

Annual Energy Savings for Green Revolving Fund 2015

Annual Energy Savings for Green Revolving Fund Summary

2015

As of December 31, 2015, 22 energy-saving projects had been completed and logged into the Green Revolving Investment Trust (GRITS) system. There are six water-saving projects and 16 energy saving projects comprised of 15 for electricity and one for natural gas.

The six water-saving projects are all existing initiatives from previous years consisting of two faucet retrofit projects and four turf removal projects. The total amount of water saved in 2015 was 2,785,390 gallons. The financial savings for water projects was \$8,634.

The financial savings from the single natural gas project was \$363.

The 15 electricity-saving initiatives are comprised of six existing projects and nine projects that were completed in 2015. Six of the nine projects completed in 2015 were part of the retro-commissioning project that was performed at Mainiero, Founders and Hoover. The total kilowatt hours saved for 2015 was 501,200. The financial savings from electrical projects was \$59,416.23.

The total amount that should be deposited into the Green Revolving Fund is \$68,413.23. If no projects are performed in 2016 (which is unlikely) the financial savings will increase to \$166,600 as a result of the ten projects completed in 2015 having a full year to generate savings versus the partial year each project had in 2015.

The GRITS System now reports electrical savings in a MMBTU format. The MMBTU savings for 2015 was 1,710 which converts to approximately 501,200 kwh which can be found on the fourth page of the electrical section of this report.

The large increase in savings in 2015 is the result of the six projects as part of the retro-commissioning project for Mainiero, Founders and Hoover and the replacement of all air conditioning units for Leo Hall and The Oaks. The Measurement and Verification Report from ABM Engineering for the retro-commissioning project is located at the back of this report. The in-house measurement and verification reports for The Oaks and Leo Hall are also located in the back of this report.

All Projects: Financial Savings Over Time, Stacked By Project

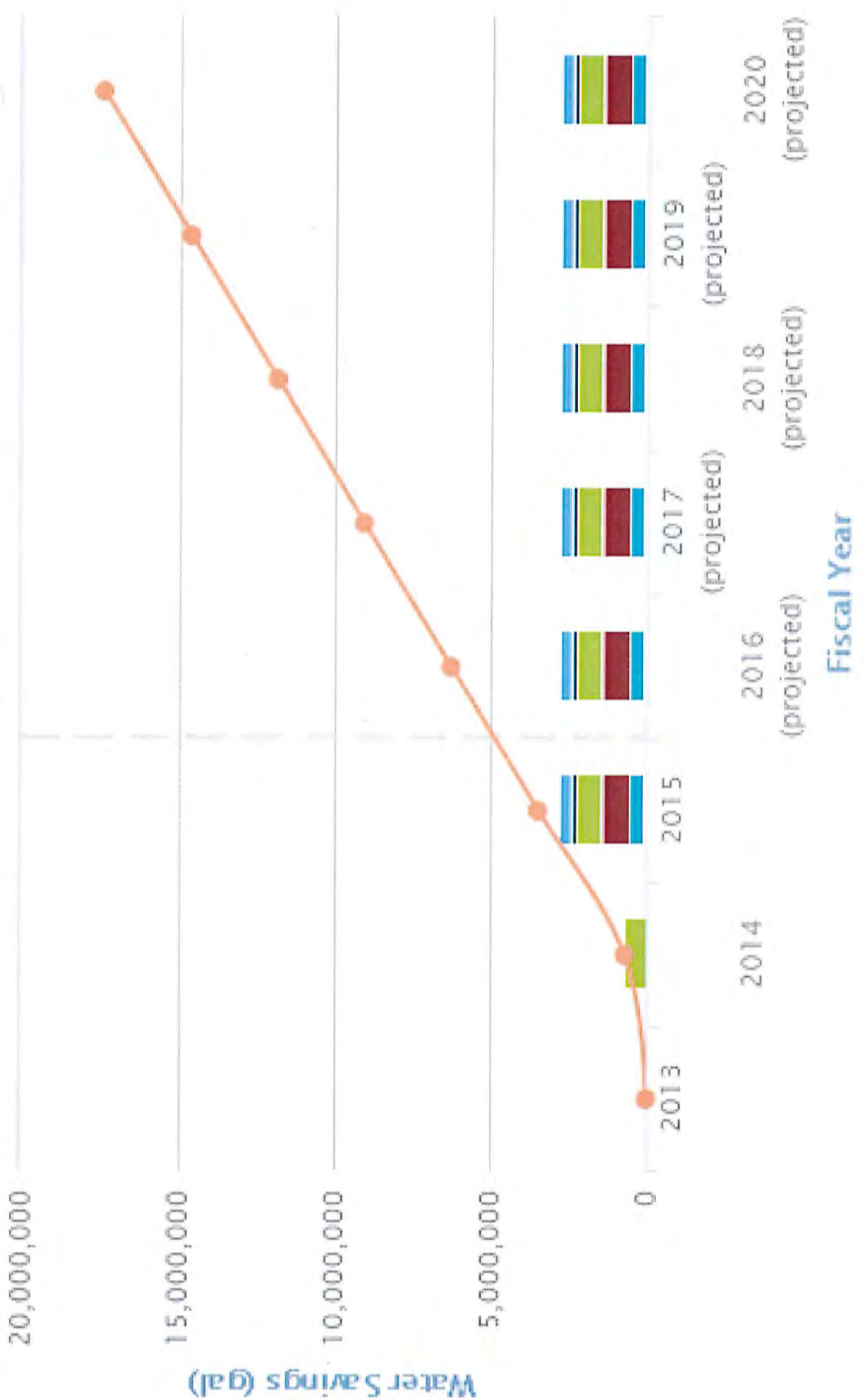


FISCAL YEAR	AVE OF TREES TURF CONVERSION (\$)	ACORN LIGHTS RETROFIT (\$)	BRANDT HALL TURF CONVERSION (\$)	CHICAGO FAUCET RETROFIT PROJECT (\$)	EXTERIOR BUILDING LIGHTS LED RETROFIT (\$)	FAUCET OUT FOR DORMS (\$)	FOUNDER HALL LAB CONTROLS (\$)	FOUNDERS HALL HOT WATER INSULATION (\$)	FOUNDERS HALL LAB #14 CONTROLS UPGRADE (\$)	HVAC CONVERSION AT LEO HALL (\$)
2013	0	0	0	843	420	0	0	0	0	0
2014	522	5,728	274	2,480	1,870	1,491	0	0	0	0
2015	1,031	6,060	541	2,480	1,870	2,790	1,460	363	1,577	494
2016	1,031	6,060	541	2,480	1,870	2,790	4,369	717	4,719	8,191
2017	1,031	6,060	541	2,480	1,870	2,790	4,369	717	4,719	8,191
2018	1,031	6,060	541	2,480	1,870	2,790	4,369	717	4,719	8,191
2019	1,031	6,060	541	2,480	1,870	2,790	4,369	717	4,719	8,191
2020	1,031	6,060	541	2,480	1,870	2,790	4,369	717	4,719	8,191

All Projects: Water Savings Over Time



All Projects: Water Savings Over Time, Stacked By Project



- AVE OF TREES TURF CONVERSION (gal)
- Chicago Faucet Retrofit Project (gal)
- STU-HAN TURF REMOVAL (gal)
- BRANDT HALL TURF CONVERSION (gal)
- FAUCET CHANGE OUT FOR DORMS (gal)
- TURF CONVERSION AT CAPS BUILDING ENTRANCE (gal)
- Cumulative Energy Savings (gal)

FISCAL YEAR	AVE OF TREES TURF CONVERSION (GAL)	BRANDT HALL TURF CONVERSION (GAL)	CHICAGO FAUCET RETROFIT PROJECT (GAL)	FAUCET CHANGE OUT FOR DORMS (GAL)	STU-HAN TURF REMOVAL (GAL)	TURF CONVERSION AT CAPS BUILDING ENTRANCE (GAL)	CUMULATIVE WATER SAVINGS (GAL)
2013	0	0	0	0	0	0	0
2014	911	478	668,493	27,123	5,039	325	702,369
2015	332,455	174,539	800,000	900,000	459,818	118,447	3,487,628
2016	332,455	174,539	800,000	900,000	459,818	118,447	6,272,887
2017	332,455	174,539	800,000	900,000	459,818	118,447	9,058,146
2018	332,455	174,539	800,000	900,000	459,818	118,447	11,843,405
2019	332,455	174,539	800,000	900,000	459,818	118,447	14,628,664
2020	332,455	174,539	800,000	900,000	459,818	118,447	17,413,923

Details

Notes

Attachments

University of La Verne

AVE OF TREES TURF CONVERSION

Archive This Project

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Remove turf from Ave of Trees area and convert to drought tolerant plant material using drip irrigation

Project Types (Required)

Water

Landscaping water/irrigation systems

Add New Project Type

Subtype

Buildings

New Building Name

Building Type

Year

Cost

Proposed (Required)

\$23,035.20

Timeline

Project Approved

April 29, 2014

Install Start Date

June 2, 2014

Actual Install Complete Date

Lifespan (Required)

June 30, 2014

20 years

Resources Tracked (Required)

Resource Units Cost per Unit Annual Savings

Water gal \$ 0.0031 332,455 gal

Add Resource Units \$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

(Options from the International Performance Measurement & Verification Protocol)

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	1,031	1,590	20,612
WATER SAVINGS (GAL)	332,455	512,768	6,649,100

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
14.59	14.59	37.1%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
1.9%	\$5,577.21	3.22%
UNIT COST PER MTCO ₂ E ABATED		
\$0.00		

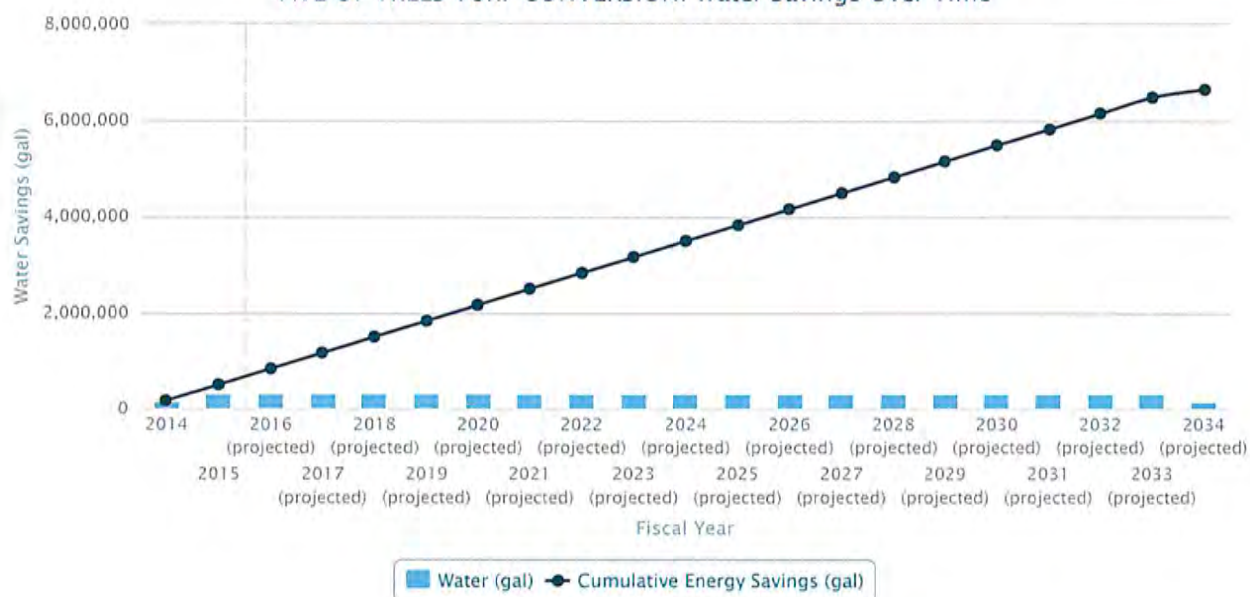
Project Transactions

Transaction Type	Date	Amount
Project Expenditure	May 9, 2014	(\$23,035.00)
Description		
Project Rebate	July 21, 2014	\$8,000.00
Description		
Add Transaction	January 13, 2016	
Description		

Project cost	\$15,035.00
Adjusted project cost to be repaid	\$15,035.00
Current amount owed on loan	\$15,035.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

AVE OF TREES TURF CONVERSION: Water Savings Over Time



FISCAL YEAR	WATER (GAL)	CUMULATIVE WATER SAVINGS (GAL)
2014	168,505	168,505
2015	332,455	500,960
2016	332,455	833,415
2017	332,455	1,165,870
2018	332,455	1,498,325
2019	332,455	1,830,780
2020	332,455	2,163,235
2021	332,455	2,495,690
2022	332,455	2,828,145
2023	332,455	3,160,600
2024	332,455	3,493,055
2025	332,455	3,825,510
2026	332,455	4,157,965
2027	332,455	4,490,420
2028	332,455	4,822,875
2029	332,455	5,155,330
2030	332,455	5,487,785
2031	332,455	5,820,240
2032	332,455	6,152,695
2033	332,455	6,485,150
2034	163,950	6,649,100

Details

Notes

Attachments

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BRANDT HALL TURF CONVERSION

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Remove turf on north side of Brandt Hall and convert to drought tolerant plant material using drip irrigation

Project Types (Required)

Water

Landscaping water/irrigation systems

- Add New Project Type

- Subtype -

Buildings

Brandt Hall

Residential house/

1960

New Building Name

- Building Type -

Year

Cost

Proposed (Required)

\$4,996.80

Timeline

Project Approved

May 9, 2014

Install Start Date

June 2, 2014

Actual Install Complete Date

June 30, 2014

Lifespan (Required)

20 years

Resources Tracked (Required)

Resource

Units

Cost per Unit

Annual Savings

Water

gal

\$ 0.0031

174,539 gal

- Add Resource -

- Units -

\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

Option C: Utility Data Analysis

Notes on this project's measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	541	835	10,821
WATER SAVINGS (GAL)	174,539	269,203	3,490,780

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)

1.47

LOAN REPAYMENT PERIOD (YEARS)

1.47

LIFETIME RETURN ON INVESTMENT (ROI)

1,257.8%

ANNUAL ROI

62.9%

NET PRESENT VALUE (NPV)

\$10,024.42

INTERNAL RATE OF RETURN (IRR)

70.36%

UNIT COST PER MTCO₂E ABATED

\$0.00

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	May 9, 2014	(\$4,997.00)
Description		
Project Rebate	July 21, 2014	\$4,200.00
Description		
- Add Transaction -	January 13, 2016	
Description		

Project cost

\$797.00

Adjusted project cost to be repaid

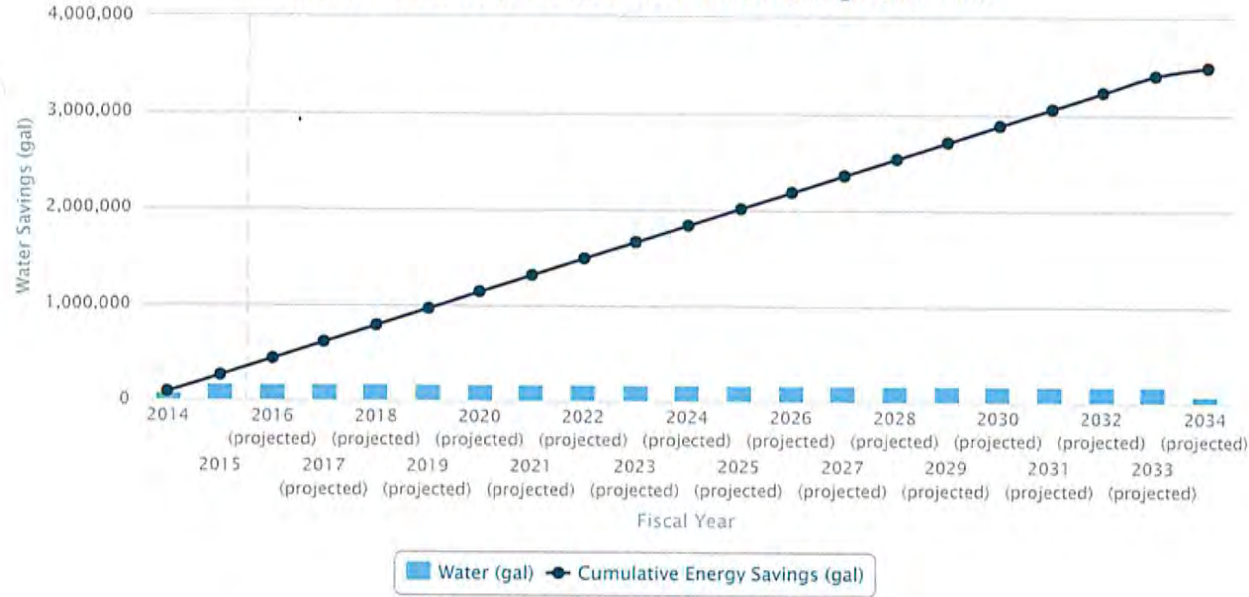
\$797.00

Current amount owed on loan

\$797.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

BRANDT HALL TURF CONVERSION: Water Savings Over Time



FISCAL YEAR	WATER (GAL)	CUMULATIVE WATER SAVINGS (GAL)
2014	88,465	88,465
2015	174,539	263,004
2016	174,539	437,543
2017	174,539	612,082
2018	174,539	786,621
2019	174,539	961,160
2020	174,539	1,135,699
2021	174,539	1,310,238
2022	174,539	1,484,777
2023	174,539	1,659,316
2024	174,539	1,833,855
2025	174,539	2,008,394
2026	174,539	2,182,933
2027	174,539	2,357,472
2028	174,539	2,532,011
2029	174,539	2,706,550
2030	174,539	2,881,089
2031	174,539	3,055,628
2032	174,539	3,230,167
2033	174,539	3,404,706
2034	86,074	3,490,780

Details

Notes

Attachments

University of La Verne

Chicago Faucet Retrofit Project

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Water saving faucets throughout campus - Water rate is \$3.11 per 1,000 gallons or \$.0031/gallon.

Project Types (Required)

Water

Sinks (faucets, aerators, etc)

- Add New Project Type

- Subtype -

Buildings

Chicago Faucet Retrofi

Office/Administrati

Year

New Building Name

- Building Type -

Year

Cost

Proposed (Required)

\$16,270.00

Timeline

Project Approved

June 1, 2013

Install Start Date

July 1, 2013

Actual Install Complete Date

August 30, 2013

Lifespan (Required)

10 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Water	gal	\$ 0.0031	800,000 gal

- Add Resource - - Units - \$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	2,480	5,891	24,800
WATER SAVINGS (GAL)	800,000	1,900,196	8,000,000

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
6.56	6.56	52.4%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
5.2%	\$8,530.00	8.55%
UNIT COST PER MTCO ₂ E ABATED		
\$0.00		

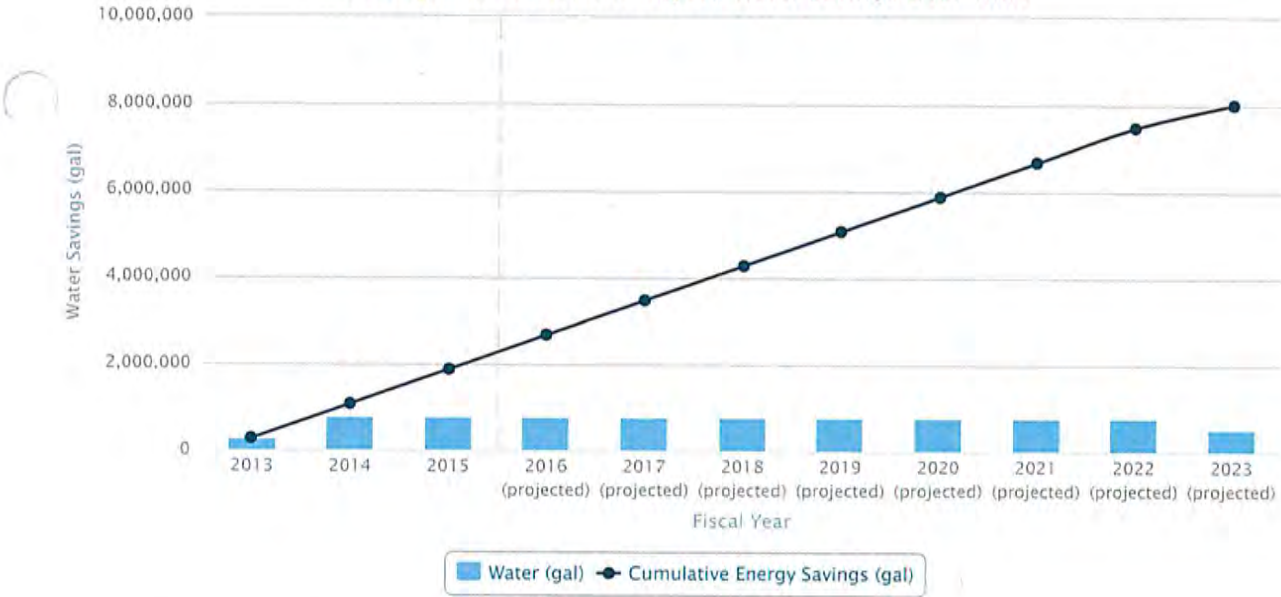
Project Transactions

Transaction Type	Date	Amount
Project Expenditure	August 30, 2013	(\$16,270.00)
Project Payment		
- Add Transaction -	January 13, 2016	
Description		

Project cost	\$16,270.00
Adjusted project cost to be repaid	\$16,270.00
Current amount owed on loan	\$16,270.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Chicago Faucet Retrofit Project: Water Savings Over Time



FISCAL YEAR	WATER (GAL)	CUMULATIVE WATER SAVINGS (GAL)
2013	271,781	271,781
2014	800,000	1,071,781
2015	800,000	1,871,781
2016	800,000	2,671,781
2017	800,000	3,471,781
2018	800,000	4,271,781
2019	800,000	5,071,781
2020	800,000	5,871,781
2021	800,000	6,671,781
2022	800,000	7,471,781
2023	528,219	8,000,000

Details

Notes

Attachments

University of La Verne

FAUCET CHANGE OUT FOR DORMS

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Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

R&R all dorm restroom faucets with Chicago Metering Faucets which includes: Brandt, Stu-Han and the Oaks

Project Types (Required)

Water

Sinks (faucets, aerators, etc)

- Add New Project Type

- Subtype -

Buildings

New Building Name

- Building Type -

Year

Cost

Proposed (Required)

\$27,537.16

Timeline

Project Approved

March 31, 2014

Install Start Date

March 31, 2014

Actual Install Complete Date

June 20, 2014

Lifespan (Required)

10 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Water	gal	\$ 0.0031	900,000 gal

- Add Resource - - Units - \$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

(Options from the International Performance Measurement & Verification Protocol)

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	2,790	4,380	27,904
WATER SAVINGS (GAL)	900,131	1,412,789	9,001,314

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
9.87	9.87	1.3%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
0.1%	\$366.91	0.24%
UNIT COST PER MTCO ₂ E ABATED		
\$0.00		

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	March 31, 2014	(\$27,537.16)

Description

- Add Transaction -

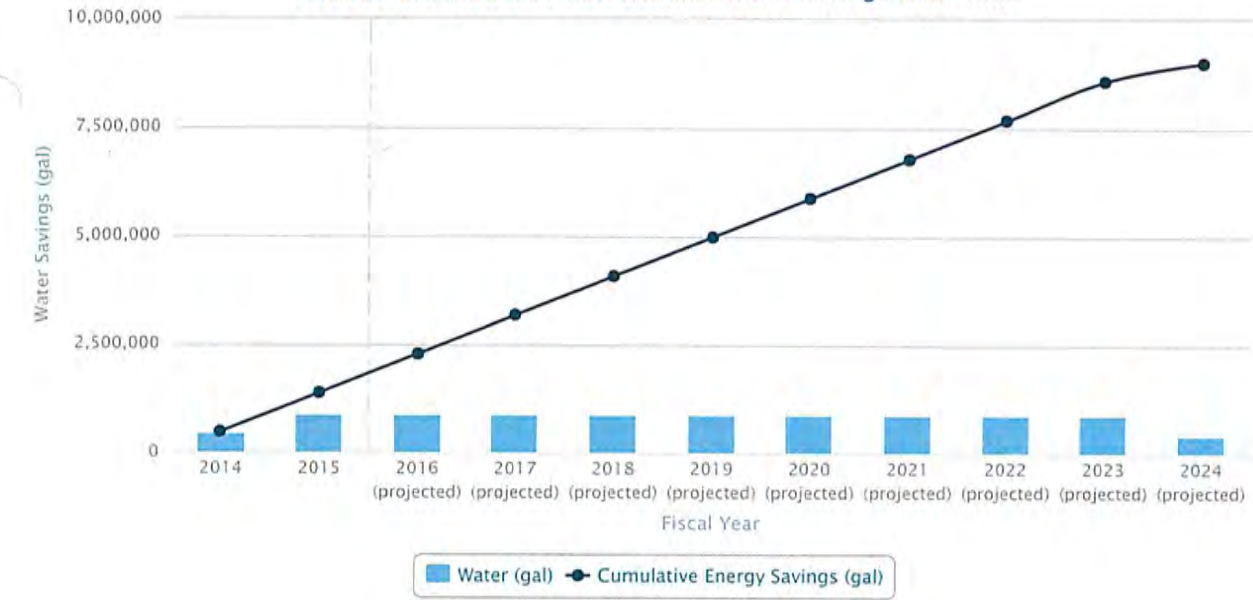
January 13, 2016

Description

Project cost	\$27,537.16
Adjusted project cost to be repaid	\$27,537.16
Current amount owed on loan	\$27,537.16

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

FAUCET CHANGE OUT FOR DORMS: Water Savings Over Time



FISCAL YEAR	WATER (GAL)	CUMULATIVE WATER SAVINGS (GAL)	Below graphs look at financial savings across all Completed and In-progress projects. To graph only one project, click 'Single Project'
2014	480,822	480,822	
2015	900,000	1,380,822	
2016	900,000	2,280,822	
2017	900,000	3,180,822	
2018	900,000	4,080,822	
2019	900,000	4,980,822	
2020	900,000	5,880,822	
2021	900,000	6,780,822	
2022	900,000	7,680,822	
2023	900,000	8,580,822	
2024	420,492	9,001,314	

Details

Notes

Attachments

University of La Verne

STU-HAN TURF REMOVAL

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Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Remove turf and convert to drought-tolerant plant material using drip irrigation

Project Types (Required)

Water

Landscaping water/irrigation systems

- Add New Project Type

- Subtype -

Buildings

Stu-Han

Residential house/a

1960

New Building Name

- Building Type -

Year

Cost

Proposed (Required)

\$23,881.78

Timeline

Project Approved

April 29, 2014

Install Start Date

May 27, 2014

Actual Install Complete Date

June 27, 2014

Lifespan (Required)

20 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Water	gal	\$ 0.0031	459,818 gal

- Add Resource -	- Units -	\$	
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Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	1,425	2,210	28,509
WATER SAVINGS (GAL)	459,818	712,988	9,196,360

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
10.02	10.02	99.6%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
5.0%	\$14,226.72	7.74%
UNIT COST PER MTCO ₂ E ABATED		
\$0.00		

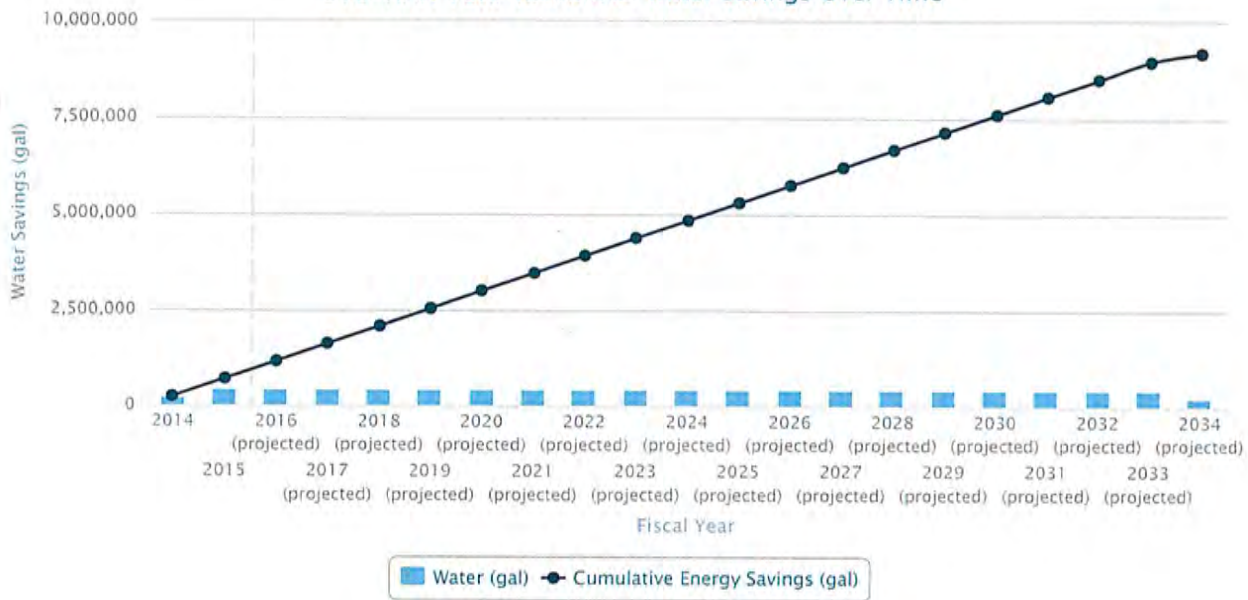
Project Transactions

Transaction Type	Date	Amount
Project Expenditure	May 7, 2014	(\$23,882.00)
Description		
Project Rebate	July 21, 2014	\$9,600.00
MWD Rebate		
- Add Transaction -	January 13, 2016	
Description		

Project cost	\$14,282.00
Adjusted project cost to be repaid	\$14,282.00
Current amount owed on loan	\$14,282.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

STU-HAN TURF REMOVAL: Water Savings Over Time



FISCAL YEAR	WATER (GAL)	CUMULATIVE WATER SAV	Below graphs look at financial savings across all Completed and in-progress projects. To graph only one project, click "Single Project"
2014	236,838	236,838	
2015	459,818	696,656	
2016	459,818	1,156,474	
2017	459,818	1,616,292	
2018	459,818	2,076,110	
2019	459,818	2,535,928	
2020	459,818	2,995,746	
2021	459,818	3,455,564	
2022	459,818	3,915,382	
2023	459,818	4,375,200	
2024	459,818	4,835,018	
2025	459,818	5,294,836	
2026	459,818	5,754,654	
2027	459,818	6,214,472	
2028	459,818	6,674,290	
2029	459,818	7,134,108	
2030	459,818	7,593,926	
2031	459,818	8,053,744	
2032	459,818	8,513,562	
2033	459,818	8,973,380	
2034	222,980	9,196,360	

Details

Notes

Attachments

University of La Verne

TURF CONVERSION AT CAPS BUILDING ENTRANCE

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Remove turf in front of building and convert to drought tolerant plant material using drip irrigation

Project Types (Required)

Water

Landscaping water/irrigation systems

- Add New Project Type

- Subtype -

Buildings

New Building Name

- Building Type -

Year

Cost

Proposed (Required)

\$4,952.58

Timeline

Project Approved

May 5, 2014

Install Start Date

June 2, 2014

Actual Install Complete Date

June 30, 2014

Lifespan (Required)

20 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Water	gal	\$ 0.0031	118,447 gal

- Add Resource -

- Units -

\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

(Options from the International Performance Measurement & Verification Protocol)

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	367	566	7,344
WATER SAVINGS (GAL)	118,447	182,689	2,368,940

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
5.73	5.73	249.2%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
12.5%	\$5,240.71	16.72%
UNIT COST PER MTCO ₂ E ABATED		
\$0.00		

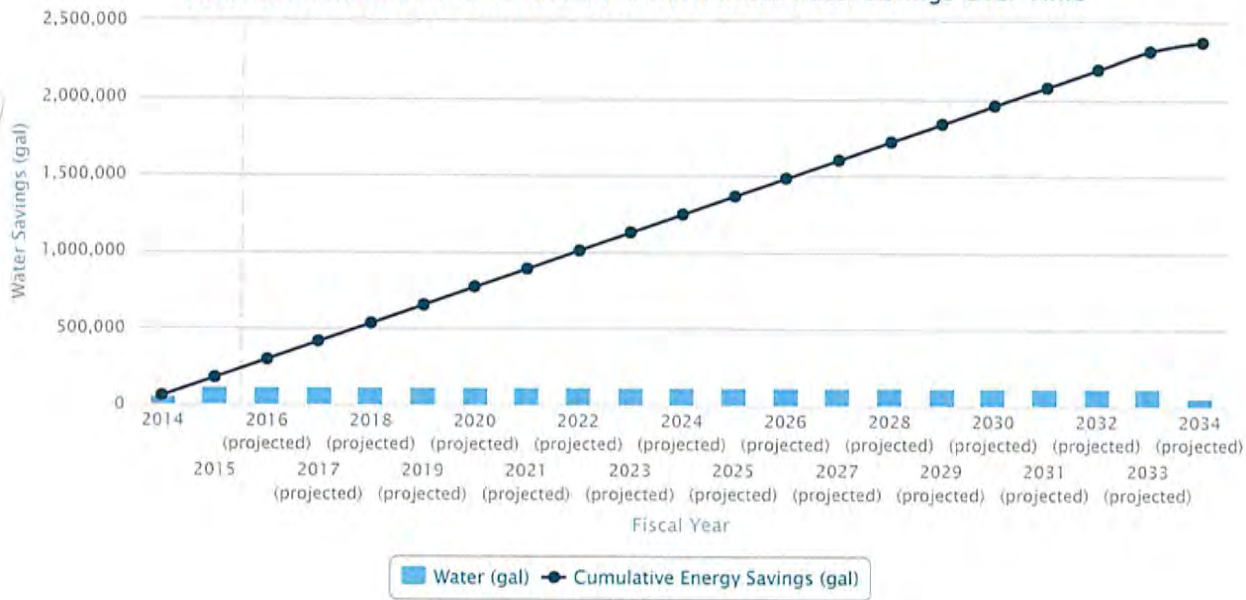
Project Transactions

Transaction Type	Date	Amount
Project Expenditure	May 9, 2014	(\$4,953.00)
Description		
Project Rebate	July 21, 2014	\$2,850.00
Description		
- Add Transaction -	January 13, 2016	
Description		

Project cost	\$2,103.00
Adjusted project cost to be repaid	\$2,103.00
Current amount owed on loan	\$2,103.00

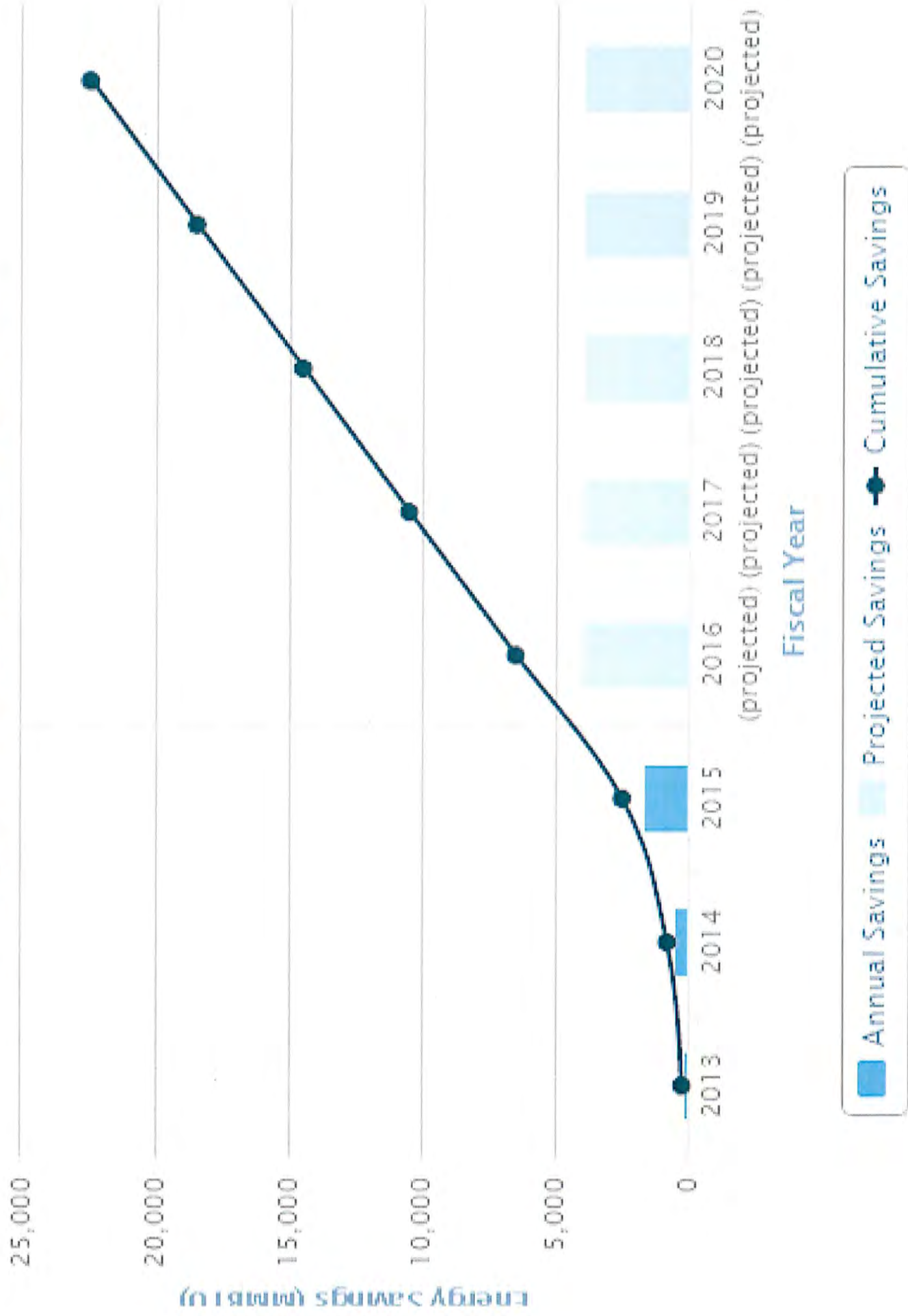
Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

TURF CONVERSION AT CAPS BUILDING ENTRANCE: Water Savings Over Time

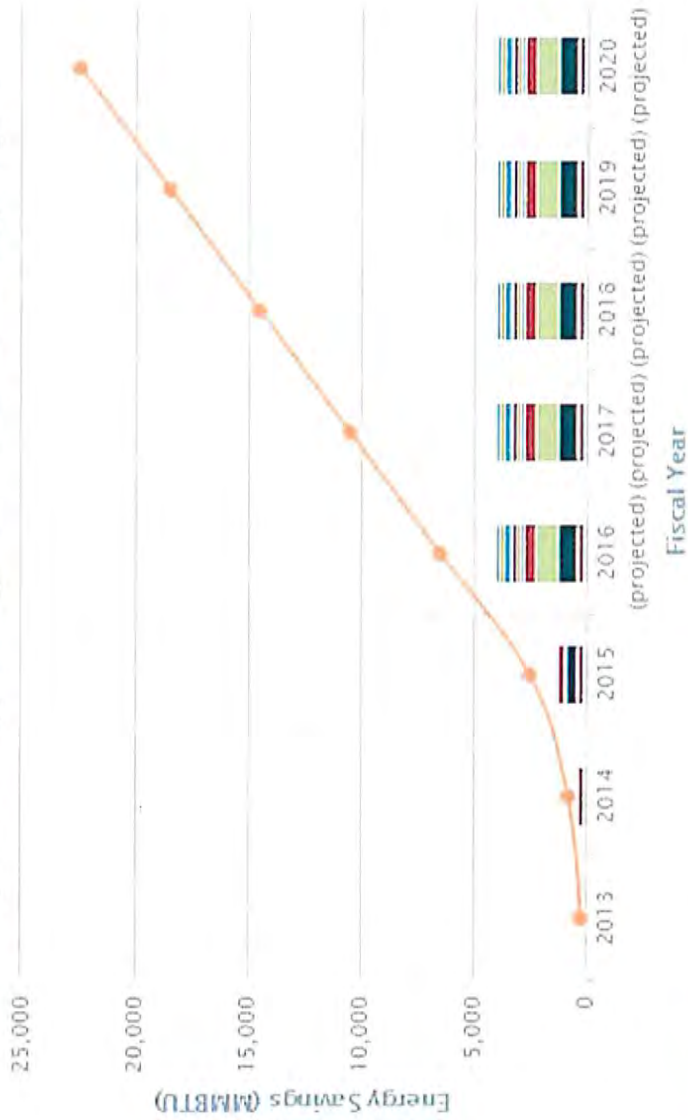


FISCAL YEAR	WATER (GAL)	CUMULATIVE WATER SAVINGS (GAL)
2014	60,035	60,035
2015	118,447	178,482
2016	118,447	296,929
2017	118,447	415,376
2018	118,447	533,823
2019	118,447	652,270
2020	118,447	770,717
2021	118,447	889,164
2022	118,447	1,007,611
2023	118,447	1,126,058
2024	118,447	1,244,505
2025	118,447	1,362,952
2026	118,447	1,481,399
2027	118,447	1,599,846
2028	118,447	1,718,293
2029	118,447	1,836,740
2030	118,447	1,955,187
2031	118,447	2,073,634
2032	118,447	2,192,081
2033	118,447	2,310,528
2034	58,412	2,368,940

All Projects: Energy Savings Over Time

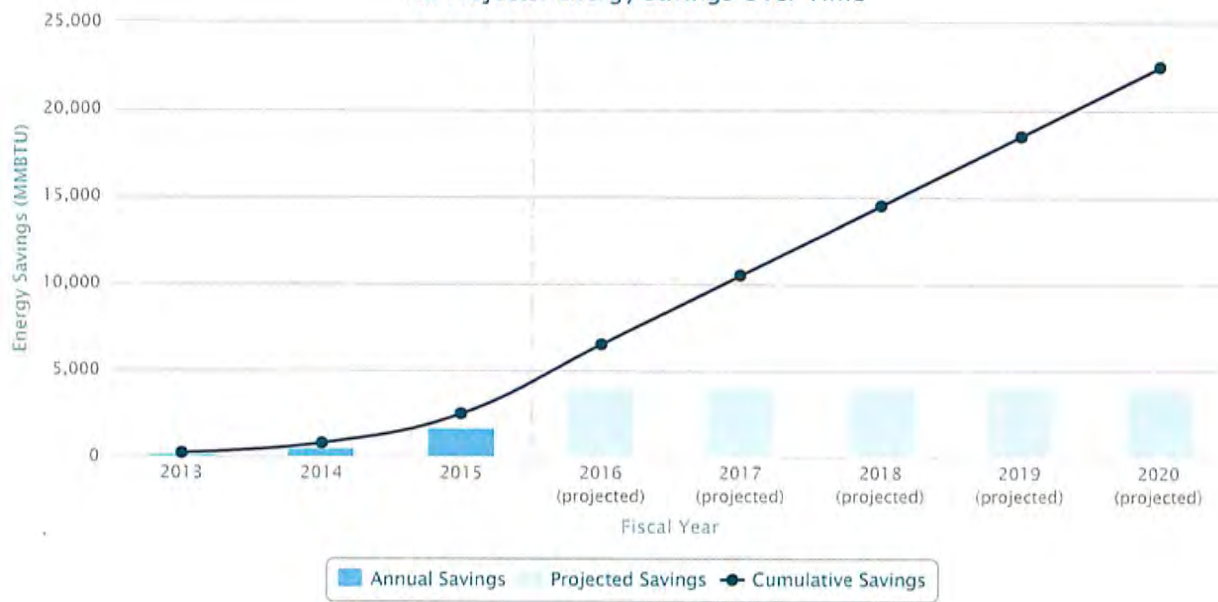


All Projects: Energy Savings Over Time, Stacked By Project



- Acorn Lights Retrofit (MMBTU)
- Exterior Building Lights LED Retrofit (MMBTU)
- Founder Hall Lab Controls (MMBTU)
- Founders Hall Hot Water Insulation (MMBTU)
- Founders Hall #14 Controls Upgrade (MMBTU)
- Hoover Building Lighting Upgrade (MMBTU)
- Hoover Controls Upgrade (MMBTU)
- HVAC Conversion at Leo Hall (MMBTU)
- HVAC Renovation at Oaks Residence Halls (MMBTU)
- La Fetra Auditorium VFD and Controls Upgrade (MMBTU)
- LED Uplights for Founders Hall (MMBTU)
- Mainiero VFD Installation and Controls Upgrade (MMBTU)
- Oaks Sconce Light LED Conversion (MMBTU)
- Parking Lot D LED Retrofit (MMBTU)
- Parking Lot E LED Retrofit (MMBTU)
- SSAP LED Retrofit (MMBTU)
- Cumulative Energy Savings (MMBTU)

All Projects: Energy Savings Over Time



FISCAL YEAR	ANNUAL SAVINGS (MMBTU)	PROJECTED SAVINGS (MMBTU)	CUMULATIVE SAVINGS (MMBTU)
2013	210	0	210
2014	564	0	773
2015	1,710	0	2,484
2016	0	4,000	6,483
2017	0	4,000	10,483
2018	0	4,000	14,482
2019	0	4,000	18,482
2020	0	4,000	22,482

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on the Web since 1996

Million BTU Conversion Chart

Energy and Work Conversion, British And American

Million BTU Conversion Chart

Energy and Work Conversion, British And American

Your value (Million BTU, MMBTU):**1,710****International System (SI)**

megajoule (MJ)	1,804,000
kilojoule (kJ)	1,804,000,000
joule (J)	1,804,000,000,000

British and American

quad	0.00000171
therm	17,100
British Thermal Unit (BTU)	1,710,000,000
Foot-Pound (ft*lbs)	1,331,000,000,000

Common Units

megacalorie (Mcal)	430,900
kilocalorie (kcal)	430,900,000
metre-kilogram (mkg)	185,100,000,000
calorie (cal)	430,900,000,000
kilowatt hour (kW*h)	501,200
watt hour (W*h)	501,200,000
watt second (W*s)	1,804,000,000,000
erg	1.804×10^{19}
electronvolt (eV)	1.126×10^{31}

**TNT Energy Equivalent**

tonne (metric) of TNT	391.2
ton of TNT	431.2
kilogram of TNT	391,200

Natural Gas Energy Equivalent**Oil and Fuel Energy Equivalent**

gigatonne of oil equivalent (Gtoe)	0.00000004309
megatonne of oil equivalent (Mtoe)	

Details

Notes

Attachments

University of La Verne

Founders Hall Hot Water Insulation

Archive This Project

GENERATE - Project PDF

Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Insulate hot water components for different air handlers within building.
Done as part of retro-commissioning project 2015.

Project Types (Required)

Water

Water heaters

— Add New Project Type —

— Subtype —

Buildings

Founders Hall

Academic/Classroom

1926

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$6,580.00

Timeline

Project Approved

May 27, 2015

Install Start Date

May 27, 2015

Actual Install Complete Date

June 30, 2015

Lifespan (Required)

25 years

Resources Tracked (Required)

Resource

Units

Cost per Unit

Annual Savings

Natural Gas

MCF

\$ 10.1000

71

MCF

— Add Resource —

— Units —

\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

Option A: Retrofit Isolation with Key Parameter Measurement

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	717	389	17,928
ENERGY SAVINGS (MMBTU)	73	40	1,821
EMISSIONS ABATED (MTCO ₂ E)	3.9	2.1	96.7

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)

9.18

LOAN REPAYMENT PERIOD (YEARS)

9.18

LIFETIME RETURN ON INVESTMENT (ROI)

172.5%

ANNUAL ROI

6.9%

NET PRESENT VALUE (NPV)

\$11,348.49

INTERNAL RATE OF RETURN (IRR)

9.87%

UNIT COST PER MTCO₂E ABATED

\$68.02

Project Transactions

Transaction Type

Date

Amount

— Add Transaction —

January 13, 2016

Description

Project cost

\$6,580.00

Adjusted project cost to be repaid

\$6,580.00

Current amount owed on loan

\$6,580.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

M&V being performed as part of retro-commissioning project

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-06-30	0.0000	0	(6,580.00)	0.00	0.00	6,580.00
2015-12-31	9.8441	37	363.46	363.46	363.46	6,216.54
2016-12-31	9.8441	73	717.10	717.10	1,080.56	5,499.44
2017-12-31	9.8441	73	717.10	717.10	1,797.66	4,782.34
2018-12-31	9.8441	73	717.10	717.10	2,514.76	4,065.24
2019-12-31	9.8441	73	717.10	717.10	3,231.86	3,348.14
2020-12-31	9.8441	73	717.10	717.10	3,948.96	2,631.04
2021-12-31	9.8441	73	717.10	717.10	4,666.06	1,913.94
2022-12-31	9.8441	73	717.10	717.10	5,383.16	1,196.84
2023-12-31	9.8441	73	717.10	717.10	6,100.26	479.74
2024-12-31	9.8441	73	717.10	539.08	6,639.34	0.00
2025-12-31	9.8441	73	717.10	179.28	6,818.62	0.00
2026-12-31	9.8441	73	717.10	179.28	6,997.89	0.00
2027-12-31	9.8441	73	717.10	179.28	7,177.17	0.00
2028-12-31	9.8441	73	717.10	179.28	7,356.44	0.00
2029-12-31	9.8441	73	717.10	179.28	7,535.72	0.00
2030-12-31	9.8441	73	717.10	179.28	7,714.99	0.00
2031-12-31	9.8441	73	717.10	179.28	7,894.27	0.00
2032-12-31	9.8441	73	717.10	179.28	8,073.54	0.00
2033-12-31	9.8441	73	717.10	179.28	8,252.82	0.00
2034-12-31	9.8441	73	717.10	179.28	8,432.09	0.00
2035-12-31	9.8441	73	717.10	179.28	8,611.37	0.00
2036-12-31	9.8441	73	717.10	179.28	8,790.64	0.00
2037-12-31	9.8441	73	717.10	179.28	8,969.92	0.00
2038-12-31	9.8441	73	717.10	179.28	9,149.19	0.00
2039-12-31	9.8441	73	717.10	179.28	9,328.47	0.00
2040-06-29	9.8441	36	354.63	88.66	9,417.12	0.00
Total Realized	-	40	389	389	-	-
Average	9.8441	73	717	-	-	-
Total Realized and Projected	-	1,821	17,928	9,417	-	-

Details

Notes

Attachments

University of La Verne

Acorn Lights Retrofit

Archive This Project

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

This project involved replacing lights along our sidewalks with LED lighting.

Project Types (Required)

Lighting

Lighting upgrade/retrofit

- Add New Project Type

- Subtype -

Buildings

Campus Acorn Lights

Other/including No

2013

New Building Name

- Building Type -

Year

Cost

Proposed (Required)

\$9,951.00

Timeline

Project Approved

November 11, 2013

Install Start Date

November 11, 2013

Actual Install Complete Date

January 21, 2014

Lifespan (Required)

10 years

Resources Tracked (Required)

Resource

Units

Cost per Unit

Annual Savings

Electricity

kWh

\$ 0.1420

42,679 kWh

- Add Resource -

- Units -

\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	6,060	12,004	60,603
ENERGY SAVINGS (MMBTU)	146	288	1,456
EMISSIONS ABATED (MTCO ₂ E)	19.8	39.2	197.8

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)
1.64LOAN REPAYMENT PERIOD (YEARS)
1.64LIFETIME RETURN ON INVESTMENT (ROI)
509.0%ANNUAL ROI
50.9%NET PRESENT VALUE (NPV)
\$50,652.27INTERNAL RATE OF RETURN (IRR)
60.73%UNIT COST PER MTCO₂E ABATED
\$50.32

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	November 11, 2013	(\$9,951.00)
Project payment		

- Add Transaction -

January 13, 2016

Description

Project cost	\$9,951.00
Adjusted project cost to be repaid	\$9,951.00
Current amount owed on loan	\$9,951.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2014-01-21	0.0000	0	(9,951.00)	0.00	0.00	9,951.00
2014-12-31	41.6161	138	5,728.34	5,728.34	5,728.34	4,222.66
2015-12-31	41.6161	146	6,060.42	4,682.10	10,410.44	0.00
2016-12-31	41.6161	146	6,060.42	1,515.10	11,925.54	0.00
2017-12-31	41.6161	146	6,060.42	1,515.10	13,440.65	0.00
2018-12-31	41.6161	146	6,060.42	1,515.10	14,955.75	0.00
2019-12-31	41.6161	146	6,060.42	1,515.10	16,470.86	0.00
2020-12-31	41.6161	146	6,060.42	1,515.10	17,985.96	0.00
2021-12-31	41.6161	146	6,060.42	1,515.10	19,501.07	0.00
2022-12-31	41.6161	146	6,060.42	1,515.10	21,016.17	0.00
2023-12-31	41.6161	146	6,060.42	1,515.10	22,531.28	0.00
2024-01-20	41.6161	8	331.17	82.79	22,614.07	0.00
Total Realized	-	288	12,004	10,464	-	-
Average	41.6161	146	6,060	-	-	-
Total Realized and Projected	-	1,456	60,603	22,614	-	-

Details

Notes  1

Attachments

University of La Verne

Exterior Building Lights LED Retrofit

 Archive This Project GENERATE - Project PDF Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

This project involved replacing external building lighting with LED lighting.

Project Types (Required)

Lighting

Lighting upgrade/retrofit

— Add New Project Type

— Subtype —

Buildings

Dailey, Stu-Han, Brand

Student/communit

2013

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$14,168.00

Timeline

Project Approved

July 1, 2013

Install Start Date

July 15, 2013

Actual Install Complete Date

October 11, 2013

Lifespan (Required)

10 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Electricity	kWh	\$ 0.1420	13,166 kWh

— Add Resource — — Units —

\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol 

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	1,870	4,226	18,696
ENERGY SAVINGS (MMBTU)	45	102	449
EMISSIONS ABATED (MTCO ₂ E) 	6.1	13.8	61.0

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS) 7.58	LOAN REPAYMENT PERIOD (YEARS) 7.58	LIFETIME RETURN ON INVESTMENT (ROI) 32.0%
ANNUAL ROI 3.2%	NET PRESENT VALUE (NPV) \$4,527.72	INTERNAL RATE OF RETURN (IRR) 5.41%
UNIT COST PER MTCO ₂ E ABATED \$232.24		

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	October 11, 2013	(\$14,168.00)
Project payment		
— Add Transaction —	January 13, 2016	
Description		

Project cost	\$14,168.00
Adjusted project cost to be repaid	\$14,168.00
Current amount owed on loan	\$14,168.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Measurement provided by independent consultant

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2013-10-11	0.0000	0	(14,168.00)	0.00	0.00	14,168.00
2013-12-31	41.6161	10	420.01	420.01	420.01	13,747.99
2014-12-31	41.6161	45	1,869.57	1,869.57	2,289.59	11,878.41
2015-12-31	41.6161	45	1,869.57	1,869.57	4,159.16	10,008.84
2016-12-31	41.6161	45	1,869.57	1,869.57	6,028.73	8,139.27
2017-12-31	41.6161	45	1,869.57	1,869.57	7,898.30	6,269.70
2018-12-31	41.6161	45	1,869.57	1,869.57	9,767.87	4,400.13
2019-12-31	41.6161	45	1,869.57	1,869.57	11,637.45	2,530.55
2020-12-31	41.6161	45	1,869.57	1,869.57	13,507.02	660.98
2021-12-31	41.6161	45	1,869.57	963.13	14,470.15	0.00
2022-12-31	41.6161	45	1,869.57	467.39	14,937.54	0.00
2023-10-10	41.6161	35	1,449.56	362.39	15,299.93	0.00
Total Realized	-	102	4,226	4,226	-	-
Average	41.6161	45	1,870	-	-	-
Total Realized and Projected	-	449	18,696	15,300	-	-

Details

Notes

Attachments

University of La Verne

Founder Hall Lab Controls

Archive This Project

GENERATE - Project PDF

Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

install sensors and controls for the hoods and HVAC controls for the four labs beneath Morgan Auditorium

Project Types (Required)

Building Heating, Ventilation, Air Conditioning (HVAC)

Fume hoods

- Add New Project Type

- Subtype -

Buildings

Founders Hall

Academic/Classroom

1926

New Building Name

- Building Type -

Year

Cost

Proposed (Required)

\$61,960.00

Timeline

Project Approved

May 27, 2015

Install Start Date

May 27, 2015

Actual Install Complete Date

September 1, 2015

Lifespan (Required)

20

years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Electricity	kWh	\$ 0.1270	34,400 kWh

- Add Resource -

- Units -

\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

- Select -

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	4,369	1,615	87,376
ENERGY SAVINGS (MMBTU)	117	43	2,348
EMISSIONS ABATED (MTCO ₂ E)	15.9	5.9	318.8

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
14.18	14.18	41.0%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
2.1%	\$25,416.00	3.53%
UNIT COST PER MTCO ₂ E ABATED		
\$194.36		

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	May 27, 2015	(\$61,960.00)
Description		
- Add Transaction -	January 13, 2016	
Description		
Project cost		\$61,960.00
Adjusted project cost to be repaid		\$61,960.00
Current amount owed on loan		\$61,960.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-09-01	0.0000	0	(61,960.00)	0.00	0.00	61,960.00
2015-12-31	37.2200	39	1,460.26	1,460.26	1,460.26	60,499.74
2016-12-31	37.2200	117	4,368.80	4,368.80	5,829.06	56,130.94
2017-12-31	37.2200	117	4,368.80	4,368.80	10,197.86	51,762.14
2018-12-31	37.2200	117	4,368.80	4,368.80	14,566.66	47,393.34
2019-12-31	37.2200	117	4,368.80	4,368.80	18,935.46	43,024.54
2020-12-31	37.2200	117	4,368.80	4,368.80	23,304.26	38,655.74
2021-12-31	37.2200	117	4,368.80	4,368.80	27,673.06	34,286.94
2022-12-31	37.2200	117	4,368.80	4,368.80	32,041.86	29,918.14
2023-12-31	37.2200	117	4,368.80	4,368.80	36,410.66	25,549.34
2024-12-31	37.2200	117	4,368.80	4,368.80	40,779.46	21,180.54
2025-12-31	37.2200	117	4,368.80	4,368.80	45,148.26	16,811.74
2026-12-31	37.2200	117	4,368.80	4,368.80	49,517.06	12,442.94
2027-12-31	37.2200	117	4,368.80	4,368.80	53,885.86	8,074.14
2028-12-31	37.2200	117	4,368.80	4,368.80	58,254.66	3,705.34
2029-12-31	37.2200	117	4,368.80	3,871.21	62,125.86	0.00
2030-12-31	37.2200	117	4,368.80	1,092.20	63,218.06	0.00
2031-12-31	37.2200	117	4,368.80	1,092.20	64,310.26	0.00
2032-12-31	37.2200	117	4,368.80	1,092.20	65,402.46	0.00
2033-12-31	37.2200	117	4,368.80	1,092.20	66,494.66	0.00
2034-12-31	37.2200	117	4,368.80	1,092.20	67,586.86	0.00
2035-08-31	37.2200	78	2,908.54	727.14	68,314.00	0.00
Total Realized	-	43	1,615	1,615	-	-
Average	37.2200	117	4,369	-	-	-
Total Realized and Projected	-	2,348	87,376	68,314	-	-

University of La Verne

Founders Hall Lab #14 Controls Upgrade

Archive This Project

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Controls upgrade for NMR lab as part of retro-commissioning project

Project Types (Required)

Building Heating, Ventilation, Air Conditioning (HVAC)
Ventilation/Air handling units

— Add New Project Type

— Subtype —

Buildings

Founders Hall

Academic/Classroom

1926

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$7,074.80

Timeline

Project Approved

May 27, 2015

Install Start Date

May 27, 2015

Actual Install Complete Date

September 1, 2015

Lifespan (Required)

20 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Natural Gas	MCF	\$ 10.1000	230 MCF
Electricity	kWh	\$ 0.1270	18,870 kWh
— Add Resource — — Units — \$			

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification Protocol

Option A: Retrofit Isolation with Key Parameter Measurement

Notes on this projects measurement and verification methodology:

http://arits.greenbillion.org/projects/1654

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	4,719	1,745	94,390
ENERGY SAVINGS (MMBTU)	300	111	6,007
EMISSIONS ABATED (MTCO ₂ E)	21.3	7.9	425.5

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
1.10	1.10	1,725.7%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
86.3%	\$89,219.80	96.35%
UNIT COST PER MTCO ₂ E ABATED		
\$12.15		

Project Transactions

Transaction Type	Date	Amount
Project Rebate	May 27, 2015	\$1,150.00
So Cal Gas Incentive		
Project Rebate	May 27, 2015	\$754.80
Description		
Project Expenditure	May 27, 2015	(\$7,074.80)
SCE Incentive		
— Add Transaction —		
	January 13, 2016	
Description		

Project cost	\$5,170.00
Adjusted project cost to be repaid	\$5,170.00
Current amount owed on loan	\$5,170.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

M&V being performed as part of retro-commissioning project 2015

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-09-01	0.0000	0	(5,170.00)	0.00	0.00	5,170.00
2015-12-31	23.5320	100	1,577.47	1,577.47	1,577.47	3,592.53
2016-12-31	23.5320	300	4,719.49	3,874.27	5,451.74	0.00
2017-12-31	23.5320	300	4,719.49	1,179.87	6,631.61	0.00
2018-12-31	23.5320	300	4,719.49	1,179.87	7,811.49	0.00
2019-12-31	23.5320	300	4,719.49	1,179.87	8,991.36	0.00
2020-12-31	23.5320	300	4,719.49	1,179.87	10,171.23	0.00
2021-12-31	23.5320	300	4,719.49	1,179.87	11,351.10	0.00
2022-12-31	23.5320	300	4,719.49	1,179.87	12,530.98	0.00
2023-12-31	23.5320	300	4,719.49	1,179.87	13,710.85	0.00
2024-12-31	23.5320	300	4,719.49	1,179.87	14,890.72	0.00
2025-12-31	23.5320	300	4,719.49	1,179.87	16,070.59	0.00
2026-12-31	23.5320	300	4,719.49	1,179.87	17,250.47	0.00
2027-12-31	23.5320	300	4,719.49	1,179.87	18,430.34	0.00
2028-12-31	23.5320	300	4,719.49	1,179.87	19,610.21	0.00
2029-12-31	23.5320	300	4,719.49	1,179.87	20,790.08	0.00
2030-12-31	23.5320	300	4,719.49	1,179.87	21,969.96	0.00
2031-12-31	23.5320	300	4,719.49	1,179.87	23,149.83	0.00
2032-12-31	23.5320	300	4,719.49	1,179.87	24,329.70	0.00
2033-12-31	23.5320	300	4,719.49	1,179.87	25,509.57	0.00
2034-12-31	23.5320	300	4,719.49	1,179.87	26,689.45	0.00
2035-08-31	23.5320	200	3,142.02	785.50	27,474.95	0.00
Total Realized	-	111	1,745	1,745	-	-
Average	23.5320	300	4,719	-	-	-
Total Realized and Projected	-	6,007	94,390	27,475	-	-

Details

Notes

Attachments

University of La Verne

Hoover Building Lighting Upgrade

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Retrofit bulbs to LED, add occupancy sensors and add daylighting controls near existing skylights as part of retro-commissioning project

Project Types (Required)

Lighting

Lighting upgrade/retrofit

— Add New Project Type —

— Subtype —

Buildings

Hoover Building

Academic/Classroom

1951

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$35,338.00

Timeline

Project Approved

May 27, 2015

Install Start Date

May 27, 2015

Actual Install Complete Date

December 1, 2015

Lifespan (Required)

10 years

Resources Tracked (Required)

Resource

Units

Cost per Unit

Annual Savings

Electricity

kWh

\$ 0.1270

49,504 kWh

— Add Resource —

— Units —

\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

Option A: Retrofit Isolation with Key Parameter Measurement

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	6,287	757	62,870
ENERGY SAVINGS (MMBTU)	169	20	1,689
EMISSIONS ABATED (MTCO ₂ E)	22.9	2.8	229.4

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)
5.26LOAN REPAYMENT PERIOD (YEARS)
5.26LIFETIME RETURN ON INVESTMENT (ROI)
90.2%ANNUAL ROI
9.0%NET PRESENT VALUE (NPV)
\$29,822.08INTERNAL RATE OF RETURN (IRR)
13.83%UNIT COST PER MTCO₂E ABATED
\$144.07

Project Transactions

Transaction Type	Date	Amount
Project Rebate	May 27, 2015	\$2,290.00
Description		
Project Expenditure	May 27, 2015	(\$35,338.00)
SCE Incentive		
— Add Transaction —	January 13, 2016	
Description		

Project cost \$33,048.00
Adjusted project cost to be repaid \$33,048.00
Current amount owed on loan \$33,048.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

M&V being performed as part of retro-commissioning project 2015

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-12-01	0.0000	0	(33,048.00)	0.00	0.00	33,048.00
2015-12-31	37.2200	14	533.97	533.97	533.97	32,514.03
2016-12-31	37.2200	169	6,287.01	6,287.01	6,820.97	26,227.03
2017-12-31	37.2200	169	6,287.01	6,287.01	13,107.98	19,940.02
2018-12-31	37.2200	169	6,287.01	6,287.01	19,394.99	13,653.01
2019-12-31	37.2200	169	6,287.01	6,287.01	25,682.00	7,366.00
2020-12-31	37.2200	169	6,287.01	6,287.01	31,969.01	1,078.99
2021-12-31	37.2200	169	6,287.01	2,381.00	34,350.00	0.00
2022-12-31	37.2200	169	6,287.01	1,571.75	35,921.76	0.00
2023-12-31	37.2200	169	6,287.01	1,571.75	37,493.51	0.00
2024-12-31	37.2200	169	6,287.01	1,571.75	39,065.26	0.00
2025-11-30	37.2200	155	5,753.04	1,438.26	40,503.52	0.00
Total Realized	-	20	757	757	-	-
Average	37.2200	169	6,287	-	-	-
Total Realized and Projected	-	1,689	62,870	40,504	-	-

Details

Notes

Attachments

University of La Verne

Hoover Controls Upgrade

Archive This Project

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Install sensors and new HVAC automation for Hoover Building

Project Types (Required)

Building Heating, Ventilation, Air Conditioning (HVAC)
Ventilation/Air handling units

— Add New Project Type —

— Subtype —

Buildings

Hoover Building

Academic/Classroom

1951

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$76,972.88

Timeline

Project Approved

May 27, 2015

Install Start Date

May 27, 2015

Actual Install Complete Date

December 1, 2015

Lifespan (Required)

20 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Natural Gas	MCF	\$ 6.5000	24 MCF
Electricity	kWh	\$ 0.1270	50,451 kWh

— Add Resource — — Units — \$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

(Options from the International Performance Measurement & Verification Protocol)

Option A: Retrofit Isolation with Key Parameter Measurement

Notes on this projects measurement and verification methodology:

<http://arits.greenbillion.org/projects/1658>

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	6,563	791	131,266
ENERGY SAVINGS (MMBTU)	197	24	3,935
EMISSIONS ABATED (MTCO ₂ E)	24.7	3.0	493.7

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
9.60	9.60	108.4%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
5.4%	\$68,285.54	8.31%
UNIT COST PER MTCO ₂ E ABATED		
\$127.57		

Project Transactions

Transaction Type	Date	Amount
Project Rebate	May 27, 2015	\$6,980.00
So Cal Gas Incentive		
Project Rebate	May 27, 2015	\$7,012.88
SCE Incentive		
Project Expenditure	May 27, 2015	(\$76,972.88)
Description		
— Add Transaction —	January 13, 2016	
Description		

Project cost	\$62,980.00
Adjusted project cost to be repaid	\$62,980.00
Current amount owed on loan	\$62,980.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

M&V being performed as part of retro-commissioning project 2015

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-12-01	0.0000	0	(62,980.00)	0.00	0.00	62,980.00
2015-12-31	21.7777	17	557.43	557.43	557.43	62,422.57
2016-12-31	21.7777	197	6,563.28	6,563.28	7,120.71	55,859.29
2017-12-31	21.7777	197	6,563.28	6,563.28	13,683.98	49,296.02
2018-12-31	21.7777	197	6,563.28	6,563.28	20,247.26	42,732.74
2019-12-31	21.7777	197	6,563.28	6,563.28	26,810.54	36,169.46
2020-12-31	21.7777	197	6,563.28	6,563.28	33,373.81	29,606.19
2021-12-31	21.7777	197	6,563.28	6,563.28	39,937.09	23,042.91
2022-12-31	21.7777	197	6,563.28	6,563.28	46,500.37	16,479.63
2023-12-31	21.7777	197	6,563.28	6,563.28	53,063.65	9,916.35
2024-12-31	21.7777	197	6,563.28	6,563.28	59,626.92	3,353.08
2025-12-31	21.7777	197	6,563.28	4,155.63	63,782.55	0.00
2026-12-31	21.7777	197	6,563.28	1,640.82	65,423.37	0.00
2027-12-31	21.7777	197	6,563.28	1,640.82	67,064.19	0.00
2028-12-31	21.7777	197	6,563.28	1,640.82	68,705.01	0.00
2029-12-31	21.7777	197	6,563.28	1,640.82	70,345.83	0.00
2030-12-31	21.7777	197	6,563.28	1,640.82	71,986.65	0.00
2031-12-31	21.7777	197	6,563.28	1,640.82	73,627.47	0.00
2032-12-31	21.7777	197	6,563.28	1,640.82	75,268.28	0.00
2033-12-31	21.7777	197	6,563.28	1,640.82	76,909.10	0.00
2034-12-31	21.7777	197	6,563.28	1,640.82	78,549.92	0.00
2035-11-30	21.7777	180	6,005.85	1,501.46	80,051.38	0.00
Total Realized	-	24	791	791	-	-
Average	21.7777	197	6,563	-	-	-
Total Realized and Projected	-	3,935	131,266	80,051	-	-

University of La Verne

HVAC Conversion at Leo Hall

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Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)
Replacement of all heating and air conditioning units at Leo Hall.

Project Types (Required)
Building Heating, Ventilation, Air Conditioning (HVAC)
Air conditioning units

— Add New Project Type

— Subtype —

Buildings

Leo Hall

Academic/Classroom

1985

New Building Name

— Building Type —

Year

Cost
Proposed (Required)
\$50,449.00

Timeline
Project Approved
May 28, 2015
Install Start Date
June 10, 2015

Actual Install Complete Date
July 8, 2015

Lifespan (Required)
15 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Electricity	kWh	\$ 0.1798	45,508 kWh
— Add Resource — — Units — \$			

Notes on this project's tracked resources (required when there are no resources tracked):
It is tracking electricity

Measurement and Verification Methodology

(Options from the International Performance Measurement & Verification protocol)

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	8,182	4,259	122,735
ENERGY SAVINGS (MMBTU)	155	81	2,329
EMISSIONS ABATED (MTCO ₂ E)	21.1	11.0	316.3

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS) 6.17	LOAN REPAYMENT PERIOD (YEARS) 6.17	LIFETIME RETURN ON INVESTMENT (ROI) 143.3%
ANNUAL ROI 9.6%	NET PRESENT VALUE (NPV) \$72,286.08	INTERNAL RATE OF RETURN (IRR) 13.98%
UNIT COST PER MTCO ₂ E ABATED \$159.50		

Project Transactions

Transaction Type	Date	Amount
— Add Transaction —	January 13, 2016	
Description		

Project cost	\$50,449.00
Adjusted project cost to be repaid	\$50,449.00
Current amount owed on loan	\$50,449.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Reading and comparison from prior utility bills dedicated to the building meter.

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-07-08	0.0000	0	(50,449.00)	0.00	0.00	50,449.00
2015-12-31	52.6942	75	3,967.87	3,967.87	3,967.87	46,481.13
2016-12-31	52.6942	155	8,182.34	8,182.34	12,150.21	38,298.79
2017-12-31	52.6942	155	8,182.34	8,182.34	20,332.55	30,116.45
2018-12-31	52.6942	155	8,182.34	8,182.34	28,514.89	21,934.11
2019-12-31	52.6942	155	8,182.34	8,182.34	36,697.23	13,751.77
2020-12-31	52.6942	155	8,182.34	8,182.34	44,879.57	5,569.43
2021-12-31	52.6942	155	8,182.34	6,222.66	51,102.23	0.00
2022-12-31	52.6942	155	8,182.34	2,045.58	53,147.81	0.00
2023-12-31	52.6942	155	8,182.34	2,045.58	55,193.40	0.00
2024-12-31	52.6942	155	8,182.34	2,045.58	57,238.98	0.00
2025-12-31	52.6942	155	8,182.34	2,045.58	59,284.56	0.00
2026-12-31	52.6942	155	8,182.34	2,045.58	61,330.15	0.00
2027-12-31	52.6942	155	8,182.34	2,045.58	63,375.73	0.00
2028-12-31	52.6942	155	8,182.34	2,045.58	65,421.32	0.00
2029-12-31	52.6942	155	8,182.34	2,045.58	67,466.90	0.00
2030-07-07	52.6942	80	4,214.46	1,053.62	68,520.52	0.00
Total Realized	-	81	4,259	4,259	-	-
Average	52.6942	155	8,182	-	-	-
Total Realized and Projected	-	2,329	122,735	68,521	-	-

University of La Verne

HVAC Renovation at Oaks Residence Halls

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Overview

Status (Required)

Completed

Project Lead

— Select —

Description (Required)

Change out of all HVAC units on the Oaks Residence Halls buildings A-F

Project Types (Required)

Building Heating, Ventilation, Air Conditioning (HVAC)

Ventilation/Air handling units

Air conditioning units

— Add New Project Type — Subtype —

Buildings

The Oaks

Dormitory/Residen

1990

New Building Name

— Building Type —

Year

Cost

roposed (Required)
\$80,853.00

Timeline

Project Approved
May 20, 2015
Install Start Date
June 9, 2015
Actual Install Complete Date
June 30, 2015

Lifespan (Required)
15 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Electricity	kWh	\$ 0.1600	170,312 kWh
— Add Resource — Units — \$			

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification Protocol

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	27,250	14,779	408,749
ENERGY SAVINGS (MMBTU)	581	315	8,717
EMISSIONS ABATED (MTCO ₂ E)	78.9	42.8	1,183.7

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS) 2.97	LOAN REPAYMENT PERIOD (YEARS) 2.97	LIFETIME RETURN ON INVESTMENT (ROI) 405.5%
ANNUAL ROI 27.0%	NET PRESENT VALUE (NPV) \$327,895.80	INTERNAL RATE OF RETURN (IRR) 33.62%
UNIT COST PER MTCO ₂ E ABATED \$68.30		

Project Transactions

Transaction Type	Date	Amount
— Add Transaction —	January 13, 2016	
Description		

Project cost

\$80,853.00

Adjusted project cost to be repaid

\$80,853.00

Current amount owed on loan

\$80,853.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Electricity being used by comparing utility bills dedicated to these buildings from previous years to current year.

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-06-30	0.0000	0	(80,853.00)	0.00	0.00	80,853.00
2015-12-31	46.8914	295	13,811.60	13,811.60	13,811.60	67,041.40
2016-12-31	46.8914	581	27,249.92	27,249.92	41,061.52	39,791.48
2017-12-31	46.8914	581	27,249.92	27,249.92	68,311.44	12,541.56
2018-12-31	46.8914	581	27,249.92	16,218.65	84,530.09	0.00
2019-12-31	46.8914	581	27,249.92	6,812.48	91,342.57	0.00
2020-12-31	46.8914	581	27,249.92	6,812.48	98,155.05	0.00
2021-12-31	46.8914	581	27,249.92	6,812.48	104,967.53	0.00
2022-12-31	46.8914	581	27,249.92	6,812.48	111,780.01	0.00
2023-12-31	46.8914	581	27,249.92	6,812.48	118,592.49	0.00
2024-12-31	46.8914	581	27,249.92	6,812.48	125,404.97	0.00
2025-12-31	46.8914	581	27,249.92	6,812.48	132,217.45	0.00
2026-12-31	46.8914	581	27,249.92	6,812.48	139,029.93	0.00
2027-12-31	46.8914	581	27,249.92	6,812.48	145,842.41	0.00
2028-12-31	46.8914	581	27,249.92	6,812.48	152,654.89	0.00
2029-12-31	46.8914	581	27,249.92	6,812.48	159,467.37	0.00
2030-06-29	46.8914	287	13,438.32	3,359.58	162,826.95	0.00
Total Realized	-	315	14,779	14,779	-	-
Average	46.8914	581	27,250	-	-	-
Total Realized and Projected	-	8,717	408,749	162,827	-	-

Details

Notes

Attachments

University of La Verne

La Fetra Auditorium VFD and Controls Upgrade

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Install VFD and upgrade controls to La Fetra Auditorium as part of retro-commissioning project

Project Types (Required)

Building Heating, Ventilation, Air Conditioning (HVAC)

Ventilation/Air handling units

— Add New Project Type

— Subtype —

Buildings

La Fetra Auditorium

Academic/Classroom

1960

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$24,905.12

Timeline

Project Approved

May 27, 2015

Install Start Date

May 27, 2015

Actual Install Complete Date

December 1, 2015

Lifespan (Required)

20

 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Natural Gas	MCF	\$ 10.1000	721 MCF
Electricity	kWh	\$ 0.1270	59,130 kWh
— Add Resource —		— Units —	\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification Protocol

Option A: Retrofit Isolation with Key Parameter Measurement

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	14,792	1,782	295,832
ENERGY SAVINGS (MMBTU)	942	113	18,830
EMISSIONS ABATED (MTCO ₂ E)	66.7	8.0	1,333.8

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
1.35	1.35	1,381.7%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
69.1%	\$275,867.08	75.15%
UNIT COST PER MTCO ₂ E ABATED		
\$14.97		

Project Transactions

Transaction Type	Date	Amount
Project Rebate	May 27, 2015	\$4,940.00
So Cal Gas Incentive		
Project Expenditure	May 27, 2015	(\$24,905.12)
Description		
— Add Transaction —	January 13, 2016	
Description		

Project cost	\$19,965.12
Adjusted project cost to be repaid	\$19,965.12
Current amount owed on loan	\$19,965.12

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

M7V being performed as part of retro-commissioning project 2015

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-12-01	0.0000	0	(19,965.12)	0.00	0.00	19,965.12
2015-12-31	23.5320	80	1,256.27	1,256.27	1,256.27	18,708.85
2016-12-31	23.5320	942	14,791.61	14,791.61	16,047.88	3,917.24
2017-12-31	23.5320	942	14,791.61	6,635.83	22,683.71	0.00
2018-12-31	23.5320	942	14,791.61	3,697.90	26,381.62	0.00
2019-12-31	23.5320	942	14,791.61	3,697.90	30,079.52	0.00
2020-12-31	23.5320	942	14,791.61	3,697.90	33,777.42	0.00
2021-12-31	23.5320	942	14,791.61	3,697.90	37,475.32	0.00
2022-12-31	23.5320	942	14,791.61	3,697.90	41,173.23	0.00
2023-12-31	23.5320	942	14,791.61	3,697.90	44,871.13	0.00
2024-12-31	23.5320	942	14,791.61	3,697.90	48,569.03	0.00
2025-12-31	23.5320	942	14,791.61	3,697.90	52,266.93	0.00
2026-12-31	23.5320	942	14,791.61	3,697.90	55,964.84	0.00
2027-12-31	23.5320	942	14,791.61	3,697.90	59,662.74	0.00
2028-12-31	23.5320	942	14,791.61	3,697.90	63,360.64	0.00
2029-12-31	23.5320	942	14,791.61	3,697.90	67,058.54	0.00
2030-12-31	23.5320	942	14,791.61	3,697.90	70,756.45	0.00
2031-12-31	23.5320	942	14,791.61	3,697.90	74,454.35	0.00
2032-12-31	23.5320	942	14,791.61	3,697.90	78,152.25	0.00
2033-12-31	23.5320	942	14,791.61	3,697.90	81,850.15	0.00
2034-12-31	23.5320	942	14,791.61	3,697.90	85,548.06	0.00
2035-11-30	23.5320	862	13,535.34	3,383.83	88,931.89	0.00
Total Realized	-	113	1,782	1,782	-	-
Average	23.5320	942	14,792	-	-	-
Total Realized and Projected	-	18,830	295,832	88,932	-	-

Details

Notes

Attachments

University of La Verne

LED Uplights for Founders Hall

Archive This Project

GENERATE - Project PDF

Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Six LED's replacing 400W MH that run 12 hours a day seven days a week

Project Types (Required)

Lighting

Lighting controls

— Add New Project Type —

— Subtype —

Buildings

Founders Hall

Academic/Classroom

1926

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$3,597.00

Timeline

Project Approved

May 14, 2015

Install Start Date

May 14, 2015

Actual Install Complete Date

May 14, 2015

Lifespan (Required)

20 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Electricity	kWh	\$ 0.1400	6,552 kWh

— Add Resource —	— Units —	\$	
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Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

Option A: Retrofit Isolation with Key Parameter Measurement

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	917	616	18,346
ENERGY SAVINGS (MMBTU)	22	15	447
EMISSIONS ABATED (MTCO ₂ E)	3.0	2.0	60.7

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
3.92	3.92	410.0%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
20.5%	\$14,748.60	25.37%
UNIT COST PER MTCO ₂ E ABATED		
\$59.24		

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	May 27, 2015	(\$3,597.00)
Description		
— Add Transaction —	January 13, 2016	
Description		
Project cost		\$3,597.00
Adjusted project cost to be repaid		\$3,597.00
Current amount owed on loan		\$3,597.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Six LED's replacing 400W MH that run 12 hours a day seven days a week

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-05-14	0.0000	0	(3,597.00)	0.00	0.00	3,597.00
2015-12-31	41.0299	14	583.04	583.04	583.04	3,013.96
2016-12-31	41.0299	22	917.28	917.28	1,500.32	2,096.68
2017-12-31	41.0299	22	917.28	917.28	2,417.60	1,179.40
2018-12-31	41.0299	22	917.28	917.28	3,334.88	262.12
2019-12-31	41.0299	22	917.28	425.91	3,760.79	0.00
2020-12-31	41.0299	22	917.28	229.32	3,990.11	0.00
2021-12-31	41.0299	22	917.28	229.32	4,219.43	0.00
2022-12-31	41.0299	22	917.28	229.32	4,448.75	0.00
2023-12-31	41.0299	22	917.28	229.32	4,678.07	0.00
2024-12-31	41.0299	22	917.28	229.32	4,907.39	0.00
2025-12-31	41.0299	22	917.28	229.32	5,136.71	0.00
2026-12-31	41.0299	22	917.28	229.32	5,366.03	0.00
2027-12-31	41.0299	22	917.28	229.32	5,595.35	0.00
2028-12-31	41.0299	22	917.28	229.32	5,824.67	0.00
2029-12-31	41.0299	22	917.28	229.32	6,053.99	0.00
2030-12-31	41.0299	22	917.28	229.32	6,283.31	0.00
2031-12-31	41.0299	22	917.28	229.32	6,512.63	0.00
2032-12-31	41.0299	22	917.28	229.32	6,741.95	0.00
2033-12-31	41.0299	22	917.28	229.32	6,971.27	0.00
2034-12-31	41.0299	22	917.28	229.32	7,200.59	0.00
2035-05-13	41.0299	8	334.24	83.56	7,284.15	0.00
Total Realized	-	15	616	616	-	-
Average	41.0299	22	917	-	-	-
Total Realized and Projected	-	447	18,346	7,284	-	-

Details

Notes

Attachments

University of La Verne

Mainiero VFD Installation and Controls Upgrade

Archive This Project

GENERATE - Project PDF

Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Install VFD and new controls for air handler that serves entire building

Project Types (Required)

Building Heating, Ventilation, Air Conditioning (HVAC)
Ventilation/Air handling units

- Add New Project Type

- Subtype -

Buildings

New Building Name

- Building Type -

Year

Cost

Proposed (Required)

\$60,819.84

Timeline

Project Approved

May 27, 2015

Install Start Date

May 27, 2015

Actual Install Complete Date

June 30, 2015

Lifespan (Required)

20

years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Natural Gas	MCF	\$ 10.1000	403 MCF
Electricity	kWh	\$ 0.1270	119,060 kWh
- Add Resource -	- Units -	\$	

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

(Options from the International Performance Measurement & Verification protocol)

- Select -

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	19,191	10,409	383,818
ENERGY SAVINGS (MMBTU)	820	445	16,395
EMISSIONS ABATED (MTCO ₂ E)	77.1	41.8	1,542.6

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
3.05	3.05	555.5%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
27.8%	\$325,268.56	33.00%
UNIT COST PER MTCO ₂ E ABATED		
\$37.96		

Project Transactions

Transaction Type	Date	Amount
Project Rebate	May 27, 2015	\$2,270.00
So Cal Gas Incentive		
Project Expenditure	May 27, 2015	(\$60,819.84)
Description		
- Add Transaction -	January 13, 2016	
Description		

Project cost	\$58,549.84
Adjusted project cost to be repaid	\$58,549.84
Current amount owed on loan	\$58,549.84

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2015-06-30	0.0000	0	(58,549.84)	0.00	0.00	58,549.84
2015-12-31	23.5320	415	9,726.90	9,726.90	9,726.90	48,822.94
2016-12-31	23.5320	820	19,190.92	19,190.92	28,917.82	29,632.02
2017-12-31	23.5320	820	19,190.92	19,190.92	48,108.74	10,441.10
2018-12-31	23.5320	820	19,190.92	12,628.55	60,737.30	0.00
2019-12-31	23.5320	820	19,190.92	4,797.73	65,535.03	0.00
2020-12-31	23.5320	820	19,190.92	4,797.73	70,332.76	0.00
2021-12-31	23.5320	820	19,190.92	4,797.73	75,130.49	0.00
2022-12-31	23.5320	820	19,190.92	4,797.73	79,928.22	0.00
2023-12-31	23.5320	820	19,190.92	4,797.73	84,725.95	0.00
2024-12-31	23.5320	820	19,190.92	4,797.73	89,523.68	0.00
2025-12-31	23.5320	820	19,190.92	4,797.73	94,321.41	0.00
2026-12-31	23.5320	820	19,190.92	4,797.73	99,119.14	0.00
2027-12-31	23.5320	820	19,190.92	4,797.73	103,916.87	0.00
2028-12-31	23.5320	820	19,190.92	4,797.73	108,714.60	0.00
2029-12-31	23.5320	820	19,190.92	4,797.73	113,512.33	0.00
2030-12-31	23.5320	820	19,190.92	4,797.73	118,310.06	0.00
2031-12-31	23.5320	820	19,190.92	4,797.73	123,107.79	0.00
2032-12-31	23.5320	820	19,190.92	4,797.73	127,905.52	0.00
2033-12-31	23.5320	820	19,190.92	4,797.73	132,703.25	0.00
2034-12-31	23.5320	820	19,190.92	4,797.73	137,500.98	0.00
2035-06-29	23.5320	404	9,464.02	2,366.00	139,866.98	0.00
Total Realized	-	445	10,409	10,409	-	-
Average	23.5320	820	19,191	-	-	-
Total Realized and Projected	-	16,395	383,818	139,867	-	-

Details

Notes

Attachments

University of La Verne

Oaks Sconce Light LED Conversion

Archive This Project

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Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Convert Sconce Lights at Oaks Residence Halls from High Pressure Sodium to LED Lights

Project Types (Required)

Lighting

Lighting upgrade/retrofit

— Add New Project Type —

— Subtype —

Buildings

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$736.03

Timeline

Project Approved

November 3, 2014

Install Start Date

November 3, 2014

Actual Install Complete Date

December 12, 2014

Lifespan (Required)

10 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Electricity	kWh	\$ 0.1420	16,055 kWh

— Add Resource — — Units — \$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

(Options from the International Performance Measurement & Verification Protocol)

Option A: Retrofit Isolation with Key Parameter Measurement

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	2,280	2,486	22,798
ENERGY SAVINGS (MMBTU)	55	60	548
EMISSIONS ABATED (MTCO ₂ E)	7.4	8.1	74.4

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
0.32	0.32	2,997.5%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
299.7%	\$22,062.41	339.90%
UNIT COST PER MTCO ₂ E ABATED		
\$9.89		

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	November 3, 2014	(\$736.03)
Description		
— Add Transaction —	January 13, 2016	
Description		

Project cost	\$736.03
Adjusted project cost to be repaid	\$736.03
Current amount owed on loan	\$736.03

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2014-12-12	0.0000	0	(736.03)	0.00	0.00	736.03
2014-12-31	41.6161	3	124.92	124.92	124.92	611.11
2015-12-31	41.6161	55	2,279.81	1,028.28	1,153.21	0.00
2016-12-31	41.6161	55	2,279.81	569.95	1,723.16	0.00
2017-12-31	41.6161	55	2,279.81	569.95	2,293.11	0.00
2018-12-31	41.6161	55	2,279.81	569.95	2,863.06	0.00
2019-12-31	41.6161	55	2,279.81	569.95	3,433.02	0.00
2020-12-31	41.6161	55	2,279.81	569.95	4,002.97	0.00
2021-12-31	41.6161	55	2,279.81	569.95	4,572.92	0.00
2022-12-31	41.6161	55	2,279.81	569.95	5,142.87	0.00
2023-12-31	41.6161	55	2,279.81	569.95	5,712.83	0.00
2024-12-11	41.6161	52	2,155.23	538.81	6,251.63	0.00
Total Realized	-	60	2,486	1,173	-	-
Average	41.6161	55	2,280	-	-	-
Total Realized and Projected	-	548	22,798	6,252	-	-

Details

Notes

Attachments

University of La Verne

Parking Lot D LED Retrofit

Archive This Project

GENERATE - Project PDF

Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

This project involved retrofitting Parking Lot D with LED bulbs.

Project Types (Required)

Lighting

Lighting upgrade/retrofit

— Add New Project Type —

— Subtype —

Buildings

Parking Lot D

Parking/Garage

2013

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$66,454.00

Timeline

Project Approved

June 3, 2013

Install Start Date

June 6, 2013

Actual Install Complete Date

June 17, 2013

Lifespan (Required)

10 years

Resources Tracked (Required)

Resource

Units

Cost per Unit

Annual Savings

Electricity

kWh

\$ 0.1420

54,354 kWh

— Add Resource —

— Units —

\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	7,718	19,898	77,183
ENERGY SAVINGS (MMBTU)	185	478	1,855
EMISSIONS ABATED (MTCO ₂ E)	25.2	64.9	251.9

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
8.61	8.61	16.1%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
1.6%	\$10,728.68	2.83%
UNIT COST PER MTCO ₂ E ABATED		
\$263.86		

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	June 17, 2013	(\$66,454.00)
Project payment		
— Add Transaction —	January 13, 2016	
Description		

Project cost	\$66,454.00
Adjusted project cost to be repaid	\$66,454.00
Current amount owed on loan	\$66,454.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2013-06-17	0.0000	0	(66,454.00)	0.00	0.00	66,454.00
2013-12-31	41.6161	101	4,186.90	4,186.90	4,186.90	62,267.10
2014-12-31	41.6161	185	7,718.27	7,718.27	11,905.16	54,548.84
2015-12-31	41.6161	185	7,718.27	7,718.27	19,623.43	46,830.57
2016-12-31	41.6161	185	7,718.27	7,718.27	27,341.70	39,112.30
2017-12-31	41.6161	185	7,718.27	7,718.27	35,059.97	31,394.03
2018-12-31	41.6161	185	7,718.27	7,718.27	42,778.24	23,675.76
2019-12-31	41.6161	185	7,718.27	7,718.27	50,496.50	15,957.50
2020-12-31	41.6161	185	7,718.27	7,718.27	58,214.77	8,239.23
2021-12-31	41.6161	185	7,718.27	7,718.27	65,933.04	520.96
2022-12-31	41.6161	185	7,718.27	2,320.29	68,253.33	0.00
2023-06-16	41.6161	85	3,531.37	882.84	69,136.17	0.00
Total Realized	-	478	19,898	19,898	-	-
Average	41.6161	185	7,718	-	-	-
Total Realized and Projected	-	1,855	77,183	69,136	-	-

Details

Notes

Attachments

University of La Verne

Parking Lot E LED Retrofit

Archive This Project

GENERATE - Project PDF

Delete This Project

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

This project involved replacing all parking lot E lighting with LED lighting.

Project Types (Required)

Lighting

Lighting upgrade/retrofit

- Add New Project Type

- Subtype -

Buildings

Parking Lot E

Parking/Garage

2013

New Building Name

- Building Type -

Year

Cost

Proposed (Required)

\$16,895.00

Timeline

Project Approved

June 3, 2013

Install Start Date

June 24, 2013

Actual Install Complete Date

June 27, 2013

Lifespan (Required)

10 years

Resources Tracked (Required)

Resource

Units

Cost per Unit

Annual Savings

Electricity

kWh

\$ 0.1420

18,179 kWh

- Add Resource -

- Units -

\$

Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

Options from the International Performance Measurement & Verification protocol

Option C: Utility Data Analysis

Notes on this projects measurement and verification methodology:

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	2,581	6,584	25,814
ENERGY SAVINGS (MMBTU)	62	158	620
EMISSIONS ABATED (MTCO ₂ E)	8.4	21.5	84.2

Financial Metrics

SIMPLE PAYBACK
PERIOD (YEARS)

6.54

LOAN
REPAYMENT
PERIOD (YEARS)

6.54

LIFETIME
RETURN ON
INVESTMENT
(ROI)

52.8%

ANNUAL ROI

5.3%

NET PRESENT
VALUE (NPV)

\$8,919.18

INTERNAL RATE
OF RETURN (IRR)

8.61%

UNIT COST PER
MTCO₂E ABATED

\$200.57

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	June 27, 2013	(\$16,895.00)
Project payment		
- Add Transaction -	January 13, 2016	
Description		

Project cost \$16,895.00

Adjusted project cost to be repaid \$16,895.00

Current amount owed on loan \$16,895.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2013-06-27	0.0000	0	(16,895.00)	0.00	0.00	16,895.00
2013-12-31	41.6161	32	1,329.61	1,329.61	1,329.61	15,565.39
2014-12-31	41.6161	62	2,581.42	2,581.42	3,911.03	12,983.97
2015-12-31	41.6161	62	2,581.42	2,581.42	6,492.44	10,402.56
2016-12-31	41.6161	62	2,581.42	2,581.42	9,073.86	7,821.14
2017-12-31	41.6161	62	2,581.42	2,581.42	11,655.28	5,239.72
2018-12-31	41.6161	62	2,581.42	2,581.42	14,236.70	2,658.30
2019-12-31	41.6161	62	2,581.42	2,581.42	16,818.12	76.88
2020-12-31	41.6161	62	2,581.42	703.02	17,521.13	0.00
2021-12-31	41.6161	62	2,581.42	645.35	18,166.49	0.00
2022-12-31	41.6161	62	2,581.42	645.35	18,811.84	0.00
2023-06-26	41.6161	30	1,251.81	312.95	19,124.79	0.00
Total Realized	-	158	6,584	6,584	-	-
Average	41.6161	62	2,581	-	-	-
Total Realized and Projected	-	620	25,814	19,125	-	-

Details

Notes

Attachments

University of La Verne

SSAP LED Retrofit

[Archive This Project](#) [GENERATE - Project PDF](#) [Delete This Project](#)

Overview

Status (Required)

Completed

Project Lead

Robert Beebe

Description (Required)

Converted 750W Metal Halide lights to 250W LED over gym floor.

Project Types (Required)

Lighting

Lighting upgrade/retrofit

— Add New Project Type —

— Subtype —

Buildings

SSAP

Athletic facility (ind

2013

New Building Name

— Building Type —

Year

Cost

Proposed (Required)

\$59,890.00

Timeline

Project Approved

June 1, 2013

Install Start Date

June 10, 2013

Actual Install Complete Date

June 28, 2013

Lifespan (Required)

15 years

Resources Tracked (Required)

Resource	Units	Cost per Unit	Annual Savings
Electricity	kWh	\$ 0.1420	38,253 kWh

— Add Resource —	— Units —	\$	
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Notes on this project's tracked resources (required when there are no resources tracked):

Measurement and Verification Methodology

(Options from the International Performance Measurement & Verification protocol [\[?\]](#))

The methodology "Measured" has been deprecated. Please select a new option.

Measured (Deprecated Option): based on sub-meters tracking

Performance

Savings Over Time

	AVERAGE ANNUAL	TOTAL TO DATE	LIFE OF PROJECT
FINANCIAL SAVINGS (\$)	5,432	13,840	81,486
ENERGY SAVINGS (MMBTU)	131	333	1,958
EMISSIONS ABATED (MTCO ₂ E)	17.7	45.2	265.9

Financial Metrics

SIMPLE PAYBACK PERIOD (YEARS)	LOAN REPAYMENT PERIOD (YEARS)	LIFETIME RETURN ON INVESTMENT (ROI)
11.03	11.03	36.1%
ANNUAL ROI	NET PRESENT VALUE (NPV)	INTERNAL RATE OF RETURN (IRR)
2.4%	\$21,596.49	4.13%
UNIT COST PER MTCO ₂ E ABATED		
\$225.24		

Project Transactions

Transaction Type	Date	Amount
Project Expenditure	June 28, 2013	(\$59,890.00)
SSAP LED retrofit		
— Add Transaction —	January 13, 2016	
Description		

Project cost	\$59,890.00
Adjusted project cost to be repaid	\$59,890.00
Current amount owed on loan	\$59,890.00

Notes on your Project's costs (This is required if saving a completed project with a project cost less than \$5):

Notes on this projects measurement and verification methodology:

Annual Tracking Data

DATE	ENERGY PRICE (\$/MMBTU)	ENERGY SAVED (MMBTU)	ANNUAL FINANCIAL SAVINGS (\$)	ANNUAL PAYBACK INTO GRF (\$)	CUMULATIVE PAYBACK INTO GRF (\$)	MONEY OWED BACK TO GRF
2013-06-28	0.0000	0	(59,890.00)	0.00	0.00	59,890.00
2013-12-31	41.6161	67	2,782.93	2,782.93	2,782.93	57,107.07
2014-12-31	41.6161	131	5,431.93	5,431.93	8,214.86	51,675.14
2015-12-31	41.6161	131	5,431.93	5,431.93	13,646.78	46,243.22
2016-12-31	41.6161	131	5,431.93	5,431.93	19,078.71	40,811.29
2017-12-31	41.6161	131	5,431.93	5,431.93	24,510.64	35,379.36
2018-12-31	41.6161	131	5,431.93	5,431.93	29,942.56	29,947.44
2019-12-31	41.6161	131	5,431.93	5,431.93	35,374.49	24,515.51
2020-12-31	41.6161	131	5,431.93	5,431.93	40,806.41	19,083.59
2021-12-31	41.6161	131	5,431.93	5,431.93	46,238.34	13,651.66
2022-12-31	41.6161	131	5,431.93	5,431.93	51,670.27	8,219.73
2023-12-31	41.6161	131	5,431.93	5,431.93	57,102.19	2,787.81
2024-12-31	41.6161	131	5,431.93	3,448.84	60,551.03	0.00
2025-12-31	41.6161	131	5,431.93	1,357.98	61,909.01	0.00
2026-12-31	41.6161	131	5,431.93	1,357.98	63,266.99	0.00
2027-12-31	41.6161	131	5,431.93	1,357.98	64,624.97	0.00
2028-06-27	41.6161	64	2,656.60	664.15	65,289.12	0.00
Total Realized	-	333	13,840	13,840	-	-
Average	41.6161	131	5,432	-	-	-
Total Realized and Projected	-	1,958	81,486	65,289	-	-



Energy Unit Savings Report Measured Report and Findings

December 21, 2015

Prepared for



1950 3rd Street

La Verne, CA 91750

Prepared by



152 Technology Drive
Irvine, CA 92618
(949) 330-1555

Brian Walker
Energy Engineer
December 21, 2015

December 21, 2015

MEASUREMENT AND VERIFICATION PLAN AND SAVINGS CALCULATION METHODS
OUTLINE - UNIVERSITY OF LAVERNE

1.1 EXECUTIVE SUMMARY/M&V OVERVIEW AND PROJECTED SAVINGS
CALCULATIONS

ABM, in partnership with NRG Energy, completed an energy reduction project for the University of La Verne in response to a RFP issued by the University in January of 2015. The RFP identified EEMs to be implemented, with the intent of the projected savings to be used to help fund the University's Green Revolving Loan Fund. Measurement and verification approach for the seven EEMs identified in the RFP was included in the implementation contract, and an Energy Unit Savings Report was to be submitted at the completion of the project. In addition to new equipment, the EEMs rely upon control system programming to ensure full savings potential. Using four week trend data for the EEMs, shown in the subsequent sections, the overall trend is positive. The trend data clearly shows lighting at Hoover is responding to the new occupancy sensors, the temperature setbacks and resets at Hoover and Mainiero, respectively, are in place and functional, and the lab air handler at Founders is no longer simultaneously heating and cooling. The initial trends do support the savings calculations in the independent eQuest model done for Founders, Hoover, and Mainiero, and at this point the project does appear to be saving energy as planned for the University.

1.1.1 Table 1 - Proposed Annual Savings Overview

ECM	Total energy savings (MMBtu/yr)	Electric energy savings (kWh/yr)	Electric demand savings (kW/yr)*	Natural gas savings (th/yr)**	Water savings (gallons/yr)	Other energy savings (MBtu/yr) **	Total energy and water cost savings, Year 1 (\$/yr)	Other energy-related O&M cost savings, Year 1 (\$/yr)	Total cost savings, Year 1 (\$/yr)
EEM-1	71			706			459		459
EEM-2	147	9,435		1,150			1,946		1,946
EEM-3	775	82,437		4,940			13,680		13,680
EEM-4	227	66,499	10				7,808		7,808
EEM-5	146	42,855					5,443		5,443
EEM-6	997	87,661		6,980			15,670		15,670
EEM-7	491	77,402		2,270			11,306		11,306
Total savings	2,854	366,289	10	16,046			56,312		56,312
First Year Projected Energy Savings: \$56,312									
Notes *Annual electric demand savings (kW/yr) is the sum of the monthly demand savings. MBtu=10 ⁶ Btu. **If energy is reported in units other than MBtu, provide a conversion factor to MBtu for link to cost schedules (e.g., 0.003413 MBtu/kWh).									

1.1.2 Table 2 - Site Use and Savings Overview

	Total energy savings (MBtu/yr)	Electric energy savings (kWh/yr)	Electric demand savings (kW/yr)*	Natural gas savings (th/yr)**	Water savings (gallons/yr)	Other energy savings (MBtu/yr)**
Total proposed project savings	2,854	366,289	10	16,046		
Usage for entire site**						
% Total site usage saved						
Project square footage (KSF)						
Total site square footage (KSF)						
% Total site area affected						
Notes MBtu=10 ⁶ Btu *Annual electric demand savings (kW/yr) is the sum of the monthly demand savings. **If energy is reported in units other than MBtu, provide a conversion factor to MBtu for link to cost schedules (e.g., 0.003413 MBtu/kWh). ***Define usage period. KSF = 10 ³ square feet.						

1.1.3 Table 3 - M&V Plan Summary

ECM No.	ECM Description	M&V Option Used*	Summary of M&V Plan
EEM-1	Founders Hall Hot Water Insulation	A	Measure heat loss via infrared camera pre and post-construction
EEM-2	Founders Hall Lab 14 RCx	A	Measure hot deck temp, cold deck temp, supply fan speed, and exhaust fan speed
EEM-3	Founders Hall LaFetra AHU DCV	A	Measure supply air temp, supply air temp and operation
EEM-4	Hoover Lighting	A	Measure lighting operation pre and post-construction
EEM-5	Founders Hall Lab Controls	A	Measure hot deck temp, cold deck temp, supply fan speed, and exhaust fan speed
EEM-6	Hoover Controls Upgrade	A	Measure supply air temp, static pressure, and operation
EEM-7	Mainiero MZ to VAV Upgrade	A	Measure hot deck temp, cold deck temp, supply fan speed, and exhaust fan speed, and operation

1.2 WHOLE PROJECT DATA/GLOBAL ASSUMPTIONS

1.2.1 Schedule and Reporting for Verification Activities

A. Table 4 - Schedule of Verification Reporting Activities

Item	Recommended time of submission	Owner's review and acceptance period
Post-Installation Report	30 to 60 days after acceptance	30 days

1.2.2 O&M Reporting Requirements

Not applicable

1.2.3 Construction Period Savings

Not applicable

1.2.4 Dispute Resolution – Any baseline adjustment is to be supported by trended data from BAS or data loggers. ABM will inform client prior to baseline adjustment.

1.2.5 Proposed Energy Savings Calculations and Methodology

ABM's program will use the IPMVP Option A standard as the means to track savings and achieve all projected results. To accomplish this, Key parameters will be measured pre and post retrofit. These parameters will be input into engineering calculations to determine the energy savings. Post retrofit inspection and control system trending will verify that the parameters are in place and performing as expected. The calculated savings will be stipulated for the remainder of the contract term.

A simple way to view the manner in which savings are computed is by using the following equation:

$$\text{Consumption Savings for Reporting Period} = (\text{Baseline Period Use or Demand} - \text{Reporting Period Use or Demand}) \pm \text{Adjustments}$$

$$\text{Cost savings for Reporting Period} = (\text{Consumption Savings} \times \text{Average tariff/cost}^*) + \text{Any other Cost savings}^{**} \pm \text{Adjustments}$$

Baseline Period Consumption – Energy Consumption for a 12 month period for which consistent data is available and is reflective of University of LaVerne's standard operating conditions.

Reporting Period Consumption – Energy Consumption for the specified contract period.

Adjustments bring energy use in the two time periods to the same set of conditions. Conditions commonly affecting energy use are weather, occupancy, and equipment operations required by these conditions. Adjustments may be positive or negative.

**Reporting period average electricity tariff/cost shall be calculated as based on utility tariffs & charges.*

***Any other Cost savings realized include Penalty avoidance, Contract demand reduction, etc.*

All mechanical and electrical systems tied to energy guarantee parameters must be maintained per manufacturer specifications and in proper working order.

1.2.6 Post-Installation M&V Activities

Adjustments

Adjustments bring energy use in the two time periods to the same set of conditions. Conditions commonly affecting energy use are weather, occupancy, and equipment operations required by these conditions. Adjustments may be positive or negative. Following are some categories of potential adjustments that will be reviewed annually during the contract term. Note that some categories may not apply to all measures.

Operating Schedule

Any changes in operating schedules like major change in operating hours across buildings will be taken into account through Operating Schedule adjustments.

Addition of facility area

Any significant addition/modification in addressable facility load would be considered as adjustment to the baseline. If consumption out of the additional load(s) is more than 5% of total loads, ABM recommends installation of a separate meter. Otherwise the parties may mutually discuss the loads and agree on an approximate value.

Working Days in a Year

In case the Reporting Period has a major change in the working days as per materiality criterion after base-lining period, the same will be taken into account to adjust the savings.

Service Specifications Policy

Respective facility service specifications like temperature, illumination level, humidity are considered as policy as provided by University of La Verne. Any permanent changes in policy from the baseline period due to business reasons will be considered for this adjustment. Policy changes suggested by ABM and approved to achieve energy efficiency contribute to savings under the Scope of Work.

Closure/ Addition of Sites

Any site closures will be removed from the baseline. Any savings achieved during this period will be reconciled.

Facility Area (sq ft) and Conditioned Space Area (sq ft)

- In case of any site layout change which may affect energy consumption significantly as per materiality criterion, an adjustment would be calculated and savings computed

accordingly. Such changes in layout should result in addition / deletion of energy consuming equipment / lighting/heat load without which, no adjustment shall be made.

- All changes to existing infrastructure carried out by University of La Verne will have to be communicated to ABM. Any re-base lining and associated works, as may be required, shall be carried out by ABM on conditions and charges that will be mutually discussed

Other Factors may include HVAC utilization levels and efficiency, Seasonal and Weather Changes (Cooling Degree Days/ Heating Degree Days) & Consumption by Medical Equipment/IT load.

1.3. ECM-Specific M&V Plan and Savings Calculation Methods

1.3.1 Measurement & Verification Plan for Specific Energy Efficiency Measures

EEM-1

Title: Founders Hall Insulate Hot Water Components

This ECM Includes:

- Adding insulation to hot water components to save wasted energy

ABM's program will use IPMVP Option A standard as the means to track savings and achieve all projected results.

Option (A) Retrofit Isolation: Key Parameter Measurement

Savings are determined by onetime pre and post field measurement of the key performance parameter(s) which define the energy use of the energy efficiency measure's (EEM) affected system(s) and/or the success of the project. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required.

The M&V process will consist of a walkthrough and visual inspection of the Founders Hall heating components both pre and post retrofit. The areas to be examined include piping, valves, tanks, etc.

Uninsulated components identified in the pre retrofit survey will be recorded. Parameter measurements will be taken for components such as pipe length, pipe diameter, space temperature and hot water temperature. These parameters will then be applied to thermal equations for heat transfer calculation. The equations are applied to the hourly bin temperature data for both the existing conditions and the proposed improvements and the difference between the two indicates the estimated savings due to the improvements.

Post retrofit inspection will verify that the improvements are in place and performing as expected. The savings are automatically fulfilled once the new insulation installation is completed and the calculated savings will be stipulated for the remainder of the contract term.

Title Pipe Insulation for Heating Systems
Project University of LaVerne
Site

Description Insulate heating system piping which are not currently insulated to reduce heat loss from piping and heat gain to the spaces.

Given

Fuel Energy Cost	=	\$10.10	\$/MCF (Nat'l Gas)
Operation (Hours/Week)	=	168.00	Hours/Week
Operation (Heating Weeks/Year)	=	52.00	Weeks/Year
Operation (Hours/Year)	=	8736	Hours/Year
Heating Media	=	Water	
Piping Material	=	Mild Steel	
Ambient Temperature	=	80 °F	

Pipe Diameter = Pipe #1 1/2 inches Pipe #2 1 1/2 inches Pipe #3 3 inches 7.00 inches Pipe #4 2 inches

Pipe Length = Pipe #1 138.50 feet Pipe #2 0.00 feet Pipe #3 0.00 feet Pipe #4 0.00 feet

Assumption

Min. Pipe Insulation Recommended	=	1.00 inches	1.00 inches	1.50 inches	1.50 inches
Circulating Temperature	=				180 °F
Heating Efficiency	=				82%
Pipe Insulation Conductivity	=				0.29 Btu*in./ (h*F2)

Formula

Piping Correction Factor = (Current Transmission Coefficient / Reference Transmission Coefficient)
 Temperature Correction Factor = (Circulating Temperature - Ambient Temperature) / (Circulating Temperature - Reference Temperature)
 Hourly Heat Loss per pipe size and length = (Heat loss per foot [from chart]) x (Piping Correction Factor) x (Temperature Correction Factor) x (Pipe Length)
 Seasonal Heat Loss = (Hourly Heat Loss Total) x (Operating hours) / (Heating Efficiency) / (1,000 Btu/Mbtu)
 Energy Loss = (Seasonal Heat Loss) / (Conversion Factor [MBtu/Unit])
 Energy Loss Cost = (Energy Loss) x (cost/unit)

Result

Existing Heat Loss	84.96 MCF
New Heat Loss	14.33 MCF
Savings	100% 70.62 MCF

EEM-2

Title: Founders Hall Lab 14 AHU RCx

This ECM Includes:

- Controls Upgrade/commissioning
- Air Balancing

ABM's program will use IPMVP Option A standard as the means to track savings and achieve all projected results.

Option (A) Retrofit Isolation: Key Parameter Measurement

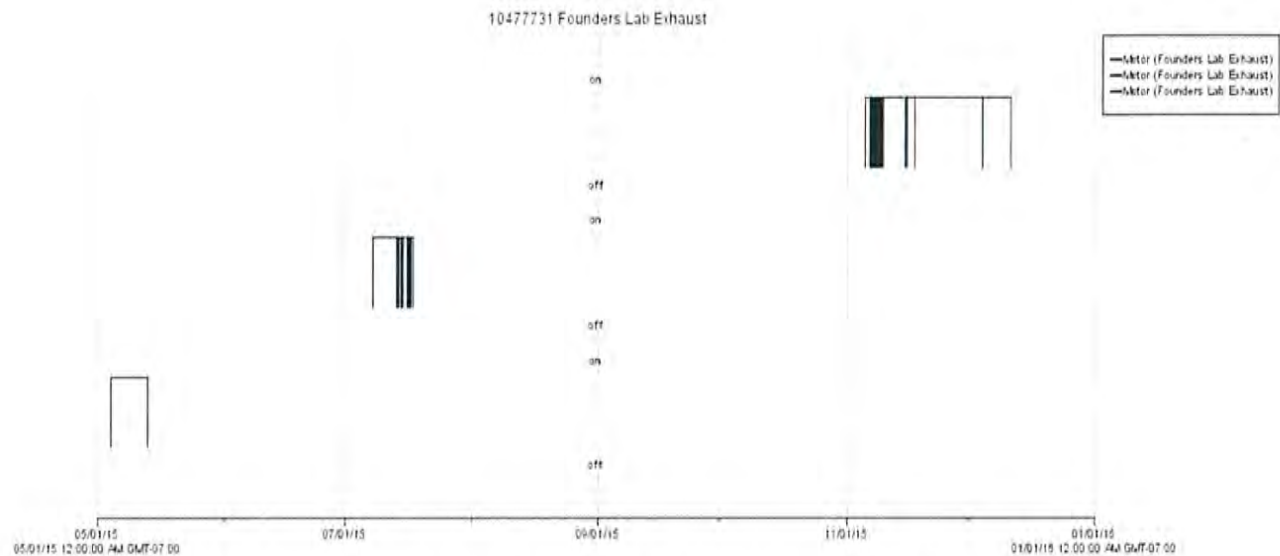
Savings are determined by onetime pre and post field measurement of the key performance parameter(s) which define the energy use of the energy efficiency measure's (EEM) affected system(s) and/or the success of the project. Measurement is accomplished either by direct measurement with field instruments, or through trend logging of the parameters on the building control system. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required.

Savings are determined by first taking field measurement of all key performance parameters which define the energy use of the EEM-affected system. Measured parameters include damper position, fan speed, air flow rate, space temperature, mixed air temperature, supply air temperature, heating and cooling valve position, outdoor air damper position, and operating hours.

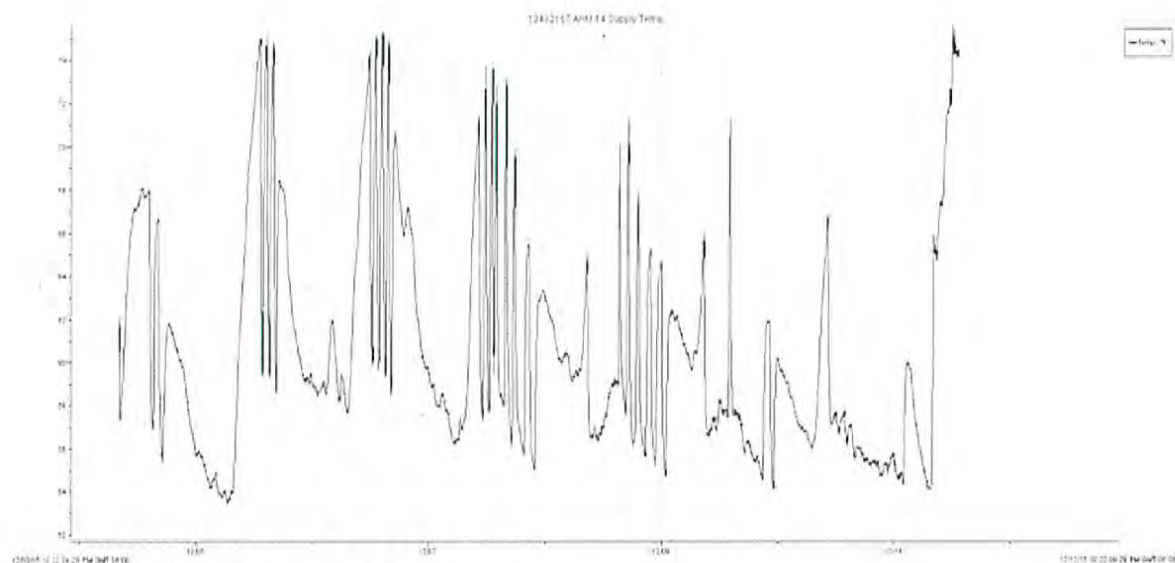
Additional parameters to be identified include heating and cooling system efficiencies.

Post retrofit measured parameters will be used to calculate the post project energy use. This will then be compared to the baseline energy use to determine the energy savings. The calculated savings will be stipulated for the remainder of the contract term.

The chart below shows that the exhaust fan, which provided too much pressurization and ran more than necessary, is now running only when the air handler is in use.



Founders Hall Lab Exhaust Pre and Post Construction (showing control of fan)



Founders Hall Lab Supply Air Temperature

AHU TEMPERATURE RESET

Job Name: University of LaVerne

Building: Founders Hall Lab 14

OVERVIEW:

This ECM is applicable to AHUs. Repair and replacement of controls and the building automation system will greatly reduce the amount of simultaneous heating and cooling, reducing the loads on both the heating and cooling plants and decreasing the amount of reheat energy required, and excess cooling energy. This ECM will conserve cooling energy at the CHW coil, as well as heating energy at the heating coil.

ASSUMPTIONS:

Current cold deck supply air setpoint.....	55 F
Reset cold deck supply air setpoint.....	65 F
Annual reset period.....	5,824 hr/yr
Total AHU supply air flow.....	3,000 CFM
Boiler efficiency.....	82%
Chiller performance factor.....	1.20 KW/ton
Avoided cost of gas.....	\$6.50 /MCF
Avoided cost of electricity.....	\$0.127 /KWH
Specific heat of air.....	1.08 BTU/CFM-F
Heating conversion factor.....	1,000,000 BTU/MCF
Cooling conversion factor.....	12,000 BTU/ton-hr

SYMBOL:

A
B
C
D
E
F
G
H

UTILITY SAVINGS CALCULATIONS:

Cooling Savings = 18,870 KWH/yr

Heating Savings = 230 MCF/yr

UTILITY SAVINGS FORMULAS:

$$\text{Cooling Savings} = \frac{\left(\frac{\text{temp.}}{\text{diff.}} \right) \times 108 \times \text{CFM} \times \left(\frac{\text{reset}}{\text{period}} \right) \times \left(\frac{\text{chiller}}{\text{factor}} \right)}{12,000}$$

$$= \frac{(B - A) \times 108 \times C \times D \times F}{12,000} = I$$

$$\text{Re heat Savings} = \frac{\left(\frac{\text{temp.}}{\text{diff.}} \right) \times 108 \times \text{CFM} \times \left(\frac{\text{reset}}{\text{period}} \right)}{1,000,000 \times \left(\frac{\text{boiler}}{\text{eff.}} \right)}$$

$$= \frac{(B - A) \times 108 \times C \times D}{1,000,000 \times E} = J$$

$$\text{Cost Savings} = \left(\frac{\text{cooling}}{\text{savings}} \right) \times \left(\frac{\text{elect.}}{\text{cost}} \right) + \left(\frac{\text{reheat}}{\text{savings}} \right) \times \left(\frac{\text{gas}}{\text{cost}} \right)$$

$$= (J \times G) + (I \times H)$$

EEM-3

Title: Founders Hall LaFetra AHU DCV

This ECM Includes:

- Controls Upgrade/commissioning
- VFD installation

ABM's program will use IPMVP Option A standard as the means to track savings and achieve all projected results.

Option (A) Retrofit Isolation: Key Parameter Measurement

Savings are determined by onetime pre and post field measurement of the key performance parameter(s) which define the energy use of the energy efficiency measure's (EEM) affected system(s) and/or the success of the project. Measurement is accomplished either by direct measurement with field instruments, or through trend logging of the parameters on the building control system. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required.

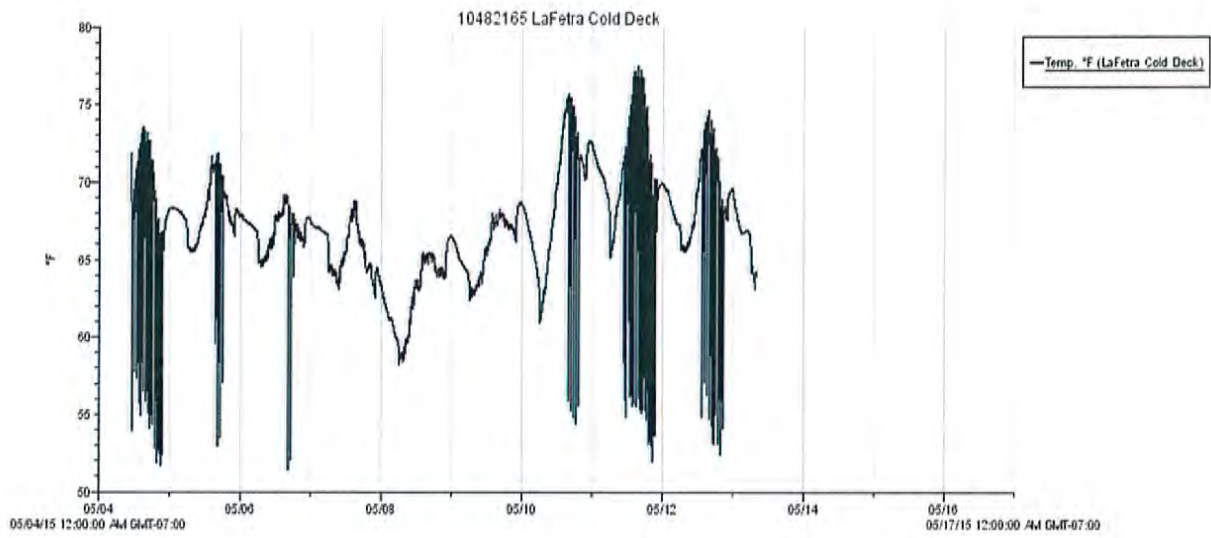
Savings are determined by first taking field measurement of all key performance parameters which define the energy use of the EEM-affected system. Measured parameters include damper position, fan speed, air flow rate, space temperature, mixed air temperature, supply air temperature, heating and cooling valve position, outdoor air damper position, and operating hours.

Additional parameters to be identified include heating and cooling system efficiencies.

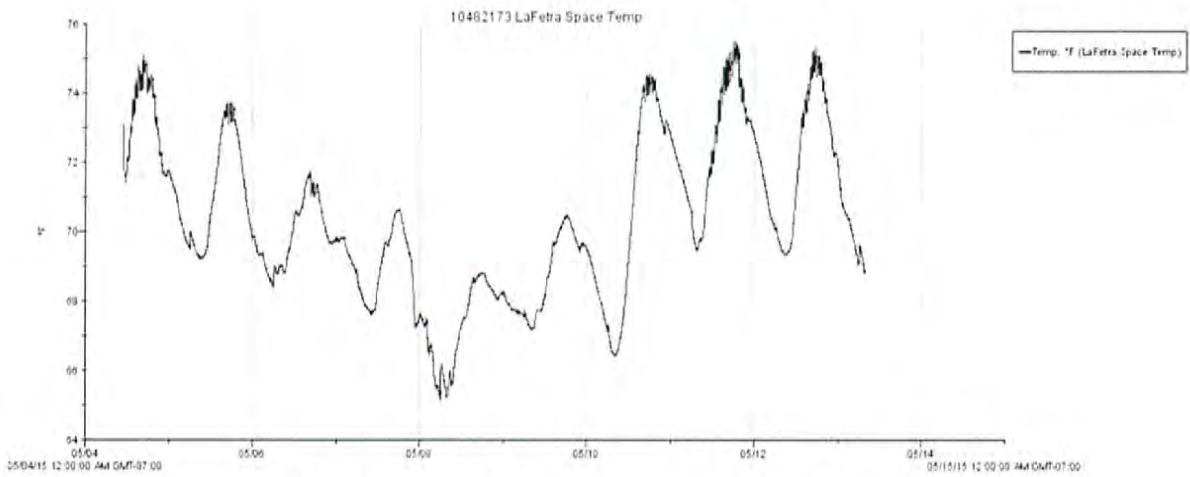
Post retrofit measured parameters will be used to calculate the post project energy use. This will then be compared to the baseline energy use to determine the energy savings. The calculated savings will be stipulated for the remainder of the contract term.

The trend data captured on the cold deck shows that the temperature is much more uniform and the temperature is reset to a higher temperature when the building is unoccupied. The cooling savings are determined by:

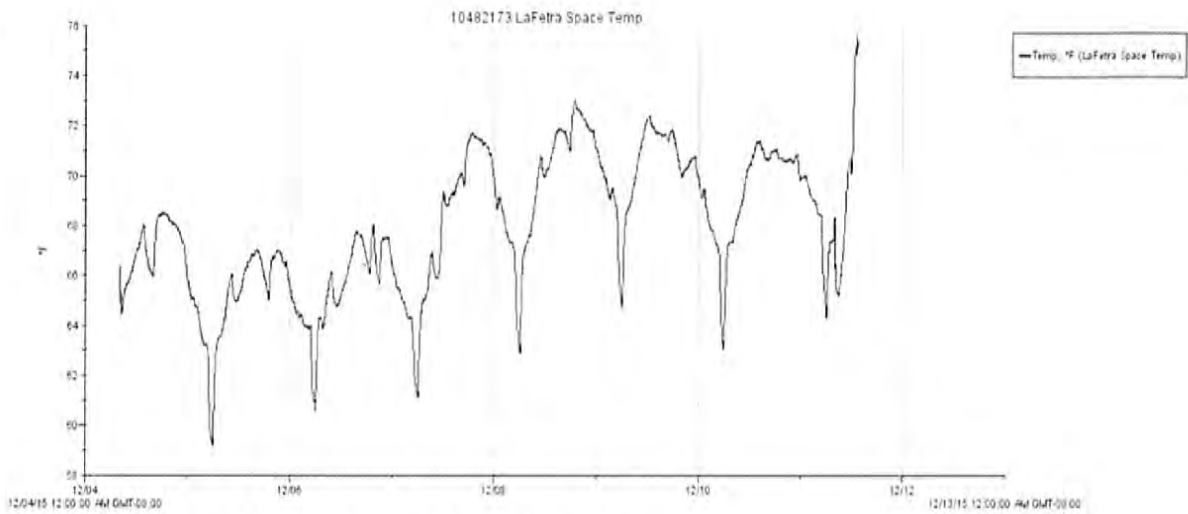
Cooling Savings (kWh): $(\text{Temp Diff}) * 1.08 * \text{CFM} * (\text{Reset period}) / 12,000$



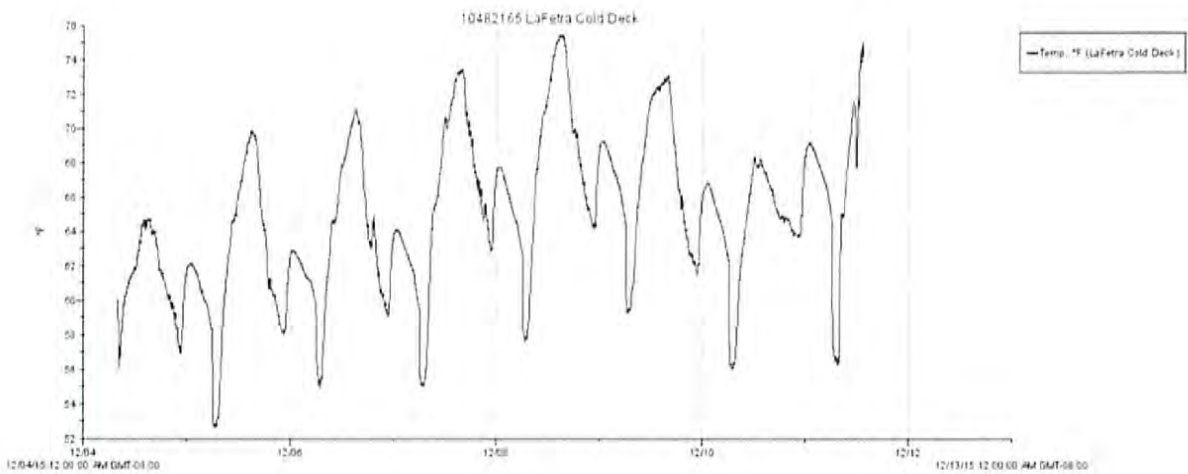
LaFetra AHU Supply Temperature Pre-Construction



LaFetra AHU Supply Temperature Post-Construction



LaFetra AHU Space Temperature Pre-Construction



LaFetra AHU Space Temperature Post-Construction (showing setbacks)

AHU TEMPERATURE RESET

Job Name: University of LaVerne

Building: LaFetra Hall

OVERVIEW:

This ECM is applicable to AHUs. Repair and replacement of controls and the building automation system will greatly reduce the amount of simultaneous heating and cooling, reducing the loads on both the heating and cooling plants and decreasing the amount of reheat energy required, and excess cooling energy. This ECM will conserve cooling energy at the CHW coil, as well as heating energy at the heating coil.

ASSUMPTIONS:

Current cold deck supply air setpoint.....	55 F
Reset cold deck supply air setpoint.....	70 F
Annual reset period.....	3,650 hr/yr
Total AHU supply air flow.....	10,000 CFM
Boiler efficiency.....	82%
Chiller performance factor.....	1.20 KW/ton
Avoided cost of gas.....	\$6.50 /MCF
Avoided cost of electricity.....	\$0.127 /KWH
Specific heat of air.....	1.08 BTU/CFM-F
Heating conversion factor.....	1,000,000 BTU/MCF
Cooling conversion factor.....	12,000 BTU/ton-hr

SYMBOL:

A
B
C
D
E
F
G
H

UTILITY SAVINGS CALCULATIONS:

Cooling Savings = 59,130 KWH/yr

Heating Savings = 721 MCF/yr

UTILITY SAVINGS FORMULAS:

$$\text{Cooling Savings} = \frac{\left(\frac{\text{temp.}}{\text{diff.}} \right) \times 108 \times \text{CFM} \times \left(\frac{\text{reset}}{\text{period}} \right) \times \left(\frac{\text{chiller}}{\text{factor}} \right)}{12,000}$$

$$= \frac{(B - A) \times 108 \times C \times D \times F}{12,000} = I$$

$$\text{Re heat Savings} = \frac{\left(\frac{\text{temp.}}{\text{diff.}} \right) \times 108 \times \text{CFM} \times \left(\frac{\text{reset}}{\text{period}} \right)}{1000,000 \times \left(\frac{\text{boiler}}{\text{eff.}} \right)}$$

$$= \frac{(B - A) \times 108 \times C \times D}{1000,000 \times E} = J$$

$$\text{Cost Savings} = \left(\frac{\text{cooling}}{\text{savings}} \right) \times \left(\frac{\text{elect.}}{\text{cost}} \right) + \left(\frac{\text{reheat}}{\text{savings}} \right) \times \left(\frac{\text{gas}}{\text{cost}} \right)$$

$$= (J \times G) + (I \times H)$$

NIGHT SETBACK - HEATING

Job Name: University of LaVerne

Building: LaFetra Auditorium

OVERVIEW:

The installation of a building automation system to control heating and cooling systems will allow the setpoint of the heating system to be adjusted automatically, on a nightly basis. This will reduce the annual costs to heat and cool the building. This calculation assumes that the heating setpoint is automatically adjusted downward during the heating season, when the building is unoccupied at night and on weekends.

ASSUMPTIONS:

Present heating energy usage.....	500 MCF
Present occupied heating setpoint.....	72 F
Proposed unoccupied heating setpoint.....	55 F
Average heating season O.A. temperature.....	53 F
Unoccupied period.....	50 hrs/wk
Avoided cost of gas.....	\$6.50 /MCF
Total weekly period.....	168 hrs/wk

SYMBOL:

A
B
C
D
E
F

UTILITY SAVINGS CALCULATIONS:

Heating Saving: = 133 MCF/yr

UTILITY SAVINGS FORMULAS:

$$\text{Heating Savings} = \left(\frac{\text{exist. gas usage}}{\text{usage}} \right) \times \left[1 - \frac{\left(\frac{\text{new temp. difference}}{\text{old temp. difference}} \right)}{\left(\frac{\text{setback}}{\text{period}} \right)} \right] \times \frac{168}{168}$$

$$= A \times \left[1 - \frac{C - D}{B - D} \right] \times \frac{E}{168} = G$$

$$\text{Cost Savings} = \left(\frac{\text{heating savings}}{\text{savings}} \right) \times \left(\frac{\text{gas cost}}{\text{cost}} \right)$$

$$= G \times F$$

SCHEDULED START/STOP

Job Name: University of LaVerne

Buildings: LaFetra Auditorium

OVERVIEW

Installation of a building automation system will allow the scheduled starting and stopping of cooling units that are now manually controlled. This reduces the annual energy consumption by allowing the equipment to be off more time than is currently possible, due to manpower limitations at the facility. The calculation assumes that during the periods that the cooling are turned off, there will be a savings in cooling energy associated with the average cooling load for the buildings.

ASSUMPTIONS:

Present operational period.....	112 hrs/wk
Proposed operational period.....	119 hrs/wk
Cooling season length.....	32 wk/yr
Estimated cooling load during shutdown period.....	7.5 tons
Cooling equipment EER rating.....	10.00 MBTU/KWH
Building temperature limit diversity factor.....	0.90
Avoided cost of electricity.....	\$0.127 /KWH
Cooling conversion factor	12 MBTU/ton-hr

SYMBOL:

A
B
C
D
E
F
G

UTILITY SAVINGS CALCULATIONS:

Shutdown Period = -7 hrs/wk

Cooling Savings = -1,814 KWH/yr

OUTSIDE AIR ECONOMIZER CYCLE

Job Name: University of LaVerne

Building: LaFetra Hall

OVERVIEW:

The installation of a building automation system to control heating and cooling systems will allow the air handling units to operate in an outside air economizer cycle mode. This will allow the use of outside air for cooling whenever the weather conditions permit. This will save the mechanical cooling energy normally used during these periods.

ASSUMPTIONS:

Total AHU airflow rate.....	<u>10,000</u> CFM
Weekly AHU operation period.....	<u>80</u> hrs/wk
Average return air temperature.....	<u>72</u> F
Average economizer period O.A. temperature.....	<u>55</u> F
Annual economizer period.....	<u>20</u> wk/yr
Chiller performance factor.....	<u>1.20</u> KW/ton
Avoided cost of electricity.....	<u>\$0.127</u> /KWH
Specific heat of air.....	<u>1.08</u> BTU/CFM-F
Cooling conversion factor.....	<u>12,000</u> BTU/ton-hr

SYMBOL:

A
B
C
D
E
F
G

UTILITY SAVINGS CALCULATIONS:

Cooling Savings

=

29,376 KWH/yr

UTILITY SAVINGS FORMULAS:

$$\text{Cooling Savings} = \frac{\text{CFM} \times 108 \times \left(\frac{\text{temperature}}{\text{difference}} \right) \times \left(\frac{\text{chiller}}{\text{factor}} \right) \times \left(\frac{\text{economizer}}{\text{period}} \right)}{12,000}$$

$$= \frac{A \times 108 \times (C - D) \times F \times B \times E}{12,000} = H$$

$$\text{Cost Savings} = \left(\frac{\text{cooling}}{\text{savings}} \right) \times \left(\frac{\text{elect}}{\text{cost}} \right)$$

$$= G \times H$$

VENTILATION REDUCTION

Job Name: University of LaVerne

Building: LaFetere Auditorium

OVERVIEW:

The amount of outside air for ventilation will be reduced in order to reduce the heating and cooling loads on the primary systems. The new ventilation quantities will be in accordance with the current building occupancy, usage and ASHRAE Standard 62-2013. The calculations assume that the ventilation air is cooled at the air handler cooling coil, from the average summer outside air temperature, down to the coil supply air setpoint. In the heating season, the ventilation air is heated at the air handler preheat coil, from the average heating season outside air temperature, up to the preheat coil leaving air setpoint.

ASSUMPTIONS:

Present ventilation	1,000 CFM
ASHRAE required ventilation.....	0 CFM
Weekly operation period.....	88 hrs/wk
Preheat coil setpoint.....	55 F
Average heating season O.A. temperature.....	52 F
Heating season length.....	20 wk/yr
Cooling coil setpoint.....	23.5 BTU/lb
Average cooling season O.A. enthalpy.....	26.7 BTU/lb
Cooling season length.....	32 wk/yr
Boiler efficiency.....	0.82 %
Chiller performance factor.....	1.20 KW/ton
Avoided cost of gas.....	\$6.50 /MCF
Avoided cost of electricity.....	\$0.127 /KWH
Air mass conversion factor.....	4.5 lb/hr-CFM
Specific heat of air.....	1.08 BTU/CFM-F
Heating conversion factor.....	1,000,000 BTU/MCF
Cooling conversion factor.....	12,000 BTU/ton-hr

SYMBOL:

A
B
C
D
E
F
G
H
I
J
K
L
M

UTILITY SAVINGS CALCULATIONS:

$$\text{Cooling Savings} = \frac{(A - B) \times 4.5 \times (H - G) \times C \times I \times K}{12,000} = O$$

$$\text{Heating Savings} = \frac{(A - B) \times 1.08 \times (D - E) \times C \times F}{1,000,000 \times J} = P$$

$$\text{Cost Savings} = O \times M + P \times L$$

$$\text{Cooling Saving} = 4,055 \text{ KWH/yr}$$

$$\text{Heating Saving} = 7 \text{ MCF/yr}$$

EEM-4

Title: Hoover Building Lighting

This ECM Includes:

- Retrofit of existing 2X2 T8 U-lamp fixtures to LED technology
- Relamp incandescent fixtures with LED technology
- Occupancy sensors
- Daylighting control near skylight

ABM's program will use IPMVP Option A standard as the means to track savings and achieve all projected results.

Option (A) Retrofit Isolation: Key Parameter Measurement

Savings are determined by onetime pre and post field measurement of the key performance parameter(s) which define the energy use of the energy efficiency measure's (EEM) affected system(s) and/or the success of the project. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required.

Savings are determined by first taking field measurement of all key performance parameters which define the energy use of the EEM-affected system. Measured parameters include fixture amperage, fixture voltage, and operating hours. Measurements will be taken on a 5% sample of each fixture type.

Post retrofit measured parameters will be used to calculate the post project energy use. This will then be compared to the baseline energy use to determine the energy savings. The calculated savings will be stipulated for the remainder of the contract term.

Lighting savings are determined by the following:

Lighting energy savings: Lighting watts * runtime hours

The data shows the lights at Hoover fluctuate with occupancy post-project. The lighting will be trended once and the savings will be stipulated for the remainder of the contract term.

TO: KREIGER, HOOPER, RM 218 - Project 2018

Weight: Hoover RM 218 - Project 2018
Weight: Hoover RM 218 - Project 2018
Weight: Hoover RM 218 - Project 2018

10/15/18 10:00:00 AM 10/15/18 10:00:00 AM 10/15/18 10:00:00 AM 10/15/18 10:00:00 AM 10/15/18 10:00:00 AM

Hoover Rm 218 Lighting Status Pre- Construction (lower graph) and Post-Construction (upper and middle graphs showing control of lighting indicating the light shut off with occupancy)

Hoover Lighting Baseline							Post retrofit				
Fixture	Quantity	W/fixture	Total watts	kW	hours	kWh	kW	kWh	occ sensors	kWh Saved	hrs
2X2 F40	35	90	3,150	3.15	3234	10,187	1.7325	5,603	2,037	4,584	1,478
2X2 F40	17	90	1,530	1.53	8760	13,403	0.8415	7,372	2,681	6,031	8,760
2X2 F40	7	90	630	0.63	1725	1,087	0.3465	598	217	489	788
2X2 F40	2	90	180	0.18	2156	388	0.099	213	78	175	985
Incand	12	100	1,200	1.20	1725	2,070	0.66	1,139	414	932	788
Incand	1	60	60	0.06	431	26	0.033	14	5	12	197
Incand	9	60	540	0.54	3234	1,746	0.297	960	349	786	1,478
2X4 2L28T8	6	66	396	0.40	3234	1,281	0.2178	704	256	576	1,478
2X4 2L28T8	6	66	396	0.40	8760	3,469	0.2178	1,908	694	1,561	8,760
2X4 2L28T8	4	66	264	0.26	431	114	0.1452	63	23	51	197
2X4 2L28T8	7	66	462	0.46	2156	996	0.2541	548	199	448	985
2X4 2L28T8	2	66	132	0.13	1725	228	0.0726	125	46	102	788
2X4 4L28T8	58	132	7,656	7.66	1725	13,207	4.2108	7,264	2,641	5,943	788
2X4 4L28T8	41	132	5,412	5.41	2156	11,668	2.9766	6,418	2,334	5,251	985
2X4 4L28T8	9	132	1,188	1.19	3234	3,842	0.6534	2,113	768	1,729	1,478
2X4 4L28T8	4	132	528	0.53	8760	4,625	0.2904	2,544	925	2,081	8,760
CFL	11	19	209	0.21	3234	676	0.11495	372	135	304	1,478
TSHO	6	148	888	0.89	1725	1,532	0.4884	842	306	689	788
TSHO	4	148	592	0.59	862	510	0.3256	281	102	230	394
TSHO	16	148	2,368	2.37	2156	5,105	1.3024	2,808	1,021	2,297	985
Totals	257		24,821	24.82		76,160	15.27955	41,888	15,232	49,504	

EEM-5

Title: Founders Hall Lab Controls

This ECM Includes:

- Controls Upgrade/commissioning

ABM's program will use IPMVP Option A standard as the means to track savings and achieve all projected results.

Option (A) Retrofit Isolation: Key Parameter Measurement

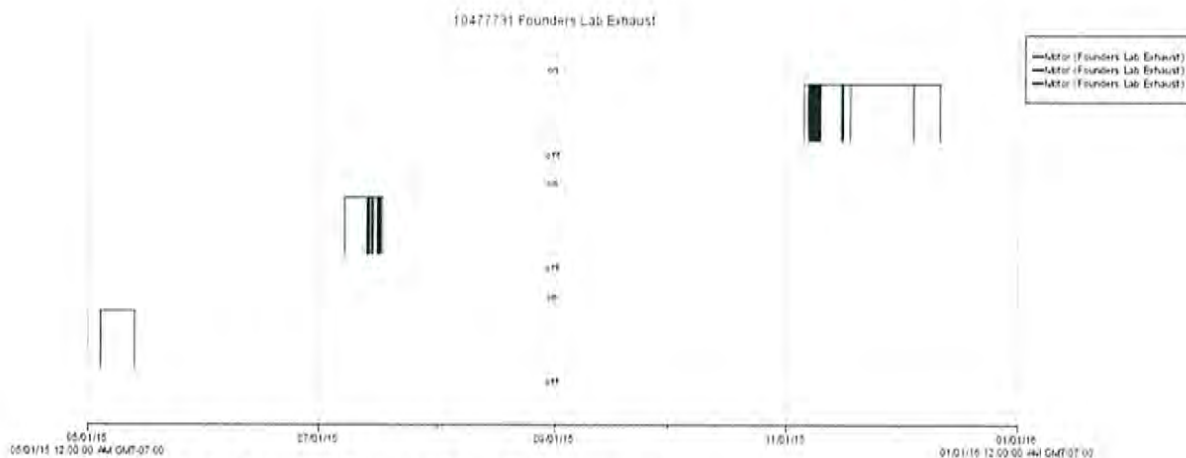
Savings are determined by onetime pre and post field measurement of the key performance parameter(s) which define the energy use of the energy efficiency measure's (EEM) affected system(s) and/or the success of the project. Measurement is accomplished either by direct measurement with field instruments, or through trend logging of the parameters on the building control system. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required.

Savings are determined by first taking field measurement of all key performance parameters which define the energy use of the EEM-affected system. Measured parameters include damper position, fan speed, air flow rate, space temperature, mixed air temperature, supply air temperature, space static pressure, heating and cooling valve position, outdoor air damper position, and operating hours.

Additional parameters to be identified include heating and cooling system efficiencies.

Post retrofit measured parameters will be used to calculate the post project energy use. This will then be compared to the baseline energy use to determine the energy savings. The calculated savings will be stipulated for the remainder of the contract term.

The chart below shows that the exhaust fan, which provided too much pressurization and ran more than necessary, initially was modulating but now is back to pre-project run times.



Founders Hall Lab Exhaust Pre and Post Construction

- Savings by utilizing VFDs on the lab exhaust fans are represented below:
 - Under existing conditions the motor was on 100% of sampled time whereas under post construction conditions, the motor on 95% of sampled time. The savings have been extrapolated to full year conditions with the speed reducing four 2 hp motors to an average of 60%:

Baseline: kWh = $0.746 * 8 * 8760 = 52,280$ kWh

Post Const: kWh = $0.746 * 4.8 * 0.6 * 8322 = 17,880$ kWh

EEM-6

Title: Hoover Controls Upgrade

This ECM Includes:

- Controls Upgrade/commissioning

ABM's program will use IPMVP Option A standard as the means to track savings and achieve all projected results.

Option (A) Retrofit Isolation: Key Parameter Measurement

Savings are determined by onetime pre and post field measurement of the key performance parameter(s) which define the energy use of the energy efficiency measure's (EEM) affected system(s) and/or the success of the project. Measurement is accomplished either by direct measurement with field instruments, or through trend logging of the parameters on the building control system. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required.

Savings are determined by first taking field measurement of all key performance parameters which define the energy use of the EEM-affected system. Measured parameters include damper position, fan speed, air flow rate, space temperature, mixed air temperature, supply air temperature, duct static pressure, heating and cooling valve position, outdoor air damper position, and operating hours.

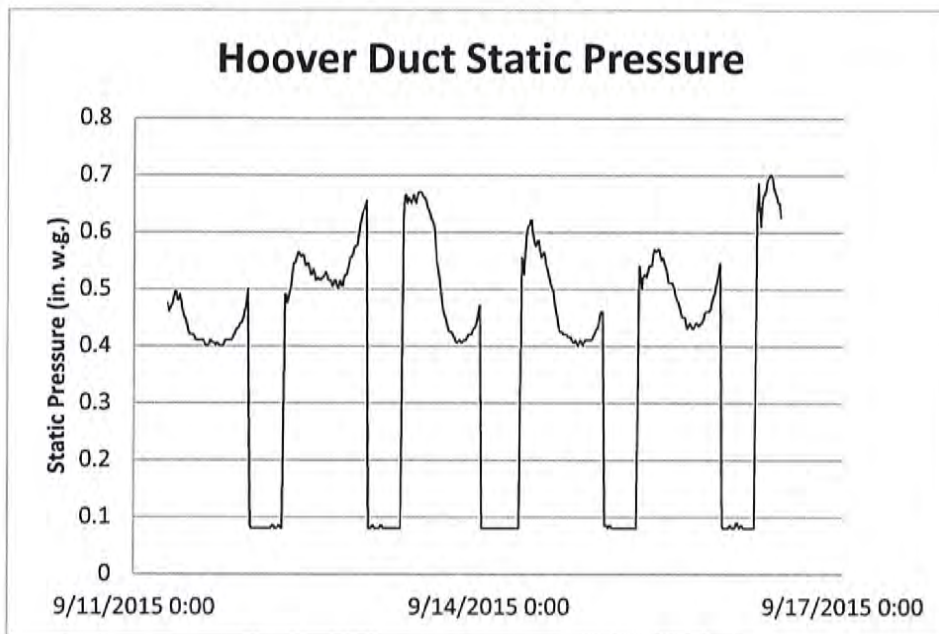
Additional parameters to be identified include heating and cooling system efficiencies.

Post retrofit measured parameters will be used to calculate the post project energy use. This will then be compared to the baseline energy use to determine the energy savings. The calculated savings will be stipulated for the remainder of the contract term.

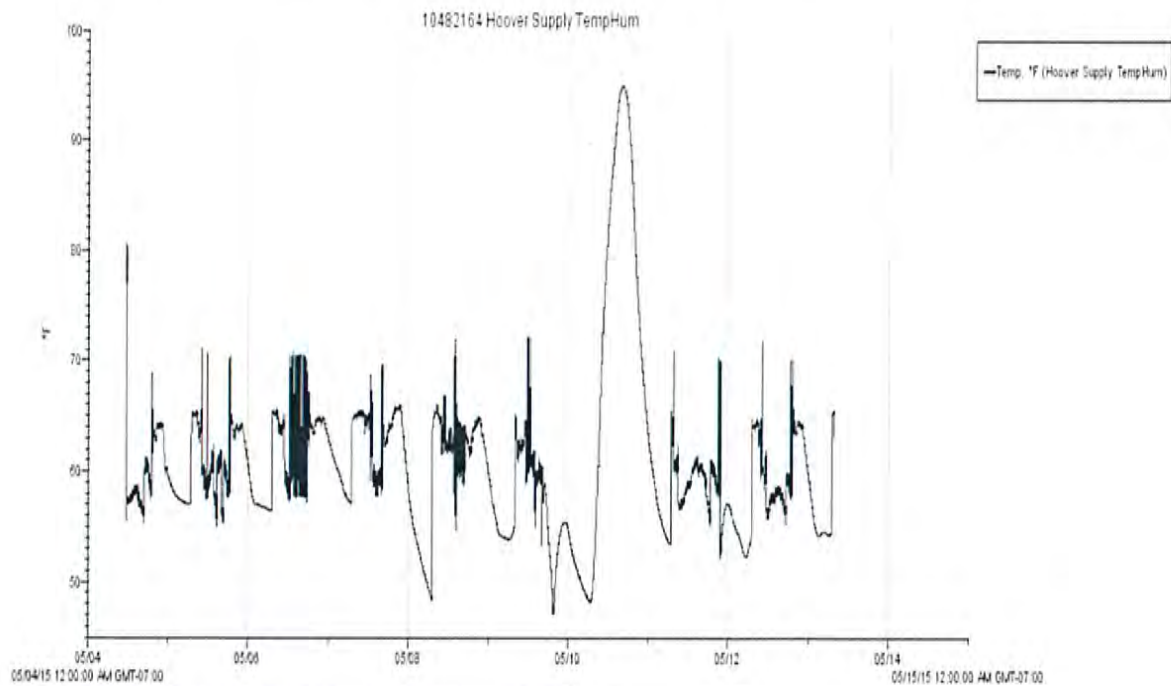
The fan energy is directly proportional to the static pressure as shown below:

Horsepower: $CFM * \text{Static Pressure} / 6356 * \text{fan efficiency} * \text{motor efficiency}$

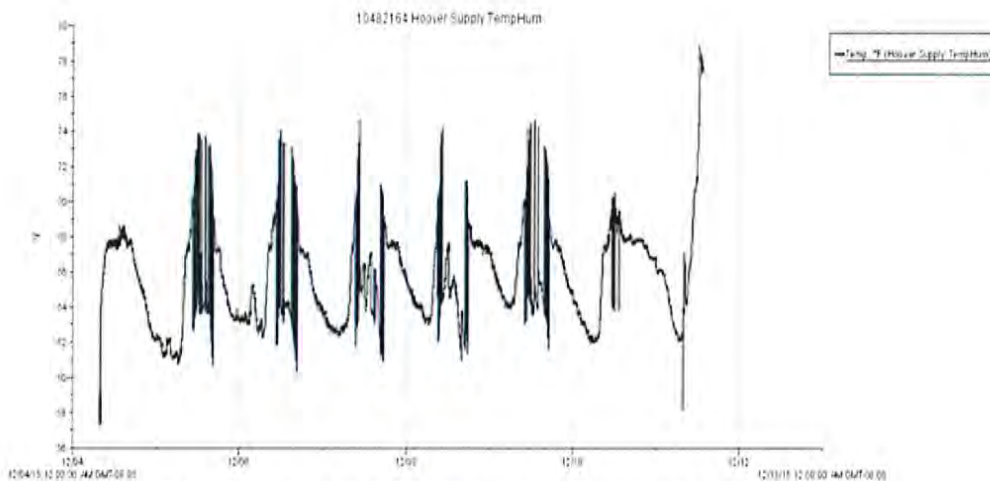
The trends indicated the static pressure is consistently reduced at the preprogrammed times and this can be extrapolated to determine the annual energy savings. In addition the supply air setpoint trends indicate that the supply air temperature is consistently resetting to a higher temperature at preprogrammed times. Trends show that the motor is running 98% of the sampled time, negating night setback heating savings.



Hoover Duct Static Pressure Post-Construction (showing resets)



Hoover Supply Air Temperature Pre-Construction



Hoover Supply Air Temperature Post-Construction (showing setbacks)

AHU TEMPERATURE RESET

Job Name: University of LaVerne

Building: Hoover

OVERVIEW:

This ECM is applicable to AHUs. Repair and replacement of controls and the building automation system will greatly reduce the amount of simultaneous heating and cooling, reducing the loads on both the heating and cooling plants and decreasing the amount of reheat energy required, and excess cooling energy. This ECM will conserve cooling energy at the CHW coil, as well as heating energy at the heating coil.

ASSUMPTIONS:

Current cold deck supply air setpoint.....	62 F
Reset cold deck supply air setpoint.....	74 F
Annual reset period.....	1,622 hr/yr
Total AHU supply air flow.....	24,000 CFM
Boiler efficiency.....	82%
Chiller performance factor.....	1.20 KW/ton
Avoided cost of gas.....	\$6.50 /MCF
Avoided cost of electricity.....	\$0.127 /KWH
Specific heat of air.....	1.08 BTU/CFM-F
Heating conversion factor.....	1,000,000 BTU/MCF
Cooling conversion factor.....	12,000 BTU/ton-hr

SYMBOL:

A	
B	
C	outdoor air below 60 deg
D	
E	
F	
G	
H	

UTILITY SAVINGS CALCULATIONS:

Cooling Savings = 50,451 KWH/yr

UTILITY SAVINGS FORMULAS:

$$\text{Cooling Savings} = \frac{\left(\frac{\text{temp.}}{\text{diff.}} \right) \times 108 \times \text{CFM} \times \left(\frac{\text{reset}}{\text{period}} \right) \times \left(\frac{\text{chiller}}{\text{factor}} \right)}{12,000}$$

$$= \frac{(B - A) \times 108 \times C \times D \times F}{12,000} = I$$

$$\text{Re heat Savings} = \frac{\left(\frac{\text{temp.}}{\text{diff.}} \right) \times 108 \times \text{CFM} \times \left(\frac{\text{reset}}{\text{period}} \right)}{1000,000 \times \left(\frac{\text{boiler}}{\text{eff.}} \right)}$$

$$= \frac{(B - A) \times 108 \times C \times D}{1,000,000 \times E} = J$$

$$\text{Cost Savings} = \left(\frac{\text{cooling}}{\text{savings}} \right) \times \left(\frac{\text{elect.}}{\text{cost}} \right) + \left(\frac{\text{reheat}}{\text{savings}} \right) \times \left(\frac{\text{gas}}{\text{cost}} \right)$$

$$= (J \times G) + (I \times H)$$

NIGHT SETBACK - HEATING

Job Name: University of LaVerne

Building: Hoover

OVERVIEW:

The installation of a building automation system to control heating and cooling systems will allow the setpoint of the heating system to be adjusted automatically, on a nightly basis. This will reduce the annual costs to heat and cool the building. This calculation assumes that the heating setpoint is automatically adjusted downward during the heating season, when the building is unoccupied at night and on weekends.

ASSUMPTIONS:

Present heating energy usage.....	<u>1,500</u> MCF
Present occupied heating setpoint.....	<u>71</u> F
Proposed unoccupied heating setpoint.....	<u>55</u> F
Average heating season O.A. temperature.....	<u>53</u> F
Unoccupied period.....	<u>3</u> hrs/wk
Avoided cost of gas.....	<u>\$6.50</u> /MCF
Total weekly period.....	<u>168</u> hrs/wk

SYMBOL:

A
B
C
D
E
F

UTILITY SAVINGS CALCULATIONS:

Heating Saving: = 24 MCF/yr

UTILITY SAVINGS FORMULAS:

$$\begin{aligned} \text{Heating Savings} &= \left(\frac{\text{exist.}}{\text{gas}} \right) \times \left[1 - \frac{\left(\frac{\text{new temp.}}{\text{difference}} \right)}{\left(\frac{\text{old temp.}}{\text{difference}} \right)} \right] \times \frac{\left(\frac{\text{setback}}{\text{period}} \right)}{168} \\ &= A \times \left[1 - \frac{C-D}{B-D} \right] \times \frac{E}{168} = G \end{aligned}$$

$$\begin{aligned} \text{Cost Savings} &= \left(\frac{\text{heating}}{\text{savings}} \right) \times \left(\frac{\text{gas}}{\text{cost}} \right) \\ &= G \times F \end{aligned}$$

EEM-7

Title: Mainiero Building MZ to VAV upgrade

This ECM Includes:

- Controls Upgrade/commissioning
- VFD/motor installation

ABM's program will use IPMVP Option A standard as the means to track savings and achieve all projected results.

Option (A) Retrofit Isolation: Key Parameter Measurement

Savings are determined by onetime pre and post field measurement of the key performance parameter(s) which define the energy use of the energy efficiency measure's (EEM) affected system(s) and/or the success of the project. Measurement is accomplished either by direct measurement with field instruments, or through trend logging of the parameters on the building control system. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required.

Savings are determined by first taking field measurement of all key performance parameters which define the energy use of the EEM-affected system. Measured parameters include damper position, fan speed, air flow rate, space temperature, mixed air temperature, supply air temperature, duct static pressure, heating and cooling valve position, and operating hours.

Additional parameters to be identified include heating and cooling system efficiencies.

Post retrofit measured parameters will be used to calculate the post project energy use. This will then be compared to the baseline energy use to determine the energy savings. The calculated savings will be stipulated for the remainder of the contract term.

The multizone unit has been converted to a variable volume unit by using controls to modulate the hot and cold deck dampers and installing a VFD on the fan motor. The VFD is controlled by the control system comparing the supply air temperature and the space temperatures. The savings derive from fan savings (variable frequency drive addition), cooling savings, and heating savings as shown below:

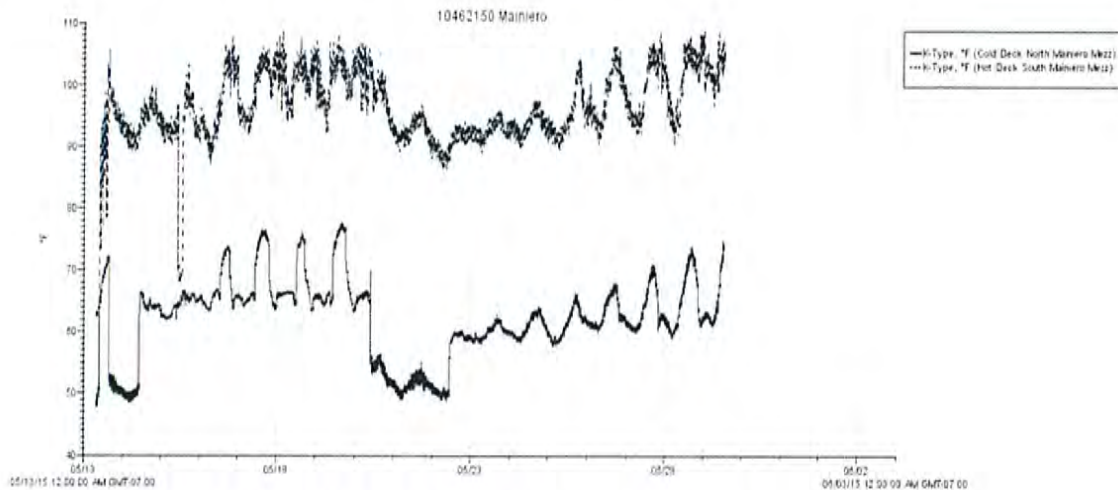
Fan Savings: $\text{horsepower} * 0.746 * ((1 - \text{avg \% load})^3) * \text{runtime hours}$

Cooling Savings: $((\text{hot deck temp} - \text{space temp}) / (\text{hot deck temp} - \text{cold deck temp})) * (1 - \text{avg \% load}) * ((\text{CFM} * \text{cold deck temp drop}) * 1.08 * \text{cooling period}) / 12000$

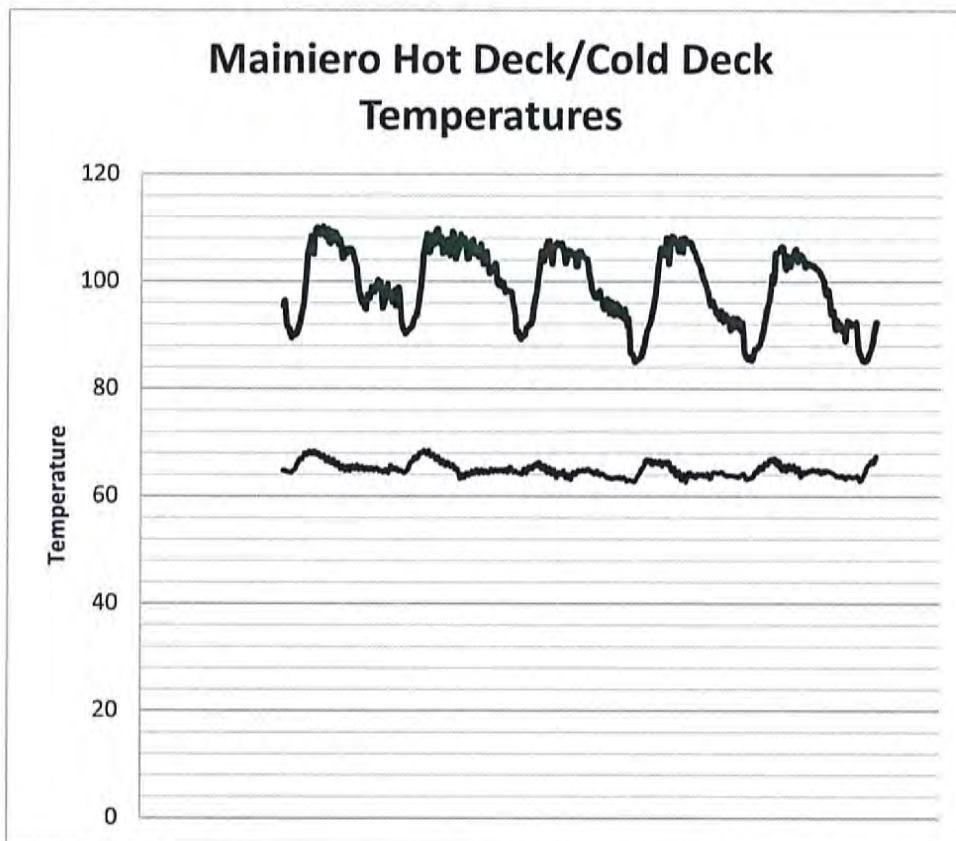
Heating Savings: $((\text{space temp} - \text{cold deck temp}) / (\text{hot deck temp} - \text{cold deck temp})) * (1 - \text{avg \% load}) * ((\text{CFM} * \text{hot deck temp rise}) * 1.08 * \text{heating period}) / (1,000,000 * \text{heating efficiency})$

The charts below show the cold deck and hot deck temperatures have been reset saving energy. This trend should hold up if the controls settings are left in place. In addition the return

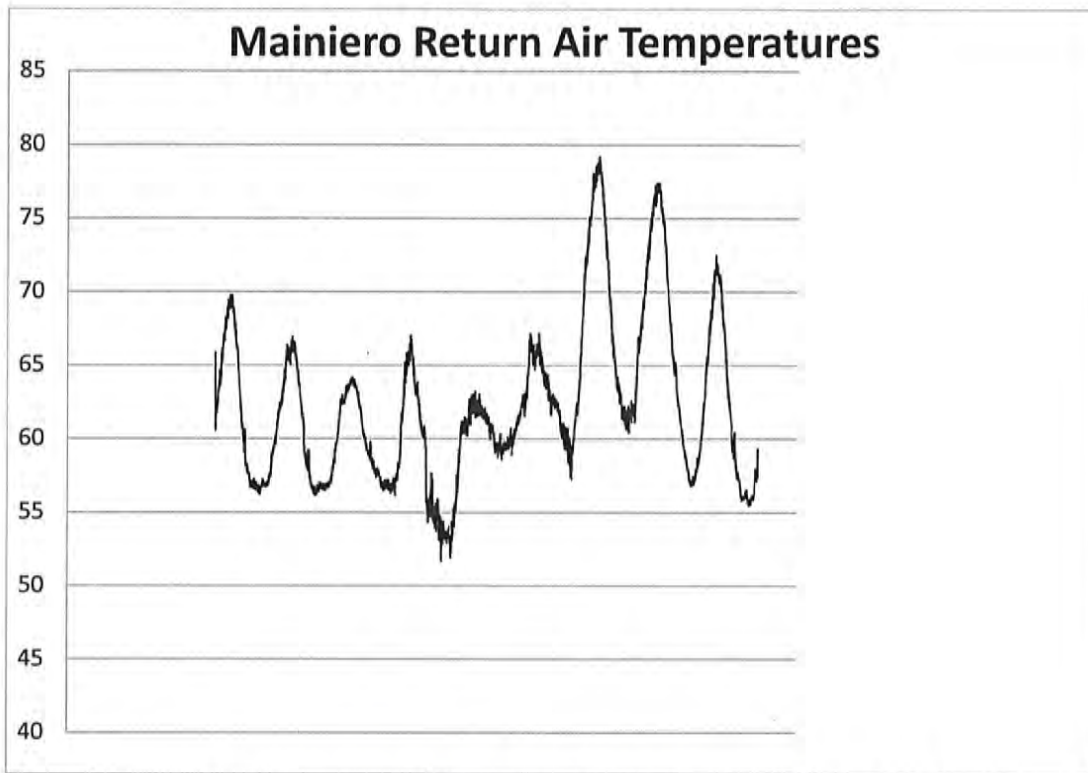
air temperatures are higher indicating the proper temperature change is in place further supporting the additional efficiency of the system conversion.



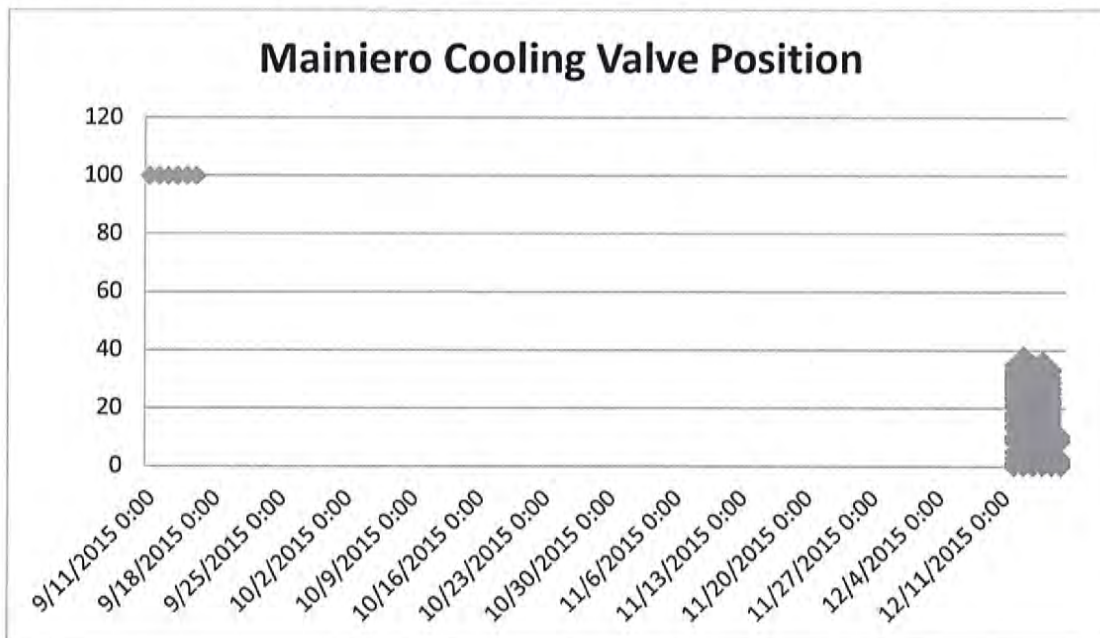
Mainiero Cold and Hot Deck Temperatures Pre-Construction



Mainiero Cold and Hot Deck Temperatures Post Construction



Mainiero Return Air Temperature Pre and Post-Construction (showing higher temperatures)



Mainiero Cooling Valve Position (showing modulation)

MULTIZONE VAV RETROFIT

Job Name: University of Laverne

Building: Mainiero Bldg.

OVERVIEW:

The existing constant volume, multizone air handling system(s) shall be converted to variable air volume (VAV) by modifying the existing control sequence of operation. These controls shall vary the flow of air to the space, based upon the output of the zone thermostats. Currently, hot and cold air are mixed together at the air handler, and air is supplied to each zone at a constant volume. With the new controls, mixing shall occur only whenever the zone air flow drops to a preset minimum level, required for ventilation purposes. A variable frequency drive shall be installed on the air handler fan motor, to modulate the air flow as needed, and reduce annual fan energy usage.

ASSUMPTIONS:

SYMBOL:

Average Percent Load.....	0.65	A
Fan Full Load Input Power.....	20 HP	B
Air Volume Delivered by Unit.....	30,000 CFM	C
Winter Thermostat Setpoint.....	72 F	D
Winter Cold Deck Temperature.....	55 F	E
Winter Hot Deck Temperature.....	97 F	F
Winter Mixed Air Temperature.....	65 F	G
Operating Hours per Week.....	112 hrs/wk	H
Heating Weeks per Year.....	20 wks/yr	I
Cooling Weeks per Year.....	32 wks/yr	J
Summer Hot Deck Temperature.....	97 F	K
Summer Thermostat Setpoint.....	71 F	L
Summer Cold Deck Temperature.....	61 F	M
Summer Mixed Air Temperature.....	80 F	N
Boiler Efficiency	0.82	O
Chiller Performance Factor.....	1.20 KW/ton	P
Gas Cost	\$6.50 /MCF	Q
Electricity Cost.....	\$0.130 /KWH	R
Specific heat of air.....	1.085 BTU/hr-CFM-F	
Heating Conversion Factor.....	1,000,000 BTU/MCF	
Cooling Conversion Factor.....	12,000 BTU/ton-hr	
Power Conversion Factor.....	0.746 KW/HP	

UTILITY SAVINGS CALCULATIONS:

$$\text{Fan Savings} = \boxed{63,031 \text{ KWH/yr}}$$

$$\text{Cooling Savings} = \boxed{56,029 \text{ KWH/yr}}$$

$$\text{Heating Savings} = \boxed{403 \text{ MCF/yr}}$$

UTILITY SAVINGS FORMULAS:

$$\text{Fan Savings} = \left(\frac{\text{fan}}{\text{HP}} \right) \times 0.746 \times \left(1 - \left(\frac{\text{avg.\%}}{\text{load}} \right)^3 \right) \times \left(\frac{\text{operating}}{\text{period}} \right)$$

$$= B \times 0.746 \times (1 - A^3) \times H \times (I + J) = S$$

$$\text{Cooling Savings} = \left[\frac{\left(\frac{\text{hot deck}}{\text{temp.}} \right) - \left(\frac{\text{space}}{\text{temp.}} \right)}{\left(\frac{\text{hot deck}}{\text{temp.}} \right) - \left(\frac{\text{cold deck}}{\text{temp.}} \right)} \right] \times \left(1 - \left(\frac{\text{avg.\%}}{\text{load}} \right) \right) \times \frac{\text{CFM} \times \left(\frac{\text{cold deck}}{\text{temp drop}} \right) \times 108 \times \left(\frac{\text{cooling}}{\text{period}} \right) \times \left(\frac{\text{chiller}}{\text{factor}} \right)}{12,000}$$

$$= \left[\frac{K - L}{K - M} \right] \times (1 - A) \times \frac{C \times (N - M) \times 108 \times H \times J \times P}{12,000} = T$$

$$\text{Heating Savings} = \left[\frac{\left(\frac{\text{space}}{\text{temp.}} \right) - \left(\frac{\text{cold deck}}{\text{temp.}} \right)}{\left(\frac{\text{hot deck}}{\text{temp.}} \right) - \left(\frac{\text{cold deck}}{\text{temp.}} \right)} \right] \times \left(1 - \left(\frac{\text{avg.\%}}{\text{load}} \right) \right) \times \frac{\text{CFM} \times \left(\frac{\text{hot deck}}{\text{temp rise}} \right) \times 108 \times \left(\frac{\text{heating}}{\text{period}} \right)}{1000,000 \times \left(\frac{\text{boiler}}{\text{eff.}} \right)}$$

$$= \left[\frac{D - E}{F - E} \right] \times (1 - A) \times \frac{C \times (F - G) \times 108 \times H \times I}{1000,000 \times O} = U$$

$$\text{Cost Savings} = \left(\left(\frac{\text{fan}}{\text{savings}} \right) + \left(\frac{\text{cooling}}{\text{savings}} \right) \right) \times \left(\frac{\text{elect.}}{\text{cost}} \right) + \left(\frac{\text{heating}}{\text{savings}} \right) \times \left(\frac{\text{gas}}{\text{cost}} \right)$$

$$= (S + T) \times R + U \times Q$$

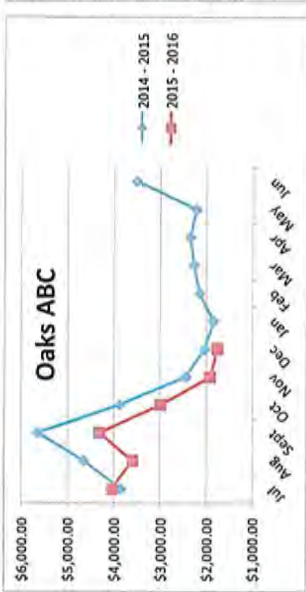
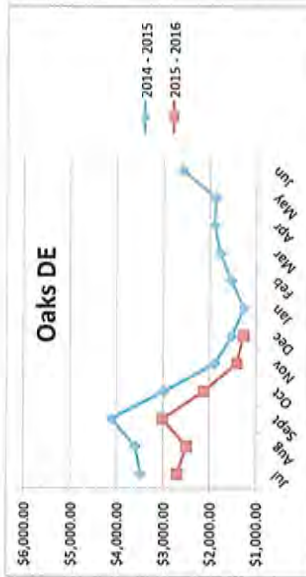
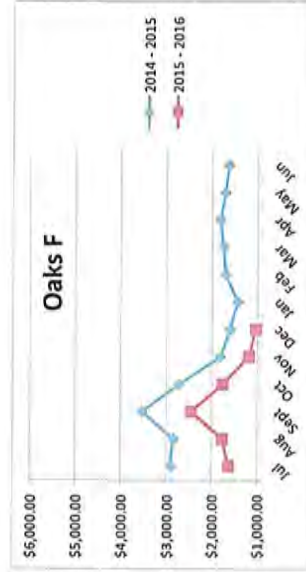
1.3.2 Measurement & Verification Plan Conclusions

Overall, the trends and one time measurements support positive savings for the project; however there are a few items which should be noted:

- The data was trended in November and the systems may operate differently based upon seasonal weather and occupancy loads in the following months.
- Some measured trend and logger values such as the setback temperatures were different than the original values in the calculations; therefore the savings will be lower than originally calculated. For example, LaFetra AHU is not being setback to 88 hours per week, so the savings from the start-stop calculation will not be realized. VFD information on Founders Hall lab exhaust is not being measured and is assumed to be operating correctly and the saving achieved. Finally, Hoover AHU is not being setback to 88 hours per week, so the savings from the setback calculation will not be realized.
- The control system cannot track damper positions so the economizer, outside air reduction and demand control ventilation savings involving CFM settings are assumed to be set and operating properly and those savings are assumed to be achieved.

Utilizing the one month trend and logger data, extrapolating this data to a twelve month period, and inserting the measured values into the original saving calculations, results in projected annual savings of 328,632 kWh and 15,890 therms. These projected units of energy have a monetary value of approximately \$52,065 utilizing the baseline energy rates of \$.127/kWh and \$.65/therm. Although this projected dollar value is less than the original projection of \$56,312, additional savings can be realized by adjusting the operating hours of systems such as LaFetra and Hoover to 88 hours per week as specified in the contract and initial projected calculations.

As the EEMs are heavily reliant on controls programming, the control system should be regularly monitored to ensure the programming remains in place and proper maintenance should be done at regular intervals.



Oaks Total	Cost	Usage
Jul14-Jul15:	\$1,836.04	13163
Aug14-Aug15:	\$3,202.94	16414
Sept14-Sept15:	\$3,499.28	19165
Oct14-Oct15:	\$2,673.04	18482
Nov14-Nov15:	\$1,608.05	11179
Dec14-Dec15:	\$1,077.89	6753
Total Saved:	\$13,899.24	85156

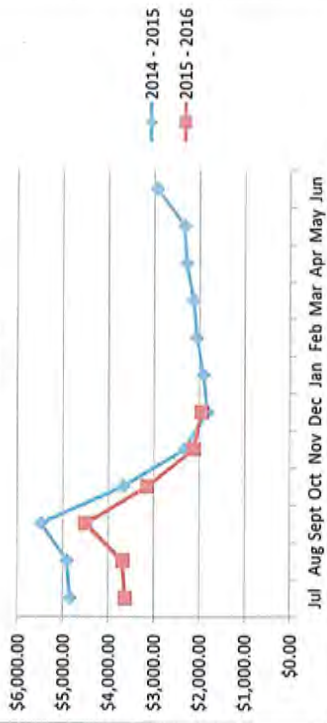
Total Oaks												
Cost	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Cost 2013 - 14:												
Cost 2014 - 15:	\$10,217.69	\$11,085.86	\$13,283.26	\$9,564.31	\$6,127.23	\$5,148.50	\$4,525.50	\$5,375.38	\$5,785.50	\$6,059.62	\$5,807.78	\$7,727.90
Cost 2015 - 16:	\$8,379.65	\$7,882.92	\$9,783.98	\$6,891.27	\$4,519.18	\$4,070.61						
kWh 2013 - 14:												
kWh 2014 - 15:	50190	52529	67819	62657	45251	38546	35031	40225	43005	44961	41322	43893
kWh 2015 - 16:	37027	36115	48654	44175	34072	31793						38410

OAKS ABC												
Cost	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Cost 2013 - 14:												
Cost 2014 - 15:	\$3,842.41	\$4,655.65	\$5,644.56	\$3,868.65	\$2,445.98	\$2,029.43	\$1,848.68	\$2,148.87	\$2,269.61	\$2,349.14	\$2,222.57	\$3,508.97
Cost 2015 - 16:	\$4,044.85	\$3,604.31	\$4,316.37	\$2,997.18	\$1,922.51	\$1,766.34						
kWh 2013 - 14:												
kWh 2014 - 15:	18235	21046	26628	24222	17671	15327	14662	16125	16827	17026	15471	17519
kWh 2015 - 16:	19054	17469	21132	19182	15145	14552						18394

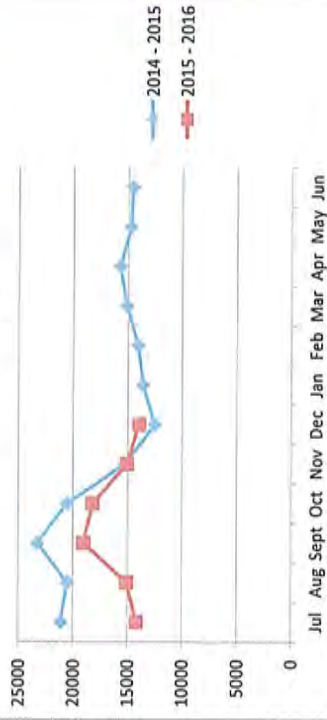
OAKS DE												
Cost	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Cost 2013 - 14:												
Cost 2014 - 15:	\$3,471.80	\$3,588.40	\$4,109.32	\$2,979.18	\$1,876.25	\$1,517.65	\$1,247.97	\$1,527.49	\$1,771.24	\$1,889.93	\$1,872.11	\$2,581.43
Cost 2015 - 16:	\$2,701.18	\$2,500.67	\$3,011.39	\$2,128.07	\$1,411.19	\$1,263.82						
kWh 2013 - 14:												
kWh 2014 - 15:	15697	16143	21405	18995	13500	11178	9933	10880	12716	13565	12838	12930
kWh 2015 - 16:	10899	10928	14850	13358	10658	10058						

OAKS F												
Cost	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Cost 2013 - 14:												
Cost 2014 - 15:	\$2,903.48	\$2,841.81	\$3,529.38	\$2,716.48	\$1,805.00	\$1,601.42	\$1,428.85	\$1,699.02	\$1,744.65	\$1,820.55	\$1,713.10	\$2,420.56
Cost 2015 - 16:	\$1,633.62	\$1,777.94	\$2,456.22	\$1,766.02	\$1,185.48	\$1,040.45						
kWh 2013 - 14:												
kWh 2014 - 15:	16258	15340	19786	19440	14080	12041	10436	13220	13462	14370	13013	14023
kWh 2015 - 16:	7074	7718	12672	11635	8268	7183						7086

Cost



kWh Usage



	Cost	Usage
Δ Jul14-Jul15:	\$1,198.10	6878
Δ Aug14-Aug15:	\$1,216.92	5374
Δ Sept14-Sept15:	\$974.43	4203
Δ Oct14-Oct15:	\$524.83	2325
Δ Nov14-Nov15:	\$190.94	181
Δ Dec14-Dec15:	-\$136.68	-1463
Total Saved:	\$3,968.54	17498

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Cost 2014 - 15:	\$4,834.16	\$4,908.17	\$5,481.42	\$3,672.83	\$2,317.36	\$1,820.09	\$1,906.81	\$2,054.14	\$2,128.49	\$2,288.67	\$2,327.09	\$2,932.00
Cost 2015 - 16:	\$3,636.06	\$3,691.25	\$4,506.99	\$3,148.00	\$2,126.42	\$1,956.77						
kWh 2014 - 15:	21068	20486	23247	20540	15241	12500	13583	14058	15110	15725	14730	14585
kWh 2015 - 16:	14190	15112	19044	18215	15060	13963						