

ENERGY SAVINGS ASSESSMENT REPORT

ECORAD

This report was prepared with the collaboration of

Pierre-Luc Laflamme, jr, eng., CMVP

Under the supervision of

Geneviève Gauthier, eng., CEM, CMVP

Assessment from March 2012 to March 2013

Sainte-Anne-de-la-Pérade Church

April 2013



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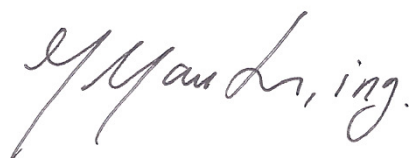
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SUMMARY

This report presents the energy savings of the Ecorad project in which the heat distribution plumbing was removed and the radiators were restored and electrified. The savings were calculated using an adjusted baseline. The methodology used for the calculation of this baseline is presented in the measurement and validation plan (M&V) prepared before the project.¹. The following table summarizes the energy savings obtained at Sainte-Anne-de-la-Pérade Church, between March 22, 2012 and March 21, 2013 relative to the baseline established from January 1, 2011 and December 31, 2011.

Table 1 : Project Energy Savings

	No. 2 Heating Oil		Electricity		Total	
	L	\$	kWh	\$	GJ	\$
Adjusted Baseline	17 654	21 141	222 970	23 547	1 486	44 688
Assessment Period	0	0	318 780	31 974	1 148	31 974
Savings	17 654	21 141	-95 810	-8 427	338	12 714

Additionally, the project resulted in a reduction of Greenhouse Gases Emissions (GGE) of 48 t CO₂e for the assessment period.

The following figures present the energy consumption and the costs according to the adjusted baseline and the assessment period.

¹ Econoler, Measurement and Verification Plan using IPMVP, Sainte-Anne-de-la-Pérade Church, 24 janvier 2013.

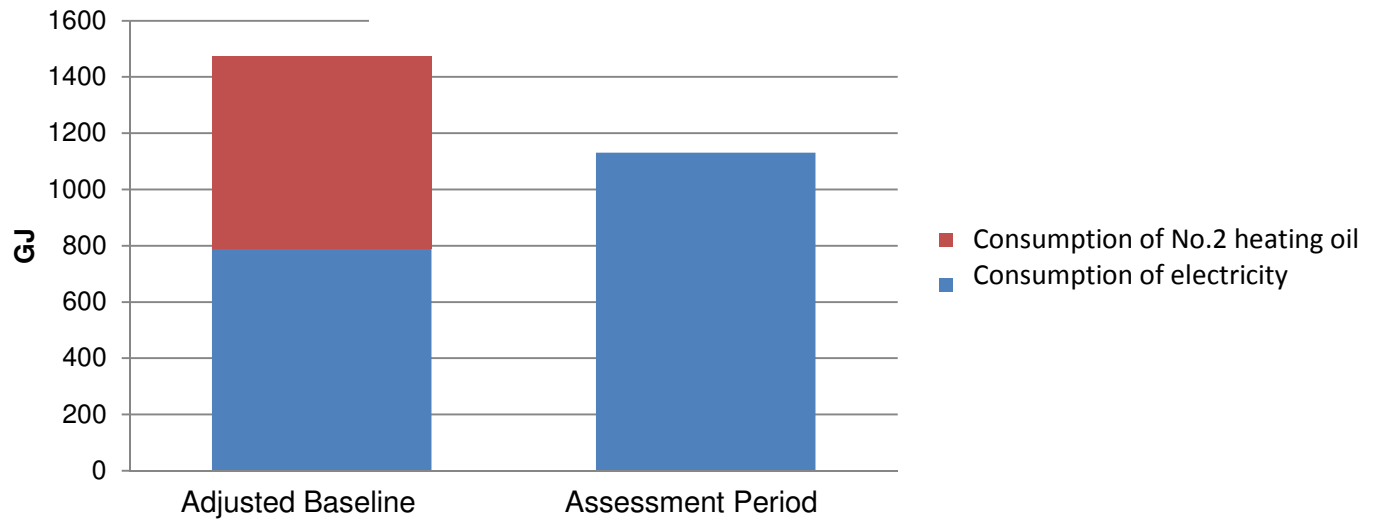


Figure 1 : Annual energy consumption for the baseline and the assessment period

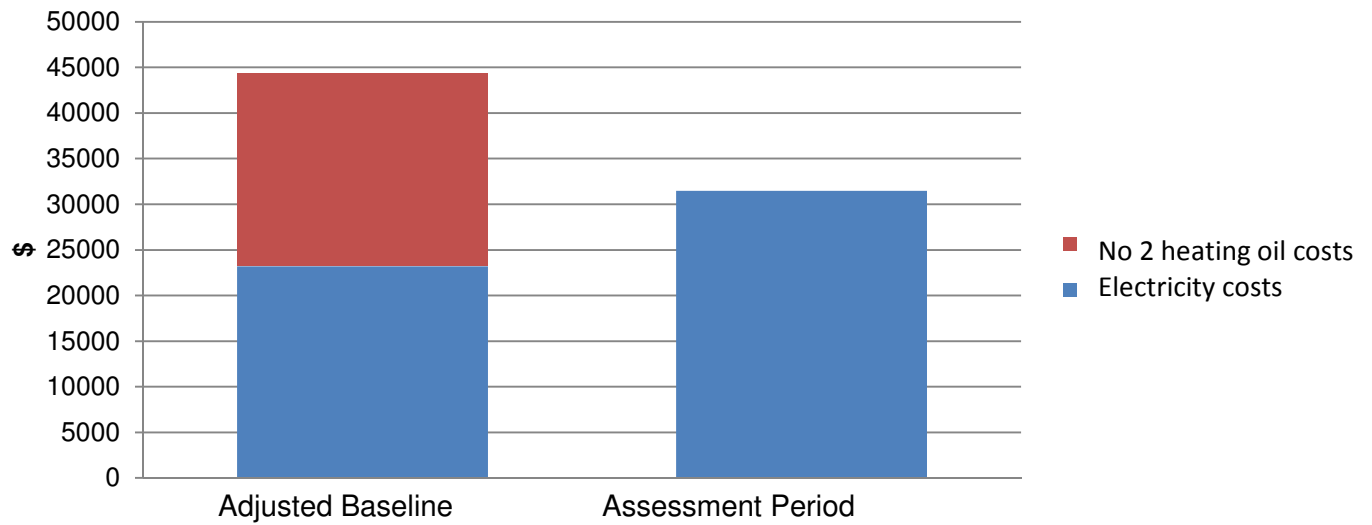


Figure 2 : Annual energy costs for the adjusted baseline and the assessment period



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ACRONYMS AND SYMBOLS

CMVP	Certified Measurement and Verification Professional
HDD	Heating Degree-Days
EE	Energy Efficiency
GHG	Greenhouse Gases
GJ	Gigajoule
IPMVP	International Performance Measurement and Verification Protocol
kW	Kilowatt
kWh	Kilowatt-hour
L	Liter
M&V	Measurement and Verification
m ³	Cubic Meter



INTRODUCTION

The Saint-Anne-de-la-Pérade Church was built in 1869. The building was heated mainly by a No. 2 heating oil boiler and an electric boiler. A system of heating pipes and cast iron radiators provided the heat which radiated in the rooms. However, the existing heating pipes were worn out and would eventually need to be replaced.

Within the framework of the Ecorad project the heat distribution plumbing was disassembled and the heating radiators were restored and electrified. The new heating system was divided into ten independent zones managed by a programmable electronic control panel. This system efficiently controls the heating in each zone. The control panel limits the power demand for heating to 95 kW in order to benefit from a better price of electricity. As well, aluminum reflective panels were installed behind the radiators in order to lessen heat loss to the walls.

The work has been completed since February 2012. This report presents the energy savings of the first year of the assessment from March 22, 2012 to March 21, 2013.



1 BUILDING'S ENERGY CONSUMPTION

This section presents the building's consumption of electricity and No.2 heating oil for the period between March 2012 and March 2013.

1.1 ELECTRICITY

This section presents data for the assessment period for the meters 640EA025280 and 640HA010926.

Meter 640EA025280

This meter now services the entire new electrical heating system of the church. Before the project, this meter was hooked up to the electric boiler, which was dismantled. The following table shows the consumption and the power demand between March 2012 and March 2013 for the meter 640EA025280.

Table 2 : Electricity Consumption (meter 640EA025280) – Assessment Period

Billing Period		Electricity Consumption (kWh)	Power Demand ² (kW)	Cost (\$)
22/03/2012	20/04/2012	22 320	96	3 659,04
21/04/2012	18/05/2012	13 320	7	1 471,94
19/05/2012	18/06/2012	120	N.A.	43,94
19/06/2012	17/07/2012	0	N.A.	41,12
18/07/2012	13/08/2012	120	N.A.	38,27
14/08/2012	12/09/2012	0	N.A.	42,53
13/09/2012	12/10/2012	2 400	39	951,89
13/10/2012	14/11/2012	19 080	37	2 564,91
15/11/2012	13/12/2012	39 960	39	3 568,05
14/12/2012	16/01/2013	65 040	111	5 657,22
17/01/2013	19/02/2013	77 640	118	6 501,57
20/02/2013	20/03/2013	41 400	109	3 479,61
Total		281 400	-	28 020,09
Average		23 450	47	2 335,00

Certain periods have very low consumption, that is to say, they were non-existent (from May 19 to September 12). In fact the main heating system was taken off line during this period.

² N.A (not applicable) indicates the periods where the billings did not show a power demand.



1.1.1 Meter 640HA01926

This meter services the lighting and the electrical outlets as well as some standard baseboard heaters. The following table shows the consumption and the power demand between March 2012 and March 2013 for the meter 640HA010926.

Table 3 : Electricity Consumption (meter 640HA010926) – Assessment Period

Billing Period		Electricity Consumption (kWh)	Power Demand (kW)	Cost ³ (\$)
22/03/2012	18/05/2012	5 700	18	602,81
19/05/2012	17/07/2012	4 680	19	500,79
18/07/2012	12/09/2012	3 660	21	396,41
13/09/2012	14/11/2012	4 860	22	520,38
15/11/2012	16/01/2013	9 060	21	948,46
17/01/2013	20/03/2013	9 420	23	984,96
Total		37 380	-	3 953,80
Average		6 230	20	658,97

1.2 NO. 2 HEATING OIL

Bearing in mind that the heating system was converted to electricity, there was no consumption of No. 2 heating oil during the assessment period.

1.3 CONSUMPTION AND POWER DEMAND

The following table shows a summary of the energy consumption for the building between March 2012 and March 2013.

Table 4 : Summary of Consumption – Assessment Period

No.2 Heating Oil		Electricity		Total	
L	\$	kWh	\$	GJ	\$
0	0	318 780	31 974	1 148	31 974

The following table shows a summary of the average actual power demand used in the building during the assessment period.

³ For this meter, an equal payment plan was used to pay invoices. Therefore the costs for each billing period are calculated using the applicable G rate for this meter.



Table 5 : Summary of the Average Demand – Assessment Period

Meter 640EA025280	Meter 640HA010926
kW	kW
47	20





2 ADJUSTMENTS FACTORS FOR THE PERIOD

This section presents the factors used to calculate the adjustments.

2.1 NO. 2 HEATING OIL

The baseline for the No. 2 heating oil is adjusted according to the heating degree days (HDD). The HDD for the period are presented in the following table.

Table 6: HDD – Assessment period for No. 2 heating oil

Period		HDD °C-day
22/03/2012	21/04/2012	409,8
22/04/2012	21/05/2012	247,35
22/05/2012	21/06/2012	61,8
22/06/2012	21/07/2012	9
22/07/2012	21/08/2012	4,8
22/08/2012	21/09/2012	60,05
22/09/2012	21/10/2012	254,35
22/10/2012	21/11/2012	435,3
22/11/2012	21/12/2012	652,15
22/12/2012	21/01/2013	852,8
22/01/2013	21/02/2013	941,95
22/02/2013	21/03/2013	567,8

2.2 ELECTRICITY

This section presents the adjustments factors for electricity.

2.2.1 Meter 640EA025280

The baseline for the meter 640EA025280 is adjusted according to the HDD³. The HDD are presented in the following table according to the billing period of the meter 640EA025280 during the assessment period.

Table 7 : HDD – Assessment period for the meter 640EA025280

Period		HDD °C-day
22/03/2012	20/04/2012	395,1
21/04/2012	18/05/2012	250,8
19/05/2012	18/06/2012	73,05
19/06/2012	17/07/2012	6,3
18/07/2012	13/08/2012	2,9
14/08/2012	12/09/2012	26,3
13/09/2012	12/10/2012	200,05
13/10/2012	14/11/2012	393,95
15/11/2012	13/12/2012	611,75
14/12/2012	16/01/2013	860,5
17/01/2013	19/02/2013	1062,4
20/02/2013	20/03/2013	605,8

2.2.2 Meter 640HA010926

The baseline for the meter 640HA010926 is adjusted according to the HDD³ and according to the number of days for the billing period. The HDD are presented in the following table, according to the billing period of the assessment period for the meter 640HA010926.

Table 8 : HDD – Assessment Period for the Meter 640EA025280

Period		HDD °C-day	Number of days
22/03/2012	18/05/2012	645,9	58
19/05/2012	17/07/2012	79,35	60
18/07/2012	12/09/2012	29,2	57
13/09/2012	14/11/2012	594	63
15/11/2012	16/01/2013	1 472,25	63
17/01/2013	20/03/2013	1 668,2	63





3 REFERENCE YEAR

This section presents the energy and the load for the adjusted baseline.

3.1 NO. 2 HEATING OIL

As mentioned previously the baseline for No. 2 heating oil is estimated according to the HDD (periodically adjusted). For the periods when the relation between the HDD and the number of days is greater than 4,2 °C, the deliveries of No. 2 heating oil of the baseline are calculated according to the following energy model :

$$R_{M-1} = 39,453 d_1 - 1\,612$$

Where :

R_{M-1} = No. 2 heating oil delivered (L)

d_1 = Heating Degree-days for the targeted period (°C-day)

For periods when the relation between the HDD and the number of days is less than 4,2 °C, the deliveries of No. 2 heating oil are at 1,617 L/day (according to the non-adjusted invoices).

Besides the Ecorad Project there were no major modifications to the Sainte-Anne-de-la-Pérade Church since the preparation of the M&V plan. Therefore the baseline does not require non-periodic adjustments.

Energy Cost

The cost of the heating oil was evaluated using a price of \$1.04 /L to the adjusted baseline. This price was current for No. 2 heating oil as of February 12, 2012 (last available invoice for heating oil). As well, the costs include the current taxes for each established billing period.

The following section presents the consumption with and without adjustments.

3.1.1 Without adjustment

The following table presents the No. 2 heating oil deliveries according to the invoices of the baseline period.

Table 9 : Deliveries of No. 2 Heating Oil for the Baseline Period

Delivery Date	Delivery of No. 2 Heating Oil L
2010-12-20	1 257
2010-12-29	1 231,5
2011-01-05	813,9
2011-01-11	773,2
2011-01-20	1 369,3
2011-01-26	1 141,4
2011-01-31	841,9
2011-02-07	655,8
2011-02-14	735,5
2011-02-21	753,7
2011-03-04	1 196,7
2011-03-11	712,9
2011-03-22	715,3
2011-04-01	849,5
2011-04-21	938,7
2011-10-05	270
2011-11-11	1 289
2011-11-28	905
2011-12-12	1 000
2011-12-20	722
2011-12-27	763
2012-01-03	752
2012-01-13	1 291
2012-01-19	851
Total	21 829,3

3.1.2 With Adjustments

The following table presents the adjusted Baseline for the consumption of No.2 heating oil.

Table 10 : Light Heating Oil – Adjusted Baseline

Period		Consumption of No.2 Heating Oil (L)	Cost (\$)
22/03/2012	21/04/2012	1 494	1 786,26
22/04/2012	21/05/2012	669	799,38
22/05/2012	21/06/2012	50	59,93
22/06/2012	21/07/2012	49	58,00
22/07/2012	21/08/2012	50	59,93
22/08/2012	21/09/2012	50	59,93
22/09/2012	21/10/2012	704	841,90
22/10/2012	21/11/2012	1 624	1 941,17
22/11/2012	21/12/2012	2 725	3 258,53
22/12/2012	21/01/2013	3 745	4 477,47
22/01/2013	21/02/2013	4 198	5 040,82
22/02/2013	21/03/2013	2 297	2 758,01
Total		17 654	21 141

3.2 ELECTRICITY

As stated earlier the baseline for electricity is subject to a periodic adjustment

Meter 640EA025280

The baseline for the meter 640EA025280 is evaluated according to the HDD (periodic adjustment). For the billing period when the HDD are higher or equal to 143 °C-day, the electricity consumption of the Baseline is calculated according to the following energy model:

$$R_{\dot{E}-1} = 40,187 d_1 - 2 076,9$$

Where :

$R_{\dot{E}-1}$ = Electricity Consumption for the targeted period (kWh)

d_1 = Heating degree-days for the targeted period (°C-day)

For the billing periods where the HDD is less than 143 °C-day, the electricity consumption is of 1,1 kWh/day (according to the unadjusted invoices).



Meter 640HA010926

For the whole year, the baseline for the meter 640HA010926 was evaluated according to the following energy model :

$$R_{\dot{E}-1} = 50,46 n_1 + 10,75 d_1 - 654,95$$

Where :

$R_{\dot{E}-1}$ = Electricity consumption for the targeted period (kWh)

n_1 = Number of days in the targeted period

d_1 = Heating degree-days for the targeted period (°C-day)

Power Demand

The power demand for the baseline is evaluated according to the invoices without periodic adjustment.

Besides the Ecorad Project there were no major modifications to the Sainte-Anne-de-la-Pérade Church since the preparation of the M&V plan. Therefore the baseline does not require non-periodic adjustments.

Energy Cost

The cost of the electricity is evaluated by applying the Hydro-Quebec rate to the adjusted baseline. The following is the Hydro-Quebec rate which was applied :

Table 11 : G Rate Structure (April 1 2012 – March 31 2013)

G Rate (April 1 2012 – March 31 2013)	
Flat monthly rate	12,33 \$
Price of the power over 50 kW	15,54 \$/kW
First 15 090 kWh	8,73 ¢/kWh
Remaining energy consumed	4,85 ¢/kWh

As well, the cost includes the current taxes for each billing period.

The following sections present the consumption with and without adjustments.

3.2.1 Without adjustments

This section presents the consumption and power demand as detailed in the invoices.

**Meter 640EA025280**

The following table presents the consumption and the power demand as measured by the meter 640EA025280.

Table 12 : Electricity Consumption for the baseline (meter 640EA025280)

Billing Period		Electricity Consumption kWh	Actual Power Demand kW
2010-12-03	2011-01-04	18 600	69
2011-01-05	2011-02-03	20 400	78,2
2011-02-04	2011-03-08	38 640	84,1
2011-03-09	2011-04-06	18 240	69,2
2011-04-07	2011-05-06	15 600	63
2011-05-07	2011-06-06	4 440	63
2011-06-07	2011-07-21	0	1,6
2011-07-22	2011-08-23	0	1,6
2011-08-24	2011-09-20	120	1,6
2011-09-21	2011-10-19	3 480	72,2
2011-10-20	2011-11-17	12 840	62,7
2011-11-18	2011-12-20	20 880	69,3
2011-12-21	2012-01-20	31 440	69,3
Total		184 680	-
Average		14 206	54,2

Meter 640HA010926

The following table shows the electricity consumption as measured by the meter 640HA010926.

Table 13 : Baseline Electricity Consumption (meter 640HA010926)

Billing Period		Electricity Consumption kWh	Actual Power Demand kW
2011-01-01	2011-01-04	1 017	37,7
2011-01-05	2011-03-08	22 620	36,1
2011-03-09	2011-03-31	4 374	32,6
2011-04-01	2011-05-06	6 846	
2011-05-07	2011-07-21	5 340	26,7
2011-07-22	2011-09-20	4 140	18,9
2011-09-21	2011-11-17	5 820	30,1
2011-11-18	2012-01-20	18 900	34,2
Total		69 057	-
Average		8 632	31,1

3.2.2 With Periodic Adjustments

This section presents the adjusted baseline for the calculations of the savings.

Meter 640EA025280

The following table presents the adjusted baseline for the meter 640EA025280.

Table 14 : Meter 640EA025280 – Adjusted Baseline

Period		Electricity Consumption (kWh)	Power Demand (kW)	Cost (\$)
22/03/2012	20/04/2012	13 801	63	1 639,63
21/04/2012	18/05/2012	8 002	63	1 033,21
19/05/2012	18/06/2012	859	1,6	100,85
19/06/2012	17/07/2012	0	1,6	13,70
18/07/2012	13/08/2012	0	1,6	12,76
14/08/2012	12/09/2012	0	1,6	14,18
13/09/2012	12/10/2012	5 963	72	1 009,30
13/10/2012	14/11/2012	13 755	63	1 645,81
15/11/2012	13/12/2012	22 508	69	2 275,30
14/12/2012	16/01/2013	32 504	69	2 892,57
17/01/2013	19/02/2013	40 618	84	3 660,51
20/02/2013	20/03/2013	22 268	69	2 270,04
Total		160 277	-	16 568
Average		13 556	47	1 381

Meter 640HA010926

The following table presents the adjusted baseline for the meter 640HA010926.

Table 15 : Meter 640HA010926 – Adjusted Baseline

Period		Electricity Consumption (kWh)	Power Demand (kW)	Cost (\$)
22/03/2012	18/05/2012	9 215	33	958
19/05/2012	17/07/2012	3 226	27	354
18/07/2012	12/09/2012	2 535	19	283
13/09/2012	14/11/2012	8 910	30	929
15/11/2012	16/01/2013	18 351	34	2 062
17/01/2013	20/03/2013	20 457	38	2 393
Total		62 693	-	6 979
Average		10 449	31	1 163



4 CALCULATION OF ENERGY SAVINGS

This section presents the savings for the first year of assessment of the Energy Efficiency (EE) project. The following table presents the energy savings at Sainte-Anne-de-la-Pérade Church, between March 22, 2012 and March 21, 2013.

Table 16 : Energy Savings of the Project

	No. 2 Heating oil		Electricity		Total	
	L	\$	kWh	\$	GJ	\$
Energy for the baseline (invoices)	21 829	20 866	253 737	24 102	1 758	44 988
Adjusted baseline	17 654	21 141	222 970	23 547	1 486	44 688
Assessment period	0	0	318 780	31 473	1 131	31 473
Savings	17 654	21 141	-95 810	-7 926	355	13 215

In the above table, the negative values represent an increase relative to the reference year. In addition, this project resulted in a reduction of greenhouse gases (GHG) of 48 t CO₂e for the assessment period.



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