BUDGET DEGREE DAYS

1. The purpose of this evidence is to provide the forecast of degree days for the 2017 test year.

2. The 2017 degree day forecasts were prepared in accordance with the Ontario Energy Board's (the "Board") EB-2012-0459 Decision with Reasons dated July 17, 2014. In that Decision the Board has approved the use of the 50:50 Hybrid method for the Central weather zone, the de Bever with Trend method for the Eastern weather zone, and the 10-year moving average method for the Niagara weather zone. Table 1 displays the 2017 degree day forecasts that were generated according to the approved methodologies for each weather zone within the franchise using Environment Canada degree days. Conversions to Gas Supply degree days are depicted in the latter part of this evidence.

Table 1
Forecast of 2017 Environment Canada Degree Days

Region	*Methodology*	*Forecast*
Central	50:50 Hybrid	3,678
Eastern	De Bever with Trend	4,377
Niagara	10-year moving average	3,413

Degree Day Forecast Methodology

3. The degree day forecast for the Central weather zone was prepared using the 50:50 Hybrid method which is an average of the 10-year Moving Average and the 20-year Trend forecast. Table 2 provides the actual Environment Canada degree day data for the Central weather zone and the resultant 10-year moving average, 20-year Trend, and 50:50 Hybrid forecast. The 10-year moving average is calculated using

data covering the period 2006 to 2015[1], while 20-year Trend model is estimated for the period 1996 to 2015. The 20-year Trend model results are provided in Table 3.

[1] The 10 year moving average for year *t* is calculated as (DD_{t-2}+DD_{t-3}+ … +DD_{t-10}+DD_{t-11})/10 where DD is the actual degree day value.

Table 2

Environment Canada Degree Day Forecast – Central

Col. 1	*Col. 2*
Calendar Year	Actual[1]
1996	4,177
1997	4,026
1998	3,220
1999	3,539
2000	3,826
2001	3,420
2002	3,630
2003	3,982
2004	3,798
2005	3,797
2006	3,378
2007	3,722
2008	3,837
2009	3,836
2010	3,501
2011	3,648
2012	3,215
2013	3,775
2014	4,103
2015	3,766
2017 Forecast (10-year Moving average)	3,678
2017 Forecast (20-year Trend)[2]	3,679
2017 Forecast (50:50 Hybrid)[3]	3,678

[1]Environment Canada heating degree day observations from Pearson Int't Airport until June 2013. Effective June 13th, 2013 Environment Canada is no longer able to provide degree day data for Pearson Int'l Airport. Data from June 12th, 2013 and thereafter are obtained from the Toronto Int'l A station.

[2]Calculated using the 20-year Trend regression equation from Table 3.

[3]Average of 10-year Moving average and 20-year Trend forecasts.

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Table 3
Model Results & Test Statistics: 20-year Trend Methodology

Sample: 1996 2015 Included observations: 20

Col. 1	*Col. 2*	*Col. 3*	*Col. 4*	*Col. 5*
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3,737.822	128.25	29.15	0.000
TREND	-2.6821	10.71	-0.25	0.805
R-squared	0.003	F-statistic	0.06	
		F-prob	0.81	

Environment Canada Central Degree Day= 3,737.822-2.6821*TREND
The trend variable takes the values of 1 through 20 for each of the years from 1996 to 2015. The value of 22 is used for 2017 to generate 2017 degree day forecast.

4. The degree day forecast for the Eastern weather zone was prepared using the de Bever with Trend method. This method regresses actual Environment Canada degree days on a constant, a 5-year weighted average of Environment Canada degree days[2] and a trend. The 5-year weighted averages are lagged two years. Table 4 displays the actual Environment Canada degree day data for the Eastern weather zone, the 5-year weighted averages used to estimate the model, and the resultant degree day forecast for 2017. The model is estimated over the period 1950 to 2015 for a total of 66 years which is determined by the cycle length with the smallest variance. Estimation results are provided in Table 5.

[2] The five-year weighted average for year *t* is calculated as $(5*DD_{t-2}+4*DD_{t-3}+3*DD_{t-4}+2*DD_{t-5}+DD_{t-6})/15$ where DD is the actual degree day value.

Table 4
Environment Canada Degree Day Forecast – Eastern

Col. 1	*Col. 2*	*Col.3*
Calendar Year	Actual[1]	5-year Weighted MA[2]
1950	4,824	4,665
1951	4,587	4,594
1952	4,404	4,661
1953	4,059	4,641
1954	4,707	4,556
1955	4,689	4,385
1956	4,799	4,465
1957	4,405	4,523
1958	4,736	4,626
1959	4,718	4,584
1960	4,451	4,652
1961	4,586	4,669
1962	4,826	4,596
1963	4,921	4,584
1964	4,569	4,667
1965	4,810	4,753
1966	4,683	4,709
1967	4,882	4,755
1968	4,780	4,735
1969	4,698	4,775
1970	4,899	4,778
1971	4,797	4,762
1972	5,014	4,805
1973	4,420	4,808
1974	4,725	4,876
1975	4,514	4,736
1976	5,008	4,723
1977	4,597	4,637
1978	4,939	4,741
1979	4,589	4,695
1980	4,920	4,790
1981	4,438	4,735
1982	4,647	4,798
1983	4,536	4,674
1984	4,535	4,658
1985	4,659	4,601
1986	4,501	4,570
1987	4,328	4,585
1988	4,640	4,564
1989	4,931	4,482
1990	4,250	4,524
1991	4,303	4,657
1992	4,861	4,537
1993	4,780	4,461
1994	4,730	4,585
1995	4,585	4,646
1996	4,603	4,681
1997	4,786	4,680
1998	3,828	4,664
1999	4,137	4,689
2000	4,543	4,399
2001	4,115	4,276
2002	4,381	4,328
2003	4,715	4,240
2004	4,637	4,273
2005	4,421	4,444
2006	4,037	4,531
2007	4,447	4,511
2008	4,488	4,373
2009	4,534	4,376
2010	3,973	4,388
2011	4,144	4,430
2012	4,055	4,293
2013	4,402	4,242
2014	4,632	4,155
2015	4,486	4,209
2017 Forecast (de Bever with Trend)[3]	4,377	

[1]Environment Canada heating degree day observations from MacDonald-Cartier Airport until December 2011. Effective December 15th, 2011, Environment Canada is no longer able to provide degree day data for MacDonald-Cartier Airport. Data from December 15th, 2011 and thereafter are obtained from the Ottawa Int'l A station.

[2]5-year weighted average lagged 2 years.

[3]Calculated using the de Bever with Trend regression equation from Table 5.

Table 5
Model Results & Test Statistics: De Bever with Trend Methodology

Sample: 1950 2015 Included observations: 66

Col. 1	*Col. 2*	*Col. 3*	*Col. 4*	*Col. 5*
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3,922.39	1,052.81	3.73	0.00
ECEDD5WA	0.1769	0.22	0.80	0.43
TREND	-4.8323	1.96	-2.47	0.02
R-squared	0.18	F-statistic	6.97	
		F-prob	0.00	

Environment Canada Eastern Degree Day= 3,922.39+0.1769*ECEDD5WA-4.8323*TREND
5-year weighted average of 4,428 is used for 2017 to generate 2017 degree day forecast.
Trend variables takes the values from 1 to 66 for the period of 1950-2015. 68 is used for 2017 to generate 2017 degree day forecast.

5. The degree day forecast for the Niagara weather zone was prepared using the 10-year Moving Average method. Table 6 displays the actual Environment Canada degree day data for the Niagara weather zone and the resultant degree day forecast which is calculated using data covering the period 2006 to 2015[3].

[3] The 10 year moving average for year *t* is calculated as (DD_{t-2}+DD_{t-3}+ … +DD_{t-10}+DD_{t-11})/10 where DD is the actual degree day value.

Table 6
Environment Canada Degree Day Forecast – Niagara

Col. 1	*Col. 2*
Calendar Year	Actual[1]
2006	3,163
2007	3,296
2008	3,480
2009	3,565
2010	3,344
2011	3,458
2012	3,021
2013	3,527
2014	3,832
2015	3,450
2017 Forecast (10-yr Moving average)	3,413

[1]Environment Canada heating degree day observations from St. Catherines Airport until August 2008. Effective September 2008 Environment Canada is no longer able to provide degree day data for St.Catherines Airport. Data from September 2008 and thereafter are obtained from the Vineland Climate Station.

Gas Supply Degree Day Conversion

6. The final step in the degree day forecast involves the conversion of Environment Canada degree days to Gas Supply degree days. Environment Canada degree days are calculated as the average of degree days related to the daily minimum and maximum temperatures within a 24-hour period. On the other hand, Gas Supply degree days are determined relative to average hourly temperatures within a 24-hour period. The latter are used by Enbridge as it is more representative of temperature variations within a given day. Although there are differences between the two measurements, the data sets are highly correlated.

Witnesses: H. Sayyan
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7. The conversion leverages the correlation between both series and is carried out by regressing actual Gas Supply degree days onto actual Environment Canada degree days. The resultant equation (one for each weather zone) is used to convert the Environment Canada degree day forecast to the Gas Supply degree day forecast. Tables 7, 8, and 9 display actual Environment Canada degree days, actual Gas Supply degree days and the resultant Gas Supply degree day forecasts for the 2017 test year for each of the Central, Eastern, and Niagara regions, respectively. Each conversion model uses a sample that is consistent with the prescribed approved methodology to generate the forecasts. The sample for the Eastern region utilizes all the historical data available for Gas Supply degree days.

Table 7
Determination of Gas Supply Equivalent Degree Days - Central

Col. 1	*Col. 2*	*Col. 3*
Calendar Year	Actual Environment Canada Degree Days	Actual Gas Supply Degree Days
1996	4,177	4,133
1997	4,026	3,966
1998	3,220	3,202
1999	3,539	3,497
2000	3,826	3,784
2001	3,420	3,400
2002	3,630	3,597
2003	3,982	3,949
2004	3,798	3,766
2005	3,797	3,750
2006	3,378	3,355
2007	3,722	3,659
2008	3,837	3,801
2009	3,836	3,767
2010	3,501	3,466
2011	3,648	3,597
2012	3,215	3,194
2013	3,775	3,746
2014	4,103	4,044
2015	3,766	3,710
2017 Forecast (10-year Moving average)[1]		3,634
2017 Forecast (20-year Trend)[2]		3,643
2017 Forecast (50:50 Hybrid)[3]		3,639

[1]2017 forecast (10-year Moving average) is calculated using the following regression equation:
Gas Supply degree day =127.3+0.953397*(Environment Canada degree day)
R-squared=0.997, Adjusted R-squared=0.9968, F-statistic=2,933.876, Prob(F-statistic)=0.000000
[2]2017 forecast (20-year Trend) is calculated using the following regression equation:
Gas Supply degree day =91.2+0.96555*(Environment Canada degree day)
R-squared=0.998, Adjusted R-squared=0.998, F-statistic=8,694.617, Prob(F-statistic)=0.000000
[3]2017 forecast (50:50 Hybrid) is an average of 10-year Moving average and 20-year Trend.

Witnesses: H. Sayyan
M. Suarez

Table 8
Determination of Gas Supply Equivalent Degree Days - Eastern

Col. 1	*Col. 2*	*Col. 3*
Calendar Year	Actual Environment Canada Degree Days	Actual Gas Supply Degree Days
1970	4,899	5,018
1971	4,797	4,584
1972	5,014	4,816
1973	4,420	4,480
1974	4,725	4,858
1975	4,514	4,229
1976	5,008	4,901
1977	4,597	4,604
1978	4,939	4,920
1979	4,589	4,550
1980	4,920	4,853
1981	4,438	4,361
1982	4,647	4,617
1983	4,536	4,515
1984	4,535	4,504
1985	4,659	4,648
1986	4,501	4,507
1987	4,328	4,268
1988	4,640	4,601
1989	4,931	4,883
1990	4,250	4,225
1991	4,303	4,270
1992	4,861	4,746
1993	4,780	4,715
1994	4,730	4,700
1995	4,585	4,530
1996	4,603	4,561
1997	4,786	4,711
1998	3,828	3,802
1999	4,137	4,112
2000	4,543	4,506
2001	4,115	4,071
2002	4,381	4,317
2003	4,715	4,663
2004	4,637	4,598
2005	4,421	4,397
2006	4,037	4,012
2007	4,447	4,411
2008	4,488	4,431
2009	4,534	4,472
2010	3,973	3,947
2011	4,144	4,108
2012	4,055	4,048
2013	4,402	4,484
2014	4,632	4,552
2015	4,486	4,397
2017 Forecast[1]		4,341

[1]2017 forecast is calculated using the following regression equation:
Gas Supply degree days = 170.503+0.95277*(Environment Canada degree days)
R-squared=0.9378 Adjusted R-squared=0.9363 F-statistic=662.87 Prob(F-statistic)=0.000000

Witnesses: H. Sayyan
M. Suarez

Table 9
Determination of Gas Supply Equivalent Degree Days - Niagara

Col. 1	*Col. 2*	*Col. 3*
Calendar Year	Actual Environment Canada Degree Days	Actual Gas Supply Degree Days
2006	3,163	3,079
2007	3,296	3,349
2008	3,480	3,510
2009	3,565	3,547
2010	3,344	3,322
2011	3,458	3,334
2012	3,021	3,013
2013	3,527	3,537
2014	3,832	3,814
2015	3,450	3,548
2017 Forecast[1]		3,405

[1]2017 forecast is calculated using the following regression equation:
Gas Supply degree days = -83.8753+1.0222*(Environment Canada degree days)
R-squared=0.9292 Adjusted R-squared=0.9203 F-statistic=104.96 Prob(F-statistic)=0.0000

2017 Degree Day Forecasts:

Table 10
Summary of 2017 Degree Days Forecast

Region	***Environment Canada Degree Days***	***Gas Supply Degree Days***
Central	3,678	3,639
Eastern	4,377	4,341
Niagara	3,413	3,405

Witnesses: H. Sayyan
M. Suarez