Volume 1 – IEC Counsel Book of Documents

Date: March 6, 2014

NFAT Review
Subject: Load Forecast and DSM

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TAB 1

> *Manitoba Hydro assumes the number of customers will change proportionately with population. This relies on the assumption that the number of people per household will not change. This has not been true in the past and is unlikely to hold true in the future. The number of occupants per household will be affected by not only the number of people, but the relative ages of the population. For instance, if the fastest growing segment of the population is over 50, there will usually be fewer people per household in the future. Another factor affecting the number of occupants per household is personal income. As income increases, the number of occupants per household generally decreases. (Simpson and Gotham, Page 6)*

Manitoba Hydro recognizes and endorses the value of statistical analysis, including regressions, and that additional analysis strengthens decision making. Manitoba Hydro remains confident that the assumption that 2.79 people per household is reasonable as a constant for the residential customer forecast used by the NFAT submission on the basis that the average number of people per household has not changed materially since 1997. By rejecting Manitoba Hydro's assumption and instead assuming a growth in average number of people per household based on the trend since 2007 as advocated by Elenchus (Page 10), Manitoba Hydro emphasizes two points: almost any statistical technique will require the application of judgment to make assumptions; and even an aggressive assumption used in the residential customer forecast has a marginal impact on the overall long-run load forecast.

From 1980 until 2012 the actual number of people per household has declined from 2.97 to 2.78, a reduction of 6.3% in absolute terms. In 2000 there were 2.8 people per household and in 2012 there were 2.79, a reduction of 0.007% in absolute terms.

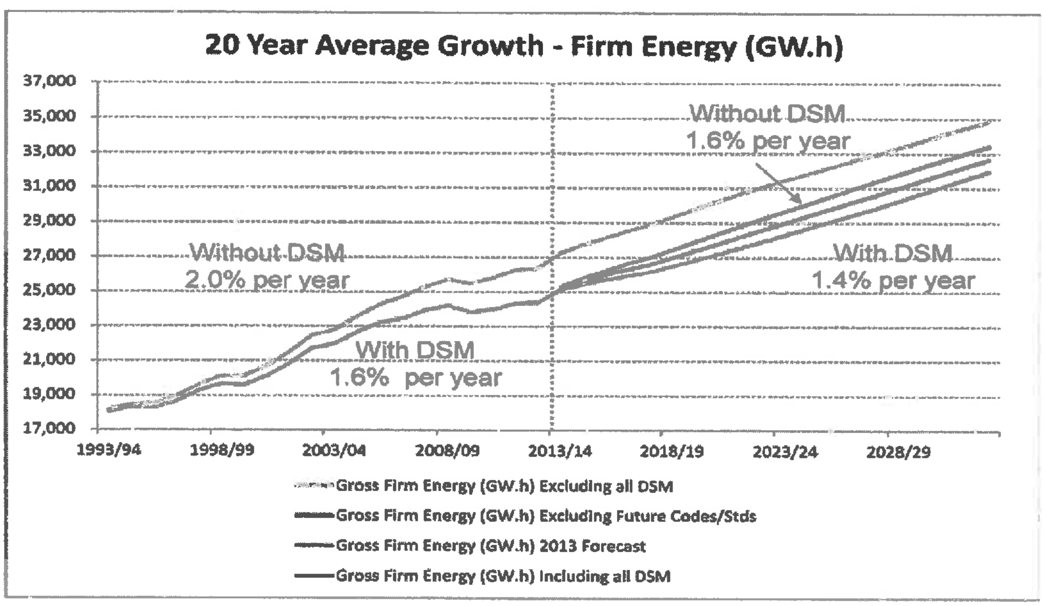
TAB 2

2.0 LOAD FORECAST

In this section of Manitoba Hydro's Rebuttal Evidence, Manitoba Hydro addresses the written evidence of IECs Elanchus and LCA as well as Intervenor witnesses Wayne Simpson and Douglas Gotham on behalf of CAC and Patrick Bowman on behalf of MIPUG.

2.1 Overview of Forecast Growth

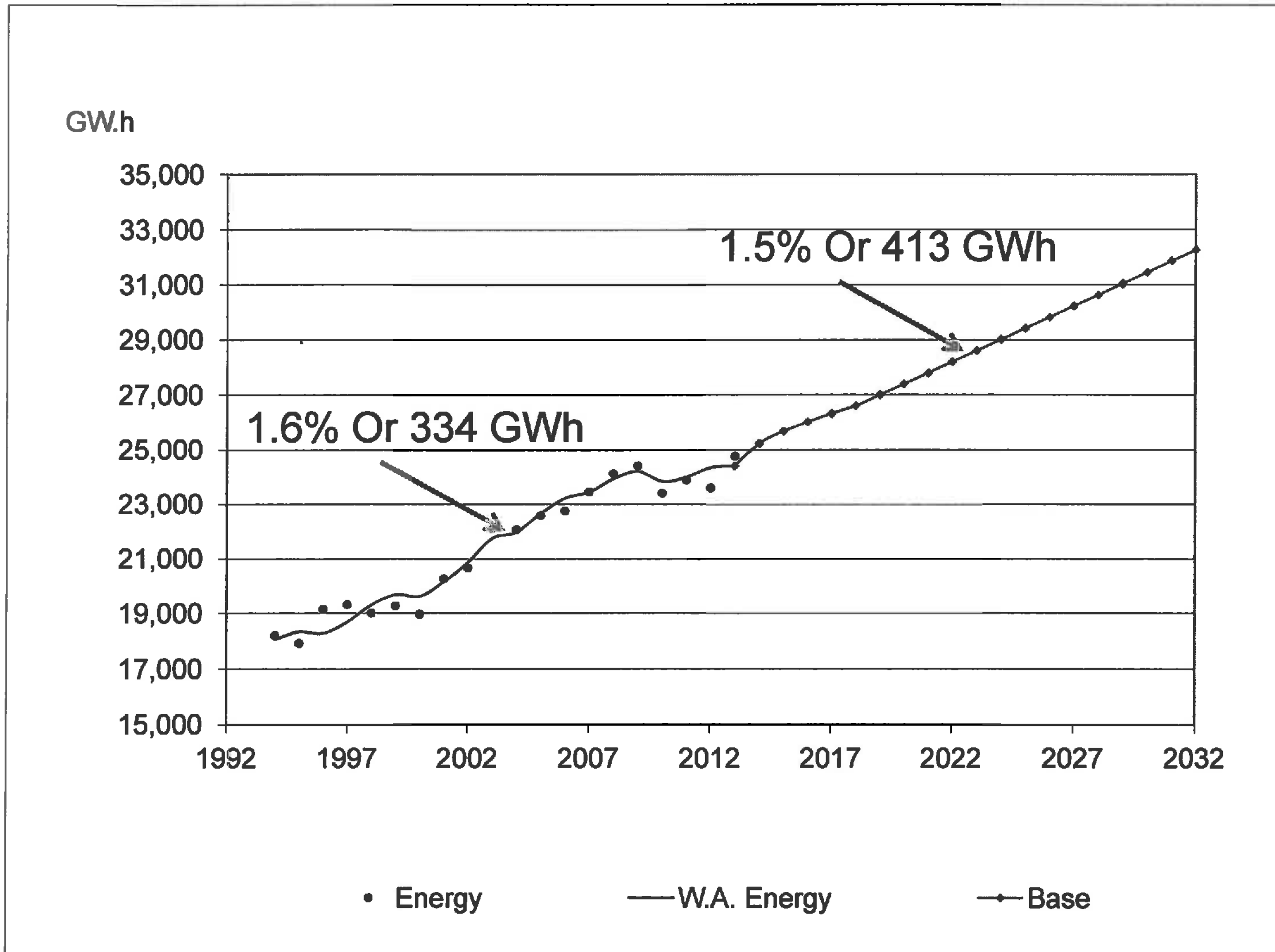
The purpose of the load forecast is to present the best estimate of long term future energy requirements for Manitoba. The following figure presents a 40 year summary of the historic and future energy requirements in Manitoba. Over the last 20 years, reflecting periods of both economic growth (beginning 1992) and economic downturn (beginning 2008) and the influence of past Demand Side Management (DSM) initiatives and changes to codes and standards Manitoba load has grown at an average rate of 1.6% per year. Without Manitoba Hydro's efforts both provincially and nationally to support DSM, Manitoba's energy requirements would have grown at an average rate of 2.0% per year over last 20 years.



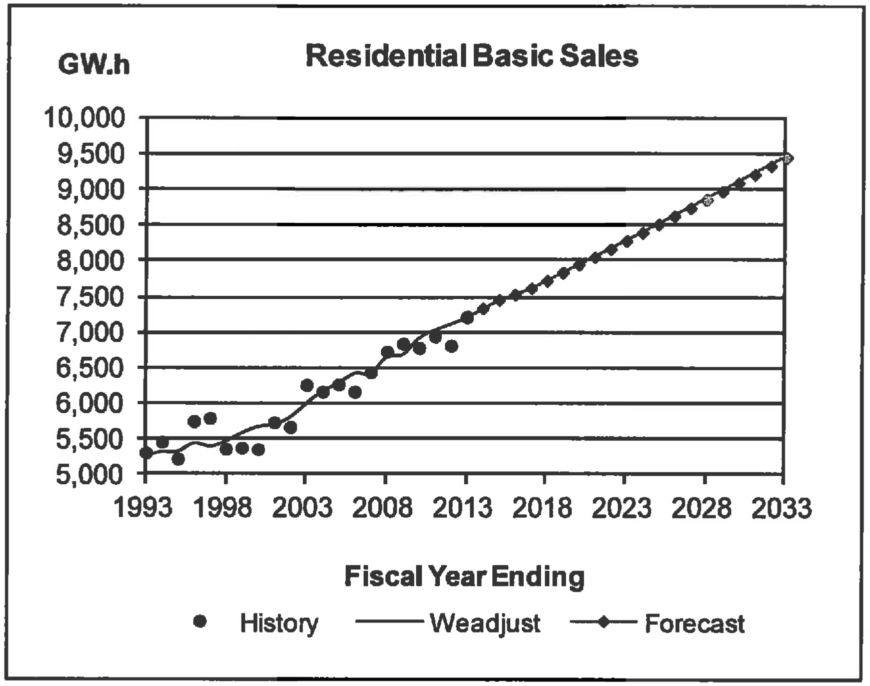
Looking forward over the next 20 years under the 2013 load forecast and incorporating projections from the 2013 Power Smart Plan, energy requirements are projected to grow at an average rate of 1.4% per year. Manitoba Hydro is continuing to expand its DSM efforts and expects to be increasing its targets. As outlined during the September 5, 2013

TAB 3

2013 Forecast – Firm Energy



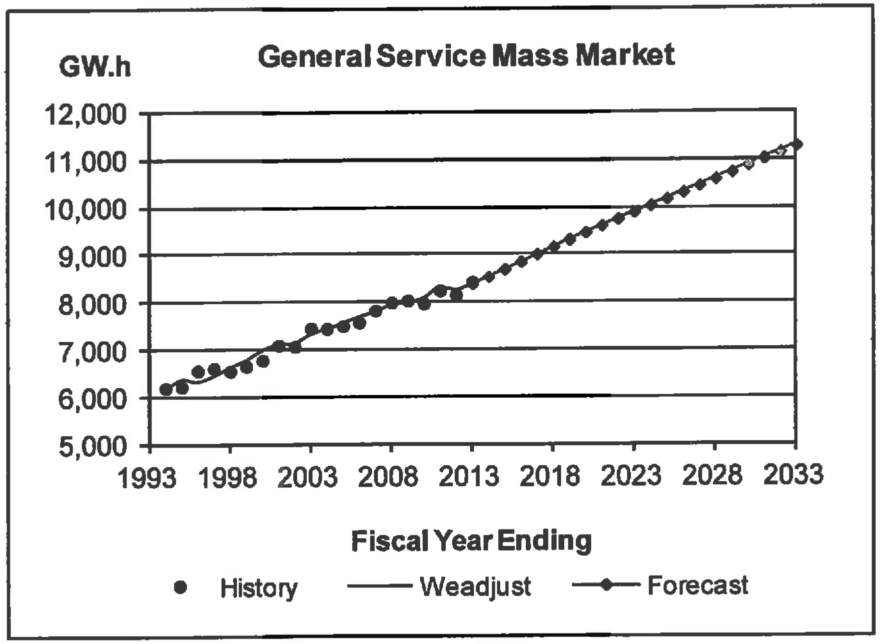
2013 Forecast - Residential



- Load has grown at a rate of 99 GW.h or 1.6% per year over the last 20 years.
- Forecast sector to grow at a rate of 112 GW.h or **1.4% per year** over the next 20 years.
- **Primary drivers of growth:**
  - **Population**
  - **Market share of electric heat**

Manitoba Hydro

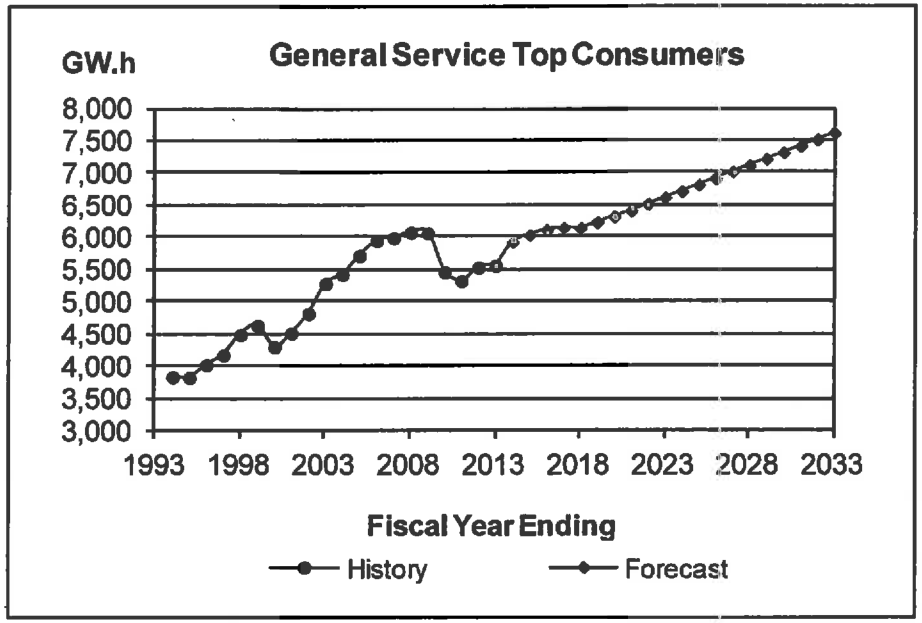
2013 Forecast – GS Mass Market



- Load has grown at a rate of 118 GW.h or 1.7% per year over the last 20 years.
- Forecast sector to grow at a rate of 144 GW.h or **1.5% per year** over the next 20 years.
- **Primary drivers for growth:**
  - **Population**
  - **GDP**

Manitoba Hydro

2013 Forecast – GS Top Consumers



- Overall sector grew by 1800 GW.h over the last 20 years, by 200 GW.h over last 10 years.
- Forecast sector to grow at a rate of 103 GW.h or **1.6% per year** over the next 20 years.

TAB 4

setting the ranges to assess sensitivity to high load and low load growth under this submission, as outlined at page 48 Section 10.2.3 of Chapter 10.

Manitoba Hydro has provided in the Load Forecast the data needed to understand the potential impact of possible future events and their respective impact on Manitoba energy and peak. These possible events (found on pages 50 to 54 of the 2013 Load Forecast) include the effect of climate change, the addition or loss of a large industrial customer, increased saturation of electric vehicles, increased saturation of electric space heat, and increased saturation of electric water heat. Weather effects are also included on page 43 of the Load Forecast. The effects of economic and demographic changes have been included in the "Changes between the 2012 and 2013 Forecasts" section, pages 12 to 16 of the 2013 Load Forecast.

Combined with the probabilistic analysis that is provided on pages 44 to 46 of the 2013 Load Forecast document, this information allows planners to derive any number of scenarios they wish to analyze.

3.0 DEMAND SIDE MANAGEMENT

In this section of Manitoba Hydro's Rebuttal Evidence, Manitoba Hydro addresses the written evidence of IEC Elanchus as well as Intervenor witness Philippe Dunsky of Dunsky Energy Consulting on behalf of CAC/GAC.

3.1 Overview

Generally, Manitoba Hydro updates its DSM plans on an annual basis to reflect new and updated information. In the past, the update was aligned with the Manitoba Hydro's overall planning cycle and the update was completed during the summer months. With the passing of the Energy Saving Act, Manitoba Hydro is now required to update its DSM Plan by March 31 of each year and the plan is to be developed in consultation with the Minister Responsible for Manitoba Hydro. Under this new process, Manitoba Hydro developed its first DSM plan in consultation with the Minister which involved a three year time horizon and included only those programs which were approved. To meet Manitoba Hydro's resource planning process and requirements, a supplementary 2013-16 Power Smart Plan, 15 Year Supplementary Analysis Report was prepared. Manitoba Hydro recognizes that the targets in this plan are conservative as some programs and opportunities which could reasonably be expected to be achieved within the planning horizon were

TAB 5

at page 48 Section 10.2.3 of Chapter 10, were used to assess sensitivity to high load and low load growth under this submission.

The five and ten year forecast accuracy, starting on page 47 of the 2013 Electric Load Forecast provides the evaluation of accuracy of past forecasts. It states:

> Manitoba Hydro's objective is that a five year forecast is within 5% and a ten year forecast is within 10%.

These are achievable levels of accuracy based on the analysis of load variability.

Manitoba Hydro understands what level of accuracy is achievable and updates its forecast annually with the most current information available to ensure it becomes the best forecast that is possible at the time it is produced.

2.7 Scenarios and Probability – A Scenario Selects Just One Possible Future

Manitoba Hydro has in the past produced Medium High and Medium Low Load Forecast Scenarios based on various economic and demographic assumptions. This requires the selection of inputs for such scenarios. Manitoba Hydro adopted its probabilistic analysis as it allows quantifiable risk-analysis to be done, where the desired likelihood of the case can be selected for the study. By comparison, arbitrarily constructed scenarios must assume a likelihood of occurring.

Elenchus recommends that Manitoba Hydro returns to its alternative economic scenarios of the past. However, during Manitoba Hydro's Electric GRA 2010/11 & 2011/12, the Public Utilities Board set forth an independent review of Manitoba Hydro Risks by Drs. Kubursi and Magee. The Load Forecast was part of this review, and Drs. Kubursi and Magee stated the following with regards to Manitoba Hydro's use of probabilistic analysis:

> *A probabilistic framework is worked out to identify the load given the probability of the actual load will be less than the forecast load. ... This is an improvement on using arbitrary pessimistic or optimistic forecasting to bracket the forecast.(page 113)*

Drs. Kubursi and Magee recommended that the probabilistic methodology be continued and expanded upon. In line with this recommendation, this methodology was used in

TAB 6

organization and a health services organization are 82,000 and 71,000 square feet respectively using approximately 14 kWh/sqft, compared to the overall average office size of 12,000 square feet using an average 16 kWh/sqft.

These trends are expected to continue, with the average use per customer increasing compared to that of past customers.

Through the econometric model used to create the General Service Mass Market forecast, Manitoba Hydro has found a significant relationship between customer growth in the Residential Basic sector and growth in GDP to customer growth in the General Service Mass Market sector, and forecasts using this relationship. The significance (t statistics) of these two variables are 3.72 and 4.05 respectively as displayed at p.62 of the 2013 Load Forecast document, indicating that these variables are both relevant. The level of forecast accuracy in this sector has proven to be acceptable as noted by Elenchus in their assessment at page 21 of their evidence.

2.3.5 Growth in Top Consumers

Elenchus expressed concerns regarding Manitoba Hydro's forecast for Top Consumers, with Drs. Simpson and Gotham simply echoing this statement at page 7 of their evidence. However, in their response to MIPUG/Elenchus-1, Elenchus clarifies that their concern is primarily in regards to the long term forecast, stating that:

> *"Elenchus is of the opinion that Manitoba Hydro has as good a handle on the short term forecast of these customers as can be expected."*

Drs. Simpson and Gotham discount Manitoba Hydro's use of "informed opinion" and "time series" in its forecast of Top Consumers on the basis that such approaches are deemed unacceptable under MISO's list of forecasting methods (Simpson and Gotham, page 1). However, the concern raised by MISO in their Review is that the utility may not be able to identify the qualifications of the "expert" providing the forecast information. This is not the case in Manitoba Hydro's practice where use of this information is restricted to short term projections based upon the plans provided by the customers themselves. In these circumstances the customer is in the best position to offer advice on their planned future short term operations. Energy is an important consideration for customers included in the Top Consumers category. Efficiency and unit energy costs are generally evaluated relative to key performance indicators established by customers to assess the effectiveness of their operations. As such, energy requirements are generally one of the key considerations related to expansions of existing facilities or location of new facilities. Given the risks associated with the shortfall of a suitable energy supply, it is in the best interests of customers to provide Manitoba Hydro with accurate information regarding their future energy needs. Given the construct of Manitoba Hydro's Top Consumers sector (relatively few customers within each industry), using other approaches such as end-use or econometric analyses will not improve the accuracy of the Top Consumers' forecast.

2.3.5.1 Short Term Forecast: Top Consumers

The Top Consumers sector is made up of just 17 companies comprising of 31 electric accounts in the Primary Metals, Chemicals, Petrol/Oil Natural Gas, Pulp/Paper, Food/Beverage and Colleges/Universities sectors.

In the short term, each company's energy requirement is forecast individually based on committed plans and stated expectations over a three to five year period, which excludes longer term plans that are either uncommitted or subject to change. Forecast energy requirements use the past energy use as a baseline, which is supplemented with information from individual customers regarding their committed plans.

Elenchus at page 23 line 15 states that Manitoba Hydro's Top Consumers "is consistently over forecast". This assessment is based upon only the most recent five year period and is dominated by the unexpected closure of one Top Consumer and by the recent economic downturn. Selecting a different or broader period to perform this analysis presents a different perspective.

By way of example, the following table produced for a period just seven years earlier shows more under-forecasting than over-forecasting (negative numbers indicate actual consumption exceeded forecast):

TAB 7

REFERENCE:

PREAMBLE: Elenchus indicates that Hydro's approach to load forecasting has been "particularly problematic for the Top Consumers sector, which in recent years has been a large source of forecast error with consistent over-forecasting of load." (page iii)

QUESTION:
Please provide all analyses and recommendations of Elenchus in respect of this over forecasting, and indicate Elenchus' detailed recommendations for Manitoba Hydro to improve on this issue.

RESPONSE:
Elenchus notes that forecasting Top Consumers is problematic for Manitoba Hydro. Manitoba Hydro forecasts for this group includes individual analysis that details where the companies think they will be in the next several years. However what is current today can change dramatically tomorrow. Mergers and acquisitions can change a company overnight and usually come unannounced. Changes in the economy as well can have unknown effect evident only after they happen. Commercial operations globally can influence demand for product domestically.

Elenchus is of the opinion that Manitoba Hydro has as good a handle on short term forecast of these customers as can be expected. Elenchus is concerned by the long term forecasts however as they may be over optimistic by not factoring in some consideration for recession cycles. Some members of this group are also highly capitalized and because of the amount of electricity required they may be price sensitive. It is this group that could be a higher risk of being impacted by grid parity.

REFERENCE:

PREAMBLE:

QUESTION:

Please provide the specific references relied upon by Elenchus to conclude that the Curtailable Rates Program is intended to address shortfalls "due to low water levels" (page 8).

RESPONSE:

Elenchus relies on information provided by MH staff through informal discussions.

TAB 8

8.2.2.1 Life Cycle Assessment Results are Highly Credible

MNP questioned the objectivity of the Pembina Institute with respect to delivering results which would tend to favor low emitting forms of generation such as hydropower versus other alternatives such as gas. MNP itself seems to contradict this point when it noted of the life cycle assessments prepared by the Pembina Institute that "*Given the expertise of the organization and a strong reputation for high quality research and analysis, Pembina is well suited to analyse the long-term climate-related impacts of energy infrastructure projects*".[122]

The detailed GHG Life Cycle Analyses completed for Keeyask and Conawapa are quantitative analyses which rely on material estimates provided by Manitoba Hydro and emission factor information from public life cycle data sets. Similarly, the methodology for determining the comparison technology intensities were not based on opinion but on the results of a literature survey of published life cycle values. MNP completed a materiality assessment of Keeyask Life Cycle Analysis component calculations, performed sensitivity testing and separately assessed the results of the literature review of the comparative technologies.

8.2.2.2 Scope of Life Cycle Assessments is Appropriate

Elenchus, in their report titled "*NFAT Review: A Review of Manitoba Hydro's Demand Side Management Plan*" recommends that ecological footprint analysis is required to assess all alternatives including demand side management (DSM) options. This recommendation would yield little or no value to the evaluation of Keeyask, Conawapa, the comparative technologies or any DSM options.

The notion that the inclusion of additional environmental indicators such as an ecological footprint would make the assessment of Keeyask or Conawapa complete is misguided. For Keeyask, other Project environmental effects have been assessed in accordance with EIS guidelines and reported in the EIS, supplemental information, responses to interrogatories, and throughout the Keeyask CEC Hearings. The GHG life cycle assessments considered emissions from all relevant project components and inputs during construction (including material sourcing, manufacture and transport), operation and land-use changes including reservoir implications.

[122] MNP IEC Report – Page 18 – 2nd paragraph

TAB 9

Besides providing results in the form of an alternate metric, evaluating Keeyask and Conawapa on an ecological footprint basis would require the utilization of the same construction, operation and land-use change impacts and would not yield fundamentally different conclusions. For example, instead of presenting the results in terms of GHG emissions directly from fossil fuelled generators Elenchus proposes that, "*...the associated emissions of carbon dioxide may be converted into an equivalent area by using assumptions about the area of forest needed to absorb those emissions.*"[123] In response to a Manitoba Hydro interrogatory, Elenchus indicates that the key benefit of an environmental footprint analysis is that all alternatives would be expressible in terms of a common unit – area of the Earth's surface.[124] Manitoba Hydro finds that the use of an ecological footprint would add little value and would present results in a way that obfuscates rather than clarifies the GHG implications.

Manitoba Hydro did not include DSM in the technology comparison within the Keeyask and Conawapa life cycle assessment studies for a number of reasons. In general, Manitoba Hydro assumes that demand side management measures are amongst the lowest GHG emitting intensity options available, and therefore assumes no negative implications when evaluating the GHG emission impacts of DSM projects and programs. However, as demand side management programs are typically combinations of numerous technologies, activities and behaviour changes, their life cycle assessment would be complex and program specific. Manitoba Hydro has judged the cost and level of effort required to develop life cycle assessments for DSM programs to be unjustified.

8.2.2.3 Keeyask and Conawapa are the Lowest GHG Emission Intensity Option

In the report prepared by Gunn & Olagunju, Table 4.6 and the associated narrative suggests that the CO2e emissions associated with wind are lower than that of hydropower renewable energy technologies.[125] This conclusion for hydropower is misleading since it is not consistent with the specific detailed GHG life cycle assessment of Keeyask and Conawapa. Although not specifically identified in this report, the referenced paper which is relied upon clearly qualifies this conclusion:

[123] NFAT Review: A Review of Manitoba Hydro's Demand Side Management Plan – Elenchus – Page 30
[124] MH-ERA-6d
[125] Gunn and Olagunju – Page 36

TAB 10

REFERENCE: Sections 3.5 Carbon Dioxide Footprint; 3.5.1.2 Elenchus' Comments, Page 30.

PREAMBLE:
The life cycle assessment (LCA) studies for Keeyask & Conawapa utilize a greenhouse gas (GHG) emission functional unit, namely tonnes CO_2eq/GW.h, to quantify the implications from these Projects and contrast them to numerous comparison technologies as documented in Appendix 7.3 of the NFAT submission. The LCAs included GHG emissions from relevant project components and inputs during construction (including material sourcing, manufacture and transport), operation and land-use changes including reservoir implications.

a) QUESTION:
How would life cycle activities such as material excavation, manufacturing and transport be specifically accounted for within an ecological footprint analysis?

RESPONSE:
Elenchus does not offer Ecological Footprint (EF) analysis services (See MH-Elenchus 3). Rather, Elenchus is aware of the methodology and refers to it in order to address one of the specific questions of the SOW. In an EF activity such as material excavation, manufacturing and transport are converted to an area of land required to support the activities. Details of the assumptions employed may be found in the reference provided in Elenchus' report or, for example, Global Footprint Network, **Calculation methodology for the national Footprint accounts.**

b) QUESTION:
How would the various GHG implications be converted to an ecological footprint?

RESPONSE:
An EF analysis represents environment impacts as areas of land. This requires assumptions about how the impacts relate to the Earth's surface. For GHGs, for example, tonnes of CO2 may be represented as the equivalent forest area required to sequester that amount of carbon. For more detail see, for example, Global Footprint Network, **Calculation methodology for the national Footprint accounts.**

c) QUESTION:
Please identify the specific key environmental indicators or outcomes (besides GHG implications) that would be considered in the proposed ecological footprint methodology.

RESPONSE:
The impacts of all of the alternatives considered would be presented in terms of one metric, the equivalent area of land required to support each alternative.

d) QUESTION:
What benefits would an ecological footprint analysis deliver relative to a GHG analysis? What are the disadvantages of ecological footprint analysis?

RESPONSE:
The key benefit is that all alternatives would be expressable in terms of a common unit – area of the Earth's surface. In contrast, normal EIAs express impacts in terms of a variety of quantitative or

qualitative factors. The MH multiple accounts approach is of this type. The key disadvantage is the number of assumptions that have to be made.