Exhibit GAC # 20

Volume 1 - Green Action Centre Book of Documents

NFAT Review
Subject: Load Forecast and DSM

INDEX

Tab	Description
1.	Evidence Green Action Centre pages 2-8 to 2-9
2.	GAC/MH 1-071, page 1
3.	GAC/MH 1-071, page 2
4.	Economic, Load and Environmental Impacts of Fuel Switching in Manitoba - Manitoba Hydro August, 2012 pages 23-24
5.	GAC/MH 1-077
6.	GAC/MH 1-079
7.	PUB/MH 1-253B
8.	Transcript of Evidence of Scott Thomson, p 245
9.	Economic and Environmental Impacts of Fuel Switching in Manitoba - Manitoba Hydro August, 2012 pages 2 and 3
10.	Manitoba's Clean Energy Strategy, pages 30 and 31

Table 2-3: MH Projection of Electric Water Penetration in New Single Detached Construction, Gas Available

Forecast Year	Electric Water Total	Other Water Total	Electric Penetration
2013/14	3,369	24	99.3%
2014/15	3,373	45	98.7%
2015/16	3,373	45	98.7%
2016/17	3,347	69	98.0%
2017/18	3,316	115	96.6%
2018/19	3,273	185	94.7%
2019/20	3,246	230	93.4%
2020/21	3,255	231	93.4%
2021/22	3,256	231	93.4%
2022/23	3,248	230	93.4%
2023/24	3,231	229	93.4%
2024/25	3,206	227	93.4%
2025/26	3,176	225	93.4%
2026/27	3,144	223	93.4%
2027/28	3,109	220	93.4%
2028/29	3,069	217	93.4%
2029/30	3,027	214	93.4%
2030/31	2,986	211	93.4%
2031/32	2,948	209	93.4%
2032/33	2,913	206	93.4%

Source: GAC/MH I-062

By 2032/33, MH projects the addition of almost 64,000 water heaters, which would increase electric use by about 223 GWh.

As shown in Table 2-4, MH projects that significant percentages of existing gas water heaters will be replaced with electric water heaters, apparently as the tanks wear out.

Table 2-4: MH Forecast of Water-Heater Conversions, Single-Family Detached Homes

Forecast Year	Gas to Electric Water Heat Conversion	Non-electric Water Heaters Replaced	% of Gas Water Heaters Converted on Failure
2013/14	2,833	12,795	22.1%
2014/15	2,695	12,576	21.4%
2015/16	2,471	12,381	20.0%
2016/17	2,252	12,207	18.4%
2017/18	2,038	12,058	16.9%
2018/19	1,831	11,931	15.3%
2019/20	1,631	11,828	13.8%
2020/21	1,481	11,741	12.6%
2021/22	1,375	11,664	11.8%
2022/23	1,272	11,595	11.0%
2023/24	1,214	11,535	10.5%
2024/25	1,196	11,477	10.4%
2025/26	1,177	11,422	10.3%
2026/27	1,159	11,368	10.2%
2027/28	1,141	11,318	10.1%
2028/29	1,123	11,270	10.0%
2029/30	1,105	11,232	9.8%
2030/31	1,089	11,199	9.7%
2031/32	1,073	11,167	9.6%
2032/33	1,057	11,137	9.5%

Sources: GAC/MH I-064 and GAC/MH I-066

By 2032/33, MH projects the conversion of over 31,000 water heaters, which would increase electric use by about 109 GWh.

MH has not provided such detailed data for the other housing categories, but the data in GAC/MH I-060 is consistent with about 3,300 existing multi-attached units switching to electricity and all of the 7,900 new such units using electricity. For apartments, GAC/MH I-060 is consistent with a 31% penetration of electric water, adding another 6,200 electric water heaters.

While we do not have comparable data for commercial fuel-switching choices, the Fuel-Switching Report (at 27) indicated that MH expected additional load growth due to increases in commercial electric space and water heating.

2.3 MH's Explanation of the Trend Towards Uneconomic Fuel Choices

The Fuel-Switching Report explained electricity's nearly complete capture of water-heating load in new single-family homes, even where gas is available, as follows:

TAB 2

REFERENCE: Appendix D 2013 Electric Load Forecast; Page No.: 54

PREAMBLE: In the 2012 Fuel-Switching Study, Manitoba Hydro found gas water heating to be less expensive than electric water heating.

QUESTION:

Please explain why Manitoba Hydro expects existing customers, to replace gas water heaters with electric water heaters when the net benefits to the customer are negative.

RESPONSE:

The economics for the customer depends upon their specific circumstances and whether the customer is considering total costs (capital and operating) or simply considering the capital cost. In many cases, customers might be primarily influenced by the upfront costs. In cases where customers replace their conventional natural gas furnaces with high efficiency models, the existing chimney may need to be sleeved or adjusted at an additional cost of approximately $550 to adequately vent a conventional natural gas water heater. If required, this will increase the cost of the installation diminishing the overall net benefit of choosing natural gas water heating.

The customer will assess the choices based upon their individual circumstances, including the age and condition of their existing water heater and the customer's personal financial situation. In some situations, contractors may encourage customers to install an electric water heater rather than assessing the need for adjusting the venting or installing a more costly side-venting natural gas water heater.

TAB 3

The following table outlines the approximate cost of installing various hot water tank alternatives:

	Average Installed Cost	Cost of Natural Gas Option Compared to Electric
New Electric Water Heater	$1,000	
Existing Natural Gas Water Heater requiring Chimney Adjustment for Venting*	$550	($450)
New Conventional Natural Gas Water Heater	$900	($100)
New Conventional Natural Gas Water Heater requiring Chimney Adjustment for Venting	$1,450	$450
New Side-Vent Natural Gas Water Heater	$1,750	$750

*Pricing assumes the current structure is favorable for chimney sleeving or adjustments (e.g. 1 storey, minimal bends in current venting).

TAB 4

4.0 Impacts of Fuel Switching in Manitoba

4.1 Per Household Impacts

This section provides the impacts for an average residential household where a natural gas heating system is replaced with either an electric or geothermal system for space and water heating. Energy load, economic, provincial leakage and environmental impacts are assessed by presenting three different fuel switching scenarios:

1. Switching from a gas to an electric furnace;
2. Switching from a gas furnace to a geothermal system (assuming SCOP of 2.5); and
3. Switching from a conventional natural gas hot water tank to an electric hot water tank.

Recognizing the potential installed performance ranges of geothermal heat pump systems, a sensitivity analysis outlining the impacts of achieving an SCOP of 3.5 is presented in Section 5.1.

4.1.1 Energy Load Impact

The following table provides the annual electric and natural gas load impact associated with a typical residential household fuel switching from gas to electric.

Load Impact of Fuel Switching
Average Residential Home

	Gas to Electric Furnace	Gas to Geothermal (SCOP 2.5)	Conventional Gas to Electric Water Heat
Electric Load Impact (kW.h)	16,391	6,556	3,489
Natural Gas Load Impact (m^3)	(1,776)	(1,776)	(491)

4.1.2 Economic Impact

The following table provides the electric and natural gas economic impact associated with an average residential household using electricity as opposed to natural gas for space and water heating applications. The economic impact is a net present value assessment taken over the life of the equipment, and includes the incremental capital cost of choosing electric over natural gas equipment in addition to operating costs. Operating costs are based on forecasted natural gas and electricity rates. Maintenance costs are not included in the calculation.

Net Economic Impact of Fuel Switching (over the life of the equipment)
Average Residential Home

	Gas to Electric Furnace	Gas to Geothermal (SCOP 2.5*)	Conventional Gas to Electric Water Heat
Utility Perspective (Electric)	($3,223)	($1,563)	($10)
Utility Perspective (Natural Gas)	($4,107)	($4,107)	($317)
Customer Perspective - Remaining Natural Gas Service	($9,146)	($12,685)	($727)
Customer Perspective - No Remaining Natural Gas Service	($7,737)	($11,276)	n/a
Integrated Utility / Customer Perspective	($15,067)	($16,946)	($1,054)

**A sensitivity analysis outlining the impacts of using a geothermal system with SCOP of 3.5 is presented in section 5.0.*

Utility Perspective – Changing to an electric space heating or water heating system results in a negative economic impact from the utility's perspective for both electricity and natural gas operations.

From the electric perspective, customers would be using more electricity, resulting in increased domestic electric revenues. However, reduced export revenues and the cost of advancing new electric infrastructure would be higher than the additional revenue gained domestically, therefore resulting in an overall negative impact.

From the natural gas perspective, customers would be consuming less natural gas, thereby decreasing revenues to Manitoba Hydro. This loss outweighs the avoided costs of purchasing natural gas and transportation costs. Therefore, the net result is a negative impact to the utility.

Customer Perspective – Changing from a natural gas space or water heating system to an electric system results in a negative economic impact to a residential customer over the life of the system. It is important to note that in an existing home, choosing an electric water heater over a less costly conventional natural gas water heater results in a negative economic impact to the customer assuming no adjustments are required to the chimney ventilation. If adjustments to the chimney are required, installation costs could increase by approximately $550.

The analysis for the Customer Perspective - Remaining Natural Gas Service assumes that the customer maintains their gas service for other appliances in the home (e.g. fireplace, stove, BBQ). If the customer were to completely eliminate natural gas service to the home, they would also save the cost of the basic monthly charge. The NPV of the natural gas basic monthly charge over 25 years (i.e. the assessment period for space heating) is $2,257. As such, the negative impact of switching from natural gas to an electric furnace decreases for the customer, as outlined in the Customer Perspective – No Remaining Gas Service.

Integrated Utility/Customer Perspective – From a combined utility and customer perspective, changing to an electric space heating or water heating system in an average residential home results in an overall negative economic impact.

TAB 5

REFERENCE: Chapter 4: The Need for New Resources; Page No.: 30

QUESTION:

Please identify existing and future market barriers to the installation of the least-cost space heating fuel choice.

RESPONSE:

The following are considered the primary barriers:

- The initial installed cost of electric heating systems is less expensive than that of natural gas systems. Some customers do not consider total cost of ownership (i.e. capital cost plus operating cost), and as such, may choose an electric heating system. In the new home market, the heating system decisions are made by the homebuilder when homes are built on speculation. A lower initial cost allows the homebuilder either to sell the home at lower price or the opportunity to make more profit per home. In addition, some builders have also indicated the additional operational benefit of not needing to coordinate additional work crews associated with natural gas.
- Past volatility in natural gas markets still resonates with customers, although less so now due to natural gas prices remaining low and declining for a number of years. Customers may still be concerned that natural gas prices may increase substantially in the future as the energy form is non-renewable. Conversely, customers have experienced low and modest electricity rate increases in Manitoba for decades.
- Some customers may simply not be aware of the differential in operating costs associated with heating their homes with natural gas or electricity.
- Electricity generated in Manitoba is primarily from renewable resources and some customers may be influenced by the environmental attractiveness from a local perspective of this source of energy relative to natural gas which produces GHG emissions.

- Electricity is generated locally as opposed to natural gas which is imported from other regions. Some customers may be influenced by their desire to support the local economy.
- Customers may be influenced by their perception related to safety in using the two alternate sources of energy. Based on Manitoba Hydro's Customer Satisfaction Tracking Study survey conducted in April of 2013, 62% of respondents felt that electricity was safer for space heating compared to 11% of customers who felt natural gas was safer.

TAB 6

REFERENCE: Appendix D 2013 Electric Load Forecast; Page No.: 54

QUESTION:

Please explain why home builders install primarily electric water heaters.

RESPONSE:

Homebuilders in Manitoba primarily install electric water heaters because this is the most economic option for the homebuilder and as such, it allows the homebuilder to keep the base cost of the home lower, thereby the homebuilder's competitive position in the new home market.

For example, the estimated cost of installing various hot water tank options is as follows:

- $1000 to install an electric hot water tank
- $2000 to install a side-vented natural gas hot water tank

A conventional natural gas hot water tank is not considered an option as it would require a chimney which would reduce the useable square footage available to the homeowner or it would require constructing a large home to accommodate the additional square footage needed for the chimney.

Additional challenges associated with installing a side-vented hot water tank include:

- The Manitoba Building Code has specific requirements as to where natural gas appliances can be vented on the exterior walls of a home. Venting cannot be installed within specified minimum distances of operable windows, exterior doors, air conditioners, fresh air intakes, utility meters, cantilevers and outdoor living spaces (i.e. decks or patios).

- In addition to venting restrictions by the building code, there are also aesthetic limitations; e.g., customers will not be satisfied with venting being visible on the front of houses.

TAB 7

REFERENCE: Technical Conference, September 5, 2013; PowerPoint

QUESTION:

Please provide details as to the gas initiative and how Manitoba Hydro intends to advertise or promote gas.

RESPONSE:

Manitoba Hydro's current strategy is not to promote natural gas over electricity. The Corporation's strategy is to educate customers on their fuel choice options so customers make informed decisions. It is expected informed customers will generally make rational decisions and the impact of this approach will result in more customers using natural gas for heating applications.

Manitoba Hydro's initiative to educate customers is through its Heating Education Campaign which takes a multi-faceted approach to educating the several stakeholders involved in the fuel choice decision. The campaign targets homeowners, heating contractors, homebuilders and land developers.

The focus of the Heating Education Campaign is to increase awareness and understanding of the total lifetime cost of natural gas, electricity and geothermal heating systems and to provide customers with the tools to effectively assess the most economic system which best meets their needs and circumstances. Total lifetime cost takes into consideration the cost to purchase, install and operate the heating system over its useful life. Messaging is communicated through a number of channels, including:

- energy bill inserts,
- newspaper advertisements in rural newspapers in gas available areas and in Winnipeg,
- magazine advertisements in local new home and renovation magazines, and

- brochures available throughout the natural gas available areas of Manitoba.

Beginning in 2012, information sessions were held throughout natural gas available areas of the Province for heating contractors, homebuilders and land developers to highlight the total lifetime costs of a heating system and the implications the heating system choice has on a customer's energy bill. Information sessions will continue to be provided on as deemed appropriate.

Educational materials have been developed with separate messaging created to target customers building a new home and those customers with existing heating systems. Other components of the educational effort introduced in 2013 include:

- targeted addressed mailings to customers with inactive natural gas services and low natural gas consumption,
- targeted unaddressed mailings to customers in natural gas available areas,
- online advertising, and
- enhancements to Corporate "Heating" webpage including the introduction of a heating cost comparison calculator and a heating system education video.

Advertising targeting new home buyers will continue to be placed in media serving natural gas available areas where there has been a high proportion of new homes being constructed with electric heating systems. Replacement system advertisements will continue to run throughout all natural gas available areas.

Manitoba Hydro's Heating Education Campaign also promotes financing options available through Manitoba Hydro which can assist customers with implementing alternative heating options. Manitoba Hydro offers a number of convenient on-bill financing services including the Power Smart Residential Loan, the Power Smart PAYS Financing Program and the Earth Power Loan Program. In many circumstances the customer's average monthly energy bill savings from

choosing a natural gas system over an electric system will offset the monthly finance fee. Educational materials speak to the availability and benefits of these convenient financing services.

To further assist customers with making fuel choice decisions, the Corporation provides technical expertise and guidance when appropriate and required. For example, during 2012 and 2013, staff performed energy assessments for 26 Hutterite colonies affected by the impending coal ban on heating. The energy assessments included an economic comparison of alternative energy choice approaches based on biomass, natural gas, geothermal, electric, propane and coal.

Manitoba Hydro's plans include ongoing monitoring of the market and assessing alternative or complementary demand side management strategies (e.g. service extension policies and incentive based programming).

TAB 8

But if it were to be that the -- that the Manitoba domestic demand did not require a Keeyask or a Conawapa, in your calculations, sir, has -- has Manitoba Hydro determined whether or not they could turn a profit if these two (2) dams are built solely to supply export contracts like the ones that have been listed?

MR. SCOTT THOMSON: Well, I -- I -- I'm -- I'm pausing. The -- we -- we don't anticipate -- and you're right. I mean, I guess we'll -- we'll have a -- a lengthy discussion in terms of -- of where we think that the load forecasts are going and -- and the ability that we have to -- to utilize DSM. And I -- we -- we'll have to talk in camera about the details of the export contracts.

But if -- if we -- if we built the -- the -- if we built the projects and never needed them domestically and we were selling power under those contracts at the -- at the prices that we've -- we've done in the early stages, and that lasted over the life of the project, I think they'd be wildly successful and profitable.

(BRIEF PAUSE)

TAB 9

EXECUTIVE SUMMARY

This report outlines the economic, load and environmental impacts of using electricity (including geothermal technology) instead of using natural gas for space and water heating purposes. The economic impact is assessed from the customer's and the utility's perspective along with a high level assessment of provincial leakage (i.e. the net impact of changes to extra-provincial natural gas purchases and electricity export sales). The environmental (greenhouse gas emission) impact is assessed from both a provincial and a global perspective. The scope of this assessment does not consider future uncertainty associated with a number of influential factors, including potential electricity rate structure changes (e.g. inverted rates) and potential changing Canadian and US government policies related to greenhouse gas (GHG) emissions. The assessment also does not account for any costs which may result from large-scale upgrading of Manitoba Hydro's electrical infrastructure due to significant energy demand changes.

Space Heating

The following table summarizes the load, economic and environmental impacts of using electricity instead of natural gas for space heating in a typical Manitoba residential home. Impacts are analyzed over the life of the equipment (i.e. 25 years). Values in brackets indicate a negative impact from an economic perspective and represent a reduction in GHG emissions from an environmental perspective.

Impact of Converting from Natural Gas to Electric Space Heat

Average Residential Home from Natural Gas to:	Electric Furnace	Geothermal (SCOP 2.5)
Annual Energy Load Impact		
Electric Load Impact (kW.h)	16,391	6,556
Natural Gas Load Impact (cu.m)	(1,776)	(1,776)
Economic Impact		
Utility Perspective (Electric)	($3,223)	($1,563)
Utility Perspective (Natural Gas)	($4,107)	($4,107)
Customer Perspective	($7,737)	($11,276)
Integrated Utility / Customer Perspective	($15,067)	($16,946)
Net Provincial Inflow (Leakage)	($6,271)	$1,061*
Annual Environmental Impact		
Manitoba (kg CO_2e/year)	(3,374)	(3,374)
US - MISO Region** (kg CO_2e/year)	0 to 12,293	0 to 4,917
Net Global**(kg CO_2e/year)	(3,374) to 8,919	(3,374) to 1,543

**The provincial inflow benefits will be offset by higher cost of geothermal units relative to the cost of natural gas furnaces and air conditioners (i.e. estimated at $2,000 to $3,000).*

***The US-MISO Region and Net Global impacts are shown as a range, which includes the impact under today's emission policies in export regions and recognizes what the potential impacts could be under more aggressive emission policies in export regions.*

From the customer, utility and provincial leakage perspectives, there are substantive benefits when customers use natural gas rather than electricity for space heating purposes. The directional impact for each of these factors are also the same when using natural gas for space heating relative to using geothermal systems, except for the provincial leakage impact. In the latter case, a more complete analysis would need to account for the higher cost of geothermal furnace units which are imported into Manitoba relative to the cost of importing natural gas furnaces and air conditioners.

Using electricity for space heating in Manitoba as opposed to natural gas will reduce GHG emissions in Manitoba; however the global GHG emissions will be higher due to reduced electricity exports from Manitoba (i.e. electricity exports would no longer displace fossil generation). In the future, the global impacts may change depending on future environmental policies (e.g. if a cap on GHG emissions was introduced within the U.S. in the future, changes in Manitoba electricity exports would potentially have no incremental impact on US GHG emissions). Given the possible future outcomes, the US and global environmental impacts are shown as a range of possible outcomes.

Water Heating

The following table summarizes the impact of using electricity instead of natural gas for water heating applications in a typical Manitoba residential home, analyzed over the life of the equipment (i.e. 10 years). Values in brackets indicate a negative impact from an economic perspective and represent a reduction in GHG emissions from an environmental perspective. The impacts are assessed for using electric hot water tanks relative to a conventional natural gas unit.

Impact of Converting from Natural Gas to Electric Water Heat

Average Residential Home from:	Conventional Gas to Electric Water Heat
Annual Energy Load Impact	
Electric Load Impact (kW.h)	3,489
Natural Gas Load Impact (cu.m)	(491)
Economic Impact	
Utility Perspective (Electric)	($10)
Utility Perspective (Natural Gas)	($317)
Customer Perspective	($727)
Integrated Utility / Customer Perspective	($1,054)
Net Provincial Inflow (Leakage)	($297)
Annual Environmental Impact	
Manitoba (kg CO_2e/year)	(933)
US - MISO Region* (kg CO_2e/year)	0 to 2,617
Net Global* (kg CO_2e/year)	(933) to 1,684

**The US-MISO Region and Net Global impacts are shown as a range, which includes the impact under today's emission policies in export regions and recognizes what the potential impacts could be under more aggressive emission policies in export regions.*

TAB 10

a7

Focused on What Matters Most:

Manitoba's Clean Energy Strategy

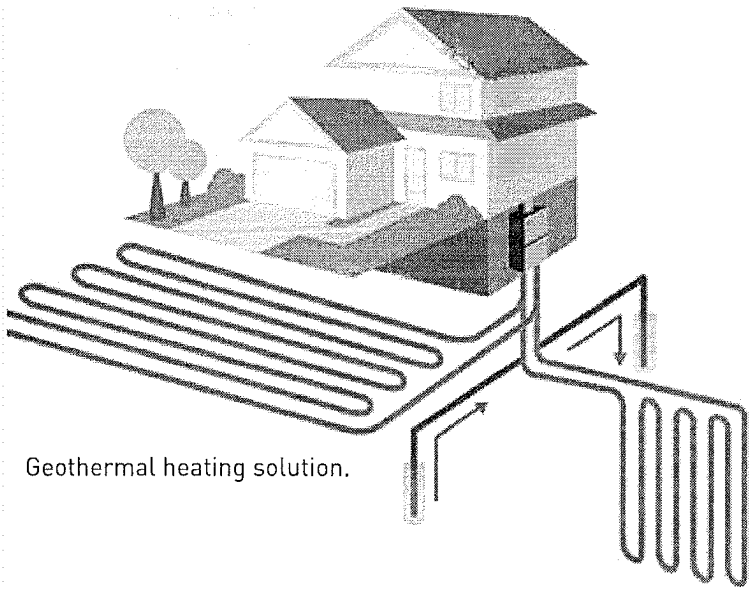
Manitoba

Green Heat

Manitobans in search of clean, low cost, stably priced sources of heating have long faced a dilemma. While natural gas (and propane and heating oil) offered a convenient source for heating space and water, it was also an imported fossil fuel, one which emitted GHGs – and one with highly volatile prices.

While Manitoba Hydro is responsible for most natural gas distribution, it has no direct control over the price of the natural gas itself, which is set outside the province. As a result, 270,000 Manitoban families and businesses pay prices set elsewhere, prices which can be low, but which have also been highly volatile over the past decade.

In fact, $300 million to $600 million leaves the Manitoban economy each year just to pay for natural gas. This money, if redirected and spent locally, would create and support thousands of Manitoba jobs. In addition, the combustion of this fossil fuel results in 2.4 million tonnes of GHG emissions in Manitoba – a full 15 per cent of all the GHGs emitted in the province – and an area needing to be reduced if Manitoba's domestic emissions are to fall.



Geothermal heating solution.

Electric Space and Water Heating – Not the Best Solution

Historically, electric heat was the main alternative for those Manitobans who needed a stably-priced alternative to natural gas. As a result, 130,000 families use all electric heat (especially in rural areas and apartments) today and 230,000 use electric hot water. Even so, using electricity – a high value energy form – to raise air or water temperatures by only a few degrees is considered a wasteful way to create heat. It is often termed, "using a chainsaw to cut butter." As a result, the conversion of buildings heated all-electrically (many of which are in rural areas) to use geothermal heat pumps, biomass or solar sources of renewable energy can produce multiple benefits (ex: lower energy costs, new local jobs, freeing up more electricity for Manitoba Hydro exports).

Heat Pumps– All the Energy You Could Want, Right Beneath Your Feet

Manitobans have increasingly been turning to popular alternatives, often called renewable or "green" heat sources, such as heat pumps, which draw energy from the ground, water or air. A heat pump, for example, can turn one kWh of electricity into three to five kWhs of heat, offering a way to take Manitoba's clean electricity and multiply the benefits. And with almost half of all solar energy reaching the earth being stored in the ground itself, a geothermal heat pump uses the ground beneath our feet to provide a clean, renewable source of heat, or cooling and all at a stable price.

Geothermal Heat Pumps – Once Again, Manitoba Leads the Way in Canada

Beginning in the year 2000, Manitoba began to back this technology and became a Canadian leader by raising its geothermal heat pump installation rate by 400 per cent. Contributing to the industry's rapid growth are innovative policy tools like the province's Green Energy Equipment Tax Credit and Geothermal Grant, the Green Building Policy, support for industry training, quality assurance and education, and Manitoba Hydro's Earth Power loan program.