2017–2018 ENERGY AUDIT

For the Immaculate Heart Community's Kenmore Residence

Roberts Environmental Center at Claremont McKenna College
Energy Analysis Team

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INTRODUCTION

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In September 2017, Agnes Dickson of the Immaculate Heart Community asked the Energy Analysis Team at the Roberts Environmental Center to conduct an energy audit of the IHC's Kenmore Residence. In October 2017, the team visited the Kenmore Residence to meet some of the residents, inspect the building, and gather data on appliance models and energy usage.

IHC History & Kenmore Residence Overview

The Immaculate Heart Community was "formed by insights from eco-feminist and justice spiritualities" inspired by the vision of Vatican II.[1] However, the Diocese of Los Angeles did not agree with IHC's redirection; in 1970, the Immaculate Heart of Mary sisters decided to form a new, independent community outside the purview of the Catholic Church.

The Kenmore Residence, located near Koreatown in Downtown Los Angeles, is a home for the senior Sisters, formerly of the order of the Immaculate Heart of Mary. The residence is an older three-story building with approximately 35 single units, a community dining room with kitchen, a small nursing office, and a street level garage under the units.

Goal of Audit

IHC believes that the greatest moral issue of today is the destruction of the earth, especially its effect on the poor and disenfranchised. One of its primary goals as an organization is stewardship for the environment, and it has long been an aspiration of the board and residents to limit their environmental impact.

IHC has established an environmental commission for educating residents and making properties more sustainable (IHC also owns another property called Casa Esperanza in Van Nuys). Because the team has past experience with residential energy audits, we were requested to intervene as a third party, present a plan and cost analysis to the Community and Board of Trustees to help realize their environmental goals. With our proposal in mind, the Board may vote to put money aside and adopt some or all recommendations in the future.

Scope of Analysis

The team was requested to make recommendations on energy usage (Sections 1-2), water usage (Section 3), residential purchasing (Section 2), and landscaping. On our site visit, we did not note great inefficiencies in landscaping, so we excluded it from our analysis and recommendations.

Although energy audits typically include energy savings from insulation, it was excluded from

[1] Immaculate Heart Community Website | History (2016).

our analysis. IHC does not pay for individual residents' energy bills and does not have central air—rooms have wall air conditioners. Insulation would primarily affect single units, as there are not many wall or window ACs in communal areas.

Interesting finding - kitchen uses more electricity than building

Limitations

The Fine Audit Model (see Section 1) only considers changes in annual consumption for electricity, given the cost of proposed appliance upgrades. However, the "Building" bill, which is IHC's largest monthly bill (at about $1500/month), combines both the electricity and water usage for the whole building. Upon review of the receipts, however, we found that half of the Building bill goes to water usage. Our proposed appliance recommendations only cover the energy half of the Building bill; behavioral and maintenance recommendations regarding water are outlined in Section 3.

The Kenmore Residence has a solar panel array on its roof. However, the date of installation and the energy production of the panels are unknown, so we were unable to include that in our energy analysis. The panels are directly connected to the building's hot water heater, so the electricity generated by the panels does not factor into the residence's energy bill.

1. THE FINE AUDIT MODEL

Max Fine CMC '21

Introduction

The Fine Audit Model (FAM) is a two part economic tool that can analyze current and future consumption of industrial and household appliances in terms of kilowatts (kW) in of a cost benefit analysis.

Methods

Part one of the FAM can be used to analyze the current energy consumption (in kW) of household and industrial appliances and compare that consumption to the consumption of substitute appliances. The FAM draws upon current and past kW usage numbers listed on electric bills to accurately simulate future average usage for these appliances over a ten-year time period. It then compares the simulated averages to an adjusted average of the substitute appliances' usage on a ten year scale.

Part two of the FAM puts that comparison through a cost-benefit analysis and payback analysis which includes monetary and converted non-monetary costs and benefits. An example of a converted non-monetary cost would be the cost of carbon, which is given a price by the EPA, but in of itself does not hold monetary value. This analysis is run on an appliance to appliance basis, which allows us to make appliance specific recommendations.

We used the FAM to compare the Immaculate Heart Community's (IHC) current household and industrial appliances to environmentally friendly alternatives. Because of the setup of the IHC's electrical grid, we performed this analysis on a room by room basis, as well as an appliance by appliance basis. Because the IHC has different rooms on different energy meters, the appliance data was separated by room. To get accurate appliance usage data, we needed to divide the FAM into subsections by energy meter to account for this.

The full list of costs and benefits considered in the FAM cost-benefit analysis for the IHC are as follows:

Costs Considered:

- Cost of appliance
- Installation
- Maintenance
- Cost of Carbon
- Cost of electricity per month per appliance (if less beneficial)

Benefits Considered:

- Carbon abatement Benefit (CAB)
- Cost of electricity per month per appliance (if more beneficial)
- Other environmental benefits

2. APPLIANCE RECOMMENDATIONS

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Table 2.1. Summary of energy expenses (past and projected), savings, and initial investment with respect to rooms according to the FAM.

Categories	Original Annual Cost ($)	New Annual Cost ($)	Annual Savings ($)	Initial Investment ($)
Building	$4,975.61	$4,751.50	$224.11	$3,840
Kitchen	$3,780.05	$3,054.60	$725.44	$2,750
Medical	$1,055.07	$899.48	$155.59	$640
Sum	$9,810.72	$8,705.58	$1,105.14	$7,230.00

Table 2.2. Number of appliances in each room as treated by the model.

UNITS OF ELECTRIC APPLIANCE ACCORDING TO ROOMS			
	Kitchen (102, 104, 106)	Medical (109)	Building
Fridge	4	1	-
Freezer	1	-	1
ACs	3	1	-
Dishwasher	1	-	-
Food warmer	1	-	-
Lights	-	-	~60
TV	-	-	2
Heat Pump	-	-	1

Notes on Selection and Inclusion

Why did we pick certain rooms and not others?

1) Those rooms that are specially picked and analyzed in our model have distinctive energy bills, as billed by LADWP, which provides solid evidence of energy consumption fluctuation throughout the course of recent years.
2) Those selected rooms have distinctive electric appliances in use, as indicated in Table 2.2.
3) According to REC Energy Team's analysis, there is considerable potential for those selected rooms to reduce energy consumption and increase energy efficiency in the long run.

Recommendations by Appliances

Elevator

1) Substitute bio hydraulic fuel— $4-5 more per gallon

Biodegradable, reduce oil spill costs, better performance like higher lubricity, higher viscosity index, heat reduction, and reduced energy usage during operation in some cases.

Valve Adjustment next maintenance

Minimize oil bypass time, minimize pump and motor run times while reducing heat in the system and surrounding environment, reducing unnecessary wasted energy on the elevator as well as increasing cooling costs for HVAC to counter the heat released from the elevator system.

2) Ventilate the machine room better

Exhausting/venting heat from the room and moving air around the tank makes for cooler system operating temperatures at a much lower cost and reduced energy usage. The tank should be at least 2-3 inches from the wall on all sides. This allows for heat dissipation naturally and a small fan can be added to move the air between the wall and tank increasing the cooling effects.

Lights in Rooms

1) Replace the fluorescent light with LED lights.

2) Have lights that the intensity is subject to change

3) Use dim LED wall light for the night.

4) Look for potential rebates for the light bulb bases.

Table 2.3. Payback period analysis of various light models.

Light Model	Actual LED Rate (Watts)	# of units	Unit Price ($)	Total Cost ($)	Payback Period (yr)		
					Low Usage (2 hr/day)	Med Usage (3 hr/day)	High Usage (5 hr/day)
LED Bulb 25 Equal	5	20	5	100	1.903	1.268	0.761
LED Bulb 125 Equal	20	20	25	500	1.812	1.208	0.725
LED Tube 32 Equal	16	10	8	80	3.805	2.537	1.522
LED Tube 96 Equal	36	10	20	200	2.537	1.691	1.015

Hallway Lights

1) Install motion detectors instead of having lights on.

2) Install LED wall lights.

Solar Panels

1) Clean the panels regularly.

2) Move them to the right side of the roof so that the new building does not block them.

Education

1) Add stickers to water faucets and light switches that say “turn off when not in use.”

Drying

1) Invest in some wire clothes racks instead of always using an electric clothes dryer.

Windows

1) Single pane windows are ineffective insulators. Install double pane windows to keep in the heat/cold.

2) Install detectors (which may come along with the AC system) to check if the windows are open while using ACs

Fridges

By upgrading five fridges (all but the Troulsen and the GE), the IHC can save 2063 kW a year and up to $370 a year. If upgrading all five fridges is not financially feasible, then the Whirlpool Prince Fridge should be upgraded first since it is the least efficient, then the Kirkland Signature, etc. The payback period for upgrading all five fridges would be close to six years.

Table 2.4. Payback period analysis of various fridge models.

Current Appliance	Current Appliance Energy Usage (KWh/year)	Recommended Update	New Appliance Energy Usage (KWh/year)	New Appliance Cost	Payback Period (Years)
Kirkland Signature	825	**Daewoo FR-1020ARW**	296	$432 for one $2160 for 5	5.817
Kenmore	463				
Frigidaire Professional	509				
Whirlpool Prince	1232				
Roper	514				

Freezer

By upgrading the garage freezer, the IHC can save 708kW and $127 a year. The payback period would be a little but more than one year. This freezer upgrade is a great opportunity to save money and energy and is highly recommended due to the extremely low payback period.

Table 2.5. Payback period analysis of the freezer.

Current Appliance	Current Appliance Energy Usage (KWh/year)	Recommended Update	Recommended Appliance Energy Usage (KWh/year)	Recommended Appliance Cost	Payback Period (Years)
Sears Coldspot	845	**Avanti CF24Q0W**	137	$151	1.2

Air Conditioning Units

Even if they are used for 3 hours a day as an average for the whole year, it would be beneficial to upgrade the three old models since saving would be $105 and 1760 kW a year. The payback period would be 2.3 years. If the AC units are used more often, that is an even bigger reason to update the models since the savings go up linearly. The low, medium, and high usages that are shown in the below table correspond to an average of 3 hours, 6 hours, and 12 hours per day for the year. The older AC units (Carrier, Emerson, and Hampton Bay) are at a high upgrade priority as they are the least efficient.

Table 2.6. Payback period analysis of various AC models.

Current Appliance	Current Appliance Energy Usage (KWh)	Recommended Update	Recommended Appliance Energy Usage (KWh)	Recommended Appliance Cost	Payback Period (Years)
Carrier	1.856	**LG LW8016ER**	0.66	$240 for one $960 for 4	Low Usage: 2.272 Med Usage: 1.136 High Usage: 0.568
Hampton Bay	0.816				
Arctic King	0.916				
Emerson Quiet Cool	1*				

* Estimated rate due to no information since the appliance is too old to be listed online

Microwave

There is no need to really upgrade this small microwave unless it is being used for hours a day.

Vacuum Machine

Though more energy-saving models are available in the market, there is no need for IHC to replace the current ones soon because they are fairly new.

Hair Dryer in the Salon

Though the current hair dryers seem to be antique models, there is no need for change unless they are frequently used.

Ice Maker

The ice maker that is currently in place is already the most efficient for its size.

Dishwasher

This is something that should be upgraded. If it is used for just 45 minutes a day, the savings could be 300 dollars a year and 1628 kW per year. The payback period for this would be 2.4 years. As with the AC units, if the dishwasher is used more than once a day, the savings go up quickly. The low, medium, and high usages that are shown in the below table correspond to an average of 45 minutes, 90 minutes, and 3 hours per day for the year.

Table 2.7. Payback period analysis of the dishwasher.

Current Appliance	Current Appliance Energy Usage (KWh)	Recommended Update	Recommended Appliance Energy Usage (KW)	Recommended Appliance Cost	Payback Period (Years)
Jackson Dishwasher	8.2	**Beko DIT28430**	Low Usage: 0.616 Med Usage: 1.232 High Usage: 2.464	$700	Low Usage: 2.388 Med Usage: 1.194 High Usage: 0.597

Carrier Heat Pump

The heat pump should be upgraded. If it is used for 3 hours a day, the savings could be 364 dollars and 2025 kW a year. The payback period would be 6.8 years, but this period gets smaller if the pump is used for more than 3 hours a day. The upfront cost of a new heat pump and installation is high and might be prohibitive. The low, medium, and high usages that are shown in the below table correspond to an average of 3 hours, 6 hours, and 12 hours per day for the year.

Table 2.8. Payback period analysis of the heat pump.

Current Appliance	Current Appliance Energy Usage	Recommended Update	Recommended Appliance Energy Usage (KW)	Recommended Appliance Cost	Payback Period (Years)

	(KWh)				
Carrier 25HCD3	3.8	AirEase SCU/BCE Series	Low Usage: 2.026 Med Usage: 4.052 High Usage: 8.103	$2,500	Low Usage: 6.856 Med Usage: 3.428 High Usage: 1.714

Food Warmer

Depending on whether or not the food warmer is actually used, it should be upgraded. Instead of having the whole buffet set up, energy could be saved by using a smaller one. With a smaller food warmer used for an hour and a half each day, IHC could save 914 kW a year with a payback period of half a year. The low, medium, and high usages that are shown in the below table correspond to an average of 45 minutes, 90 minutes, and 3 hours per day for the year.

Table 2.9. Payback period analysis of the food warmer.

Current Appliance	Current Appliance Energy Usage (KWh)	Recommended Update	Recommended Appliance Energy Usage (KW)	Recommended Appliance Cost	Payback Period (Years)
Unknown	3.8	NutriChef PKWTR30	Low Usage: 0.0493 Med Usage: 0.0986 High Usage: 0.1971	$70	Low Usage: 0.851 Med Usage: 0.425 High Usage: 0.213

Televisions

If the TVs are constantly on relaying a video feed, there are alternative TVs that will use less energy. By saving up to 1218 kW can be saved a year with a payback period of 1.46 years. If the TVs are not on all the time, then the switch is probably not worth it. The low, medium, and high usages that are shown in the below table correspond to an average of 6 hours, 12 hours, and 24 hours per day for the year.

Table 2.10. Payback period analysis of TV models.

Current Appliance	Current Appliance Energy Usage (KWh)	Recommended Update	Recommended Appliance Energy Usage (KW)	Recommended Appliance Cost	Payback Period (Years)
LG 32LD400	0.077	**Samsung UN24M4500AFXZA**	Low Usage: 0.0438 Med Usage: 0.0876 High Usage: 0.1752	$160 each $320 total	Low Usage: 5.840 Med Usage: 2.920 High Usage: 1.460
Spectre X322BV	0.102				

Summary of Payback Periods

Table 2.11 below shows the payback periods for each appliance if IHC chooses to adopt the recommended purchases.

Table 2.11. Summary of payback period analysis of all appliance models based on low, medium and high usage.

	Number of Years For Payback			Initial Cost of Replacing Appliances
	Low Usage	Medium Usage	High Usage	
Fridge	N/A	5.817	N/A	$2160
Freezer	N/A	1.186	N/A	$151
ACs	2.272	1.136	0.568	$960
Dishwasher	2.388	1.194	0.597	$700
Food warmer	0.851	0.425	0.213	$70
Lights	2.054	1.370	0.822	$880
TV	5.840	2.920	1.460	$320

Heat Pump	6.856	3.428	1.714	$2500

Table 2.12 below shows the monthly and annual savings in each room (i.e. each separate bill paid by IHC) if the recommended appliances are purchased.

Table 2.12: Annual and monthly costs of operating appliances in each room compared to using recommended appliances.

	Original Annual Cost	New Annual Cost	Annual Savings	Original Monthly Cost	New Monthly Cost	Monthly Savings
Building	$4,702	$4,478	$224	$392	$373	$19
Kitchen	$9,843	$8,307	$1,535	$820	$692	$128
Bathroom	$9,836	$9,836	$0	$820	$820	$0
Medical	$9,829	$8,311	$1,518	$819	$693	$126
Chapel	$9,837	$9,837	$0	$820	$820	$0
Sum	$44,047	$40,769	$3,278	$3,671	$3,397	$273
Average	$8,809	$3,397	$655.6	$734	$679	$55

3. WATER

Max Fine CMC ‘21 & Lauren D’Souza CMC ‘18

Water

The electricity bill for the building seems larger than the kitchen, but most of that cost difference is water. About half of the building bill can be attributed to high water usage, as all of the water is paid for in that bill. While there is nothing that we can suggest physically changing to reduce the cost, there are a few suggestions and policy changes that can be implemented to reduce the cost of water usage.

1) One way to reduce the cost of water would be to talk to your water distributor and look at available plans to see if there is a cheaper option. Because the IHC uses a large amount of water, it is possible that there is an industrial plan that would provide water at a lower per gallon rate.
2) Check for leaks. Due to the very high numbers on the building bills for water, there is a good chance that there is a leak somewhere in the building. It is worth investigating some of the interior piping to make sure that everything is working the way it should.
3) In fact, most of the shower heads, faucets, and toilets used now at IHC are very old models. It is a good idea to look into replacement. There are many water-saving new models available, and some of them have consumer rebates. The change may also add not only something eco-friendly but also a fresh taste to the community.
4) Monitor water usage in the kitchen specifically. The kitchen areas use the largest amount of water, so it is worth investing in monitors for that area to separate that data out of the rest of the building. This will ensure that if a leak pops up, it will be much easier to locate. Also, it will raise awareness for water usage in the kitchen, and help residents and staff understand how much water different appliances use. Monitoring the kitchen can also help isolate appliances that could be changed out for ones that use less water.
5) Educational and systemic changes. The number one way to reduce the cost of water is to have people use less of it. This can be accomplished by educating residents on typical water conservation practices, such as turning off the sink while brushing one’s teeth. Systemically, water costs more to use at certain times of the day. It is worth looking at and better understanding the IHC’s water plan to see if activities that use water, such as doing the dishes, would save money by doing it at a different time.

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