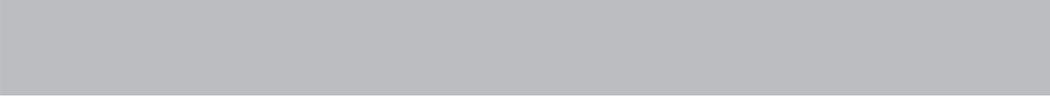
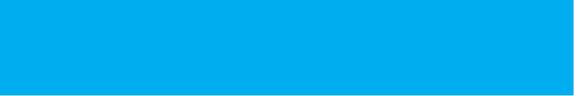


## Section IV: Introduction

This *Field Guide* presents over 50 recommended techniques to use when building energy-efficient homes. These techniques are based on DBEDT's *Energy Efficiency Guidelines* (see page 3) that are intended to save energy, add value, and improve the comfort and quality of life of Hawaii's home owners.

As an architect, contractor or owner-builder, you may wonder how one energy efficient home can make such a difference. Why should you care? This section addresses these legitimate concerns and:

- Presents information about the true cost of energy to you and our natural environment. (Chapter 18)
- Highlights the three “big bang” techniques that will provide the greatest improvements in terms of comfort, energy savings, and reduced impact on the environment. (Chapter 19)
- Provides information about incentives and other resources that will help you make these improvements. (Chapter 20)
- Provides information about enhancing your efforts to protect the environment by using additional “green” building methods beyond energy efficiency. (Chapter 21)



## Chapter 18: The Cost of Energy

The energy used to operate your home brings with it great convenience and comfort. Unfortunately, energy use has significant economic and environmental costs as well.

The most obvious cost is reflected in your utility bill. Electricity rates are high in Hawaii, from one and one-half to nearly three times the national average. This is primarily because most of the electricity purchased in Hawaii is produced from burning fossil fuels, fuels that must be imported from the mainland USA and foreign countries.

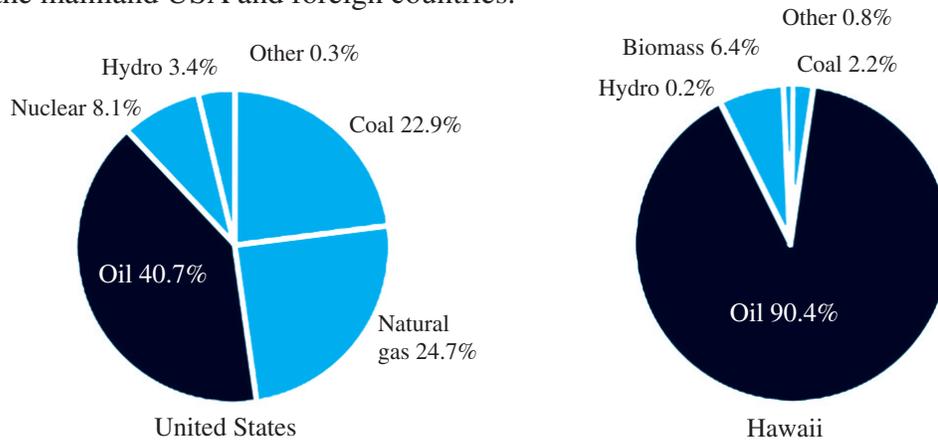


Fig. 18-1: Energy Production, USA and Hawaii.

Nearly 90% of Hawaii’s energy is produced by burning fossil fuel (oil and coal). All this fuel is imported to the islands at an annual cost of about \$2.5 billion, 7% of our Gross State Product. (Source: DBEDT Energy Resources Coordinator’s Annual Report 2000)

Besides affecting your pocketbook, this reliance on petroleum-based energy has other significant disadvantages, including:

- It diverts money from more constructive purposes.
- It makes Hawaii residents highly vulnerable when there are disruptions in fuel supply and price fluctuations.
- Oil-to-energy conversion pollutes the environment.

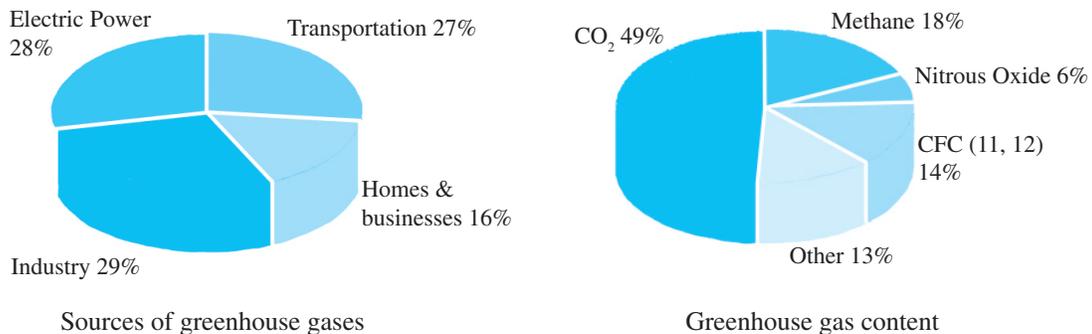


Fig. 18-2: Sources of Greenhouse Gases.

Oil-to-energy conversion (burning oil to generate electricity) produces large amounts of carbon dioxide (CO<sub>2</sub>), methane, nitrous oxide (NO<sub>x</sub>) and other products of combustion. These “greenhouse gases” contribute significantly to global warming and environmental pollution. (Source: DBEDT)

Reducing the use of petroleum in Hawaii through energy efficiency and the use of solar water heating can reduce this trend and have a significantly positive effect. So each house you build using the State's *Energy Efficiency Guidelines* can make a difference!

Fig. 18-3: Solar Hot Water Heaters Reduce Greenhouse Gas Emissions.

As of July 1998, roughly 70,000 Hawaii households in owner-occupied dwellings (about 36%) were using solar water heating systems, helping to significantly reduce greenhouse gas emissions. (Source: DBEDT)



47,518 barrels of oil not burned



24,800 tons of CO<sub>2</sub> not emitted



69 tons/kWh of NO<sub>x</sub> not emitted

### Conservation is Common Sense in Hawaii

Given climatic conditions so favorable to conservation in Hawaii, it is hard to justify building anything but energy-efficient homes. By using solar water heaters, the home owners referred to in Figure 18-3 have saved 735 gigawatt hours (the equivalent of a 10.2 megawatt power plant) since HECO's solar water heating program was initiated in 1996.

This is only a small measure of the vast energy savings possible if all homes in Hawaii were built using the comprehensive *Energy Efficiency Guidelines* presented in this *Field Guide*. These energy savings translate to a cleaner environment and a stronger, vital economy.

## Chapter 19: Energy-Efficient Features Pay Off in Savings and Comfort

### Three “Big Bang” Techniques for Hawaii

This chapter reviews and expands on three energy-efficient features previously discussed, which offer “big bang” results in comfort, energy savings, and increased livability. These “big bang” strategies are:

- Utility-approved Solar Water Heater
- Radiant Barrier
- Natural Ventilation

*A 1999 survey of home shoppers conducted by the National Association of Home Builders (NAHB) and Fulton Research, Inc. lists energy efficiency as one of the top ten items home buyers want. (NAHB)*

These three are an excellent place to start because in combination they provide significant reductions in energy use and operating costs for home owners.

For builders, the added comfort and energy savings, as well as financial incentives currently available (see Chapter 20), will make your homes more appealing to cost and value-conscious home buyers. In addition, home buyers will appreciate efforts to protect and connect with the beauty of Hawaii’s natural environment.

Naturally, you will get the best “bang for your buck” by combining and integrating several energy-efficient features. After the three highlighted examples in this chapter, you should consider other features that do not add significant cost and are easy to implement, such as shading and using light-colored finishes for the buildings roof and walls. Next, consider additional features that may add cost but significantly improve on the overall efficiency or cost-effectiveness of the features you have already decided to incorporate. For example, by combining energy- and water-efficient appliances with solar water heating you can reduce the size requirements of the solar water heating system.

Considering the cost of living in Hawaii, combining solar water heating with energy- and water-saving appliances and equipment, natural ventilation, and insulation/radiant barrier will save about \$8,000 to more than \$20,000 over 20 years for a typical Oahu family of four. (Source: DBEDT)

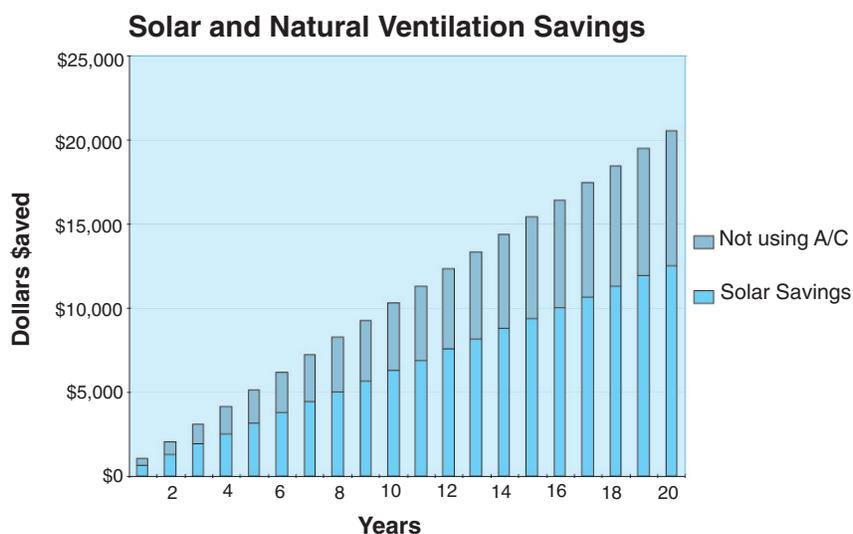


Fig. 19-1: Energy-Efficiency in the Home Means \$\$ Savings!

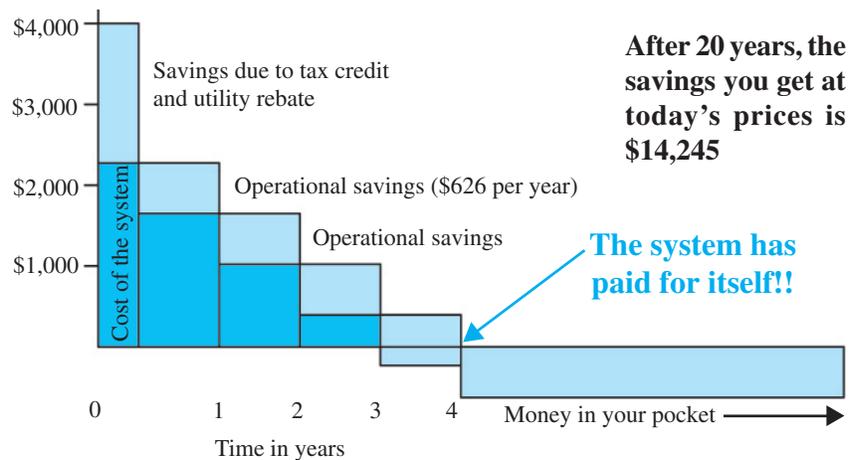
DBEDT identified \$8,000 to \$20,520 savings (not including energy income tax credit or utility rebates) resulting from selected energy efficient features. This chart illustrates the cumulative “cash flow,” or funds available for uses other than utility bills, resulting from incorporating solar water heating and not using air conditioning over a 20-year period for a typical Oahu family of four (solar savings calculated at 14.5¢ per kWh). (Source: DBEDT)

### Solar Water Heating: When Getting in Hot Water is a Good Thing!

The “Number One” method to conserve energy in Hawaii’s homes is through the installation of a utility approved solar water heating system (see Chapter 13). With a properly sized solar water heating system, a family of four can save nearly 40% on their monthly electricity bill — about \$626 per year for a family of four at 14.5 cents per kilowatt hour. The initial cost for installation is about \$4,000, but current state income tax credits and utility rebates reduce this cost by about \$1,725 (Oahu). Annual savings provide an effective payback period of about 3.6 years. Households using solar water heating have been surveyed to determine level of satisfaction and repair requirements. HECO reports that 90% of those surveyed were satisfied with their system’s performance, and 85% said their system had required no major repairs.

Fig. 19-2: Solar Water Heating Payback.

The chart shows how the payback from a solar water heating system works, showing system cost, operational savings, and incentives. This chart is based on estimated hot water usage by an average Oahu family of four calculated at 14.5 cents per kWh. Neighbor Island residents would realize an even faster payback and greater lifetime savings because their electricity rates are higher.



See page G-3, Appendix G, for the savings calculation.

### Radiant Barriers: No Sweat

A radiant barrier properly installed in the roof (see Chapters 7 and 8) will typically:

- Reduce ceiling temperature by 18° F.
- Reduce indoor temperature by 4° F
- Make people feel 9° cooler
- Can eliminate the need for air conditioning, which will save the cost of the air conditioner plus the \$200 to \$400 per year needed to run it.
- Make you eligible for possible utility incentive programs.

A radiant barrier installed in the walls (see Chapter 9) provides measurable benefits by reducing heat gain on the east and west walls during early morning and late afternoon hours. Cooler indoor temperatures naturally reduces the need for artificial cooling.

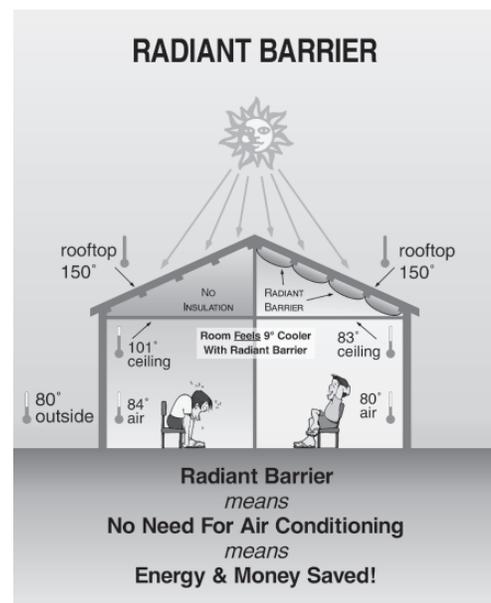


Fig. 19-3: Benefits of Radiant Barriers.

## Natural Ventilation: Stay Connected

The most obvious benefit of a high quality natural ventilation design is the ability to eliminate air conditioning (see Chapter 12). It saves you the cost of the air conditioning system, plus the \$200 to \$400 per year needed to run it.

As noted in Chapter 17, there are occasions when air conditioning may be necessary. In general, however, effectively designed natural ventilation provides comfort along with the health and quality of life benefits of staying connected to Hawaii's beautiful outdoor environment.

Our climate allows us to have our windows open during most of the year. This helps flush out pollutants that would otherwise accumulate in our homes, such as volatile organic compounds (VOCs), pollen, mold spores, and dust mites – all health hazards to those suffering from allergies or asthmatic conditions.

In addition, staying connected means you will benefit from a greater tolerance to temperature and humidity variations indoors and you will not experience extreme differences in temperature and humidity when you move from indoors to outdoors. In addition to causing discomfort, environmental health professionals believe that moving between artificially cooled indoors to warmer outdoor environments on a regular basis can make you more vulnerable to a variety of health complaints.

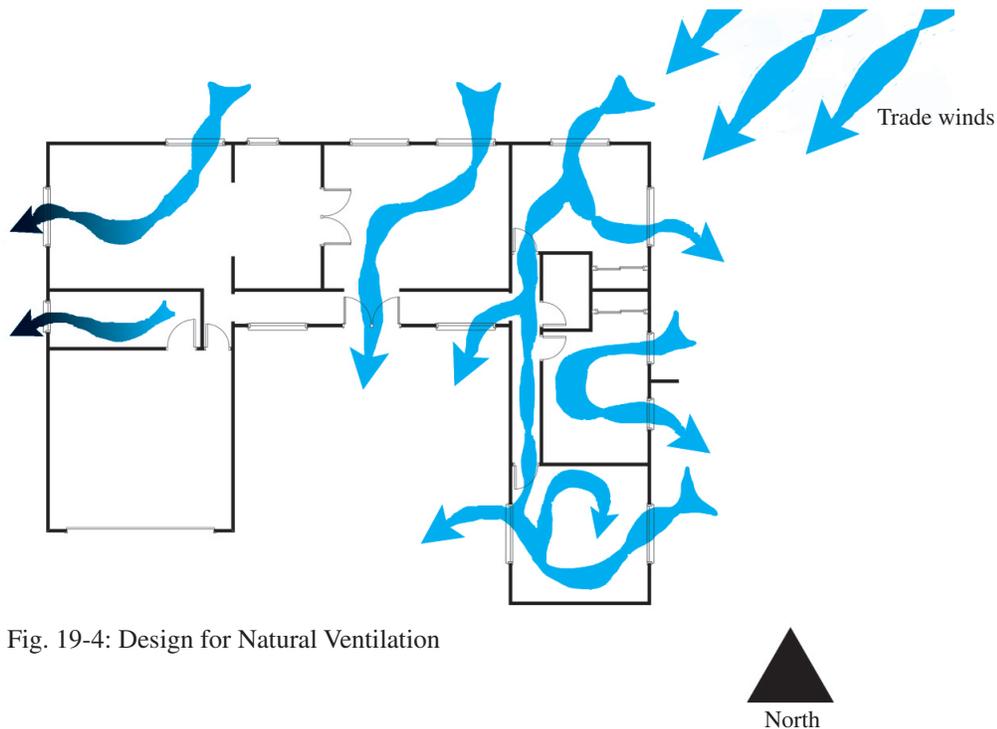
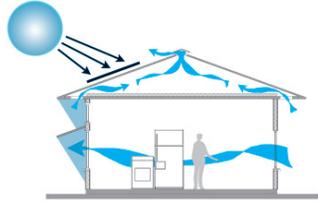
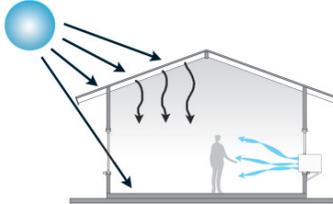


Fig. 19-4: Design for Natural Ventilation

## Putting It All Together

Table 19-A (on the next page) compares the operating savings that result from incorporating several of these recommended energy-efficient features. (These estimates are based on average residential conditions on Oahu.)

Table 19-A: Comparison of an energy-efficient home and an inefficient air conditioned home.

Energy Efficient House		Inefficient Air-conditioned House	
			
Energy Efficient item	Operating cost per year	Item	Operating cost per year
Solar water heater	\$0	Electric water heater	\$400
Keeping your house cool with radiant barrier, insulation, and natural ventilation	\$0	Window AC unit	\$200-400
		Central AC unit	\$400-500
Energy efficient clothes washer	\$45	Standard clothes washer	\$140
Energy Star refrigerator	\$80	Standard refrigerator	\$116
Energy efficient lighting	\$90	Standard lighting	\$190
<b>Total</b>	<b>\$215</b>	<b>Total</b>	<b>\$1,046-1,346</b>
<b>Saving due to energy efficiency</b>	<b>\$831-1,131 per year!</b>		

Note: Family energy uses are rapidly changing here and throughout the USA. Spas, large entertainment systems, computer equipment, and other amenities are creating higher demand for the residential energy sector. The figures of Table 19-A above reflect a traditional, lower residential energy demand. The costs for electricity are calculated at 14.5 cents per kWh.

The Model Demonstration Home, dedicated on May 15, 2001, as the First Hawaii BuiltGreen™ Home, was built using several of these energy-efficiency features, as well as many other environmentally responsible construction materials and practices. It provides an excellent “real” example of an economical, energy and resource efficient home that is comfortable without air conditioning. See Appendix I for more information.

### “Big Picture” Benefits

Besides these benefits to homeowners, the features highlighted in this chapter provide benefits to *everyone* in Hawaii. For example:

- The Hawaii solar industry estimates that there are about 700 people employed in the solar industry and its ancillary businesses.
- The labor income effect is \$6.6 million per year for an annual installation of 2,477 solar systems. (Source: DBEDT)
- Using solar energy and energy-efficient technologies instead of imported energy keeps money in Hawaii. Assuming all of the single family households in Hawaii (191,894 owner-occupied units) incorporated the features included in Table 19-A and incurred the operating savings estimated, between \$159,463,914 and \$217,032,114 would be available for constructive purposes in Hawaii, rather than for buying energy produced from imported oil. (Source: DBEDT)
- Avoiding petroleum-based energy reduces pollution (see Chapter 18).

## Chapter 20: Incentive Programs and Other Resources

### Solar Energy Incentives

The State of Hawaii provides Energy Income Tax Credits through Chapter 235-12 of the Hawaii Revised Statutes. For example, solar systems installed and placed in service between January 1, 1990, and July 1, 2003, earn a tax credit of 35% or \$1,750 (whichever is less) for single family homes, and a tax credit of 35% or \$350 (whichever is less) for units in a multi-family structure. The tax credit applies to solar water heaters and photovoltaic systems, as well as to other devices that convert solar radiation to electricity or thermal energy. The State also provides tax credits for heat pumps, wind systems, and ice storage. For more information on the State tax credit, contact the Taxpayers Services Branch, State Department of Taxation, 587-4242. Neighbor Island residents call toll free, 1-800-222-3229.

In addition, savings in utility costs generated from a U.S. Department of Housing and Urban Development (HUD) accepted solar energy system may be considered when qualifying borrowers for HUD-insured mortgages. Some restrictions apply. Contact HUD at 522-8190 for more information.

Local utilities offer incentive programs as well, summarized below. See Appendix G for more information.

#### Hawaiian Electric Company (HECO)

Through its “Energy Solutions for the Home” program, HECO offers the following benefits to those installing solar water heating systems:

- Standards and specifications for system installation.
- A \$500 discount on installation costs.
- Inspection by HECO to ensure proper installation.

HECO provides a list of participating solar contractors. For more information on HECO’s Utility Rebate Program, including a copy of the booklet “Energy Solutions Power Book,” call 947-6937.

#### Hawaii Electric Light Company (HELCO)

Through its “Residential Efficient Water Heating Program,” HELCO offers the following benefits to those installing solar water heating systems:

- HELCO’s standards and specifications for installation.
- A \$1,000 co-payment for new construction and remodels to reduce installation cost.
- Inspection by HELCO to ensure proper installation.

HELCO provides a list of participating solar contractors. For more information on HELCO’s Residential Efficient Water Heating Program, call 969-0127.

### **Maui Electric Light Company (MECO)**

MECO's "SolarWise" program encourages builders to include solar water heating as a standard feature on all new residential construction. MECO works with several builder partners who offer this feature as part of their homes. These SolarWise homes qualify for the EPA's Energy Star® Program as well, making them eligible for discounts on closing costs or other favorable financing (see "Energy Efficient Mortgages," below).

MECO provides a list of participating SolarWise builders. For more information on MECO's SolarWise Program, call 888-632-6786 (tollfree).

### **Kauai Electric Division, Citizens Utilities**

Kauai Electric's "Energy Wise Residential Program" is different from the other utility programs in that it is primarily geared towards providing incentives for retrofitting existing housing, in particular homes that have a conventional electric heater or a solar water heating system with electric backup. The utility offers free home audits, as well as upgrades including energy-saving showerheads, faucet aerators, and tank wraps, and compact fluorescent lamps to replace heavily used incandescent lamps. In addition, the utility may provide recommendations regarding heater temperature settings. As part of the analysis, the utility evaluates the feasibility of either installing a heat pump or solar water heating system. If the utility's recommendation is to install such a system, the utility provides an incentive rebate and information on participating installers.

Kauai Electric offers incentive rebates only when the maximum allowable cost is greater than a threshold determined by the utility. For example, as of this writing, incentives are paid when the maximum allowable cost for a solar water heating system is greater than \$3,268 or when the maximum allowable cost for a heat pump is greater than \$2,400. The amount of rebate can vary depending on the owner's income and other circumstances. For example, an owner occupant can receive a 45% rebate. An owner occupant qualifying under federal income guidelines (or an apartment tenant with a willing landlord) can receive a 70% rebate on installation costs. For current information call Kauai Electric at 808-246-8232.

For new construction that is being built for an owner occupant and where the owner intends to install conventional electric water heating, the utility can perform a cost-benefit analysis to determine if a solar water heating system is cost effective. If so, an incentive rebate is available, (80% of the maximum allowable cost) less \$500, the amount the owner would have paid for the electric heater.

### **Energy Efficient Mortgages**

Lenders around the country, including some in Hawaii, recognize the value of energy efficient homes. Homes built in Hawaii that qualify for the USDOE/EPA-sponsored Energy Star® Program are eligible for new mortgage products being offered by Fannie Mae and other lending institutions.

Energy efficient mortgages (EEMS) allow home owners to borrow more money or pay less money down because of projected lower monthly costs for operating a high performing energy-efficient home. In the first case, the owner gets more home for their money. In the second case, the owner enjoys a positive monthly cash flow when compared to a conventional home.

Solar water heating savings can be reflected in a lower minimum income requirement for financing as in the example using HECO data in Table 20-A. In this example, a home with a solar water heater *decreases* your utility bill by \$29 a month, offsetting the \$19 per month mortgage increase.

Table 20-A: Lower Minimum Income Requirement for Financing Due to Solar Water Heating Savings (HECO, 2000)

Monthly Savings	Without Solar	With Solar
Mortgage amount	\$200,000	\$202,650
Monthly mortgage payment	\$1,398	\$1,417
Monthly electric bill	\$103	\$74
Monthly mortgage and electric bill combined	\$1,501	\$1,491
Monthly savings	\$0	\$10

Lower Income Requirement	Without Solar	With Solar
Debt-to-income ratio	28%	30%
Annual income requirement	\$60,000	\$56,000

Or in increased buying power, as in the example using MECO data in Table 20-B.

Table 20-B: Increased Buying Power Due to Solar Water Heating Savings (MECO, 2000)

Monthly Savings	Without Solar	With Solar
Monthly mortgage payment	\$160,000	\$162,480
Monthly electric bill	\$1,119	\$1,136
Monthly mortgage and electric bill combined	\$126	\$1,232
Monthly savings <sup>1</sup>	\$0	\$13
Increased Buying Power	Without Solar	With Solar
Buyer's total monthly income	\$5,000	\$5,000
Qualifying ratio	28%	30%
Maximum monthly payment	\$1,400	\$1,500
Maximum loan amount	\$178,850	\$191,600
Added borrowing power with Energy Star mortgage	\$0	\$12,750

<sup>1</sup> Note: based on 7.5%, 30-yr. Fixed, 35% State Tax credit of \$1,085, MECO rebate of \$1,000.

For ease of implementation in Hawaii, Energy Star® Homes Program has developed equivalencies for homes participating in the HECO, MECO, and HELCO solar domestic water heating programs. Non-air conditioned homes participating in the programs comply with Energy Star® requirements if they have a solar water heater. Air conditioned homes must be built to the “Hawaii Model Energy Code – Residential Requirements for Air Conditioned Homes,” and perform additional measures from three options described in a memo dated April 11, 2000 (see Appendix F). For more information about Energy Star®, check out: [www.epa.gov/docs/GCDOAR/energystar.html](http://www.epa.gov/docs/GCDOAR/energystar.html). See Appendix B for additional resources.

## Chapter 21: Going the Extra Mile to Build “Green”

By building an energy efficient home you do a great deal to protect the quality of life in Hawaii. If you wish to do even more, consider building a “green” home.

What is a green home? It is a resource-efficient home that incorporates environmentally sensitive concepts and products in its design, construction, and operation. In addition to energy efficiency, a green home provides improved air quality; uses environmentally preferable building materials, including recycled-content products; conserves and protects water supplies; reduces construction waste; and preserves valuable natural site features.

Green homes are healthier, perform better, last longer, and are easier to maintain. In the long run, owners of green homes in Hawaii save energy, save money, preserve the environment, and help improve the state’s economy, all at the same time.

By building green you add value and reduce the life-cycle cost of a home.

On May 15, 2001, a model demonstration home built to the State’s *Energy Efficiency Guidelines* (see page 3) was dedicated as the First Hawaii BUILTGREEN™ Home in the state (see Appendix I for Case Study). That means it not only met the intent of the *Guidelines*, but it met a set of “green” criteria developed by the Building Industry Association of Hawaii (BIA) in partnership with government and utility representatives. These criteria were reviewed and approved by developer members of the BIA.

The Hawaii BUILTGREEN™ program is a voluntary program where home projects are certified by the builder to include energy efficient, materials efficient, improved air quality, and site protection features. For more information about the program, please call the BIA-Hawaii at 847-4666.

For information about resource-efficient building in Hawaii, see:

“HABiT Guide to Resource-Efficient Building in Hawaii,” a 1999 publication of DBEDT and the Hawaii Advanced Building Technologies Training (HABiT) Program. The HABiT program seeks to improve the quality of Hawaii’s buildings by promoting structures that are climatically adapted, energy and resource efficient, durable, comfortable, and healthy for Hawaii’s people. The Guide focuses on residential, primarily new, construction.

Also see additional resources in Appendix B.



