Sustainable Construction in Indian Country

Energy Efficiency Evaluation and Recommendations

14380 S. Farm Road Multifamily Housing

November 27, 2012

Cocopah Indian Housing and Development
Somerton, AZ

U.S. Department of Housing and Urban Development | Office of Policy Development and Research

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Introduction

The Cocopah Indian Tribe, in southwestern Arizona, is committed to providing its members with safe, affordable, healthy, and energy efficient housing. This vision should encourage members living on the Reservation to remain and encourage members' now living off-Reservation to return.[1] As part of this vision, the Cocopah Indian Housing and Development (CIHAD) decided to explore various options to retrofit an existing 2 story 8 unit garden apartment building with more energy efficient sustainable features.

The Cocopah Reservation is located in a low-lying desert with an extremely hot-dry climate. Geographical location and weather directly influences energy consumption and costs in buildings. For the Cocopah Tribe, the largest category for energy consumption and cost is space cooling. Utilities costs are the second largest costs for households after mortgages and rents. Any retrofitting to make homes more energy efficient and affordable creates a win situation for the Tribe and household occupants.

This assessment provides information on the most economically feasible upgrade options for this garden apartment building. This assessment provides information and strategies on how to reduce the annual operation costs through load reductions, energy efficiency improvements, and renewable energy resources. It presents an energy assessment analysis on the Building's design and load consumption before and after the installation of energy efficient sustainable features. The comparison provides information for determining which of the energy efficiency strategies would likely result in the most effective savings on energy consumption and cost and makes recommendations for upgrades based on project payback periods.

CIHAD participated as a demonstration project under HUD's Sustainable Construction in Indian Country initiative (SCinIC). SCinIC, under the HUD Office of Policy Development and Research, promotes the enhanced use of sustainable materials and technologies in Native American housing communities through technical assistance, training, and promotional materials.

[1] Cocopah Indian Housing and Development Web Page: www.ontherez.org

Cocopah Tribe Location and Climate

The Cocopah Reservation is located in southwestern Arizona, near the Town of Somerton in southern Yuma County approximately 13 miles south of Yuma, 15 miles north of San Luis, Mexico and 180 miles east of San Diego. The Reservation's unique geographical location borders the United States, Mexico, Arizona and California. The Reservation consists of 6,565 acres in three sections: North, West and East.

The region is one of low-lying desert with the Colorado River bordering North Cocopah. The reservation is less than 300 feet above sea level, the area has an extremely hot, dry climate typical of the Sonoran Desert. The year round temperature averages 74 degrees with summertime highs frequently exceeding 110 degrees. Winter lows seldom go below 40 degrees. The area averages slightly less than three inches of precipitation per year. [2]

The geographical location of a community is very much impacted by its sources of energy, consumption patterns, and costs. This is because weather directly influences energy consumption and costs in homes and buildings.

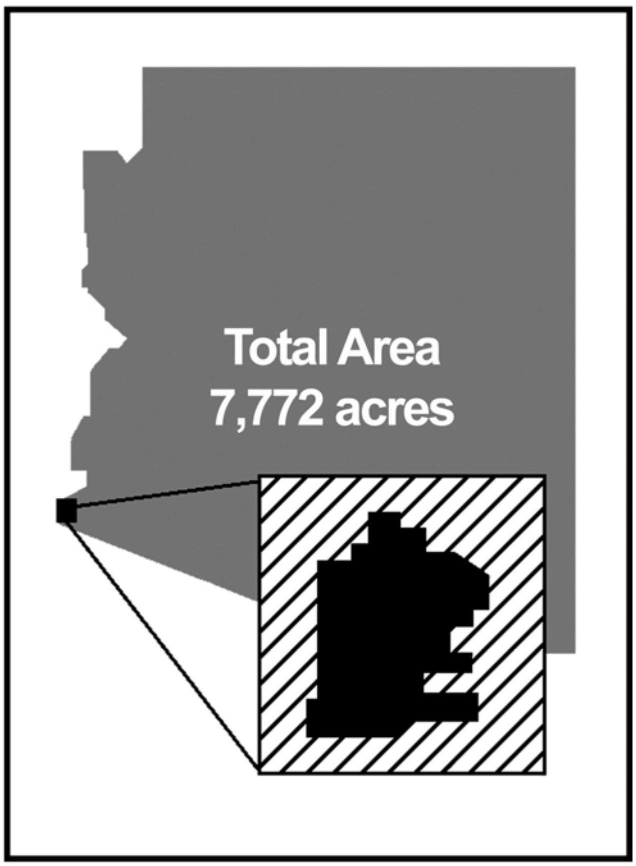

Figure 1: Map of the Cocopah Tribal Lands

[2] Tiller's Guide to Indian Country: Economic Profiles of American Indian Reservations; Cocopah Tribe, pgs. 293-294.

Figures 2 & 3: Traditional Cocopah Home

1. Site and Building Description

Constructed in 2003, the site has three eight-unit buildings and a community building, figure 4. The buildings are arranged on the site in the shape of a rectangle with a building at each corner. Two of the apartment buildings face south (including building B), and the other housing building and community center are oriented to the north with parking located in the center of the rectangle. Each of the 24 units is approximately 855 to 1,107 square feet, making each building approximately 8,532 square feet. Each of the two-bedroom units has a full bathroom, living room, dining room and kitchen. The three-bedroom units have two full bathrooms, living room, dining area, kitchen, and storage room. The laundry facilities are in the shared community building on site. For the focus of this energy assessment, building B energy consumption and costs will be examined.

Figure 4: Cocopah Site Image

1.1 Building Envelope

Figure 5: Building B

Walls: The typical wall construction from the inside to outside is 5/8" gypsum board, 2x6 wood stud construction at 16" on center with R-19 fiberglass batt insulation, 60 MIL building paper, and 7/16" oriented strand board sheathing with stucco and mesh. It is estimated that the wall assembly has a thermal resistance rating (R-value) of R-22.

Roof: The roof is gabled with a 4:12 slope. It is constructed with 2x6 pre-engineered wood trusses at 24" on center, covered in 7/16" oriented strand board, #15 felt, and 240# fiberglass shingles. There is R-32 blown insulation above the ceiling.

Floor: The main floor is a 5" reinforced concrete slab on 2" of clean sand. The second floor is 2x10 wood floor joists at 16" on center with ¾" gypsum concrete subfloor and ¾" tongue and groove CDX plywood. The bedrooms, hall, dining room, and living room are carpeted. The kitchen, storage, and bathrooms are vinyl composite tile.

Windows: All windows are operable and have clear double pane glazing.

1.2 HVAC

The plan of the building places all HVAC equipment in a closet central to each unit.

Heating/Cooling: The units have Amana split system heat pumps that are 3 to 3.5 ton (1000 to 1200 cubic feet per minute or CFM) depending on unit size. According to plan there is an ambient temperature 115 °F cooling, 40 °F heating and minimum SEER of 12.0.

Ventilation: Ventilation air will be provided by infiltration and operable windows. Each bathroom also has an exhaust fan rated at 100 CFM.

1.3 Domestic Hot Water

The units have 40 gallon electric water heaters (Whirlpool E1F40RD045V) with an energy factor (EF)[3] of 0.92.

1.4 Lighting

When day-lighting from the windows is insufficient, lighting in the building is provided by incandescent light fixtures throughout each unit. Table 1 indicates fixture locations, wattage, estimated operating hours, and kilowatt-hour (kWh) usage. It was assumed that 60 watt (60W) incandescent lamps were used in each fixture throughout each unit of the building.

Table 1: Existing Building Incandescent Lighting Information

Location	Fixture Type	Watts	Operating Hours	kWh Usage
(4) 2 Bedrooms	2-lamp 60W	960	365	350
(4) 3 Bedrooms	2-lamp 60W	1,440	365	526
(8) Kitchen	1-lamp 60W	480	365	175
(8) Living room	1-lamp 60W	480	365	175
(4) 1 Bathroom	3-lamp 60W	720	730	526
(4) 2 Bathrooms	3-lamp 60W	1,440	730	1,051
(8) Hall	1-lamp 60W	480	2,190	1,051
Totals per Building:		**6,000**	**5,110**	**3,854**
3,854 kWh * 13 cents = $501.02				

Table 2 indicates the estimated savings from replacing all of the 60W incandescent lamps with 13W compact fluorescent lamps (CFLs).

Table 2: Upgrading Lighting to CFLs

Location	Fixture Type	Watts	Operating Hours	kWh Usage
(4) 2 Bedrooms	2-lamp 13W	224	365	82
(4) 3 Bedrooms	2-lamp 13W	336	365	123
(8) Kitchen	1-lamp 13W	120	365	44
(8) Living room	1-lamp 13W	120	365	44
(4) 1 Bathroom	3-lamp 13W	180	730	131
(4) 2 Bathrooms	3-lamp 13W	360	730	263
(8) Hall	1-lamp 13W	120	2,190	263
Totals per Building:		**1,460**	**5,110**	**949**
949 kWh * 13 cents = $123.37		**$377.65 savings** over 60W incandescent		

1.5 Additional Plug Loads

Additional plug loads in the building include typical residential appliances such as task lighting, TVs, and standard kitchen equipment (refrigerators, stove, and microwaves).

[3] EF is the energy efficiency of water heater and accounts for energy loss of heating and storing the water.

2. Energy Analysis Approach

The approach used to develop this report involved several steps. First, initial information was collected from the CIHAD about building B's design, occupancy data, energy consumption, and energy costs. This included the following:

- Building plans
- Utility consumption data for the last 12 months
- Geographical location and climate data
- Details about unit occupancy, mechanical equipment, HVAC systems, and lighting fixtures from interviews with CIHAD staff during a site visit

Utility consumption was then compared with annual heating and cooling degree day data to determine any correlation between energy usage and climate conditions; the results were examined for anomalies. Data, observations, and photos were recorded during a site visit conducted from April 2-4, 2012.

A baseline energy model was constructed in computer modeling software that performs building energy simulations. The HVAC load design and analysis software e-QUEST version 3.64 was used to model the building. This modeled data is calibrated to match the actual building energy usage as shown by the utility bills and then used as a baseline for evaluating the energy cost reduction measures (ECRMs). The program calculates the amount of energy (and the resulting utility cost of that energy) the building is expected to use over an entire typical weather year. Model inputs are taken from information collected during the site visit and information provided by the tribe. The weather file for e-QUEST was taken from the Yuma, Arizona, weather station. Assumptions made for the e-Quest model include:

- The building type and daily operation schedules are significant factors in energy consumption and costs. The type of occupants and income levels are also a significant factor in energy usage. Senior and disabled residents tend to occupy homes for longer periods and family developments generally have more occupants. It is assumed that 40 people will be living in each building (two people per bedroom). While occupancy is highly dependent on the individual lifestyles of the families it is assumed that half of the household will spend most of their time at home. Therefore it is assumed that the families will primarily be in the units 75 percent of the time during the week (approximately 126 hours/week).

- Air changes per hour (ACH) of 0.5.

- Non-ENERGY STAR appliances.

- Lighting power density of approximately 0.76 W/ft^2 for the building.

A computer analysis of the ECRMs was performed. The baseline model is changed to reflect the implementation of theses ECRMs and the computer model generates the expected energy consumption and utility costs. When necessary, some ECRMs are evaluated outside of the modeling software using spreadsheet calculations.

Finally, the estimated savings and additional costs of implementing ECRMs are evaluated in a life cycle cost analysis. This analysis assumes a 20-year life cycle and calculates the internal rate of return (IRR) and the net present value (NPV) of each ECRM and a package of ECRMs. IRR is essentially the annual yield on an equivalent investment. A project is a good investment if its IRR is greater than the rate of return that could be earned by an alternative investment (other projects, bonds, bank accounts, etc.). For this project, 5 percent is assumed as the minimum acceptable rate of return. The NPV calculation uses a discount rate to find the present value of savings occurring at a future date. The discount rate is your minimum acceptable rate of return, or your time value of money. Again, 5 percent is assumed. Investments have a positive NPV when the IRR is greater than the discount rate. Therefore projects with IRR greater than the discount rate and a positive NPV are considered to be good investments and are recommended.

3. Energy Consumption and Analysis

3.1 Utility Consumption Benchmarking

Utility data was provided for the eight units of building B for the 2011 calendar year. The Cocopah Tribe receives their electricity through Arizona Public Service (APS) Electric and it is delivered at an estimated rate of $0.13 per kWh. This rate includes meter fees and taxes. The estimated annual energy use intensity (EUI) of the building is 43 kBtu/ft^2/yr. The estimated annual energy cost intensity (ECI) is $1.67 /ft^2. These two values can be used to benchmark the energy performance of the current building against similar buildings. The charts below show the difference that changing from incandescent lamps to CFLs can make. The EUI drops to 41 kBtu/ft^2/yr and the ECI becomes $1.58/ft^2/yr. This results in a $506 savings from a simple and inexpensive energy upgrade.

Utility Consumption Analysis Building B

Average Annual Consumption			Annual Costs		Average Unit Cost	
Electricity	70,509	kWh	$9,295	100%	0.13	$/kWh
Natural Gas		therms				$/therm
		Total:	**$9,295**			
Total Conditioned Area	5,574	ft^2				
Electricity Use Intensity	13	kWh/ft^2/yr	**Natural Gas Use Intensity**			Therms/ft^2/yr
Energy Use Intensity	**43**	**kBtu/ft^2/yr**	**Energy Cost Intensity**		**$1.67**	**$/ft^2/yr**
Electricity is provided by APS Electric						

Utility Consumption Analysis Building B after CFL Upgrade

Average Annual Consumption			Annual Costs		Average Unit Cost	
Electricity	67,604	kWh	$8,789	100%	0.13	$/kWh
Natural Gas		therms				$/therm
		Total:	**$8,789**			
Total Conditioned Area	5,574	ft^2				
Electricity Use Intensity	12	kWh/ft^2/yr	**Natural Gas Use Intensity**			Therms/ft^2/yr
Energy Use Intensity	**41**	**kBtu/ft^2/yr**	**Energy Cost Intensity**		**$1.58**	**$/ft^2/yr**

3.2 Energy Consumption Profiles

The SCinIC team analyzed one year of electric data provided by the housing authority. The utility data covers the months from January 2011 through December 2011. The building was then modeled using the closest weather station, Yuma, Arizona, which recorded 1,182 heating degree days and 4,848 cooling degree days.[4] Degree days are indicative of the duration and intensity of the heating and cooling seasons and are used in this analysis to track how electricity usage corresponds to seasonal weather changes.

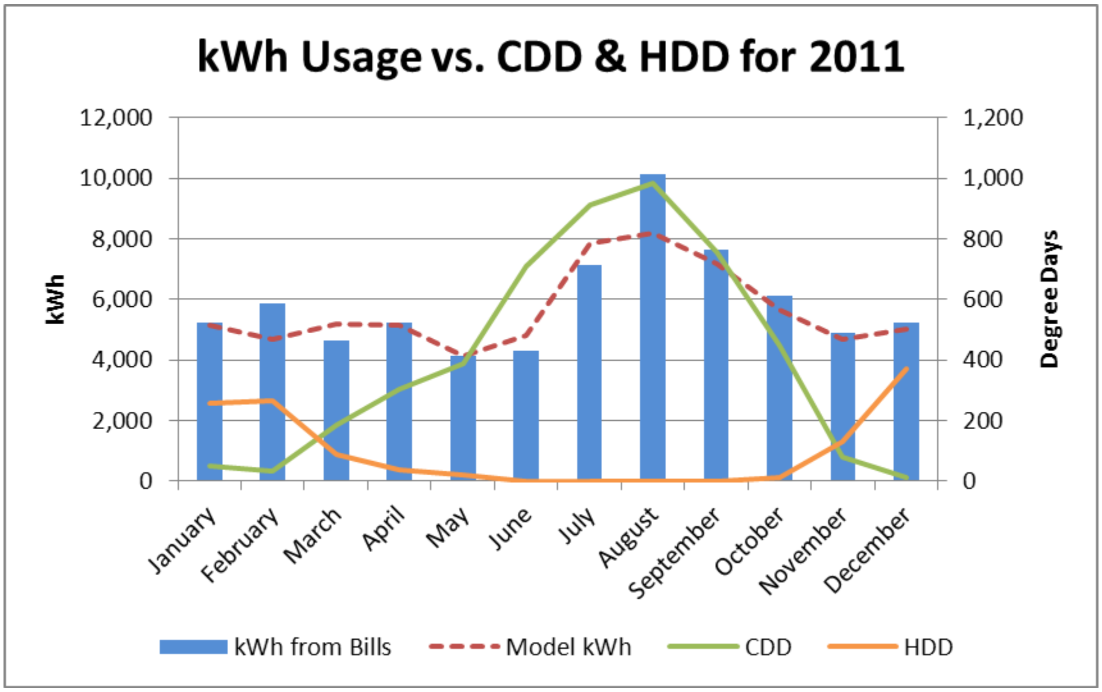

Figure 6. Electricity Consumption vs. Cooling Degree Days & Heating Degree Days

Figure 6 compares the Cocopah Building B electricity usage with cooling degree days, heating degree days, and the modeled electricity usage. Electricity is used for lighting, heating, cooling, domestic hot water, plug loads, fans, and pumps. The base electrical load for the building is just over 4,000 kWh per month. The building uses this amount of electricity regardless of weather. The graph shows that additional electricity use does correspond with the cooling degree days and heating degree days. The modeled electricity use comes within 4 percent of the metered annual electricity use.

[4] Heating and cooling degree day data was obtained from: http://www.degreedays.net/

3.3 Breakdown of Annual Energy Consumption and Costs

Using the modeled energy data, an energy consumption profile was created for the Cocopah Building B. Figure 7 shows the energy consumption and cost breakdown for the building. The largest category of energy usage is space cooling (32 percent) costing $2,852. The second largest is interior lighting (29 percent) costing $1,885, and then miscellaneous plug loads (20 percent) costing $1,645.

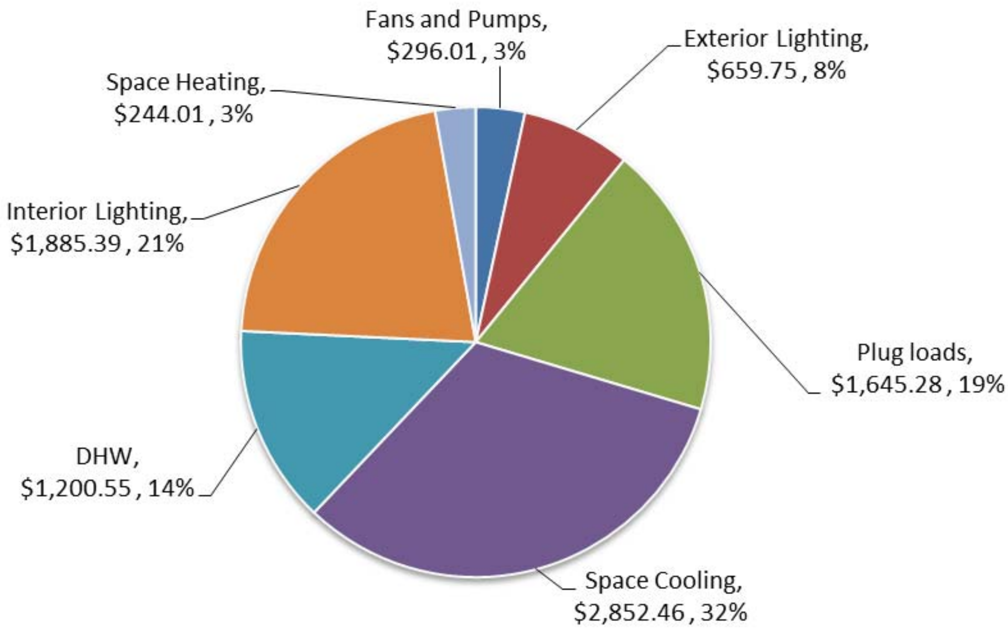

Figure 7. Annual Energy Consumption & Cost Breakdown

4. Energy Cost Reduction Measures

Energy conservation is best achieved through a multifaceted approach that involves load reduction, efficiency improvements, and renewable generation. Addressing any one of these pathways will save energy.

Load reduction, whether no cost or low cost, should be the first step. Load reduction involves managing energy consumption by simply turning things off when not needed or implementing control systems to help manage unnecessary energy use. Examples of load reduction include using nighttime thermostat setbacks or turning off lights in well-lit areas on sunny days to reduce lighting loads. Envelope upgrades such as adding insulation or window shades can result in load reduction but usually require large capital expenditures.

Energy efficiency improvements should be considered next. While typically more expensive than load reduction, energy efficiency improvements are more cost effective than implementing renewable energy generation. Efficiency improvements involve replacing old or failing systems with modern technologies which perform the same function while consuming less energy. Examples of energy efficiency improvements include installing boilers with greater heating efficiencies, installing lighting with increased luminous efficacy, and installing energy efficient appliances such as ENERGY STAR refrigerators.

The final step is energy generation. This step offsets a portion of the remaining energy consumption with onsite energy generation. Onsite energy generation is purposefully recommended after load reduction and efficiency improvements. Accomplishing the first two steps makes it possible to install lower capacity, therefore less expensive, generation systems.

This section addresses all three approaches.

4.1 ECRM 1: Lighting Upgrade

Lighting is currently provided by incandescent light fixtures throughout the building. A 60W incandescent lamp in each fixture calculates to a lighting power density of 0.76 W/ft^2. By replacing the 60W incandescent lamps with 13W CFLs, 2,171 kWh may be saved annually, resulting in an annual cost savings of $282. The lifespan of lighting is calculated at 5 years. The replacement of the incandescent lamps with CFLs will pay back in just over a year, therefore implementation of this measure is highly recommended.

Table 3: Lighting Upgrade Energy Savings

ECRM 1: CFL Lighting Upgrade						
Annual Savings			Economic Analysis			
kWh	Cost	% Energy	Investment	IRR[5]	NPV[6]	Simple Payback (years)
2,171	$282	3%	$395	66%	$788	1.40

[5] Internal Rate of Return: Rate of return on investment for project

[6] Net Present Value: Shows project earns this amount more or less than the desired rate of return (5 percent)

4.2 ECRM 2: Old Refrigerator Replacement

Refrigerators consume the most energy of all household appliances due to the 24 hour a day/ 7 day a week operational schedule. With recent improvements in insulation and compressor technology, new refrigerators use much less energy than older models. ENERGY STAR qualified refrigerators are in fact required by the U.S. Department of Energy to use 20 percent less energy than models not labeled with the ENERGY STAR logo. The refrigerator currently in use in each of the eight units of the building is a 1995 GE CTX18CAX which costs $112 annually to run. An equivalent new ENERGY STAR model would only cost $51 annually to run. Table 4 shows the savings for upgrading to ENERGY STAR refrigerators in Building B. Refrigerator replacement is a highly recommended measure.

Table 4: Energy Star Refrigerator Replacement

ECRM 3: Refrigerator Upgrade						
Annual Energy Savings			Economic Analysis			
kWh	Cost	% Energy	Investment	IRR	NPV	Simple Payback (years)
3,754	$488	6%	$3,200	9%	$541	6.56

4.3 ECRM 3: Exterior Window Shade Upgrade

Preventing the sun from heating a space may be best accomplished by adding shading devices to the exterior on the south of the building. Using interior window shades is helpful but allows the heat to enter through the window while exterior shades prevent some of the solar radiation from reaching the window and therefore entering the building.

The windows on the south side of the building currently have no exterior shading device other than the 2' overhang for the windows on the second floor. By adding 4' louvered shades (as seen in figures 8 & 9) above the windows on the south side of the building, 1,860 kWh may be saved annually resulting in an annual cost savings of $242.

Figure 8: Building B with 4' Louvered Window Shades

Figure 9: Building B with 4' Louvered Window Shades

If 8’ decks (as seen in figures 10 & 11) were added for the second floor that shaded the 1st floor windows, 2,240 kWh could be saved annually resulting in an annual cost savings of $291.

Figure 10: Building B with 8' Decks for Window Shades

Figure 11: Building B with 8' Decks for Window Shades

The lifespan of the shading is calculated at 20 years. The additional 4’ shading will pay back in far less time than the 6’ decks which will pay back in just over the 20 year lifespan. Implementation of this measure using exterior window shades is highly recommended.

Table 5: Exterior Window Shade Upgrade Energy Savings

ECRM 4: Exterior Window Shade Upgrade							
Options	Annual Savings			Economic Analysis			
	kWh	Cost	% Energy	Investment	IRR	NPV	Simple Payback (years)
4’ Window Shades	1,860	$242	3%	$2,000	10%	$965	8.27
Decks/Window Shades	2,240	$291	3%	$6,000	0%	-$2,258	20.60

4.4 ECRM 4: Triple Pane Low-E Window Upgrade

The current windows of the building are typical double pane windows with clear glazing. By replacing them with triple pane window that have low emissivity, 2,100 kWh may be saved annually resulting in an annual cost savings of $273. The lifespan of windows is calculated at 20 years. The window replacement with triple pane windows will pay back in just over the 20 year lifespan. Implementation of this measure is recommended.

Table 6: Triple Pane Low-E Window Upgrade Energy Savings

ECRM 5: Triple Pane Low-E Window Upgrade						
Annual Savings			Economic Analysis			
kWh	Cost	% Energy	Investment	IRR	NPV	Simple Payback (years)
2,100	$273	3%	$6,000	-1%	-$2,474	21.98

4.5 ECRM 5: HVAC Upgrade

The HVAC system currently in use in each of the eight units of the building is a split system single zone with an air source heat pump. It has a cooling efficiency of 12 SEER, and a heating efficiency of 3 coefficient of performance (COP). If this system was replaced with an ENERGY STAR rated system with a 14.5 SEER and a 3.6 COP, 4,720 kWh may be saved annually resulting in an annual cost savings of $614. The lifespan of HVAC is calculated at 20 years. This upgrade will not pay back during its lifespan: therefore, implementation of this measure is recommended only when the current units are in need of replacement.

Table 7: HVAC Upgrade Energy Savings

ECRM 2: HVAC Upgrade						
Annual Savings			Economic Analysis			
kWh	Cost	% Energy	Investment	IRR	NPV	Simple Payback (years)
4,720	$614	7%	$16,000	-2%	-$7,955	26.08

4.6 ECRM 6: Radiant Barrier Upgrade

The existing attic insulation is blown-in R-32. By adding a radiant barrier with additional attic insulation of R-11 (a combined total of R-43), heating and cooling losses may be minimized. The calculations below use $1.20/ sq. ft. for insulation and labor. If this cost could be reduced to under $0.40/sq. ft. the additional insulation would pay for itself within its 25-year lifespan.

Table 8: Radiant Barrier Upgrade Energy Savings

ECRM 6: Radiant Barrier Upgrade						
Annual Savings			Economic Analysis			
kWh	Cost	% Energy	Investment	IRR	NPV	Simple Payback (years)
450	$59	1%	$4,608	-7%	-$3,603	78.77

5. Renewable Energy-Related Measures

5.1 ECRM 7: Solar Thermal Domestic Hot Water

Building B currently uses around 9,200 kWh to heat water per year. Evacuated-tube solar collectors could offset most of the electricity used for heating hot water. Panels are available capable of producing 28,000 British thermal units (BTUs)/day in the southern Arizona region. The panel size is around 55ft² (varies by manufacturer) and the building would need two to produce all of the building's hot water needs. The panels would have a first cost of nearly $3,000. The economics of this are favorable with a 4-year payback before incentives.

There are Federal tax credit incentives and also Arizona Public Services incentives available, which could lower the cost. If the 30 percent federal tax credit and the $0.50/kWh saved APS incentive (up to half of the project cost) can be taken advantage of, the cost would be reduced to $600 and would pay back in less than a year. Another consideration is the large amount of space required for installation. A storage tank may also be necessary for the hot water loop. Consulting with a system designer to establish the best setup for the building is recommended. Table 9 summarizes the analysis of this measure.

Table 9: Solar Thermal Energy Savings

ECRM 7: Solar Thermal						
Annual Savings			Economic Analysis			
kWh	Cost	% Energy	Investment	IRR	NPV	Simple Payback (years)
6,465	$840	10%	$3,000	28%	$8,424	3.57
With tax credit and incentive:			$600	140%	$10,710	0.71

5.2 ECRM 8: Photovoltaic Array

The purpose of a photovoltaic array (PVs) is to reduce the use of traditional energy sources. This system captures solar energy and converts it to electricity for use in the home which cuts down on the amount of energy that must be purchased from the utility company. When analyzed using the PV Watts calculator, the following results indicate that a 4.0 kW array in the Somerton, AZ, area will produce 6,221 kWh annually. The investment cost is calculated with the $8,400 federal/state tax credit and the $800 state utility rebate. With the tax credit, the calculator shows that this array would pay back within the photovoltaic 25-year lifespan. The measure is recommended for implementation.

Table 10: Photovoltaic Array Energy Savings

ECRM 8: Photovoltaic Array Upgrade						
Annual Savings			Economic Analysis			
kWh	Cost	% Energy	Investment	IRR	NPV	Simple Payback (years)
6,221	$809	9%	$17,800	1%	-$6,097	22.01

5.3 ECRM 9: Geothermal System

The purpose of a geothermal system is to reduce the use of traditional energy sources. This system uses the temperature of the earth to heat and cool buildings. There is a federal tax credit (30 percent of measure cost) available for implementing a geothermal system. When analyzed in the e-Quest model, the following results indicate this measure should not be implemented as the measure will not pay off in its lifetime (20 years).

Table 11: Geothermal System Energy Savings

ECRM 9: Geothermal System Upgrade						
Annual Savings			**Economic Analysis**			
kWh	**Cost**	**% Energy**	**Investment**	**IRR**	**NPV**	**Simple Payback (years)**
-940	-$122	-1%	$48,000		-$47,165	-392.8
with 30% Federal Tax Credit:			$33,600		-$33,478	-269.8

5.4 Package of Recommended ECRMs

The purpose of this package is to combine the ECRMs recommended for implementation, and calculate the combined energy savings for these measures. This package includes CFL, refrigerator, and exterior window shades. There is an additional calculation with the addition of the photovoltaic array and solar thermal. When analyzed in the e-Quest model, the following results indicate these measures should be implemented as the package of ECRMs will pay off well within the lifetime of the photovoltaic array and solar thermal (25 years).

Table 12: Package of ECRMs Energy Savings

Package Upgrade							
ECRMs	**Annual Savings**			**Economic Analysis**			
	kWh	**Cost**	**% Energy**	**Investment**	**IRR**	**NPV**	**Simple Payback (years)**
Package	7,785	$1,012	12%	$5,595	17%	$6,683	5.53
with Photovoltaic Array & Solar Thermal	20,471	$2,661	30%	$23,995	9	$8,733	9.02

After implementing the ECRM package, the utility consumption analysis would be estimated as:

Utility Consumption Analysis of Building B after Upgrade						
Average Annual Consumption			Annual Costs		Average Unit Cost	
Electricity	50,038	kWh	$6,505	100%	0.13	$/kWh
Natural Gas		therms				$/therm
		Total:	**$6,505**			
Total Conditioned Area	5,574	ft^2				
Electricity Use Intensity	9	$kWh/ft^2/yr$	**Natural Gas Use Intensity**			$Therms/ft^2/yr$
Energy Use Intensity	**31**	**$kBtu/ft^2/yr$**	**Energy Cost Intensity**		**$1.17**	**$\$/ft^2/yr$**

6. Leveraging ECRMs with Utility Resources

Local utility companies may offer energy efficiency incentives and on-site energy assessments of buildings to eligible customers. The Database of State Incentives for Renewables & Efficiency: http://www.dsireusa.org/ provides a summary of available and eligible state and utility resources.

APS provides a Multifamily Energy Efficiency Program (MEEP). The program provides a free on-site energy assessment to identify areas of upgrade for energy savings, free energy cost reduction measures (ECRMs), and technical and field support to assist with installation to eligible building owners. In May 2012, the Tribe requested an on-site energy assessment of Building B to determine eligible ECRMs. In June, MEEP installed, at no cost the following ECRMs:

- **24 Kitchen Faucet Aerators and 36 Bathroom Faucet Aerators**
  The aerators use 1.5 gallons per minutes using 31 percent less water compared to the standard 2.5 gallons per minute faucet. By using a lower flow faucet, less energy is used for heating hot water for everyday use.

- **38 Low-Flow Showerheads**
  The low-flow showerheads use 1.5 gallons per minute using 20 percent less water than the standard 2.5 gallons per minute showerheads. It is estimated that $246 in utility bills and   8,212 gallons of water per year will be saved.

- **360 Compact Fluorescent Lamps**
  The energy consumption models shows that, for Cocopah residents, household lighting accounts for over 20 percent of their total energy use.[7] Switching to energy-efficiency lighting is one of the fastest ways to cut energy bills. CFLs last about 10 times longer and use about 75 percent less energy than traditional incandescent bulbs. A typical CLF lamp can pay for itself in energy savings in less than 9 months and can continue to cut energy costs each month.

- Incentives are offered for solar thermal domestic hot water, and photovoltaic array installation.

[7] http://www.energysavers.gov/tips/indoor_lighting.cfm

7. Develop an Energy Management Strategy

Organizations that adopt and practice an energy management strategy are rewarded with lower energy use. These plans are very effective and are considered low cost. The United States Green Building Council (USGBC) recommends using an energy management plan to save 10 percent of energy use. The SCinIC team recommends this plan to CIHAD. Here are the steps that describe an energy management strategy offered by ENERGY STAR.[8]

1) **Make a Commitment:** Recognize that the economic, environmental, political, and social impacts of energy consumption are sufficient motivation to change our energy use patterns.

2) **Assess performance:** Make a personalized accounting of energy use and costs. Benchmark your site by comparing its energy performance with similar sites.

3) **Set Goals:** Review your objectives and constraints. Establish priorities and set measurable goals with target dates.

4) **Create an Action Plan:** Define the technical steps. Apply proven methods to increase energy efficiency or get specialized guidance. Assign roles and resources. Consider rolling savings from earlier efforts into future, more complex initiatives.

5) **Implement Action Plan:** Install equipment and change operational procedures. Establish a maintenance schedule. Train equipment operators and building occupants on the changes. Track and monitor conditions.

6) **Evaluate Progress:** Compare current performance to established goals. Understand what worked well in order to identify best practices. Adjust procedures, goals, and schedule the next evaluation.

7) **Recognize Achievements:** Provide internal recognition for the efforts and achievement of individuals, teams, and facilities. Seek external recognition from government agencies, media, or third party organizations.

   The quickest, easiest, and cheapest way to reduce loads during peak hours is to ensure that lights and equipment are turned off whenever they are not required. This could be achieved by developing better occupancy habits by the residents. Savings can also be achieved by changing the thermostat settings to minimum cooling during the peak day time. Thermostat should be set to 78 °F for occupied zones.

[8] For more information on the ENERGY STAR energy management strategy: http://www.energystar.gov/index.cfm?c=guidelines.guidelines_index

8. Conclusions and Recommendations

In summary, this report provides information and strategies on how to reduce the annual operation cost through load reduction, energy efficiency improvements, and renewable energy sources. Table 13 includes a summary of the quantified results.

Table 13: Summary of ECRMs

Energy Cost Reduction Measure (ECRM)	Number of ECRMs	Annual Energy Savings			Economic Analysis			
		kWh	Cost	% Energy	Investment	IRR	NPV	Simple Payback (years)
CFLs	79	2,171	$282	3%	$395	66%	$788	1.40
Refrigerators	8	3,754	$488	6%	$3,200	9%	$541	6.56
Window Shades	20	1,860	$242	3%	$2,000	10%	$965	8.27
Window Shades 2	4	2,240	$291	3%	$6,000	0%	-$2,258	20.60
Triple low-e windows	20	2,100	$273	3%	$6,000	-1%	-$2,474	21.98
HVAC Upgrade	8	4,720	$614	7%	$16,000	-2%	-$7,955	26.08
Radiant Barrier	3,840 ft^2	450	$59	1%	$4,608	-7%	-$3,603	78.77
Solar Thermal	2	6,465	$840	10%	$600	140%	$10,710	0.71
Photovoltaic Array	4 KW	6,221	$809	9%	$17,800	1%	-$6,097	22.01
Geothermal	32 wells	-940	-$122	-1%	$48,000	0%	-$47,165	-392.80
All Recommend ECRMs		20,471	$2,661	30%	$23,995	9%	$8,733	9.02

Attachment A

Your New Energy-Efficient Products

Congratulations! Your property has chosen to participate in the APS Multifamily Energy Efficiency Program (MEEP). Three different energy-efficiency products have been installed in your home - at absolutely no cost to you. You will immediately start using less energy while showering, rinsing or washing dishes, and lighting your home as a result of the following product installations:

Kitchen and Bathroom Faucet Aerators (1.5 gallons per minute)

- They use 31 percent* less water compared to the standard 2.5 gpm faucet
- Lower flow means less energy is used for water heating for normal use
- The aerators have flow-control construction of long-lasting Celcon plastic

Energy-efficient Showerheads (1.5 gallons per minute)

- ShowerStart™ technology lets you know when your shower is warm and ready
- 54-nozzle, full face spray pattern provides maximum coverage for warmth and comfort
- Saves up to $246 in utility bills and 8,212 gallons of water per year

Compact Fluorescent Light Bulbs (CFLs)

- CFLs last up to 10 times longer than traditional incandescent bulbs
- CFLs use up to 75 percent less energy
- They're safe and better for the environment

Dispose of compact fluorescent light bulbs (CFLs) safely and properly: Once a CFL bulb burns out, most of the mercury has been used up. However, it's still important that the bulb remain intact - you should not break or crush it. Return the CFL bulb to its original packaging and take it to your county's solid waste facility or your local The Home Depot store for proper disposal. Visit the ENERGY STAR (R) website at energystar.gov for more information on CFL recycling.

*Savings are approximate and will vary with efficiency of heating and water heating system, temperature of incoming and outgoing water, and number of occupants per unit.

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If you have questions about the products you received, please call 855-733-1117.