AMERESCO
Green • Clean • Sustainable

Volume I
Energy Audit Report

Prepared for
Hawaii Public Housing Authority
September 24, 2009

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Section 1:
Executive Summary

Project Overview

Ameresco, Inc. is pleased to provide this Energy Audit Report to the Hawaii Public Housing Authority (HPHA), pursuant to the Energy Audit Agreement. This report is the culmination of a comprehensive utility study of 67 conventional federal public housing sites involving 5,269 dwelling units and associated facilities. The study included extensive site examination,[1] analysis of historical utility billing data for all utility services, building energy modeling, development engineering, and an investment grade financial assessment.

To the greatest extent feasible, we have attempted to respond in the energy conservation measures (ECMs) presented in this report to HPHA's desire to reduce energy and water costs while also addressing vital, utility-related capital needs. In each case, we compared measure payback against life cycle, but also considered other tangible benefits not directly related to savings in making our recommendations.

The current recommended package of improvements, totaling approximately $44.1M, encompasses the best economic payback approach while addressing various capital-intensive upgrades. Savings under an Energy Services Agreement will cover the entire project capital cost via a guaranteed-savings, 20-year term financing, which is described in more detail later in this section.

1 Our findings are based on the results of a complete survey of the common areas and mechanical rooms and in-apartment visits representing approximately a 10% sample of the portfolio.

Implementation of this project is expected to produce nearly $4.3M in annual utility cost savings during the first year of project repayment,[2] representing a reduction of nearly 30% in utility expenditures. In addition, nearly half the total project investment is dedicated to renewable energy, including solar hot water heating systems at 14 developments and a solar photovoltaic power generating system. Combined, these renewable energy measures will generate about 25% of the overall project savings or about $1M in the first year.

This Energy Audit Report is broken out into six main sections:

- Section 1 is this Executive Summary, which reviews the overall project financing and measure selection, costs and savings;
- Section 2 describes the utility baseline developed for this project, including any adjustments made, as well as the current tenant utility allowances and the utility rates applied to the savings;
- Section 3 presents a detailed description of the recommended ECMs, a summary of measures considered but not recommended, and general information detailing how Ameresco proposes to design, implement, and commission the ECMs and provide concurrent training and resident education;
- Section 4 describes the long term services proposed during the repayment term of the Energy Services Agreement (ESA), including annual equipment and systems inspections and measurement and verification of the savings; as well as the opportunity for resident education, and long-term maintenance services. Section 4 also presents the HUD conservation incentives proposed.
- Section 5 presents the existing site conditions reports; and
- Section 6 contains the attachments to this report which include the utility baselines, recommended product cut sheets, lighting audits, a summary of measure costs and savings by site, and a 20-year life cycle cost analysis.

[2] Project repayment is anticipated to begin in 2012, after a two-year construction cycle.

While we recognize that the final package of measures may be adjusted, it is our recommendation that the package we have developed, with input from HPHA staff and finance committee board members, is the most economically beneficial and comprehensive from a property upgrade and deferred maintenance perspective. We look forward to working with HPHA to finalize the package of measures and services in order to execute the Energy Services Agreement (ESA) by February 2010.

To that end, we propose the following next steps:

- HPHA Board of Directors approves the proposed scope of work and financing engagement letter at the October 15 board meeting;
- Ameresco develops the ESA and associated appendices; Ameresco and HPHA also determine the scope of long-term services (e.g. maintenance) (November);
- Submit the ESA to HUD for approval (November);
- Secure financing (January 2010);
- Secure HUD approval of the ESA (February 2010)
- Execute financing and ESA (February 2010)

Ameresco would like to acknowledge and give special thanks to Mr. Chad Taniguchi, Ms. Barbara Arashiro, Mr. Richard Speer, Mr. Glenn Sunakoda, and Mr. Marcel Audant, as well as the many other management and facilities staff whose input and support during the audit was invaluable. Ameresco would also like to thank the finance committee of the HPHA Board of Directors, including Mr. Travis Thompson, Ms. Linda Smith, and Mr. Eric Beaver for their input and guidance.

Environmental Benefit

Based on the energy savings projected for this project, the following reductions in greenhouse gas emissions are expected:

Greenhouse Gas	Emissions Reduction
CO_2	8,500 Tons
SO_X	36,800 Lbs
NO_X	30,700 Lbs

The efficiency improvements and renewable energy component proposed in this project will provide a significant and sustainable step towards meeting Hawaii's Clean Energy Initiative goals by 2030.

A. Project Funding

1. Capital Lease

All funding for the project will be secured from guaranteed savings using a capital municipal lease. This is a financing obligation under which HPHA owns the installed equipment upon acceptance, and the lender, acting as lessor under the capital lease, retains a security interest (lien) on the equipment until the capital lease is paid in full at the end of the lease term. The capital lease is the most common financing structure provided to HUD as part of the project approval process and the structure most often applied to performance contracts.

Current interest rates on these projects are ranging between 5-6.5%, depending on the tax-exempt or taxable (leveraging the federal government's offer of such tax credits or rebates as Build America Bonds) status, market stability, the finance term (including the construction period), HPHA's financial stability, PHAS report scores, bank-qualified or non bank-qualified status (bank-qualified indicates that the PHA will not issue more than $30 million in tax-exempt financing in a given calendar year). The actual interest rate typically will float until actual closing of the project financing occurs, subsequent to HUD approval.

Ameresco has already completed a competitive process for seeking investor or bank participation in this project, nationwide and locally. As a result, Ameresco has identified an investment bank with the willingness, capability, and experience with similar projects to secure competitively-priced financing for this project. Recently, Ameresco has been quoted an all-inclusive finance rate for this project at approximately 4.78%. This all-in rate is based on the expectation that HPHA would be successful in obtaining an "A-" rating from Standard and Poor's and use of the federal government stimulus program involving Build America Bonds.

To close the project financing, HPHA will need to provide its three most recent years of financial statements to Ameresco, as well three years of its PHAS reports and other similar management information. A rating on the credit and project may be required during this process. During the document preparation process, HPHA will need to provide a Board Resolution, an Opinion of Counsel (affirming the lease is a legal, valid and binding agreement for HPHA), and an insurance certificate indicating coverage. Often, legal property descriptions (obtained from deeds or other documents acceptable to the investor), are also needed before project closing. Once credit review is obtained, the lender will proceed to close the project financing, subject to execution of the Energy Services Agreement with Ameresco, and to HUD approval.

Throughout the 20-year repayment term of the project, Ameresco will work with HPHA to secure the necessary HUD conservation incentives required for the repayment of the lease.

2. Utility Rebates

Ameresco has estimated that approximately $362,842 in electric rebates are available from the Hawaii Energy Efficiency Program, as presented in Table 1.A.[3] At this time, neither the gas company nor any of the respective water providers are known to offer any rebates which would be available to the housing authority for this project. Ameresco will continue to work in collaboration with HPHA to secure additional conservation incentives.

Table 1.A Projected Utility Incentives By Measure

Energy Conservation Measure	Big Island	Neighbor Islands	Oahu High-Rises	Oahu Low-Rises	Measure Total
ECM 5: Install Efficient Building Water Pressure Controls	-	-	$ 4,800	-	$ 4,800
ECM 6: Upgrade Common Area Lighting	$ 3,714	$ 2,144	$ 25,742	$ 6,500	$ 38,101
ECM 7: Upgrade Apartment Lighting	-	$ 23,651	-	-	$ 23,651
ECM 8: Install High-Efficiency Air Conditioning	$ 179	-	-	$ 362	$ 540
ECM 9: Install Energy Star Refrigerators	$ 1,350	$ 8,200	$ 2,250	$ 17,450	$ 29,250
ECM 10: Install Vending Machine Controls	-	-	$ 300	-	$ 300
ECM 17: Install New Solar Domestic Water Heaters	$ 43,000	$ 18,000	-	$ 210,000	$271,000
Totals	$ 48,243	$ 51,995	$ 28,292	$ 234,312	$ 362,842

All rebates would flow directly to HPHA and can be used to fund additional improvements or to reduce or pre-pay the debt on the project. In the cash flow presented in this section, Ameresco has assumed that any incentives will be used to reduce the amount financed.

[3] Rebate amounts are subject to change, based on measure qualification and funding availability at the time of application.

3. Authority Cost Contribution

The project financing as currently presented in this report is entirely self-funding and does not require a capital cost contribution by HPHA.

B. Measure Selection

The measure matrices presented in Tables 1.B.1-4 present the recommended Energy Conservation Measures (ECMs) included in the Energy Audit Report. This package of measures represents the most beneficial mix of measures that will achieve both utility cost savings and needed capital upgrades, without sacrificing resident comfort or adversely impacting operations and maintenance costs.

In selecting measures for inclusion in this project, we first determined the measure simple payback (which equals the measure cost divided by the initial year savings) and compared that to the anticipated life cycle of the proposed equipment. Where measure paybacks were long or non-existent (i.e. little or no measurable savings), we also considered other factors or benefits, such as replacing aging roofs where new solar equipment was recommended. Listed here are the life cycle assumptions used in our analysis:

Measure Type	Useful Life
Water Fixtures	25 years
Lighting Fixtures	20 years
Solar Photovoltaic Systems	30 years
Solar Hot Water Systems	30 years
Building Water Pressure Controls	25 years
Window Air Conditioners	10 years
Refrigerators	10 years
Vending Machine Controls	20 years
Electric Meters	20 years
High Efficiency Packaged Water Heaters	20 years
Roofing Systems	25 years
Gas-fired Instantaneous Water Heaters	20 years
Electric Transformers	30 years

The above useful life estimates are based on properly maintained and serviced equipment.[4]

While other combinations of measures are possible given HPHA's needs, we feel that the enclosed package represents the best combination of measures. Please refer to Section 3 of the audit report for a detailed description of the proposed measures. Section 3 also includes a summary of other

[4]The recent HUD notice, PIH-2009-16 (HA), *Guidance on Energy Performance Contracts, including those with terms up to 20 years*, provides accepted useful life estimates for a number of systems.

measures considered during the audit but not recommended at this time. Listed below is a brief summary of the proposed measures.

ECM 1: Install HET Toilets

Ameresco proposes to replace existing apartment and common area toilets at most HPHA sites with new, high efficiency (HET) toilets that use 1.28 gallons of water per flush. The proposed toilet products use between 20% and 60% less water than the current stock of toilets in place and are certified by the EPA for both performance and efficiency. This measure will not only provide significant water savings, but will also fully modernize and standardize the stock of toilets throughout the majority of HPHA developments. The sites excluded from this measure were those found to have existing toilets with efficient or measured low flush rates or the cost of water was low.

ECM 2: Install Low-Flow Showerheads & Faucet Aerators

At locations where new toilets are proposed, Ameresco also proposes to furnish and install 1.75 gallons-per-minute (GPM) fixed-mount and 1.5 GPM handheld showerheads to replace existing standard flow models. Additionally, Ameresco proposes to replace all kitchen and bathroom aerators at affected sites with new aerators rated at 1.5 and 1.0 GPM, respectively.

ECM 3: Install Front-Loading Washers

Ameresco proposes to replace leased and select HPHA-owned top-loading washing machines in community laundry rooms at sites also receiving new apartment-based water conserving fixtures with more efficient front-loading washing machines. Compared to the existing top-loading washers, the new washers will use significantly less water and energy and require less detergent per load.

ECM 4: Install New Sink Faucets

Ameresco proposes to replace all aging kitchen faucets at Kuhio Park Terrace high rise buildings A and B with new hardware including low-flow aerators. The proposed measure will save water, while also providing residents with better functioning hardware.

ECM 5: Install Efficient Building Water Pressure Controls

Ameresco proposes to replace the current building water pressure booster pumps at Kalakaua Homes, Paoakalani, and Kalanihuia with new, high-efficiency packaged booster pump systems. The new booster pumps will be equipped with variable frequency drive (VFD) controls, resulting in more effective and efficient building water pressure delivery.

ECM 6: Upgrade Common Area Lighting

Ameresco proposes to install energy efficient lighting systems in the common areas that will reduce existing energy and maintenance costs. The upgrade will feature new, premium efficiency linear fluorescent T8 lamps operating on electronic ballasts, as well as high-quality compact fluorescent lamps or fixtures. In addition, selected areas, such as offices, restrooms, and community rooms, having intermittent occupancy, will receive occupant-sensing lighting controls.

ECM 7: Upgrade Apartment Lighting

Ameresco proposes to install energy efficient lighting systems throughout most apartments. The primary lighting retrofit in the apartments will consist of new compact fluorescent lamps or fixtures in various configurations. In addition, new, premium efficiency linear fluorescent T8 lamps and electronic ballasts will be retrofit into existing fixtures.

ECM 8: Install High Efficiency Air Conditioning

Ameresco proposes to replace old and inefficient window-type air conditioning units with more efficient, Energy Star rated units.

ECM 9: Install Energy Star Refrigerators

Ameresco proposes to replace select old and inefficient refrigerators throughout the HPHA portfolio with Energy Star rated models.

ECM 10: Install Vending Machine Controls

Ameresco proposes to install occupancy sensing, plug load controllers to reduce the unnecessary operation of vending machines during periods of low use.

ECM 11: Consolidate Electric Meters

Ameresco proposes to consolidate the individual apartment electric meters at Waipahu II and Wahiawa Terrace into one electric meter and HECO account per building. In addition, new check meters will be installed in the existing common area and apartment utility meter sockets to allow for check metering if HPHA desires. This ECM will have the effect of greatly reducing the number of monthly meter charges while also reducing the electric rate paid by HPHA by switching from residential-based to less costly commercial-based tariffs.

ECM 12: Install New Transformers

Ameresco proposes to replace the existing outdoor building transformer at Paoakalani and the 40 year old transformer and high voltage switchgear at Makua Alii with new, energy-efficient equipment

of the same configuration. The proposed installations will improve the electrical service reliability at the two developments.

ECM 13: Install Solar Photovoltaic Arrays

Ameresco proposes to install a 107.36 kWdc (89.1 kW) solar photovoltaic (PV) system on the rooftop of Makamae that will generate nearly 50% of the buildings current energy use. As part of this installation, HPHA will also be able to take advantage of HECO's net energy metering rule. Net energy metering will allow HPHA to export surplus electricity into the grid when the power generated by the PV system exceeds the requirement of the building, thereby obtaining the full savings benefit of the proposed PV system.

ECM 14: Install Electric Check Meters

At Kuhio Park Terrace, Waipahu II, and Wahiawa Terrace, Ameresco proposes to implement a check-metering system featuring Automated Meter Reading (AMR). The new AMR system will provide a seamless means for HPHA to monitor apartment electric consumption and bill residents for any usage above a set threshold level. The housing authority will have the ability to access and download consumption data and overage usage by apartment via a web-based host service for its billing purposes. Check metering has the advantage over converting to tenant-paid utilities because the electric use continues to be master-metered and the utility billing remains on a lower cost, commercial rate.

ECM 15: Install High Efficiency Central Domestic Water Heaters

Ameresco proposes to replace the domestic water heating systems at Ka Hale Kahaluu, Makua Alii, Punchbowl Homes, Kalanihuia, Makamae, Pumehana, and Spencer House with new, energy-efficient, condensing-type water heaters. These water heaters operate at efficiencies in excess of 90% under most operating conditions, and will significantly reduce energy use and greenhouse gas emissions related to domestic hot water production at the affected sites.

ECM 16: Install New Solar Domestic Water Heaters

Ameresco proposes to install new or refurbish existing solar domestic hot water heating systems at a total of 14 developments. The new solar water heating equipment will provide HPHA with clean, renewable, free hot water that will displace at least 90% of the existing electric or gas water heating energy in most cases, while greatly reducing the carbon footprint of HPHA facilities and helping the State of Hawaii meet its goal of 40% renewable energy by 2030.

ECM 17: Replace Roofs

In anticipation of the proposed solar hot water installations included under ECM-16, Ameresco proposes to replace the existing roofs on the two Kuhio Park Terrace (KPT) towers and the 21 buildings of Kuhio Homes. In addition, Ameresco will also install new perimeter fencing on both KPT towers, and re-roof the KPT community building.

ECM 18: Install Gas Fired Instantaneous Water Heaters

Ameresco proposes to correct existing hot water service deficiency problems while also reducing utility costs at Mayor Wright Homes by replacing the existing electric and gas back-up hot water heating equipment with new, gas-fired, instantaneous hot water heating units. Given the uncertain long term disposition of this property, this measure provides a lower cost, yet effective alternative to installing new solar hot water heaters.

Table 1.B.1 Measure Matrix - Big Island

ECM #	Description	Lanakila Homes I	Lanakila Homes II	Lanakila Homes IV	Hale Aloha O Puna	Hale Olaloa	Kauhale O'Hanakahi	Pahala	Pomaikai Homes	Punahele Homes	Ka Hale Kahaluu	Hale Hookipa	Kaimalino	Kealakehe	Nani Olu	Noelani II	Hale Hauoli	Ke Kumu 'Ekolu	Noelani I
		1004	1013	1104	1051	1052	1097	1045	1029	1028	1061	1053	1032	1070	1063	1078	1031	1097	1071
1	Install HET Toilets	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Install Low-Flow Showerheads & Faucet Aerators	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	Install Front-Loading Washers							✓			✓	✓		✓		✓	✓		✓
4	Install New Sink Faucets																		
5	Install Efficient Building Water Pressure Controls																		
6	Upgrade Common Area Lighting	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
7	Upgrade Apartment Lighting	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	Install High-Efficiency Air Conditioning	✓																	
9	Install Energy Star Refrigerators						✓	✓				✓				✓			✓
10	Install Vending Machine Controls																		
11	Consolidate Electric Meters																		
12	Install New Transformers																		
13	Install Solar Photovoltaic Arrays																		
14	Install Electric Check-Meters																		
15	Install High-Efficiency Central Domestic Water Heaters										✓								
16	Install New Solar Domestic Water Heaters													✓		✓		✓	✓
17	Replace Roofs																		
18	Install Gas-Fired Instantaneous Water Heaters																		

Table 1.B.2 Measure Matrix - Neighbor Islands

ECM #	Description	Kapaa	Hale Hoolulu	Hale Nana Kai O Kea	Hui O Hanamaulu	Kalaheo	Kekaha Ha'aheo	Eleele Homes	Hale Hoonanea (Port Allen)	Home Nani	Kawailehua - Federal	Kahekili Terrace [a & b]	David Malo Circle	Makani Kai Hale I	Piilani Homes	Makani Kai Hale II	Kahale Mua - Federal
		1018	1019	1054	1021	1022	1064	1020	1055	1023	1086	1017	1016	1092	1044	1097	1088
1	Install HET Toilets	✓		✓	✓	✓	✓	✓	✓	✓	✓						✓
2	Install Low-Flow Showerheads & Faucet Aerators	✓		✓	✓	✓	✓	✓	✓	✓	✓						✓
3	Install Front-Loading Washers																✓
4	Install New Sink Faucets																
5	Install Efficient Building Water Pressure Controls																
6	Upgrade Common Area Lighting	✓	✓	✓	✓		✓		✓	✓		✓		✓	✓		✓
7	Upgrade Apartment Lighting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	Install High-Efficiency Air Conditioning	✓															
9	Install Energy Star Refrigerators	✓		✓	✓	✓			✓			✓	✓	✓	✓		
10	Install Vending Machine Controls																
11	Consolidate Electric Meters																
12	Install New Transformers																
13	Install Solar Photovoltaic Arrays																
14	Install Electric Check-Meters																
15	Install High-Efficiency Central Domestic Water Heaters																
16	Install New Solar Domestic Water Heaters										✓		✓				
17	Replace Roofs																
18	Install Gas-Fired Instantaneous Water Heaters																

Table 1.B.3 Measure Matrix - Oahu Low Rise Sites, Kuhio Homes, and Central Office

ECM #	Description	Kalakaua Homes	Makua Alii	Paoakalani	Punchbowl Homes	Kalanihuia	Makamae	Pumehana	Kuhio Park Terrace	Kuhio Homes	HPHA Central Office
		1062	1012	1036	1011	1024	1046	1047	1010	1007	N/A
1	Install HET Toilets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Install Low-Flow Showerheads & Faucet Aerators	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	Install Front-Loading Washers	✓	✓	✓	✓	✓	✓	✓	✓		
4	Install New Sink Faucets								✓		
5	Install Efficient Building Water Pressure Controls	✓		✓		✓					
6	Upgrade Common Area Lighting	✓	✓	✓	✓	✓	✓	✓	✓		
7	Upgrade Apartment Lighting	✓	✓	✓	✓	✓	✓	✓	✓	✓	
8	Install High-Efficiency Air Conditioning										
9	Install Energy Star Refrigerators						✓				
10	Install Vending Machine Controls					✓			✓		✓
11	Consolidate Electric Meters										
12	Install New Transformers		✓	✓							
13	Install Solar Photovoltaic Arrays						✓				
14	Install Electric Check-Meters								✓		
15	Install High-Efficiency Central Domestic Water Heaters		✓		✓	✓	✓	✓			
16	Install New Solar Domestic Water Heaters								✓	✓	
17	Replace Roofs								✓	✓	
18	Install Gas-Fired Instantaneous Water Heaters										

Table 1.B.4 Measure Matrix - Oahu Low Rise Sites

ECM #	Description	Puuwai Momi	Hale Laulima	Salt Lake	Waipahu I	Waipahu II	Kalihi Valley Homes	Mayor Wright Homes	Kaahumanu Homes	Kamehameha Homes	Spencer House	Waimaha-Sunflower	Kau'iokalani	Maili I	Maili II	Nanakuli Homes	Koolau Village	Hookipa Kahaluu	Kaneohe Apartments	Kauhale O'hana	Waimanalo Homes	Waimanalo Homes II	Kauhale Nani	Wahiawa Terrace	Kupuna Home O'Waialua	Palolo Valley Homes
		1026	1027	1066	1038	1039	1005	1003	1009	1099	1073	1057	1091	1033	1108	1035	1030	1072	1069	1090	1025	1107	1056	1015	1050	1008
1	Install HET Toilets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
2	Install Low-Flow Showerheads & Faucet Aerators	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
3	Install Front-Loading Washers			✓		✓					✓	✓	✓					✓							✓	
4	Install New Sink Faucets																									
5	Install Efficient Building Water Pressure Controls																									
6	Upgrade Common Area Lighting	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓			✓	✓	✓	✓	✓			✓	✓	✓	✓
7	Upgrade Apartment Lighting	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	Install High-Efficiency Air Conditioning	✓						✓																		
9	Install Energy Star Refrigerators							✓		✓	✓										✓					
10	Install Vending Machine Controls																									
11	Consolidate Electric Meters					✓																		✓		
12	Install New Transformers																									
13	Install Solar Photovoltaic Arrays																									
14	Install Electric Check-Meters					✓																		✓		
15	Install High-Efficiency Central Domestic Water Heaters										✓															
16	Install New Solar Domestic Water Heaters	✓	✓						✓								✓	✓								✓
17	Replace Roofs																									
18	Install Gas-Fired Instantaneous Water Heaters							✓																		

C. Measure Savings and Costs Summary

Appearing in Table 1.C is a compilation of the savings, costs, and simple paybacks for all of the recommended measures at all facilities. For a similar breakdown by individual site, please refer to Attachment G of this report.

The project costs presented in Table 1.C are inclusive of the following:

- Equipment and materials
- State of Hawaii general excise tax
- City permits
- Installation labor
- Subcontractor performance and payment bonding
- Ameresco performance and payment bonding
- Engineering services and quality control
- Project management
- On-site construction supervision
- Audit fee
- Financing services
- Subcontract administration, including handling of payment requisitions, monitoring for compliance with Davis-Bacon wage requirements, and handling of all federally mandated wage earnings reports
- Commissioning
- Staff training
- Resident education during construction
- Tenant coordinators (a total of 6 tenant coordinators over a 22-month period has been included)
- Overhead and profit

The costs associated with equipment and materials, taxes, installation labor, any outsourced engineering or other professional services, and bonding comprise the project "direct costs." The remainder of the cost components are collectively termed the project "indirect costs," which are

estimated on a project basis and then prorated over the measure direct costs to form the total project cost for each measure.

Table 1.C ECM Summary

All Developments

Totals		6,802,173	2,347,179	130,129	29,403	176,667	$ 44,149,930	$ 4,265,658	10.4
#	Description	Master Paid Electric Savings {kWh}	Resident Paid Electric Savings {kWh}	Master Paid Natural Gas Savings {therms}	Resident Paid Natural Gas Savings {therms}	Master Paid Water Savings {kgal}	Total Project Costs	Dollar Savings	Total Payback
1	Install HET Toilets	0	0	0	0	96,460	$ 3,834,844	$ 525,565	7.3
2	Install Low-Flow Showerheads & Faucet Aerators	418,245	423,727	77,793	15,843	70,184	$ 978,678	$ 954,141	1.0
3	Install Front-Loading Washers	7,950	0	2,486	0	4,188	$ 91,092	$ 33,570	2.7
4	Install New Sink Faucets	0	0	5,117	0	5,835	$ 181,596	$ 51,140	3.6
5	Install Efficient Building Water Pressure Controls	64,038	0	0	0	0	$ 271,373	$ 16,642	16.3
6	Upgrade Common Area Lighting	567,343	0	0	0	0	$ 689,898	$ 164,861	4.2
7	Upgrade Apartment Lighting	1,514,307	1,088,871	0	0	0	$ 5,635,924	$ 823,516	6.8
8	Install High-Efficiency Air Conditioning	5,234	0	0	0	0	$ 13,042	$ 1,847	7.1
9	Install Energy Star Refrigerators	93,903	204,419	0	0	0	$ 794,270	$ 97,890	8.1
10	Install Vending Machine Controls	4,368	0	0	0	0	$ 3,909	$ 1,134	3.4
11	Consolidate Electric Meters	0	0	0	0	0	$ 192,002	$ 15,093	12.7
12	Install New Transformers	0	0	0	0	0	$ 569,891	$ -	-
13	Install Solar Photovoltaic Arrays	163,917	0	0	0	0	$ 996,241	$ 41,304	24.1
14	Install Electric Check-Meters	1,147,602	0	0	0	0	$ 914,213	$ 307,888	3.0
15	Install High-Efficiency Central Domestic Water Heaters	0	0	24,772	0	0	$ 1,020,720	$ 77,074	13.2
16	Install New Solar Domestic Water Heaters	1,445,203	630,162	86,761	13,561	0	$ 18,748,245	$ 972,277	19.3
17	Replace Roofs	0	0	0	0	0	$ 7,104,195	$ -	-
18	Install Gas-Fired Instantaneous Water Heaters	1,370,065	0	-66,800	0	0	$ 2,109,799	$ 181,714	11.6

D. Cash Flow Projection

Please refer to Table 1.D for the cash flow generated for this project. For purposes of this report, we have assumed a 4.78% finance rate in the project cash flow, with construction starting in February 2010 and lasting 24 months, and an escalating lease payment (as savings escalate over the term of the contract). In addition, we have assumed that interest during construction will be capitalized, and the financed amount is net of any utility rebates available.

The savings used in the cash flow are based on the predicted consumption savings, valued at the average cost per unit of energy or water utilizing projected 2012 utility rates, the base rates, which are then escalated annually by 3%. During the repayment term, the savings rates will be valued at the greater of the then-current retail utility rates or the escalated base rates. For more information on determination of the projected utility rates, please refer to Section 2.C. For more information on the HUD funding methods proposed for this project, please refer to Section 4.A of this report.

In accordance with HUD Notice PIH 2006-06, *Guidance on Energy Performance Contracts with Terms up to 20 Years*, further adjustments to the utility costs savings should be considered to account for the degradation or discounting of savings over the debt repayment period associated with an extended finance term. Any savings adjustment factors are included in the life-cycle cost analysis presented in Attachment I of this report, with the adjusted savings applied to the cash flow.

For this project, we have assumed the following savings degradation factors in the cash flow:

- Refrigerators and window air conditioners: Life cycle of this equipment is typically around 10 years; therefore, after Year-10 of the project repayment period, savings associated with these measures cease.

- Apartment plumbing fixtures: one percent annual savings degradation per year, compounding after Year-10 of the project repayment period, is applied to account for normal equipment wear and tear.

- For all remaining measures, no savings degradation factors were applied since with the proper maintenance and repair these measures should last up to or beyond the 20-year project term.

The life cycle cost analysis also factors in any added (incremental) maintenance costs associated with each measure. For this project, we have budgeted for a preventative maintenance and repair reserve fund for the following measures:

- Solar Photovoltaic System

- Solar Domestic Hot Water Systems
- Central Domestic Hot Water Systems
- Building Water Pressure Booster Pumps
- Electric Check-Meters
- Instantaneous Hot Water Heaters

Collectively, the Year-1 maintenance reserve fund amount is projected at $570,043, escalated at 3% annually thereafter. Please refer to the individual ECM maintenance service descriptions in Section 3.B as well as the general discussion in Section 4.D for more information regarding the maintenance services and costs.

The remaining measures are not anticipated to add to but may even reduce existing maintenance costs. However, HUD rules pertaining to energy performance contracts do not allow accounting for deferred maintenance costs in the project cash flow.

The cash flow also includes Ameresco's long-term services fee associated with monitoring and verification of the project savings, annual measure inspections, and providing support to the housing authority in securing the HUD incentives, as described in Section 4 of this report. The associated fee for the first year of repayment is $182,752, and will escalate annually at a rate of 3% over the contract term. Resident education during the repayment term has not been included as part of our long-term services, but could be added for an additional fee. However, resident education during the project construction phase is included as part of our construction services.

As we prepare the Energy Services Agreement, the project cash flow may be adjusted to reflect revised scope or finance rate, for example. The final cash flow projection is contained as an attachment to the Energy Services Agreement.

Table 1.D Cash Flow Projection
All Sites - 20-Year Comprehensive ECM Package

Base Use and Rates

	Electric {kWh}	Gas {therms}	Water {kgal}	Tenant Allowances
Base Use	17,405,593	634,967	699,888	$4,732,736
2012 Rates	$0.2960	$3.0763	$5.2900	-
Escalation	3.00%	3.00%	3.00%	3.00%

Master Metered Savings Projection

	Electric {kWh}	Gas {therms}	Water {kgal}
Consumption	6,802,173	130,129	176,667
2012 Rates	$0.2907	$3.1308	$5.5101
Escalation	3.00%	3.00%	3.00%
Savings-1st Year	$1,977,211	$407,413	$973,447
Adjustment [1]	$15,093		
Net Savings	$1,992,304	$407,413	$973,447

[1] Rate tariff savings associated with meter consolidation measure

Resident Paid Savings Projection

	Electric {kWh}	Gas {therms}	Water {kgal}
Consumption	2,347,179	29,403	-
2012 Rates	$0.3256	$4.3609	-
Escalation	3.00% All Tenant Paid Rates		
Savings-1st Year	$764,268	$128,226	-

Cash Flow Data

Project Funding	
Project Cost	$ 44,149,930
Utility Rebates	$ (367,642)
Customer Cost Contribution	$ -
Net Project Cost	$ 43,782,288
Construction Loan Interest	$ 4,628,026
Minimum Lease Proceeds	$ 48,410,314
Construction Term (months)	24
Finance Term (yrs)	20
Estimated Finance Rate	4.78%

Year	Base Electric Bill	Base Gas Bill	Base Water Bill	Tenant Allowances	Total Utilities & Allowances	Electric Savings	Gas Savings	Water Savings	Resident Paid Savings	Total Savings	Debt Payment	Ameresco Annual Fees	Incremental Maintenance Costs	Savings Minus Debt, Fees, Maint.	Debt, Fees, Plus Maint. As % of Savings
2012	$ 5,151,604	$ 1,953,334	$ 3,702,415	$ 4,732,736	$ 15,540,089	$ 1,992,304	$ 407,413	$ 973,447	$ 892,494	$ 4,265,658	$ 2,992,779	$ 182,752	$ 570,043	$ 520,084	88%
2013	$ 5,306,152	$ 2,011,934	$ 3,813,488	$ 4,874,718	$ 16,006,292	$ 2,052,073	$ 419,636	$ 1,002,651	$ 919,269	$ 4,393,628	$ 3,082,563	$ 188,235	$ 587,144	$ 535,686	88%
2014	$ 5,465,336	$ 2,072,292	$ 3,927,892	$ 5,020,960	$ 16,486,480	$ 2,113,635	$ 432,225	$ 1,032,730	$ 946,847	$ 4,525,437	$ 3,175,040	$ 193,882	$ 604,759	$ 551,757	88%
2015	$ 5,629,297	$ 2,134,460	$ 4,045,729	$ 5,171,589	$ 16,981,075	$ 2,177,044	$ 445,191	$ 1,063,712	$ 975,252	$ 4,661,200	$ 3,270,291	$ 199,698	$ 622,901	$ 568,309	88%
2016	$ 5,798,175	$ 2,198,494	$ 4,167,101	$ 5,326,736	$ 17,490,507	$ 2,242,355	$ 458,547	$ 1,095,623	$ 1,004,510	$ 4,801,036	$ 3,368,400	$ 205,689	$ 641,589	$ 585,359	88%
2017	$ 5,972,121	$ 2,264,449	$ 4,292,114	$ 5,486,538	$ 18,015,222	$ 2,309,626	$ 472,304	$ 1,128,492	$ 1,034,645	$ 4,945,067	$ 3,469,452	$ 211,860	$ 660,836	$ 602,919	88%
2018	$ 6,151,284	$ 2,332,382	$ 4,420,878	$ 5,651,135	$ 18,555,679	$ 2,378,915	$ 486,473	$ 1,162,347	$ 1,065,685	$ 5,093,419	$ 3,573,535	$ 218,215	$ 680,661	$ 621,007	88%
2019	$ 6,335,823	$ 2,402,354	$ 4,553,504	$ 5,820,669	$ 19,112,349	$ 2,450,282	$ 501,067	$ 1,197,217	$ 1,097,655	$ 5,246,221	$ 3,680,741	$ 224,762	$ 701,081	$ 639,637	88%
2020	$ 6,525,898	$ 2,474,424	$ 4,690,109	$ 5,995,289	$ 19,685,720	$ 2,523,791	$ 516,099	$ 1,233,134	$ 1,130,585	$ 5,403,608	$ 3,791,163	$ 231,505	$ 722,114	$ 658,826	88%
2021	$ 6,721,674	$ 2,548,657	$ 4,830,812	$ 6,175,147	$ 20,276,291	$ 2,599,504	$ 531,582	$ 1,270,128	$ 1,164,502	$ 5,565,716	$ 3,904,898	$ 238,450	$ 743,777	$ 678,591	88%
2022	$ 6,923,325	$ 2,625,117	$ 4,975,737	$ 6,360,402	$ 20,884,580	$ 2,626,708	$ 544,031	$ 1,295,457	$ 1,111,879	$ 5,578,075	$ 3,913,569	$ 245,603	$ 766,090	$ 652,812	88%
2023	$ 7,131,024	$ 2,703,870	$ 5,125,009	$ 6,551,214	$ 21,511,117	$ 2,703,852	$ 556,748	$ 1,321,163	$ 1,142,463	$ 5,724,227	$ 4,016,109	$ 252,972	$ 789,073	$ 666,073	88%
2024	$ 7,344,955	$ 2,784,987	$ 5,278,759	$ 6,747,750	$ 22,156,451	$ 2,783,262	$ 569,739	$ 1,347,246	$ 1,173,881	$ 5,874,128	$ 4,121,279	$ 260,561	$ 812,745	$ 679,543	88%
2025	$ 7,565,304	$ 2,868,536	$ 5,437,122	$ 6,950,183	$ 22,821,144	$ 2,865,002	$ 583,008	$ 1,373,705	$ 1,206,156	$ 6,027,871	$ 4,229,145	$ 268,378	$ 837,128	$ 693,220	88%
2026	$ 7,792,263	$ 2,954,592	$ 5,600,235	$ 7,158,688	$ 23,505,779	$ 2,949,141	$ 596,561	$ 1,400,538	$ 1,239,311	$ 6,185,551	$ 4,339,774	$ 276,429	$ 862,241	$ 707,108	89%
2027	$ 8,026,031	$ 3,043,230	$ 5,768,243	$ 7,373,449	$ 24,210,952	$ 3,035,751	$ 610,402	$ 1,427,745	$ 1,273,370	$ 6,347,268	$ 4,453,234	$ 284,722	$ 888,109	$ 721,204	89%
2028	$ 8,266,812	$ 3,134,527	$ 5,941,290	$ 7,594,652	$ 24,937,281	$ 3,124,903	$ 624,536	$ 1,455,325	$ 1,308,357	$ 6,513,120	$ 4,569,596	$ 293,263	$ 914,752	$ 735,510	89%
2029	$ 8,514,816	$ 3,228,563	$ 6,119,528	$ 7,822,492	$ 25,685,399	$ 3,216,671	$ 638,970	$ 1,483,273	$ 1,344,297	$ 6,683,211	$ 4,688,931	$ 302,061	$ 942,194	$ 750,025	89%
2030	$ 8,770,261	$ 3,325,420	$ 6,303,114	$ 8,057,167	$ 26,455,961	$ 3,311,134	$ 653,707	$ 1,511,590	$ 1,381,216	$ 6,857,646	$ 4,811,314	$ 311,123	$ 970,460	$ 764,748	89%
2031	$ 9,033,368	$ 3,425,182	$ 6,492,208	$ 8,298,882	$ 27,249,640	$ 3,408,369	$ 668,753	$ 1,540,270	$ 1,419,140	$ 7,036,532	$ 4,936,820	$ 320,457	$ 999,574	$ 779,681	89%
Total	$ 138,425,523	$ 52,486,803	$ 99,485,288	$ 127,170,395	$ 417,568,009	$ 52,864,322	$ 10,716,991	$ 25,315,792	$ 22,831,514	$ 111,728,619	$ 78,388,634	$ 4,910,616	$ 15,317,272	$ 13,112,098	88%

Section 2:
Baseline Development

Ameresco analyzed and documented historic utility use and costs as the basis for the master-metered, utility consumption baselines. This section describes the baseline development, any adjustments to baseline consumption, and the rates applied to the master-metered utility savings. This section also includes a description of the existing resident utility allowances and the rates applied to the savings affecting these.

A. Master-Metered Utilities

Utility consumption data is reported to HUD for the July 1 through June 30 reporting period. The three-year utility baseline used in this report is a three-year average of data from July 2005 – June 2008, consistent with 24 CFR 990.185. Throughout this section, "Fiscal year ending" or "FYE" is synonymous with the July to June reporting period.

At the beginning of the project, HPHA provided a list of account numbers for each utility account type paid by the housing authority. This included all master-metered and HPHA paid electric, natural gas/propane, and water consumption. Accounts paid by residents for consumption inside their apartments were not included in the bill sample. HPHA also provided to Ameresco digital accounting records which show the historical cost and consumptions as reported to HUD over the last several years.

Hawaiian Electric Co., Inc. (HECO), Hawaii Electric Light Co., Inc (HELCO), Maui Electric Co., Inc. (MECO), and the Kauai Island Utility Cooperative provide electric supply services to the HPHA properties. The Gas Company LLC provides synthetic natural gas and propane supply and delivery services. For many sites, propane supply purchases are governed by a commodity purchase contract between the State of Hawaii/HPHA and The Gas Company. There are five different water and sewage service providers which include Board of Water Supply – City and County of Honolulu, Department of Water – County of Kauai, Department of Water – County of Hawaii, West Hawaii Water Company, and the County of Maui.

Ameresco received most of the billing data directly from the utility providers but for periods where histories could not be so obtained, Ameresco used HPHA accounting records.

HPHA is billed against general commercial and residential tariffs for electricity and natural gas, and by volume for water service. When possible, to ensure the utility accounts were accurately tabulated for the sites, Ameresco cross-referenced its database with the sample bills provided by the housing authority.

Table 2.A.1 presents the number of master-metered accounts by site. For the baseline use by site, including any adjustments, as well as historical rates and account numbers for electricity, gas, and water included in the baseline, please refer to Attachments A, B, and C, respectively, in Section 6, as well as each site's Existing Conditions Report in Section 5. Three sites, Pomaikai, Mayor Wright Homes and Kuhio Park Terrace, had significant solar energy contributions to domestic hot water production during the baseline period. These baseline contributions are noted in each site's natural gas baseline disaggregations in Attachment B.

Development	Electricity	Natural Gas	Water	Total
Lanakila Homes I	1	0	9	10
Lanakila Homes II	5	0	0	5
Lanakila Homes IV	0	0	0	0
Hale Aloha O Puna	2	1	1	4
Hale Olaloa	2	1	1	4
Kauhale O'Hanakahi	0	1	1	2
Pahala	2	1	1	4
Pomaikai Homes	1	1	1	3
Punahele Homes	1	0	1	2
Ka Hale Kahaluu	9	1	5	15
Hale Hookipa	7	1	3	11
Kaimalino	4	1	1	6
Kealakehe	11	1	3	15
Nani Olu	2	0	1	3
Noelani II	5	1	1	7
Hale Hauoli	3	1	1	5
Ke Kumu 'Ekolu	3	1	2	6
Noelani I	2	0	1	3
Kapaa	38	2	4	44
Hale Hoolulu	13	1	1	15
Hale Nana Kai O Kea	1	1	1	3
Hui O Hanamaulu	63	1	1	65
Kalaheo	9	1	1	11
Kekaha Ha'aheo	8	13	3	24
Eleele Homes	25	1	1	27
Hale Hoonanea (Port Allen)	51	1	2	54
Home Nani	15	1	1	17
Kawailehua - Federal	1	0	0	1
Kahekili Terrace [a & b]	17	2	4	23
David Malo Circle	1	0	1	2
Makani Kai Hale I	1	1	3	5
Piilani Homes	2	0	1	3
Makani Kai Hale II	0	0	0	0
Kahale Mua - Federal	2	1	1	4

Development	Electricity	Natural Gas	Water	Total
Kalakaua Homes	1	1	1	3
Makua Alii	1	1	1	3
Paoakalani	1	1	1	3
Punchbowl Homes	1	2	1	4
Kalanihuia	1	2	1	4
Makamae	2	1	1	4
Pumehana	2	1	1	4
Kuhio Park Terrace	4	1	5	10
Kuhio Homes	22	2	1	25
Puuwai Momi	1	0	22	23
Hale Laulima	1	0	1	2
Salt Lake	3	1	1	5
Waipahu I	3	1	1	5
Waipahu II	22	1	1	24
Kalihi Valley Homes	15	0	2	17
Mayor Wright Homes	1	1	1	3
Kaahumanu Homes	19	1	1	21
Kamehameha Homes	3	0	1	4
Spencer House	1	1	1	3
Waimaha-Sunflower	10	0	2	12
Kau'iokalani	2	1	1	4
Maili I	1	0	2	3
Maili II	2	0	2	4
Nanakuli Homes	1	0	4	5
Koolau Village	7	0	6	13
Hookipa Kahaluu	3	1	1	5
Kaneohe Apartments	2	1	2	5
Kauhale O'hana	3	1	1	5
Waimanalo Homes	0	0	41	41
Waimanalo Homes II	0	0	0	0
Kauhale Nani	2	1	1	4
Wahiawa Terrace	69	1	1	71
Kupuna Home O'Waialua	3	1	3	7
Palolo Valley Homes	11	1	1	13
Total	527	64	171	762

Table 2.A.1 – Quantity of Master - Metered Utility Accounts

Master-Metered Baseline Adjustments

The largest and most prevalent baseline adjustment accounts for a change in occupancy and population at each site from the three-year average (or whatever time period was selected for the baseline, as explained below) to a site-by-site occupancy level determined by HPHA, projected for 2012 and beyond. Table 2.A.2, below, shows the percent occupancy for the base period and the occupancy projected for 2012. These percentages were used to adjust electricity, natural gas and propane baselines. Table 2.A.2 also shows the population levels in the base vs. projected 2012 levels. These levels were used to adjust water baselines, as population is the most accurate predictor of water use, not number of occupied units. (In Table 2.A.2, percent occupancy appears for sites even if no adjustment was necessary, as at sites where all use is for common areas not generally affected by occupancy or population shifts.)

Other adjustments are described below, by utility.

Electricity Baseline Adjustments

Occupancy – All occupancy-related adjustments to electricity baselines are listed in the Electric Utility Baseline summary for each site grouping at the beginning of Attachment A. Only occupancy-sensitive end-uses are adjusted, such as domestic hot water, general appliances and apartment lighting. Common area uses, such as corridor lighting, office space uses, etc. were generally not adjusted.

Service Deprivation (Domestic Hot Water) – In addition to a modest occupancy adjustment at Mayor Wright Homes (Oahu), the domestic hot water portion of the three-year electricity baseline is increased from 241,688 kWh to 1,380,674 kWh to compensate for severe domestic hot water temperature deprivation during all three baseline years. Deprivation reduced energy use in two primary ways: the water is inadequately heated to temperature and less water is used when the water is not hot enough (a shorter shower, colder clothes washes, etc.).

The net effect of the all occupancy and service deprivation adjustments resulted in a baseline increase from 15.2 million to 17.4 million kWhs, or 14.5%.

Poor/inconsistent data quality –

Electricity data received for all Big Island sites included only the period September 2006 through February 2009. That 27-month period is used to construct for all Big Island baselines, except for Kealakehe, where only FYE 2008 data is used, as the other data did not correlate well, given the comparative occupancy levels. For the same reason, FYE 2007 and 2008 are used for the Salt Lake baseline. (These are technically baseline substitutions as opposed to adjustments.)

Very few monthly readings are missing within the years for which data was received. When necessary, these readings are estimated by averaging the use from similar time periods in other years. At Kauhale O'Hana, the baseline is set using most recent 24 months use received (calendar years '07 and '08) as a new meter with significant use appeared in the data set in January 2007.

Miscellaneous - Three sites on Oahu (Kalakaua Homes, Makua Alii and Paoakalani) share one master electric account number and meter. HPHA respectively allocates use to each site in a 38/36/26 percent split, based on relative square footage. Our engineering analysis of uses at each site resulted in a 21/50/29 percent split and our electric baselines are expressed accordingly. Electricity savings at all three sites are still valued at the marginal rate for the entire use.

Natural Gas/Propane Baseline Adjustments

Occupancy – All occupancy-related adjustments to natural gas or propane baselines are listed in the Natural Gas/Propane Utility Baseline summary for each site grouping at the beginning of Attachment B. Only occupancy-sensitive uses are adjusted, such as domestic hot water and cooking use. Common area uses, such as office space domestic hot water use, etc. were generally not adjusted.

Service Deprivation (Domestic Hot Water) – Master-metered natural gas/propane service adjustments were not necessary at any sites.

The net effect of the all occupancy adjustments resulted in a gas/propane baseline increase from roughly 582,000 to 635,000 therms, or 9.1%.

Poor/inconsistent data quality –

Since other years' data did not correlate well, given the comparative occupancy levels, FYE 2008 gas data is used at Kauhale O'Hanakahi, FYE 2007 at Ka Hale Kahuluu, FYE 2007 and 2008 at Spencer House, and FYE 2008 at both Waipahu I and II. (These are technically baseline substitutions as opposed to adjustments.)

Very few monthly readings are missing within the years for which data was received. When necessary, these readings are estimated by averaging the use from similar time periods in other years.

Miscellaneous - Kalakaua Homes, Makua Alii and Paoakalani also share one master gas account, but the use is recorded on two separate meters, one recording all gas use at Makua Alii, the other use at Paoakalani and Kalakaua (for the low-rise laundry facility). Our gas baselines are prorated accordingly. Natural gas savings at all three sites are still valued at the marginal rate for the entire account.

Water/Sewer Baseline Adjustments

Population (# of residents) – All population-related adjustments to water baselines are listed in the Water and Sewer Baseline summary for each site grouping at the beginning of Attachment C. Only resident-sensitive uses are adjusted, including apartment based water consumption and central laundry, as well as site-by-site estimates of existing lawn and garden irrigation applied by residents via hoses and sprinklers. Common area uses, such as site office use and central, HPHA controlled, irrigation system use, etc., were generally not adjusted.

Service Deprivation (Domestic Hot Water) – Along with the electricity baseline adjustment described above, the Mayor Wright Homes three-year water baseline was increased by 11 gallons per person per day (an incremental increase to 2012 occupancy level) to compensate for severe domestic hot water temperature deprivation during all three baseline years. Deprivation reduced energy use in two primary ways: the water is inadequately heated to temperature and less water is used when the water is not hot enough (a shorter shower, colder clothes washes, etc.).

The net effect of the all population and service deprivation adjustments resulted in a water baseline increase from roughly 700,000 to 769,000 kgals, or 9.9%.

Poor/inconsistent data quality –

The data received for several sites is such that the FYE 2006 – 2008 base period could not be used. At these sites, the data do not correlate well, given comparative occupancy levels and site conditions. The most recent year(s) of rational data are used to form the base period. Partial period data was applied for Hale Hookipa and Ke Kumu 'Ekolu (Mar. '08 - Feb. '09), Hale Hauoli and Noelani I it is (FYE 2007 and 2008), and for David Malo Circle (calendar year 2007). Also, at Punchbowl Homes, the data suggests that the previously out of service central irrigation system was back in use for FYE 2008, so only that year is used to form the baseline. (These are technically baseline substitutions as opposed to adjustments.)

Very few monthly or quarterly readings are missing within the years for which data was received. When necessary, these readings are estimated by averaging the use from similar time periods in other years. At Kalakauua Homes, there was a severe and unexplained drop in water use from April through July of 2007. This period is not included in the baseline average use for these months. Data for Mali II was only available from Sep. '08 to Apr. '09. That period's use is annualized to form the baseline.

Miscellaneous –

The following HPHA HUD sites all share one master water account per group of sites: Lanakila I, II and IV; Ma Kani Kai Hale I and II, and Waimanalo I and II. The water baselines presented in Attachment C for these sites are prorated on a population basis, for the three-year base period, or

other base period if applicable. The Lanakila water baseline period is March 2008 – February 2009. Lanakila III, which also shared the same water account, was fully abandoned by then while the other three sites were almost fully occupied after recent modernization efforts were completed.

Two HUD sites, Kawailehua and Kahale Mua, share water meters with Hawaii State sites (the Kawailehua meter also serves a County site). HPHA allocates approximately 55% of metered use to Kawailehua and 25% of metered usage to Kahale Mua. Ameresco used HPHA's FYE 2008 allocations to establish the baselines at these sites.

Water and sewage savings at all split-account sites are still valued at the marginal rate for the entire account.

For all master-metered accounts, the energy savings have been adjusted for 2012 occupancy as required.

Table 2.A.2 Baseline Period and Projected 2012 Occupancy and Population Data

Development	Occupancy Rates					Resident Population		
	2006	2007	2008	3-Year Average	Projected 2012	Nov. 2008	3-Year Average[1]	Projected 2012[1]
Lanakila Homes I [1]	37.4%	31.9%	31.9%	33.8%	97.2%	51	51	78
Lanakila Homes II	81.1%	90.3%	86.6%	86.0%	95.5%	129	136	151
Lanakila Homes IV	55.0%	92.9%	92.7%	80.2%	97.9%	176	151	184
Hale Aloha O Puna	82.5%	75.8%	63.3%	73.9%	93.3%	24	23	29
Hale Olaloa	90.5%	88.3%	98.0%	92.3%	96.0%	56	55	57
Kauhale O'Hanakahi	74.2%	68.8%	71.3%	71.4%	100.0%	73	65	91
Pahala	74.3%	67.0%	72.9%	71.4%	87.5%	16	17	21
Pomaikai Homes	84.2%	78.3%	72.5%	78.3%	95.0%	13	17	21
Punahele Homes	90.6%	86.9%	87.5%	88.3%	96.7%	70	69	75
Ka Hale Kahaluu	55.8%	13.7%	39.5%	36.3%	96.0%	210	79	210
Hale Hookipa	78.6%	74.2%	65.6%	72.8%	100.0%	33	33	36
Kaimalino	82.5%	91.5%	90.6%	88.2%	95.0%	118	110	118
Kealakehe	85.1%	93.6%	76.6%	85.1%	97.9%	153	136	156
Nani Olu	78.9%	86.2%	74.5%	79.9%	100.0%	38	32	41
Noelani II	67.4%	56.6%	76.0%	66.7%	95.8%	107	82	117
Hale Hauoli	91.5%	89.4%	89.2%	90.0%	97.5%	34	37	40
Ke Kumu 'Ekolu	74.2%	68.8%	71.3%	71.4%	100.0%	90	90	106
Noelani I	79.8%	77.2%	78.9%	78.7%	94.7%	42	45	54
Kapaa	96.3%	93.1%	89.6%	93.0%	94.4%	98	99	101
Hale Hoolulu	93.8%	97.9%	100.0%	97.2%	100.0%	12	12	12
Hale Nana Kai O Kea	97.6%	99.3%	99.6%	98.8%	100.0%	37	40	40
Hui O Hanamaulu	91.1%	92.2%	88.9%	90.8%	97.8%	145	148	159
Kalaheo	78.1%	62.5%	56.3%	65.6%	100.0%	11	12	18
Kekaha Ha'aheo	94.4%	95.6%	96.9%	95.7%	97.4%	165	162	165
Eleele Homes	97.9%	94.8%	97.9%	96.9%	100.0%	83	84	87
Hale Hoonanea (Port Allen)	97.5%	96.3%	96.7%	96.8%	97.5%	43	42	42
Home Nani	95.2%	99.4%	94.0%	96.2%	100.0%	14	13	14
Kawailehua - Federal	93.3%	99.7%	95.0%	96.0%	100.0%	89	93	97
Kahekili Terrace [a & b]	70.0%	83.4%	81.1%	78.2%	90.2%	168	199	230
David Malo Circle	69.9%	91.7%	86.1%	82.6%	94.4%	62	69	75
Makani Kai Hale I	80.3%	72.0%	76.3%	76.2%	88.0%	83	83	96
Piilani Homes	96.8%	96.0%	87.5%	93.5%	95.2%	33	42	43
Makani Kai Hale II	74.2%	68.8%	71.3%	71.4%	100.0%	13	12	17
Kahale Mua - Federal	65.3%	77.7%	70.7%	71.2%	80.0%	98	92	103

Table 2.A.2 Baseline Period and Projected 2012 Occupancy and Population Data (Cont'd)

Development	Occupancy Rates					Resident Population		
	2006	2007	2008	3-Year Average	Projected 2012	Nov. 2008	3-Year Average[1]	Projected 2012[1]
Kalakaua Homes	96.5%	97.4%	98.8%	97.5%	99.0%	404	405	411
Makua Alii	95.3%	95.6%	95.7%	95.6%	97.6%	253	251	257
Paoakalani	91.8%	91.3%	91.7%	91.6%	96.7%	176	176	186
Punchbowl Homes	95.2%	96.6%	95.5%	95.8%	96.8%	194	205	208
Kalanihuia	96.7%	96.6%	96.1%	96.5%	96.7%	194	195	195
Makamae	74.3%	71.2%	68.0%	71.2%	96.8%	99	100	137
Pumehana	91.2%	92.9%	91.1%	91.7%	97.8%	154	153	164
Kuhio Park Terrace	84.5%	88.6%	93.7%	88.9%	94.5%	2,166	2,039	2,166
Kuhio Homes	93.0%	94.7%	97.8%	95.1%	98.5%	507	501	519
Puuwai Momi	95.9%	94.1%	98.0%	96.0%	98.1%	935	912	931
Hale Laulima	97.7%	95.6%	97.7%	97.0%	97.2%	130	126	126
Salt Lake	100.0%	97.0%	98.5%	98.5%	100.0%	40	39	40
Waipahu I	89.9%	89.5%	94.3%	91.2%	100.0%	72	69	76
Waipahu II	91.3%	92.1%	94.6%	92.6%	95.0%	63	61	63
Kalihi Valley Homes	58.8%	64.2%	71.9%	65.0%	85.0%	1,449	1,111	1,454
Mayor Wright Homes	94.4%	94.0%	94.5%	94.3%	97.0%	1,282	1,261	1,297
Kaahumanu Homes	94.7%	94.8%	96.8%	95.5%	98.0%	461	452	464
Kamehameha Homes	94.9%	96.3%	96.8%	96.0%	99.0%	565	552	570
Spencer House	96.6%	91.2%	82.4%	90.0%	94.1%	40	51	53
Waimaha-Sunflower	79.2%	89.4%	93.2%	87.2%	90.0%	356	361	372
Kau'iokalani	92.0%	79.8%	77.7%	83.2%	86.0%	162	204	211
Maili I	100.0%	100.0%	98.3%	99.4%	100.0%	77	81	81
Maili II	0.0%	22.9%	91.7%	38.2%	100.0%	99	99	108
Nanakuli Homes	97.0%	97.0%	91.0%	95.0%	97.2%	140	150	153
Koolau Village	96.1%	94.0%	97.4%	95.8%	98.8%	326	325	334
Hookipa Kahaluu	76.9%	75.4%	78.6%	77.0%	96.4%	134	128	161
Kaneohe Apartments	100.3%	89.9%	97.9%	96.1%	100.0%	62	60	62
Kauhale O'hana	97.8%	73.0%	78.0%	82.9%	96.0%	99	98	113
Waimanalo Homes	99.0%	99.8%	100.0%	99.6%	100.0%	89	89	89
Waimanalo Homes II	99.0%	95.5%	99.6%	98.0%	100.0%	79	81	83
Kauhale Nani	91.2%	84.5%	93.5%	89.7%	98.0%	134	137	149
Wahiawa Terrace	81.8%	81.4%	91.5%	84.9%	95.0%	212	200	224
Kupuna Home O'Waialua	77.3%	72.5%	81.5%	77.1%	87.5%	38	34	39
Palolo Valley Homes	91.5%	93.2%	93.6%	92.7%	94.1%	476	469	476

[1] Baseline tenant population by site was determined by multiplying the Nov. 2008 population by the ratio of the baseline period occupancy rate to the 2008 occupancy rate. A similar methodology was applied to project the 2012 tenant population. Lanakila I Base %s include units eventually demolished.

B. Utility Allowances

Thirty-six developments have utility allowances for either electricity or natural gas, or a combination of the two. These sites are listed in Table 2.B.1. In addition, six sites have electricity and/or gas threshold allowances for surcharges. In a study conducted for the HPHA by NFC, Inc in 2004, consumption allowances were developed and are still being used today with annual updates for rate increases.

Development Name	Studio	1-bedroom	2-bedroom	3-bedroom	4-bedroom	5-bedroom
Lanakila Homes I		$ 181.01	$ 205.77	$ 246.13	$ 287.58	
Lanakila Homes II		$ 181.01	$ 205.77	$ 246.13	$ 287.58	
Lanakila Homes IV		$ 181.01	$ 205.77	$ 246.13	$ 287.58	
Kauhale O'Hanakahi				$ 126.82		
Punahele Homes			$ 205.77			
Ka Hale Kahaluu		$ 138.11	$ 149.40	$ 165.13	$ 179.65	
Kealakehe		$ 138.11	$ 149.40	$ 165.13		
Nani Olu		$ 201.02				
Noelani II				$ 313.13		
Ke Kumu 'Ekolu				$ 126.82		
Noelani I		$ 201.02	$ 240.14			
Kekaha Ha'aheo		$ 112.82	$ 177.14	$ 213.16		
Kawailehua - Federal				$ 213.16		
Kahale Mua - Federal				$ 242.34		
Kalakaua Homes		$ 96.51	$ 104.28	$ 115.12		
Kuhio Homes		$ 74.85	$ 82.62	$ 88.73	$ 98.73	
Hale Laulima			$ 166.77	$ 217.04		
Salt Lake		$ 96.51				
Kalihi Valley Homes		$ 105.12	$ 117.34	$ 136.78	$ 155.66	$ 170.38
Mayor Wright Homes		$ 74.85	$ 82.62	$ 88.73	$ 98.73	$ 104.84
Kaahumanu Homes			$ 82.62	$ 88.73		
Kamehameha Homes		$ 144.97	$ 165.35	$ 200.92		
Spencer House			$ 82.62	$ 88.73		
Waimaha-Sunflower		$ 105.12	$ 117.34	$ 136.78		
Kau'iokalani				$ 88.73		
Maili I			$ 117.34	$ 136.78		
Maili II			$ 117.34		$ 155.66	
Nanakuli Homes				$ 136.78		
Koolau Village		$ 144.97	$ 165.35	$ 200.92	$ 236.13	
Hookipa Kahaluu		$ 139.83	$ 166.77	$ 217.04		
Kaneohe Apartments		$ 139.83	$ 166.77			
Kauhale O'hana				$ 88.73		
Waimanalo Homes			$ 165.35	$ 200.92	$ 236.13	
Waimanalo Homes II			$ 165.35	$ 200.92	$ 236.13	
Kauhale Nani		$ 144.97	$ 165.35	$ 200.92		
Palolo Valley Homes		$ 144.56	$ 171.50	$ 221.02	$ 269.62	$ 314.33

Table 2.B.1. Estimated Utility Allowances based on 2009 Electric and Gas Rates

Development Name	General	DHW	Solar	Cooking
Lanakila Homes I	✓			
Lanakila Homes II	✓			
Lanakila Homes IV	✓			
Kauhale O'Hanakahi	✓			
Punahele Homes	✓			
Ka Hale Kahaluu	✓			✓
Kealakehe	✓			✓
Nani Olu	✓	✓		✓
Noelani II	✓	✓		✓
Ke Kumu 'Ekolu	✓			
Noelani I	✓	✓		✓
Kekaha Ha'aheo	✓			
Kawailehua - Federal	✓			
Kahale Mua - Federal	✓			
Kalakaua Homes	✓			✓
Kuhio Homes	✓			
Hale Laulima	✓	✓		✓
Salt Lake	✓			✓
Kalihi Valley Homes	✓	✓	✓	✓
Mayor Wright Homes	✓			
Kaahumanu Homes	✓			
Kamehameha Homes	✓			
Spencer House	✓			
Waimaha-Sunflower	✓	✓	✓	✓
Kau'iokalani	✓			
Maili I	✓	✓	✓	✓
Maili II	✓	✓	✓	✓
Nanakuli Homes	✓	✓	✓	✓
Koolau Village	✓			
Hookipa Kahaluu	✓	✓		✓
Kaneohe Apartments	✓	✓		✓
Kauhale O'hana	✓			
Waimanalo Homes	✓			
Waimanalo Homes II	✓			
Kauhale Nani	✓			
Palolo Valley Homes	✓	✓		

Table 2.B.2. Developments with Electric Utility Allowances and what the Allowance Covers

Development Name	DHW	Cooking
Lanakila Homes I	✓	✓
Lanakila Homes II	✓	✓
Lanakila Homes IV	✓	✓
Punahele Homes	✓	✓
Kekaha Ha'aheo	✓	✓
Kawailehua - Federal	✓	✓
Kahale Mua - Federal	✓	✓
Kamehameha Homes	✓	✓
Koolau Village	✓	✓
Waimanalo Homes	✓	✓
Waimanalo Homes II	✓	✓
Kauhale Nani	✓	✓
Punahele Homes	✓	

Table 2.B.3. Developments with Natural Gas Utility Allowances and what the Allowance Covers

The NFC, Inc. study included allowances in units (kWh and therms) per apartment. At six sites (Kappa, Hui O Hanamaulu, Kalaheo, Makua Alii, Kau'iokalani and Kauhale O'hana), electricity and/or natural gas threshold levels of consumption have been established, above which a resident may be assessed a surcharge for additional monthly use. In addition, the electricity allowance at several sites is reduced by a calculated solar domestic hot water system contribution to hot water production. The dollar values of the projected allowance savings presented in Attachment D and the

values applied in the project cash flow are based on projected 2012 utility rates as calculated by Ameresco.

The percent reductions in allowances indicated in Attachment D for some sites are quite high – in the range of 40% to almost 70%. At each site, these high reductions are due to one or more of the following: a new solar hot water system is proposed to replace load currently handled by electricity or gas; all of the existing lighting is multi-bulb incandescent; and/or the existing allowances (particularly for the larger apartments) are not as high as the existing equipment warrants. This latter issue should be addressed by HPHA, with Ameresco's assistance, when next year's allowances are set.

Utility Allowance Adjustments

The electricity, natural gas and solar use levels established in the 2004 NFC study did not require adjustment. All measure energy savings impacting allowances have been adjusted to a site-by-site occupancy level determined by HPHA to be reasonable for 2012 and beyond, per Table 2.A.2, above.

C. Baseline and Savings Rates

The utility rate schedules and values in this section reflect current (2009) tariffs. Since the likely first year of debt repayment is 2012, all stated utility marginal savings rates (the unit cost savings within the tariff block the savings will occur) have been escalated to projected 2012 levels. These projections take into account published and approved rate increases, as applicable for any year or years up to 2012. Absent approved increases, all savings rates are escalated by a 3% annual inflation factor.

Electricity

Electricity rates are published on the HECO website while the "fuel oil adjustment" history was sent directly to Ameresco. KIUC rates, including fuel oil adjustments, are updated monthly and are published on their website. Master-metered electricity use at all HPHA sites is billed under one or more of the tariffs listed in Table 2.C.1.

Current master-metered average electric rates vary from $0.1999/kWh to $0.7478/kWh. However, savings are valued at the site-by-site average marginal cost per kWh, which excludes any fixed monthly charges and takes into account the cost per kWh in the rate block(s) where the savings actually occur. Projected 2012 master-metered average marginal savings rates vary from $0.2475/kWh to $0.5451/kWh with a weighted average of $0.2907/kWh. In general, the calculated marginal savings rates differ from those presented in the baseline Attachments since those rates represent the actual average unit cost paid by HPHA for FYE 2008.

Electric meter consolidation savings (ECM 11) are valued as the difference between the annual total cost of energy on the current individual meter tariff (Rate R) and the annual total cost of energy on the commercial tariff likely to be implemented upon meter consolidation (either Rate G or J).

Rate	Detail	HECO - Oahu	HELCO - Big Island	MECO - Maui	MECO - Molokai	KIUC - Kauai
Fuel Oil Adjustment [1]		$ 0.05935 /kwh	$ 0.09689 /kwh	$ 0.12234 /kwh	$ 0.13707 /kwh	-
R & D	Customer Charge - 1 PH	$ 9.03	$ 11.08	$ 8.04	$ 8.01	$ 9.72
	Customer Charge - 3 PH	$ 19.20	$ 16.07	$ 12.87	$ 12.82	-
	Energy Charge	$ 0.21837 /kwh	$ 0.30638 /kwh	$ 0.25555 /kwh	$ 0.29678 /kwh	$ 0.30738 /kwh
G	Customer Charge - 1 PH	$ 33.18	$ 31.02	$ 22.52	$ 23.50	$ 21.89
	Customer Charge - 3 PH	$ 60.83	$ 53.18	$ 38.60	$ 35.25	-
	Energy Charge	$ 0.20303 /kwh	$ 0.33005 /kwh	$ 0.26490 /kwh	$ 0.36175 /kwh	$ 0.32429 /kwh
J	Customer Charge - 1 PH	$ 56.13	$ 36.56	$ 37.53	$ 32.05	$ 36.48
	Customer Charge - 3 PH	$ 78.58	$ 62.05	$ 53.62	$ 42.73	-
	Demand	$ 9.54 /kW	$ 7.76 /kW	$ 6.17 /kW	$ 5.07 /kW	$ 6.08 /kW
	First 200 kWh / kW	$ 0.17399 /kwh	$ 0.27573 /kwh	$ 0.24185 /kwh	$ 0.31718 /kwh	$ 0.29342 /kwh
	Next 200 kWh / kW	$ 0.16111 /kwh	$ 0.25116 /kwh	$ 0.23098 /kwh	$ 0.25472 /kwh	$ 0.29342 /kwh
	Over 400 kWh / kW	$ 0.14956 /kwh	$ 0.24007 /kwh	$ 0.19921 /kwh	$ 0.23519 /kwh	$ 0.29342 /kwh
H	Customer Charge - 1 PH	$ 28.40	$ 31.02	$ 28.95	$ 23.50	-
	Customer Charge - 3 PH	$ 68.15	$ 53.18	$ 46.11	$ 29.91	-
	Demand	$ 10.22 /kW	$ 7.76 /kW	$ 4.83 /kW	$ 6.41 /kW	-
	Energy Charge	$ 0.17397 /kwh	$ 0.26976 /kwh	$ 0.23704 /kwh	$ 0.25818 /kwh	-
PP3	Customer Charge	$ 455.00	-	-	-	-
	First 500 kW	$ 17.19 /kW	-	-	-	-
	Next 1000 kW	$ 16.62 /kW	-	-	-	-
	Over 1500 kW	$ 15.48 /kW	-	-	-	-
	First 200 kWh / kW	$ 0.15966 /kwh	-	-	-	-
	Next 200 kWh / kW	$ 0.15075 /kwh	-	-	-	-
	Over 400 kWh / kW	$ 0.14730 /kwh	-	-	-	-

Table 2.C.1. Electric Rate Schedules Effective August 2009

Natural Gas/Propane

Gas rates are updated monthly and are published on the The Gas Company's website, while propane rates are based on the commodity purchase contract between the State of Hawaii/HPHA and The Gas Company. Master-metered gas use at all HPHA sites is billed under one or more of the tariffs listed in Table 2.C.2.

[1] Fuel oil adjustments used are based on the average cost between January 2005 and April 2009, with the temporary fuel cost spike experienced between March of 2008 and December of 2008 eliminated. The exact spike period varied from island to island (March – September for Oahu and June – December for all other islands).

Current master-metered average gas rates vary from $2.4799/therm to $6.7343/therm. However, savings are valued at the site-by-site average marginal cost per therm, which excludes any fixed monthly charges. Projected 2012 master-metered average marginal savings rates vary from $2.524/therm to $4.694/therm with a weighted average of $ 3.1308/therm. Note that these marginal savings rates differ from those presented in the baseline Attachments since those rates represent the actual average unit cost paid by HPHA for FYE 2008.

Therms generated by solar domestic hot water equipment during the baseline period are considered free energy, but are included in the analysis of domestic hot water requirements at applicable sites. The energy savings produced by any new solar equipment recommended for installation is valued at the marginal cost of whatever fuel source is being displaced.

Rate	Detail	Oahu	Big Island - Hilo	Maui	Molokai	Kauai
Fuel Clause [2]		$ 0.089 /therm	$ 0.376 /therm	$ 0.376 /therm	$ 0.376 /therm	$ 0.376 /therm
General Service	Customer Charge	$ 12.50	$ 12.50	$ 12.50	-	$ 12.50
	First 20 Therms	$ 4.757 /therm	$ 4.304 /therm	$ 2.854 /therm	-	$ 3.704 /therm
	Over 20 Therms	$ 4.207 /therm	$ 3.904 /therm	$ 2.854 /therm	-	$ 2.854 /therm
Residential Service	Customer Charge	$ 8.50	$ 8.50	$ 8.50	$ 8.50	$ 8.50
	All Therms	$ 3.887 /therm	$ 3.872 /therm	$ 3.094 /therm	$ 3.520 /therm	$ 3.520 /therm
Multiple Unit Housing	Customer Charge	$ 62.00	$ 62.00	$ 62.00	-	$ 62.00
	First Block	$ 3.277 /therm	$ 2.254 /therm	$ 2.254 /therm	-	$ 2.254 /therm
	Over First Block	$ 2.803 /therm	$ 1.934 /therm	$ 1.894 /therm	-	$ 1.894 /therm
	First Block is under:	350 therms	450 therms	600 therms	-	350 therms
Propane Contract	$ / Gal	$ 2.440 /gal	$ 2.590 /gal	$ 2.450 /gal	-	$ 2.650 /gal
	$ / therm	$ 2.624 /therm	$ 2.785 /therm	$ 2.634 /therm	-	$ 2.849 /therm

Table 2.C.2. Hawaii Gas Company Natural Gas Rates effective June 2009

Water & Sewer

The marginal water and sewer rate structure, as published on each water provider's website, is listed in Table 2.C.3.

Current master-metered average water rates vary from $ 2.493/kgal to $ 8.065/kgal. However, savings are valued at the site-by-site average marginal cost per kgal, which takes into account the cost

[2] Fuel oil adjustments used are based on the average cost between May 2007 and July 2009, with the temporary fuel cost spike experienced between March of 2008 and January of 2009 eliminated. The exact spike period varied from island to island (April – October for Oahu and July – January for all other islands).

per kgal in the rate block(s) where the savings actually occur. Projected 2012 master-metered average marginal savings rates vary from $ 1.803/kgal to $ 5.993/kgal with a weighted average of $ 5.5101 /kgal. Note that these rates differ from those presented in the baseline Attachments since those rates represent the actual average unit cost paid by HPHA for FYE 2008.

Water Rate Structure	kgal (per Dwelling Unit)		Water Unit Cost	Sewage Unit Cost	Unit Cost
	Min.	Max.			
Oahu (July 2010)	0	2	$ 2.79	$ -	$ 2.79
	2	9	$ 2.79	$ 2.51	$ 5.30
	9	22	$ 3.36	$ 2.51	$ 5.87
	22	∞	$ 5.01	$ 2.51	$ 7.52
Maui (July 2010)	0	6	$ 1.65	$ 3.38	$ 5.03
	6	10	$ 1.65	$ -	$ 1.65
	10	30	$ 2.90	$ -	$ 2.90
	30	∞	$ 4.10	$ -	$ 4.10
Molokai (July 2009)	0	∞	$ 5.15	$ -	$ 5.15
West Hawaii (July 2010)	0	∞	$ 1.70	$ 1.81	$ 3.51

Water Rate Structure - Big Island - Excluding West Hawaii (July 2009)															
kgal (5/8")		kgal (1")		kgal (1-1/2")		kgal (2")		kgal (4")		kgal (6")		Water Unit Cost	Sewage Unit Cost	Unit Cost
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.			
0	5	0	5	0	5	0	5	0	5	0	5	$ 2.58	$ -	$ 2.58
5	15	5	100	5	400	5	900	5	4700	5	10000	$ 3.38	$ -	$ 3.38
15	40	100	300	400	1000	900	2000	4700	10000	10000	25000	$ 4.58	$ -	$ 4.58
40	∞	300	∞	1000	∞	2000	∞	10000	∞	25000	∞	$ 5.48	$ -	$ 5.48
kgal (5/8")		kgal (3/4")		kgal (1")		kgal (1-1/2")		kgal (2")		kgal (3")		Water Unit Cost	Sewage Unit Cost	Unit Cost
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.			
0	20	0	70	0	200	0	500	0	1000	0	2000	$ 3.41	$ -	$ 3.41
20	40	70	140	200	400	500	1000	1000	2000	2000	4000	$ 4.21	$ -	$ 4.21
40	∞	140	∞	400	∞	1000	∞	2000	∞	4000	∞	$ 5.91	$ -	$ 5.91

Table 2.C.3. Published Marginal Water & Sewage Rates (Where sewage costs are zero, sewage treatment cost is fixed per billing period and does not vary by consumption)

Allowance Savings Rates

The projected 2012 marginal, residential rates are applied to savings against utility allowances. For electricity savings, these rates range from $ 0.3035/kWh to $ 0.4407/kWh, with an overall average marginal electricity savings rate of $ 0.3256/kWh.

For natural gas and propane, these marginal savings rates range from $ 4.2578/therm to $4.6427/therm, resulting in an average marginal natural gas/propane savings rate of $ 4.3609/therm.

Section 3:
Energy Conservation Measures

This section of the audit report presents a detailed description of the energy conservation measures (ECMs) recommended, including a description of the existing and proposed conditions, scope of work, and recommended product selections. In addition, a summary of measures considered but not recommended is included at the end of this section.

The description below of General Considerations presents an overview of how Ameresco will design, implement, and commission the following energy conservation measures. Also detailed below is how Ameresco will provide the necessary training and education to familiarize your staff and residents with the new equipment and systems.

A. General Considerations

1. Designing and Specifying Measures

Once the project implementation phase begins, Ameresco will prepare and submit to HPHA a detailed submittal for each measure for approval prior to equipment procurement and installation. These submittals will include but will not be limited to scopes of work, plans, specifications, line-by-line lighting audits, and product cut sheets. Upon approval, these submittals will constitute the construction documents. If engineering plans and specifications are prepared, Ameresco will submit to HPHA progress sets for review and comment. If test installations are warranted, such as for lighting or plumbing fixtures, these will be provided as necessary. Upon completion of the construction phase, the design documents will be revised as needed to reflect "As-Built" conditions and submitted in multiple to HPHA for permanent record.

2. Construction

Upon execution of the Energy Services Agreement (ESA), a project manager is assigned that will coordinate all implementation efforts from design, through procurement and construction, to commissioning and final turnover to HPHA. The project manager will be the single point of contact for HPHA throughout this entire process. The project manager will also be assisted by a number of assistant project or construction managers throughout the project construction phase. A number of resident coordinators will also be utilized, paid for through this performance contract. An Ameresco project manager or designated representative will typically be on-site during construction. Through effective management practices and communication, it is Ameresco's goal to minimize disruptions to HPHA staff and residents caused by this project to the greatest extent possible.

The project manager will be responsible for developing and updating the project implementation schedule and coordinating all day-to-day construction activities with Ameresco's subcontractors and designated HPHA personnel. The project manager will also collaborate with HPHA personnel to disseminate information to the residents with regards to in-apartment activities and access schedules. The project manager will schedule, record, and distribute the minutes of construction progress meetings held on-site that will be attended by Ameresco's project managers, HPHA representatives, active subcontractors, and engineers as necessary. These meetings will usually occur every two weeks or as dictated by current construction events. The project manager is also responsible for coordinating the completion of all punch-lists, delivering all operations and maintenance manuals, and scheduling all HPHA staff training and resident education.

3. Commissioning

Ameresco personnel, in coordination with factory-authorized startup technicians and/or the installing subcontractors, will commission and test the new systems at start-up with corroboration by HPHA personnel. The operation of the systems will also be proven at this time. Prior notification of these tests will be provided, to allow scheduling with HPHA personnel. Results of the commissioning procedures will be documented and a written report for each measure will be provided to HPHA for approval. Any deficiencies in the system will be noted in the report and corrected immediately.

4. Training and Resident Education

Once each measure is installed, Ameresco will familiarize the designated HPHA staff with the new equipment and systems and train them for any additional or special maintenance or operating procedures that may be required (separate from what may be provided by Ameresco) to assure a seamless turn-over to HPHA. In some cases, training may involve employing factory-authorized service representatives and is usually provided after a measure is installed and substantially complete but prior to or immediately after the measure is brought fully online. Ameresco will provide all necessary operations and maintenance manuals for the new equipment and will review with HPHA maintenance staff all operating and preventative and long-term service requirements to assure the proper function of the new equipment.

In addition to training provided for designated HPHA maintenance personnel, Ameresco will also conduct resident information sessions focused on increasing resident awareness, understanding, and acceptance of the new measures and to provide any information necessary to promote the proper operation of the new equipment. Resident education during construction is provided when those measures directly impacted by tenant behavior (e.g., low flow toilets, solar hot water heaters) are implemented. Information is usually disseminated in written form and at resident education sessions provided at one or more HPHA locations. The training will be provided by an experienced resident educator and will be coordinated with HPHA personnel.

B. Energy Conservation Measures

ECM 1:
Install HET Toilets

Developments Affected

All sites except Hale Olaloa, Kauhale O'Hanakahi, Hale Hoolulu, All Maui Sites, and Kauhale Nani

Existing Conditions

The existing apartment toilets in HPHA's portfolio are a mix of 1.6 and 3.5 gallons-per-flush (GPF) models with tested flow rates ranging from 1.0 to as high as 6.5 GPF. The majority of apartment toilets in these developments are standard gravity-flush, tank-type models. However, flushometer (tankless) toilets are found at Kuhio Park Terrace high-rise and in a number of common area restrooms. Puuwai Momi, Kamehameha Homes, Kau'iokalani, and a few apartments at Kalihi Valley Homes, Nankuli Homes, and Kauhale Nani have pressure-assisted toilets. Apartment toilets are primarily floor-mounted, floor-outlet types. Makamae and a number of apartments at Palolo Valley Homes have floor-mounted, wall-outlet models. A small number of wall-outlet models are also found in common area restrooms.

The sites excluded from this measure were found to have existing toilets with efficient, or measured low flush rates including Hale Olaloa, Kauhale O'Hanakahi, Hale Hoolulu, and Kauhale Nani. On Maui, the relatively low cost of water[1], coupled with relatively efficient flush volumes, precluded recommendation of new toilet installations at these sites.

During our site inspections, we noted that a high percentage of the existing 1.6 GPF toilets had tested flush rates well in excess of the manufacturers rated consumption. Primary toilet manufacturers found in HPHA's portfolio include virtually all of the major manufacturers. However, most are Crane, Kohler, Briggs and American Standard models.

[1] Developments on Maui pay a fixed rate for sewage, so only water billing is impacted by reduced consumption.

Determination of the quantities and types of plumbing fixtures and flush rates was based on information gathered by sampling 10% of the apartments and all common areas during the energy audit. Toilet flush rates were measured wherever possible with a special flow meter. Testing could not be performed on some models due to the configuration of the bowl. In these cases, Ameresco estimated toilet water consumption by toilet age, tank volume, flush cycle time and/or billing analysis. Please see Tables 1.1 - 1.4 below for a summary of the existing conditions.

Table 1.1: Big Island Apartment Toilet Type and Flush Rates by Development

Development	Estimated % High Volume Toilets	Estimated % 1.6 GPF Toilets	Tested Flush Rate - High-Volume Toilets (GPF)	Tested Flush Rate - 1.6 GPF Toilets (GPF)
Lanakila Homes I	0%	100%	n/a	1.6 - 3.2
Lanakila Homes II	0%	100%	n/a	1.6 - 3.2
Lanakila Homes III				
Lanakila Homes IV	0%	100%	n/a	1.6 - 3.2
Hale Aloha O Puna	50%	50%	No Test	No Test
Hale Olaloa	0%	100%[1]	n/a	No Test
Kauhale O'Hanakahi	0%	100%	n/a	No Test
Pahala	100%	0%	No Test	n/a
Pomaikai Homes	75%	25%	No Test	No Test
Punahele Homes	0%	100%	n/a	2.3 – 3.2
Ka Hale Kahaluu	0%	100%	n/a	1.6 - 3.0
Hale Hookipa	75%	25%	3.2 – 3.5	2.0
Kaimalino	100%	0%	2.7 – 4.5	n/a
Kealakehe	33%	67%	3.5 – 5.0	1.7 - 2.5
Nani Olu	67%	33%	3.3 - 4.5	1.8
Noelani II	80%	20%	3.4 - 5.0	2.1
Hale Hauoli	100%	0%	2.8 - 4.2	n/a
Ke Kumu 'Ekolu	0%	100%	n/a	1.6 – 3.2
Noelani I	100%	0%	No Test	n/a

1 Common area has one 3.5 gpf toilet.

Table 1.2: Neighbor Islands Apartment Toilet Type and Flush Rates by Development

Development	Estimated % High Volume Toilets	Estimated % 1.6 GPF Toilets	Tested Flush Rate - High-Volume Toilets (GPF)	Tested Flush Rate - 1.6 GPF Toilets (GPF)
KAUAI				
Kapaa	69%	31%	3.7 – 5.0	1.6 – 2.6
Hale Hoolulu	75%	25%	2.8 - 3.1	2.7
Hale Nana Kai O Kea	33%	67%	3.3 - 5.2	1.9
Hui O Hanamaulu	0%	100%	n/a	2.0 - 2.6
Kalaheo	80%	20%	2.5 – 3.1	No Test
Kekaha Ha'aheo	100%	0%	3.4 - 5.0	No Test
Eleele Homes	86%	14%	3.3 - 5.0	1.6
Hale Hoonanea (Port Allen)	100%[2]	0%	2.0 - 3.0	n/a
Home Nani	100%	0%	4.5 – 6.5	n/a
Kawailehua - Federal	83%	17%	4.0 - 6.2	1.8
MAUI				
Kahekili Terrace [a&b]	0%	100%	n/a	No Test
David Malo Circle	0%	100%	n/a	No Test
Makani Kai Hale I	0%	100%	n/a	No Test
Piilani Homes	73%	27%	No Test	No Test
Makani Kai Hale II	0%	100%	n/a	No Test
MOLOKAI				
Kahale Mua - Federal	0%[3]	100%	n/a	No Test

2 Common area has one 1.6 gpf toilet.

3 Common area has two 3.5 gpf toilets.

Table 1.3: Oahu High-Rise Apartment Toilet Type and Flush Rates by Development

Development	Estimated % High Volume Toilets	Estimated % 1.6 GPF Toilets	Tested Flush Rate - High-Volume Toilets (GPF)	Tested Flush Rate - 1.6 GPF Toilets (GPF)
Kalakaua Homes	88%	12%	2.4 – 3.3	No Test
Makua Alii	90%	10%	No Test	2.3 – 3.6
Paoakalani	100%	0%	2.6 - 5.0	n/a
Punchbowl Homes	100%	0%	No Test	n/a
Kalanihuia	100%	0%	No Test	n/a
Makamae	76%	24%	3.7 - 4.7	1.3 – 1.6
Pumehana	31%	69%	No Test	1.7 – 3.2
Kuhio Park Terrace	75%	25%	No Test	No Test
Kuhio Homes	82%	18%	3.2 - 5.1	1.6
HPHA Central Office	68%	32%	No Test	No Test

Table 1.4: Oahu Low-Rise Apartment Toilet Type and Flush Rates by Development

Development	Estimated % High Volume Toilets	Estimated % 1.6 GPF Toilets	Tested Flush Rate - High-Volume Toilets (GPF)	Tested Flush Rate - 1.6 GPF Toilets (GPF)
Puuwai Momi	0%	100%	n/a	No Test
Hale Laulima	67%	33%	No Test	No Test
Salt Lake	75%	25%	No Test	No Test
Waipahu I	0%	100%	n/a	2.2 - 5.2
Waipahu II	0%	100%	n/a	1.7 - 6.4
Kalihi Valley Homes	10%	90%	No Test	1.6 - 2.6
Mayor Wright Homes	50%	50%	2.1 - 5.0	1.3 – 3.2
Kaahumanu Homes	64%	36%	3.1 - 4.0	1.9 – 3.1
Kamehameha Homes	0%	100%	n/a	1.3 - 4.1
Spencer House	60%	40%	No Test	No Test
Waimaha-Sunflower	0%	100%	n/a	1.6 - 2.7
Kau'iokalani	0%	100%	n/a	1.6 - 2.0
Maili I	0%	100%	n/a	1.6 - 4.2
Maili II	0%	100%	n/a	1.4 - 6.0
Nanakuli Homes	0%	100%	n/a	1.7 - 6.0
Koolau Village	0%	100%	n/a	1.0 - 3.3
Hookipa Kahaluu	67%	33%	2.0 - 6.5	1.6 - 2.9
Kaneohe Apartments	0%	100%	n/a	1.9 - 5.4
Kauhale O'hana	0%	100%	n/a	1.9 - 3.9
Waimanalo Homes	0%	100%	n/a	1.2 - 3.0
Waimanalo Homes II	0%	100%	n/a	1.4 – 2.4
Kauhale Nani	0%	100%	n/a	No Test
Wahiawa Terrace	82%	18%	No Test	No Test
Kupuna Home O'Waialua	50%	50%	No Test	No Test
Palolo Valley Homes	42%	58%	2.8 - 4.8	1.5 - 4.0

Proposed Conditions

Ameresco proposes to replace all existing toilets, including both 3.5 GPF as well as 1.6 GPF models, at the developments included in this measure, with new, water conserving, high-efficiency (HET) toilets. HET rated toilets have flush rates of 1.28 GPF or less. Manufacturers such as Toto, American Standard, and Caroma, or equal, offer these products.

The new floor-mounted, floor-outlet, tank-type toilets will come equipped with Fluidmaster 400A fill valves, or a proprietary valve, instead of the standard ball float, which requires more frequent adjustments to maintain proper fill level in the toilet tank. The new apartment toilets will have a high-volume, three-inch flapper for efficient flushing. Caroma offers dual-flush models (1.28 GPF - .8 GPF). All flushometer toilets will be replaced with new HET china and piston flush valves. All bowls will be elongated types and bowl height (standard or ADA) will match existing. All apartments designated as accessible will be equipped with ADA compliant toilets.

Overall, Ameresco proposes to replace a total of 5,921 toilets, which includes 133 common area toilets. In addition, 30 urinal flush valves will be replaced with 0.5 GPF valves. Tables 1.5 - 1.8 list toilet replacement types and quantities, as well as urinal retrofit quantities, by development. Please refer to the Attachments for sample product cut sheets of the proposed plumbing fixtures.

Since the proposed replacement inventory was based on a sampling of apartments, final replacement fixture types and counts will be reconciled during construction with an equitable adjustment made to the project cost if necessary. In addition, Ameresco has budgeted for the replacement of damaged flanges and stop valves for up to 10% of the toilet installations. Any floor or wall refinishing work required in the event the new toilets do not match the existing toilet footprint is not included. However, Ameresco will make all reasonable efforts to specify new toilet products that closely match the existing toilet footprint to the extent possible without compromising water efficiency or installation quality. Also, repair of any existing damage due to floor rot from existing or past water leaks is excluded.

Table 1.5 Hawaii (Big Island) Toilet Replacement Quantities by Development and Toilet Type

Big Island	Total # Apts.	Total # Apartment Toilets	Total # Common Toilets	Type P-1	Type P-2	Type P-3	Type P-4	Type P-5	Type P-6	Type P-7	Type P-8	Type P-9	Urinal Retrofit	Total New Toilets
Lanakila Homes I	36	42	6		43	2		3					2	48
Lanakila Homes II	44	50	0		50									50
Lanakila Homes III	0	0	0											
Lanakila Homes IV	48	56	0		56									56
Hale Aloha O Puna	30	30	2		29	3								32
Hale Olaloa	50	50	2											
Kauhale O'Hanakahi	20	40	2											
Pahala	24	24	2		25	1								26
Pomaikai Homes	20	20	2		20			2						22
Punahele Homes	30	30	0		30									30
Ka Hale Kahaluu	50	80	1		81									81
Hale Hookipa	32	32	2		32	2								34
Kaimalino	40	42	1		43									43
Kealakehe	48	64	2		64	2							1	66
Nani Olu	32	32	2		32	2								34
Noelani II	24	48	2		48	2							1	50
Hale Hauoli	40	40	3		43								1	43
Ke Kumu 'Ekolu	20	40	0		38	2								40
Noelani I	19	19	0		19									19
Total	607	739	29	0	653	16	0	5	0	0	0	0	5	674

Table 1.6 Outer Islands Toilet Replacement Quantities by Island, Development and Toilet Type

Outer Islands	Total # Apts.	Total # Apartment Toilets	Total # Common Toilets	Type P-1	Type P-2	Type P-3	Type P-4	Type P-5	Type P-6	Type P-7	Type P-8	Type P-9	Urinal Retrofit	Total New Toilets
KAUAI														
Kapaa	36	46	4		48			2						50
Hale Hoolulu	12	12	1											
Hale Nana Kai O Kea	38	38	2		40								1	40
Hui O Hanamaulu	46	58	1		59									59
Kalaheo	8	10	0		10									10
Kekaha Ha'aheo	78	78	2		80									80
Eleele Homes	24	30	0		30									30
Hale Hoonanea (Port Allen)	40	40	1		41									41
Home Nani	14	14	0		14									14
Kawailehua - Federal	25	50	0		50									50
MAUI														
Kahekili Terrace [a&b]	82	94	2											
David Malo Circle	18	20	0											
Makani Kai Hale I	25	50	3											
Piilani Homes	42	42	3											
Makani Kai Hale II	4	8	0											
MOLOKAI														
Kahale Mua - Federal	25	42	2		42							2	1	44
Total	517	632	21	0	414	0	0	2	0	0	0	2	2	418

Table 1.7 Oahu High-Rise Toilet Replacement Quantities by Development and Toilet Type

Big Island	Total # Apts.	Total # Apartment Toilets	Total # Common Toilets	Type P-1	Type P-2	Type P-3	Type P-4	Type P-5	Type P-6	Type P-7	Type P-8	Type P-9	Urinal Retrofit	Total New Toilets
Kalakaua Homes	221	257	3		259	1							1	260
Makua Alii	211	211	9		212			8					3	220
Paoakalani	151	151	5		151			3	2				2	156
Punchbowl Homes	156	156	5		157			4					3	161
Kalanihuia	151	151	7		152			3	3				1	158
Makamae	124	124	1		4		120						0	124
Pumehana	139	139	2		139			2					0	141
Kuhio Park Terrace	614	656	7		42			619	2				2	663
Kuhio Homes	134	179	0		179								0	179
HPHA Central Office		0	21		19								2	19
Total	1,901	2,024	60	0	1,314	1	120	639	7	0	0	0	14	2,081

Table 1.8 Oahu Low-Rise Toilet Replacement Quantities by Development and Toilet Type

Big Island	Total # Apts.	Total # Apartment Toilets	Total # Common Toilets	Type P-1	Type P-2	Type P-3	Type P-4	Type P-5	Type P-6	Type P-7	Type P-8	Type P-9	Urinal Retrofit	Total New Toilets
Puuwai Momi	260	298	2		300									300
Hale Laulima	36	36	2		38									38
Salt Lake	28	49	0		49									49
Waipahu I	19	19	0		19									19
Waipahu II	20	20	0		19	1								20
Kalihi Valley Homes	373	511	8		515			4					1	519
Mayor Wright Homes	364	422	7		422			7					3	429
Kaahumanu Homes	152	152	0		152									152
Kamehameha Homes	221	257	3		260								1	260
Spencer House	17	33	1		34									34
Waimaha-Sunflower	130	130	3		130			1	2				1	133
Kau'iokalani	50	100	2		100							2	1	102
Maili I	20	20	0		20									20
Maili II	24	36	0		36									36
Nanakuli Homes	36	36	0		36									36
Koolau Village	80	128	3		128	1						2	1	131
Hookipa Kahaluu	56	72	2		72	2							1	74
Kaneohe Apartments	24	24	0		23	1								24
Kauhale O'hana	25	25	0		25									25
Waimanalo Homes	19	38	0		38									38
Waimanalo Homes II	22	44	0		44									44
Kauhale Nani	50	70	2											
Wahiawa Terrace	60	68	1		67	2								69
Kupuna Home O'Waialua	40	40	2		40	2								42
Palolo Valley Homes	118	154	0		144		10							154
Total	2,244	2,782	38		2,711	9	10	12	2	0	0	4	9	2,748

Table 1.5 - 1.8 Key for Toilet Types

P-1.	**Gravity Flush, Tank-Type Toilet, Standard Height, Round Front, Floor Mounted, Floor outlet, 1.28 gpf**
P-2.	**Gravity Flush, Tank-Type Toilet, Standard Height, Elongated Front, Floor Mounted, Floor Outlet, 1.28 gpf**
P-3.	**Gravity Flush, Tank-Type Toilet, ADA Height Compliant, Elongated Front, Floor Mounted, Floor Outlet, 1.28 gpf**
P-4.	**Pressure-Assist, Tank-Type Toilet, Elongated Front, Floor Mounted, Wall Outlet, 1.28 gpf**
P-5.	**Flushometer bowl and valve, Standard Height, Elongated Front, Floor Mounted, Floor Outlet, 1.28 gpf**
P-6.	**Flushometer bowl and valve, ADA Height Compliant, Floor Mounted, Floor Outlet, 1.28 gpf**
P-7	**N/A**
P-8.	**N/A**
P-9.	**Flushometer bowl and valve, ADA Height Compliant, Wall Mounted, Wall Outlet, 1.28 gpf**

Notes: Urinal retrofit includes new, .5 GPF, piston-type flush valve.

All new tank-type toilets will be furnished complete with new seats and braided water supply connections. Flushometer toilets will be equipped with new seats and piston-type flush valve.

ECM 2:
Install Low-Flow Showerheads & Faucet Aerators

Developments Affected

All sites except Hale Olaloa, Kauhale O'Hanakahi, Hale Hoolulu, All Maui Sites, and Kauhale Nani

Existing Conditions

Measured flow rates for apartment showerheads ranged from 1.5 to 5.5 gallons-per-minute (GPM). However, the majority of showerheads were found to have measured flow rates of 2.0 to 3.0 GPM.

The existing kitchen and bathroom sink faucets have aerators with measured flow rates ranging from 1.0 to as high as 6.0 GPM. Most aerator flow rates ranged from 2.0 to 2.5 GPM. Although most faucets have aerators installed, a number of faucets with no aerators were encountered during the energy audit at a number of developments. Furthermore, at Kuhio Park Terrace high rises, a number of existing kitchen faucets have no aerators and were leaking. At Mayor Wright, many of the existing bath sinks are equipped with aging sinks having separate faucets for hot and cold water. In both cases, aerator installation is not possible without first replacing the faucet hardware.

Determination of the quantities, tested flow rates, and types of aerators and showerheads was based on information gathered by sampling approximately 10% of the apartments and all common areas during the energy audit.

Proposed Conditions

At locations where new toilets are installed, Ameresco also proposes to install new, low-consumption faucet aerators and showerheads. Ameresco proposes to furnish and install a total of 4,006, 1.75 GPM fixed-head showerheads and 1,245, 1.5 GPM hand-held models. Fixed-head showerheads will

be NRG Model ES-220C-75, or equal, and hand-held units will be NRG Model ES-735HHW-1.5, or equal.

Ameresco also proposes to replace a total of 10,887 faucet aerators with new models rated at 1.5 GPM for kitchens and 1.0 GPM for bathrooms. A total of 5,921 bathroom and 4,966 kitchen faucet aerators will be replaced. The aerator and showerhead replacement schedules are shown in Tables 2.1 and 2.2 below. Bathroom aerators will be NRG Model TS-100S, or equal. Kitchen aerators will be NRG Model TS-350, or equal. Please refer to the Attachments for sample product cut sheets of the proposed plumbing fixtures.

The Kuhio Park Terrace High Rise kitchen faucets that will be replaced under ECM-4 will also include low-flow-aerators. At Mayor Wright, Ameresco considered installing new sinks along with faucet hardware. However, the long payback associated with this measure precluded its inclusion in this project.

Since the proposed replacement inventory was based on a sampling of apartments, final replacement fixture types and counts will be reconciled during construction with an equitable adjustment made to the project cost if necessary.

Table 2.1 Big Island & Neighbor Island Showerhead and Faucet Aerator Replacement Quantities by Development

Big Island Developments	Shower Heads Fixed	Shower Heads Handheld	Bath Aerators	Kitchen Aerators	Neighbor Island Developments	Shower Heads Fixed	Shower Heads Handheld	Bath Aerators	Kitchen Aerators
Lanakila Homes I	42	0	48	36	KAUAI				
Lanakila Homes II	50	0	50	44	Kapaa	32	5	50	36
Lanakila Homes III					Hale Hoolulu				
Lanakila Homes IV	56	0	56	48	Hale Nana Kai O Kea	23	15	40	38
Hale Aloha O Puna	0	30	32	30	Hui O Hanamaulu	35	12	59	46
Hale Olaloa					Kalaheo	8	0	10	8
Kauhale O'Hanakahi					Kekaha Ha'aheo	78	0	80	78
Pahala	0	24	26	24	Eleele Homes	20	4	30	24
Pomaikai Homes	10	10	22	20	Hale Hoonanea (Port Allen)	24	16	41	40
Punahele Homes	15	15	30	30	Home Nani	14	0	14	14
Ka Hale Kahaluu	60	20	81	50	Kawailehua - Federal	25	0	50	25
Hale Hookipa	16	16	34	32	MAUI				
Kaimalino	24	16	43	40	Kahekili Terrace [a&b]				
Kealakehe	48	0	66	48	David Malo Circle				
Nani Olu	32	0	34	32	Makani Kai Hale I				
Noelani II	16	8	50	24	Piilani Homes				
Hale Hauoli	30	10	43	40	Makani Kai Hale II				
Ke Kumu 'Ekolu	40	0	40	20	MOLOKAI				
Noelani I	19	0	19	19	Kahale Mua - Federal	6	19	44	25
Big Island Sub Total	458	149	674	537	Neighbor Islands Sub Total	265	71	418	334

Table 2.2 Oahu High-Rise & Low-Rise Showerhead and Faucet Aerator Replacement Quantities by Development

Oahu High-Rise Developments	Shower Heads Fixed	Shower Heads Handheld	Bath Aerators	Kitchen Aerators	Oahu Low-Rise Developments	Shower Heads Fixed	Shower Heads Handheld	Bath Aerators	Kitchen Aerators
Kalakaua Homes	186	35	260	221	Puuwai Momi	182	78	300	260
Makua Alii	0	211	220	211	Hale Laulima	27	9	38	36
Paoakalani	124	27	156	151	Salt Lake	25	24	49	28
Punchbowl Homes	107	49	161	156	Waipahu I	13	6	19	19
Kalanihuia	113	38	158	151	Waipahu II	13	7	20	20
Makamae	124	0	125	124	Kalihi Valley Homes	352	21	519	373
Pumehana	79	60	141	139	Mayor Wright Homes	278	86	429	364
Kuhio Park Terrace	558	56	663	614	Kaahumanu Homes	140	12	152	152
Kuhio Homes	121	13	179	134	Kamehameha Homes	181	76	260	221
HPHA Central Office			18		Spencer House	33	0	34	17
					Waimaha-Sunflower	130	0	133	130
					Kau'iokalani	75	25	102	50
					Maili I	10	10	20	20
					Maili II	27	9	36	24
					Nanakuli Homes	24	12	36	36
					Koolau Village	80	48	131	80
					Hookipa Kahaluu	32	24	74	56
					Kaneohe Apartments	16	8	24	24
					Kauhale O'hana	25	0	25	25
					Waimanalo Homes	22	11	38	19
					Waimanalo Homes II	23	8	44	22
					Kauhale Nani				
					Wahiawa Terrace	53	15	69	60
					Kupuna Home O'Waialua	0	40	42	40
					Palolo Valley Homes	109	9	154	118
Oahu High-Rise Sub Total	1,414	487	2,081	1,901	Oahu Low-Rise Sub Total	1,870	538	2,748	2,194

ECM 3:
Install Front-Loading Washers

Developments Affected

Pahala, Ka Hale Kahaluu, Hale Hookipa, Kealakehe, Noelani II, Hale Hauoli, Noelani I, Kahale Mua, Kalakaua Homes, Makua Alii, Paoakalani, Punchbowl Homes, Kalanihuia, Makamae, Pumehana, Kuhio Park Terrace, Salt Lake, Waipahu II, Spencer House, Waimaha-Sunflower, Kau'iokalani, Hookipa Kahaluu, and Kupuna Home O'Waialua

Existing Conditions

Tables 3.1 and 3.2 present the sites with central laundry facilities, as well as types and quantities of washers, and whether the equipment is owned or leased by HPHA. One site, Kekaha Ha'aheo, also has apartment hookups for washers, while all other developments appear to have exclusively apartment hookups.

Laundry equipment leasing companies include: TW Systems, Commercial Route Operator, Luke/Starbucks and Dexter Lee. The Hawaii Public Housing Authority pays for all utilities associated with the central laundry facilities and shares revenues with the leasing companies.

Figure 3.1 These top-loading washers are typical of what is found in HPHA's central laundries. Top-loading washers use significantly more water than front-loading models.

Table 3.1 Big Island & Neighbor Islands Existing Central Laundry Washer Quantities

Big Island Developments	Qty Existing Top-Load Washers	Qty Existing Front-Load Washers	HPHA Leased or Owned	Neighbor Island Developments	Qty Existing Top-Load Washers	Qty Existing Front-Load Washers	HPHA Leased or Owned
Lanakila Homes I				KAUAI			
Lanakila Homes II				Kapaa			
Lanakila Homes III				Hale Hoolulu	1	0	Owned
Lanakila Homes IV				Hale Nana Kai O Kea	2	0	Owned
Hale Aloha O Puna	1	0	Owned	Hui O Hanamaulu			
Hale Olaloa	3	0	Leased	Kalaheo			
Kauhale O'Hanakahi	2	0	Leased	Kekaha Ha'aheo	2	0	Owned
Pahala	2	0	Leased	Eleele Homes			
Pomaikai Homes	1	0	Owned	Hale Hoonanea (Port Allen)	2	0	Owned
Punahele Homes				Home Nani	1	0	Owned
Ka Hale Kahaluu	6	2	Leased	Kawailehua - Federal			
Hale Hookipa	3	0	Leased	MAUI			
Kaimalino			Leased	Kahekili Terrace [a&b]			
Kealakehe	5	0	Leased	David Malo Circle			
Nani Olu	2	1	Owned	Makani Kai Hale I	3	1	Leased
Noelani II	3	0	Owned	Piilani Homes	3	0	Leased
Hale Hauoli	2	1	Leased	Makani Kai Hale II			
Ke Kumu 'Ekolu	2	1	Owned	MOLOKAI			
Noelani I	2	0	Leased	Kahale Mua - Federal	3	1	Leased
Big Island Sub Total	34	5		Neighbor Islands Sub Total	17	2	

Table 3.2 Oahu High-Rise and Low-Rise Existing Central Laundry Washer Quantities

Oahu High-Rise Developments	Qty Existing Top-Load Washers	Qty Existing Front-Load Washers	HPHA Leased or Owned	Oahu Low-Rise Developments	Qty Existing Top-Load Washers	Qty Existing Front-Load Washers	HPHA Leased or Owned
Kalakaua Homes	13	2	Leased	Puuwai Momi			
Makua Alii	1	3	Leased	Hale Laulima			
Paoakalani	4	1	Leased	Salt Lake	2	1	Leased
Punchbowl Homes	2	1	Leased	Waipahu I	0	0	Removed
Kalanihuia	4	1	Leased	Waipahu II	2	0	Leased
Makamae	3	1	Leased	Kalihi Valley Homes			
Pumehana	4	1	Leased	Mayor Wright Homes			
Kuhio Park Terrace	24	0	Owned	Kaahumanu Homes			
Kuhio Homes				Kamehameha Homes			
				Spencer House	2	1	Leased
				Waimaha-Sunflower	9	0	Leased
				Kau'iokalani	4	1	Leased
				Maili I			
				Maili II			
				Nanakuli Homes			
				Koolau Village			
				Hookipa Kahaluu	4	1	Leased
				Kaneohe Apartments	0	0	Removed
				Kauhale O'hana	0	0	Removed
				Waimanalo Homes			
				Waimanalo Homes II			
				Kauhale Nani	4	1	Leased
				Wahiawa Terrace			
				Kupuna Home O'Waialua	2	0	Leased
				Palolo Valley Homes			
Oahu High-Rise Sub Total	55	10		Oahu Low-Rise Sub Total	29	5	

Proposed Conditions

As part of the water conservation program, Ameresco recommends that top-loading washers in central laundries be replaced with front-loading washers at select sites also receiving new apartment-based water conservation fixtures. Please refer to Tables 3.3 and 3.4 for a list of sites and washer quantities included in this project.[1] In most cases, replacing HPHA-owned washers did not prove feasible. In those cases, we listed the cost, savings and payback under section 3.0.19, Measures Considered But Not Recommended.

Front-loading washing machines use substantially less water and energy and require less detergent to clean the same amount of laundry, if not more, per load, than top-loading models. Also, water extraction is significantly improved, reducing dryer times for residents.

For the leased equipment, Ameresco has not included any appliance costs or vendor fees associated with replacing the existing washers with front-loading units at any of the central laundry sites, as laundry equipment vendors are usually amenable to swapping the washers at no cost. (However, some vendors require a revised or new lease be executed as condition of this swap-out.) The costing included with this measure applies to only HPHA-owned washers.

Table 3.3 Big Island & Neighbor Island Proposed Central Laundry Washer Replacement Quantities

Big Island Developments	Qty Proposed Front-Load Washers	HPHA Leased or Owned	Neighbor Island Developments	Qty Proposed Front-Load Washers	HPHA Leased or Owned
Pahala	2	Leased	MOLOKAI		
Ka Hale Kahaluu	6	Leased	Kahale Mua - Federal	3	Leased
Hale Hookipa	3	Leased			
Kealakehe	5	Leased			
Noelani II	3	Owned			
Hale Hauoli	2	Leased			
Noelani I	2	Leased			
Big Island Sub Total	23		Neighbor Islands Sub Total	3	

[1] HPHA could also consider replacing top-loading washers at other sites with central laundries for additional savings.

Table 3.4 Oahu High- & Low-Rise Proposed Central Laundry Washer Replacement Quantities

Oahu High-Rise Developments	Qty Proposed Top-Load Washers	HPHA Leased or Owned	Oahu Low-Rise Developments	Qty Proposed Top-Load Washers	HPHA Leased or Owned
Kalakaua Homes	13	Leased	Salt Lake	2	Leased
Makua Alii	1	Leased	Waipahu II	2	Leased
Paoakalani	4	Leased	Spencer House	2	Leased
Punchbowl Homes	2	Leased	Waimaha-Sunflower	9	Leased
Kalanihuia	4	Leased	Kau'iokalani	4	Leased
Makamae	3	Leased	Hookipa Kahaluu	4	Leased
Pumehana	4	Leased	Kupuna Home O'Waialua	2	Leased
Kuhio Park Terrace	24	Owned			
Oahu High-Rise Sub Total	55		Oahu Low-Rise Sub Total	25	

ECM 4:
Install New Sink Faucets

Developments Affected

Kuhio Park Terrace High Rise Buildings A & B

Existing Conditions

During the site inspection for the energy audit, Ameresco observed leaking kitchen faucets in a number of the apartments. In addition, these kitchen sink faucets cannot be retrofit with standard aerators.

Proposed Conditions

Ameresco proposes to replace all kitchen faucets at Kuhio Park Terrace high rise buildings A and B with new water-efficient models. A total of 572 kitchen sinks will be fitted with new hardware. The new faucet hardware will be Delta Classic two-handle kitchen faucets, or equivalent, and will be fitted with 1.5 gallons-per-minute (GPM) aerators.

In addition, an allowance for replacement of failed kitchen sink shut-off valves for up to 10% of the installations is included.

Figure 4.1 Kuhio Park Terrace existing kitchen faucets

ECM 5:
Install Efficient Building Water Pressure Controls

Developments Affected

Kalakaua Homes, Paoakalani, and Kalanihuia

Existing Conditions

Domestic water booster pumps are used at the sites listed above to maintain sufficient water pressure throughout all levels of the buildings. However, the existing booster systems are oversized and poorly controlled, which not only wastes electrical energy, but also contributes to water waste by over pressurizing apartment plumbing fixtures, such as faucet aerators and showerheads, and exacerbating leaks. Even though the recommended minimum delivered water pressure for top floor apartments is 30 PSI, the actual delivered water pressures at the upper levels of these three sites was measured at over 60 PSI, over twice the recommended pressure. Delivered pressure on lower floors is even higher, with ground floor readings in excess of 100 PSI observed.

Figure 5.1: Ameresco will replace many of the existing water booster pumps that run at constant speed, regardless of load with new, high-efficiency, variable speed, dual pump packaged booster pump systems. This will result in more effective and efficient building water pressure delivery.

Currently, Kalakaua Homes has three, 7.5 horsepower domestic water booster pumps. Two of these pumps run constantly while the third is a spare. Paoakalani has two, 15 horsepower booster pumps, while Kalanihuia has two, 7.5 horsepower booster pumps. In these two cases, the pumps run in lead/lag configuration. Constant water pressure set point is maintained with a pressure reducing valve and the pumps operate at constant speed. Furthermore, all of these pumps are equipped with older vintage, standard efficiency motors.

Proposed Conditions

Ameresco proposes to replace the current booster pumps with new, high-efficiency, variable speed, dual pump packaged booster pump systems. The new booster pumps will be equipped with variable frequency drives (VFDs) and controls, resulting in more effective and efficient building water pressure delivery.

Bell & Gossett 70VS Series booster pumps, or equal, are recommended for this application. The new pump packages will include premium efficiency motors, variable frequency drives, and digital controls for pressure control, pump staging and rotation, and low-load shutdown. The variable frequency drives will control the delivered water pressure by modulating the pumps to maintain a constant pressure at the highest elevation in the building. A new pressure sensor will be installed on the top floor of each building to provide feedback to the booster pump controller. Additionally, hydro-pneumatic tanks will be provided to maintain water pressure for extended periods when the pumps shut down during low loads. New or existing pressure reducing valves will be included and used only in the event of drive failure.

These new packaged system pumps and motors have been sized based on existing design loading and in most cases, downsized from existing conditions. With the proposed two-stage pump configuration, the pumps will be cycled for efficiency and to maximize pump life.

Electricity savings will result by controlling the pump motor speed with the VFDs. Since the amount of power consumed with a VFD varies with nearly the cube of the motor speed, use of the VFDs in place of existing constant speed drives will result in lower motor power consumption under most operating conditions. In addition, the use of premium efficiency motors will result in further energy savings.

The existing pumps at Kalakaua and Paoakalani will be replaced by two new 7.5 hp pumps per site, while the pumps at Kalanihuia will be replaced by two new 5 hp pumps.

Utility Incentives

The Hawaiian Energy Efficiency Program offers generous prescriptive rebates for new packaged booster pump systems with VFDs. As of September 2009, this rebate is valued at $1,600 per system. Ameresco estimates that the total value of this incentive for the included developments is $4,800.

Maintenance Considerations

The proposed water booster pumps will require regular maintenance and service to maintain the projected energy savings. In the maintenance cost estimate included in the project cash flow, Ameresco has budgeted for normal preventative maintenance and potential equipment failures over

the 20 year project term. These maintenance assumptions are presented in Table 5.1. A levelized annual service cost of $4,714 was estimated and carried in Year 1 of the project cash flow, escalating at 3% annually.

Table 5.1: Budgeted Maintenance Items for Variable Speed Water Booster Systems

Service Items	Frequency
Clean and inspect drive contacts and verify control settings	Annually
Replace 50% of all drives	Every 10 Years
Replace 50% of all remote pressure sensors	Every 10 Years

Scope of Work

Replace existing domestic water booster pumps at Kalakaua Midrise, Paoakalani High Rise, and Kalanihuia High Rise in accordance with the scope of work below.

- All work shall be done in accordance with applicable state and local plumbing codes.

Kalakaua Mid-Rise

- Disconnect, remove, and legally dispose of existing 7.5 hp, constant –speed packaged booster pumps and associated controls and equipment made obsolete by the new work.
    - Demo and remove existing concrete pad.
- Install new 4" 4'x7' concrete pad in place of the existing pad.
- Provide and install new B&G 70VS Series, 2-Pump Variable Speed Pressure Booster Package (or equal), in accordance with manufacturer's instructions. Provide factory authorized start-up.
    - Variable Speed Booster Package shall be equipped with 7.5 hp pumps.
- Connect new packaged booster pump 4" suction and discharge header to existing city water and building cold water lines.
- Provide and install conductors and conduit to connect the existing booster pump power circuits to the new packaged unit.
- Provide and install one B&G WTA-404 (or equal) hydro-pneumatic tank. New hydro-pneumatic tank shall have acceptance volume of 15 gallons and shall be ASME rated.
    - Mount new hydro-pneumatic tank on the new concrete pad.
    - Charge tank to 80 PSI
    - Connect new tank to output of the packaged booster pump discharge header after the PRVs.

- Provide and install one new B&G Powersave ST-101 (or equal) pressure transducer in the 1/2"cold water supply feed on the 10th floor supply closet mop sink riser. Provide and install 24Vcontrol wiring between new pressure transducer and new packaged booster pump control panel. Any exposed control wiring in public areas or mechanical rooms must be in conduit. Control wiring that is run above a ceiling plenum does not require conduit.

Paoakalani High-Rise

- Disconnect, remove, and legally dispose of existing 15 hp, constant –speed booster pumps and associated controls and equipment made obsolete by the new work.
    - Demo and remove existing concrete pads.
    - Demo and remove existing, separate booster pump discharge headers and PRVs back to building distribution tie-in point at mechanical room ceiling.
- Install new 4" 4'x7' concrete pad in place of the existing pads.
- Provide and install new B&G 70VS Series, 2-Pump Variable Speed Pressure Booster Package (or equal), in accordance with manufacturer's instructions. Provide factory-authorized start-up.
    - Variable Speed Booster Package shall be equipped with 7.5 hp pumps.
- Connect new packaged booster pump 4" suction and discharge header to existing city water and building cold water lines.
- Provide and install conductors and conduit to connect the existing booster pump power circuits to the new packaged unit.
- Provide and install one B&G WTA-404 (or equal) hydro-pneumatic tank. New hydro-pneumatic tank shall have acceptance volume of 22.5 gallons and shall be ASME rated.
    - Mount new hydro-pneumatic tank on the new concrete pad.
    - Charge tank to 100 PSI
    - Connect new tank to output of the packaged booster pump discharge header after the PRVs.
- Provide and install one new B&G Powersave ST-101 (or equal) pressure transducer in the 1/2"cold water supply feed on the 16th floor supply closet mop sink riser. Provide and install 24Vcontrol wiring between new pressure transducer and new packaged booster pump control panel. Any exposed control wiring in public areas or mechanical rooms must be in conduit. Control wiring that is run above a ceiling plenum does not require conduit.

Kalanihuia High-Rise

- Disconnect, remove, and legally dispose of existing, 7.5 hp, constant –speed packaged booster pumps and associated controls and equipment made obsolete by the new work.

  - Demo and remove existing concrete pad.
  - Demo and remove existing CW risers between booster pumps and CW distribution header at pump room ceiling. Existing PRVs to remain.
- Install new 4" 4'x7' concrete pad in place of the existing pads.
- Provide and install new B&G 70VS Series, 2-Pump Variable Speed Pressure Booster Package (or equal), in accordance with manufacturer's instructions. Provide factory-authorized start-up.
  - Variable Speed Booster Package shall be equipped with 5 hp pumps.
- Connect new packaged booster pump 4" suction and discharge header to existing city water and CW distribution header at pump room ceiling.
- Adjust existing PRVs at pump room ceiling to new settings.
- Provide and install conductors and conduit to connect the existing booster pump power circuits to the new packaged unit.
- Provide and install one B&G WTA-404 (or equal) hydro-pneumatic tank. New hydro-pneumatic tank shall have acceptance volume of 19 gallons and shall be ASME rated.
  - Mount new hydro-pneumatic tank on the new concrete pad.
  - Charge tank to 90 PSI
  - Connect new tank to existing domestic service CW distribution at pump room ceiling after the existing PRVs.
- Provide and install one new B&G Powersave ST-101 (or equal) pressure transducer in the 1/2"cold water supply feed on the 15th floor supply closet mop sink riser. Provide and install 24Vcontrol wiring between new pressure transducer and new packaged booster pump control panel. Any exposed control wiring in public areas or mechanical rooms must be in conduit. Control wiring that is run above a ceiling plenum does not require conduit.

ECM 6:
Upgrade Common Area Lighting

Developments Affected

All sites except Punahele Homes, Kalaheo, Eleele Homes, Kawailehua – Federal, David Malo Circle, Kuhio Homes, Salt Lake, Kaahumanu Homes, Maili I & II, and Waimanalo Homes & Waimanalo Homes II

Existing Conditions

Common area lighting at the HPHA developments varies widely by fixture type and efficiency. While some fixtures have already been upgraded with more efficient fluorescent technologies, there are still a number of fixtures that have yet to be upgraded. Approximately 35% of the common area fixtures are equipped with energy-efficient technologies including T8 linear fluorescent lamps, compact fluorescents, high-pressure sodium, and LED exit signs.

Incandescent lamps make up 16% of the existing common area fixtures. T12 linear and U-tube fluorescent lamps are used in wraps and troffers and make up 46% of common area fixtures. Existing T8 lamps account for 7%, compact fluorescent lamps make up 19%, and circline lamps 1%. The remaining common area fixtures, primarily used in exterior applications (with the exception of LED exit signs), are made up of 8% high pressure sodium, 1% metal halide, 1% LED and 1% mercury vapor.

The operating schedules of the various lighting systems were determined through a combination of staff interviews, field observations, and data from similar housing projects throughout the country. A detailed list of existing fixtures by development and location can be found in Common Area Lighting Audit in the Attachments.

Proposed Conditions

Ameresco proposes to install energy efficient lighting systems in the common areas for HPHA that will reduce existing energy and maintenance costs. The upgrade will feature primarily new, premium efficiency, 28-Watt T8 lamps operating on electronic ballasts, which will improve the overall color, quality, and consistency of the lighting. Ballast output will be tailored to each specific location, in order to obtain desired light levels without sacrificing potential energy savings.

Incandescent lamps will be replaced with high-quality compact fluorescent lamps or fixtures, providing equal or greater light output. Selected high pressure sodium, metal halide and mercury vapor fixtures will be replaced with more efficient compact fluorescents. The proposed retrofits are recommended based on maintaining or improving light levels so no adverse impact will be experienced by tenants, visitors, and staff.

In selected areas, such as offices, restrooms, and community rooms, having intermittent occupancy, Ameresco will also install occupant-sensing controls.

Please refer to the Common Area Lighting Audit in the Attachments for detailed information on the proposed retrofits by development and location. The Attachments also include sample product cut sheets for the proposed retrofits. Note that common area lighting improvements for Makani Kai Hale II are included under Makani Kai Hale I in the costs and savings summary, but the lighting audit in the Attachments has the retrofits grouped under Makani Kai Hale II. Similarly, all common area lighting improvements at Lanakila I, II and IV are grouped under Lanakila I.

Efficiency Incentives/Rebates

Ameresco will work together with SAIC, the efficiency administrator for HECO, HELCO, and MECO, and Kauai Island Utility Cooperative (KIUC) to secure all available efficiency incentives on behalf of HPHA. Based on current efficiency incentive levels, Ameresco expects to obtain approximately $38,101 for common area lighting efficiency improvements.

ECM 7:
Upgrade Apartment Lighting

Developments Affected

All sites except Mayor Wright

Existing Conditions

Typical lighting fixtures encountered in the apartments include globes, drums, squares, jars, and vanities. These fixtures are found in kitchens, bedrooms, baths, hallways, and living and dining areas. The most common lamp type used is a 60-Watt incandescent. Incandescent lamps make up 53% of all apartment lighting. T8 linear fluorescent lamps, as well as the less efficient T12 lamps, are used in wrap fixtures in some kitchens and bathrooms. These linear fluorescent lamps make up 22% of all interior lamps, with 11% T8 and 11% T12 and fluorescent circline fixtures account for 3%. Energy-efficient compact fluorescent lamps are used in a variety of fixtures, but mostly drums. A number of the compact fluorescent lamps are "screw-in" types that are installed in incandescent fixtures. Compact fluorescent lamps make up 22% of all interior lamps. A more detailed list of existing fixtures by development and location can be found in the Apartment Lighting Audit in the Attachments.

Proposed Conditions

The primary lighting retrofit in the apartments will consist of new compact fluorescent fixtures. New compact fluorescent drums, squares, wall packs, vanities and sconces will be installed to replace like fixtures currently using incandescent lamps in kitchens, bedrooms, baths, halls and living and dining areas. Existing fluorescent fixtures with either T8 or T12 lamps will also be upgraded to premium T8 lamps with electronic ballasts.

Ameresco proposes to use pin-based compact fluorescent fixtures which will help ensure that incandescent lamps are not re-installed into fixtures, thereby maintaining long-term persistence of

energy savings. Ameresco will retrofit existing incandescent fixtures with tamper-resistent, pin-based sockets in areas with low hours of use, such as closets, as well as in kitchen range hoods, and in fixtures that are known to be mounted on asbestos-containing material (ACM) surfaces. Developments with known ACMs which will impact the apartment lighting retrofits include: Paoakalani (bathroom ceiling-mounted fixtures only), Kalanihuia, Pumehana, Salt Lake, Kalihi Valley Homes (non-modernized apartments only), and Spencer House.

All new lamp and fixture combinations will have equal, or greater light output when compared with the existing lighting fixtures.

Please refer to the Apartment Lighting Audit in the Attachments for information on the proposed retrofits for the apartments. The Attachments also include sample product cut sheets for the proposed retrofits. Note that apartment lightig improvements for Lanakila IV are included under Lanakila I & II.

Efficiency Incentives/Rebates

Ameresco will work together with SAIC, the efficiency administrator for HECO, HELCO, and MECO, and Kauai Island Utility Cooperative (KIUC) to secure all available efficiency incentives on behalf of HPHA. Of utmost importance to SAIC in distributing rebates for HECO, HELCO, and MECO, is persistence of savings. Lighting efficiency improvements in apartments for these utilities are not currently eligible for incentives due to concern over savings persistence with residents having primary responsibility for changing lamps. SAIC would require a letter from HPHA stating that the authority is responsible for maintaining fixtures and changing lamps in order to receive incentives. However, KIUC is willing to provide incentives for lighting efficiency improvements in apartments.

Based on current efficiency incentive levels, Ameresco expects to obtain approximately $23,650 for apartment lighting efficiency improvements from KIUC. With a change in current policy and a commitment to maintain the apartment lighting fixtures and assume responsibility for changing the lamps in all elderly and family apartment units, HPHA could be eligible for approximately $188,000 in incentives. Alternatively, HPHA could agree to maintain fixtures for specific developments, such as those housing elderly residents, where it is likely that maintenance staff already changes the majority of the lamps for the residents, and receive a rebate of approximately $38,230.

ECM 8:
Upgrade Air Conditioning Systems

Developments Affected

Lanakila I, Kappa, Puuwai Momi, and Mayor Wright

Existing Conditions

Window type air conditioning units are found in offices and community buildings throughout various developments. Some apartments also have window air conditioners, when there is a medical requirement for a tenant. The units recommended for replacement in this measure affect only common area units, determined to have a payback on investment within 10 years. These units are listed on Table 8.1.

Proposed Conditions

Ameresco proposes to replace the existing window air conditioning units listed in Table 8.1 with Energy Star units. Please refer to the attachments for sample product cut sheets of the proposed equipment.

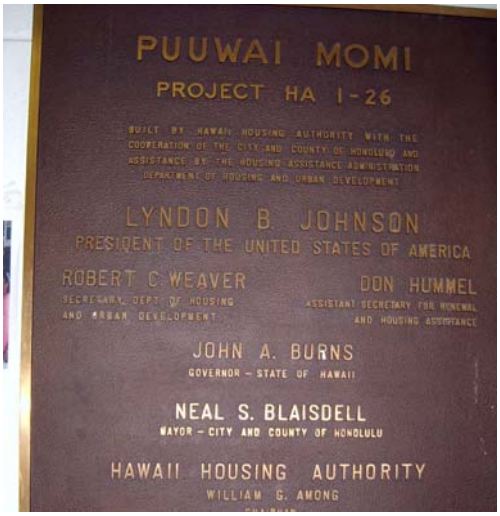

Figure 8.1: Ameresco proposes to replace many of the old window air conditioning units with new energy efficient ones.

Table 8.1 Window Air Conditioning Unit Replacement Schedule

Site	Location	Type	Existing BTU	Existing EER	Proposed BTU	Proposed EER
Lanakila I	Managers office	window	6500	9.7	6000	10.7
Lanakila I	Room 8	window	6500	9.7	6000	10.7
Lanakila I	Office	window	8000	9.8	7800	10.8
Lanakila I	Room 1	window	10000	7.5	10000	10.8
Kappa	Community Hall	window	15000	9.7	15000	10.8
Kappa	Reception Area	window	15000	9.7	15000	10.8
Kappa	Maintenance Foreman Office	window	6000	9.5	6000	10.7
Kappa	Maintenance Office	window	7800	9.7	7800	10.8
Puuwai Momi	Office 2	window	8000	8.5	7800	10.8
Puuwai Momi	File Room	window	8000	8.5	7800	10.8
Puuwai Momi	Office 3	window	8000	9.5	7800	10.8
Mayor Wright	Office	window	13500	9.5	12000	10.8
Mayor Wright	Office	window	13500	9.5	12000	10.8
Mayor Wright	Office	window	13500	9.5	12000	10.8

ECM 9:
Install Energy Star Refrigerators

Developments Affected

Kauhale O'Hanakahi, Pahala, Hale Hookipa, Noelani II, Noelani I, Kapaa, Hale Nana Kai O Kea, Hui O'Hanamaulu, Kalaheo, Hale Honanea (Port Allen), Kahekili Terrace [a & b], Piilani Homes, David Malo Circle, Makani Kai Hale I, Makamae, Mayor Wright Homes, Kamehameha Homes, Spencer House, and Waimanalo Homes

Existing Conditions

The existing refrigerators in HPHA apartments and common areas range in age and efficiency and come in a variety of makes and models. Sizes of existing refrigerators typically range from 14 to 18 cubic feet. Typical manufacturers include GE, Hotpoint, Magic Chef, Kenmore, Frigidaire, Whirlpool and Roper. Annual rated refrigerator energy consumption ranges from 372 kWh to 1,651 kWh, depending on the age and model of the refrigerator.

Determination of the quantities and vintages of existing refrigerators was based on information gathered by sampling approximately 10% of the apartments and 100% of the common areas during the energy audit.

Figure 9.1 Existing, aging refrigerator models will be replaced with new energy efficient types.

Proposed Conditions

Ameresco proposes to install 591 Hotpoint Model HTH16BBX refrigerators to replace selected, less efficient 14-18 cubic foot (CF) models as indicated in Table 9.1. The Hotpoint refrigerator specified is a 16 CF, Energy Star model rated at 363 kWh per year.

Units selected for replacement included sites where the aggregate payback was within approximately 10 years, which represents the typical life of a house hold refrigerator. Other sites considered but not recommended for this measure are listed in section 3.B.19.

Since the proposed replacement counts were based on a sampling of apartments, final appliance replacement counts will be reconciled during construction with an equitable adjustment made to the project cost if necessary.

Table 9.1 Refrigerator Replacement Schedule for Site

Development Name	Total Apartments	Replacement Qty (16CF)
Kauhale O'Hanakahi	20	1
Pahala	24	7
Hale Hookipa	32	17
Noelani II	24	1
Noelani I	19	5
Kapaa	36	9
Hale Nana Kai O Kea	38	21
Hui O Hanamaulu	46	25
Kalaheo	8	4
Hale Hoonanea (Port Allen)	40	10
Kahekili Terrace [a & b]	82	36
Piilani Homes	42	35
David Malo Circle	20	17
Makani Kai Hale I	24	8
Makamae	124	46
Mayor Wright Homes	364	110
Kamehameha Homes	221	208
Spencer House	17	17
Waimanalo Homes	19	14
Total		591

ECM 10: Install Vending Machine Controls

Developments Affected

Kuhio Park Terrace, Kalanihuia, and HPHA Central Office

Existing Conditions

The existing beverage machines at the developments listed above are typically stocked with soda and/or juice, and the machines are lit and cooled 24 hours per day regardless of occupancy or activity.

Proposed Conditions

Ameresco proposes to install occupancy sensing, plug load controllers to reduce the unnecessary operation of the existing vending machines during unoccupied periods. The controllers will use sensors to detect when the space or area is unoccupied and turn off the vending machines without compromising product quality.

Ameresco proposes to install a total of six VendingMiser™ controllers on six soft drink vending machines listed in Table 10.1. The controller is external to the vending machine, and does not require vendor maintenance. Major soft drink manufacturers have approved the controller for use on beverage machines offering their products.

The controller employs infrared sensing technology to interrupt power to a vending machine when the surrounding area is unoccupied. Regardless of occupancy, the controller intermittently enables

the refrigerated vending machines to ensure that the product remains cold. The controller is designed so that it will not de-energize the vending machine during a cooling compressor cycle. Please refer to the Attachments for product information.

Table 10.1: Beverage Machine Quantities by Development

Development	Beverage Machine Qty
Kuhio Park Terrace	4
Kalanihuia	1
HPHA Central Office	1
Total	6

ECM 11:
Consolidate Electric Meters

Developments Affected

Waipahu II and Wahiawa Terrace

Figure 11.1: HPHA pays the utility company a separate monthly customer charge for each electric meter shown here at Waipahu II

Existing Conditions

Currently the Hawaii Public Housing Authority pays for all electric utility usage metered by the Hawaiian Electric Company (HECO) at the sites listed above. Each apartment is individually metered, yet the bills are sent directly to, and paid directly by the Authority. Since the apartments are individually metered, these accounts are each billed according HECO's basic residential tariff and each is charged a separate customer charge.

Table 11.1 Existing Electric Utility Meter Quantities by Development

Building	Qty of Building Type	Qty. Apartment Meters	Qty. Common Area Meters
Waipahu II	1	20	2
Wahiawa Terrace Building Type 1	4	8	1
Wahiawa Terrace Building Type 2	4	7	1

Proposed Conditions

Ameresco proposes to consolidate the electric meters at each of the above sites into one electric meter and HECO account per building. New check meters will be installed in the existing common area and apartment utility meter sockets to allow for check metering if HPHA desires. At Waipahu II, the new meter will be located adjacent to the existing meter bank. At Wahiawa Terrace, the new meter will be installed in place of the existing main building disconnects. Consolidation of these meters at these sites is subject to HECO approval after final design submittal. HECO has given Ameresco preliminary approval based on the scope of work below and it is expected that the final approval will be obtained after completion of the construction design documents. However, should HECO fail to approve meter consolidation at these sites, construction of this measure cannot go forward.

The new meter at Waipahu II will qualify for a general commercial rate tariff with demand billing (Rate J). The new meters at Wahiawa Terrace will qualify for a general commercial rate tariff (Rate G) offered by HECO. The new commercial rate tariffs have a higher per meter charge than the residential tariff, but the consolidation will result in fewer individual meters. In addition, the commercial rate has a lower charge per kWh for energy delivery. This ECM will have the effect of greatly reducing the number of monthly meter charges while also reducing the overall (blended) electric rate paid by HPHA.

Additionally, this measure was also considered, but is not recommended, for Waipahu I. The resulting payback here was estimated at about 27 years, primarily due to the complexity of the installation.

Scope of Work

Overview

Consolidate electric utility metering at Waipahu II and Wahiawa Terrace by reducing the number of utility company meters to one meter per building in accordance with the scope of work below.

- All work shall be done in accordance with applicable state and local electrical codes.
- Coordinate all power shutdowns with HPHA and the utility.
- Coordinate all work with the utility including all necessary utility paperwork.
- All new materials shall be per utility standards.
- Ground all new equipment per NEC and utility standards.

Waipahu II

- Provide and install one new utility-approved CT cabinet inline with the existing line-side electrical distribution adjacent to the existing utility meter bank.
    - New CT cabinet shall be sized to allow for adequate bending radius of the applicable size and quantity of conductors in accordance with utility requirements. Conductors shall be sized for 120/240 V, 1 PH, 400 A service to the building. Cabinet shall have NEMA 3R rating.
    - Provide and install horizontal and vertical instrument transformer mounting brackets.
    - Utility will provide and install the new CTs.
- Provide and install new utility-approved 4 jaw meter socket and NEMA 3R enclosure adjacent to the new CT cabinet.
    - The meter socket shall have provisions to install a test switch.
    - Provide and install 1 ¼" conduit between the new CT cabinet and new meter enclosure.
- Utility will provide and install new utility meter and seal new meter enclosure and CT cabinet.
- Connect the new CT cabinet to the existing meter bank using the existing conductors and conduit.
- Provide and install new conductors and conduit between the existing weatherhead and the new CT cabinet.
- Utility shall remove and dispose of the 20 existing individual apartment meters and 2 existing common area meters.
- Install 22 new utility-grade check meters in place of the existing meters. New check meters shall be Itron or equal.

Wahiawa Terrace

For Each of 8 Apartment Buildings at Wahiawa Terrace:

- Demo and remove the existing main service disconnect for each building.
- Provide and install one new utility-approved 4 jaw meter socket and NEMA 3R enclosure inline with the existing line-side electrical service in place of the existing main building disconnect.
    - New equipment shall be rated for 120/208 V, 1 PH, 200 A service
- Provide and install one new main service disconnect directly below the new meter enclosure.
- Utility will provide and install new utility meter and seal new meter enclosure.

- Utility shall remove and dispose of the existing individual apartment and common area meters. Existing meter enclosures shall remain in place. Four Type A Buildings each have 8 apartment meters and one common area meter. Four Type B Buildings each have 7 apartment meters and one common area meter.
- Install new utility-grade check meters in place of the existing meters. New check meters shall be Itron or equal. Install 9 new check meters in Type A buildings and 8 new check meters in Type B buildings.

ECM 12:
Install New Transformers

Developments Affected

Makua Alii and Paoakalani

Existing Conditions

The existing indoor substation transformer and high-voltage switchgear at Makua Alii are original to the building (over 40 years old) and are reaching the end of their useful life. The transformer was manufactured by ESCO Transformers, is mineral oil-filled, rated at 500 kVA, and provides step-down of power from 12,470 Volts to 120/208 Volts. The transformer and switchgear are located in the transformer vault on the ground floor.

Figure 12.1: The substation transformer at Makua Alii is nearing the end of its useful life and will be replaced.

The existing pad-mounted, outdoor transformer located behind Paoakalani is a used transformer from the University of Hawaii that was installed on an emergency basis in December 2008. The transformer was manufactured by Siemens in 2004. The existing transformer is oil-filled, rated at 500 kVA, and provides step-down of power from 12,470 Volts to 120/208 Volts.

HPHA requested that Ameresco evaluate replacing these units as part of the energy audit.

Proposed Conditions

Ameresco proposes to replace the existing transformer at Paoakalani and the transformer and high voltage switchgear at Makua Alii with new, energy-efficient equipment of the same configuration. The new transformer at Paoakalani shall be a Cooper Power Systems, or equal, pad-mounted transformer, rated at 500 kVA. The new transformer at Makua Alii shall be a Cooper Power Systems, or equal, substation transformer, rated at 500 kVA, while the new high voltage switchgear at Makua Alii shall be by Eaton Corporation, or equal, rated at 15 kV and 600 Amps. Please refer to the Attachments for product cut sheets.

The proposed installations will improve the electrical service reliability at the two developments. Replacing the existing switchgear at Makua Alii is also necessary for the replacement of the 500 kVA transformer, which is mounted behind the switchgear in an enclosed location. Replacing the existing transformers may also result in modest energy savings, but these have not been quantified.

Scope of Work

Overview

Ameresco proposes to replace the existing transformer at Paoakalani and the transformer and high voltage switchgear at Makua Alii in accordance with the following scope of work.

- All work shall be done in accordance with applicable state and local electrical codes.
- Ameresco shall provide temporary power services as necessary to minimize building shutdown times during work. Ameresco shall also coordinate all power shutdowns with HPHA and the utility.
- All new materials shall be per utility standards.
- All installation work shall be per NEC and utility standards.

Demolition

- Disconnect, remove and legally dispose of the existing electrical equipment.
- Ameresco understands that there is no asbestos or other hazardous material present in the areas or equipment to be affected by the proposed work. If such materials are encountered, their identification and removal will be HPHA's responsibility.

Electrical

- Provide and install new 500 kVA transformers in place of existing equipment.
    - Reuse existing line and load side power wiring.
    - Connect to the existing distribution bus.

- Provide and install new 15 kV high voltage switchgear at Makua Alii.

Exclusions

- Repair of existing deficiencies in line-side or load-side wiring and connections is excluded.
- Correction of any existing code violations is excluded.

ECM 13:
Install Photovoltaic Arrays

Developments Affected

Makamae

Existing Conditions

Makamae is a four-story, rectangular-shaped building with excellent solar orientation and an open exposure. The building roof is approximately 15,900 square feet and has a membrane surface that is in excellent condition. The roof-top is relatively clear of equipment; existing roof penetrations include building air ventilation, plumbing vent stacks and roof drains.

A majority of the electric use for the site is master-metered on one HECO meter, with an average monthly peak demand of about 60 kW.

Figure 13.1: Ameresco proposes to generate nearly 50% of the buildings current energy use with a solar photovoltaic (PV) system.

Proposed Conditions

Ameresco proposes to install a 107.36 kWdc (89.1 kW) solar photovoltaic (PV) system on the rooftop of Makamae that will generate nearly 50% of the buildings current energy use.

The proposed system was designed around the SunPower photovoltaic panel system, which is currently the most efficient PV system commercially available. Furthermore the system was sized to take advantage of HECO's net metering rule, which is described later in this section.

The proposed PV system will consist of approximately 352 panels, based on the modular, SunPower T5 Solar Roof Tile System and featuring the 305 Watt-rated panels. With this system, the panel, frame, and non-penetrating roof mounting system are integrated into one unit for ease of installation and maintenance—no additional mounting hardware is required. The system is rated to withstand a wind speed of 120 mph, which exceeds the minimum design wind speed requirement of 105 mph per Hawaii building codes. At a weight of only 2.4 pounds per square foot, the installation of the system should not require reinforcement of the existing pre-stressed concrete slab roof.

The solar PV equipment will be designed and integrated with the building's electrical system in accordance with HECO's interconnection permit. The solar array will be connected to a Satcon or SMA Sunny Towers DC (direct current) to AC (alternating current) inverter, which will convert the high-voltage DC power produced by the solar array, to 480V 3-phase power for interconnection into the existing main electrical distribution panel.

The system will include all required fused combiner enclosures, as well as a fused disconnect switch and labeling as required by the utility and code to provide a safe and fully functional PV system.

During the design phase, Ameresco will conduct a structural review of the proposed installation. Though unlikely, any additional structural support required for the proposed PV installation would be in addition to this measure scope of work and cost. Ameresco will also apply for and obtain the necessary utility interconnect permit.

Ameresco will also provide a data acquisition system (DAS) that will measure and monitor solar irradiance, ambient temperature, AC power generated, and overall system performance for trouble-shooting and maintenance.

Utility Incentives

As part of this installation, HPHA will be able to take advantage of HECO's net energy metering rule. This rule applies to renewable power generation technologies only, capped at 100 kW.[1] Net energy metering will allow HPHA to export surplus electricity into the grid when the power

[1] By law, the cap on the total power producing capacity of generators that can take advantage of net energy metering is set at one percent of the electric utility's system peak demand. The public utilities commission, by rule or order, can increase this percentage. The actual number of customers who can sign up before this cap is reached depends on the combined size of the individual renewable energy systems. On Oahu, 40 percent of the cap is reserved for systems of 10 kW or smaller. Ameresco is not aware at this time that this cap has been reached for larger systems.

generated by the PV system exceeds the requirement of the building. On a monthly basis, any electric power measured in kilowatt-hours that the PV system supplies to the grid will be subtracted from the kilowatt-hours obtained from the utility to determine the net amount of electricity that the site will be billed for.[2] Net metering will allow HPHA to obtain the full savings benefit of the proposed PV system.

Maintenance Considerations

The proposed PV system will require regular maintenance and service to maintain the projected energy savings. In the maintenance cost estimate included in the project cash flow, Ameresco has budgeted for annual preventative maintenance and potential equipment failures over the 20 year project term. These maintenance assumptions are presented on Table 13.1. A levelized annual service cost of $8,083 was estimated and carried in Year 1 of the project cash flow, escalating at 3% annually.

The SunPower PV panels are designed for a 30-year life and come with a 10-year limited product warranty and 25-year limited power warranty.

Table 13.1 Budgeted Maintenance Items for Solar PV System

Item	Frequency
Wash panels and inspect condition and integrity of mounting system	Annual
Inspect wiring and electrical components; inspect and tighten electrical connections	Annual
Test operation of all safety devices	Annual
Provide and install spare parts as needed: fuses, air filter elements, etc.	Varies
Replace inverter	Year 15

[2] Unused credits (excess net generation expressed as a monetary value) are carried over monthly for up to 12 months. Unused credits left at the end of each 12-month reconciliation period may not be carried over to the next 12-month period. Since the proposed PV system is expected to offset about half the building's electric load on an annual basis, unused net metering credits should not be a concern.

ECM 14:
Install Electric Check-meters

Developments Affected

Kuhio Park Terrace, Waipahu II, Wahiawa Terrace

Existing Conditions

Currently HPHA pays for all common and apartment electric usage at the above listed developments. Because tenants are not responsible for paying for their electricity use at these sites, they have no incentive to conserve energy.

Figure 14.1: At Kuhio Park Terrace, Waipahu II, and Wahiawa Terrace, a new AMR system will provide a seamless means for HPHA to monitor apartment electric consumption and bill residents for any usage above a set threshold level

Electricity at Kuhio Park Terrace is billed under two large master-metered accounts. In addition, outside of each apartment is an abandoned electric meter, likely installed with the intent of check-metering the tenants. At Waipahu II and Wahiawa Terrace, each apartment has an individual electric meter and the corresponding utility account is billed to and paid for by HPHA. As part of ECM 11, Consolidate Electric Meters, these individual apartment utility meters will be consolidated by building into a single master-meter while the existing meters will be replaced with check-meters. All three cases provide an opportunity to check-meter and bill tenants for excess usage.

To determine savings potential from check metering at these three developments, Ameresco developed an end-use analysis of apartment electric use. This analysis was based in part on data

collected during the energy audit, including light fixtures and refrigerator inventories. For base household end-uses, such as fans, toasters, televisions, etc., Ameresco applied wattage and usage factor data from the 1998 HUD Allowance Guidebook. Combined, these estimates were used to develop a projection of reasonable apartment electric use. These results were then compared to apartment electric use projections based on HPHA's current, standardized tenant electric allowances. In all cases, we found that apartment electric use based on our end-use analysis predicted lower, though relatively close, consumption than that estimated using HPHA allowances. As a result, the projected savings against existing tenant allowances formed the basis for our savings projections. Please refer to Table 14.1 for a summary of the savings analysis results.

Table 14.1 – Check-meter Savings Estimate

Development	Electric Baseline Consumption (kWh)	Estimated Common Area Electric Use (kWh)	Estimated Baseline Apartment Electric Use (kWh)	Estimated Apartment Electric Use Based on End-use Analysis (kWh)	Estimated Apartment Electric Use Based on Existing Allowances (kWh)	Estimated Savings (kWh)	Estimated Savings Percentage Against Baseline Apartment Electric Use
Kuhio Park Terrace	3,195,128	481,767	2,713,361	1,677,239	1,796,294	917,067	34%
Waipahu II	116,215	0	116,215	64,628	77,995	38,220	33%
Wahiawa	288,660	0	288,660	156,937	168,687	119,972	42%

Proposed Conditions

At Kuhio Park Terrace, Waipahu II, and Wahiawa Terrace, Ameresco proposes to implement a check-metering system featuring Automated Meter Reading (AMR). The new AMR system will provide a seamless means for HPHA to monitor apartment electric consumption and bill residents for any usage above a set threshold level. Individual apartment electric consumption data will be automatically transmitted from new apartment-based utility-grade electric meters to a wireless receiver, located on site, which in turn will transmit this information to a remote host site. The housing authority will then have the ability to access and download consumption data and overage usage by

Figure 14.2: Existing unused 5-Jaw meter socket at Kuhio Park Terrace that can be fitted with a new meter with AMR capabilities.

apartment via a web-based service for its billing purposes. Check metering has the advantage over converting to tenant-paid utilities because the existing, master-metered electric accounts remain on a lower commercial rate, rather than converting to higher residential rate tariffs.

The AMR system will be comprised of AMR-capable electric meters and data collectors which will also automatically transmit the consumption data to a host site via a web link (e.g. Ethernet connection). Kuhio Park Terrace will also be equipped with a number of data repeaters, to assure seamless transfer of data from the farthest meters to the central collector.

Ameresco has identified Itron as a full-services provider of AMR equipment and hosting services. Please refer to the product cut sheets in the attachments for more information.

It is also noted that most set-up costs associated with this measure have been allocated to Kuhio Park Terrace, as this is the largest application of this measure. If Kuhio Park Terrace is eliminated from this scope, that would preclude application of this measure at the remaining two, smaller sites.

Scope of Work (Hardware)

Installation Work

All meters, transmitters, repeaters, concentrators, modems, antennas, and included mounting brackets will be provided. All installations shall be done in accordance with local and national code requirements. Precise locations of concentrators and repeaters at each development will be determined once installation of meters and transmitters is complete. The proposed check-meter equipment is presented in Table 14.2.

Table 14.2 – Schedule of Proposed Equipment for Check-Meters

Development	Qty of Meters	Qty of Collectors	Qty Repeaters
Kuhio Park Terrace	614	1	4
Waipahu II	20	1	0
Wahiawa	60	1	0

Electric Meter Installation

- Remove and legally dispose of existing apartment electric meters and replace with new Itron Centron Polyphase electric meters at Kuhio Park Terrace. AMR-equipped meters will be installed at Waipahu II and Wahiawa Terrace under ECM 11, Consolidate Electric Meters.

Repeater and Data Concentrator Antenna and Unit Mounting

Concentrator and Repeater (Typical, All Developments)

- Furnish and mount an antenna mast on the roof of building for the concentrator or repeater.
- Mount concentrator or repeater unit on wall in building. Connect concentrator unit to web access (Cost for web connection hardware is not included).
- Drill through sill to provide access point for antenna communications cable into the building. Seal new penetrations against leaks.
- Run communications cable from antenna to receiver unit in weather resistant conduit. Apply non-corrosive compound to outdoor coaxial connections to reduce corrosion.
- Furnish and install inline coaxial lightning protection on each cable line between antenna and repeater or receiver unit, and connect to building ground with grounding wire.

Electrical Work

- Provide and install a new wall mounted 120V AC convenience outlet for the repeater or concentrator. All wiring must be installed in EMT conduit or Wiremold.
- Connect power to concentrator and repeater unit.
- Installation shall be done in accordance with local and national code requirements.

Hosting Services/Monthly Service Costs

The proposed electric check-metering system will require internet service and AMR reading and hosting services. In the maintenance cost estimate included in the project cash flow, Ameresco has budgeted for these fees over the 20 year project term. These maintenance assumptions are presented in Table 14.3. A levelized annual service cost of $29,839 was estimated and carried in Year 1 of the project cash flow, escalating at 3% annually.

Table 14.3 – Budgeted AMR Monthly Service Costs (based on 2009 vendor pricing estimates)

Item	Cost
Hosting Service Fee	$ 2.83 per meter per month
Internet Service Subscription	$ 50.00 per month per account*

*It was assumed that an existing Ethernet connection will be used at Kuhio Park Terrace while additional internet connections will be required at Waipahu II and Wahiawa Terrace.

ECM 15:
Install High-Efficiency Central Domestic Water Heaters

Developments Affected

Ka Hale Kahaluu, Makua Alii, Punchbowl Homes, Kalanihuia, Makamae, Pumehana, and Spencer House

Existing Conditions

The sites listed above are currently equipped with old and inefficient, gas-fired, central domestic hot water (DHW) systems as detailed in Table 15.1. These water heaters were found to operate at efficiencies ranging from 60% to 70%.

Figure 15.1: The existing central DHW heaters at Kalanihuia, like other sites at HPHA, operate at efficiencies ranging from 60-70%.

Proposed Conditions

Ameresco proposes to replace the domestic water heating systems at the affected sites with new, energy-efficient, condensing-type water heaters. The new water heaters will be A. O. Smith Cyclone Xi, A. O. Smith Vertex, Lochinvar Armor, or equal. These water heaters operate at efficiencies in excess of 90% in condensing mode, where a majority of the combustion heat is extracted, and will significantly reduce energy use and greenhouse gas emissions related to DHW production at the affected sites. Please refer to the Attachments for product information.

The new water heating system configuration at each site is detailed in Table 15.1. The scope of work description included below is typical for all sites. These new energy-efficient domestic hot water

Table 15.1 Existing and Proposed Domestic Water Heating Configurations

Development	Existing Configuration	Proposed Water Heater Qty.	Post-Retrofit Details
Ka Hale Kahaluu	(2) mechanical rooms, each with (3) 199 MBtu/hr Bradford White atmospheric storage water heaters	6	(2) mechanical rooms, each with (2) 250 MBtu/hr A.O. Smith Cyclone Xi BTH250 direct-vented storage water heaters and (1) 76 MBtu/hr A.O. Smith Vertex GPHE50 direct-vented storage water heater
Makua Alii	(3) 625 MBtu/hr Bock atmospheric storage water heaters	3	(3) 500 MBtu/hr A.O. Smith Cyclone Xi BTH500 direct-vented storage water heaters
Punchbowl Homes	(3) 420 MBtu/hr A.O. Smith atmospheric water heaters and (1) 1,500-gallon storage tank.	3	(3) 399 MBtu/hr Lochinvar Armor condensing water heaters; the existing 1,500-gallon storage tank remains.
Kalanihuia	(3) 360 MBtu/hr Ruud or Bradford White atmospheric storage water heaters	3	(3) 300 MBtu/hr A.O. Smith Cyclone Xi BTH300 direct-vented storage water heaters
Makamae	(3) 360 MBtu/hr Bock atmospheric storage water heaters	3	(3) 250 MBtu/hr A.O. Smith Cyclone Xi BTH250 direct-vented storage water heaters
Pumehana	(3) Raypack gas-fired, atmospheric boilers (Zones 1 and 3 rated at 726 MBtu/hr and Zone 2 rated at 1,467 MBtu/hr) and (1) standby gas-fired water heater.	4	(3) 300 MBtu/hr A.O. Smith Cyclone Xi BTH300 direct-vented storage water heaters to replace existing Zone 1-3 heaters. Existing Zone 3 heater to be refurbished and replace existing standby heater.
Spencer House	(1) 199 MBtu/hr Bradford White atmospheric storage water heater	1	(1) 300 MBtu/hr A.O. Smith Cyclone Xi BTH300 direct-vented storage water heater

systems have been sized based on an average HPHA population density of 1.2 occupants per bedroom and assuming 10 gallons of hot water per occupant per hour at 120ºF, slightly exceeding ASHRAE's Hot Water Demand and Use Guidelines for Apartment Buildings. In most cases, this sizing methodology resulted in down-sized water heaters compared to the existing units (which may have been sized using the less-accurate fixture count method). Properly-sized water heaters are more cost-effective and provide more efficient load-matching modulation control than heaters which are oversized.

Maintenance Considerations

The proposed high-efficiency domestic hot water heating systems will require regular maintenance and service to maintain the projected energy savings. In the maintenance cost estimate included in the project cash flow, Ameresco has budgeted for normal preventative maintenance and potential equipment failures over the 20 year project term. These maintenance assumptions are presented in Table 15.2. A levelized annual service cost of $39,754 was estimated and carried in Year 1 of the project cash flow, escalating at 3% annually. .

Table 15.2 Budgeted Maintenance Items for High-Efficiency Central DHW Systems

Service Item	Frequency
Drain, flush, clean, and inspect all new central water heaters	Annually
Replace sacrificial anodes in all new central water heaters	Every 5 Years
Replace combustion heat exchangers	Year 15

Scope of Work (typical for all sites)

Overview

In the existing mechanical room: replace the existing gas-fired domestic hot water heaters and associated equipment and piping with a new system which will consist of modulating, high-efficiency water heaters, new piping and new hot water return pumps. All materials, work and construction shall follow the 1997 UPC as adopted by the City and County of Honolulu.

Demolition

- Disconnect, remove and legally dispose of the existing water heaters and all associated equipment and materials made obsolete by the new work, including the existing circulators, air separator, and all piping and hangers to the points of connection.

Mechanical — Pumps, Piping & Accessories

- Provide a 4 inch high concrete pad for the each new water heater.
- Install new high efficiency condensing water heaters in accordance with manufacturer's instructions and applicable codes. Ameresco will furnish factory-authorized water heater startup for all commercial water heaters.
    - Each water heater shall be factory equipped with intelligent electronic control system with LCD display. Controller shall provide precise temperature control, run history information, diagnostics and monitoring status data.
- Provide and install a Grundfos Versaflo Model TP32-80 all bronze circulator pump (or equal) manufactured for hot water return pumping.
- Provide and install new hydronic specialties including isolation valves, check valves, unions, and air/dirt separators.
- Provide and install new piping, fittings, flanges, unions, valves, strainers, traps, vacuum breakers, thermometers and pressure gauges as required. Also provide appropriately sized condensate neutralizer for vent condensate before routing to existing floor drain.

Mechanical — Combustion Air & Exhaust

- Provide new 4 inch CPVC exhaust and intake duct for each water heater to provide sealed combustion.

Plumbing — Gas

- Modify and install new water heater gas trains into existing gas piping located in mechanical room.

Electrical — Power

- Provide power to new water heater system from existing distribution panel located in the mechanical room. Install additional compatible circuit breakers in spare positions as needed.

Electrical — Controls

- Connect the water heater microprocessors such that the heaters communicate with each other. Provide all necessary control and power wiring to integrate the pumps with the hot water heaters.
- Provide and install all control wiring in conduit.

Insulation and Labeling

- Provide and install Owens Coming or equal rigid, preformed, fiberglass pipe insulation with all-service jacket for all new hot water piping, elbows, valves, fittings (except unions), and

connections to existing piping in the mechanical room. Jacket pipe with PVC jacket kits and seal exposed fiberglass ends with white mastic waterproofing paint.

- Provide appropriate labeling for all new hot water supply, hot water return, cold water supply, gas, and exhaust piping.

Commissioning

- Ameresco shall provide for a factory authorized technician to perform water heater start-up.
- Flush strainers and dirt separator at completion of test period.
- Ameresco shall clean, disinfect and test the new piping and heating system before placing into service. The disinfection process shall follow City and County of Honolulu standards and the 1997 UPC, Section 609.9.

ECM 16:
Install New Solar Domestic Water Heaters

Developments Affected

Kealakehe, Noellani II, Ke Kumo ʻEkolu, Noelani I, Kawailehua – Federal, David Malo Circle, Kuhio Park Terrace, Kuhio Homes, Puuwai Momi, Hale Laulima, Kaahumanu Homes, Koolau Village, Hookipa Kahaluu, and Palolo Valley Homes

Existing Conditions

The existing domestic hot water (DHW) systems at the sites listed above consist of either gas-fired or electric central DHW heating systems in each building, or individual apartment gas-fired or electric storage DHW heaters inside or outside, behind each unit. Some individual apartment electric storage DHW heaters have existing solar-preheat systems or tank-mounted heat pumps, but they are generally in poor condition and do not fully function. Additionally, several sites have existing central solar hot water equipment, but those systems are not properly maintained, and are in various states of disrepair. Refer to Table 16.1 for a site-by-site description of the existing DHW heating systems affected by this scope.

Figure 16.1: Much of HPHA's existing solar DHW equipment is in poor condition. For example, entire sections of the solar DHW heating system at Kuhio Park Terrace Building A have been removed or disabled.

Additional sites were also considered for this measure. But due primarily to long payback, these installations were not recommended. Please refer to Section 3.B.19 for a complete listing of these sites including estimated costs, savings, and payback.

Table 16.1 Solar Hot Water Sites Existing & Proposed Conditions

Development	Island	Existing Conditions	Proposed System Type	Proposed Solar Storage Type	Auxiliary DHW Heaters	Qty. New Solar Panels	Qty. New Storage Tanks	Qty. New Aux. Water Heaters	Additional Site Specific Notes
Kealakehe	Hawaii	Apartments are served by four central electric storage type domestic hot water heaters per building. Existing thermal solar equipment is not functional.	Active	Central	Existing Central Electric	64	4	0	
Noelani II	Hawaii	Units are served by individual, 40 gallon, electric storage-type domestic hot water heaters.	Active	Individual Apt	New Individual Electric	48	0	24	
Ke Kumu 'Ekolu	Hawaii	Units are served by individual 40 gallon, propane storage-type domestic hot water heaters	Thermosiphon	Individual Apt	Existing Individual Gas	40	20	0	
Noelani I	Hawaii	Units are served by individual, 40 gallon, electric storage-type domestic hot water heaters.	Active	Individual Apt	New Individual Electric	38	0	19	
Kawailehua - Federal	Kauai	Units are served by individual 40 gallon, propane storage-type domestic hot water heaters.	Thermosiphon	Individual Apt	Existing Individual Gas	50	25	0	
David Malo Circle	Maui	Units are served by individual, 30 or 40 gallon, electric storage-type domestic hot water heaters.	Active	Individual Apt	New Individual Electric	36	0	18	
Kuhio Park Terrace Tower A	Oahu	The two high rise buildings are each served by a central domestic hot water system consisting of atmospheric, natural gas-fired boilers and large storage tanks. Building A has an existing thermal solar system, but much of the collectors are disconnected, damaged, or leaking. The low-rise units are served by individual natural gas-fired, storage-type domestic hot water heaters with solar thermal preheat, but much of the solar equipment is disconnected or missing entirely. Note that the low-rise units are not included in this scope as those buildings are planned for demolition	Active	Central	Existing Central Gas	228	0	0	Refurbish existing racks and tanks, piping, replace panels, controls, and pipe insulation. Solar capacity limited by roof area.
Kuhio Park Terrace Tower B	Oahu		Active	Central	Existing Central Gas	228	4	0	Completely new solar DHW system. Solar capacity limited by roof area.
Kuhio Homes	Oahu	Apartment units are served by individual, 30 gallon, natural gas domestic hot water heaters.	Active	Central	Existing Individual Gas	213	21	0	Includes additional structural work to distribute storage tank roof load through buildings.
Puuwai Momi	Oahu	Apartment units have individual 30 gallon electric storage-type domestic hot water heaters. Most of existing thermal solar is shut down and disconnected due to leaks and broken panels.	Active	Individual Apt	Existing Individual Electric	430	72	0	Replace and enlarge existing non-functional solar systems.
Hale Laulima	Oahu	Apartment units have individual 50 gallon electric storage-type, domestic hot water heaters with tank-mounted heat pumps. One building has existing thermal solar	Active	Individual Apt	New Individual Electric	72	0	36	
Kaahumanu Homes	Oahu	Units are served by individual, atmospheric, natural gas-fired, 30 gallon storage-type domestic hot water heaters. Existing solar thermal DHW is inoperable and tanks have been removed.	Thermosiphon	Individual Apt	Existing Individual Gas	304	152	0	Includes demo of non-functioning solar equipment including existing racks, panels, and rooftop distribution piping.
Koolau Village	Oahu	Units are served by individual 40 and 50 gallon, propane storage-type domestic hot water heaters	Thermosiphon	Individual Apt	Existing Individual Gas	160	80	0	
Hookipa Kahaluu	Oahu	Units are primarily served by 80 gallon individual, electric storage-type domestic hot water heaters. Apartments at two of the buildings have existing thermal solar preheat.	Active	Individual Apt	New Individual Electric	128	0	56	
Palolo Valley Homes	Oahu	Units are served by individual, 30 or 40 gallon, electric storage-type domestic hot water heaters.	Thermosiphon	Individual Apt	Existing Individual Electric	236	118	0	
Totals						2,275	496	153	

Proposed Conditions

Overview

Ameresco proposes to install new or refurbish existing solar domestic hot water heating systems at selected developments at HPHA. Ameresco thoroughly evaluated new solar water heating systems at 28 separate developments in support of the State of Hawaii's renewable portfolio and HPHA

conservation goals. As a result, Ameresco has included costs and savings for 14 of the developments as part of this project. Our criteria for site selection was a simple payback on installed cost at around 30 years or less, which represents the likely life cycle of properly maintained solar water heating systems. The new solar water heating equipment will provide HPHA with clean, renewable, free hot water heating energy that will displace at least 90% of the existing DHW energy load in most cases, while greatly reducing the carbon footprint of HPHA facilities and helping the State of Hawaii meet its goal of 40% renewable energy by 2030.

Figure 16.2: Ameresco will install new solar DHW equipment on the roofs of buildings at Kuhio Homes and other selected HPHA developments.

Ameresco has based the solar designs for all sites on the requirements of the Hawaiian Energy Efficiency Program's solar domestic hot water program in order to comply with industry best practices and take advantage of available utility incentives where applicable. Individual and central solar hot water storage capacities are based on an average occupancy of 1.5 occupants per bedroom based on HPHA occupancy density data and 20 gallons of hot water use per occupant per day. Solar collector capacities are sized to meet 90-110% of the solar storage load, as stipulated by the program.

In general, active collector systems[1] are proposed for all sites where the existing DHW systems are electric and there will be either central solar hot water storage or where there is available space in individual apartment utility spaces to install new, individual electric auxiliary DHW tanks with the appropriate storage capacity. In cases where existing DHW systems are gas-fired, or appropriately- sized individual electric auxiliary tanks will not physically fit within available space in the apartments, passive or thermosiphon collector systems[2] are proposed.

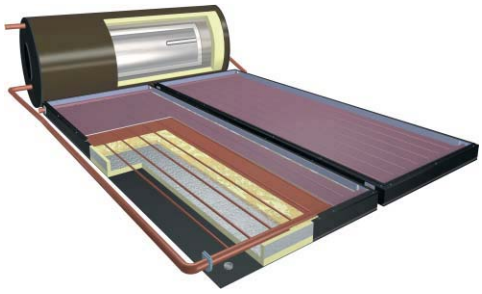

Figure 16.3: Thermosiphon solar DHW systems will be installed at developments with individual apartment-based, gas-fired DHW heaters.

[1] Active systems consist of roof-mounted solar collector panels and either individual apartment or centrally based storage tanks with circulator pumps and controls which engage the pump whenever the water temperature in the collectors is higher than that of the water in the storage tank.
[2] Thermosiphon systems consist of roof-mounted solar collector panels and roof-mounted storage tanks without a circulator pump or controls, relying on natural convection to transfer heat to the storage tank mounted above the solar panel and preheating the water entering the existing auxiliary DHW heater.

Wherever the existing DHW systems are individual, apartment-based type and it is feasible to do so, the solar designs call for individual apartment storage tanks. Sites with central DHW heating systems generally will have central solar storage tanks and centralized solar collectors. The exceptions to these criteria are Kuhio Homes and Puwaii Momi, where existing conditions (including energy billing methods and mechanical infrastructure) make it more cost-effective to install central collectors and storage while keeping the existing individual DHW heaters as distributed auxiliary heating.

Utility Incentives

The Hawaiian Energy Efficiency Program offers generous prescriptive rebates for new solar DHW systems installed on Oahu, Maui, Molokai, and the Big Island where the new solar equipment will displace electrically heated DHW use which is billed on a residential utility rate schedule. As of September 2009, this rebate is valued at $1,000 per apartment. Ameresco estimates that the total value of this incentive for the included developments is $271,000. This amount is included in the project cash flow.

Maintenance Considerations

The proposed new solar water heating systems will require regular maintenance and service to maintain the projected energy savings. In the maintenance cost estimate included in the project cash flow, Ameresco has budgeted for normal preventative maintenance and potential equipment failures over the 20 year project term. These maintenance assumptions are presented in Table 16.2. A levelized annual service cost of $444,775 was estimated and carried in Year 1 of the project cash flow, escalating at 3% annually.

Table 16.2 Budgeted Maintenance Items for New Solar Water Heating Systems

Item	Frequency
Clean and inspect all collectors[3]	Every 2 Years
Replace damaged collectors (assume 2% of total)	Every 5 Years
Replace 50% of all collectors	Year 20
Replace 50% of thermosiphon tanks	Year 15
Replace 50% of central storage tanks	Year 15
Replace 50% of circulators and controls	Every 10 Years

[3] Ameresco's proposed annual performance inspection of installed equipment conducted as part of it's annual measurement and verification services should flag any deficiencies or other issues in between service inspections.

Item	Frequency
Replace (Ameresco-installed) individual electric auxiliary tanks	Year 12
Replace sacrificial anodes in storage tanks	Every 6 Years
Replace damaged outdoor pipe insulation (assume 20%)	Year 15
Repair Outdoor Storage Tank Insulation (assume 5% of all tanks)	Every 5 Years

Scope of Work (typical for all sites)

At affected sites, Ameresco will install new or refurbish existing solar DHW heating systems on building roofs and in various mechanical areas. For each site, Ameresco will provide the following general scope:

- All work will be performed in accordance with the standards of the Hawaii Energy Efficiency Program.
- Disconnect, remove and legally dispose of existing solar collectors, auxiliary electric water heaters and all associated equipment and materials made obsolete by the new work, as called out for specific sites in Table 16.1.
- Provide and install new collectors, mounting brackets, collector supports, circulators, controls, temperature sensors, thermosiphon tanks, central storage tanks, solar supply, return and new cold water distribution piping, pipe supports, insulation, and fittings required to provide a complete and operating solar DHW system. All products and materials shall be on the Hawaii Energy Efficiency Program's Accepted Products List, where applicable.
    - Insulation exposed to weather shall be provided with PVC or metal jacketing as recommended by the manufacturer.
    - Collector support structure materials shall be aluminum metal strut with non-corrosive finish, or equal. Wood or wood products are not acceptable.
    - Fittings shall be bronze, brass, or wrought copper with 10% silver solder approved for potable water distribution.
    - Solar collectors shall be SunEarth Empire Series, or equal. Thermosiphon tanks shall be SunSiphon-Solar Edwards or equal. Differential temperature controllers shall be SunEarth or equal.
    - Central storage tanks shall be Hanson Water Tank, or equal, and be of horizontal design with saddles. Tanks shall be carbon steel, glass lined, and equipped with magnesium anode rods. Tanks shall be coated with zinc chromate for corrosion protection. Tanks shall be insulated with R-16 polyurethane foam and coated with acrylic weatherproof coating.

  - New auxiliary electric DHW heaters shall be Ruud RSPER120-1, Ruud RSPER80-1, or equal.
- Provide and install new supports to meet weight, seismic, and wind structural loads created by new solar equipment as required by codes.
- Patch and repair any new roof or wall penetrations to match surrounding material and provide a water-tight seal.
- Test and adjust the systems for proper operation.
- Repair of existing roof deficiencies is excluded, except as described under ECM 17: Replace Roofs.
- Ameresco understands that there is no asbestos or other hazardous material, such as lead paint, present in the areas to be affected by the proposed construction. If such materials are encountered, their identification and removal will be HPHA's responsibility.

Structural Considerations

Based on our preliminary design assessment, no structural modifications should be necessary for installation of the above scope of work. The exception being only Kuhio Homes, for which a cost allowance was budgeted for structural work as described in Table 16.1. If after further design, additional structural work is determined to be required for any of the remaining sites, this additional scope and any associated costs would be in addition to that presented in this audit.

ECM 17:
Replace Roofs

Developments Affected

Kuhio Park Terrace (high-rise towers only) and Kuhio Homes

Existing Conditions

Kuhio Park Terrace

Figure 17.1 Kuhio Park Terrace high-rise Tower B

Kuhio Park Terrace (KPT) consists of a total of 614 apartments in two, 16-story towers and 14, two-story low-rise buildings. The KPT low-rise buildings are not included in this project as these may be demolished at a future time. Each tower has three rectangular-shaped wings that radiate out from a central point. Each of the two towers has approximately 22,000 square feet of roof area, including the elevator penthouse. The roof of Tower A has a solar hot water system that is approximately 25 years old and in poor condition. There is currently no solar hot water system on the roof of Tower B.

The existing tower roofs are a built-up, asphalt membrane system near the end of their useful life. In addition, some of the edge flashing is missing and there is spalling of the concrete deck in some areas. Existing roof penetrations include building air ventilation, plumbing vent stacks and roof drains, while the existing roof-mounted equipment (excluding the solar equipment) and vents cover a relatively small area. In addition, a chain link fence runs along the entire perimeter of the Tower A roof to create a fall barrier for servicing the solar equipment. There is corrosion on the fence and some of the bases of the support posts also are corroded. There is currently no fence on the roof of Tower B.

Kuhio Homes

Figure 17.2 Kuhio Homes roof-tops as viewed from KPT Tower A.

Kuhio Homes houses 134 apartments in 21, two-story buildings. The site has four building types that range in roof area from 1,924 to 2,800 square feet apiece. The buildings have a total, combined roof area of approximately 60,255 square feet. The building roofs are a built-up, asphalt membrane system that are near the end of their useful life. Existing roof penetrations include building air ventilation equipment and plumbing vent stacks. There are no solar water heating systems currently on the Kuhio Homes roofs.

Proposed Conditions

In anticipation of the proposed solar hot water installations included under ECM-16, Ameresco proposes to replace the existing roofs on the two KPT towers and the 21 buildings of Kuhio Homes. In addition, Ameresco proposes to replace the roof of the KPT community building per request of HPHA.

Ameresco also proposes to install new perimeter fencing on both KPT towers. Given the deterioration of the existing fencing posts, plates and anchors on Tower A, complete replacement of the existing fencing is warranted and will give HPHA similar life cycles for the new equipment on both towers. The Kuhio Homes buildings do not require fencing for installation of solar hot water heating equipment.

The new roofing systems will feature a TPO (Thermoplastic Polyolefin) membrane which will provide a durable and long-lasting roof surface. In addition, the heat reflective properties of TPO roofs exceed Energy Star performance levels for energy efficiency.

Roofing Scope of Work (typical, all installations)

As part of the roofing project, Ameresco proposes to:

- Remove existing roofing and insulation materials down to the concrete roof deck (including building eyebrows and elevator penthouse roofs)
- Properly dispose of existing roofing and insulation materials
- Apply temporary roof layer as needed to seal from the elements as fence posts and solar racking systems are installed
- Install new roofing insulation tapered to roof drains as applicable

- Install new ¼" DensDeck cover board over new roof insulation
- Install new .50 Mil Duro-Last Single-Ply TPO Roof System. TPO membrane shall be white and fully adhered.
- Install new drip edge flashings at the eaves
- Install new termination bar flashing at wall to roof transitions
- Install new elastomeric roof coating and fabric at parapet walls and perimeter curbs
- Install new TPO boot flashings at vent pipes
- New roofing system shall carry a 15-year manufacturer's warranty on materials and installation workmanship[1]

Exclusions:

- Repair of concrete spalling or other existing structural deficiencies
- Removal and/or relocation of any existing cellular or other, temporarily-mounted rooftop equipment
- Hazardous material testing and/or abatement (none anticipated)

Fencing Scope of Work for Kuhio Park Terrace Towers A & B

The new fencing will feature 316 stainless steel posts, plates and anchors and a galvanized chain link fence with PVC coated fabric and top rail. Ameresco proposes to:

- Remove and properly dispose of existing fencing and support posts on Tower A
- Install grade 316 stainless steel posts, plates and anchors. Install posts with welded base plates and anchor posts with epoxy 10' on center.
- For each tower, install approximately 1,500 linear feet of 4' high, galvanized chain link fence with PVC-coated fabric, ties and top rail.

All materials and debris shall be hoisted external to the buildings. All roofing and fencing work shall be completed in accordance with all applicable codes and safety standards. Work with be coordinated with HPHA to minimize disruption to residents.

[1] A 20-year limited warranty is also available from the manufacturer.

ECM 18:
Install Gas-Fired Instantaneous Domestic Water Heaters

Developments Affected

Mayor Wright Homes

Existing Conditions

The existing domestic hot water (DHW) systems at Mayor Wright are generally in very poor condition and many do not provide sufficient hot water. All residential buildings at the site have some amount of solar thermal DHW equipment on the roof. However, much of this equipment is near failure or has already failed. Many collectors are broken, a large fraction of the storage tanks have corroded through, and much of the rooftop piping leaks. Originally, each DHW system also had an instantaneous (tankless) electric resistance DHW heater as a back-up to meet peak loads or in case of solar equipment failure. However, the vast majority of these units have failed as well. HPHA has been replacing the electric instantaneous DHW heaters with gas-fired units on an ongoing basis, which has mitigated this problem to some extent. Approximately 17% of the development has been converted to gas domestic hot water so far.

Figure 18.1: The original, electric, instantaneous DHW heaters at Mayor Wright no longer provide sufficient hot water.

Non-functioning electric back-up DHW heaters, combined with poor solar equipment performance, creates a deficiency of service situation in which residents of these units cannot get enough hot water to meet minimum sanitary code standards. During inspection of a 10% sample of apartments, units connected to functioning solar and gas DHW systems were observed to have average delivered water

temperatures of around 115ºF, while units connected to solar and non-functioning electric DHW systems had an average delivered temperature of around 90ºF. Minimum hot water supply temperature required by code is 110ºF.

This site was also considered for ECM 16: Install New Solar Domestic Water Heaters. But due to a lower first cost, and because Mayor Wright is under consideration for eventual demolition or redevelopment, instantaneous gas-fired DHW water heaters were recommended instead. Please refer to Section 3.B.19 for estimated costs, savings, and payback for installing new solar equipment at Mayor Wright.

Figure 18.2: The existing gas instantaneous DHW heaters are in poor condition and will be replaced.

Proposed Conditions

Ameresco proposes to replace the existing electric and gas back-up hot water heating equipment at Mayor Wright with new, natural gas-fired, instantaneous DHW heating units. These new water heaters will work in conjunction with the existing, functional solar equipment to prove sufficient hot water to all residents of the development. However, the new gas water heaters have been sized assuming no supplemental heating is provided by the solar hot water systems.

Ruud GT-199X commercial, gas-fired, instantaneous water heaters, or equal, are recommended for this application. Please refer to the Attachments for product information. Each new instantaneous hot water heater was sized based on an average HPHA population density of 1.2 occupants per bedroom and peak per capita hot water demand assuming 1.2 gallons of hot water per occupant per peak five minutes at 120ºF, in accordance with recommendations in ASHRAE's Hot Water Demand and Use Guidelines. Two water heaters will be provided per system (total of 80) and each unit is sized to provide 100% redundancy should one unit fail.

Figure 18.3: Ameresco recommends Ruud outdoor, commercial-grade water heaters for this application.

Ameresco has based savings for this measure on an adjusted electric baseline, which reflects the energy that would have been used for heating hot water at Mayor Wright if the electric water heaters had been fully functional during the three-year base period[1].

This measure will provide cost savings, since all hot water at this site will be generated by gas instead of electricity, net of the existing solar equipment output.

Maintenance Considerations

The proposed instantaneous domestic hot water heaters will require regular maintenance and service to maintain the projected savings. In the maintenance cost estimate included in the project cash flow, Ameresco has budgeted for normal preventative maintenance and potential equipment failures over the 20 year project term. These maintenance assumptions are presented in Table 18.1. A levelized annual service cost of $42,878 was estimated and carried in Year 1 of the project cash flow, escalating at 3% annually.

Table 18.1 Budgeted Maintenance Items for Instantaneous Gas-Fired DHW Heaters

Service Item	Frequency
Drain, flush, clean, and inspect all new instantaneous DHW heaters	Annually
Replace failed burners and heat exchangers (20% of total units)	Every 10 Years
Replace failed water heater (10% of total units)	Year 15

Scope of Work

At Mayor Wright, Ameresco will replace all existing gas and electric instantaneous DHW heaters on building roofs with new commercial, gas-fired, instantaneous hot water heaters in accordance with the following scope:

Demolition

- Disconnect, remove and legally dispose of the existing instantaneous water heaters and all associated equipment and materials made obsolete by the new work, and all piping to the points of connection.
- Existing solar domestic hot water equipment to remain.

Mechanical

[1] Additionally, the water baseline for Mayor Wright has been adjusted for this development to account for the additional water that residents would have likely used if they had sufficient hot water service. This is described in more detail in Section 2.A.

- Provide and install 160, new, gas-fired instantaneous DHW heaters in place of the existing units on each residential building roof. Each separate DHW system (total 80) shall receive two new water heaters.
    - New water heaters shall be Ruud GT-199X, or equal, natural gas-fired, modulating, commercial, outdoor-rated, instantaneous models.
    - Install new high efficiency condensing water heaters in accordance with manufacturer's instructions and applicable codes.

Plumbing — Gas

- Provide and install new Schedule 40 galvanized steel gas piping, new check meters[2], and regulators, to run new gas service to building roofs from new tap in the existing building gas supply main at grade, where required.

Electrical

- Provide power to new instantaneous water heater system from existing electrical connections on the roof.
- Provide and install one EZ link cable per pair of water heaters to integrate modulation and lead/lag control between units serving the same DHW system.
- Provide and install all control wiring in the proper conduit.

Insulation and Labeling

- Provide and install flexible elastomeric cellular insulation with PVC or metal jacketing for all new rooftop water distribution piping and fittings.
- Label all new hot water and gas piping.

[2] Each gas end-use at Mayor Wright (including both individual apartment cooking and existing central gas hot water), is measured by an existing gas check meter which is not currently monitored by HPHA. For consistency, Ameresco has included new gas check meters at each water heater installation to allow monitoring of gas used by the new instantaneous DHW heaters, should HPHA choose to do so.

Measures Considered But Not Recommended

Table 19.1 presents a summary of measures evaluated during the audit phase, but which are not recommended as part of this project at this time for reasons noted here.

Table 19.1 Measures Considered but Not Recommended

CNR #	Description	Development	Total Project Costs	Dollar Savings	Total Payback	Basis for Exclusion
1	Install New Solar Domestic Water Heaters	Salt Lake	$903,152	$12,457	72.5	Payback exceeds measure life
2	Install New Solar Domestic Water Heaters	Pahala	$525,942	$7,766	67.7	Payback exceeds measure life
3	Install New Solar Domestic Water Heaters	Hui O Hanamaulu	$994,061	$16,721	59.4	Payback exceeds measure life
4	Install New Solar Domestic Water Heaters	Kaneohe Apartments	$551,050	$10,700	51.5	Payback exceeds measure life
5	Install New Solar Domestic Water Heaters	Kau'iokalani	$954,781	$18,610	51.3	Payback exceeds measure life
6	Install New Solar Domestic Water Heaters	Kaimalino	$699,278	$15,373	45.5	Payback exceeds measure life
7	Install New Solar Domestic Water Heaters	Kahale Mua - Federal	$754,556	$16,716	45.1	Payback exceeds measure life
8	Install New Solar Domestic Water Heaters	Waimaha-Sunflower	$439,064	$10,951	40.1	Payback exceeds measure life

CNR #	Description	Development	Total Project Costs	Dollar Savings	Total Payback	Basis for Exclusion
9	Install New Solar Domestic Water Heaters	Nanakuli Homes	$782,036	$20,290	38.5	Payback exceeds measure life
10	Install New Solar Domestic Water Heaters	Makani Kai Hale I	$514,414	$13,366	38.5	Payback exceeds measure life
11	Install New Solar Domestic Water Heaters	Kauhale O'hana	$436,157	$12,135	35.9	Payback exceeds measure life
12	Install New Solar Domestic Water Heaters	Kalihi Valley Homes	$3,417,024	$98,486	34.7	Payback exceeds measure life
13	Install New Solar Domestic Water Heaters	Mayor Wright Homes	$4,758,864	$391,104	12.2	First cost with respect to site disposition; instantaneous gas water heaters recommended
14	Install New Solar Domestic Water Heaters	Kuhio Park Terrace - Low Rise	n/a	n/a	n/a	Anticipated demolition
15	Install Energy Star Refrigerators	Koolau Village	$152,451	$4,374	34.9	Payback exceeds measure life
16	Install Energy Star Refrigerators	Makua Alii	$185,759	$8,319	22.3	Payback exceeds measure life
17	Install Energy Star Refrigerators	Kupuna Home O'Waialua	$13,048	$587	22.2	Payback exceeds measure life
18	Install Energy Star Refrigerators	Punchbowl Homes	$197,963	$9,247	21.4	Payback exceeds measure life
19	Install Energy Star Refrigerators	Paoakalani	$145,082	$6,809	21.3	Payback exceeds measure life
20	Install Energy Star Refrigerators	Waimaha-Sunflower	$14,353	$692	20.7	Payback exceeds measure life

CNR #	Description	Development	Total Project Costs	Dollar Savings	Total Payback	Basis for Exclusion
21	Install Energy Star Refrigerators	Kuhio Park Terrace	$417,620	$20,315	20.6	Payback exceeds measure life
22	Install Energy Star Refrigerators	Pumehana	$155,929	$7,593	20.5	Payback exceeds measure life
23	Install Energy Star Refrigerators	Nanakuli Homes	$53,220	$2,598	20.5	Payback exceeds measure life
24	Install Energy Star Refrigerators	Kaneohe Apartments	$13,184	$672	19.6	Payback exceeds measure life
25	Install Energy Star Refrigerators	Waimanalo Homes II	$15,381	$821	18.7	Payback exceeds measure life
26	Install Energy Star Refrigerators	Maili II	$15,657	$852	18.4	Payback exceeds measure life
27	Install Energy Star Refrigerators	Ka Hale Kahaluu	$19,585	$1,070	18.3	Payback exceeds measure life
28	Install Energy Star Refrigerators	Kalihi Valley Homes	$190,498	$10,762	17.7	Payback exceeds measure life
29	Install Energy Star Refrigerators	Lanakila Homes	$18,034	$1,036	17.4	Payback exceeds measure life
30	Install Energy Star Refrigerators	Hookipa Kahaluu	$31,315	$1,938	16.2	Payback exceeds measure life
31	Install Energy Star Refrigerators	Kalanihuia	$37,965	$2,362	16.1	Payback exceeds measure life
32	Install Energy Star Refrigerators	Waipahu II	$24,859	$1,609	15.5	Payback exceeds measure life
33	Install Energy Star Refrigerators	Kalakaua Homes	$241,352	$15,950	15.1	Payback exceeds measure life
34	Install Energy Star Refrigerators	Waipahu I	$19,640	$1,298	15.1	Payback exceeds measure life

CNR #	Description	Development	Total Project Costs	Dollar Savings	Total Payback	Basis for Exclusion
35	Install Energy Star Refrigerators	Puuwai Momi	$310,538	$21,081	14.7	Payback exceeds measure life
36	Install Energy Star Refrigerators	Kau'iokalani	$35,021	$2,432	14.4	Payback exceeds measure life
37	Install Energy Star Refrigerators	Kuhio Homes	$33,898	$2,426	14.0	Payback exceeds measure life
38	Install Energy Star Refrigerators	Nani Olu	$15,260	$1,100	13.9	Payback exceeds measure life
39	Install Energy Star Refrigerators	Hale Laulima	$35,229	$2,573	13.7	Payback exceeds measure life
40	Install Energy Star Refrigerators	Palolo Valley Homes	$35,229	$2,614	13.5	Payback exceeds measure life
41	Install Energy Star Refrigerators	Salt Lake	$18,267	$1,372	13.3	Payback exceeds measure life
42	Install Energy Star Refrigerators	Kaahumanu Homes	$183,974	$14,000	13.1	Payback exceeds measure life
43	Install Energy Star Refrigerators	Hale Olaloa	$47,167	$3,598	13.1	Payback exceeds measure life
44	Install Energy Star Refrigerators	Hale Hauoli	$13,873	$1,064	13.0	Payback exceeds measure life
45	Install Energy Star Refrigerators	Wahiawa Terrace	$1,315	$112	11.8	Payback exceeds measure life
46	Install Front-Loading Washers	Hale Hoolulu	$3,807	$43	87.6	Payback exceeds measure life
47	Install Front-Loading Washers	Home Nani	$3,807	$51	75.1	Payback exceeds measure life
48	Install Front-Loading Washers	Pomaikai Homes	$3,777	$63	60.0	Payback exceeds measure life

CNR #	Description	Development	Total Project Costs	Dollar Savings	Total Payback	Basis for Exclusion
49	Install Front-Loading Washers	Hale Nana Kai O Kea	$7,615	$145	52.6	Payback exceeds measure life
50	Install Front-Loading Washers	Hale Hoonanea (Port Allen)	$7,615	$152	50.1	Payback exceeds measure life
51	Install Front-Loading Washers	Nani Olu	$7,554	$169	44.8	Payback exceeds measure life
52	Install Front-Loading Washers	Hale Aloha O Puna	$3,777	$88	42.9	Payback exceeds measure life
53	Consolidate Electric Meters	Waipahu I	$65,091	$2,401	27.1	Payback
54	Install Electric Check-Meters	Waipahu I	$54,625	$4,886	11.2	Impractical without meter consolidation
55	Install Electric Check-Meters	Eleele Homes	$65,964	$11,858	5.6	Impractical without meter consolidation (meter consolidation would result in higher utility charges)
56	Install High-Efficiency Air Conditioning	Kalanihuia	$1,630	$72	22.5	Payback exceeds measure life
57	Install High-Efficiency Air Conditioning	Kuhio Park Terrace	$2,446	$142	17.2	Payback exceeds measure life
58	Install High-Efficiency Air Conditioning	Kalihi Valley Homes	$3,552	$283	12.5	Payback exceeds measure life
59	Install High-Efficiency Air Conditioning	Punchbowl Homes	$2,190	$180	12.2	Payback exceeds measure life
60	Install Office Computer Controls	Kapaa	$1,973	$175	11.2	Payback exceeds PC life
61	Install Office Computer Controls	Kekaha Ha'aheo	$789	$74	10.7	Payback exceeds PC life

CNR #	Description	Development	Total Project Costs	Dollar Savings	Total Payback	Basis for Exclusion
62	Install Office Computer Controls	Kahekili Terrace [a & b]	$3,156	$323	9.8	Payback exceeds PC life
63	Install Office Computer Controls	Lanakila Homes I	$4,734	$533	8.9	Payback exceeds PC life
64	Install Office Computer Controls	Hale Hauoli	$1,184	$134	8.9	Payback exceeds PC life
65	Install Office Computer Controls	Noelani I	$1,184	$134	8.9	Payback exceeds PC life
66	Install Office Computer Controls	Ka Hale Kahaluu	$1,184	$134	8.9	Payback exceeds PC life
67	Install Office Computer Controls	Kalanihuia	$1,691	$191	8.8	Payback exceeds PC life
68	Install Office Computer Controls	Kuhio Park Terrace	$2,537	$300	8.5	Payback exceeds PC life
69	Install Office Computer Controls	Kalakaua Homes	$1,691	$203	8.3	Payback exceeds PC life
70	Install Office Computer Controls	Makua Alii	$634	$76	8.3	Payback exceeds PC life
71	Install Office Computer Controls	Puuwai Momi	$2,114	$259	8.2	Payback exceeds PC life
72	Install Office Computer Controls	Waimaha-Sunflower	$2,114	$265	8.0	Payback exceeds PC life
73	Install Office Computer Controls	Koolau Village	$846	$109	7.7	Payback exceeds PC life
74	Install Office Computer Controls	Palolo Valley Homes	$846	$109	7.7	Payback exceeds PC life
75	Install Office Computer Controls	Kalihi Valley Homes	$2,114	$274	7.7	Payback exceeds PC life

CNR #	Description	Development	Total Project Costs	Dollar Savings	Total Payback	Basis for Exclusion
76	Install Office Computer Controls	Mayor Wright Homes	$2,748	$356	7.7	Payback exceeds PC life
77	Install Office Computer Controls	Kahale Mua - Federal	$789	$104	7.6	Payback exceeds PC life
78	Install Office Computer Controls	HPHA Central Office	$26,216	$0	-	No savings applicable to Central Office Cost Ctr
79	Install HET Toilets	David Malo Circle	$13,880	$126	109.8	Payback exceeds measure life
80	Install Low-Flow Showerheads & Faucet Aerators	David Malo Circle	$4,182	$8,287	0.5	Installation and water savings measurement impractical without toilet replacement
81	Install HET Toilets	Hale Hoolulu	$8,773	$220	40.0	Payback exceeds measure life
82	Install Low-Flow Showerheads & Faucet Aerators	Hale Hoolulu	$2,769	$1,170	2.4	Installation and water savings measurement impractical without toilet replacement
83	Install HET Toilets	Kahekili Terrace [a & b]	$67,149	$1,046	64.2	Payback exceeds measure life
84	Install Low-Flow Showerheads & Faucet Aerators	Kahekili Terrace [a & b]	$19,322	$8,974	2.2	Installation and water savings measurement impractical without toilet replacement
85	Install HET Toilets	Kauhale Nani	$44,576	$938	47.5	Payback exceeds measure life

CNR #	Description	Development	Total Project Costs	Dollar Savings	Total Payback	Basis for Exclusion
86	Install Low-Flow Showerheads & Faucet Aerators	Kauhale Nani	$9,374	$12,622	0.7	Installation and water savings measurement impractical without toilet replacement
87	Install Front-Loading Washers	Kauhale Nani	$0	$267	0.0	Water savings measurement impractical without toilet replacement
88	Install HET Toilets	Piilani Homes	$31,879	$634	50.3	Payback exceeds measure life
89	Install Low-Flow Showerheads & Faucet Aerators	Piilani Homes	$9,676	$7,771	1.2	Installation and water savings measurement impractical without toilet replacement
90	Install Front-Loading Washers	Piilani Homes	$0	$222	0.0	Water savings measurement impractical without toilet replacement
91	Install New Sink Faucets	Mayor Wright Homes	$232,522	$7,767	29.9	Payback with respect to site disposition
92	Replace Heat Pump Water Heater	Paoakalani	$131,851	$1,537	85.8	Payback exceeds measure life
93	Install High-Efficiency Central Domestic Water Heaters	Paoakalani	$159,150	$2,452	64.9	Payback exceeds measure life
94	Install High-Efficiency Central Domestic Water Heaters	Kuhio Park Terrace - Twr A	n/a	n/a	n/a	No practical or safe means of venting

CNR #	Description	Development	Total Project Costs	Dollar Savings	Total Payback	Basis for Exclusion
95	Install High-Efficiency Central Domestic Water Heaters	Kuhio Park Terrace - Twr B	n/a	n/a	n/a	No practical or safe means of venting; boilers replaced in 2009
96	Solar Golf Cart Conversion	Kalihi Valley Homes	$14,318	$119	119.9	Payback exceeds measure life
97	Solar Golf Cart Conversion	Mayor Wright Homes	$16,970	$149	113.7	Payback exceeds measure life
98	Upgrade Apartment Lighting	Mayor Wright Homes	$401,888	$18,704	21.5	Payback with respect to site disposition
99	Upgrade Common Area Lighting	Salt Lake	$15,798	$245	64.4	Payback exceeds measure life
100	Install Wind Turbines	Pumehana	$258,749	$2,576	100.4	Payback exceeds measure life

Section 4:
Long Term Services

A. Measurement and Verification

In a performance contract, the utility consumption and cost savings produced by the project must be sufficient to cover all project costs, including up-front capital costs, any additional or incremental maintenance, monitoring and verification (M&V) and inspectional services, and resident education on energy conservation, over the contract term.

In a federal public housing energy performance contract, the savings stream from the improvements must be tied to the utility subsidies provided by HUD. Per 24 CFR 990.185, three methods of securing HUD conservation incentives are available to this project: Frozen Rolling Base, Additional Operating or "Add-on" Subsidy, and Allowance Adjustment. For this project, Ameresco recommends a combination of all three incentives, thereby ensuring that the funding is aligned with the technical assumptions and monitoring methodologies.

Frozen Rolling Base. HUD's Frozen Rolling Base incentive applies to authority-paid utilities. Under this incentive, savings are measured at the utility meter and then-current utility rates are applied each year to determine the dollar savings. Utility consumption savings are compared annually to the "frozen" base consumption. For this project, this subsidy is recommended for the following savings:

- All water consumption savings[1]
- Building-wide gas savings where solar hot water or high efficiency central water heater installations were proposed
- Building-wide electric savings where solar hot water installations were proposed
- Electric savings at Makamae, where installation of a solar photovoltaic system was proposed
- Electric savings and increased gas consumption at Mayor Wright Homes, where installation of gas-fired instantaneous water heaters was proposed

This methodology is applied where the savings can be readily and cost-effectively measured at the meter,[2] and the incentive structure will provide a revenue stream to HPHA from savings net of debt and any service fees associated with this project, as long as at least 75% of the savings contribute to

[1] The exceptions include Kawailehua and Kahale Mua, which share water meters with Hawaii state or county properties. At these two locations, Ameresco will stipulate the water consumption savings using an Add-on operating subsidy.

[2] Typically, the frozen rolling base incentive is recommended for any utility where the predicted consumption savings is anticipated to reach or exceed approximately 20% of the base consumption or if there is a high probability that the savings can be accurately identified otherwise at the meter for a given site.

the project costs. Measuring utility consumption savings using utility billing data comparisons is a methodology known as "Option C" under the energy industry standard monitoring protocol, the International Performance Measurement and Verification Protocol ("IPMVP").

Additional Operating Subsidy. Under the Additional Operating Subsidy, HUD will pay a fixed additional operating subsidy to cover costs for ECMs on authority-paid utilities where the utility consumption savings by the various measures may not be easily measured using utility billing data. Since the affected utility baselines continue to "roll," 75% of any savings that appear in the metered utility use can be retained by the authority for the four year roll-out period. This subsidy is recommended to capture savings associated with common area and apartment lighting upgrades, vending machine controls, refrigerator replacements, high-efficiency air conditioning, efficient building water pressure controls, meter consolidation, and electric check meters. An Add-on subsidy will also be used to capture gas and electric savings associated with water conservation measures. The Add-on incentive structure lends itself to verification utilizing the agreed-upon calculations of savings and is known as "Option A" under the IPMVP.

Allowance Adjustment. The HUD-accepted methodology for retaining savings against resident-paid utilities provides for a "frozen" utility consumption allowance from which the incremental savings valued at the then-current utility rates is retained by the authority to support the project costs. In essence, a lowering of the utility allowance commensurate with the utility savings from the installed ECMs provides a larger rental revenue income to the authority. This methodology will be applied to retain electric savings from apartment lighting upgrades, refrigerator replacements, solar water heating, and water conservation measures at sites with tenant-paid electricity, and tenant-paid gas savings associated with water conservation measures and solar water heating at sites with tenant-paid gas. Calculated savings are utilized to provide the adjustment to the allowances.

Tables 4.A.1-4 illustrate our recommendations for the application of the ongoing annual HUD incentives by site.

Table 4.A.1: Proposed HUD Incentives by Site – Big Island

Development	AMP #	Project #	HPHA Paid Electricity		HPHA Paid Gas or Propane		HPHA Paid Water & Sewer		Tenant Allowances
			Frozen Base	Add-on Subsidy	Frozen Base	Add-on Subsidy	Frozen Base	Add-on Subsidy	Allowance Adjustment[3]
Lanakila Homes I	37	1004		X			X		E,G
Lanakila Homes II	37	1013					X		E,G
Lanakila Homes III	37	1014							
Lanakila Homes IV	37	1104					X		E,G
Hale Aloha O Puna	37	1051		X		X	X		
Hale Olaloa	37	1052		X					
Kauhale O'Hanakahi	37	1097		X					E
Pahala	37	1045		X		X	X		
Pomaikai Homes	37	1029		X		X	X		
Punahele Homes	37	1028					X		E,G
Ka Hale Kahaluu	43	1061		X	X		X		E
Hale Hookipa	43	1053		X		X	X		
Kaimalino	43	1032		X		X	X		
Kealakehe	43	1070	X			X	X		E
Nani Olu	43	1063		X			X		E
Noelani II	46	1078		X			X		E
Hale Hauoli	46	1031		X		X	X		
Ke Kumu 'Ekolu	46	1097		X	X		X		E
Noelani I	46	1071		X			X		E

3 Allowances impacted: E=Electric allowance; G=Natural gas or propane allowance; W=Water and sewer allowance.

Table 4.A.2: Proposed HUD Incentives by Site – Neighbor Islands

Development	AMP #	Project #	HPHA Paid Electricity		HPHA Paid Gas or Propane		HPHA Paid Water & Sewer		Tenant Allowances
			Frozen Base	Add-on Subsidy	Frozen Base	Add-on Subsidy	Frozen Base	Add-on Subsidy	Allowance Adjustment[4]
KAUAI									
Kapaa	38	1018		X		X	X		
Hale Hoolulu	38	1019		X					
Hale Nana Kai O Kea	38	1054		X		X	X		
Hui O Hanamaulu	38	1021		X		X	X		
Kalaheo	38	1022		X		X	X		
Kekaha Ha'aheo	38	1064		X		X	X		E,G
Eleele Homes	38	1020		X		X	X		
Hale Hoonanea (Port Allen)	38	1055		X		X	X		
Home Nani	38	1023		X		X	X		
Kawailehua - Federal	38	1086						X	E,G
MAUI									
Kahekili Terrace [a&b]	39	1017		X					
David Malo Circle	39	1016	X						
Makani Kai Hale I	39	1092		X					E
Piilani Homes	39	1044		X					
Makani Kai Hale II	39	1097							E
MOLOKAI									
Kahale Mua - Federal	39	1088		X		X		X	E,G

4 Allowances impacted: E=Electric allowance; G=Natural gas or propane allowance; W=Water and sewer allowance.

Table 4.A.3: Proposed HUD Incentives by Site – Oahu High-Rise and Kuhio Homes

Development	AMP #	Project #	HPHA Paid Electricity		HPHA Paid Gas or Propane		HPHA Paid Water & Sewer		Tenant Allowances
			Frozen Base	Add-on Subsidy	Frozen Base	Add-on Subsidy	Frozen Base	Add-on Subsidy	Allowance Adjustment[5]
Kalakaua Homes	34	1062		X		X	X		E
Makua Alii	34	1012		X	X		X		
Paoakalani	34	1036		X		X	X		
Punchbowl Homes	35	1011		X	X		X		
Kalanihuia	35	1024		X	X		X		
Makamae	35	1046	X		X		X		
Pumehana	35	1047		X	X		X		
Kuhio Park Terrace	40	1010		X	X		X		
Kuhio Homes	40	1007			X		X		E

5 Allowances impacted: E=Electric allowance; G=Natural gas or propane allowance; W=Water and sewer allowance.

Table 4.A.4: Proposed HUD Incentives by Site – Oahu Low-Rise

Development	AMP #	Project #	HPHA Paid Electricity		HPHA Paid Gas or Propane		HPHA Paid Water & Sewer		Tenant Allowances
			Frozen Base	Add-on Subsidy	Frozen Base	Add-on Subsidy	Frozen Base	Add-on Subsidy	Allowance Adjustment[6]
Puuwai Momi	30	1026	X				X		
Hale Laulima	30	1027		X			X		E
Salt Lake	30	1066				X	X		E
Waipahu I	30	1038		X		X	X		
Waipahu II	30	1039		X		X	X		
Kalihi Valley Homes	31	1005		X			X		E
Mayor Wright Homes	32	1003	X		X		X		E
Kaahumanu Homes	33	1009			X		X		E
Kamehameha Homes	33	1099		X			X		E,G
Spencer House	35	1073		X	X		X		E
Waimaha-Sunflower	44	1057		X			X		E
Kau'iokalani	44	1091		X		X	X		E
Maili I	44	1033					X		E
Maili II	44	1108					X		E
Nanakuli Homes	44	1035		X			X		E
Koolau Village	45	1030		X			X		E,G
Hookipa Kahaluu	45	1072		X			X		E
Kaneohe Apartments	45	1069		X			X		E
Kauhale O'hana	45	1090		X		X	X		E
Waimanalo Homes	45	1025					X		E,G
Waimanalo Homes II	45	1107					X		E,G
Kauhale Nani	49	1056		X					E
Wahiawa Terrace	49	1015		X		X	X		
Kupuna Home O'Waialua	49	1050		X		X	X		
Palolo Valley Homes	50	1008		X			X		E

6 Allowances impacted: E=Electric allowance; G=Natural gas or propane allowance; W=Water and sewer allowance.

Deliverables

As part of our long term services, Ameresco will provide measurement and verification of the energy and water savings generated by this project during the project repayment period to assure that the necessary HUD utility incentives are secured. At the end of each contract year, Ameresco will submit to HPHA, an annual reconciliation report, highlighting the savings generated over the past year and for the project to date. This report will also note any changes to the baseline or savings adjustments, and is submitted in fulfillment of the energy services guarantee.

As part of our annual services, Ameresco will also provide assistance to HPHA to assure compliance with the HUD reporting requirements relating to this project in order to secure the necessary incentives.

B. Annual Site Inspections

To assure the continued persistence of savings over the contract term, Ameresco will inspect the installed measures on an annual basis. This will entail the inspection of an approximately 5% sample of apartments at each site and a review of all systems installed under this project, to check that the installed measures (e.g., toilets, light fixtures, solar equipment) are in place and operating properly and maintained according to recommended practices. All measures involving centralized systems will be inspected and maintenance records reviewed. During the inspection process, Ameresco will meet with HPHA's maintenance staff to answer any questions or concerns they may have and to provide any supplemental information or additional service recommendations on the installed measures as needed (for measures which Ameresco does not have direct service responsibility). The findings of the annual inspection will be provided as part of the annual savings reconciliation report.

C. Resident Education

Resident understanding of the proper use of the installed measures and willingness to adopt efficiency practices can increase realized savings, particularly with measures that the resident controls entirely within the apartment, such as water fixtures and lighting. To help foster an understanding of the goals of energy conservation, address issues of tenant comfort and convenience, and emphasize proper use of the installed measures, Ameresco can provide annual resident education services over the term of the contract as an additional service.

Our resident education sessions are planned and executed in a manner aimed to reach the above goals, while also fostering a partnership environment between the housing authority, the residents and Ameresco. The services provided as part of resident education include the following:

- Annual production and distribution of a newsletter to each site, highlighting the project savings to date and emphasizing proper use of the affected equipment. The newsletter is written in English, but written translation services are available.
- Annual on-site resident information sessions, with a typical agenda as follows:
    - Overview on partnership to save energy and resident efforts to date.
    - Current tips on saving energy and water, which can be followed by residents in their apartments to enhance the overall savings.
    - Demonstrations on how to effectively use specific energy conservation measures installed in the apartments.
    - Games and/or special topics on energy conservation.
    - Refreshments and door prizes.

D. Maintenance Services

A number of the measures proposed for installation under the energy performance contract have standard maintenance requirements that HPHA's maintenance staff is used to performing. These measures include new toilets and water savings devices, lighting, air conditioners, and refrigerators. However, the project also includes energy-saving measures with unique maintenance requirements. Proper and timely performance of the required maintenance tasks by skilled technicians for these measures is critical for both the longevity and performance efficiency of the measures over their expected life. These measures are listed in Table 4.D.

For each of the measures listed in Table 4.D, Ameresco has developed an annualized, 20-year maintenance budget covering both normal preventative maintenance and unscheduled repair or replacement of equipment or components. The details of the budgeted service items are presented in the ECM descriptions found in Section 3.B. Ameresco has applied the total annual service reserve shown in Table 4.D to the project cash flow found in Section 1.D.

To estimate the service reserve for each measure, Ameresco first determined the variable, year-to-year service costs associated with preventative maintenance and unscheduled repair work based on life expectancy of individual components within a system and potential for premature failures. Ameresco then determined a net present value of the cash stream using a 2.5% discount factor and then matched that to an annualized payment escalating at 3% annually. This in effect spreads the maintenance cost liability evenly over the 20-year project term, as savings escalate. As service is needed, funds are then withdrawn from the reserve.

Ameresco has presented these annualized maintenance costs estimates on a budgetary basis. The assumption here is that Ameresco will provide the maintenance services associated with the measures presented in Table 4.D, with the exception of check metering. (The estimated annual cost for automatic meter reading and reporting services was provided by a host services vendor.) Once Ameresco and HPHA review and discuss the specific scope and terms of the services provided, these costs will be revised as necessary.

Table 4.D: Estimated Annual Maintenance Service Reserve by Measure

ECM #	ECM Description	1st Year Reserve (2012)
5	Install Efficient Building Water Pressure Controls	$4,714
13	Install Solar Photovoltaic Arrays	$8,083
14	Install Electric Check-Meters	$29,839
15	Install High-Efficiency Central Domestic Water Heaters	$39,754
16	Install Solar Domestic Water Heaters	$444,775
18	Install Gas-Fired Instantaneous Water Heaters	$42,878
	Total	$570,043

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