

Grafton, Lorain, & North Coast Correctional Institutions, OH Savings Measurement & Verification Report Year 1: November 2010 – October 2011

The following report outlines the specific algorithms used in measuring and verifying the savings associated with the implementation of specific measures within this project.

Annual Calculation of Energy Cost Savings

The following equation was used to determine the dollar amount of energy savings achieved annually.

$$\text{Total Annual Guaranteed Savings} = \sum((\text{Baseline Energy Usage} \times \text{Baseline Energy Rates}) - (\text{Post Energy Usage} \times \text{Post Energy Rates}))$$

The Total Annual Guaranteed Savings amount for the ECMs installed is \$459,233 per year for years 1 through 10 of the guarantee period.

Ameresco guarantees the Total Annual Guaranteed Savings Amount, but does not guarantee the savings amount achieved by each individual savings measure or at each individual location.

Energy Rates

All electrical savings are calculated using a blended rate per kWh that averages the demand and usage costs over all kWh.

Baseline Energy Rates are stipulated as set forth below:

<u>Site</u>	<u>Electricity</u>	<u>Natural Gas</u>
Grafton	\$0.077 / kWh	\$11.86 / MCF
Grafton Farm	\$0.077 / kWh	\$14.53 / MCF
Lorain	\$0.070 / kWh	\$14.53 / MCF
North Coast	\$0.071 / kWh	\$14.53 / MCF

Post Energy Rates are equal to or less than the Baseline Energy Rates, therefore the Baseline Energy Rates were used in calculation of the Total Annual Savings, as stated in the contract.

ECM 1-Lighting System Improvements

IPMVP Option

The measurement and verification protocol for this measure is based on IPMVP Option A.

Savings Calculations

The Baseline Energy Usage, Post Energy Usage, and savings calculations for this ECM are shown in the following table:

Table ECM 1-1

LORCI Location	Old Fixture	Old Watts/ Fixture	Old Qty	Old Watts	New Fixture	New Watts/ Fixture	New Qty	New Watts	Watts Saved	Operating Hours	Baseline Kwh	kWh Savings
Interior	T1234/62	144	1,513	217,872	F028/841/XP/SS Quicktronic 4L IS-	86	1,513	130118	87754	5256	1,145,135	461,235
-	2-Eff icient Magn									5256		
Interior	T1235U3/62	72	400	28,800	F030/841/XP/SS Quicktronic 2L IS-	52	400	20800	8000	5256	151,373	42,048
-	1-Efficient Magne									5256		
Interior	T1234/62	72	1,150	82,800	F028/841/XP/SS Quicktronic 2L IS	48	1,150	55200	27600	5256	435,197	145,066
-	1-Efficient Magne									5256		
Interior	96T12110	237	14	3,318	NF (4) 4 ft t-8 4L	137	14	1918	1400	5256	17,439	7,358
-	1-Efficient Magne									5256		
Exterior	1000w MV Magnetic	1080	140	151,200	750w MVR Pulse Star	815	140	114100	37100	5256	794,707	194,998
-										5256		
Exterior	400 MH Magnetic	464	20	9,280	320 MHPS CEW PS	365	20	7300	1980	5256	48,776	10,407
-										5256		
Exterior	150w HPS Magnetic	190	12	2,280	125w MHPS CEW	150	12	1800	480	5256	11,984	2,523
-										5256		
Exterior	100w HPS Magnetic	128	95	12,160	64w CFL Electronic	70	95	6650	5510	5256	63,913	28,961
-										5256		
Interior	175 w MH Magnetic	210	200	42,000	125w MHPS CEW	150	200	30000	12000	5256	220,752	63,072
-										5256		
Interior	400 MH Magnetic	464	72	33,408	320 MHPS CEW PS	365	72	26280	7128	5256	175,592	37,465
-										5256		
Interior	Incand. 100A None	100	210	21,000	Comp. Four. 42w 1-42W Reactor	45	210	9450	11550	5256	110,376	60,707
-												
Total				604,118			3826	403616	200502		3,175,244	1,053,839
Northcoast												
Location	Old Fixture	Old Watts/ Fixture	Old Qty	Old Watts	New Fixture	New Watts/ Fixture	New Qty	New Watts	Watts Saved	Operating Hours	Baseline Kwh	kWh Savings
Interior	4ft 32w T8 Lamp Only	32	4450	142,400	4ft 28w T8 Lamp Only	28	4450	124600	17800	5256	748,454	93557
-												
Total				142,400			4450	124600	17800			93557
Grafton												
Location	Old Fixture	Old Watts/ Fixture	Old Qty	Old Watts	New Fixture	New Watts/ Fixture	New Qty	New Watts	Watts Saved	Operating Hours	Baseline Kwh	kWh Savings
Interior	T1234/62	72	1,800	129,600	F028/841/XP/SS Quicktronic 2L IS	48	1,800	86,400	43,200	5,256	681,178	227,059
-	1-Efficient Magne									5,256		
Interior	T1234/62	144	350	50,400	F028/841/XP/SS Quicktronic 4L IS-	86	350	30,100	20,300	5,256	264,902	106,697
-	2-Eff icient Magn									5,256		
Interior	T1234/62	107	225	24,075	F028/841/XP/SS Quicktronic 3L IS-	72	225	16,200	7,875	5,256	126,538	41,391
-	2-Efficient Magne									5,256		
Interior	175 w MH Magnetic	210	141	29,610	125w MHPS CEW	150	141	21,150	8,460	5,256	155,630	44,466
-										5,256		
Interior	150w HPS Magnetic	190	62	11,780	125w MHPS CEW	150	62	9,300	2,480	5,256	61,916	13,035
-										5,256		
Interior	400 MH Magnetic	464	48	22,272	320 MHPS CEW PS	365	48	17,520	4,752	5,256	117,062	24,977
-										5,256		
Interior	Incand. 100A None	100	300	30,000	Comp. Four. 42w 1-42W Reactor	45	300	13,500	16,500	5,256	157,680	86,724
-										5,256		
Interior	F20T12 Standard Magneti	52	35	1,820	T8172 2L Electronic LW	30	35	1,050	770	5,256	9,566	4,047
-										5,256		
Interior	T1235U3/62	72	75	5,400	F030/841/XP/SS Quicktronic 2L IS-	52	75	3,900	1,500	5,256	28,382	7,884
-	1-Efficient Magne									5,256		
Exterior	250w HPS Magnetic	295	180	53,100	175 w MH PS CEW Pulse Star	208	180	37,440	15,660	5,256	279,094	82,309
-										5,256		
Exterior	1000w MV Magnetic	1080	32	34,560	750w MVR Pulse Star	815	32	26,080	8,480	5,256	181,647	44,571
-										5,256		
Exterior	Incand. 75A None	75	20	1,500	Comp. Four. 64 M Remote	65	20	1,300	200	5,256	7,884	1,051
-												
Total				394,117			3,268	263,940	130,177		2,071,479	684,210

At the Lorain, North Coast and Grafton sites, the impact of the lighting retrofit on the heating and cooling costs will be captured under the M&V plan for ECM 4 – Direct Digital Controls. At the Grafton Farm, the impact of the lighting retrofit on the heating and cooling costs is minimal and therefore omitted from the calculations.

Baseline Energy Usage

Baseline Energy Usage is calculated as the product of power consumption (watts / fixture) multiplied by quantity of fixtures multiplied by operating hours.

The baseline power consumption (watts / fixture) used in the calculation of Baseline Energy Usage is the amount specified in the “Old Watts / Fixture” column of Table ECM 1-1.

Quantities for each fixture type used in the Baseline Energy Usage calculation are the amounts specified in the “Old Qty” column of Table ECM 1-1.

Operating hours used in the calculation of Baseline Energy Usage and Post Energy Usage are the amounts specified in the “Operating Hours” column of Table ECM 1-1.

Post Energy Usage

The Post Energy Usage was calculated as the product of the Operating Hours as determined in the previous section multiplied by the quantity of fixtures as determined in the previous section multiplied by the measured power consumption as determined in the Metering Plan section below.

Metering Plan

Ameresco measured the post-installation fixture input power for 10% of the installed fixtures (for fixture types with at least 100 fixtures). The sample values were within 5% of the values shown in the “New Watts” column of the table above, therefore the values in the table above were used. Each individual line item of Table ECM 1-1 was assessed separately. Fixture types with less than 100 total fixtures used the amounts specified in the “New Watts per Fixture” column of Table ECM 1-1. Measurements were taken one time at the completion of construction and those values will be used for every year of the guarantee period.

ECM 2-Steam System Upgrades at Farm

IPMVP Option

The measurement and verification protocol for this measure is based on IPMVP Option C.

Baseline Energy Usage & Post Energy Usage

The natural gas Baseline Energy Usage and Post Energy Usage for the Farm are shown in the following table. The Baseline Year was March 2007 – February 2008 and Year 1 was November 2010 – October 2011.

Total Gas Usage	Baseline (MCF)	Year 1 (MCF)
January	3,782	613
February	2,950	1,187
March	2,189	1,043
April	1,114	778
May	707	624
June	540	343
July	506	337
August	534	309
September	718	379
October	1,306	512
November	2,178	747
December	2,356	2,068
Total	18,880	8,940

The Projected Savings for this ECM was 10,549 MCF per year. After making weather-related adjustments to the baseline usage (shown in the following section), the total Annual Savings for this reporting period is **10,312 MCF**.

Critical Variables Impacting Energy Usage

Some variables beyond Ameresco’s control can have a significant impact on energy consumption. The primary variable impacting this ECM is weather, and the method that was used to determine baseline adjustments is described below.

Baseline natural gas usage was divided between weather-related and non-weather-related usage. Non-weather-related usage, or the Base Load, was determined by averaging the consumption in June, July and August, then multiplying by 12. This is the usage attributed to base utilities such as domestic hot water, kitchen and laundry use. Weather-Related Use is the total usage minus the Base Load. Heating Degree Days (HDD) were obtained from the nearest representative NOAA weather station. The Adjusted natural gas baseline is shown below.

Adjusted natural gas baseline = baseline weather-related MCF x (current HDD / baseline HDD) + non-weather-related MCF = **19,252 MCF**

Metering Plan

Actual monthly data was obtained from Columbia Gas for account # 12222655 001 000 9.

ECM 3-Direct Digital Controls

IPMVP Option

The measurement and verification protocol for this measure is based on IPMVP Option C.

Baseline Energy Usage & Post Energy Usage

The electric and natural gas Baseline Energy Usages and Post Energy Usages for both Grafton and Lorain are shown in the following tables. The Baseline Year was March 2007 – February 2008 and Year 1 was November 2010 – October 2011.

Baseline		Grafton		Lorain	
		Electric (kWh)	Gas (MCF)	Electric (kWh)	Gas (MCF)
January	2008	413,108	5,765	439,200	5,928
February	2008	433,795	6,442	464,400	6,401
March	2007	402,396	5,556	397,200	5,720
April	2007	392,059	4,035	420,000	4,632
May	2007	381,460	3,003	387,600	3,262
June	2007	405,071	1,885	428,400	2,070
July	2007	437,072	1,363	426,000	1,528
August	2007	493,285	1,381	456,000	1,499
September	2007	464,545	1,112	436,800	1,228
October	2007	441,337	1,579	400,800	1,569
November	2007	362,918	2,955	409,200	2,507
December	2007	383,400	4,776	427,200	4,731
Totals		5,010,446	39,852	5,092,800	41,075

Year 1		GCI		LORCI	
		Electric (kWh)	Gas (MCF)	Electric (kWh)	Gas (MCF)
January	2011	401,384	5,949	378,000	5,535
February	2011	405,323	4,835	396,000	4,304
March	2011	374,909	4,627	382,800	4,234
April	2011	377,682	3,106	324,000	2,670
May	2011	380,568	1,858	348,000	1,771
June	2011	401,666	1,538	318,000	1,437
July	2011	448,474	1,170	366,000	1,144
August	2011	527,808	1,286	370,800	1,212
September	2011	458,912	1,390	392,400	1,363
October	2011	370,902	2,593	346,800	2,104
November	2010	347,195	3,947	316,800	3,643
December	2010	392,078	5,770	346,800	5,174
Totals		4,886,901	38,069	4,286,400	34,591

The combined Natural Gas Projected Savings for this ECM was 7,796 MCF per year and the total actual Annual Savings for this reporting period was **9,994 MCF**, as shown in the table below. Note that weather-related adjustments were made to the baselines and are detailed in the following section.

Natural Gas Savings (MCF)			
	Grafton	Lorain	Total
Projected Savings	4,985	2,811	7,796
Year 1 Savings	2,643	7,351	9,994

The combined Electric Projected Savings for this ECM was 507,463 kWh per year and the total actual Annual Savings for this reporting period was **957,942 kWh**, as shown in the table below. Note that weather-related adjustments were made to the baselines and are detailed in the following section.

Electric Savings (kWh)			
	Grafton	Lorain	Total
Projected Savings	289,911	217,552	507,463
Year 1 Savings	140,295	817,647	957,942

Critical Variables Impacting Energy Usage

Some variables beyond Ameresco’s control can have a significant impact on energy consumption. The primary variable impacting this ECM is weather, and the method that was used to determine baseline adjustments is described below.

Baseline natural gas usage was divided between weather-related and non-weather-related usage. Non-weather-related usage, or the Base Load, was determined by averaging the consumption in July, August and September, then multiplying by 12. This is the usage attributed to base utilities such as domestic hot water, kitchen and laundry use. Weather-Related Use is the total usage minus the Base Load. Heating Degree Days (HDD) were obtained from the nearest representative NOAA weather station. The Adjusted natural gas baselines are shown below.

GRAFTON Adjusted natural gas baseline = baseline weather-related MCF x (current HDD / baseline HDD) + non-weather-related MCF = **40,712 MCF**

LORAIN Adjusted natural gas baseline = baseline weather-related MCF x (current HDD / baseline HDD) + non-weather-related MCF = **41,942 MCF**

Baseline electric usage was divided between non-weather-related usage, heating-related usage and cooling-related usage. Non-weather-related usage, or the Base Load, was determined by averaging the consumption in the Spring/Fall months, then multiplying by 12. Heating-related usage was determined by averaging the consumption in the Winter months, then multiplying by 4. And cooling-related usage was determined by averaging the consumption in the summer months, then multiplying by 4. Heating Degree Days (HDD) and Cooling Degree Days (CDD) were obtained from the nearest representative NOAA weather station. The Adjusted electric baselines are shown below.

GRAFTON Adjusted electric baseline = baseline heating-related Kwh x (current HDD/baseline HDD) + baseline cooling-related Kwh x (current CDD/baseline CDD) + non-weather-related Kwh = **5,027,196 kWh**

LORAIN Adjusted electric baseline = baseline heating-related Kwh x (current HDD/baseline HDD) + baseline cooling-related Kwh x (current CDD/baseline CDD) + non-weather-related Kwh = **5,104,047 kWh**

Metering Plan

Natural Gas: Actual monthly data was obtained from Columbia Gas for account # 12985841 001 000 2 (Grafton) and account # 12985843 001 000 8 (Lorain).

Electric: Actual monthly data was obtained from Ohio Edison for account # 56143479 (Grafton) and from the Village of Grafton for account # 01*750*01 (Lorain).

ECM 4-Optimize Controls at North Coast

IPMVP Option

The measurement and verification protocol for this measure is based on IPMVP Option C.

Baseline Energy Usage & Post Energy Usage

The electric and natural gas Baseline Energy Usage and Post Energy Usage for North Coast are shown in the following tables. The Baseline Year was March 2007 – February 2008 and Year 1 was November 2010 – October 2011.

Baseline Year		Electric (kWh)	Gas (MCF)
January	2008	265,200	2,356
February	2008	279,000	3,782
March	2007	238,200	2,950
April	2007	249,000	2,189
May	2007	250,800	1,114
June	2007	287,400	707
July	2007	294,600	540
August	2007	321,600	506
September	2007	300,000	534
October	2007	279,600	718
November	2007	265,200	1,306
December	2007	264,600	2,348
Totals		3,295,200	19,050

Year 1		Electric (kWh)	Gas (MCF)
January	2011	218,400	2,687
February	2011	238,200	2,783
March	2011	256,200	1,954
April	2011	262,200	1,635
May	2011	180,000	1,075
June	2011	218,400	665
July	2011	308,400	520
August	2011	311,400	449
September	2011	429,600	492
October	2011	165,600	579
November	2010	216,000	1,062
December	2010	235,200	1,889
Totals		3,039,600	15,790

The Projected Savings for this ECM were 313,710 kWh and 2,367 MCF per year per year. After making weather-related adjustments to the baseline usage (shown in the following section), the total Annual Savings for this reporting period are **269,563 kWh** and **3,637 MCF**.

Critical Variables Impacting Energy Usage

Some variables beyond Ameresco’s control can have a significant impact on energy consumption. The primary variable impacting this ECM is weather, and the method that was used to determine baseline adjustments is described below.

Baseline natural gas usage was divided between weather-related and non-weather-related usage. Non-weather-related usage, or the Base Load, was determined by averaging the consumption in July, August and September, then multiplying by 12. This is the usage attributed to base utilities such as domestic hot water, kitchen and laundry use. Weather-Related Use is the total usage minus the Base Load. Heating Degree Days (HDD) were obtained from the nearest representative NOAA weather station. The Adjusted natural gas baselines are shown below.

Adjusted natural gas baseline = baseline weather-related MCF x (current HDD / baseline HDD) + non-weather-related MCF = **19,427 MCF**

Baseline electric usage was divided between non-weather-related usage, heating-related usage and cooling-related usage. Non-weather-related usage, or the Base Load, was determined by averaging the consumption in the Spring/Fall months, then multiplying by 12. Heating-related usage was determined by averaging the consumption in the winter months, then multiplying by 4. And cooling-related usage was determined by averaging the summer months, then multiplying by 4. Heating Degree Days (HDD) and Cooling Degree Days (CDD) were obtained from the nearest representative NOAA weather station. The Adjusted electric baselines are shown below.

Adjusted electric baseline = baseline heating-related Kwh x (current HDD/baseline HDD) + baseline cooling-related Kwh x (current CDD/baseline CDD) + non-weather-related Kwh = **3,309,163 kWh**

Metering Plan

Natural Gas: Actual monthly data was obtained from Columbia Gas for account # 15767888.

Electric: Actual monthly data was obtained from the Village of Grafton for account # 01*9999*94.

ECM 5-Window Weatherization

IPMVP Option

The measurement and verification protocol for this measure is based on IPMVP Option D.

Savings Calculations

The annual energy savings associated with this ECM were stipulated as set forth below for the duration of this Agreement.

Grafton: 54 MCF / Year

Lorain: 44 MCF / Year

Since Baseline Energy Usage and Post Energy Usage were not established for this ECM, this ECM's contribution to the Total Annual Savings Amount is equal to the annual energy savings values set forth above multiplied by the Post Energy Rates determined in accordance with this Agreement.

Baseline Energy Usage

Not applicable

Post Energy Usage

Not applicable

Metering Plan

None

ECM 6-Waste Oil Application

IPMVP Option

The measurement and verification protocol for this measure is based on IPMVP Option D.

Savings Calculations

The annual natural gas savings associated with this ECM were stipulated to be 120 MCF / year for the duration of this Agreement.

Since Baseline Energy Usage and Post Energy Usage were not established for this ECM, this ECM's contribution to the Total Annual Savings Amount is equal to the annual energy savings value set forth above multiplied by the Post Energy Rates determined in accordance with this Agreement.

Baseline Energy Usage

Not applicable

Post Energy Usage

Not Applicable

Metering Plan

Not Applicable

ECM 7-Laundry Improvements

IPMVP Option

The measurement and verification protocol for this measure is based on IPMVP Option D.

Savings Calculations

The annual natural gas savings associated with this ECM were stipulated to be 325 MCF / year for the duration of this Agreement.

Since Baseline Energy Usage and Post Energy Usage were not established for this ECM, this ECM's contribution to the Total Annual Savings Amount is equal to the annual energy savings value set forth above multiplied by the Post Energy Rates determined in accordance with this Agreement.

Baseline Energy Usage

Not applicable

Post Energy Usage

Not Applicable

Metering Plan

Not Applicable

Summary

The total annual savings for the first year of the guarantee period are as shown below.

GCI	Electric Savings	Gas Savings
	KWH	MCF
Projected Savings	974,121	4,985
Year 1 Savings	824,505	2,817
Exceeded Savings By:	-149,616	-2,168

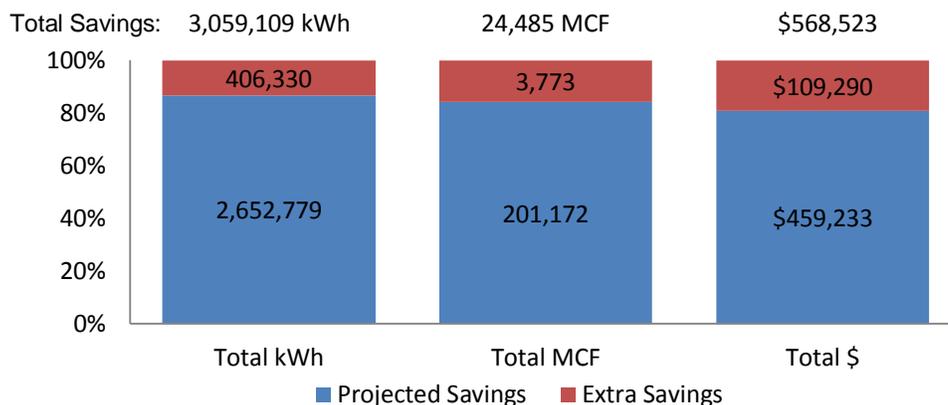
Farm	Electric Savings	Gas Savings
	KWH	MCF
Projected Savings	0	10,549
Year 1 Savings	0	10,312
Exceeded Savings By:	0	-237

LORCI	Electric Savings	Gas Savings
	KWH	MCF
Projected Savings	1,271,391	2,811
Year 1 Savings	1,871,485	7,720
Exceeded Savings By:	600,094	4,909

NCCTF	Electric Savings	Gas Savings
	KWH	MCF
Projected Savings	407,267	2,367
Year 1 Savings	363,119	3,637
Exceeded Savings By:	-44,148	1,270

Total	Electric Savings	Gas Savings	Total Savings
	KWH	MCF	\$
Projected Savings	2,652,779	20,712	\$459,233
Year 1 Savings	3,059,109	24,485	\$568,523
Exceeded Savings By:	406,330	3,773	\$109,290

* Savings based on rates listed on Page 1.



Conclusion

This concludes the first annual measurement and verification report for Grafton, Lorain, and North Coast Correctional Institutions, covering the period from November 2010 through October 2011. It is clear from the data presented in this report that the project is achieving great overall savings.

We continue to look forward to the success of this project and the opportunity to provide you with an improved infrastructure, lower operational costs and a better environment for the staff and inmates of Grafton Prison for years to come. It has been a pleasure working with you, and we look forward to helping your facilities see continued positive results from this endeavor.

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