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Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Building Energy Audit Report for Hickam AFB, HI

WD Chvála, Jr.
DR Dixon
MI De La Rosa
DR Brown

September 2010

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Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

An assessment of energy efficiency opportunities at Hickam Air Force Base (AFB), HI was performed by a team of engineers from Pacific Northwest National Laboratory (PNNL) under contract to the Department of Energy/Federal Energy Management program (FEMP). The effort used the Facility Energy Decision System (FEDS) model to determine how energy is consumed at Hickam AFB, identify the most cost-effective energy retrofit measures, and calculate the potential energy and cost savings.

A team of engineers from PNNL visited Hickam AFB on 19-29 January 2010 to collect data for the FEDS assessment. During this visit, PNNL engineers collected energy-related information and data from 34 representative buildings, central plants, and other energy systems for input into the FEDS model.

The economic results presented in this report are based on the use of two different sources of capital funds to implement the energy projects; appropriated funds, and alternative financing (e.g., energy savings performance contract [ESPC]). The alternative financing economic input assumptions are for generic ESPC financing to illustrate the differences that the source of capital makes on the technology choices. The FEDS software is capable of performing the comprehensive assessment using other sources of capital (e.g., utility financing) with their distinct economic inputs. Thus, the site is encouraged to re-run the FEDS software using site-specific alternative financing options and reassess the results. This assessment does not include costs for design; supervision, inspection and overhead (SIOH), or any contingency funds, only the direct capital cost. These additional costs are usually estimated as a % of direct capital cost. A capital cost multiplier (e.g., typically 1.16 for design and SIOH) can be entered in FEDS and new results produced, or the results can be manually adjusted by increasing capital costs by the appropriate percentage and recalculating net present value (NPV), savings-to-investment ratio (SIR), and payback period.

This report documents the findings of the FEDS assessment and model results for appropriated funds and alternative financing sources of capital for the projects. A complete list of the 135 cost-effective energy- and cost-reducing retrofit measures is included in Appendix C-1 for projects funded using the appropriated funding source of capital. The complete list of 88 cost-effective energy and cost-reducing retrofit measures is included in Appendix C-2 for projects funded using the alternative financing source of capital.

Table ES.1 summarizes the results of the energy assessment by retrofit category for appropriated funding sources of capital. Table ES.2 summarizes the results of the energy assessment by retrofit category for alternative financing sources of capital.

Table ES.1 Summary of Potential Energy and Cost Savings for Hickam AFB Using the Appropriated Funds Source of Capital

Retrofit Category	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
Cooling	14,057	2,820,521	5,839,032	829,207	7.04	2.06
Hot Water	8,200	3,998,220	780,747	376,988	2.07	6.49
Lights	26,579	20,022,961	6,385,181	1,576,090	4.05	4.14
Envelope	5,020	3,544,797	1,007,113	273,564	3.68	4.11
Total	53,856	30,386,499	14,012,073	3,055,849	4.59	3.78

Table ES.2 Summary of Potential Energy and Cost Savings for Hickam AFB Using the Alternative Financing Source of Capital

Retrofit Category	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple payback (yr)	SIR
Cooling	2,195	272,865	449,371	125,096	3.59	1.60
Hot Water	7,636	1,513,034	580,792	352,364	1.65	3.58
Lights	21,532	4,368,106	3,611,535	1,369,636	2.64	2.27
Envelope	550	58,376	140,688	34,678	4.06	1.39
Total	31,913	6,212,381	4,782,386	1,881,774	2.54	2.34

For appropriated funds source of capital in Table ES.1, Hickam AFB can save 53,856 MMBtu/year and $3,055,849/year if all cost-effective retrofits are implemented. The site can reduce its energy consumption by 15.1% by implementing the 135 cost-effective energy- and cost-reducing projects identified in this report.

For alternative financing source of capital in Table ES.2, Hickam AFB can save 31,913 MMBtu/year and $1,881,774/year if all cost-effective retrofits are implemented. The site can reduce its energy consumption by 9.1% by implementing the 88 cost-effective energy- and cost-reducing projects identified in this report.

In addition to this report, the Hickam AFB energy manager will receive a complete record of the FEDS input and output files. The FEDS input files consist of the relevant building and equipment data collected and the assumptions made to perform the complex engineering analysis. The FEDS output files contain considerably more detail in support of future project development.

Emissions Reduction

Implementing all the cost-effective building retrofits using appropriated funds will result in a 18% reduction in greenhouse gas emissions. These reductions are summarized in table ES.3 and included for each building in appendix D.

Table ES.3 Emissions Reduction from Cost-Effective Retrofits

Greenhouse Gas	Reduction
Sulfur Oxides (lb)	148,499
Nitrogen Oxides (lb)	71,453
Carbon Monoxide (lb)	123,218
Carbon Dioxide (tons)	15,155
Particulate Matter (lb)	2,948
Hydrocarbons (lb)	50,864

Job Creation

The jobs created from implementation of all the cost-effective retrofits using appropriated funds total 152 job-years. One job-year is equal to $92,000 in capital spending for implementation.

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Description of ARRA program

On February 13, 2009, Congress passed the American Recovery and Reinvestment Act (ARRA) of 2009 at the urging of President Obama, who signed it into law 4 days later. A direct response to the economic crisis, the Recovery Act has three immediate goals:

- Create new jobs and save existing ones
- Spur economic activity and invest in long-term growth
- Foster unprecedented levels of accountability and transparency in government spending.[1]

The U.S. Pacific Command (PACOM) is facing significant energy challenges and has identified the need for a comprehensive and integrated approach to addressing these challenges. In a letter dated March 30, 2009, the PACOM Director of Resources and Assessments requested the support of the Department of Energy Federal Energy Management Program (DOE FEMP) in specific assessment, analysis, and training tasks to work toward the accomplishment of PACOM's energy security strategy. An integrated set of ARRA proposals for FEMP assistance requested national laboratory support for the execution of the identified tasks. The resulting 2009-2010 FEMP PACOM scope of work includes renewable energy and efficiency assessments, energy manager training and development, smart grid and islanding feasibility studies, alternative contracting assistance, and technology demonstrations.

In a competitive grant approach across the services and commands, the national laboratories were awarded over $3,000,000 from DOE FEMP to support PACOM needs. The funds are dedicated to technical assistance projects aimed at bringing the most advanced energy-efficiency, renewable power generation, and microgrid assessments and analyses to Department of Defense (DOD) installations in Hawai`i and throughout the Pacific region.

This comprehensive building energy efficiency assessment represents a single task (Task 2.1, FEMP project 237) in the larger PACOM, ARRA-funded energy program.

[1] http://www.recovery.gov/

Background

As the United States' oldest combatant command, PACOM has been a force for peace and a committed partner in the Asia-Pacific region for more than 60 years. With an area of responsibility (AOR) that includes more than 3.4 billion people and encompasses about half the Earth's surface, the Command remains a significant stabilizing influence in the world. PACOM is supported by four component commands: U.S. Pacific Fleet, U.S. Pacific Air Forces, U.S. Army Pacific, and U.S. Marine Corps Forces, Pacific. These commands are headquartered in Hawai'i and have forces stationed and deployed throughout the region.

Home of Headquarters Pacific Air Forces (PACAF) and the 15th Airlift Wing, Hickam Air Force Base is the largest installation in the wing and consists of 2,850 acres of land and facilities valued at more than $405 million. Sharing its runways with adjacent Honolulu International Airport (HIA), Hickam and the HIA constitute a single airport complex operated under a joint-use agreement.

The mission of the 15th Airlift Wing is to partner with the Hawaii Air National Guard to provide strategic and tactical airlift capability to PACAF and Air Mobility Command to support local and worldwide missions of combat support and humanitarian or disaster relief. The second mission of the 15th Airlift Wing is to enhance PACAF's power and reach by ensuring world-class en route support, maintaining operational ready forces, and providing superior customer service. The third mission of the wing is to provide airlift support to the commander, Pacific Air Forces and the commander, Pacific Command.

On an average day U.S. military forces in Hawai'i require 3 GW of electricity, representing approximately 10% of the total electricity needs of the islands. A map of military sites on O'ahu is included in Figure 1. Facilities on other islands include: Pacific Missile Range Facility (PMRF) on Kaua`i, Pohakuloa Training Area (PTA) and Kilauea Military Center (KMC) on Hawai`i Island, and the Maui High Performance Computing Center (MHPCC) on Maui. In addition to most of these sites, the FEMP PACOM program tasks are performing work in Alaska, Guam, and Japan.

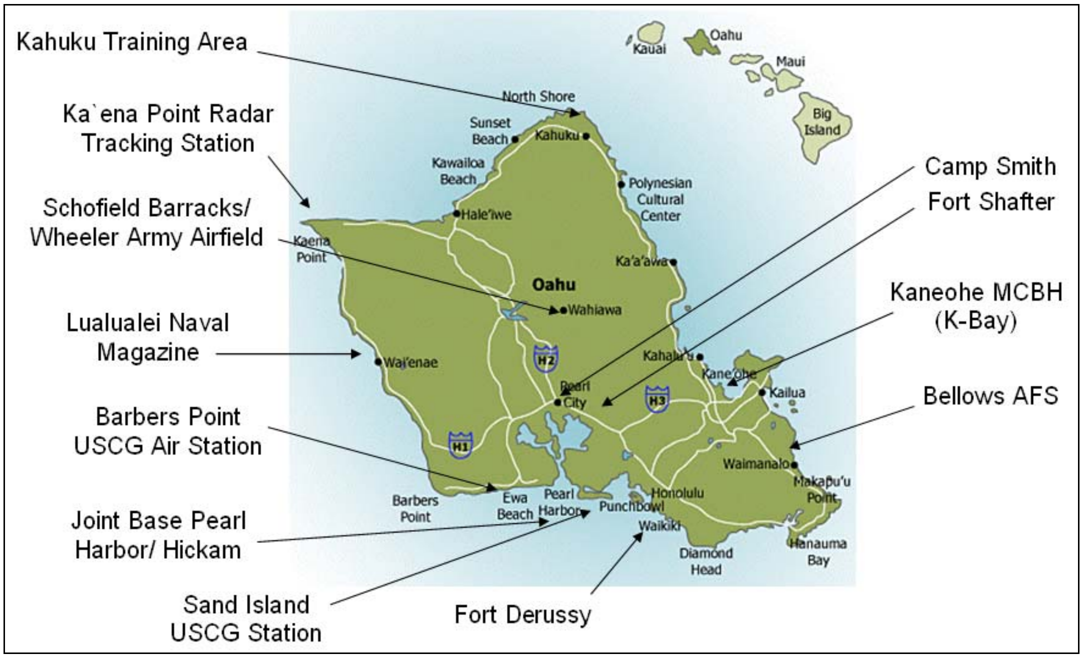

Figure 1 Military Installations on O`ahu, Hawai`i

Introduction

This report contains the results of a comprehensive building energy efficiency assessment conducted at Hickam AFB, Hawaii, by Pacific Northwest National Laboratory (PNNL). The scope of this activity was based on performing a site-wide energy assessment using the Facility Energy Decision System (FEDS) process to identify cost-effective energy- and cost-reduction projects. In addition, 34 buildings were selected for detailed energy audits of sufficient scope to comply with Energy Independence and Security Act (EISA), section 432 requirements for energy and water evaluations at covered facilities. The results of the FEDS assessment will be used by the installation to develop an implementation plan for the energy conservation measures identified, and outline how Hickam AFB will meet the goals of Executive Order 13423 by FY 2015.

Purpose

The purpose of this report is to present the findings resulting from the site visit performed January 19-29, 2010, and subsequent modeling and analysis. The objective of the site visit was to collect the necessary data to conduct a detailed site assessment using the FEDS process, which would result in a list of cost-effective, energy- and cost-reduction projects for Hickam AFB.

Site Visits and Teams

The formal kickoff of the site assessment at Hickam AFB was held on the morning of January 19, 2010. The PNNL team presented an overview of the FEDS assessment process, the data requirements, and schedule for the Hickam AFB work. Participating in this meeting was:

1. Randy Grant – Hickam AFB Energy Manager
2. Jill Sims – Project Manager/Technical lead, SENTECH Hawaii
3. Roger Dunn– Resource Efficiency Manager, Hickam AFB
4. Jared Strebel – Resource Efficiency/Energy Manager, NAVFAC Hawaii
5. Doug Dixon – PNNL
6. Daryl Brown – PNNL
7. Bill Chvála – PNNL
8. Marcus De La Rosa – PNNL

Current Status

The Energy Policy Act (EPAct) of 2005 set annual energy reduction goals in British thermal unit (Btu) per gross square foot (sq ft) (Btu/sq ft) of 2% per year for FY 2006 through FY 2015. The overall goal is 20% reduction by FY 2015 using FY 2003 as the baseline year. EPAct 2005 goals apply equally to all buildings: standard and industrial. Executive Order (E.O.) 13423 *Strengthening Federal Environmental, Energy, and Transportation Management (January 26, 2007)*, increased the energy reduction goal to 3% per year or 30% reduction by FY 2015. In addition, the E.O. established a water reduction goal for federal facilities. Agencies are to reduce water consumption intensity, relative to a FY 2007 baseline, by 2% annually through FY 2015, or 16% total by FY 2015.

Hickam AFB is behind the compliance glide path — 6.4% above the 2003 baseline, compared to the FY 2009 targeted reduction of 9.0% below the baseline. The historical energy intensity for Hickam AFB Defense Utility Energy Reporting System (DUERS) is shown in Figure 2.

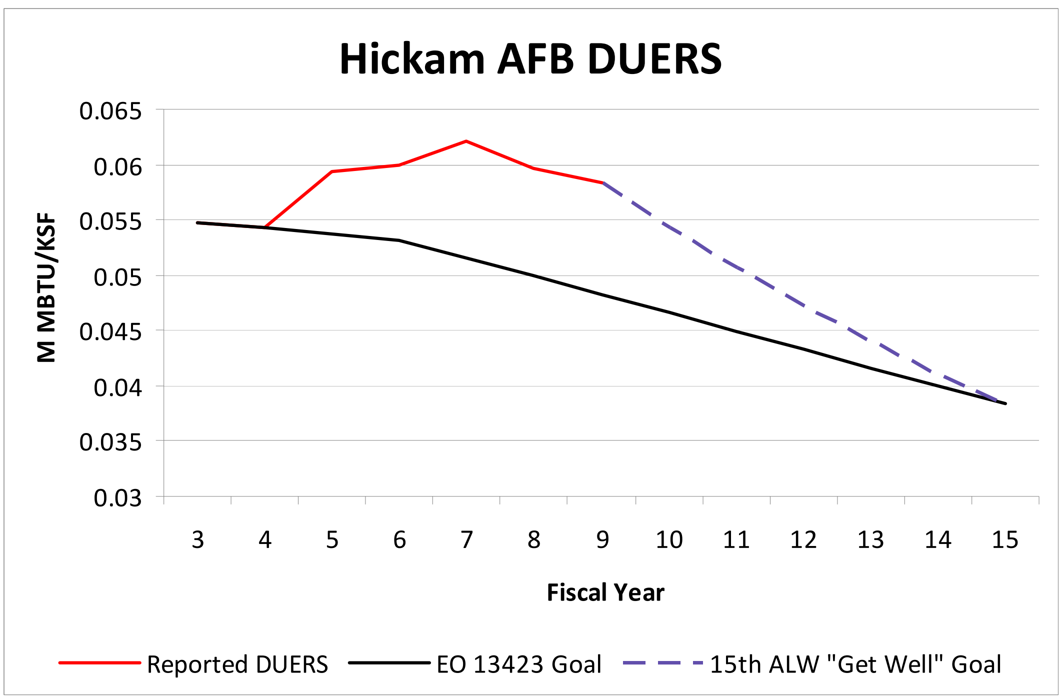

Figure 2 Hickam AFB Energy Reduction Glide Path

Description of Facilities

Hickam AFB is a large Air Force installation consisting of 322 buildings totaling approximately 4.87 million square feet, not including the family housing facilities. The scope of the FEDS assessment performed at Hickam AFB included all facilities in the primary cantonment area. Because family housing has been privatized and is metered separately, it was not considered in this analysis.

Table 1 identifies the list of facility categories for the FEDS assessment and the facility proxies for each category. The facilities at Hickam AFB were divided into 30 categories for the purpose of building audits. A complete listing of the facilities (buildings) associated with each FEDS facility category (including subgroups) is provided in Appendix B.

Table 1. List of Facilities by Facility Category Description

FEDS Facility Category Code	Facility Category Description	Proxy Facility No.	Facility Quantity	Category Area (sq. ft.)
1a	Overhead Protection/Tent Pad	2186	15	38,382
10a	Large Older Admin/School/HQ	1102	1	519,549
10b	Mid-sized Older Admin/School/HQ	2035	6	469,042
10c	Smaller Older Admin/School/HQ	1204	9	150,726
10d	Mid-size Newer Admin/School/HQ	2155	3	71,322
10e	Smaller Newer Admin/School/HQ	502	13	60,670
10f	Larger Newer Admin/School/HQ	2133	4	115,164
10g	Smaller New Admin/School/HQ	2003, 2125	21	74,987
21a	Health Clinic/Vet	559	4	93,381
23a	Hospital/Medical Center	1060	8	54,337
30a	Dormitory Airman Permanent Party	1805	2	121,649
30b	Dormitory Airman Permanent Party	1856	3	121,924
30c	Dormitory Airman Visiting Quarters	1166	18	256,336
40a	Larger Base Engineer Maintenance Shop	2040,1715, 2177	8	242,165
40b	Smaller Base Engineer Maintenance Shop	4016	7	50,939
40c	Shop Aircraft Maintenance	2131	15	126,642
50a	Warehouse Supply and Equipment Base	1728, 1072	10	1,012,107
50v	Vehicle Maintenance Shop	2002	11	91,158
50b	Exchange Store/Security/MWR	1713	20	229,766
50c	Hanger Aircraft Maintenance	2130	1	56,734
50d	Warehouse Supply and Equipment Base	1070	51	162,973
60a	Airman Dining Hall	1860	2	50,108
60b	Enlisted Open Mess	1804	10	100,424
60m	Multipurpose Recreation Building	594	41	42,761
60c	Exchange Sales Store	2093	3	305,569
60t	Air Passenger Terminal	2028	1	46,128
80a	Child Care Center	1597	15	51,664
80b	Recreation Center	1891	16	100,297
80c	Religious Education Facility	1750	3	11,839
80d	Gymnasium	1120	1	46,719
-	**Total**	**34 bldgs**	**322**	**4,875,462**

Analytical Approach

The general approach was to develop a model of the buildings and other energy-related infrastructure at Hickam AFB, calibrate that model to actual FY 2009 energy use, and then utilize the model to predict energy consumption and identify cost-effective retrofits under typical meterological year (TMY) weather conditions.

Buildings

Building inventory data for Hickam AFB were obtained from the Air Force Automated Civil Engineering System. A total of 30 building groups were developed to represent the Base and each of the buildings at Hickam AFB was assigned to one of the groups. The mean building size (square footage) and vintage (age) were then calculated for each group based on the building inventory specific to Hickam AFB. Building characteristics were developed from a combination of inferencing relationships within the FEDS model (driven by building type, size, climate, and vintage), walk-through audits of selected buildings at Hickam AFB, and additional building data collected while visiting the Base.

Central Energy Plants

Any building that provides heating or cooling to more than one building is considered a Central Energy Plant (CEP) in the FEDS analysis. Hickam AFB has has no large central hot water or steam plants.

Hickam AFB has one central air-cooled chiller plant that we could identify (see Table 2). The plant has a combined capacity of 80 tons of cooling, providing cooling to 108,794 square feet of building space. The CEP serves buildings 2130, 2131, and 2133.

Table 2. Central Energy Plants and the Buildings They Serve at Hickam AFB

Chilled Water Plant	Number of Chillers	Total Capacity (Tons)	Total Floor Area (ft^2)	Buildings Served
2134	2	80	108,794 ft^2	2130, 2131, 2133

Energy Prices

Hickam Air Force Base, Pearl Harbor, and Camp Smith (hereinafter, Hickam, Pearl, and Smith) are all served by Hawaiian Electric Company (HECO) under Schedule PP, Large Power Primary Voltage Service. Minor differences in the marginal electricity costs for the three organizations stem from differences in their power factors and the use of Rider M, Off-Peak and Curtailable Services, by Pearl.

The root marginal demand charge for Schedule PP is $11.85/kW. Energy charges are billed per a declining block structure that is a function of the peak demand. This effectively results in an additional $2.78/kW demand charge because an increase in demand shifts more energy into higher-priced blocks. The first 200 kWh/kW are billed at $0.121534/kWh, and the second 200 kWh/kW are billed at $0.113702/kWh. All kWh in excess of 400 kWh/kW are billed at $0.110668/kWh. The demand profiles at Hickam, Pearl, and Smith all result in the marginal kWh being billed at the rate for the third block.

Several adjustments are applied that affect the marginal electricity cost. The total bill is decreased by 0.1% for each 1% that power factors are above 85% (and vice-versa if the power factor is below 85%). "Interim" increases in the rates established in 2007 and 2009 add 2.82% to the total bill. Finally, the combination of Public Benefit Funds, Energy Cost, and Integrated Resource Planning surcharges add a little more than $0.03 to the cost of each kWh.

The billing demand for each month is the higher of the actual peak demand for that month or the average of peak demand for that month and the peak demand for the previous 11 months. This structure cannot be directly modeled in FEDS, but was found to be equivalent to a 92% annual demand ratchet, which can be modeled in FEDS.

Pearl utilizes Rider M to reduce its demand charge by agreeing to reduce its load from 5-9 PM, Monday through Friday. This rider reduces its billing demand by 75% of the difference between its overall peak demand and its peak demand during the 5-9 PM period. For Pearl, the Rider M billing demand averaged 96% of its actual peak demand during 2009. This is equivalent to using the actual peak demand as the billing demand and reducing the demand charge by 4%, which was the modeling approach used for FEDS.

The resulting marginal electricity costs are summarized in Table 3.

Table 3. Marginal Electricity Rates for Hickam, Pearl, and Smith

	Hickam	Pearl	Smith
Demand Charge, $/kW	14.92	14.24	14.86
Energy Charge, $/kWh	0.1433	0.1426	0.1431
Demand Ratchet, %	92%	N/A	92%

Hickam AFB uses a modest amount of propane and fuel oil, which are delivered regularly. Propane cost is $32.15 / MMBtu and fuel oil is $5.10 / Gallon.

Other Loads

No comprehensive inventory of exterior lighting was documented. A count of street lights was taken from site plans but runway and taxi lights were not accounted for. Previous experience at other military installations was used to estimate load. This estimate is based on total square footage at Hickam AFB multiplied by typical lighting density found at other military sites. The resulting exterior lighting annual electric consumption was estimated at 2.59 million kWh.

The estimated annual electricity consumption for water pumping (potable water and sewage) was nearly 1.0 million kWh. This estimate is based on assumptions developed at other military installations with similar site characteristics, size, and water consumption. Electricity distribution losses were assumed to be 4% of purchased electricity.

Model Calibration

Building energy use was simulated with FEDS and combined with the non-building energy infrastructure characterization to predict the total site energy consumption for FY 2009. Uncertain elements of the modeling assumptions were adjusted until the model's energy consumption prediction matched "reasonably well" with actual energy consumption for FY 2009. Specific model calibration results are shown in Table 4.[2]

Table 4. FEDS Calibration Results

Modeled Element	Fuel Type	Error
Total by Fuel Type	Electricity	-0.61 %
	Propane	1.50 %
	Fuel Oil #2	11.09 %
Total Energy	All	-0.61 %

[2] For example, an error of +0.5% means that the model predicts energy consumption 0.5% higher than reported consumption.

Description of Opportunities Identified

The number of conceivable energy conservation measures, fuel-switching opportunities, and renewable-energy projects at federal sites is very large. The FEDS model is used to cost-effectively identify energy saving opportunities for the site. FEDS is a software tool that provides a comprehensive method to quickly and objectively identify energy improvements that offer maximum life-cycle cost savings. FEDS determines the optimum set of cost-effective retrofits from a current database of hundreds of proven technologies. These include retrofits for heating, cooling, lighting, motors, building envelope, and hot water systems. Interactive effects are also evaluated as part of the optimization process so that energy savings are not double counted or undercounted. The results are based on life-cycle cost economics consistent with 10 CFR 436.

FEDS identifies the package of retrofits that individually and collectively minimize the life-cycle cost of building energy services, resulting in projects where the net present value (NPV) of the investment is greater than or equal to zero and the savings-to-investment ratio (SIR) is greater than or equal to one. Results are developed for government (appropriated) and alternative (e.g., energy savings performance contract [ESPC] and utility energy services contract [UESC]) financing assumptions.

In general, the discount rate is higher and the economic evaluation life is shorter for alternative financing compared to government financing. The economic life for the latter is set at 25 years with the discount rate adjusted each year in response to market conditions. The currently prescribed government discount rate is 3.0% in real terms, i.e., in excess of general inflation. Alternative financing assumptions are not prescribed, but set by negotiation between the energy services company (ESCO) and the Federal organization. An economic evaluation life of 10 years and a real discount rate of 10% are used to represent alternative financing conditions in this assessment, based on a collection of prior site experiences in the Army. This assessment does not include costs for design; supervision, inspection and overhead (SIOH), or any contingency funds, only the direct capital cost. These additional costs are usually estimated as a % of direct capital cost. A capital cost multiplier (e.g., typically 1.16 for design and SIOH) can be entered in FEDS and new results produced, or the results can be manually adjusted by increasing capital costs by the appropriate percentage and recalculating NPV, SIR, and payback period.

Table 5a summarizes the FEDS results by retrofit category (e.g., cooling) and type (e.g., chillers) using appropriated funding as the source of capital for the projects. Table 5b summarizes the FEDS results by retrofit category using alternative financing as the source of capital for the projects. The complete list of cost-effective energy- and cost-reduction projects resulting from the FEDS modeling and analysis are presented Appendices C-1 (appropriated funds) and C-2 (alternative financing).[3]

[3] It should be noted that in addition to this report, the Hickam AFB energy manager will also receive a CD-ROM, which includes all the FEDS input data and output project files. The input data files reflect information collected during the site visits and additional assumptions required to perform the FEDS modeling and assessment. The output project files contain significantly more detailed information to support the list of cost-effective energy projects identified in Appendices C-1 and C-2.

Table 5a. Summary of All Cost-Effective Projects Identified from the FEDS Assessment for Hickam AFB Using Appropriated Sources of Capital (by Retrofit Category and Type)

Retrofit Category	Retrofit Technology	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
Cooling	Packaged ACTotal	895	41,361	179,467	60,318	2.98	3.80
	Water-Cooled Chiller Total	12,989	3,073,646	5,478,947	787,151	6.96	2.02
	Window AC Total	173	16,816	196,484	19,857	9.89	1.20
	Subtotal	14,057	2,820,521	5,839,032	867,326	7.04	2.06
Hot Water	Distillate Oil Boiler Total	522	340,737	56,604	14,521	3.90	7.60
	Heat Pump Water Heater Total	7,407	3,624,423	708,402	351,313	2.02	6.42
	Misc Measures Total	271	33,060	15,741	11,154	1.41	4.69
	Subtotal	8,200	3,998,220	780,747	376,988	2.07	6.49
Lights	CFL Total	2,421	2,502,424	126,319	156,479	0.81	20.55
	EXIT Lighting Total	2,908	3,242,580	209,262	204,437	1.02	16.45
	Super T8 total	15,641	11,463,234	4,323,525	942,054	4.59	3.66
	T8 Total	284	160,785	237,780	23,557	10.09	1.64
	High Pressure Sodium Total	5,122	2,471,851	1,411,822	234,220	6.03	2.76
	Ballast Total	203	182,087	76,473	15,343	4.98	3.36
	Subtotal	26,579	20,022,961	6,385,181	1,576,090	4.05	4.14
Envelope	Roof Insulation Total	4,989	3,538,677	983,515	271,778	3.62	4.19
	Windows Total	31	6,102	23,598	1,786	13.2	1.30
	Subtotal	5,020	3,544,797	1,007,113	273,564	3.68	4.11
Grand Total		53,856	30,386,499	14,012,073	3,055,849	4.59	3.78

From Table 5a, the total cost-effective energy savings is estimated at 53,856 MMBtu/year representing $3,055,849/year savings with an overall savings to investment ratio (SIR) of 3.78. This represents 15.1% in energy savings based on FY 2009 energy data reported to DUERS.

The greatest energy saving potential was found in lighting retrofits. Although T8 lighting is good, advanced T8 lighting can yield additional savings (15,641 MMBtu/year), followed by installation of water cooled chillers (12,989 MMBtu/year). Similiarly, advanced T8 retrofits yields the largest estimated dollar savings ($942,054/year) and water cooled chillers ($787,151/year).

Table 5b. Summary of All Cost-Effective Projects Identified from the FEDS Assessment for Hickam AFB Using Alternative Financing Sources of Capital (by Retrofit Category and Type)

Retrofit Category	Retrofit Technology	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple payback (yr)	SIR
Cooling	Packaged AC Total	960	193,476	175,291	63,405	2.76	2.10
	Water-Cooled Chiller Total	1,235	79,389	274,080	61,691	4.44	1.28
	Subtotal	2,195	272,865	449,371	125,096	3.59	1.60
Hot Water	Heat Pump Water Heater Total	6,946	1,359,000	572,481	327,997	1.75	3.36
	Misc Measures Total	690	154,034	8,311	24,367	0.34	13.36
	Subtotal	7,636	1,513,034	580,792	352,364	1.65	3.58
Lights	CFL Total	2,241	803,188	55,504	147,301	0.38	15.04
	EXIT Lighting Total	2,927	1,009,594	175,183	202,065	0.87	6.86
	Super T8 Lights	6,969	1,118,055	1,504,908	450,038	3.34	1.77
	T8 Lights	4,254	1,117,475	653,941	302,677	2.16	2.70
	High Pressure Sodium Total	5,029	301,927	1,171,181	255,984	4.58	1.29
	Ballast Total	112	17,867	50,818	11,571	4.39	1.34
	Subtotal	21,532	4,368,106	3,611,535	1,369,636	2.64	2.27
Envelope	Roof Insulation Total	550	58,376	140,688	34,678	4.06	1.39
	Subtotal	550	58,376	140,688	34,678	4.06	1.39
Grand Total		31,913	6,212,381	4,782,386	1,881,774	2.54	2.34

From Table 5b, the total cost-effective energy savings is estimated at 31,913 MMBtu/year representing $1,881,774/year savings with an overall savings to investment ratio (SIR) of 2.34. This represents 9.1% in energy savings based on FY 2009 energy data reported to DUERS.

The greatest energy saving potential was found in advanced T8 lighting measures (6,969 MMBtu/year), followed by heat pump water heater systems (6,946 MMBtu/year). Similiarly, the largest estimated dollar savings was advanced T8 lighting measures ($450,038/year) followed by heat pump water heater systems ($327,997/year).

As would be expected, the total number of cost-effective retrofits is fewer (and installed cost/ capital investment is significantly less) under alternative financing source of capital, and thus, the energy and dollar savings are likewise less. The total number of cost-effective retrofits using appropriated source of capital is 135 and the total number of cost-effective retrofits using alternative financing source of capital is 88. Using appropriated funding will save 21,943 MMBtu/year and $1,174,075/year more than alternative financing. Utilizing alternative financing reduces the simple payback from 4.59 to 2.54 years because some projects with longer paybacks are eliminated under the alternative financing scenario.

The complete list of cost-effective energy- and cost-reduction projects is given Appendix C-1 for appropriated funds sources of capital and in Appendix C-2 for alternative financing sources of capital.[4]

[4] The Hickam AFB energy manager will also receive a CD, that includes all the FEDS input data and output project files. The input data files reflect information collected during the site visits and additional assumptions required to perform the FEDS modeling and assessment.

Conversion to Water-Cooled Chillers

Water-cooled condensing of cooling equipment refrigerant results in a significant improvement in efficiency compared to air-cooled condensing chillers. This advantage stems from two factors. Condenser water from an evaporative cooling tower is generally cooler than ambient air (except when the relative humidity is very high), and water is a more effective heat transfer fluid than air. The two factors work together to lower the refrigerant condensing temperature, hence improving both theoretical and actual refrigeration cycle efficiency. Combining cooling loads met by multiple smaller cooling units into fewer central units allows additional efficiency gains by using centrifugal compressors, a more efficient technology than alternative compressor types commonly used in smaller cooling equipment. These advantages do come at a price, however. Condensing refrigerant with water requires additional costs associated with a cooling tower, condenser water pumps and piping, and a shell to enclose the water as it passes by the condenser tubing. The condenser pump also represents an additional power consuming device that an air-cooled unit does not have. Finally, the distribution of centrally chilled water incurs pumping and piping costs and pumping energy not required by distributed direct expansion coolers (e.g., window air conditioner [AC] and packaged rooftop AC).

For the reasons noted above, water-cooled chillers offer significant performance advantages over air-cooled equipment that must be weighed against their additional capital costs. During the last few decades, space cooling has become much more common in Hawaiian military facilities because internal heating loads (e.g., personal computers and other office equipment) have increased, building designs have become less suitable for natural ventilation, and occupants expect a more comfortable working environment. The FEDS model generated retrofit recommendations for replacing air-cooled chillers with water-cooled chillers <u>at the building level</u>. The following paragraphs discuss the impact of combining these energy conservation measures (ECMs) into a centralized chilled-water plant. More details of the assessment of water-cooled chillers at Hickam AFB are provided in Appendix E.

Buildings 2130, 2131, and 2133 are currently served by a small central cooling plant comprised of two air-cooled chillers. The proposed retrofit would replace the existing air-cooled chillers with two water-cooled chillers, a cooling tower, and condenser water pumps and piping. The existing chilled water pumps and piping would not change and the electrical service to the central plant should be adequate for the retrofit.

The peak and annual building cooling loads were estimated with the FEDS model and the performance of the existing chillers was estimated from manufacturer's specifications for the two units. From this information, the annual kWh and peak kW electrical loads were calculated and then combined with Hickam's electricity rates to calculate the current annual electricity costs. The existing system performance and electricity cost figures are presented in Table 6.

Although the FEDS model estimates a peak of only 61 tons for the three buildings, two 40-ton water-cooled chillers were assumed for the retrofit to match the existing nameplate capacity of the two air-cooled chillers. In this size range, the water-cooled chillers were assumed to use a rotary screw compressor rated at 0.73 kW/ton. In addition, the condenser water pump and cooling tower fan would be expected to consume 0.12 kW/ton for a total cooling plant performance of 0.85 kW/ton. The annual electricity bill for the water-cooled system was calculated to be $35,360 based on these assumptions, resulting in an annual savings of about $15,000 and a peak electric load reduction of 22 kW.

Table 6. Hickam Buildings 2130, 2131, 2133 Existing System Performance and Electricity Cost

Building	Peak Load, Tons	Annual Load, Ton-hours	Annual Capacity Factor	Existing Air Cooled kW/ton	Existing Annual Electricity kWh	Existing Peak Electricity kW	Existing Annual Electricity Cost
2130	18.1	73,335	0.46	1.204	88,296	21.8	
2131	10.3	40,647	0.45	1.204	48,939	12.4	
2133	32.7	100,092	0.35	1.204	120,511	39.3	
Totals	**61.0**	**214,074**	**0.40**	**1.204**	**257,745**	**73.5**	**$50,087**

The two new 40-ton water-cooled chillers were estimated to cost $88,200 and the cooling tower, condenser pump, and piping an additional $26,100. These figures include all direct construction costs, but do not include any allowance for design or SIOH costs. Based on the direct cost, the payback period is 8 years. With an additional 16% for design and SIOH, the payback period rises to 9 years.

Installation Load Reduction Potential

Using the FEDS model, the impact on electric demand can be estimated from implementing all the cost-effective projects at Hickam. The existing peak electric demand from all building loads[5] at Hickam is 17,545 kW. This peak occurs at 1300 hours during a September weekday. By implementing all the FEDS recommended retrofits, the peak demand can be reduced by 3,294 kW to 14,251 kW. This represents a 19% reduction in peak demand.

Annual Installation Electric Demand

	Demand (kW)	Dollars (2009)
Installation Peak Demand:		
existing	17,545	2,936,232
post-retrofit	14,251	2,376,252
difference	-3,294	-559,980
% change	-19	-19

Time of Installation Peak Demand:	Existing	Post-Retrofit
Month	September	September
Day Type	Weekday	Weekday
Hour	1300	1300

[5] The modeled electric demand in FEDS is for all building loads and may not include certain non-building electric loads (e.g., booster pumps, lift stations, transmission losses, etc.).

Recommendations for More In-Depth Assessments

The FEDS model can provide an unbiased assessment of literally hundreds of energy conservation projects; unfortunately, it is not all-inclusive. While the scope of this project is limited to energy-saving projects included in the FEDS model, the energy-saving opportunities identified below were recognized during the site visit and may be worth additional consideration by the site energy staff. It is recommended that the site consider additional assessment of these potential projects.

Cool Roofs. FEDS does not evaluate the potential savings for cool roof projects.

Building Controls. Recommendations for building controls cannot be easily inferred by the FEDS model engine. A detailed building assessment focused on all heating, ventilation and air conditioning (HVAC) equipment is required to develop project proposals.

Programmable Thermostats. The FEDS model does not consider programmable thermostats in the energy analysis. Programmable thermostats are considered a conservation measure rather than an equipment replacement or building improvement. Programmable thermostats could be a useful conservation measure in smaller commercial buildings or any building that is unoccupied during part of the day.

Implementation Options

Hickam AFB would have a number of options for implementing the energy conservation measures (ECMs) identified in this assessment. As shown in Table 7, implementing the building level ECMs using appropriated funds would require an investment of about $14.0M, and result in 53,856 MMBtu/year representing $3,055,849/year savings with an overall savings to investment ratio (SIR) of 3.8. Using alternative financing (ESPC or UESC) would result in 31,913 MMBtu/year representing $1,881,774/year savings with an overall savings to investment ratio (SIR) of 2.3, for an investment cost of $4.8M. However, the investment cost under alternative financing does not include the financing charges over the life of the project.

The recommended option for implementing the building level ECMs would be to pursue appropriated funds either through the Energy Conservation Investment Program (ECIP) or sustainment, renovation, and modernization (SRM) at the Base level. This would result in the greatest energy and cost savings (see Table 7). The ECIP program within the Air Force may not be an option for these building energy-efficiency ECMs as the focus of the current program is on renewable energy projects. If appropriated funds are not available, then alternative financing would provide the means to get most of the projects implemented without the upfront investment on the part of the Air Force.

Table 7. Comparison of Funding Sources

Funding Source	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Estimated Financing Costs ($)[6]	Total Cost ($)	SIR
Appropriated funding	53,856	3,055,849	14,012,073	0	14,012,073	3.8
Alternative financing	31,913	1,881,774	4,782,386	3,440,614	8,223,000	2.3

Public benefit funds may be available for some of these ECMs through Hawai'i Energy. Hawai'i Energy operates the new and expanded Hawai'i Energy-Efficiency Programs under contract to the Hawai'i Public Utilities Commission (HPUC) and they are paid for by electric utility ratepayer fees.

[6] Assumes alternative financing at an annual interest rate of 6% for 20 years.

Emissions Reduction

Implementing all the cost-effective building retrofits using appropriated funds will result in a 18% reduction in greenhouse gas emissions. These reductions are summarized in table 8 and included for each building in appendix D.

Table 8. Reduction in Greenhouse Gas Emissions

Greenhouse Gas	Totals
Sulfur Oxides (lb)	
existing	828,151
post-retrofit	679,652
difference	-148,499
% change	-18
Nitrogen Oxides (lb)	
existing	397,557
post-retrofit	326,103
difference	-71,453
% change	-18
Carbon Monoxide (lb)	
existing	685,129
post-retrofit	561,911
difference	-123,218
% change	-18
Carbon Dioxide (tons)	
existing	84,302
post-retrofit	69,147
difference	-15,155
% change	-18
Particulate Matter (lb)	
existing	16,428
post-retrofit	13,481
difference	-2,948
% change	-18
Hydrocarbons (lb)	
existing	283,022
post-retrofit	232,157
difference	-50,864
% change	-18

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Appendix A

FEDS Data Collection Form

Appendix A
FEDS Data Collection Form

The following form is used to collect FEDS input data during building audits. Note that not all data types indicated on this form are applicable to all buildings. Nor is all the information indicated on this form always available. Where necessary, the FEDS model infers the values for missing data based on other known building characteristics.

FEDS Building Information for ___________________________

Building Number / Description / Size:						
	Description	**% of building**	**# of floors**	**Occupancy Schedule:**	**Start**	**End**
Use Area 1				**Weekday:**		
Use Area 2				*(military time)* **Saturday:**		
Use Area 3				**Sunday:**		
Aspect ratio (N:E):				# Occupants: (occupied); (unoccupied)		
Zones: Single (1) Perimeter w/ halls (4) Central w/ perimeter (5)				**Unoccupied Months:**		

ENVELOPE

Roof type: BUILT-UP METAL PANEL SHINGLES/SHAKES	**Floor type:** SLAB ON GRADE CRAWL SPACE
- if built-up, deck type: WOOD CONCRETE METAL	- insulation? type / thickness / R-value:
- insulation? type / thickness / R-value:	- ground floor carpet (crawlspace only)? YES NO
- floor-floor height:	
- floor-ceiling height:	**Windows - #panes:** 1 2 3
- suspended ceiling? YES NO	**- frame type:** WOOD/VINYL METAL THERMAL BREAK METAL
Wall: WOOD SIDING MASONRY/WOOD MASONRY CURTAIN MET PANEL	- TINTING SHADING FILM
- insulation? type / thickness / R-value:	**- % of wall area that is glass:**

LIGHTING

Technology Type	**Fixture Description (size, #lamps, wattage, reflectors,** ballasts, application, etc.)*****	**Use Area or % of building served**	**Fixture density or count**	**Mounting Method**	Utilization
Exit Signs					
		Exterior		--	
		Exterior		--	
		Exterior		--	

INC = incandescent CFL = compact fluorescent FL = fluorescent MV = mercury vapor MH = metal halide HPS = high pressure sodium
LPS = low pressure sodium EX = exit sign *2-tube T12=2T12; 4-tube T12=4T12; 2-tube T8=2T8; 2-tube T5=2T5; 4-tube Biax=4BIAX

SERVICE HOT WATER

Portion of building set served (whole buildings) (sq. ft, %, # of buildings, or USE AREA)	**System 1:**	**System 2:**	**System 3:**
Fuel type			
System type	DISTRIBUTED LOOP	DISTRIBUTED LOOP	DISTRIBUTED LOOP
Equipment vintage			
Tank capacity (gallons, #tanks**)**			
Heating capacity (loop only)			
Thermostat set point, °F			
Tank insulation – thickness/R-value			
Efficiency			
Loop length (perimeter or stacked service)			
#Faucets / aerators installed (%)			
#Showers / low-flow showerheads installed (%)			
Note presence of: bottom boards, near tank pipe insul., tank wrap, heat traps, electronic pilots			

Auditor: ______________________________________ **Date:** __________________ **Sheet** ________ **of** ________

HVAC

Portion of set <u>NOT</u> heated (ft^2, %, # of bldgs, use area):	HEATING		
Portion of building set served (whole buildings) (sq. ft, percent, number of buildings, or USE AREA)	**Type 1:**	**Type 2:**	**Type 3:**
Fuel type			
Equipment type: 0=Elec. resistance baseboard 1=Forced air furnace			
2=Air-source HP 3=Ground-coupled HP 4=Radiator/central steam/hw 5=Fan coils/central steam/hw/electricity 6=AHU/central steam/hw 7=Radiator/boiler 8=Fan coils/boiler 9=AHU/boiler 10=Radiant/central steam/hw 11=Radiant/single bldg boiler 12=Infrared			
Output capacity (total per building)			
Number of pieces of equipment			
Efficiency (%)			
Equipment vintage (approximate if necessary – new/old)			
Thermostat set point(s), °F			

Portion of set <u>NOT</u> cooled (ft^2, %, # of bldgs, use area):	COOLING		
Portion of building set served (whole buildings) (sq. ft, percent, number of buildings, or USE AREA)	**Type 1:**	**Type 2:**	**Type 3:**
Fuel type			
Equipment type: 0 = Evap. cooler 1 = Window/wall units			
2 = Air source heat pump 3 = Ground-coupled heat pump 4 = Package or split DX 5 = Fan coils/central chilled water 6 = AHU/central chilled water 7 = Fan coils/absorption chiller 8 = AHU/absorption chiller 9 = Fan coils/conventional chiller 10 = AHU/conventional chiller			
Output capacity (total per building)			
Number of units			
Manufacturer & model #			
Equipment vintage (approximate if necessary – new/old)			
Thermostat set point(s), °F			

	VENTILATION		
Ventilation control mode: 0=cycle 1=constant			
2=constant occupied hours/cycle unoccupied hours 3=constant occupied hours/off unoccupied hours 4=no mechanical ventilation			
Ventilation supply air (cfm)			
Outdoor air (NONE, 100%, OTHER?)			
Infiltration (note cracks, open windows, CFM or ACH)			
Desiccant dehumidification (and heat source)?			

MISC. EQUIPMENT

Refrigeration, food prep, or other - note if irregular. Atypical equipment: description including type, fuel, capacity, utilization.

MOTORS

	Type 1:	**Type 2:**	**Type 3:**	**Type 4:**
Horsepower				
# Motors of this type				
Utilization				
Other nameplate data				

NOTES/DRAWINGS

Appendix B

Facility Category Descriptions and Associated Buildings

Appendix B
Facility Category Descriptions and Associated Buildings

The following table identifies the buildings in the 30 facility categories defined by the assessment team. The table below includes the FEDS facility category code, the proxy building number(s) audited for the purpose of developing the FEDS model, the proxy building total square footage, the total number of buildings in the category, the total square footage in that category and the percentage of square footage represented by the proxy buildings. Overall, PNNL audited 944,397 ft^2 of building space out of a total of 4,875,472 ft^2, or 19%.

Category Description [FEDS Facility Category Code]	Proxy (Audited) Building Number	Proxy Building (ft^2)	Total Bldgs. In Category	Non-Audited Buildings in Group	Total Area in Category (ft^2)	Proxy Area % of Category
1	2186	2,125	15	01754, 2072, 72934, 71949, 71941, 71942, 72727, 3008, 3393, 4017, 1229, 1212, 1100, 2134	38,382	6%
10a	N/A	N/A	1	1102	519,549	0%
10b	2035	86,391	6	2060, 2045, 3440, 1200, 1050	469,042	18%
10c	1204	11,374	9	1110, 1113, 3225, 2171, 2050, 1001, 1201, 1071	150,726	8%
10d	2155	21,745	3	1105, 3382	71,332	30%
10e	502	9,217	13	4071, 1106, 1153, 3404, 3510, 1012, 1035, 3373, 2104, 3561, 3560, 188	60,670	15%
10f	2133	25,764	4	02140, 1850, 3386	115,164	22%
10g	2125	3,867	21	4100, 3417, 3417, 1222, 2003, 2176, 2070, 1727, 3020, 2167, 3002, 3227, 192, 4073, 3250, 4070, 3596, 3201, 3203, 2042	74,987	5%
21a	559	78,823	4	554, 1864, 3365	93,381	84%
23a	1060	14,920	8	988, 2141, 3385, 1010, 2076, 1011, 3195	54,337	27%
30a	1805	55,187	2	1843	121,649	45%
30b	1856	43,187	3	1852, 1854	121,924	35%
30c	1166	25,113	18	941, 1156, 1158, 920, 1153, 1166, 1168, 1172, 725, 727, 728, 920, 922, 925, 926, 934, 940	256,336	10%
40a	2177	3,200	8	2030, 2040, 1715, 1203, 1207, 1202, 1220	242,165	1%

Category Description [FEDS Facility Category Code]	Proxy (Audited) Building Number	Proxy Building (ft^2)	Total Bldgs. In Category	Non-Audited Buildings in Group	Total Area in Category (ft^2)	Proxy Area % of Category
40b	4016	7,701	7	3416, 2010, 3402, 3245, 3431, 3422	50,939	15%
40c	2131	26,296	15	2025, 3004, 3392, 3407, 3407, 3435, 3426, 3431, 3435, 3247, 2019, 3437, 3430, 3434	126,642	21%
50a	1072	83,379	10	1055, 1728, 4069, 1073, 1045, 3400, 3415, 2115, 3564	1,012,107	8%
50v	2002	23,981	11	4002, 2073, 1720, 2006, 3380, 2001, 2022, 3425, 4003, 3424	91,158	26%
50b	1713	30,400	20	3220, 1722, 1723, 1711, 1714, 1042, 1710, 2110, 3520, 2116, 1205, 3192, 2158, 3226, 4032, 3567, 3505, 987, 3381	229,766	13%
50c	2130	56,734	1	--	56,734	100%
50d	1070	62,779	51	1219, 3379, 3044, 3594, 4115, 2175, 1760, 3572, 3584, 3576, 3455, 1043, 1816, 1844, 4030, 1806, 2187, 2185, 2037, 14170, 3515, 3525, 4068, 3039, 2023, 2179, 1223, 2161, 2188, 3436, 1097, 2069, 4119, 1809, 3571, 2192, 3577, 3578, 3587, 3589, 3585, 1091, 1093, 3485, 1810, 1845, 1846, 1847, 1849, 2024	162,973	39%
60a	1860	12,941	2	3417	50,108	26%
60b	1804	27,579	10	901, 1756, 3465, 1250, 2096, 900, 2105, 905, 908	100,424	27%
60m	594	293	41	1028, 1249, 1109, 601, 1046, 2150, 3406, 4008, 2156, 1217, 3190, 3395, 1058, 1108, 2154, 1124, 1333, 427, 3458, 2098, 2157, 1629, 1861, 906, 2039, 4072, 7475, 924, 3205, 2153, 180, 3001, 2169, 1281, 2051, 210, 3389, 918, 3410, 3246	42,761	1%
60c	2093	115,408	3	1235, 1232	305,569	38%
60t	2028	46,128	1	--	46,128	100%
80a	1597	12,760	15	1335, 1654, 1399, 623, 1598, 1588, 1586, 1656, 1657, 1587, 1589, 626, 627, 1655	51,664	25%

Category Description [FEDS Facility Category Code]	Proxy (Audited) Building Number	Proxy Building (ft^2)	Total Bldgs. In Category	Non-Audited Buildings in Group	Total Area in Category (ft^2)	Proxy Area % of Category
80b	1891	3,090	16	1859, 1889, 1122, 595, 1029, 3460, 501, 1095, 2094, 425, 1092, 1225, 3470, 3360, 1848	100,297	3%
80c	1750	7,296	3	500, 1856	11,839	62%
80d	1120	46,719	1	--	46,719	100%
Totals		**944,397**	**322**		**4,875,472**	**19%**

Appendix C

Comprehensive List of Cost-Effective Projects Identified from the FEDS Assessment Using Appropriated/Alternative Financed Sources of Capital

Appendix C-1
Comprehensive List of Cost-Effective Projects Identified from the FEDS Assessment Using Appropriated Source of Capital

Table C-1 identifies the 135 cost-effective energy- and cost-reducing retrofit projects identified from the FEDS modeling and analysis based on the assumption that the projects will be funded using appropriated source of capital funds. Key energy and economic results are presented for each cost-effective retrofit measure. The projects are grouped by building category. More detail, supporting each line-item project recommendation, is contained in the FEDS input and output files, which are delivered to the site energy manager on a CD in conjunction with this report.

Table C-1 Comprehensive List of Cost-Effective Projects Using Appropriated Sources of Capital

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
1	Replace 175W Metal Halide with 4 Super T8 30W Lights	365	409,722	62,537	27,899	2.24	7.60
10b	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	-	65	37	16	2.31	5.80
	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	-	96	41	22	1.86	7.40
	Replace LED EXIT Lights with Electroluminescent Panel	-	417	224	37	6.05	2.90
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	49	39,932	13,522	3,188	4.24	4.00
	Replace 175W Metal Halide with 4 Super T8 30W Lights	36	37,250	11,463	2,885	3.97	4.20
	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	1,768	531,811	593,472	108,437	5.47	2.60
	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators	45	11,224	2,442	2,394	1.02	13.60
	Replace 75W Incandescent Lights with 18W CFL Lights	1,713	1,881,018	18,316	113,005	0.16	103.70
	Replace LED EXIT Lights with Electroluminescent Panel	10	22,807	11,182	1,973	5.67	3.00
	Replace 3 T8 32W Lights with 3 Super T8 28W Lights	1,313	452,649	673,226	67,673	9.95	1.70
10c	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	1,288	276,428	576,738	76,285	7.56	1.80
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	1,284	818,851	572,171	83,008	6.89	2.40

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
10d	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	38	39,699	1,864	2,465	0.76	22.30
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	536	314,391	180,520	29,555	6.11	2.70
	Replace 2 T12 40W Lights with 2 Super T8 32W Lights	10	9,466	1,693	664	2.55	6.60
10e	Replace Electric Package Unit with Window AC Unit (ultra high efficiency)	96	12,594	152,253	15,158	10.04	1.20
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	171	180,588	8,076	11,196	0.72	23.40
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	64	22,682	38,324	3,658	10.48	1.60
	Suspended Ceiling: Increase Insulation by R-19	319	183,955	104,477	17,334	6.03	2.80
10f	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	821	230,892	251,246	44,753	5.61	2.50
	Wrap Tank with insulation	1,020	778,332	36,477	49,939	0.73	15.60
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	52	55,454	2,485	3,439	0.72	23.30
	Replace 3 T8 32W Lights with 2 Super T8 32W Lights	1,107	807,796	279,792	65,067	4.30	3.90
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	49	20,792	26,300	2,822	9.32	1.80
10g	Replace LED EXIT Lights with Electroluminescent Panel	6	13,497	6,523	1,163	5.61	3.10
	Replace 3 T8 32W Lights with 3 Super T8 25W Lights	507	453,305	106,802	33,284	3.21	5.20

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
21a	Wrap Tank with insulation, Aerators, LFSHs	1,622	1,018,881	104,979	81,745	1.28	8.80
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	216	234,671	11,182	14,579	0.77	22.00
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	749	641,000	147,645	47,091	3.14	5.30
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	150	128,641	51,726	10,719	4.83	3.50
	Attic Ceiling: Increase Insulation by R-13 (blow-in cellulose)	23	4,093	17,876	1,321	13.53	1.20
23a	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	662	93,096	357,541	37,471	9.54	1.50
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	53	55,601	2,485	3,447	0.72	23.40
	Replace 2 T12 40W Lights with 2 Super T8 30W Lights	56	40,310	19,895	3,590	5.54	3.00
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	32	20,631	12,805	1,997	6.41	2.60
30a	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	619	151,454	180,106	31,976	5.63	2.50
	Wrap Tank with insulation	743	74,683	74,929	34,745	2.16	5.20
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	118	125,587	5,591	7,786	0.72	23.50
	Replace 1 T8 32W Lights with 1 Super T8 25W Lights	47	29,680	29,561	3,497	8.45	2.00
30b	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	815	137,186	218,606	42,889	5.10	2.70

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
	Replace Distillate Oil Central Boiler with Central Heat Pump Hot Water System	454	273,922	67,621	16,516	4.09	3.80
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	184	193,347	8,386	11,977	0.70	24.10
30c	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	2832	343,656	1,529,812	153,440	9.97	1.4
	Wrap Tank with insulation	1,713	949,321	192,544	84,474	2.28	5.00
	Wrap Tank with insulation	758	454,295	41,607	23,323	1.78	9.80
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	959	1,048,312	50,318	65,142	0.77	21.80
40a	Replace Electric Package Unit with Window AC Unit (ultra high efficiency)	102	5,999	57,342	6,184	9.27	1.20
	Replace Electric Water Heater with Heat Pump Water Heater, Aerators	5	504	1,748	288	6.07	1.50
	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	-	85	73	22	3.32	4.20
	Replace 400W Metal Halide Lights with 310W High Pressure Sodium Lights	82	26,921	50,532	4,650	10.87	1.50
40b	Wrap Tank with Insulation, Insulate Pipe Near Tank, LFSHs, Lower Tank Temperature	2	145	1,062	105	10.11	1.40
	Wrap Tank with Insulation, Insulate Pipe Near Tank, LFSHs, Lower Tank Temperature	2	262	1,062	128	8.30	1.70
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	33	38,642	2,174	2,415	0.90	18.80
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	48	51,025	2,174	3,160	0.69	24.50

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	1,297	1,005,482	130,584	68,276	1.9	8.70
40c	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	1,503	126,015	625,995	80,900	7.74	1.80
	Replace LED EXIT Lights with Electroluminescent Panel	4	9,529	4,659	824	5.65	3.00
	Replace 400W Metal Halide Lights with 310W High Pressure Sodium Lights	2,259	1,205,265	634,806	110,803	5.73	2.90
	Replace 250W Metal Halide Lights with 200W High Pressure Sodium Lights	245	148,979	190,109	20,025	9.49	1.80
	Replace LED EXIT Lights with Electroluminescent Panel	3	8,573	4,659	766	6.08	2.80
50a	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	2	430	335	109	3.07	4.50
	Replace LED EXIT Lights with Electroluminescent Panel	4	12,574	6,833	1,124	6.08	2.80
	Replace LED EXIT Lights with Electroluminescent Panel	5	13,149	6,833	1,158	5.90	2.90
	Replace 3 T8 32W Lights with 2 Super T8 32W Lights	1,513	1,115,730	146,985	75,676	1.94	8.60
	Replace 3 T8 32W Lights with 3 Super T8 25W Lights	84	79,643	36,435	6,878	5.30	3.20
	Replace 400W Metal Halide Lights with 310W High Pressure Sodium Lights	2,439	990,934	500,265	90,733	5.51	3.00
	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	5	1,158	335	253	1.32	10.50
50b	Replace 100W Incandescent Lights with 26W CFL Lights	38	42,543	965	2,596	0.37	45.10

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
	Replace LED EXIT Lights with Electroluminescent Panel	6	12,957	6,212	1,114	5.58	3.10
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	4	2,386	2,021	263	7.68	2.20
	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	670	574,453	62,828	38,300	1.64	10.1
	Replace LED EXIT Lights with Electroluminescent Panel	4	11,431	6,212	1,022	6.08	2.80
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	668	539,907	232,446	46,058	5.05	3.30
50c	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (ultra high efficiency)	690	296,787	158,025	33,291	4.75	3.00
	Wrap Tank with Insulation and Insulate Pipe Near Tank	1	65	168	27	6.22	1.40
	Replace LED EXIT Lights with Electroluminescent Panel	-	627	311	54	5.76	3.00
	Replace 3 T8 32W Lights with 2 Super T8 32W Lights	277	201,116	36,526	14,237	2.57	6.50
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	174	90,829	49,621	8,435	5.88	2.80
	Replace 1500W Metal Halide Lights with 1000W High Pressure Sodium Lights	97	99,752	36,110	8,009	4.51	3.80
50d	Replace 100W Incandescent Lights with 26W CFL Lights	94	88,642	25,797	6,795	3.80	4.40
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	237	276,021	15,530	17,249	0.90	18.80
	Replace 1 T12 40W Lights with 1 Super T8 32W Lights	136	40,029	188,354	13,457	14.00	1.20

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	902	884,636	44,561	55,844	0.80	20.90
50v	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	10	10,909	512	678	0.76	22.30
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	59	63,430	2,904	3,936	0.74	22.80
	Replace T12 Magnetic Ballasts with T12 Electronic Ballast	183	147,282	55,831	12,121	4.61	3.60
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	636	532,150	150,383	40,735	3.69	4.50
	Replace 2 T12 40W Lights with 2 Super T8 32W Lights	43	38,390	13,653	3,086	4.42	3.80
	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	1,235	610,435	311,584	55,412	5.62	3.00
60a	Replace Propane Central Boiler with Conventional Distillate Oil Boiler, wrap tank with insulation	522	340,737	56,604	14,521	3.90	7.60
	Replace 25W Incandescent Lights with 5W CFL Lights	206	101,167	70,815	10,326	6.86	2.40
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	41	42,011	1,864	2,604	0.72	23.50
60b	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	989	353,402	760,855	96,296	7.90	1.80
	Wrap Tank with Insulation	136	13,926	6,414	4,373	1.47	3.20
	Replace 75W Incandescent Lights with 18W CFL Lights	287	293,399	8,688	17,961	0.48	34.80
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	136	143,673	6,212	8,899	0.70	24.10

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
	Replace 3 T8 32W Lights with 3 Super T8 25W Lights	77	48,227	47,123	5,640	8.36	2.00
	Suspended Ceiling: Increase Insulation by R-19	191	44,282	172,935	13,054	13.25	1.30
60c	Replace Electric Water Heater with Heat Pump Water Heater	455	43,139	133,662	22,976	5.82	1.60
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	53	61,092	3,355	3,814	0.88	19.20
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	6	6,789	373	424	0.88	19.20
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	3,470	2,737,402	686,561	204,230	3.36	5.00
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	366	289,499	88,090	22,512	3.91	4.30
60m	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	194	226,336	12,735	14,144	0.90	18.80
60t	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	217	64,113	85,505	14,146	6.04	2.30
	Replace Electric Water Heater with Heat Pump Water Heater	21	3,090	3,427	982	3.49	2.70
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	13	14,052	621	871	0.71	23.60
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	811	664,582	87,739	44,944	1.95	8.60
	Suspended Ceiling: Increase Insulation by R-19	194	115,027	79,435	11,687	6.80	2.40
80a	Replace Electric Water Heater with Heat Pump Water Heater	616	28,256	51,408	36,325	1.42	6.60

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
	Replace LED EXIT Lights with Electroluminescent Panel	4	9,192	4,659	803	5.80	3.00
	Replace 4 T12 40W Lights with 4 T8 32W Lights	58	44,649	24,602	4,113	5.98	2.80
	Replace 3 T8 32W Lights with 3 Super T8 25W Lights	399	244,588	316,737	33,176	9.55	1.80
	Replace Metal Halide Magnetic Ballast with Metal Halide Electronic Ballasts	20	34,805	20,642	3,222	6.41	2.70
80b	Replace existing Package Unit with Single Zone Package Unit (very high efficiency)	895	41,361	179,467	60,318	3	3.80
	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators	54	2,370	3,024	2,801	1.08	13.00
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	117	121,348	4,970	7,503	0.66	25.40
	Replace 3 T8 32W Lights with 2 Super T8 32W Lights	376	336,340	75,078	24,493	3.07	5.50
	Replace 2 T12 40W Lights with 2 Super T8 30W Lights	36	24,408	13,129	2,238	5.87	2.90
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	231	175,954	95,237	16,106	5.91	2.80
80c	Wrap Tank with Insulation	2	193	160	89	1.80	2.20
	Replace 75W Incandescent Lights with 18W CFL Lights	73	84,112	1,564	5,098	0.31	54.80
	Replace 100W Incandescent Lights with 26W CFL Lights	10	11,543	174	698	0.25	67.40
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	40	42,260	1,864	2,619	0.71	23.70

Bldg. Set ID	Technology Change	Energy Savings (MMBtu/yr)	Net Present Value ($)	Installed Cost ($)	1st year savings ($)	Simple Payback (yr)	SIR
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	7	4,563	4,027	509	7.91	2.10
	Replace 3 T8 32W Lights with 3 Super T8 25W Lights	5	4,142	3,006	423	7.11	2.40
	Replace 2 T12 40W Lights with 2 Super T8 32W Lights	37	28,251	9,478	2,237	4.24	4.00
	Insulate Built-up Roof Surface (R-15) and Re-Roof	158	116,314	59,235	10,550	5.61	3.00
80d	Replace Electric Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	525	155,727	112,069	27,663	4.05	3.40
	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators	22	3,041	588	815	0.72	17.80
	Replace 40W Incandescent EXIT Lights with Electroluminescent Panel	13	14,174	621	878	0.71	23.80
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	120	106,019	11,663	7,027	1.66	10.10
	Replace 2 T12 40W Lights with 2 Super T8 25W Lights	43	28,117	14,429	2,541	5.68	2.90
	Install Thermal Break Aluminum Frame Double Pane Super Low-e Window	31	6,120	23,598	1,786	13.21	1.30

Appendix C-2
Comprehensive List of Cost-Effective Projects Identified from the FEDS Assessment Using Alternative Financing Sources of Capital

Table C-2 identifies the 88 cost-effective energy- and cost-reducing retrofit projects identified from the FEDS modeling and analysis based on the assumption that they will be funded using alternative financing source of capital funds. Alternative financing includes UESC and ESPC, as well as any other third party financing. Key energy and economic results are presented for each cost-effective retrofit measure. The projects are grouped by building category.

Table C-2 Comprehensive List of Cost-Effective Projects Using Alternative Financing Sources of Capital

FEDS Category	Technology Change	Energy Savings (MMBtu/yr)	1st year savings ($)	Installed Cost ($)	Net Present Value ($)	SIR
1	Replace 175W Metal Halide Lights with 4 Super T8 30W Lights	365	29,120	62,537	109,318	2.70
10b	Replace 75W Incandescent Lights with 18W CFL Lights	1,708	112,610	18,316	638,124	35.80
	Replace LED EXIT Lights with Electroluminescent EXIT Lights	10	2,156	11,182	1,872	1.20
	Faucet Aerators	39	2,126	429	11,775	28.50
	Faucet Aerators, Lower Tank Temperature	-	11	4	60	17.20
	Faucet Aerators, Lower Tank Temperature	-	17	8	93	13.10
	Replace 4 T12 40W Lights with 4 T8 32W Lights	33	2,441	6,190	8,088	2.30
	Replace 175W Metal Halide Lights with 4 Super T8 30W Lights	35	3,182	11,463	7,323	1.60
10c	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	1,402	116,224	572,171	110,933	1.20
10d	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	38	2,489	1,864	12,719	7.80
	Replace 2 T12 40W Lights with 2 T8 32W Lights	10	679	1,693	2,274	2.30
10e	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	173	11,434	8,076	58,838	8.30
	Suspended Ceiling: Increase Insulation by R-11	301	18,388	79,922	25,635	1.30
10f	Replace Electric Central Boiler with a Central Heat Pump Hot Water System, Wrap Tank with Insulation	1,020	49,939	36,477	250,499	7.90

FEDS Category	Technology Change	Energy Savings (MMBtu/yr)	1st year savings ($)	Installed Cost ($)	Net Present Value ($)	SIR
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	52	3,470	2,485	17,826	8.20
	Replace 3 T8 32W Lights with 2 Super T8 32W Lights	1,107	61,136	279,792	72,136	1.30
10g	Replace LED EXIT Lights with Electroluminescent EXIT Lights	6	1,270	6,523	1,162	1.20
	Replace 3 T8 32W Lights with 3 Super T8 25W Lights	507	37,937	106,802	116,142	2.10
21a	Replace Electric Central Boiler with a Central Heat Pump Hot Water System, Wrap Tank with Insulation, Aerators, LFSH	1,622	81,745	104,979	364,597	4.50
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	217	14,717	11,182	75,065	7.70
	Replace 4 T12 40W Lights with 4 T8 32W Lights	526	37,484	67,589	151,218	3.20
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	151	12,812	51,726	23,706	1.50
23a	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	56	3,661	2,485	18,920	8.60
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	34	2,727	12,805	3,200	1.20
	Replace 2 T12 40W Lights with 2 T8 32W Lights	46	3,444	11,833	8,330	1.70
30a	Replace Electric Central Boiler with a Central Heat Pump Hot Water System, Wrap Tank with Insulation	743	34,745	74,929	124,587	2.70
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	117	7,810	5,591	40,123	8.20
30b	Replace Distillate Oil Central Boiler with a Central Heat Pump Hot Water System	454	16,516	67,621	34,985	1.50
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	184	12,055	8,386	62,138	8.40
30c	Replace Electric Central Boiler with a Central Heat Pump Hot Water System					

FEDS Category	Technology Change	Energy Savings (MMBtu/yr)	1st year savings ($)	Installed Cost ($)	Net Present Value ($)	SIR
		1,712	84,422	192,033	293,507	2.50
	Replace Propane Central Boiler with a Central Heat Pump Hot Water System, Wrap Tank with Insulation	758	23,323	41,607	131,676	4.20
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	1,061	70,862	50,318	364,412	8.20
40a	Faucet Aerators, Lower Tank Temperature	2	98	40	522	14.00
	Faucet Aerators, Lower Tank Temperature	-	15	17	67	4.90
40b	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	33	2,443	2,174	12,192	6.60
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	48	3,175	2,174	16,395	8.50
40c	Replace LED EXIT Lights with Electroluminescent EXIT Lights	5	924	4,659	923	1.20
	Replace 400W Metal Halide Light with 310W High Pressure Sodium Light	2,493	128,874	634,806	105,504	1.20
50a	Faucet Aerators, Lower Tank Temperature	4	220	89	1,175	14.30
	Faucet Aerators, Lower Tank Temperature	1	77	89	349	4.90
	Replace 3 T8 32W Lights with 2 Super T8 32W Lights	1,513	79,041	146,985	309,936	3.10
	Replace 400W Metal Halide Light with 310W High Pressure Sodium Light	2,439	119,609	500,265	188,322	1.40
50b	Replace 4 T12 40W Lights with 4 T8 32W Lights	469	37,100	106,410	110,668	2.00
	Replace 100W Incandescent Lights with 26W CFL Lights	38	2,611	965	14,194	15.70

FEDS Category	Technology Change	Energy Savings (MMBtu/yr)	1st year savings ($)	Installed Cost ($)	Net Present Value ($)	SIR
	Replace LED EXIT Lights with Electroluminescent EXIT Lights	6	1,216	6,212	1,142	1.20
50c	Replace Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (ultra high efficiency)	690	33,310	158,025	32,843	1.20
	Replace LED EXIT Lights with Electroluminescent EXIT Lights	-	59	311	50	1.20
	Replace 3 T8 32W Lights with 2 Super T8 32W Lights	277	16,480	36,526	59,374	2.60
	Replace 2 T8 32W Lights with 2 Super T8 25W Lights	174	11,570	49,621	18,109	1.40
	Replace 1500W Metal Halide Light with 1000W High Pressure Sodium Light	97	7,501	36,110	8,101	1.20
50d	Replace 100W Incandescent Lights with 26W CFL Lights	94	6,764	25,797	13,735	1.50
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	237	17,450	15,530	87,088	6.60
50v	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	8	601	512	3,019	6.90
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	48	3,407	2,904	17,109	6.90
	Replace 4 T12 40W Lights with 4 T8 32W Lights	366	27,067	68,843	89,460	2.30
	Replace 2 T12 40W Lights with 2 T8 32W Lights	43	3,562	13,653	7,350	1.50
	Replace 2 T12 96W Magnetic Ballast with 2 T12 96W Electronic Ballast	92	6,930	30,176	10,333	1.30
60a	Wrap Tank with Insulation	437	14,055	536	100,131	187.90
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	40	2,596	1,864	13,332	8.20
60b	Wrap Tank with Insulation	136	4,373	6,414	20,924	3.00

FEDS Category	Technology Change	Energy Savings (MMBtu/yr)	1st year savings ($)	Installed Cost ($)	Net Present Value ($)	SIR
	Replace 75W Incandescent Lights with 18W CFL Lights	317	19,410	8,688	104,442	13.00
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	151	9,649	6,212	50,154	9.10
60c	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	54	3,887	3,355	19,488	6.80
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	6	432	373	2,165	6.80
	Replace 4 T12 40W Lights with 4 T8 32W Lights	2,411	165,766	314,297	656,171	3.10
	Replace 4 T12 40W Lights with 4 T8 32W Lights	258	18,490	40,326	67,979	2.70
60m	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	194	14,308	12,735	71,412	6.60
60t	Replace Electric Water Heater with Heat Pump Water Heater	21	982	3,427	2,196	1.60
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	14	943	621	4,888	8.90
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	911	51,498	87,739	210,894	3.40
	Suspended Ceiling: Increase Insulation by R-11	249	16,290	60,766	32,741	1.50
80a	Replace Electric Water Heater with Heat Pump Water Heater	616	36,325	51,408	156,953	4.10
	Replace 150W Metal Halide Magnetic Ballast with 150W Metal Halide Electronic Ballast	20	4,641	20,642	7,534	1.40
80b	Replace Electric Package Unit with Single Zone Package Unit (high efficiency)	960	63,405	175,291	193,476	2.10
	Faucet Aerators	48	2,503	229	14,140	62.80

FEDS Category	Technology Change	Energy Savings (MMBtu/yr)	1st year savings ($)	Installed Cost ($)	Net Present Value ($)	SIR
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	116	7,522	4,970	38,996	8.80
	Replace 4 T8 32W Lights with 3 Super T8 32W Lights	373	21,152	75,078	47,084	1.60
	Replace 2 T12 40W Lights with 2 T8 32W Lights	27	1,958	7,809	3,652	1.50
80c	Wrap Tank with Insulation	2	89	160	288	2.10
	Replace 75W Incandescent Lights with 18W CFL Lights	73	5,174	1,564	28,614	19.30
	Replace 100W Incandescent Lights with 26W CFL Lights	11	732	174	4,079	24.50
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	40	2,645	1,864	13,615	8.30
	Replace 2 T12 40W Lights with 2 T8 32W Lights	37	2,627	9,478	6,027	1.60
80d	Replace Air-Cooled Chiller with Water-Cooled Chiller and Cooling Tower (very high efficiency)	545	28,381	116,055	46,546	1.40
	Wrap Tank with Insulation, Aerators	21	783	296	4,510	16.20
	Replace 40W Incandescent EXIT Lights with Electroluminescent EXIT Lights	13	884	621	4,551	8.30
	Replace 4 T12 40W Lights with 3 Super T8 32W Lights	120	7,159	11,663	29,900	3.60
	Replace 2 T12 40W Lights with 2 T8 32W Lights	28	2,059	5,820	6,258	2.10

Appendix D

Building Details

Pacific Northwest
NATIONAL LABORATORY

U.S. DEPARTMENT OF
ENERGY

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Appendix D-1
Energy Conservation Measures for Individual Buildings Appropriated Funding

The following information identifies the cost-effective energy- and cost-reducing retrofit projects using appropriated funding for the buildings visited during the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Building 2186 Storage Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2186 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2186

Building 2186 is overhead storage for landscaping equipment built in 1986. 2186 has some lighting but no cooling or building envelope. Building 2186 is 2,125 sf.

Appropriated Funding Results

FEDS did not find any life cycle cost effective retrofits using appropriated funding.

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 2,451 kwh before retrofits and 2,451 kwh after proposed retrofits are implemented. The energy use intensity goes from 3.9 MBtu/Ksf to 3.9 MBtu/Ksf after retrofits.

Covered lighting 2186

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	2,451	1,153.2	3.9	434
post-retrofit	2,451	1,153.2	3.9	431
difference	0	0.0	0.0	-3
% change	0	0	0	-1
Total (MBtu)				
existing	8	3.9	3.9	434
post-retrofit	8	3.9	3.9	431
difference	0	0.0	0.0	-3
% change	0	0	0	-1

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 2,451 kwh/year.

Covered lighting 2186

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	0	2,451	0
post-retrofit	0	0	0	0	2,451	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	0	0	0	8	0
post-retrofit	0	0	0	0	8	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	0	4	0
post-retrofit	0	0	0	0	4	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Covered lighting 2186
Sulfur Oxides (lb)	
existing	22
post-retrofit	22
difference	0
% change	0
Nitrogen Oxides (lb)	
existing	11
post-retrofit	11
difference	0
% change	0
Carbon Monoxide (lb)	
existing	18
post-retrofit	18
difference	0
% change	0
Carbon Dioxide (tons)	
existing	2
post-retrofit	2
difference	0
% change	0
Particulate Matter (lb)	
existing	0
post-retrofit	0
difference	0
% change	0
Hydrocarbons (lb)	
existing	8
post-retrofit	8
difference	0
% change	0

Building 2035 Hanger

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2035 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2035

Building 2035 is a hangar with two high-bay spaces originally built in 1937. One of the high-bays has been converted to office space where an administration building has been built inside the hanger. This building inside a building is cooled by air cooled chillers and receives little to no solar radiation. The other high-bay is used to store and transport aircraft parts and has a small office space served by an electric DX, or package unit. Building 2035 is 86,391 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the air cooled chiller with a very high efficiency water cooled chiller for hangar 13. 32W T8 fluorescent lamps are suggested to be replaced with 28W SuperT8 lamps as well as other lighting retrofits. Suspended ceiling insulation is recommended to be increased as well as upgrades to the hot water system for hangar 13. The FEDS analysis suggested replacing the lighting for hangar 11 as well as various upgrades to the hot water system.

Appropriated funding FEDS results for hangar 13 building 2035:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Large 1930's admin space 2035 hangar 13	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	255	16,564	94,307	79,487	2.5
Large 1930's admin space 2035 hangar 13	Lights	FL237: FL 2X4 3F32T8 ELC3 REF	FL296: FL 2X4 3F28ST8 ELC3 REF	20	1,038	10,283	7,011	1.7
Large 1930's admin space 2035 hangar 13	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	2	330	1,864	3,809	3.0
Large 1930's admin space 2035 hangar 13	Lights	IN8: INC 75 CEIL	CF5: CFL 18 INTEGRAL UNIT ELC	317	20,921	3,373	348,237	#####
Large 1930's admin space 2035 hangar 13	Hot Water	Electric Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators	8	451	526	2,091	11.9
Large 1930's admin space 2035 hangar 13	Roof	Roof Insulation R-Value 8.90	Suspended Ceiling: Increase Insulation by R-19	37	2,675	37,191	7,320	1.2

Appropriated funding FEDS results for hangar 11 building 2035:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1930's wharehouse space hangar 11	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	9	565	2,491	6,986	3.8
1930's wharehouse space hangar 11	Lights	MH4: MH 175 PEND	FL289: FL 2X4 4F30ST8 ELC2 REF	6	513	2,111	6,558	4.1
1930's wharehouse space hangar 11	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	6	37	69	2.8
1930's wharehouse space hangar 11	Hot Water	Electric Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	-	2	6	11	5.9
1930's wharehouse space hangar 11	Hot Water	Electric Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	-	4	8	17	7.1

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for the administration space for a typical year was 795,887 kwh before retrofits and 593,955 kwh after proposed retrofits are implemented. The energy use intensity goes from 62.9 MBtu/Ksf to 46.9 MBtu/Ksf after retrofits.

Large 1930's admin space 2035 hangar 13

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	795,887	18,425.9	62.9	141,087
post-retrofit	593,955	13,750.9	46.9	104,498
difference	-201,932	-4,675.0	-16.0	-36,588
% change	-25	-25	-25	-26
Total (MBtu)				
existing	2,716	62.9	62.9	141,087
post-retrofit	2,027	46.9	46.9	104,498
difference	-689	-16.0	-16.0	-36,588
% change	-25	-25	-25	-26

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for the highbay space in the building for a typical year was 62,619 kwh before retrofits and 58,228 kwh after proposed retrofits are implemented. The energy use intensity goes from 4.9 MBtu/Ksf to 4.6 MBtu/Ksf after retrofits.

Large 1930's warehouse space 2035 hangar 11

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	62,619	1,449.6	4.9	11,100
post-retrofit	58,228	1,348.0	4.6	10,244
difference	-4,391	-101.6	-0.3	-856
% change	-7	-7	-7	-8
Total (MBtu)				
existing	214	4.9	4.9	11,100
post-retrofit	199	4.6	4.6	10,244
difference	-15	-0.3	-0.3	-856
% change	-7	-7	-7	-8

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the administration space of the building with 253,896 kWh/year, followed by motors and miscellaneous equipment with 137,454 kWh/year.

Large 1930's admin space 2035 hangar 13

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	253,896	69,266	226,334	240,705	5,687
post-retrofit	0	137,454	57,522	155,064	240,705	3,210
difference	0	-116,442	-11,744	-71,270	0	-2,476
% change	0	-46	-17	-31	0	-44
Total (MBtu)						
existing	0	867	236	772	822	19
post-retrofit	0	469	196	529	822	11
difference	0	-397	-40	-243	0	-8
% change	0	-46	-17	-31	0	-44
Total (MBtu/1000ft2)						
existing	0	20	5	18	19	0
post-retrofit	0	11	5	12	19	0
difference	0	-9	-1	-6	0	0
% change	0	-46	-17	-31	0	-44

Lighting is the largest load in the highbay space of the building with 53,825 kWh/year, followed by motors and miscellaneous equipment with 8,705 kWh/year.

1930's warehouse space 2035 hangar 11

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	0	0	53,825	8,705	88
post-retrofit	0	0	0	49,471	8,705	52
difference	0	0	0	-4,354	0	-36
% change	0	0	0	-8	0	-41
Total (MBtu)						
existing	0	0	0	184	30	0
post-retrofit	0	0	0	169	30	0
difference	0	0	0	-15	0	0
% change	0	0	0	-8	0	-41
Total (MBtu/1000ft2)						
existing	0	0	0	4	1	0
post-retrofit	0	0	0	4	1	0
difference	0	0	0	0	0	0
% change	0	0	0	-8	0	-41

* Energy consumption values for both distributed and central SHW are reported for Hot Water annual energy use.

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Large 1930's admin space 2035 hangar 13
Sulfur Oxides (lb)	
existing	7,195
post-retrofit	5,369
difference	-1,825
% change	-25
Nitrogen Oxides (lb)	
existing	3,438
post-retrofit	2,566
difference	-872
% change	-25
Carbon Monoxide (lb)	
existing	5,914
post-retrofit	4,413
difference	-1,500
% change	-25
Carbon Dioxide (tons)	
existing	728
post-retrofit	543
difference	-185
% change	-25
Particulate Matter (lb)	
existing	142
post-retrofit	106
difference	-36
% change	-25
Hydrocarbons (lb)	
existing	2,447
post-retrofit	1,826
difference	-621
% change	-25

Large 1930's warehouse space hangar 11

Sulfur Oxides (lb)	
existing	566
post-retrofit	526
difference	-40
% change	-7
Nitrogen Oxides (lb)	
existing	271
post-retrofit	252
difference	-19
% change	-7
Carbon Monoxide (lb)	
existing	465
post-retrofit	433
difference	-33
% change	-7
Carbon Dioxide (tons)	
existing	57
post-retrofit	53
difference	-4
% change	-7
Particulate Matter (lb)	
existing	11
post-retrofit	10
difference	-1
% change	-7
Hydrocarbons (lb)	
existing	193
post-retrofit	179
difference	-14
% change	-7

Building 1204 Administration Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1204 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1204

Building 1204 is a small admin building built in 1939. This building is served by an air cooled chiller and has little to no insulation in its building envelope. Building 1204 is 11,374 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the air cooled chiller with a high efficiency water cooled chiller. This analysis also suggests replacing 32W T8 fluorescent lamps with 25W SuperT8 lamps.

Appropriated funding FEDS results for building 1204:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Small 1040's admin 1204	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	97	6,275	52,914	19,891	1.7
Small 1040's admin 1204	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	57	3,684	25,464	36,259	2.4

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 250,798 kwh before retrofits and 204,306 kwh after proposed retrofits are implemented. The energy use intensity goes from 75.3 MBtu/Ksf to 61.3 MBtu/Ksf after retrofits.

Small 1040's admin 1204

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	250,798	22,050.1	75.3	44,459
post-retrofit	204,306	17,962.5	61.3	35,945
difference	-46,492	-4,087.6	-14.0	-8,514
% change	-19	-19	-19	-19
Total (MBtu)				
existing	856	75.3	75.3	44,459
post-retrofit	697	61.3	61.3	35,945
difference	-159	-14.0	-14.0	-8,514
% change	-19	-19	-19	-19

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 83,381 kWh/year, followed by ventilation with 72,592 kWh/year.

Small 1040's admin 1204

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	83,381	72,592	38,645	56,179	0
post-retrofit	0	50,888	72,592	24,646	56,179	0
difference	0	-32,493	0	-13,999	0	0
% change	0	-39	0	-36	0	0
Total (MBtu)						
existing	0	285	248	132	192	0
post-retrofit	0	174	248	84	192	0
difference	0	-111	0	-48	0	0
% change	0	-39	0	-36	0	0
Total (MBtu/1000ft2)						
existing	0	25	22	12	17	0
post-retrofit	0	15	22	7	17	0
difference	0	-10	0	-4	0	0
% change	0	-39	0	-36	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Small 1040's admin 1204
Sulfur Oxides (lb)	
existing	2,267
post-retrofit	1,847
difference	-420
% change	-19
Nitrogen Oxides (lb)	
existing	1,083
post-retrofit	883
difference	-201
% change	-19
Carbon Monoxide (lb)	
existing	1,863
post-retrofit	1,518
difference	-345
% change	-19
Carbon Dioxide (tons)	
existing	229
post-retrofit	187
difference	-43
% change	-19
Particulate Matter (lb)	
existing	45
post-retrofit	37
difference	-8
% change	-19
Hydrocarbons (lb)	
existing	771
post-retrofit	628
difference	-143
% change	-19

Building 2155 Administration Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2155 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2155

Building 2155 is a weapons systems management facility built in 1968. This building is cooled by a DX, or package unit and has little to no insulation in the building envelope. Building 2155 is 21,745 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing some of the lighting in the building as well as increasing the insulation in the suspended ceiling.

Appropriated funding FEDS results for building 2155:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
medium 1960's admin 2155	Lights	FL51: FL 2X4 2F32T8 ELC2	FL303: FL 2X4 2F25ST8 ELC2 REF	23	1,289	7,449	14,120	2.9
medium 1960's admin 2155	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	858	621	13,848	23.3
medium 1960's admin 2155	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	3	184	451	2,656	6.9
medium 1960's admin 2155	Roof	Roof Insulation R-Value 8.90	Suspended Ceiling: Increase Insulation by R-19	35	2,334	37,446	1,386	1.0

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 314,110 kwh before retrofits and 292,777 kwh after proposed retrofits are implemented. The energy use intensity goes from 49.3 MBtu/Ksf to 46.0 MBtu/Ksf after retrofits.

Medium 1960's admin 2155

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	314,110	14,445.2	49.3	55,682
post-retrofit	292,777	13,464.1	46.0	51,510
difference	-21,333	-981.1	-3.3	-4,172
% change	-7	-7	-7	-7
Total (MBtu)				
existing	1,072	49.3	49.3	55,682
post-retrofit	999	46.0	46.0	51,510
difference	-73	-3.3	-3.3	-4,172
% change	-7	-7	-7	-7

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 145,710 kWh/year, followed by space cooling with 92,995 kWh/year.

Medium 1960's admin 2155

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	92,995	52,915	22,491	145,710	0
post-retrofit	0	80,242	52,944	13,881	145,710	0
difference	0	-12,753	29	-8,610	0	0
% change	0	-14	0	-38	0	0
Total (MBtu)						
existing	0	317	181	77	497	0
post-retrofit	0	274	181	47	497	0
difference	0	-44	0	-29	0	0
% change	0	-14	0	-38	0	0
Total (MBtu/1000ft2)						
existing	0	15	8	4	23	0
post-retrofit	0	13	8	2	23	0
difference	0	-2	0	-1	0	0
% change	0	-14	0	-38	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Medium 1960's admin 2155
Sulfur Oxides (lb)	
existing	2,840
post-retrofit	2,647
difference	-193
% change	-7
Nitrogen Oxides (lb)	
existing	1,357
post-retrofit	1,265
difference	-92
% change	-7
Carbon Monoxide (lb)	
existing	2,334
post-retrofit	2,175
difference	-159
% change	-7
Carbon Dioxide (tons)	
existing	287
post-retrofit	268
difference	-20
% change	-7
Particulate Matter (lb)	
existing	56
post-retrofit	52
difference	-4
% change	-7
Hydrocarbons (lb)	
existing	966
post-retrofit	900
difference	-66
% change	-7

Building 502 Law Office

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 502 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 502

Building 502 is a small law office building built in 1971 that is served by two separate electric DX units with a courtroom in the center of the office space. Building 502 is 9,217 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the package unit with high efficiency window units. The FEDS analysis also suggests upgrading the lighting from 32W T8 lamps to 25W Super T8 lamps and replacing the exit lights with electroluminescent panels. The electric water heater is suggested to be replaced by a heat pump water heater and insulation in the suspended ceiling is recommended to be increased.

Appropriated funding FEDS results for building 502:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
small 1960s admin 502	Cooling	Electric Package Unit {C1}	Window Unit AC (ultra high efficiency)	13	1,546	15,573	1,191	1.1
small 1960s admin 502	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	862	621	13,893	23.4
small 1960s admin 502	Lights	FL51: FL 2X4 2F32T8 ELC2	FL303: FL 2X4 2F25ST8 ELC2 REF	10	556	5,822	3,445	1.6
small 1960s admin 502	Hot Water	Electric Water Heater	Heat Pump Water Heater (Com)	3	139	1,285	2	1.0
small 1960s admin 502	Roof	Roof Insulation R-Value 0.00	Suspended Ceiling: Increase Insulation by R-19	48	2,817	15,872	31,000	3.0

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 143,177 kwh before retrofits and 116,778 kwh after proposed retrofits are implemented. The energy use intensity goes from 53.0 MBtu/Ksf to 43.2 MBtu/Ksf after retrofits.

Small 1960s admin 502

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	143,177	15,534.1	53.0	25,381
post-retrofit	116,778	12,669.9	43.2	20,545
difference	-26,399	-2,864.2	-9.8	-4,836
% change	-18	-18	-18	-19
Total (MBtu)				
existing	489	53.0	53.0	25,381
post-retrofit	399	43.2	43.2	20,545
difference	-90	-9.8	-9.8	-4,836
% change	-18	-18	-18	-19

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 58,890 kWh/year, followed by motors and miscellaneous equipment with 45,525 kWh/year.

Small 1960s admin 502

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	58,890	24,575	13,327	45,525	860
post-retrofit	0	39,561	23,243	8,333	45,525	116
difference	0	-19,329	-1,332	-4,995	0	-744
% change	0	-33	-5	-37	0	-87
Total (MBtu)						
existing	0	201	84	45	155	3
post-retrofit	0	135	79	28	155	0
difference	0	-66	-5	-17	0	-3
% change	0	-33	-5	-37	0	-87
Total (MBtu/1000ft2)						
existing	0	22	9	5	17	0
post-retrofit	0	15	9	3	17	0
difference	0	-7	0	-2	0	0
% change	0	-33	-5	-37	0	-87

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Small 1960s admin 502
Sulfur Oxides (lb)	
existing	1,294
post-retrofit	1,056
difference	-239
% change	-18
Nitrogen Oxides (lb)	
existing	619
post-retrofit	504
difference	-114
% change	-18
Carbon Monoxide (lb)	
existing	1,064
post-retrofit	868
difference	-196
% change	-18
Carbon Dioxide (tons)	
existing	131
post-retrofit	107
difference	-24
% change	-18
Particulate Matter (lb)	
existing	26
post-retrofit	21
difference	-5
% change	-18
Hydrocarbons (lb)	
existing	440
post-retrofit	359
difference	-81
% change	-18

Building 2133 Administration Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2133 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2133

Building 2133 is a weapon systems management facility built in 2005. 2133 is cooled by an air cooled chiller and has some insulation in its building envelope. Building 2133 is 25,764 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the air cooled chiller with a very high efficiency water cooled chiller. FEDS also suggests replacing some of the lights and replacing the electric central boiler with a central heat pump water heater.

Appropriated funding FEDS results for building 2133:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
medium 2000's admin 2133	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	180	9,823	58,197	48,779	2.3
medium 2000's admin 2133	Lights	FL236: FL 2X4 3F32T8 ELC3	FL279: FL 2X4 2F32ST8 ELC2 REF	246	14,500	62,594	179,762	3.9
medium 2000's admin 2133	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	857	621	13,807	23.2
medium 2000's admin 2133	Lights	CF20: CFL 2-13 + BLST UNIT	FL53: FL 1X4 1F32T8 ELC1	-	72	1,208	46	1.0
medium 2000's admin 2133	Lights	FL51: FL 2X4 2F32T8 ELC2	FL303: FL 2X4 2F25ST8 ELC2 REF	11	629	5,884	4,605	1.8
medium 2000's admin 2133	Hot Water	Electric Central Boiler	Central Heat Pump Hot Water System, Wrap Tank	249	12,188	8,565	190,452	16.2

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 586,408 kwh before retrofits and 373,475 kwh after proposed retrofits are implemented. The energy use intensity goes from 77.7 MBtu/Ksf to 49.5 MBtu/Ksf after retrofits.

Medium 2000's admin 2133

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	586,408	22,760.8	77.7	103,952
post-retrofit	373,475	14,496.0	49.5	65,708
difference	-212,933	-8,264.8	-28.2	-38,245
% change	-36	-36	-36	-37
Total (MBtu)				
existing	2,001	77.7	77.7	103,952
post-retrofit	1,275	49.5	49.5	65,708
difference	-727	-28.2	-28.2	-38,245
% change	-36	-36	-36	-37

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 170,993 kWh/year, followed by motors and miscellaneous equipment with 132,355 kWh/year.

Medium 2000's admin 2133

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	170,993	53,772	149,077	132,355	80,211
post-retrofit	0	95,734	50,731	87,362	132,355	7,293
difference	0	-75,259	-3,041	-61,715	0	-72,917
% change	0	-44	-6	-41	0	-91
Total (MBtu)						
existing	0	584	184	509	452	274
post-retrofit	0	327	173	298	452	25
difference	0	-257	-10	-211	0	-249
% change	0	-44	-6	-41	0	-91
Total (MBtu/1000ft2)						
existing	0	23	7	20	18	11
post-retrofit	0	13	7	12	18	1
difference	0	-10	0	-8	0	-10
% change	0	-44	-6	-41	0	-91

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Medium 2000's admin 2133
Sulfur Oxides (lb)	
existing	5,301
post-retrofit	3,376
difference	-1,925
% change	-36
Nitrogen Oxides (lb)	
existing	2,533
post-retrofit	1,613
difference	-920
% change	-36
Carbon Monoxide (lb)	
existing	4,357
post-retrofit	2,775
difference	-1,582
% change	-36
Carbon Dioxide (tons)	
existing	537
post-retrofit	342
difference	-195
% change	-36
Particulate Matter (lb)	
existing	105
post-retrofit	67
difference	-38
% change	-36
Hydrocarbons (lb)	
existing	1,803
post-retrofit	1,148
difference	-655
% change	-36

Building 2125 Administration Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2125 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2125

Building 2125 is an administration building built in 1994. This petroleum operations building is cooled by an electric package unit and has little to no insulation in its building envelope. Building 2125 is 3,867 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the 32W T8 lighting with 25W Super T8 lighting as well as replacing the exit lighting and increasing the insulation in the roof to 4 inches of fiberglass.

Appropriated funding FEDS results for building 2125:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Small 1990's admin 2125	Lights	FL38: FL 2X4 3F32T8 EEF1,2	FL304: FL 2X4 3F25ST8 ELC3 REF	26	1,720	5,508	23,438	5.3
Small 1990's admin 2125	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	56	311	643	3.1

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 56,331 kwh before retrofits and 48,664 kwh after proposed retrofits are implemented. The energy use intensity goes from 48.7 MBtu/Ksf to 43.0 MBtu/Ksf after retrofits.

Small 1990's admin 2125

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	56,331	14,567.1	49.7	9,963
post-retrofit	48,664	12,584.4	43.0	8,555
difference	-7,667	-1,982.7	-6.8	-1,408
% change	-14	-14	-14	-14
Total (MBtu)				
existing	192	49.7	49.7	9,963
post-retrofit	166	43.0	43.0	8,555
difference	-26	-6.8	-6.8	-1,408
% change	-14	-14	-14	-14

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 18,138 kWh/year, followed by lights with 16,214 kWh/year.

Small 1990's admin 2125

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	18,138	4,917	16,214	16,002	1,060
post-retrofit	0	16,612	4,444	10,546	16,002	1,060
difference	0	-1,526	-473	-5,668	0	0
% change	0	-8	-10	-35	0	0
Total (MBtu)						
existing	0	62	17	55	55	4
post-retrofit	0	57	15	36	55	4
difference	0	-5	-2	-19	0	0
% change	0	-8	-10	-35	0	0
Total (MBtu/1000ft2)						
existing	0	16	4	14	14	1
post-retrofit	0	15	4	9	14	1
difference	0	-1	0	-5	0	0
% change	0	-8	-10	-35	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Small 1990's admin 2125
Sulfur Oxides (lb)	
existing	509
post-retrofit	440
difference	-69
% change	-14
Nitrogen Oxides (lb)	
existing	243
post-retrofit	210
difference	-33
% change	-14
Carbon Monoxide (lb)	
existing	419
post-retrofit	362
difference	-57
% change	-14
Carbon Dioxide (tons)	
existing	52
post-retrofit	45
difference	-7
% change	-14
Particulate Matter (lb)	
existing	10
post-retrofit	9
difference	-1
% change	-14
Hydrocarbons (lb)	
existing	173
post-retrofit	150
difference	-24
% change	-14

Building 559 Clinic Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 559 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 559

Building 559 is the air force clinic built in 1942. This building is cooled by water cooled chillers and has an electric central hot water system. Building 559 is 78,823 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests several lighting upgrades as well as replacing the electric central boiler with a central heat pump system. Increasing the insulation of the attic by using blow-in cellulose is also suggested.

Appropriated funding FEDS results for building 559:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Medical facilities 559	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	633	39,807	124,627	542,013	5.3
Medical facilities 559	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	54	3,653	2,795	58,803	22.0
Medical facilities 559	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	127	9,090	43,662	109,270	3.5
Medical facilities 559	Hot Water	Electric Central Boiler	Central Heat Pump Hot Water System, Wrap Tank, Aerators, LFSHs	939	47,853	74,876	579,478	7.2
Medical facilities 559	Roof	Roof Insulation R-Value 11.00	Attic Ceiling: Increase Insulation by R-13 (blow-in cellulose)	19	1,137	15,089	3,830	1.3

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 1,458,222 kwh before retrofits and 938,860 kwh after proposed retrofits are implemented. The energy use intensity goes from 63.6 MBtu/Ksf to 41.1 MBtu/Ksf after retrofits.

Medical facilities 559

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	1,458,222	18,500.0	63.1	258,498
post-retrofit	938,860	11,911.0	40.7	165,179
difference	-519,361	-6,589.0	-22.5	-93,319
% change	-36	-36	-36	-36
Other Fuels (MBtu)				
existing	34	0.4	0.4	1,100
post-retrofit	34	0.4	0.4	1,100
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	5,011	63.6	63.6	259,599
post-retrofit	3,239	41.1	41.1	166,280
difference	-1,773	-22.5	-22.5	-93,319
% change	-35	-35	-35	-36

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 396,160 kWh/year, followed by lighting with 363,057 kWh/year.

Medical facilities 559

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	250,456	157,151	363,057	396,160	291,398
post-retrofit	0	214,134	147,139	165,200	396,160	16,228
difference	0	-36,322	-10,012	-197,857	0	-275,170
% change	0	-15	-6	-54	0	-94
Other Fuels (MBtu)						
existing	0	0	0	0	34	0
post-retrofit	0	0	0	0	34	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	855	536	1,239	1,386	995
post-retrofit	0	731	502	564	1,386	55
difference	0	-124	-34	-675	0	-939
% change	0	-15	-6	-54	0	-94
Total (MBtu/1000ft2)						
existing	0	11	7	16	18	13
post-retrofit	0	9	6	7	18	1
difference	0	-2	0	-9	0	-12
% change	0	-15	-6	-54	0	-94

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Medical facilities 559
Sulfur Oxides (lb)	
existing	13,191
post-retrofit	8,496
difference	-4,695
% change	-36
Nitrogen Oxides (lb)	
existing	6,311
post-retrofit	4,068
difference	-2,244
% change	-36
Carbon Monoxide (lb)	
existing	10,861
post-retrofit	7,002
difference	-3,859
% change	-36
Carbon Dioxide (tons)	
existing	1,337
post-retrofit	862
difference	-475
% change	-36
Particulate Matter (lb)	
existing	261
post-retrofit	168
difference	-93
% change	-36
Hydrocarbons (lb)	
existing	4,493
post-retrofit	2,896
difference	-1,597
% change	-36

Building 1060 Laboratory Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1060 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1060

Building 1060 is a lab built in 1943. This lab is cooled by an air cooled chiller and has an electric water heater. 1060 is 14,920 sf.

<no picture is available>

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the air cooled chiller with a water cooled chiller. The analysis also suggests replacing several of the lighting technologies in the building including the exit lights, T12 and T8 lights.

Appropriated funding FEDS results for building 1060:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Labs 1060	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	139	7,949	58,769	29,552	1.9
Labs 1060	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	868	621	14,008	23.5
Labs 1060	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	9	550	3,516	5,698	2.6
Labs 1060	Lights	FL3: FL 2X4 2F40T12 STD2	FL283: FL 2X4 2F30ST8 ELC2 (FIX REPL)	15	990	5,463	11,141	3.0

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 292,009 kwh before retrofits and 239,726 kwh after proposed retrofits are implemented. The energy use intensity goes from 66.8 MBtu/Ksf to 54.8 MBtu/Ksf after retrofits.

Labs 1060

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	292,009	19,571.7	66.8	51,764
post-retrofit	239,726	16,067.4	54.8	42,176
difference	-52,284	-3,504.3	-12.0	-9,588
% change	-18	-18	-18	-19
Total (MBtu)				
existing	997	66.8	66.8	51,764
post-retrofit	818	54.8	54.8	42,176
difference	-178	-12.0	-12.0	-9,588
% change	-18	-18	-18	-19

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 116,645 kWh/year, followed by motors and miscellaneous equipment with 77,382 kWh/year.

Labs 1060

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	116,645	52,192	44,584	77,382	1,207
post-retrofit	0	73,090	51,672	36,375	77,382	1,207
difference	0	-43,555	-520	-8,208	0	0
% change	0	-37	-1	-18	0	0
Total (MBtu)						
existing	0	398	178	152	264	4
post-retrofit	0	249	176	124	264	4
difference	0	-149	-2	-28	0	0
% change	0	-37	-1	-18	0	0
Total (MBtu/1000ft2)						
existing	0	27	12	10	18	0
post-retrofit	0	17	12	8	18	0
difference	0	-10	0	-2	0	0
% change	0	-37	-1	-18	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Labs 1060
Sulfur Oxides (lb)	
existing	2,640
post-retrofit	2,167
difference	-473
% change	-18
Nitrogen Oxides (lb)	
existing	1,261
post-retrofit	1,036
difference	-226
% change	-18
Carbon Monoxide (lb)	
existing	2,170
post-retrofit	1,781
difference	-388
% change	-18
Carbon Dioxide (tons)	
existing	267
post-retrofit	219
difference	-48
% change	-18
Particulate Matter (lb)	
existing	52
post-retrofit	43
difference	-9
% change	-18
Hydrocarbons (lb)	
existing	898
post-retrofit	737
difference	-161
% change	-18

Building 1805 Dormitory Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1805 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1805

Building 1805 is a dormitory built in 1970. The dormitory is cooled by an air cooled chiller and has little to no insulation in its building envelope. This building has a desuperheater system, providing some of the hot water to the building. 1805 is 55,187 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the air cooled chiller with a water cooled chiller as well as replacing some of the lighting technologies and replacing the electric central boiler with a central heat pump. Increasing the perimeter insulation as well as replacing the windows was also suggested.

Appropriated funding FEDS analysis results for building 1805:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Dorms 1970's 1805	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	172	9,749	87,783	27,443	1.5
Dorms 1970's 1805	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	58	3,862	2,795	62,275	23.3
Dorms 1970's 1805	Lights	FL41: FL 1X4 1F32T8 EEF1	FL302: FL 1X4 1F25ST8 ELC1 REF	23	1,693	14,346	14,333	2.0

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 515,140 kwh before retrofits and 334,549 kwh after proposed retrofits are implemented. The energy use intensity goes from 31.9 MBtu/Ksf to 20.7 MBtu/Ksf after retrofits.

Dorms 1970's 1805

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	515,140	9,334.4	31.9	91,072
post-retrofit	441,113	7,993.1	27.3	77,967
difference	-74,027	-1,341.4	-4.6	-13,105
% change	-14	-14	-14	-14
Total (MBtu)				
existing	1,758	31.9	31.9	91,072
post-retrofit	1,506	27.3	27.3	77,967
difference	-253	-4.6	-4.6	-13,105
% change	-14	-14	-14	-14

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 188,139 kWh/year, followed by hot water with 121,790 kWh/year.

Dorms 1970's 1805

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	188,139	96,012	37,709	71,490	121,790
post-retrofit	0	131,176	95,260	21,397	71,490	121,790
difference	0	-56,963	-752	-16,312	0	0
% change	0	-30	-1	-43	0	0
Total (MBtu)						
existing	0	642	328	129	244	416
post-retrofit	0	448	325	73	244	416
difference	0	-194	-3	-56	0	0
% change	0	-30	-1	-43	0	0
Total (MBtu/1000ft2)						
existing	0	12	6	2	4	8
post-retrofit	0	8	6	1	4	8
difference	0	-4	0	-1	0	0
% change	0	-30	-1	-43	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Dorms 1970's 1805
Sulfur Oxides (lb)	
existing	4,657
post-retrofit	3,988
difference	-669
% change	-14
Nitrogen Oxides (lb)	
existing	2,225
post-retrofit	1,906
difference	-320
% change	-14
Carbon Monoxide (lb)	
existing	3,828
post-retrofit	3,278
difference	-550
% change	-14
Carbon Dioxide (tons)	
existing	471
post-retrofit	404
difference	-68
% change	-14
Particulate Matter (lb)	
existing	92
post-retrofit	79
difference	-13
% change	-14
Hydrocarbons (lb)	
existing	1,584
post-retrofit	1,356
difference	-228
% change	-14

Building 1856 Dormitory Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1856 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1856

Building 1856 is a dormitory built in 1995. The dormitory is cooled by an electric air cooled chiller and has substantial roofing and wall insulation in its building envelope. The central hot water system runs on diesel fuel and works in conjunction with a desuperheater. Building 1856 is 43,187 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the air cooled chiller with a very high efficiency water cooled chiller. The distillate oil, or diesel, central hot water boiler is suggested to be replaced with a central heat pump hot water system. An increase in the perimeter insulation is suggested as well as replacing the exit lighting.

Appropriated funding FEDS analysis results for building 1856:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Dorms 1990's 1856 - heat recovery	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	286	15,031	75,277	48,558	2.8
Dorms 1990's 1856 - heat recovery	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	62	3,994	2,795	64,466	24.1
Dorms 1990's 1856 - heat recovery	Hot Water	Distillate Oil Central Boiler	Central Heat Pump Hot Water System	151	5,505	22,540	91,307	3.8

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 418,237 kwh before retrofits and 320,744 kwh after proposed retrofits are implemented. The modeled distillate oil consumption for a typical year was 1,252 gallons before retrofits and 0 gallons after proposed retrofits are implemented. The energy use intensity goes from 37.1 MBtu/Ksf to 25.3 MBtu/Ksf after retrofits.

Dorms 1990's 1856

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	418,237	9,684.3	33.1	73,940
post-retrofit	320,744	7,426.9	25.3	56,404
difference	-97,494	-2,257.5	-7.7	-17,536
% change	-23	-23	-23	-24
Distillate Oil (gal)				
existing	1,252	29.0	4.0	6,385
post-retrofit	0	0.0	0.0	0
difference	-1,252	-29.0	-4.0	-6,385
% change	-100	-100	-100	-100
Total (MBtu)				
existing	1,601	37.1	37.1	80,325
post-retrofit	1,095	25.3	25.3	56,404
difference	-506	-11.7	-11.7	-23,921
% change	-32	-32	-32	-30

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 233,630 kWh/year, followed by ventilation with 66,184 kWh/year.

Dorms 1990's 1856

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	233,630	61,498	66,184	56,926	0
post-retrofit	0	143,688	59,912	53,680	56,926	6,538
difference	0	-89,942	-1,586	-12,504	0	6,538
% change	0	-38	-3	-19	0	n/a
Distillate Oil (gal)						
existing	0	0	0	0	0	1,252
post-retrofit	0	0	0	0	0	0
difference	0	0	0	0	0	-1,252
% change	0	0	0	0	0	-100
Total (MBtu)						
existing	0	797	210	226	194	174
post-retrofit	0	490	204	183	194	22
difference	0	-307	-5	-43	0	-151
% change	0	-38	-3	-19	0	-87
Total (MBtu/1000ft2)						
existing	0	18	5	5	4	4
post-retrofit	0	11	5	4	4	1
difference	0	-7	0	-1	0	-4
% change	0	-38	-3	-19	0	-87

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

		Dorms	1990's	1856
Sulfur Oxides (lb)				
existing	3,868			
post-retrofit	2,900			
difference	-968			
% change	-25			
Nitrogen Oxides (lb)				
existing	1,866			
post-retrofit	1,386			
difference	-480			
% change	-26			
Carbon Monoxide (lb)				
existing	3,246			
post-retrofit	2,383			
difference	-863			
% change	-27			
Carbon Dioxide (tons)				
existing	399			
post-retrofit	293			
difference	-106			
% change	-26			
Particulate Matter (lb)				
existing	78			
post-retrofit	57			
difference	-21			
% change	-27			
Hydrocarbons (lb)				
existing	1,331			
post-retrofit	986			
difference	-345			
% change	-26			

Building 1166 Lodging Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1166 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1166

Building 1166 is a hotel style building used as a temporary lodging facility and was built in 1968. The building is cooled by an air cooled chiller and has little to no insulation in the building envelope. Building 1166 is 25,113 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the air cooled chiller with a water cooled chiller. The analysis also suggests lighting retrofits as well as replacing the current electric and propane hot water boilers with a central heat pump hot water system. Increasing the roof insulation on the interior surface of the roof was also suggested.

Appropriated funding FEDS analysis results for building 1166:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Lodging facilities 1166	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	197	10,822	95,816	31,149	1.6
Lodging facilities 1166	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	52	3,577	2,795	57,532	21.6

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 425,234 kwh before retrofits and 315,695 kwh after proposed retrofits are implemented. The modeled other fuels (propane) consumption for a typicalyear was 48 MBtu before retrofits and 0 MBtu after proposed retrofits are implemented. The energy use intensity goes from 59.7 MBtu/Ksf to 42.9 MBtu/Ksf after retrofits.

Lodging facilities 1166

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	425,234	16,932.8	57.8	75,177
post-retrofit	349,027	13,898.3	47.4	61,691
difference	-76,207	-3,034.6	-10.4	-13,487
% change	-18	-18	-18	-18
Other Fuels (MBtu)				
existing	48	1.9	1.9	1,531
post-retrofit	48	1.9	1.9	1,531
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	1,499	59.7	59.7	76,708
post-retrofit	1,239	49.3	49.3	63,221
difference	-260	-10.4	-10.4	-13,487
% change	-17	-17	-17	-18

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 116,650 kWh/year, followed by ventilation with 117,053 kWh/year.

Lodging facilities 1166

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	166,650	117,053	61,726	38,238	41,566
post-retrofit	0	103,613	117,053	48,556	38,238	41,566
difference	0	-63,037	0	-13,170	0	0
% change	0	-38	0	-21	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	0	48
post-retrofit	0	0	0	0	0	48
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	569	400	211	131	189
post-retrofit	0	354	400	166	131	189
difference	0	-215	0	-45	0	0
% change	0	-38	0	-21	0	0
Total (MBtu/1000ft2)						
existing	0	23	16	8	5	8
post-retrofit	0	14	16	7	5	8
difference	0	-9	0	-2	0	0
% change	0	-38	0	-21	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

Lodging facilities 1166

Sulfur Oxides (lb)	
existing	3,856
post-retrofit	3,167
difference	-689
% change	-18
Nitrogen Oxides (lb)	
existing	1,854
post-retrofit	1,524
difference	-329
% change	-18
Carbon Monoxide (lb)	
existing	3,196
post-retrofit	2,629
difference	-566
% change	-18
Carbon Dioxide (tons)	
existing	393
post-retrofit	323
difference	-70
% change	-18
Particulate Matter (lb)	
existing	77
post-retrofit	63
difference	-14
% change	-18
Hydrocarbons (lb)	
existing	1,320
post-retrofit	1,085
difference	-234
% change	-18

Building 2040 Aircraft Maintenance Shop

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2040 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2040

Building 2040 is an aircraft maintenance shop built in 1937. 2040 is cooled by an air cooled chiller and has little to no insulation in its building envelope. Building 2040 is 77,439 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing T12 lighting with Super T8 lighting. It was also suggested to make changes to the hot water system including reducing the temperature, installing aerators and increasing insulation in the conditioned space. FEDS had no life cycle cost effective retrofits for the unconditioned space.

Appropriated funding FEDS analysis results for building 2040 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 2040	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	80	5,264	20,804	67,417	4.2
1940's shops 2040	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	53	311	617	3.0
1940's shops 2040	Lights	FL3: FL 2X4 2F40T12 STD2	FL283: FL 2X4 2F30ST8 ELC2 (FIX REPL)	11	771	4,743	8,199	2.7
1940's shops 2040	Lights	FL2: FL 2X4 3F40T12 STD1,2	FL304: FL 2X4 3F25ST8 ELC3 REF (FIX REPL)	12	774	4,161	8,814	3.1
1940's shops 2040	Hot Water	Electric Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	2	111	214	486	7.2

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 352,637 kwh. No proposed retrofits were suggested for the unconditioned space. The energy use intensity is 18.3 MBtu/Ksf.

1940's shops 2040 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	352,637	5,362.8	18.3	62,343
post-retrofit	352,637	5,362.8	18.3	62,013
difference	0	0.0	0.0	-330
% change	0	0	0	-1
Total (MBtu)				
existing	1,204	18.3	18.3	62,343
post-retrofit	1,204	18.3	18.3	62,013
difference	0	0.0	0.0	-330
% change	0	0	0	-1

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 156,928 kwh before retrofits and 125,990 kwh after proposed retrofits are implemented. The energy use intensity goes from 46.2 MBtu/Ksf to 37.1 MBtu/Ksf after retrofits.

1940's shops 2040

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	156,928	13,523.7	46.2	27,743
post-retrofit	125,990	10,857.4	37.1	22,156
difference	-30,939	-2,666.2	-9.1	-5,587
% change	-20	-20	-20	-20
Total (MBtu)				
existing	536	46.2	46.2	27,743
post-retrofit	430	37.1	37.1	22,156
difference	-106	-9.1	-9.1	-5,587
% change	-20	-20	-20	-20

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the unconditioned space of the building with 308,331 kWh/year, followed by lighting with 44,307 kWh/year.

		1940's shops	2040 unconditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	44,307	308,331	0
post-retrofit	0	0	0	44,307	308,331	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	0	0	151	1,052	0
post-retrofit	0	0	0	151	1,052	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	2	16	0
post-retrofit	0	0	0	2	16	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0

Motors and miscellaneous equipment is the largest load in the conditioned space of the building with 56,167 kWh/year, followed by space cooling with 52,533 kWh/year.

		1940's shops	2040 conditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	52,533	2,983	43,930	56,167	1,315
post-retrofit	0	47,075	2,665	19,342	56,167	741
difference	0	-5,459	-318	-24,588	0	-574
% change	0	-10	-11	-56	0	-44
Total (MBtu)						
existing	0	179	10	150	192	4
post-retrofit	0	161	9	66	192	3
difference	0	-19	-1	-84	0	-2
% change	0	-10	-11	-56	0	-44
Total (MBtu/1000ft2)						
existing	0	15	1	13	17	0
post-retrofit	0	14	1	6	17	0
difference	0	-2	0	-7	0	0
% change	0	-10	-11	-56	0	-44

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

1940's shops 2040 unconditioned space

Sulfur Oxides (lb)	
existing	3,188
post-retrofit	3,188
difference	0
% change	0
Nitrogen Oxides (lb)	
existing	1,523
post-retrofit	1,523
difference	0
% change	0
Carbon Monoxide (lb)	
existing	2,620
post-retrofit	2,620
difference	0
% change	0
Carbon Dioxide (tons)	
existing	323
post-retrofit	323
difference	0
% change	0
Particulate Matter (lb)	
existing	63
post-retrofit	63
difference	0
% change	0
Hydrocarbons (lb)	
existing	1,084
post-retrofit	1,084
difference	0
% change	0

	1940's shops	2040 conditioned space
Sulfur Oxides (lb)		
existing	1,419	
post-retrofit	1,139	
difference	-280	
% change	-20	
Nitrogen Oxides (lb)		
existing	678	
post-retrofit	544	
difference	-134	
% change	-20	
Carbon Monoxide (lb)		
existing	1,166	
post-retrofit	936	
difference	-230	
% change	-20	
Carbon Dioxide (tons)		
existing	144	
post-retrofit	115	
difference	-28	
% change	-20	
Particulate Matter (lb)		
existing	28	
post-retrofit	23	
difference	-6	
% change	-20	
Hydrocarbons (lb)		
existing	483	
post-retrofit	387	
difference	-95	
% change	-20	

Building 1715 Recycling Center

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1715 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1715

1715 is a recycling center built in 1944. The majority of the space is unconditioned, with a small office that is served by an electric package unit. The building was modeled as two linked buildings, one conditioned, one unconditioned. Building 1715 is 30,400 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing lights in the unconditioned space as well as replacing lights in the conditioned space.

Appropriated funding FEDS results for building 1715 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 1715	Lights	FL62: FL 1X8 2F96T12 STD2	FL131: FL 1X8 2F96T12ES ELC2 REF (FIX REPL)	22	1,613	10,748	16,329	2.5
1940's shops 1715	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	102	621	1,143	2.8

Appropriated funding FEDS results for building 1715 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 1715	Lights	FL37: FL 2X4 4F32T8 EEF2	FL280: FL 2X4 3F32ST8 ELC3 REF	115	7,656	25,173	103,216	5.1
1940's shops 1715	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	54	311	626	3.0

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for the unconditioned space in the building a typical year was 147,909 kwh before retrofits and 141,258 kwh after proposed retrofits are implemented. The energy use intensity goes from 18.0 MBtu/Ksf to 17.2 MBtu/Ksf after retrofits.

1940's shops 1715 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	147,909	5,288.5	18.0	26,220
post-retrofit	141,258	5,050.7	17.2	24,852
difference	-6,651	-237.8	-0.8	-1,367
% change	-4	-4	-4	-5
Total (MBtu)				
existing	505	18.0	18.0	26,220
post-retrofit	482	17.2	17.2	24,852
difference	-23	-0.8	-0.8	-1,367
% change	-4	-4	-4	-5

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for the conditioned space in the building a typical year was 332,402 kwh before retrofits and 299,027 kwh after proposed retrofits are implemented. The energy use intensity goes from 466.5 MBtu/Ksf to 424.6 MBtu/Ksf after retrofits.

1940's shops 1715 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	332,402	136,678.6	466.5	58,765
post-retrofit	299,027	122,955.2	419.6	52,585
difference	-33,375	-13,723.4	-46.8	-6,180
% change	-10	-10	-10	-11
Total (MBtu)				
existing	1,134	466.5	466.5	58,765
post-retrofit	1,021	419.6	419.6	52,585
difference	-114	-46.8	-46.8	-6,180
% change	-10	-10	-10	-11

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the unconditioned space of the building with 131,142 kWh/year, followed by lighting with 16,767 kWh/year.

1940's shops 1715 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	16,767	131,142	0
post-retrofit	0	0	0	10,116	131,142	0
difference	0	0	0	-6,651	0	0
% change	0	0	0	-40	0	0
Total (MBtu)						
existing	0	0	0	57	448	0
post-retrofit	0	0	0	35	448	0
difference	0	0	0	-23	0	0
% change	0	0	0	-40	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	2	16	0
post-retrofit	0	0	0	1	16	0
difference	0	0	0	-1	0	0
% change	0	0	0	-40	0	0

Lighting is the largest load in the conditioned space of the building with 234,179 kWh/year, followed by space cooling with 82,158 kWh/year.

		1940's shops	1715 conditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	82,158	4,295	234,179	11,772	0
post-retrofit	0	75,557	3,928	207,770	11,772	0
difference	0	-6,600	-366	-26,409	0	0
% change	0	-8	-9	-11	0	0
Total (MBtu)						
existing	0	280	15	799	40	0
post-retrofit	0	258	13	709	40	0
difference	0	-23	-1	-90	0	0
% change	0	-8	-9	-11	0	0
Total (MBtu/1000ft2)						
existing	0	115	6	329	17	0
post-retrofit	0	106	6	292	17	0
difference	0	-9	-1	-37	0	0
% change	0	-8	-9	-11	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1940's shops	1715 unconditioned space
Sulfur Oxides (lb)		
existing	1,337	
post-retrofit	1,277	
difference	-60	
% change	-4	
Nitrogen Oxides (lb)		
existing	639	
post-retrofit	610	
difference	-29	
% change	-4	
Carbon Monoxide (lb)		
existing	1,099	
post-retrofit	1,050	
difference	-49	
% change	-4	
Carbon Dioxide (tons)		
existing	135	
post-retrofit	129	
difference	-6	
% change	-4	
Particulate Matter (lb)		
existing	26	
post-retrofit	25	
difference	-1	
% change	-4	
Hydrocarbons (lb)		
existing	455	
post-retrofit	434	
difference	-20	
% change	-4	

	1940's shops	1715 conditioned space
Sulfur Oxides (lb)		
existing	3,005	
post-retrofit	2,703	
difference	-302	
% change	-10	
Nitrogen Oxides (lb)		
existing	1,436	
post-retrofit	1,292	
difference	-144	
% change	-10	
Carbon Monoxide (lb)		
existing	2,470	
post-retrofit	2,222	
difference	-248	
% change	-10	
Carbon Dioxide (tons)		
existing	304	
post-retrofit	274	
difference	-31	
% change	-10	
Particulate Matter (lb)		
existing	59	
post-retrofit	53	
difference	-6	
% change	-10	
Hydrocarbons (lb)		
existing	1,022	
post-retrofit	920	
difference	-103	
% change	-10	

Building 2177 Maintenance Shop

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2177 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2177

2177 is a base engineer maintenance shop built in 1944. This building is partially cooled. Building 2177 is 3,200 sf.

<no photo is available>

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing T12 lighting with T8 lighting in the unconditioned spaces. Upgrades to the hot water system include insulating the tank and pipes as well as installing aerators and lowering the tank temperature for the unconditioned spaces. For the conditioned spaces FEDS suggests replacing the lighting, and upgrading the hot water system.

Appropriated funding FEDS results for building 2177 unconditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 2177	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	7	526	2,437	6,431	3.6
1940's shops 2177	Hot Water	Electric Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	-	1	6	7	4.2

Appropriated funding FEDS results for building 2177 conditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 2177	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	7	43	89	3.1
1940's shops 2177	Lights	MH5: MH 250 PEND	FL309: FL 2X3 6F40BX ELC2 REF	4	242	1,703	2,332	2.4
1940's shops 2177	Hot Water	Electric Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators, Lower Tank Temperature	-	3	9	11	4.3

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 13,067 kwh before retrofits and 11,096 kwh after proposed retrofits are implemented. The energy use intensity goes from 27.9 MBtu/Ksf to 23.7 MBtu/Ksf after retrofits.

1940's shops   2177 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	13,067	8,166.8	27.9	2,311
post-retrofit	11,096	6,935.2	23.7	1,951
difference	-1,971	-1,231.6	-4.2	-360
% change	-15	-15	-15	-16
Total (MBtu)				
existing	45	27.9	27.9	2,311
post-retrofit	38	23.7	23.7	1,951
difference	-7	-4.2	-4.2	-360
% change	-15	-15	-15	-16

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 29,056 kwh before retrofits and 27,936 kwh after proposed retrofits are implemented. The energy use intensity goes from 62.0 MBtu/Ksf to 59.6 MBtu/Ksf after retrofits.

1940's shops 2177 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	29,056	18,159.8	62.0	5,139
post-retrofit	27,936	17,460.1	59.6	4,911
difference	-1,119	-699.6	-2.4	-228
% change	-4	-4	-4	-4
Total (MBtu)				
existing	99	62.0	62.0	5,139
post-retrofit	95	59.6	59.6	4,911
difference	-4	-2.4	-2.4	-228
% change	-4	-4	-4	-4

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the unconditioned space of the building with 7,502 kWh/year, followed by lighting with 5,536 kWh/year.

		1940's shops	2177 unconditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	5,536	7,502	29
post-retrofit	0	0	0	3,575	7,502	19
difference	0	0	0	-1,961	0	-10
% change	0	0	0	-35	0	-35
Total (MBtu)						
existing	0	0	0	19	26	0
post-retrofit	0	0	0	12	26	0
difference	0	0	0	-7	0	0
% change	0	0	0	-35	0	-35
Total (MBtu/1000ft2)						
existing	0	0	0	12	16	0
post-retrofit	0	0	0	8	16	0
difference	0	0	0	-4	0	0
% change	0	0	0	-35	0	-35

Space cooling is the largest load in the conditioned space of the building with 10,796 kWh/year, followed by lighting with 8,210 kWh/year.

1940's shops 2177 conditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	10,796	2,268	8,210	7,745	38
post-retrofit	0	10,550	2,211	7,408	7,745	23
difference	0	-246	-57	-801	0	-16
% change	0	-2	-3	-10	0	-41
Total (MBtu)						
existing	0	37	8	28	26	0
post-retrofit	0	36	8	25	26	0
difference	0	-1	0	-3	0	0
% change	0	-2	-3	-10	0	-41
Total (MBtu/1000ft2)						
existing	0	23	5	18	17	0
post-retrofit	0	23	5	16	17	0
difference	0	-1	0	-2	0	0
% change	0	-2	-3	-10	0	-41

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1940's shops	2177 unconditioned space
Sulfur Oxides (lb)		
existing	118	
post-retrofit	100	
difference	-18	
% change	-15	
Nitrogen Oxides (lb)		
existing	56	
post-retrofit	48	
difference	-9	
% change	-15	
Carbon Monoxide (lb)		
existing	97	
post-retrofit	82	
difference	-15	
% change	-15	
Carbon Dioxide (tons)		
existing	12	
post-retrofit	10	
difference	-2	
% change	-15	
Particulate Matter (lb)		
existing	2	
post-retrofit	2	
difference	0	
% change	-15	
Hydrocarbons (lb)		
existing	40	
post-retrofit	34	
difference	-6	
% change	-15	

	1940's shops	2177 conditioned space
Sulfur Oxides (lb)		
existing	263	
post-retrofit	253	
difference	-10	
% change	-4	
Nitrogen Oxides (lb)		
existing	126	
post-retrofit	121	
difference	-5	
% change	-4	
Carbon Monoxide (lb)		
existing	216	
post-retrofit	208	
difference	-8	
% change	-4	
Carbon Dioxide (tons)		
existing	27	
post-retrofit	26	
difference	-1	
% change	-4	
Particulate Matter (lb)		
existing	5	
post-retrofit	5	
difference	0	
% change	-4	
Hydrocarbons (lb)		
existing	89	
post-retrofit	86	
difference	-3	
% change	-4	

Building 4016 Maintenance Shop

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 4016 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 4016

Building 4016 is a base engineer maintenance shop built in 1973. 4016 is cooled by multiple package units and has little to no insulation in its building enveloped. Building 4016 is 7,701 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the electric package unit with an ultra high efficiency window AC unit in the conditioned space. The EXIT lights are suggested to be replaced and upgrades to the hot water heater are also suggested. To the unconditioned space FEDS suggests replacing T8 lights with Super T8 lighting, replacing the EXIT lighting and making various improvements to the hot water system.

Appropriated funding FEDS results for building 4016 conditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1970's shops 4016	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	14	881	621	14,215	23.9
1970's shops 4016	Hot Water	Electric Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, LFSHs, Lower Tank Temperature	-	20	152	42	1.8

Appropriated funding FEDS results for building 4016 unconditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1970's shops 4016	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	5	344	311	5,520	18.8
1970's shops 4016	Lights	FL41: FL 1X4 1F32T8 EEF1	FL302: FL 1X4 1F25ST8 ELC1REF	1	124	869	1,230	2.4
1970's shops 4016	Hot Water	Electric Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, LFSHs, Lower Tank Temperature	-	15	152	22	1.4

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for the conditioned spaces of the building for a typical year was 67,485 kwh before retrofits and 63,631 kwh after proposed retrofits are implemented. The energy use intensity goes from 39.9 MBtu/Ksf to 37.6 MBtu/Ksf after retrofits.

1970's shops   4016 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	67,485	11,685.8	39.9	11,936
post-retrofit	63,631	11,018.3	37.6	11,186
difference	-3,855	-667.5	-2.3	-750
% change	-6	-6	-6	-6
Total (MBtu)				
existing	230	39.9	39.9	11,936
post-retrofit	217	37.6	37.6	11,186
difference	-13	-2.3	-2.3	-750
% change	-6	-6	-6	-6

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for the unconditioned spaces of the building for a typical year was 12,772 kwh before retrofits and 10,903 kwh after proposed retrofits are implemented. The energy use intensity goes from 22.6 MBtu/Ksf to 19.3 MBtu/Ksf after retrofits.

1970's shops 4016 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	12,772	6,634.9	22.6	2,259
post-retrofit	10,903	5,663.7	19.3	1,917
difference	-1,869	-971.2	-3.3	-342
% change	-15	-15	-15	-15
Total (MBtu)				
existing	44	22.6	22.6	2,259
post-retrofit	37	19.3	19.3	1,917
difference	-6	-3.3	-3.3	-342
% change	-15	-15	-15	-15

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the conditioned space of the building with 27,381 kWh/year, followed by space cooling with 23,540 kWh/year.

1970's shops 4016

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	23,540	5,159	10,761	27,381	643
post-retrofit	0	22,675	5,057	7,983	27,381	534
difference	0	-865	-103	-2,779	0	-109
% change	0	-4	-2	-26	0	-17
Total (MBtu)						
existing	0	80	18	37	93	2
post-retrofit	0	77	17	27	93	2
difference	0	-3	0	-9	0	0
% change	0	-4	-2	-26	0	-17
Total (MBtu/1000ft2)						
existing	0	14	3	6	16	0
post-retrofit	0	13	3	5	16	0
difference	0	-1	0	-2	0	0
% change	0	-4	-2	-26	0	-17

Motors and miscellaneous equipment is the largest load in the unconditioned space of the building with 8,620 kWh/year, followed by lighting with 3,738 kWh/year.

1970's shops 4016

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	3,738	8,620	415
post-retrofit	0	0	0	1,959	8,620	324
difference	0	0	0	-1,779	0	-90
% change	0	0	0	-48	0	-22
Total (MBtu)						
existing	0	0	0	13	29	1
post-retrofit	0	0	0	7	29	1
difference	0	0	0	-6	0	0
% change	0	0	0	-48	0	-22
Total (MBtu/1000ft2)						
existing	0	0	0	7	15	1
post-retrofit	0	0	0	3	15	1
difference	0	0	0	-3	0	0
% change	0	0	0	-48	0	-22

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1970's shops	4016 conditioned space
Sulfur Oxides (lb)		
existing	610	
post-retrofit	575	
difference	-35	
% change	-6	
Nitrogen Oxides (lb)		
existing	292	
post-retrofit	275	
difference	-17	
% change	-6	
Carbon Monoxide (lb)		
existing	501	
post-retrofit	473	
difference	-29	
% change	-6	
Carbon Dioxide (tons)		
existing	62	
post-retrofit	58	
difference	-4	
% change	-6	
Particulate Matter (lb)		
existing	12	
post-retrofit	11	
difference	-1	
% change	-6	
Hydrocarbons (lb)		
existing	208	
post-retrofit	196	
difference	-12	
% change	-6	

	1970's shops	4016 unconditioned space
Sulfur Oxides (lb)		
existing	115	
post-retrofit	99	
difference	-17	
% change	-15	
Nitrogen Oxides (lb)		
existing	55	
post-retrofit	47	
difference	-8	
% change	-15	
Carbon Monoxide (lb)		
existing	95	
post-retrofit	81	
difference	-14	
% change	-15	
Carbon Dioxide (tons)		
existing	12	
post-retrofit	10	
difference	-2	
% change	-15	
Particulate Matter (lb)		
existing	2	
post-retrofit	2	
difference	0	
% change	-15	
Hydrocarbons (lb)		
existing	39	
post-retrofit	34	
difference	-6	
% change	-15	

Building 2131 Administration Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2131 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2131

Building 2131 is a building with some administration space as well as some lab-space and unconditioned high-bay space. Building 2131 was built in 2008 and is 26,296 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the air cooled chiller with a water cooled chiller as well as replacing the EXIT lights with electroluminescent panels for the administration and laboratory space. FEDS also suggests replacing the air cooled chiller with a very high efficiency water cooled chiller and replacing the EXIT and metal halide lighting

Appropriated funding FEDS results for building 2131 administration and laboratory space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1990's shops 2131	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	79	4,220	37,473	5,341	1.6
1990's shops 2131	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	65	373	752	3.0
1990's shops 2131	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	43	248	501	3.0

Appropriated funding FEDS results for building 2131 high bay space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1990's shop highbay space 2131	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	102	621	1,143	2.8
1990's shop highbay space 2131	Lights	MH13: MH 250 WALL	HS26: HPS 200 WALL	5	396	3,457	3,247	1.9

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for administration and laboratory spaces of the building for a typical year was 221,784 kwh before retrofits and 198,333 kwh after proposed retrofits are implemented. The energy use intensity goes from 57.6 MBtu/Ksf to 51.5 MBtu/Ksf after retrofits.

1990's shops administration and laboratory space 2131

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	221,784	16,868.3	57.6	39,316
post-retrofit	198,333	15,084.7	51.5	34,894
difference	-23,451	-1,783.6	-6.1	-4,422
% change	-11	-11	-11	-11
Total (MBtu)				
existing	757	57.6	57.6	39,316
post-retrofit	677	51.5	51.5	34,894
difference	-80	-6.1	-6.1	-4,422
% change	-11	-11	-11	-11

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for high bay spaces of the building for a typical year was 228,359 kwh before retrofits and 195,226 kwh after proposed retrofits are implemented. The energy use intensity goes from 59.3 MBtu/Ksf to 50.7 MBtu/Ksf after retrofits.

1990's shop highbay space 2131

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	152,074	11,570.7	39.5	26,965
post-retrofit	150,489	11,450.1	39.1	26,689
difference	-1,585	-120.6	-0.4	-276
% change	-1	-1	-1	-1
Total (MBtu)				
existing	519	39.5	39.5	26,965
post-retrofit	514	39.1	39.1	26,689
difference	-5	-0.4	-0.4	-276
% change	-1	-1	-1	-1

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 84,806 kWh/year, followed by space cooling with 62,357 kWh/year.

1990's shops administration and laboratory space 2131

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	62,357	14,183	57,107	84,806	3,330
post-retrofit	0	39,030	14,175	56,992	84,806	3,330
difference	0	-23,327	-8	-116	0	0
% change	0	-37	0	0	0	0
Total (MBtu)						
existing	0	213	48	195	289	11
post-retrofit	0	133	48	195	289	11
difference	0	-80	0	0	0	0
% change	0	-37	0	0	0	0
Total (MBtu/1000ft2)						
existing	0	16	4	15	22	1
post-retrofit	0	10	4	15	22	1
difference	0	-6	0	0	0	0
% change	0	-37	0	0	0	0

Motors and miscellaneous equipment is the largest load in the building with 92,181 kWh/year, followed by space cooling with 57,524 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
1990's shop highbay space 2131

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	57,524	92,181	2,368
post-retrofit	0	0	0	55,940	92,181	2,368
difference	0	0	0	-1,585	0	0
% change	0	0	0	-3	0	0
Total (MBtu)						
existing	0	0	0	196	315	8
post-retrofit	0	0	0	191	315	8
difference	0	0	0	-5	0	0
% change	0	0	0	-3	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	15	24	1
post-retrofit	0	0	0	15	24	1
difference	0	0	0	0	0	0
% change	0	0	0	-3	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1990's shops administration and laboratory space 2131
Sulfur Oxides (lb)	
existing	2,005
post-retrofit	1,793
difference	-212
% change	-11
Nitrogen Oxides (lb)	
existing	958
post-retrofit	857
difference	-101
% change	-11
Carbon Monoxide (lb)	
existing	1,648
post-retrofit	1,474
difference	-174
% change	-11
Carbon Dioxide (tons)	
existing	203
post-retrofit	181
difference	-21
% change	-11
Particulate Matter (lb)	
existing	40
post-retrofit	35
difference	-4
% change	-11
Hydrocarbons (lb)	
existing	682
post-retrofit	610
difference	-72
% change	-11

1990's shop highbay space 2131

Sulfur Oxides (lb)	
existing	1,375
post-retrofit	1,360
difference	-14
% change	-1
Nitrogen Oxides (lb)	
existing	657
post-retrofit	650
difference	-7
% change	-1
Carbon Monoxide (lb)	
existing	1,130
post-retrofit	1,118
difference	-12
% change	-1
Carbon Dioxide (tons)	
existing	139
post-retrofit	138
difference	-1
% change	-1
Particulate Matter (lb)	
existing	27
post-retrofit	27
difference	0
% change	-1
Hydrocarbons (lb)	
existing	468
post-retrofit	463
difference	-5
% change	-1

Building 1728 Warehouse

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1728 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1728

1728 is a warehouse building built in 1993. This building partially unconditioned with the office space being served by an electric air cooled chiller. Building 1728 is 140,383 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing lights in the conditioned and unconditioned spaces. For the conditioned space, it is recommended to increase roof insulation as well as increasing the insulation on the hot water tank, the hot water system pipes and installing aerators.

Appropriated funding FEDS results for building 1728 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1050's Wharehouse/storage 1728	Lights	MH6: MH 400 PEND	HS18: HPS 310 PEND	175	6,807	38,531	73,510	2.9
1050's Wharehouse/storage 1728	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	102	621	1,143	2.8
1050's Wharehouse/storage 1728	Lights	HS13: HPS 70 PEND	FL279: FL 2X4 2F32ST8 ELC2 REF	10	1,043	9,512	8,235	1.9

Appropriated funding FEDS results for building 1728 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1050's Wharehouse/storage 1728	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	51	311	571	2.8
1050's Wharehouse/storage 1728	Lights	FL37: FL 2X4 4F32T8 EEF2	FL280: FL 2X4 3F32ST8 ELC3 REF	55	3,213	3,312	50,587	16.3

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for the unconditioned space for a typical year was 493,902 kwh before retrofits and 439,598 kwh after proposed retrofits are implemented. The energy use intensity goes from 12.2 MBtu/Ksf to 10.9 MBtu/Ksf after retrofits.

1050's Wharehouse/storage 1728 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	493,902	3,584.7	12.2	87,317
post-retrofit	439,598	3,190.5	10.9	77,305
difference	-54,304	-394.1	-1.3	-10,011
% change	-11	-11	-11	-11
Total (MBtu)				
existing	1,686	12.2	12.2	87,317
post-retrofit	1,500	10.9	10.9	77,305
difference	-185	-1.3	-1.3	-10,011
% change	-11	-11	-11	-11

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for the unconditioned space for a typical year was 96,903 kwh before retrofits and 80,766 kwh after proposed retrofits are implemented. The energy use intensity goes from 127.2 MBtu/Ksf to 106.0 MBtu/Ksf after retrofits.

1050's Wharehouse/storage 1728 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	96,903	37,256.0	127.2	17,131
post-retrofit	80,766	31,051.9	106.0	14,203
difference	-16,137	-6,204.1	-21.2	-2,928
% change	-17	-17	-17	-17
Total (MBtu)				
existing	331	127.2	127.2	17,131
post-retrofit	276	106.0	106.0	14,203
difference	-55	-21.2	-21.2	-2,928
% change	-17	-17	-17	-17

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Lighting is the largest load in the unconditioned space of the building with 253,372 kWh/year, followed by motors and miscellaneous equipment with 240,530 kWh/year.

1050's Wharehouse/storage 1728 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	253,372	240,530	0
post-retrofit	0	0	0	199,068	240,530	0
difference	0	0	0	-54,304	0	0
% change	0	0	0	-21	0	0
Total (MBtu)						
existing	0	0	0	865	821	0
post-retrofit	0	0	0	679	821	0
difference	0	0	0	-185	0	0
% change	0	0	0	-21	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	6	6	0
post-retrofit	0	0	0	5	6	0
difference	0	0	0	-1	0	0
% change	0	0	0	-21	0	0

Motors and miscellaneous equipment is the largest load in the conditioned space of the building with 31,893 kWh/year, followed by space cooling with 28,814 kWh/year.

1050's Wharehouse/storage 1728 conditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	28,814	9,289	26,560	31,893	347
post-retrofit	0	24,548	8,639	15,339	31,893	347
difference	0	-4,266	-649	-11,222	0	0
% change	0	-15	-7	-42	0	0
Total (MBtu)						
existing	0	98	32	91	109	1
post-retrofit	0	84	29	52	109	1
difference	0	-15	-2	-38	0	0
% change	0	-15	-7	-42	0	0
Total (MBtu/1000ft2)						
existing	0	38	12	35	42	0
post-retrofit	0	32	11	20	42	0
difference	0	-6	-1	-15	0	0
% change	0	-15	-7	-42	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1050's Wharehouse/storage	1728 unconditioned space
Sulfur Oxides (lb)		
existing	4,465	
post-retrofit	3,974	
difference	-491	
% change	-11	
Nitrogen Oxides (lb)		
existing	2,134	
post-retrofit	1,899	
difference	-235	
% change	-11	
Carbon Monoxide (lb)		
existing	3,670	
post-retrofit	3,266	
difference	-403	
% change	-11	
Carbon Dioxide (tons)		
existing	452	
post-retrofit	402	
difference	-50	
% change	-11	
Particulate Matter (lb)		
existing	88	
post-retrofit	79	
difference	-10	
% change	-11	
Hydrocarbons (lb)		
existing	1,519	
post-retrofit	1,352	
difference	-167	
% change	-11	

1050's Wharehouse/storage 1728 conditioned space

Sulfur Oxides (lb)	
existing	876
post-retrofit	730
difference	-146
% change	-17
Nitrogen Oxides (lb)	
existing	419
post-retrofit	349
difference	-70
% change	-17
Carbon Monoxide (lb)	
existing	720
post-retrofit	600
difference	-120
% change	-17
Carbon Dioxide (tons)	
existing	89
post-retrofit	74
difference	-15
% change	-17
Particulate Matter (lb)	
existing	17
post-retrofit	14
difference	-3
% change	-17
Hydrocarbons (lb)	
existing	298
post-retrofit	248
difference	-50
% change	-17

Building 1072 Supply Warehouse

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1072 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1072

1072 is a warehouse building built in 1941. The warehouse is largely unconditioned but has a few small offices that are conditioned by DX units. Building 1072 is 83,379 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing lights in the conditioned and unconditioned spaces of the building. FEDS also suggests adding insulation to the interior of the roof and replacing the single pane windows with double pane, super low-e windows in the conditioned space.

Appropriated funding FEDS results for building 1072 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1050's Wharehouse/storage 1072	Lights	MH6: MH 400 PEND	HS18: HPS 310 PEND	69	2,679	15,160	28,922	2.9
1050's Wharehouse/storage 1072	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	102	621	1,143	2.8
1050's Wharehouse/storage 1072	Lights	FL236: FL 2X4 3F32T8 ELC3	FL279: FL 2X4 2F32ST8 ELC2 REF	128	6,814	13,362	100,543	8.5

Appropriated funding FEDS results for building 1072 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1050's Wharehouse/storage 1072	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	56	311	661	3.1
1050's Wharehouse/storage 1072	Lights	FL236: FL 2X4 3F32T8 ELC3	FL279: FL 2X4 2F32ST8 ELC2 REF	40	2,099	3,158	31,829	11.1
1050's Wharehouse/storage 1072	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches of Fiberglass	302	15,861	22,799	241,103	11.6

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for the unconditioned space fo the building for a typical year was 404,132 kwh before retrofits and 346,253 kwh after proposed retrofits are implemented. The energy use intensity goes from 17.5 MBtu/Ksf to 15.0 MBtu/Ksf after retrofits.

1050's Wharehouse/storage 1072

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	404,132	5,134.6	17.5	71,446
post-retrofit	346,253	4,399.2	15.0	60,890
difference	-57,879	-735.4	-2.5	-10,556
% change	-14	-14	-14	-15
Total (MBtu)				
existing	1,379	17.5	17.5	71,446
post-retrofit	1,182	15.0	15.0	60,890
difference	-198	-2.5	-2.5	-10,556
% change	-14	-14	-14	-15

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for the conditioned space fo the building for a typical year was 163,410 kwh before retrofits and 64,784 kwh after proposed retrofits are implemented. The energy use intensity goes from 83.6 MBtu/Ksf to 33.1 MBtu/Ksf after retrofits.

1050's Wharehouse/storage 1072

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	163,410	24,499.2	83.6	28,889
post-retrofit	64,784	9,712.7	33.1	11,393
difference	-98,626	-14,786.4	-50.5	-17,497
% change	-60	-60	-60	-61
Total (MBtu)				
existing	558	83.6	83.6	28,889
post-retrofit	221	33.1	33.1	11,393
difference	-337	-50.5	-50.5	-17,497
% change	-60	-60	-60	-61

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Lighting is the largest load in the unconditioned space of the building with 266,729 kWh/year, followed by motors and miscellaneous equipment with 137,403 kWh/year.

1050's Wharehouse/storage 1072 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	266,729	137,403	0
post-retrofit	0	0	0	208,850	137,403	0
difference	0	0	0	-57,879	0	0
% change	0	0	0	-22	0	0
Total (MBtu)						
existing	0	0	0	910	469	0
post-retrofit	0	0	0	713	469	0
difference	0	0	0	-198	0	0
% change	0	0	0	-22	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	12	6	0
post-retrofit	0	0	0	9	6	0
difference	0	0	0	-3	0	0
% change	0	0	0	-22	0	0

Space cooling is the largest load in the unconditioned space of the building with 79,200 kWh/year, followed by ventilation with 53,432 kWh/year.

1050's Wharehouse/storage 1072 conditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	79,200	53,432	19,134	11,644	0
post-retrofit	0	25,266	16,793	11,081	11,644	0
difference	0	-53,934	-36,639	-8,052	0	0
% change	0	-68	-69	-42	0	0
Total (MBtu)						
existing	0	270	182	65	40	0
post-retrofit	0	86	57	38	40	0
difference	0	-184	-125	-27	0	0
% change	0	-68	-69	-42	0	0
Total (MBtu/1000ft2)						
existing	0	41	27	10	6	0
post-retrofit	0	13	9	6	6	0
difference	0	-28	-19	-4	0	0
% change	0	-68	-69	-42	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1050's Wharehouse/storage	1072 unconditioned space
Sulfur Oxides (lb)		
existing	3,653	
post-retrofit	3,130	
difference	-523	
% change	-14	
Nitrogen Oxides (lb)		
existing	1,746	
post-retrofit	1,496	
difference	-250	
% change	-14	
Carbon Monoxide (lb)		
existing	3,003	
post-retrofit	2,573	
difference	-430	
% change	-14	
Carbon Dioxide (tons)		
existing	370	
post-retrofit	317	
difference	-53	
% change	-14	
Particulate Matter (lb)		
existing	72	
post-retrofit	62	
difference	-10	
% change	-14	
Hydrocarbons (lb)		
existing	1,243	
post-retrofit	1,065	
difference	-178	
% change	-14	

	1050's Wharehouse/storage	1072 conditioned space
Sulfur Oxides (lb)		
existing	1,477	
post-retrofit	586	
difference	-892	
% change	-60	
Nitrogen Oxides (lb)		
existing	706	
post-retrofit	280	
difference	-426	
% change	-60	
Carbon Monoxide (lb)		
existing	1,214	
post-retrofit	481	
difference	-733	
% change	-60	
Carbon Dioxide (tons)		
existing	150	
post-retrofit	59	
difference	-90	
% change	-60	
Particulate Matter (lb)		
existing	29	
post-retrofit	12	
difference	-18	
% change	-60	
Hydrocarbons (lb)		
existing	503	
post-retrofit	199	
difference	-303	
% change	-60	

Building 1070 Warehouse Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1070 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1070

1070 is a warehouse building with some conditioned hazmat storage built in 1941. Building 1070 is mostly unconditioned storage with a small office that is conditioned by a small DX unit. Building 1070 is 62,779 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing lighting in the unconditioned space as well as replacing the EXIT lighting fixtures in the conditioned and unconditioned spaces. FEDS also suggests increasing the insulation in the roof of the conditioned office space.

Appropriated funding FEDS results for building 1070 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
small storage 1070	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	5	344	311	5,520	18.8
small storage 1070	Lights	IN27: INC 100 WALL	CF9: CFL 26 INTEGRAL UNIT ELC	9	666	2,530	8,694	4.4
small storage 1070	Lights	FL5: FL 1X4 1F40T12 STD1	FL53: FL 1X4 1F32T8 ELC1	2	177	2,467	524	1.2

Appropriated funding FEDS results for building 1070 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
small storage 1070	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	6	420	311	6,786	22.8
small storage 1070	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	20	1,034	4,290	12,902	4.0

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for unconditioned spaces in the building for a typical year was 15,732 kwh before retrofits and 11,110 kwh after proposed retrofits are implemented. The modeled other fuels (propane) consumption for the unconditioned spaces in the building for a typical year was 382 MBtu before retrofits and 382 MBtu after proposed retrofits are implemented. The energy use intensity goes from 7.1 MBtu/Ksf to 6.8 MBtu/Ksf after retrofits.

Small storage 1070 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	15,732	255.7	0.9	2,781
post-retrofit	11,110	180.6	0.6	1,954
difference	-4,623	-75.1	-0.3	-828
% change	-29	-29	-29	-30
Other Fuels (MBtu)				
existing	382	6.2	6.2	12,278
post-retrofit	382	6.2	6.2	12,278
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	436	7.1	7.1	15,060
post-retrofit	420	6.8	6.8	14,232
difference	-16	-0.3	-0.3	-828
% change	-4	-4	-4	-5

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for conditioned spaces in the building for a typical year was 25,042 kwh before retrofits and 17,627 kwh after proposed retrofits are implemented. The modeled other fules (propane) consumption for the unconditioned spaces in the building for a typical year was 8 MBtu before retrofits and 8 MBtu after proposed retrofits are implemented. The energy use intensity goes from 74.3 MBtu/Ksf to 54.1 MBtu/Ksf after retrofits.

Small storage 1070 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	25,042	19,954.1	68.1	4,427
post-retrofit	17,627	14,045.3	47.9	3,100
difference	-7,416	-5,908.8	-20.2	-1,327
% change	-30	-30	-30	-30
Other Fuels (MBtu)				
existing	8	6.2	6.2	250
post-retrofit	8	6.2	6.2	250
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	93	74.3	74.3	4,678
post-retrofit	68	54.1	54.1	3,350
difference	-25	-20.2	-20.2	-1,327
% change	-27	-27	-27	-28

Appropriated Funding Energy Consumption by End Use

Lighting is the largest load in the unconditioned space of the building with 14,736 kWh/year, followed by motors and miscellaneous equipment with 997 kWh/year.

small storage 1070 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	14,736	997	0
post-retrofit	0	0	0	10,113	997	0
difference	0	0	0	-4,623	0	0
% change	0	0	0	-31	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	382	0
post-retrofit	0	0	0	0	382	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	0	0	50	385	0
post-retrofit	0	0	0	35	385	0
difference	0	0	0	-16	0	0
% change	0	0	0	-31	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	1	6	0
post-retrofit	0	0	0	1	6	0
difference	0	0	0	0	0	0
% change	0	0	0	-31	0	0

Space cooling is the largest load in the conditioned space of the building with 12,471 kWh/year, followed by motors and miscellaneous equipment with 6,323 kWh/year.

small storage 1070

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	12,471	3,435	2,814	6,323	0
post-retrofit	0	7,504	2,375	1,424	6,323	0
difference	0	-4,967	-1,060	-1,389	0	0
% change	0	-40	-31	-49	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	8	0
post-retrofit	0	0	0	0	8	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	43	12	10	29	0
post-retrofit	0	26	8	5	29	0
difference	0	-17	-4	-5	0	0
% change	0	-40	-31	-49	0	0
Total (MBtu/1000ft2)						
existing	0	34	9	8	23	0
post-retrofit	0	20	6	4	23	0
difference	0	-14	-3	-4	0	0
% change	0	-40	-31	-49	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Small storage	1070 unconditioned space
Sulfur Oxides (lb)		
existing	238	
post-retrofit	196	
difference	-42	
% change	-18	
Nitrogen Oxides (lb)		
existing	202	
post-retrofit	182	
difference	-20	
% change	-10	
Carbon Monoxide (lb)		
existing	407	
post-retrofit	373	
difference	-34	
% change	-8	
Carbon Dioxide (tons)		
existing	47	
post-retrofit	43	
difference	-4	
% change	-9	
Particulate Matter (lb)		
existing	7	
post-retrofit	6	
difference	-1	
% change	-12	
Hydrocarbons (lb)		
existing	144	
post-retrofit	130	
difference	-14	
% change	-10	

	Small storage	1070 conditioned space
Sulfur Oxides (lb)		
existing	228	
post-retrofit	161	
difference	-67	
% change	-29	
Nitrogen Oxides (lb)		
existing	111	
post-retrofit	79	
difference	-32	
% change	-29	
Carbon Monoxide (lb)		
existing	192	
post-retrofit	137	
difference	-55	
% change	-29	
Carbon Dioxide (tons)		
existing	24	
post-retrofit	17	
difference	-7	
% change	-29	
Particulate Matter (lb)		
existing	5	
post-retrofit	3	
difference	-1	
% change	-29	
Hydrocarbons (lb)		
existing	79	
post-retrofit	56	
difference	-23	
% change	-29	

Building 2002 Vehicle Maintenance Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2002 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2002

2002 is a vehicle maintenance building with conditioned admin and unconditioned workshop space built in 1940. Building 2002 generally has fluorescent lighting, an electric hot water system and its administration spaces are cooled by an electric package, or DX, unit. Building 2002 is 23,981 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the EXIT lighting as well as replacing the T12 Fluorescent lighting in the unconditioned spaces. In the conditioned spaces FEDS suggests replacing EXIT lighting, T12 Flourescent lighting, and increasing the insulation on the interior of the metal roof.

Appropriated funding FEDS results for building 2002 unconditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Vehicle maintenance 2002	Lights	FL62: FL 1X8 2F96T12 STD2	FL131: FL 1X8 2F96T12ES ELC2 REF (FIX REPL)	13	888	5,076	9,820	2.9
Vehicle maintenance 2002	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	1	106	93	1,695	19.2
Vehicle maintenance 2002	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	30	1,998	8,916	24,600	3.8
Vehicle maintenance 2002	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	8	599	528	9,603	19.2
Vehicle maintenance 2002	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	4	280	1,241	3,490	3.8

Appropriated funding FEDS results for building 2002 conditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Vehicle maintenance 2002	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	1	64	47	1028	23.1
Vehicle maintenance 2002	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	5	364	264	5873	23.2
Vehicle maintenance 2002	Lights	FL62: FL 1X8 2F96T12 STD2	FL131:FL 1X8 2F96T12ES ELC2REF (FIX REPL)	3	220	1015	2674	3.8
Vehicle maintenance 2002	Lights	FL1:FL2X4 4F40T12 STD2	FL280: FL2X4 3F32ST8 ELC3 REF (FIX REPL)	8	497	1783	6558	4.7
Vehicle maintenance 2002	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	1	56	248	698	3.8
Vehicle maintenance 2002	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior surface of Metal Roof: 4 inches Fiberglass	129	6,404	16,393	90,163	6.5

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year for the unconditioned space was 125,846 kwh before retrofits and 112,380 kwh after proposed retrofits are implemented. The energy use intensity goes from 22.4 MBtu/Ksf to 20.0 MBtu/Ksf after retrofits.

Vehicle maintenance 2002 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	125,846	6,559.9	22.4	22,248
post-retrofit	112,380	5,858.0	20.0	19,763
difference	-13,465	-701.9	-2.4	-2,486
% change	-11	-11	-11	-11
Total (MBtu)				
existing	430	22.4	22.4	22,248
post-retrofit	384	20.0	20.0	19,763
difference	-46	-2.4	-2.4	-2,486
% change	-11	-11	-11	-11

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year for the conditioned space was 98,451 kwh before retrofits and 56,191 kwh after proposed retrofits are implemented. The energy use intensity goes from 70.1 MBtu/Ksf to 40.0 MBtu/Ksf after retrofits.

Vehicle maintenance 2002 conditioned spaces

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	98,451	20,527.7	70.1	17,405
post-retrofit	56,191	11,716.3	40.0	9,882
difference	-42,259	-8,811.4	-30.1	-7,524
% change	-43	-43	-43	-43
Total (MBtu)				
existing	336	70.1	70.1	17,405
post-retrofit	192	40.0	40.0	9,882
difference	-144	-30.1	-30.1	-7,524
% change	-43	-43	-43	-43

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 94,120 kWh/year, followed by lighting with 31,616 kWh/year.

Vehicle maintenance 2002 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	0	0	31,616	94,120	110
post-retrofit	0	0	0	18,150	94,120	110
difference	0	0	0	-13,465	0	0
% change	0	0	0	-43	0	0
Total (MBtu)						
existing	0	0	0	108	321	0
post-retrofit	0	0	0	62	321	0
difference	0	0	0	-46	0	0
% change	0	0	0	-43	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	6	17	0
post-retrofit	0	0	0	3	17	0
difference	0	0	0	-2	0	0
% change	0	0	0	-43	0	0

* Energy consumption values for both distributed and central SHW are reported for Hot Water annual energy use.

Space cooling is the largest load in the building with 59,237 kWh/year, followed by motors and miscellaneous equipment with 23,530 kWh/year.

Vehicle maintenance 2002 conditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	59,237	6,969	8,605	23,530	110
post-retrofit	0	25,090	2,917	4,544	23,530	110
difference	0	-34,147	-4,052	-4,061	0	0
% change	0	-58	-58	-47	0	0
Total (MBtu)						
existing	0	202	24	29	80	0
post-retrofit	0	86	10	16	80	0
difference	0	-117	-14	-14	0	0
% change	0	-58	-58	-47	0	0
Total (MBtu/1000ft2)						
existing	0	42	5	6	17	0
post-retrofit	0	18	2	3	17	0
difference	0	-24	-3	-3	0	0
% change	0	-58	-58	-47	0	0

* Energy consumption values for both distributed and central SHW are reported for Hot Water annual energy use.

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Vehicle maintenance	2002 unconditioned space
Sulfur Oxides (lb)		
existing	1,138	
post-retrofit	1,016	
difference	-122	
% change	-11	
Nitrogen Oxides (lb)		
existing	544	
post-retrofit	485	
difference	-58	
% change	-11	
Carbon Monoxide (lb)		
existing	935	
post-retrofit	835	
difference	-100	
% change	-11	
Carbon Dioxide (tons)		
existing	115	
post-retrofit	103	
difference	-12	
% change	-11	
Particulate Matter (lb)		
existing	23	
post-retrofit	20	
difference	-2	
% change	-11	
Hydrocarbons (lb)		
existing	387	
post-retrofit	346	
difference	-41	
% change	-11	

	Vehicle maintenance 2002 conditioned space
Sulfur Oxides (lb)	
existing	890
post-retrofit	508
difference	-382
% change	-43
Nitrogen Oxides (lb)	
existing	425
post-retrofit	243
difference	-183
% change	-43
Carbon Monoxide (lb)	
existing	731
post-retrofit	418
difference	-314
% change	-43
Carbon Dioxide (tons)	
existing	90
post-retrofit	51
difference	-39
% change	-43
Particulate Matter (lb)	
existing	18
post-retrofit	10
difference	-8
% change	-43
Hydrocarbons (lb)	
existing	303
post-retrofit	173
difference	-130
% change	-43

Building 1713 Warehouse Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1713 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1713

1713 is a warehouse building built in 1944. 1713 is the main recycling center on base and has a small conditioned office space served by an electric package, or DX, unit. Building 1713 is 30,400 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the lighting in the building in the conditioned and unconditioned spaces as well as increasing the interior insulation of the roof for the conditioned space only.

Appropriated funding FEDS results for building 1713 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's storage 1713	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	26	2,334	24,875	14,590	1.6
1940's storage 1713	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	51	311	572	2.8

Appropriated funding FEDS results for building 1713 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's storage 1713	Lights	FL1: FL 2X4 4F40T12 STD2	FL244: FL 2X4 4F32T8 ELC4	6	493	2,721	5,580	3.1
1940's storage 1713	Cooling	Electric Package Unit	Window Unit AC (standard efficiency)	1	210	1691	392	1.4
1940's storage 1713	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	53	311	597	2.9
1940's storage 1713	Lights	IN8: INC 75 CEIL	CF5: CFL 18 INTEGRAL UNIT ELC	1	88	48	1,429	30.6
1940's storage 1713	Lights	IN11: INC 100 CEIL	CF9: CFL 26 INTEGRAL UNIT ELC	1	108	48	1,763	37.5
1940's storage 1713	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	11	717	2,078	9,852	5.7

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for the unconditioned space in the building for a typical year was 22,232 kwh before retrofits and 14,495 kwh after proposed retrofits are implemented. The energy use intensity goes from 2.5 MBtu/Ksf to 1.7 MBtu/Ksf after retrofits.

1940's storage 1713 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	22,232	746.3	2.5	3,941
post-retrofit	14,495	486.5	1.7	2,550
difference	-7,738	-259.7	-0.9	-1,391
% change	-35	-35	-35	-35
Total (MBtu)				
existing	76	2.5	2.5	3,941
post-retrofit	49	1.7	1.7	2,550
difference	-26	-0.9	-0.9	-1,391
% change	-35	-35	-35	-35

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for the conditioned space in the building for a typical year was 10,421 kwh before retrofits and 3,445 kwh after proposed retrofits are implemented. The energy use intensity goes from 58.5 MBtu/Ksf to 19.3 MBtu/Ksf after retrofits.

1940's storage 1713 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	10,421	17,140.2	58.5	1,842
post-retrofit	3,445	5,666.8	19.3	606
difference	-6,976	-11,473.4	-39.2	-1,236
% change	-67	-67	-67	-67
Total (MBtu)				
existing	36	58.5	58.5	1,842
post-retrofit	12	19.3	19.3	606
difference	-24	-39.2	-39.2	-1,236
% change	-67	-67	-67	-67

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Lighting is the largest load in the unconditioned space of the building with 21,755 kWh/year, followed by motors and miscellaneous equipment with 477 kWh/year.

1940's storage 1713 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	21,755	477	0
post-retrofit	0	0	0	14,017	477	0
difference	0	0	0	-7,738	0	0
% change	0	0	0	-36	0	0
Total (MBtu)						
existing	0	0	0	74	2	0
post-retrofit	0	0	0	48	2	0
difference	0	0	0	-26	0	0
% change	0	0	0	-36	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	2	0	0
post-retrofit	0	0	0	2	0	0
difference	0	0	0	-1	0	0
% change	0	0	0	-36	0	0

Space cooling is the largest load in the building with 5,318 kWh/year, followed by lighting with 4,901 kWh/year.

1940's storage 1713 conditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	5,318	193	4,901	10	0
post-retrofit	0	800	62	2,574	10	0
difference	0	-4,517	-131	-2,327	0	0
% change	0	-85	-68	-47	0	0
Total (MBtu)						
existing	0	18	1	17	0	0
post-retrofit	0	3	0	9	0	0
difference	0	-15	0	-8	0	0
% change	0	-85	-68	-47	0	0
Total (MBtu/1000ft2)						
existing	0	30	1	28	0	0
post-retrofit	0	4	0	14	0	0
difference	0	-25	-1	-13	0	0
% change	0	-85	-68	-47	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1940's storage	1713	unconditioned space
Sulfur Oxides (lb)			
existing	201		
post-retrofit	131		
difference	-70		
% change	-35		
Nitrogen Oxides (lb)			
existing	96		
post-retrofit	63		
difference	-33		
% change	-35		
Carbon Monoxide (lb)			
existing	165		
post-retrofit	108		
difference	-57		
% change	-35		
Carbon Dioxide (tons)			
existing	20		
post-retrofit	13		
difference	-7		
% change	-35		
Particulate Matter (lb)			
existing	4		
post-retrofit	3		
difference	-1		
% change	-35		
Hydrocarbons (lb)			
existing	68		
post-retrofit	45		
difference	-24		
% change	-35		

	1940's storage 1713 conditioned space
Sulfur Oxides (lb)	
existing	94
post-retrofit	31
difference	-63
% change	-67
Nitrogen Oxides (lb)	
existing	45
post-retrofit	15
difference	-30
% change	-67
Carbon Monoxide (lb)	
existing	77
post-retrofit	26
difference	-52
% change	-67
Carbon Dioxide (tons)	
existing	10
post-retrofit	3
difference	-6
% change	-67
Particulate Matter (lb)	
existing	2
post-retrofit	1
difference	-1
% change	-67
Hydrocarbons (lb)	
existing	32
post-retrofit	11
difference	-21
% change	-67

Building 2130 Corrosion Control Hangar

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2130 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2130

2130 is a corrosion control facility for aircraft built in 2008. Building 2130 cleans aircraft of corrosion causing agents and has a large ventilation system to aid its mission. Building 2130 is 56,734 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the lighting in the building . FEDS also suggests various upgrades to the hot water system for the unconditioned space. For the conditioned space FEDS suggests replacing the air cooled chiller with a very high efficiency water cooled chiller, insulating the hot water system and repacing some fo the lighting.

Appropriated funding FEDS results for building 2130 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
2008 hanger 2130	Hot Water	Electric Water Heater	Wrap Tank with Insulation and Insulate Pipe Near Tank	1	27	168	65	1.4
2008 hanger 2130	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	51	311	572	2.8
2008 hanger 2130	Lights	MH8: MH 1500 PEND	HS20: HPS 1000 PEND	61	5,784	30,695	67,757	3.2

Appropriated funding FEDS results for building 2130 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
2008 hanger conditioned space 2130	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	120	7,819	44,112	64,450	2.5
2008 hanger conditioned space 2130	Hot Water	Electric Water Heater	Wrap Tank with Insulation and Insulate Pipe Near Tank	1	27	168	65	1.4
2008 hanger conditioned space 2130	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	1	107	627	1,229	3.0
2008 hanger conditioned space 2130	Lights	FL236: FL 2X4 3F32T8 ELC3	FL279: FL 2X4 2F32ST8 ELC2 REF	109	5,596	14,473	78,914	6.5
2008 hanger conditioned space 2130	Lights	FL51: FL 2X4 2F32T8 ELC2	FL303: FL 2X4 2F25ST8 ELC2 REF	67	3,263	19,435	34,889	2.8

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for the unconditioned space for a typical year was 194,224 kwh before retrofits and 176,113 kwh after proposed retrofits are implemented. The energy use intensity goes from 13.7 MBtu/Ksf to 12.5 MBtu/Ksf after retrofits.

2008 hanger unconditione space 2130

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	194,224	4,027.4	13.7	34,438
post-retrofit	176,113	3,651.9	12.5	31,233
difference	-18,111	-375.5	-1.3	-3,205
% change	-9	-9	-9	-9
Total (MBtu)				
existing	663	13.7	13.7	34,438
post-retrofit	601	12.5	12.5	31,233
difference	-62	-1.3	-1.3	-3,205
% change	-9	-9	-9	-9

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for the conditioned space for a typical year was 410,499 kwh before retrofits and 218,352 kwh after proposed retrofits are implemented. The energy use intensity goes from 164.6 MBtu/Ksf to 127.7 MBtu/Ksf after retrofits.

2008 hanger conditioned space 2130

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	410,499	48,237.3	164.6	72,786
post-retrofit	318,352	37,409.2	127.7	56,459
difference	-92,147	-10,828.1	-37.0	-16,328
% change	-22	-22	-22	-22
Total (MBtu)				
existing	1,401	164.6	164.6	72,786
post-retrofit	1,087	127.7	127.7	56,459
difference	-314	-37.0	-37.0	-16,328
% change	-22	-22	-22	-22

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the unconditioned space with 117,194 kWh/year, followed by lighting with 73,546 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
2008 hanger 2130

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	73,546	117,194	3,483
post-retrofit	0	0	0	55,600	117,194	3,319
difference	0	0	0	-17,947	0	-164
% change	0	0	0	-24	0	-5
Total (MBtu)						
existing	0	0	0	251	400	12
post-retrofit	0	0	0	190	400	11
difference	0	0	0	-61	0	-1
% change	0	0	0	-24	0	-5
Total (MBtu/1000ft2)						
existing	0	0	0	5	8	0
post-retrofit	0	0	0	4	8	0
difference	0	0	0	-1	0	0
% change	0	0	0	-24	0	-5

Lighting is the largest load in the conditioned space with 172,239 kWh/year, followed by space cooling with 120,545 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
2008 hanger conditioned space 2130

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	120,545	52,328	172,239	62,803	2,584
post-retrofit	0	70,213	52,328	130,587	62,803	2,420
difference	0	-50,332	0	-41,651	0	-164
% change	0	-42	0	-24	0	-6
Total (MBtu)						
existing	0	411	179	588	214	9
post-retrofit	0	240	179	446	214	8
difference	0	-172	0	-142	0	-1
% change	0	-42	0	-24	0	-6
Total (MBtu/1000ft2)						
existing	0	48	21	69	25	1
post-retrofit	0	28	21	52	25	1
difference	0	-20	0	-17	0	0
% change	0	-42	0	-24	0	-6

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	2008 hanger	unconditioned space	2130
Sulfur Oxides (lb)			
existing	1,756		
post-retrofit	1,592		
difference	-164		
% change	-9		
Nitrogen Oxides (lb)			
existing	839		
post-retrofit	761		
difference	-78		
% change	-9		
Carbon Monoxide (lb)			
existing	1,443		
post-retrofit	1,309		
difference	-135		
% change	-9		
Carbon Dioxide (tons)			
existing	178		
post-retrofit	161		
difference	-17		
% change	-9		
Particulate Matter (lb)			
existing	35		
post-retrofit	31		
difference	-3		
% change	-9		
Hydrocarbons (lb)			
existing	597		
post-retrofit	542		
difference	-56		
% change	-9		

	2008 hanger	conditioned space	2130
Sulfur Oxides (lb)			
existing	3,711		
post-retrofit	2,878		
difference	-833		
% change	-22		
Nitrogen Oxides (lb)			
existing	1,773		
post-retrofit	1,375		
difference	-398		
% change	-22		
Carbon Monoxide (lb)			
existing	3,050		
post-retrofit	2,365		
difference	-685		
% change	-22		
Carbon Dioxide (tons)			
existing	376		
post-retrofit	291		
difference	-84		
% change	-22		
Particulate Matter (lb)			
existing	73		
post-retrofit	57		
difference	-16		
% change	-22		
Hydrocarbons (lb)			
existing	1,262		
post-retrofit	979		
difference	-283		
% change	-22		

Building 1860 Dining Hall

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1860 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1860

1860 is a dining hall built in 1969. It is lighted mostly by T8's and is cooled by an electric air cooled chiller   Building 1860 is 12,941 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing incandescent lights with CFL lights, replacing the air cooled chiller with a water cooled reciprocating chiller and replacing the propane water heater with a conventional distillate oil boiler.

Appropriated funding FEDS results for building 1860:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Dining Hall 1860	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	174	10,591	57,337	11,791	2.6
Dining Hall 1860	Lights	IN18: INC 25 WALL	CF14: CFL 5 + BLST UNIT	12	642	4,340	6,348	2.5
Dining Hall 1860	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	869	621	14,011	23.6
Dining Hall 1860	Hot Water	Other Fuels Central Boiler	Conventional Distillate Oil Boiler - 86.5% Combustion Efficiency, Wrap Tank	240	7,636	22,413	163,808	9.0
Dining Hall 1860	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	14	927	621	14,985	25.1
Dining Hall 1860	Hot Water	Other Fuels Central Boiler	Conventional Distillate Oil Boiler - 83% Combustion Efficiency, Wrap Tank	230	7,536	15,786	164,000	12.4
Dining Hall 1860	Window	Metal Frame Single Pane Window	Install Aluminum Frame Double Pane Super Low-e Window	26	1,607	23,991	2,756	1.1

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 485,332 kwh before retrofits and 413,895 kwh after proposed retrofits are implemented. The energy use intensity goes from 203.1 MBtu/Ksf to 148.0 MBtu/Ksf after retrofits.

Dining Hall 1860

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	485,332	37,503.4	128.0	86,015
post-retrofit	413,895	31,983.2	109.1	72,819
difference	-71,437	-5,520.2	-18.8	-13,196
% change	-14	-14	-14	-15.3
Distillate Oil (gal)				
existing	0	0.0	0.0	0
post-retrofit	2,222	171.7	171.7	11,333
difference	2,222	171.7	171.7	11,333
% change	n/a	n/a	n/a	n/a
Other Fuels (MBtu)				
existing	971	75.0	75.0	31,223
post-retrofit	116	15.0	15.0	6,225
difference	-408	-52.5	-52.5	-13,111
% change	-78	-78	-78	-78
Total (MBtu)				
existing	2,628	203.1	203.1	117,208
post-retrofit	1,915	148.0	148.0	90,377
difference	-443	-55.1	-55.1	-26,831
% change	-27	-27	-27	-23

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 221,654 kWh/year, followed by motors and miscellaneous equipment with 160,038 kWh/year.

Dining Hall 1860

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	221,654	70,607	33,032	160,038	0
post-retrofit	0	158,713	70,302	24,842	160,038	0
difference	0	-62,941	-305	-8,190	0	0
% change	0	-28	0	-25	0	0
Distillate Oil (gal)						
existing	0	0	0	0	0	0
post-retrofit	0	0	0	0	0	2,222
difference	0	0	0	0	0	2,222
% change	0	0	0	0	0	n/a
Other Fuels (MBtu)						
existing	0	0	0	0	193	778
post-retrofit	0	0	0	0	193	0
difference	0	0	0	0	0	-778
% change	0	0	0	0	0	-100
Total (MBtu)						
existing	0	756	241	112	740	423
post-retrofit	0	542	240	85	740	162
difference	0	-214	-1	-27	0	-261
% change	0	-28	0	-24	0	-62
Total (MBtu/1000ft2)						
existing	0	116	37	17	114	124
post-retrofit	0	87	37	13	114	49
difference	0	-29	0	-4	0	-75
% change	0	-25	0	-24	0	-61

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Dining Hall 1860
Sulfur Oxides (lb)	
existing	4,630
post-retrofit	3,944
difference	-686
% change	-15
Nitrogen Oxides (lb)	
existing	2,437
post-retrofit	1,961
difference	-476
% change	-20
Carbon Monoxide (lb)	
existing	4,344
post-retrofit	3,469
difference	-875
% change	-20
Carbon Dioxide (tons)	
existing	526
post-retrofit	424
difference	-102
% change	-20
Particulate Matter (lb)	
existing	96
post-retrofit	82
difference	-14
% change	-15
Hydrocarbons (lb)	
existing	1,736
post-retrofit	1,428
difference	-308
% change	-18

Building 1804 Dining Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1804 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1804

1804 is an open mess facility built in 2003. Building 1804 has incandescent and 32W T8 lilghts, an electric air cooled chiller and little to no insulation in its building envelope. Building 1804 is 27,579 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the air cooled chiller with a very high efficiency air cooled chiller. Incandescent lights are suggested to be replaced by CFL lights, FEDS suggests increasing the insulation on the hot water tank and increasing insulation in the suspended ceiling.

Appropriated funding FEDS results for building 1804:

Bldg. Set Description		End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Dining	1804	Cooling	Electric Air-Cooled Chiller {C1}	Air-Cooled Electric Chiller (very high efficiency)	142	60,113	304,293	333,778	2.9
Dining	1804	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	143	9,245	6,212	149,431	25.1
Dining	1804	Lights	IN25: INC 75 WALL	CF5: CFL 18 INTEGRAL UNIT ELC	312	19,296	8,978	315,418	36.1
Dining	1804	Lights	FL38: FL 2X4 3F32T8 EEF1,2	FL304: FL 2X4 3F25ST8 ELC3 REF	22	1,598	12,941	14,068	2.1
Dining	1804	Hot Water	Other Fuels Water Heater	Wrap Tank with Insulation	45	1,457	2,138	4,640	3.2
Dining	1804	Roof	Roof Insulation R-Value 8.90	Suspended Ceiling: Increase Insulation by R-19	64	4,362	47,492	25,081	1.5

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 1,001,869 kwh before retrofits and 795,914 kwh after proposed retrofits are implemented. The modeled other fuels (propane) consumption for a typical year was 881 gallons before retrofits and 836 gallons after proposed retrofits are implemented. The energy use intensity goes from 155.9 MBtu/Ksf to 128.8 MBtu/Ksf after retrofits.

Dining 1804

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	1,001,869	36,327.2	124.0	177,601
post-retrofit	795,914	28,859.4	98.5	140,030
difference	-205,955	-7,467.8	-25.5	-37,571
% change	-21	-21	-21	-21
Other Fuels (MBtu)				
existing	881	32.0	32.0	28,333
post-retrofit	836	30.3	30.3	26,875
difference	-45	-1.6	-1.6	-1,457
% change	-5	-5	-5	-5
Total (MBtu)				
existing	4,301	155.9	155.9	205,934
post-retrofit	3,552	128.8	128.8	166,906
difference	-748	-27.1	-27.1	-39,028
% change	-17	-17	-17	-19

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 387,047 kWh/year, followed by motors and miscellaneous equipment with 316,839 kWh/year.

Dining 1804

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	387,047	100,190	197,794	316,839	0
post-retrofit	0	287,902	86,126	105,048	316,839	0
difference	0	-99,145	-14,063	-92,746	0	0
% change	0	-26	-14	-47	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	725	156
post-retrofit	0	0	0	0	725	111
difference	0	0	0	0	0	-45
% change	0	0	0	0	0	-29
Total (MBtu)						
existing	0	1,321	342	675	1,806	156
post-retrofit	0	983	294	359	1,806	111
difference	0	-338	-48	-317	0	-45
% change	0	-26	-14	-47	0	-29
Total (MBtu/1000ft2)						
existing	0	48	12	24	66	6
post-retrofit	0	36	11	13	66	4
difference	0	-12	-2	-11	0	-2
% change	0	-26	-14	-47	0	-29

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Dining	1804
Sulfur Oxides (lb)		
existing	9,277	
post-retrofit	7,404	
difference	-1,873	
% change	-20	
Nitrogen Oxides (lb)		
existing	4,636	
post-retrofit	3,731	
difference	-906	
% change	-20	
Carbon Monoxide (lb)		
existing	8,114	
post-retrofit	6,549	
difference	-1,565	
% change	-19	
Carbon Dioxide (tons)		
existing	991	
post-retrofit	799	
difference	-192	
% change	-19	
Particulate Matter (lb)		
existing	188	
post-retrofit	151	
difference	-37	
% change	-20	
Hydrocarbons (lb)		
existing	3,301	
post-retrofit	2,657	
difference	-645	
% change	-20	

Building 594 Lavatory Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 594 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 594

594 is a lavatory by the baseball fields built in 1977. Building 594 is not cooled and has very little lighting. Building 594 is 293 sf.

Appropriated Funding Results

FEDS did not find any life cycle cost effective retrofits using appropriated funding.

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 2,429 kwh before retrofits and 1,040 kwh after proposed retrofits are implemented. The energy use intensity goes from 34.9 MBtu/Ksf to 18.7 MBtu/Ksf after retrofits.

sanitary latrines/small storage 594

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	2,429	8,290.3	28.3	431
post-retrofit	1,040	3,548.5	12.1	183
difference	-1,389	-4,741.8	-16.2	-248
% change	-57	-57	-57	-58
Other Fuels (MBtu)				
existing	2	6.6	6.6	63
post-retrofit	2	6.6	6.6	63
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	10	34.9	34.9	493
post-retrofit	5	18.7	18.7	245
difference	-5	-16.2	-16.2	-248
% change	-46	-46	-46	-50

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Lighting is the largest load in the building with 2,091 kWh/year, followed by motors and miscellaneous equipment with 338 kWh/year.

Sanitary latrines/small storage 594

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	2,091	338	0
post-retrofit	0	0	0	702	338	0
difference	0	0	0	-1,389	0	0
% change	0	0	0	-66	0	0
Total (MBtu)						
existing	0	0	0	7	3	0
post-retrofit	0	0	0	2	3	0
difference	0	0	0	-5	0	0
% change	0	0	0	-66	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	24	11	0
post-retrofit	0	0	0	8	11	0
difference	0	0	0	-16	0	0
% change	0	0	0	-66	0	0

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Sanitary latrines/small storage 594
Sulfur Oxides (lb)	
existing	22
post-retrofit	10
difference	-13
% change	-56
Nitrogen Oxides (lb)	
existing	11
post-retrofit	5
difference	-6
% change	-54
Carbon Monoxide (lb)	
existing	20
post-retrofit	9
difference	-10
% change	-53
Carbon Dioxide (tons)	
existing	2
post-retrofit	1
difference	-1
% change	-53
Particulate Matter (lb)	
existing	0
post-retrofit	0
difference	0
% change	-55
Hydrocarbons (lb)	
existing	8
post-retrofit	4
difference	-4
% change	-54

Building 2093 Commissary

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2093 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2093

2093 is the commissary and was built in 1975. Building 2093 has large conditioned service spaces as well as large unconditioned storage spaces. Building 2093 is 115,408 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the water cooled chiller with an ultra high efficiency water cooled chiller. FEDS suggests replacing the electric water heater with a heat pump water heater and replacing some of the lighting.

Appropriated funding FEDS results for building 2093:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Comissary, large sales 2093	Cooling	Electric Water-Cooled Reciprocating Chiller {C1}	Water-Cooled Centrifugal Electric Chiller (ultra high efficiency)	743	45,994	284,148	205,262	2.3
Comissary, large sales 2093	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	1,603	91,420	259,302	1,271,569	5.9
Comissary, large sales 2093	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	22	1,453	1,118	23,392	21.9
Comissary, large sales 2093	Lights	FL200: FL 1X8 1F96T8 EEF1	FL250: FL 1X8 1F96T8 ELC1	63	7,061	76,308	44,218	1.6
Comissary, large sales 2093	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	164	9,787	33,270	130,720	4.9
Comissary, large sales 2093	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	2	162	124	2,600	21.9
Comissary, large sales 2093	Hot Water	Electric Water Heater	Heat Pump Water Heater (Com)	168	8,496	47,981	16,739	1.6

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 6,735,356 kwh before retrofits and 5,877,351 kwh after proposed retrofits are implemented. The energy use intensity goes from 199.2 MBtu/Ksf to 173.8 MBtu/Ksf after retrofits.

Comissary, large sales 2093

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	6,735,356	58,361.3	199.2	1,193,974
post-retrofit	5,877,351	50,926.7	173.8	1,034,038
difference	-858,005	-7,434.5	-25.4	-159,936
% change	-13	-13	-13	-13
Total (MBtu)				
existing	22,988	199.2	199.2	1,193,974
post-retrofit	20,059	173.8	173.8	1,034,038
difference	-2,928	-25.4	-25.4	-159,936
% change	-13	-13	-13	-13

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 4,432,117 kWh/year, followed by lighting with 1,096,681 kWh/year.

Commissary, large sales 2093

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	778,012	369,229	1,096,681	4,432,117	59,317
post-retrofit	0	418,662	352,544	663,912	4,432,117	10,116
difference	0	-359,350	-16,685	-432,769	0	-49,201
% change	0	-46	-5	-39	0	-83
Total (MBtu)						
existing	0	2,655	1,260	3,743	15,127	202
post-retrofit	0	1,429	1,203	2,266	15,127	35
difference	0	-1,226	-57	-1,477	0	-168
% change	0	-46	-5	-39	0	-83
Total (MBtu/1000ft2)						
existing	0	23	11	32	131	2
post-retrofit	0	12	10	20	131	0
difference	0	-11	0	-13	0	-1
% change	0	-46	-5	-39	0	-83

* Energy consumption values for both distributed and central SHW are reported for Hot Water annual energy use.

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Commissary, large sales 2093
Sulfur Oxides (lb)	
existing	60,888
post-retrofit	53,131
difference	-7,756
% change	-13
Nitrogen Oxides (lb)	
existing	29,096
post-retrofit	25,389
difference	-3,706
% change	-13
Carbon Monoxide (lb)	
existing	50,044
post-retrofit	43,669
difference	-6,375
% change	-13
Carbon Dioxide (tons)	
existing	6,163
post-retrofit	5,378
difference	-785
% change	-13
Particulate Matter (lb)	
existing	1,205
post-retrofit	1,051
difference	-153
% change	-13
Hydrocarbons (lb)	
existing	20,712
post-retrofit	18,074
difference	-2,638
% change	-13

Building 2028 Passenger Terminal

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2028 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2028

2028 is the air passenger terminal built in 1973. Building 2028 has a water cooled reciprocating chiller, metal halide, fluorescent, incandescent and high pressure sodium lights and little to no insulation in the building envelope. Building 2028 is 46,128 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the lighting, replacing the electric water heater with a heat pump water heater and increasing the insulation in the suspended ceiling.

Appropriated funding FEDS results for building 2028:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Airport terminal 2028	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	834	45,921	87,739	680,850	8.8
Airport terminal 2028	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	14	904	621	14,601	24.5
Airport terminal 2028	Lights	MH13: MH 250 WALL	HS26: HPS 200 WALL	79	5,359	33,413	56,951	2.7
Airport terminal 2028	Hot Water	Electric Water Heater	Heat Pump Water Heater (Com)	22	1,004	5,098	2,295	1.8
Airport terminal 2028	Roof	Roof Insulation R-Value 0.00	Suspended Ceiling: Increase Insulation by R-19	186	12,438	79,435	127,524	2.6

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 804,699 kwh before retrofits and 482,604 kwh after proposed retrofits are implemented. The energy use intensity goes from 59.5 MBtu/Ksf to 35.7 MBtu/Ksf after retrofits.

Airport terminal 2028

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	804,699	17,444.9	59.5	142,649
post-retrofit	482,604	10,462.3	35.7	84,907
difference	-322,095	-6,982.6	-23.8	-57,741
% change	-40	-40	-40	-40
Total (MBtu)				
existing	2,746	59.5	59.5	142,649
post-retrofit	1,647	35.7	35.7	84,907
difference	-1,099	-23.8	-23.8	-57,741
% change	-40	-40	-40	-40

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Lighting is the largest load in the building with 410,212 kWh/year, followed by space cooling with 235,351 kWh/year.

Airport terminal 2028

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	235,351	67,184	410,212	84,592	7,360
post-retrofit	0	139,143	39,140	218,736	84,592	994
difference	0	-96,209	-28,044	-191,476	0	-6,366
% change	0	-41	-42	-47	0	-86
Total (MBtu)						
existing	0	803	229	1,400	289	25
post-retrofit	0	475	134	747	289	3
difference	0	-328	-96	-654	0	-22
% change	0	-41	-42	-47	0	-86
Total (MBtu/1000ft2)						
existing	0	17	5	30	6	1
post-retrofit	0	10	3	16	6	0
difference	0	-7	-2	-14	0	0
% change	0	-41	-42	-47	0	-86

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Airport terminal 2028
Sulfur Oxides (lb)	
existing	7,274
post-retrofit	4,363
difference	-2,912
% change	-40
Nitrogen Oxides (lb)	
existing	3,476
post-retrofit	2,085
difference	-1,391
% change	-40
Carbon Monoxide (lb)	
existing	5,979
post-retrofit	3,586
difference	-2,393
% change	-40
Carbon Dioxide (tons)	
existing	736
post-retrofit	442
difference	-295
% change	-40
Particulate Matter (lb)	
existing	144
post-retrofit	86
difference	-58
% change	-40
Hydrocarbons (lb)	
existing	2,475
post-retrofit	1,484
difference	-990
% change	-40

Building 1597 Child Care Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1597 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1597

1597 is a child care center built 1985. Building 1597 is conditioned by an electric air cooled chiller, has many fluorescent and some metal halide lights and has some insulation in the building envelope. Building 1597 is 12,760 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing some of the lighting as well as replacing the electric water heater with a heat pump water heater.

Appropriated funding FEDS results for building 1597:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
youth Center 1597	Lights	FL38: FL 2X4 3F32T8 EEF1,2	FL304: FL 2X4 3F25ST8 ELC3 REF	24	1,956	18,356	14,731	1.8
youth Center 1597	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	106	621	1,216	3.0
youth Center 1597	Lights	MH40: MH 150 HE WALL	MH67: MH 150 HE WALL ELC	1	215	1,376	2,320	2.7
youth Center 1597	Lights	FL41: FL 1X4 1F32T8 EEF1	FL302: FL 1X4 1F25ST8 ELC1 REF	-	42	652	55	1.1
youth Center 1597	Lights	FL38: FL 2X4 3F32T8 EEF1,2	FL304: FL 2X4 3F25ST8 ELC3 REF	7	562	2,760	6,697	3.4
youth Center 1597	Hot Water	Electric Water Heater	Heat Pump Water Heater (Com)	42	2,455	6,854	1,579	3.4

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 200,246 kwh before retrofits and 177,850 kwh after proposed retrofits are implemented. The energy use intensity goes from 53.6 MBtu/Ksf to 47.6 MBtu/Ksf after retrofits.

Youth Center 1597

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	200,246	15,693.2	53.6	35,497
post-retrofit	177,850	13,938.1	47.6	31,290
difference	-22,395	-1,755.1	-6.0	-4,207
% change	-11	-11	-11	-12
Total (MBtu)				
existing	683	53.6	53.6	35,497
post-retrofit	607	47.6	47.6	31,290
difference	-76	-6.0	-6.0	-4,207
% change	-11	-11	-11	-12

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 84,926 kWh/year, followed by motors and miscellaneous equipment with 36,565 kWh/year.

Youth Center 1597

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	84,926	36,501	27,943	36,565	14,310
post-retrofit	0	83,699	35,937	19,739	36,565	1,910
difference	0	-1,227	-564	-8,204	0	-12,400
% change	0	-1	-2	-29	0	-87
Total (MBtu)						
existing	0	290	125	95	125	49
post-retrofit	0	286	123	67	125	7
difference	0	-4	-2	-28	0	-42
% change	0	-1	-2	-29	0	-87
Total (MBtu/1000ft2)						
existing	0	23	10	7	10	4
post-retrofit	0	22	10	5	10	1
difference	0	0	0	-2	0	-3
% change	0	-1	-2	-29	0	-87

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Youth Center 1597
Sulfur Oxides (lb)	
existing	1,810
post-retrofit	1,608
difference	-202
% change	-11
Nitrogen Oxides (lb)	
existing	865
post-retrofit	768
difference	-97
% change	-11
Carbon Monoxide (lb)	
existing	1,488
post-retrofit	1,321
difference	-166
% change	-11
Carbon Dioxide (tons)	
existing	183
post-retrofit	163
difference	-20
% change	-11
Particulate Matter (lb)	
existing	36
post-retrofit	32
difference	-4
% change	-11
Hydrocarbons (lb)	
existing	616
post-retrofit	547
difference	-69
% change	-11

Building 1891 Bowling Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1971 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1891

1891 is a bowling facility built in 1971. The facility was once a gymnasium, but has since been converted to a bowling center. Building 1891 is cooled by an electric package unit, has fluorescent, incandescent, and metal halide lights and some insulation in the building envelope. Building 1891 is 3,090 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the electric package unit with a very high efficiency single zone package unit. FEDS also suggests delamping 4 tube T8 fixtures to 3 tube T8 fixtures as well as increasing insulation in the attic ceiling, and various improvements to the electric hot water system.

Appropriated funding FEDS results for building 1891:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
misc recreation bldgs 1891	Cooling	Electric Package Unit {C1}	Single Zone Packaged AC Unit (very high efficiency / small)	108	9,969	30,233	6,907	3.8
misc recreation bldgs 1891	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	7	464	311	7,525	25.2
misc recreation bldgs 1891	Lights	FL37: FL 2X4 4F32T8 EEF2	FL280: FL 2X4 3F32ST8 ELC3 REF	22	1,440	4,416	19,784	5.5
misc recreation bldgs 1891	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	14	1,007	5,952	11,004	2.8
misc recreation bldgs 1891	Hot Water	Electric Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators	3	175	189	148	13.0
misc recreation bldgs 1891	Roof	Roof Insulation R-Value 11.00	Attic Ceiling: Increase Insulation by R-30 (blow-in cellulose)	13	740	3,705	8,601	3.3

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 158,242 kwh before retrofits and 100,281 kwh after proposed retrofits are implemented. The energy use intensity goes from 176.2 MBtu/Ksf to 112.2 MBtu/Ksf after retrofits.

Misc recreation bldgs 1891

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	158,242	51,211.1	174.8	28,052
post-retrofit	100,281	32,453.5	110.8	17,643
difference	-57,961	-18,757.6	-64.0	-10,408
% change	-37	-37	-37	-37
Other Fuels (MBtu)				
existing	4	1.4	1.4	143
post-retrofit	4	1.4	1.4	143
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	545	176.2	176.2	28,195
post-retrofit	347	112.2	112.2	17,787
difference	-198	-64.0	-64.0	-10,408
% change	-36	-36	-36	-37

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 82,546 kWh/year, followed by lighting with 38,734 kWh/year.

Misc recreation bldgs 1891

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	82,546	19,939	38,734	14,816	2,206
post-retrofit	0	34,693	19,204	30,351	14,816	1,217
difference	0	-47,853	-735	-8,383	0	-989
% change	0	-58	-4	-22	0	-45
Other Fuels (MBtu)						
existing	0	0	0	0	4	0
post-retrofit	0	0	0	0	4	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	282	68	132	55	8
post-retrofit	0	118	66	104	55	4
difference	0	-163	-3	-29	0	-3
% change	0	-58	-4	-22	0	-45
Total (MBtu/1000ft2)						
existing	0	91	22	43	18	2
post-retrofit	0	38	21	34	18	1
difference	0	-53	-1	-9	0	-1
% change	0	-58	-4	-22	0	-45

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Misc recreation bldgs 1891
Sulfur Oxides (lb)	
existing	1,432
post-retrofit	908
difference	-524
% change	-37
Nitrogen Oxides (lb)	
existing	685
post-retrofit	435
difference	-250
% change	-37
Carbon Monoxide (lb)	
existing	1,179
post-retrofit	748
difference	-431
% change	-37
Carbon Dioxide (tons)	
existing	145
post-retrofit	92
difference	-53
% change	-37
Particulate Matter (lb)	
existing	28
post-retrofit	18
difference	-10
% change	-37
Hydrocarbons (lb)	
existing	488
post-retrofit	309
difference	-178
% change	-37

Building 1750 Religious Education Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1750 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1750

1750 is a religious education facility built in 1977. Building 1750 is conditioned by an electric package unit. The building has incandescent, fluorescent, and metal halide lights and has little to no insulation in the building envelope. Building 1750 is 7,296 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the lighting in the building, increasing the insulation in the roof and increasing the insulation on the hot water tank.

Appropriated funding FEDS results for building 1750:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Religious facilities 1750	Lights	FL38: FL 2X4 3F32T8 EEF1,2	FL304: FL 2X4 3F25ST8 ELC3 REF	3	256	1,853	2,473	2.3
Religious facilities 1750	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	851	621	13,734	23.1
Religious facilities 1750	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	4	305	2,482	2,654	2.1
Religious facilities 1750	Lights	IN8: INC 75 CEIL	CF5: CFL 18 INTEGRAL UNIT ELC	23	1,611	502	26,565	53.9
Religious facilities 1750	Lights	IN11: INC 100 CEIL	CF9: CFL 26 INTEGRAL UNIT ELC	3	223	58	3,682	64.6
Religious facilities 1750	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	16	932	3,949	11,771	4.0
Religious facilities 1750	Hot Water	Distillate Oil Water Heater	Wrap Tank with Insulation	1	30	53	64	2.2
Religious facilities 1750	Roof	Roof Insulation R-Value 0.00	Insulate Built-up Roof Surface (R-15) and Re-Roof	94	6,283	36,504	68,040	2.9

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 133,294 kwh before retrofits and 87,822 kwh after proposed retrofits are implemented. The modeled distillate oil consumption for a typical year was 64 gallons before retrofits and 58 gallons after proposed retrofits are implemented. The energy use intensity goes from 63.6 MBtu/Ksf to 42.2 MBtu/Ksf after retrofits.

Religious facilities 1750

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	133,294	18,269.4	62.4	23,629
post-retrofit	87,822	12,037.0	41.1	15,451
difference	-45,472	-6,232.4	-21.3	-8,178
% change	-34	-34	-34	-35
Distillate Oil (gal)				
existing	64	8.7	1.2	324
post-retrofit	58	7.9	1.1	294
difference	-6	-0.8	-0.1	-30
% change	-9	-9	-9	-9
Total (MBtu)				
existing	464	63.6	63.6	23,953
post-retrofit	308	42.2	42.2	15,745
difference	-156	-21.4	-21.4	-8,208
% change	-34	-34	-34	-34

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 60,705 kWh/year, followed by lighting with 31,784 kWh/year.

Religious facilities 1750

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	60,705	29,785	31,784	11,019	0
post-retrofit	0	30,632	29,151	17,020	11,019	0
difference	0	-30,073	-635	-14,764	0	0
% change	0	-50	-2	-46	0	0
Distillate Oil (gal)						
existing	0	0	0	0	0	64
post-retrofit	0	0	0	0	0	58
difference	0	0	0	0	0	-6
% change	0	0	0	0	0	-9
Total (MBtu)						
existing	0	207	102	108	38	9
post-retrofit	0	105	99	58	38	8
difference	0	-103	-2	-50	0	-1
% change	0	-50	-2	-46	0	-9
Total (MBtu/1000ft2)						
existing	0	28	14	15	5	1
post-retrofit	0	14	14	8	5	1
difference	0	-14	0	-7	0	0
% change	0	-50	-2	-46	0	-9

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Religious facilities 1750
Sulfur Oxides (lb)	
existing	1,209
post-retrofit	798
difference	-411
% change	-34
Nitrogen Oxides (lb)	
existing	579
post-retrofit	382
difference	-197
% change	-34
Carbon Monoxide (lb)	
existing	997
post-retrofit	659
difference	-339
% change	-34
Carbon Dioxide (tons)	
existing	123
post-retrofit	81
difference	-42
% change	-34
Particulate Matter (lb)	
existing	24
post-retrofit	16
difference	-8
% change	-34
Hydrocarbons (lb)	
existing	412
post-retrofit	272
difference	-140
% change	-34

Building 1120 Gymnasium

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1120 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1120

1120 is the main gymnasium built in 1949. Building 1120 is conditioned by an electric air cooled chiller. It has fluorescent, metal halide and high pressure sodium lights as well as little to no insulation in its building envelope. Building 1120 is 46,719 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the electric air cooled chiller with a very high efficiency water cooled chiller. FEDS also suggests replacing some of the lighting, installing double pane super low-e windows, and making various improvements to the hot water system.

Appropriated funding FEDS results fobuilding 1750:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
gymnasium 1120	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	525	27,663	112,069	155,721	3.4
gymnasium 1120	Lights	FL3: FL 2X4 2F40T12 STD2	FL303: FL 2X4 2F25ST8 ELC2 REF (FIX REPL)	43	2,541	14,429	28,120	2.9
gymnasium 1120	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	878	621	14,174	23.8
gymnasium 1120	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	120	7,027	11,663	106,029	10.1
gymnasium 1120	Hot Water	Distillate Oil Water Heater	Wrap Tank with Insulation, Insulate Pipe Near Tank, Aerators	22	815	588	3,041	17.8
gymnasium 1120	Window	Metal Frame Single Pane Window	Install Thermal Break Aluminum Frame Double Pane Super Low-e Window	31	1,790	23,598	6,184	1.3

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 1,054,786 kwh before retrofits and 827,778 kwh after proposed retrofits are implemented. The modeled distillate oil consumption for a typical year was 356 gallons before retrofits and 196 gallons after proposed retrofits are implemented. The energy use intensity goes from 78.1 MBtu/Ksf to 61.1 MBtu/Ksf after retrofits.

Gymnasium 1120

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	1,054,786	22,577.2	77.1	186,981
post-retrofit	827,778	17,718.2	60.5	145,636
difference	-227,008	-4,859.0	-16.6	-41,345
% change	-22	-22	-22	-22
Distillate Oil (gal)				
existing	356	7.6	1.1	1,814
post-retrofit	196	4.2	0.6	999
difference	-160	-3.4	-0.5	-815
% change	-45	-45	-45	-45
Total (MBtu)				
existing	3,649	78.1	78.1	188,795
post-retrofit	2,852	61.1	61.1	146,635
difference	-797	-17.1	-17.1	-42,160
% change	-22	-22	-22	-22

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 445,860 kWh/year, followed by motors and miscellaneous equipment with 256,750 kWh/year.

Gymnasium 1120

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	445,860	141,105	211,070	256,750	0
post-retrofit	0	276,537	122,765	171,725	256,750	0
difference	0	-169,323	-18,340	-39,345	0	0
% change	0	-38	-13	-19	0	0
Distillate Oil (gal)						
existing	0	0	0	0	0	356
post-retrofit	0	0	0	0	0	196
difference	0	0	0	0	0	-160
% change	0	0	0	0	0	-45
Total (MBtu)						
existing	0	1,522	482	720	876	49
post-retrofit	0	944	419	586	876	27
difference	0	-578	-63	-134	0	-22
% change	0	-38	-13	-19	0	-45
Total (MBtu/1000ft2)						
existing	0	33	10	15	19	1
post-retrofit	0	20	9	13	19	1
difference	0	-12	-1	-3	0	0
% change	0	-38	-13	-19	0	-45

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Gymnasium 1120
Sulfur Oxides (lb)	
existing	9,560
post-retrofit	7,497
difference	-2,063
% change	-22
Nitrogen Oxides (lb)	
existing	4,573
post-retrofit	3,585
difference	-988
% change	-22
Carbon Monoxide (lb)	
existing	7,877
post-retrofit	6,172
difference	-1,704
% change	-22
Carbon Dioxide (tons)	
existing	970
post-retrofit	760
difference	-210
% change	-22
Particulate Matter (lb)	
existing	190
post-retrofit	149
difference	-41
% change	-22
Hydrocarbons (lb)	
existing	3,256
post-retrofit	2,553
difference	-704
% change	-22

Building 2003 Vehicle Maintenance Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2003 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2003

2003 is a vehicle maintenance administration facility built in 1994. Building 2003 is conditioned by an electric package unit, is lit by 32 watt fluorescent T8's and has little to no insulation in its building envelope. Building 2003 is 6,848 sf.

Appropriated Funding Results

A FEDS analysis using appropriated funding suggests replacing the fluorescent lighting, the EXIT lighting, increasing the insulation in the roof and replacing the electric water heater with a heat pump water heater.

Appropriated funding FEDS results for building 2003:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st year savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Small 1990's admin	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	98	5,891	14,843	83,966	6.7
Small 1990's admin	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	1	113	621	1,318	3.1
Small 1990's admin	Lights	FL41: FL 1X4 1F32T8 EEF1	FL302: FL 1X4 1F25ST8 ELC1 REF	4	324	2,310	3,185	2.4
Small 1990's admin	Hot Water	Electric Water Heater	Heat Pump Water Heater (Com)	5	212	1,714	137	1.1
Small 1990's admin	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	299	16,487	23,407	250,910	11.7

Appropriated Funding Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 234,145 kwh before retrofits and 120,033 kwh after proposed retrofits are implemented. The energy use intensity goes from 116.7 MBtu/Ksf to 59.8 MBtu/Ksf after retrofits.

Small 1990's admin 2003

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	234,145	34,191.8	116.7	41,507
post-retrofit	120,033	17,528.2	59.8	21,118
difference	-114,112	-16,663.6	-56.9	-20,389
% change	-49	-49	-49	-49
Total (MBtu)				
existing	799	116.7	116.7	41,507
post-retrofit	410	59.8	59.8	21,118
difference	-389	-56.9	-56.9	-20,389
% change	-49	-49	-49	-49

* Dollar values for electricity include both energy and demand components.

Appropriated Funding Energy Consumption by End Use

Space cooling is the largest load in the building with 91,143 kWh/year, followed by ventilation with 56,887 kWh/year.

Small 1990's admin 2003

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	91,143	56,887	56,227	28,339	1,550
post-retrofit	0	34,654	21,727	35,104	28,339	209
difference	0	-56,490	-35,159	-21,122	0	-1,341
% change	0	-62	-62	-38	0	-87
Total (MBtu)						
existing	0	311	194	192	97	5
post-retrofit	0	118	74	120	97	1
difference	0	-193	-120	-72	0	-5
% change	0	-62	-62	-38	0	-87
Total (MBtu/1000ft2)						
existing	0	45	28	28	14	1
post-retrofit	0	17	11	17	14	0
difference	0	-28	-18	-11	0	-1
% change	0	-62	-62	-38	0	-87

Appropriated Funding Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Small 1990's admin 2003
Sulfur Oxides (lb)	
existing	2,117
post-retrofit	1,085
difference	-1,032
% change	-49
Nitrogen Oxides (lb)	
existing	1,011
post-retrofit	519
difference	-493
% change	-49
Carbon Monoxide (lb)	
existing	1,740
post-retrofit	892
difference	-848
% change	-49
Carbon Dioxide (tons)	
existing	214
post-retrofit	110
difference	-104
% change	-49
Particulate Matter (lb)	
existing	42
post-retrofit	21
difference	-20
% change	-49
Hydrocarbons (lb)	
existing	720
post-retrofit	369
difference	-351
% change	-49

Appendix D-2
Energy Conservation Measures for Individual Buildings Alternative Financing

The following information identifies the cost-effective energy- and cost-reducing retrofit projects using alternative financing for the buildings visited during the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure

Building 2186 Storage Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2186 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2186

Building 2186 is overhead storage for landscaping equipment built in 1986. 2186 has some lighting but no cooling or building envelope. Building 2186 is 2,125 sf.

Alternative Financing Results

FEDS did not find any life cycle cost effective retrofits using alternative financing.

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 2,451 kwh before retrofits and 2,451 kwh after proposed retrofits are implemented. The energy use intensity goes from 3.9 MBtu/Ksf to 3.9 MBtu/Ksf after retrofits.

Covered lighting 2186

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	2,451	1,153.2	3.9	434
post-retrofit	2,451	1,153.2	3.9	433
difference	0	0.0	0.0	-1
% change	0	0	0	0
Total (MBtu)				
existing	8	3.9	3.9	434
post-retrofit	8	3.9	3.9	433
difference	0	0.0	0.0	-1
% change	0	0	0	0

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Annual Energy Use by Building Set, Fuel Type, and End Use
Building Set ... 1
Covered lighting 2186

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	0	2,451	0
post-retrofit	0	0	0	0	2,451	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	0	0	0	8	0
post-retrofit	0	0	0	0	8	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	0	4	0
post-retrofit	0	0	0	0	4	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Covered lighting 2186
Sulfur Oxides (lb)	
existing	22
post-retrofit	22
difference	0
% change	0
Nitrogen Oxides (lb)	
existing	11
post-retrofit	11
difference	0
% change	0
Carbon Monoxide (lb)	
existing	18
post-retrofit	18
difference	0
% change	0
Carbon Dioxide (tons)	
existing	2
post-retrofit	2
difference	0
% change	0
Particulate Matter (lb)	
existing	0
post-retrofit	0
difference	0
% change	0
Hydrocarbons (lb)	
existing	8
post-retrofit	8
difference	0
% change	0

Building 2035 Hanger

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2035 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2035

Building 2035 is a hangar with two high-bay spaces originally built in 1937. One of the high-bays has been converted to office space where an administration building has been built inside the hanger. This building inside a building is cooled by air cooled chillers and receives little to no solar radiation. The other high-bay is used to store and transport aircraft parts and has a small office space served by an electric DX, or package unit. Building 2035 is 86,391 sf.

Alternative Financing Results

A FEDS analysis using alternative financing for hangar 13 suggests replacing the air cooled chiller with a standard efficiency water cooled reciprocating chiller, replacing the incandescent lights with CFLs, installing aerators, and replacing LED EXIT signs with electroluminescent signs. The FEDS analysis suggests for hangar 11 installing aerators, lowering the hot water tank temperature, replacing LED EXIT lights with electroluminescent signs, T12 lights and metal halide lights.

Alternative financing FEDS results for building 2035 hangar 13:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Large 1930's admin space 2035 hangar 13	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (standard efficiency) and Cooling Tower	227	14,916	85,130	1,520	1.0
Large 1930's admin space 2035 hangar 13	Hot Water	Electric Water Heater	Faucet Aerators	7	392	79	2,169	28.6
Large 1930's admin space 2035 hangar 13	Lights	IN8: INC 75 CEIL	CF5: CFL 18 INTEGRAL UNIT ELC	322	21,166	3,373	119,968	36.6
Large 1930's admin space 2035 hangar 13	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	2	361	1,864	323	1.2

Alternative financing FEDS results for building 2035 hangar 11:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1930's wharehouse space hangar 11	Hot Water	Electric Water Heater	Faucet Aerators, Lower Tank Temperature	-	2	1	10	17.0
1930's wharehouse space hangar 11	Hot Water	Electric Water Heater	Faucet Aerators, Lower Tank Temperature	-	3	2	16	9.0
1930's wharehouse space hangar 11	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	7	37	4	1.1
1930's wharehouse space hangar 11	Lights	FL1: FL 2X4 4F40T12 STD2	FL244: FL 2X4 4F32T8 ELC4	6	446	1,140	1,466	2.3
1930's wharehouse space hangar 11	Lights	MH4: MH 175 PEND	FL289: FL 2X4 4F30ST8 ELC2 REF	6	581	2,111	1,321	1.6

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for hangar 13 for a typical year was 795,887 kwh before retrofits and 624,153 kwh after proposed retrofits are implemented. The energy use intensity goes from 62.9 MBtu/Ksf to 49.3 MBtu/Ksf after retrofits.

Large 1930's admin space 2035 hangar 13

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	795,887	18,425.9	62.9	141,004
post-retrofit	624,153	14,450.0	49.3	110,284
difference	-171,734	-3,975.9	-13.6	-30,720
% change	-22	-22	-22	-22
Total (MBtu)				
existing	2,716	62.9	62.9	141,004
post-retrofit	2,130	49.3	49.3	110,284
difference	-586	-13.6	-13.6	-30,720
% change	-22	-22	-22	-22

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for hangar 11 for a typical year was 62,619 kwh before retrofits and 58,981 kwh after proposed retrofits are implemented. The energy use intensity goes from 4.9 MBtu/Ksf to 4.7 MBtu/Ksf after retrofits.

1930's warehouse space hangar 11

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	62,619	1,449.6	4.9	11,094
post-retrofit	58,981	1,365.4	4.7	10,422
difference	-3,638	-84.2	-0.3	-672
% change	-6	-6	-6	-6
Total (MBtu)				
existing	214	4.9	4.9	11,094
post-retrofit	201	4.7	4.7	10,422
difference	-12	-0.3	-0.3	-672
% change	-6	-6	-6	-6

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Annual Energy Use by Building Set, Fuel Type, and End Use
Large 1930's admin space 2035 hangar 13

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	253,896	69,266	226,334	240,705	5,687
post-retrofit	0	159,419	60,916	159,538	240,705	3,575
difference	0	-94,477	-8,350	-66,796	0	-2,112
% change	0	-37	-12	-30	0	-37
Total (MBtu)						
existing	0	867	236	772	822	19
post-retrofit	0	544	208	545	822	12
difference	0	-322	-28	-228	0	-7
% change	0	-37	-12	-30	0	-37
Total (MBtu/1000ft2)						
existing	0	20	5	18	19	0
post-retrofit	0	13	5	13	19	0
difference	0	-7	-1	-5	0	0
% change	0	-37	-12	-30	0	-37

Annual Energy Use by Building Set, Fuel Type, and End Use
Large 1930's warehouse space 2035 hangar 11

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	0	0	53,825	8,705	88
post-retrofit	0	0	0	50,215	8,705	61
difference	0	0	0	-3,611	0	-27
% change	0	0	0	-7	0	-31
Total (MBtu)						
existing	0	0	0	184	30	0
post-retrofit	0	0	0	171	30	0
difference	0	0	0	-12	0	0
% change	0	0	0	-7	0	-31
Total (MBtu/1000ft2)						
existing	0	0	0	4	1	0
post-retrofit	0	0	0	4	1	0
difference	0	0	0	0	0	0
% change	0	0	0	-7	0	-31

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Large 1930's admin space 2035 hangar 13
Sulfur Oxides (lb)	
existing	7,195
post-retrofit	5,642
difference	-1,552
% change	-22
Nitrogen Oxides (lb)	
existing	3,438
post-retrofit	2,696
difference	-742
% change	-22
Carbon Monoxide (lb)	
existing	5,914
post-retrofit	4,638
difference	-1,276
% change	-22
Carbon Dioxide (tons)	
existing	728
post-retrofit	571
difference	-157
% change	-22
Particulate Matter (lb)	
existing	142
post-retrofit	112
difference	-31
% change	-22
Hydrocarbons (lb)	
existing	2,447
post-retrofit	1,919
difference	-528
% change	-22

	1930's wharehouse space 2035 hangar 11
Sulfur Oxides (lb)	
existing	566
post-retrofit	533
difference	-33
% change	-6
Nitrogen Oxides (lb)	
existing	271
post-retrofit	255
difference	-16
% change	-6
Carbon Monoxide (lb)	
existing	465
post-retrofit	438
difference	-27
% change	-6
Carbon Dioxide (tons)	
existing	57
post-retrofit	54
difference	-3
% change	-6
Particulate Matter (lb)	
existing	11
post-retrofit	11
difference	-1
% change	-6
Hydrocarbons (lb)	
existing	193
post-retrofit	181
difference	-11
% change	-6

Building 1204 Administration Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1204 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1204

Building 1204 is a small admin building built in 1939. This building is served by an air cooled chiller and has little to no insulation in its building envelope. Building 1204 is 11,374 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing 32W T8 lighting with 25W Super T8 lighting.

Alternative financing FEDS results for building 1204:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Small 1040's admin 1204	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	62	5,156	25,464	4,841	1.2

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 250,798 kwh before retrofits and 232,667 kwh after proposed retrofits are implemented. The energy use intensity goes from 75.3 MBtu/Ksf to 69.8 MBtu/Ksf after retrofits.

Small 1040's admin 1204

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	250,798	22,050.1	75.3	44,433
post-retrofit	232,667	20,456.1	69.8	41,111
difference	-18,131	-1,594.0	-5.4	-3,322
% change	-7	-7	-7	-7
Total (MBtu)				
existing	856	75.3	75.3	44,433
post-retrofit	794	69.8	69.8	41,111
difference	-62	-5.4	-5.4	-3,322
% change	-7	-7	-7	-7

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 83,381 kWh/year, followed by ventilation with 72,592 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Small 1040's admin 1204

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	83,381	72,592	38,645	56,179	0
post-retrofit	0	79,249	72,592	24,646	56,179	0
difference	0	-4,131	0	-13,999	0	0
% change	0	-5	0	-36	0	0
Total (MBtu)						
existing	0	285	248	132	192	0
post-retrofit	0	270	248	84	192	0
difference	0	-14	0	-48	0	0
% change	0	-5	0	-36	0	0
Total (MBtu/1000ft2)						
existing	0	25	22	12	17	0
post-retrofit	0	24	22	7	17	0
difference	0	-1	0	-4	0	0
% change	0	-5	0	-36	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Small 1040's admin 1204
Sulfur Oxides (lb)	
existing	2,267
post-retrofit	2,103
difference	-164
% change	-7
Nitrogen Oxides (lb)	
existing	1,083
post-retrofit	1,005
difference	-78
% change	-7
Carbon Monoxide (lb)	
existing	1,863
post-retrofit	1,729
difference	-135
% change	-7
Carbon Dioxide (tons)	
existing	229
post-retrofit	213
difference	-17
% change	-7
Particulate Matter (lb)	
existing	45
post-retrofit	42
difference	-3
% change	-7
Hydrocarbons (lb)	
existing	771
post-retrofit	715
difference	-56
% change	-7

Building 2155 Adminstration Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2155 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2155

Building 2155 is a weapons systems management facility built in 1968. This building is cooled by a DX, or package unit and has little to no insulation in the building envelope. Building 2155 is 21,745 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing several lighting technologies.

Alternative financing FEDS results for building 2155:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
medium 1960's admin 2155	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	855	621	4,382	8.1
medium 1960's admin 2155	Lights	FL51: FL 2X4 2F32T8 ELC2	FL303: FL 2X4 2F25ST8 ELC2 REF	23	1,494	7,449	1,288	1.2
medium 1960's admin 2155	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	3	186	451	636	2.4

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 314,110 kwh before retrofits and 302,889 kwh after proposed retrofits are implemented. The energy use intensity goes from 49.3 MBtu/Ksf to 47.5 MBtu/Ksf after retrofits.

Medium 1960's admin 2155

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	314,110	14,445.2	49.3	55,650
post-retrofit	302,889	13,929.1	47.5	53,519
difference	-11,221	-516.0	-1.8	-2,131
% change	-4	-4	-4	-4
Total (MBtu)				
existing	1,072	49.3	49.3	55,650
post-retrofit	1,034	47.5	47.5	53,519
difference	-38	-1.8	-1.8	-2,131
% change	-4	-4	-4	-4

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 145,710 kWh/year, followed by space cooling with 92,995 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
medium 1960's admin 2155

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	92,995	52,915	22,491	145,710	0
post-retrofit	0	90,499	52,799	13,881	145,710	0
difference	0	-2,496	-116	-8,610	0	0
% change	0	-3	0	-38	0	0
Total (MBtu)						
existing	0	317	181	77	497	0
post-retrofit	0	309	180	47	497	0
difference	0	-9	0	-29	0	0
% change	0	-3	0	-38	0	0
Total (MBtu/1000ft2)						
existing	0	15	8	4	23	0
post-retrofit	0	14	8	2	23	0
difference	0	0	0	-1	0	0
% change	0	-3	0	-38	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	medium 1960's admin 2155
Sulfur Oxides (lb)	
existing	2,840
post-retrofit	2,738
difference	-101
% change	-4
Nitrogen Oxides (lb)	
existing	1,357
post-retrofit	1,308
difference	-48
% change	-4
Carbon Monoxide (lb)	
existing	2,334
post-retrofit	2,250
difference	-83
% change	-4
Carbon Dioxide (tons)	
existing	287
post-retrofit	277
difference	-10
% change	-4
Particulate Matter (lb)	
existing	56
post-retrofit	54
difference	-2
% change	-4
Hydrocarbons (lb)	
existing	966
post-retrofit	931
difference	-35
% change	-4

Building 502 Law Office

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 502 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 502

Building 502 is a small law office building built in 1971 that is served by two separate electric DX units with a courtroom in the center of the office space. Building 502 is 9,217 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests increasing the insulation in the suspended ceiling as well as replacing the EXIT lighting.

Alternative financing FEDS results for building 502:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
small 1960s admin 502	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	880	621	4,530	8.3
small 1960s admin 502	Roof	Roof Insulation R-Value 0.00	Suspended Ceiling: Increase Insulation by R-11	45	2,764	12,142	3,725	1.3

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 143,177 kwh before retrofits and 126,257 kwh after proposed retrofits are implemented. The energy use intensity goes from 53.0 MBtu/Ksf to 46.8 MBtu/Ksf after retrofits.

Small 1960s admin 502

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	143,177	15,534.1	53.0	25,366
post-retrofit	126,257	13,698.3	46.8	22,309
difference	-16,920	-1,835.7	-6.3	-3,057
% change	-12	-12	-12	-12
Total (MBtu)				
existing	489	53.0	53.0	25,366
post-retrofit	431	46.8	46.8	22,309
difference	-58	-6.3	-6.3	-3,057
% change	-12	-12	-12	-12

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 58,890 kWh/year, followed by motors and miscellaneous equipment with 45,525 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Small 1960s admin 502

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	58,890	24,575	13,327	45,525	860
post-retrofit	0	47,074	22,250	10,549	45,525	860
difference	0	-11,816	-2,325	-2,779	0	0
% change	0	-20	-9	-21	0	0
Total (MBtu)						
existing	0	201	84	45	155	3
post-retrofit	0	161	76	36	155	3
difference	0	-40	-8	-9	0	0
% change	0	-20	-9	-21	0	0
Total (MBtu/1000ft2)						
existing	0	22	9	5	17	0
post-retrofit	0	17	8	4	17	0
difference	0	-4	-1	-1	0	0
% change	0	-20	-9	-21	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Small 1960s admin 502
Sulfur Oxides (lb)	
existing	1,294
post-retrofit	1,141
difference	-153
% change	-12
Nitrogen Oxides (lb)	
existing	619
post-retrofit	545
difference	-73
% change	-12
Carbon Monoxide (lb)	
existing	1,064
post-retrofit	938
difference	-126
% change	-12
Carbon Dioxide (tons)	
existing	131
post-retrofit	116
difference	-15
% change	-12
Particulate Matter (lb)	
existing	26
post-retrofit	23
difference	-3
% change	-12
Hydrocarbons (lb)	
existing	440
post-retrofit	388
difference	-52
% change	-12

Building 2133 Administration Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2133 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2133

Building 2133 is a weapon systems management facility built in 2005. 2133 is cooled by an air cooled chiller and has some insulation in its building envelope. Building 2133 is 25,764 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the electric hot water boiler with a heat pump water heater. FEDS also suggests replacing some of the lighting technologies.

Alternative financing FEDS results for building 2133:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
medium 2000's admin 2133	Hot Water	Electric Central Boiler	Central Heat Pump Hot Water System, Wrap Tank	249	12,188	8,565	61,475	8.2
medium 2000's admin 2133	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	14	937	621	4,854	8.8
medium 2000's admin 2133	Lights	FL236: FL 2X4 3F32T8 ELC3	FL279: FL 2X4 2F32ST8 ELC2 REF	271	14,972	62,594	23,564	1.4

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 586,408 kwh before retrofits and 429,858 kwh after proposed retrofits are implemented. The energy use intensity goes from 77.7 MBtu/Ksf to 56.9 MBtu/Ksf after retrofits.

Medium 2000's admin 2133

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	586,408	22,760.8	77.7	103,892
post-retrofit	429,858	16,684.4	56.9	75,953
difference	-156,550	-6,076.3	-20.7	-27,938
% change	-27	-27	-27	-27
Total (MBtu)				
existing	2,001	77.7	77.7	103,892
post-retrofit	1,467	56.9	56.9	75,953
difference	-534	-20.7	-20.7	-27,938
% change	-27	-27	-27	-27

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 170,993 kWh/year, followed by lighting with 149,077 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Medium 2000's admin 2133

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	170,993	53,772	149,077	132,355	80,211
post-retrofit	0	149,639	50,710	89,861	132,355	7,293
difference	0	-21,354	-3,062	-59,216	0	-72,917
% change	0	-12	-6	-40	0	-91
Total (MBtu)						
existing	0	584	184	509	452	274
post-retrofit	0	511	173	307	452	25
difference	0	-73	-10	-202	0	-249
% change	0	-12	-6	-40	0	-91
Total (MBtu/1000ft2)						
existing	0	23	7	20	18	11
post-retrofit	0	20	7	12	18	1
difference	0	-3	0	-8	0	-10
% change	0	-12	-6	-40	0	-91

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Medium 2000's admin 2133
Sulfur Oxides (lb)	
existing	5,301
post-retrofit	3,886
difference	-1,415
% change	-27
Nitrogen Oxides (lb)	
existing	2,533
post-retrofit	1,857
difference	-676
% change	-27
Carbon Monoxide (lb)	
existing	4,357
post-retrofit	3,194
difference	-1,163
% change	-27
Carbon Dioxide (tons)	
existing	537
post-retrofit	393
difference	-143
% change	-27
Particulate Matter (lb)	
existing	105
post-retrofit	77
difference	-28
% change	-27
Hydrocarbons (lb)	
existing	1,803
post-retrofit	1,322
difference	-481
% change	-27

Building 2125 Administration Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2125 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2125

Building 2125 is an administration building built in 1994. This petroleum operations building is cooled by an electric package unit and has little to no insulation in its building envelope. Building 2125 is 3,867 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the 32W T8 lighting with 25W Super T8 lighting as well as replacing the exit lighting and increasing the insulation in the roof to 4 inches of fiberglass.

Alternative financing FEDS results for building 2125:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Small 1990's admin 2125	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	61	311	56	1.2
Small 1990's admin 2125	Lights	FL38: FL 2X4 3F32T8 EEF1,2	FL304: FL 2X4 3F25ST8 ELC3 REF	26	1,960	5,508	6,011	2.1

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 56,331 kwh before retrofits and 48,664 kwh after proposed retrofits are implemented. The energy use intensity goes from 49.7 MBtu/Ksf to 43.0 MBtu/Ksf after retrofits.

Small 1990's admin 2125

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	56,331	14,567.1	49.7	9,957
post-retrofit	48,664	12,584.4	43.0	8,592
difference	-7,667	-1,982.7	-6.8	-1,365
% change	-14	-14	-14	-14
Total (MBtu)				
existing	192	49.7	49.7	9,957
post-retrofit	166	43.0	43.0	8,592
difference	-26	-6.8	-6.8	-1,365
% change	-14	-14	-14	-14

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 18,138 kWh/year, followed by lighting with 16,214 kWh/year.

Small 1990's admin 2125

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	18,138	4,917	16,214	16,002	1,060
post-retrofit	0	16,612	4,444	10,546	16,002	1,060
difference	0	-1,526	-473	-5,668	0	0
% change	0	-8	-10	-35	0	0
Total (MBtu)						
existing	0	62	17	55	55	4
post-retrofit	0	57	15	36	55	4
difference	0	-5	-2	-19	0	0
% change	0	-8	-10	-35	0	0
Total (MBtu/1000ft2)						
existing	0	16	4	14	14	1
post-retrofit	0	15	4	9	14	1
difference	0	-1	0	-5	0	0
% change	0	-8	-10	-35	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

Small 1990's admin 2125

Sulfur Oxides (lb)	
existing	509
post-retrofit	440
difference	-69
% change	-14
Nitrogen Oxides (lb)	
existing	243
post-retrofit	210
difference	-33
% change	-14
Carbon Monoxide (lb)	
existing	419
post-retrofit	362
difference	-57
% change	-14
Carbon Dioxide (tons)	
existing	52
post-retrofit	45
difference	-7
% change	-14
Particulate Matter (lb)	
existing	10
post-retrofit	9
difference	-1
% change	-14
Hydrocarbons (lb)	
existing	173
post-retrofit	150
difference	-24
% change	-14

Building 559 Clinic

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 559 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 559

Building 559 is the air force clinic built in 1942. This building is cooled by water cooled chillers and has an electric central hot water system. Building 559 is 78,823 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the electric boiler with a heat pump water heater as well as various improvements to the lighting in the building.

Alternative financing FEDS results for building 559:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Medical facilities 559	Hot Water	Electric Central Boiler	Central Heat Pump Hot Water System, Wrap Tank, Aerators, LFSHs	939	47,853	74,876	199,891	3.7
Medical facilities 559	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	54	3,674	2,795	18,739	7.7
Medical facilities 559	Lights	FL1: FL 2X4 4F40T12 STD2	FL244: FL 2X4 4F32T8 ELC4	445	31,658	57,052	127,748	3.2
Medical facilities 559	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	127	10,803	43,662	19,937	1.5

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 1,458,222 kwh before retrofits and 999,686 kwh after proposed retrofits are implemented. The modeled other fuels (propane) consumption for a typical year was 34 MBtu before retrofits and 34 MBtu after proposed retrofits are implemented. The energy use intensity goes from 63.6 MBtu/Ksf to 43.7 MBtu/Ksf after retrofits.

Medical facilities 559

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	1,458,222	18,500.0	63.1	258,347
post-retrofit	999,686	12,682.7	43.3	176,639
difference	-458,535	-5,817.3	-19.9	-81,708
% change	-31	-31	-31	-32
Other Fuels (MBtu)				
existing	34	0.4	0.4	1,100
post-retrofit	34	0.4	0.4	1,100
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	5,011	63.6	63.6	259,447
post-retrofit	3,446	43.7	43.7	177,739
difference	-1,565	-19.9	-19.9	-81,708
% change	-31	-31	-31	-31

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 396,160 kWh/year, followed by lighting with 363,057 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Medical facilities 559

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	250,456	157,151	363,057	396,160	291,398
post-retrofit	0	225,865	150,343	211,091	396,160	16,228
difference	0	-24,591	-6,808	-151,966	0	-275,170
% change	0	-10	-4	-42	0	-94
Other Fuels (MBtu)						
existing	0	0	0	0	34	0
post-retrofit	0	0	0	0	34	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	855	536	1,239	1,386	995
post-retrofit	0	771	513	720	1,386	55
difference	0	-84	-23	-519	0	-939
% change	0	-10	-4	-42	0	-94
Total (MBtu/1000ft2)						
existing	0	11	7	16	18	13
post-retrofit	0	10	7	9	18	1
difference	0	-1	0	-7	0	-12
% change	0	-10	-4	-42	0	-94

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Medical facilities 559
Sulfur Oxides (lb)	
existing	13,191
post-retrofit	9,046
difference	-4,145
% change	-31
Nitrogen Oxides (lb)	
existing	6,311
post-retrofit	4,330
difference	-1,981
% change	-31
Carbon Monoxide (lb)	
existing	10,861
post-retrofit	7,454
difference	-3,407
% change	-31
Carbon Dioxide (tons)	
existing	1,337
post-retrofit	918
difference	-420
% change	-31
Particulate Matter (lb)	
existing	261
post-retrofit	179
difference	-82
% change	-31
Hydrocarbons (lb)	
existing	4,493
post-retrofit	3,083
difference	-1,410
% change	-31

Building 1060 Laboratory

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1060 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1060

Building 1060 is a lab built in 1943. This lab is cooled by an air cooled chiller and has an electric water heater. 1060 is 14,920 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing various lighting technologies in the building. FEDS suggests replacing T12, T8 and EXIT lights.

Alternative financing FEDS results for building 1060:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Labs 1060	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	14	905	621	4,669	8.5
Labs 1060	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	9	743	3,516	844	1.2
Labs 1060	Lights	FL3: FL 2X4 2F40T12 STD2	FL51: FL 2X4 2F32T8 ELC2	12	935	3,249	2,233	1.7

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 292,009 kwh before retrofits and 281,462 kwh after proposed retrofits are implemented. The energy use intensity goes from 66.8 MBtu/Ksf to 64.4 MBtu/Ksf after retrofits.

Labs 1060

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	292,009	19,571.7	66.8	51,734
post-retrofit	281,462	18,864.8	64.4	49,733
difference	-10,547	-706.9	-2.4	-2,001
% change	-4	-4	-4	-4
Total (MBtu)				
existing	997	66.8	66.8	51,734
post-retrofit	961	64.4	64.4	49,733
difference	-36	-2.4	-2.4	-2,001
% change	-4	-4	-4	-4

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 116,645 kWh/year, followed by motors and miscellaneous equipment with 77,382 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Labs 1060

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	116,645	52,192	44,584	77,382	1,207
post-retrofit	0	114,048	51,676	37,150	77,382	1,207
difference	0	-2,596	-516	-7,434	0	0
% change	0	-2	-1	-17	0	0
Total (MBtu)						
existing	0	398	178	152	264	4
post-retrofit	0	389	176	127	264	4
difference	0	-9	-2	-25	0	0
% change	0	-2	-1	-17	0	0
Total (MBtu/1000ft2)						
existing	0	27	12	10	18	0
post-retrofit	0	26	12	8	18	0
difference	0	-1	0	-2	0	0
% change	0	-2	-1	-17	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Labs 1060
Sulfur Oxides (lb)	
existing	2,640
post-retrofit	2,544
difference	-95
% change	-4
Nitrogen Oxides (lb)	
existing	1,261
post-retrofit	1,216
difference	-46
% change	-4
Carbon Monoxide (lb)	
existing	2,170
post-retrofit	2,091
difference	-78
% change	-4
Carbon Dioxide (tons)	
existing	267
post-retrofit	258
difference	-10
% change	-4
Particulate Matter (lb)	
existing	52
post-retrofit	50
difference	-2
% change	-4
Hydrocarbons (lb)	
existing	898
post-retrofit	866
difference	-32
% change	-4

Building 1805 Dormitory

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1805 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1805

Building 1805 is a dormitory built in 1970. The dormitory is cooled by an air cooled chiller and has little to no insulation in its building envelope. This building has a desuperheater system, providing some of the hot water to the building. 1805 is 55,187 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the electric hot water heater with a heat pump water heater and replacing the EXIT lighting.

Appropriated funding FEDS analysis results for building 1805:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Dorms 1970's 1805	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	62	4,053	2,795	20,914	8.5

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 515,140 kwh before retrofits and 391,677 kwh after proposed retrofits are implemented. The energy use intensity goes from 31.9 MBtu/Ksf to 24.2 MBtu/Ksf after retrofits.

Dorms 1970's 1805

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	515,140	9,334.4	31.9	91,013
post-retrofit	496,775	9,001.7	30.7	87,776
difference	-18,365	-332.8	-1.1	-3,237
% change	-4	-4	-4	-4
Total (MBtu)				
existing	1,758	31.9	31.9	91,013
post-retrofit	1,695	30.7	30.7	87,776
difference	-63	-1.1	-1.1	-3,237
% change	-4	-4	-4	-4

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 188,139 kWh/year, followed by hot water with 121,790 kWh/year.

Dorms 1970's 1805

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	188,139	96,012	37,709	71,490	121,790
post-retrofit	0	182,899	95,392	25,205	71,490	121,790
difference	0	-5,240	-620	-12,504	0	0
% change	0	-3	-1	-33	0	0
Total (MBtu)						
existing	0	642	328	129	244	416
post-retrofit	0	624	326	86	244	416
difference	0	-18	-2	-43	0	0
% change	0	-3	-1	-33	0	0
Total (MBtu/1000ft2)						
existing	0	12	6	2	4	8
post-retrofit	0	11	6	2	4	8
difference	0	0	0	-1	0	0
% change	0	-3	-1	-33	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Dorms 1970's 1805
Sulfur Oxides (lb)	
existing	4,657
post-retrofit	4,491
difference	-166
% change	-4
Nitrogen Oxides (lb)	
existing	2,225
post-retrofit	2,146
difference	-79
% change	-4
Carbon Monoxide (lb)	
existing	3,828
post-retrofit	3,691
difference	-136
% change	-4
Carbon Dioxide (tons)	
existing	471
post-retrofit	455
difference	-17
% change	-4
Particulate Matter (lb)	
existing	92
post-retrofit	89
difference	-3
% change	-4
Hydrocarbons (lb)	
existing	1,584
post-retrofit	1,528
difference	-56
% change	-4

Building 1856 Dormitory

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1856 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1856

Building 1856 is a dormitory built in 1995. The dormitory is cooled by an electric air cooled chiller and has substantial roofing and wall insulation in its building envelope. The central hot water system runs on diesel fuel and works in conjunction with a desuperheater. Building 1856 is 43,187 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the air cooled chiller with a very high efficiency water cooled chiller, replacing the diesel hot water boiler with a heat pump hot water system and replacing the EXIT lighting.

Alternative financing FEDS analysis results for building 1856:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Dorms 1990's 1856 - heat recovery	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	286	15,031	75,277	10,924	1.1
Dorms 1990's 1856 - heat recovery	Hot Water	Distillate Oil Central Boiler	Central Heat Pump Hot Water System	151	5,505	22,540	11,662	1.5
Dorms 1990's 1856 - heat recovery	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	61	4,021	2,795	20,726	8.4

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 418,237 kwh before retrofits and 320,744 kwh after proposed retrofits are implemented. The modeled distillate oil consumption for a typical year was 1,252 gallons before retrofits and 0 gallons after proposed retrofits are implemented. The energy use intensity goes from 37.1 MBtu/Ksf to 25.3 MBtu/Ksf after retrofits.

Dorms 1990's 1856

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	418,237	9,684.3	33.1	73,892
post-retrofit	320,744	7,426.9	25.3	56,633
difference	-97,494	-2,257.5	-7.7	-17,259
% change	-23	-23	-23	-23
Distillate Oil (gal)				
existing	1,252	29.0	4.0	6,385
post-retrofit	0	0.0	0.0	0
difference	-1,252	-29.0	-4.0	-6,385
% change	-100	-100	-100	-100
Total (MBtu)				
existing	1,601	37.1	37.1	80,278
post-retrofit	1,095	25.3	25.3	56,633
difference	-506	-11.7	-11.7	-23,645
% change	-32	-32	-32	-29

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 233,630 kWh/year, followed by ventilation with 66,184 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Dorms 1990's 1856

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	233,630	61,498	66,184	56,926	0
post-retrofit	0	143,688	59,912	53,680	56,926	6,538
difference	0	-89,942	-1,586	-12,504	0	6,538
% change	0	-38	-3	-19	0	n/a
Distillate Oil (gal)						
existing	0	0	0	0	0	1,252
post-retrofit	0	0	0	0	0	0
difference	0	0	0	0	0	-1,252
% change	0	0	0	0	0	-100
Total (MBtu)						
existing	0	797	210	226	194	174
post-retrofit	0	490	204	183	194	22
difference	0	-307	-5	-43	0	-151
% change	0	-38	-3	-19	0	-87
Total (MBtu/1000ft2)						
existing	0	18	5	5	4	4
post-retrofit	0	11	5	4	4	1
difference	0	-7	0	-1	0	-4
% change	0	-38	-3	-19	0	-87

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Dorms 1990's	1856
Sulfur Oxides (lb)		
existing	3,868	
post-retrofit	2,900	
difference	-968	
% change	-25	
Nitrogen Oxides (lb)		
existing	1,866	
post-retrofit	1,386	
difference	-480	
% change	-26	
Carbon Monoxide (lb)		
existing	3,246	
post-retrofit	2,383	
difference	-863	
% change	-27	
Carbon Dioxide (tons)		
existing	399	
post-retrofit	293	
difference	-106	
% change	-26	
Particulate Matter (lb)		
existing	78	
post-retrofit	57	
difference	-21	
% change	-27	
Hydrocarbons (lb)		
existing	1,331	
post-retrofit	986	
difference	-345	
% change	-26	

Building 1166 Lodging Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1166 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1166

Building 1166 is a hotel style building used as a temporary lodging facility and was built in 1968. The building is cooled by an air cooled chiller and has little to no insulation in the building envelope. Building 1166 is 25,113 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the hot water systems with a heat pump water heater. FEDS also suggests replacing the EXIT lighting and adding insulation to the interior surface of the metal roof.

Alternative financing FEDS analysis results for building 1166:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Lodging facilities 1166	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	58	3,898	2,795	20,020	8.2

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 425,234 kwh before retrofits and 374,596 kwh after proposed retrofits are implemented. The modeled other fuels (propane) consumption for a typical year was 48 MBtu before retrofits and 0 MBtu after proposed retrofits are implemented. The energy use intensity goes from 59.7 MBtu/Ksf to 50.9 MBtu/Ksf after retrofits.

Lodging facilities 1166

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	425,234	16,932.8	57.8	75,129
post-retrofit	407,904	16,242.8	55.4	72,073
difference	-17,330	-690.1	-2.4	-3,055
% change	-4	-4	-4	-4
Other Fuels (MBtu)				
existing	48	1.9	1.9	1,531
post-retrofit	48	1.9	1.9	1,531
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	1,499	59.7	59.7	76,659
post-retrofit	1,440	57.3	57.3	73,604
difference	-59	-2.4	-2.4	-3,055
% change	-4	-4	-4	-4

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 166,650 kWh/year, followed by ventilation with 117,053 kWh/year.

Lodging facilities 1166

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	166,650	117,053	61,726	38,238	41,566
post-retrofit	0	161,824	117,053	49,222	38,238	41,566
difference	0	-4,826	0	-12,504	0	0
% change	0	-3	0	-20	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	0	48
post-retrofit	0	0	0	0	0	48
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	569	400	211	131	189
post-retrofit	0	552	400	168	131	189
difference	0	-16	0	-43	0	0
% change	0	-3	0	-20	0	0
Total (MBtu/1000ft2)						
existing	0	23	16	8	5	8
post-retrofit	0	22	16	7	5	8
difference	0	-1	0	-2	0	0
% change	0	-3	0	-20	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Lodging facilities 1166
Sulfur Oxides (lb)	
existing	3,856
post-retrofit	3,699
difference	-157
% change	-4
Nitrogen Oxides (lb)	
existing	1,854
post-retrofit	1,779
difference	-75
% change	-4
Carbon Monoxide (lb)	
existing	3,196
post-retrofit	3,067
difference	-129
% change	-4
Carbon Dioxide (tons)	
existing	393
post-retrofit	377
difference	-16
% change	-4
Particulate Matter (lb)	
existing	77
post-retrofit	73
difference	-3
% change	-4
Hydrocarbons (lb)	
existing	1,320
post-retrofit	1,266
difference	-53
% change	-4

Building 2040 Aircraft Maintenance Shop

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2040 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2040

Building 2040 is an aircraft maintenance shop built in 1937. 2040 is cooled by an air cooled chiller and has little to no insulation in its building envelope. Building 2040 is 77,439 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing some of the lighting technologies, and various upgrades to the electric water heater system for the conditioned spaces. FEDS had no life cycle cost effective retrofits for the unconditioned space.

Appropriated funding FEDS analysis results for building 2040 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 2040	Hot Water	Electric Water Heater	Faucet Aerators, Lower Tank Temperature	1	89	46	465	11.1
1940's shops 2040	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	58	311	47	1.2
1940's shops 2040	Lights	FL2: FL 2X4 3F40T12 STD1,2	FL236: FL 2X4 3F32T8 ELC3	8	599	1,764	1,742	2.0
1940's shops 2040	Lights	FL1: FL 2X4 4F40T12 STD2	FL244: FL 2X4 4F32T8 ELC4	56	4,034	9,524	13,994	2.5
1940's shops 2040	Lights	FL3: FL 2X4 2F40T12 STD2	FL51: FL 2X4 2F32T8 ELC2	9	695	2,821	1,253	1.4

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 352,637 kwh. No proposed retrofits were suggested for the unconditioned space. The energy use intensity is 18.3 MBtu/Ksf.

1940's shops 2040 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	352,637	5,362.8	18.3	62,302
post-retrofit	352,637	5,362.8	18.3	62,264
difference	0	0.0	0.0	-38
% change	0	0	0	0
Total (MBtu)				
existing	1,204	18.3	18.3	62,302
post-retrofit	1,204	18.3	18.3	62,264
difference	0	0.0	0.0	-38
% change	0	0	0	0

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for the conditioned space a typical year was 156,928 kwh before retrofits and 134,998 kwh after proposed retrofits are implemented. The energy use intensity goes from 46.2 MBtu/Ksf to 39.7 MBtu/Ksf after retrofits.

1940's shops 2040 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	156,928	13,523.7	46.2	27,725
post-retrofit	134,998	11,633.7	39.7	23,836
difference	-21,931	-1,889.9	-6.5	-3,889
% change	-14	-14	-14	-14
Total (MBtu)				
existing	536	46.2	46.2	27,725
post-retrofit	461	39.7	39.7	23,836
difference	-75	-6.5	-6.5	-3,889
% change	-14	-14	-14	-14

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the unconditioned space of the building with 308,331 kWh/year, followed by lighting with 44,307 kWh/year.

		1940's shops	2040 unconditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	44,307	308,331	0
post-retrofit	0	0	0	44,307	308,331	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	0	0	151	1,052	0
post-retrofit	0	0	0	151	1,052	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	2	16	0
post-retrofit	0	0	0	2	16	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0

Motors and miscellaneous equipment is the largest load in the conditioned space of the building with 56,167 kWh/year, followed by space cooling with 52,533 kWh/year.

1940's shops 2040

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	52,533	2,983	43,930	56,167	1,315
post-retrofit	0	48,660	2,757	26,536	56,167	878
difference	0	-3,874	-226	-17,394	0	-437
% change	0	-7	-8	-40	0	-33
Total (MBtu)						
existing	0	179	10	150	192	4
post-retrofit	0	166	9	91	192	3
difference	0	-13	-1	-59	0	-1
% change	0	-7	-8	-40	0	-33
Total (MBtu/1000ft2)						
existing	0	15	1	13	17	0
post-retrofit	0	14	1	8	17	0
difference	0	-1	0	-5	0	0
% change	0	-7	-8	-40	0	-33

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1940's shops	2040 unconditioned space
Sulfur Oxides (lb)		
existing	3,188	
post-retrofit	3,188	
difference	0	
% change	0	
Nitrogen Oxides (lb)		
existing	1,523	
post-retrofit	1,523	
difference	0	
% change	0	
Carbon Monoxide (lb)		
existing	2,620	
post-retrofit	2,620	
difference	0	
% change	0	
Carbon Dioxide (tons)		
existing	323	
post-retrofit	323	
difference	0	
% change	0	
Particulate Matter (lb)		
existing	63	
post-retrofit	63	
difference	0	
% change	0	
Hydrocarbons (lb)		
existing	1,084	
post-retrofit	1,084	
difference	0	
% change	0	

	1940's shops	2040 conditioned space
Sulfur Oxides (lb)		
existing	1,419	
post-retrofit	1,220	
difference	-198	
% change	-14	
Nitrogen Oxides (lb)		
existing	678	
post-retrofit	583	
difference	-95	
% change	-14	
Carbon Monoxide (lb)		
existing	1,166	
post-retrofit	1,003	
difference	-163	
% change	-14	
Carbon Dioxide (tons)		
existing	144	
post-retrofit	124	
difference	-20	
% change	-14	
Particulate Matter (lb)		
existing	28	
post-retrofit	24	
difference	-4	
% change	-14	
Hydrocarbons (lb)		
existing	483	
post-retrofit	415	
difference	-67	
% change	-14	

Building 1715 Recycling Center

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1715 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1715

1715 is a recycling center built in 1944. The majority of the space is unconditioned, with a small office that is served by an electric package unit. The building was modeled as two linked buildings, one conditioned, one unconditioned. Building 1715 is 30,400 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing lights in the unconditioned space as well as replacing lights in the conditioned space.

Alternative financing FEDS results for building 1715 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 1715	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	112	621	62	1.1
1940's shops 1715	Lights	FL62: FL 1X8 2F96T12 STD2	FL74: FL 1X8 2F96T12 ELC2	14	1,129	5,809	796	1.1

Alternative financing FEDS results for building 1715 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 1715	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	59	311	50	1.2
1940's shops 1715	Lights	FL37: FL 2X4 4F32T8 EEF2	FL280: FL 2X4 3F32ST8 ELC3 REF	115	8,684	25,173	25,616	2.0

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 147,909 kwh before retrofits and 143,661 kwh after proposed retrofits are implemented. The energy use intensity goes from 18.0 MBtu/Ksf to 17.5 MBtu/Ksf after retrofits.

1940's shops 1715 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	147,909	5,288.5	18.0	26,132
post-retrofit	143,661	5,136.6	17.5	25,366
difference	-4,248	-151.9	-0.5	-766
% change	-3	-3	-3	-3
Total (MBtu)				
existing	505	18.0	18.0	26,132
post-retrofit	490	17.5	17.5	25,366
difference	-14	-0.5	-0.5	-766
% change	-3	-3	-3	-3

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 331,402 kwh before retrofits and 299,027 kwh after proposed retrofits are implemented. The energy use intensity goes from 466.5.6 MBtu/Ksf to 419.6 MBtu/Ksf after retrofits.

1940's shops   1715 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	332,402	136,678.6	466.5	58,727
post-retrofit	299,027	122,955.2	419.6	52,798
difference	-33,375	-13,723.4	-46.8	-5,929
% change	-10	-10	-10	-10
Total (MBtu)				
existing	1,134	466.5	466.5	58,727
post-retrofit	1,021	419.6	419.6	52,798
difference	-114	-46.8	-46.8	-5,929
% change	-10	-10	-10	-10

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the unconditioned space of the building with 131,142 kWh/year, followed by lighting with 16,767 kWh/year.

1940's shops 1715 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	16,767	131,142	0
post-retrofit	0	0	0	10,116	131,142	0
difference	0	0	0	-6,651	0	0
% change	0	0	0	-40	0	0
Total (MBtu)						
existing	0	0	0	57	448	0
post-retrofit	0	0	0	35	448	0
difference	0	0	0	-23	0	0
% change	0	0	0	-40	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	2	16	0
post-retrofit	0	0	0	1	16	0
difference	0	0	0	-1	0	0
% change	0	0	0	-40	0	0

Lighting is the largest load in the conditioned space of the building with 234,179 kWh/year, followed by space cooling with 82,158 kWh/year.

1940's shops 1715

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	82,158	4,295	234,179	11,772	0
post-retrofit	0	75,557	3,928	207,770	11,772	0
difference	0	-6,600	-366	-26,409	0	0
% change	0	-8	-9	-11	0	0
Total (MBtu)						
existing	0	280	15	799	40	0
post-retrofit	0	258	13	709	40	0
difference	0	-23	-1	-90	0	0
% change	0	-8	-9	-11	0	0
Total (MBtu/1000ft2)						
existing	0	115	6	329	17	0
post-retrofit	0	106	6	292	17	0
difference	0	-9	-1	-37	0	0
% change	0	-8	-9	-11	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1940's shops	1715 unconditioned space
Sulfur Oxides (lb)		
existing	1,337	
post-retrofit	1,299	
difference	-38	
% change	-3	
Nitrogen Oxides (lb)		
existing	639	
post-retrofit	621	
difference	-18	
% change	-3	
Carbon Monoxide (lb)		
existing	1,099	
post-retrofit	1,067	
difference	-32	
% change	-3	
Carbon Dioxide (tons)		
existing	135	
post-retrofit	131	
difference	-4	
% change	-3	
Particulate Matter (lb)		
existing	26	
post-retrofit	26	
difference	-1	
% change	-3	
Hydrocarbons (lb)		
existing	455	
post-retrofit	442	
difference	-13	
% change	-3	

	1940's shops	1715 conditioned space
Sulfur Oxides (lb)		
existing	3,005	
post-retrofit	2,703	
difference	-302	
% change	-10	
Nitrogen Oxides (lb)		
existing	1,436	
post-retrofit	1,292	
difference	-144	
% change	-10	
Carbon Monoxide (lb)		
existing	2,470	
post-retrofit	2,222	
difference	-248	
% change	-10	
Carbon Dioxide (tons)		
existing	304	
post-retrofit	274	
difference	-31	
% change	-10	
Particulate Matter (lb)		
existing	59	
post-retrofit	53	
difference	-6	
% change	-10	
Hydrocarbons (lb)		
existing	1,022	
post-retrofit	920	
difference	-103	
% change	-10	

Building 2177 Maintenance Shop

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2177 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2177

2177 is a base engineer maintenance shop built in 1944. This building is partially cooled. Building 2177 is 3,200 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing T12 lighting with T8 lighting in the unconditioned spaces. Upgrades to the hot water system include insulating the tank and pipes as well as installing aerators and lowering the tank temperature for the unconditioned spaces. For the conditioned spaces FEDS suggests replacing the lighting, and upgrading the hot water system.

Alternative financing FEDS results for building 2177 unconditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 2177	Hot Water	Electric Water Heater	Faucet Aerators, Lower Tank Temperature	-	1	2	5	3.9
1940's shops 2177	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	7	585	2,437	1,000	1.4

Alternative financing FEDS results for building 2177 conditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's shops 2177	Hot Water	Electric Water Heater	Faucet Aerators, Lower Tank Temperature	-	1	2	9	5.0
1940's shops 2177	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	7	43	7	1.2

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 13,067 kwh before retrofits and 11,100 kwh after proposed retrofits are implemented. The energy use intensity goes from 27.9 MBtu/Ksf to 23.7 MBtu/Ksf after retrofits.

1940's shops 2177 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	13,067	8,166.8	27.9	2,310
post-retrofit	11,100	6,937.4	23.7	1,960
difference	-1,967	-1,229.4	-4.2	-350
% change	-15	-15	-15	-15
Total (MBtu)				
existing	45	27.9	27.9	2,310
post-retrofit	38	23.7	23.7	1,960
difference	-7	-4.2	-4.2	-350
% change	-15	-15	-15	-15

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 42,463 kwh before retrofits and 27,009 kwh after proposed retrofits are implemented. The energy use intensity goes from 90.6 MBtu/Ksf to 57.6 MBtu/Ksf after retrofits.

1940's shops   2177 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	29,056	18,159.8	62.0	5,136
post-retrofit	29,035	18,146.8	61.9	5,126
difference	-21	-12.9	0.0	-9
% change	0	0	0	0
Total (MBtu)				
existing	99	62.0	62.0	5,136
post-retrofit	99	61.9	61.9	5,126
difference	0	0.0	0.0	-9
% change	0	0	0	0

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the unconditioned space of the building with 7,502 kWh/year, followed by lighting with 5,536 kWh/year.

		1940's shops	2177 unconditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	5,536	7,502	29
post-retrofit	0	0	0	3,575	7,502	22
difference	0	0	0	-1,961	0	-6
% change	0	0	0	-35	0	-23
Total (MBtu)						
existing	0	0	0	19	26	0
post-retrofit	0	0	0	12	26	0
difference	0	0	0	-7	0	0
% change	0	0	0	-35	0	-23
Total (MBtu/1000ft2)						
existing	0	0	0	12	16	0
post-retrofit	0	0	0	8	16	0
difference	0	0	0	-4	0	0
% change	0	0	0	-35	0	-23

Space cooling is the largest load in the conditioned space of the building with 10,796 kWh/year, followed by lighting with 10,793 kWh/year.

		1940's shops	2177 conditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	10,796	2,268	8,210	7,745	38
post-retrofit	0	10,793	2,267	8,202	7,745	28
difference	0	-2	-1	-8	0	-10
% change	0	0	0	0	0	-26
Total (MBtu)						
existing	0	37	8	28	26	0
post-retrofit	0	37	8	28	26	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	-26
Total (MBtu/1000ft2)						
existing	0	23	5	18	17	0
post-retrofit	0	23	5	17	17	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	-26

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1940's shops	2177 unconditioned space
Sulfur Oxides (lb)		
existing	118	
post-retrofit	100	
difference	-18	
% change	-15	
Nitrogen Oxides (lb)		
existing	56	
post-retrofit	48	
difference	-8	
% change	-15	
Carbon Monoxide (lb)		
existing	97	
post-retrofit	82	
difference	-15	
% change	-15	
Carbon Dioxide (tons)		
existing	12	
post-retrofit	10	
difference	-2	
% change	-15	
Particulate Matter (lb)		
existing	2	
post-retrofit	2	
difference	0	
% change	-15	
Hydrocarbons (lb)		
existing	40	
post-retrofit	34	
difference	-6	
% change	-15	

	1940's shops 2177 conditioned space
Sulfur Oxides (lb)	
existing	263
post-retrofit	262
difference	0
% change	0
Nitrogen Oxides (lb)	
existing	126
post-retrofit	125
difference	0
% change	0
Carbon Monoxide (lb)	
existing	216
post-retrofit	216
difference	0
% change	0
Carbon Dioxide (tons)	
existing	27
post-retrofit	27
difference	0
% change	0
Particulate Matter (lb)	
existing	5
post-retrofit	5
difference	0
% change	0
Hydrocarbons (lb)	
existing	89
post-retrofit	89
difference	0
% change	0

Building 4016 Maintenance Shop

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 4016 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 4016

Building 4016 is a base engineer maintenance shop built in 1973. 4016 is cooled by multiple package units and has little to no insulation in its building enveloped. Building 4016 is 7,701 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the EXIT lighting. In the unconditioned space FEDS suggests replacing the EXIT lighting as well.

Alternative financing FEDS results for building 4016 unconditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1970's shops 4016	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	14	863	621	4,433	8.1

Alternative financing FEDS results for building 4016 unconditioned spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1970's shops 4016	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	5	348	311	1,742	6.6

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 67,485 kwh before retrofits and 63,739 kwh after proposed retrofits are implemented. The energy use intensity goes from 39.9 MBtu/Ksf to 37.7 MBtu/Ksf after retrofits.

1970's shops   4016 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	67,485	11,685.8	39.9	11,928
post-retrofit	63,739	11,037.1	37.7	11,254
difference	-3,746	-648.7	-2.2	-674
% change	-6	-6	-6	-6
Total (MBtu)				
existing	230	39.9	39.9	11,928
post-retrofit	218	37.7	37.7	11,254
difference	-13	-2.2	-2.2	-674
% change	-6	-6	-6	-6

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 12,772 kwh before retrofits and 11,383 kwh after proposed retrofits are implemented. The energy use intensity goes from 22.6 MBtu/Ksf to 20.2 MBtu/Ksf after retrofits.

1970's shops 4016 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	12,772	6,634.9	22.6	2,257
post-retrofit	11,383	5,913.1	20.2	2,010
difference	-1,389	-721.7	-2.5	-248
% change	-11	-11	-11	-11
Total (MBtu)				
existing	44	22.6	22.6	2,257
post-retrofit	39	20.2	20.2	2,010
difference	-5	-2.5	-2.5	-248
% change	-11	-11	-11	-11

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the conditioned space of the building with 27,381 kWh/year, followed by space cooling with 23,540 kWh/year.

		1970's shops	4016 conditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	23,540	5,159	10,761	27,381	643
post-retrofit	0	22,675	5,057	7,983	27,381	643
difference	0	-865	-103	-2,779	0	0
% change	0	-4	-2	-26	0	0
Total (MBtu)						
existing	0	80	18	37	93	2
post-retrofit	0	77	17	27	93	2
difference	0	-3	0	-9	0	0
% change	0	-4	-2	-26	0	0
Total (MBtu/1000ft2)						
existing	0	14	3	6	16	0
post-retrofit	0	13	3	5	16	0
difference	0	-1	0	-2	0	0
% change	0	-4	-2	-26	0	0

Motors and miscellaneous equipment is the largest load in the unconditioned space of the building with 8,620 kWh/year, followed by lighting with 3,738 kWh/year.

		1970's shops	4016 unconditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	3,738	8,620	415
post-retrofit	0	0	0	2,349	8,620	415
difference	0	0	0	-1,389	0	0
% change	0	0	0	-37	0	0
Total (MBtu)						
existing	0	0	0	13	29	1
post-retrofit	0	0	0	8	29	1
difference	0	0	0	-5	0	0
% change	0	0	0	-37	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	7	15	1
post-retrofit	0	0	0	4	15	1
difference	0	0	0	-2	0	0
% change	0	0	0	-37	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1970's shops	4016 conditioned space
Sulfur Oxides (lb)		
existing	610	
post-retrofit	576	
difference	-34	
% change	-6	
Nitrogen Oxides (lb)		
existing	292	
post-retrofit	275	
difference	-16	
% change	-6	
Carbon Monoxide (lb)		
existing	501	
post-retrofit	474	
difference	-28	
% change	-6	
Carbon Dioxide (tons)		
existing	62	
post-retrofit	58	
difference	-3	
% change	-6	
Particulate Matter (lb)		
existing	12	
post-retrofit	11	
difference	-1	
% change	-6	
Hydrocarbons (lb)		
existing	208	
post-retrofit	196	
difference	-12	
% change	-6	

	1970's shops	4016 unconditioned space
Sulfur Oxides (lb)		
existing	115	
post-retrofit	103	
difference	-13	
% change	-11	
Nitrogen Oxides (lb)		
existing	55	
post-retrofit	49	
difference	-6	
% change	-11	
Carbon Monoxide (lb)		
existing	95	
post-retrofit	85	
difference	-10	
% change	-11	
Carbon Dioxide (tons)		
existing	12	
post-retrofit	10	
difference	-1	
% change	-11	
Particulate Matter (lb)		
existing	2	
post-retrofit	2	
difference	0	
% change	-11	
Hydrocarbons (lb)		
existing	39	
post-retrofit	35	
difference	-4	
% change	-11	

Building 2131 Administrative Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2131 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2131

Building 2131 is a building with some administration space as well as some lab-space and unconditioned high-bay space. Building 2131 was built in 2008 and is 26,296 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the EXIT lighting in the laboratory and administration spaces. FEDS also suggests replacing EXIT lighting and metal halide lighting in the high bay space.

Alternative financing FEDS results for building 2131 administration and laboratory spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1990's shops 2131	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	73	373	69	1.2
1990's shops 2131	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	48	248	46	1.2

Alternative financing FEDS results for building 2131 high bay spaces:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1990's shop highbay space 2131	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	112	621	10	1.1

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 221,784 kwh before retrofits and 221,610 kwh after proposed retrofits are implemented. The energy use intensity goes from 57.6 MBtu/Ksf to 57.5 MBtu/Ksf after retrofits.

1990's shops administration and laboratory space 2131

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	221,784	16,868.3	57.6	39,293
post-retrofit	221,610	16,855.0	57.5	39,157
difference	-174	-13.2	0.0	-135
% change	0	0	0	0
Total (MBtu)				
existing	757	57.6	57.6	39,293
post-retrofit	756	57.5	57.5	39,157
difference	-1	0.0	0.0	-135
% change	0	0	0	0

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 152,074 kwh before retrofits and 151,958 kwh after proposed retrofits are implemented. The energy use intensity goes from 39.5 MBtu/Ksf to 39.5 MBtu/Ksf after retrofits.

1990's shop highbay space 2131

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	152,074	11,570.7	39.5	26,948
post-retrofit	151,958	11,561.9	39.5	26,933
difference	-116	-8.8	0.0	-15
% change	0	0	0	0
Total (MBtu)				
existing	519	39.5	39.5	26,948
post-retrofit	519	39.5	39.5	26,933
difference	0	0.0	0.0	-15
% change	0	0	0	0

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 84,806 kWh/year, followed by space cooling with 62,357 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
1990's administration and laboratory space 2131

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	62,357	14,183	57,107	84,806	3,330
post-retrofit	0	62,310	14,171	56,992	84,806	3,330
difference	0	-47	-11	-116	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	213	48	195	289	11
post-retrofit	0	213	48	195	289	11
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu/1000ft2)						
existing	0	16	4	15	22	1
post-retrofit	0	16	4	15	22	1
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0

Motors and miscellaneous equipment is the largest load in the building with 92,181 kWh/year, followed by space cooling with 57,524 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
1990's shop highbay space 2131

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	57,524	92,181	2,368
post-retrofit	0	0	0	57,409	92,181	2,368

difference	0	0	0	-116	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	0	0	196	315	8
post-retrofit	0	0	0	196	315	8
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	15	24	1
post-retrofit	0	0	0	15	24	1
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1990's administration and lab space 2131
Sulfur Oxides (lb)	
existing	2,005
post-retrofit	2,003
difference	-2
% change	0
Nitrogen Oxides (lb)	
existing	958
post-retrofit	957
difference	-1
% change	0
Carbon Monoxide (lb)	
existing	1,648
post-retrofit	1,647
difference	-1
% change	0
Carbon Dioxide (tons)	
existing	203
post-retrofit	203
difference	0
% change	0
Particulate Matter (lb)	
existing	40
post-retrofit	40
difference	0
% change	0
Hydrocarbons (lb)	
existing	682
post-retrofit	681
difference	-1

1990's shop highbay space 2131

Sulfur Oxides (lb)	
existing	1,375
post-retrofit	1,374
difference	-1
% change	0
Nitrogen Oxides (lb)	
existing	657
post-retrofit	656
difference	0
% change	0
Carbon Monoxide (lb)	
existing	1,130
post-retrofit	1,129
difference	-1
% change	0
Carbon Dioxide (tons)	
existing	139
post-retrofit	139
difference	0
% change	0
Particulate Matter (lb)	
existing	27
post-retrofit	27
difference	0
% change	0
Hydrocarbons (lb)	
existing	468
post-retrofit	467
difference	0
% change	0

Building 1728 Warehouse

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1728 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1728

1728 is a warehouse building built in 1993. This building partially unconditioned with the office space being served by an electric air cooled chiller. Building 1728 is 140,383 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing lights in the conditioned and unconditioned spaces. For the conditioned space, it is recommended to increase roof insulation as well as installing aerators.

Alternative financing FEDS results for building 1728 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1050's Wharehouse/storage 1728	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	112	621	62	1.1
1050's Wharehouse/storage 1728	Lights	MH6: MH 400 PEND	HS18: HPS 310 PEND	175	8,758	38,531	11,889	1.3

Alternative financing FEDS results for building 1728 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1050's Wharehouse/storage 1728	Hot Water	Electric Water Heater	Faucet Aerators	-	21	14	109	8.7
1050's Wharehouse/storage 1728	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	56	311	30	1.1
1050's Wharehouse/storage 1728	Lights	FL37: FL 2X4 4F32T8 EEF2	FL280: FL 2X4 3F32ST8 ELC3 REF	55	3,428	3,312	16,684	6.0
1050's Wharehouse/storage 1728	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	118	7,242	8,890	32,679	4.7

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 493,902 kwh before retrofits and 442,488 kwh after proposed retrofits are implemented. The energy use intensity goes from 12.2 MBtu/Ksf to 11.0 MBtu/Ksf after retrofits.

1050's Warehouse/storage 1728 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	493,902	3,584.7	12.2	87,503
post-retrofit	442,488	3,211.5	11.0	78,185
difference	-51,414	-373.2	-1.3	-9,318
% change	-10	-10	-10	-11
Total (MBtu)				
existing	1,686	12.2	12.2	87,503
post-retrofit	1,510	11.0	11.0	78,185
difference	-175	-1.3	-1.3	-9,318
% change	-10	-10	-10	-11

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 146,926 kwh before retrofits and 97,702 kwh after proposed retrofits are implemented. The energy use intensity goes from 192.8 MBtu/Ksf to 128.2 MBtu/Ksf after retrofits.

1050's Warehouse/storage 1728 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	146,926	56,488.3	192.8	26,030
post-retrofit	97,702	37,563.3	128.2	17,263
difference	-49,224	-18,925.0	-64.6	-8,767
% change	-34	-34	-34	-34
Total (MBtu)				
existing	501	192.8	192.8	26,030
post-retrofit	333	128.2	128.2	17,263
difference	-168	-64.6	-64.6	-8,767
% change	-34	-34	-34	-34

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Lighting is the largest load in the unconditioned space of the building with 253,372 kWh/year, followed by motors and miscellaneous equipment with 240,530 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
1050's Warehouse/storage 1728 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	253,372	240,530	0
post-retrofit	0	0	0	201,958	240,530	0
difference	0	0	0	-51,414	0	0
% change	0	0	0	-20	0	0
Total (MBtu)						
existing	0	0	0	865	821	0
post-retrofit	0	0	0	689	821	0
difference	0	0	0	-175	0	0
% change	0	0	0	-20	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	6	6	0
post-retrofit	0	0	0	5	6	0
difference	0	0	0	-1	0	0
% change	0	0	0	-20	0	0

Space cooling is the largest load in the conditioned space of the building with 60,659 kWh/year, followed by motors and miscellaneous equipment with 31,893 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
1050's Warehouse/storage 1728 conditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	60,659	27,479	26,560	31,893	334
post-retrofit	0	27,215	23,026	15,339	31,893	229
difference	0	-33,444	-4,453	-11,222	0	-105
% change	0	-55	-16	-42	0	-31
Total (MBtu)						
existing	0	207	94	91	109	1
post-retrofit	0	93	79	52	109	1
difference	0	-114	-15	-38	0	0
% change	0	-55	-16	-42	0	-31
Total (MBtu/1000ft2)						
existing	0	80	36	35	42	0
post-retrofit	0	36	30	20	42	0
difference	0	-44	-6	-15	0	0
% change	0	-55	-16	-42	0	-31

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1050's Wharehouse/storage 1728 unconditioned space
Sulfur Oxides (lb)	
existing	4,465
post-retrofit	4,000
difference	-465
% change	-10
Nitrogen Oxides (lb)	
existing	2,134
post-retrofit	1,911
difference	-222
% change	-10
Carbon Monoxide (lb)	
existing	3,670
post-retrofit	3,288
difference	-382
% change	-10
Carbon Dioxide (tons)	
existing	452
post-retrofit	405
difference	-47
% change	-10
Particulate Matter (lb)	
existing	88
post-retrofit	79
difference	-9
% change	-10
Hydrocarbons (lb)	
existing	1,519
post-retrofit	1,361
difference	-158
% change	-10

1050's Wharehouse/storage 1728 conditioned space

Sulfur Oxides (lb)	
existing	1,328
post-retrofit	883
difference	-445
% change	-34
Nitrogen Oxides (lb)	
existing	635
post-retrofit	422
difference	-213
% change	-34
Carbon Monoxide (lb)	
existing	1,092
post-retrofit	726
difference	-366
% change	-34
Carbon Dioxide (tons)	
existing	134
post-retrofit	89
difference	-45
% change	-34
Particulate Matter (lb)	
existing	26
post-retrofit	17
difference	-9
% change	-34
Hydrocarbons (lb)	
existing	452
post-retrofit	300
difference	-151
% change	-34

Building 1072 Supply Warehouse

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1072 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1072

1072 is a warehouse building built in 1941. The warehouse is largely unconditioned but has a few small offices that are conditioned by DX units. Building 1072 is 83,379 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing lights in the conditioned and unconditioned spaces of the building. FEDS also suggests adding insulation to the interior of the roof and replacing the single pane windows with double pane, super low-e windows in the conditioned space.

Alternative financing FEDS results for building 1072 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1050's Wharehouse/storage 1072	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	112	621	62	1.1
1050's Wharehouse/storage 1072	Lights	FL236: FL 2X4 3F32T8 ELC3	FL279: FL 2X4 2F32ST8 ELC2 REF	128	6,785	13,362	25,840	2.9
1050's Wharehouse/storage 1072	Lights	MH6: MH 400 PEND	HS18: HPS 310 PEND	69	3,445	15,160	4,677	1.3

Alternative financing FEDS results for building 1072 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1050's Wharehouse/storage 1072	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	61	311	61	1.2
1050's Wharehouse/storage 1072	Lights	FL236: FL 2X4 3F32T8 ELC3	FL279: FL 2X4 2F32ST8 ELC2 REF	41	2,214	3,158	9,617	4.0
1050's Wharehouse/storage 1072	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	299	15,650	22,799	67,034	3.9

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 404,132 kwh before retrofits and 346,253 kwh after proposed retrofits are implemented. The energy use intensity goes from 17.5 MBtu/Ksf to 15.0 MBtu/Ksf after retrofits.

1050's Wharehouse/storage 1072 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	404,132	5,134.6	17.5	71,400
post-retrofit	346,253	4,399.2	15.0	61,137
difference	-57,879	-735.4	-2.5	-10,263
% change	-14	-14	-14	-14
Total (MBtu)				
existing	1,379	17.5	17.5	71,400
post-retrofit	1,182	15.0	15.0	61,137
difference	-198	-2.5	-2.5	-10,263
% change	-14	-14	-14	-14

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 163,410 kwh before retrofits and 65,956 kwh after proposed retrofits are implemented. The energy use intensity goes from 83.6 MBtu/Ksf to 33.7 MBtu/Ksf after retrofits.

1050's Wharehouse/storage 1072 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	163,410	24,499.2	83.6	28,870
post-retrofit	65,956	9,888.4	33.7	11,646
difference	-97,454	-14,610.7	-49.9	-17,225
% change	-60	-60	-60	-60
Total (MBtu)				
existing	558	83.6	83.6	28,870
post-retrofit	225	33.7	33.7	11,646
difference	-333	-49.9	-49.9	-17,225
% change	-60	-60	-60	-60

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Lighting is the largest load in the unconditioned space of the building with 266,729 kWh/year, followed by motors and miscellaneous equipment with 137,403 kWh/year.

1050's Warehouse/storage 1072 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	266,729	137,403	0
post-retrofit	0	0	0	208,850	137,403	0
difference	0	0	0	-57,879	0	0
% change	0	0	0	-22	0	0
Total (MBtu)						
existing	0	0	0	910	469	0
post-retrofit	0	0	0	713	469	0
difference	0	0	0	-198	0	0
% change	0	0	0	-22	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	12	6	0
post-retrofit	0	0	0	9	6	0
difference	0	0	0	-3	0	0
% change	0	0	0	-22	0	0

Space cooling is the largest load in the conditioned space of the building with 79,200 kWh/year, followed by ventilation with 53,432 kWh/year.

1050's Wharehouse/storage 1072 conditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	79,200	53,432	19,134	11,644	0
post-retrofit	0	25,968	17,263	11,081	11,644	0
difference	0	-53,232	-36,169	-8,052	0	0
% change	0	-67	-68	-42	0	0
Total (MBtu)						
existing	0	270	182	65	40	0
post-retrofit	0	89	59	38	40	0
difference	0	-182	-123	-27	0	0
% change	0	-67	-68	-42	0	0
Total (MBtu/1000ft2)						
existing	0	41	27	10	6	0
post-retrofit	0	13	9	6	6	0
difference	0	-27	-19	-4	0	0
% change	0	-67	-68	-42	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1050's Wharehouse/storage	1072 unconditioned space
Sulfur Oxides (lb)		
existing	3,653	
post-retrofit	3,130	
difference	-523	
% change	-14	
Nitrogen Oxides (lb)		
existing	1,746	
post-retrofit	1,496	
difference	-250	
% change	-14	
Carbon Monoxide (lb)		
existing	3,003	
post-retrofit	2,573	
difference	-430	
% change	-14	
Carbon Dioxide (tons)		
existing	370	
post-retrofit	317	
difference	-53	
% change	-14	
Particulate Matter (lb)		
existing	72	
post-retrofit	62	
difference	-10	
% change	-14	
Hydrocarbons (lb)		
existing	1,243	
post-retrofit	1,065	
difference	-178	
% change	-14	

	1050's Wharehouse/storage	1072 conditioned space
Sulfur Oxides (lb)		
existing	1,477	
post-retrofit	596	
difference	-881	
% change	-60	
Nitrogen Oxides (lb)		
existing	706	
post-retrofit	285	
difference	-421	
% change	-60	
Carbon Monoxide (lb)		
existing	1,214	
post-retrofit	490	
difference	-724	
% change	-60	
Carbon Dioxide (tons)		
existing	150	
post-retrofit	60	
difference	-89	
% change	-60	
Particulate Matter (lb)		
existing	29	
post-retrofit	12	
difference	-17	
% change	-60	
Hydrocarbons (lb)		
existing	503	
post-retrofit	203	
difference	-300	
% change	-60	

Building 1070 Warehouse Building

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1070 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1070

1070 is a warehouse building with some conditioned hazmat storage built in 1941. Building 1070 is mostly unconditioned storage with a small office that is conditioned by a small DX unit. Building 1070 is 62,779 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing lighting in the unconditioned space as well as replacing the EXIT lighting fixtures in the conditioned and unconditioned spaces. FEDS also suggests increasing the insulation in the roof of the conditioned office space.

Alternative financing FEDS results for building 1070 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
small storage 1070	Lights	IN27: INC 100 WALL	CF9: CFL 26 INTEGRAL UNIT ELC	9	663	2,530	1,347	1.5
small storage 1070	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	9	698	621	3,483	6.6

Alternative financing FEDS results for building 1070 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
small storage 1070	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	6	426	311	2,186	8.0
small storage 1070	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	20	1,034	4,290	1,641	1.4

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 17,134 kwh before retrofits and 11,645 kwh after proposed retrofits are implemented. The modeled other fuels (propane) consumption for a typical year was 382 MBtu before retrofits and 382 MBtu after proposed retrofits are implemented. The energy use intensity goes from 7.2 MBtu/Ksf to 6.9 MBtu/Ksf after retrofits.

Small storage 1070 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	17,134	278.5	1.0	3,028
post-retrofit	11,645	189.3	0.6	2,056
difference	-5,489	-89.2	-0.3	-972
% change	-32	-32	-32	-32
Other Fuels (MBtu)				
existing	382	6.2	6.2	12,278
post-retrofit	382	6.2	6.2	12,278
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	440	7.2	7.2	15,307
post-retrofit	422	6.9	6.9	14,334
difference	-19	-0.3	-0.3	-972
% change	-4	-4	-4	-6

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 25,042 kwh before retrofits and 17,627 kwh after proposed retrofits are implemented. The modeled other fuels (propane) consumption for a typical year was 8 MBtu before retrofits and 8 MBtu after proposed retrofits are implemented. The energy use intensity goes from 74.3 MBtu/Ksf to 54.1 MBtu/Ksf after retrofits.

Small storage 1070

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	25,042	19,954.1	68.1	4,424
post-retrofit	17,627	14,045.3	47.9	3,112
difference	-7,416	-5,908.8	-20.2	-1,312
% change	-30	-30	-30	-30
Other Fuels (MBtu)				
existing	8	6.2	6.2	250
post-retrofit	8	6.2	6.2	250
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	93	74.3	74.3	4,675
post-retrofit	68	54.1	54.1	3,363
difference	-25	-20.2	-20.2	-1,312
% change	-27	-27	-27	-28

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Lighting is the largest load in the building with 16,137 kWh/year, followed by motors and miscellaneous equipment with 997 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Small storage 1070 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	16,137	997	0
post-retrofit	0	0	0	10,649	997	0
difference	0	0	0	-5,489	0	0
% change	0	0	0	-34	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	382	0
post-retrofit	0	0	0	0	382	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	0	0	55	385	0
post-retrofit	0	0	0	36	385	0
difference	0	0	0	-19	0	0
% change	0	0	0	-34	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	1	6	0
post-retrofit	0	0	0	1	6	0
difference	0	0	0	0	0	0
% change	0	0	0	-34	0	0

Space cooling is the largest load in the building with 12,471 kWh/year, followed by motors and miscellaneous equipment with 6,323 kWh/year.

small storage 1070

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	12,471	3,435	2,814	6,323	0
post-retrofit	0	7,504	2,375	1,424	6,323	0
difference	0	-4,967	-1,060	-1,389	0	0
% change	0	-40	-31	-49	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	8	0
post-retrofit	0	0	0	0	8	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	43	12	10	29	0
post-retrofit	0	26	8	5	29	0
difference	0	-17	-4	-5	0	0
% change	0	-40	-31	-49	0	0
Total (MBtu/1000ft2)						
existing	0	34	9	8	23	0
post-retrofit	0	20	6	4	23	0
difference	0	-14	-3	-4	0	0
% change	0	-40	-31	-49	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Small storage	1070 unconditioned space
Sulfur Oxides (lb)		
existing	250	
post-retrofit	201	
difference	-50	
% change	-20	
Nitrogen Oxides (lb)		
existing	208	
post-retrofit	184	
difference	-24	
% change	-11	
Carbon Monoxide (lb)		
existing	418	
post-retrofit	377	
difference	-41	
% change	-10	
Carbon Dioxide (tons)		
existing	48	
post-retrofit	43	
difference	-5	
% change	-10	
Particulate Matter (lb)		
existing	7	
post-retrofit	6	
difference	-1	
% change	-14	
Hydrocarbons (lb)		
existing	148	
post-retrofit	131	
difference	-17	
% change	-11	

	Small storage	1070 conditioned space
Sulfur Oxides (lb)		
existing	228	
post-retrofit	161	
difference	-67	
% change	-29	
Nitrogen Oxides (lb)		
existing	111	
post-retrofit	79	
difference	-32	
% change	-29	
Carbon Monoxide (lb)		
existing	192	
post-retrofit	137	
difference	-55	
% change	-29	
Carbon Dioxide (tons)		
existing	24	
post-retrofit	17	
difference	-7	
% change	-29	
Particulate Matter (lb)		
existing	5	
post-retrofit	3	
difference	-1	
% change	-29	
Hydrocarbons (lb)		
existing	79	
post-retrofit	56	
difference	-23	
% change	-29	

Building 2002 Vehicle Maintenance Shop

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2002 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2002

2002 is a vehicle maintenance building with admin and workshop space built in 1940. Building 2002 generally has fluorescent lighting, an electric hot water system and its administration spaces are cooled by an electric package, or DX, unit. Building 2002 is 23,981 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the EXIT lighting as well as replacing the T12 Fluorescent lighting in the unconditioned space. In the conditioned space FEDS suggests replacing EXIT lighting, T12 Flourescent lighting and adding insulation to the interior surface of the metal roof.

Alternative financing FEDS results for building 2002 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Vehicle maintenance 2002	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	1	105	93	522	6.6
Vehicle maintenance 2002	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	8	593	528	2,961	6.6
Vehicle maintenance 2002	Lights	FL1: FL 2X4 4F40T12 STD2	FL244: FL 2X4 4F32T8 ELC4	16	1,244	3,265	4,014	2.2
Vehicle maintenance 2002	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	3	259	993	534	1.5
Vehicle maintenance 2002	Lights	FL62: FL 1X8 2F96T12 STD2	FL74: FL 1X8 2F96T12 ELC2	6	487	2,195`	655	1.3

Alternative financing FEDS results for building 2002 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Vehicle maintenance 2002	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	1	65	47	335	8.2
Vehicle maintenance 2002	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	5	367	264	1,888	8.2
Vehicle maintenance 2002	Lights	FL1: FL 2X4 4F40T12 STD2	FL244: FL 2X4 4F32T8 ELC4	5	386	816	1,435	2.1
Vehicle maintenance 2002	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	1	65	248	134	1.5
Vehicle maintenance 2002	Lights	FL62: FL 1X8 2F96T12 STD2	FL74: FL 1X8 2F96T12 ELC2	3	245	1,015	413	1.4
Vehicle maintenance 2002	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	139	7,145	16,393	24,618	2.5

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 125,846 kwh before retrofits and 115,487 kwh after proposed retrofits are implemented. The energy use intensity goes from 22.4 MBtu/Ksf to 20.5 MBtu/Ksf after retrofits.

Vehicle maintenance 2002 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	125,846	6,559.9	22.4	22,234
post-retrofit	115,487	6,020.0	20.5	20,391
difference	-10,359	-540.0	-1.8	-1,843
% change	-8	-8	-8	-8
Total (MBtu)				
existing	430	22.4	22.4	22,234
post-retrofit	394	20.5	20.5	20,391
difference	-35	-1.8	-1.8	-1,843
% change	-8	-8	-8	-8

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 97,300 kwh before retrofits and 52,706 kwh after proposed retrofits are implemented. The energy use intensity goes from 69.2 MBtu/Ksf to 37.5 MBtu/Ksf after retrofits.

Vehicle maintenance 2002 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	97,300	20,287.8	69.2	17,191
post-retrofit	52,706	10,989.5	37.5	9,306
difference	-44,595	-9,298.3	-31.7	-7,885
% change	-46	-46	-46	-46
Total (MBtu)				
existing	332	69.2	69.2	17,191
post-retrofit	180	37.5	37.5	9,306
difference	-152	-31.7	-31.7	-7,885
% change	-46	-46	-46	-46

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 94,120 kWh/year, followed by lighting with 31,616 kWh/year.

Vehicle maintenance 2002 unconditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	0	0	31,616	94,120	110
post-retrofit	0	0	0	21,257	94,120	110
difference	0	0	0	-10,359	0	0
% change	0	0	0	-33	0	0
Total (MBtu)						
existing	0	0	0	108	321	0
post-retrofit	0	0	0	73	321	0
difference	0	0	0	-35	0	0
% change	0	0	0	-33	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	6	17	0
post-retrofit	0	0	0	4	17	0
difference	0	0	0	-2	0	0
% change	0	0	0	-33	0	0

* Energy consumption values for both distributed and central SHW are reported for Hot Water annual energy use.

Space cooling is the largest load in the building with 58,459 kWh/year, followed by motors and miscellaneous equipment with 23,530 kWh/year.

Vehicle maintenance 2002 conditioned space

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	58,459	6,597	8,605	23,530	110
post-retrofit	0	21,603	2,411	5,052	23,530	110
difference	0	-36,856	-4,186	-3,552	0	0
% change	0	-63	-63	-41	0	0
Total (MBtu)						
existing	0	200	23	29	80	0
post-retrofit	0	74	8	17	80	0
difference	0	-126	-14	-12	0	0
% change	0	-63	-63	-41	0	0
Total (MBtu/1000ft2)						
existing	0	42	5	6	17	0
post-retrofit	0	15	2	4	17	0
difference	0	-26	-3	-3	0	0
% change	0	-63	-63	-41	0	0

* Energy consumption values for both distributed and central SHW are reported for Hot Water annual energy use.

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Vehicle maintenance	2002 unconditioned space
Sulfur Oxides (lb)		
existing	1,138	
post-retrofit	1,044	
difference	-94	
% change	-8	
Nitrogen Oxides (lb)		
existing	544	
post-retrofit	499	
difference	-45	
% change	-8	
Carbon Monoxide (lb)		
existing	935	
post-retrofit	858	
difference	-77	
% change	-8	
Carbon Dioxide (tons)		
existing	115	
post-retrofit	106	
difference	-9	
% change	-8	
Particulate Matter (lb)		
existing	23	
post-retrofit	21	
difference	-2	
% change	-8	
Hydrocarbons (lb)		
existing	387	
post-retrofit	355	
difference	-32	
% change	-8	

	Vehicle maintenance	2002 conditioned space
Sulfur Oxides (lb)		
existing	1,138	
post-retrofit	1,044	
difference	-94	
% change	-8	
Nitrogen Oxides (lb)		
existing	544	
post-retrofit	499	
difference	-45	
% change	-8	
Carbon Monoxide (lb)		
existing	935	
post-retrofit	858	
difference	-77	
% change	-8	
Carbon Dioxide (tons)		
existing	115	
post-retrofit	106	
difference	-9	
% change	-8	
Particulate Matter (lb)		
existing	23	
post-retrofit	21	
difference	-2	
% change	-8	
Hydrocarbons (lb)		
existing	387	
post-retrofit	355	
difference	-32	
% change	-8	

Building 1713 Warehouse

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1713 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1713

1713 is a warehouse building built in 1944. 1713 is the main recycling center on base and has a small conditioned office space served by an electric package, or DX, unit. Building 1713 is 30,400 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the lighting in the building in the conditioned and unconditioned spaces as well as increasing the interior insulation of the roof for the conditioned space only.

Alternative financing FEDS results for building 1713 unconditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's storage 1713	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	56	311	31	1.1

Alternative financing FEDS results for building 1713 conditioned space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
1940's storage 1713	Lights	IN8: INC 75 CEIL	CF5: CFL 18 INTEGRAL UNIT ELC	1	89	48	477	10.9
1940's storage 1713	Lights	IN11: INC 100 CEIL	CF9: CFL 26 INTEGRAL UNIT ELC	1	110	48	594	13.3
1940's storage 1713	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	58	311	41	1.1
1940's storage 1713	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	14	961	2,078	3,438	2.7

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 22,232 kwh before retrofits and 22,175 kwh after proposed retrofits are implemented. The energy use intensity goes from 2.5 MBtu/Ksf to 2.5 MBtu/Ksf after retrofits.

1940's storage   1713 unconditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	22,232	746.3	2.5	3,930
post-retrofit	22,175	744.3	2.5	3,915
difference	-58	-1.9	0.0	-14
% change	0	0	0	0
Total (MBtu)				
existing	76	2.5	2.5	3,930
post-retrofit	76	2.5	2.5	3,915
difference	0	0.0	0.0	-14
% change	0	0	0	0

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for a typical year was 10,421 kwh before retrofits and 5,573 kwh after proposed retrofits are implemented. The energy use intensity goes from 58.5 MBtu/Ksf to 31.3 MBtu/Ksf after retrofits.

1940's storage 1713 conditioned space

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	10,421	17,140.2	58.5	1,841
post-retrofit	5,573	9,165.9	31.3	984
difference	-4,848	-7,974.3	-27.2	-857
% change	-47	-47	-47	-47
Total (MBtu)				
existing	36	58.5	58.5	1,841
post-retrofit	19	31.3	31.3	984
difference	-17	-27.2	-27.2	-857
% change	-47	-47	-47	-47

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Lighting is the largest load in the unconditioned space of the building with 21,755 kWh/year, followed by motors and miscellaneous equipment with 477 kWh/year.

		1940's storage	1713 unconditioned space			
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	21,755	477	0
post-retrofit	0	0	0	21,697	477	0
difference	0	0	0	-58	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	0	0	74	2	0
post-retrofit	0	0	0	74	2	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	2	0	0
post-retrofit	0	0	0	2	0	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0

Space cooling is the largest load in the building with 5,318 kWh/year, followed by lighting with 4,901 kWh/year.

		1940's storage	1713	conditioned space		
Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	5,318	193	4,901	10	0
post-retrofit	0	1,345	46	4,172	10	0
difference	0	-3,973	-147	-729	0	0
% change	0	-75	-76	-15	0	0
Total (MBtu)						
existing	0	18	1	17	0	0
post-retrofit	0	5	0	14	0	0
difference	0	-14	-1	-2	0	0
% change	0	-75	-76	-15	0	0
Total (MBtu/1000ft2)						
existing	0	30	1	28	0	0
post-retrofit	0	8	0	23	0	0
difference	0	-22	-1	-4	0	0
% change	0	-75	-76	-15	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	1940's storage	1713 unconditioned space
Sulfur Oxides (lb)		
existing	201	
post-retrofit	200	
difference	-1	
% change	0	
Nitrogen Oxides (lb)		
existing	96	
post-retrofit	96	
difference	0	
% change	0	
Carbon Monoxide (lb)		
existing	165	
post-retrofit	165	
difference	0	
% change	0	
Carbon Dioxide (tons)		
existing	20	
post-retrofit	20	
difference	0	
% change	0	
Particulate Matter (lb)		
existing	4	
post-retrofit	4	
difference	0	
% change	0	
Hydrocarbons (lb)		
existing	68	
post-retrofit	68	
difference	0	
% change	0	

1940's storage	1713	conditioned space
Sulfur Oxides (lb)		
existing	94	
post-retrofit	50	
difference	-44	
% change	-47	
Nitrogen Oxides (lb)		
existing	45	
post-retrofit	24	
difference	-21	
% change	-47	
Carbon Monoxide (lb)		
existing	77	
post-retrofit	41	
difference	-36	
% change	-47	
Carbon Dioxide (tons)		
existing	10	
post-retrofit	5	
difference	-4	
% change	-47	
Particulate Matter (lb)		
existing	2	
post-retrofit	1	
difference	-1	
% change	-47	
Hydrocarbons (lb)		
existing	32	
post-retrofit	17	
difference	-15	
% change	-47	

Building 2130 Corrosion Control Hangar

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2130 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2130

2130 is a corrosion control facility for aircraft built in 2008. Building 2130 cleans aircraft of corrosion causing agents and has a large ventilation system to aid its mission. Building 2130 is 56,734 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the lighting in the high bay space of the building. In the administration space FEDS also suggests replacing the air cooled chiller with a high efficiency water cooled chiller.

Alternative financing FEDS results for building 2130 high-bay space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
2008 hanger unconditioned space 2130	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	-	56	311	31	1.1
2008 hanger unconditioned space 2130	Lights	MH8: MH 1500 PEND	HS20: HPS 1000 PEND	61	5,353	30,695	1,011	1.0

Alternative financing FEDS results for building 2130 administration space:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
2008 hanger conditioned space 2130	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (high efficiency) and Cooling Tower	106	7,130	39,495	2,124	1.1

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for the unconditioned space of the building for a typical year was 194,224 kwh before retrofits and 176,277 kwh after proposed retrofits are implemented. The energy use intensity goes from 13.7 MBtu/Ksf to 12.5 MBtu/Ksf after retrofits.

2008 hanger unconditioned space 2130

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	194,224	4,027.4	13.7	34,417
post-retrofit	176,277	3,655.3	12.5	31,244
difference	-17,946	-372.1	-1.3	-3,173
% change	-9	-9	-9	-9
Total (MBtu)				
existing	663	13.7	13.7	34,417
post-retrofit	602	12.5	12.5	31,244
difference	-61	-1.3	-1.3	-3,173
% change	-9	-9	-9	-9

* Dollar values for electricity include both energy and demand components.

The modeled energy consumption for the conditioned space of the building for a typical year was 402,873 kwh before retrofits and 314,844 kwh after proposed retrofits are implemented. The energy use intensity goes from 161.6 MBtu/Ksf to 126.3 MBtu/Ksf after retrofits.

2008 hanger conditioned space 2130

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	402,873	47,341.1	161.6	71,390
post-retrofit	314,844	36,997.0	126.3	55,804
difference	-88,029	-10,344.1	-35.3	-15,587
% change	-22	-22	-22	-22
Total (MBtu)				
existing	1,375	161.6	161.6	71,390
post-retrofit	1,075	126.3	126.3	55,804
difference	-300	-35.3	-35.3	-15,587
% change	-22	-22	-22	-22

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the unconditioned space of the building with 117,194 kWh/year, followed by space cooling with 73,546 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
2008 hanger unconditioned space 2130

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	73,546	117,194	3,483
post-retrofit	0	0	0	55,600	117,194	3,483
difference	0	0	0	-17,946	0	0
% change	0	0	0	-24	0	0
Total (MBtu)						
existing	0	0	0	251	400	12
post-retrofit	0	0	0	190	400	12
difference	0	0	0	-61	0	0
% change	0	0	0	-24	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	5	8	0
post-retrofit	0	0	0	4	8	0
difference	0	0	0	-1	0	0
% change	0	0	0	-24	0	0

Lighting is the largest load in the conditioned space of the building with 172,239 kWh/year, followed by space cooling with 117,190 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
2008 hanger conditioned space 2130

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	117,190	48,056	172,239	62,803	2,584
post-retrofit	0	70,813	48,056	130,587	62,803	2,584
difference	0	-46,377	0	-41,651	0	0
% change	0	-40	0	-24	0	0
Total (MBtu)						
existing	0	400	164	588	214	9
post-retrofit	0	242	164	446	214	9
difference	0	-158	0	-142	0	0
% change	0	-40	0	-24	0	0
Total (MBtu/1000ft2)						
existing	0	47	19	69	25	1
post-retrofit	0	28	19	52	25	1
difference	0	-19	0	-17	0	0
% change	0	-40	0	-24	0	0

Alternative Financing Emission Reduction
The emission reductions from implemented the proposed retrofits are as follows:

	2008 hanger unconditioned space 2130
Sulfur Oxides (lb)	
existing	1,756
post-retrofit	1,594
difference	-162
% change	-9
Nitrogen Oxides (lb)	
existing	839
post-retrofit	761
difference	-78
% change	-9
Carbon Monoxide (lb)	
existing	1,443
post-retrofit	1,310
difference	-133
% change	-9
Carbon Dioxide (tons)	
existing	178
post-retrofit	161
difference	-16
% change	-9
Particulate Matter (lb)	
existing	35
post-retrofit	32
difference	-3
% change	-9
Hydrocarbons (lb)	
existing	597
post-retrofit	542
difference	-55
% change	-9

2008 hanger	conditioned space 2130
Sulfur Oxides (lb)	
existing	3,642
post-retrofit	2,846
difference	-796
% change	-22
Nitrogen Oxides (lb)	
existing	1,740
post-retrofit	1,360
difference	-380
% change	-22
Carbon Monoxide (lb)	
existing	2,993
post-retrofit	2,339
difference	-654
% change	-22
Carbon Dioxide (tons)	
existing	369
post-retrofit	288
difference	-81
% change	-22
Particulate Matter (lb)	
existing	72
post-retrofit	56
difference	-16
% change	-22
Hydrocarbons (lb)	
existing	1,239
post-retrofit	968
difference	-271
% change	-22

Building 1860 Dining Hall

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1860 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1860

1860 is a dining hall built in 1969. It is lighted mostly by T8's and is cooled by an electric air cooled chiller Building 1860 is 12,941 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing incandescent lights with CFL lights, replacing the EXIT lighting, replacing the air cooled chiller with a standard efficiency water cooled reciprocating chiller and wrapping the hot water tank with insulation.

Alternative financing FEDS results for building 1860:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Dining Hall 1860	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (standard efficiency) and Cooling Tower	148	9,129	48,417	4,355	1.1
Dining Hall 1860	Hot Water	Other Fuels Central Boiler	Wrap Tank with Insulation	219	7,025	268	50,050	187.8
Dining Hall 1860	Lights	IN18: INC 25 WALL	CF14: CFL 5 + BLST UNIT	13	799	4,340	309	1.1
Dining Hall 1860	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	14	891	621	4,590	8.4

Alternative financing FEDS results for building 1860:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Dining Hall 1860	Hot Water	Other Fuels Central Boiler	Wrap Tank with Insulation	219	7,025	268	50,050	187.8
Dining Hall 1860	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	14	928	621	4,802	8.7

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 485,332 kwh before retrofits and 429,230 kwh after proposed retrofits are implemented. The modeled other fuels (propane) consumption for a typical year was 971 MBtu before retrofits and 534 MBtu after proposed retrofits are implemented. The energy use intensity goes from 203.1 MBtu/Ksf to 154.5 MBtu/Ksf after retrofits.

Dining Hall 1860

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	485,332	37,503.4	128.0	85,984
post-retrofit	429,230	33,168.2	113.2	75,842
difference	-56,102	-4,335.2	-14.8	-10,142
% change	-11.6	-11.6	-11.6	-11.8
Other Fuels (MBtu)				
existing	971	75.0	75.0	31,223
post-retrofit	534	41.3	41.3	17,172
difference	-437	-33.8	-33.8	-14,051
% change	-45	-45	-45	-45
Total (MBtu)				
existing	2,628	203.1	203.1	117,208
post-retrofit	1,999	154.5	154.5	93,014
difference	-629	-48.6	-48.6	-24,194
% change	-24	-24	-24	-21

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 221,654 kWh/year, followed by motors and miscellaneous equipment with 160,038 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Dining Hall 1860

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	221,654	70,607	33,032	160,038	0
post-retrofit	0	174,142	70,209	24,842	160,038	0
difference	0	-47,512	-398	-8,190	0	0
% change	0	-21	-1	-25	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	193	778
post-retrofit	0	0	0	0	193	340
difference	0	0	0	0	0	-438
% change	0	0	0	0	0	-56
Total (MBtu)						
existing	0	756	241	51	740	408
post-retrofit	0	594	240	40	740	175
difference	0	-162	-1	-11	0	-248
% change	0	-21	-1	-22	0	-59
Total (MBtu/1000ft2)						
existing	0	116	37	17	114	124
post-retrofit	0	40	37	13	114	53
difference	0	-21	0	-4	0	-71
% change	0	-18	0	-24	0	-57

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Dining Hall 1860
Sulfur Oxides (lb)	
existing	48,430
post-retrofit	43.439
difference	-4,991
% change	-10
Nitrogen Oxides (lb)	
existing	4,630
post-retrofit	4,014
difference	-616
% change	-13
Carbon Monoxide (lb)	
existing	2,437
post-retrofit	2,041
difference	-749
% change	-16
Carbon Dioxide (tons)	
existing	4,344
post-retrofit	3,595
difference	-749
% change	-17
Particulate Matter (lb)	
existing	268
post-retrofit	165
difference	-749
% change	-38
Hydrocarbons (lb)	
existing	1,736
post-retrofit	1,453
difference	-283
% change	-16

Building 1804 Dining Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1804 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1804

1804 is an open mess facility built in 2003. Building 1804 has incandescent and 32W T8 lilghts, an electric air cooled chiller and little to no insulation in its building envelope. Building 1804 is 27,579 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests wrapping the hot water tank with insulation, replacing incandescent lamps with CFL lamps and replacing the EXIT lighting.

Alternative financing FEDS results for building 1804:

Bldg. Set Description		End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Dining	1804	Hot Water	Other Fuels Water Heater	Wrap Tank with Insulation	37	1,202	1,764	5,751	3.0
Dining	1804	Lights	IN25: INC 75 WALL	CF5: CFL 18 INTEGRAL UNIT ELC	334	20,370	8,978	109,722	13.2
Dining	1804	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	23	1,471	932	7,663	9.2

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 809,008 kwh before retrofits and 704,303 kwh after proposed retrofits are implemented. The modeled other fuels (propane) consumption for a typical year was 855 MBtu before retrofits and 818 MBtu after retrofits. The energy use intensity goes from 131.1 MBtu/Ksf to 116.8 MBtu/Ksf after retrofits.

Dining 1804

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	809,008	29,334.2	100.1	143,329
post-retrofit	704,303	25,537.7	87.2	124,446
difference	-104,705	-3,796.5	-13.0	-18,882
% change	-13	-13	-13	-13
Other Fuels (MBtu)				
existing	855	31.0	31.0	27,501
post-retrofit	818	29.7	29.7	26,299
difference	-37	-1.4	-1.4	-1,202
% change	-4	-4	-4	-4
Total (MBtu)				
existing	3,617	131.1	131.1	170,830
post-retrofit	3,222	116.8	116.8	150,745
difference	-395	-14.3	-14.3	-20,085
% change	-11	-11	-11	-12

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 316,839 kWh/year, followed by motors and miscellaneous equipment with 262,004 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Dining 1804

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	262,004	56,199	173,967	316,839	0
post-retrofit	0	229,877	48,157	109,431	316,839	0
difference	0	-32,127	-8,042	-64,536	0	0
% change	0	-12	-14	-37	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	725	130
post-retrofit	0	0	0	0	725	93
difference	0	0	0	0	0	-37
% change	0	0	0	0	0	-29
Total (MBtu)						
existing	0	894	192	594	1,806	130
post-retrofit	0	785	164	373	1,806	93
difference	0	-110	-27	-220	0	-37
% change	0	-12	-14	-37	0	-29
Total (MBtu/1000ft2)						
existing	0	32	7	22	66	5
post-retrofit	0	28	6	14	66	3
difference	0	-4	-1	-8	0	-1
% change	0	-12	-14	-37	0	-29

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Dining 1804
Sulfur Oxides (lb)	
existing	7,527
post-retrofit	6,571
difference	-956
% change	-13
Nitrogen Oxides (lb)	
existing	3,794
post-retrofit	3,329
difference	-465
% change	-12
Carbon Monoxide (lb)	
existing	6,661
post-retrofit	5,855
difference	-806
% change	-12
Carbon Dioxide (tons)	
existing	813
post-retrofit	714
difference	-99
% change	-12
Particulate Matter (lb)	
existing	153
post-retrofit	134
difference	-19
% change	-12
Hydrocarbons (lb)	
existing	2,702
post-retrofit	2,370
difference	-331
% change	-12

Building 594 Lavatory Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 594 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 594

594 is a lavatory by the baseball fields built in 1977. Building 594 is not cooled and has very little lighting. Building 594 is 293 sf.

Alternative Financing Results

FEDS did not find any life cycle cost effective retrofits using alternative financing.

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 2,429 kwh before retrofits and 2,429 kwh after proposed retrofits are implemented. The energy use intensity goes from 34.9 MBtu/Ksf to 34.9 MBtu/Ksf after retrofits.

sanitary latrines/small storage 594

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	2,429	8,290.3	28.3	430
post-retrofit	2,429	8,290.3	28.3	430
difference	0	0.0	0	0
% change	0	0	0	0
Other Fuels (MBtu)				
existing	2	6.6	6.6	63
post-retrofit	2	6.6	6.6	63
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	10	34.9	34.9	493
post-retrofit	10	34.9	34.9	493
difference	0	0.0	0.0	0
% change	0	0	0	0

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Lighting is the largest load in the building with 2,091 kWh/year, followed by motors and miscellaneous equipment with 338 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Building Set ... 60m
sanitary latrines/small storage 594

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	0	0	2,091	338	0
post-retrofit	0	0	0	2,091	338	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Other Fuels (MBtu)						
existing	0	0	0	0	2	0
post-retrofit	0	0	0	0	2	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	0	0	7	3	0
post-retrofit	0	0	0	7	3	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu/1000ft2)						
existing	0	0	0	24	11	0
post-retrofit	0	0	0	24	11	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	sanitary latrines/small storage 594
Sulfur Oxides (lb)	
existing	22
post-retrofit	22
difference	0
% change	0
Nitrogen Oxides (lb)	
existing	11
post-retrofit	11
difference	0
% change	0
Carbon Monoxide (lb)	
existing	20
post-retrofit	20
difference	0
% change	0
Carbon Dioxide (tons)	
existing	2
post-retrofit	2
difference	0
% change	0
Particulate Matter (lb)	
existing	0
post-retrofit	0
difference	0
% change	0
Hydrocarbons (lb)	
existing	8
post-retrofit	8
difference	0
% change	0

Building 2093 Commissary

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2093 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2093

2093 is the commissary and was built in 1975. Building 2093 has large conditioned service spaces as well as large unconditioned storage spaces. Building 2093 is 115,408 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the electric water heater with a heat pump water heater and replacing some of the lighting.

Alternative financing FEDS results for building 2093

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Comissary, large sales 2093	Hot Water	Electric Water Heater	Heat Pump Water Heater (Com)	168	8,496	47,981	643	1.0
Comissary, large sales 2093	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	23	1,560	1,118	8,017	8.2
Comissary, large sales 2093	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	3	174	124	891	8.2
Comissary, large sales 2093	Lights	FL1: FL 2X4 4F40T12 STD2	FL244: FL 2X4 4F32T8 ELC4	124	8,350	15,231	33,517	3.2
Comissary, large sales 2093	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	1,745	103,847	259,302	344,042	2.3

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 6,735,356 kwh before retrofits and 6,130,693 kwh after proposed retrofits are implemented. The energy use intensity goes from 199.2 MBtu/Ksf to 181.3 MBtu/Ksf after retrofits.

Commissary, large sales 2093

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	6,735,356	58,361.3	199.2	1,193,276
post-retrofit	6,130,693	53,121.9	181.3	1,083,257
difference	-604,664	-5,239.4	-17.9	-110,018
% change	-9	-9	-9	-9
Total (MBtu)				
existing	22,988	199.2	199.2	1,193,276
post-retrofit	20,924	181.3	181.3	1,083,257
difference	-2,064	-17.9	-17.9	-110,018
% change	-9	-9	-9	-9

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Motors and miscellaneous equipment is the largest load in the building with 4,432,117 kWh/year, followed by lighting with 1,096,681 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Building Set ... 60c
Comissary, large sales 2093

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water *
Electricity (kWh)						
existing	0	778,012	369,229	1,096,681	4,432,117	59,317
post-retrofit	0	646,309	351,845	690,305	4,432,117	10,116
difference	0	-131,703	-17,383	-406,376	0	-49,201
% change	0	-17	-5	-37	0	-83
Total (MBtu)						
existing	0	2,655	1,260	3,743	15,127	202
post-retrofit	0	2,206	1,201	2,356	15,127	35
difference	0	-450	-59	-1,387	0	-168
% change	0	-17	-5	-37	0	-83
Total (MBtu/1000ft2)						
existing	0	23	11	32	131	2
post-retrofit	0	19	10	20	131	0
difference	0	-4	-1	-12	0	-1
% change	0	-17	-5	-37	0	-83

* Energy consumption values for both distributed and central SHW are reported for Hot Water annual energy use.

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Comissary, large sales 2093
Sulfur Oxides (lb)	
existing	60,888
post-retrofit	55,422
difference	-5,466
% change	-9
Nitrogen Oxides (lb)	
existing	29,096
post-retrofit	26,484
difference	-2,612
% change	-9
Carbon Monoxide (lb)	
existing	50,044
post-retrofit	45,552
difference	-4,493
% change	-9
Carbon Dioxide (tons)	
existing	6,163
post-retrofit	5,610
difference	-553
% change	-9
Particulate Matter (lb)	
existing	1,205
post-retrofit	1,096
difference	-108
% change	-9
Hydrocarbons (lb)	
existing	20,712
post-retrofit	18,853
difference	-1,859
% change	-9

Building 2028 Passenger Terminal

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2028 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2028

2028 is the air passenger terminal built in 1973. Building 2028 has a water cooled reciprocating chiller, metal halide, fluorescent, incandescent and high pressure sodium lights and little to no insulation in the building envelope. Building 2028 is 46,128 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the lighting, replacing the electric water heater with a heat pump water heater and increasing the insulation in the suspended ceiling.

Alternative financing FEDS results for building 2028:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Airport terminal 2028	Hot Water	Electric Water Heater	Heat Pump Water Heater (Com)	22	1,004	5,098	654	1.1
Airport terminal 2028	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	889	621	4,581	8.4
Airport terminal 2028	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	832	47,481	87,739	187,832	3.1
Airport terminal 2028	Roof	Roof Insulation R-Value 0.00	Suspended Ceiling: Increase Insulation by R-11	161	10,970	60,766	2,203	1.0

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 804,699 kwh before retrofits and 512,174 kwh after proposed retrofits are implemented. The energy use intensity goes from 59.5 MBtu/Ksf to 37.9 MBtu/Ksf after retrofits.

Airport terminal 2028

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	804,699	17,444.9	59.5	142,565
post-retrofit	512,174	11,103.3	37.9	90,498
difference	-292,525	-6,341.6	-21.6	-52,067
% change	-36	-36	-36	-37
Total (MBtu)				
existing	2,746	59.5	59.5	142,565
post-retrofit	1,748	37.9	37.9	90,498
difference	-998	-21.6	-21.6	-52,067
% change	-36	-36	-36	-37

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Lighting is the largest load in the building with 410,212 kWh/year, followed by space cooling with 235,351 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Airport terminal 2028

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	235,351	67,184	410,212	84,592	7,360
post-retrofit	0	149,320	42,071	235,198	84,592	994
difference	0	-86,032	-25,113	-175,014	0	-6,366
% change	0	-37	-37	-43	0	-86
Total (MBtu)						
existing	0	803	229	1,400	289	25
post-retrofit	0	510	144	803	289	3
difference	0	-294	-86	-597	0	-22
% change	0	-37	-37	-43	0	-86
Total (MBtu/1000ft2)						
existing	0	17	5	30	6	1
post-retrofit	0	11	3	17	6	0
difference	0	-6	-2	-13	0	0
% change	0	-37	-37	-43	0	-86

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Airport terminal 2028
Sulfur Oxides (lb)	
existing	7,274
post-retrofit	4,630
difference	-2,644
% change	-36
Nitrogen Oxides (lb)	
existing	3,476
post-retrofit	2,213
difference	-1,264
% change	-36
Carbon Monoxide (lb)	
existing	5,979
post-retrofit	3,806
difference	-2,173
% change	-36
Carbon Dioxide (tons)	
existing	736
post-retrofit	469
difference	-268
% change	-36
Particulate Matter (lb)	
existing	144
post-retrofit	92
difference	-52
% change	-36
Hydrocarbons (lb)	
existing	2,475
post-retrofit	1,575
difference	-900
% change	-36

Building 1597 Child Care Center

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1597 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1597

1597 is a child care center built 1985. Building 1597 is conditioned by an electric air cooled chiller, has many fluorescent and some metal halide lights and has some insulation in the building envelope. Building 1597 is 12,760 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing some of the lighting as well as replacing the electric water heater with a heat pump water heater.

Alternative financing FEDS results for building 1597:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
youth Center 1597	Hot Water	Electric Water Heater	Heat Pump Water Heater (Com)	42	2,455	6,854	7,220	2.1
youth Center 1597	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	1	117	621	91	1.1
youth Center 1597	Lights	MH40: MH 150 HE WALL	MH67: MH 150 HE WALL ELC	1	310	1,376	502	1.4

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 200,246 kwh before retrofits and 187,306 kwh after proposed retrofits are implemented. The energy use intensity goes from 53.6 MBtu/Ksf to 50.1 MBtu/Ksf after retrofits.

Youth Center 1597

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	200,246	15,693.2	53.6	35,477
post-retrofit	187,306	14,679.1	50.1	33,096
difference	-12,940	-1,014.1	-3.5	-2,381
% change	-6	-6	-6	-7
Total (MBtu)				
existing	683	53.6	53.6	35,477
post-retrofit	639	50.1	50.1	33,096
difference	-44	-3.5	-3.5	-2,381
% change	-6	-6	-6	-7

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 84,926 kWh/year, followed by motors and miscellaneous equipment with 36,565 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Youth Center 1597

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	84,926	36,501	27,943	36,565	14,310
post-retrofit	0	84,901	36,490	27,439	36,565	1,910
difference	0	-25	-11	-505	0	-12,400
% change	0	0	0	-2	0	-87
Total (MBtu)						
existing	0	290	125	95	125	49
post-retrofit	0	290	125	94	125	7
difference	0	0	0	-2	0	-42
% change	0	0	0	-2	0	-87
Total (MBtu/1000ft2)						
existing	0	23	10	7	10	4
post-retrofit	0	23	10	7	10	1
difference	0	0	0	0	0	-3
% change	0	0	0	-2	0	-87

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Youth Center 1597
Sulfur Oxides (lb)	
existing	1,810
post-retrofit	1,693
difference	-117
% change	-6
Nitrogen Oxides (lb)	
existing	865
post-retrofit	809
difference	-56
% change	-6
Carbon Monoxide (lb)	
existing	1,488
post-retrofit	1,392
difference	-96
% change	-6
Carbon Dioxide (tons)	
existing	183
post-retrofit	171
difference	-12
% change	-6
Particulate Matter (lb)	
existing	36
post-retrofit	33
difference	-2
% change	-6
Hydrocarbons (lb)	
existing	616
post-retrofit	576
difference	-40
% change	-6

Building 1891 Bowling Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1891 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description

1891 is a bowling facility built in 1971. The facility was once a gymnasium, but has since been converted to a bowling center. Building 1891 is cooled by an electric package unit, has fluorescent, incandescent, and metal halide lights and some insulation in the building envelope. Building 1891 is 3,090 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the electric package unit with a very high efficiency single zone package unit. FEDS also suggests delamping 4 tube T8 fixtures to 3 tube T8 fixtures as well as increasing insulation in the attic ceiling, and installing faucet aerators.

Alternative financing FEDS results for building 1891:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
misc recreation bldgs 1891	Cooling	Electric Package Unit {C1}	Single Zone Packaged AC Unit (very high efficiency / small)	119	10,538	31,186	31,012	2.0
misc recreation bldgs 1891	Hot Water	Electric Water Heater	Faucet Aerators	3	156	14	884	62.8
misc recreation bldgs 1891	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	7	456	311	2,358	8.6
misc recreation bldgs 1891	Lights	FL37: FL 2X4 4F32T8 EEF2	FL280: FL 2X4 3F32ST8 ELC3 REF	21	1,206	4,416	2,550	1.6
misc recreation bldgs 1891	Roof	Roof Insulation R-Value 11.00	Attic Ceiling: Increase Insulation by R-13 (blow-in cellulose)	8	480	1,775	985	1.6

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 158,242 kwh before retrofits and 104,256 kwh after proposed retrofits are implemented. The energy use intensity goes from 176.2 MBtu/Ksf to 116.6 MBtu/Ksf after retrofits.

Misc recreation bldgs 1891

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	158,242	51,211.1	174.8	27,976
post-retrofit	101,296	32,782.0	111.9	17,813
difference	-56,946	-18,429.1	-62.9	-10,162
% change	-36	-36	-36	-36
Other Fuels (MBtu)				
existing	4	1.4	1.4	143
post-retrofit	4	1.4	1.4	143
difference	0	0.0	0.0	0
% change	0	0	0	0
Total (MBtu)				
existing	545	176.2	176.2	28,119
post-retrofit	350	113.3	113.3	17,957
difference	-194	-62.9	-62.9	-10,162
% change	-36	-36	-36	-36

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 82,546 kWh/year, followed by lighting with 38,734 kWh/year.

Misc recreation bldgs 1891

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	82,546	19,939	38,734	14,816	2,206
post-retrofit	0	36,161	18,751	30,351	14,816	1,217
difference	0	-46,385	-1,189	-8,383	0	-989
% change	0	-56	-6	-22	0	-45
Other Fuels (MBtu)						
existing	0	0	0	0	4	0
post-retrofit	0	0	0	0	4	0
difference	0	0	0	0	0	0
% change	0	0	0	0	0	0
Total (MBtu)						
existing	0	282	68	132	55	8
post-retrofit	0	123	64	104	55	4
difference	0	-158	-4	-29	0	-3
% change	0	-56	-6	-22	0	-45
Total (MBtu/1000ft2)						
existing	0	91	22	43	18	2
post-retrofit	0	40	21	34	18	1
difference	0	-51	-1	-9	0	-1
% change	0	-56	-6	-22	0	-45

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Misc recreation bldgs 1891
Sulfur Oxides (lb)	
existing	1,432
post-retrofit	917
difference	-515
% change	-36
Nitrogen Oxides (lb)	
existing	685
post-retrofit	439
difference	-246
% change	-36
Carbon Monoxide (lb)	
existing	1,179
post-retrofit	756
difference	-423
% change	-36
Carbon Dioxide (tons)	
existing	145
post-retrofit	93
difference	-52
% change	-36
Particulate Matter (lb)	
existing	28
post-retrofit	18
difference	-10
% change	-36
Hydrocarbons (lb)	
existing	488
post-retrofit	313
difference	-175
% change	-36

Building 1750 Religious Education Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1750 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1750

1750 is a religious education facility built in 1977. Building 1750 is conditioned by an electric package unit. The building has incandescent, fluorescent, and metal halide lights and has little to no insulation in the building envelope. Building 1750 is 7,296 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the lighting in the building, increasing the insulation in the roof and increasing the insulation on the hot water tank.

Alternative financing FEDS results for building 1750:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Religious facilities 1750	Hot Water	Distillate Oil Water Heater	Wrap Tank with Insulation	1	30	53	96	2.1
Religious facilities 1750	Lights	IN8: INC 75 CEIL	CF5: CFL 18 INTEGRAL UNIT ELC	23	1,625	502	8,983	18.9
Religious facilities 1750	Lights	IN11: INC 100 CEIL	CF9: CFL 26 INTEGRAL UNIT ELC	3	228	58	1,271	22.9
Religious facilities 1750	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	866	621	4,449	8.2
Religious facilities 1750	Lights	FL4: FL 1X4 2F40T12 STD2	FL52: FL 1X4 2F32T8 ELC2	16	1,095	3,949	2,511	1.6
Religious facilities 1750	Roof	Roof Insulation R-Value 0.00	Insulate Built-up Roof Surface (R-10) and Re-Roof	89	5,915	31,383	2,573	1.1

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 113,294 kwh before retrofits and 91,403 kwh after proposed retrofits are implemented. The energy use intensity goes from 63.6 MBtu/Ksf to 43.9 MBtu/Ksf after retrofits.

Religious facilities 1750

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	133,294	18,269.4	62.4	23,615
post-retrofit	91,403	12,527.9	42.8	16,150
difference	-41,891	-5,741.6	-19.6	-7,465
% change	-31	-31	-31	-32
Distillate Oil (gal)				
existing	64	8.7	1.2	324
post-retrofit	58	7.9	1.1	294
difference	-6	-0.8	-0.1	-30
% change	-9	-9	-9	-9
Total (MBtu)				
existing	464	63.6	63.6	23,939
post-retrofit	320	43.9	43.9	16,445
difference	-144	-19.7	-19.7	-7,494
% change	-31	-31	-31	-31

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 60,705 kWh/year, followed by lighting with 31,784 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Religious facilities 1750

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	60,705	29,785	31,784	11,019	0
post-retrofit	0	32,588	29,173	18,623	11,019	0
difference	0	-28,117	-613	-13,161	0	0
% change	0	-46	-2	-41	0	0
Distillate Oil (gal)						
existing	0	0	0	0	0	64
post-retrofit	0	0	0	0	0	58
difference	0	0	0	0	0	-6
% change	0	0	0	0	0	-9
Total (MBtu)						
existing	0	207	102	108	38	9
post-retrofit	0	111	100	64	38	8
difference	0	-96	-2	-45	0	-1
% change	0	-46	-2	-41	0	-9
Total (MBtu/1000ft2)						
existing	0	28	14	15	5	1
post-retrofit	0	15	14	9	5	1
difference	0	-13	0	-6	0	0
% change	0	-46	-2	-41	0	-9

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Religious facilities 1750
Sulfur Oxides (lb)	
existing	1,209
post-retrofit	830
difference	-379
% change	-31
Nitrogen Oxides (lb)	
existing	579
post-retrofit	398
difference	-181
% change	-31
Carbon Monoxide (lb)	
existing	997
post-retrofit	686
difference	-312
% change	-31
Carbon Dioxide (tons)	
existing	123
post-retrofit	84
difference	-38
% change	-31
Particulate Matter (lb)	
existing	24
post-retrofit	17
difference	-8
% change	-31
Hydrocarbons (lb)	
existing	412
post-retrofit	283
difference	-129
% change	-31

Building 1120 Gymnasium

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 1120 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 1120

1120 is the main gymnasium built in 1949. Building 1120 is conditioned by an electric air cooled chiller. It has fluorescent, metal halide and high pressure sodium lights as well as little to no insulation in its building envelope. Building 1120 is 46,719 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the air cooled chiller with a very high efficiency water cooled chiller, replacing T12 lighting with T8 and Super T8 lighting, replacing the EXIT lighting and insulating the hot water tank.

Alternative financing FEDS results for building 1750:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
gymnasium 1120	Cooling	Electric Air-Cooled Chiller {C1}	Water-Cooled Reciprocating Electric Chiller (very high efficiency) and Cooling Tower	545	28,385	116,055	46,568	1.4
gymnasium 1120	Hot Water	Distillate Oil Water Heater	Wrap Tank with Insulation, Aerators	21	783	296	4,510	16.2
gymnasium 1120	Lights	EX1: EXIT - INC (2x20)	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	13	884	621	4,551	8.3
gymnasium 1120	Lights	FL1: FL 2X4 4F40T12 STD2	FL280: FL 2X4 3F32ST8 ELC3 REF (FIX REPL)	120	7,159	11,663	29,900	3.6
gymnasium 1120	Lights	FL3: FL 2X4 2F40T12 STD2	FL51: FL 2X4 2F32T8 ELC2	28	2,059	5,820	6,258	2.1

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 1,054,786 kwh before retrofits and 843,837 kwh after proposed retrofits are implemented. The energy use intensity goes from 78.1 MBtu/Ksf to 62.2 MBtu/Ksf after retrofits.

Gymnasium 1120

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	1,054,786	22,577.2	77.1	186,872
post-retrofit	843,837	18,062.0	61.6	149,101
difference	-210,949	-4,515.3	-15.4	-37,771
% change	-20	-20	-20	-20
Distillate Oil (gal)				
existing	356	7.6	1.1	1,814
post-retrofit	202	4.3	0.6	1,031
difference	-154	-3.3	-0.5	-783
% change	-43	-43	-43	-43
Total (MBtu)				
existing	3,649	78.1	78.1	188,686
post-retrofit	2,908	62.2	62.2	150,132
difference	-741	-15.9	-15.9	-38,554
% change	-20	-20	-20	-20

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 445,860 kWh/year, followed by motors and miscellaneous equipment with 256,750 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Gymnasium 1120

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	445,860	141,105	211,070	256,750	0
post-retrofit	0	287,173	124,835	175,079	256,750	0
difference	0	-158,688	-16,270	-35,991	0	0
% change	0	-36	-12	-17	0	0
Distillate Oil (gal)						
existing	0	0	0	0	0	356
post-retrofit	0	0	0	0	0	202
difference	0	0	0	0	0	-154
% change	0	0	0	0	0	-43
Total (MBtu)						
existing	0	1,522	482	720	876	49
post-retrofit	0	980	426	598	876	28
difference	0	-542	-56	-123	0	-21
% change	0	-36	-12	-17	0	-43
Total (MBtu/1000ft2)						
existing	0	33	10	15	19	1
post-retrofit	0	21	9	13	19	1
difference	0	-12	-1	-3	0	0
% change	0	-36	-12	-17	0	-43

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Gymnasium 1120
Sulfur Oxides (lb)	
existing	9,560
post-retrofit	7,642
difference	-1,918
% change	-20
Nitrogen Oxides (lb)	
existing	4,573
post-retrofit	3,655
difference	-919
% change	-20
Carbon Monoxide (lb)	
existing	7,877
post-retrofit	6,292
difference	-1,584
% change	-20
Carbon Dioxide (tons)	
existing	970
post-retrofit	775
difference	-195
% change	-20
Particulate Matter (lb)	
existing	190
post-retrofit	151
difference	-38
% change	-20
Hydrocarbons (lb)	
existing	3,256
post-retrofit	2,602
difference	-654
% change	-20

Building 2003 Vehicle Maintenance Facility

The following information identifies the cost-effective energy- and cost-reducing retrofit projects for building 2003 identified from the FEDS modeling and analysis. Key energy and economic results are presented for each cost-effective retrofit measure.

Facility Description 2003

2003 is a vehicle maintenance administration facility built in 1994. Building 2003 is conditioned by an electric package unit, is lit by 32 watt fluorescent T8's and has little to no insulation in its building envelope. Building 2003 is 6,848 sf.

Alternative Financing Results

A FEDS analysis using alternative financing suggests replacing the fluorescent lighting, the EXIT lighting and increasing the insulation in the roof on the interior surface.

Alternative financing FEDS results for building 2003:

Bldg. Set Description	End Use	Existing Technology	Retrofit Technology	Energy Savings (MMBtu/yr)	1st Year Savings ($/yr)	Installed Cost ($)	Net Present Value ($)	SIR
Small 1990's admin	Lights	EX6: EXIT - LED	EX12: EXIT - ELECTROLUMINESCENT PANEL RETRO KIT	1	123	621	122	1.2
Small 1990's admin	Lights	FL41: FL 1X4 1F32T8 EEF1	FL302: FL 1X4 1F25ST8 ELC1 REF	4	411	2,310	141	1.1
Small 1990's admin	Lights	FL39: FL 2X4 2F32T8 EEF2	FL303: FL 2X4 2F25ST8 ELC2 REF	98	5,828	14,843	19,000	2.3
Small 1990's admin	Roof	Roof Insulation R-Value 0.00	Add Insulation to Interior Surface of Metal Roof: 4 inches Fiberglass	299	16,487	23,407	71,229	4.0

Alternative Financing Energy Consumption by Fuel Type

The modeled energy consumption for a typical year was 234,145 kwh before retrofits and 121,374 kwh after proposed retrofits are implemented. The energy use intensity goes from 116.7 MBtu/Ksf to 60.5 MBtu/Ksf after retrofits.

Small 1990's admin 2003

Fuel	Energy	Energy Intensity (user units/1000ft2)	Energy Intensity (MBtu/1000ft2)	Dollars (2009)*
Electricity (kWh)				
existing	234,145	34,191.8	116.7	41,483
post-retrofit	121,374	17,724.0	60.5	21,446
difference	-112,771	-16,467.8	-56.2	-20,037
% change	-48	-48	-48	-48
Total (MBtu)				
existing	799	116.7	116.7	41,483
post-retrofit	414	60.5	60.5	21,446
difference	-385	-56.2	-56.2	-20,037
% change	-48	-48	-48	-48

* Dollar values for electricity include both energy and demand components.

Alternative Financing Energy Consumption by End Use

Space cooling is the largest load in the building with 91,143 kWh/year, followed by ventilation with 56,887 kWh/year.

Annual Energy Use by Building Set, Fuel Type, and End Use
Small 1990's admin 2003

Fuel	Heating	Cooling	Vent	Lights	Motors and Misc Equip	Hot Water
Electricity (kWh)						
existing	0	91,143	56,887	56,227	28,339	1,550
post-retrofit	0	34,654	21,727	35,104	28,339	1,550
difference	0	-56,490	-35,159	-21,122	0	0
% change	0	-62	-62	-38	0	0
Total (MBtu)						
existing	0	311	194	192	97	5
post-retrofit	0	118	74	120	97	5
difference	0	-193	-120	-72	0	0
% change	0	-62	-62	-38	0	0
Total (MBtu/1000ft2)						
existing	0	45	28	28	14	1
post-retrofit	0	17	11	17	14	1
difference	0	-28	-18	-11	0	0
% change	0	-62	-62	-38	0	0

Alternative Financing Emission Reduction

The emission reductions from implemented the proposed retrofits are as follows:

	Small 1990's admin 2003
Sulfur Oxides (lb)	
existing	2,117
post-retrofit	1,097
difference	-1,019
% change	-48
Nitrogen Oxides (lb)	
existing	1,011
post-retrofit	524
difference	-487
% change	-48
Carbon Monoxide (lb)	
existing	1,740
post-retrofit	902
difference	-838
% change	-48
Carbon Dioxide (tons)	
existing	214
post-retrofit	111
difference	-103
% change	-48
Particulate Matter (lb)	
existing	42
post-retrofit	22
difference	-20
% change	-48
Hydrocarbons (lb)	
existing	720
post-retrofit	373
difference	-347
% change	-48

Appendix E

Conversion to Water-Cooled Chillers for Building Space Cooling

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Appendix E
Conversion to Water-Cooled Chillers for Building Space Cooling

Water-cooled condensing of cooling equipment refrigerant results in a significant improvement in efficiency compared to air-cooled condensing. This advantage stems from two factors. Condenser water from an evaporative cooling tower is generally cooler than ambient air (except when the relative humidity is very high), and water is a more effective heat transfer fluid than air. The two factors work together to lower the refrigerant condensing temperature, hence improving both theoretical and actual refrigeration cycle efficiency. Combining cooling loads met by multiple smaller cooling units into fewer central units allows additional efficiency gains by using centrifugal compressors, a more efficient technology than alternative compressor types commonly used in smaller cooling equipment. These advantages do come at a price, however. Condensing refrigerant with water requires additional costs associated with a cooling tower, condenser water pumps and piping, and a shell to enclose the water as it passes by the condenser tubing. The condenser pump also represents an additional power consuming device that an air-cooled unit does not have. Finally, the distribution of centrally chilled water incurs pumping and piping costs and pumping energy not required by distributed direct expansion coolers (e.g., window air conditioner [AC] and packaged rooftop AC).

For the reasons noted above, water-cooled chillers offer significant performance advantages over air-cooled equipment that must be weighed against their additional capital costs. During the last few decades, space cooling has become much more common in Hawaiian military facilities because internal heating loads (e.g., personal computers and other office equipment) have increased, building designs have become less suitable for natural ventilation, and occupants expect a more comfortable working environment. The paragraphs that follow document the expected costs and energy savings associated with example conversions to water-cooled chillers at Hickam, Pearl, and Smith. Many other similar conversions are possible at these three facilities, but additional analysis was not possible with the assessment resources available. The installations are encouraged to consider additional opportunities for using water-cooled chillers where the economics are justified.

Hickam AFB

Buildings 2130, 2131, and 2133 are currently served by a small central cooling plant comprised of two air-cooled chillers. The proposed retrofit would replace the existing air-cooled chillers with two water-cooled chillers, a cooling tower, and condenser water pumps and piping. The existing chilled water pumps and piping would not change and the electrical service to the central plant should be adequate for the retrofit.

The peak and annual building cooling loads were estimated with the FEDS model, and the performance of the existing chillers was estimated from manufacturer's specifications for the two units. From this information, the annual kWh and peak kW electrical loads were calculated and then combined with Hickam's electricity rates to calculate the current annual electricity costs. The existing system performance and electricity cost figures are presented in Table E1.

Although the FEDS model estimates a peak of only 61 tons for the three buildings, two 40-ton water-cooled chillers were assumed for the retrofit to match the existing nameplate capacity of the two air-cooled chillers. In this size range, the water-cooled chillers were assumed to use a rotary screw compressor rated at 0.73 kW/ton. In addition, the condenser water pump and cooling tower fan would be expected to consume 0.12 kW/ton for a total cooling plant performance of 0.85 kW/ton. The annual electricity bill for the water-cooled system was calculated to be $35,360 based on these assumptions, resulting in an annual savings of about $15,000 and a peak electric load reduction of 22 kW.

Table E 1. Hickam Buildings 2130, 2131, 2133 Existing System Performance and Electricity Cost

Building	Peak Load, Tons	Annual Load, Ton-hours	Annual Capacity Factor	Existing Air Cooled kW/ton	Existing Annual Electricity kWh	Existing Peak Electricity kW	Existing Annual Electricity Cost
2130	18.1	73,335	0.46	1.204	88,296	21.8	
2131	10.3	40,647	0.45	1.204	48,939	12.4	
2133	32.7	100,092	0.35	1.204	120,511	39.3	
Totals	**61.0**	**214,074**	**0.40**	**1.204**	**257,745**	**73.5**	**$50,087**

The two new 40-ton water-cooled chillers were estimated to cost $88,200 and the cooling tower, condenser pump, and piping an additional $26,100. These figures include all direct construction costs, but do not include any allowance for design or SIOH costs. Based on the direct cost, the payback period is 8 years. With an additional 16% for design and SIOH, the payback period rises to 9 years.

Pearl Harbor

Building 631, the Navy Exchange (NEX) and Commissary, is currently served by a collection of packaged rooftop direct expansion (DX) AC units. The proposed retrofit would replace the existing DX units with a new chilled water coil (in the existing air-handler units [AHU]), two water-cooled chillers, a cooling tower, condenser water pumps and piping, and chilled water pumps and piping. The new chiller plant was assumed to be sited on the ground on the southeast side of the building, next to the Commissary.

The peak and annual building cooling loads were estimated with the FEDS model and the performance of the existing packaged DX units was estimated from the vintage of the existing equipment. From this information, the annual kWh and peak kW electrical loads were calculated and then combined with Pearl's electricity rates to calculate the current annual electricity costs. The existing system performance and electricity cost figures are presented in Table E2.

Table E 2. Pearl Building 631 Existing System Performance and Electricity Cost

Building	Peak Load, Tons	Annual Load, Ton-hours	Annual Capacity Factor	Existing Air Cooled kW/ton	Existing Annual Electricity kWh	Existing Peak Electricity kW	Existing Annual Electricity Cost
Navy Exchange (NEX)	275.1	918,580	0.38	1.2859	1,181,180	354	
NEX Food Court	125.0	342,737	0.31	1.2859	440,717	161	
Commissary	194.4	716,633	0.42	1.2859	921,501	250	
Totals	594.5	1,977,950	0.38	1.2859	2,543,446	764	$493,300

In this size range, the water-cooled chillers were assumed to use a centrifugal compressor rated at 0.51 kW/ton. In addition, the chilled water pumps, condenser water pumps, and cooling tower fan would be expected to consume 0.18 kW/ton for a total cooling plant performance of 0.69 kW/ton. The annual electricity bill for the water-cooled system was calculated to be $264,700 based on these assumptions, resulting in an annual savings of $228,600 and a peak electric load reduction of 354 kW.

A new 600-ton water-cooled chiller plant (chillers, cooling tower, pumps, plant piping, electrical, controls, and structure) was estimated to cost $656,000. Chilled water piping running to and from the ground to every rooftop air-handling unit was estimated to cost $225,000. The cost of the new chilled water coils was estimated to be $180,000. These figures include all direct construction costs, but do not include any allowance for design or SIOH costs. Based on the direct cost, the payback period is 4 years. With an additional 16% for design and SIOH, the payback period rises to 4.5 years.

Camp Smith

Buildings 401, 402, 403, and 404 are currently served by window DX AC units. The proposed retrofit would replace the window units with room fan coil units, external chilled water supply and return piping and a central water-cooled chiller plant serving all four buildings. The same plant would also serve Building 20, which already has air-cooled chillers, hence chilled water piping within the building, but will need chilled water supply and return piping from the new central plant to Building 20. The new chiller plant was assumed to be sited on the West side of Bailey Road, opposite Building 401.

The peak and annual building cooling loads were estimated with the FEDS model and the performance of the existing window DX AC units and air-cooled chillers were estimated from manufacturer's specifications for the two types of units. From this information, the annual kWh and peak kW electrical loads were calculated and then combined with Smith's electricity rates to calculate the current annual electricity costs. The existing system performance and electricity cost figures are presented in Table E3.

Table E 3. Smith Buildings 401-404, and Building 20 Existing System Performance and Electricity Cost

Building	Peak Load, Tons	Annual Load, Ton-hours	Annual Capacity Factor	Existing Air Cooled kW/ton	Existing Annual Electricity kWh	Existing Peak Electricity kW	Existing Annual Electricity Cost
401	65.7	147,804	0.26	1.16	171,515	76.2	
402	65.7	147,804	0.26	1.16	171,515	76.2	
403	65.7	147,804	0.26	1.16	171,515	76.2	
404	65.7	147,804	0.26	1.16	171,515	76.2	
20	142.8	419,327	0.34	1.44	603,203	205.3	
Totals	405.5	1,010,544	0.28	1.26	1,289,263	510	$275,500

In this size range, the water-cooled chillers were assumed to use a centrifugal compressor rated at 0.57 kW/ton. In addition, the chilled water pumps, condenser water pumps, and cooling tower fan would be expected to consume 0.18 kW/ton for a total cooling plant performance of 0.75 kW/ton. The annual electricity bill for the water-cooled system was calculated to be $164,200 based on these assumptions, resulting in an annual savings of $111,300 and a peak electric load reduction of 206 kW.

A new 400-ton water-cooled chiller plant (chillers, cooling tower, pumps, plant piping, electrical, controls, and structure) was estimated to cost $520,000. Chilled water piping that would be mounted on the exterior of Buildings 401-404 was estimated to cost $85,000. Chilled water piping running to and from the new central plant to Buildings 401-404 and 20 was estimated to cost $189,000. The cost of the new chilled water coils for Buildings 401-404 was estimated to be $75,000. These figures include all direct construction costs, but do not include any allowance for design or SIOH costs. Based on the direct cost, the payback period is 8 years. With an additional 16% for design and SIOH, the payback period rises to 9 years.

Before implementing this project, Camp Smith should consider other possible means of serving these five buildings with water-cooled chillers. An expansion of the chilled water plant serving Building 700 may offer some economies over the new plant proposed here, but the chilled water distribution piping would be longer. Integration with a new chilled water plant serving the eventual replacement of the Old Hospital Complex would probably be ideal if the Complex is going to be replaced relatively soon.

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