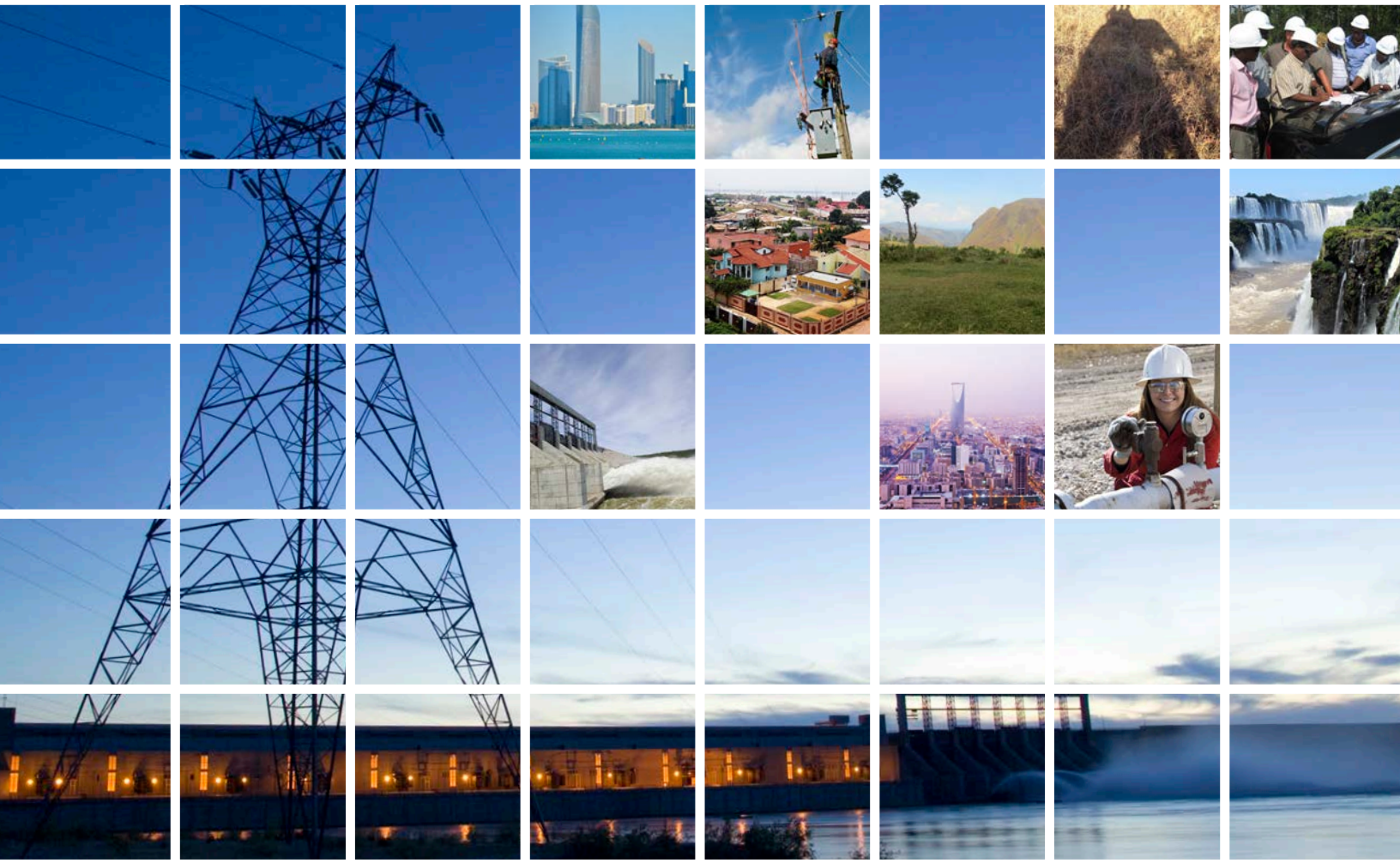
Summary Report

North Slave Resiliency Study

May 2016



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HYDRO INTERNATIONAL

The North Slave System

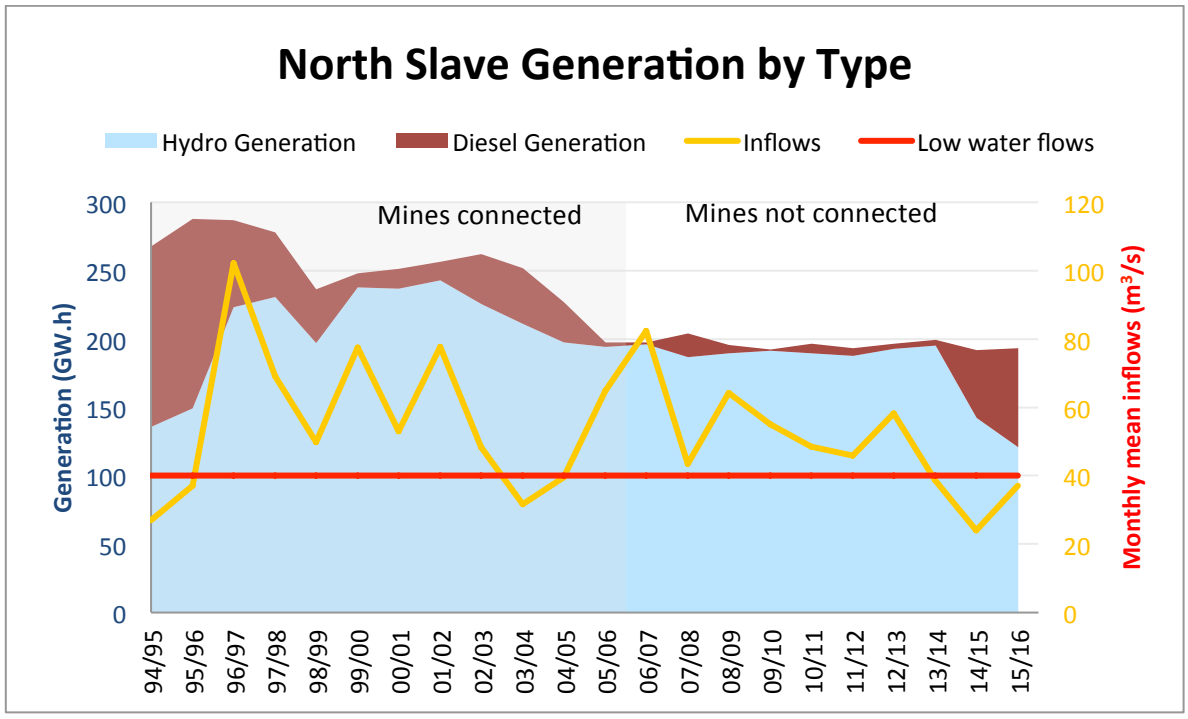
Hydroelectric plants on the Snare and Yellowknife Rivers supply electricity to Yellowknife, Dettah, N'Dilo, and Behchoko.

Snare Cascades

Hydropower is used whenever possible because it is a renewable resource that is relatively low-cost to operate. However, NWT hydropower costs more to generate compared to hydro generated in much of Canada. This is partly because the North Slave system is smaller than the systems in southern Canada and also because it is not connected to an all-season road, which increases operating costs associated with travel and infrastructure. The North Slave system is also not connected to a large power grid, which means that full scale backup generation systems must be installed to serve a relatively small customer base.

The amount of electricity that can be generated from water depends on the flow in the rivers. When river flows are high, some water can be stored in reservoirs for later use. However, only a limited amount of water can be stored, and excess water must be spilled. In contrast, there may not be enough water to meet customers' needs during dry years. In this case, hydropower still provides most customer needs, but expensive-to-run diesel generators (located at the Jackfish station near Yellowknife) must supply the difference.

As shown below, hydropower has historically supplied most of the electrical load. Load was higher prior to 2005 when the Con and Giant mines were operating. The recent drought that began in 2014 required significant diesel generation, which greatly increased the cost to produce electric power.

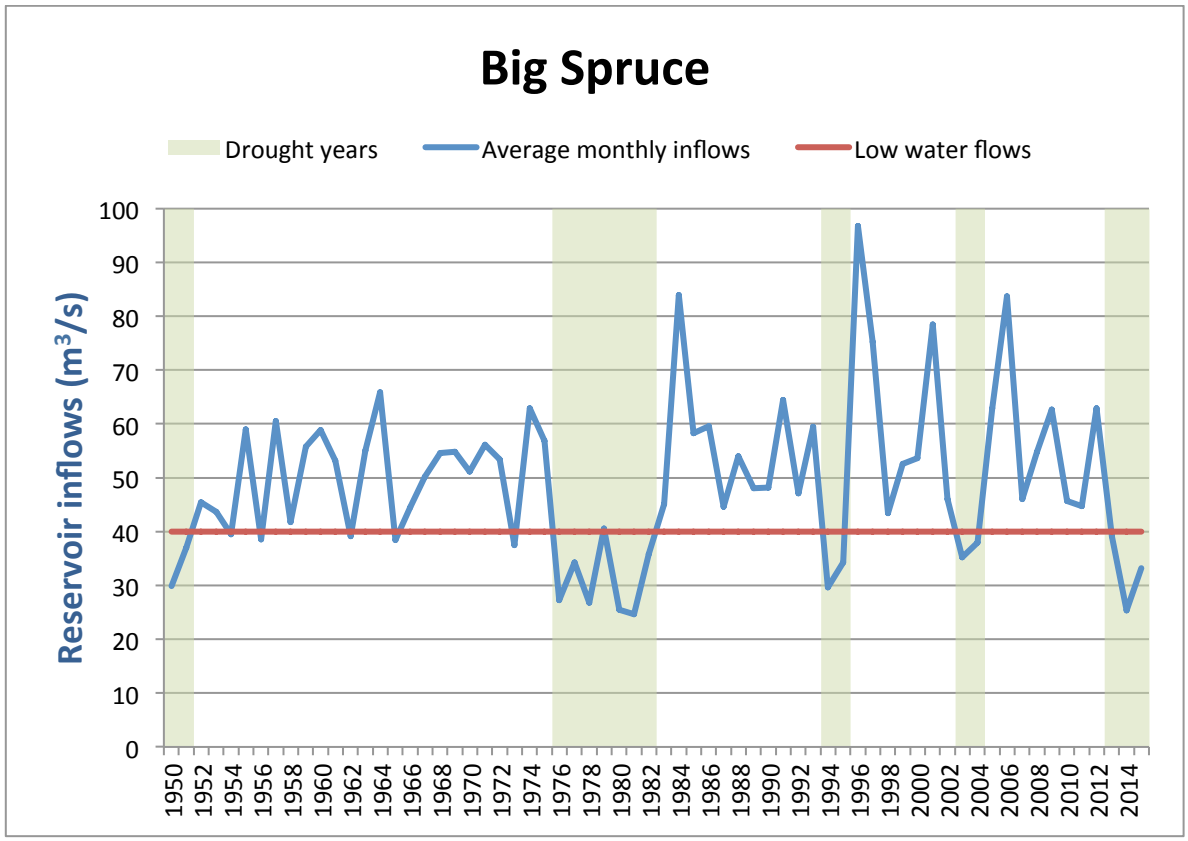


Manitoba Hydro International Ltd. (MHI) was asked to determine the following:

- Is climate change contributing to droughts in this area?
- Can alternative energy sources be developed to reduce energy costs?
- How can customers be protected from steep rate increases during the dry years?

Climate Change

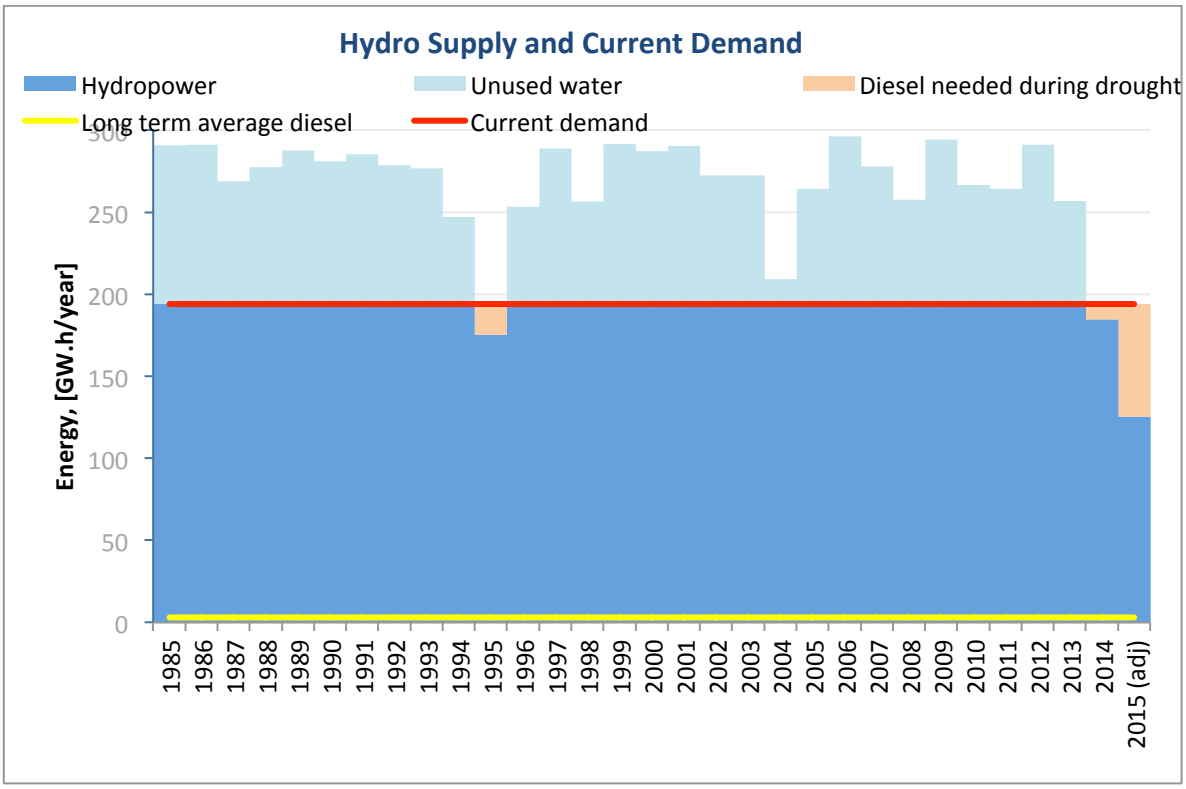
Experts generally accept that the climate has changed over the past 50 years and will continue to change throughout the near future. Available information indicates that droughts on the North Slave hydroelectric system are relatively common, and that the recent drought is consistent with previous droughts. The figure below shows that five droughts have occurred over the past 65 years. Note that hydrology data prior to 1985 is considered less reliable than data post 1985.



Possible Additions and Modifications to the Current System

Water flows in the North Slave system have usually produced more hydropower than customers currently use. At current demand levels, there would have been enough water flow to supply 100 per cent of customer demand for 28 of the last 31 years, and much water would have been spilled during those years. In addition, hydropower met most customer needs during the drought years, as shown in the figure below. Even as demand grows, this trend is likely to continue for at least the next 20 years unless large mining loads are connected to the system.

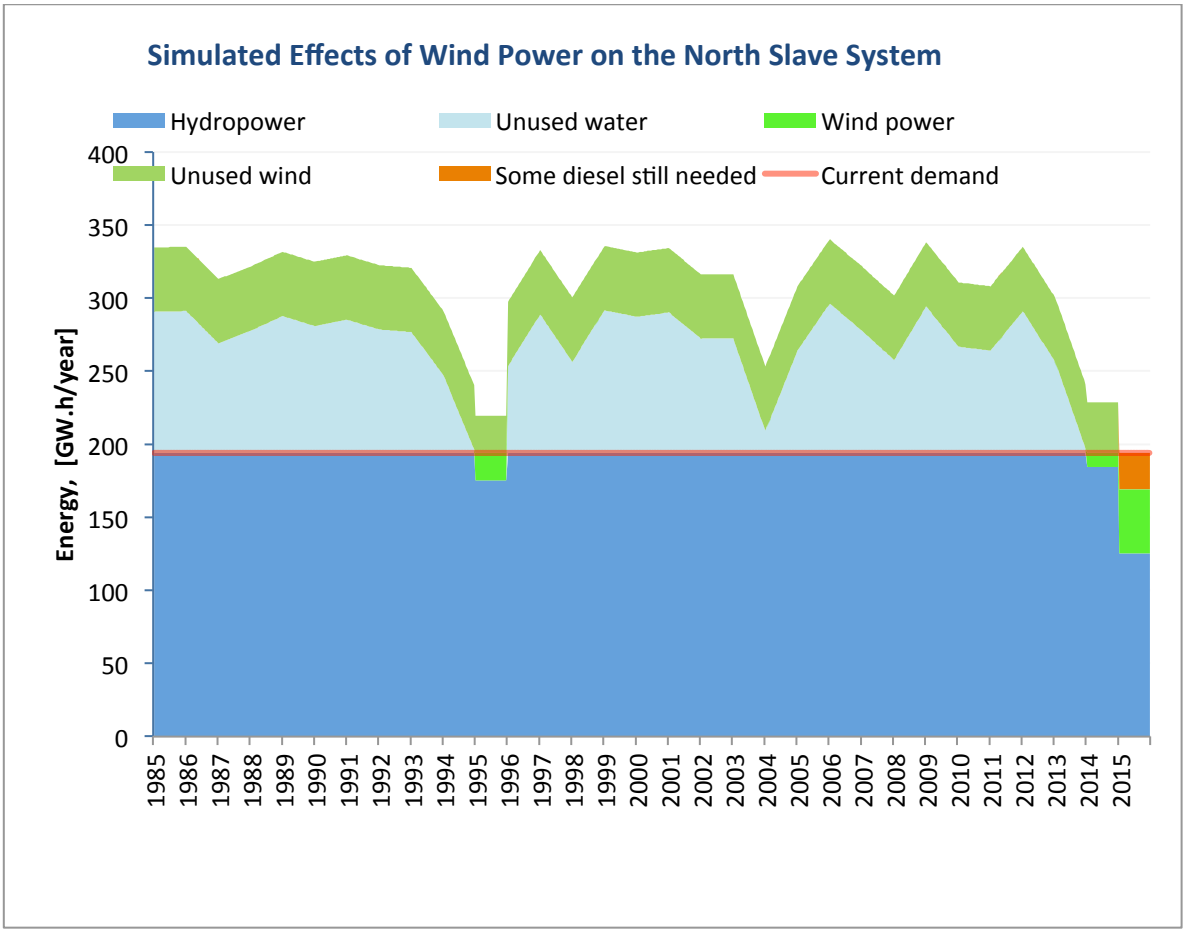
Surplus hydro will be available about 90 per cent of the time for at least the next 20 years. The surplus will allow the system to accommodate significant new load such as a new mine.


Hydro Supply and Current Demand
Hydropower
Unused water
Diesel needed during drought
Long term average diesel
Current demand
Energy, [GW.h/year]
300
250
200
150
100
50
0
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015 (adj)

Wind and Solar Energy

Adding new renewable energy sources, such as wind or solar farms, could remove the need for some diesel generation. However, building these renewable energy sources today would be costly, because more hydro energy is available than required, 90 per cent of the time. Therefore, much of the wind or solar energy would either be wasted or would cause more hydro energy to go unused, as shown in the figures below. In addition, the costs of building, operating, and maintaining wind or solar plants would need to be paid for every year.

Photo courtesy of Diavik Diamond Mines



At current demand levels, wind or solar energy would not save enough diesel fuel during years of drought to cover the costs. Moreover, because wind and solar energy depend on weather conditions, diesel fuel would still be required to supply energy when the wind is not blowing and the sun is not shining.

Thermal generation such as diesel is the most cost effective generation to respond to the occasional droughts.

Biomass

Biomass is only a practical option when it is used to produce heat for other purposes, and electricity is then generated as a secondary product. The North Slave system already produces more hydro than customers can use most of the time. Therefore, as with the wind and solar energy described above, the extra biomass energy would be useful only 10 per cent of the time. The overall cost and reliability would not be competitive with existing diesel plants.

Any new generation, including biomass, wind, solar, or hydro will be unused most of the time and add unnecessary expenses to customers' bills.

Upgrading the Existing Hydro System

There may be options to improve the current hydro system by adding storage or by rehabilitating the Bluefish plant. However, it takes years to perform detailed investigations and then implement the most cost-effective solutions.

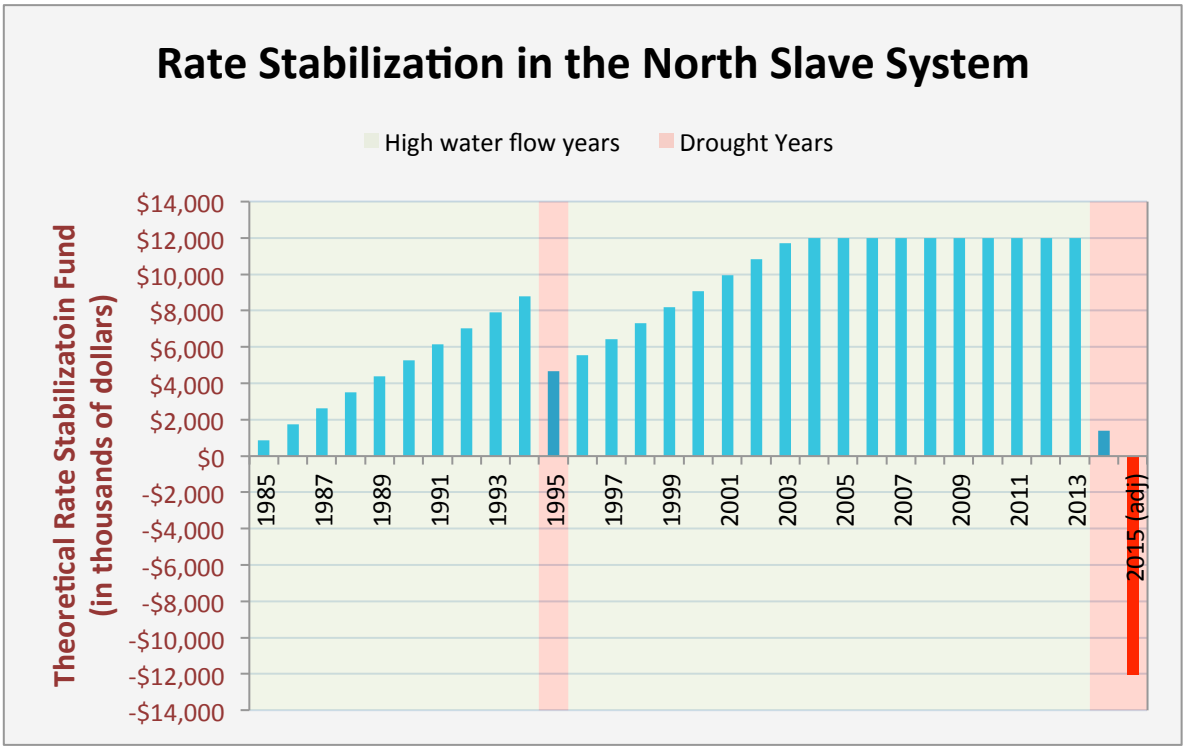
Rate Structure Options

Large amounts of back-up fuel is needed roughly 10 per cent of the time. The back-up generation costs should be managed to spread cost over many years

With the existing system, there are three general approaches for dealing with the effects of higher electricity costs when diesel generation is necessary:

1. Customers can pay regular prices in most years and pay an additional surcharge or rate-rider when there is not enough hydroelectric energy to meet demand. This option is generally unpopular with customers and few jurisdictions use this method, because it causes rate shock during drought years.
2. Customers can pay regular prices every year, with the government (as the utility owner) paying the incremental fuel cost whenever droughts occur. The Government of the Northwest Territories used this method to manage costs during the recent drought. Some jurisdictions use this approach, but it causes customers who do not use this electricity to collectively subsidize those who use it.
3. Prices can be set at a stable level by averaging the rates over all expected flow conditions, with a specified portion deposited into a rate stabilization account during good flow years so that they can later be withdrawn in the low flow years. Customers, utilities, and regulators often choose this approach because it keeps rates predictable over time and eliminates rate shocks. Had this approach been used over the past 30 years, average power rates would have increased by about two per cent. In addition, the Government of the Northwest Territories would not have had to subsidize electricity costs over the past two years.

The chart below shows how a rate stabilization account would have worked over the last 31 years if customers used the same amount of power as they do today and if the fund was capped to a $12 million surplus and a $12 million deficit. In this scenario, the 2 per cent charge would not have been added to general rates over the 2004-2013 period when the fund reached its ceiling. Setting up a stabilization account today would produce similar but not identical results because water flows are unpredictable and change over time.



Conclusions and Recommendations

Despite the periodic droughts that occur on the North Slave system, the current system is quite resilient to drought and is operated in a way that minimizes generation costs. Data collected so far suggests that in most years, the North Slave system will continue to produce more power than can be used. Therefore, it would be expensive to develop new power sources that would only be used to produce power 10 per cent of the time. The most cost-effective, short-term option is to continue using diesel generation to meet any demand that exceeds existing hydro system capabilities. This strategy should be regularly reviewed as changes occur in customer demand, fuel price expectations, feasibility and costs of alternate facilities, water forecasts and expectations, environmental issues, and regulatory requirements. In particular, defer renewable investments until new load emerges. Improvements in the existing system should continue to be investigated as part of the regular course of business.

Although the North Slave is resilient to drought, water shortages are expected from time to time. One way to prepare for such conditions would be to establish an effective stabilization fund that increases during the water surplus years and is drawn down during the drought years. Such a fund would effectively smooth out energy costs without forcing payers, such as individual customers or the government, to accept rate shock during drought years.

For more information or for a copy of the complete report, please contact the Government of the Northwest Territories.

About Manitoba Hydro International Ltd.

Manitoba Hydro International Ltd. (MHI) assists clients to deliver electricity and natural gas efficiently, effectively, and in a sustainable manner. Using the support and resources of its parent utility, Manitoba Hydro, MHI provides specialized energy services including utility management, consulting, training, advisory, and engineering and construction management.

For over 30 years, MHI has delivered a broad range of energy sector services to clients in over 75 countries. Using this international experience and Manitoba Hydro's methods and technologies, MHI offers real solutions and true value to clients around the world. MHI is dedicated to creating lasting relationships, and collaborating closely with clients to suit their specific needs and achieve their desired outcomes.





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