CNF/RCM/TREE I NFAAT - 3

INTERROGATORY

3. In the TREE/RCM NFAAT TSA Submission, in response to Question 10, reference is made to the calibration of the Manitoba Hydro Load Forecast to an end use model. Please provide further explanation of the method employed, the results obtained, and how the results are relevant to the question of the need for and alternatives to Wuskwatim Advancement.

NOTE TO REVISED RESPONSE:

This interrogatory response has been revised (March 26, 2004), based on Manitoba Hydro's latest corrections to the DSM Market Potential Study for the industrial and agricultural sectors (Manitoba Hydro Undertaking MH-34, which includes revised versions of Exhibits 3-1 through 3-5 of the DSM Market Potential Study for the Industrial and Agricultural sectors. The DSM Market Potential Study contains erroneous versions of these tables and graphs. The revised answer does not involve any changes to our adjusted forecast, only in the explanation of why the DSM Market Potential study for the industrial sector is inconsistent with the Manitoba Hydro Load Forecast and Economic Outlook.

Creation and Calibration of an End Use Model

The general indicators discussed in CNF/RCM/TREE I NFAAT - -CNF 2 provide some "big picture" indications of the electricity future forecast by Manitoba Hydro, but the calibration of an end use model of electricity demand to the load forecast is a more effective method for doing a "reality" check on the levels of electricity demand predicted by the load forecast. End use models typically represent the demand for electricity as the product of an activity variable (e.g. a household of a particular type, industrial output for a particular industry, square metres of floor area for a particular type of building), a set of energy utilization indices (EUI) that characterize the electricity use per unit of activity for various end uses (e.g. kW.hour per square metres for office building lighting, etc.). Some models further disaggregate the EUI into energy intensity, a saturation factor, and a market share for electricity. Synergistic effects between end uses (e.g. between electric lighting and building heat and air conditioning loads) are either modeled explicitly or captured by whole building or whole system simulations.

We used a two step method. First, we constructed a disaggregated end use model of electricity use in Manitoba in the base year 2002/03. Second, we calibrated this model to the Manitoba Hydro 2002 Load Forecast.[1] The first task is necessary to replace the macro-economic variables that underlie Manitoba Hydro's forecast model with the end-use activity variables that underlie an end-use model. The second task is necessary to ensure that our end use analysis and DSM

[1] Although the 2003 Load Forecast was available for this exercise (and has the advantage of having the former Winnipeg Hydro demand folded into its Residential and General Service categories), the 2002 Load Forecast was chosen because it is the "forecast of reference" for most of the material that Manitoba Hydro has tabled in support of Wuskwatim Advancement, and because it is the forecast that was the reference point for the Manitoba Hydro DSM Market Potential studies which contain the best available sector, subsector and end use breakdowns of Manitoba electricity consumption. We calibrated only for the "bookend" years – 2002/3 and 2017/18.

potential analysis are consistent with the load forecast. This is similar to the method employed in the DSM Market Potential Study except that consultants did not tune their reference projections to the Load Forecast, with the result that the DSM Market Potential Study estimates of DSM potential are not consistent with Manitoba Hydro's load forecast.

We forced our model into agreement with the Load Forecast by using the 2003 Load Forecast relations between Winnipeg Hydro and Manitoba Hydro electricity demand to adjust the Residential and General Service categories in the 2002 Load Forecast. For example, by comparing both the historical and forecast electricity demand in the residential sector in the 2003 Load Forecast (which included the residential portion of the former Winnipeg Hydro demand) with the residential portion of the 2002 Load Forecast (which did not include the Winnipeg Hydro demand), we were able to revise the 2002 Load Forecast residential sector demand numbers so that they included the residential portion of the Winnipeg Hydro demand.

For the residential and commercial sectors, our general approach was to adopt the MH DSM Market Potential Study subsector and end use definitions, activity levels, saturation factors and fuel shares. We also started with the DSM Market Study EUI's. In the case of the residential sector, we then made adjustments to the EUI's – very slight for the base year and somewhat larger but still small for 2017/18 – to "force" our results into agreement with the 2002 Load Forecast. This is what we mean by "calibration". In the case of the commercial sector, we reallocated the "Small Commercial" building floor area to the "medium" building categories (and renamed them "small and medium") and reallocated the "Other Commercial" sector in the DSM Market Potential Study to the "Other Institutional" segment so that our model represented all commercial electricity use and so that all commercial electricity was assigned to a particular building type.

For the industrial sector, DSM Market Potential Study was used for creating the end use profile of electricity use. However, in order to bring the 2002/03 calibration into line with the 2002 Load Forecast , the sum of the Commercial and Industrial sectors need to be about equal to the sum of the Top Consumers and Mass Market categories in the 2002 Load Forecast (as adjusted). Our assessment of the DSM Market Potential studies for the commercial and industrial sectors was that the adjustment should be made disproportionately to the industrial sector numbers in the reference projection in the DSM Market Potential study. (The DSM Market Potential Study for the Industrial Sector used output growth rates that were relatively high and not directly tied to the Manitoba Hydro Forecast and that resulted in industrial sector electricity use that is relatively high compared to the Load Forecast.) At the same time, the 2002/03 industrial sector electricity intensities were adjusted so that the calibrated model would yield a result in line with the General Service category in the Load Forecast.

The table on the following page compares the total sector electricity demand from the Manitoba Hydro DSM Market Potential Study, the 2002 Load Forecast (as adjusted), the 2003 Load Forecast, and the Torrie Smith (TSA) calibration to the 2002 Load Forecast. The TSA calibratio n lines up with the 2002 Load Forecast with respect to both absolute levels of demand and growth rates.

Table TREE/RCM - CNF3. 1

Comparison of DSM Potential Study Reference Projections, Manitoba Hydro Load Forecasts and TSA End Use Calibration

	2002/03	2007/08	2012/13	2017/18	15 year growth rate
A. DSM Market Potential Study Reference Projection					
1. Residential	6,199	6,309	6,410	6,553	0.4%
2. Commercial	4,814	5,208	5,638	6,107	1.6%
3. Industrial	7,200	8,703	9,603	10,157	2.3%
4. Commercial plus Industrial	12,014	13,911	15,241	16,264	2.0%
5. Total	18,213	20,220	21,651	22,817	1.5%
B. Manitoba Hydro 2002 Forecast (Adjusted)*					
1. Residential	6,101	6,287	6,463	6,654	0.6%
2. General Service	12,369	13,311	14,368	15,258	1.4%
3. Total	18,470	19,598	20,831	21,912	1.1%
C. Manitoba Hydro 2003 Forecast					
1. Residential	6,171	6,309	6,510	6,724	0.6%
2. General Service	12,796	14,117	14,939	15,865	1.5%
3. Total	18,857	20,426	21,449	22,589	1.2%
D. TSA Calibration					
1. Residential	6,100			6,650	0.6%
2. Commercial	4,800			5,679	1.1%
3. Industrial	7,550			9,500	1.5%
4. Commercial plus Industrial	12,350			15,179	1.4%
5. Total	18,450			21,829	1.1%

* The MH 2002 Forecast has been adjusted by allocating the Winnipeg Hydro consumption (net of distribution losses) to the residential and General Service categories. The adjustment is based on the relation between Winnipeg Hydro and Manitoba Hydro data contained in the MH 2003 Forecast. Also, the entry for 2002/03 in the MH 2002 forecast is not an actual but a forecast.

There are two main reasons why this type of calibration is relevant to the question of the need for and alternatives to Wuskwatim Advancement.

First, it can shed light on unrealistic assumptions embedded in the load forecast, and the load forecast is one of the foundation documents in the case for advancing Wuskwatim and for the timing of its eventual domestic need date. If it requires unreasonable assumptions to "tune" an end use model to the Load Forecast, it indicates that aggregate and correlative methods used to produce the forecast need to be deconstructed and reconsidered.

Second, measures for efficiency improvements are assessed relative to the load forecast, and so the end use calibration of the load forecast is necessary to ensure that engineering estimates of DSM potential are neither double counted nor undercounted. As illustrated in the above table, the DSM Market Potential Study residential reference projection (line A.1) is in reasonable agreement with the 2002 Load Forecast residential numbers (line B.1), as adjusted to include Winnipeg Hydro, although it starts a bit higher and ends a bit lower, reflecting a growth rate that is considerably lower than the forecast. With regard to the sum of the Commercial and Industrial sector reference projections in the Market Potential Study (line A.4), the 15 year growth rate of 2%/annum is much higher than the 2002 Load Forecast rate for General Service of 1.4%/annum (line B.2.) The 2.3%/annum growth in the industrial sector is particularly high relative to Manitoba Hydro, and reflects the lack of a rigorous or end use based method in the DSM Market Potential Study for producing the reference projection in this sector.

Comparison of TSA Model Calibration with DSM Market Potential Study Reference Projection

The TSA calibration for the residential sector (line D.1) is not very different from the DSM Market Potential Study reference projection for the residential sector (line A.1). We found the DSM Market Potential Study assumed values for the end use inputs to be reasonable, and made only slight adjustments to the EUI's so that our calibration would be in agreement with the Load Forecast (line B.1), as adjusted to include the former Winnipeg Hydro.

For the commercial sector, we found that the assumed values for EUI's, fuel shares, and saturation levels for new and existing buildings that were used in the DSM Market Potential Study were reasonable. With regard to activity levels (floor area), Manitoba Hydro does not have an estimate of floor area by building type for the province, and so base year floor areas in the Market Potential Study were derived by dividing Manitoba Hydro data on sales to different building types by the consultants' estimate of average EUI's by end use for those building types. This of course guarantees that the product of floor area and EUI will reproduce the sales data for the base year, and we adopted these floor areas in our base year calibration.

In the DSM Market Potential study, it is stated that the 2002 Load Forecast contains electricity growth in the commercial sector of 1.6% per year[2], and the consultants then used floor area in future years as the swing variable to "tune up" their model so that electricity consumption grows at 1.6% per year. Because there are some improvements in the EUI values in future years, this means that floor area growth rates are actually somewhat higher than 1.6% in the DSM Market Potential reference projection for the commercial sector.

The 1.6% growth rate in electricity presumed in the DSM Market Potential appears to be the overall forecast growth rate for the Mass Market portion of General Service demand in the Load Forecast, but that rate includes both commercial and industrial customers, including the Top

[2] The 2002 Load Forecast does not contain a forecast of commercial electricity use, and we were unable to find the reference in the 2002 Load Forecast to the 1.6% per year forecast growth that was used to calibrate the consultants' reference projection for the commercial sector in the DSM Market Potential study. The forecast growth rate for the General Service category is about (just under) 1.6% per year for the 2002/03 period, but this incorporates commercial and industrial customers. Historically in Manitoba, the growth rate for electricity consumption by Top Customers has been much higher than for the Mass Market portion of the General Service demand (i.e. other industrial and commercial). In the 2002 forecast, a similar growth rate (about 1.6% per year) was forecast for both Top Customer and Mass Market (although slightly higher for the Top Customer category). In the 2003 Forecast, Manitoba Hydro forecasts the 15 year growth rate of the Top Customers will be 50% higher than for the Mass Market customers, and on overall growth rate for General Service of about 1.4% per year.

Customers. In addition, the overall growth rate for General Service in the 2002 Load Forecast is only 1.6% per year, and given that the Top Customer category has historically grown much faster than the Mass Market category, and that in the most recent forecast Manitoba Hydro projects that this will continue to be the case, and that the overall growth rate for General Service demand will be less than 1.6% per year, the assumed growth rate for commercial electricity in the DSM Market Potential Study (line A.2) seems high.

But the key weakness with the method in the Commercial Sector DSM Market Potential study is that it lacks an independent projection for commercial building floor area. In general, economic output in the commercial sector grows faster than floor area, and in the context of historical growth in output of service sector industries the 1.6%-plus floor area growth rates in the DSM Market Potential study seem too high (even though without such high floor area growth rates the consultants would have fallen short of the load forecast for General Service electricity demand of 1.6% per year).[3]

With regard to the industrial sector, the DSM Market Potential Study reference projection reflects a fifteen year growth rate (2002/03 to 2017/18) for grid electricity consumption of 2.3% per year. This results in a combined growth rate for the commercial and industrial sectors in the DSM Market Potential Stud y of 2.0% per year (line A.4 in the table), as compared with the 2002 Load Forecast rate of 1.4% per year (line B.2 in the table).

There is a modest 0.9% annual improvement assumed in industrial electricity sector productivity in the DSM Market Potential Study, and this is the same rate that we have used in our reference projection. Where we differ with the DSM Market Potential study is in the industry-specific output growth rates. The DSM Market Potential Study utilizes output growth rates from a source[4] that is unrelated to, incompatible with, and has much higher output growth than the economic growth in Manitoba Hydro's Economic Outlook, which underpins the Load Forecast. The result is that in the DSM Market Potential Study, industrial electricity growth is driven by activity growth rates of 4.3% per year for the Chemical Treatment and Miscellaneous Manufacturing sectors, and 2.5% for other industries, and this is the main reason why the DSM Market Potential reference projection for industrial electricity growth is consistent with the Manitoba Hydro Load Forecast against which it is supposed to be measuring DSM potential.

The economic growth rate in Manitoba Hydro's 2002 Economic Outlook of 1.9% (2002/03-2017/18) is about the same as the actual economic growth rate over the past 18 years (1.8%) so we used Statistics Canada data on the composition of economic growth in Manitoba over this period to allocated growth rates to primary, secondary and agricultural output as shown in Table TREE/RCM CNF 3.2.

[3] Manitoba Hydro has not invested in measuring and tracking economic output and floor area growth by market segment in the commercial and institutional market that it serves, and this is a significant weakness it the utility's ability to analyze market trends and possibilities in this vitally important sector of the electricity market.
[4] Centre for Spatial Economics, "The Main Drivers Study: The Province of Manitoba", May 2002.

Table TREE/RCM CNF 3.2

Industry Annual Growth Rates, 2002/3-2017/18		
Sub-Sector	DSM Market Potential Study	TSA Calibration
Primary Metals	2.5%	1.6%
Chemical Treatment	4.3%	2.3%
Petroleum	2.5%	2.0%
Pulp & Paper	2.5%	2.0%
Misc. Industrial/Mfg.	4.3%	2.3%
Food & Beverage	4.3%	2.0%
Mining	2.4%	2.0%
Hog Ag.	2.4%	2.0%
Other Ag.	2.4%	2.0%

While Manitoba Hydro utilizes a fairly intensive, customer-specific process for forecasting the electricity demand from the all-important "Top Customer" category, it understandably only extends for a few years into the future (as far ahead as their Top Customers have plans for expansion or contraction) and isn't much use on the time scale of the Wuskwatim Advancement . In the 2002 Load Forecast, starting in 2006/07 the forecast method involves the simple assumption that there will be 60 million kilowatt-hours of new industrial demand that year, increasing to 90 million kilowatt-hours per year of new demand by 2012/13, and continuing to the end of the forecast period. This single, broad assumption accounts for two thirds of the proposed Wuskwatim dam output by the time of the forecast "domestic need date".

It should also be noted that the electricity productivity improvement rate of 0.9% per year assumed in both the DSM Market Potential Study and in our reference projection is modest compared to recent historical trends. In the five years from 1996 to 2001, the electricity productivity of most industries in Canada improved, and the overall electricity productivity of industrial manufacturing GDP increased by 10.1% between 1996 and 2001. Further, some of the largest gains were in the electricity intensive industries that are such important players in the Manitoba economy, with GDP per kilowatt-hour up by 46% in metals smelting and refining, 39% in fertilizer and pesticide production, 34% in the machinery industries, and 20-33% in food and beverage industries.[5]

The importance to load forecasting of understanding electricity productivity trends and developments at the industry-specific level was underlined by a recent attempt to calibrate a detailed industrial end use model (ISTUM) to B.C. Hydro's forecast.[6] The ISTUM model, which represents industrial production processes at a detailed level and which also tracks the impact of

[5] Electricity intensities and productivities based on industry-specific GDP and electricity consumption data from the NRCan Office of Energy Efficiency Comprehensive Energy Use Database, available online at http://oee.nrcan.gc.ca/Neud/dpa/trends_id_ca.cfm.

[6] Marbek Resource Consultants and Willis Energy Services, "BC Hydro Conservation Potential Review 2002: Industrial Sector Report (Base Year: Fiscal 2000/01)", prepared for B.C. Hydro, July 2003.

natural capital stock turnover in at an industry-specific level, was used to develop a reference projection (i.e. no new DSM programs) of industrial electricity demand in B.C. Starting with projected activity levels provided by the B.C. Hydro load forecast department, the ISTUM simulation predicted a significantly lower demand for electricity (2,800 GW.hours or 13.5% lower after 15 years) than contained in the B.C. Hydro Load Forecast.

Summary Conclusion

Our overall conclusion from the calibration exercise is that the Manitoba Hydro Load Forecast cannot be represented in an end use model without assuming activity levels that are higher than the demographic and economic forecasts underlying the Load Forecast would suggest, and without assuming electricity efficiencies that are lower than recent trends would suggest. In other words, while it is true that the Manitoba Hydro Load Forecast is forecasting lower growth in electricity consumption than previous forecasts, the forecasting method is continuing its historical tendency to bias the results in the direction of higher electricity demand than the assumed growth in population and economic activity would likely require. As Manitoba Hydro's NFAAT case makes clear, the forecast growth in domestic demand is a foundation for their case that the Wuskwatim dam should be built before it is needed, but it is a shaky foundation for a billion dollar decision, as except for the residential sector the Load Forecast does not stand up well to end use analysis.

CNF/RCM/TREE I NFAAT - 4

INTERROGATORY

4. In the TREE/RCM NFAAT TSA Submission, in response to Question 11, there is reference to a "reference scenario of future electricity demand in Manitoba". Please provide additional details of this reference scenario and how and why it differs from Manitoba Hydro's Load Forecast.

NOTE TO REVISED RESPONSE:

This interrogatory response has been revised (March 26, 2004), based on Manitoba Hydro's latest corrections to the DSM Market Potential Study for the industrial and agricultural sectors (Manitoba Hydro Undertaking MH-34, which includes revised versions of Exhibits 3-1 through 3-5 of the DSM Market Potential Study for the Industrial and Agricultural sectors. The DSM Market Potential Study contains erroneous versions of these tables and graphs. The revised answer does not involve any changes to our adjusted forecast, only in the explanation of why the DSM Market Potential study for the industrial sector is inconsistent with the Manitoba Hydro Load Forecast and Economic Outlook.

RESPONSE:

In order to tune our end use model of Manitoba electricity use to Manitoba Hydro's Load Forecast, we found that we had to make assumptions that did not seem reasonable with respect to commercial sector floor area growth and with respect to industrial sector output growth. These conclusions are described in response to CNF/RCM/TREE I NFAAT – 3 (revised).

We therefore made two adjustments to our reference projection, both of which had the effect of lowering the projected future electricity demand from the levels contained in the 2002 Basic Load Forecast.

With regard to commercial and institutional sector floor areas and floor area growths, Manitoba Hydro does not have estimates of floor area in the province for different building types. The floor area numbers in the DSM Market Potential Study are in fact derived from Manitoba Hydro sales data and the estimates of electricity use per square metre for different building types. We have generally accepted these floor areas as a starting point, but the DSM Market Potential Study only models about 86% of commercial sector electricity use; the residual 14% is left in an "Other" sector which is not represented in the model. The TSA end use model calibration includes all commercial/institutional building energy use; this is why total floor area in 2002/03 in the TSA column is about 14.5% greater than the DSM Market Potential study.

In addition to including this additional floor area in the total, the TSA base year calibration reallocates the "Small Commercial" segment to particular building types. The resulting total commercial electricity use was about equal to the base year total in the DSM Market Potential study.

With regard to projected growth in the commercial sector, we adopted the EUI's in the DSM Market Potential Study reference case, as they seemed reasonable and are well supported by audit data. As discussed in CNF/RCM/TREE I NFAAT - 3, however, the "floor area" growth rates in the DSM Market Potential study seem too high for the level of population and economic growth used for the 2002 Load Forecast. For example, in the DSM Market Potential Study, floor area in institutional sectors such as schools, universities, and hospitals grows several times faster than population and growth in retail and office building space grows nearly as fast as economic output in these segments, counter to historical trends and common sense. The consultants adopted these high growth rates so that the reference projection of electricity consumption would come up to 1.6% per year (the rate of growth of the General Service load in the 2002 Load Forecast), but the result is activity growth that is inconsistent with the low population growth and industry-led economic growth embedded in the Load Forecast.

We therefore adopted lower growth rates for the commercial/institutional building types, with some segments growing slightly faster than population (schools, universities, food retail, recreation), and with retail, offices and warehousing space growing at about half the rate projected in the DSM Market Potential Study, reflecting the continuing trend for output growth to outpace floor area growth in these segments. The floor areas we used are compared with the floor areas in the DSM Market Potential Study in Table TREE/RCM CNF4.1.

The result of these revisions to the floor areas (while still adopting the EUI's used in the DSM Market Potential reference projection) is a decrease in annual electricity use in 2017/18 of 225 GW.hours per year by 2017/18.

With regard to the industrial sector, we adjusted the output growth rates to align them with the economic output in the Load Forecast and Economic Outlook. We did this by assuming the subsector growth rates would maintain their relative positions to each other, with general manufacturing and chemical treatment having the highest rates (2.3% per year), mining somewhat less than the average (1.6% per year) and other industrial and agricultural sectors growing at 2.0% per year over the fifteen year period. These growth rates were combined with electricity intensity improvements equal to those assumed in the DSM Market Potential Study (i.e. 0.9% per year). This results in a total electricity productivity improvement of 14.4% by 2017/18, compared to the 10% improvement in electricity productivity that took place in Canadian industry in only five years from 1996-2001.

It is important to note that this difference is distinct from the difference Manitoba Hydro projects by 2017/18 between its Basic Forecast and Medium Low Forecast. In the case of the adjustments we made, we did not change any of the assumptions or forecasts for population and economic growth that underlie the Load Forecast. Instead, we changed either the physical activity levels (in the case of the commercial sector) or the individual industry growth rates (in the case of the industrial sector) to bring them in line with those in Manitoba Hydro's 2002 Basic Forecast. In contrast, the Medium High and Medium Low forecasts produced by Manitoba Hydro are based on changed assumptions about the underlying demographic and economic drivers of the econometric equations used to generate the forecast. Whereas the Medium Low and Medium High forecasts illustrate how the output of econometric equations changes under conditions of lower or higher economic growth, end use representations are useful for testing the "believability" of the econometric predictions in the real world of energy end uses.

Table TREE/RCM - CNF4. 1

Commercial and Institutional Building Floor Area, DSM Market Potential Study Vs. TSA Reference Projection						
	2002/03		2017/18		Percent Growth over Fifteen Years	
	DSM Study	TSA Model	DSM Study	TSA Model	DSM Study	TSA Model
Small and Medium Offices		3,443,426		4,198,183		22%
Medium Offices	891,119		1,158,820		30%	
Large Offices	2,063,452	2,056,574	2,723,173	2,507,350	32%	22%
Small and Medium Non-food Retail		2,987,593		3,442,835		15%
Medium Non-food Retail	975,288		1,280,801		31%	
Large Non-Food Retail	1,854,143	1,847,963	2,399,340	2,129,551	29%	15%
Food Retail	506,132	504,444	645,365	535,573	28%	6%
Medium Hotels/Motels	428,930	427,500	582,962	453,881	36%	6%
Large Hotels/Motels	508,547	506,852	704,843	538,129	39%	6%
Personal Care Homes	485,879	493,056	634,954	523,482	31%	6%
Health	1,040,412	1,036,944	1,294,349	1,100,934	24%	6%
Small and Med Schools		2,748,889		2,918,521		6%
Medium Schools	1,582,404		2,119,268		34%	
Large Schools	588,722	586,759	769,344	622,968	31%	6%
Universities/Colleges	1,057,878	1,054,352	1,382,452	1,119,415	31%	6%
Franchise Restaurants	196,302	195,648	254,024	220,487	29%	13%
Warehouses	1,700,483	2,840,000	2,168,274	3,248,522	28%	14%
Recreation Facilities	812,802	1,280,000	1,067,415	1,379,434	31%	8%
Religious		410,000		435,301		6%
Large Urban Religious	180,509		229,037		27%	
Small Commercial	5,276,570		6,695,104		27%	
Other	Unspecified*	650000	Unspecified*	862,037		33%
Total/Average	**20,149,573**	**23,070,000**	**26,109,525**	**26,236,605**	**30%**	**14%**

* The DSM Market Potential Study only models about 86% of commercial sector electricity use; the residual 14% is left in an "Other" sector which is not represented in the model. The TSA end use model calibration includes all commercial/institutional building energy use; this is why total floor area in 2002/03 in the TSA column is about 14.5% greater than the DSM Market Potential study.

The reference projection that we used as a baseline for DSM assessment is summarized in Table TREE/RCM CNF 4.2.

Table TREE/RCM - CNF4. 2

Summary of TSA Reference Projection				
	Electricity Consumption			
	2002/03	2017/18		
		Existing	New	Total
RESIDENTIAL				
Pre-1986 SFD	3,530	3,272	404	3,676
1986-Present SFD	732	678	45	723
Northern SFD	378	353	46	398
Reserve SFD	379	362	3	365
Row/Duplex	360	346	31	377
Apartment	597	576	46	622
Mobile Home	209	198		198
TOTAL RESIDENTIAL	**6,185**	**5,785**	**576**	**6,360**
COMMERCIAL/INSTITUTIONAL				
Small & Medium Offices	550	523	118	642
Large Offices	441	423	83	506
Large Non-Food Retail	340	316	53	370
Small & Medium Non-Food Retail	556	518	77	595
Food Retail	266	257	17	273
Franchise Restaurants	130	123	15	138
Large Hotel/Motel	113	103	6	109
Medium Hotel/Motel	88	82	4	87
Large Schools	102	98	7	105
Small & Medium Schools	374	357	26	384
University/Colleges	166	158	9	167
Health	275	272	19	291
Recreation Facilities	382	367	28	394
Warehouses	333	333	45	378
Personal Care Homes	115	113	6	119
Religious Facilities	34	31	3	34
Other Institutions	117	111	-	111
Apartment Common Areas	402	349	80	429
TOTAL COMMERCIAL	**4,784**	**4,534**	**597**	**5,131**
INDUSTRIAL				
Primary Metals	2,084			2,309
Chemical Treatment	1,506			1,850
Petroleum	780			917
Pulp & Paper	786			924
Misc. Industrial/Mfg.	700			860
Food & Beverage	487			572
Mining	223			262
Hog Ag.	395			464
Other Ag.	154			181
TOTAL INDUSTRIAL/AGRICULTURE	**7,115**			**8,338**
TOTAL ELECTRICITY DEMAND	**18,084**			**19,830**

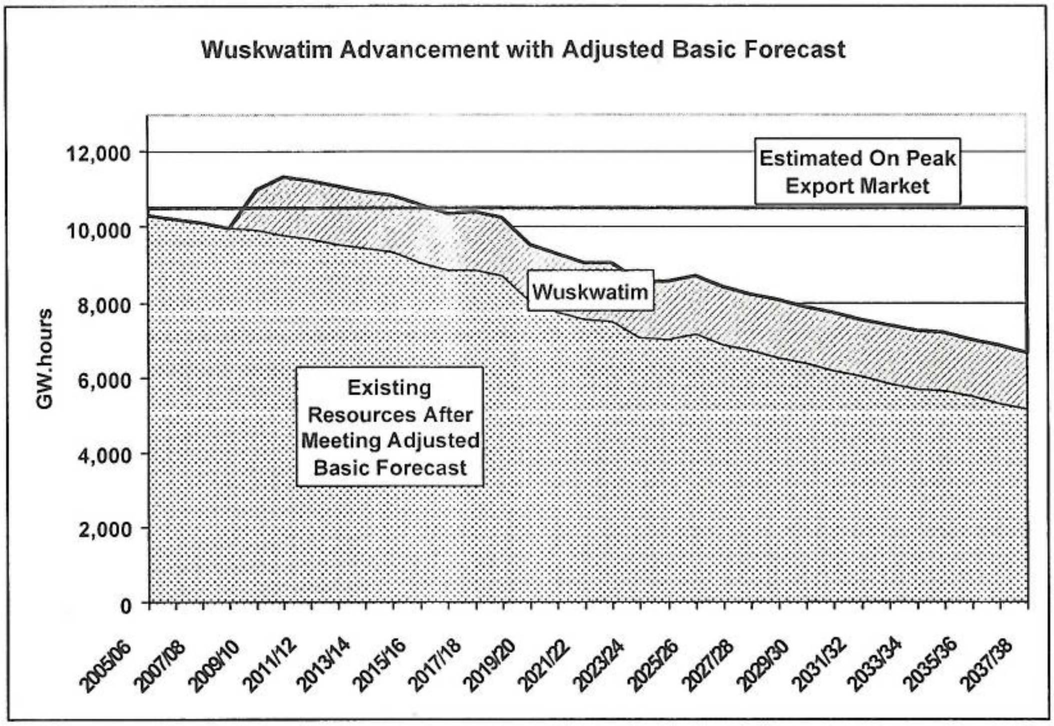
While this exercise was necessarily restricted to a cursory end use audit of the Load Forecast, there are clear indications that the forecast is high relative to the level of demographic and economic growth being projected. Interestingly, the exception is the residential forecast, where Manitoba Hydro does employ end use modeling. For the commercial and industrial/agricultural sectors, however, end use modeling suggests that commercial sector floor area growth rates are too high and that industrial electricity growth is overestimated. Adjusting for these two factors reduces the projected electricity demand in 2017/18 by over 2,000 GW.hours.

Figure TREE/RCM I NFAAT – 4.1 illustrates the effect these adjustments have on the "energy available for export". Our calibration and adjustment was done to the 2002 Load Forecast and does not reflect the higher than forecast actual demand that occurred in 2002/03. According to Manitoba Hydro, the actual, weather corrected demand in 2002/03 was 400 GW.hours higher than forecast in the 2002 Load Forecast.

Our scenario is also based on the population and economic growth reflected in the 2002 Load Forecast, and specifically the Basic Forecast. We have not assumed lower population or economic growth in adjusting the scenario, only changes in the rate of floor area growth relative to economic growth and in the subsector growth rates for agriculture and industry. It is interesting to note, however, that the effect of these adjustments results in a greater reduction in future electricity demand (relative to Manitoba Hydro's Base Forecast) than the population and economic assumptions that underlie the Medium Low Forecast. What our exercise shows is that there are quite plausible, reasonable, and even probable scenarios in which the forecast electricity demand will come out lower than the Basic Forecast, without assuming lower population or economic growth.[7]

[7] Exhibit TREE/RCM 1001, tabled at the hearings on March 10, 2004 presented a figure similar to the one above that showed the impact on "energy available for export" of assuming the Medium Low Forecast. The data for the Medium Low forecast in that figure were taken from Table A.8 (Manitoba Hydro NFAAT Vol. 1 Attachment 3). However, it would appear that the there is systemic error in both Table A.7 (Dependable Energy Medium High variation) and Table A.8 (Dependable Energy Medium Low variation). The "2002 Base Load" row in these tables should be Gross Energy (Net Firm plus Station Service), but it appears that station service has been subtracted from rather than added to the forecast Net Firm energy, resulting in all the numbers for both the Medium Low and Medium High forecasts being too high, by about 400 GW.hours per year. We do not know if the error is restricted to these tables or affects other figures in Manitoba Hydro's evidence that portray results associated with the Medium Low or Medium High forecasts.

Figure TREE/RCM CNF 4.1



CNF/RCM/TREE I NFAAT – 6.

INTERROGATORY

6. In the TREE/RCM NFAAT TSA Submission, in response to Question 12, it is stated that there are some cases where Manitoba Hydro's DSM consultants have not identified technologies that are economic. Please identify these technologies and estimate the extent to which their inclusion would increase the total estimated DSM resource.

RESPONSE:

The DSM Market Potential Study provides a conservative estimate of the economic potential for electricity efficiency improvement in Manitoba over the next fifteen years. In fact, most attempts to estimate the size of the economic potential for DSM are conservative. Unlike supply-side resources such as oil and gas and hydropower, which are finite in size and can be physically measured, the demand side resource is limited only by human ingenuity and innovation, and it grows every time someone thinks of a way of doing something with less electricity. The portion of the resource that can be developed for a particular CCE (6.15 cents Canadian in the case of the Market Potential DSM Study) will also be sensitive to changes in end use markets and technologies and practices. At any given time there will be a body of conventional thinking, as reflected in the DSM Market Potential Study, on the typical technologies and practices that constitute the amount of DSM that could be developed for a particular threshold price per kW.hour (using the narrowly focused CCE method).

Given that the DSM Market Potential Study identifies DSM potential (with a CCE of less than 6.15 cents per kilowatt-hour) that is about six times higher than Manitoba Hydro's current Power Smart program (and over ten times higher for the residential sector), it could be argued that it makes little difference whether the DSM Market Potential Study estimate is on the low side. However, the perception of how much DSM is available for 6.15 cents per kilowatt-hour is one of the key drivers of the process within Manitoba Hydro for deciding how much DSM is "achievable".

In our review of the DSM Market Potential Study, we did not and could not attempt to reproduce the study itself, or to check every number in the voluminous reports. Rather, our approach was to combine an assessment of the overall method and conclusions with some detailed "spot checking" of the calculations. Our overall conclusion is that the study generally conforms to standard industry practices with respect to the application of the CCE method, but that there is a tendency to conservative assumptions (i.e. assumptions that underestimate the potential). In taking a closer look at the DSM Market Potential Study for the commercial sector, we made the following observations:

1. Table TREE/RCM CNF 6.1 lists the whole building energy intensities from the DSM Market Potential Study for the commercial sector. These numbers represent the total fuel and electricity per square metre of building floor area in each segment, and have been constructed from the data in Appendices A, B, D and E of the Commercial Sector report. As the intensities in TREE/RCM CNF 6.1 reveal, the overall whole building energy

performance improvement in the DSM Market Potential Study is very modest, for both new and existing buildings. While the study refers to "whole building EUI's" for electricity that improve by 20-30% (see Exhibit 5.2 and 5.3 of the Commercial Sector study), the "whole building EUI's" referred to are actually whole *segment* electricity EUI's computed by dividing total segment electricity use by total segment floor area. As such, they are not reflections of the improvement that is occurring at the whole building level, and their rate of improvement (as shown in Exhibits 5.2 and 5.3 of the Commercial Sector study) is much higher than for actual building energy intensities.

Table TREE/RCM CNF 6.1

	Whole Building Energy Intensities - Existing Buildings (MJ per sqm)			Whole Building Energy Intensities - New Buildings (MJ per sqm)		
Segment	Reference	Economic Potential	Percent Improve-ment	Reference	Economic Potential	Percent Improve-ment
Large Office	1433	1255	12%	1424	1195	16%
Medium Office	934	819	12%	925	670	28%
Large Retail	1214	1142	6%	1137	940	17%
Medium Retail	1431	1272	11%	1115	1058	5%
Food Retail	2769	2436	12%	2286	1956	14%
Large Hotel	1352	1197	11%	1234	1134	8%
Medium Hotel	1556	1438	8%	1259	1081	14%
Health	1816	1750	4%	2121	1998	6%
Personal Care Homes	1255	1131	10%	1039	877	16%
Large Schools	882	819	7%	793	630	21%
Medium Schools	776	726	6%	637	498	22%
Universities	1021	893	13%	879	742	16%
Franchise Restaurants	3762	3469	8%	3505	3211	8%
Warehouses	1342	1277	5%	1161	1138	2%
Recreational	1709	1501	12%	1573	1169	26%
Religious	859	787	8%	865	766	11%

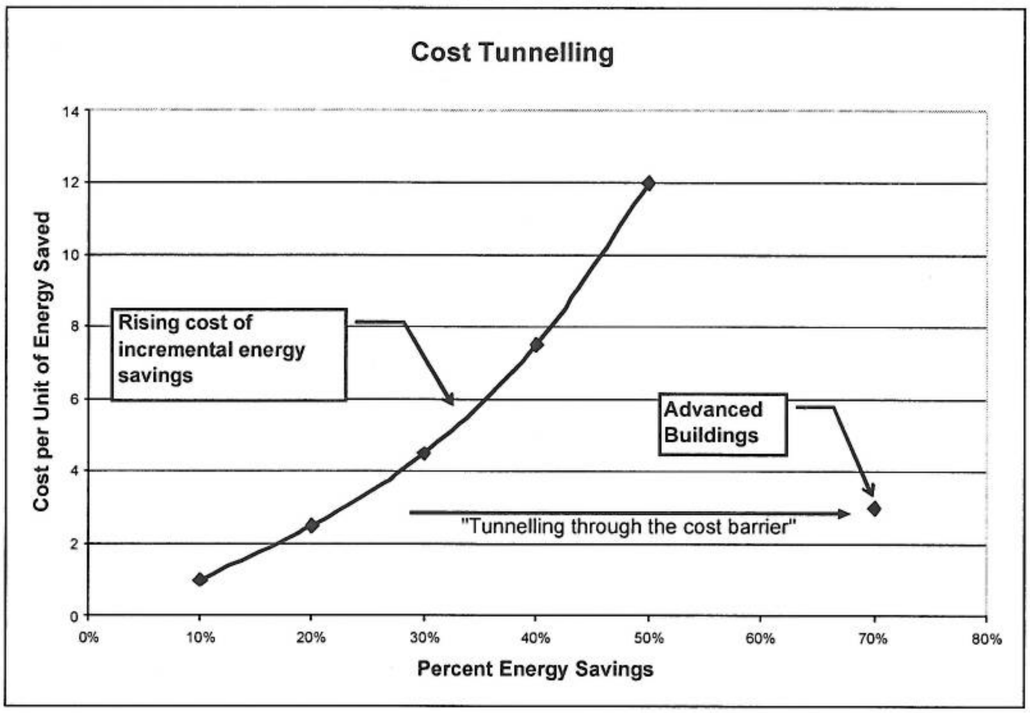
2. The overall building energy performance improvements in Table TREE/RCM CNF 6.1 are well below the 25-35% whole building improvements that are generally found to be economic for existing buildings[9]. For new buildings, the absolute whole building intensities are relatively high compared with the performance of new, advanced buildings, suggesting the full potential for improvement in these buildings has been

[9] For example, see the benchmarking and best practice reports on the Web site of the federal government's Energy Innovators program (http://oee.nrcan.gc.ca/eii/publications.cfm?PrintView=N&Text=N) or the case studies and project descriptions on the site of Toronto's Better Buildings Partnership, http://www.city.toronto.on.ca/wes/techservices/bbp/index.htm. Savings in the 20-35% are typical, and actual savings usually exceed expectations by a significant margin.

missed by the scope and method of the study. Of course the focus of the study was on electricity, but the total potential for electricity improvement cannot be determined out of context. Basic air sealing and weatherization are not included in the analysis, let alone comprehensive, whole building analysis that fully captures the gas and electricity savings potential, and the synergies between them. A few space heating measures were analyzed for electrically heated buildings, but most commercial and institutional buildings in Manitoba are gas heated, and the DSM Market Potential Study has not included a comprehensive and integrated analysis of the opportunities for energy savings in these buildings.

3. In the specific case of new buildings, the potential for "cost tunneling" does not appear to have been explored in the Market Potential Study. Experience with advanced buildings indicates that energy efficient "green" buildings (energy use 50% or more lower than the National Model Energy Code for Buildings) can achieve unit costs of saved energy that are lower than for buildings that deviate only incrementally from conventional design.[10] This phenomenon, sometimes called "cost tunneling" because the cost of saved energy appears to "tunnel" through the cost barrier, is illustrated in Figure TREE/RCM CNF 6.1. The energy intensities of new buildings in the DSM Market Potential Study (Table TREE/RCM CNF 6.1) are much higher than what one would expect from advanced buildings.

Figure TREE/RCM CNF 6.1



[10] See www.advancedbuildings.org for descriptions and case studies of these buildings.

4. In addition to the energy savings in these advanced buildings, they are proving to be superior buildings in many other ways, and the people who work in them are more productive. These productivity gains are worth much more than the energy savings[11] and are emerging as an important driver of the demand for these buildings. This raises another, generic issue with respect to the DSM Market Potential Study estimate of economic potential. The CCE for a particular technology or technique will depend on what portion of the cost of the measure is charged to the electricity savings. However, technology choice seldom turns on the cost of electricity, and end users will adopt new technologies for their amenity value and a host of other factors, economic and otherwise. The result is almost always a reduction in the electricity intensity of the end use service. For example, the adoption of flat screen computer monitors could hardly be justified on the basis of their CCE, and yet they will soon completely displace CRT monitors. In Manitoba, it seems likely that there will be a significant uptake of ground source heat pumps in the residential sector, even though their CCE would appear to be greater than 6.15 cents per kilowatt-hour. That such technologies get adopted in spite of the fact that they cannot be justified on the basis of a CCE calculation does not mean that they are not economic, but that the CCE is an inadequate test for gauging the full potential for economic technologies that will reduce the electricity intensity of the economy. These technological trends could be identified and anticipated in the load forecasting or future demand scenario analysis, but in the case of Manitoba Hydro, they are not.

5. Another observation with respect to the Commercial Sector DSM Market Potential Study is that the modeled electricity use comprised less than 70% of sector electricity use. Most of the unmodelled consumption is in the "small commercial" (18.4%) and "other commercial" (12.8%) categories, and the electricity savings potential for this 31% of the sector total is almost certainly underestimated in the DSM Market Potential Study. With regard to the "other commercial" sector, it was assumed that savings could be achieved that corresponded to the average level of savings in the rest of the commercial sector. However, from what we know about the users in this category (e.g. Pinawa Research Facility, Winnipeg Airport), the energy use patterns would be similar to universities and institutional buildings, and it therefore seems likely that above average rates of savings should be possible. In the case of the "small commercial" category, it represents 26% of total floor area, about 18% of sector electricity use, but only 15% of electricity savings potential. However, the "small commercial" floor area is not evenly distributed among building types, and is heavily dominated by small offices and small retail, both building types with savings potentials well above the 16.7% assumed for "small commercial".

6. The DSM Market Potential Study assumes that the electricity savings potential for small buildings is less (on a kW.hour per square metre basis) than for medium and large buildings, but no analysis is presented to support this position. Small building savings potential was not analyzed in the study and some measures that are relatively important

[11] See the web site of the U.S. Green Building Council for more on the benefits of green buildings, and their economic value. www.usgbc.org.

for small buildings (air sealing, for example) are not included in the DSM Market Potential Study.

7. The omission of air sealing as a measure is also a questionable assumption for medium (and perhaps also some large) buildings.

8. In some cases, technologies that would appear to be economic are not included in the "roll up" to all sectors. For example, integrated lighting systems, which can achieve savings of 70% or more in electricity use, are applied only to office buildings, and then only to General Lighting. No analysis is presented for why this technology could not be economic in some other building segments (e.g. schools, universities, some parts of large hospital, hotel and recreational buildings, etc).

9. The savings that could be achieved from more efficient computers, office equipment and other types of plug loads in the commercial buildings sector seem very conservative in light of the advances that are being made in this area. The only technology included here is the Energy Star compliant computer; electricity efficiency and reduction of standby losses in everything from photocopiers to fax machines to telecommunications equipment, cash registers, and all manner of other plug load is left out of the assessment of economic potential, but with no quantitative justification. In addition, the single measure (Energy Star computers) that is included is only included in the economic potential assessment for three building types: offices, universities and hospitals.

10. In the DSM Market Potential Study for the residential sector, the integrated design approach is not applied to new apartment buildings, and a number of other measures have been excluded from the assessment for apartment buildings, including basic air sealing and weatherizing, window upgrades to low-e argon, block heaters and car warmers and water heater insulation.

CNF/RCM/TREE I NFAAT – 7

INTERROGATORY

7. In the TREE/RCM NFAAT TSA Submission, in response to Question 12, it is stated that some technologies identified as economic in the Manitoba Hydro DSM studies do not appear to have been included in the "roll-up" of the total estimated DSM potential in Manitoba. Please provide specifics and an indication of the extent to which this affects the total estimated DSM resource.

RESPONSE:

Our approach to assessing the DSM Market Potential study was analogous to that of a financial audit. We could not redo the studies, or check every number, so we did "spot checks" of assumptions and calculations. (Our overall assessment of the estimate of the "economic potential" is included in CNF/TREE/RCM I NFAAT – 6), including references to technologies that were not included in the "roll-up".

CNF/RCM/TREE I NFAAT – 8

INTERROGATORY:

8. In the TREE/RCM NFAAT TSA Submission, in response to Question 13, it is stated that a number of "questionable assumptions" were identified in the sector DSM reports that could lead to an underestimation of the DSM potential in Manitoba. Please provide further documentation of the points identified, and any others not already included in this or other question responses.

RESPONSE:

Our approach to assessing the DSM Market Potential study was analogous to that of a financial audit. We could not redo the studies, or check every number, so we did "spot checks" of assumptions and calculations. Our overall assessment of the estimate of "economic potential" in the DSM Market Potential Study is included in CNF/TREE/RCM I NFAAT – 6, and a more general critique of the CCE method as a determinant of economic potential is included in CNF/TREE/RCM I NFAAT – 5. In addition to the assessment of the amount of DSM that is available with CCE less than 6.15 cents per kilowatt-hour, the DSM Market Potential Study also includes an assessment of what portion of that "economic potential" is achievable. Further comments on this aspect of the answer to this question are provided in CNF/TREE/RCM I NFAAT – 10.

CNF/TREE/RCM I NFAAT - 9

INTERROGATORY

9. In the TREE/RCM NFAAT TSA Submission, in response to Question 14, reference is made to a scenario of electricity demand in Manitoba that includes both the effects of Torrie Smith's modifications to the load forecast and DSM potential estimates. Please provide details of this scenario and elaborate on its significance to the question of the need for and alternatives to Wuskwatim Advancement.

RESPONSE:

As explained in CNF/TREE/RCM I NFAAT – 4, the baselines for the commercial and industrial sectors in the DSM Market Potential Study are inconsistent with both the Manitoba Hydro Economic Outlook and Load Forecast, and an adjusted version of the Basic Forecast was developed to correct those inconsistencies. In CNF/TREE/RCM I NFAAT – 5, we argue that the CCE method is too narrowly focused to properly capture the full economic benefits of DSM, and in CNF/TREE/RCM I NFAAT – 6 we have pointed out a number of ways in which the Market Potential Study has underestimated the amount of DSM that could be developed with a CCE of 6.15 cents per kilowatt-hour or less.

It was beyond the resources available to us to conduct a full scale analysis of the economic potential for DSM, but we did produce an estimate based on our adjusted baseline and a few other specific adjustments to the assumptions in the DSM Market Potential Study. The results are summarized in Table TREE/RCM CNF 9.1

The first row in each section of the table – "Manitoba Hydro (MPS) -- refers to the reference projection and the DSM economic potential reflected in the DSM Market Potential Study. As reflected by the DSM Market Potential Study, the identified savings potential are disproportionately located in the buildings sectors, with the residential sector comprising 29% of the reference demand but 44% of the identified DSM potential and the commercial sector comprising 27% of the reference demand but 35% of the identified DSM potential. In contrast, the industrial sector comprises fully 45% of the reference demand, but only 21% of the identified DSM potential.

The second row of each section – "Manitoba Hydro Adjusted" – reflects a combination of our adjusted Basic Forecast and the EUI's associated with the Economic Potential projection in the DSM Market Potential Study. By reducing the reference (pre DSM) projection of electricity use in 2018, we also reduce the base against which electricity savings can be obtained, and so the absolute amount of DSM (in GW.hours) is less when the Market Potential EUI's are applied to our adjusted forecast. For the residential sector we did not make any significant adjustments to the Basic Forecast, so there is no difference between the "Manitoba Hydro (MPS)" and "Manitoba Hydro Adjusted" lines. For the commercial and industrial sectors, the GW.hours of DSM potential obtained by applying the Market Potential Study EUI's to the Adjusted Forecast are lower than in Manitoba Hydro's unadjusted case by about 20% and 10%, respectively. As a percentage of electricity demand in these sectors, there is hardly any change at all. The main reason the DSM reduction is so modest is that most of DSM in the Market Potential Study takes place in the existing stock of buildings and equipment (simply because there is so much more of it than new buildings and equipment), and the DSM potential is largely unaffected by the reduced demand growth rate contained in the Adjusted Basic Forecast.

Table TREE/RCM CNF 9.1

Comparison of Estimates of Economic Potential for DSM (all figures in GW.hours)

	Reference Demand in 2018	Demand in 2018 with Economic Potential	Economic Potential DSM	DSM as % of Reference Demand
RESIDENTIAL				
Manitoba Hydro (MPS)	6,553	5,016	1,537	23.5%
Manitoba Hydro Adjusted	6,553	5,016	1,537	23.5%
Torrie Smith	6,553	4,250	2,303	35.1%
COMMERCIAL				
Manitoba Hydro (MPS)	6,107	4,868	1,239	20.3%
Manitoba Hydro Adjusted	5,131	4,145	986	19.2%
Torrie Smith	5,131	3,591	1,540	30.0%
INDUSTRIAL				
Manitoba Hydro (MPS)	10,157	9,407	750	7.4%
Manitoba Hydro Adjusted	8,338	7,704	634	7.6%
Torrie Smith	8,338	7,676	663	7.9%
TOTALS				
Manitoba Hydro (MPS)	**22,817**	**19,291**	**3,526**	**15.5%**
Manitoba Hydro Adjusted	**20,022**	**16,865**	**3,157**	**15.8%**
Torrie Smith	**20,022**	**15,516**	**4,506**	**22.5%**

The third row of each section of the table – "Torrie Smith" – contains our estimate of the DSM potential in Manitoba by 2018. As already noted, this does not reflect a full scale re-evaluation of the economic potential, only a rough estimate. In fact, it has been produced by making a few additions and adjustments to the technologies and application rates already in the DSM Market Potential assessment. It does not begin to reflect a consideration of the economic potential for DSM that would be revealed by the type of whole systems analysis that would be required to properly include the types of hidden benefits of DSM described in CNF/TREE/RCM I NFAAT – 5.

We have included measures from the DSM Market Potential Study up to 8 ¢/kWh, as a partial reflection of the benefits of the DSM that are not captured in the 6.15 ¢/kWh figure as discussed in CNF/TREE/RCM I NFAAT - 5.

In the residential sector, we have included ground source heat pumps in existing dwellings with forced air electric heating systems. In the DSM Market Potential Study, the CCE for this technology is 8.2 ¢/kWh, before efficiency improvements are made to the housing envelope. The consultants make the argument that the GHSP and envelope upgrades are competing for the same market, and that the overall DSM potential would not be affected very much by including the GSHP's in existing dwellings (see TREE/RCM/MH/NCN I NFAAT - 018a) but we question both these assumptions. The gains from the heat pump are still quite significant, even after envelope upgrades, and the CCE of a bundled package including heat pumps and envelope upgrades would be only marginally more than the 8.2 ¢/kWh for the heat pump without the upgrades. There are comfort, security and other amenities associated with the heat pump option that are not captured in the CCE but which at least some Manitoban homeowners are already valuing sufficiently to invest in the heat pump technology.

We have also added DSM potential to the Apartment dwelling category for a number of low cost measures apparently omitted from this segment in the Market Potential Study, including basic air sealing and weatherizing, block heaters and car warmers, water heater insulation blankets, and window upgrades to low-e argon (incremental). In addition, we have assumed integrated design for new apartment building construction to achieve energy intensities at least 40% below standard construction practices.

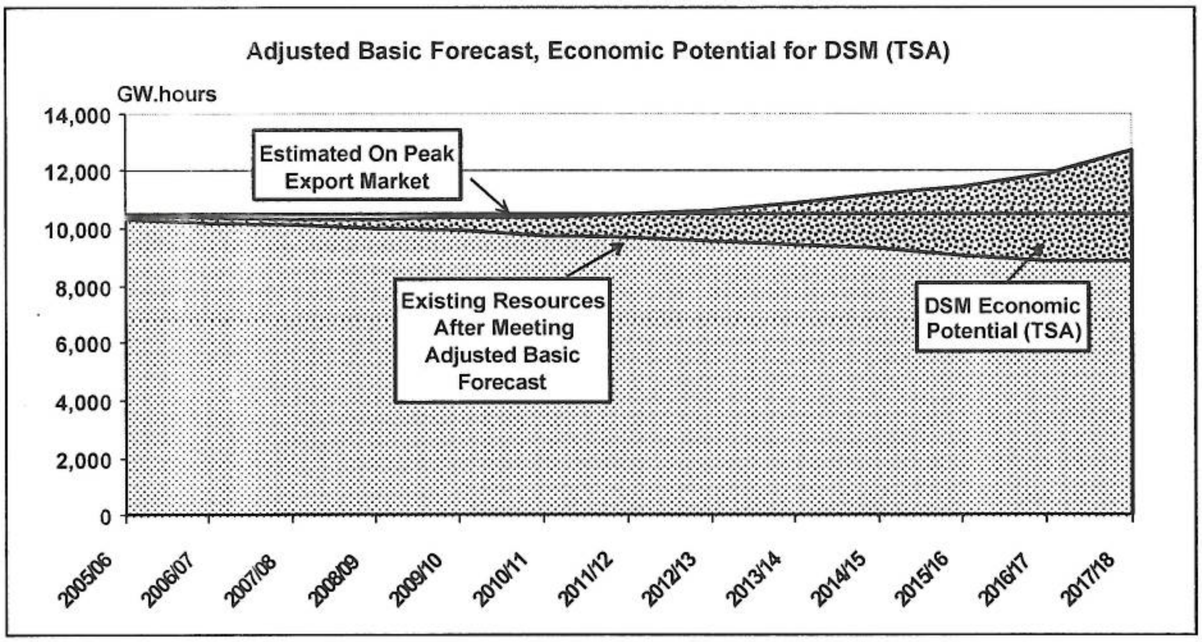
The DSM Market Potential Study for the Industrial sector uses output growth rates that are inconsistent with the 2002 Load Forecast. In the adjusted Basic Forecast for the industrial sector, we combined an industry-wide 0.9% per year improvement in electricity productivity (the same as in the Market Potential Study) with output growth rates consistent with the Economic Forecast. The result is a reference projection for industrial electricity in 2018 that is 1,800 GW.hour lower than the reference projection in the DSM Market Potential Study. This difference is more than double the 750 GW.hours of industrial DSM in the Market Potential Study, and also more than the output of the proposed Wuskwatim dam.

As we could not perform a detailed assessment of DSM potential in Manitoba industry, we adopted the percent improvements over the reference EUI's that were used in the DSM Market Potential Study. Because the reference demand is lower, the total GW.hour savings also come out lower than in the DSM Market Potential Study. As we have argued in CNF/TREE/RCM I NFAAT - 6, the estimate of industrial sector DSM potential is particularly conservative, notwithstanding the structure of the Manitoba manufacturing sector and the importance of the Top Customers. However, in the absence of an independent analysis we have adopted the conservative percent improvements in EUI from the DSM Market Potential Study.

Turning to the Commercial Sector, in CNF/TREE/RCM I NFAAT - 6 we have pointed out a number of conservatisms with respect to the estimate of economic potential in the DSM Market Potential Study. In our estimate we have adopted the EUI's from the Market Potential Study for lighting, cooling equipment, and food service equipment. We found that, after allocating the small commercial floor area primarily to offices, retail and schools, we were able to match the base year commercial sales data accurately. By allocating the small commercial electricity use to these segments (with relatively small amounts to warehousing) rather than assuming it was distributed across all segments, the overall potential for efficiency improvement increases. Because the whole building energy intensity improvements in the Market Potential Study Economic Potential estimate were well below the 25-30% whole building improvement generally considered economic in commercial and institutional buildings [12], we also increased the improvement in HVAC and miscellaneous equipment EUI's by about 30% relative to the Market Potential Study.

The resulting overall estimate of economic potential for DSM increases to 22.5% over the reference projection, as compared with the 15.8% improvement reflected in the Market Potential Study estimate. In terms of absolute GW.hours of DSM potential, our estimate of 4,500 GW.hours by 2018 is about 1,000 GW.hours higher than the Market Potential estimate and about 1,350 GW.hours higher than the estimate that corresponds to a combination of our adjusted Basic Forecast and the Market Potential Study EUI's. After adjusting the total demand figures to account for transmission, distribution and other differences between end use sales and gross power, and subtracting the DSM that is already embedded in the current Power Smart program, the size of our estimate of the economic potential for DSM is illustrated in Figure TREE/RCM CNF 9.1 below.

Figure TREE/RCM – CNF 9.1



[12] For example, see the benchmarking and best practice reports on the Web site of the federal government's Energy Innovators program (http://oee.nrcan.gc.ca/eii/publications.cfm?PrintView=N&Text=N) or the case studies and project descriptions on the site of Toronto's Better Buildings Partnership, http://www.city.toronto.on.ca/wes/techservices/bbp/index.htm. Savings in the 20-35% are typical, and actual savings usually exceed expectations by a significant marg in.

CNF/TREE/RCM I NFAAT - 10

INTERROGATORY

10. In the TREE/RCM NFAAT TSA Submission, in response to Question 16, a number of "bullet points" are listed characterizing advanced approaches to DSM acquisition. Please provide additional explanation of these points.

RESPONSE:

1. Comprehensive

A comprehensive approach to energy efficiency means focusing on how technologies, approaches, professional and trade skills can achieve a comfortable, healthy and productive end result. It encompasses an end user perspective, and does not focus on a single fuel (e.g. electricity) or a single technology. Piecemeal, unconnected energy efficiency programs and measures often fail to maximize energy and economic savings and can work at cross purposes. Comprehensive approaches are holistic, capturing a certain amount of electricity resources from each client, similar to 'buying savings'. Instead of going back several times to each customer at a higher cost the utility optimizes the efficiency potential one customer at a time.

The Vermont Public Services Board described comprehensive demand management this way –

> *"Utility demand-side investments should be comprehensive in terms of the customer audiences they target, the end-uses and technologies they treat and the technical and financial assistance they provide. Comprehensive strategies for reducing or eliminating market obstacles to least cost efficiency savings typically include the following elements: (1) aggressive, individualized marketing to secure customer interest and participation (2)flexible financial incentives to shoulder some of the direct customer costs of the measures (3) technical assistance and quality control to guide equipment selection, installation and operation and (4)careful integration with the market infrastructure including trade allies, equipment suppliers building code and lenders. Together these steps lower the customers efficiency markup by squarely addressing the factors that contribute to it."*[13]

The City of Seattle through its municipal utility is an example of a utility that practices comprehensive demand management. "Since 1977, conservation has been Seattle's energy resource of choice." Over 70% of residential customers as well as 40% of commercial, industrial and institutional buildings have benefited *more than once* from Seattle's energy conservation and efficiency programs. The development of their own energy code and a rejection of nuclear power

[13] Quoted from Vermont Energy Services Board Decision in Docket 5270 April 1990 III-44 in John Plunkett, "Building Ontario Hydro's Conservation Power Plant, Volume II", prepared by Resource Insight Inc., Vermont, November 1992.

more than 30 years ago made Seattle determined to use energy efficiency as a resource option in tandem with low cost hydropower for its energy future (www.seattle.gov/light).

The municipal utility of Fort Collins Colorado has adopted and implemented a comprehensive energy efficiency approach to meet a 10% energy reduction per capita target over a ten year period starting in 2002 which is expected to decrease electricity use by 17% overall as part of a broader environmental sustainability objective (www.ci.fort-collins.co.us/electric). In both Seattle and Fort Collins, linking several objectives and multiple programs together and providing the resources to increase participation have worked successfully. The energy efficiency programs of National Grid in the northeastern United States bring financial resources, expertise and targeted programs to all sectors of its marketplace, and provide another illustration of a comprehensive approach to DSM (www.nationalgridus.com), as do the Hood River Conservation Project of Bonneville Power and the Espanola Conservation Project of Ontario Hydro, described further below.

In summary, an agency/utility has mastered 'comprehensiveness' when it knows when and where to intervene successfully to reach all its energy users equitably, mobilizing the physical capital and human resources to select the best overall solution for each client from an array of possible energy efficient improvements *and* has built in a plan to see the projects through to fruition.

To match this description of the ideal approach to demand management requires all the following components.

2. Customized services and customer-orientation

Customers demand fuel and electricity not for their own sake, but for the energy end use services they help provide, and successful DSM will focus on helping the customer meet their fundamental end use service requirements in the most effective and profitable manner.

There are many barriers preventing customers from making energy efficiency improvements, such as lack of time, lack of knowledge, lack of product availability or reluctance to deal with contractors. These act as barriers which reinforce each other and short of preparing a different program for each client, comprehensive demand management programs need to address *all* obstacles that may get in the way of implementation by the customers in a particular client group.

Comprehensive programs began originally with large commercial and industrial energy efficiency programs where it was typical to look at business operations individually and 'customize' each solution. It is equally important but far less common to recognize the diversity in residential customers where single, duplex, multifamily low and high-rise residential buildings, owned, rented, condominium or coop accommodation, senior and low-income residencies all have there own specific need for energy services and client-centred attention.

Program costs are lower and the energy efficiency results higher when a comprehensive program is in place to do all the cost-effective DSM at once than to go back several times. It is also important to intervene when new purchases and new construction occurs to make those inevitable purchases and installations as energy efficient as possible by reaching the customer when they are most receptive and where the results to both the client and the utility will be maximized.

3. Marketing of co-benefits to overcome customer inertia

This is integral to a customer-oriented approach, as the collateral benefits of energy efficiency improvements will often be more important and more valuable to the customer than the value of the energy savings. For the residential client it is important to point out how the energy saving measure will enhance their quality of life. If the measure saves the client money, improves their home's value, increases the level of comfort and ease they feel in their surroundings, while removing the inconveniences of outdated equipment and maintenance tasks (without replacing them with more difficult tasks) *and* performs better than less energy efficient equipment, then each of these factors should be mentioned to enhance the likelihood that the client will be willing to make the decision to implement the change.

Commercial and industrial clients also have many of the same concerns as a residential customer but they will be coupled with commercially sensitive issues of confidentiality, product pricing, process secrecy, maintaining product quality, productivity and staff training.

All benefits in either case should be described as fully as possible with financial savings and productivity improvements quantified, and assistance and training of householders and employees to provide assurance of on-going success with the installation.

Other 'co-benefits' include environmental and health improvements from reduced energy use. The Ontario 'Green Community' initiatives started in 1991 to reduce energy and water use and soon spread to 25 other communities in Ontario. The Sustainable Communities Project and the Partners for Climate Protection Campaign in Canada are examples of energy efficiency projects that are clearly merged with and central to the achievement of a broader range of environmental objectives.

4. Technology specific yet integrated within a broader marketing strategy

Technology specific programs such as HVAC replacement programs for residential or commercial and industrial clients require manufacturers to continue to improve the efficiency of the product, retailers to make the product readily available (not just by special order), architects, engineers or heating and cooling technicians to properly size and specify the product, contractors and installers to carefully fit the equipment in place, and the purchasers to look after it. In order for all these actors to take the decisions that will lead to the widespread adoption of advanced efficiency HVAC equipment requires the continuing education of design professionals and installers with direct incentives for them to recommend more efficient products to their clients which will also encourage the manufacturers and retailers 'upstream' to produce greater quantities of the product. Lastly, developers, contractors, commercial building and factory owners and homeowners and tenants need incentives in order to chose the most efficient product and thereby drive the market for more production.

Wherever a heating or cooling decision is being made there are issues related to efficiency that extend beyond the choice of HVAC technology. Any load affecting element such as lighting and any opportunity to reduce load through building shell retrofits will reduce the size of the heating and/or cooling system and the cost of the unit. These steps are best taken *before* the HVAC system is selected to avoid a lost opportunity.

Program strategy may be focused on advanced cooling technology but in order to put in place the best solution overall from an energy perspective the program design will require that the building system shell be assessed first and improved, the heating system replaced at the same time and several training and incentive programs be put in place to function to bring a market transformation into place so that more efficient equipment will be utilized as a matter of course. Ultimately, equipment manufacturers may chose to eliminate less efficient products or new efficiency standards may eliminate older less efficient models.

The community-based energy efficiency program in Seattle Washington incorporates home weatherization and business lighting programs with HVAC efficiency upgrades for free or with financial incentives such as payment of the full incremental cost associated with the higher efficiency product (www.seattle.gov/light/conserve/resident/cv5_mfc.htm, www.seattle.gov/light/conserve/resident/bsbinder/cv5_bsbi.html). There are also many examples of low income programs and commercial programs which are low and no cost options for the customer, such as the Massachusetts Home Energy Service (www.nationalgrid.com/masselectric/home/energyeff/4_energy_svcs.asp), the Residential High-Use Program and the Small Commercial and Industrial Retrofit Program, the New Construction Program and the Retrofit Program for Commercial and Industrial customers of NSTAR (www.nstaronline.com), and the Municipal Building Program the Energy Advantage Program and the Energy Conscious Construction Program for C&I customers of Western Massachusetts Electric (www.wmeco.com). As well, several programs tied to the above programs include better training, equipment calibration testing, and financial incentives to technicians who select and install energy efficient cooling equipment (e.g. the Cool Smart program offered by the National Grid, Massachusetts Electric and NStar utilities (www.macoolsmart.com) and the Cool Advantage program of the New Jersey Clean Air Collaborative (www.njcleanenergy.com/html//1residentail/1_cool_advantage.html). Major financial incentive programs are also offered to design team architects and engineers and building owners who meet energy efficiency goals in new construction in a Pacific Gas and Electric program called Savings By Design (www.pge.com/biz/energy_tools_resources/savings_by_design).

NStar also provides more comprehensive coverage in the installation of HVAC systems through its participation in a large group of utilities in the "Check Me" program which provides quality assurance to homeowners and small commercial establishments in sizing and assessing the need for replacement A/C equipment (www.proctoreng.com).

5. Program marketing and support services

Marketing is most effective when it is focused on the timing and the channels through which efficiency decisions are made. Consequently there may be several different venues to reach the same target group.

In the case of new construction, design professionals need to be reached through the channels related to their professions, with broader appeal to the public in ads and periodicals. When equipment has failed and needs to be replaced, the critical path for information is the advice of the renovator/contractor or equipment provider. Here program information needs to be targeted to the suppliers, along with direct incentives and training packages.

The right level of technical assistance to the customer varies with the size and complexity of the situation. In order to prevent the customer from spending money unnecessarily on major retrofits, a residential audit with a blower door to test for air infiltration and duct leaks may be more expensive than a mailed in self-audit but much more accurate. Testing after the installation also detects problems if the house has been sealed too tightly for the amount of controlled ventilation that is in place.

6. Financial Incentives and Direct Investment

The greater the financial incentive to change, the more market and socio-economic barriers come down. Financial incentives can be particularly effective at reducing the following barriers:

1) The unlevel playing field of energy supply and energy demand pricing. However capital intensive electricity supply may be, it appears to the utility customer as a smoothed unit price per kilowatt-hour, whereas efficiency improvements almost invariably require significant "upfront" investments by the user. Well designed DSM programs can address this imbalance.

2) Access to capital for energy efficiency is rationed. The price and terms of acquiring the capital to pay for it are less favourable than for a utility making a supply decision.

3) Conflicting interests of owners and tenants or builders and homebuyers where the cost may not be borne by the owner or builder because they see no benefit to themselves to make the investment in energy efficiency.

4) Perceived risk of adopting 'new' technologies where the risk-taker is uncertain of the benefit in the long run or its affect on the resale value of the property versus using electricity in familiar ways in familiar equipment.

5) Limited information on how much technologies cost , comparing the various products as well as how different measures represent savings that are mutually reinforcing (such as efficient lighting and air conditioning) complementary (insulation and efficient furnaces) or less than the sum of their individual benefits (insulation and low e window replacement) requires much research as the technologies evolve. Expert assessment is often required.

6) The inconvenience of dealing with salespeople, installers and banks as well as the noise, dust or other inconvenience the installation may cause, and the learning curve associated with a different technology such as a programmable thermostat, all serve as drawbacks to going ahead with efficiency measures.

7) Lastly, the real or perceived reduction in quality of life from technologies replacing tried and true amenities.

Of all the barriers none work in isolation. It is the reinforcing nature of this multitude of barriers which confound the adoption of energy efficiency on par with electricity supply options.

Of all the characteristics of a good energy efficiency program nothing overcomes these barriers better than direct investment.

The Hood River Conservation Project of Bonneville Power sought to achieve 100% participation at a time in the mid 1980's when typical participation rates in utility-sponsored conservation programs were on the order of 3% to 6%. . Homeowners contributed a mere 1% of the cost to install any of 15 weatherization measures, which ranged from enhanced insulation to water heater wraps, while HRCP paid the remaining 99%. Although there was a comprehensive marketing program community interest was so high that a 91% participation rate was achieved and most of the marketing budget was never used (http://sol.crest.org/efficiency/irt/12.htm).

The Ontario Hydro Power Savers Program in Espanola Ontario paid for audits and Ontario implemented a direct investment or 'market saturation' approach. Eighty-seven per cent of residential and commercial customers took part and seventy per cent of the kW value of savings was implemented. Measures that passed the Utility Cost Test were implemented free by Ontario Hydro. Measures that meet the Total Customer Cost Test where the cost benefit to the utility and the customer were both assessed required a customer contribution. On average Ontario Hydro paid $3,794 per electric home while the homeowner paid $2,260. Ontario Hydro estimated that if the Espanola Project were done in all small communities in Ontario, they would save approximately 900MW of power or the equivalent of one nuclear reactor (http://sol.crest.org/efficiency/irt/16.htm).

From a utility's perspective the approach should be to use the most aggressive strategy possible to capture the most cost-effective savings *per customer* and this is only accomplished by making it as easy as possible for participants to accept all the recommended measures.

7.-10. Partnerships and collaborations; Supporting programs and services (training, financing, training); Energy Star standard

Non-utility programs are increasing along with partnerships and collaboratives to provide funding, coordination, sharing of programs across state boundaries, specific training, R&D and consumer education. The Energy Star symbol of efficiency has spread across programs as a recognizable brand in the U.S. and in Canada

Some of the most innovative and aggressive DSM programs occurred as a result of the formation of 'collaboratives' in the early 1990's where utilities and environmental organizations partnered along with state and local government agencies to develop programs with fixed targets.

An example is the Northeast Energy Efficiency Partnerships Inc. (NEEP), a nonprofit regional organization founded in 1996 whose mission is to promote energy efficiency in homes, buildings and industry in the Northeast United States. Because of the number of states it covers and the number of partnerships it has developed, the organization has the ability to transform the marketplace for energy efficient equipment and services . NEEP is a major marketing force for energy efficient products, services and practices. NEEP's Board of Directors is comprised of leaders from the energy, environmental and public sectors. Business and trade organizations serve in an advisory capacity to guide NEEP policy and program efforts and, as appropriate, to participate in regional initiatives. NEEP receives funding through federal grants, private foundation funds, as well as through fees for services. Current initiatives that NEEP helps plan, convene and facilitate include: Energy Start appliances (http://www.neep.org/residentialappliances/index.html), Energy Star Residential HVAC, (http://www.neep.org/residentialhvac/index.html), the Design Lights Consortium (http://www.designlights.org/), premium efficiency motors (http://www.neep.org/commercialmotors/index.html), high efficiency commercial unitary HVAC (http://www.neep.org/commercialhvac/index.html), Northeast States Minimum Efficiency Standards Project (http://www.neep.org/Standards/index.html), Building Operator Certification (http://www.neep.org/boc/index.html), High Performance Schools Exchange (http://www.neep.org/HPSE/index.html), and the Northeast Regional Building Energy Codes Project (http://www.neep.org/energycodes/index.html).

Many different models have developed over the past fifteen years, such as Rebuild America (a network of organizations across the United States who are using an integrated systems approach to schools, housing, public and commercial buildings, factories, vehicles and electricity transmission systems to help save energy, improve building performance and air quality through conservation). Rebuild Boston Energy Initiative, one of the first Rebuild America partnerships, uses energy efficiency and water conservation as a catalyst for revitalizing some of the economically distressed neighborhoods of Boston. Energy efficiency initiatives are a mechanism for revitalization and job creation, especially for youth at risk. To date, the partnership has helped facilitate the increased energy efficiency of more than 13 million square feet of new and retrofitted facilities in the City.

Vermont, Wisconsin New York and Oregon have charged organizations with coordinating energy efficiency and renewable energy initiatives and some environmental initiatives in their state. NYSERDA created in 1975 by the New York State Legislature (http://assembly.state.ny.us/leg/?cl=89&a=120) administers the **New York Energy Smart**^{SM} program. Some 2,700 projects in 40 programs in energy efficiency services, including those directed at the low-income sector, research and development, and environmental protection activities are funded by a charge on the electricity transmitted and distributed by the State's investor-owned utilities.

In Canada, the City of Cornwall was one of three pilot communities for Ontario's Green Communities Initiative in 1991. With provincial funding and extensive community support from the public, local gas and electric utilities, service clubs and the Chamber of Commerce, over 10,000 homes in and around the community of 47,000 were assessed complete with direct installation of free energy and water saving measures and recommendations for more energy efficient improvements. The typical customer saved about $96 in energy costs annually with no money down. Furthermore, the program has created an estimated 60 new jobs in town (http://sol.crest.org/efficiency/irt/102.pdf).

CNF/TREE/RCM I NFAAT - 11

INTERROGATORY

11. The TREE/RCM NFAAT TSA Submission, in response to Question 17, Manitoba Hydro's Power Smart program is characterized as a "second generation" program, "falling behind" in terms of current best practice in the acquisition of the DSM resource. Please define what is meant by a "second generation" DSM program, and elaborate on how Manitoba Hydro's Power Smart program compares with current best practice in this field.

RESPONSE:

Please refer also to CNF/TREE/RCM I NFAAT – 10 for examples of best practice DSM programs.

The first generation of electricity energy efficiency programs began during the energy crisis of the mid 1970's. These programs were based on the expectation that all the public needed was information on the benefits of saving electricity, coupled with a price signal that would stimulate conservation.

In Canada the federal government was the main provider of information during the energy crisis. Electrical utilities also offered brochures encouraging weatherization based on the higher standard of insulation that electrically heated houses required. During that period of time insulation and weather-stripping materials were obtainable but many of the products we identify today with energy efficiency were either not widely available or not yet developed.

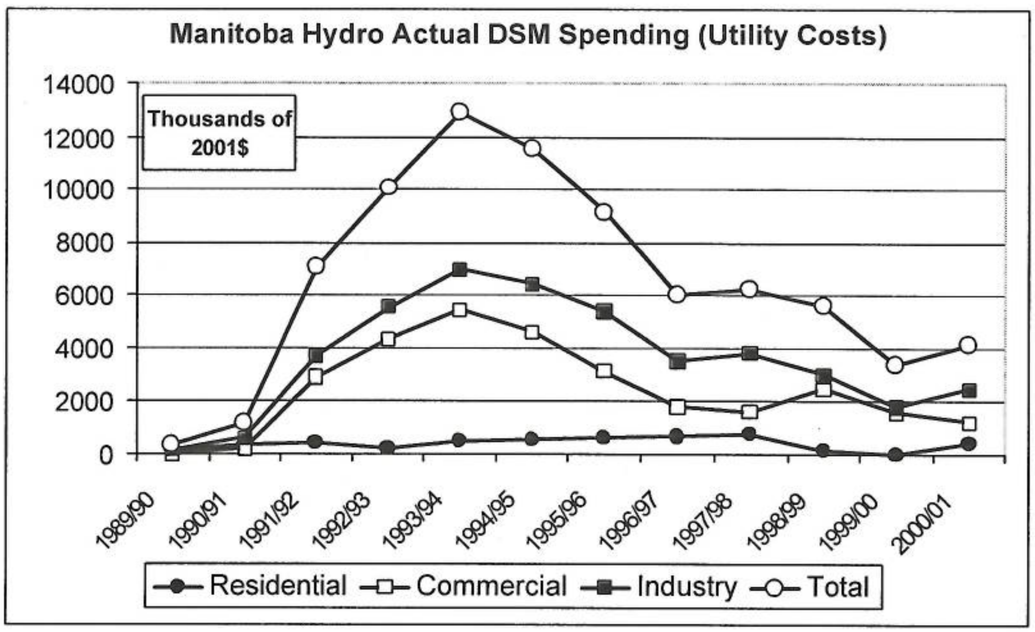
Another energy shock occurred between 1979 and 1984 with the Iran-Iraq war. Again the federal government took the lead establishing energy efficiency labeling programs (Energuide) and grant and audit programs to switch off of oil, to insulate and weather-strip. The R-2000 program began. In the commercial sector the government offered rebates to replace commercial lights with more efficient florescent bulbs and ballasts. Energy efficiency R&D and demonstration projects were funded, and the infrastructure to supply energy conservation products and services began to develop. Meanwhile in the electricity sector utilities marketed electricity aggressively based on a surplus of generating capacity. The electrical energy conservation programs of the 1970's were abandoned.

When oil prices fell back to pre-OPEC levels between 1985 and 1987 and other energy price increases subsided, the momentum of energy conservation continued although at a more modest rate. The marketplace offered a wider array of energy saving products and utilities offered to help consumers to adopt them now that public awareness was increased. This was the second generation of electricity efficiency programs. These second generation programs go beyond information and address the barriers that had prevented consumers from making the efficiency improvements on their own. Utility-backed loan programs at market rates were offered to spread the cost of the energy efficiency improvements over time. Modest rebates were offered in some programs to stimulate the uptake of specific technologies; for example, Manitoba Hydro's $5 rebate on automobile timers. Audits were provided at cost to the consumer; for example, the Home Comfort and Energy Saving Program of Manitoba Hydro slated to start immediately in the PowerSmart Resource Options Plan of 1998. It included a self-administered audit for a fee of $30 and a loan at a rate to allow for cost recovery to the consumer. Today the program has expanded to include a walk-through audit for $75 (about half the cost to the utility) a free on-line energy assessment and the mail-in audit (reduced to $20). Loan rates are down to 6.5% for a 5 year term.

The problem with second generation programs is that they do not capture the full level of savings that are cost effective and they do not get the market penetration rates that program designers hope for in order to transform the marketplace to one that supplies predominantly energy efficient technologies. Efficient technologies and systems such as R2000 homes and C2000 buildings remain a high priced niche market.

This is where Manitoba Hydro and many other utilities have been stalled in DSM program implementation over the past fifteen years. The amount of energy efficiency obtained is not as big as it could be because the utility has had too few energy efficiency measures applied to too few customers. The second generation programs have also suffered from a lack of continuity and constancy of funding and support. This problem has been especially severe in jurisdictions where utility restructuring, re-regulation and privatization have reduced or eliminated utility DSM programs. Although these issues have not posed significant barriers to DSM in Manitoba, the lack of continuity is apparent in Manitoba Hydro's on-again, off-again support for DSM, as illustrated in Figure TREE/RCM CNF 11.1. [14]

Figure TREE/RCM CNF 11.1



[14] Data for the tables and figures in this response are taken from Manitoba Hydro's annual Power Smart reports.

Manitoba Hydro's waning commitment to DSM is also illustrated by a comparison of "five years forward" DSM budgets with actual five year DSM spending, as shown in Figure TREE/RCM CNF 11.2.

Figure TREE/RCM CNF 11.2

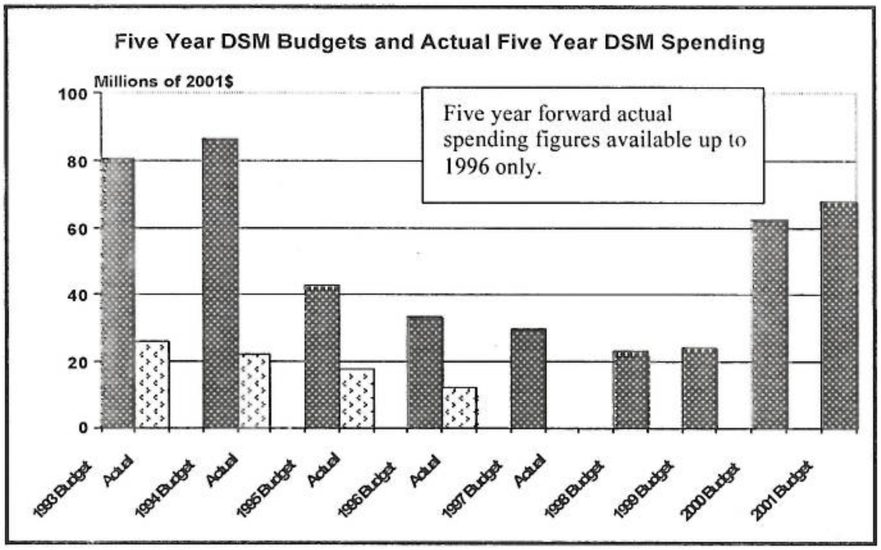


Table TREE/RCM CNF 11.1

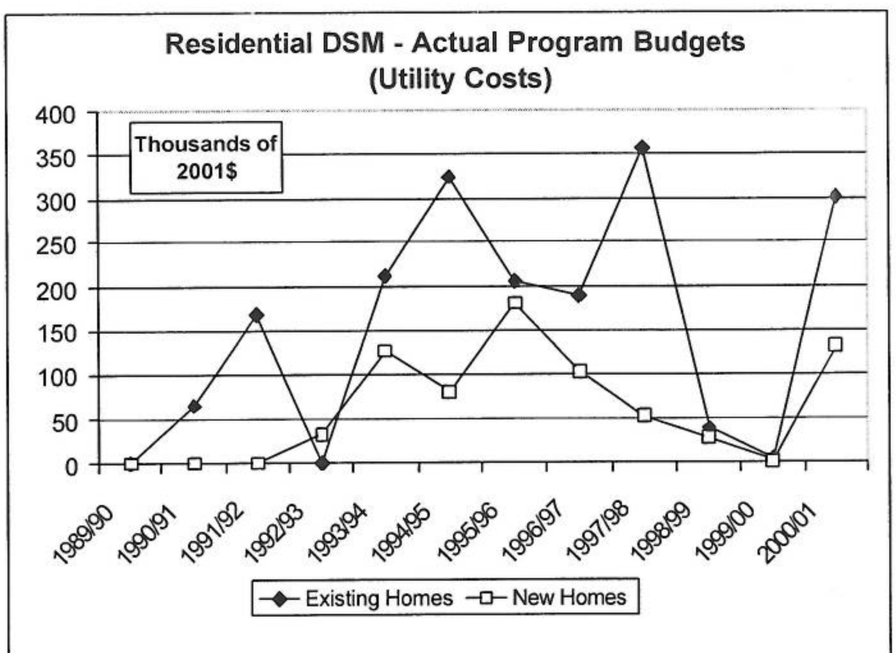
Manitoba Hydro's DSM Forecasts to 'Target' Year 2001					
Year	Approach	GWh by 2001	MW by 2001	Cost in Current Yr Millions $	Cost in Yr 2001 Millions$
1991	High Intensity Resource Option	1049	285	309	391
1992	no info	1049	285	no info	
1993	Total Resource Cost (TRC)Test Option	822	285	270	
1994	Total Resource Cost (TRC)Test Option including 'non-program implementers)	904	264	217	250
*1995*Last year the target is 2001*	All Economic Lost Opportunities	584	207	137	155
Actual DSM Achieved by 2001		**446 GWh**	**82**	**38.9**	**38.9**

The history of the Power Smart is one of plans made but not implemented. As shown in TREE/RCM Table 11.1, in 1991, 1,049 GW.hours of energy savings were planned to be in place by the year 2001 and $309 million was going to be spent achieving that goal. By 2001, actual savings were 446 GW.hours and expenditures over ten years totaled $38 million. The reality of DSM delivery and funding from 1993 onward does not match the approved DSM funding projected or the innovative program offerings proposed in the MH Approved PowerSmart Resource Plans issued annually from 1993 until 2001. In fact, it is often difficult to discern any pattern or relationship between Manitoba Hydro's approved Power Smart DSM budgets and what actually gets spent, except that spending is consistently well below budgeted levels.

The year 2001 was used as the 'target year' in the Power Smart Plan of 1995. From that year onward the target moved to 2011. Only 43% of the 2001 target set in 1991 was reached by 2001. The goal for the new 'target year' 2011 of 988 GW.hours of energy saved is still less than the 1049 GWh Manitoba Hydro expected to achieve by 2001 when the 1991 and the 1992 PowerSmart forecasts were done. Even as late as 1994 the estimated returns for 2001 of 904 GW.hours is close to what is now proposed to be achieved in 2011.

Taking a closer look at the residential sector DSM targets and spending reveals the extent of both the erratic commitment to DSM and the extent to which targets and budgets set ten years ago were never delivered on. Figure TREE/RCM CNF 11.3 shows the DSM budgets for new and existing homes throughout the 1990's and Table TREE/RCM CNF 11.2 details the extent to which planned support for residential DSM never materialized.

Figure TREE/RCM CNF 11.3



Graph derived from Power Smart® Resource Options for the 2001 Corporate Plan
Manitoba Hydro, June 2001, pg. C.4.

Table TREE/RCM CNF 11.2

Year	Program Title	Description	Proposed Date for Full Implementation	First Year Budget (Full Implementation)		Incentives Budget		Cumulative Budget by 2000/01	
				Expected	Actual	Expected	Actual	Expected	Actual
1993/94	Residential Comprehensive Program	A free audit and 75% of the installed equipment costs for weatherization, water heaters and lighting. There are 98,000 all-electric homes eligible. Expected energy saving per home 7,768 kWh/yr.	1996/97	$5,500,000	$188,000	$1,630 per home (reduced incentive option $537 about 25% of total cost)	$0	$80,000,000	1991 to 2001 $1,860,000
1994/95	Residential Comprehensive Program	A free audit and 75% of the installed equipment costs for weatherization, water heaters (no lighting). The number of eligible all-electric homes reduced to 46,400 with expected savings per home of 6,781 kWh/yr.	1996/97	$5,000,000	$188,000	75% of installed cost	$0	$60,000,000	1991 to 2001 $1,860,000
1995	Residential Insulation Program	MH will pay approximately 50% of the material cost. An average of 2,370 participants expected per year.	1995	$453,000	$206,000	$110 on average per participant	$0	$4,444,000	1991 to 2001 $1,860,000
1996	Residential Comprehensive Program	Insulate all electric homes that are being renovated between 1996-2000. MH pays 100% of the incremental material cost for the upgrade to PowerSmart levels of insulation.	1996/97	$558,000	$188,000	Estimated to be $436 per customer	$0	$2,499,000 from 1996 *to 2000* only (see pg. c.5 Power Smart 1996 Plan)	1991 to 2001 $1,860,000

Year	Program Title	Description	Proposed Date for Full Implementation	First Year Budget (Full Implementation)		Incentives Budget		Cumulative Budget by 2000/01	
				Expected	Actual	Expected	Actual	Expected	Actual
1998	Home Comfort and Energy Savings Program	Self-administered audit ($30 fee) plus a loan with a rate to allow for cost recovery.	1998/99	$100,000	$38,000	0	$0	$275,000 from 1998/99 to 2000/01 (see pg. c.4. Power Smart 1998 Plan)	1991 to 2001 $1,860,000
1999	Residential (Power Smart) Insulation Program	Insulate all electric homes that are being renovated. Offer to pay 100% of the incremental material cost for the upgrade to Powersmart levels of insulation.	1999	$570,000	$4,000	Estimated to average $476 per customer	$0	$1.187 million for this measure only until 2001 (see p.b.4 Powersmart 1999 Plan)	1991 to 2001 1,860,000
2000	Residential Basement Insulation Program	About 3,060 all-electric homes have no insulation in the basement or crawlspace. MH will pay approximately 66% of the installed measure to insulate basements.	2000	$1,146,000	$301,000	Estimated to average $1,278 per home	$0	$1.146 million for this measure only 2000/01	1991 to 2001 $1,860,000
2001	Residential Basement Insulation Program	Same as the 2000 program except only half of the savings are expected in 2011 as were expected in the 2000 Plan (20.60 GWh instead of 42.18 GWh even though the elig ible number of all electric houses has gone up to 3,193 from 3,060.	2001	$1,276,000	Not available	Estimated to average $1,503 per home	$0	*Not available*	*Not available*

Third generation programs grew out of experiments conducted by regional energy planning groups and 'collaboratives'. They are focused on developing the economic potential for energy efficiency by increasing the utility investment to leve ls that achieve full or nearly full customer participationand that cover full installation of all cost-effective measures.[15]

Between 1983 and 1985 Bonneville Power, PG&E, the Northwest Power Planning Council (a business organization of energy efficiency firms) and local utilities experimented with full cost, direct installation for energy efficiency improvements. The Hood River Conservation Project was an idea conceived by the Natural Resources Defense Council (an environmental NGO) to test what would happen if all the costs and installations were paid for and done by the utility. The counties of Hood River and Wasco in Oregon were selected and weatherized as required in a two year period. The project achieved 85% uptake at a time when 3 to 6% was standard. Consumers paid 1% of the cost of the measures.

Other third generation collaboratives confirmed that the more you pay for cost effective conservation the higher the participation rate. In 1991 and 1992, Ontario Hydro initiated a 'market saturation' PowerSavers Project with the City of Espanola with the goal of weatherizing and upgrading the efficiency of buildings in the community. In Espanola, the participation rate was 91%, with 70% of the identified energy savings being implemented. On average, Ontario Hydro paid $3,794 per all-electric household and the customer paid on average $2,260. For all-electric commercial properties the uptake was 54%. Counting all DSM program costs, Ontario Hydro found an average CCE of 4.4 to 4.8 ¢/kWh (5% real discount rate). The cost for each kW saved was about $2,168. During the same time period in the United States many utilities in the northeastern states began third generation program collaboratives (see www.neep.org). California has also been very active in this area in recent years. An example of a program that started in 1990 and is still in place today is a Massachusetts Electric small commercial/industrial program which pays 80% of the cost of energy efficiency retrofits (http://www.nationalgridus.com/masselectric/business/energyeff/3_small.asp).

Third generation electricity efficiency programs are also organized around points of market intervention such as a decision to replace failed or old equipment. Retailers may be offered money for every high efficiency appliance they sell and customers will be rebated the difference between the average cost of the appliance and the more energy efficient model.

The latest upswing in Manitoba Hydro's cyclical DSM commitment (i.e. the Power Smart Plan for the 2001 Corporate Plan) has elements of third generation programming, with more programs and larger incentives to both the customers and the suppliers. The programs are targeted to groups in the design and retrofit delivery sector as well as to customers. In fact many of the programs in the Power Smart Resource Options documents from 1993/4 to 2001 are third generation in concept and design.

[15] See John Plunkett, "Building Ontario Hydro's Conservation Power Plant Volume II: Demand Management Program Design for Least Cost Planning", prepared by Resource Insight Inc. for the Coalition of Environmental Groups and submitted to the Ontario Hydro Environmental Assessment Board, Ontario Hydro Demand/Supply Plan Hearings, November 1992

Third generation programs are determined to stay on target from year-to-year for the full duration of the planned campaign period, with strong support from marketing and promotion, technical analysis and expert advice. Even after energy efficiency measures are installed, third generation programs continue to help with the commissioning of new equipment, maintenance support and on-going training to ensure that savings continue. Lastly, third generation programs realize that energy efficiency improvements continue as technology develops and new replacement opportunities arise such that the utility is never 'done with a client'. Customers will continue to be participants again and again into the future.

CNF/TREE/RCM I NFAAT - 12

INTERROGATORY

12. In the TREE/RCM NFAAT TSA Submission, in response to Question 18, it is stated that "the price of electricity, the rate and direction of change of the price of electricity, and the structure of the electricity rate schedule are all contributing factors in determining the level of electricity demand". Please provide addtional details on the relationship between electricity price, electricity demand, and programs to acquire the DSM resource.

RESPONSE:

Please refer to CAC/TREE/RCM I NFAAT – 8 for TREE/RCM's position on the role of electricity price in encouraging energy efficiency.

In an end use services orientation to the energy economy, end users seek to minimize the total cost of acquiring end use services. Depending on the relative importance of energy commodity prices to the total end use service cost, electricity and other energy commodity demand may not be as sensitive to commodity price as a more narrowly focused orientation might predict. The contribution of the supply of kilowatt-hours to the cost of providing the energy services to which those kilowatt-hours contribute varies over a wide range, and the relative importance to the end user of the price per kilowatt-hour therefore also varies over a wide range. For some end users and end uses (e.g. sodium chlorate producers) the cost of electricity is a major business expense. For other end users (e.g. general manufacturing, non-electrically heated homes and buildings) electricity is a relatively small cost. Electricity is typically less than two percent of value added for general manufacturing and less (often much less) than 10% of the cost of owning and operating a non-electrically heated house or commercial building. This is one of the reasons why there is such a large, pent-up supply of "economic" DSM, and also why the "collateral benefits" of DSM often provide a more compelling motivation for efficiency improvements than the direct savings from reduced electricity use.

Having said that, there is no question that conservation programs are more successful when implemented during supply crises and during periods of rapid price increases and/or uncertain future prices. There is also little argument over the importance to successful DSM programs of electricity prices and rate schedules that reflect the true costs of production and the marginal costs of expanding production. Declining block rate structures that reward higher consumption with lower rates even while the increased consumption is taking power from higher valued exports markets and/or forcing expensive capital expansion of the supply system, send the wrong signal to consumers and work at cross purposes to DSM and the minimization of energy service costs. Such subsidies would be more effectively redirected to conservation and DSM investments, with appropriate protection for low income consumers.

CNF/TREE/RCM I NFAAT - 13

INTERROGATORY

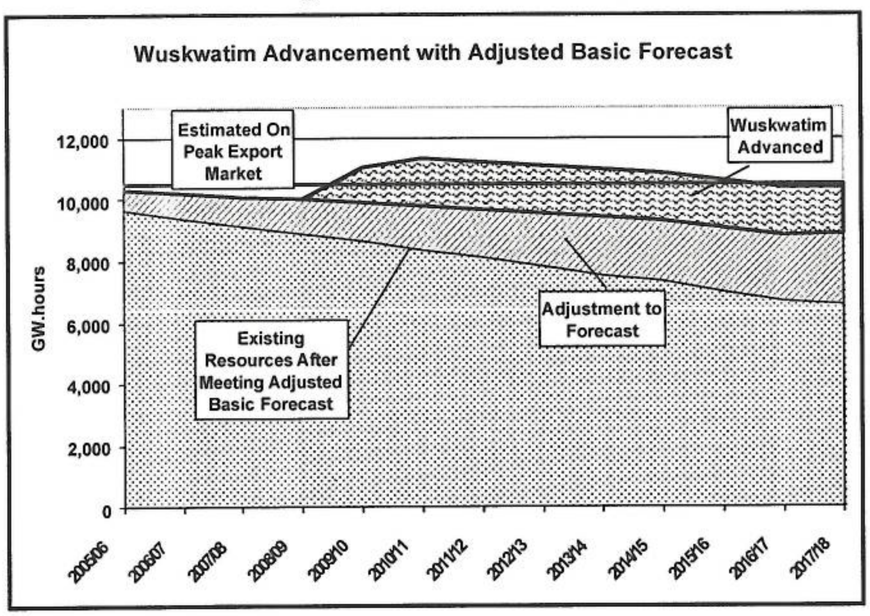
13. In the TREE/RCM NFAAT TSA Submission, in response to Question 19, it is stated that a scenario of the demand for central power plant electricity in Manitoba was developed that would result from a more aggressive approach to the DSM alternative. Please provide further documentation of this scenario.

RESPONSE:

Manitoba Hydro has predicated the case for advancing Wuskwatim on the position that the utility will otherwise not have enough power to meet the demand for on-peak export power that their transmission and interconnection capacity permits (i.e. 10,500 GW.hours per year under median flow conditions). This suggests that alternatives to Wuskwatim Advancement would therefore consist of alternative strategies for maintaining export capacity at that level.

In developing possible alternatives to Wuskwatim Advancement, we have maintained the 2002 Basic Forecast with respect to its population and economic growth rates and projected residential electricity growth, but we have adjusted the projected electricity demand in the commercial and industrial sectors to reflect more realistic assumptions about commercial sector floor area growth and individual industrial output growth rates (see CNF/TREE/RCM I NFAAT – 4). As shown in Figure TREE/RCM I NFAAT – CNF 13.1, this adjustment results in a narrowing of the gap between the estimated on-peak export market and the existing resources available to meet that market, after meeting domestic demand under the Basic Forecast and after allowing for the current Power Smart program. In fact, the adjusted Basic Forecast is lower than Manitoba Hydro's Medium Low Forecast.

Figure TREE/RCM CNF 13.1



Manitoba Hydro has not identified or analyzed alternatives to Wuskwatim Advancement based on demand side management and distributed generation. To illustrate what such scenarios could look like, we have developed a couple of possibilities for how Manitoba Hydro's export capability could be maintained at 10,500 GW.hours a year or more through to 2018 and beyond, without the need for Wuskwatim Advancement. These scenarios show different combinations of wind power and DSM, according to the following increments:

For wind power(see CNF/TREE/RCM I NFAAT – 14), three possible levels are considered:

100 MW– This is close to the amount that is already committed in Manitoba, and it represents the minimum amount included in all our scenarios.

250 MW by 2011 – Manitoba Hydro's current estimate

500 MW by 2016 – a doubling of current MH estimate, but developed over a longer period.

For DSM:

No incremental DSM – No additional DSM beyond the current Power Smart program.

2 X DSM– This would represent an increment of670 GW.hours by 2018, beyond what is already included in the current Manitoba Hydro load forecast and Power Smart program and as such represents a conservative (i.e. low) estimate. According to the DSM Market Potential Study estimate of economic DSM potential, this would equal about 34% of the DSM they identified as being available at 6.15 ¢/kWh or less, and it is an amount that lies between the "upper" and "lower" levels of "achievability" identified in that study. However, the 2X DSM level represents only about 27% of our estimate of economic potential, which puts it below the "most likely" level of achievability identified in the Market Potential Study.

3 X DSM– This would represent an increment of 1,340 GW.hour by 2018, beyond what is already included in the current Manitoba Hydro load forecast and Power Smart program. In terms of the Market Potential Study estimate of economic DSM, it would represent about 50% of the DSM identified as being available for 6.15 ¢/kWh or less, as compared with the 41% identified as representing the "upper achievability" limit. However, in terms of our estimate of the economic potential for DSM, the 3X DSM level represents about 40%, which puts it right at the "upper achievable" level in the terminology of the Market Potential Study.

4 X DSM– This would represent an increment of about 2,000 GW.hours of DSM by 2018, beyond what is already included in the current Manitoba Hydro load forecast and Power Smart program. It represents two thirds of the DSM in the Market Potential Study identified as being available for 6.15 ¢/kWh or less, and 53% of our estimate of the economic potential for DSM.

Alternatives to Wuskwatim Advancement:

The following illustrate a range of possible combinations of incremental DSM and distributed generation (wind power) that would maintain peak market export capacity at or near 10,500 GW.hours per year to 2018 and beyond. No power from Wuskwatim is assumed in any of these scenarios.

Figure TREE/RCM CNF 13.2

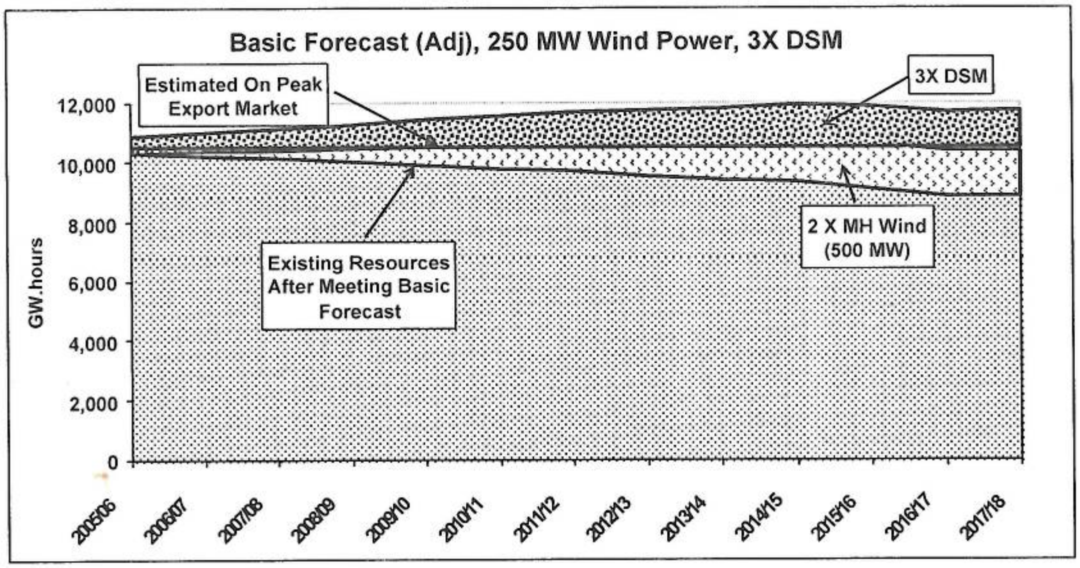


Figure TREE/RCM CNF 13.3

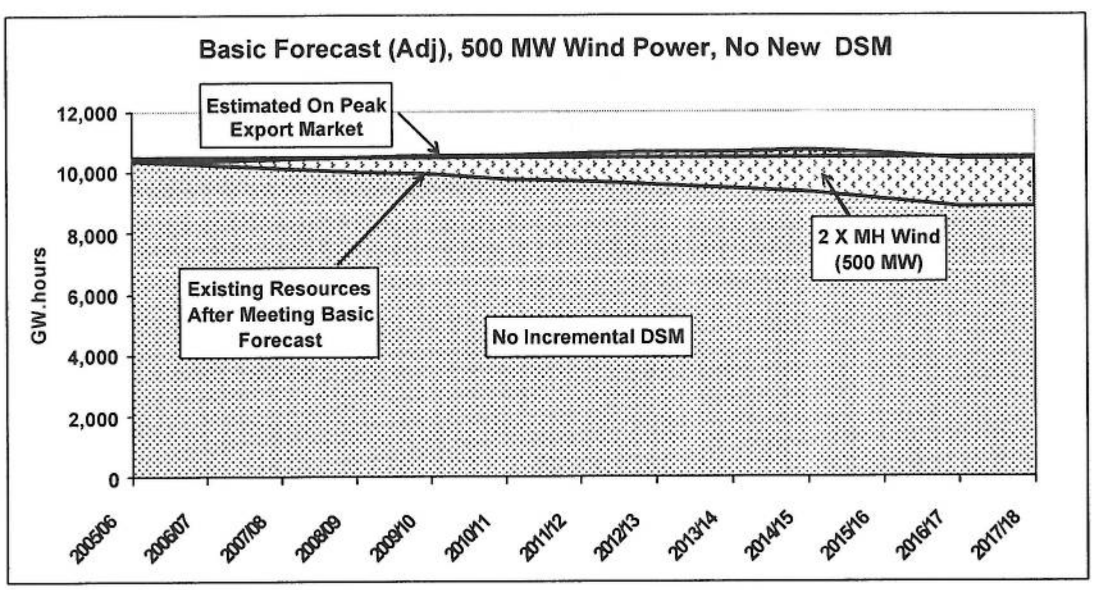


Figure TREE/RCM CNF 13.4

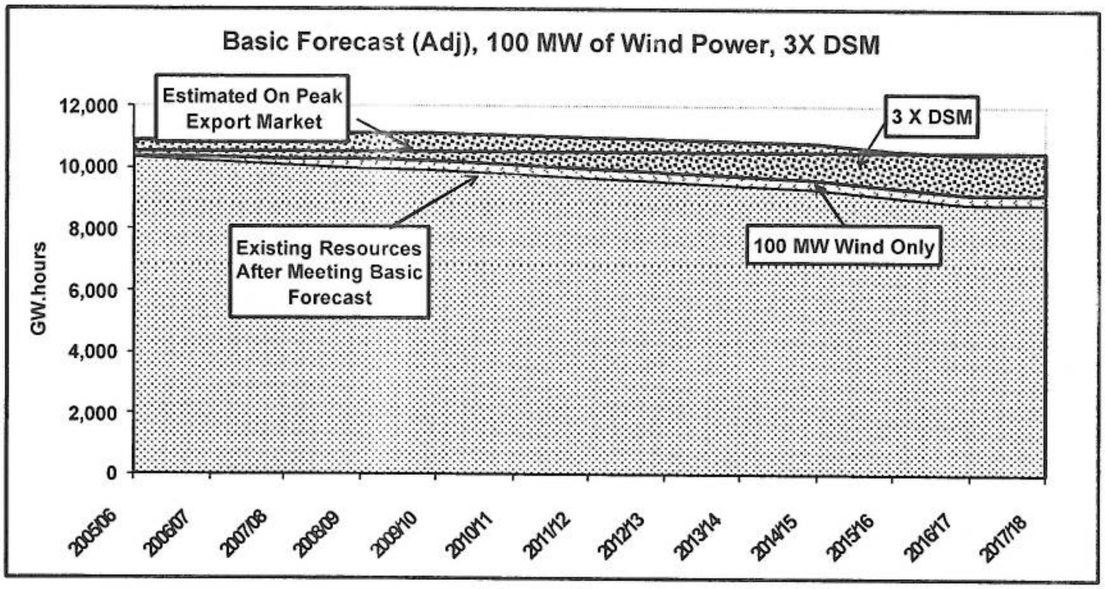


Figure TREE/RCM CNF 13.5

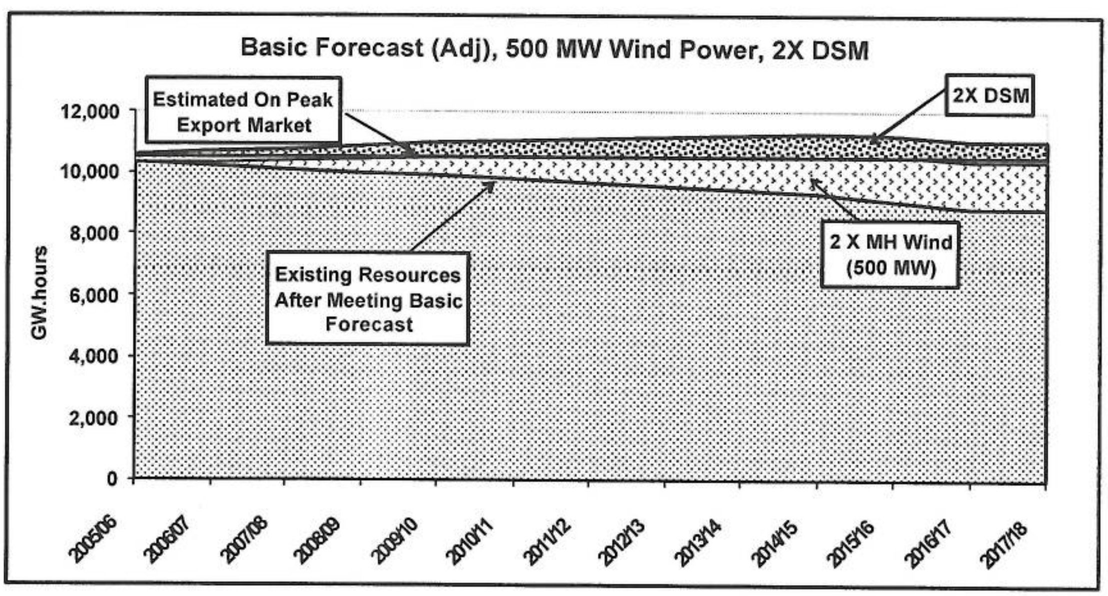


Figure TREE/RCM CNF 13.6

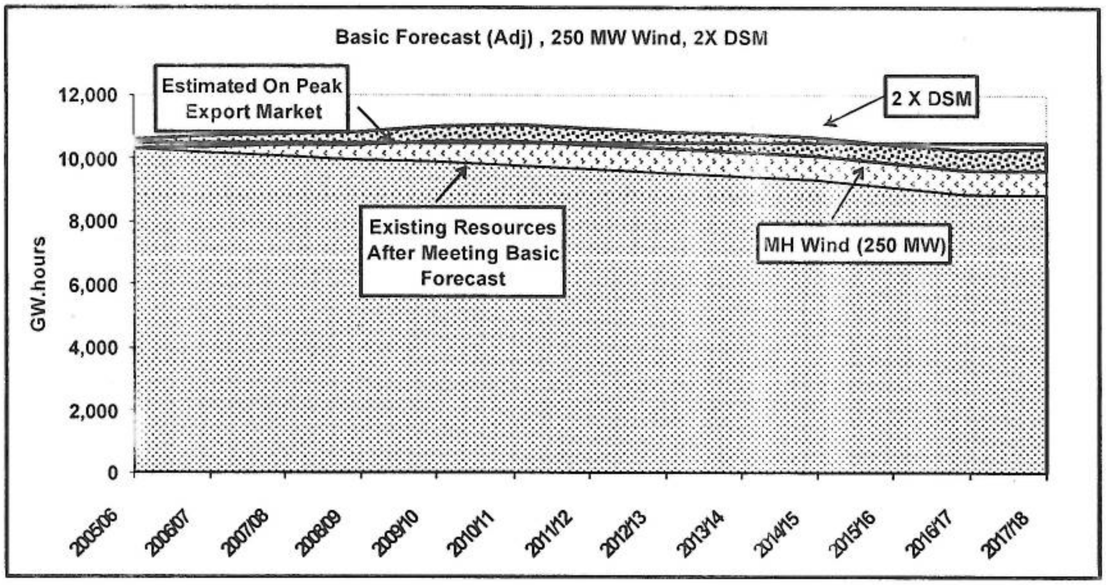


Figure TREE/RCM CNF 13.8

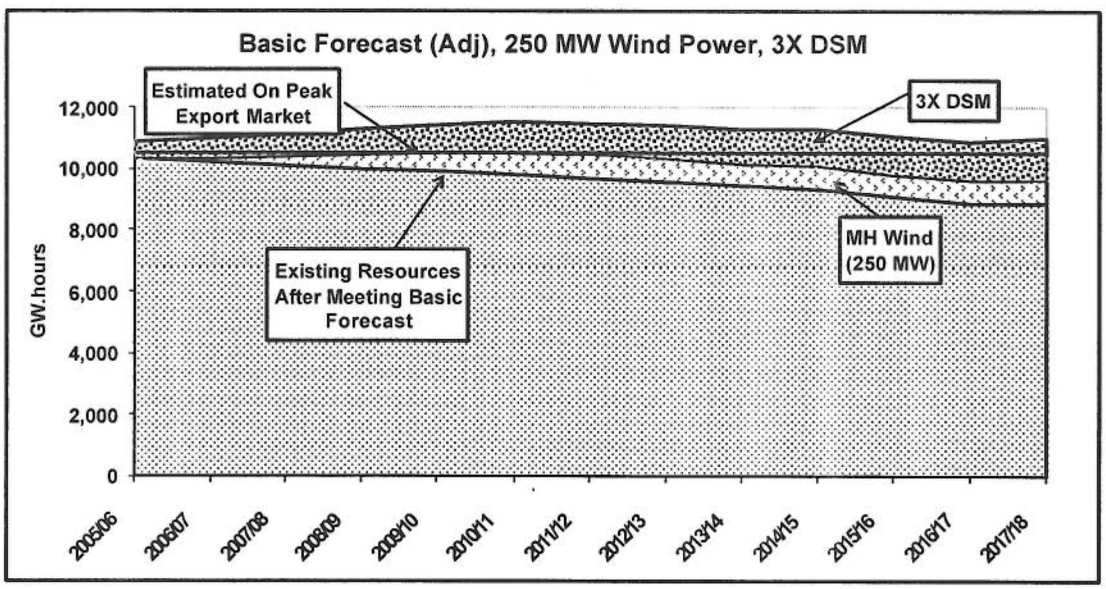
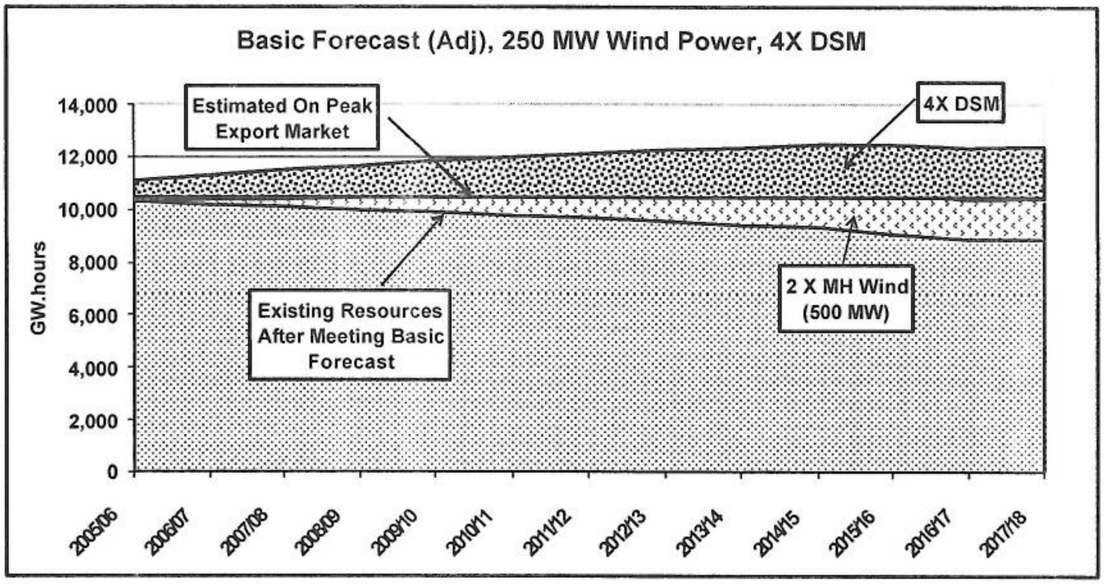


Figure TREE/RCM CNF 13.9



CNF/TREE/RCM I NFAAT - 14

INTERROGATORY

14. Please describe the role of distributed generation, and wind power in particular, in this scenario.

RESPONSE:

Setting aside electricity efficiency itself, which is in fact a type of distributed generation, on the time scale of the Wuskwatim Advancement, wind power has the potential to make a significant contribution to electricity supply in Manitoba. In our scenarios we have included three levels of wind power development: **Sequoia** (100 MW), **MH Wind** (250 MW) and **2X MH Wind** (500 MW).

Sequoia (100 MW) represents the proposal currently being licensed by Manitoba Conservation and is the minimum about of wind included in all our illustrative scenarios. [16]

MH Wind is equivalent to the amount that has been targeted by Manitoba Hydro during this time period. Specifically, for MH Wind, we have assumed 250 MW of wind power development comes on line between 2007 and 2011, with a 35% annual capacity factor and total annual electricity production of 767 GW.hours.

2X MH Wind assumes that 500 MW of wind power comes on line between 2007 and 2016 at the same capacity factor yielding 1,534 GW.hours of electrical energy annually. 2X MH Wind can also serve as a proxy to include other forms of distributed generation, such as biomass and other NUG opportunities.

With respect to the potential for 2X MH Wind, we note that Manitoba Hydro has made a conservative estimate of wind potential based on incomplete knowledge of integration requirements and costs, and given the targets for wind generation in Minnesota and private-sector interest in wind development in Manitoba, and Manitoba Hydro's commitment to implement all feasible and cost-effective wind generation, we think it prudent to consider a scenario with a higher level of wind.

With respect to non-utility generation opportunities, we note that the MIPUG presentation indicated that some of their members could supply power at the right price (p. 1533 of the transcript).

> As far back as the 1990 PUB hearing into Hydro's capital plan, basically the Conawapa hearing, the PUB found that non-utility generation is endorsed by the board and Manitoba Hydro is encouraged to pursue this supply option vigorously. For industrial customers engaged in forestry

[16] "Wind-farm power proposal fast-tracked for licence", by Helen Fallding, Winnipeg Free Press. November 3rd, 2003.)

> activities, in particular, there is significant potential to generate renewable power using what would otherwise be waste material. However, unlike the prospective wind power developers that have recently arrived in Manitoba, the large industrials who have made a long term commitment to Manitoba are not being offered a price for their potential power that is representative of export market prices.

This is another instance in which low tail-block energy rates of less than 2 cents/kW.h paid by large industrial customers undermine conservation and NUG, in conjunction with Hydro's policy of running the meter backwards to pay them for the power they produce at the same rate they pay for power consumed.

CNF/TREE/RCM I NFAAT - 15

INTERROGATORY

15. In the TREE/RCM NFAAT TSA Submission, in response to Question 20, it is suggested that there is a "DSM/DG alternative to" Wuskwatim Advancement. How does this approach differ from Manitoba Hydro's position that DSM and distributed generation development can proceed at the same time as Wuskwatim Advancement?

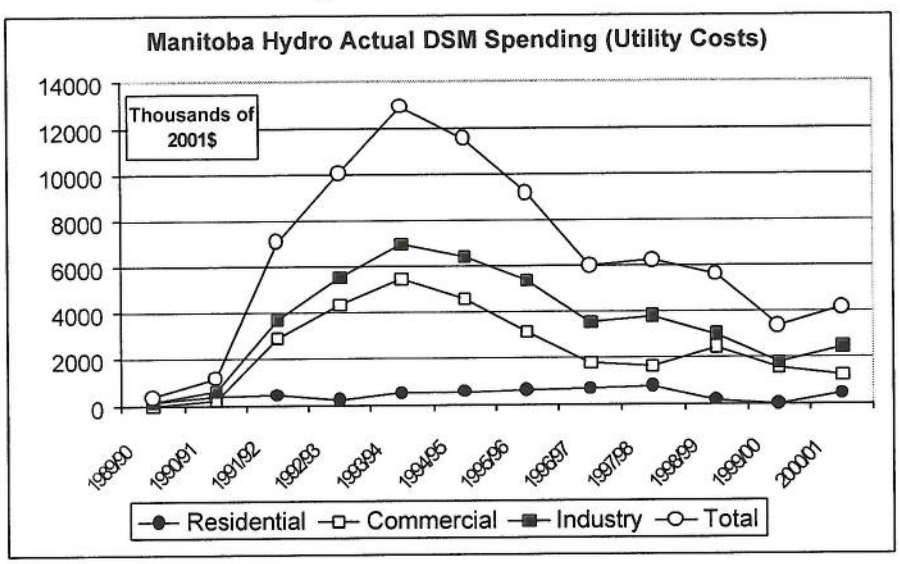
RESPONSE:

There is a fundamental difference between Manitoba Hydro's approach to DSM and distributed generation and the approach we have put forward.

Manitoba Hydro may be an organization in transition, but its dominant culture is still one of a supply-oriented provider of electricity, as evidenced by its organization chart, its supply-oriented approach to planning, the cyclical history of its commitment to DSM, its superficial load forecasting methodology, its confusion of Wuskwatim IRR sensitivity analysis with NFAAT analysis, and the very fact that it has come forward with an application to advance the Wuskwatim dam having already spent $50 million on the project without having first systematically identified and analyzed alternatives.

As illustrated in Figure TREE/RCM Fig CNF 15.1, in this supply-oriented frame, DSM is treated as a "swing fuel", with the organizational commitment going up and down according to short and medium term market conditions. If the value of electricity surplus to Manitoba's domestic needs declines because of circumstances beyond the utility's control or as the result of utility commitments to expand supply beyond what the high price market demands, then the value of DSM to the utility also declines, and DSM investments and Power Smart budgets shrink.

Figure TREE/RCM CNF 15.1



At the moment, DSM is on an upward cycle at Manitoba Hydro, with a flurry of new programs having been announced in recent months. However, the rise and fall and rise of Power Smart at Manitoba Hydro over the past 10-15 years does not reflect a deep or sustained commitment to an energy services orientation to the marketplace. When combined with Manitoba Hydro's failure to identify and analyze DSM/DG alternatives to Wuskwatim Advancement, the impression is one of a utility that still takes a predominantly supply-side approach to its market and its business planning, which in turn raises the prospect of yet another downturn in its DSM commitment in the future. While Manitoba Hydro evidently believes that there is no combination of future electricity demand and DSM it can realistically achieve that would put them in a significant surplus position with respect to their capacity to sell to the peak export market, they may be wrong. More importantly, without the type of detailed identification and analysis of alternatives to Wuskwatim Advancement that should have been the central focus of their NFAAT case, it is impossible to know if their proposal is the best way for them to deliver on their central mission.

In contrast, the approach reflected by the DSM/DG alternatives suggested in CNF/TREE/RCM I NFAAT – 13 reflects an alternative orientation. In terms of the utility's mission to "to provide for the continuance of a supply of energy adequate for the needs of the province, to promote economy and efficiency in the development, generation, transmission, distribution, supply, and end-use of energy, and to market *energy services* within and outside the province" (emphasis added), this alternative approach moves the provision and marketing of *energy services* to the central position in the utility's business planning.

In this frame, the demand side resource is not treated as a reserve to be turned on and off as the electricity supply market dictates, but as the foundation for building a sustainable energy future. In this approach, an intensified and sustained commitment to accelerating the DSM/DG resource is the priority strategy for maintaining peak export capability at 10,500 GW.hour per year (median flow conditions), the benchmark that Manitoba Hydro has put forward for justifying Wuskwatim Advancement. Once an irrevocable commitment to advancing Wuskwatim is made, the DSM resource is in jeopardy, not unlike it was ten years ago when the utility was in its last DSM "up cycle".

In terms of the opportunity to move toward a sustainable energy future, with all the economic and environmental benefits that would ensue, Manitoba is in an advantageous position. Delaying supply side expansion poses no threat to the reliability of electricity supply for Manitoba's domestic needs. As a public utility that supplies electricity, gas and DSM/DG resources, Manitoba Hydro is in the rare position of being able to take an integrated and comprehensive approach to the provision of energy services. Manitoba Hydro has not had to cope with the restructuring, re-regulation, and privatization of the electric utility sector that has disoriented so many other public utilities in Canada and elsewhere. Although it turned down its funding of PowerSmart in the 1990's, Manitoba Hydro has maintained a core capability to deliver DSM programs. It is also free of the risks and costs that accompany nuclear and fossil-fuel based power systems, and its existing hydroelectricity supply system is complementary to accelerated development of DSM and distributed generation.

CNF/TREE/RCM I NFAAT - 16

INTERROGATORY

16. In the TREE/RCM NFAAT TSA Submission, in response to Question 21, it is stated that a DSM/DG "alternative to" Wuskwatim Advancement offers environmental, economic, social, employment, and financial advantages. Please elaborate on these benefits, providing quantitative estimates where possible.

RESPONSE:

The types of alternatives to Wuskwatim Advancement summarized in CNF/TREE/RCM I NFAAT – 13 have a number of advantages over committing to another central power plant like Wuskwatim. If Manitoba Hydro had conducted a NFAAT analysis of Wuskwatim Advancement, it would have centred on the identification, analysis and quantification of these benefits. While the onus for a NFAAT analysis is squarely on the proponent, we do list here some of the benefits that would be particularly important to include in such an analysis. We have identified some of these benefits in our response to CNF/TREE/RCM I NFAAT – 5, and many of them relate to the system-wide benefits of a business and planning strategy based on smaller, "grainier" increments of "supply" that add up to risk diversification and minimization, more efficient utilization of capital, and the prospects of a long term utility strategy compatible with a transition to sustainable development.

The DSM/DG alternative begins to deliver benefits immediately. In Manitoba Hydro's Wuskwatim Advancement case, there is a significant lost opportunity represented by the gap between the peak export market and the energy the utility has available after meeting the domestic demand. In this future, by the time the Wuskwatim dam comes on line in 2010, this gap will have grown to the point where even Wuskwatim will not close it, and the projected lost export revenue will have reached hundreds of millions of dollars. Immediately after Wuskwatim is started up, the gap begins to grow again and the lost revenues continue their accumulation until the next dam comes on line. In contrast, the DSM/DG alternatives summarized in CNF/TREE/RCM I NFAAT – 13 can be developed immediately, thereby capturing the lost opportunities that accompany the Wuskwatim Advancement option. The overall impact of this advantage on both rates and Manitoba Hydro's financial position over the 2003-2018 period would be an important component of a NFAAT analysis of Wuskwatim Advancement.

Beyond these and related financial benefits of the DSM/DG resource, there are environmental benefits to the demand side case which have not been contested and are acknowledged by Manitoba Hydro. The DSM options create more jobs and more evenly distributed employment than the hydro megaproject alternative, and this advantage of the DSM/DG resource is discussed further in MH/NCN/TREE/RCM III NFAAT – 12. The community economic development associated with DSM/DG strategies originates and focuses on the needs of the local community, and largely avoids the contentious and often divisive issues that arise around megaprojects whose size and rationale are out of all proportion to local needs. In addition, the DSM/DG alternatives to Wuskwatim Advancement also allow additional time for the resolution of historical grievances related to the social and environmental damage done by previous hydroelectric developments in the north. It would also provide time for Manitoba Hydro to implement DSM and DG resource development in northern and Native communities, thereby furthering enhancing prospects for future cooperation and partnership.

The DSM/DG alternative to Wuskwatim Advancement hedges against the risk of "oversupply", the risk that the utility will end up with more power than it can sell into the high price market, a situation that could lengthen the payback period for Wuskwatim and send the utility's "on-again, off-again" commitment to DSM into another downturn.