ENERGY and WATER CONSERVATION

ACTION PLAN

for

NATIONAL PARK SERVICE

GATEWAY NATIONAL RECREATION AREA

Volume III – Wildlife Refuge

Final Report

August 2000

SUD ASSOCIATES, P.A.

Sustain-
ability

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ENERGY and WATER CONSERVATION ACTION PLAN

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NATIONAL PARK SERVICE

GATEWAY NATIONAL RECREATION AREA

Volume III– Wildlife Refuge

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AUDIT INFORMATION

Walk-Through Building Energy Audit
with Water Conservation Screening and Renewables Screening

August 2000

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Cost: $28,700
Building Type: Varied
Age: 30-70 years
Number of Buildings: 32
Total Square Footage: 591,830 SF

PREFACE

Landsberg Engineering, P.C., a subcontractor to Sud Associates, P.A., prepared this document for the U.S Department of Energy as a contractor under the SAVEnergy Program. The authors of this report are Brett Fero and Paul Remington. The report was reviewed for technical quality by Dennis Landsberg.

ACKNOWLEDGEMENTS

Special thanks are due to Lynn Pilgrim and Ken Hanaki, P.E. for coordinating the site visits.

WILDLIFE REFUGE
TABLE CONTENTS

	Page
EXECUTIVE SUMMARY: A description of the facilities and recommendations.	1
ECM SUMMARY: A table that lists energy savings, installation costs and Payback periods for survey recommendations.	3
INTRODUCTION: An overview of the survey process and energy management.	4
GENERAL BUILDING BACKGROUND: Building, Systems and Use.	5
Visitor Center	
Building 101	
HISTORICAL UTILITY SUMMARY: Available utility data.	7
GENERAL OBSERVATIONS	8
WATER CONSERVATION AND RENEWABLES SCREENING:	8
OPERATION AND MAINTENANCE MEASURES: Descriptions of the cost saving changes identified for the facility.	9
Visitor Center	
Building 101	
ENERGY CONSERVATION MEASURES: Descriptions of the cost saving improvements identified for the facility.	10
Visitor Center	
Building 101	
FUNDING RECOMMENDATIONS: Description of financing options.	15
ACTION PLAN RECOMMENDATIONS: Summary recommendations.	23
APPENDICES:	
APPENDIX A: TARIFF and UTILITY INFORMATION	
APPENDIX B: ENERGY CONSERVATION DETAILS	
APPENDIX C: SCREENING TOOLS Input/Output	

EXECUTIVE SUMMARY

This is the **Energy and Water Conservation Plan** for the Wildlife Refuge. This report documents opportunities to save money through more efficient use of electricity, other fuels and water for the two buildings at this facility.

Visitor Center:

Physical description of structures: This 3,300 square foot, concrete block building is open to the public 7 days a week. The 27-year old structure includes a flat built up roof, and double glazed windows. A 720 square foot trailer has been added to the South side of the building to accommodate office space needs.

Physical description of major energy using systems: An oil-fired boiler serves as the primary heating source to perimeter baseboard radiators and unit heaters. Supplemental electric resistance heating serves the some bathrooms and vestibules. A 40-gallon electric water heater is used to provide domestic hot water. Lighting consists primarily of fluorescent fixtures installed in dropped ceilings.

Building 101:

Physical description of structures: This 50-year old ranch style house with an attached garage has been converted into office space. The wood frame house includes wooden, double-hung windows with exterior storm windows. The roof is constructed of a sloped wooden deck with asphalt shingles.

Physical description of major energy using systems: The building is heated by an oil-fired boiler and is not air-conditioned. Domestic hot water is supplied by and 40-gallon electric water heater.

Visitor Center and Building 101:

Assessment of recommended modifications to operating and maintenance procedures:

In general, insulate exposed all heating or domestic hot water piping in the building. Exposed piping in unconditioned areas is lost energy, and exposed piping indoors may lead to over and under heating spaces.

Reduce hot water temperatures to 125F. Increased water temperatures increase stand-by losses from the tank, and may cause injury when used.

Assessment of recommended energy conservation measures:

The major energy conservation measures include adding insulation, implementing night setback during unoccupied periods, installing energy efficient lighting measures and installing occupancy sensors.

Assessment of Water Conservation and Renewables Screenings:

Water consumption is included in the tax base in New York City and there are no water bills for these buildings. The report presents other options for reducing water consumption through the use of low flow fixtures. However, implementation of these measures will not lower costs and therefore Watergy was not run on these buildings.

The renewables screening for these facilities included input parameters for wind and solar ventilation preheat. These are not practical for these buildings.

Wildife Refuge
ECM Summary Table

Facility	Building	ECM # Number	ECM Description	Savings Energy kWh/yr	Savings Cost $/yr	Demand kW/mo	Total Electric Cost Svgs ($)	Fossil Fuel Type	Fossil Fuel Savings MTBU/yr	Fossil Fuel Cost Savings $	Total Cost Svgs $	Capital Cost $	Simple Payback Years
Wildlife Refuge	Visitors Center	125	Add Door Weatherstriping	0	0	0	0	Oil	14.3	120	120	470	3.9
Wildlife Refuge	Visitors Center	233	Install Night Setback and Outside Air Reset	0	0	0	0	Oil	119.2	980	980	200	0.2
Wildlife Refuge	Visitors Center	301	Replace Incandescent Lighting	1398	88	1.2	325	Oil	-3.1	-25	390	185	0.5
Wildlife Refuge	Visitors Center	304	Replace Lamps/Ballasts	3380	210	1.3	355	Oil	-7.2	-59	505	2410	4.8
Wildlife Refuge	Visitors Center	310	Replace Incandescent Lighting	1110	70	0.3	85	Oil	-2.8	-25	130	20	0.2
Wildlife Refuge	Visitors Center	325	Replace Exit Signs	460	30	0.1	15	Oil	-1.1	-10	35	135	3.9
Wildlife Refuge	Visitors Center	332	Install Occupancy Sensors	2825	178	0	0	Oil	-6.1	-50	130	870	6.7
Total	Visitors Center			9173	576	2.9	780		113.2	931	2290	4290	1.9
Wildlife Refuge	Bldg 101	102	Increase Attic Insulation	0	0	0	0	Oil	53	435	435	1200	2.8
Wildlife Refuge	Bldg 101	104	Insulate Crawl Space	0	0	0	0	Oil	69.2	570	570	1420	2.5
Wildlife Refuge	Bldg 101	110	Replace Windows	0	0	0	0	Oil	34.9	290	290	2560	8.8
Wildlife Refuge	Bldg 101	120	Install Storm Doors	0	0	0	0	Oil	13.2	110	110	600	5.5
Wildlife Refuge	Bldg 101	125	Add Door Weatherstriping	0	0	0	0	Oil	5.9	50	50	180	3.6
Wildlife Refuge	Bldg 101	233	Install Night Setback	0	0	0	0	Oil	29.7	245	245	200	0.8
Wildlife Refuge	Bldg 101	301	Replace Incandescent Lighting	1640	290	0	0	Oil	-3.5	-30	260	245	0.9
Wildlife Refuge	Bldg 101	302	Replace Quartz Halogen	195	35	0	0	Oil	-0.4	-3	30	40	1.3
Wildlife Refuge	Bldg 101	310	Replace Incandescent Lighting Exterior	1172	206	0	0	Oil	0	0	205	180	0.9
Total	Bldg 101			3007	531	0	0		202	1667	2195	6625	3.0
Grand Total				12180	1107	2.9	780		315.2	2598	4485	10915	4.9

INTRODUCTION

This is the **Energy and Water Conservation Plan** for the Wildlife Refuge. This report documents opportunities to save money through more efficient use of electricity, other fuels and water in these facilities.

This report should give you a better understanding of how your facility operates. **Its main purpose is to identify energy conservation measures (ECMs) you can take to improve your management and control of energy usage.**

Information contained in this report was collected during a site visit made to the Gateway National Recreation Area on February 28-March 3 and March 20-24, 2000. The audit was conducted by Brett Fero and Paul Remington of Landsberg Engineering, P.C., Consulting Engineers, under subcontract to Sud Associates, P.A.

ENERGY MANAGEMENT

Energy conservation can not be achieved by a single action. It is an ongoing activity that should become a part of the institutional culture. At the National Parks Service, many of you are actively involved in energy conservation. Some interior lighting has already been replaced with energy conserving types.

The decision to undertake this audit is an important milestone in your energy conservation plan. Proper follow through of the recommendations made in this report will maximize its benefits. For example, the controls and lighting ECMs outlined in this action plan can be executed very cost effectively if they are incorporated in the design of new projects.

One method of implementing these recommendations would be to officially appoint an energy coordinator and an Energy Advisory Council. The Council would be comprised of individuals from various divisions and sections of the National Parks Service and and future tenants of currently vacant buildings. The coordinator should review the findings of this energy audit with the Council. The ECMs to be implemented should be finalized and a timetable should be established.

Since the recommendations of the audit are primarily of a conceptual nature, any valid concerns should be addressed during the detailed implementation phase. If appropriate, the recommendations should be modified. There should be no attempt to force acceptance of the modifications. Early in the planning stages, the Council should solicit support from top management and involve personnel from all departments. This can be done by publicizing the benefits of energy conservation and the intended action plan. The plan should be flexible enough to accommodate unforeseen factors.

GENERAL BUILDING BACKGROUND

VISITOR CENTER

GENERAL INFORMATION

The Visitor Center is a single –story structure located at the Wildlife Refuge in Queens, NY. It is open to the public seven days per week from 7 AM to 5 PM. Total measured floor area for the main building is approximately 3,300 gross square feet GSF). In addition to the main building, there is a trailer located next to the building on the south side that is used for offices. A hot water line has been extended from the main building for space heating. The floor area for the trailer is about 720 square feet. The 27 year old building appears to be in very good condition.

The windows are double glazed and appear to be in very good condition. The main entrance doors are glass and are in need of weatherstripping.

The exterior walls are concrete block. No major insulation is thought to exist.

The roof is a flat built up type over a metal deck. No major insulation is thought to exist.

ENERGY CONSUMING SYSTEMS

Major energy consuming systems include heating and lighting. Domestic hot water is mainly used for hand washing.

The building is heated by an older, Burnham oil-fired boiler rated at 190,000 BTUH. There are two zones controlled by manual thermostats. Hot water is sent to perimeter baseboard radiators and Modine unit heaters in the garage area. There is some electric resistance heat located in the bathrooms near the lobby and by the front entrance doors.

Lighting consists mainly of T-12 fluorescent fixtures, with 40-watt lamps and magnetic ballasts, installed in the dropped ceiling. Some incandescent track lighting is installed in the lecture area, but is only used occasionally.

Two small window units in the lecture area and one in the office area supply air conditioning.

Domestic hot water provided by a Bradford White 40-gallon electric heater. Hot water temperature was measured at 140F at a sink.

Electricity is separately metered at the building.

BUILDING 101

GENERAL INFORMATION

Building 101 is located at the Wildlife Refuge in Queens, NY. It is a 1950's ranch style house with an attached garage that has been converted to office space. The office operates normal business hours five days per week. Total measured floor area for the main building is approximately 2,030 GSF. The facility database lists the square footage as 2,400. The crawlspace is uninsulated below the house. The 50-year-old building appears to be in good condition.

The windows are the original wood-framed, double-hung units with exterior storm windows. The main windows are in need of replacement.

The exterior walls are wood frame with no known insulation.

The roof has a sloped wood deck with asphalt shingles. There are a few inches of blown in insulation in the floor of the attic.

ENERGY CONSUMING SYSTEMS

Major energy consuming systems include heating and lighting. Domestic hot water is mainly used for hand washing. Several personal computers and a copier are used.

The building is heated by an older, American Standard oil-fired boiler rated at 141,000 BTUH. There is one heating zone controlled by a Chronotherm thermostat. Hot water is sent to perimeter cast iron radiators.

Lighting consists mainly of incandescent fixtures surface mounted on the ceiling. Fluorescent lighting illuminates the garage area. Most areas have local light switches.

There is no central air conditioning system.

Domestic hot water provided by an electric, 40-gallon heater. Hot water temperature was measured at 150F at a sink.

Electricity is metered at the building. Propane is used for the kitchen stove.

CURRENT CONSERVATION MEASURES

Visitor Center: None.

Building 101: None.

HISTORICAL UTILITY SUMMARY

Wildlife Refuge Visitor Center

Con Ed Rate EL9 General Large 29-5121-2170-0000-7

	kWh	Cost	kW	kW Cost	Total Cost
Aug-99	1,980	$350	8.2	$210	$560
Jul	3,420	$471	9	$232	$703
Jun	3,780	$508	10.2	$255	$763
May	2,580	$387	9	$218	$605
Apr	2,220	$363	10.8	$233	$596
Feb	2,940	$389	10.8	$202	$591
Jan	3,540	$495	13.8	$271	$766
Dec	3,420	$480	12.8	$256	$736
Nov	4,560	$678	17.4	$389	$1,067
Oct	2,640	$440	13.8	$271	$711
Sep	2,160	$315	7.8	$180	$495
Aug-98	1,860	$275	7.8	$153	$428
	35,100	**$5,151**	**131.4**	**$2,870**	**$8,021**

	Gal #2 oil	Oil Cost
Annual Oil	**2,373**	**$2,705**

Wildlife Refuge Bldg 101

Con Ed Rate EL2 small non residential 29-5121-2180-0000-6

	kWh	Cost
Aug-99	844	$173
Jul	1,053	$211
Jun	1,118	$219
May	962	$190
Apr	1,027	$177
Feb	536	$100
Jan	667	$123
Dec	736	$136
Nov	872	$159
Oct	707	$130
Sep	845	$155
Aug-98	776	$143
Annualized	10,143	1,916

	Gal #2 oil	Oil Cost
Annual Oil	**1,158**	**$1,320**

GENERAL OBSERVATIONS

Visitor Center:

The Visitor's Center is located in a wooded area located near the water in a nature preserve area. It appears that it was built with a low roof to lessen intrusiveness to the area. Plants and trees near the building help it blend into the surroundings. A trailer has been added for additional office space. The building is in good overall condition but could benefit from some updates to its energy systems.

Building 101:

This building is located in the area of the Visitor's Center but is not visible from the road. The older ranch house is in good overall condition but could benefit from some updating to its windows, insulation and lighting.

WATER CONSERVATION AND RENEWABLES SCREENING

Water Conservation Screening: Water consumption is included in the tax base in New York City and there are no water bills for these buildings. Water consumption can be reduced through the use of flow restrictors in faucets, low flow showerheads and low flow toilets and urinals. However, implementation of these measures will not lower water costs and therefore Watergy was not run on these buildings.

Renewables Screening: The renewables screening for this facility includes input parameters for infiltration and wind generation. Infiltration measures have been addressed. A colleague recently conducted a detailed wind and photovoltaic study for the New York City Area. A 7 MW wind generation system, using $0.05 per kWh, will pay back in about 17 years. A 50 kW wind generation system will payback in about 25 years. Photovoltaic systems were found to have even longer payback periods than the wind systems.

Regarding solar ventilation pre-heating, the buildings do not have ventilating systems.

OPERATION AND MAINTENANCE MEASURES

Four low cost modifications that will reduce energy consumption were identified during the audit and are shown in the summary table.

Visitor Center:

O&M 254: Install Pipe Insulation

There are some missing areas of pipe insulation the mechanical room.

Insulate all exposed heating and/or domestic hot water piping with one-inch pipe insulation.

O&M 401: Reduce the domestic hot water temperature - Water heaters typically arrive from the factory with the thermostat set at 140F. Water at this temperature or higher may cause injury. By turning down the setpoint temperatures to 125F, heating energy and standby losses will be reduced. It should be noted that water that is hot enough to disinfect will cause injury. Use disinfectant soap if this is an issue. The water heater in this building was set at 140F.

For electric water heaters, open the access panel on each electric water heater and adjust the thermostat setpoint temperature to 125F. Measure delivered hot water temperature at the closest fixture to verify thermostat accuracy, and adjust thermostat if required.

Building 101:

O&M 254: Install Pipe Insulation

There are some missing areas of pipe insulation the mechanical room.

Insulate all exposed heating and/or domestic hot water piping with one-inch pipe insulation.

O&M 401: Reduce the domestic hot water temperature

The water heater in this building was set at 150F. Adjust the setpoint to 125F as described above.

ENERGY CONSERVATION MEASURES

This section of the report contains descriptions of the ECM's that are listed in the Savings Summary and recommendations for further action. Any questions that you have regarding the recommendations can be addressed to Landsberg Engineering, P.C., Consulting Engineers, 518/383-9505.

ECMs were identified for lighting, building envelope, and HVAC systems. The lighting modifications consist of improving lighting controls and upgrading to more efficient lighting sources. Envelope improvements include adding weatherstripping, insulation, and storm doors. HVAC improvements include reducing the space temperature setting during the unoccupied hours.

These recommendations are based on observations made during an energy conservation audit of the facility and from written and oral information provided by the facility staff. No attempts were made to verify the accuracy of this information. The recommendations are of a conceptual nature. Any details included in the description were used for estimation and are suggestions for further evaluation only. **Prior to their implementation, all recommendations should be carefully evaluated and a detailed design should be undertaken to make sure that they are appropriate for the facility.** The actual results experienced by the facility may vary from those given in this report.

Complete savings and cost calculations are included in the Appendices. The NIST Building Life Cycle Cost Program version 4.7-99 was used to calculate Life Cycle Cost. Discount factors and price escalation rates for electricity and natural gas were taken from the "Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis 1999."

VISITOR CENTER RECOMMENDED ECMS:

ECM 125: Weatherstrip Doors

Exterior doors require weatherstripping to eliminate infiltration. During the energy survey, gaps were observed along doorjambs and meeting rails.

For steel and aluminum doors, install new weatherstripping as follows:
Door head and jambs: adhesive jamb weatherstripping
Doorsill: gasketed threshold

For wood doors install new weatherstripping as follows:
Door head and jambs: spring bronze
Doorsill: gasketed threshold

ECM 233: Install Night Setback and Outdoor Air Reset

An oil-fired hot water boiler heats the building. The temperature of the water heating loop is manually set. In periods of mild weather, the boiler short cycles and loses excess. Additionally, the thermostat controls in the building maintain a constant temperature at all times.

Installation of an outdoor reset control will permit modulation of the water heating loop temperature with both outside air temperature and building occupancy. Installation of a night setback thermostat will permit the space temperature to be lowered automatically during the heating season when the building is unoccupied.

ECM 301: Replace Incandescent Lighting – Interior

There are several incandescent lamps in use in the building.

Replace all incandescent bulbs with warm white, instant start, compact fluorescent lamps. If the recommended lamp sizes do not fit, use a smaller size. For recessed fixtures, lamp extenders may be required.

ECM 304: Install T-8 Fluorescent Lamps and Ballasts

Most manufacturers of fluorescent lamps now offer energy saving T-8 lamps that are designed for use with T-8 electronic ballasts. T-8 fluorescent systems use about 25% less energy than the 34-watt lamps now in use. Electronic ballasts do not produce the "flicker" associated with magnetic ballasts and therefore light quality is improved. Electronic ballasts transform the electrical characteristics of the power supply into those needed by the lamps. Ballasts consume energy whether or not lamps are connected to them. Electronic ballasts not only use less energy but also enable the lamps to use less energy because of modified electrical characteristics.

All T-12 lamps and ballasts should be replaced with like T-8 units. Reflectors and lenses should be cleaned at the time of ballast and lamp replacement.

ECM 310: Replace Incandescent Lighting – Exterior

There are several exterior incandescent lamps in use on the exterior of the building.

Replace all incandescent bulbs with warm white, instant start, compact fluorescent lamps. If the recommended lamp sizes do not fit, use a smaller size. For recessed fixtures, lamp extenders may be required. Note that waterproof lamps are available.

ECM 325: Install LED Exit Signs

Two 15-watt incandescent lights illuminate the existing exit signs.

Replace the existing incandescent lamps with an LED rebuild kit. The LED lamps draw only 2-watts each, and last 25 years. Alternately, the exit signs can be replaced with LED exit signs.

ECM 332: Install Occupancy Sensors

During the survey it was observed that lights in offices, the break room, toilet rooms, corridors, and storage spaces remain illuminated when unoccupied.

For offices and break rooms where the occupants are in line of site of the wall switch, install infrared sensors mounted in wall-switch boxes. Install ultrasonic ceiling-mounted sensors in corridors, toilet rooms and spaces where occupants are not in line of site of the wall switch. Set time delays for 6 minutes in offices, 30 minutes in toilet rooms and 20 minutes in corridors.

Send an administrative notice to instruct all personnel to switch lights off as they leave the room using the existing wall switches or the button on the sensor. Automatic off operation should be used only when occupants forget to turn off the lights manually.

In mechanical areas, use digital time switches. These units flash one minute before they turn off, providing occupants with time to reset them.

BUILDING 101 RECOMMENDED ECMS:

ECM 102: Install Attic Insulation

The existing attic contains a small amount of insulation that is in poor condition. The uninsulated attic ceilings permit heat loss in the heating season and the conduction of heat to the conditioned spaces below during the cooling season.

Increase the R-value of the roof by adding twelve inches of R-38 fiberglass batt insulation, or blown insulation as appropriate. Install access hatches if required to install the insulation.

ECM 104: Insulate Crawl Spaces

The building crawl spaces are currently uninsulated. This increases energy use by permitting unconditioned air to enter the building through the floor.

Install R-19 fiberglass batt insulation in the crawl space under the existing floor.

ECM 110: Repair/Replace Windows

The existing single-glazed wood-framed windows are in poor condition and allow large quantities of unconditioned air to enter the building.

Replace the existing windows with new windows fitted with low-e thermopane glass.

ECM 120: Install Storm Doors

The existing storm doors are in need of replacement. Replace doors with a good quality storm door to reduce infiltration and conduction losses.

ECM 125: Weatherstrip Doors

Exterior doors require weatherstripping to eliminate infiltration. During the energy survey, gaps were observed along doorjambs and meeting rails.

For steel and aluminum doors, install new weatherstripping as follows:

Door head and jambs: adhesive jamb weatherstripping
Doorsill: gasketed threshold

For wood doors install new weatherstripping as follows:

Door head and jambs: spring bronze
Door sill: gasketed threshold

ECM 233: Install Night Setback

Installation of a programmable thermostat will ensure that the heating temperature is reduced to 60F when the building is unoccupied.

ECM 301: Replace Incandescent Lighting – Interior

There are several incandescent lamps in use in the building.

Replace all incandescent bulbs with warm white, instant start, compact fluorescent lamps. If the recommended lamp sizes do not fit, use a smaller size. For recessed fixtures, lamp extenders may be required.

ECM 302: Replace Quartz Halogen Lighting – Interior

There is one floor lamp that likely has a 500-watt quartz halogen lamp.

Replace the floor lamp with one that has two 55-watt compact fluorescent lamps installed.

310: Replace Incandescent Lighting - Exterior

There are several exterior incandescent spot lights that could be replace with higher efficiency high-pressure sodium fixtures. It is recommended to replace the 150-watt incandescent fixtures with 35-watt high-pressure sodium fixtures.

FUNDING RECOMMENDATIONS

ALTERNATIVE METHODS FOR THE FEDERAL GOVERNMENT TO FINANCE AND IMPLEMENT ENERGY EFFICIENT PROJECTS[1]

To meet the ambitious requirements of Federal energy management legislation, the Federal government can access five sources of financing (four available nationally and one available in New York State only) to fund energy efficiency project implementation

1. Agency Capital Funds (Direct Appropriations)
2. FEMP's Federal Energy Efficiency Fund (FEEF)
3. Utility Incentives
4. Energy Saving Performance Contracts (ESPC)
5. The New York Energy Research and Development Authority (NYSERDA).

1. AGENCY CAPITAL FUNDS (DIRECT APPROPRIATIONS)

Historically, Federal appropriations have provided the bulk of energy efficiency financing for government agencies. To encourage agencies to invest in energy efficiency, EPACT permits agencies to retain a portion of the savings produced by energy efficient projects. Despite the incentive, energy efficiency continues to receive a low priority in the budget process of many agencies. The lack of adequate funding is one of the main constraints to improved energy efficiency.

Advantages

Direct appropriations allow the Federal government to retain all of the savings from cost effective renovations and so not incur any interest charge. Since the government's appropriated funds are sourced through tax revenue or bonds, the "cost" to appropriate these funds is lower than the cost to borrow money from a bank or a financial institution. This approach also enables the agency to implement an energy efficiency project with minimal contractual obligations on the government's part.

Disadvantages

Larger renovations, even if they are cost-effective, require submission and approval through the Federal budget process. Some renovations for energy efficiency financed by any of the other financing mechanisms would have reached break-even point and would be in the profit mode before large renovations could be financed and constructed through the budget cycle. However, agency appropriation is highly preferable to the do-nothing choice and is life-cycle cost-effective for Federal agencies.

[1] Items 1-4 from Energy Savings Performance Contracting Guidance Manual, Version 1.0.

With the government's intent to reduce the deficit appropriations for energy and facility-related projects, which are not directly related to agency mission, may not be funded or may be delayed. Funding for specific projects may be rejected if the payback period is too long.

2. FEDERAL ENERGY EFFICIENCY FUND

Section 546(b) of NECPA, as amended by EPACT, directs DOE to establish a Federal Energy Efficiency Fund (FEEF or Fund) to provide grants to agencies to assist them in meeting the mandated energy management requirements. The legislation anticipated that these funds would enhance and stimulate other funding sources, such as agency appropriations, utility demand side management incentives, and Energy Savings Performance Contracts.

The factors to be considered in determining whether to provide funding for proposals include:

1. The cost-effectiveness of the project.
2. The amount of energy and cost savings anticipated to the Federal government.
3. The amount of funding committed to the project by the agency requesting financial assistance.
4. The extent that a proposal leverages financing from other non-Federal sources.
5. Any other factor which DOE determines will result in the greatest amount of energy and cost savings to the Federal government.

The FEEF also allows agencies to apply for grant funds to support facility audits.

Advantages

FEEF is a source of capital that will be appropriated to DOE specifically for grants to agencies and it is expected to grow. It is available to agencies based on the competitiveness of the proposals submitted. All cost-effective energy and water-saving technologies can be proposed. Grant funding can cover all aspects of the projects, including all the costs related to getting an Energy Savings Performance Contract in place.

Due to the continuous competitive evaluation process, proposals may be submitted at any time of the year. Funding is provided by interagency agreement upon completion of evaluation and determination to award.

Disadvantages

Only the best proposals will receive funding. Those proposals which are marginally cost-effective are not likely to receive funding.

3. UTILITY INCENTIVES - DEMAND SIDE MANAGEMENT (DSM) PROGRAMS

Utility companies offer financial or other incentives to their customers to install energy efficient equipment, or construct more energy efficient buildings, since reducing demand or load growth is more cost effective than constructing a new power plant or increasing transmission and distribution systems. In addition, particularly investor-owned and regulated utilities commonly receive approval from regulatory commissions to earn incentives or profits on demand side management (DSM) investments. Utility DSM programs provide a technical resource or source of funding that can be leveraged to help implement an energy project.

Federal agencies are encouraged and authorized to participate in utility DSM programs by EPACT which stated that:

- Agencies are authorized and encouraged to participate in programs to increase energy efficiency and for water conservation or the management of electricity demand conducted by gas, water or electric utilities and generally available to customers of such utilities.
- Each agency may accept financial incentive, goods or services generally available from any such utility, to increase energy efficiency or to conserve water or manage electricity demand.
- Each agency is encouraged to enter into negotiations with electric, water, and gas utilities to design cost-effective demand management and conservation incentive programs to address the unique needs of each agency's facilities.
- If an agency satisfies the criteria which generally apply to other customers of a utility incentive program, such agency may not be denied collection of rebates or other incentives.

Utility DSM programs can be grouped into three general categories:

1. Audits/Cost Sharing/Rebates
2. Customized
3. DSM Bidding

1. Audits, cost sharing and rebates are made available to customers who conduct all activity to finance, design, and construct the energy project. Audits and financial incentives are usually made available to customers through an application process where the customer agrees to specific program requirements. For example, a rebate typically requires pre- and post-installation inspections by utility representatives to confirm energy efficient equipment conforms to DSM program requirements and are eligible for rebate payments. Audits may be made available at no cost to the customer or cost-shared. Energy technology feasibility studies such as those for thermal energy storage systems, are commonly cost-shared. The common element is that these programs usually only require a written agreement to comply with program requirements and do not necessitate a modification to an existing utility contract or a new contract. Execution of energy projects is still accomplished by the utility customer (agency). For example, the agency would acquire funding, contract for, or create project design specifications, and complete project construction with a contractor.

2. Customized programs are programs where the utility offers a menu of services for its customers, which may include: facility audits, technical and price proposals, engineering analysis and project design, project financing, installation, commissioning and sometimes equipment maintenance. In this case, the customer (agency) enters into a contract directly with the utility company who provides some of the turnkey services, but typically contracts out most of the design, installation and maintenance requirements of the project. DSM financial incentives ("rebates/cost sharing") may take the form of buying down the capital cost of the project. Repayment to the utility is usually accomplished by a "service charge" on the utility bill over several years, where the utility charge is not more than the projected monthly cost savings of the energy project. Several agencies have implemented customized DSM programs, on a sole source basis, with the serving utility. Most have used Basic Ordering Agreements (BOAs), which are not contracts, but serve to establish applicability or scope (eg., all agency buildings within the utility service territory) and the terms and conditions of contracts generated from the BOA for specific projects implemented. For example, the General Services administration has signed a BOA with a California utility which can be used by all Federal agencies within the utility service territory.
3. DSM bidding programs are another mechanism a utility can use to acquire DSM load reduction benefits. In this case, the utility company issues a competitive solicitation from firms who can provide energy services to its customers. Firms, typically Energy Service Companies (ESCOs), that are awarded DSM bid contracts are required to deliver scheduled utility system load reductions (eg., deliver 5 Megawatts (MW) peak load reduction in 3 years for a sustained period of 10 years). In return the utility pays for demand reduction and energy savings at established rates of multiyear contract terms. The ESCOs awarded the DSM bid contracts are then expected to market their services to customers and enter into separate contracts with numerous customers to implement facility energy efficiency improvements to achieve scheduled delivery of energy savings and demand reductions to the utility. ESCOs or firms with DSM bid contracts are in a unique position to offer energy services where the utility payment they receive for delivered energy savings is a financial incentive they can pass on to contracted clients (ie., the utility and utility customer (agency) share in the cost of acquiring facility energy services over a multi-year contract term).

Advantages

This is a win-win situation. It is an excellent opportunity to leverage utility sector funds or technical services to implement energy projects. Utilities with DSM programs want to reduce the demand placed on their system and are willing to pay their customers to assist them in achieving long range cost avoidance to the utility of new power plant construction. Consider that DSM programs are costly to market and implement for utilities, therefore large customers, such as Federal agencies, are attractive as they may be able to achieve DSM program goals at less cost. As the prospects for retail wheeling of electrical power nears, it appears electric utilities are more willing to negotiate an incentive program that fits the customer's needs and offers high value services besides delivery of reliable power.

Disadvantages

Rebate only programs will still require the agency to acquire agency capital funds to implement an energy project. Due to competitive forces in the market place, currently available DSM programs may be eliminated or reduced from their current level, and thus may not be available in the mid to long-term future.

NOTE: In New York State the Public Service Commission has established a System Benefit charge, collected via a tariff on electric utility bills. This program covers most New York State utilities including Con Edison and LIPA. These utilities no longer operate their own DSM Programs, although they may offer to buy capacity in the form of conservation. The money is used to fund Energy $mart Programs, administered by the New York State Energy Research and Development Authority. The purpose of this approach is to establish uniform programs and delivery of services across the state. NYSERDA is discussed under item 5. The DSM discussion has been left intact in the event the PSC changes its mind in the future and DSM programs are once again established. Lipa does bid DSM load reductions.

4. ENERGY SAVINGS PERFORMANCE CONTRACTING

In an ESPC, the ESCO (or contractor) incurs all costs of implementing energy savings measures, including:

- performing the audit
- designing the project
- acquiring and installing equipment
- training personnel
- operating and maintaining equipment

In exchange, the ESCO receives a share of any energy cost savings directly resulting from implementation of energy conservation measures during the term of the contract.

EPACT and the Executive Order strongly recommend this method of financing for energy efficiency projects. Specific provisions of EPACT provide that:

- Agencies are allowed to enter into contracts for 25 years without funding of cancellation charges.
- Congress is notified 30 days before awarding contracts in excess of $750,000.
- Funds are available to cover ESPC payments in the first fiscal year.
- DOE is directed to establish a pre-qualified list.
- ESCOs incur costs of conservation measures for a share of the savings.
- Payments are to be made from the utility and related operation and maintenance funds.
- ESCOs guarantee savings to agencies.
- DOE is directed, by rule, to establish methods and procedures for Federal agency use of ESPC.

FEMP has developed a list of firms from which agencies may select pre-qualified ESCOs for ESPC, as directed by EPACT and implemented by rule. The rule can be found in the *Code of Federal Regulations Title 10 Part 436.*

Advantages
ESPC allows Federal agencies to update aging buildings systems, streamline operations, and train maintenance workers to reduce operating costs. ESPC can be used when:

- Updating aging equipment with newer more efficient products.
- Helping agencies meet the energy cost reduction goals of Executive Order 12902 and EPACT.
- Conserving nonrenewable fuels and achieving environmental benefits by reducing energy consumption.
- Reducing utility costs with out sacrificing service.

ESPC allows agencies to implement energy saving projects at its facilities if agency funding or other sources are not available.

Disadvantages
The government does not immediately retain all the savings a project generates as it would if the project were funded by direct appropriations.

5. NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY (NYSERDA)

The New York State Energy Research and Development Authority is currently operating an "Energy $mart" Program, funded by system benefit charges collected on electric utility bills. Programs include a New Construction Program and a Low Interest Loan Program. The New Construction Program is targeted at new construction and buildings undergoing substantial renovation. Rebates are offered for pre-qualified conservation measures. For custom measures, the program pays offset design review and energy conservation improvement analysis services, paying up to $10,000 in fees per building and 50% of fees in excess of $10,000. Qualifying conservation measures are eligible for rebates of up to 70% of the incremental cost differential between standard systems and the proposed systems. Rebates of 80% are available for green buildings. The loan program provides an interest buydown of about 4% for loans of up to $500,000 and a duration of five years or less. A percentage of the loan must be for energy improvements that save electricity.

Advantages
The NYSERDA programs substantially reduce the incremental first cost of acquiring high efficiency building equipment.

Disadvantages
The above NYSERDA programs are primarily targeted at electric energy savings. The rebates cannot be used for gas or oil saving measures, or fuel switching. The New Construction Program has a $250,000 agency cap for rebates; the Loan Program has a $500,000 cap.

COMBINATIONS OF THE FIVE TYPES OF FINANCING

Using a combination of the five financing methods to reduce energy costs may be the best strategy. For example, if a facility can utilize an advanced technology, such as microturbines, yet the system's economics exceed the agency's maximum payback period, a FEEF grant can be combined with agency funds to install the system. Another example may involve the replacement of an aged chiller. NYSERDA new construction program rebates for the installation of an energy efficient chiller can be combined with an ESPC and eliminate the need to use

government funding. Also, an agency with limited technical and procurement staff to develop an ESPC solicitation could apply for a FEEF grant to pay for a facility audit and technical support.

FINANCING SUMMARY

ECM#	ECM Description	Recommended Financing
102	Increase Attic Insulation	In House
104	Insulate Crawl Space	ESPC/FEEF
110	Replace Windows	ESPC/FEEF
120	Install Storm Doors	In House
125	Weatherstrip Doors	In House
233	Install Night Setback and O.A. Reset	ESPC/FEEF
301	Replace Incandescent	ESPC/NYSERDA
302	Replace Quartz Halogen	ESPC/NYSERDA
310	Replace Incandescent Lighting	ESPC/NYSERDA
325	Replace Exit Signs	ESPC/NYSERDA

ACTION PLAN RECOMMENDATIONS

The recommended ECMs should be reviewed and refined in consultation with the Energy Advisory Council. Acceptable ECMs should be subject to further scrutiny before implementation. A more detailed take off should be undertaken to verify quantities and installation cost, and the savings potential should be reviewed.

The lighting measures most easily implemented by ESPC/NYSERDA, but could also be implemented with agency funding. The attic insulation, weatherstripping and storm doors, should be implemented with agency funds.

Water consumption is included in the tax base in New York City and there are no water bills for these buildings. Implementation of water saving measures will not lower consumption costs.

Renewable energy sources from the sun and wind were evaluated for New York City, and were found to have excessive payback periods using $0.05 per kWh and current technology implementation costs. Regarding solar ventilation pre-heating, the buildings do not have ventilating systems.

APPENDIX A: TARIFF AND UTILITY INFORMATION

SERVICE CLASSIFICATION NO. 2

GENERAL - SMALL

Applicable to Use of Service for

Light, heat, and power for general uses where the Customer's requirements do not exceed 10 kilowatts subject to the Common Provisions Applicable to Rate I and Rate II and the Special Provisions of this Service Classification.

Character of Service

Of the various characteristics of service listed and more fully described in General Rule III-2, the following may be designated for service by the Company under this Service Classification, subject to the limitations set forth in such Rule. Frequencies and voltages shown are approximate. All are continuous.

Standard Service

Any derivative of the standard alternating current, 3 phase, 4 wire system at 60 cycles and 120/208 volts.

Non-Standard Service

Direct Current at 120, 120/240 or 240 volts

Low Tension Alternating Current - 60 cycles:

Single phase at 120/240 volts
Three phase at 265/460 volts
Three phase at 240 volts
Two phase at 120/240 or 230 or 240 volts

(Service Classification No. 2 - Continued on Leaf No. 212)

SERVICE CLASSIFICATION NO. 2 - Continued
GENERAL - SMALL

Rate I - General - Small

Applicability: To all Customers other than those billed under Rate II.

Energy Charge *(cents per kwhr per month)*

Billing Period	Kwhr Blocks	Generation	Transmission	Distribution	Total
Winter	First 900	7.46	1.04	5.57	14.07
	Next 1,100	7.03	0.94	4.96	12.93
	Over 2,000	4.57	0.33	1.88	6.78
Summer	First 900	8.01	1.18	6.38	15.57
	Next 1,100	7.58	1.08	5.77	14.43
	Over 2,000	5.06	0.47	2.74	8.27

Customer Charge
$9.89 per month, exclusive of increase in rates and charges.

System Benefits Charge is 0.1 cent per kwhr.

Rate II - General - Small - Time-of-Day

Applicability: To all Customers, other than those Customers with unmetered service and those Customers who receive direct current service only, who elect to be billed at a time-of-day rate.

Energy Charge *(cents per kwhr per month)*

Billing Period	Time Period *	Generation	Transmission	Distribution	Total
Summer	*On-Peak*	13.50	2.56	10.67	26.73
	Off-Peak	3.62	0.14	0.61	4.37
Winter	*On-Peak*	8.44	1.31	5.33	15.08
	Off-Peak	3.62	0.14	0.61	4.37

* *On Peak*: Monday through Friday 8:00 A.M. to 10:00 P.M. Eastern Daylight Time
Off Peak: The entire 48 hours of Saturday and Sunday and Monday through Friday 10:00 P.M. to 8:00 A.M. Eastern Daylight Time

Customer Charge
$ 19.00 per month, exclusive of increase in rates and charges.

System Benefits Charge is 0.1 cent per kwhr.

(Service Classification No. 2 - Continued on Leaf No. 213)

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Date Effective: April 1, 1999

Issued by Joan S. Freilich, Executive Vice President and
Chief Financial Officer
4 Irving Place, New York, N.Y. 10003

SERVICE CLASSIFICATION NO. 2 - Continued

GENERAL - SMALL

Common Provisions Applicable to Rate I and Rate II

Fuel Adjustment

The charges set forth herein shall be subject to a fuel adjustment per kwhr supplied hereunder when changes from the base cost of fuel occur (as explained in General Information Section VII).

Increase in Rates and Charges

The rates and charges under this Service Classification including fuel adjustment, Customer charge, and other charges and adjustments (as explained in General Information Section VIII-(B)) are increased by the applicable percentage as explained in General Information Section VIII-(A) and shown on the related Statement.

Determination of Demand

Except as otherwise provided below, the Company will install a demand measuring device of a type approved by the Public Service Commission for the determination of the maximum demand:

(a) If it is determined that the Customer is using, or might use, more than 10 kw of maximum demand; or

(b) If the Customer's prorated consumption for a 60-day period, determined from actual readings used for billing, exceeds 6,000 kwhr for two successive periods, provided, however, that the Company may cease to meter the demand if the demand recorded in each of the previous 12 months has not exceeded 10 kw.

See General Rule III-11 (D) for definition of maximum demand.

The Company will not install a demand measuring device and may remove a demand measuring device previously installed under this provision:

(a) During any period the Customer takes service under Rate II prior to April 1, 1991; or

(b) If the Customer is taking temporary service as defined in General Rule III-1 (F).

(Service Classification No. 2 - Continued on Leaf No. 214)

SERVICE CLASSIFICATION NO. 2 - Continued

GENERAL - SMALL

Common Provisions Applicable to Rate I and Rate II - Continued

Terms of Payment

Net cash on presentation of bill, subject to a late payment charge in accordance with the provisions of General Rule III-11 (N).

Term

30 days from the date of installation of service hereunder; terminable thereafter by the Customer upon 5 days' prior notice in writing, and by the Company in accordance with law or the Provisions of this Rate Schedule. A Customer who elects to discontinue being billed under Rate II will be ineligible for time-of-day billing for a period of one and one-half years from the date of the Customer's election.

Definition of Billing Periods

The summer billing period is the four month period from June 1 to September 30. The winter billing period is the balance of the year. When a bill includes periods during both the summer billing period and the winter billing period, the rates and charges applicable will be prorated based on the number of days in the summer billing period and the number of days in the winter billing period related to the total number of days in the billing period.

Special Provisions

(A) The Company's service and supply of electric energy under this Service Classification will not be furnished otherwise than directly to a Customer of the Company, solely through the Company's meter or meters, upon the individual application of such Customer upon the form of application prescribed in this Rate Schedule, and will be supplied only on condition that such electric service is for the Customer's own use and, except as provided for in Rider G, will not be remetered (or submetered) or resold, assigned or otherwise disposed of to another or others, provided that the Customer may, except as otherwise prohibited in Special Provision B of this Service Classification, redistribute or furnish electric energy for the use of the tenants or occupants in the building or premises at which the Customer is supplied with electric service under this Service Classification, and provided that the Customer shall not resell, make a specific charge for, or remeter (or submeter) or measure any of the electric energy so redistributed or furnished.

(Service Classification No. 2 - Continued on Leaf No. 215)

Date of Issue: October 7, 1993

Date Effective: January 1, 1994

Issued by Raymond J. McCann, Executive Vice President and
Chief Financial Officer
4 Irving Place, New York, N.Y. 10003

SERVICE CLASSIFICATION NO. 2 - Continued

GENERAL - SMALL

Special Provisions - Continued

(B) The Company will not furnish electric energy to any Customer, for the purpose of redistributing such electric energy in residential buildings in which the internal wiring has not been installed prior to January 1, 1977, except upon a waiver of this provision by the Public Service Commission or if the service is to be measured by a "shared meter" as that term is defined in Public Service Law Section 52 and regulations adopted by the Public Service Commission.

(C) Whenever a Customer's metered use under this Service Classification exceeds 10 kilowatts of maximum demand in two consecutive months, the Customer's use thereafter will be billed under the appropriate Service Classification for the Customer's use of service.

(D) Where a Customer's account under Rate II is metered with multiple meters and where the registration on some of the meters is not on a time-of-day basis, the registrations of such meters will be billed on the time-of-day characteristics indicated by the time-of-day meter. If the conjunctionally or plurally-metered Customer so elects, however, the electricity supplied through the non-time-of-day meters will be billed as one separate account under the appropriate rate.

(E) Customers taking service under this Service Classification who are eligible for service under Service Classification Nos. 1 or 7 on July 1, 1992, due to the revision of Special Provision B (2) of Service Classification Nos. 1 and 7 effective July 1, 1992, and who apply for service under Service Classification Nos. I or 7 before January 1, 1993, will be transferred to and rebilled under Service Classification Nos. 1 or 7 beginning with the Customer's first bill rendered on or after July 1, 1992, and their accounts will be credited with the difference without interest.

(F) Where a Customer is served by direct-current service, the Customer will be billed for charges for direct-current service, in addition to the rates stated under Rates I and II and Rider D, if applicable, as follows:

Customer Charge per month

For the period April 1, 1998 through March 31, 1999	$ 2.50
For the period April 1, 1999 through March 31, 2000	$ 5.00
For the period April 1, 2000 through March 31, 2001	$ 7.50
For the period beginning April 1, 2001	$ 10.00

Distribution Charge per kilowatthour of direct-current service per month

For the period April 1, 1998 through March 31, 1999	3.0 cents
For the period April 1, 1999 through March 31, 2000	6.0 cents
For the period April 1, 2000 through March 31, 2001	9.0 cents
For the period beginning April 1, 2001	11.0 cents

(Service Classification No. 2 - Continued on Leaf No. 215-A)

Date of Issue: January 15, 1998

Date Effective: April 1, 1998

Issued by Joan S. Freilich, Senior Vice President and
Chief Financial Officer
4 Irving Place, New York, N.Y. 10003

SERVICE CLASSIFICATION NO. 2 - Continued

GENERAL - SMALL

Special Provisions - Continued

(G) The foregoing rates and charges shall apply to all electric service supplied hereunder on and after the effective date hereof. Where a bill includes periods before the effective date and after the effective date, the rates and charges applicable will be prorated based on the number of days of service rendered before the effective date and on and after the effective date related to the total number of days in the billing period.

(H) The following Riders may be applied to this Service Classification: A, B, C, D, E, F, G, I, L, and T. Riders I and L apply to Rate I Customers only.

(I) For general rules, regulations, terms and conditions under which service willbe supplied, see General Information Section III.

(J) For form of application under this Service Classification, see General Information Section IX.

SERVICE CLASSIFICATION NO. 9

GENERAL - LARGE

Applicable to Use of Service for

Light, heat, and power for general uses where the Customer's initial requirements are expected to be in excess of 10 kilowatts subject to the Common Provisions Applicable to Rate I, Rate II and Rate III and the Special Provisions of this Service Classification.

Character of Service

Of the various characteristics of service listed and more fully described in General Rule III-2, the following may be designated for service by the Company under this Service Classification, subject to the limitations set forth in such Rule. Frequencies and voltages shown are approximate. All are continuous.

Standard Service

Any derivative of the standard alternating current, 3 phase, 4 wire system at 60 cycles and 120/208 volts.

Non-Standard Service

Direct Current at 120, 120/240 or 240 volts

Low Tension Alternating Current - 60 cycles:

Single phase at 120/240 volts
Three phase at 265/460 volts
Three phase at 240 volts
Two phase at 120/240 or 230 or 240 volts

High Tension Alternating Current - 60 cycles:

Three phase at 2,400/4,150 volts
Three phase at 3,000 or 7,800 volts
Three phase at 6,900 volts
Three phase at 13,200 volts
Three phase at 33,000 volts
Single phase and three phase at 2,400 volts

(Service Classification No. 9 - Continued on Leaf No. 272)

Date of Issue: April 7, 1995

Date Effective: April 9, 1995

Issued by Raymond J. McCann, Executive Vice President and
Chief Financial Officer
4 Irving Place, New York, N.Y. 10003

Issued under authority
of order of the
Public Service Commission,
issued April 6, 1995,
in Case No. 94-E-0334.

SERVICE CLASSIFICATION NO. 9 - Continued
GENERAL - LARGE

Rate I - General - Large

Applicability: To all Customers other than those billed under Rate II or Rate III.

Demand Charge *(per month of the maximum demand)*

Billing Period	Kw Blocks	Low Tension Service Generation	Transmission	Distribution	Total
Winter	First 5 (or less)	$ 40.20	$ 10.25	$ 42.80	$ 93.25
	Next 895	$ 8.04 per kw	$ 2.05 per kw	$ 8.56 per kw	$ 18.65 per kw
	Over 900	$ 7.08 per kw	$ 1.82 per kw	$ 7.57 per kw	$ 16.47 per kw
Summer	First 5 (or less)	$ 50.15	$ 12.55	$ 53.05	$115.75
	Next 895	$ 10.03 per kw	$ 2.51 per kw	$ 10.61 per kw	$ 23.15 per kw
	Over 900	$ 9.07 per kw	$ 2.29 per kw	$ 9.61 per kw	$ 20.97 per kw

Billing Period	Kw Blocks	High Tension Service Generation	Transmission	Distribution	Total
Winter	First 5 (or less)	$ 40.20	$ 10.25	$ 28.65	$ 79.10
	Next 895	$ 8.04 per kw	$ 2.05 per kw	$ 5.73 per kw	$ 15.82 per kw
	Over 900	$ 7.08 per kw	$ 1.82 per kw	$ 5.06 per kw	$ 13.96 per kw
Summer	First 5 (or less)	$ 50.15	$ 12.55	$ 38.90	$101.60
	Next 895	$ 10.03 per kw	$ 2.51 per kw	$ 7.78 per kw	$ 20.32 per kw
	Over 900	$ 9.07 per kw	$ 2.29 per kw	$ 7.10 per kw	$ 18.46 per kw

Energy Charge *(cents per kwhr per month)*

Kwhr Blocks	Low Tension Service Generation	Transmission	Distribution	Total
First 15,000	4.41	0.24	1.06	5.71
Over 15,000	4.02	0.24	1.06	5.32

Kwhr Blocks	High Tension Service Generation	Transmission	Distribution	Total
First 15,000	4.09	0.22	0.99	5.30
Over 15,000	3.73	0.22	0.99	4.94

System Benefits Charge is 0.1 cent per kwhr.

(Service Classification No. 9 - Continued on Leaf No. 272-A)

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Date Effective: April 1, 1999

Issued by Joan S. Freilich, Executive Vice President and
Chief Financial Officer
4 Irving Place, New York, N.Y. 10003

SERVICE CLASSIFICATION NO. 9 - Continued
GENERAL - LARGE

Rate I - General - Large- Continued

Maximum Rate: Whenever the application of the foregoing total demand and energy charges, including the system benefits charge, to the Customer's use in a given monthly period results in a rate per kwhr in excess of the total maximum rate below, an amount equal to the total maximum rate will be billed in lieu thereof, except where such rate would result in a reduction in the minimum charge or Minimum Monthly Charge otherwise applicable.

	Generation	Transmission	Distribution	System Benefits Charge	Total
Cents per kwhr per month	17.45	3.62	15.21	0.10	36.38

Minimum Charge

The minimum charge shall be the charge for 5 kilowatts of demand per month, exclusive of energy charge, fuel adjustment, other charges and adjustments as explained in General Information Section VIII-(B), and increase in rates and charges.

(Service Classification No. 9 - Continued on Leaf No. 273)

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Chief Financial Officer
4 Irving Place, New York, N.Y. 10003

SERVICE CLASSIFICATION NO. 9 - Continued

GENERAL - LARGE

Rate II - General - Large - Time-of-Day

Applicability:

Mandatory: To Customers whose maximum demand in any month between January 1, 1975, and September 30, 1988, exceeded 3,000 kw (Phase 1); to Customers whose maximum demand in any month between January 1, 1980, and September 30, 1988, exceeded 1,500 kw but was equal to or less than 3,000 kw excluding those Customers taking service under Riders I, J or L and billed under Rate II as provided below (Phase 2).

Mandatory Time-of-Day Rates also apply to:

(1) any Customer, other than those Customers taking service under Riders I, J or L, whose monthly maximum demand after September 30, 1988, exceeds 1,500 kw in any annual period ending September 30;

(2) any new Customer, other than a new Customer taking service under Riders I, J or L, whose monthly maximum demand in the Company's estimate will exceed 1,500 kw during the first year of service;

(3) successors of Customers referred to above; and

(4) any Customer taking service under Riders I, J or L, whose monthly maximum demand exceeds 900 kw, or in the case of a new Customer, whose monthly maximum demand in the Company's estimate will exceed 900 kw during the first year of service.

A Rate II Customer shall be transferred to and billed under Rate I when the Customer's monthly maximum demand does not exceed 900 kw for 12 consecutive months unless the Customer elects to be billed under Rate III. A Customer with multiple meters whose demand meter registrations are added together for billing purposes pursuant to the provisions of this Rate Schedule shall be billed under Rate II if the Customer qualifies for Rate II pursuant to one or more of the criteria stated above and if at least one of the meters:

(1) has registered 500 kw or more in any month in the 12-month period ending October 6, 1989; or

(2) registers 500 kw or more in any month in any annual period ending September 30 after October 6, 1989.

Optional: To Customers eligible to take service under Special Provision H.

(Service Classification No. 9 - Continued on Leaf No. 274)

SERVICE CLASSIFICATION NO. 9 - Continued
GENERAL - LARGE

Rate II - General - Large - Time-of-Day - Continued

Demand Charges *(per kw of maximum demand for each time period per month)*

	Generation	Transmission	Distribution	Total
Summer				
Monday through Friday (8 AM to 6 PM)	$ 14.10	$ 5.25	$ -	$ 19.35
Monday through Friday (8 AM to 10 PM)	$ -	$ -	$ 10.75 (P)	$ 10.75
All hours - All days (Low Tension Only)	$ -	$ -	$ 9.79 (S)	$ 9.79
Winter				
Monday through Friday (8 AM to 10 PM)	$ 4.13	$ 2.68	$ 5.42 (P)	$ 12.23
All hours - All days (Low Tension Only)	$ -	$ -	$ 3.17 (S)	$ 3.17

(P) - Primary (S) - Secondary

The total demand charge for each billing period shall be sum of the generation, transmission, primary distribution, and secondary distribution charges, each charge determined by multiplying the maximum demand for the respective time period by the rate applicable for that time period.

Energy Charge *(cents per kwhr per month)*

Billing Period	Time Period *	High Tension Service Generation	Transmission	Distribution	Total
Summer	*On-Peak*	3.31	0.09	0.33	3.73
	Off-Peak	2.82	0.09	0.33	3.24
Winter	*On-Peak*	3.94	0.09	0.33	4.36
	Off-Peak	3.06	0.09	0.33	3.48

Billing Period	Time Period *	Low Tension Service Generation	Transmission	Distribution	Total
Summer	*On-Peak*	3.42	0.09	0.33	3.84
	Off-Peak	2.87	0.09	0.33	3.29
Winter	*On-Peak*	4.06	0.09	0.33	4.48
	Off-Peak	3.11	0.09	0.33	3.53

* *On Peak*: Monday through Friday 8:00 A.M. to 10:00 P.M.
Off Peak: The entire 48 hours of Saturday and Sunday and Monday through Friday 10:00 P.M. to 8:00 A.M

System Benefits Charge is 0.1 cent per kwhr.

(Service Classification No. 9 - Continued on Leaf No. 275)

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Chief Financial Officer
4 Irving Place, New York, N.Y. 10003

SERVICE CLASSIFICATION NO. 9 - Continued
GENERAL - LARGE

Rate III - General - Large - Voluntary Time-of-Day

Applicability: To Customers not subject to Rate II who elect to be billed at a time-of-day rate.

Demand Charges *(per kw of maximum demand for each time period per month)*

	Generation	Transmission	Distribution	Total
Summer				
Monday through Friday (8 AM to 6 PM)	$ 15.32	$ 5.28		$ 20.60
Monday through Friday (8 AM to 10 PM)	$ -	$ -	$ 11.05 (P)	$ 11.05
All hours - All days (Low Tension Only)	$ -	$ -	$ 9.79 (S)	$ 9.79
Winter				
Monday through Friday (8 AM to 10 PM)	$ 5.35	$ 2.73	$ 5.70 (P)	$ 13.78
All hours - All days (Low Tension Only)	$ -	$ -	$ 3.17 (S)	$ 3.17

(P) - Primary (S) - Secondary

The total demand charge for each billing period shall be sum of the generation, transmission, primary distribution, and secondary distribution charges, each charge determined by multiplying the maximum demand for the respective time period by the rate applicable for that time period.

Energy Charge *(cents per kwhr per month)*

Billing Period	Time Period *	High Tension Service Generation	Transmission	Distribution	Total
Summer	*On-Peak*	3.31	0.09	0.33	3.73
	Off-Peak	2.82	0.09	0.33	3.24
Winter	*On-Peak*	3.94	0.09	0.33	4.36
	Off-Peak	3.06	0.09	0.33	3.48

Billing Period	Time Period *	Low Tension Service Generation	Transmission	Distribution	Total
Summer	*On-Peak*	3.42	0.09	0.33	3.84
	Off-Peak	2.87	0.09	0.33	3.29
Winter	*On-Peak*	4.06	0.09	0.33	4.48
	Off-Peak	3.11	0.09	0.33	3.53

* *On Peak*: Monday through Friday 8:00 A.M. to 10:00 P.M.
Off Peak: The entire 48 hours of Saturday and Sunday and Monday through Friday 10:00 P.M. to 8:00 A.M

System Benefits Charge is 0.1 cent per kwhr.

(Service Classification No. 9 - Continued on Leaf No. 276)

Date of Issue: January 29, 1999
Date Effective: April 1, 1999

Issued by Joan S. Freilich, Executive Vice President and
Chief Financial Officer
4 Irving Place, New York, N.Y. 10003

SERVICE CLASSIFICATION NO. 9 - Continued

GENERAL - LARGE

Common Provisions Applicable to Rate I, Rate II, and Rate III

Fuel Adjustment

The charges set forth herein shall be subject to a fuel adjustment per kwhr supplied hereunder when changes from the base cost of fuel occur (as explained in General Information Section VII).

Increase in Rates and Charges

The rates and charges under this Service Classification including fuel adjustment, minimum charge or Minimum Monthly Charge, and other charges and adjustments (as explained in General Information Section VIII-(B)) are increased by the applicable percentage as explained in General Information Section VIII-A and shown on the related Statement.

Determination of Demand

The Company will install a demand measuring device of a type approved by the Public Service Commission for the determination of the maximum demand, except as otherwise provided under General Rule III-1 (F) relating to temporary service. (See General Rule III-11 (D) for definition of maximum demand.) With respect to Rate II, when demand is determined by a magnetic tape recorder or a demand storage unit, the maximum demand for generation and transmission, primary distribution, and secondary distribution shall be the integrated demand occurring during the two highest contiguous fifteen minute intervals during the applicable time periods.

Terms of Payment

Net cash on presentation of bill, subject to late payment charge in accordance with provisions of General Rule III-11 (N).

Term

One year from the date of installation of service hereunder except as provided in Rider O; terminable thereafter by the Customer upon 30 days' prior notice in writing and by the Company in accordance with law or the provisions of this Rate Schedule. A Customer who elects to transfer from Rate I to Rate III will be ineligible for billing at Rate I for one year subsequent to the commencement of billing at Rate III. This limitation will apply to all Customers served under Rate III on and after April 1, 1996. A Customer who elects to discontinue being billed under Rate III will be ineligible for voluntary time-of-day rates for a period of one and one-half years from the commencement of billing at Rate I.

Definition of Billing Periods

The summer billing period is the four month period from June 1 to September 30. The winter billing period is the balance of the year. When a bill includes periods during both the summer billing period and the winter billing period, the rates and charges applicable will be prorated based on the number of days in the summer billing period and the number of days in the winter billing period related to the total number of days in the billing period.

(Service Classification No. 9 - Continued on Leaf No. 277)

SERVICE CLASSIFICATION NO. 9 - Continued

GENERAL - LARGE

Common Provisions Applicable to Rate I, Rate II, and Rate III - Continued

Commencement of Service

For Customers transferred to Rate II from Rate I or Rate III, billing under Rate II shall commence when the Customer's entire usage is subsequent to December 31 of the annual period ending September 30 in which the Customer becomes subject to Rate II. For Customers billed under Rate II whose monthly maximum demand does not exceed 900 kw for 12 consecutive months, billing under Rate I shall commence in the first billing period thereafter unless the Customer elects to transfer to Rate III. For Customers electing to transfer to Rate III, billing under Rate III shall commence in the first billing period beginning after March 31, 1991, following the Company's receipt and acceptance of the Customer's written request to be served under Rate III and the installation of appropriate time-of-day metering equipment if necessary. For Customers electing to transfer to Rate I from Rate III, billing under Rate I shall commence with the first billing period following the Company's receipt and acceptance of the Customer's written request for service under Rate I. Any new Customer electing Rate III at the commencement of service shall be billed under Rate I until appropriate time-of-day metering equipment is installed. The provisions of this paragraph do not apply to Customers taking service pursuant to Special Provision H.

Minimum Monthly Charge

The Customer will be subject to the Minimum Monthly Charge, as described in General Rule III-11(U), when the Minimum Monthly Charge exceeds the monthly pure base revenue. The Minimum Monthly Charge is the product of the Customer's Contract Demand and one-half the distribution demand charge. The Contract Demand is determined each month and is equal to the Customer's highest registered demand in the most recent 18 months, or the highest registered demand on the Customer's account if the account has less than 18 months of demand history, provided, however, that if a Customer requests and receives a reduction in the Contract Demand (as explained in General Rule III-11(U)), the demand history prior to the reduction will not be considered in determining the Contract Demand for subsequent months. For a Customer billed under Special Provision D of this Service Classification, the billable demand will be the basis for the Customer's Contract Demand.

Special Provisions

(A) The Company's service and supply of electric energy under this Service Classification will not be furnished otherwise than directly to a Customer of the Company, solely through the Company's meter or meters, upon the individual application of such Customer upon the form of application prescribed in this Rate Schedule, and will be supplied only on condition that such electric service is for the Customer's own use and, except as provided for in Rider G, will not be remetered (or submetered), or resold, assigned or otherwise disposed of to another or others except as provided under Special Provision B below.

(Service Classification No. 9 - Continued on Leaf No. 278)

SERVICE CLASSIFICATION NO. 9 - Continued

GENERAL - LARGE

Special Provisions - Continued

(B) The Customer may redistribute or furnish electric energy for use of tenants or occupants in the building or premises at which the Customer is supplied with electric service under this Service Classification where the electric energy so redistributed is to:

(1) Transient or non-transient occupants of a facility operated primarily for transients;

(2) Rooming houses, dormitories, hospitals, nursing homes, and other institutional care facilities, where the tenants or occupants do not occupy individual flats or apartments equipped with separate kitchen and bathroom facilities;

(3) Portions of the Customer's premises which are impractical to meter separately, such as:

(a) concession stands in office building lobbies or amusement parks not completely separated from the areas surrounding them,

(b) individual offices in professional suites having facilities and office services shared by the occupants of such offices,

(c) incidental storage space provided in connection with occupancy of other portions of the Customer's premises;

(4) Occupants of the Customer's premises who are primarily engaged in the business of supplying incidental goods or services to the Customer or the Customer's students or employees; and

(5) Tenants occupying space which does not exceed 10 percent of the total square foot area supplied under this Service Classification.

The Customer shall not resell, make a specific charge for, or remeter (or submeter) or measure any of the electric energy so redistributed or furnished.

(C) Whenever a Customer's maximum demand for a period of 12 consecutive months shall not have exceeded 5 kilowatts, the Customer will thereafter be billed under Service Classification No. 2 - General - Small.

(D) When the service furnished under Rate I of this Service Classification is used by the Customer for the operation of electric space heating equipment which is permanently installed and exclusively supplies, and is adequate to supply the entire space heating requirements of such Customer's premises served hereunder, provided that such service is not used in conjunction with Riders I, J or L, the number of kilowatts of demand billed shall be subject to reduction as follows:

(Service Classification No. 9 - Continued on Leaf No. 279)

Date of Issue: April 7, 1995

Date Effective: April 9, 1995

Issued by Raymond J. McCann, Executive Vice President and
Chief Financial Officer
4 Irving Place, New York, N.Y. 10003

Issued under authority
of order of the
Public Service Commission,
issued April 6, 1995,
in Case No. 94-E-0334.

SERVICE CLASSIFICATION NO. 9 - Continued

GENERAL - LARGE

Special Provisions - Continued
(D) - Continued

For the winter billing period, the demand billed shall be the number of kilowatts of measured demand reduced by:

(1) one-half of the connected kilowatt load of the foregoing space heating equipment; or

(2) one-half of the kilowatt space heating requirements as determined by the Company from its heat loss survey of the premises served,

whichever is less, provided, however, that the demand billed shall be at least equal to one-half of the measured demand or 10 kilowatts, whichever is greater. For purposes of this Special Provision, when a Customer is served under Rider Q of this Rate Schedule and/or under the Economic Development Delivery Service ("EDDS") Rate Schedule, and the balance of the Customer's requirements is served under this Service Classification, "measured demand" is defined as the Customer's maximum monthly demand less the Rider Q demand and EDDS demand; "connected kilowatt load" is defined as the product of the Customer's connected kilowatt load and the ratio of the load to be served under this Service Classification and the maximum monthly demand; and "kilowatt space heating requirements" is defined as the product of the Customer's kilowatt space heating requirements and the ratio of the load to be served under this Service Classification and the maximum monthly demand.

This special provision will be subject to the same proration provision as the other rates and charges applicable to this Service Classification.

The foregoing reduction shall be applied only from and after the giving of written notice to the Company of the qualifying heating installation and appropriate access to the premises to enable the Company to determine the Customer's eligibility. The Customer shall thereafter notify the Company in writing of any changes in the installation or the use thereof.

(E) Where both high tension and low tension service are supplied and billed under Rate I to a Customer under a single agreement, the high tension service will be billed at the high tension rate and the low tension service will be billed at the appropriate succeeding steps of the low tension rate. For Rate I, where the Customer is billed on the basis of coincident maximum demand, the number of kilowatts of high tension demand, for billing purposes, will be determined by applying to the coincident maximum demand the ratio that the high tension non-coincident maximum demand bears to the sum of the high tension and the low tension non-coincident maximum demands. The number of kilowatts of low tension demand, for billing purposes, shall be equal to the difference between the number of kilowatts of high tension demand, determined as herein provided, and the coincident maximum demand.

With respect to energy billed under Rate II or Rate III where both high tension and low tension service are supplied and billed to a Customer under a single agreement, the number of kilowatthours of on-peak energy for the high tension and low tension service will be determined by applying to the high tension and low tension energy the ratio that the on-peak energy for the entire account bears to the sum of the on-peak and off-peak energy for the entire account. The off-peak high tension and low tension energy will be the balance of the energy use for high tension and low tension, respectively.

(Service Classification No. 9 - Continued on Leaf No. 280)

SERVICE CLASSIFICATION NO. 9 - Continued

GENERAL - LARGE

Special Provisions - Continued

(F) Where a Customer's account under Rate II or Rate III is metered with multiple meters and where the registration of some of the meters is not on a time-of-day basis, the registrations of such meters will be billed on the time-of-day characteristics indicated by the time-of-day meter. If the conjunctionally or plurally-metered Customer so elects, however, the electricity supplied through the non-time-of-day meters will be billed as one separate account under the appropriate rate, except as provided under Special Provision J.

(G) By order of the Public Service Commission in Case 91-E-0462, electrically-heated nursing homes receiving service under Service Classification No. 12 as of April 17, 1992, shall be transferred to Service Classification No. 9 on July 1, 1992, and thereafter be billed at the applicable Service Classification No. 9 rates and charges and prorated in accordance with Special Provision I, provided however, that for the first five years following the transfer to Service Classification No. 9 the increased charges shall be phased-in as follows: in the first year, bills will be calculated at the applicable Service Classification No. 9 rates and charges less eighty percent of the difference between the applicable Service Classification No. 9 and Service Classification No. 12 rates and charges; in the second year, bills will be calculated at the applicable Service Classification No. 9 rates and charges less sixty percent of the difference between the applicable Service Classification No. 9 and Service Classification No. 12 rates and charges; in the third year, bills will be calculated at the applicable Service Classification No. 9 rates and charges less forty percent of the difference between the applicable Service Classification No. 9 and Service Classification No. 12 rates and charges; in the fourth year, bills will be calculated at the applicable Service Classification No. 9 rates and charges less twenty percent of the difference between the applicable Service Classification No. 9 and Service Classification No. 12 rates and charges; and commencing with the fifth year following the transfer to Service Classification No. 9, these accounts shall be billed at one hundred percent of the rates and charges of Service Classification No. 9.

(H) The Company will provide service under Rate II on an optional basis to a limited number of Customers who have the major portion of their heating or cooling requirements supplied by thermal storage.

This service is provided under the following conditions:

(1) Approximately 20 Customers will be accepted;

(2) Customers must otherwise be eligible for service under Rate I of this Service Classification;

(Service Classification No. 9 - Continued on Leaf No. 281)

SERVICE CLASSIFICATION NO. 9 - Continued

GENERAL - LARGE

Special Provisions - Continued

(H) - Continued

(3) The Customer will permit the Company to install, maintain, and inspect upon reasonable notice, all equipment required to measure and collect any data reasonably necessary to determine the operating characteristics of installations served under this provision; and

(4) Subject to continuing regulatory approval, the Company will provide service at least until August 1, 1997, under this or a similar classification providing an off-peak and on-peak rate form, but the level of the rates and charges, the definition of billing periods, and the terms and conditions of service may vary from those initially offered.

(I) Where a Customer is served by direct-current service, the Customer will be billed for charges for direct-current service, in addition to the rates stated under Rates I and II and Rider D, if applicable, as follows:

Customer Charge per month

For the period April 1, 1998 through March 31, 1999.....$100.00
For the period April 1, 1999 through March 31, 2000.....$200.00
For the period April 1, 2000 through March 31, 2001.....$300.00
For the period beginning April 1, 2001.....$385.00

Distribution Charge per kilowatthour of direct-current service per month

For the period April 1, 1998 through March 31, 1999.....3.0 cents
For the period April 1, 1999 through March 31, 2000.....6.0 cents
For the period April 1, 2000 through March 31, 2001.....9.0 cents
For the period beginning April 1, 2001.....11.0 cents

(J) Where direct-current service was provided on a multi-metered account under this Service Classification as of April 1, 1998, the direct-current meter(s) may not thereafter be segregated for billing under an energy-only Service Classification of this Rate Schedule or any other Rate Schedule, unless expressly permitted.

(K) The foregoing rates and charges shall apply to all electric service supplied hereunder on and after the effective date hereof. Where a bill includes periods before the effective date and after the effective date, the rates and charges applicable will be prorated based on the number of days of service rendered before the effective date and on and after the effective date related to the total number of days in the billing period.

(Service Classification No. 9 - Continued on Leaf No. 281-A)

SERVICE CLASSIFICATION NO. 9 - Continued

GENERAL - LARGE

Special Provisions - Continued

(L) The following Riders may be applied to this Service Classification: A, B, C, D, E, F, G, I, J, L, N, O, Q, S, and T.

(M) For general rules, regulations, terms and conditions under which service will be supplied, see General Information Section III.

(N) For form of application under this Service Classification, see General Information Section IX.

(O) For information relating to individually negotiated contracts entered into pursuant to the provisions of this Service Classification, see Appendix A to this Rate Schedule.

APPENDIX B: ENERGY CONSERVATION DETAILS

APPENDIX B: SAMPLE ENERGY CONSERVATION MEASURES

100 SERIES - BUILDING ENVELOPE

	Life	
101	25	Roof Insulation
102	25	Ceiling Insulation
103	25	Suspending Ceiling System
104	25	Floor Insulation
105	25	Wall Insulation
106	25	Ventilation Louvers
107	25	Gable Vents
108	25	Attic Exhaust Fan
109	25	Skylight
110	25	Repair/Replace Windows
111	25	Upgrade Window Repacement
112	25	Reduce Window Area
113	8	Window Sealant and Caulking
114	8	Window Weatherstripping
115	10	Solar Film
116	10	Change Door/Window Operation
117	25	Secondary Glazing System
120	25	Replace Doors
121	10	Repair Doors
122	10	Door Closers
123	10	Door Thresholds
124	25	Insulate Exterior Doors
125	8	Door Weatherstripping
126	25	Vestibule
130	25	Repair Building Envelope
131	10	Air Curtain
140		Misc Building Envelope

200 SERIES - HVAC

	Life	
201	20	Change Fuel
202	20	New AC System
203	20	Chiller Replacement
204	10	Replace Low Efficiency Units
205	10	Purchase High Efficiency Units
206	10-20	Install Dedicated Conditioning System
209	10	Heat Pump
210	20	Evaporative Cooler
212	20	Variable Air Volume
213	20	Economizer
214	20	Heat Recovery
215	20	Cooling Towers
216	20	Ventilation
217	10	Destratification Fans
218	20	Boiler Replacement
219	20	Boiler Burners
220	20	Radiant Heating
221	10	Dehumidification
222	10	Humidification
230	10	Chiller Control
231	10	DDC Controls
232	10	Variable Speed Drives
233	10	Night Setback
234	10	Tamper Resistant Thermostat
235	10	Temperature Reset Control
236	10	Occupant Sensor A/C Control
237	10	Interlock Exhaust Fans with Lighting
238	10	Outside Air Damper Operators
239	10	CO2 Outside Air Control
240	10	Exhaust Fan Thermostat
241	10	Exhaust Fan Timer
242	10	Exhaust Fan Operation
243	10	Boiler Oxygen Control
244	10	Emissions Exhaust System
245	10	Temperature Setpoint on Duct Heaters
246	10	Radiator Control
247	10	Repair Controls
250	20	Add Return Air Ductwork
251	8	Weatherstrip Plenum Doors
252	25	Insulate Ductwork
253	20	Replace Missing Access Panels
254	20	Pipe Insulation
255	20	Suction Line Insulation
256	20	Insulate Condensate/Feedwater Tank
257	10	Backdraft Damper for Exhaust Fan
260	20	Reduce Conditioning Hours
261	10	Reduce Outside Air
262	20	Utilize Conditioned Exhaust Air
263	10-20	Stop Conditioning Unused Areas
264	10	Minimize Use of Exhaust Fans
265	10-18	Fan Horsepower
266	20	Water Treatment
267	10	Tube Cleaning
268	10	System Balancing
269	10	Clean Condenser Coils
270	10	Clear Supply/Return Path
271	10	Control Calibration
272	10	Leak Repair
273	20	Steam Traps
274	20	Steam Lines
275	20	Replace Boiler Feedwater Storage Tank
276	18	HVAC Motor Replacement or Modification
280	10	Improve Maintenance
281	10-20	Misc HVAC

300 SERIES - LIGHTING/ELECTRICAL

	Life	
301	5-8	Replace Incandescent Lighting - Interior
302	20	Replace Quartz Halogen Lighting - Interior
303	20	Replace Mercury Vapor Lighting - Interior
304	20	Replace T12 Fluorescent Lamps and Ballasts - Interior
305	20	Replace T12 Fluorescent Fixtures - Interior
306	5-20	Replace Misc Lighting - Interior
310	5	Replace Incandescent Lighting - Exterior
311	20	Replace Quartz Halogen Lighting - Exterior
312	20	Replace Mercury Vapor Lighting - Exterior
313	20	Replace T12 Fluorescent Lamps and Ballasts - Exterior
314	20	Replace T12 Fluorescent Fixtures - Exterior
315	20	Replace Misc Lighting - Exterior
320	20	Disconnect Unneeded Lighting
321	20	Disconnect Ballasts on Delamped Fixtures
322	10	Freezer / Refrigerator Lighting
323	20	Reduce Light Level
324	25	Convert Exit Signs
325	25	Replace Exit Signs
326	5-20	Misc Lighting
330	10	Infrared Occupancy Sensor Lighting Control
331	10	Ultrasonic Occupancy Sensor Lighting Control
332	10	Other Occupancy Sensor Lighting Control
333	10	Photocell Lighting Control
334	10	Timer Lighting Control
335	10	Misc Lighting Control
340	20	Correct Unbalanced Load
341	20	Correct Voltage
342	20	Utilize Generator for Power
343	5-20	Misc Electrical

400 SERIES - WATER HEATING

	Life	
401	10	Reduce Water Temperature
402	10	Reduce Capacity
403	10	Disconnect Water Heater
404	10	Timer Control
405	10	Spring Wound Timer Control
406	10	Timer Control on Recirculator
407	10	Lockout Controls
408	10	Instantaneous Water Heater
409	10	Booster Heater
410	10	Decentralize System
411	10	Replace Water Heater
412	20	Insulate Piping
413	10	Insulate Water Heater
414	10	Self-Closing Faucets
415	10	Flow Restrictors
416	10	Low Flow Shower Heads
417	20	Heat Reclaim
418	10	Change Water Heater Fuel
419	18	Motor Replacement or Modification
420	10	Water Heating Heat Pump
421	10	WH Pump Control
422	10	Pool Heater
423	10	Pool Temperature
424	10	Misc Water Heating

500 SERIES - MISCELLANEOUS

	Life	
501	18	Motor Replacement or Modification
502	10	Energy Management System
503	10	Pool Pumps
504	10	Pool Cover
505	10	Elevator Operation
506	10	Elevator Controls
507	10	Kitchen Efficiency
508	10	Appliances
509	10	Anti-Sweat Freezer / Refrigerator Cases Heaters
510	10	Freezer / Refrigerator Case Covers
511	10	Maintain Freezer / Refrigerator Cases
512	10	Excessive Refrigerator/Freezer Capacity
513	5-8	Residential Make Ready Procedures
520	10	Repair Water Leak
521	10	Water Saving Device or Fixture
522		Misc

600 SERIES - RENEWABLE AND ADVANCED ENERGY SYSTEMS

601	20	Wind Turbine
602	20	Photovoltaics
603	20	Solar
604	20	Fuel Cells
605	20	Engine Driven Cooling
606	20	Thermal Storage
607	20	Ice Storage
608	20	Ground Source or Geothermal Heat Pump
609	20	Cogeneration
620	20	Other Energy Source

700 SERIES - RATES AND METERING

701	20	Change Rate
702	20	Change within Rate
703	20	Change Demand
704	20	Peak Load Shedding
705	20	Eliminate Rate Penalty
706	20	Power Factor Correction
707	20	Operation Schedule
708	20	Misc Rate Measure
710	20	Out-of-Tolerance Meter
711	20	Metering Problem
712	20	Primary Metering
713	20	Metering Multiplier
714	20	Consolidate Metering
715	20	Submetering
716	20	Meter Unmetered Service
717	20	Misc Metering Problem

NEW_YORK_CITY , NY
ECM Number: 125WLRVC - Heating Infiltration
ECM Description: Add Door Weatherstripping

OCCUPIED	UNOCCUPIED	PARAMETER	
72	72	Ti	Heating Season Setpoint Temperature, F
46.3	43.2	To	Average Outdoor Temeprature, F
5	5	V	Average Wind Speed, MPH
2736	3072	H	Hours In Period, H
Existing	Proposed		
154	154	L	Crack Length (FT)
0.032	0.000	W	Crack Width (IN)
59.1	0.0	EA	Effective Air Leakage Area, IN^2
59.1		AI	Reduction of Effected Air Leakage Area, IN^2
2		S#	Number Of Stories (1-3)
2		SC	Sheilding Class (1-5)
0.0299		Cs	Stack Coefficient, $CFM^2/(IN^4-F)$ - From ASHRAE 97F25.22
0.0121		Cw	Wind Coefficient, $CFM^2/(IN^4-MPH^2)$ - From ASHRAE 97F25.22
75%		E	Seasonal Efficiency
Gal		FU	Fuel Unit
138,690		FCF	Fuel Conversion Factor, BTU/Fuel Unit
1.14		FC	Fuel Cost ($/Fuel Unit)

1) FLOW RATE REDUCTION, CFM = $AI*[Cs*(Ti-To) + Cw*V^2]^{0.5}$

OCCUPIED PERIOD

= 59.136 IN^2 * [0.0299 CFM^2/(IN^4-F) * (72 F - 46.3 F) + (0.0121 CFM^2/IN^4-MPH^4 * (5 MPH)^2]^0.5
= 61.22 CFM

UNOCCUPIED PERIOD

= 59.136 IN^2 * [0.0299 CFM^2/(IN^4-F) * (72 F - 43.2 F) + (0.0121 CFM^2/IN^4-MPH^4 * (5 MPH)^2]^0.5
= 63.81 CFM

2) ANNUAL INPUT ENERGY SAVINGS = [1.08 * FLOW RATE * (Ti - To) * H * FCF] / SEASONAL EFFICIENCY

OCCUPIED PERIOD

= [1.08 * 61.2 CFM * (72 F - 46.3 F) * 2736 Hrs * (MTBU /1,000,000 BTU) / 75% = 6.2 MBTU
= [1.08 * 61.2 CFM * (72 F - 46.3 F) * 2736 Hrs * (Gal/ 138,690 BTU)] / 75%
= 45 Gal

UNOCCUPIED PERIOD

= [1.08 * 63.8 CFM * (72 F - 43.2 F) * 3072 Hrs * (MBTU/1,000,000 BTU) / 75% = 8.1 MBTU
= [1.08 * 63.8 CFM * (72 F - 43.2 F) * 3072 Hrs * (Gal/ 138,690 BTU)] / 75%
= 59 Gal

TOTAL SAVINGS

= 14.3 MBTU
= 103 Gal

3) ANNUAL ENERGY COST SAVINGS:

= 103 Gal * (1.14 $/Gal)
= $ 118

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wildlife Refuge Visitors Center**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 125 Add Door Weatherstripping

Div.	Description	Qty.	Unit	2000 Bare Costs Material	Labor	Equipment	Total	Total	MEANS Ref.
	Adhesive Jamb Weatherstripping	66	LF	$0.95	$1.80	$0	$2.75	$182	
	(Compression Bulb Type)								
	Overhead Door Weatherstripping	88	LF	$1.50	$1.80	$0	$3.30	$290	
	Subtotal					$0.00	$6.05	$471.90	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$471.90	
	Escalation 0%							$0.00	
	Subtotal							$471.90	
	Contingencies 0%							$0.00	
	Total							$471.90	
	Roundoff							$470	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

****
* N I S T B L C C: COMPARATIVE ECONOMIC ANALYSIS (ver. 4.70-99) *
****

Project: National Park Service
Base Case: WLRVC-125
Alternative: WLRVC-125B

Principal Study Parameters:

Analysis Type: Federal Analysis--Energy Conservation Projects
Study Period: 8.25 Years (SEP 2000 through NOV 2008)
Plan/Constr. Period: 0.25 Years (SEP 2000 through NOV 2000)
Service Period: 8.00 Years (DEC 2000 through NOV 2008)
Discount Rate: 3.1% Real (exclusive of general inflation)
Base Case LCC File: WLR125.LCC
Alternative LCC File: WLR125B.LCC

Comparison of Present-Value Costs

	Base Case: WLRVC-125	Alternative: WLRVC-125B	Savings from Alt.
Initial Investment item(s):			
Capital Requirements as of Serv. Date	$0	$466	-$466
Subtotal	$0	$466	-$466
Future Cost Items:			
Energy-related Costs	$977	$0	$977
Subtotal	$977	$0	$977
Total P.V. Life-Cycle Cost	$977	$466	$511

Net Savings from Alternative 'WLRVC-125B' compared to Base Case 'WLRVC-125'

Net Savings	=	P.V. of Non-Investment Savings	$977
	-	Increased Total Investment	$466
		Net savings:	$511

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and residual value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

Savings-to-Investment Ratio (SIR)
For Alternative 'WLRVC-125B' compared to Base Case 'WLRVC-125'

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 2.09$$

Adjusted Internal Rate of Return (AIRR)
For Alternative 'WLRVC-125B' compared to Base Case 'WLRVC-125'

(Reinvestment Rate = 3.10%; Study Period = 8 years)

AIRR = 12.77%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 4
Discounted Payback occurs in year 4

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	0.0	0.0	0.0	0.0
Distil. Oil	MBtu	14.3	0.0	14.3	114.4

BLDG NAME	Wildlife Refuge
BLDG DESC	Visitors Center

INSIDE	OUTSIDE	PARAMETER
72	10	DESIGN TEMP, F
OCC	UNOCC	PARAMETER
72	72	SET POINT, F
68	68	BOILER SHUTOFF TEMP, F
2420	3388	ANNUAL HOURS, HRS
46.5	43.2	AVERAGE OUTSIDE TEMP, F
	Gal	FUEL UNITS
	138690	HTG FUEL CONV. FACT X/BTU)
	75%	% SEASONAL HTG EFF
	7 AM - 6 PM	OCCUPIED HOURLY SCHED
	SAT - SUN	OCCUPIED DAILY SCHEDULE
	SEPT 15 - MAY 15	MONTHLY HEATING SCHEDULE

SUMMARY ZONE:	
119231	HEAT LOSS, BTUH
14908	OCCUPIED HEAT GAIN, BTUH
1394	UNOCCUPIED HEAT GAIN, BTUH
1923	BUILDING LOAD COEFFICEINT
64.2	OCCUPIED BAL PT TEMP, F
71.3	UNOCCUPIED BAL PT TEMP, F
82592076	OCC ANNUAL HEATING LOAD, BTU
161575075	UNOCC ANNUAL HEATING LOAD, BTU
244167151	TOTAL ANNUAL HEATING LOAD, BTU
2,347	HEATING FUEL CONSUMPTION, Gal

BLDG NAME	Wildlife Refuge
BLDG DESC	Visitors Center

INSIDE	OUTSIDE	PARAMETER
72	10	DESIGN TEMP, F
OCC	UNOCC	PARAMETER
72	55	SET POINT, F
68	68	BOILER SHUTOFF TEMP, F
2420	3388	ANNUAL HOURS, HRS
46.5	43 2	AVERAGE OUTSIDE TEMP, F
	Gal	FUEL UNITS
	138690	HTG FUEL CONV. FACT X/BTU)
	75%	% SEASONAL HTG EFF
	7 AM - 6 PM	OCCUPIED HOURLY SCHED
	SAT - SUN	OCCUPIED DAILY SCHEDULE
	SEPT 15 - MAY 15	MONTHLY HEATING SCHEDULE

SUMMARY ZONE:	
119231	HEAT LOSS, BTUH
14908	OCCUPIED HEAT GAIN, BTUH
1394	UNOCCUPIED HEAT GAIN, BTUH
1923	BUILDING LOAD COEFFICEINT
64.2	OCCUPIED BAL PT TEMP, F
54.3	UNOCCUPIED BAL PT TEMP, F
82592076	OCC ANNUAL HEATING LOAD, BTU
72156998	UNOCC ANNUAL HEATING LOAD, BTU
154749073	TOTAL ANNUAL HEATING LOAD, BTU
1,488	HEATING FUEL CONSUMPTION, Gal

HEAT LOSS WORKSHEET

Wildlife Refuge
Visitors Center

72	(F) Design or Inside Average Setpoint Temperature					
10	(F) Outside Design Temperature					
COMPONENT	LABEL	DESCRIPTION	AREA (SF)	U-VALUE (BTU/HR*SF*F)	TEMP. DIFF. (DEG. F)	HEAT LOSS (BTU/HR)
EXTERIOR WALLS	TYPE1	N-1989 WALL	724	0.166	62	7451
	TYPE1	S-1989 WALL	748	0.166	62	7698
	TYPE1	E-1989 WALL	1141	0.166	62	11743
	TYPE1	W-1989 WALL	1002	0.166	62	10313
WINDOWS	TYPE1	N-DG,SLD,MTL 1989	24	0.830	62	1235
	TYPE1	S-DG,SLD,MTL 1989	0	0.830	62	0
	TYPE1	E-DG,SLD,MTL 1989	48	0.830	62	2470
	TYPE1	W-DG,SLD,MTL 1989	48	0.830	62	2470
	TYPE2	E-SG,SLD,MTL 1989	12	0.900	62	670
	TYPE2	W-SG,SLD,MTL 1989	12	0.900	62	670
EXTERIOR DOORS	TYPE1	E-GLASS	42	0.900	62	2344
	TYPE1	W-GLASS	42	0.900	62	2344
	TYPE1	W-OVERHEAD	160	0.900	62	8928
	TYPE1	W-METAL	21	0.830	62	1081
					SUBTOTAL:	59416

HEAT LOSS WORKSHEET

Wildlife Refuge
Visitors Center

72	(F) Design or Inside Average Setpoint Temperature					
10	(F) Outside Design Temperature					
COMPONENT	LABEL	DESCRIPTION	AREA (SF)	U-VALUE (BTU/HR*SF*F)	TEMP. DIFF. (DEG. F)	HEAT LOSS (BTU/HR)
ROOF/CEILING	TYPE1	FLAT	7684	0.066	62	31443
PARTITION WALLS BETWEEN ZONES						
FLOORS OVER CRAWL SPACES						
SLAB ON GRADE	Q = PERIMETER		(LF)	COEFF. * (BTUH/LF*F)	TEMP. DIFF. (DEG. F)	=
	SLAB1		362	0.5	62	11222
INFILTRATION	Q = 0.018 *		CFM *	AC/HR *	TEMP. DIFF. (DEG. F)	=
		0.018	76840	0.2	62	17151
VENTILATION	Q =		1.08	* CFM *	TEMP. DIFF. (DEG. F)	=
			1.08	0	62	0
					SUBTOTAL:	59816
					GRAND TOTAL:	119231

OCCUPIED HEAT GAIN WORKSHEET

Wildlife Refuge
Visitors Center

GAIN TYPE	DESCRIPT.	ORIENTATION	AREA (SF)	WINTER SOLAR FACTOR (BTU/HR*SF)	WEIGHTING FACTOR	SHADING COEFF.	HEAT GAIN (BTU/HR)
SOLAR	TYPE1	N-CLEAR	24	5.88	0.64	0.7	63
	TYPE1	S-CLEAR	0	48.36	0.64	0.7	0
	TYPE1	E-CLEAR	48	23.65	0.64	0.7	509
	TYPE1	W-CLEAR	48	23.65	0.64	0.7	509
						SUBTOTAL:	1080

	DESCRIPT.	CONNECTED WATTS	BALLAST FACTOR	USAGE FACTOR	% HEAT TO SPACE	3.413 (BTUH/WATT)	HEAT GAIN (BTU/HR)
LIGHTING	FLOUR.	4648	1	0.8	95	3.413	12056
	INCAND.	1350	1	0.2	100	3.413	922
	OTHER					3.413	0
						SUBTOTAL:	12978

	TYPE OF WORK	HEAT GAIN RATE (BTUH/PERSON)	USAGE FACTOR	NUMBER OF PEOPLE	HEAT GAIN (BTU/HR)
PEOPLE	STUDENTS	0	0.85	90	0
	STAFF	200	0.85	5	850
				SUBTOTAL:	850

	MISC. GAINS	AREA	HEAT GAIN RATE (BTUH/SF)		USAGE FACTOR	HEAT GAIN (BTU/HR)
PROCESS						
					SUBTOTAL:	0

	DESCRIPTION	COEFF. (BTUH/LF*F)	PERIMETER (LF)	* TEMP. DIFF. (DEGREES F)	=	HEAT GAIN (BTU/HR)
GROUND LOSSES						
					SUBTOTAL:	0
					TOTAL:	14908

UNOCCUPIED HEAT GAIN WORKSHEET

Wildlife Refuge
Visitors Center

GAIN TYPE	DESCRIPT.	ORIENTATION	AREA (SF)	WINTER SOLAR FACTOR (BTU/HR*SF)	WEIGHTING FACTOR	SHADING COEFF.	HEAT GAIN (BTU/HR)
SOLAR	TYPE1	N-CLEAR	24	5.88	0.36	0.7	36
	TYPE2	S-CLEAR	0	48.36	0.36	0.7	0
	TYPE3	E-CLEAR	48	23.65	0.36	0.7	286
	TYPE4	W-CLEAR	48	23.65	0.36	0.7	286
						SUBTOTAL:	608

	DESCRIPT.	CONNECTED WATTS		USAGE FACTOR	% HEAT TO SPACE	3.413 (BTUH/WATT)	HEAT GAIN (BTU/HR)
LIGHTING	FLOUR.	4848		0.05	95	3.413	786
	INCAND.	1350		0	100	3.413	0
	OTHER						
						SUBTOTAL:	786

	TYPE OF WORK	HEAT GAIN RATE (BTUH/PERSON)	USEAGE FACTOR	NUMBER OF PEOPLE	HEAT GAIN (BTU/HR)
PEOPLE					
				SUBTOTAL:	0

	MISC. GAINS	AREA	HEAT GAIN RATE (BTUH/SF)		USAGE FACTOR	HEAT GAIN (BTU/HR)
PROCESS						
					SUBTOTAL:	0

	DESCRIPTION	COEFF (BTUH/LF*F)	PERIMETER (LF)	* TEMP. DIFF. (DEGREES F)	=	HEAT GAIN (BTU/HR)
GROUND LOSSES						0
					SUBTOTAL:	0
					TOTAL:	1394

BALANCE POINT TEMPERATURE CALCULATIONS

Wildlife Refuge
Visitors Center

PARAMETERS	
119231	TOTAL HEAT LOSS (BTUH)
62	DESIGN TEMP DIFF (DEGREES F)
14908	OCCUPIED HEAT GAIN (BTUH)
1394	UNOCCUPIED HEAT GAIN (BTUH)
72	OCCUPIED TEMP SET POINT (DEGREES F)
72	UNOCCUPIED TEMP SET POINT (DEGREES F)

1. BUILDING LOAD COEFFICIENT (BLC):

BUILDING LOAD COEFFICIENT = TOTAL HEAT LOSS/DESIGN TEMP. DIFF.

BLC = 119231 BTUH/ 62 F = 1923 BTUH/F

2. BALANCE POINT TEMPERATURES:

BAL. PT. TEMP. = SET PT. TEMP - (HEAT GAIN/ BUILDING LOAD COEFFICIENT)

Occupied Balance Point Temperature	= 72 F - (14908 BTUH / 1923 BTUH/F) =	64.25 F
Unoccupied Balance Point Temperature	= 72 F - (1394 BTUH / 1923 BTUH/F) =	71.28 F

ANNUAL HEATING LOAD AND ENERGY CALCULATIONS

PARAMTETERS			
OCCUPIED	UNITS	UNOCCUPIED	DATA DESCRIPTION
64.2	Degrees F	68.0	Balance Point Temperature
2420	HR	3388	Accumulated Bin Hours
46.5	Degrees F	43.2	Average Outside Air Temperature
1923	BTUH/F	1923	Building Load Coefficient

OCCUPIED SCHEDULES	
Hourly	7 AM - 6 PM
Daily	SAT - SUN
Monthly	SEPT 15 - MAY 15

1. ANNUAL HEATING LOAD = Building Load Coefficient x (Balance Point Temperature - Average Temperature) x Accumulated hours

OCCUPIED ANNUAL HEATING LOAD:

= 1923 BTUH/F * (64.2 F - 46.5 F) * 2420 HR 82,592,076 BTU

UNOCCUPIED ANNUAL HEATING LOAD:

= 1923 BTUH/F * (68 F - 43.2 F) * 3388 HR 161,575,075 BTU

TOTAL **244,167,151** BTU

2. ANNUAL HEATING ENERGY

Gal	Heating Fuel Units
138690	Heating Fuel Conversion Factor (Btu/Unit)
75%	Seasonal Heating Efficiency (%)

ANNUAL HEATING ENERGY CONSUMPTION:

= Annual Heating Load / Seasonal Heating Efficiency

= 244167151 BTU / 75 % = 325,556,202 BTU input

ANNUAL HEATING FUEL CONSUMPTION:

= Annual Heating Energy Consumption / Fuel Heating Conversion Factor

= 325556202 BTU / (138690 BTU/ Gal) = 2,347 Gal

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Project Name: **National Park Service - Wildlife Refuge Visitors Center**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 233 Install Night Setback Thermostat

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	Boiler Water Temperature Controller	0	ea	$500.00	$3,320.00	$0.00	$0.00	$0.00	
	Night Thermostat	1	ea	$100.00	$100.00	$100.00	$100.00	$200.00	
	Subtotal					$100.00	$100.00	$200.00	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$200.00	
	Escalation 0%							$0.00	
	Subtotal							$200.00	
	Contingencies 0%							$0.00	
	Total							$200.00	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

****
* N I S T B L C C: COMPARATIVE ECONOMIC ANALYSIS (ver. 4.70-99) *
****

Project: National Park Service
Base Case: WLRVC-233
Alternative: WLRVC-233B

Principal Study Parameters:

Analysis Type: Federal Analysis--Energy Conservation Projects
Study Period: 10.25 Years (SEP 2000 through NOV 2010)
Plan/Constr. Period: 0.25 Years (SEP 2000 through NOV 2000)
Service Period: 10.00 Years (DEC 2000 through NOV 2010)
Discount Rate: 3.1% Real (exclusive of general inflation)
Base Case LCC File: WLVC233.LCC
Alternative LCC File: WLVC233B.LCC

Comparison of Present-Value Costs

	Base Case: WLRVC-233	Alternative: WLRVC-233B	Savings from Alt.
Initial Investment item(s):			
Capital Requirements as of Serv. Date	$0	$198	-$198
Subtotal	$0	$198	-$198
Future Cost Items:			
Energy-related Costs	$9,913	$0	$9,913
Subtotal	$9,913	$0	$9,913
Total P.V. Life-Cycle Cost	$9,913	$198	$9,714

Net Savings from Alternative 'WLRVC-233B' compared to Base Case 'WLRVC-233'

Net Savings	=	P.V. of Non-Investment Savings	$9,913
	-	Increased Total Investment	$198
		Net savings:	$9,714

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and residual value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

Savings-to-Investment Ratio (SIR)
For Alternative 'WLRVC-233B' compared to Base Case 'WLRVC-233'

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 49.94$$

Adjusted Internal Rate of Return (AIRR)
For Alternative 'WLRVC-233B' compared to Base Case 'WLRVC-233'

(Reinvestment Rate = 3.10%; Study Period = 10 years)

AIRR = 51.00%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 1
Discounted Payback occurs in year 1

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	0.0	0.0	0.0	0.0
Distil. Oil	MBtu	119.2	0.0	119.2	1,192.0

FACILITY: Wildlife Refuge Visitors Center

ECM DESCRIPTION: Lamp/Ballast Replacement

PARMETERS		
75%	Percent	Heating System Efficiency
138,690	BTU/gal	Heating Fuel Type Conversion Factor
2.3	COP	Cooling COP
3,413	BTU/kWh	Cooling Fuel Type Conversion Factor

ECM FIXTURE DETAILS

			PRE-RETROFIT CONDITIONS					POST-RETROFIT CONDITIONS					LIGHTING KWH SAVINGS			KW SAVINGS		COST SAVINGS ($)					Non-Elec. Heating Fuel Svgs MBTU	Non-Elec. Clg Fuel Svgs MBTU
	ECM Number	Tariff	Fixt. Qnty	Fixture Description	Watts per Fixture	Installed Watts	Annual Operating Hours	Fixt. Qnty	Fixture Description	Watts per Fixture	Installed Watts	Annual Operating Hours	All Periods	Occuring in Heating Mode Only	Occuring in Cooling Mode Only	Installed Lighting	On-Peak	Demand	Lighting Energy	Heating (Penalty)	Cooling (Credit)	Total		
Electrical Room	301	WREL9	1	1I75	75	75	500	1	1CF23	23	23	500	28	12	-	0.05	0.05	14	2	(0)	-	15	(0.1)	-
Lecture	301	WREL9	9	1I150	150	1,350	1,200	9	1CF23	23	207	1,200	1,372	661	-	1.14	1.14	312	86	(25)	-	374	(3.0)	-
Trailer	304	WREL9	6	2F34T12SM	82	492	2,600	6	2F32T8	60	360	2,600	343	183	-	0.13	0.13	36	22	(6)	-	52	(0.7)	-
Locker Room	304	WREL9	1	2F96T12M	129	129	2,600	1	2F96T8	110	110	2,600	49	23	-	0.02	0 02	5	3	(1)	-	7	(0.1)	-
Garage	304	WREL9	5	2F96T12HO	218	1,090	2,600	5	2F96T8	110	550	2,600	1,404	668	-	0.54	0.54	147	88	(25)	-	211	(3.0)	-
Storage	304	WREL9	2	2F34T12SM	82	164	2,600	2	2F32T8	60	120	2,600	114	54	-	0.04	0.04	12	7	(2)	-	17	(0.2)	-
Break Room	304	WREL9	4	2F20T12	46	184	2,600	4	2F18T8	39	156	2,600	73	35	-	0.03	0.03	8	5	(1)	-	11	(0.2)	-
Office	304	WREL9	2	2F96T12M	129	258	2,600	2	2F96T8	110	220	2,600	99	47	-	0.04	0.04	10	6	(2)	-	15	(0.2)	-
Women's Rm	304	WREL9	1	2F34T12SM	82	82	2,600	1	2F32T8	60	60	2,600	57	27	-	0.02	0.02	6	4	(1)	-	9	(0.1)	-
Men's Rm	304	WREL9	1	2F34T12SM	82	82	2,600	1	2F32T8	60	60	2,600	57	27	-	0.02	0.02	6	4	(1)	-	9	(0.1)	-
Entrance	304	WREL9	1	2F34T12SM	82	82	265	1	2F32T8	60	60	265	6	3	-	0.02	0.02	6	0	(0)	-	6	(0.0)	-
Lobby	304	WREL9	2	2F96T12M	129	258	2,600	2	2F96T8	110	220	2,600	99	47	-	0.04	0.04	10	6	(2)	-	15	(0.2)	-
Lecture	304	WREL9	18	2F34T12SM	82	1,476	2,600	18	2F32T8	60	1,080	2,600	1,030	489	-	0.40	0.40	108	65	(18)	-	155	(2.2)	-
Outside rear door	310	WREL9	2	1I175	175	350	3,650	2	1CF23	23	46	3,650	1,110	612	-	0.30	0.30	83	70	(23)	-	130	(2.8)	-
Electrical Room	332	WREL9	1	CF23	23	23	1,200	1	1CF23	23	23	200	23	11	-	-	-	-	1	(0)	-	1	(0.1)	-
Trailer	332	WREL9	6	2F32T8	60	360	2,600	6	2F32T8	60	360	1,800	288	137	-	-	-	-	18	(5)	-	13	(0.6)	-
Locker Room	332	WREL9	1	2F96T8	110	110	2,600	1	2F96T8	110	110	500	231	110	-	-	- -	-	15	(4)	-	10	(0.5)	-
Garage	332	WREL9	5	2F96T8	110	550	2,600	5	2F96T8	110	550	1,800	440	209	-	-	-	-	28	(8)	-	20	(1.0)	-
Storage	332	WREL9	2	2F32T8	60	120	1,200	2	2F32T8	60	120	250	114	55	-	-	-	-	7	(2)	-	5	(0.2)	-
Break Room	332	WREL9	4	2F18T8	39	156	2,600	4	2F18T8	39	156	750	289	137	-	-	-	-	18	(5)	-	13	(0.6)	-
Office	332	WREL9	2	2F96T8	110	220	2,600	2	2F96T8	110	220	1,800	176	84	-	-	-	-	11	(3)	-	8	(0.4)	-
Women's Rm	332	WREL9	1	2F32T8	60	60	2,600	1	2F32T8	60	60	750	111	53	-	-	-	-	7	(2)	-	5	(0.2)	-
Men's Rm	332	WREL9	1	2F32T8	60	60	2,600	1	2F32T8	60	60	750	111	53	-	-	-	-	7	(2)	-	5	(0.2)	-
Lobby	332	WREL9	2	2F96T8	110	220	2,600	2	2F96T8	110	220	1,800	176	84	-	-	-	-	11	(3)	-	8	(0.4)	-
Lecture	332	WREL9	18	2F32T8	60	1,080	2,600	18	2F32T8	60	1,080	1,800	864	410	-	-	-	-	54	(15)	-	39	(1.9)	-
Exit Sign	325	WREL9	2	2I15	30	60	8,760	2	2LED2	4	8	8,760	459	232	-	0.05	0.05	14	29	(9)	-	35	(1.1)	-

R16

ECM SUBTOTALS

	KWH SAVINGS				KW SAVINGS		COST SAVINGS ($)					Non-Elec. Heating Fuel Svgs MBTU	Non-Elec. Clg Fuel Svgs MBTU
ECM Number	Lighting	Heating (Penalty)	Cooling (Credit)	Total	Installed Lighting	On-Peak	Demand	Lighting Energy	Heating (Penalty)	Cooling (Credit)	Total		
301	1,398	-	-	1,398	1.20	1.20	326	88	(25)	-	389	(3.1)	-
304	3,331	-	-	3,331	1.30	1.30	355	210	(59)	-	506	(7.2)	-
310	1,110	-	-	1,110	0.30	0.30	83	70	(23)	-	130	(2.8)	-
332	2,823	-	-	2,823	-	-	-	178	(50)	-	128	(6.1)	-
325	459	-	-	459	0.05	0.05	14	29	(9)	-	35	(1.1)	-
Grand Total	9,120	-	-	9,120	2.85	2.85	779	575	(166)	-	1,187	(20.2)	-

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Project Name: **National Park Service - Wild Life Refuge Visitors Center**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 301 Replace Interior Incandescent Lights

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	5w CFL	0	ea	$3.30	$5.51	$0.00	$0.00	$0.00	
	7w CFL	0	ea	$3.30	$4.44	$0.00	$0.00	$0.00	
	9w CFL	0	ea	$3.30	$10.98	$0.00	$0.00	$0.00	
	11w CFL, Dimmable, 120V, E26/E27	0	ea	$3.30	$14.12	$0.00	$0.00	$0.00	
	15w CFL, Dimmable, 120V, E26,E27	0	ea	$3.30	$14.12	$0.00	$0.00	$0.00	
	18w CFL, Dimmable, 120V, E26,E27	0	ea	$3.30	$14.12	$0.00	$0.00	$0.00	
	24w CFL, Dimmable, 120V, E26,E27	10	ea	$3.30	$15.35	$33.00	$153.50	$186.50	
	24w CFL	0	ea	$3.30	$12.88	$0.00	$0.00	$0.00	
	25w CFL	0	ea	$3.30	$22.91	$0.00	$0.00	$0.00	
	30w CFL	0	ea	$3.30	$24.10	$0.00	$0.00	$0.00	
	5w Candelbra	0	ea	$1.00	$3.00	$0.00	$0.00	$0.00	
	Subtotal					$33.00	$153.50	$186.50	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$186.50	
	Escalation 0%							$0.00	
	Subtotal							$186.50	
	Contingencies 0%							$0.00	
	Total							$186.50	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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Project Name: **National Park Service - Wild Life Refuge Visitors Center**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-99
Date:

Measure: 304 Replace Lamps and Ballasts - Interior

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	T-8 2 lamp ballasts 4' Metric	0	ea	$12.50	$20.77	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 4' Metric	0	ea	$11.50	$20.77	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 2' Metric	0	ea	$11.50	$27.00	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 2' Metric	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 3' Metric	0	ea	$11.50	$27.00	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 3' Metric	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 5' Metric	0	ea	$11.50	$27.00	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 5' Metric	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 8'	0	ea	$12.50	$39.17	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 6'	0	ea	$12.50	$39.17	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 6'	0	ea	$12.50	$39.17	$0.00	$0.00	$0.00	
	F32 T-8 Lamps	58	ea	$1.50	$2.27	$87.00	$131.66	$218.66	
	F18 T-8 Lamps	8	ea	$1.50	$5.17	$12.00	$41.36	$53.36	
	F96 T-8 Lamps	20	ea	$1.50	$8.99	$30.00	$179.80	$209.80	
	F32 T-8 U Lamps	0	ea	$1.50	$12.51	$0.00	$0.00	$0.00	
	T-8 Socket Sets	0	ea		$2.00	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 2' US Style	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 2' US Style	4	ea	$12.50	$30.00	$50.00	$120.00	$170.00	
	T-8 1 lamp electronic ballasts 4' US Style	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 2 lamp electronic ballasts 4' US Style	29	ea	$12.50	$30.00	$362.50	$870.00	$1,232.50	
	T-8 4 lamp electronic ballasts 4' US Style	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 2 lamp electronic ballasts 8' US Style	10	ea	$12.50	$40.00	$125.00	$400.00	$525.00	
	T-8 4 lamp electronic ballasts 8' US Style	0	ea	$12.50	$40.00	$0.00	$0.00	$0.00	
	T-8 3 lamp electronic ballasts 8' US Style	0	ea	$12.50	$40.00	$0.00	$0.00	$0.00	
	Subtotal					$666.50	$1,742.82	$2,409.32	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$2,409.32	
	Escalation 0%							$0.00	
	Subtotal							$2,409.32	
	Contingencies 0%							$0.00	
	Total							$2,409.32	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wild Life Refuge Visitors Center**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 310 Replace Incandescent Lighting - Exterior

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	5w CFL	0	ea	$3.30	$5.51	$0.00	$0.00	$0.00	
	7w CFL	0	ea	$3.30	$4.44	$0.00	$0.00	$0.00	
	11w CFL	0	ea	$3.30	$10.98	$0.00	$0.00	$0.00	
	11w CFL, Dimmable, 120V, E26/E27	0	ea	$3.30	$14.12	$0.00	$0.00	$0.00	
	15w CFL, Dimmable, 120V, E26,E27	0	ea	$3.30	$14.12	$0.00	$0.00	$0.00	
	18w CFL, Dimmable, 120V, E26,E27	0	ea	$3.30	$14.12	$0.00	$0.00	$0.00	
	24 CFL, Dimmable, 120V, E26,E27	1	ea	$3.30	$15.35	$3.30	$15.35	$18.65	
	23w CFL	0	ea	$3.30	$12.88	$0.00	$0.00	$0.00	
	24w CFL	0	ea	$3.30	$12.88	$0.00	$0.00	$0.00	
	30w CFL	0	ea	$3.30	$24.10	$0.00	$0.00	$0.00	
	Subtotal					$3.30	$15.35	$18.65	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$18.65	
	Escalation 0%							$0.00	
	Subtotal							$18.65	
	Contingencies 0%							$0.00	
	Total							$18.65	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wild Life Refuge Visitors Center**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 325 Replace Exit Signs

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	Single Face 4 watt LED Exit Sign	2	ea	$40.00	$27.50	$80.00	$55.00	$135.00	
	Double Face 4 watt LED Exit Sign	0	ea	$40.00	$28.50	$0.00	$0.00	$0.00	
	Single Face with Battery	0	ea	$40.00	$48.50	$0.00	$0.00	$0.00	
	Double Face with Battery	0	ea	$40.00	$49.50	$0.00	$0.00	$0.00	
	Combination Exit Sign and Emergency	0	ea	$40.00	$92.00	$0.00	$0.00	$0.00	
	Subtotal					$80.00	$55.00	$135.00	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$135.00	
	Escalation 0%							$0.00	
	Subtotal							$135.00	
	Contingencies 0%							$0.00	
	Total							$135.00	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wild Life Refuge Visitors Center**
Project No.:
Calculated by:
Checked by:
Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 332 Install Occupancy Sensor Lighting Control

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	Watt Stopper Switch Sensors	14	ea	$10.00	$52.00	$140.00	$728.00	$868.00	
	Infrared Switch Sensors WI-200	0	ea		$63.68	$0.00	$0.00	$0.00	
	Ceiling Mounted Infrared Sensors CI-200	0	ea	$49.50	$55.88	$0.00	$0.00	$0.00	
	Power Packs	0	ea		$14.81	$0.00	$0.00	$0.00	
	Mounting Brackets	0	ea		$5.25	$0.00	$0.00	$0.00	
	Junction Box and Plate	0	ea		$5.75	$0.00	$0.00	$0.00	
	Low Voltage Wiring	0	ea		$3.45	$0.00	$0.00	$0.00	
	MyTech Ultra sonic sensors (Restroom)	0	ea	$49.50	$72.80	$0.00	$0.00	$0.00	
	Digital Time Switch	0	ea	$49.50	$34.01	$0.00	$0.00	$0.00	
	Ceiling Mounted Ultra sonic Sensors W-2000H	0	ea	$49.50	$62.43	$0.00	$0.00	$0.00	
	Ceiling Mounted Ultrasonic Sensors W-500A	0	ea	$49.50	$35.96	$0.00	$0.00	$0.00	
	Ceiling Mounted Ultrasonic Sensors W-2000A	0	ea	$49.50	$50.84	$0.00	$0.00	$0.00	
	Subtotal					$140.00	$728.00	$868.00	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$868.00	
	Escalation 0%							$0.00	
	Subtotal							$868.00	
	Contingencies 0%							$0.00	
	Total							$868.00	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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**********************************************************************
*     N I S T  B L C C:  COMPARATIVE  ECONOMIC  ANALYSIS (ver. 4.70-99)     *
**********************************************************************

          Project: National Park Service
          Base Case: WRVC-301
          Alternative: WRVC-301B

          Principal Study Parameters:
          ---------------------------
          Analysis Type: Federal Analysis--Energy Conservation Projects
          Study Period:          8.25 Years (SEP 2000 through NOV 2008)
          Plan/Constr. Period:   0.25 Years (SEP 2000 through NOV 2000)
          Service Period:        8.00 Years (DEC 2000 through NOV 2008)
          Discount Rate:   3.1% Real (exclusive of general inflation)
          Base Case LCC File:   WRVC301.LCC
          Alternative LCC File: WRVC301B.LCC

                  Comparison of Present-Value Costs

                                      Base Case:    Alternative:    Savings
                                      WRVC-301      WRVC-301B       from Alt.
Initial Investment item(s):           ------------  ------------  ------------
 Capital Requirements as of Serv. Date         $0          $184         -$184
                                      ---------     ---------     ---------
     Subtotal                                  $0          $184         -$184
Future Cost Items:
 Energy-related Costs                      $2,736          $172        $2,564
                                      ---------     ---------     ---------
     Subtotal                              $2,736          $172        $2,564
                                      ---------     ---------     ---------
   Total P.V. Life-Cycle Cost              $2,736          $355        $2,380

    Net Savings from Alternative 'WRVC-301B' compared to Base Case 'WRVC-301'

          Net Savings  =  P.V. of Non-Investment Savings       $2,564
                       -  Increased Total Investment             $184
                                                            ----------
                                                Net savings:    $2,380


   Note: the SIR and AIRR computations include differential initial costs,
   capital replacement costs, and residual value (if any) as investment costs,
   per NIST Handbook 135 (Federal and MILCON analyses only).

                  Savings-to-Investment Ratio (SIR)
          For Alternative 'WRVC-301B' compared to Base Case 'WRVC-301'

                          P.V. of non-investment savings
                SIR  =  ------------------------------  =  13.97
                            Increased total investment

                  Adjusted Internal Rate of Return (AIRR)
```

For Alternative 'WRVC-301B' compared to Base Case 'WRVC-301'
(Reinvestment Rate = 3.10%; Study Period = 8 years)

AIRR = 41.92%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 1
Discounted Payback occurs in year 1

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	1,398.0	0.0	1,398.0	11,184.0
Distil. Oil	MBtu	0.0	0.0	0.0	0.0
Natural Gas	MBtu	0.0	3.1	-3.1	-24.8

EMISSIONS REDUCTION SUMMARY

Energy type	Average Annual Emissions			Life-Cycle Reduction
	Base Case	Alternative	Reduction	
Electricity:				
CO2 (Kg):	1,355.2	0.0	1,355.2	10,841.3
SO2 (Kg):	4.7	0.0	4.7	37.2
NOx (Kg):	4.1	0.0	4.1	32.7
Distil. Oil:				
CO2 (Kg):	0.0	0.0	0.0	0.0
SO2 (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Natural Gas:				
CO2 (Kg):	0.0	163.7	-163.7	-1,309.8
SO2 (Kg):	0.0	0.0	-0.0	-0.0
NOx (Kg):	0.0	0.1	-0.1	-1.0
Total:				
CO2 (Kg):	1,355.2	163.7	1,191.4	9,531.5
SO2 (Kg):	4.7	0.0	4.7	37.2
NOx (Kg):	4.1	0.1	4.0	31.6

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**********************************************************************
*     N I S T  B L C C:  COMPARATIVE  ECONOMIC  ANALYSIS (ver. 4.70-99)     *
**********************************************************************

          Project: National Park Service
          Base Case: WRVC-304
          Alternative: WRVC-304B

          Principal Study Parameters:
          ---------------------------
          Analysis Type: Federal Analysis--Energy Conservation Projects
          Study Period:          20.25 Years (SEP 2000 through NOV 2020)
          Plan/Constr. Period:    0.25 Years (SEP 2000 through NOV 2000)
          Service Period:        20.00 Years (DEC 2000 through NOV 2020)
          Discount Rate:   3.1% Real (exclusive of general inflation)
          Base Case LCC File:    WRVC304.LCC
          Alternative LCC File: WRVC304B.LCC

                  Comparison of Present-Value Costs

                                      Base Case:    Alternative:    Savings
                                      WRVC-304      WRVC-304B       from Alt.
Initial Investment item(s):           ------------  ------------  ------------
 Capital Requirements as of Serv. Date         $0        $2,392       -$2,392
                                      ---------     ---------     ---------
     Subtotal                                  $0        $2,392       -$2,392
Future Cost Items:
 Energy-related Costs                      $7,545        $1,078        $6,467
                                      ---------     ---------     ---------
     Subtotal                              $7,545        $1,078        $6,467
                                      ---------     ---------     ---------
   Total P.V. Life-Cycle Cost              $7,545        $3,469        $4,076

    Net Savings from Alternative 'WRVC-304B' compared to Base Case 'WRVC-304'

          Net Savings  =  P.V. of Non-Investment Savings        $6,467
                       -  Increased Total Investment            $2,392
                                                           -------------
                                                Net savings:    $4,076

    Note: the SIR and AIRR computations include differential initial costs,
    capital replacement costs, and residual value (if any) as investment costs,
    per NIST Handbook 135 (Federal and MILCON analyses only).

                  Savings-to-Investment Ratio (SIR)
          For Alternative 'WRVC-304B' compared to Base Case 'WRVC-304'

                          P.V. of non-investment savings
                SIR  =  ------------------------------  =   2.70
                          Increased total investment

                  Adjusted Internal Rate of Return (AIRR)
```

For Alternative 'WRVC-304B' compared to Base Case 'WRVC-304'
(Reinvestment Rate = 3.10%; Study Period = 20 years)

AIRR = 8.29%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 6
Discounted Payback occurs in year 6

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	3,381.0	0.0	3,381.0	67,620.0
Distil. Oil	MBtu	0.0	7.2	-7.2	-144.0

EMISSIONS REDUCTION SUMMARY

Energy type	Average Annual Emissions			Life-Cycle Reduction
	Base Case	Alternative	Reduction	
Electricity:				
CO2 (Kg):	3,277.4	0.0	3,277.4	65,548.0
SO2 (Kg):	10.5	0.0	10.5	210.1
NOx (Kg):	9.9	0.0	9.9	197.5
Distil. Oil:				
CO2 (Kg):	0.0	522.5	-522.5	-10,449.1
SO2 (Kg):	0.0	0.8	-0.8	-15.7
NOx (Kg):	0.0	0.5	-0.5	-9.1
Total:				
CO2 (Kg):	3,277.4	522.5	2,754.9	55,098.9
SO2 (Kg):	10.5	0.8	9.7	194.4
NOx (Kg):	9.9	0.5	9.4	188.3

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* N I S T B L C C: COMPARATIVE ECONOMIC ANALYSIS (ver. 4.70-99) *
****

Project: National Park Service
Base Case: WRVC-310
Alternative: WRVC-310B

Principal Study Parameters:

Analysis Type: Federal Analysis--Energy Conservation Projects
Study Period: 5.25 Years (SEP 2000 through NOV 2005)
Plan/Constr. Period: 0.25 Years (SEP 2000 through NOV 2000)
Service Period: 5.00 Years (DEC 2000 through NOV 2005)
Discount Rate: 3.1% Real (exclusive of general inflation)
Base Case LCC File: WRVC310.LCC
Alternative LCC File: WRVC310B.LCC

Comparison of Present-Value Costs

	Base Case: WRVC-310	Alternative: WRVC-310B	Savings from Alt.
Initial Investment item(s):			
Capital Requirements as of Serv. Date	$0	$20	-$20
Subtotal	$0	$20	-$20
Future Cost Items:			
Energy-related Costs	$668	$119	$549
Subtotal	$668	$119	$549
Total P.V. Life-Cycle Cost	$668	$139	$530

Net Savings from Alternative 'WRVC-310B' compared to Base Case 'WRVC-310'

Net Savings	=	P.V. of Non-Investment Savings	$549
	-	Increased Total Investment	$20
		Net savings:	$530

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and residual value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

Savings-to-Investment Ratio (SIR)
For Alternative 'WRVC-310B' compared to Base Case 'WRVC-310'

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 27.68$$

Adjusted Internal Rate of Return (AIRR)

For Alternative 'WRVC-310B' compared to Base Case 'WRVC-310'
(Reinvestment Rate = 3.10%; Study Period = 5 years)

AIRR = 94.08%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 1
Discounted Payback occurs in year 1

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	1,110.0	0.0	1,110.0	5,550.0
Distil. Oil	MBtu	0.0	2.8	-2.8	-14.0

EMISSIONS REDUCTION SUMMARY

Energy type	Average Annual Emissions			Life-Cycle Reduction
	Base Case	Alternative	Reduction	
Electricity:				
CO2 (Kg):	1,076.0	0.0	1,076.0	5,379.9
SO2 (Kg):	3.9	0.0	3.9	19.3
NOx (Kg):	3.2	0.0	3.2	16.2
Distil. Oil:				
CO2 (Kg):	0.0	203.2	-203.2	-1,015.9
SO2 (Kg):	0.0	0.3	-0.3	-1.5
NOx (Kg):	0.0	0.2	-0.2	-0.9
Total:				
CO2 (Kg):	1,076.0	203.2	872.8	4,364.1
SO2 (Kg):	3.9	0.3	3.6	17.8
NOx (Kg):	3.2	0.2	3.1	15.3

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**********************************************************************
*     N I S T  B L C C:  COMPARATIVE  ECONOMIC  ANALYSIS (ver. 4.70-99)      *
**********************************************************************

          Project: National Park Service
          Base Case: WRVC-325
          Alternative: WRVC-325B

          Principal Study Parameters:
          ---------------------------
          Analysis Type: Federal Analysis--Energy Conservation Projects
          Study Period:          20.25 Years (SEP 2000 through NOV 2020)
          Plan/Constr. Period:    0.25 Years (SEP 2000 through NOV 2000)
          Service Period:        20.00 Years (DEC 2000 through NOV 2020)
          Discount Rate:   3.1% Real (exclusive of general inflation)
          Base Case LCC File:    WRVC325.LCC
          Alternative LCC File: WRVC325B.LCC

                    Comparison of Present-Value Costs

                                        Base Case:    Alternative:    Savings
                                        WRVC-325      WRVC-325B       from Alt.
Initial Investment item(s):             ----------    ----------      ----------
 Capital Requirements as of Serv. Date         $0          $134           -$134
                                        ---------     ---------       ---------
     Subtotal                                  $0          $134           -$134
Future Cost Items:
 Energy-related Costs                        $573          $164           $409
                                        ---------     ---------       ---------
     Subtotal                                $573          $164           $409
                                        ---------     ---------       ---------
   Total P.V. Life-Cycle Cost                $573          $298           $275

    Net Savings from Alternative 'WRVC-325B' compared to Base Case 'WRVC-325'

          Net Savings  =  P.V. of Non-Investment Savings          $409
                       -  Increased Total Investment              $134
                                                             -------------
                                                Net savings:        $275

   Note: the SIR and AIRR computations include differential initial costs,
   capital replacement costs, and residual value (if any) as investment costs,
   per NIST Handbook 135 (Federal and MILCON analyses only).

                    Savings-to-Investment Ratio (SIR)
          For Alternative 'WRVC-325B' compared to Base Case 'WRVC-325'

                              P.V. of non-investment savings
                    SIR  =  ------------------------------  =   3.05
                                Increased total investment

                    Adjusted Internal Rate of Return (AIRR)
```

For Alternative 'WRVC-325B' compared to Base Case 'WRVC-325'
(Reinvestment Rate = 3.10%; Study Period = 20 years)

AIRR = 8.94%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 5
Discounted Payback occurs in year 5

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	459.0	0.0	459.0	9,180.0
Distil. Oil	MBtu	0.0	1.1	-1.1	-22.0

EMISSIONS REDUCTION SUMMARY

Energy type	Average Annual Emissions			Life-Cycle Reduction
	Base Case	Alternative	Reduction	
Electricity:				
CO2 (Kg):	444.9	0.0	444.9	8,898.7
SO2 (Kg):	1.4	0.0	1.4	28.5
NOx (Kg):	1.3	0.0	1.3	26.8
Distil. Oil:				
CO2 (Kg):	0.0	79.8	-79.8	-1,596.4
SO2 (Kg):	0.0	0.1	-0.1	-2.4
NOx (Kg):	0.0	0.1	-0.1	-1.4
Total:				
CO2 (Kg):	444.9	79.8	365.1	7,302.3
SO2 (Kg):	1.4	0.1	1.3	26.1
NOx (Kg):	1.3	0.1	1.3	25.4

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**********************************************************************
*     N I S T  B L C C:  COMPARATIVE  ECONOMIC  ANALYSIS (ver. 4.70-99)     *
**********************************************************************

          Project: National Park Service
          Base Case: WRVC-332
          Alternative: WRVC-332B

          Principal Study Parameters:
          ---------------------------
          Analysis Type: Federal Analysis--Energy Conservation Projects
          Study Period:          10.25 Years (SEP 2000 through NOV 2010)
          Plan/Constr. Period:    0.25 Years (SEP 2000 through NOV 2000)
          Service Period:        10.00 Years (DEC 2000 through NOV 2010)
          Discount Rate:   3.1% Real (exclusive of general inflation)
          Base Case LCC File:    WRVC332.LCC
          Alternative LCC File: WRVC332B.LCC

                    Comparison of Present-Value Costs

                                      Base Case:    Alternative:    Savings
                                      WRVC-332      WRVC-332B       from Alt.
Initial Investment item(s):           ------------  ------------  ------------
 Capital Requirements as of Serv. Date         $0          $863         -$863
                                      ---------     ---------     ---------
     Subtotal                                $0          $863         -$863
Future Cost Items:
 Energy-related Costs                    $1,421          $509          $912
                                      ---------     ---------     ---------
     Subtotal                            $1,421          $509          $912
                                      ---------     ---------     ---------
   Total P.V. Life-Cycle Cost            $1,421        $1,373           $48


    Net Savings from Alternative 'WRVC-332B' compared to Base Case 'WRVC-332'


          Net Savings  =  P.V. of Non-Investment Savings          $912
                       -  Increased Total Investment              $863
                                                              ----------
                                                 Net savings:      $48


   Note: the SIR and AIRR computations include differential initial costs,
   capital replacement costs, and residual value (if any) as investment costs,
   per NIST Handbook 135 (Federal and MILCON analyses only).


                    Savings-to-Investment Ratio (SIR)
          For Alternative 'WRVC-332B' compared to Base Case 'WRVC-332'


                          P.V. of non-investment savings
                SIR  =  ------------------------------  =   1.06
                             Increased total investment


                    Adjusted Internal Rate of Return (AIRR)
          For Alternative 'WRVC-332B' compared to Base Case 'WRVC-332'
```

(Reinvestment Rate = 3.10%; Study Period = 10 years)

AIRR = 3.65%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 8
Discounted Payback occurs in year 10

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption - Base Case	Average Annual Consumption - Alternative	Savings	Life-Cycle Savings
Electricity	kWh	2,823.0	0.0	2,823.0	28,230.0
Distil. Oil	MBtu	0.0	6.1	-6.1	-61.0

EMISSIONS REDUCTION SUMMARY

Energy type	Average Annual Emissions - Base Case	Average Annual Emissions - Alternative	Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Kg):	2,736.5	0.0	2,736.5	27,365.0
SO2 (Kg):	9.2	0.0	9.2	92.1
NOx (Kg):	8.2	0.0	8.2	82.4
Distil. Oil:				
CO2 (Kg):	0.0	442.6	-442.6	-4,426.3
SO2 (Kg):	0.0	0.7	-0.7	-6.6
NOx (Kg):	0.0	0.4	-0.4	-3.9
Total:				
CO2 (Kg):	2,736.5	442.6	2,293.9	22,938.6
SO2 (Kg):	9.2	0.7	8.5	85.4
NOx (Kg):	8.2	0.4	7.9	78.6

NEW_YORK_CITY , NY
ECM Number: 110Bldg101 - Heating Conduction
ECM Description: Replace Windows

EXISTING	PROPOSED	PARAMETER
0.9	3	R-Value, BTU/H-FT^2-F
72	72	Occupied Heating Season Setpoint Temperature, F
72	72	Unoccupied Heating Season Setpoint Temperature, F
160		Surface Area, Sf
55		Balance Point Temperature, F
75%		Season System Efficiency
Gal		Fuel Unit
138,690		Fuel Conversion Factor, BTU/ Fuel Unit
1.140		Fuel Cost in $/Fuel Unit

Average Bin Temp (F)	Area (SF)	OCCUPIED OPERATION						UNOCCUPIED OPERATION						Total Annual Energy Savings (BTU)
		Annual Hours	U-Value (1/R-Value) Existing (BTU/H-FT^2-F)	U-Value (1/R-Value) Proposed (BTU/H-FT^2-F)	Delta Temperature Existing (F)	Delta Temperature Proposed (F)	Energy Savings (BTU)	Annual Hours	U-Value (1/R-Value) Existing (BTU/H-FT^2-F)	U-Value (1/R-Value) Proposed (BTU/H-FT^2-F)	Delta Temperature Existing (F)	Delta Temperature Proposed (F)	Energy Savings (BTU)	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
			1/Rexisting	1/Rproposed	72 F -Tbin	72 F -Tbin	(D*F-E*G)*B*C		1/Rexisting	1/Rproposed	72 F -Tbin	72 F -Tbin	(J*L-K*M)*B*I	H+N
-17.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
-12.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
-7.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
-2.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
2.5	160	0	1.111	0.333	-	-	-	5	1.111	0.333	69.5	69.5	43,244	43,244
7.5	160	6	1.111	0.333	64.5	64.5	48,160	14	1.111	0.333	64.5	64.5	112,373	160,533
12.5	160	19	1.111	0.333	59.5	59.5	140,684	31	1.111	0.333	59.5	59.5	229,538	370,222
17.5	160	33	1.111	0.333	54.5	54.5	223,813	89	1.111	0.333	54.5	54.5	603,618	827,431
22.5	160	86	1.111	0.333	49.5	49.5	529,760	137	1.111	0.333	49.5	49.5	843,920	1,373,680
27.5	160	116	1.111	0.333	44.5	44.5	642,382	206	1.111	0.333	44.5	44.5	1,140,782	1,783,164
32.5	160	362	1.111	0.333	39.5	39.5	1,779,431	426	1.111	0.333	39.5	39.5	2,094,027	3,873,458
37.5	160	416	1.111	0.333	34.5	34.5	1,786,027	493	1.111	0.333	34.5	34.5	2,116,613	3,902,640
42.5	160	332	1.111	0.333	29.5	29.5	1,218,809	297	1.111	0.333	29.5	29.5	1,090,320	2,309,129
47.5	160	232	1.111	0.333	24.5	24.5	707,342	330	1.111	0.333	24.5	24.5	1,006,133	1,713,476
52.5	160	378	1.111	0.333	19.5	19.5	917,280	383	1.111	0.333	19.5	19.5	929,413	1,846,693
57.5	160	262	1.111	0.333	14.5	14.5	472,764	290	1.111	0.333	14.5	14.5	523,289	996,053
62.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
67.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
72.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
77.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
82.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
87.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
92.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
97.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
102.5	160	0	1.111	0.333	-	-	-	0	1.111	0.333	-	-	-	-
TOTAL		2,242					8,466,453	2,701					10,733,271	19,199,724

ANNUAL ENERGY SAVINGS

= (Energy Savings * Energy Conversion Factor)/Seasonal Efficiency

= (19,199,724 BTU * Gal/138,690 BTU) / (75% EFF)= 185 Gal
= (19,199,724 BTU * (MBTU/ 1,000,000 BTU)) / (75% EFF)= 25.6 MBTU
= 185 Gal * (1.14 $/Gal)
= $ 210

NEW_YORK_CITY , NY
ECM Number: 110Bldg101 - Heating Infiltration
ECM Description: Replace Windows

OCCUPIED	UNOCCUPIED	PARAMETER	
72	72	Ti	Heating Season Setpoint Temperature, F
46.3	43.2	To	Average Outdoor Temeprature, F
5	5	V	Average Wind Speed, MPH
2736	3072	H	Hours In Period, H
Existing	Proposed		
100	100	L	Crack Length (FT)
0.032	0.000	W	Crack Width (IN)
38.4	0.0	EA	Effective Air Leakage Area, IN^2
38.4		AI	Reduction of Effected Air Leakage Area, IN^2
2		S#	Number Of Stories (1-3)
2		SC	Sheilding Class (1-5)
0.0299		Cs	Stack Coefficient, $CFM^2/(IN^4\text{-}F)$ - From ASHRAE 97F25.22
0.0121		Cw	Wind Coefficient, $CFM^2/(IN^4\text{-}MPH^2)$ - From ASHRAE 97F25.22
75%		E	Seasonal Efficiency
Gal		FU	Fuel Unit
138,690		FCF	Fuel Conversion Factor, BTU/Fuel Unit
1.14		FC	Fuel Cost ($/Fuel Unit)

1) FLOW RATE REDUCTION, CFM = $AI*[Cs*(Ti-To) + Cw*V^2]^{0.5}$

OCCUPIED PERIOD

= 38.4 IN^2 * [0.0299 CFM^2/(IN^4-F) * (72 F - 46.3 F) + (0.0121 CFM^2/IN^4-MPH^4 * (5 MPH)^2]^0.5
= 39.76 CFM

UNOCCUPIED PERIOD

= 38.4 IN^2 * [0.0299 CFM^2/(IN^4-F) * (72 F - 43.2 F) + (0.0121 CFM^2/IN^4-MPH^4 * (5 MPH)^2]^0.5
= 41.43 CFM

2) ANNUAL INPUT ENERGY SAVINGS = [1.08 * FLOW RATE * (Ti - To) * H * FCF] / SEASONAL EFFICIENCY

OCCUPIED PERIOD

= [1.08 * 39.8 CFM * (72 F - 46.3 F) * 2736 Hrs * (MTBU /1,000,000 BTU) / 75% = 4. MBTU
= [1.08 * 39.8 CFM * (72 F - 46.3 F) * 2736 Hrs * (Gal/ 138,690 BTU)] / 75%
= 29 Gal

UNOCCUPIED PERIOD

= [1.08 * 41.4 CFM * (72 F - 43.2 F) * 3072 Hrs * (MBTU/1,000,000 BTU) / 75% = 5.3 MBTU
= [1.08 * 41.4 CFM * (72 F - 43.2 F) * 3072 Hrs * (Gal/ 138,690 BTU)] / 75%
= 38 Gal

TOTAL SAVINGS

= 9.3 MBTU
= 67 Gal

3) ANNUAL ENERGY COST SAVINGS:

= 67 Gal * (1.14 $/Gal)
= $ 77

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wildlife Refuge Bldg 101**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 110 - Replace Windows

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	Double hung replacement windows	160	Sq Ft	$8.00	$8.00	$0	$16.00	$2,560	
	Subtotal							$2,560.00	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$2,560.00	
	Escalation 0%							$0.00	
	Subtotal							$2,560.00	
	Contingencies 0%							$0.00	
	Total							$2,560.00	
	Roundoff							$2,560	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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**************************************************************************
*     N I S T  B L C C:  COMPARATIVE  ECONOMIC  ANALYSIS (ver. 4.70-99)     *
**************************************************************************

          Project: National Park Service
          Base Case: WLR101-110
          Alternative: WLR101-110B

          Principal Study Parameters:
          ---------------------------
          Analysis Type: Federal Analysis--Energy Conservation Projects
          Study Period:         20.25 Years (SEP 2000 through NOV 2020)
          Plan/Constr. Period:   0.25 Years (SEP 2000 through NOV 2000)
          Service Period:       20.00 Years (DEC 2000 through NOV 2020)
          Discount Rate:   3.1% Real (exclusive of general inflation)
          Base Case LCC File:   101110.LCC
          Alternative LCC File: 101110B.LCC

                  Comparison of Present-Value Costs

                                        Base Case:    Alternative:    Savings
                                        WLR101-110    WLR101-110B     from Alt.
Initial Investment item(s):             ----------    -----------     ----------
 Capital Requirements as of Serv. Date         $0        $2,541        -$2,541
                                        ---------     ---------     ---------
    Subtotal                                   $0        $2,541        -$2,541
Future Cost Items:
 Energy-related Costs                      $5,293            $0         $5,293
                                        ---------     ---------     ---------
    Subtotal                               $5,293            $0         $5,293
                                        ---------     ---------     ---------
   Total P.V. Life-Cycle Cost              $5,293        $2,541         $2,753

  Net Savings from Alternative 'WLR101-110B' compared to Base Case 'WLR101-110'

        Net Savings  =  P.V. of Non-Investment Savings        $5,293
                     -  Increased Total Investment            $2,541
                                                            ----------
                                          Net savings:        $2,753


  Note: the SIR and AIRR computations include differential initial costs,
  capital replacement costs, and residual value (if any) as investment costs,
  per NIST Handbook 135 (Federal and MILCON analyses only).

                    Savings-to-Investment Ratio (SIR)
       For Alternative 'WLR101-110B' compared to Base Case 'WLR101-110'

                          P.V. of non-investment savings
                SIR  =  ------------------------------  =   2.08
                             Increased total investment


                    Adjusted Internal Rate of Return (AIRR)
       For Alternative 'WLR101-110B' compared to Base Case 'WLR101-110'
```

(Reinvestment Rate = 3.10%; Study Period = 20 years)

AIRR = 6.91%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 8
Discounted Payback occurs in year 9

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	0.0	0.0	0.0	0.0
Distil. Oil	MBtu	34.9	0.0	34.9	698.0

NEW_YORK_CITY , NY
ECM Number: 102Bldg101 - Heating Conduction
ECM Description: Insulate Ceiling

EXISTING	PROPOSED	PARAMETER
5	24	R-Value, BTU/H-FT^2-F
72	72	Occupied Heating Season Setpoint Temperature, F
72	72	Unoccupied Heating Season Setpoint Temperature, F
1,628		Surface Area, Sf
55		Balance Point Temperature, F
75%		Season System Efficiency
Gal		Fuel Unit
138,690		Fuel Conversion Factor, BTU/ Fuel Unit
1.140		Fuel Cost in $/Fuel Unit

Average Bin Temp (F)	Area (SF)	OCCUPIED OPERATION						UNOCCUPIED OPERATION						Total Annual Energy Savings (BTU)
		Annual Hours	U-Value (1/R-Value) Existing (BTU/H-FT^2-F)	U-Value (1/R-Value) Proposed (BTU/H-FT^2-F)	Delta Temperature Existing (F)	Delta Temperature Proposed (F)	Energy Savings (BTU)	Annual Hours	U-Value (1/R-Value) Existing (BTU/H-FT^2-F)	U-Value (1/R-Value) Proposed (BTU/H-FT^2-F)	Delta Temperature Existing (F)	Delta Temperature Proposed (F)	Energy Savings (BTU)	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
			1/Rexisting	1/Rproposed	72 F -Tbin	72 F -Tbin	(D*F-E*G)*B*C		1/Rexisting	1/Rproposed	72 F -Tbin	72 F -Tbin	(J*L-K*M)*B*I	H+N
-17.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
-12.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
-7.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
-2.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
2.5	1,628	0	0.200	0.042	-	-	-	5	0.200	0.042	69.5	69.5	89,574	89,574
7.5	1,628	6	0.200	0.042	64.5	64.5	99,756	14	0.200	0.042	64.5	64.5	232,763	332,519
12.5	1,628	19	0.200	0.042	59.5	59.5	291,405	31	0.200	0.042	59.5	59.5	475,451	766,856
17.5	1,628	33	0.200	0.042	54.5	54.5	463,593	89	0.200	0.042	54.5	54.5	1,250,297	1,713,891
22.5	1,628	86	0.200	0.042	49.5	49.5	1,097,313	137	0.200	0.042	49.5	49.5	1,748,045	2,845,357
27.5	1,628	116	0.200	0.042	44.5	44.5	1,330,592	206	0.200	0.042	44.5	44.5	2,362,947	3,693,539
32.5	1,628	362	0.200	0.042	39.5	39.5	3,685,806	426	0.200	0.042	39.5	39.5	4,337,440	8,023,245
37.5	1,628	416	0.200	0.042	34.5	34.5	3,699,467	493	0.200	0.042	34.5	34.5	4,384,224	8,083,692
42.5	1,628	332	0.200	0.042	29.5	29.5	2,524,567	297	0.200	0.042	29.5	29.5	2,258,423	4,782,989
47.5	1,628	232	0.200	0.042	24.5	24.5	1,465,146	330	0.200	0.042	24.5	24.5	2,084,044	3,549,189
52.5	1,628	378	0.200	0.042	19.5	19.5	1,899,998	383	0.200	0.042	19.5	19.5	1,925,130	3,825,128
57.5	1,628	262	0.200	0.042	14.5	14.5	979,256	290	0.200	0.042	14.5	14.5	1,083,909	2,063,164
62.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
67.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
72.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
77.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
82.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
87.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
92.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
97.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
102.5	1,628	0	0.200	0.042	-	-	-	0	0.200	0.042	-	-	-	-
TOTAL		2,242					17,536,897	2,701					22,232,246	39,769,144

ANNUAL ENERGY SAVINGS

= (Energy Savings * Energy Conversion Factor)/Seasonal Efficiency

= (39,769,144 BTU * Gal/138,690 BTU) / (75% EFF)= 382 Gal
= (39,769,144 BTU * (MBTU/ 1,000,000 BTU)) / (75% EFF)= 53.0 MBTU
= 382 Gal * (1.14 $/Gal)
= $ 436

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wildlife Refuge Bldg 101**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 102 - Increase Attic Insulation

Div.	Description	Qty.	Unit	Material	Labor	Equipment	Total	Total	MEANS Ref.
	Fiberglass Insulation:								
	unfaced, batts or blankets								
	3.5" thick, R=11.0, 15" Wide	0	Sq Ft	$0.18	$0.16	$0	$0.34	$0.00	
	6.0" thick, R=19.0, 15" Wide	0	Sq Ft	$0.30	$0.12	$0	$0.42	$0	
	9.0" thick, R=30.0, 15" Wide	0	Sq Ft	$0.50	$0.21	$0	$0.71	$0.00	
	12" thick, R=38.0, 15" Wide	0	Sq Ft	$0.64	$0.21	$0	$0.85	$0.00	
	Prepare and Clean	0	LS	$0.00	$0.05	$0	$0.05	$0	
	Existing Ceiling Spaces								
	Provide Additional Ceiling Edge	0	LS	$50.00	$25.00	$0	$75.00	$0.00	
	Wood Framing/Blocking								
	Attic Access Hatches	0	ea	$25.00	$15.00	$0	$40.00	$0	
	3'-0" square								
	Polyisocyanurate Insulation:		Sq Ft	$0.47	$0.30	$0	$0.77	$0	
	Rigid Boards, Foil-Faced								
	2" thick, R=14.2, 4' x 8' Boards								
	Suspended Wood Panels	0	Sq Ft	$0.31	$0.15	$0	$0.46	$0	
	Add R-19 Blown Insulation	1,630	Sq Ft	$0.35	$0.39	$0	$0.74	$1,206	
	Subtotal					$0.00	$119.34	$1,206.20	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$1,206.20	
	Escalation 0%							$0.00	
	Subtotal							$1,206.20	
	Contingencies 0%							$0.00	
	Total							$1,206.20	
	Roundoff							$1,205	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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**************************************************************************
*    N I S T  B L C C:  COMPARATIVE  ECONOMIC  ANALYSIS (ver. 4.70-99)    *
**************************************************************************

          Project: National Park Service
          Base Case: WLR101-102
          Alternative: WLR101-102B

          Principal Study Parameters:
          ---------------------------
          Analysis Type: Federal Analysis--Energy Conservation Projects
          Study Period:         20.25 Years (SEP 2000 through NOV 2020)
          Plan/Constr. Period:   0.25 Years (SEP 2000 through NOV 2000)
          Service Period:       20.00 Years (DEC 2000 through NOV 2020)
          Discount Rate:   3.1% Real (exclusive of general inflation)
          Base Case LCC File:   101102.LCC
          Alternative LCC File: 101102B.LCC

                  Comparison of Present-Value Costs

                                      Base Case:    Alternative:    Savings
                                      WLR101-102    WLR101-102B     from Alt.
Initial Investment item(s):           ----------    -----------   ----------
 Capital Requirements as of Serv. Date        $0        $1,191       -$1,191
                                      ---------     ---------     ---------
     Subtotal                                 $0        $1,191       -$1,191
Future Cost Items:
 Energy-related Costs                     $8,039            $0        $8,039
                                      ---------     ---------     ---------
     Subtotal                             $8,039            $0        $8,039
                                      ---------     ---------     ---------
   Total P.V. Life-Cycle Cost             $8,039        $1,191        $6,848

  Net Savings from Alternative 'WLR101-102B' compared to Base Case 'WLR101-102'

        Net Savings  =  P.V. of Non-Investment Savings        $8,039
                     -  Increased Total Investment            $1,191
                                                          -----------
                                        Net savings:          $6,848

  Note: the SIR and AIRR computations include differential initial costs,
  capital replacement costs, and residual value (if any) as investment costs,
  per NIST Handbook 135 (Federal and MILCON analyses only).

                  Savings-to-Investment Ratio (SIR)
       For Alternative 'WLR101-102B' compared to Base Case 'WLR101-102'

                          P.V. of non-investment savings
              SIR  =  ------------------------------  =   6.75
                            Increased total investment

                  Adjusted Internal Rate of Return (AIRR)
       For Alternative 'WLR101-102B' compared to Base Case 'WLR101-102'
```

(Reinvestment Rate = 3.10%; Study Period = 20 years)

AIRR = 13.30%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 3
Discounted Payback occurs in year 3

ENERGY SAVINGS SUMMARY

Energy type	Units	---- Average Annual Consumption ----- Base Case	Alternative	Savings	Life-Cycle Savings
Electricity	kWh	0.0	0.0	0.0	0.0
Distil. Oil	MBtu	53.0	0.0	53.0	1,060.0

NEW_YORK_CITY , NY
ECM Number: 104Bldg101 - Heating Conduction
ECM Description: Insulate Crawl Space

EXISTING	PROPOSED	PARAMETER
4	23	R-Value, BTU/H-FT^2-F
72	72	Occupied Heating Season Setpoint Temperature, F
72	72	Unoccupied Heating Season Setpoint Temperature, F
1,628		Surface Area, Sf
55		Balance Point Temperature, F
75%		Season System Efficiency
Gal		Fuel Unit
138,690		Fuel Conversion Factor, BTU/ Fuel Unit
1.140		Fuel Cost in $/Fuel Unit

Average Bin Temp (F)	Area (SF)	OCCUPIED OPERATION						UNOCCUPIED OPERATION						Total Annual Energy Savings (BTU)
		Annual Hours	U-Value (1/R-Value) Existing (BTU/H-FT^2-F)	U-Value (1/R-Value) Proposed (BTU/H-FT^2-F)	Delta Temperature Existing (F)	Delta Temperature Proposed (F)	Energy Savings (BTU)	Annual Hours	U-Value (1/R-Value) Existing (BTU/H-FT^2-F)	U-Value (1/R-Value) Proposed (BTU/H-FT^2-F)	Delta Temperature Existing (F)	Delta Temperature Proposed (F)	Energy Savings (BTU)	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
			1/Rexisting	1/Rproposed	72 F -Tbin	72 F -Tbin	(D*F-E*G)*B*C		1/Rexisting	1/Rproposed	72 F -Tbin	72 F -Tbin	(J*L-K*M)*B*I	H+N
-17.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
-12.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
-7.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
-2.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
2.5	1,628	0	0.250	0.043	-	-	-	5	0.250	0.043	69.5	69.5	116,836	116,836
7.5	1,628	6	0.250	0.043	64.5	64.5	130,116	14	0.250	0.043	64.5	64.5	303,604	433,720
12.5	1,628	19	0.250	0.043	59.5	59.5	380,094	31	0.250	0.043	59.5	59.5	620,153	1,000,247
17.5	1,628	33	0.250	0.043	54.5	54.5	604,687	89	0.250	0.043	54.5	54.5	1,630,822	2,235,509
22.5	1,628	86	0.250	0.043	49.5	49.5	1,431,277	137	0.250	0.043	49.5	49.5	2,280,058	3,711,336
27.5	1,628	116	0.250	0.043	44.5	44.5	1,735,554	206	0.250	0.043	44.5	44.5	3,082,105	4,817,659
32.5	1,628	362	0.250	0.043	39.5	39.5	4,807,572	426	0.250	0.043	39.5	39.5	5,657,530	10,465,103
37.5	1,628	416	0.250	0.043	34.5	34.5	4,825,392	493	0.250	0.043	34.5	34.5	5,718,554	10,543,946
42.5	1,628	332	0.250	0.043	29.5	29.5	3,292,913	297	0.250	0.043	29.5	29.5	2,945,769	6,238,682
47.5	1,628	232	0.250	0.043	24.5	24.5	1,911,060	330	0.250	0.043	24.5	24.5	2,718,318	4,629,377
52.5	1,628	378	0.250	0.043	19.5	19.5	2,478,258	383	0.250	0.043	19.5	19.5	2,511,040	4,989,298
57.5	1,628	262	0.250	0.043	14.5	14.5	1,277,290	290	0.250	0.043	14.5	14.5	1,413,794	2,691,084
62.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
67.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
72.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
77.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
82.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
87.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
92.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
97.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
102.5	1,628	0	0.250	0.043	-	-	-	0	0.250	0.043	-	-	-	-
TOTAL		2,242					22,874,214	2,701					28,998,582	51,872,796

ANNUAL ENERGY SAVINGS

= (Energy Savings * Energy Conversion Factor)/Seasonal Efficiency

= (51,872,796 BTU * Gal/138,690 BTU) / (75% EFF)= 499 Gal
= (51,872,796 BTU * (MBTU/ 1,000,000 BTU)) / (75% EFF)= 69.2 MBTU
= 499 Gal * (1.14 $/Gal)
= $ 569

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wildlife Refuge Bldg 101**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 104 - Insulate Crawl Space

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	Fiberglass Insulation:								
	unfaced, batts or blankets								
	3.5" thick, R=11.0, 15" Wide	0	Sq Ft	$0.18	$0.16	$0	$0.34	$0.00	
	6.0" thick, R=19.0, 15" Wide	1,630	Sq Ft	$0.75	$0.12	$0	$0.87	$1,418	
	9.0" thick, R=30.0, 15" Wide	0	Sq Ft	$0.50	$0.21	$0	$0.71	$0.00	
	12" thick, R=38.0, 15" Wide	0	Sq Ft	$0.64	$0.21	$0	$0.85	$0.00	
	Prepare and Clean	0	LS	$0.00	$0.05	$0	$0.05	$0	
	Existing Ceiling Spaces								
	Provide Additional Ceiling Edge	0	LS	$50.00	$25.00	$0	$75.00	$0.00	
	Wood Framing/Blocking								
	Attic Access Hatches	0	ea	$25.00	$15.00	$0	$40.00	$0	
	3'-0" square								
7	Polyisocyanurate Insulation:		Sq Ft	$0.47	$0.30	$0	$0.77	$0	
	Rigid Boards, Foil-Faced								
	2" thick, R=14.2, 4' x 8' Boards								
	Suspended Wood Panels	0	Sq Ft	$0.31	$0.15	$0	$0.46	$0	
7	Add R-19 Blown Insulation	0	Sq Ft	$0.35	$0.39	$0	$0.74	$0	
	Subtotal					$0.00	$119.79	$1,418.10	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$1,418.10	
	Escalation 0%							$0.00	
	Subtotal							$1,418.10	
	Contingencies 0%							$0.00	
	Total							$1,418.10	
	Roundoff							$1,420	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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* N I S T B L C C: COMPARATIVE ECONOMIC ANALYSIS (ver. 4.70-99) *
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Project: National Park Service
Base Case: Bldg101-104
Alternative: Bldg101-104B

Principal Study Parameters:

Analysis Type: Federal Analysis--Energy Conservation Projects
Study Period: 20.25 Years (SEP 2000 through NOV 2020)
Plan/Constr. Period: 0.25 Years (SEP 2000 through NOV 2000)
Service Period: 20.00 Years (DEC 2000 through NOV 2020)
Discount Rate: 3.1% Real (exclusive of general inflation)
Base Case LCC File: 101104.LCC
Alternative LCC File: 101104B.LCC

Comparison of Present-Value Costs

	Base Case: Bldg101-104	Alternative: Bldg101-104B	Savings from Alt.
Initial Investment item(s):			
Capital Requirements as of Serv. Date	$0	$1,409	-$1,409
Subtotal	$0	$1,409	-$1,409
Future Cost Items:			
Energy-related Costs	$10,496	$0	$10,496
Subtotal	$10,496	$0	$10,496
Total P.V. Life-Cycle Cost	$10,496	$1,409	$9,087

Net Savings from Alternative 'Bldg101-104B' compared to Base Case 'Bldg101-104'

Net Savings	=	P.V. of Non-Investment Savings	$10,496
	-	Increased Total Investment	$1,409
		Net savings:	$9,087

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and residual value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

Savings-to-Investment Ratio (SIR)
For Alternative 'Bldg101-104B' compared to Base Case 'Bldg101-104'

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 7.45$$

Adjusted Internal Rate of Return (AIRR)
For Alternative 'Bldg101-104B' compared to Base Case 'Bldg101-104'

(Reinvestment Rate = 3.10%; Study Period = 20 years)

AIRR = 13.85%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 3
Discounted Payback occurs in year 3

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	0.0	0.0	0.0	0.0
Distil. Oil	MBtu	69.2	0.0	69.2	1,384.0

NEW_YORK_CITY , NY
ECM Number: 120Bldg101 - Heating Infiltration
ECM Description: Replace Storm Doors

OCCUPIED	UNOCCUPIED	PARAMETER	
72	72	Ti	Heating Season Setpoint Temperature, F
46.3	43.2	To	Average Outdoor Temeprature, F
5	5	V	Average Wind Speed, MPH
2736	3072	H	Hours In Period, H
Existing	Proposed		
60	60	L	Crack Length (FT)
0.032	0.000	W	Crack Width (IN)
23.0	0.0	EA	Effective Air Leakage Area, IN^2
23.0		AI	Reduction of Effected Air Leakage Area, IN^2
2		S#	Number Of Stories (1-3)
2		SC	Sheilding Class (1-5)
0.0299		Cs	Stack Coefficient, $CFM^2/(IN^4\text{-}F)$ - From ASHRAE 97F25.22
0.0121		Cw	Wind Coefficient, $CFM^2/(IN^4\text{-}MPH^2)$ - From ASHRAE 97F25.22
75%		E	Seasonal Efficiency
Gal		FU	Fuel Unit
138,690		FCF	Fuel Conversion Factor, BTU/Fuel Unit
1.14		FC	Fuel Cost ($/Fuel Unit)

1) FLOW RATE REDUCTION, CFM = $AI*[Cs*(Ti-To) + Cw*V^2]^{0.5}$

OCCUPIED PERIOD

= 23.04 IN^2 * [0.0299 CFM^2/(IN^4-F) * (72 F - 46.3 F) + (0.0121 CFM^2/IN^4-MPH^4 * (5 MPH)^2]^0.5
= 23.85 CFM

UNOCCUPIED PERIOD

= 23.04 IN^2 * [0.0299 CFM^2/(IN^4-F) * (72 F - 43.2 F) + (0.0121 CFM^2/IN^4-MPH^4 * (5 MPH)^2]^0.5
= 24.86 CFM

2) ANNUAL INPUT ENERGY SAVINGS = [1.08 * FLOW RATE * (Ti - To) * H * FCF] / SEASONAL EFFICIENCY

OCCUPIED PERIOD

= [1.08 * 23.9 CFM * (72 F - 46.3 F) * 2736 Hrs * (MTBU /1,000,000 BTU) / 75% = 2.4 MBTU
= [1.08 * 23.9 CFM * (72 F - 46.3 F) * 2736 Hrs * (Gal/ 138,690 BTU)] / 75%
= 17 Gal

UNOCCUPIED PERIOD

= [1.08 * 24.9 CFM * (72 F - 43.2 F) * 3072 Hrs * (MBTU/1,000,000 BTU) / 75% = 3.2 MBTU
= [1.08 * 24.9 CFM * (72 F - 43.2 F) * 3072 Hrs * (Gal/ 138,690 BTU)] / 75%
= 23 Gal

TOTAL SAVINGS

= 5.6 MBTU
= 40 Gal

3) ANNUAL ENERGY COST SAVINGS:

= 40 Gal * (1.14 $/Gal)
= $ 46

NEW_YORK_CITY , NY
ECM Number: 120Bldg101 - Heating Conduction
ECM Description: Replace Storm Doors

EXISTING	PROPOSED	PARAMETER
1.5	4.5	R-Value, BTU/H-FT^2-F
72	72	Occupied Heating Season Setpoint Temperature, F
72	72	Unoccupied Heating Season Setpoint Temperature, F
83		Surface Area, Sf
55		Balance Point Temperature, F
75%		Season System Efficiency
Gal		Fuel Unit
138,690		Fuel Conversion Factor, BTU/ Fuel Unit
1.140		Fuel Cost in $/Fuel Unit

Average Bin Temp (F)	Area (SF)	OCCUPIED OPERATION						UNOCCUPIED OPERATION						Total Annual Energy Savings (BTU)
		Annual Hours	U-Value (1/R-Value) Existing (BTU/H-FT^2-F)	U-Value (1/R-Value) Proposed (BTU/H-FT^2-F)	Delta Temperature Existing (F)	Delta Temperature Proposed (F)	Energy Savings (BTU)	Annual Hours	U-Value (1/R-Value) Existing (BTU/H-FT^2-F)	U-Value (1/R-Value) Proposed (BTU/H-FT^2-F)	Delta Temperature Existing (F)	Delta Temperature Proposed (F)	Energy Savings (BTU)	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
			1/Rexisting	1/Rproposed	72 F -Tbin	72 F -Tbin	(D*F-E*G)*B*C		1/Rexisting	1/Rproposed	72 F -Tbin	72 F -Tbin	(J*L-K*M)*B*I	H+N
-17.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
-12.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
-7.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
-2.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
2.5	83	0	0.667	0.222	-	-	-	5	0.667	0.222	69.5	69.5	12,819	12,819
7.5	83	6	0.667	0.222	64.5	64.5	14,276	14	0.667	0.222	64.5	64.5	33,311	47,587
12.5	83	19	0.667	0.222	59.5	59.5	41,703	31	0.667	0.222	59.5	59.5	68,042	109,744
17.5	83	33	0.667	0.222	54.5	54.5	66,345	89	0.667	0.222	54.5	54.5	178,930	245,274
22.5	83	86	0.667	0.222	49.5	49.5	157,036	137	0.667	0.222	49.5	49.5	250,162	407,198
27.5	83	116	0.667	0.222	44.5	44.5	190,420	206	0.667	0.222	44.5	44.5	338,160	528,581
32.5	83	362	0.667	0.222	39.5	39.5	527,474	426	0.667	0.222	39.5	39.5	620,729	1,148,204
37.5	83	416	0.667	0.222	34.5	34.5	529,429	493	0.667	0.222	34.5	34.5	627,425	1,156,854
42.5	83	332	0.667	0.222	29.5	29.5	361,290	297	0.667	0.222	29.5	29.5	323,202	684,492
47.5	83	232	0.667	0.222	24.5	24.5	209,676	330	0.667	0.222	24.5	24.5	298,247	507,923
52.5	83	378	0.667	0.222	19.5	19.5	271,908	383	0.667	0.222	19.5	19.5	275,505	547,413
57.5	83	262	0.667	0.222	14.5	14.5	140,141	290	0.667	0.222	14.5	14.5	155,118	295,259
62.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
67.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
72.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
77.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
82.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
87.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
92.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
97.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
102.5	83	0	0.667	0.222	-	-	-	0	0.667	0.222	-	-	-	-
TOTAL		2,242					2,509,699	2,701					3,181,648	5,691,347

ANNUAL ENERGY SAVINGS

= (Energy Savings * Energy Conversion Factor)/Seasonal Efficiency

= (5,691,347 BTU * Gal/138,690 BTU) / (75% EFF)= 55 Gal
= (5,691,347 BTU * (MBTU/ 1,000,000 BTU)) / (75% EFF)= 7.6 MBTU
= 55 Gal * (1.14 $/Gal)
= $ 62

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wildlife Refuge Bldg 101**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 120 - Install New Storm Doors

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	Exterior Storm Door	3	ea	$50.00	$150.00	$150.00	$450.00	$600.00	
	Subtotal					$150.00	$450.00	$600.00	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$600.00	
	Escalation 0%							$0.00	
	Subtotal							$600.00	
	Contingencies 0%							$0.00	
	Total							$600.00	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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* N I S T B L C C: COMPARATIVE ECONOMIC ANALYSIS (ver. 4.70-99) *
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Project: National Park Service
Base Case: 101-120
Alternative: 101-120B

Principal Study Parameters:

Analysis Type: Federal Analysis--Energy Conservation Projects
Study Period: 20.25 Years (SEP 2000 through NOV 2020)
Plan/Constr. Period: 0.25 Years (SEP 2000 through NOV 2000)
Service Period: 20.00 Years (DEC 2000 through NOV 2020)
Discount Rate: 3.1% Real (exclusive of general inflation)
Base Case LCC File: 101120.LCC
Alternative LCC File: 101120B.LCC

Comparison of Present-Value Costs

	Base Case: 101-120	Alternative: 101-120B	Savings from Alt.
Initial Investment item(s):			
Capital Requirements as of Serv. Date	$0	$595	-$595
Subtotal	$0	$595	-$595
Future Cost Items:			
Energy-related Costs	$2,002	$0	$2,002
Subtotal	$2,002	$0	$2,002
Total P.V. Life-Cycle Cost	$2,002	$595	$1,407

Net Savings from Alternative '101-120B' compared to Base Case '101-120'

Net Savings	=	P.V. of Non-Investment Savings	$2,002
	-	Increased Total Investment	$595
		Net savings:	$1,407

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and residual value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

Savings-to-Investment Ratio (SIR)
For Alternative '101-120B' compared to Base Case '101-120'

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 3.36$$

Adjusted Internal Rate of Return (AIRR)
For Alternative '101-120B' compared to Base Case '101-120'

(Reinvestment Rate = 3.10%; Study Period = 20 years)

AIRR = 9.46%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 5
Discounted Payback occurs in year 6

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	0.0	0.0	0.0	0.0
Distil. Oil	MBtu	13.2	0.0	13.2	264.0

NEW_YORK_CITY , NY
ECM Number: 125Bldg101 - Heating Infiltration
ECM Description: Add Door Weatherstripping

OCCUPIED	UNOCCUPIED	PARAMETER	
72	72	Ti	Heating Season Setpoint Temperature, F
46.3	43.2	To	Average Outdoor Temeprature, F
5	5	V	Average Wind Speed, MPH
2736	3072	H	Hours In Period, H
Existing	Proposed		
63	63	L	Crack Length (FT)
0.032	0.000	W	Crack Width (IN)
24.2	0.0	EA	Effective Air Leakage Area, IN^2
24.2		AI	Reduction of Effected Air Leakage Area, IN^2
2		S#	Number Of Stories (1-3)
2		SC	Sheilding Class (1-5)
0.0299		Cs	Stack Coefficient, $CFM^2/(IN^4\text{-}F)$ - From ASHRAE 97F25.22
0.0121		Cw	Wind Coefficient, $CFM^2/(IN^4\text{-}MPH^2)$ - From ASHRAE 97F25.22
75%		E	Seasonal Efficiency
Gal		FU	Fuel Unit
138,690		FCF	Fuel Conversion Factor, BTU/Fuel Unit
1.14		FC	Fuel Cost ($/Fuel Unit)

1) FLOW RATE REDUCTION, CFM = $AI*[Cs*(Ti-To) + Cw*V^2]^{0.5}$

OCCUPIED PERIOD

= 24.192 IN^2 * [0.0299 CFM^2/(IN^4-F) * (72 F - 46.3 F) + (0.0121 CFM^2/IN^4-MPH^4 * (5 MPH)^2]^0.5
= 25.05 CFM

UNOCCUPIED PERIOD

= 24.192 IN^2 * [0.0299 CFM^2/(IN^4-F) * (72 F - 43.2 F) + (0.0121 CFM^2/IN^4-MPH^4 * (5 MPH)^2]^0.5
= 26.10 CFM

2) ANNUAL INPUT ENERGY SAVINGS = [1.08 * FLOW RATE * (Ti - To) * H * FCF] / SEASONAL EFFICIENCY

OCCUPIED PERIOD

= [1.08 * 25 CFM * (72 F - 46.3 F) * 2736 Hrs * (MTBU /1,000,000 BTU) / 75% = 2.5 MBTU
= [1.08 * 25 CFM * (72 F - 46.3 F) * 2736 Hrs * (Gal/ 138,690 BTU)] / 75%
= 18 Gal

UNOCCUPIED PERIOD

= [1.08 * 26.1 CFM * (72 F - 43.2 F) * 3072 Hrs * (MBTU/1,000,000 BTU) / 75% = 3.3 MBTU
= [1.08 * 26.1 CFM * (72 F - 43.2 F) * 3072 Hrs * (Gal/ 138,690 BTU)] / 75%
= 24 Gal

TOTAL SAVINGS

= 5.9 MBTU
= 42 Gal

3) ANNUAL ENERGY COST SAVINGS:

= 42 Gal * (1.14 $/Gal)
= $ 48

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wildlife Refuge Bldg 101**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 125 Add Door Weatherstripping

Div.	Description	Qty.	Unit	2000 Bare Costs Material	Labor	Equipment	Total	Total	MEANS Ref.
	Adhesive Jamb Weatherstripping	65	LF	$0.95	$1.80	$0	$2.75	$179	
	(Compression Bulb Type)								
	Subtotal					$0.00	$2.75	$178.75	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$178.75	
	Escalation 0%							$0.00	
	Subtotal							$178.75	
	Contingencies 0%							$0.00	
	Total							$178.75	
	Roundoff							$180	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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* N I S T B L C C: COMPARATIVE ECONOMIC ANALYSIS (ver. 4.70-99) *
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Project: National Park Service
Base Case: WLR101-125
Alternative: WLR101-125B

Principal Study Parameters:

Analysis Type: Federal Analysis--Energy Conservation Projects
Study Period: 8.25 Years (SEP 2000 through NOV 2008)
Plan/Constr. Period: 0.25 Years (SEP 2000 through NOV 2000)
Service Period: 8.00 Years (DEC 2000 through NOV 2008)
Discount Rate: 3.1% Real (exclusive of general inflation)
Base Case LCC File: 101125.LCC
Alternative LCC File: 101125B.LCC

Comparison of Present-Value Costs

	Base Case: WLR101-125	Alternative: WLR101-125B	Savings from Alt.
Initial Investment item(s):			
Capital Requirements as of Serv. Date	$0	$179	-$179
Subtotal	$0	$179	-$179
Future Cost Items:			
Energy-related Costs	$403	$0	$403
Subtotal	$403	$0	$403
Total P.V. Life-Cycle Cost	$403	$179	$225

Net Savings from Alternative 'WLR101-125B' compared to Base Case 'WLR101-125'

Net Savings	=	P.V. of Non-Investment Savings	$403
	-	Increased Total Investment	$179
		Net savings:	$225

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and residual value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

Savings-to-Investment Ratio (SIR)
For Alternative 'WLR101-125B' compared to Base Case 'WLR101-125'

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 2.26$$

Adjusted Internal Rate of Return (AIRR)
For Alternative 'WLR101-125B' compared to Base Case 'WLR101-125'

(Reinvestment Rate = 3.10%; Study Period = 8 years)

AIRR = 13.79%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 4
Discounted Payback occurs in year 4

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	0.0	0.0	0.0	0.0
Distil. Oil	MBtu	5.9	0.0	5.9	47.2

BLDG NAME	Wildlife refuge
BLDG DESC	Building 101

INSIDE	OUTSIDE	PARAMETER
72	10	DESIGN TEMP, F
OCC	UNOCC	PARAMETER
72	72	SET POINT, F
68	68	BOILER SHUTOFF TEMP, F
1881	3927	ANNUAL HOURS, HRS
47	43.4	AVERAGE OUTSIDE TEMP, F
	Gal	FUEL UNITS
	138690	HTG FUEL CONV. FACT X/BTU)
	80%	% SEASONAL HTG EFF
	7 AM - 5 PM	OCCUPIED HOURLY SCHED
	MON - FRI	OCCUPIED DAILY SCHEDULE
	SEPT 15 - MAY 15	MONTHLY HEATING SCHEDULE

SUMMARY ZONE:	
39713	HEAT LOSS, BTUH
3467	OCCUPIED HEAT GAIN, BTUH
917	UNOCCUPIED HEAT GAIN, BTUH
641	BUILDING LOAD COEFFICEINT
66.6	OCCUPIED BAL PT TEMP, F
70.6	UNOCCUPIED BAL PT TEMP, F
23616086	OCC ANNUAL HEATING LOAD, BTU
61923292	UNOCC ANNUAL HEATING LOAD, BTU
85539378	TOTAL ANNUAL HEATING LOAD, BTU
771	HEATING FUEL CONSUMPTION, Gal

BLDG NAME	Wildlife refuge
BLDG DESC	Building 101

INSIDE	OUTSIDE	PARAMETER
72	10	DESIGN TEMP, F
OCC	UNOCC	PARAMETER
72	60	SET POINT, F
68	68	BOILER SHUTOFF TEMP, F
1881	3927	ANNUAL HOURS, HRS
47	43.4	AVERAGE OUTSIDE TEMP, F
	Gal	FUEL UNITS
	138690	HTG FUEL CONV. FACT X/BTU)
	80%	% SEASONAL HTG EFF
	7 AM - 5 PM	OCCUPIED HOURLY SCHED
	MON - FRI	OCCUPIED DAILY SCHEDULE
	SEPT 15 - MAY 15	MONTHLY HEATING SCHEDULE

SUMMARY ZONE:	
39713	HEAT LOSS, BTUH
3467	OCCUPIED HEAT GAIN, BTUH
917	UNOCCUPIED HEAT GAIN, BTUH
641	BUILDING LOAD COEFFICEINT
66.6	OCCUPIED BAL PT TEMP, F
58.6	UNOCCUPIED BAL PT TEMP, F
23616086	OCC ANNUAL HEATING LOAD, BTU
38183535	UNOCC ANNUAL HEATING LOAD, BTU
61799620	TOTAL ANNUAL HEATING LOAD, BTU
557	HEATING FUEL CONSUMPTION, Gal

HEAT LOSS WORKSHEET

Wildlife refuge
Building 101

72	(F) Design or Inside Average Setpoint Temperature					
10	(F) Outside Design Temperature					
COMPONENT	LABEL	DESCRIPTION	AREA (SF)	U-VALUE (BTU/HR*SF*F)	TEMP. DIFF. (DEG. F)	HEAT LOSS (BTU/HR)
EXTERIOR WALLS	TYPE1	N-1989 WALL	287	0.160	62	2847
	TYPE1	S-1989 WALL	310	0.160	62	3075
	TYPE1	E-1989 WALL	676	0.160	62	6706
	TYPE1	W-1989 WALL	669	0.160	62	6636
WINDOWS	TYPE1	N-SG,WD	23	0.080	62	114
	TYPE1	S-SG,WD	0	0.080	62	0
	TYPE1	E-SG,WD	42	0.080	62	208
	TYPE1	W-SG,WD	70	0.080	62	347
EXTERIOR DOORS						
	TYPE1	E-WOOD	42	0.660	62	1719
	TYPE1	S-WOOD	21	0.660	62	859
					SUBTOTAL:	22512

HEAT LOSS WORKSHEET

Wildlife refuge
Building 101

72	(F) Design or Inside Average Setpoint Temperature					
10	(F) Outside Design Temperature					
COMPONENT	LABEL	DESCRIPTION	AREA (SF)	U-VALUE (BTU/HR*SF*F)	TEMP. DIFF. (DEG. F)	HEAT LOSS (BTU/HR)
ROOF/CEILING	TYPE1	FLAT	1550	0.052	62	4997
PARTITION WALLS BETWEEN ZONES	TYPE1	GARAGE	200	0.09	40	720
FLOORS OVER CRAWL SPACES	TYPE1	FLAT	1550	0.2	27	8370
SLAB ON GRADE	* Q = PERIMETER		(LF)	COEFF. * (BTUH/LF*F)	TEMP. DIFF. (DEG. F)	=
	SLAB1		0	0.5	62	0
INFILTRATION	Q = 0.018 *		CFM *	AC/HR *	TEMP. DIFF. (DEG. F)	=
	0.018		13950	0.2	62	3114
VENTILATION	Q =		1.08	* CFM *	TEMP. DIFF. (DEG. F)	=
			1.08	0	62	0
					SUBTOTAL:	17201
					GRAND TOTAL:	39713

OCCUPIED HEAT GAIN WORKSHEET

Wildlife refuge
Building 101

GAIN TYPE	DESCRIPT.	ORIENTATION	AREA (SF)	WINTER SOLAR FACTOR (BTU/HR*SF)	WEIGHTING FACTOR	SHADING COEFF.	HEAT GAIN (BTU/HR)
SOLAR	TYPE1	N-CLEAR	23	5.88	0.64	0.7	61
	TYPE1	S-CLEAR	0	48.36	0.64	0.7	0
	TYPE1	E-CLEAR	42	23 65	0.64	0.7	445
	TYPE1	W-CLEAR	70	23.65	0.64	0.7	742
						SUBTOTAL:	1247

	DESCRIPT.	CONNECTED WATTS	BALLAST FACTOR	USAGE FACTOR	% HEAT TO SPACE	3.413 (BTUH/WATT)	HEAT GAIN (BTU/HR)
LIGHTING	FLOUR.	420	1	0.4	100	3.413	573
	INCAND.	840	1	0.4	100	3.413	1147
	OTHER					3.413	0
						SUBTOTAL:	1720

	TYPE OF WORK	HEAT GAIN RATE (BTUH/PERSON)	USAGE FACTOR	NUMBER OF PEOPLE	HEAT GAIN (BTU/HR)
PEOPLE	STUDENTS	0	0.85	90	0
	STAFF	200	0.5	5	500
				SUBTOTAL:	500

	MISC. GAINS	AREA	HEAT GAIN RATE (BTUH/SF)		USAGE FACTOR	HEAT GAIN (BTU/HR)
PROCESS						
					SUBTOTAL:	0

	DESCRIPTION	COEFF. (BTUH/LF*F)	PERIMETER (LF)	* TEMP. DIFF. (DEGREES F)	=	HEAT GAIN (BTU/HR)
GROUND LOSSES						
					SUBTOTAL:	0
					TOTAL:	3467

UNOCCUPIED HEAT GAIN WORKSHEET

Wildlife refuge
Building 101

GAIN TYPE	DESCRIPT.	ORIENTATION	AREA (SF)	WINTER SOLAR FACTOR (BTU/HR*SF)	WEIGHTING FACTOR	SHADING COEFF.	HEAT GAIN (BTU/HR)
SOLAR	TYPE1	N-CLEAR	23	5.88	0.36	0.7	34
	TYPE2	S-CLEAR	0	48.36	0.36	0.7	0
	TYPE3	E-CLEAR	42	23.65	0.36	0 7	250
	TYPE4	W-CLEAR	70	23.65	0.36	0.7	417
						SUBTOTAL:	702

	DESCRIPT.	CONNECTED WATTS		USAGE FACTOR	% HEAT TO SPACE	3.413 (BTUH/WATT)	HEAT GAIN (BTU/HR)
LIGHTING	FLOUR.	420		0.05	100	3.413	72
	INCAND.	840		0.05	100	3.413	143
	OTHER						
						SUBTOTAL:	215

	TYPE OF WORK	HEAT GAIN RATE (BTUH/PERSON)	USEAGE FACTOR	NUMBER OF PEOPLE	HEAT GAIN (BTU/HR)
PEOPLE					
				SUBTOTAL:	0

	MISC. GAINS	AREA	HEAT GAIN RATE (BTUH/SF)		USAGE FACTOR	HEAT GAIN (BTU/HR)
PROCESS						
					SUBTOTAL:	0

	DESCRIPTION	COEFF (BTUH/LF*F)	PERIMETER (LF)	* TEMP. DIFF. (DEGREES F)	=	HEAT GAIN (BTU/HR)
GROUND LOSSES						0
					SUBTOTAL:	0
					TOTAL:	917

BALANCE POINT TEMPERATURE CALCULATIONS

Wildlife refuge
Building 101

PARAMETERS	
39713	TOTAL HEAT LOSS (BTUH)
62	DESIGN TEMP DIFF (DEGREES F)
3467	OCCUPIED HEAT GAIN (BTUH)
917	UNOCCUPIED HEAT GAIN (BTUH)
72	OCCUPIED TEMP SET POINT (DEGREES F)
72	UNOCCUPIED TEMP SET POINT (DEGREES F)

1. BUILDING LOAD COEFFICIENT (BLC):

BUILDING LOAD COEFFICIENT = TOTAL HEAT LOSS/DESIGN TEMP. DIFF.

BLC = 39713 BTUH/ 62 F = 641 BTUH/F

2. BALANCE POINT TEMPERATURES:

BAL. PT. TEMP. = SET PT. TEMP - (HEAT GAIN/ BUILDING LOAD COEFFICIENT)

Occupied Balance Point Temperature = 72 F - (3467 BTUH / 641 BTUH/F) = 66.59 F
Unoccupied Balance Point Temperature = 72 F - (917 BTUH / 641 BTUH/F) = 70.57 F

ANNUAL HEATING LOAD AND ENERGY CALCULATIONS

PARAMTETERS			
OCCUPIED	UNITS	UNOCCUPIED	DATA DESCRIPTION
66.6	Degrees F	68.0	Balance Point Temperature
1881	HR	3927	Accumulated Bin Hours
47	Degrees F	43.4	Average Outside Air Temperature
641	BTUH/F	641	Building Load Coefficient

OCCUPIED SCHEDULES	
Hourly	7 AM - 5 PM
Daily	MON - FRI
Monthly	SEPT 15 - MAY 15

1. ANNUAL HEATING LOAD = Building Load Coefficient x (Balance Point Temperature - Average Temperature) x Accumulated hours

OCCUPIED ANNUAL HEATING LOAD:

= 641 BTUH/F * (66.6 F - 47 F) * 1881 HR 23,616,086 BTU

UNOCCUPIED ANNUAL HEATING LOAD:

= 641 BTUH/F * (68 F - 43.4 F) * 3927 HR 61,923,292 BTU

TOTAL 85,539,378 BTU

2. ANNUAL HEATING ENERGY

Gal	Heating Fuel Units
138690	Heating Fuel Conversion Factor (Btu/Unit)
80%	Seasonal Heating Efficiency (%)

ANNUAL HEATING ENERGY CONSUMPTION:

= Annual Heating Load / Seasonal Heating Efficiency

= 85539378 BTU / 80 % = 106,924,223 BTU input

ANNUAL HEATING FUEL CONSUMPTION:

= Annual Heating Energy Consumption / Fuel Heating Conversion Factor

= 106924223 BTU / (138690 BTU/ Gal) = 771 Gal

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Project Name: **National Park Service - Wildlife Refuge Bldg 101**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 233 Install Night Setback Thermostat

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	Boiler Water Temperature Controller	0	ea	$500.00	$3,320.00	$0.00	$0.00	$0.00	
	Night Thermostat	1	ea	$100.00	$100.00	$100.00	$100.00	$200.00	
	Subtotal					$100.00	$100.00	$200.00	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$200.00	
	Escalation 0%							$0.00	
	Subtotal							$200.00	
	Contingencies 0%							$0.00	
	Total							$200.00	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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*     N I S T  B L C C:  COMPARATIVE  ECONOMIC  ANALYSIS (ver. 4.70-99)     *
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Project: National Park Service
Base Case: WLR101-233
Alternative: WLR101-233B

Principal Study Parameters:

Analysis Type: Federal Analysis--Energy Conservation Projects
Study Period: 10.25 Years (SEP 2000 through NOV 2010)
Plan/Constr. Period: 0.25 Years (SEP 2000 through NOV 2000)
Service Period: 10.00 Years (DEC 2000 through NOV 2010)
Discount Rate: 3.1% Real (exclusive of general inflation)
Base Case LCC File: WLR233.LCC
Alternative LCC File: WLR233B.LCC

Comparison of Present-Value Costs

	Base Case: WLR101-233	Alternative: WLR101-233B	Savings from Alt.
Initial Investment item(s):			
Capital Requirements as of Serv. Date	$0	$198	-$198
Subtotal	$0	$198	-$198
Future Cost Items:			
Energy-related Costs	$2,470	$0	$2,470
Subtotal	$2,470	$0	$2,470
Total P.V. Life-Cycle Cost	$2,470	$198	$2,271

Net Savings from Alternative 'WLR101-233B' compared to Base Case 'WLR101-233'

Net Savings	=	P.V. of Non-Investment Savings	$2,470
	-	Increased Total Investment	$198
		Net savings:	$2,271

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and residual value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

Savings-to-Investment Ratio (SIR)
For Alternative 'WLR101-233B' compared to Base Case 'WLR101-233'

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 12.44$$

Adjusted Internal Rate of Return (AIRR)
For Alternative 'WLR101-233B' compared to Base Case 'WLR101-233'

(Reinvestment Rate = 3.10%; Study Period = 10 years)

AIRR = 31.85%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 1
Discounted Payback occurs in year 1

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	0.0	0.0	0.0	0.0
Distil. Oil	MBtu	29.7	0.0	29.7	297.0

FACILITY: Wildlife Refuge Bldg 101

ECM DESCRIPTION: Lamp/Ballast Replacement

PARMETERS		
75%	Percent	Heating System Efficiency
138,690	BTU/gal	Heating Fuel Type Conversion Factor
2.3	COP	Cooling COP
3,413	BTU/kWh	Cooling Fuel Type Conversion Factor

ECM FIXTURE DETAILS

			PRE-RETROFIT CONDITIONS					POST-RETROFIT CONDITIONS					LIGHTING KWH SAVINGS			KW SAVINGS		COST SAVINGS ($)					Non-Elec. Heating Fuel Svgs MBTU	Non-Elec. Clg Fuel Svgs MBTU
	ECM Number	Tariff	Fixt. Qnty	Fixture Description	Watts per Fixture	Installed Watts	Annual Operating Hours	Fixt. Qnty	Fixture Description	Watts per Fixture	Installed Watts	Annual Operating Hours	All Periods	Occuring In Heating Mode Only	Occuring In Cooling Mode Only	Installed Lighting	On-Peak	Demand	Lighting Energy	Heating (Penalty)	Cooling (Credit)	Total		
Ceiling lamp	301	EL2	2	1I60	60	120	2,600	2	1CF15	15	30	2,600	234	111	-	0.09	-	-	41	(4)	-	37	(0.5)	-
Hallway	301	EL2	3	1I60	60	180	2,600	3	1CF15	15	45	2,600	351	167	-	0.14	-	-	62	(6)	-	55	(0.8)	-
Office	301	EL2	3	1I60	60	180	2,600	3	1CF15	15	45	2,600	351	167	-	0.14	-	-	62	(6)	-	55	(0.8)	-
Office	301	EL2	2	1I60	60	120	2,600	2	1CF15	15	30	2,600	234	111	-	0.09	-	-	41	(4)	-	37	(0.5)	-
Office	301	EL2	2	1I60	60	120	2,600	2	1CF15	15	30	2,600	234	111	-	0.09	-	-	41	(4)	-	37	(0.5)	-
Office	301	EL2	2	1I60	60	120	2,600	2	1CF15	15	30	2,600	234	111	-	0.09	-	-	41	(4)	-	37	(0.5)	-
Floor Lamp	302	EL2	1	1Q500flr	500	500	500	1	2CF55FLR	110	110	500	195	91	-	0.39	-	-	34	(3)	-	31	(0.4)	-
Bathroom	304	EL2	1	1F20T12	24	24	1,200	1	1F18T8	20	20	1,200	5	3	-	0.00	-	-	1	(0)	-	1	(0.0)	-
Garage	304	EL2	2	2F34T12SM	82	164	1,200	2	2F32T8	60	120	1,200	53	-	-	0.04	-	-	9	-	-	9	-	-
Garage	304	EL2	2	2F20T12	46	92	1,200	2	2F18T8	39	78	1,200	17	-	-	0.01	-	-	3	-	-	3	-	-
Office	332	EL2	3	1CF15	15	45	2,600	3	1CF15	15	45	1,800	36	17	-	-	-	-	6	(1)	-	6	(0.1)	-
Office	332	EL2	2	1CF15	15	30	2,600	2	1CF15	15	30	1,800	24	11	-	-	-	-	4	(0)	-	4	(0.1)	-
Office	332	EL2	2	1CF15	15	30	2,600	2	1CF15	15	30	1,800	24	11	-	-	-	-	4	(0)	-	4	(0.1)	-
Office	332	EL2	2	1CF15	15	30	2,600	2	1CF15	15	30	1,800	24	11	-	-	-	-	4	(0)	-	4	(0.1)	-
Exterior	310	EL2	3	1I150	150	450	3,650	3	1HPS35	43	129	3,650	1,172	-	-	0.32	-	-	206	-	-	206	-	-

ECM SUBTOTALS

	KWH SAVINGS				KW SAVINGS		COST SAVINGS ($)					Non-Elec. *Heating* Fuel Svgs MBTU	Non-Elec. *Clg Fuel* Svgs MBTU
ECM Number	Lighting	Heating (Penalty)	Cooling (Credit)	Total	Installed Lighting	On-Peak	Demand	Lighting Energy	Heating (Penalty)	Cooling (Credit)	Total		
301	1,638	-	-	1,638	0.63	-	-	288	(29)	-	259	(3.5)	-
302	195	-	-	195	0.39	-	-	34	(3)	-	31	(0.4)	-
304	75	-	-	75	0.06	-	-	13	(0)	-	13	(0.0)	-
310	1,172	-	-	1,172	0.32	-	-	206	-	-	206	-	-
332	108	-	-	108	-	-	-	19	(2)	-	17	(0.2)	-
Grand Total	3,188	-	-	3,188	1.40	-	-	560	(34)	-	525	(4.2)	-

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Project Name: **National Park Service - Wild Life Refuge Visitors Center Bldg 101**
Project No.:
Calculated by:
Checked by:
Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 301 Replace Interior Incandescent Lights

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	5w CFL	0	ea	$3.30	$5.51	$0.00	$0.00	$0.00	
	7w CFL	0	ea	$3.30	$4.44	$0.00	$0.00	$0.00	
	9w CFL	0	ea	$3.30	$10.98	$0.00	$0.00	$0.00	
	11w CFL, Dimmable, 120V, E26/E27	0	ea	$3.30	$14.12	$0.00	$0.00	$0.00	
	15w CFL, Dimmable, 120V, E26,E27	14	ea	$3.30	$14.12	$46.20	$197.68	$243.88	
	18w CFL, Dimmable, 120V, E26,E27	0	ea	$3.30	$14.12	$0.00	$0.00	$0.00	
	24w CFL, Dimmable, 120V, E26,E27	0	ea	$3.30	$15.35	$0.00	$0.00	$0.00	
	24w CFL	0	ea	$3.30	$12.88	$0.00	$0.00	$0.00	
	25w CFL	0	ea	$3.30	$22.91	$0.00	$0.00	$0.00	
	30w CFL	0	ea	$3.30	$24.10	$0.00	$0.00	$0.00	
	5w Candelbra	0	ea	$1.00	$3.00	$0.00	$0.00	$0.00	
	Subtotal					$46.20	$197.68	$243.88	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$243.88	
	Escalation 0%							$0.00	
	Subtotal							$243.88	
	Contingencies 0%							$0.00	
	Total							$243.88	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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Project Name: **National Park Service - Wild Life Refuge Visitors Center Bldg 101**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 302 Replace Quartz Halogen - Interior

Div.	Description	Qty.	Unit	Unit Cost Labor	Unit Cost Material	Total Labor	Total Material	Total	Ref.
	Flourescent Floor Lamp	1	ea	$0.00	$40.00	$0.00	$40.00	$40.00	
	Subtotal					$0.00	$40.00	$40.00	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$40.00	
	Escalation 0%							$0.00	
	Subtotal							$40.00	
	Contingencies 0%							$0.00	
	Total							$40.00	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

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Project Name: National Park Service - Wild Life Refuge Visitors Center Bldg 101
Project No.:
Calculated by:
Checked by:
Sheet No: 1 of 1
Date: 16-May-99
Date:

Measure: 304 Replace Lamps and Ballasts - Interior

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	T-8 2 lamp ballasts 4' Metric	0	ea	$12.50	$20.77	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 4' Metric	0	ea	$11.50	$20.77	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 2' Metric	0	ea	$11.50	$27.00	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 2' Metric	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 3' Metric	0	ea	$11.50	$27.00	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 3' Metric	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 5' Metric	0	ea	$11.50	$27.00	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 5' Metric	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 8'	0	ea	$12.50	$39.17	$0.00	$0.00	$0.00	
	T-8 2 lamp ballasts 6'	0	ea	$12.50	$39.17	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 6'	0	ea	$12.50	$39.17	$0.00	$0.00	$0.00	
	F32 T-8 Lamps	4	ea	$1.50	$2.27	$6.00	$9.08	$15.08	
	F18 T-8 Lamps	3	ea	$1.50	$5.17	$4.50	$15.51	$20.01	
	F96 T-8 Lamps	0	ea	$1.50	$8.99	$0.00	$0.00	$0.00	
	F32 T-8 U Lamps	0	ea	$1.50	$12.51	$0.00	$0.00	$0.00	
	T-8 Socket Sets	0	ea		$2.00	$0.00	$0.00	$0.00	
	T-8 1 lamp ballasts 2' US Style	3	ea	$12.50	$30.00	$37.50	$90.00	$127.50	
	T-8 2 lamp ballasts 2' US Style	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 1 lamp electronic ballasts 4' US Style	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 2 lamp electronic ballasts 4' US Style	2	ea	$12.50	$30.00	$25.00	$60.00	$85.00	
	T-8 4 lamp electronic ballasts 4' US Style	0	ea	$12.50	$30.00	$0.00	$0.00	$0.00	
	T-8 2 lamp electronic ballasts 8' US Style	0	ea	$12.50	$40.00	$0.00	$0.00	$0.00	
	T-8 4 lamp electronic ballasts 8' US Style	0	ea	$12.50	$40.00	$0.00	$0.00	$0.00	
	T-8 3 lamp electronic ballasts 8' US Style	0	ea	$12.50	$40.00	$0.00	$0.00	$0.00	
	Subtotal					$73.00	$174.59	$247.59	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$247.59	
	Escalation 0%							$0.00	
	Subtotal							$247.59	
	Contingencies 0%							$0.00	
	Total							$247.59	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wild Life Refuge Visitors Center Bldg 101**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 310 Replace Incandescent Lighting - Exterior

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	35 watt high pressure sodium	1	ea	$80.00	$100.00	$80.00	$100.00	$180.00	
	Subtotal					$80.00	$100.00	$180.00	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$180.00	
	Escalation 0%							$0.00	
	Subtotal							$180.00	
	Contingencies 0%							$0.00	
	Total							$180.00	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

LANDSBERG
ENGINEERING, P.C.

Project Name: **National Park Service - Wild Life Refuge Visitors Center Bldg 101**
Project No.:
Calculated by:
Checked by:

Sheet No: 1 of 1
Date: 16-May-00
Date:

Measure: 332 Install Occupancy Sensor Lighting Control

Div.	Description	Qty.	Unit	Unit Labor	Cost Material	Total Labor	Total Material	Total	Ref.
	Watt Stopper Switch Sensors	4	ea	$10.00	$52.00	$40.00	$208.00	$248.00	
	Infrared Switch Sensors WI-200	0	ea		$63.68	$0.00	$0.00	$0.00	
	Ceiling Mounted Infrared Sensors CI-200	0	ea	$49.50	$55.88	$0.00	$0.00	$0.00	
	Power Packs	0	ea		$14.81	$0.00	$0.00	$0.00	
	Mounting Brackets	0	ea		$5.25	$0.00	$0.00	$0.00	
	Junction Box and Plate	0	ea		$5.75	$0.00	$0.00	$0.00	
	Low Voltage Wiring	0	ea		$3.45	$0.00	$0.00	$0.00	
	MyTech Ultra sonic sensors (Restroom)	0	ea	$49.50	$72.80	$0.00	$0.00	$0.00	
	Digital Time Switch	0	ea	$49.50	$34.01	$0.00	$0.00	$0.00	
	Ceiling Mounted Ultra sonic Sensors W-2000H	0	ea	$49.50	$62.43	$0.00	$0.00	$0.00	
	Ceiling Mounted Ultrasonic Sensors W-500A	0	ea	$49.50	$35.96	$0.00	$0.00	$0.00	
	Ceiling Mounted Ultrasonic Sensors W-2000A	0	ea	$49.50	$50.84	$0.00	$0.00	$0.00	
	Subtotal					$40.00	$208.00	$248.00	
	Contractor's OH & P 0%							$0.00	
	Subtotal							$248.00	
	Escalation 0%							$0.00	
	Subtotal							$248.00	
	Contingencies 0%							$0.00	
	Total							$248.00	

The costs noted above are estimates only and may be modified by changing conditions or the passage of time.

****
* N I S T B L C C: COMPARATIVE ECONOMIC ANALYSIS (ver. 4.70-99) *
****

Project: National Park Service
Base Case: WLR101-301
Alternative: WLR101-301B

Principal Study Parameters:

Analysis Type: Federal Analysis--Energy Conservation Projects
Study Period: 8.25 Years (SEP 2000 through NOV 2008)
Plan/Constr. Period: 0.25 Years (SEP 2000 through NOV 2000)
Service Period: 8.00 Years (DEC 2000 through NOV 2008)
Discount Rate: 3.1% Real (exclusive of general inflation)
Base Case LCC File: WLR301.LCC
Alternative LCC File: WLR301B.LCC

Comparison of Present-Value Costs

	Base Case: WLR101-301	Alternative: WLR101-301B	Savings from Alt.
Initial Investment item(s):			
Capital Requirements as of Serv. Date	$0	$243	-$243
Subtotal	$0	$243	-$243
Future Cost Items:			
Energy-related Costs	$1,900	$239	$1,662
Subtotal	$1,900	$239	$1,662
Total P.V. Life-Cycle Cost	$1,900	$482	$1,419

Net Savings from Alternative 'WLR101-301B' compared to Base Case 'WLR101-301'

Net Savings =	P.V. of Non-Investment Savings	$1,662
-	Increased Total Investment	$243
	Net savings:	$1,419

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and residual value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

Savings-to-Investment Ratio (SIR)
For Alternative 'WLR101-301B' compared to Base Case 'WLR101-301'

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 6.83$$

Adjusted Internal Rate of Return (AIRR)

For Alternative 'WLR101-301B' compared to Base Case 'WLR101-301'
(Reinvestment Rate = 3.10%; Study Period = 8 years)

AIRR = 30.15%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 1
Discounted Payback occurs in year 1

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	1,638.0	0.0	1,638.0	13,104.0
Distil. Oil	MBtu	0.0	3.5	-3.5	-28.0

EMISSIONS REDUCTION SUMMARY

Energy type	Average Annual Emissions			Life-Cycle Reduction
	Base Case	Alternative	Reduction	
Electricity:				
CO2 (Kg):	1,587.8	0.0	1,587.8	12,702.5
SO2 (Kg):	5.5	0.0	5.5	43.6
NOx (Kg):	4.8	0.0	4.8	38.3
Distil. Oil:				
CO2 (Kg):	0.0	254.0	-254.0	-2,031.8
SO2 (Kg):	0.0	0.4	-0.4	-3.1
NOx (Kg):	0.0	0.2	-0.2	-1.8
Total:				
CO2 (Kg):	1,587.8	254.0	1,333.8	10,670.7
SO2 (Kg):	5.5	0.4	5.1	40.6
NOx (Kg):	4.8	0.2	4.6	36.5

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*     N I S T  B L C C:  COMPARATIVE  ECONOMIC  ANALYSIS (ver. 4.70-99)      *
**********************************************************************

          Project: National Park Service
          Base Case: WLR101-302
          Alternative: WLR101-302B

          Principal Study Parameters:
          ---------------------------
          Analysis Type: Federal Analysis--Energy Conservation Projects
          Study Period:          20.25 Years (SEP 2000 through NOV 2020)
          Plan/Constr. Period:    0.25 Years (SEP 2000 through NOV 2000)
          Service Period:        20.00 Years (DEC 2000 through NOV 2020)
          Discount Rate:   3.1% Real (exclusive of general inflation)
          Base Case LCC File:    WLR302.LCC
          Alternative LCC File: WLR302B.LCC

                    Comparison of Present-Value Costs

                                      Base Case:    Alternative:    Savings
                                      WLR101-302    WLR101-302B    from Alt.
Initial Investment item(s):           ----------    -----------    ----------
 Capital Requirements as of Serv. Date       $0            $40         -$40
                                      ---------     ---------     ---------
     Subtotal                                $0            $40         -$40
Future Cost Items:
 Energy-related Costs                      $453            $55         $399
                                      ---------     ---------     ---------
     Subtotal                              $453            $55         $399
                                      ---------     ---------     ---------
   Total P.V. Life-Cycle Cost              $453            $95         $359


  Net Savings from Alternative 'WLR101-302B' compared to Base Case 'WLR101-302'


          Net Savings  =  P.V. of Non-Investment Savings          $399
                       -  Increased Total Investment               $40
                                                              ----------
                                                 Net savings:     $359


    Note: the SIR and AIRR computations include differential initial costs,
    capital replacement costs, and residual value (if any) as investment costs,
    per NIST Handbook 135 (Federal and MILCON analyses only).


                    Savings-to-Investment Ratio (SIR)
          For Alternative 'WLR101-302B' compared to Base Case 'WLR101-302'


                          P.V. of non-investment savings
                SIR  =  ------------------------------  =  10.04
                           Increased total investment


                    Adjusted Internal Rate of Return (AIRR)
```

For Alternative 'WLR101-302B' compared to Base Case 'WLR101-302'
(Reinvestment Rate = 3.10%; Study Period = 20 years)

AIRR = 15.54%

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 2
Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	195.0	0.0	195.0	3,900.0
Distil. Oil	MBtu	0.0	0.4	-0.4	-8.0

EMISSIONS REDUCTION SUMMARY

Energy type	Average Annual Emissions			Life-Cycle Reduction
	Base Case	Alternative	Reduction	
Electricity:				
CO2 (Kg):	189.0	0.0	189.0	3,780.5
SO2 (Kg):	0.6	0.0	0.6	12.1
NOx (Kg):	0.6	0.0	0.6	11.4
Distil. Oil:				
CO2 (Kg):	0.0	29.0	-29.0	-580.5
SO2 (Kg):	0.0	0.0	-0.0	-0.9
NOx (Kg):	0.0	0.0	-0.0	-0.5
Total:				
CO2 (Kg):	189.0	29.0	160.0	3,200.0
SO2 (Kg):	0.6	0.0	0.6	11.2
NOx (Kg):	0.6	0.0	0.5	10.9

****
* N I S T B L C C: COMPARATIVE ECONOMIC ANALYSIS (ver. 4.70-99) *
****

Project: National Park Service
Base Case: WLR101-310
Alternative: WLR101-310B

Principal Study Parameters:

Analysis Type: Federal Analysis--Energy Conservation Projects
Study Period: 5.25 Years (SEP 2000 through NOV 2005)
Plan/Constr. Period: 0.25 Years (SEP 2000 through NOV 2000)
Service Period: 5.00 Years (DEC 2000 through NOV 2005)
Discount Rate: 3.1% Real (exclusive of general inflation)
Base Case LCC File: WLR310.LCC
Alternative LCC File: WLR310B.LCC

Comparison of Present-Value Costs

	Base Case: WLR101-310	Alternative: WLR101-310B	Savings from Alt.
Initial Investment item(s):			
Capital Requirements as of Serv. Date	$0	$179	-$179
Subtotal	$0	$179	-$179
Future Cost Items:			
Energy-related Costs	$896	$0	$896
Subtotal	$896	$0	$896
Total P.V. Life-Cycle Cost	$896	$179	$718

Net Savings from Alternative 'WLR101-310B' compared to Base Case 'WLR101-310'

Net Savings	=	P.V. of Non-Investment Savings	$896
	-	Increased Total Investment	$179
		Net savings:	$718

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and residual value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

Savings-to-Investment Ratio (SIR)
For Alternative 'WLR101-310B' compared to Base Case 'WLR101-310'

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 5.02$$

Adjusted Internal Rate of Return (AIRR)

For Alternative 'WLR101-310B' compared to Base Case 'WLR101-310'
(Reinvestment Rate = 3.10%; Study Period = 5 years)

AIRR = 40.18%

Estimated Years to Payback (from beginning of Service Period)

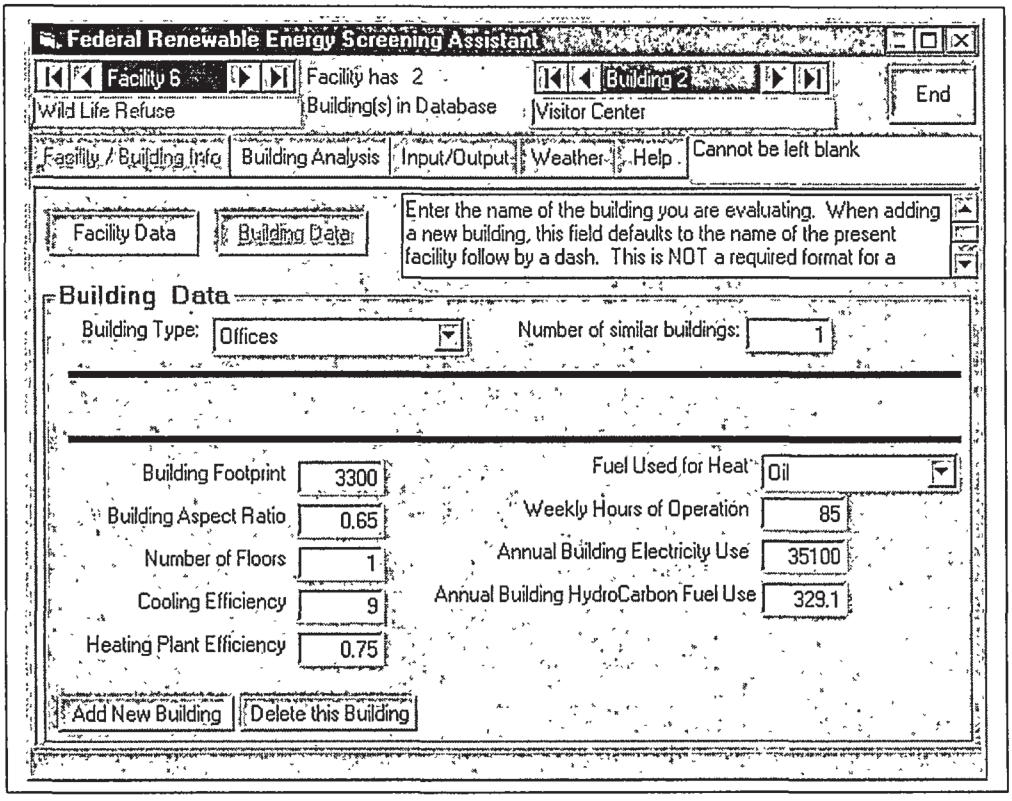
Simple Payback occurs in year 1
Discounted Payback occurs in year 1

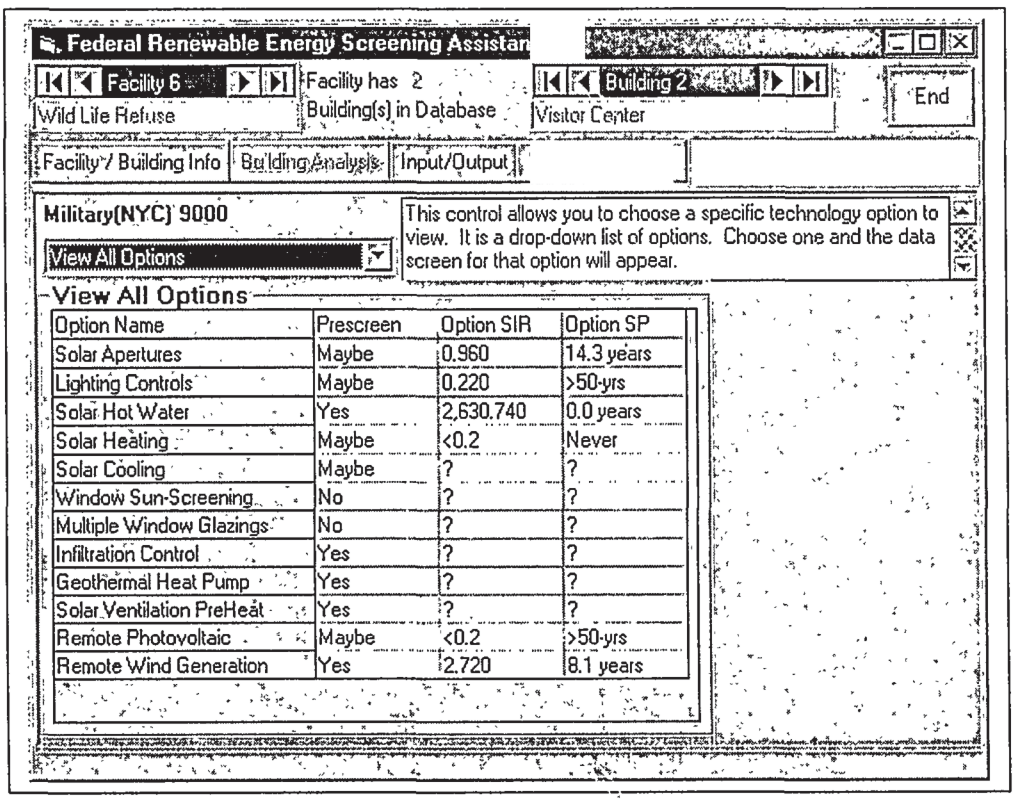
ENERGY SAVINGS SUMMARY

Energy type	Units	Average Annual Consumption			Life-Cycle Savings
		Base Case	Alternative	Savings	
Electricity	kWh	1,172.0	0.0	1,172.0	5,860.0
Distil. Oil	MBtu	0.0	0.0	0.0	0.0

APPENDIX C: SCREENING TOOLS Input/Output

FRESA v2.5: WILDLIFE REFUGE, VISITORS CENTER





Option Name	Prescreen	Option SIR	Option SP
Solar Apertures	Maybe	0.960	14.3 years
Lighting Controls	Maybe	0.220	>50-yrs
Solar Hot Water	Yes	2,630.740	0.0 years
Solar Heating	Maybe	<0.2	Never
Solar Cooling	Maybe	?	?
Window Sun-Screening	No	?	?
Multiple Window Glazings	No	?	?
Infiltration Control	Yes	?	?
Geothermal Heat Pump	Yes	?	?
Solar Ventilation PreHeat	Yes	?	?
Remote Photovoltaic	Maybe	<0.2	>50-yrs
Remote Wind Generation	Yes	2.720	8.1 years

FRESA v2.5: WILDLIFE REFUGE, BLDG 101, DISTRIC OFFICE

