

2004-2005 CPUC Energy Efficiency Program Narrative:

**HEED, Home Energy Efficient Design,
(SDG&E Portion)
A Statewide Tool for Residential Ratepayers**

Electronic Submission sent to: eeproposals@cpuc.ca.gov

Containing two attached files: one narrative and one workbook

Due on September 23, 2003, before 11:59 pm

Four (4) Paper Copies (one unbound, three tape bound) to be Delivered no later than 5 PM September 26, 2003 with Confirmation Email attached as Cover of each, to:

Energy Efficiency Proposals c/o Julia Cordell

California Public Utilities Commission

Energy Division _NGEERA Branch

505 Van Ness Avenue

San Francisco, CA 94102

Proposal Proceeding Number: R.01-08-028

Submitted by:

Tamara Coombs, Contract and Grant Officer,

UCLA Office of Contract and Grant Administration

Suite 1200

10920 Wilshire,

Los Angeles, CA 90024

310-794-0622

tcombs@resadmin.ucla.edu

On Behalf of:

Murray Milne, Research Professor

UCLA Department of Architecture and Urban Design

1327 Perloff Hall

Los Angeles, CA 90095-1467

310-454-7328

milne@ucla.edu

TABLE OF CONTENTS

I. PROGRAM OVERVIEW	
A. Brief Description, including target market segments	3
B. Program Rationale, including discussion of market barriers.	3
C. Program Objectives: Statewide Marketing and Outreach Program ...	8
1. Ability to Overcome Market Failures:	9
2. Equity:	10
3. Innovation:	11
4. Coordination with Other Programs Implementers:	11
II. PROGRAM PROCESS	
A. Program Implementation	12
B. Marketing and Outreach Plan.	13
Marketing Materials: Worked Example of HEED	17
C. Customer Enrollment	25
D. Not Applicable (Materials Procurement)	25
E. Not Applicable (Payment of Incentives)	25
F. Staff and Subcontractor Responsibilities	25
G. Work Plan and Timeline for Program Implementation	26
III. CUSTOMER ELIGIBILITY	
A. Customer Description	33
B. Customer Sizes Targeted	33
C. Customer Complaint Resolution	34
D. Geographic Areas	35
IV. MEASURE AND ACTIVITY DESCRIPTION	
A. Energy Savings Assumptions	36
B. Not Applicable (Deviations in Standard Cost-effectiveness Values). ...	38
C. Not Applicable (Rebate Amounts)	39
D. Activities Description	39
V. GOALS	40
VI. PROGRAM EVALUATION, MEASUREMENT, AND VERIFICATION (EM&V)	42
VII. QUALIFICATIONS	
A. Primary Implementer	44
B. Subcontractors	44
C. Resumes and Description of Relevant Experience	45
VIII. BUDGET	49

I. PROGRAM OVERVIEW

A. Program Overview: Statewide Information Program

HEED (Home Energy Efficiency Design) is an intuitive and easy-to-use energy design tool that can show California's residential ratepayers the Energy Costs Savings of remodel, repair, and re-design decisions for their homes. To date over 2600 copies have been downloaded from UCLA's web site making HEED the nation's third most popular residential whole-building energy design tool. This version was developed with prior funding from the CPUC and covers the Southern California Edison and the Southern California Gas service territories. The Objective of this current Information Program Proposal is to complete the Statewide version of HEED, by expanding it to cover the remaining two service territories, Pacific Gas and Electric (PG&E) and San Diego Gas and Electric (SDG&E). We also propose to add many new features that have been requested by the utilities and by our users. In addition we are proposing a series of workshops throughout the state, and a media support effort to provide information to the popular press in California to help publicize HEED's availability. We hope this new statewide version of HEED will be made available to all Californians on the Flex Your Power web site that gets millions of hits every year. This would help fill a serious gap in the free tools that are available to California Ratepayers. Putting a statewide version of HEED in place will clearly demonstrate to residential ratepayers that the CPUC cares about their problems and has provided a tool to help them find the answers. Every year Californians spend over \$15 billion on residential alterations, additions and repairs. The objective of HEED is to persuade homeowners to invest some of these funds in improving their home's long term energy efficiency.

Note: As we understand the Process for Submission, we are required to submit two separate proposals, splitting the total effort on HEED between PG&E and SDG&E, therefore these narratives are identical except for the Timeline and Budgets, and there is a different Worksheet attached to each proposal.

B. Program Rationale

B.1 Prior Program Success

This proposal is built on a pair of prior CPUC funded projects for SCG and SCE, the latter of which was completed in March 2002. Beta test versions of HEED were released as early as April of 2001, and the official public release version was dated June 2002. As of September 2003 HEED was the third most popular downloadable residential whole-building energy design tool behind MECcheck (a code compliance tool) and Micropas (which costs \$750). HEED was ahead of Energy-10 (which costs \$250)¹. As of September 2003 over 2638 different users have downloaded copies of HEED.

In the survey of our users by our EM&V consultant in March 2002, when responding to

the question, “Did you like HEED?”, 83.8% answered “yes”. When asked, “Did you learn anything?”, 73.0% answered “yes”. When asked, “How far did you get?”, 43.8% said they ran HEED more than once. A summary of these results are published on the HEED web site².

B.2 Basis and Need for this New Program:

Most of the electricity that California’s Investor Owned Utilities (IOUs) supply to their residential customers is used to cool, heat, and light homes and apartments. Virtually every decision made by homeowners, renters, apartment managers, or homebuilders about their home’s design, operation, or maintenance, influences the amount of energy it consumes. The problem is that these ratepayers have no easy way to accurately visualize the energy costs of all their various options as applied to their own unique home.

Over \$3.7 billion in Building Permits for Residential Alterations and Additions are issued annually to Californians according to the Construction Industry Research Board³. Estimates are that three or four times this amount of work is actually done without a permit by do-it-yourselfers and informal subcontractors, and by homeowners doing repairs and equipment replacements. Thus raising this total to over \$15,000,000,000. If this huge group of homeowners can be shown the economic benefits of investing even a tiny fraction of these funds on energy efficiency improvements, the potential impact on California’s housing stock would be immense.

It is estimated that more than half of the energy consumed in California’s residential buildings is used by homes that are over 25 years old, most of which will need some type of repair or remodeling work in the next few years. In these older homes, many components are beginning to reach the end of their useful life cycle. When that time comes, each of these homeowner is left out on their own, because there is no place to turn for unbiased technical support specific to their particular home, in their particular climate, and with their particular utility rates. The objective of HEED is to offer that support.

This Home Improvement market⁴ is made up of a variety of sub-groups that might be called:

- Style/Trend Setters: who tend to be indifferent to initial costs, long term savings, or energy issues.
- Minimal Maintenance: who try to solve immediate problems, are most concerned with first cost, and probably will only respond to point-of-sale energy messages.
- Confused Novice: who are worried by sales pitches or conflicting advice from friends, and who should start with the kind of basic information provided by utility hot lines or on-line programs like HIT or HES (see Table 1).
- Frugal Handyman: who are concerned about both first cost and long term payoff, as well as energy conservation.
- Type-A Homeowner: who seek the highest quality materials, products, workmanship, and energy efficiency, and tend to subcontract most work.

- Hard Core Do-It-Yourselfer: who are willing to take on any job, no matter how difficult, and for whom technical complexity is no problem.

The latter three types are likely to do some research in order to discover the best solutions to their problem, which these days usually means turning to the internet. All three types are interested in energy efficiency. Fortunately, these particular groups tend to be quite knowledgeable about how their house is constructed and maintained. For example, they know if their attic is insulated and whether their floor is a slab or raised. They know their home's square footage and the direction it faces and they are easily capable of measuring the size of their windows. It is this group to whom HEED is specifically targeted.

The problem is how to reach this particular group of consumers, and how to answer their individual questions in a way that applies to their own specific home. They need a decision-making tool that shows exactly how much money they will save with each different option in their own unique situation.

Reaching these groups of consumers is extremely difficult because they are so diverse and disaggregated. They are not part of a trade group or profession that has a newsletter or regular meetings. They do not show up at national conferences. Many of them speak Spanish. Women play a major role in decisions about how these remodeling funds are spent, that has been largely underestimated according to the Home Improvement Research Institute (HIRI). Interestingly, one of the few things they all have in common is that they all receive a bill from their local utility every month and almost everyone now has access to the Internet, which defines a strategy for reaching this constituency.

B.3 Filling the Gap:

Increasingly, home improvement decision makers are turning to the internet for help. For the beginners and energy novices, there are a number of web sites offering very general energy saving tips and on-line audits (see Table 1). At the other end of the spectrum there are many engineering-oriented software programs for energy consultants and technically inclined architects.

But there is a gap for all the people in between: DIYers, home buyers, homeowners contracting major upgrades, home builders, designers and architects. These more-knowledgeable users need a tool that is fast, easy to use, accurate, and automatically loads all the data needed for their home (local utility rates, building materials, and local weather).⁵ But most important, this tool must be free, because these homeowners are not willing to purchase and learn to use the more complex computer programs used by energy professionals.

Type of Consumer	Existing Residential Energy Programs	How HEED Fills this Gap
Initial Consumer Contact: Consumer Energy Center or Utility's Telephone Hot Line	Energy Saving Tips, Energy Conservation Best Practices, Home Energy Surveys	
Energy Novice: with Basic Questions, Seeking Information for a Generic Home	Online Energy Audit, Appliance Checklist, HIT Home Improvement Tool, HES Home Energy Saver	
Do-It-Yourselfers: About to Make Repair, Redesign, or Remodeling Decisions for their own particular Home		HEED lets homeowners draw in their own home, then shows the annual savings in energy costs for each different remodeling choice
Homeowners Contracting for Major Upgrades: Needing a Way to Validate the Claims of Home Remodeling Contractors.		HEED plots bar charts comparing up to nine different proposed alternatives in terms of their home's annual energy costs
Prospective Home Buyers: Want to Compare the Energy Costs of Different New or Used Homes		HEED allows different homes in different zipcodes to be accurately simulated using local utility rates and local climate data
Home Builders: Need a Graphic Tool to Show Potential Customers How Various Upgrades Will Make Their Homes More Energy Efficient, or Why Their Home Out-Performs the Competition		HEED has over two dozen different graphic outputs showing many different ways to evaluate a home's performance, including indoor air temperatures, and hourly costs of air conditioners, furnaces, fans, appliances, and lighting
Designers, Architects, Interior Decorators, (and also Beginning Students): Need an Intuitive, Easy-to-Use Tool to Help Them on "Day One" to Create a Better Home, along with Graphics to Clearly Communicate its Energy Performance to their Clients		HEED provides many Advanced Design options appealing to the design community, including 3-D plots comparing the performance of different schemes as they evolve, a series of 3-D bar charts showing dozens of other variables, plus drawings of each elevation
Energy Consultants, Engineers, and Technically Inclined Architects (and also Advanced Students): Use Powerful and Complex Software Primarily for Mechanical Systems Design and Code Compliance, When the Building is Well Along in Design	DOE-2*, Energy-10*, EnergyPlus, Energy-Pro*, E-Quest, GreenDesignTools*, MicroPas*, VisualDOE*, all of which require special training (*Costs range \$250 - \$1600, and most are intended for Non-Residential Buildings)	

Table 1: Filling the Gap in the Needs of Home Improvement Decision-makers: Currently there is a gap in the kinds of tools available to consumers who are making critical decisions about the \$15 billion spent annually in California for residential alterations, additions, and repairs. Notice there are many excellent tools available for novices at top of the spectrum, and for energy specialists at the bottom. However there are no tools specifically intended for ratepayers and other home improvement decision-makers in the middle, ranging from the more knowledgeable Do-It-Yourselfers to Designers looking for a "Day-One" tool. This is the gap that HEED fills.

This decision-making tool must show exactly how much money they will save in energy costs with each different option applied to their own unique home. For example, will they save more money by investing in an awning to shade their patio doors or in a more efficient air conditioner? Will they save more by insulating their attic compared to installing tinted double glazed windows? (For one homeowner's answer see Table 2.)

The need for this level of detail is why this tool must be go beyond the very general kinds of energy advice and the entry-level home surveys that are currently available. This tool must be usable when people are just beginning to think about the project when only a few facts are known, because this is when all the most important design decisions (mistakes) are made that effect the home's energy consumption.

If each homeowner can be shown the economic benefits of investing even a small fraction of his or her own funds in energy efficiency improvements, the potential impact on energy consumption at the statewide scale would be huge. And more important, these permanent Energy Efficiency improvements come without the need for State funds in the form of rebates or subsidies.

B.4 How HEED Meets these Needs:

HEED was developed to meet this specific set of needs. It can accommodate all kinds of dwellings including single family detached homes, townhouses, and condominiums or apartment houses with exterior or interior hallways. It handles units in highrise or lowrise buildings. Even renters who pay their own utility bills will be able use HEED to test energy conservation strategies that are portable and affordable.

HEED uses a number of unique features to let homeowners easily and quickly sketch in all the important information about their home. HEED starts by asking the ratepayer to load in four facts: their zipcode, which gives their local utility rates and climate, building type, square footage, and number of stories. With this information HEED creates two basecase buildings, Scheme 1 Meets the Energy Code, and Scheme 2 More energy Efficient. Then in Scheme 3 the ratepayer can quickly sketch in their actual floor plan by filling squares in a checkerboard. They can click and drag windows onto each façade, and they can correctly orient their home by rotating a 3-D image to face the correct compass heading. Radio button lists let them simply click on the appropriate definitions of their building's construction. They can copy this scheme and test thousands of different design alternatives. In this way HEED can deliver detailed energy efficiency advice personalized to each ratepayer's unique building and particular needs. Also this shows how easy it is to make any type of change. Easy-to-read bar charts show the annual energy cost comparisons for up to 9 different schemes. Allowing these kinds of detailed inputs and revisions helps reassure ratepayers that the output results accurately reflect the performance of their own particular house.

This high level of precision is essential in order to encourage ratepayers to trust in the future

economic payoffs of the energy efficiency investments they make today. For example, glazing has by far the greatest impact on a home's energy performance, therefore it is essential for an energy design tool to allow homeowners to input the actual dimensions and orientation of all their home's windows and sun shading. It must allow them to input the data from the National Fenestration Rating Council sticker on the windows they are thinking about buying (U factor, Transmissivity, and Solar Heat Gain Coefficient). It also must allow them to input the particular dimensions of the patio awning they are considering, or the R-value of the attic insulation that is being proposed, or any of hundreds of other possible options.

Our approach does not depend on subsidies or rebates to encourage implementation, but rather it gives ratepayers the information they need to invest their own funds by showing them the long-term energy cost savings of making each different investment. Rather than being the passive recipients of services supplied by others, this project is aimed at customers who are proactive, and are at a point in their lives where they are preparing to invest their own funds in their own economic interest.

We are proposing a different, more innovative Energy Efficiency Information program. Rather than being generic (non customer-specific), our goal is reach that underserved segment that needs very specific information about how to improve the energy performance of their own particular dwelling.

C. Program Objectives:

The objective of HEED is to help those ratepayers who are thinking about do-it-yourself home repair, remodeling and redesign projects, or who are working with an architect or builder to design a new home for themselves, or who are in the market to buy a new home and are trying to decide which will be most energy efficient. HEED's objective is also to reach the thousands of small contractors, custom builders, developers, architects, and designers who serve this constituency.

Statewide information-only programs are to be evaluated against the following four Program Objectives:

1. Ability to Overcome Market Barriers
2. Equity:
3. Innovation:
4. Coordination with other Program Implementers

C.1 Ability to Overcome Market Barriers:

The **Market Barriers** this project addresses are the **lack of consumer information** about the cost and benefits of energy efficiency measures specific to each individual customer's specific circumstances. It is important to note that this is not a typical passive hand-out-a-brochure or fill-out-an-energy-survey type of information project. Rather it actively engages each customer in a detailed and accurate analysis of their own unique home, and offers the possibility of testing virtually any alternative that has implications for its energy consumption.

This proposal is aimed at ratepayers who might be homeowners, renters, or apartment house managers. It also serves homebuilders and remodeling contractors, as well as designers and architects who serve this clientele. The barriers this project overcomes are slightly different for each of these different groups:

- Homeowners have a direct financial stake in their home's performance, so the barrier is how to convince them that energy efficient repair and remodeling decisions will really pay off in terms of reduced electrical bills.
- Renters who pay their own electricity bills are only interested in buying things that will pay off in less than one year that they typically will stay in their unit, or that are portable and will work in the next unit they rent.
- Apartment house managers have much better access to their building's performance data, and also have the management control to be sure that decisions about changes actually get implemented, so if they pay the entire building's utility bills, they need to be able to evaluate the cost-effectiveness of various repair and remodeling decisions in each unit. Even if they are only interested in saving electricity in their lobbies and common areas, being able to test various alternatives that will give them the kind of information they need to make informed repair and maintenance decisions.
- Homebuilders and Contractors do not pay the home's monthly energy bills, however their customers are becoming increasingly interested in this aspect of their product. Their barrier is how to help them to communicate to prospective customers the increased value of the energy efficiency features built into their homes.

HEED also addresses some secondary barriers that apply to everyone, such as showing where to buy energy efficient products, where to find the appropriate construction materials, or where to locate a specialized sub-contractor. All of these are addressed in the Internet links built into the Advice function inside HEED.

This barrier of easy access to immediately useful information is overcome when ratepayers visit to our web site, download and install the software, and then describe their own home. Alternatively they can attend one of our workshops, where they will find themselves loading in their own dwelling and learning how to make it more energy efficient. Our objective is to empower ratepayers with the information they need to know how to invest their home repair and remodeling dollars in the most energy efficient options.

HEED serves the more demanding users, those with the greatest need for hard, technically accurate data about the performance of their own unique home. This is the segment of the ratepayer population that we believe is not adequately served by the more traditional statewide consumer information programs (see Table 1).

C.2 Equity

This project is designed to reach all five of the undeserved and hard-to-reach populations:

- **Language:** HEED is one of the few projects that offers its software in Spanish as well as English. In this project's marketing and outreach phase we propose also to offer a set of workshops in Spanish. We will also be available for on-line consulting for any queries received in Spanish.
- **Housing Type:** HEED currently addresses all forms of residential construction, not only single family detached houses, but also townhouses and multi family buildings, including condominiums and apartments, either low-rise or high-rise with either interior or exterior entries.
- **Geographic:** HEED is proposed to serve every zipcode in each IOU service territory. Thus we serve sparsely populated deserts and mountains and rural agricultural areas, just as well as the densely populated urban areas. HEED also specifically considers the energy implications of each different climates in these all these areas. Because it is Internet based we can provide software and respond to technical queries equally well for people in any geographic area.
- **Home Ownership:** HEED is blind to home owners versus renters. If they pay a utility bill, renters can use HEED to test all kinds of low-cost or portable energy conserving features that help reduce their monthly energy costs. For example, renters should know that a programmable thermostat pays for itself in less than one year and can be easily removed and installed in their next apartment.
- **Income:** HEED can serve any income level, but it should be emphasized that the lower income populations will derive the greatest relative benefit from using it to find cost effective ways to reduce their utility bills. This is because utilities represent a higher percentage of their income, and because these low income people often find themselves in older, poorly maintained housing where a few simple changes can sometimes make a very big difference.

C.3 Innovation

We believe that innovation is one of the strongest attributes of our proposed project. HEED is rated by our users to be one of the most innovative and easy-to-use compared to even the most powerful building simulation tools. Our intuitive, ratepayer-friendly graphic design approach is not available in any other programs:

- Simple 4-question initial design screen
- Zipcode input pre-loads the homeowner's utility rates and climate data
- Expert system that creates the Title 24 and more Energy Efficient Building
- Fill-in-the-checkerboard floor plan drawing screen
- Building orientation defined by rotating a 3-D picture of the house
- Click and Drag windows onto each elevation
- Radio button lists to define home construction options
- Easy to read bar charts show energy costs comparisons for up to 9 schemes

No other whole-building energy design tool has these features.

C.4 Coordination with Other Program Implementers

HEED is designed for total coordination with all other programs. There is no limit to the number of other CPUC Programs that HEED can put (literally) at the fingertips of ratepayers.

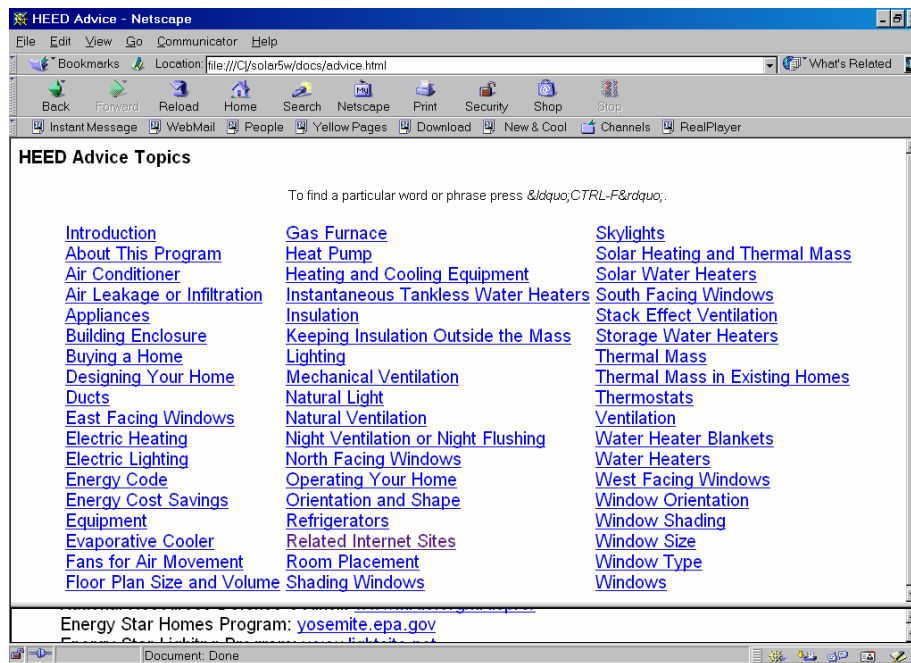
HEED contains built-in Internet links to many other existing programs run by each IOU, state agencies, private entities, and the federal government. Our objective is to provide the user access to whatever information they need at the exact moment they need it. For example, in the Window Design screen, clicking on the Advice icon can bring up Internet links to the American Fenestration Council, various glass manufactures performance data pages, and to the local utility's replacement windows rebate program. As part of this project we will add links to any new CPUC funded sites that provide useful data for HEED's users.

II. PROGRAM PROCESS

A. Program Implementation

A.1 Plans for Coordinating with Other Energy Efficiency Programs

HEED is designed to explicitly coordinate with all other Energy Efficiency Programs. When the user clicks on the “Advice” icon on the top of the screen, a page opens that contains web links to web sites that provide all kinds of information for the homeowner. At present it contains links to many Energy Efficiency Programs that provide things like appliance replacement programs, water heater replacement programs, and Energy Star performance data.



As Part of this Statewide Information Project, this feature of HEED will be expanded to include all the Energy Efficiency programs that each IOU wishes to offer in its service area.

A.2 How HEED Differs From Existing Related Programs:

It appears that the CPUC has not funded any Statewide Information programs similar to HEED. Nothing similar is posted on the Flex Your Power site. A software project by SCE called eQuest is intended for non-residential applications and is much more complex for homeowners to use. The Energy Design Resources program offers software but it too is explicitly limited to non-residential applications for design professionals.

HEED is intended use by for residential ratepayers, and has a great many unique features: HEED's most unique feature is the extremely intuitive interface. For example HEED is the only ratepayer-friendly energy design tool currently available that lets users:

- draw in their actual floorplan using an easy fill-in-the-squares drawing technique,
- click on a 3-D image of their house to rotate it to its exact orientation,
- drag and drop their actual windows to the correct location on each facade,
- automatically attach garages their home, or neighboring units to townhouses or apartments,
- select from simple checklists the wall, roof, and floor construction, glass type, insulation, and heating and cooling equipment, etc.
- handle all residential building types: single family house, townhouse, condominium or apartment,
- calculate their actual savings using each IOU's latest residential rates,
- input their zipcode to load in their actual climate data, and electric and gas rates,
- input only four facts about their home and then see two basecase buildings: one that meets Title 24, and a second one that is about 30% More Energy Efficient.
- and it is free.

Another of HEED's unique features is that it calculates indoor electric lighting levels for each hour of the year as a function outdoor sunlight, window size, orientation, and room depth. All of this is used to calculate how the home's electric lighting load is reduced by daylight availability. In many California climates, electric lighting is one of the major categories of energy consumption.

HEED is the only ratepayer-friendly whole building analysis tool created specifically for the each IOU's service territory zipcodes, climate zones, rate structures and incentive programs.

The first building that the expert system automatically creates Meets Title 24, the California Energy Code, and follows the required modeling assumptions of California's Residential Alternative Calculation Method (ACM). The second scheme that it automatically creates is Scheme 2, a More Energy Efficient house, that has the same square footage, latitude and climate, but HEED chooses the optimum Energy Efficiency strategies including building proportions, thermal mass, percent glazing on each orientation, shading, and ventilation cooling strategies.

Yet another of HEED's unique features is the fact that it accurately addresses occupant comfort by calculating Indoor Temperature each hour, which is important information needed if the homeowner is considering installing a smart whole house fan.

Still another unique aspect of HEED is that because ratepayers draw in their own floorplan and place their own windows on each wall, than they have much greater confidence that the results really do represent their own particular home. Because of the highly graphic (right-

brain) nature of the various outputs, users not only visually grasp concepts faster and in greater detail, but they also come to understand intuitively the dynamic nature of how their building responds over time. This intuitive understanding never could have been communicated in words or number alone as many other programs depend on.

Because this tool is open-ended, homeowners can define their own unique home and explore the results at their own pace and in as much depth as they choose. With the opportunity to acquire this kind of knowledge, ratepayers are in a much stronger position to make informed judgments about the energy efficient design and operation of their homes.

While HEED is extremely easy for homeowners to understand and use, it is actually driven by a very sophisticated hourly heat-balance simulation, similar to the approach used by DOE's new EnergyPlus non-residential program. HEED has been validated using the ASHRAE/BESTEST Procedure compared to the results of programs like DOE-2 and Blast.⁶ HEED is the result of more than \$575,000 of research contracts and over 25 years of development work.

Our long experience at developing user-friendly software has taught us much about how to create programs that can be used intuitively, that automatically catches any of their errors or illogical inputs, and that produces easily understood graphic results.

HEED is the only energy design tool with all this power that is available in both English and Spanish.

And it is free.

A.3 Lack of Comparable Work:

In developing HEED we evaluated all the other web sites and energy design tools that might possibly be made available to IOU ratepayers. Some of these are not useful to residential ratepayers, because they are not designed for homes or apartments. Others are very general programs that can only be run over the Internet and have limited capacity to model an individual home because of limitations like only allowing a few fixed generic window shapes and floorplan layouts. The list of similar programs includes:

- E-Quest: A large (13.4 meg) PowerDOE front end with a heavy emphasis on mechanical equipment, intended for non-residential buildings, available for free downloading on the EnergyDesignResources CD and web site. (Developed at J. J. Hirsch Associates, funded by SCE, PG&E, SDG&E and others.)
- GreenDesignTools/VisualDOE: not a free program (about \$800), and of limited use to homeowners. The proposed Home Energy module in this series has a similar interface as VisualDOE but with less functionality (in the \$200 range although it has never been released). (Developed at Eley Associates, funding from DOE and PIER).
- EMCOR Energy Edge: Not intended for residential buildings or use by homeowners.

Based on a long checklist format emphasizing mechanical equipment, requiring a great deal of technical input data but producing minimal output. Currently in development is a CAD interface tool called EnergyWorkshop that is intended for sophisticated architectural users. (developed at GeoPraxis, funded by PIER) .

- ACEEE web site: Provides valuable general performance data on hundreds of appliances, and HVAC equipment, but no whole-building performance simulation capability. (developed by the American Council for an Energy Efficient Economy, funded by DOE).
- EPA EnergyStar web sites: Provides valuable general information, lists thousands of appliances, energy efficient products, contractors, local utility programs, store locations, (and a simple generic home audit tool), but can not calculate the energy cost saved by a specific home remodeling option. (developed by LBL and others, funded by EPA).
- HES: Home Energy Saver and HIT: Home Improvement Tool: Both are excellent general information programs for energy novices, but they must be run interactively over the Internet, they cannot accurately model actual floorplans, they have very limited ability to model windows (HES requires all windows to be 3'x4' and HIT only lets the user estimate the percent of glazing on each wall), and they have limited capacity to model shading. (both developed at LBL, funded by DOE). Note that windows and shading will have by far the greatest impact in determining a home's overall performance, therefore describing them in detail is critically important to accurately calculating a building's energy consumption.
- Energy 10: Not a free program (about \$250). Intended for small commercial or residential buildings. More complex to use and has less graphic output capability than HEED.
- EnergyPlus: A huge new program currently in beta test, but it officially has no user interface, and third-party interfaces will not be free. It is intended for large non-residential buildings (being developed by U.S.DOE).

Compared to all the above tools available to California ratepayers, the extensions we are propose to make to HEED will offer a number of unique advantages, not available anywhere else:

B. Marketing Plan

B.1 Distribution Strategy:

This Statewide Information Project uses a variety of techniques to reach potential users, and to encouraging them to download HEED, this Home Energy Efficient Design tool.

Media Coverage: Initial contact with individual ratepayers will most likely be via some form of mass media as a result of press releases by the Media Support activity that is included of this project. One avenue might be through an article in the local newspaper. Another possible

source of contact with ratepayers is hearing it mentioned on a Flex Your Power radio spot. The objective of all media coverage is to point potential users to one of the web sites or workshops.

Utility Bill Stuffers: Another simple way to encourage Californians to download HEED is to include information in the utility bill stuffer that every ratepayer receives monthly. Unfortunately we have found utilities understandably reluctant to see something like HEED increase the burden on their already-overloaded internal customer support lines. Therefore, this notice probably should emphasize that HEED was developed by UCLA and that customer support is provided by an email Hot Line at UCLA to answer user queries, along with a file of Frequently Asked Questions.

Web Sites: The latest version of HEED will always be available on the UCLA Energy Design Tools site. Even when HEED was still in its unofficially beta test version, over 1500 copies downloaded, which demonstrates that there is a significant group of users who are ‘Googling’ in search of this kind of information. However, our primary hope is that HEED will eventually be made available to all California Consumers via a link from the Flex Your Power web site. (We recently presented HEED to the State Consumer Services Agency who indicated their support for having it included among the Flex Your Power offerings.) Another possible way of reaching ratepayers are the possibility of including links from the various IOU web sites.

Workshops: We proposing to staff six workshops that will be offered throughout the PG&E and SDG&E service territories in either English or Spanish at the request of the IOU.

The ultimate objective of all these various marketing avenues is to encourage California ratepayers to download a copy of HEED and to use it to help make informed decisions about their anticipated repair and replacement projects. To answer questions from users, this project includes provision for an email based user support hotline. In fact the system is currently in place and receives one or two queries a week from our existing user base. We also maintain a list of a dozen Frequently Asked Questions (FAQs) developed from the most common queries we have received to date.

From a marketing point of view, persuading ratepayers to use a free tool like HEED to calculate their long-term savings with different home improvement options is much less costly than trying to drive this market segment toward higher efficiency through enforcing stronger regulations, legislating required changes, or by paying them rebates or incentives.

To date, there is no formal distribution strategy by SCE or SCG. Depending only on word-of-mouth and on people who find HEED by searching (“Googling”) the internet, over 2600 different users have downloaded copies of HEED making it already the third most popular ‘whole house’ design tool.⁷

B.2 Marketing Materials:

The primary ‘marketing material’ in this project is the HEED program itself. This proposal required that all Marketing Materials must be approved by the IOU before distribution. Thus the following worked example shows that HEED is an easy-to-use tool that shows homeowners exactly how much money they will save each year on their gas and electric bills by making various home remodeling improvements.

HEED Worked Example:

The following images show what it would be like for a ratepayer to use HEED. This demonstration was run using the current version, however it gives a good feel for what the proposed new version will look like.

This particular example created 9 different schemes and took less than an hour to run. It shows how easy it is for users to input their own floor plan, define their own windows, then click and drag them onto the correct wall. In this example the users input a few typical remodeling options and saw how much money each would save in utility bills.

Assume Mr. and Ms. Ratepayer have decided to invest some money in improvements for their 1960s tract home in Westwood (near the UCLA campus). HEED starts by asking them four basic questions about their home: the building type, square footage, number of stories, and zipcode. With this it automatically finds the local utility rates and hourly climate data. It then designs two basecase homes; Scheme 1 Meets the Energy Code, and Scheme 2 More Energy Efficient (about 30% better).

Solar 5: Java Version

Exit Basic Advanced Evaluate Library Print Advice Help About

INITIAL DESIGN

What would you like to do?:

- Construct a brand new home
- Remodel within your Home's Existing Walls
- Add on outside your existing floor plan

What kind of home will it be?:

- Single Family House
- Town House, attached to others
- Apartment or Condo unit (entry from interior hallway)
- Apartment or Condo unit (entry directly from outdoors)

How big will your home be?:

2000 Square Feet for Example...

How many stories does your home have?

1

What is your Zipcode?:

90024 contains Los Angeles(Westwood) City

What is your name?:

Ms/Mr SCE Ratepayer

To proceed click the Next button below...

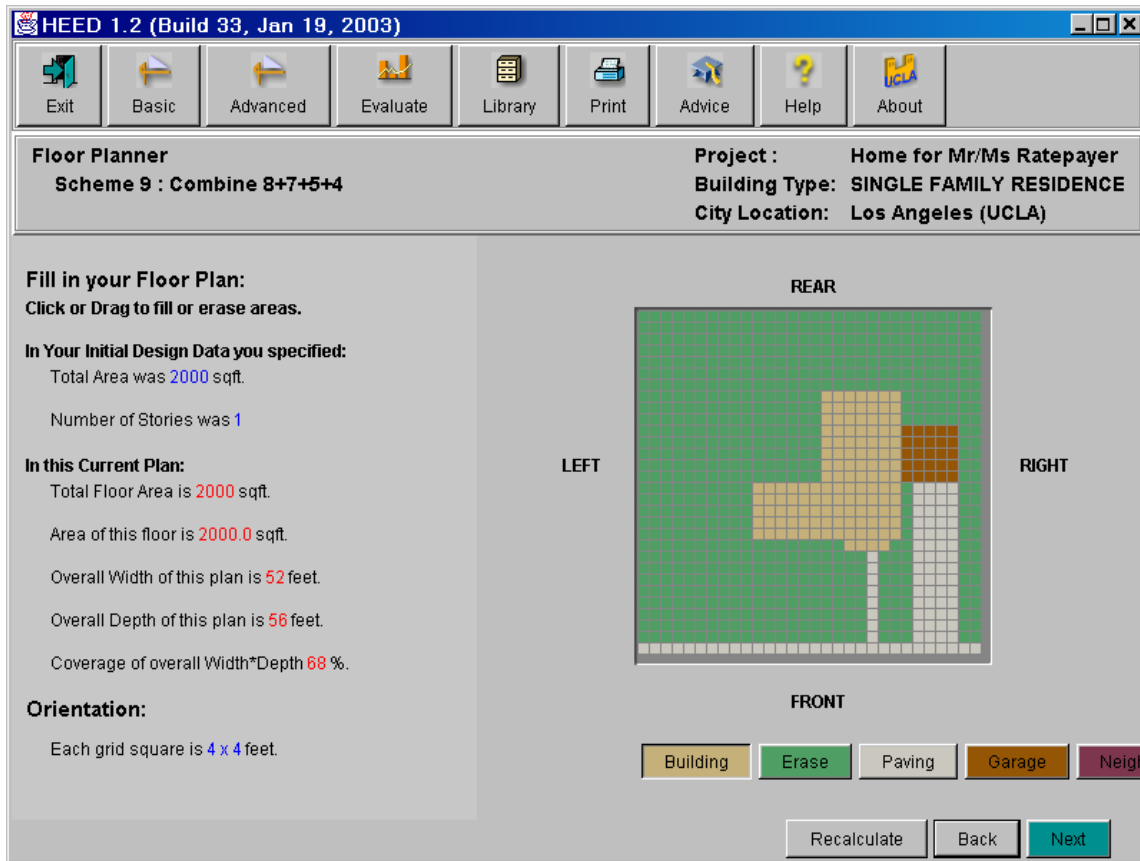
Solar 5 : Comments Recalculate Back Next

INITIAL DESIGN: On this first screen once our users, Ms/Mr SCE Ratepayer, answer these questions, the built-in expert system designs two different homes.

Scheme 1 is called “Meets Energy Code,” and this design meets the minimum California Energy Code for Low-Rise Residential Buildings (Package D). It has a square floor plan with a raised floor, the legal minimum number of windows distributed equally on all walls, and code minimum type of glazing (per the CEC’s ACM specifications⁸).

Scheme 2 is called “More Energy Efficient,” and it is has a rectangular floor plan with a slab on grade and most of the required glass on the south wall with optimally sized shading and double glazing, plus a whole-house fan.

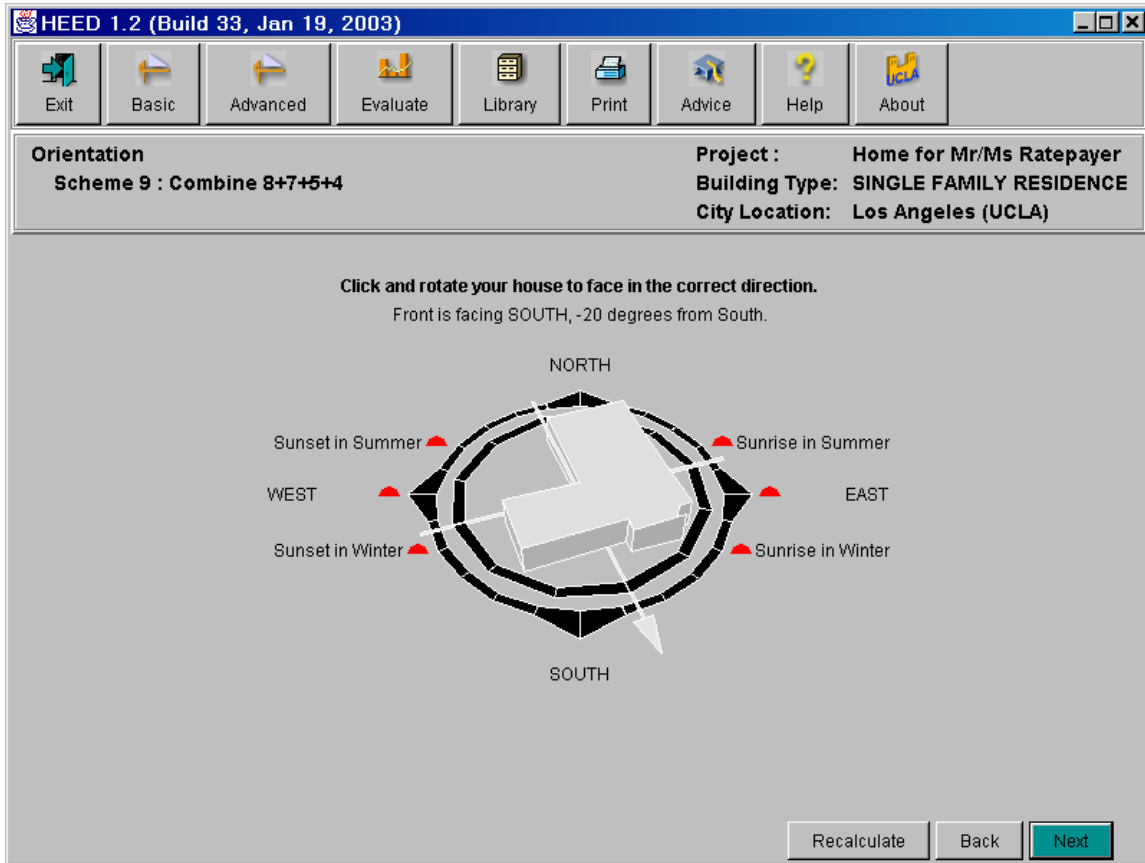
Next HEED makes a copy called Scheme 3 and prompts Mr. and Ms. Ratepayer to change it to better represent their own house as it currently exists. So now Mr. and Ms. Ratepayer draw in their house’s floor plan by clicking on squares in the Floorplanner grid. They also rotate it to do the correct orientation, and click and drag their windows to the correct location on each facade. Finally they describe its construction by selecting from lists of different options.



FLOOR PLANNER:

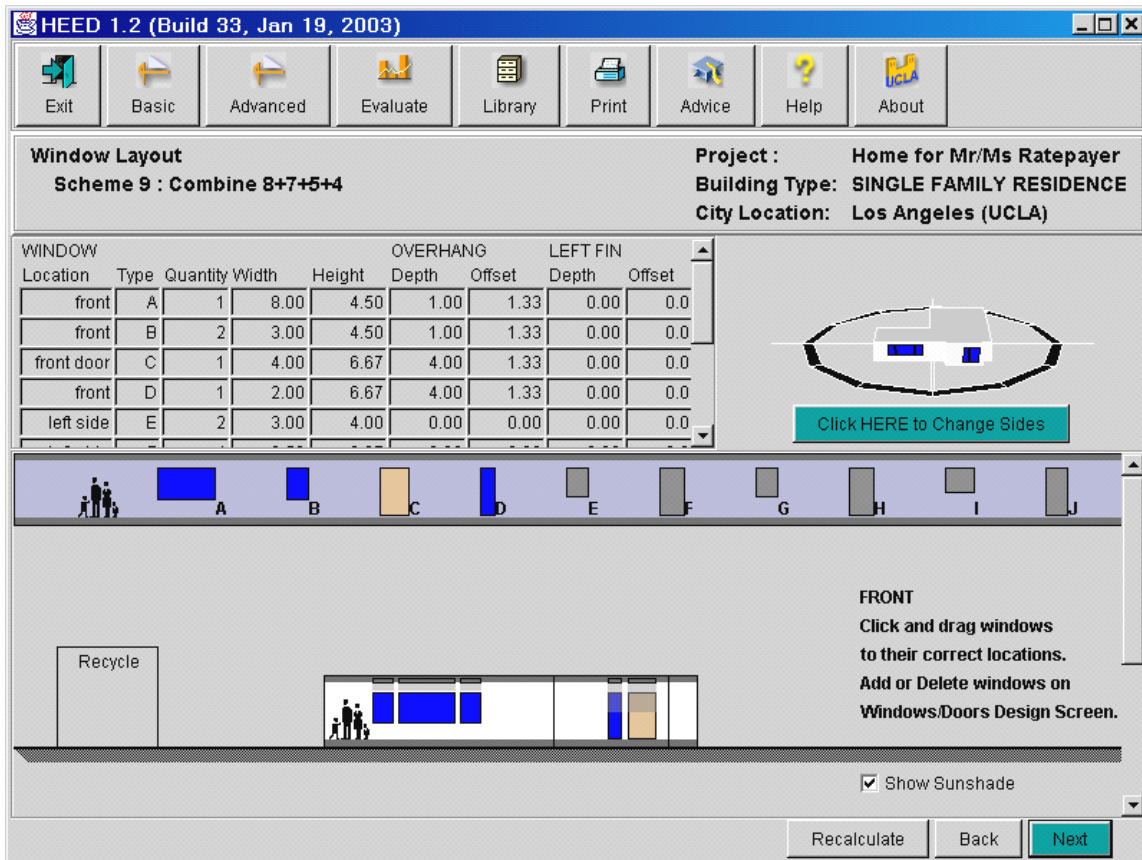
On this screen the users have drawn in the outline of their L-shaped ranch style home by simply clicking on squares in the checkerboard. In this case the same 2000 square feet are distributed into two wings. As the users make changes, the left hand panel updates all the dimensions like Overall Width, Overall Depth, and Percent of Coverage. In this case they have added their attached garage along with a driveway and sidewalks, all of which help give a sense of scale and familiarity.

Notice that as the users make changes, the design data is immediately updated in red on the left hand panel.



ORIENTATION:

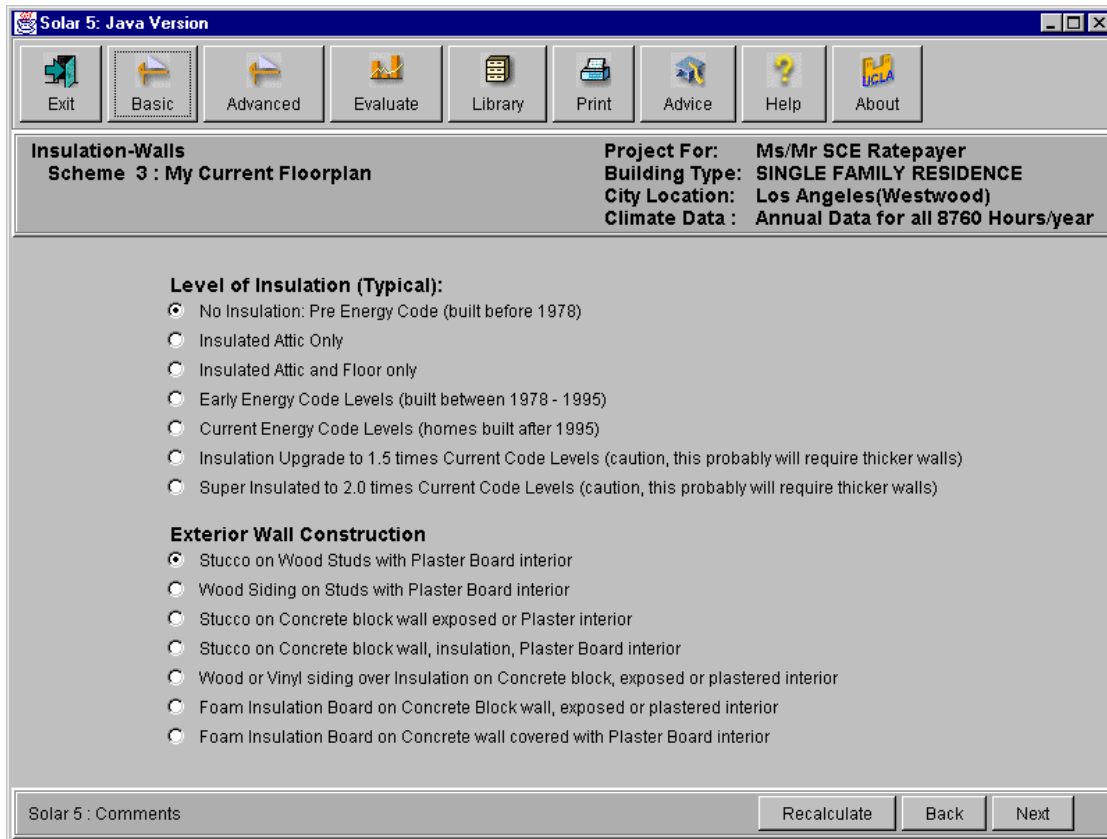
Their floor plan is now shown in 3-D, overlaid on a compass. The users can now click and drag their house around so that the front faces in the correct direction. In this case they adjusted it to face about 20 degrees East of due South. To help the user figure out which direction their house faces, this compass also shows the directions of sunrise and sunset in the summer, winter, and equinox.



WINDOW LAYOUT:

Mr. and Ms. Ratepayer described their home's current windows and doors on a prior screen similar to the upper-left panel. They could also have included skylights. Now on this screen they can click and drag each individual window to its correct location on each elevation of the building. To delete windows they drag them into the Recycle bin. To look at each different side of their home they click the green bar, which will rotate clockwise the little thumb-nail sketch of their house and will change to the next elevation in order.

This step is extremely important for the accuracy of the computer simulation because it gives users an easy visual check to be sure they have not left any windows out or defined them as the wrong size. These kinds of data input mistakes are the biggest source of errors with energy analysis programs that do not give this kind of visual feedback. HEED is the only program that offers this option. But for Mr/Ms Ratepayer the most important benefit is the reassurance that the computer is actually modeling their own particular unique house, and thus they have more confidence in the energy cost figures that it calculates.



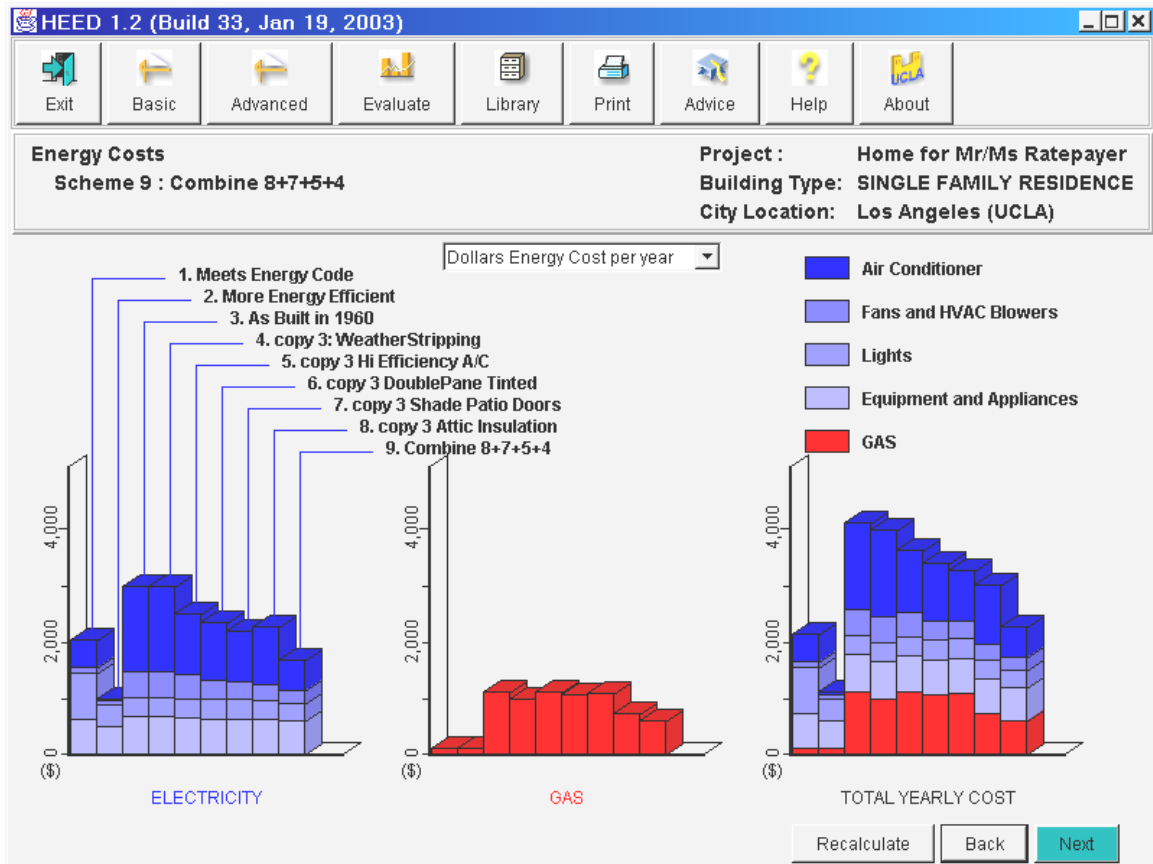
INSULATION AND WALL DESIGN:

There are many other aspects of their home that they can change by simply clicking on one of the various 'radio button' lists like these. In this case they have indicated that their 1970s tract house has no insulation. They also described their exterior walls as stucco on wood studs with plasterboard interiors.

If they are unsure about what is in their walls or ceilings, clicking on Help explains various easy ways to find out, plus it offers definitions of all the terms used here. Please notice that HEED does not use technical architectural or engineering terms, but only the kind of things that most homeowners already know about their building.

Similar lists are presented for:

- Roof Construction
- Floor Construction
- Glass Type
- Infiltration and Weather Stripping
- Ventilation (and free Economizer Cooling)
- Furnaces
- Air Conditioners



FINAL ENERGY COSTS:

This screen shows Ms/Mr Ratepayer their annual cost for Electricity, for Gas, and the Total Yearly Cost. There are nine bars, one for each of nine different designs. The first (left) bar in each of the three sets is for “Scheme 1, Meets Energy Code,” the basecase design that the expert system automatically created for a new 2000 square foot house. The second bar shows “Scheme 2, More Energy Efficient,” the second basecase design that the expert system created, which uses about a third less total energy.

The third bar in each set shows the results the homeowners got after drawing in their own building, that they called “Scheme 3, My Current Floorplan”. Note that this 1960s design uses about twice the Total Yearly Cost of a modern building that meets the energy code.

After they complete describing “Scheme 3, Home as Built”, they begin creating other new schemes by simply clicking on "Copy" and changing each different attribute of their house that they wished to test. Often this was as simple as clicking another button in one of the radio-button lists. Mr. and Ms. Ratepayer are considering a number of different home improvement options so they added each one to a different copy of their original tract house. For example they tried comparing the cost savings of weather-stripping, a high efficiency air conditioner, double pane tinted windows, awnings to shade patio sliding glass doors, attic insulation, and a final scheme that combines their choice of four of these do-it-yourself

(DIY) projects:

1. Meets Energy Code (designed automatically by HEED)
2. More Energy Efficient (also designed automatically by HEED)
3. Home As Built in 1960 (as drawn in by the homeowners)
4. Copy of 3: Weather-Stripping
5. Copy of 3: Hi Efficiency Air Conditioner
6. Copy of 3: Double Pane Tinted Windows
7. Copy of 3: Shades for Patio Sliders
8. Copy of 3: Install Attic Insulation
9. Combine Schemes 8+7+5+4 (incorporating all four do-it-yourself projects)

The graph shows that the right combination of these home improvement options could make their home use about the same amount of energy as a home of the same size that meets the current California Energy Code (compare Scheme 9 vs. Scheme 1).

In this way HEED delivers detailed energy efficiency comparisons personalized to each ratepayer's unique home and the specific design options they are interested in.

FINDING THE COST EFFECTIVE OPTIONS

The final step is for Mr. and Ms. Ratepayer to get estimates of the costs of doing these remodeling projects. A visit to the local home center outlet will yield accurate estimates for the Do-It-Yourself (DIY) options. Estimates for the contracted work would mean phone calls to local contractors in the Yellow Pages. This feature is to be added to this proposed new version of HEED so that these values can be loaded into a Cost Effectiveness Spreadsheet (Table 2). To calculate the number of years it will take to pay back the investment, the estimated cost is divided by the annual energy savings. Anything less than about 7 years is considered to be a very good investment (equivalent to at least 10% annual rate of return).

	Options Tested	Annual Energy Costs	Savings Compared to Scheme 3	Estimated Costs of Improvements		Years to Pay Back Annual Energy Savings	
				DIY	Contracted	DIY	Contracted
3.	Home As Built in 1960	\$4066	-				
4.	Copy 3: Weather-stripping	\$3950	\$116	\$200	\$500	2	5
5.	Copy 3: Hi Efficiency A/C	\$3601	\$465	\$2500	\$4000	5	9
6.	Copy 3: Double Pane Tinted	\$3377	\$689	-	\$8000	-	(12)
7.	Copy 3: Shade Patio Doors	\$3233	\$833	\$800	\$1600	1	2
8.	Copy 3: Attic Insulation	\$2977	\$1089	\$1000	\$2000	1	2
9.	Combine 8+7+5+4	\$2255	\$1811	\$4500	\$8000	2.5	4.5

Table 2: These estimates show that Scheme 9, the Combination of the four Do-It-Yourself projects, would pay for itself in only 2.5 years, a wonderful investment in any economy. Even if Mr. and Ms. Ratepayer contracted out this work they would get a 4.5 year payback, still a very sound investment. (This economic analysis is a mockup of one of the new functions that will be added in the proposed new HEED)

The best single option for Mr. and Ms. Ratepayer is Scheme 8, to Install Attic Insulation; it will save them \$1089 per year in total gas and electric bills compared to Scheme 3, their Home As Built in 1960. Based on estimates they received for installing this attic insulation, this project would have a 2 year payback if they contracted it out, or a one year payback if they did it themselves.

When they combined this with three other DIY options in Scheme 9, it yields a total annual savings of \$1811 and a 2.5 year payback, which is an excellent return on investment. Even if they decide to contract out this work it would have a 4.5 year payback, still a very attractive investment.

C. Customer Enrollment

There is no formal enrollment required for this project. Once anyone download a copy of the program, their email address in effect ‘enrolls’ them in the program. There are many opportunities for them to contact us for more information, and we may contact them in the future for the on-line user survey. If required, we can query then ahead of time to find out which IOU serves their home, or we may wait for the on-line survey to ask this information.

D. Materials Procurement (Not Applicable)

E. Payment of Incentives (Not Applicable)

F. Staff and Subcontractor Responsibilities

The work on this project will be done by the Energy Design Tools Group at UCLA under the direction of Murray Milne, Research Professor, along with a team of six people. Two of these people will be subcontracted, the Graphics/Web Specialist and the EM&V Consultant:

Project Leader is Murray Milne, who is responsible for Overall Project Management, Overall Program Design, Development of the Computation Kernel, Workshop Presentations, and Email Hotline. He has designed and developed HEED since its inception, and was Project Leader on the prior CPUC funded projects for SCG (through UCLA) and SCE (through CTG Energetics). He is budgeted at 30% time.

Program Analyst is Carlos F. Gomez who is a software specialist responsible for System Management, Systems Integration of all Software Components, and who participates in all Workshops. He has been associated with HEED since its inception. Budgeted at 20% time.

System Graphics Consultant is tba, and will be responsible for Graphics Screen Development, plus Web Site Development and Maintenance, and will be provided by the Software Technical Support Subcontractor. Budgeted at 20% time.

Spanish Language Translator is Pablo La Roche, Assistant Professor, who is responsible for translating the full English version into Spanish, and for co-presenting the Spanish Language Workshops. He was responsible for translating the current Spanish version of HEED. Budgeted at 10% time for year two.

Staff Research Associate is tba, and will be responsible for Media Liaison, IOU Technical Data Liaison, and Workshop Logistics Coordination. Budgeted at 15% time.

Graduate Student Researcher is Grace Tsai, who will be responsible for various programming tasks. She was also involved in the prior version of HEED. Budgeted at 10% time.

The EM&V Consultant is either Robin Liggett, PhD or another contractor tba. Dr. Liggett was the EM&V consultant for the prior version of HEED and produced the Internet Based User Survey.

G. Work Plan and Timeline for Program Implementation

G.1 Work Plan: What We Will Do:

Note: Most of these tasks are to be performed on both the PG&E and SDG&E contracts, with effort proportional to the Public Goods Charges collected in each IOU service territory, while a few of these tasks are performed exclusively in one or the other of these contracts. This allocation is spelled out in the following section, II.G.2 Timeline.

1. We will develop a Statewide version of HEED using the current SCE/SCG version as the platform, and adding new functionality for PG&E and SDG&E:
 - We will expand HEED's zipcodes database to include all the zipcodes, the appropriate rate category, and climate zones for both the PG&E and SDG&E service territories.
 - We will write new utility rate screens and calculation algorithms for PG&E and SDG&E.
 - We will expand the built-in Energy Efficiency Strategies information in "Help" to explain these new PG&E and SDG&E rates and climatic design implications.
 - We will expand the built-in 'Advice' feature by adding the web sites, rebate programs, and other background information desired by PG&E and SDG&E.

- We will create a new Energy Savings Design Alternatives Screen: given each ratepayer's input design data, this new screen will suggest the most cost effective improvements whether using the PG&E or SDG&E climates and utility rates.
 - We will establish a Media Liaison position responsible for production of draft press releases and technical articles, and for coordination with the CPUC, and the PG&E and SDG&E Public Relations Divisions.
 - We will develop a marketing plan with PG&E and SDG&E including workshop scheduling and logistics, and the possibility of bill-stuffer announcements.
 - We will revise HEED to accommodate the proposed revisions in the California Energy Code, Title 24, in time for its release in 2005.
 - We will select and EM&V consultant and develop an Evaluation Verification and Measurement (EM&V) Plan
 - We will work with our EM&V consultant to establish ratepayer attitudes toward HEED and its impact on California's energy consumption (we anticipate that this will take the form of an internet user survey as well as surveys following each of the workshops).
 - We will translate all this new material in HEED into Spanish and update the current version.
2. We will develop new capabilities needed in the Statewide version. These have been (somewhat arbitrarily) assigned to either PG&E or SDG&E. Because this is a cooperative statewide project, work done for one utility will automatically be available to the other utilities
- 2.1 The PG&E portion of this project includes:
- We will develop the Basement thermal performance algorithm and accompanying graphic screens, (currently HEED accommodates slab on grade and raised floor, but basements are rarely encountered in Southern California)
 - We will develop the expanded Pitched Roof algorithm and accompanying graphic screens, allowing users to define various roof slopes and overhangs (currently HEED accommodates either a flat roof or generic pitched roof)
 - We will develop a new computational procedure and screen graphic technique to accommodate multi-story homes with different footprints on each floor, requiring modification of the graphic input screens and development of a new calculation algorithm (HEED now assumes each level of multi-floor homes has the same footprint)
 - We will develop the option of buildings with multiple thermal control zones (currently HEED assumes there is only one thermostat in the home)
 - We will develop a new graphic screen to let the homeowner draw in Windows and Doors of any rectangular size and shape (currently in HEED window dimensions are typed in)
 - We will develop a new display screen and calculation algorithms to automatically

calculate the correct furnace and air conditioner sizing, according to ASHRAE's Manual J procedure.

- We will develop the new Economic Payoff spreadsheet screen and calculation procedure for comparing the savings from each different set of energy design revisions and computing payback based on the homeowners estimates of project cost, whether do-it-yourself or contracted out.
- We will create a new expanded Tutorial/Demonstration to show first-time users HEED's new features and how to use them.

2.2 The SDG&E portion of this project includes:

- We will develop Water Heater calculation algorithm and a new display screen (HEED currently emphasizes building envelope design issues, but at a recent demonstration for SDG&E this option was explicitly requested).
 - We will develop a new computational procedure to accommodate homes with Internal Courtyards or Atria, requiring a new floor planner graphic input screen (currently HEED does not accommodate buildings with interior courtyards)
3. We will demonstrate the performance of this tool in field validation studies in the form of six workshops for PG&E and SDG&E ratepayers:
- We will staff hands-on workshops in any part of the PG&E and the SDG&E utility districts, if requested, to help publicize HEED's availability and to offer training to any ratepayers, but more important these workshops help us to field-validate the software and to show how well our intended constituency uses it (we have budgeted staffing for a total of six workshops).
 - We will conduct post-workshop EM&V surveys to identify user observations about HEED's strengths and weaknesses. This information will help us advance the concurrent development of HEED.
 - We will validate HEED using ASHRAE Standard 140 (BestTest).
4. We will provide ratepayer support:
- We will maintain at UCLA the free public access web site from which ratepayers can download the latest version of HEED (www.aud.ucla.edu/heed), in either English or Spanish, and can access the Frequently Asked Questions file (FAQs). This site will record users email addresses who download HEED so we can notify them of future updates and in order to later conduct the evaluation survey. If desired the PG&E and SDG&E web sites can link transparently to this site.
 - We will post the latest Beta Test Version of HEED on the web site (continuing each quarter).
 - We will make copies of HEED available to download directly from PG&E and SDG&E servers if requested.
 - We will also make a master CD self installation copy of HEED available (similar to Energy Design Resources CD) that can be copied and distributed by PG&E and SDG&E if desired.

- We will maintain the database of email addresses of users who downloaded copies of HEED (we anticipate that this will be used by our EM&V consultant for an internet survey of our users to establish attitudes about HEED and its impact on the state’s energy consumption).
 - We will staff the email User Support Hot-Line for HEED.
 - We will expand the Help and Advice pull-down menu content inside HEED as necessary to reflect all the additional issues that develop in the new version, which acts as the users manual and as the technical support manual.
 - We will also maintain a list of Frequently Asked Questions (FAQ) that will be posted on the web site.
5. We will continue to maintain a Spanish version of HEED.
- We will translate into Spanish all user screens as (HEED is the only whole-building design tool developed in the U.S. that is also available in Spanish).
 - We will translate into Spanish all ‘Help’ and ‘Advice’ content to act as the Spanish Language users manual and technical support manual.
 - We are also prepared to offer workshops in Spanish if requested.

G.2 Timeline for Program Implementation

The following timeline has been divided into calendar quarters, but it can easily be later broken down into monthly tasks if required. Note that some of these tasks may run for more than one quarter.

All tasks are assigned to both PG&E and SDG&E (P+S), unless explicitly assigned to one or the other. All these assignments and costs are divided somewhat arbitrarily in order to comply with the ratio of Public Goods Funds Collections in the PG&E and SDG&E service territories, which are in the ratio of .76 to .24⁹. Because the objective is to build a Statewide version of HEED, work performed under one utility’s contract will still be available to the other utilities. The objective is to be inclusive and cooperative, rather than exclusive and competitive.

Note: P or S indicates whether a task is to be performed in either the PG&E or the SDG&E contract. **Because this Narrative describes the SDG&E Portion of the HEED Project, these tasks have been indicated in Bold Face.**

Year One - First Quarter:

P+S Expand HEED’s zipcodes database to include all the zipcodes, appropriate rate category, and climate zones for both the PG&E and SDG&E service territories.

P+S Select EM&V Contractor and Develop an Evaluation Verification and

Measurement (EM&V) plan to establish ratepayer attitudes toward HEED and to quantify its impact on California's energy consumption (we anticipate that this will take the form of an internet user survey as well as surveys following each of the workshops).

- P Develop a new computational procedure and screen graphic techniques to accommodate multi-story homes with different footprints on each floor, requiring modification of the graphic input screens and development of a new calculation algorithm (HEED now assumes each level of multi-floor homes has the same footprint)
- P+S **Maintain at UCLA the free public access web site from which ratepayers can download the latest version of HEED (www.aud.ucla.edu/heed), in either English or Spanish, and can access the Frequently Asked Questions file (FAQs). This site will record users email address so we can notify them of future updates and in order to later conduct the evaluation survey. If desired the PG&E and SDG&E web sites can link transparently to this site.**
- P+S **Maintain a database of email addresses of users who downloaded copies of HEED (we anticipate that this will be used by our EM&V consultant for an internet survey of our users to establish attitudes about HEED and its impact on the state's energy consumption).**
- P+S **Staff the email User Support Hot-Line for HEED.**
- P+S **Maintain a list of Frequently Asked Questions (FAQ) that will be posted on the web site.**

Year One - Second Quarter:

- P+S **Write new utility rate screens and energy cost calculation algorithms for PG&E and SDG&E.:**
- P+S **Establish a Media Liaison position responsible for production of draft press releases and technical articles, and for coordination with the CPUC, and with PG&E and SDG&E Public Relations Divisions.**
- P Develop the option of buildings with multiple thermal control zones (currently HEED assumes there is only one thermostat in the home)
- P+S **Develop the new Economic Payoff spreadsheet screen and calculation procedure for comparing the savings from each different set of energy design revisions and computing payback based on the homeowners estimates of project cost, whether do-it-yourself or contracted out.**

Year One - Third Quarter:

- P+S **Develop the Marketing Plan with each IOU including workshop logistics and the possibility of bill-stuffer announcements**
- P+S **Expand the built-in Energy Efficiency Strategies information in "Help" to explain these new PG&E and SDG&E rates and climatic design implications**
- S **Develop Water Heater calculation algorithm and a new display screen (HEED currently emphasizes building envelope design issues, however at a recent**

demonstration for SDG&E this option was explicitly requested).

- P Develop a new graphic screen to let the homeowner draw in Windows and Doors of any rectangular size and shape (currently in HEED window dimensions are typed in)

Year One - Fourth Quarter:

- P+S Expand the built-in “Advice” feature by adding the web sites, rebate programs, and other background information desired by PG&E and SDG&E.**
- P Develop the expanded Pitched Roof algorithm and accompanying graphic screens, allowing users to define various roof slopes (currently HEED accommodates either a flat or generic pitched roof)
- P Develop the Basements thermal performance algorithm and accompanying graphic screens, (currently HEED accommodates slab on grade and raised floor, because basements are rarely encountered in Southern California)
- P+S Post the latest Beta Test Version of HEED on the web site (continuing each quarter).**

Year Two - First Quarter:

- P Develop a new display screen and calculation algorithms to automatically calculate the correct furnace and air conditioner sizing, according to ASHRAE’s Manual J procedure.
- S Develop a new computational procedure to accommodate homes with Internal Courtyards or Atria, requiring a new floor planner graphic input screen (currently HEED does not accommodate buildings with interior courtyards)**
- P+S Staff hands-on workshops in any part of the PG&E and the SDG&E utility districts, if requested, to help publicize its availability and to offer training to any ratepayers, but more important these workshops help to field-validate the software and to show how well our intended constituency uses it**
- P+S Conduct post-workshop EM&V surveys to identify user observations about HEED’s strengths and weaknesses. This information will help us advance the concurrent development of HEED.**

Year Two - Second Quarter:

- P+S Revise HEED as necessary to accommodate the proposed revisions in the California Energy Code, Title 24, in time for its release in 2005**
- P+S Create a new Energy Savings Design Alternatives Screen: for each ratepayer’s input design data, this new screen will suggest the most cost effective improvements considering their particular climate and utility rates.**
- P Create a new expanded Tutorial/Demonstration to show first-time users HEED’s new features and how to use them.

Year Two - Third Quarter:

- P+S Translate all the new screens added to HEED into Spanish to update the current Spanish version (HEED is the only design tool developed in the U.S. that is also available in both English and Spanish)**
- P+S Expand the 'Help' and 'Advice' content inside HEED as necessary to reflect all the additional issues that develop in the new version, which acts as a Users Manual and Technical Support Manual.**
- P+S Translate all the new Help and Advice content into Spanish**
- P+S Staff workshops in Spanish if requested.**

Year Two - Fourth Quarter:

- P+S Work with our Evaluation Verification and Measurement (EM&V) consultant to establish ratepayer attitudes toward HEED and to quantify its impact on California's energy consumption (we anticipate that this will take the form of an internet user survey as well as surveys following each of the workshops).**
- P+S Validate HEED using ASHRAE Standard 140 (BestTest).**
- P+S Provide copies of HEED to download directly from PG&E and SDG&E servers if requested.**
- P+S Provide a master CD self installing copy of HEED that can be copied and distributed by PG&E and SDG&E if desired (similar to Energy Design Resources).**

III. CUSTOMER DESCRIPTION

A. Customer Description

The Target Market Segment of this project is:

- Residential Single-Family
- Residential Multi-Family

The Target Market Types are:

- Residential Retrofit and Renovation, including new windows, walls and roofs
- Residential New Construction
- Residential Heating and Cooling
- Residential Lighting

HEED is especially successful at reaching almost every Residential **Hard-to-Reach** Customer in California:

- Language: This program is unusual in offering both Spanish and English versions of the software (we know of no other whole-building design tool that is available in Spanish).
- Geographic: Rural and urban customers are served equally well because it is delivered via the internet, and the user support hotline uses email..
- Income: Any income level is served, including those that fall into the low and moderate income level.
- Housing Type: All types of Single Family and Multi-Family dwellings including Single Family Detached, Townhouses, and Apartments and Condominiums with either interior or exterior corridors, highrise or lowrise.
- Home Ownership: Homeowner and Renters are served equally well, although renters will be more interested in the low-cost portable solutions, or in appliances and equipment that could be moved to their next home.
- The only limitation is that customers must have access to the internet or to a computer (with a CD reader). However almost everyone in California now has access to a computer either at home, at work, at school, or the public library.

The potential Market Value is \$15 Billion every year: The Construction Industry Research Board¹⁰ reports that in California the building permits issued for Residential Repair and Remodeling totaled over \$3.7 billion annually. It is estimated that four times this amount of work is actually done without permits by do-it-yourselfers or informal contractors, plus money spent on normal home repairs and equipment replacement. This means that every year \$15 billion of economic activity could potentially be leveraged in the interest of improving the energy efficiency of California's housing stock. This estimate for California may actually be a bit low because on the national level, the Home Improvement Research Institute¹¹ estimates that over \$300 billion is spent annually on all forms of home improvements and

repairs, and California accounts for about 10% of that total.

If California ratepayers decide to invest even a tiny fraction of these funds in energy efficiency improvements, the annual potential resources could be immense. It is perhaps worth noting that the annual cost of this HEED project represents only 1/7000 of this \$15 billion market.

The potential **Market Size** encompasses all PG&E and SDG&E residential customers: The maximum potential size of our customer group is anyone in the IOU's service territory, that is to say anyone who pays a utility bill. Within this huge population, we estimate that every year about one third of these ratepayers will be making repair or remodeling changes in their home, or will be purchasing new appliances or equipment. Virtually every decision they make about the operation or maintenance or remodeling or rehabilitation or design of their home will have some kind of impact on its energy consumption.

Almost every ratepayers who goes to a store like Home Depot or Best Buy to make a major purchase will be making the kind of decision that HEED can easily evaluate, involving things like exterior awnings, window shades, new appliances, etc. HEED is most relevant however for major repair and remodeling projects such as new roofs, new siding, window replacement, HVAC upgrades, insulation, or room additions. The older their house is, the more often they will be making major revisions that effect its energy performance. In California people move to a new residence on average every four years, and this too is a decision on which HEED can give useful guidance that could help reduce monthly payments. Moving into a new home is also the time when people tend to make modifications that affect energy consumption. This means that over three years virtually everyone in each IOU service territory would benefit from using HEED.

B. Customer Eligibility

Anyone in a household that pays a utility bill in each IOU service territory is eligible to participate in this program and use HEED.

C. Customer Complaint Resolution

Because this project includes an email-based customer service hot-line, users who have questions have a source of personal one-on-one information and feedback. In the many years that HEED has been available, we have never received a "customer complaint." In fact our users are usually grateful for the personal attention they receive and the fact that we quickly move to address any problems they may have encountered.

D. Geographic Areas

This project is targeted for ratepayers in every IOU's service territory. With the completion of this project our database will include all the zipcodes, rate, and climate zones in all four utility territories. This means that we our target geographic area are all the million of Californians who live in a household that pays a utility bill.

IV. MEASURE AND ACTIVITY DESCRIPTION

A. Energy Savings Assumptions

Note: This section, as defined in the 2004-2005 EE Instructions, does not apply to this type of Statewide Information Projects. However we will use this section to present some of the relevant features of HEED.

A.1 Peak and Annual Energy Savings in HEED:

Because HEED is intended for consumers without special technical training, annual energy savings are presented in terms of dollars, as shown on the Energy Cost bar chart and the Summary Table. This also means that homeowners can cross-compare electricity and gas savings according to the same metric. However for advanced users HEED also plots graphically and prints out the annual peak consumption and annual energy consumption, should this kind of information prove necessary or useful to ratepayers in the future (i.e. for code compliance or rebate program validation).

Coincident Peak Demand Reduction is plotted on HEED's Advanced 3-D Comparison screen of Peak Loads:

- Peak Hour's Electricity (kW)
- Peak Hour's Heating Fuel (kBTUH)

Electric Energy Savings is printed in the Advanced BEPS, Building Energy Performance Standards screen:

- Total Electricity Consumption Annually (kWhr)

Gas Energy Savings is also printed in the Advanced BEPS, Building Energy Performance Standards screen:

- Total Heating Fuel Consumption Annually (therms)

In HEED, the BEPS screen and the 3-D Comparison Charts also contain a great deal of annual and peak building data for over 4 dozen different variables of building performance. These are among the 48 different Advanced Design Data Input and Evaluation screens available to advanced users. However HEED is designed so that typical homeowners only needs to use the Basic Design data input and display screens, and may never choose to look at these Advanced screens. Many users find that the Annual Energy Cost bar charts are all they need (see example at the end of II.B.5).

A.2 Building Design Variables Affecting Energy Assumption:

Looking only at the options in the Basic Design pulldown menu, HEED offers the following building design variables. After the user inputs the first four items, HEED's expert system creates the two basecase buildings, the Title 24 building and an Energy Efficient design that is about 30% better. When the user copies either of these as the basis for further changes, all the following variables are automatically loaded and so the users only need to change the one or two Building Design Variables that they are interested in testing. Most of this data is input by either clicking and dragging or else by selecting from radio button lists of options:

- Building Type (detached, townhouse, condo, apartment)
- Zipcode (established climate zone, gas and electric utility, rate zones)
- Total Square Footage
- Number of Stories
- Orientation (compass heading of front wall)
- Floor Plan (drawing established overall length and width and percent of coverage)
- Attached Structures (garages, neighbors it any)
- Window Size and Location (on each façade or roof)
- Glazing Type for Each Window (u-factor, transmissivity, SHGC)
- Overhangs Depth and Offset for Each Window
- Side Fins Depth and Offset for Each Window
- Level of Insulation
- Radiant Barriers in Attics
- Exterior Wall Construction
- Roof Construction (and color)
- First Floor Construction
- Weather Stripping and Infiltration
- Ventilation (whole-house fans or natural ventilation)
- Furnaces
- Air Conditioners
- Appliances

Please note that for each of these Basic data input options, there is a corresponding but more detailed set of input options in the Advanced Design pull down menu which is primarily numerical, and will appeal to the more technically advanced users.

A.3 Energy Modeling Theoretical Approach:

The computational engine inside HEED is an hourly heat balance algorithm that has been in development for over the past 25 years. This is the same approach used in DOE's new EnergyPlus project. HEED uses the basic ASHRAE equations to establish building loads and the Mackey and Wright equations to compute heat flow through opaque envelope elements with thermal mass. The thermal storage effect of thermal mass in the interior is computed using the Admittance Factor approach as modified by Givoni. An important feature is that the mechanical system is coupled directly in at each hourly time step (not in separate loads

and plant modules as in DOE2). This means that indoor air temperature is computed directly considering factors like thermostat dead band, set-backs and set-ups, natural ventilation, and economizer cooling based on air volumes optimized for outdoor air temperatures and seasonal comfort needs. This indoor air temperature is computed by the convergence of a pair of successive approximation routines that calculate the hourly heat balance. Although currently HEED accommodates only one thermal zone (i.e. one thermostat), it is designed to handle up to nine separate thermal zones, a feature that will be implemented as part of this current proposal.

HEED contains 8760 hour climate data for all of the 16 California Climate Zones. It also has the capacity to directly read the new EnergyPlus .epw format climate data files, which are available for over 500 stations world wide. HEED also calculates available daylight and the resulting lighting electrical loads that vary as a function of façade design, orientation, and outdoor atmospheric conditions, and which in turn effect indoor thermal loads (this is plotted in the Advanced Daylighting screen). HEED also calculates the atmospheric pollution levels for each scheme (which are plotted in one of the Advanced 3-D Comparison Charts).

HEED has been validated using the ANSI/ASHRAE Standard 140-2001, which compares its performance against programs like DOE2 and Blast. These results are posted on the HEED web site. This test protocol was formerly known as the BestTest procedure.

B. Not Applicable (Deviations in Standard Cost-Effectiveness Values)

Note: This section, as defined in the 2004-2005 EE Instructions, does not apply to Statewide Information Projects. However we will use this opportunity to present an admittedly crude but none-the-less impressive estimate of HEED's Cost Effectiveness.

HEED is a relatively low cost project, but it has the possibility of very high long-term payoffs.

The primary advantage is that this relatively small amount of funding is leveraged to influence the \$15 billion that Californians spend annually out of their own pockets for home repair and remodeling. This means that no further Public Goods funds are needed to continue to create permanent energy efficient improvements in the state's housing stock.

If California ratepayers can be persuaded to invest even a tiny fraction of these funds in energy efficiency improvements, the annual potential impact could be immense. Although it is an admittedly crude estimate, it is worth noting that the annual cost of this HEED project represents only 1/7000 of this \$15 billion market.

Note that the permanent building envelope changes recommended by HEED tend to have long 10 to 20 year life spans. This is in contrast to projects involving rebates, subsidies, or product give-aways which tend to have shorter life spans (i.e. light bulbs or kitchen appliances).

Note also that this first year Cost-Effectiveness will compound every year into the future as more and more new ratepayers use HEED for the first time. Our experience shows that each year an increasing number of new users are finding the HEED web site and downloading copies.

C. Not Applicable (Rebate Amounts)

D. Activities Descriptions

Because this is an Information Only project, none of the program activities are expected to produce measurable energy savings. The list of all these program activities is given in Section II.G.1 Work Plan.

V. GOALS

A. Energy and Peak Demand Savings Goals:

Because this is an open-ended Information Only Project, where customers have a nearly infinite set of possible problems and potential solutions, we have no way of accurately predicting *a-priori* the energy savings each user will experience. This is in contrast, for example, to a project that installs CFLs in a thousand homes, where the peak watts and annual energy consumption can be easily estimated

B. Other Objective Measures for Evaluating Program Progress:

An Information Project like this will have many different kinds of payoffs, most of which cannot be quantified in immediate terms of energy saved. For example, we believe that even if people who attend our workshops never actually run HEED again, they will still retain a better understanding of how energy is used in their home, and will use this knowledge in making future home repair and remodeling decisions. This kind of success is hard to quantify in Evaluation, Measurement, and Verification terms.

There are some measures of success that can be quantified:

- We will be able to quantify the readership of print media in which we have been able to place articles describing HEED.
- We can easily count the participants in the workshops we give.
- We can automatically count the number of copies of HEED that are downloaded.
- We know the email address of every download, so we will send our email survey to everyone on that list, soliciting the extent to which it has helped them improve the energy efficiency of their home.
- With this data we will should be able project the electricity and gas savings. We anticipate that the present value of those savings will greatly exceed cost of this project.

At the completion of this project our EM&V consultant might be able to document how much energy customers think they have saved by implementing changes in their dwelling that they analyzed using HEED. The Internet surveys of people who downloaded our software might identify ratepayers willing to give us more detailed quantitative data of their experience, however this awaits the final EM&V consultant's approach which will be developed after this project is launched.

But there are many other non-quantitative benefits of using HEED to improve your home's performance. For example, if Ms/Mr Ratepayer invest their own funds to make permanent changes to their home that will save the \$50 every month on their utility bills, they should be

impressive. However, they also need to be told that their house will be more comfortable and less drafty. They also need to be reminded that their home's value will increase.

VI. PROGRAM EVALUATION, MEASUREMENT, AND VERIFICATION (EM&V)

A. Proposed Program Evaluation Approach:

Because this is an Information-only program, it is required to have only an Evaluation plan. This plan is to be developed by the eventual EM&V consultant. The main thrust of this effort is to find ways to measure how well ratepayers are using this software and to verify that they actually make cost effective changes in their homes based on what they learned from HEED. We anticipate that this plan, once it is developed, will meet the following objectives:

- Providing up-front market assessments and baseline analysis: It would be useful to try to estimate the initial market conditions at the time this project is funded. We already know a few landmarks such as the fact that about \$15 billion is spent annually on residential remodeling and repairs in California. We will also be able to identify the percent of households in each service territory that have internet access. We know that already over 2600 people have downloaded copies of HEED, making it one of the most popular energy design tools in the nation.
- Providing ongoing feedback and corrective and constructive guidance: This function can easily be provided by our EM&V consultant based on user surveys completed by people who attend the workshops included in this project. Another way we receive ongoing feedback is from the type of questions that appear on the email hotline. If anything is going wrong this is where we should find out about it almost immediately.
- Measuring indicators of the effectiveness of specific programs, including testing of the assumptions that underlie the program theory and approach: As part of the development of this new version of HEED, we will again conduct a software validation study based on ANSI/ASHRAE Standard 140, Standard Method of Test and Evaluation of Building Energy Analysis Computer Programs.
- Assessing the overall level of Performance and success of the program: This is the kind of evaluation that we anticipate the EM&V consultant will derive from our final internet survey of ratepayers who downloaded copies of HEED. This instrument is not yet designed, but based on our experience with a similar internet-based survey of users of the prior version of HEED, gathering this type of information should not be difficult..
- Informing decision regarding compensation and final payments: Should this prove to become an issue, the EM&V consultant will undoubtedly be able to make a valuable contribution to its resolution.
- Helping to assess whether there is a continuing need for the program: In our prior internet-based user survey we received overwhelming support for the value of HEED. This may not be a major issue because the cost of continuing to offer HEED is relatively small, compared to the cost of its development.

B. Potential EM&V Contractors:

In our prior CPUC Funded project to develop HEED for the SCE service territory, we used as the EM&V consultant Professor Robin Liggett, PhD, of UCLA's School of Public Policy. She is a specialist in data analysis and internet surveys. She developed an excellent test instrument and used it to conduct the internet survey. Then she collected the results and analyzed the data, producing an extremely valuable report. The results of her EM&V efforts are summarized on the HEED web site.

For a second potential EM&V contractor we have no particular preference or personal experience. Therefore, based on the firm's reputation alone, would list Donald Dohrmann, PhD, of ADM Associates. They have been involved in a great deal of energy consulting work in California and are experienced in the requirements of EM&V project design.

C. Funding for EM&V Work:

We have budgeted \$20,000 which is five times higher than the cost of our prior EM&V consulting effort. Therefore while the requirements are a bit more complex, we feel this amount should be adequate.

VII. IMPLEMENTER'S QUALIFICATIONS

A. Primary Implementer:

Murray Milne, the manager of this current project was also the manager of the prior two CPUC funded components of this proposal in which modules were developed for SCG (completed in 1999) and for SCE (completed in 2002). Altogether at UCLA since 1972 he has managed over \$1,037,000 in research, totaling 48 different projects.

Murray Milne has been developing user-friendly energy design tools for over twenty five years. All his software, which has won numerous awards, is available cost free from his web site. It is being used in more than half the schools of architecture and by architects and homeowners around the world. Over 4,000 copies of Climate Consultant have been downloaded and over 10,000 copies of Solar-5 were downloaded although it has now been superseded by HEED. To date 2,638 different users have downloaded copies of HEED, Home Energy Efficient Design, making it the third most popular residential whole-building energy analysis tool¹². His design tools are widely regarded for their innovative graphics, their sophisticated algorithms, and their ease of use. He has also presented dozens of workshops for professionals who are using his software.

He is a Registered Architect in the State of California, and specializes in Energy Efficient and Climate Responsive designs. One of the condominium projects he designed in Malibu received design awards in the AIA Sunset Magazine Competition and from Architectural Record Magazine, and has been published in architectural magazines here and in Japan. This building was selected by the Department of Energy as one of the most energy conserving multi-family housing projects in the nation. He has designed projects in the full range of U.S. climates, including residential projects designed for Key Largo Florida (hot-humid), Tehachapi California (hot-arid), Mammoth California (cold), and Los Angeles (temperate). He was a consultant on the Ronald Reagan State Office Building in downtown Los Angeles, responsible for energy and daylighting. He received a Progressive Architecture Awards Citation in 1983 as a member of the team that developed the project entitled "Teaching Passive Design in Architecture". In 1987 he received another P/A Citation for his research work on the "SOLAR-5 Passive Solar Design Tool". This software was named one of the Nations Ten Most Innovative Energy Developments by the U.S. Department of Energy. It also received a Special Commendation from the California Energy Commission. All this software is available at no cost from www.aud.ucla.edu/energy-design-tools.

He served as Associate Dean of the School of Architecture and Urban Planning from 1971 to 1975. He was selected as a Guggenheim Fellow in 1981. In 2001 he was named as Passive Solar Pioneer by the American Solar Energy Society for his work on user-friendly energy design tools.

B. Qualifications of Subcontractors:

We are proposing to use two Subcontractors. One subcontract for EM&V we propose to let to Robin Liggett, PhD., who performed this service on our prior CPUC funded HEED contract. The second subcontract for Software Technical Support , Screen Graphics, and Web Maintenance we propose to let to CTG Energetics, the firm with who we were associated on our prior CPUC funded HEED contract. Thus both have experience in managing programs similar to the one proposed here.

Robin Liggett, PhD., specializes in Quantitative Methods and Operations Research. She has conducted numerous user surveys and has pioneered the development of internet-based survey instruments She is a Professor with joint appointment in the School of Public Policy and in the Department of Architecture and Urban Design at UCLA. She teaches courses in Statistics and in Quantitative Methods. Her research emphasizes the development of computerized tools for facilities management.. She holds a B.A. degree in Mathematics from Pomona College, and M.S. and PhD. in Operations Research from UCLA.

CTG Energetics, Inc. is an affiliate of Constructive Technologies Group which performs energy consulting and sustainable design services for design teams, building owners, property managers, contractors, and utilities. CTG's founder and president, Dr. Malcolm Lewis, has been a leader in the design and development of energy-efficient buildings for over twenty years. He heads a team of experts who bring experience and technical knowledge to the problem of introducing leading edge concepts into "real world" designs. Based on our experience working with CTG in the prior HEED project, we know that on his staff are experts with the specialized knowledge we need for graphics programming and web site maintenance.

C. Resumes and Description of Relevant Experience:

The Primary Program Manager is Murray Milne:

Professor Milne serves as a consultant for architectural firms and governmental agencies on all aspects of energy conserving design. He has published over 150 technical papers. His architectural designs have won numerous awards and been published in books and magazines here and abroad. He has taught graduate courses on various aspects of energy responsive design for the past thirty five years. He served as Associate Dean of the UCLA School of Architecture and Urban Planning from 1971 to 1975. He was selected as a Guggenheim Fellow in 1981. He was named Solar Pioneer in 2001 by the American Solar Energy Association .

Awards and Honors

AIA/Sunset Magazine Western Homes Awards Competition, Merit Award for Malibu Project, 1977-78.

Architectural Record Magazine, Malibu Project Selected as One of Six Apartments of the Year, 1978.

Guggenheim Fellow, 1980-81, "Energy and Architectural Aesthetics".

Oakland Museum, "Solar Age Architecture," Malibu Condominiums selected as One of Six Best Solar Buildings in California, exhibition at March 10 to June 28, 1981.

Progressive Architecture Award Citation, 30th Annual P/A Awards Program, 1983, for "Teaching Passive Solar Design in Architecture", a Research Project conducted by a team of Eleven Universities.

Progressive Architecture Award Citation, 34th Annual P/A Awards Program, 1987, for "SOLAR-5, A Micro-Computer Design Tool".

California Energy Commission, Special Commendation for Development of SOLAR-5, selected as one of the two most significant energy innovations in California in 1987.

U.S. Department of Energy, SOLAR-5 selected as one of the nine National Energy Innovation Awards, presented by Secretary of Energy, John Harrington, October 20, 1987.

U.S. Department of Energy Daylighting Experts Team, appointed December 1991.

Design for Excellence Competition, Invited to Serve on Design Jury, 1992.

Leading Edge Design Competition, Professional Division, Certificate of Commendation, "Integration of Energy-Responsive Design", 1992, awarded for the Coastline Drive Condominiums, 1992.

AIA Design Awards, Valley Chapter, Invited to Serve on Design Jury, 1993.

Department of Energy Experts Group on Energy Design Tools, Invited participant, Washington, D.C., June 1993.

AIA Design Awards, Santa Barbara Chapter, Invited to serve on Design Jury, 1994.

Leading Edge Design Competition, Student Division, Faculty Advisor for First Place winning projects in 1992 (Burhan Tjakra), 1993 (Adham Refaat), 1994 (Will Shephird), 1995 (Vikas Shrestha), 1997, (Anupama Kohli), and in 1999 Highest Award Co-Winners (Pablo LaRoche, Andrew Obermeyer, Rodrigo Rivero, Katharina Schendl)

Named Passive Solar Pioneer by the American Solar Energy Association, 2002

Professional Registration

State of California, Architect, C 10305

Education:

University of Michigan, B.S. Mechanical Engineering, 1959

University of Michigan, M.S. Industrial Engineering, 1961

University of California, Berkeley, M.Arch., 1965

Consultancies:

American Institute of Architects (Energy and Design Education Programs)

Albert C. Martin & Associates, Architects (Computer Applications)

Malcolm Lewis & Associates, Engineers (Climatological Site Analysis for

Warner Center Office Towers)
Welton Becket & Associates, Architects (Energy Analysis and Daylighting Experimental Studies for the Ronald Reagan State Office Building, Downtown Los Angeles)
John Wiley and Sons, Publisher (Technical Review)
Wiley Professional Software (Software Evaluation)
University of Southern California (Development of Daylighting Design Tool Software)
California Polytechnic University in Pomona (Evaluation of Computer Aided Design Curriculum)
Miralles Associates, Architects, (Evaluation of Daylighting and Energy Performance for the Department of Water and Power Facility)
Van Nostrand Reinhold (Technical Book Proposal Evaluations)
Power-DOE project, EPRI (Computer Interface Design Review)
AJL Lumsden Associates (Energy Design Performance Simulation for the Korea Energy Center Building)
Fields Devereaux Architects and Engineers (Energy Design Performance for the Oak Park Library and the Lakeview Terrace Library)
CTG Energetics (Skylight Studies for the Monterey Bay Aquarium Addition)
Greenworks (Skylight Model Testing and Daylight Analysis for Atrium in a Three Story Office Building)

Selected Bibliography:

"Can the Internet Help Create Energy Efficient Housing on a Global Scale", with Carlos Gomez, Donald Leeper, Yoshihiro Kobayashi, Proceedings of PLEA 2000, the Passive and Low Energy Architecture Association, Cambridge, England, July 2000

"Teaching Issues, Tools, and Methodologies for Sustainability", Proceedings of TIA 2000, The Conference on Technical Instruction in Architecture, Oxford, England, July 10-12, 2000

"A Drag-and-Drop Energy Design Tool", with Carlos Gomez, Don Leeper, Yoshihiro Kobayashi, Jennifer Zurich, Deborah Weintraub, Hernando Miranda, Proceedings of the American Solar Energy Society, April, 2001

"Designing High Performance Buildings Using HEED and SOLAR-5 Workshop", presented for the City of Los Angeles Architectural Division, Sustainable Design Implementation Program, June 8, 2001

"Strategies to Visualize the Cooling Performance of Buildings", with Carlos Gomez, Donald Leeper, and Yoshihiro Kobayashi, Cooling Frontiers, the Advanced edge of Cooling Research and Applications in the Build Environment, College of Architecture and Environmental Design, Arizona State University, October, 2001

"HEED, Home energy Efficient Design", with Carlos Gomez, Don Leeper, Yoshihiro Kobayashi, Jennifer Zurick, Deborah Weintraub, Hernando Mmiranda, Proceedings of PLEA

2001, the Passive and Low Energy Architecture Association, Florianopolis, Brazil,
November 2001

“A Climate Responsive School in Southern California”, with Pablo La Roche, Andrew Obermeyer, Rodrigo Rivero, Katharina Schendl, and Alan Locke, Proceedings of PLEA 2001, the Passive and Low Energy Architecture Association, Florianopolis, Brazil, November 2001

“Visualizing Building Energy Performance” and “Designing Your Own High-Performance Building”, presented at the Municipal Green Building Conference and Expo, March 19, 2002, Sponsored by the U.S. Green Building Council and Southern California Gas Company.

“Designing High Performance Buildings with HEED”, Workshop presented at ED6, EnviroDesign 6, April 4, 2002, Seattle, Washington

“Climates of Southern California”, presented for the Los Angeles Committee on the Environment, May 16, 2002 (special tool created: www.aud.ucla.edu/energy-design-tools: Climate Consultant-SC).

“HEED Succeeds Solar-5”, (describing experience using HEED), by Bruce Haglund, University of Idaho, Home Energy , May/June, 2002

“Using HEED to Design Energy Efficient Affordable Housing”, with Carlos Gomez, Don Leeper, Yoshi Kobayashi, Tim Kohut, and Paki Muthig, Proceedings of ASES 2002, June 18, Reno, Nevada

“Designing High-Performance Buildings”, Computer-based Workshop presented at the Second Annual Municipal Green Building Conference and Expo, April 2, 2003, Sponsored by the U.S. Green Building Council and Southern California Gas Company.

“Heeding the Needs of Home Improvement Decision-Makers”, with Carlos Gomez, Don Leeper, and Pablo LaRoche, Proceedings of the American Solar Energy Society 2003, June 2003, Austin, Texas

“Effects of Window Size and Mass on Thermal Comfort Using an Intelligent Ventilation Controller”, with Pablo LaRoche, Proceedings of the American Solar Energy Society 2003, June 2003, Austin, Texas

“Sizing Skylights for Daylighting Landscaping in an Atrium”, with James Weiner, Proceedings of the American Solar Energy Society 2003, June 2003, Austin, Texas

VIII. BUDGET

HEED, HOME ENERGY EFFICIENT DESIGN:

This is a Statewide Information-only Program

	Total Project Year 1 and 2	PG&E Portion Year 1 and 2	SDG&E Portion Year 1 and 2
BUDGET SUMMARY			
Administrative Costs			
Managerial and Clerical Labor (included in Overhead)			
Human Resources Support			
Faculty Benefits: 12.7%	\$ 7,620	\$ 5,791	\$ 1,829
Staff Benefits: 4.4%	\$ 3,168	\$ 2,408	\$ 760
Graduate Student Benefits: 3.0%		\$ 120	\$ 38
Travel and Conference Fees			
Workshop Travel (6 workshops, 2 people)	\$ 3,600	\$ 2,736	\$ 864
Workshop Lodging (6 workshops, 2 people)	\$ 1,440	\$ 1,094	\$ 346
Workshop Per Diem (6 days, 2 people)	\$ 516	\$ 392	\$ 124
Overhead:			
Computer Equipment Maintenance	\$ 4,800	\$ 3,648	\$ 1,152
Office Supplies, Xerox, etc	\$ 2,400	\$ 1,824	\$ 576
UCLA Overhead (53.5% of Direct Expenses*)	\$ 136,627	\$ 103,837	\$ 32,791
Marketing/Advertising/Outreach			
Labor: Validation Workshops			
Workshop Leader (\$50/hour, 6 days)	\$ 2,400	\$ 1,824	\$ 576
Workshop Co-Leader (\$50/hour, 6 days)	\$ 2,400	\$ 1,824	\$ 576
Staff Research Associate (\$32/hour, 15% time)	\$ 19,200	\$ 14,592	\$ 4,608
Web Development and Hosting	\$ 9,600	\$ 7,296	\$ 2,304
Direct Implementation			
Labor: Software Development			
Project Leader, Murray Milne (\$50/hour, 30% time)	\$ 60,000	\$ 45,600	\$ 14,400
Programmer Analyst III (\$50/hour, 20% time)	\$ 40,000	\$ 30,400	\$ 9,600
Spanish Translator (\$32/hour, 10% time year 2)	\$ 12,800	\$ 9,728	\$ 3,072
Graduate Student Researcher (18.32/hour, 10% time)	\$ 5,276	\$ 4,010	\$ 1,266
Labor: Subcontracted Software Technical Support			
Systems Development (\$75/hour, 20% time)	\$ 60,000	\$ 45,600	\$ 14,400
Evaluation, Measurement, and Verification			
EM&V Subcontractor Labor	\$ 20,000	\$ 15,200	\$ 4,800
Other			
None			
Two-Year Direct Expenses	\$ 255,378	\$ 194,088	\$ 61,291
Two-Year Overhead (see above line item)	\$ 136,627	\$ 103,837	\$ 32,791
Two-Year Total Project Cost	\$ 392,006	\$ 297,924	\$ 94,081

* UCLA Overhead is projected to rise to 54.5% on 7/05, but this will not increase the Total Cost of this project.

END NOTES:

¹ Appendix 2: Disk-based Energy Calculators, “Review and Comparison of Web- and Disk Based Tools for Residential Energy Analysis”, Evan Mills, Lawrence Berkeley Laboratory, LBNL-50950, September, 2002

² “HEED, Home Energy Efficient Design User Survey”, Robin S. Liggett, PhD., UCLA, March 2002

³ Construction Industry Research Board, California Building Permit Summary, Table 1-A: Residential Building Permits, State of California, showed that \$3,744,237,000 in permits were issued in 2001 for Residential Alterations and Additions.

⁴ The growth in the Home Improvement Industry has been fueled by the Baby Boomers, who have been a major factor in the rise of home center outlets: Home Improvement Research Institute (HIRI), www.hiri.org

⁵ “Barriers in Developing and Using Simulation-Based Decision Support Software”, Papamichael, K., et.al, Proceedings of the ACEEE 2002 Summer Study on Energy Efficiency in Buildings, Asilomar

⁶ HEED produces valid heating and cooling results for 28 different test buildings using ASHRAE’s “Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs”, (ANSI/ASHRAE Standard 140-2001) Grace Tsai, et.al. (see report on HEED web site)

⁷ “Review and Comparison of Web- and Disk Based Tools for Residential Energy Analysis”, Evan Mills, Lawrence Berkeley Laboratory, LBNL-50950, September, 2002

⁸ AB970 Low-Rise Residential Alternative Calculation Method (ACM) Approval Manual, California Energy Commission, P400-01-004 and P400-01-012

⁹ Interim Opinion Soliciting 2004-2005 Energy Efficiency Program Proposals and Addressing Scope of Proceedings, Decision 03-08-067, Filed August 23, 2003, Page 3 of Attachment 1 shows that Public Goods Charge (PGC) Collections for PG&E are \$240,956,000 and for SDG&E are \$75,000,000, for a ratio of .76 to .24.

¹⁰ Construction Industry Research Board, California Building Permit Summary, Table 1-A: Residential Building Permits, State of California, By County, Calendar Year 2001

¹¹ Home Improvement Research Institute (HIRI), www.hiri.org

¹² Appendix 2: Disk-based Energy Calculators, “Review and Comparison of Web- and Disk Based Tools for Residential Energy Analysis”, Evan Mills, Lawrence Berkeley Laboratory, LBNL-50950, September, 2002