BREN SCHOOL OF
ENVIRONMENTAL SCIENCE & MANAGEMENT
UNIVERSITY OF CALIFORNIA, SANTA BARBARA

EnergyRubix:
Streamlining Residential Energy Efficiency

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EnergyRubix: Streamlining Residential Energy Efficiency

As authors of this Group Project report, we are proud to archive this report on the Bren School's website such that the results of our research are available for all to read. Our signatures on the document signify our joint responsibility to fulfill the archiving standards set by the Bren School of Environmental Science & Management.

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The mission of the Bren School of Environmental Science & Management is to produce professionals with unrivaled training in environmental science and management who will devote their unique skills to the diagnosis, assessment, mitigation, prevention, and remedy of the environmental problems of today and the future. A guiding principal of the School is that the analysis of environmental problems requires quantitative training in more than one discipline and an awareness of the physical, biological, social, political, and economic consequences that arise from scientific or technological decisions.

The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) Program. It is a three-quarter activity in which small groups of students conduct focused, inter-disciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Final Group Project Report is authored by MESM students and has been reviewed and approved by:

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LIST OF ACRONYMS

AB 32	Global Warming Solutions Act
AB 811	Assembly Bill 811
ACES	The American Clean energy & Security Act
AIA	American Institute of Architects
ARRA	American Recovery and Reinvestment Act
BPI	Building Performance Institute
CAS	Climate Action Strategy
CBPCA	California Building Performance Contractors Association
CDD	Cooling Degree Days
CEC	California Energy Commission
CFL	Compact Fluorescent Light
CHEERS	California Home Energy Efficiency Rating Services
CHEP	Comprehensive Home Energy Performance
CHPP	Comprehensive Home Performance Program
CHP	Comprehensive Home Performance
CPUC	California Public Utilities' Commission
CLEESP	California Long Term Energy Efficiency Strategic Plan
EEM	Energy efficient mortgage
EIEA	Energy Improvement and Extension Act of 2008
GHG	Greenhouse Gas
HAR	Home Assessment Report
HDD	Heating Degree Days
HPA	Home Performance Assessment
HUP	Home Upgrade Plan
HERS	Home Energy Rating Services
HR 2454	The American Clean Energy & Security Act (ACES)
HVAC	Heating, Ventilation, and Air Conditioning
LED	Light-emitting Diode
MBP	Master Bid Proposal
PACE	Property assessed clean energy
PEST	Political, Economical, Social, Technical Analysis
QA/QC	Quality Assurance, Quality Control
RESNET	Residential Energy Services Network
ROI	Return on Investment
S. 1733	Clean Energy Jobs & American Power Act
SB CEC	Community Environmental Council (Santa Barbara)
SBCA	Santa Barbara Contractors' Association
SCE	Southern California Edison
SoCalGas	Southern California Gas Company
SWOT	Strengths Weaknesses, Opportunities, Threats Analysis
UCSB	University of California, Santa Barbara
U.S. EPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

EnergyRubix is a home performance solutions company that provides a streamlined service to assist homeowners with the energy efficiency retrofit process and delivers qualified leads to certified contractors. Our business model is designed to seamlessly connect homeowners to appropriate renovation contractors, providing the residential sector with an accessible, efficient, and simplified approach to completing energy efficiency retrofits.

The building sector is responsible for approximately one-third of California's energy consumption and greenhouse gas emissions, of which more than half originate from residential buildings. The majority of California's existing housing stock is inefficient, resulting in excess energy use, uncomfortable rooms, and high utility bills.

Historically low energy prices, high upfront costs, inadequate financial incentives, overlooked benefits of home performance (e.g. increased home comfort, improved air quality), and uncertainty of future energy savings and return on investment, have prevented many homeowners from pursing energy efficiency retrofits.

California has led the country in energy efficiency and climate change legislation. Assembly Bill 32, the Global Warming Solutions Act, calls for 15% reduction in statewide greenhouse gas emissions by 2020. The California Energy Commission estimates that in order to achieve this goal, nine million homes in California, or nearly 75% of the State's existing housing stock, will need to be retrofitted for improved energy efficiency.[1]

Recently, there has been a wave of policies and incentives both from California and the federal government to reduce capital and upfront costs. California's Assembly Bill 811 allows jurisdictions to provide low interest loans to homeowners for the completion of energy efficiency retrofits and renewable energy projects that will be paid back through the home's property tax. The federally proposed Home Star program will cover up to half of project costs, depending on the amount of verified energy savings achieved.

Although reduced monetary costs will partially drive demand for energy efficiency retrofit services, the energy retrofit process remains complicated and time consuming. Homeowners are unaided in undergoing an energy assessment, interpreting results, selecting contractors to complete the work, and applying for incentives and other financing mechanisms. Knowledge gaps and communication barriers between homeowners and contractors often lead to overwhelming stress and frustration. Homeowners need a manageable approach to maximize the energy performance of their home.

BUSINESS MODEL

EnergyRubix provides a service that streamlines the energy efficiency retrofit process for homeowners, taking care of the entire process from beginning to end. EnergyRubix serves as an energy consultant to homeowners and as a broker between homeowners and home performance contractors. By addressing the complexity of the energy efficiency retrofit process internally, EnergyRubix offers simplicity through its three-step service for homeowners while providing job opportunities for contractors.

[1] Santa Barbara County (2009 November 2). Santa Barbara County Municipal Energy Financing District Feasibility Study.

EnergyRubix has developed a Home Performance Assessment (HPA) protocol to diagnose a home's energy use and recommends cost-effective solutions based on proven building science and energy-modeling simulators such as EnergyPro v5. Homeowners will receive a comprehensive Home Assessment Report (HAR) following the HPA with outlined findings of test results and recommendations for improvements.

An EnergyRubix contractor will compose a Master Bid Proposal (MBP) according to the scope of work outlined in the HAR. The MBP includes photographs, measurements, descriptions of problem areas, energy saving opportunities, and recommended strategies for retrofitting. The MBP will be accessible to member contractors on the EnergyRubix web portal, EnergyRubix Online. Fully-insured license B general contractors can become online members to log in and make bids using the MBP as a template.

The online bidding process eliminates the need for multiple contractors to be onsite for inspection, and no longer leaves homeowners to interpret multiple quotes on their own. At the same time EnergyRubix Online reduces the amount of time and money member contractors would otherwise have spent on soliciting job opportunities. EnergyRubix can use the MBP to easily compare bids on the basis of work scope, cost estimates, and thoroughness to select the optimal contractor for each project.

Upon contractor selection, EnergyRubix will create a Home Upgrade Plan (HUP) which lays out the scope of work, estimated energy and GHG emissions savings of the improvements, retrofit costs, and relevant rebates, incentives, and tax credits. At this stage, contractors and homeowners are placed in contact, and liability is transferred to the contractor who then performs the retrofit work.

PRODUCT DEVELOPMENT

EnergyRubix has completed three pilot projects within California, in Contra Costa, Los Angeles, and Santa Barbara Counties, to develop consistent methodologies, report templates, and to refine the overall service concept. These projects were critical in gaining expertise about the energy assessment and retrofit process, particularly the complexities involved in comparing contractor bids and completing energy efficiency retrofits.

The EnergyRubix team has been working with a home in Contra Costa County since the summer of 2009. The Contra Costa pilot project began with a thorough Building Performance Institute (BPI) certified assessment. The development team prepared a HAR for the homeowners, placed them in contact with two contractors, and helped them compare bids. The homeowners selected a contractor and EnergyRubix is monitoring the progress of the retrofit work, to be completed in April 2010.

OPERATIONS

EnergyRubix will establish its first office in Santa Barbara County and plans to expand throughout central and southern California. A conservative market analysis indicates at least 18 percent of the housing stock in Santa Barbara County fits into our target market, based on building size, building age, housing type, and household income.

Accordingly, EnergyRubix will initiate targeted marketing strategies involving direct mailings, participation at local events, and strategic partnerships to direct potential customers to EnergyRubix Online, which serves as both a promotional hub and an integral part of our service. A successful

marketing strategy will enable a rapid expansion model that aims to position EnergyRubix as a leader among home performance providers.

EnergyRubix's growth relies on a nexus and node expansion model that limits managerial costs to the nexus office, allowing each node to focus resources on maximizing sales and revenue. Nodes will have relatively small start up costs as they focus on simply delivering the EnergyRubix service, requiring skeleton support staffs and small office spaces. By the fifth year of operations EnergyRubix will have nodes throughout Los Angeles, Riverside, San Bernardino, Orange, and San Diego Counties. Node density and location will be dependent on the market potential of each geographic location.

The level of our success depends on the ability of our marketing strategy to generate enough leads to exceed the cost of our operations. Ideally, each node will complete 500 assessments per year and 250 home upgrade plans. With nine offices operating at this capacity EnergyRubix has the potential to generate substantial revenue with low overhead costs and minimal liability. This translates to an impressive internal rate of return for investors, and significant statewide energy reductions in the process.

ABSTRACT

EnergyRubix is a home performance solutions company that streamlines the energy efficiency improvement process for homeowners and contractors. Our innovative approach will reduce barriers that currently prevent homeowners from completing home retrofits, while providing qualified leads for contractors through our online bidding service, EnergyRubix Online. EnergyRubix serves as a consultant to homeowners, identifying home energy problem areas and finding solutions that cost effectively reduce energy use. EnergyRubix then acts as broker between homeowners and contractors, using EnergyRubix Online to select contractor proposals that best meet the homeowners' expectations. This combined service reduces overall transaction costs and the time and money spent by both homeowners and contractors, allowing home energy upgrades to become a sensible solution for hundreds of thousands of homes across California. We have designed our expansion model accordingly, with a highly scalable model that allows us to rapidly expand throughout California, thus achieving a significant reduction in statewide energy consumption and greenhouse gas emissions.

Business Plan

I. BUSINESS PLAN

1.0 BUSINESS MODEL

EnergyRubix serves as an energy consultant to homeowners and as a broker between homeowners and contractors, absorbing the complexity of the home retrofit process for both parties. The business model flow chart (**Figure 1**) is a snapshot of how our business functions to streamline the home performance upgrade process for homeowners and contractors. The boxes on the left represent the services we offer homeowners, the boxes on the right represent the services we offer contractors, and the boxes in the middle are internal steps necessary to link the two parties together. At the end of this process the homeowner engages the contractor and the retrofit work can be completed.

We greatly simplify the process for homeowners, providing them with the added values of reduced transaction costs and maximized energy savings. Contractors benefit from our service because we reduce their marketing costs, present them with ready-to-bid jobs, and reduce time associated with visiting homes to place initial bids.

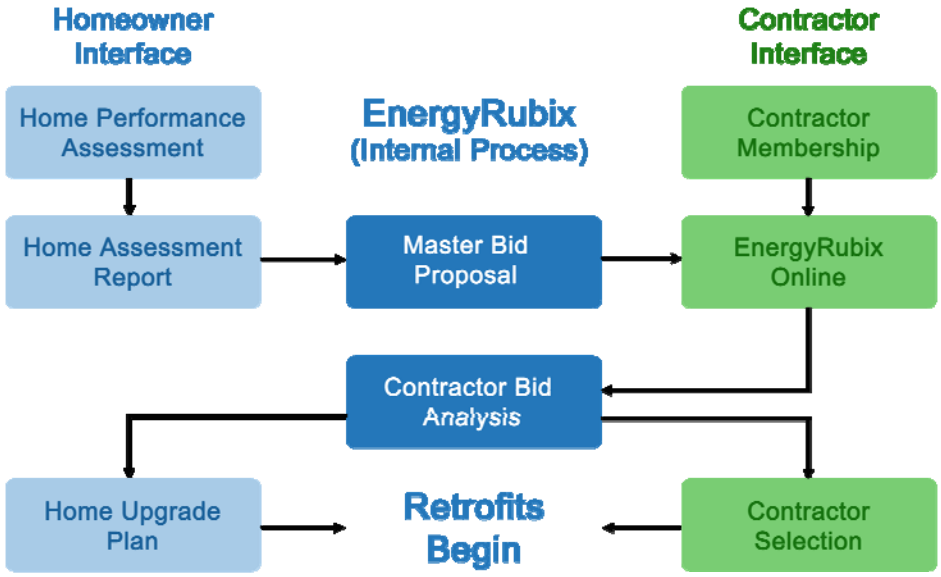


Figure 1: The homeowner interface indicates deliverables to homeowners. The contractor interface illustrates the contractor bidding and selection process. The internal processes indicate steps that link the two interfaces but that are internal to our business.

1.1 THE ENERGYRUBIX SERVICE

EnergyRubix will manage retrofit projects from beginning to end, by identifying energy issues in the home, recommending improvements, finding the appropriate contractor to complete the work, providing financial guidance, and filing applications for incentives and rebates.

In Part I of our service we perform a Home Performance Assessment (HPA) and generate a comprehensive Home Assessment Report (HAR). In Part II of our service we select a contractor (for the homeowner) through our online bidding process on the EnergyRubix web portal, EnergyRubix Online. Part III of our service has two components: (a) the generation of a Home Upgrade Plan (HUP), which includes estimated energy and GHG savings resulting from the work to be done and (b) detailed financial guidance outlining available rebates and incentives and associated savings and payback times. EnergyRubix concludes its service by filing all rebate and incentive applications for the homeowner.

Part I: Home Performance Assessment and Home Assessment Report
EnergyRubix will conduct a comprehensive Home Performance Assessment identifying problem areas of the home and potential improvements, while focusing on energy efficiency and comfort issues (e.g. thermal comfort, air quality). An EnergyRubix assessor, certified in the Home Energy Rating System (HERS) and knowledgeable of Building Performance Institute (BPI) methodology[2], will conduct the HPA, examining the building envelope, insulation (thermal envelope), lighting and appliances, and the heating, cooling, ventilation, and air conditioning (HVAC) distribution systems.

The information collected during the Assessment will be used to produce a comprehensive Home Assessment Report (HAR). The HAR will outline the findings of the HPA and will provide recommendations for improvements, as well as estimated energy and cost savings that would result from completing retrofits. This information will be presented in an easy-to-read Assessment Summary Table at the beginning of the report (**Figure 2**).

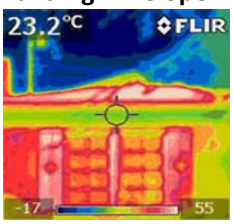
The EnergyRubix assessor will present the homeowner with the HAR and discuss the potential utility bill savings and GHG emissions reduction. Homeowners will recognize the value of continuing with our service in Part II (contractor selection) when they decide to go forward with the project and realize the difficulty of comparing contractor bids and selecting a contractor.

[2] The Home Energy Rating Services, HERS, is a tool to diagnose problem areas in a home and to ensure 2005 Title 24 energy efficiency requirements compliance. The Building Performance Institute, or BPI, rating is not as diagnostic as the HERS assessment but includes additional measures such as air quality, combustion, and health and safety. Together, the two systems give homeowners a thorough and comprehensive home report. See the Supporting Research section for additional information comparing the two systems.

EnergyRubix
Home Energy Solutions

ASSESSMENT SUMMARY

Building Envelope



Findings:	French doors are single-pane and leaky
Recommendations:	Add weather-stripping
Estimated Cost:	$125
Estimated Savings (per year):	$55
Payback Period	3 years

Insulation

Findings:	Roof insulation is insufficient and improperly installed
Recommendations:	Add or replace with new R-30 insulation
Estimated Cost:	$1,500
Estimated Savings (per year):	$225
Payback Period	6.5 years

HVAC

Findings:	Lower story ducts are insufficient
Recommendations:	Duct system needs to be sealed and rebalanced
Estimated Cost:	$2,000
Estimated Savings (per year):	$160
Payback Period	12.5 years

Lighting & Appliances

Findings:	Most lighting is incandescent
Recommendations:	Replace with CFL or LED light fixtures
Estimated Cost:	$150
Estimated Savings (per year):	$200
Payback Period	< 1 year

Figure 2: This sample Assessment Summary Table will demonstrate valuable information to homeowners including return on investment, cost of retrofits, potential energy savings estimates, and estimated cost. This table is designed to be simple enough to educate the customer about his or her options.

Part II: Online Bidding and Contractor Selection

Once the homeowner decides to continue with the EnergyRubix service, a BPI certified EnergyRubix contractor will use the information from the HAR to gauge the type of work needed to improve the efficiency of the home. After making a short house visit to assess problem areas and ensure the thoroughness of the HPA, the EnergyRubix contractor will prepare a Master Bid Proposal (MBP), which is designed for contractors to get an understanding of the proposed work in detail. The MBP will include photos, measurements, a floor plan, and descriptions of issues, opportunities, and recommended strategies for improvements identified during the assessment. Specific descriptions of the work to be completed will allow contractors to understand the project scope well enough to estimate a bid.

The MBP will be uploaded to the EnergyRubix web portal, *EnergyRubix Online*, where member contractors can log in and make bids using the MBP as a template. Our online bidding process will eliminate the need for homeowners to make numerous phone calls to find contractors and compare bids. This process will also eliminate the need for various contractors to spend hours at a client's home. After the bidding process is complete, EnergyRubix will evaluate and compare the bids on the basis of work scope, cost estimates, and thoroughness, and will select the optimal contractor for each specific job.

EnergyRubix Online: A Nexus for Homeowners and Contractors

Central to the EnergyRubix service is the interactive website, *EnergyRubix Online*, which contains pages specific to homeowners, contractors, and local partners.[3]

The homeowner pages explain the value of the EnergyRubix service and provide educational resources on energy efficiency, building science, and energy saving practices. An up-to-date news section will contain updates on new policies, incentives, and developments in the field. A testimonials page will provide examples of completed projects will be provided and customer reviews. A homeowner login allows homeowners to access all documents (HAR, HUP, etc) as well as track the energy and GHG emission savings of their home after completing a project.

The contractor page demonstrates the value of working with EnergyRubix through reduced time and monetary costs associated with marketing and generating leads. A contractor membership allows contractors to log onto EnergyRubix Online, create a customized profile, view available projects, and make bids. As members, contractors will receive email notifications as new projects matching their skill set become available, as well a newsletters highlighting project reviews and information on relevant policies and trainings.

[3] The preliminary EnergyRubix website can be viewed at http://fiesta.bren.ucsb.edu/~energyrubix/.

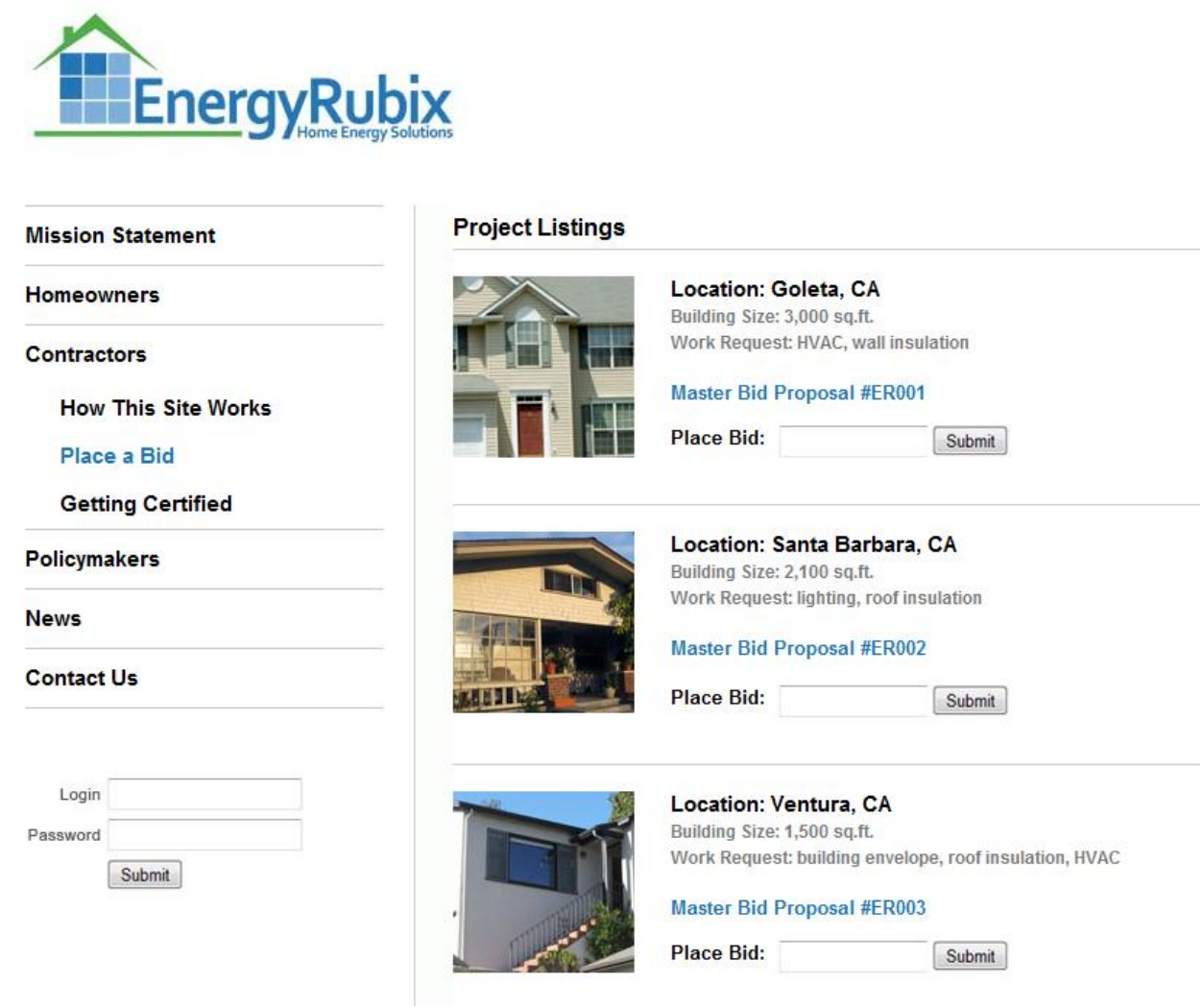


Figure 3: *EnergyRubix Online* shows lists of available projects on the bidding page, each with a customized Master Bid Proposal, which provides contractors with detailed information on the problem areas and recommended retrofits, methodology, floor plan, and photographs.

Part III: Home Upgrade Plan and Financial Analysis

After the contractor is selected, EnergyRubix will use the accepted contractor bid to create a thorough Home Upgrade Plan (HUP) that lays out the work plan, estimated energy and GHG emissions savings of the improvements, and the estimated costs of each retrofit. The HUP will include a detailed financial analysis of all available rebates, incentives, and tax credits to show how the costs of the project will be reduced. EnergyRubix will then file all necessary applications for rebates and incentives to ensure project costs are minimized for the homeowner while further reducing time and stress.

1.2 INTERNAL OPERATIONS

Home Performance Assessment Protocol

One EnergyRubix assessor, who is both HERS certified and trained in BPI home performance techniques, will complete a Home Performance Assessment on each home. Currently, typical assessments take between 6-8 hours for an average sized home. We have observed that these assessments are often done without a strict protocol and can result in redundancy in testing and data collection. To avoid this EnergyRubix has developed a streamlined home assessment protocol.

EnergyRubix will conduct a pre-assessment interview with the homeowner online, to determine unique features of the home and specific areas of concern. This interview will gather valuable customer information to help shorten assesment time.

Assessment costs include certification classes (capital cost), initial equipment purchase (thermal camera, camera, blower door, ductblaster, laser tape measure, smoke gun, furnace combustion testing equipment, etc.) (capital cost), hourly employee wages (variable costs), and travel expenses (variable costs).

Home Assessment Report Generation

The data from the HPA will be entered into EnergyPro 5, an energy modeling program that simulates the current energy performance of the home, a HERS score, and other energy performance indicators. The HERS score ranks the home's energy performance and suggests general recommendations to improve performance.

EnergyRubix staff must decipher which retrofits are needed to address energy issues indentified in the HPA, since even the most powerful modeling software is limited in its ability to replicate the unique details of a home. The BPI methodology is best suited to identify solutions to these problems and we will combine the BPI based approach with the HERS assessment to generate the Home Assessment Report.

Improvements in software capabilities should decrease the lagtime between assessment, data entry, and report generation. Ideally, this entire process would be completed on the same day. Home Assessment Report generation costs include EnergyPro software covering four residential modules (Title 24 compliance, HVAC sizing, GreenPoint Rated, and Performance-non-California Code Analysis) a $100 fee for a HERS rating, and hourly employee salaries.[4]

Master Bid Proposal Generation

A certified home performance contractor will review the Home Assessment Report and use it to guide the 1 to 2 hour performance inspection of the client's home. The purpose of this home inspection is for the experienced contractor to see first-hand the type of work that will be needed to address each of the home's issues.

The contractor will take detailed pictures of problem areas where retrofit work will be performed and ensure that all relevant information has been included. After collecting this information, the contractor will create the Master Bid Proposal. The MBP will include the level of detail needed by member contractors to make confident bids on the project. These details include documentation of the

[4] Energy Soft (2010). EnergyPro 5.0 Update Order Form. Retrieved January 21, 2010 from http://www.energysoft.com/user/EPUpdateCalc.pdf.

inefficiency issues of the home, the recommended measures for improvement, photos of each area of concern, and a floorplan (real or approximate). Once completed, the Master Bid Proposal will be posted to EnergyRubix Online and be available to member contractors.

EnergyRubix Online and the Bidding Process

The EnergyRubix website allows contractors to place bids on existing projects based on the MBP. Contractors will be charged a one-time membership fee.[5] Maintening the EnergyRubix website will require one full time staff member per node to handle onsite marketing, maintenance, and updates.

Contractor Selection

The same EnergyRubix certified home performance contractor who generated the MBP will review the online bids once bidding has closed. The bids will be easily comparable since a template is provided for member contractors to complete. The EnergyRubix contractor, being familiar with the home, will be able to select the optimal contractor based on his work proposal and expenses. This selection process is estimated to take 1 to 2 hours.

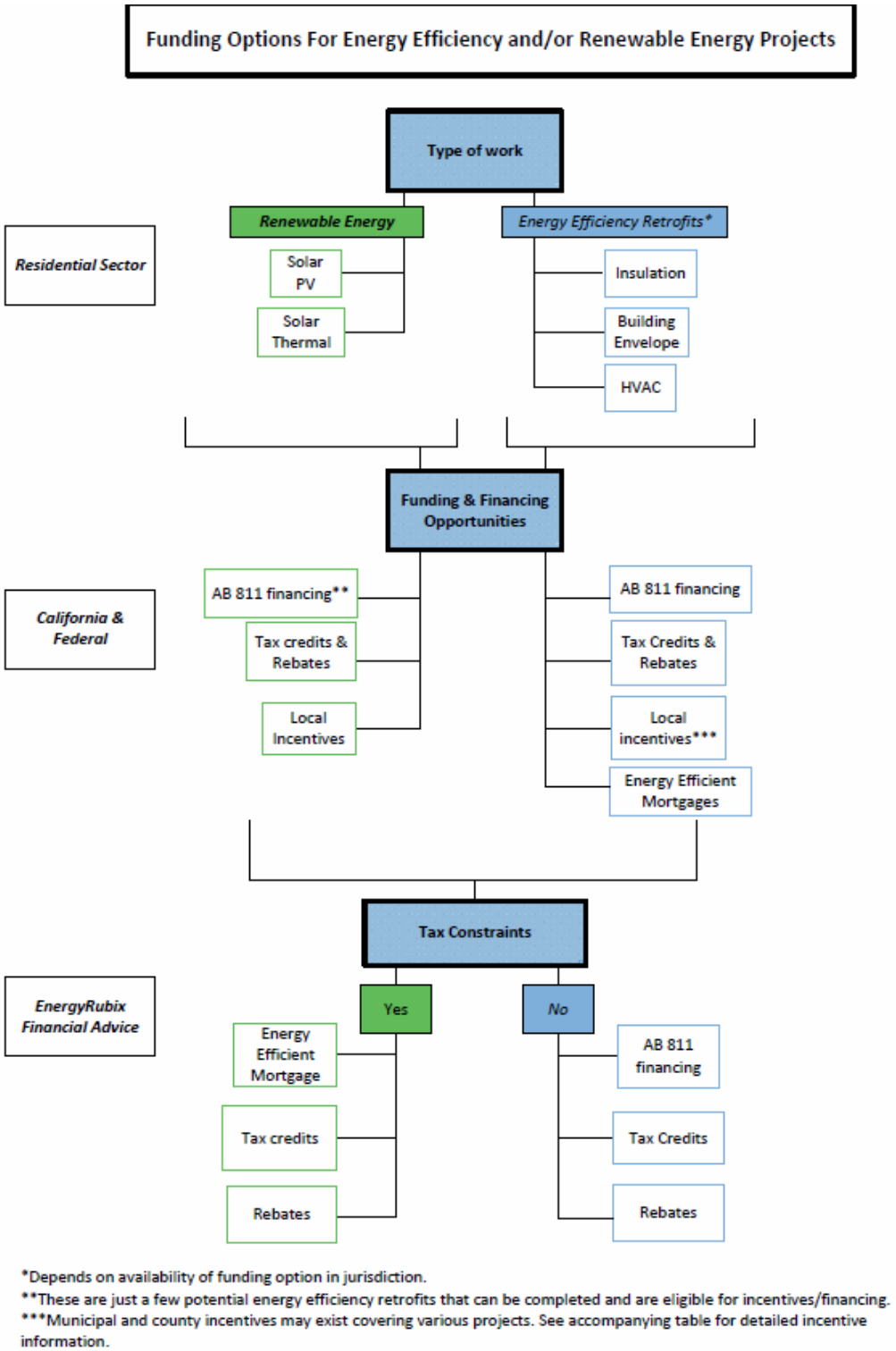
Home Upgrade Plan Generation

An EnergyRubix consultant will generate a Home Upgrade Plan (HUP) that details the proposed improvements, combining information from the HAR and the final contractor bid. The HUP will serve as a roadmap for the homeowner and selected contractor and final project costs will be based on the total available rebates and incentives (**Figure 4**). The HUP will include potential energy and GHG emissions savings. An EnergyRubix policy expert will file rebate and incentive applications for for the homeowner. Internal costs for HUP generation include employee time to determine avilable financing and file applications.

Project Completion

After project completion, homeowners will be encouraged to login onto EnergyRubix Online and upload their utility information. EnergyRubix Online can help homeowners track their energy use and savings overs time. Customers may also provide feedback about the EnergyRubix service and rate contractors on the “testimonials” page. Any liability concerns for issues that arise after projects are completed will be addressed by the hired contractor.

[5] Pricing to be finalized.



*Depends on availability of funding option in jurisdiction.
**These are just a few potential energy efficiency retrofits that can be completed and are eligible for incentives/financing.
***Municipal and county incentives may exist covering various projects. See accompanying table for detailed incentive information.

Figure 4: This flow chart indicates the funding options for renewable and energy efficiency projects. EnergyRubix will provide guidance on available incentives and file applications for customers.

1.3 MARKET ANALYSIS

Company Challenge

California is considered a leader in building energy efficiency for new construction within the United States. However, the majority of the State's existing housing stock is still vastly inefficient, forcing homeowners to pay higher energy bills and compromising the occupants' comfort. Barriers that have prevented most existing homes from achieving high energy efficiency include: historically low energy prices, high upfront costs of retrofits, lack of sufficient financial incentives, insufficient information on building performance, difficulty in finding trained energy assessment technicians, and uncertainty in energy and cost paybacks.

EnergyRubix is focused on creating a streamlined energy efficiency retrofit service for homeowners that will reduce upfront capital costs, time, and effort, all while ensuring that homes are assessed and retrofitted by the best local energy assessors and contractors. We believe this will sufficiently lower the barriers to home energy retrofitting to make it an appealing option for hundreds of thousands of households across Central and Southern California. Our challenge is to connect with both contractors and homeowners and effectively communicate the value we offer to each party.

PEST Analysis: Political, Economic, Social, and Technical Impetus

The political, economic, social, and technical climates surrounding energy efficiency in buildings has rapidly been gaining momentum. EnergyRubix recognizes this paradigm shift and intends to take advantage of all relevant policies, programs, and economic incentives that are currently being offered. It is clear from our PEST analysis that this environment will support the growing demand for a strong energy efficiency industry. EnergyRubix will establish itself as a forerunner in the field, providing targeted tools for homeowners and contractors alike.

Political

The unprecedented American Recovery & Reinvestment Act (ARRA) towards the development of a "green economy" in the United States is evidence that a new wave of environmentalism is upon us, targeting energy use in both the commercial and residential building sectors. The following policies are extremely important in developing and maintaining our business (See the Supporting Research section for detailed information regarding these and other policies):

- **AB 32, The Global Warming Solutions Act**: Signed in 2006, AB 32 establishes a market based and regulatory framework to reduce GHG emissions in the state of California. AB 32 calls for a 15% reduction of statewide GHG emissions by 2020 and an 80% reduction by 2050.[6] This bill sets the stage for the expansion of energy efficiency.
- **AB 811, Energy Efficiency Loan Financing**: This innovative Bill allows for jurisdictions to create special financing districts where property owners can take out low-interest loans to complete solar installations, energy efficiency retrofits, and/or water conservation projects. Loans are paid back through property taxes over time, alleviating huge upfront costs. Several counties, including Santa Barbara County, and cities, including Palm Desert, throughout California have created programs specific for their areas.
- **CaliforniaFIRST, state-wide AB 811 program**: This program applies the existing AB 811 framework to a statewide financing program. Jurisdictions that participate in this

[6] Santa Barbara County (2009 November 2). Santa Barbara County Municipal Energy Financing District Feasibility Study.

program will be attractive markets for EnergyRubix to explore.

- **California Public Utilities Commission (CPUC) Long Term Energy Efficiency Strategic Plan (CLEESP)**: This is the CPUC's comprehensive energy reduction goals for buildings. The Plan sets two critical goals for the residential sector by 2020: (1) 25% of existing residential buildings must reduce the amount of purchased power by 70% from 2008 levels and (2) the remaining 75% of existing homes must reduce the amount of power purchased by 30% from 2008. Such lofty goals will require a prepared workforce that can meet the potential retrofit demand in a timely manner.

Economic

A major barrier to completing energy efficiency projects are relatively high upfront costs and drawn-out return-on-investments (ROI). Incentives and financing tools are critical for promoting energy efficiency work. Currently, various federal and state incentives, including tax credits and rebates, cover some project costs or alleviate payments.

- **Federal tax credits and incentives**: Current federal tax incentives provide 30% of the cost or up to $1,500 for energy efficiency improvements and appliances.
- **AB 811 financing**: This financing mechanism will greatly help alleviate the large upfront costs associated with energy efficiency projects.
- **HOME STAR**: Also known as "Cash-for-Caulkers," this federal program could provide homeowners with up to 50% of energy efficiency project costs. This promising incentive in combination with AB 811 financing in California could yield significant savings for hesitant homeowners.

Social

California, as a leader in the world of green venture investment, provides ideal conditions for developing an energy efficiency business. Between 2007 and 2009, green jobs increased by 5% while overall jobs dropped by 1%.[7] This indication of the movement toward a green economy signals the potential for the success of our business as the number of supporting industries continues to increase.

Santa Barbara is recognized as a progressive environmental community, participating in the Architecture 2030 plan and developing one of the earliest AB 811 financing districts in California. In addition to a supportive mind set, 81% of the housing stock in Santa Barbara County was built prior to the 1990 Title 24 requirements, indicating an inefficient building stock with a significant potential for improvement.[8]

In addition, it is clear from AB 811 programs in Palm Desert and Sonoma County that there is a demand for energy efficiency retrofits, especially when upfront costs are eliminated. Sonoma County's first round of AB 811 funding sold out in just 9 minutes.[9] Renewable Funding conducted a survey of 1000 homeowners in California, 83% of which were somewhat interested in participating in an AB 811 program.[10] This indicates the potential demand for the EnergyRubix service as such programs are developed across the state and upfront costs of home energy efficiency improvements are replaced with property taxes.

[7] Next 10 (2009 December) Many Shades of Green: Diversity and Distribution of California's Green Jobs. Retrieved January 20, 2010 from http://www.next10.org/next10/pdf/Many_Shades_of_Green_1209.pdf.
[8] Santa Barbara County (2009 November 2). Santa Barbara County Municipal Energy Financing District Feasibility Study.
[9] SB CEC (2009 September). AB 811 financing workshop.
[10] Santa Barbara County (2009 November 2). Santa Barbara County Municipal Energy Financing District Feasibility Study.

Technical

As the political and socio-economic interests for energy efficiency have aligned, energy efficiency technology and rating systems have increasingly improved in order to meet demand and serve as useful tools for homeowners.

Energy audits are critical tools for diagnosing and identifying problem areas associated with energy inefficiency. In California, HERS is the most recognized rating system. The CEC has been developing HERS II as a more tangible and understandable rating system for homeowners. In HERS II homes receive a score from 0 to 250, zero being an energy-neutral home (energy neutral) and 250 being an extremely inefficient home. HERS II will provide homeowners with a simple and easily interpretable diagnostic tool.

HERS audits gather data from a series of diagnostic equipment such as infrared thermal cameras, duct blower tests, and blower door tests. These tools will allow the EnergyRubix team to thoroughly analyze a home's performance and create targeted recommendations. In addition to HERS, Building Performance Institute testing involves more holistic analyses including home health and safety. By relying on aspects of a BPI examination and HERS assessment, EnergyRubix will provide homeowners with the most comprehensive service possible.

The load order, or sequence of work, has become increasingly important in the building industry. Most AB 811 financing programs require energy efficiency projects, such as installing functional insulation, sealing windows and doors, and replacing HVAC equipment, to be completed prior to renewable energy projects, such as solar photovoltaic installations. This is critical wording in financing administration since until recently, solar panels were seen as the best way to reduce energy use. Realizing the work order will be another critical EnergyRubix service.

Geography and Climate

The EnergyRubix business model has been developed to target the Southern California residential building sector, with the first office located in Santa Barbara County. Santa Barbara County is located mostly within Climate Zone 5 as can be seen in **Figure 5**.[11] In general, Zones 5 and 6 are mild and experience a comfortable coastal environment requiring very little cooling and heating.[12]

Areas south and east of Santa Barbara County, such as Long Beach (Zone 8), Los Angeles (Zone 9), and Riverside (Zone 10) experience a more extreme temperature spread, requiring more heating and cooling.[13] Figure 6 below compares heating degree days (HDD) and cooling degree days (CDD) between these six climate zones.

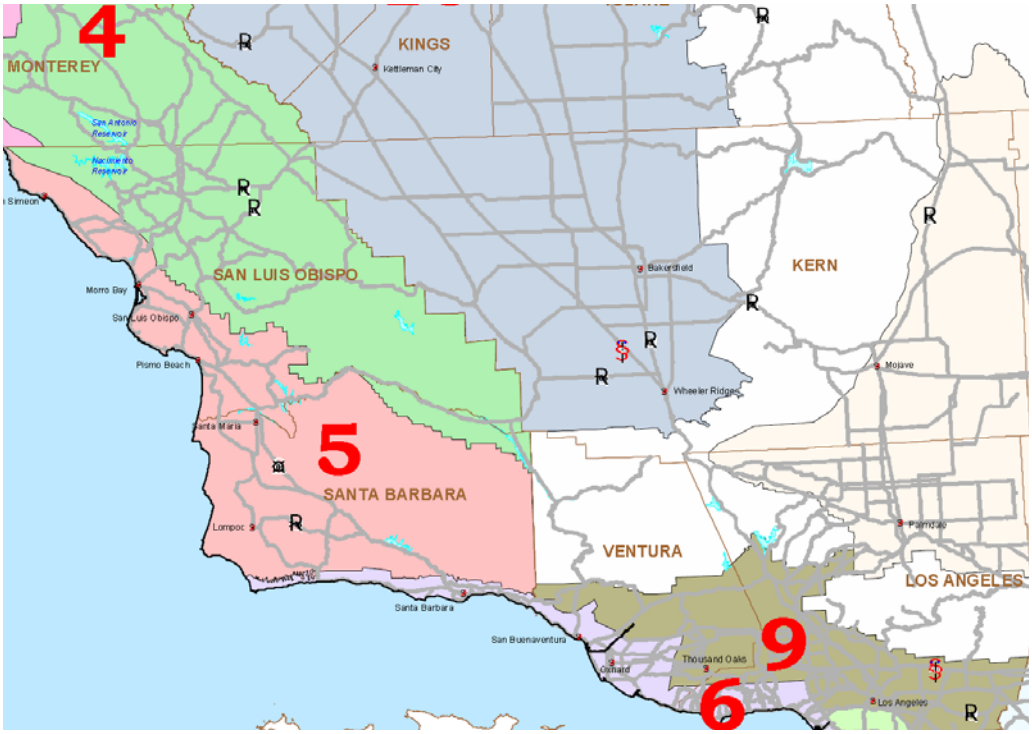


Figure 5: This Climate Zone map indicates the general mild climate zones that are characteristic of the California central coast region. Climate zones are hotter and more extreme in southern and inland portions of California.[14]

[11] Figure adapted from: Santa Barbara County (2009 November 2) Municipal Energy Financing District Feasibility Study.
[12] Pacific Gas Electric (2009) Guide to California Climate Zones: Zones 4 and 5. Retrieved January 21, 2010 from http://www.pge.com/mybusiness/edusafety/training/pec/toolbox/arch/climate/index.shtml.
[13] IBID.
[14] California Energy Commission. California Energy Maps. www.energy.ca.gov/maps/building_climate_zones.html

While Santa Barbara's climate may be too mild to establish a major market, it is an excellent location to test and perfect our service model for several reasons:

- Santa Barbara County is the first coastal community to take advantage of the financing tool offered by AB 811 (see policy section of Supporting Research).
- Overall, the Santa Barbara Community is progressive and informed about environmental issues, making it an ideal candidate for our target market.
- Higher than average household income ($57,059 median) and older building stock (89% built before 1990) make for a larger potential market share.
- The EnergyRubix team has made connections in the County through the Bren School and the Eco-Entrepreneurship program that will be critical in our initial launch.

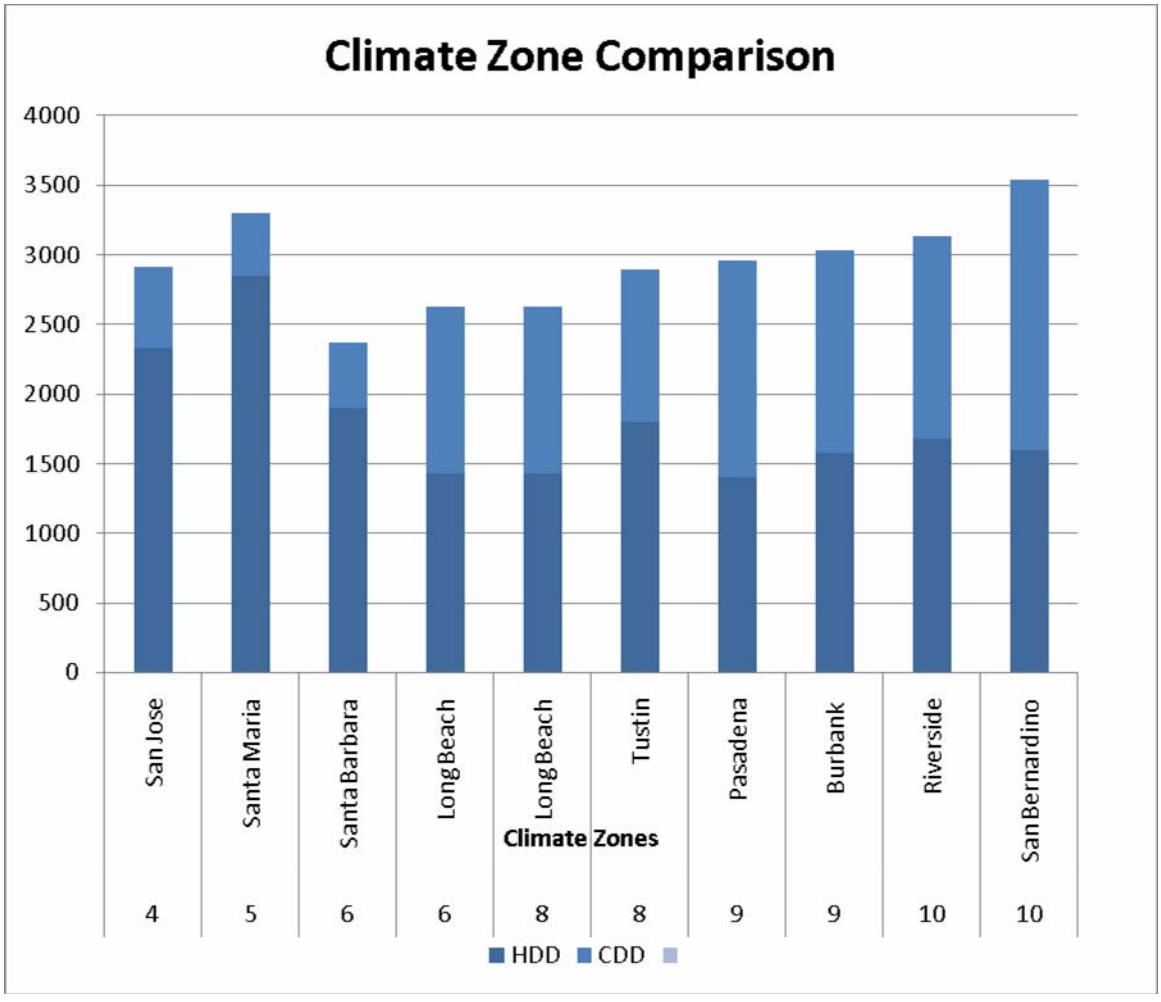


Figure 6: This figure compares the heating degree days (HDD) and cooling degree days (CDD) for climate zones 4, 5, 6, 8, 9 and 10. Cooling degree days (requiring air conditioning) increase the further south and east one travels, demonstrating greater market potential south of Santa Barbara County.

Customer Analysis

Our target market was formed after identifying specific lifestyle and housing characteristics of Santa Barbara residents. Our service delivers maximum value to this particular target market, as defined by the following criteria:

(1) **Ownership**: Homeowners tend to have the desire and ability to make significant changes to their properties. Home performance not only saves energy and money over time, but also significantly increases the comfort, durability, and value of the home. Only homeowners can fully take advantage of all of these benefits.

(2) **Permanency**: Many of these retrofits, while having some immediate benefits, will have far greater benefits over the long term (>10 years). For this reason target homeowners ideally will plan on living in their current home for at least 10 years. Households with children often remain in their current dwelling for longer periods of time, and thus make excellent candidates.

(3) **Building Size**: Larger homes tend to have higher utility bills because of either greater occupancy rates (e.g. families with children) and/or greater square footage. It takes more energy to heat, cool, and light a larger space. This presents a greater opportunity for energy savings and a faster return on investment time.

(4) **High Utility Bills**: Homes must have a minimum level of utility bills (electric, gas) to see significant financial return on their investment. While financial return is not the only selling point of our service, it is an important one.

(5) **Income Level**: Larger homes often indicate higher homeowner income than smaller homes. It is likely that these homeowners have the ability and willingness to pay for upgrading their homes. Our service and financial models assume that average retrofit project costs of $15-$20K.

(6) **Housing Age**: Older homes have more opportunity for improvement than new homes. In California, Title 24 Energy Efficiency Standards underwent a major update in 1990 that significantly boosted the energy efficiency of all homes built after that year. EnergyRubix targets homes built before 1990; there are still many cases of inefficient homes built after that year.

(7) **Housing Structure**: Single-unit detached homes are ideal because these structures generally do not share building systems with other households such as central HVAC, heating, walls, etc. Working with multiple households or a homeowners association on a single project can raise transaction costs. Additionally, there is little incentive to make energy improvements for multiple unit residences where the property manager is not responsible for paying the utility bills. This is commonly referred to as the principal agent problem, and more innovative leasing options may eventually overcome this barrier. However, for our initial growth phase, we do not consider multi-unit residences.

Our service offers the long-term benefits of financial payback, increased household comfort, and environmental benefits. Educating potential clients on all associated benefits and the concept of home energy performance can be challenging, but certain customer traits will increase the probability of understanding the full value of our service:

- College education: Explaining home energy performance sufficiently for clients to understand its value is difficult. Higher-educated customers are more likely to understand and appreciate our service.
- Good financial records/credit scores/retirement funds/investment portfolio, etc.: Households that make or understand long-term financial investments will be more likely to value the long-term financial paybacks that our service offers.
- Environmental appreciation: A general understanding of climate change and the perceived importance of reducing the carbon footprint will help sell our service.
- Target age group between 30 - 65 years old: This age group is more likely to be educated, have a family, and own a home.

Many of our clients will share similar characteristics to homeowners that are current customers of home remodel companies. Our target market will also be similar to that of solar installation companies, such as SolarCity, one of our strategic partners.

Target Market

Our target market size was estimated using census tract information, including number of households, house size, house age, household income, housing structure, and homeownership, but did not include size of energy bills or expected permanency (See **Appendix 1 and 2**). All market sizes were estimated as conservatively as possible; however, many of the listed variables (e.g. housing size and household income) may have some co-dependency.

Under these constraints, different combinations of parameters were used to identify three separate estimates of market size. The "true" potential market size is assumed to be somewhere within the range of these estimates. Market segments were analyzed on the citywide level within Santa Barbara County (**Table 1**) and on the countywide level for Southern California (**Table 2**). Additional market segment estimates were derived for Los Angeles and San Bernardino Counties, where EnergyRubix plans to expand to during Phase II of operations (see **Figure 8** for Expansion Plan).

Segment A (income) combines all homes built prior to 1990 with household incomes above $100,000. Income level is most likely related to housing size, housing structure, and homeownership, but not necessarily housing age.

Segment B (ideal home) combines all owner occupied homes with homes that are at least 6 rooms (3-4 bedrooms) or larger, built prior to 1990. There may be too high of a co-dependency between homeownership and housing size to use both parameters, but nonetheless this serves as a conservative estimate. This estimate was used to calculate the market capture rate in our financial projections (see **Table 4** for Financial Plan). This conservative estimate still accounts for 18% of all households in Santa Barbara County. While data on the household distribution of energy consumption was not available, house size and house age can be used as a proxy for energy consumption.

Segment C (technical feasibility) combines all 1-unit detached homes with homes built prior to 1990, with all 5-room houses removed. Most 5-room homes in Santa Barbara are assumed to be 1-unit detached and were therefore taken out of this estimate because 6-room homes are the minimum ideal size. Most homes with less than 5 rooms are not assumed to be single-unit detached.

Table 1: City-Wide Market Analysis: The market analysis included dividing homes into three segments, excluding co-dependent variables. Our conservative analysis indicated that EnergyRubix could roughly provide service to 15% of homes in the City of Santa Barbara[15]

	Santa Barbara	% total	Santa Maria	% total	Lompoc	% total
Segment A (income)	19,252	27%	4,772	12%	2,464	14%
Segment B (ideal home)	10,649	15%	7,969	20%	3,557	20%
Segment C (technical feasibility)	20,055	26%	9,867	24%	7,117	37%

Table 2: County-Wide Market Analysis: The county wide market analysis indicates 18% of homes in Santa Barbara County would be ideal candidates for the EnergyRubix service. [16]

	Santa Barbara	% total	Los Angeles	% total	San Bernardino	% total
Segment A (income)	28,863	21%	441,274	14%	47,915	9%
Segment B (ideal home)	**25,244**	**18%**	396,937	13%	119,689	23%
Segment C (technical feasibility)	41,813	28%	949,804	29%	223,631	37%

The target market size was estimated to be between 25,244 (**Table 2**) and 41,813 homes in Santa Barbara County. The city of Santa Barbara matched Segment A estimates best because of high household income levels and an old building stock. On a percentage basis (market capture rate), Santa Maria best matched our ideal home segment estimate. Santa Maria has the highest homeownership rates and has larger homes than Santa Barbara city. Lompoc best matched our technical feasibility segment and has a larger building stock of old (prior to 1990) single unit-detached homes. Overall, the city of Santa Barbara, due to its large population, holds the greatest proportion of our target market under all three estimates.

Los Angeles and San Bernardino counties both have a larger absolute market potential. In Los Angeles this is primarily due to the sheer number of total households. However, San Bernardino also has a larger market potential due to a greater number of households, but the market capture rates show a much larger range between the three estimates (9%, 23%, and 37% respectively). San Bernardino has very high homeownership rates and a large number of single unit detached homes, which explains a large Segment C estimate, but income levels are significantly lower which explains a low Segment A estimate.

It should be noted that while the percent of building stock built prior to 1990 was fairly similar between the three counties (see **Appendix 2** for full data sets), Santa Barbara housing data was taken from the 2007 American Community Survey while Los Angeles and San Bernardino housing data was only available from the 2000 US Census. This means houses built between years 2000-2007 were not taken into account for Los Angeles and San Bernardino counties, while they were for Santa Barbara.

[15] Segments were estimated using the 2007 American Community Survey and the 2000 US Census data.
http://quickfacts.census.gov/qfd/states/06/06111.html
http://www.sbcag.org/census.html
[16] IBID.

Therefore, while the number of target houses remains the same, the percent of building stock built prior to 1990 is less than what is indicated for Los Angeles and San Bernardino. This means Santa Barbara has a significantly older building stock than the other two counties, and if 2007 data were available, it would indicate that the real market capture rates of the other two counties are slightly lower than what is shown in **Table 2**.

SWOT Analysis: Strengths, Weaknesses, Opportunities, and Threats

A SWOT (strengths, weaknesses, opportunities, threats) Analysis was performed to evaluate our competitiveness in the newly emerging home performance marketplace.

Strengths	**Weaknesses**
• First known company to offer a streamlined home performance solution as energy assessor and third party broker of contractor bids • HERS and BPI certified energy assessment draws from best of both systems • Online Bidding Process has potential to be very popular with both homeowners and contractors, creating industry wide brand recognition • Streamlined approach that reduces time, effort, and costs will be very appealing to homeowners • Nexus and Node business model does not require large amounts of capital to launch, ideal for expansion	• No Intellectual Property to help protect against competition • No traction, therefore difficult to measure demand for untested product • Profit margins are considerably smaller than if retrofit work was performed in-house • Maintaining fully staffed offices before demand reaches projected potential would be a high cost to the company
Opportunities	**Threats (Risks)**
• Global environmental awareness coupled with climate change concern and soaring Federal oil receipts has created an incentive based niche market for energy improvement products and services • Total number of houses in Santa Barbara is excess of 150,000; 124,000 built before 1990. • Target market sizes in other counties in southern California are even more promising • Municipal Bonds for Energy Efficiency will provide funding to encourage installation and upgrades for existing homes to improve energy efficiency • California and the US have one of the biggest budgets for energy improvements and the government has set aside $16 billion for repairing public housing and conducting retrofits for energy efficiency	• Barriers to entry are very low and future incentives make market very lucrative, attracting numerous competitors • Low customer willingness to pay • Lack of client knowledge of the importance of energy efficiency • Rising unemployment figures could restrain homeowners from investing in energy improvements • Difficulty finding investors • Requires forming multiple partnerships with local contractors who may not respond well to new method • Contractors may not be willing to place bids online without visiting the residence

1.4 SALES & MARKETING STRATEGY

Our market analysis has shown that there is a sufficiently large market segment that would benefit from our service, but the challenge is in communicating that benefit to an uninformed client base. For EnergyRubix, the demand for our service will be dependent on our ability to quickly and clearly educate potential customers about the benefits of home performance upgrades. Educating clients takes time and effort; therefore, we must be highly selective of the client base we attempt to reach. Our marketing campaign is centered on a direct-marketing approach coupled with local presence and relationship building that will help to build our brand.

The EnergyRubix Service

Branding
EnergyRubix's unique service will set it apart from the rest of the existing energy efficiency start-ups in California. Our homeowner and contractor oriented approach will set a standard for how such business should be conducted. Our highly trained, respectful, and knowledgeable staff will represent the values of our company from beginning to end. Our online presence will be professional, organized, and frequently updated to serve as an informative and useful tool for homeowners and contractors. As our reputation as a professional service grows and we expand throughout Southern California, the EnergyRubix brand will become synonymous with energy efficiency.

Logo
Our logo is composed of our company's name, theme colors of blue and green, a company description, and an illustration of a house.

The blue and green colors symbolize the environmental nature of our business while the white background is associated with the simplicity and transparency of our service. The cube-like home symbolizes the concept of putting all the pieces together to match like a colored 3-D cube and examining a home as an entire system.

The phrase, "Home Energy Solutions" targets our business towards homeowners while suggesting that "we fix problems". A trademark for the EnergyRubix logo will be pursued immediately upon starting the venture.

Services
EnergyRubix provides four different products or deliverables to homeowners and contractors:

- Home Performance Assessment for homeowners
- Home Assessment Report for homeowners
- The Master Bid Proposal and *EnergyRubix Online*
- Home Upgrade Plan including financial guidance for homeowners

Each product listed above serves to educate our customers and therefore must be both professional and easily understood. Customers will be more comfortable signing up for the different stages of our service if they know why they need EnergyRubix's guidance through the multi-step home retrofit process. A more detailed description of our service can be found in the EnergyRubix Service section.

The Value for Clients and Partners

EnergyRubix eliminates the barriers to home energy efficiency retrofit projects. The HPA and HAR provide homeowners with the essential information and recommendations necessary to improve their home. *EnergyRubix Online* and the MBP save homeowners hours of time by eliminating the need to search for qualified contractors and schedule multiple contractor visits while also simplifying the contractor bid selection process. Our service reduces the uncertainty, time, and monetary investment associated with typical home improvement projects.

By attaining an EnergyRubix Online membership, contractors are provided with pre-qualified leads. Instead of relying on word-of-mouth or paid advertisements to market their services, EnergyRubix will allow them to focus on construction rather than soliciting new business.

EnergyRubix will not compete with existing contractors. As a result, our service helps to build home performance industries wherever we operate. Such industries are imperative to the success of California and the U.S. in reaching climate change mitigation goals.

Intellectual Property

To help secure our brand, we will protect the titles of our deliverables (the Home Performance Assessment, the Home Assessment Report, the Master Bid Proposal, *EnergyRubix Online*, and the Home Upgrade Plan) and our logo by filing for trademarks. Currently, these products cannot be protected through patents or copyrights.

Quality Assurance & Liability

EnergyRubix defines quality as achieving the greatest energy savings through the simplest, most cost effective, and least time consuming process for both the homeowner and contractor.

The EnergyRubix website will help maintain the quality of our service by allowing homeowners to post feedback and testimonials. Testimonials will be critical in building our reputation and maintaining the highest quality service. The website's transparency will pressure our staff and member contractors to complete projects to the highest standard.

EnergyRubix will act only as the referral agent and does not perform the retrofit services. Therefore, the largest responsibility will be to employ due diligence in ensuring member contractors are properly

licensed, certified, and have good reputability. We will work only with BPI home performance contractors to help ensure that the work is done properly. Although contractors employed by EnergyRubix will have full insurance, liability for damages that might result during the project may be an issue if customers perceive responsibility to fall on the entity that referred the contractors.

We can attempt to address this liability by including a provision in the referral contract stating that contractors are solely responsible for quality control issues on the premises, however EnergyRubix does do thorough screening of contractor credentials to ensure only quality contractors receive leads. Additionally we will establish EnergyRubix as a LLC to insulate its executives from individual responsibility. An LLC provides our venture with a more flexible management structure than a corporation and is taxed as a partnership, avoiding double taxation.

Pricing Strategy

We compared our valued added to customers and contractors against the value provided by similar services and the costs associated with our internal processes to estimate our service prices. The following is the price breakdown and justification for all the individual revenue streams.

The Home Performance Assessment *(Revenue Stream 1a)*
The EnergyRubix Home Performance Assessment, our introductory service, includes the HPA and the HAR. The fee for this service will depend on the square footage of the home, but for an average 2,500 square foot house we will charge $695.

Personnel who are trained in both HERS and BPI perform the assessment. HERS is the official California state endorsed energy rating technique and is important for certain state incentives, rebates, running simple energy models, and official documentation. Unlike HERS, BPI analysis provides solutions. By combining the best of both systems we add value. Typical HERS audits cost between $400 and $500. Typical BPI assessments range from $450 to $695 (both include a report).

Contractor Membership Fees *(Revenue Stream 1b)*
Efficiency First[17], a national lobbying group for the home performance industry, charges annual membership fees to contractors starting at $250. Following this model, we will charge $250 annually for membership once we have established a reputation for providing quality leads (see Expansion Plan).

Bidding Process and Contractor Selection *(Revenue Stream 2a)*
EnergyRubix will charge the contractor a referral fee of 3% of the total project cost once a bid is selected for homeowner and the scope of work and price are set.

The Home Upgrade Plan *(Revenue Stream 2b)*
EnergyRubix will charge the homeowner a fee estimated to be 3% of the total project cost for developing this plan. To avoid conflict of interest, the actual fee will be calculated based upon square footage of the home and which building systems are actually addressed in the project scope (i.e. HVAC, lighting, insulation, air seal, etc.). After the retrofit process is completed, EnergyRubix will put interested homeowners in touch with a solar photovoltaic installation company and collect a solar referral fee of approximately $400 from the solar company.

[17] efficencyfirst.org

Distribution Channels

EnergyRubix does not rely on external distribution entities. The Home Performance Assessment, the corresponding Home Assessment Report, and the final Home Upgrade Plan are delivered directly to our end customer, the homeowner. However, potential customers learn about EnergyRubix through our website, referral, word of mouth, or our promotional materials and special events. Our website will provide all necessary information about our service.

An EnergyRubix consultant will field all initial questions and run through a questionnaire to gauge interest and opportunity. This initial interview can also be done entirely through our website, our main distribution channel, where customers can answer frequently asked questions, enter in utility bill information, and view rough estimates for potential energy savings.

Our energy assessors are building performance technicians as well as salesmen. As they diagnosis and evaluate the home, they are also selling the second part of our service to our clients. These employees are highly critical to the success of the company and will receive sales training.

Market Coverage

Our target market analysis concluded that our product demand is not limited by our market size. Our financial projections assume a market capture rate well below 1%. However, as a startup we are limited by our ability to meet that demand. Market coverage is based on maximizing the rate of assessments performed. Having a sufficiently large market base allows us to be selective with other clients, using targeting marketing strategies that attract homeowners who have the most to gain from our service.

Membership Selection and Partnerships

EnergyRubix relies on outside contractors to perform all retrofit work. As partners, we benefit by increasing demand for each other's work. Because we are trying to push the industry forward, beyond standard practice, we require all contractor members to have some home performance or green building training, whether it is through BPI, Build It Green, or United States Green Building Council. This will help to ensure the contractors we select will do superior work, worthy of our referral.

During our initial phase of business development, we partnered with SolarCity, a national leader in residential solar installation. We will refer clients interested in solar panel installation to SolarCity and expect SolarCity to refer their clients to our energy assessment service. New solar incentives (e.g. New Homes Solar Partnership) now require an energy audit prior to being eligible for rebates, and having SolarCity within our network will be a demand booster.

Promotion

Rather than mass marketing to a large audience, we will focus on targeted direct marketing, with a primary emphasis on homeowners. We will gradually increase our exposure to the home remodeling market by expanding our marketing to include:

- Middle to upper class homeowners in older home neighborhoods (see Target Market section)
- General and Specialty Contractors
- Home Improvement Centers
- Solar installation companies

Lead Generation

Lead brokers such as USA Data[18] can provide leads to identify the addresses of homes falling within the EnergyRubix target market. Costs of employing this service vary depending on the type of information requested, the level of detail, and the quantity of records generated. For example, a plain Excel list of over 29,000 Santa Barbara homeowners costs $1,600. The average response rate for direct mailing is 1% to 2%. Essentially, EnergyRubix will need to send out 25,000 direct mailers with a 2% response rate to hear back from 500 homeowners.

Anchor Points

In order to establish an identity, credibility, and name recognition, "anchor points" will allows us to target specific customers within preferred communities. Anchor points include: home improvement stores (that agree to host our illuminated window sign and brochures) and local promotion events (where we can meet and interact with the local community). EnergyRubix will maintain a constant presence at these anchor points.

Another marketing approach is to set up kiosks, booths, or stands at the malls and shopping centers. Upfront costs of such advertisement range from $2,000 to $10,000,[19] depending on the product, size, location, and season.[20] Liability insurance is required.

Targeted marketing also involves setting up demonstrations or booths at Home Depot, Costco, or other large stores with the goal of growing interest from homeowners and to gather potential customer contact information. These demonstrations will require endorsement from the host company, and a portion of EnergyRubix booth sales.[21]

Anchor points will include:

- Contractor's offices on main streets
- Home improvement stores in shopping centers (e.g. Home Depot, Ace Hardware)
- Banks/Loan Offices on main streets

Supporting promotional events can include:

- Home improvement trade shows
- Earth Day
- Festival Booths
- Monthly speaker events and demonstrations hosted at our office or a host home

Supporting promotional materials will include:

- Information Kiosks with onsite energy savings estimators operated by sales team
- Brochures
- Postcards mailed to targeted neighborhoods prior to sales calls and door visits
- Flyers/Posters (invitations to local events)
- Power point presentations (for web, email, and events)
- Public relations/articles/media interviews calendar of events in newspapers

[18] USA Data website: www.usadata.com. More on pricing information can be found here: http://www.usadata.com/faq-pricing.html
[19] "How to Start a Kiosk Business." Entrepreneur. http://www.entrepreneur.com/startingabusiness/startupbasics/location/article63012.html
[20] Some malls charge a percentage of the sales and add it on to the rent.
[21] Olivia. (2 February 2010) Store Manager at Home Depot, Goleta.

Website Development—Promotion and Service Support

EnergyRubix Online is a source for communication and portal for advertisement. With homeowner input of energy and utility savings, service ratings, and comments, website users can identify the value of home performance upgrades and quality of work. Contractors can visit EnergyRubix Online to get a sense of the types of project requested and needed in their community and can see proof of the possible lead generation on the website. Ideally the EnergyRubix website will lead to a snowball effect of interest as more and more people become educated about the value of our service.

Our website provides educational tools that promote our company, services, and the energy efficiency industry as a whole. There are specific areas directed towards each of our target groups with homeowner logins, contractor logins, and partnerships.

We intend to rely heavily on cross- linking with other organizations such as the Community Environmental Council, Santa Barbara Contractor's Association, and the California Building Performance Contractors Association. The EnergyRubix website will also feature a newsroom to provide the latest industry trends and news, drawing people to our website to use it as a resource. EnergyRubix members will receive monthly e-Newsletters as well as bulletins on special events and promotions.

Building Relationships via Local Presence and Partnerships

By investing in developing relationships with other relevant organizations and community members from the beginning, we can increase awareness and brand equity in the long term. EnergyRubix intends to participate in local events and partner with local businesses, organizations, and contractors to generate awareness. The CEC holds an Energy Symposium periodically presenting another opportunity for EnergyRubix to participate and promote our services.

Other upcoming events in California include: Redding Home & Garden Expo, Spring Home Show-San Francisco, Orange County Home Show, California Construction Expo, National Green Builders Products Expo, Building Industry Show, and International Builder's Show. Additional opportunities include:

- Participating in local Chamber of Commerce events
- Participating in local Contractors Association meetings/events
- Direct mail new brochures to contractors/American Institute of Architects (AIA) members/government project managers
- Sponsor local university events
- Provide green consulting clinics at schools/events/open houses
- Partnering with building companies and solar installers to refer each other

1.5 FINANCIAL PLAN AND BREAK-EVEN POINT

The EnergyRubix financial plan represents the costs of business operations (including costs of expansion) and demonstrates investment necessary to start the business. Included in the financial analysis is a monthly breakdown of the first year of operations. The income statement shows that we expect to be profitable in the first year of operations and we project our profits to increase substantially each year. This growth allows us to break even rapidly and we will be able to pay back our investors with a generous return on their investment.

The EnergyRubix revenue model (**Table 3**) outlines the price we will charge for each step of our service as well as internal company costs. Ideally, as more contractors and homeowners become familiar with the EnergyRubix process, the company's overhead costs, coordination, and website upkeep will become a shrinking percentage of the revenue stream.

Table 3: On average, EnergyRubix will collect $2,295 of income per home, at an internal cost of $690, resulting in $1,605 of revenue.

EnergyRubix
Revenue Model
Year 1- July 1, 2010 - June 30, 2011

Revenue:		
Home Assessment + Report		$695
Master Bid Proposal + Online Bidding		
Home Upgrade Plan		$1,200
Supplemental Revenue		
Solar Referral Fees		$400
Total Sales Revenue		$2,295
Cost of Goods Sold:		
	(Labor)	(Fees)
Home Assessment + Report	$290	$100
Master Bid Proposal + Online Bidding	$160	
Home Upgrade Plan	$140	
Supplemental Revenue		
Solar Referral Fees	$0	$0
Total Cost		$690
Cash Flow		$ 1,605

Key Assumptions

In the EnergyRubix revenue model, we assumed clients would be willing to pay $695 for the HPA and the generation of the HAR (Part I of the service), similar to what is currently charged for a BPI certified assessment. We will collect 6% profit from the total project cost (3% from the contractor and 3% from the homeowner) for developing the HUP and selecting an optimal contractor (Part II of the service). Our cost breakdown is as follows:

- Average project value$20,000: We distributed the annual number of projects evenly across a range based on our pilot projects of $5,000 - $50,000
- HAR labor cost includes: Eight hours of labor for a certified EnergyRubix assessor at $30/hour and two hours of labor for an EnergyRubix accounts manager at $25 per hour
- HERS score: $100 from CHEERS (California Home Energy Efficiency Rating System)
- Master Bid Proposal generation process includes: three hours of EnergyRubix contractor labor at $45/hour and one hour of web assistant labor at $25/hour
- HUP generation process includes: two hours of EnergyRubix contractor labor at $45/hour and two hours of account manager labor at $25/hour[22]

[22] All hours adjusted to include approximate cost for insurance & benefits.

Table 4: Five year projection of net income and investment requirements.

EnergyRubix

Statement of Revenue, Expenses, and Net Income

Year 1- beginning July 1, 2011

			2011	2012	2013	2014	2015
Revenue:							
Annual number of contracts							
Assessment & Design	Part I	Q'ty	500	1500	2500	3500	4500
Bidding Process	Part II		250	750	1250	1750	2250
Supplemental Revenue							
Solar Referral Fees			50	150	250	350	450
Sales Revenue:	Unit Price						
Assessment+ Design							
Part I	$ 695		$ 347,500	1,042,500	1,737,500	2,432,500	3,127,500
Energy Retrofits							
Part II	See Table		351,000	1,053,000	1,755,000	2,457,000	3,159,000
Supplemental Revenue							
Solar Referral Fees	$ 400		20,000	60,000	100,000	140,000	180,000
Total Sales Income			$ 718,500	2,155,500	3,592,500	5,029,500	6,466,500
Other:							
Outside Investment:							
Family & Friends							
Angel Funding							
Total Investment			$ 550,000	1,100,000	1,100,000	1,100,000	1,100,000
Total Income			$ 1,268,500	3,255,500	4,692,500	6,129,500	7,566,500
Expenses:							
Operations							
Marketing			(100000)	(300000)	(500000)	(700000)	(900000)
Certifications			(8260)	(24780)	(41300)	(57820)	(74340)
Equipment			(74000)	(222000)	(370000)	(518000)	(666000)
Rent			(8000)	(24000)	(40000)	(56000)	(72000)
Administrative			(21555)	(64665)	(107775)	(150885)	(193995)
Salary & Wage:							
COO			(50000)	(50000)	(50000)	(50000)	(50000)
Assessors			(160000)	(480000)	(800000)	(1120000)	(1440000)
CFO			(50000)	(50000)	(50000)	(50000)	(50000)
CEO			(50000)	(50000)	(50000)	(50000)	(50000)
Contractors			(44000)	(88000)	(220000)	(220000)	(264000)
Web Service Coordinator			(50000)	(50000)	(50000)	(50000)	(50000)
Assistant			(35000)	(70000)	(175000)	(175000)	(210000)
Accounts Manager			(35000)	(70000)	(175000)	(175000)	(210000)
Total Expenses			$ (685815)	(1543445)	(2629075)	(3372705)	(4230335)
Net Income			$ 32,685	612,055	963,425	1,656,795	2,236,165

Key Assumptions

(1) We assume that we will be able to complete 500 assessments annually at each node of operation (See **Table 8** for Sales Forecast), representing an average of 2.5 assessments per week over 50 weeks of business in a year. We also assume sales success rate of 50% between Part I to Part II. Solar referral income assumes 20% of Part II customers will be referred to our solar partner. In year one there will be one Nexus of operation and in each successive year two nodes will be opened. At year five there will be one nexus office and eight nodes operating at the same output of 500 assessments per year.

(2) We cannot be sure that charging $695 for Part I will be accepted by the market until we determine the willingness to pay by actually selling our service.

(3) We assume that we will be successful in acquiring the necessary capital to make our aggressive expansion plan a reality. We expect to raise five separate rounds of funds, each round supporting two nodes that require $550,000 to cover the first year of operation. We will require $100,000 of marketing budget to successfully generate 500 assessments at each node of operation.

We assume:

- Current certification costs: $2,065 for each assessor to become a home performance rater, will not increase during the first five years of operation
- Equipment costs: $18,500 will cover the equipment costs necessary for start up in the first year (2000 F-150, blower door, infrared camera, duct blaster, tape, plastic sheet, tape measure, flash light, etc.)
- Rental office space estimated cost $450/month

Because of efficiency gains from our web-based service, we used an administrative cost of 3% of total revenue, which is lower than the industry average. We assume we can find a qualified people to work for lower salaries with the expectation of output dependent bonuses. Each node will have four assessors earning $35,000/year, one sales/marketing earning $35,000/year, one contractor earning $40,000/year, one web assistant earning $22,000/year, and one accounts manager earning $22,000/year.

Based on these financial assumptions we calculated the estimated income and break-even point:

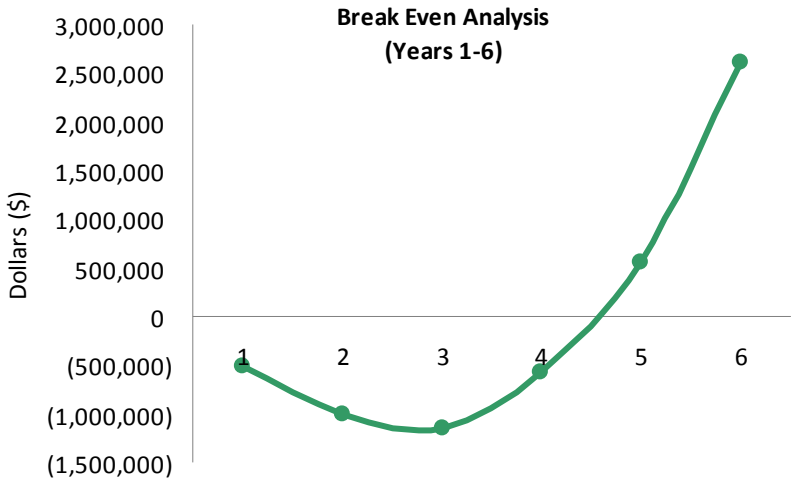


Figure 7: Net Income and Investment Break-Even Point. Year 1 represents 2011 when EnergyRubix begins operations. EnergyRubix expects to break even between 2013 and 2014, with steady income growth following that point.

In Year 1, EnergyRubix will collect $550,000 of angel investment. Between years two and five of operation, an additional annual amount of $1,100,000 will be raised to allow for rapid expansion. We project positive net incomes for years 1 to 5 and a break-even point, where we will overcome our investment debt, at the start of year five of operations. Investor return on investment will be negotiated during each successful round of angel investment. Chief Officer salaries will be $50,000 with net income dependent bonuses at the end of the year.

Table 5: Balance sheet for the first year of operations after receiving $550,000 in angel investment, purchasing $74,000 in equipment, and gaining $45,975 in net income. Asset depreciation details can be found in Table 11.

EnergyRubix
Pro Forma Balance Sheet
Year 1

	June 30, 2010		July 1, 2010		June 30, 2011	
Assets						
Current assets						
Cash	550,000		476,000		450,435	
Accounts receivable	-		-		86,340	
Total Current Assets		550,000		476,000		536,775
Fixed Assets	-		74,000		74,000	
Less Accumulated Depreciation	-		-		(14,800)	
Net Fixed Assets		-		74,000		59,200
Total assets		550,000		550,000		595,975
Liabilities and Equity						
Current liabilities	-	-	-	-	-	-
Total current liabilities		-		-		-
Equity						
Angel investment	550,000		550,000		550,000	
Retained earnings	-		-		45,975	
		550,000		550,000		595,975
Total Liabilities and Equity		550,000		550,000		595,975

Table 6: Income Statement for the first year of operations.

EnergyRubix
Pro Forma Income Statement
Year 1

		Source of Estimate
Sales	$718,900	Forecasted sales
Cost of sales		
Salaries	$474,000	Expenses
Marketing	$100,000	
Total cost of sales	$574,000	
Gross profit	$144,900	
Rent	$8,000	Expenses
Certifications	$8,260	Expenses
Administrative	$21,555	Expenses
Depreciation	$14,800	FA Detail
Bad Debts expense	$21,555	Cash Collections
Total Operating Expenses	$74,170	
Income before taxes	$70,730	
Income taxes (35% rate)	$24,756	
Net income	$45,975	

Table 7: Cash collections and disbursements for the first year of operations. In January 2011, after just seven months of operations, we project that cash collections will exceed disbursements. (*Minimum cash required balance equals one month's salary expense.)

EnergyRubix
Cash Forecast
Year 1

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	End of Year
Cash Balance--beg.	$550,000	$425,014	$391,922	$361,237	$341,231	$330,697	$322,532	$325,185	$337,471	$352,165	$377,696	$412,861	
Add:													
Cash Collections (Fig. 14)	9,633	19,267	21,675	32,353	41,826	44,194	55,012	64,645	67,053	77,891	87,524	89,933	$611,005
Total Cash	$559,633	$444,281	$413,597	$393,590	$383,057	$374,891	$377,544	$389,830	$404,524	$430,055	$465,220	$502,794	$502,794
Less:													
Marketing	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$100,000
Salaries	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	474,000
Certifications	8,260	0	0	0	0	0	0	0	0	0	0	0	8,260
Rent	667	667	667	667	667	667	667	667	667	667	667	667	8,000
Bank Charges	0	0	0	0	0	0	0	0	0	0	0	0	0
Credit Card Fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Dues/Subs	0	0	0	0	0	0	0	0	0	0	0	0	0
Conferences	0	0	0	0	0	0	0	0	0	0	0	0	0
Insurance	0	0	0	0	0	0	0	0	0	0	0	0	0
Workers Compensation	0	0	0	0	0	0	0	0	0	0	0	0	0
Utilities	0	0	0	0	0	0	0	0	0	0	0	0	0
Phone	0	0	0	0	0	0	0	0	0	0	0	0	0
Administrative (3% Sales)	1,796	1,796	1,796	1,796	1,796	1,796	1,796	1,796	1,796	1,796	1,796	1,796	21,555
Purchase of fixed assets	74,000	0	0	0	0	0	0	0	0	0	0	0	74,000
Taxes	2,063	2,063	2,063	2,063	2,063	2,063	2,063	2,063	2,063	2,063	2,063	2,063	24,756
Total Cash Disbursements	$134,619	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$710,571
Tentative Cash balance (deficit)	425,014	391,922	361,237	341,231	330,697	322,532	325,185	337,471	352,165	377,696	412,861	450,435	450,435
Minimum cash required*	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	39,500	--
Borrowing required	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	--
Ending cash balance	$425,014	$391,922	$361,237	$341,231	$330,697	$322,532	$325,185	$337,471	$352,165	$377,696	$412,861	$450,435	$450,435
Loan balance	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Table 8: Sales forecast for the first year of operations, assuming a quarterly increase from 1 – 4 assessments per week for the four on staff assessors. The $400 discrepancy between sales forecast and total sales income results from internal rounding errors within data set that result from monthly extrapolation.

EnergyRubix
Sales Forecast
Year 1

		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual Total
Part I	Q'ty	17	17	17	33	33	33	50	50	50	67	67	67	500
Part II		8	8	8	17	17	17	25	25	25	33	33	33	250
Solar Referrals		2	2	2	3	3	3	5	5	5	7	7	7	50
Unit Price														
$695	$	11,583	11,583	11,583	23,167	23,167	23,167	34,750	34,750	34,750	46,333	46,333	46,333	347,500
See Table		11,700	11,700	11,700	23,400	23,400	23,400	35,100	35,100	35,100	46,800	46,800	46,800	351,000
$400		800	800	800	1,200	1,200	1,200	2,000	2,000	2,000	2,800	2,800	2,800	20,400
Total	$	24,083	24,083	24,083	47,767	47,767	47,767	71,850	71,850	71,850	95,933	95,933	95,933	718,900

Table 9: Expenses forecast for the first year of operations. Administrative costs are calculated at 3% of total sales.

EnergyRubix
Expenses Forecast
Year 1

Expenses:	Annual	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Marketing	$100,000	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	$8,333	
Salaries	$474,000	$39,500	$39,500	$39,500	$39,500	$39,500	$39,500	$39,500	$39,500	$39,500	$39,500	$39,500	$39,500	
Operations														
Certifications	$8,260	$8,260	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Rent	$8,000	$667	$667	$667	$667	$667	$667	$667	$667	$667	$667	$667	$667	
Bank Charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Credit Card	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Dues/Subs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Conferences	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Insurance	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Workers Comp.	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Utilities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Phone	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Administrative	$21,555	$1,796	$1,796	$1,796	$1,796	$1,796	$1,796	$1,796	$1,796	$1,796	$1,796	$1,796	$1,796	
Operation Expenses	$37,815	$10,723	$2,463	$2,463	$2,463	$2,463	$2,463	$2,463	$2,463	$2,463	$2,463	$2,463	$2,463	
Non-Operations														
Tax (35%)	$24,756	$2,063	$2,063	$2,063	$2,063	$2,063	$2,063	$2,063	$2,063	$2,063	$2,063	$2,063	$2,063	$24,756
	$636,571	$60,619	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$52,359	$636,571

Table 10: Projected Cash Collections for first year of operations. This assumes 40% of sales will be collected the same month the sale is completed, with an additional three months required to collect an additional 65%. 5% of sales are expected to be lost as bad debt.

EnergyRubix
Estimates of Cash Collections
by quarter, Year 1

		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun		
Sales		$24,083	$24,083	$24,083	$47,767	$47,767	$47,767	$71,850	$71,850	$71,850	$95,933	$95,933	$95,933		
Collections of sales															
1st Month	40%	$9,633	$9,633	$9,633	$19,107	$19,107	$19,107	$28,740	$28,740	$28,740	$38,373	$38,373	$38,373		
2nd Month	40%		9,633	9,633	9,633	19,107	19,107	19,107	28,740	28,740	28,740	38,373	38,373		
3rd Month	10%			2,408	2,408	2,408	4,777	4,777	4,777	7,185	7,185	7,185	9,593		
4th Month	5%				1,204	1,204	1,204	2,388	2,388	2,388	3,593	3,593	3,593		
Total Cash		$9,633	$19,267	$21,675	$32,353	$41,826	$44,194	$55,012	$64,645	$67,053	$77,891	$87,524	$89,933		
Write-offs	5%				1,204	1,204	1,204	2,388	2,388	2,388	3,593	3,593	3,593	**$21,555**	
AR Balance		$14,450	$19,267	$21,675	$37,089	$43,030	$46,603	$63,441	$70,646	$75,443	$93,485	$101,894	**$107,895**		$611,005

Table 11: Projected Fixed Asset depreciation for first year of operations. The Annual Depreciation Expense is calculated by dividing the total value of the equipment by its useful life span.

EnergyRubix
Fixed Asset Detail
Year 1

Description	Date Purchased	Purchase Value	Life (years)	Monthly Depreciation Expense	Annual Depreciation Expense
General Startup Equipment	7/1/2010	$74,000	5	$1,233	$14,800

1.6 GROWTH AND EXPANSION

EnergyRubix will begin operations in the greater Santa Barbara area and then spread to other targeted areas of southern California. Our business model is intended to be easily replicable and eventually we will have multiple offices throughout California. EnergyRubix intends on being an industry leader as the implementation of home energy performance solutions becomes mainstream throughout California.

EnergyRubix will employ a rapid expansion model of one nexus office and subsequent node offices throughout central and southern California to limit managerial costs of the nexus office and achieving the same sales revenue at each node office. Initially, our nexus office will open in Santa Barbara Country where we will perfect our business model and gain public exposure and market share. The original Santa Barbara office will move to Los Angeles County and serve as the managerial or nexus office. The Santa Barbara office will then become the first node. Each node will require $550,000 of investment capital.

2010-2011

After acquiring $550,000 in the first round of angel funding, EnergyRubix will begin operations in the Goleta area of Santa Barbara County in 2010. Goleta offers lower rental fees for office space than downtown Santa Barbara and is more centrally located between the three largest cities in the county: Lompoc, Santa Maria and Santa Barbara.

Although the mild climate in the coastal region is not ideal for an energy efficiency company, Santa Barbara County provides EnergyRubix with a market of environmentally progressive customers, a stock of old and inefficient houses, and a local government that is one of the first central coast communities to adopt the AB 811 program (see PEST analysis and Supporting Research for more information). The Santa Barbara office will serve as the nexus office as EnergyRubix perfects its service model and establishes itself as a recognized company.

2011

In 2011, after one year in Santa Barbara, EnergyRubix hopes to acquire a second round of angel funding of $1,100,000 to transplant its nexus office to Los Angeles and open a second node in another ideal location. The Santa Barbara office will then become the first node office, focusing solely on energy efficiency projects. The executive team, comprised of the Chief Executive Officer, Chief Operations Officer, Chief Financial Officer, and Chief Technical Officer, will move to the Los Angeles office to help penetrate this new market.

2012 and Beyond

As EnergyRubix continues its rapid expansion, it hopes to become well known and respected within the marketplace as the brand name in residential energy efficiency upgrades. By 2015, the fifth year in business, EnergyRubix will have 8 nodes and 1 nexus office throughout Los Angeles, Riverside, San Bernardino, Orange, and San Diego counties, as indicated in **Figure 8**. Each node will follow a standardized operations methodology to ensure the EnergyRubix process efficiency is maintained. Node density and location will be dependent on market size and potential.

EnergyRubix aims to capture first mover advantage and use our unique web-based service to establish itself as the “go-to” provider. We recognize that the market we enter is competitive but at this stage, the industry is still emerging. Therefore, rapid expansion will aid our success as the industry grows. As appropriate, EnergyRubix will likely expand its services throughout the southwest opening multiple offices throughout states such as Arizona, New Mexico, Nevada, and Texas. This final stage of expansion will rely on the legislation of reliable and long-term incentive policies in those areas, similar to those in California.

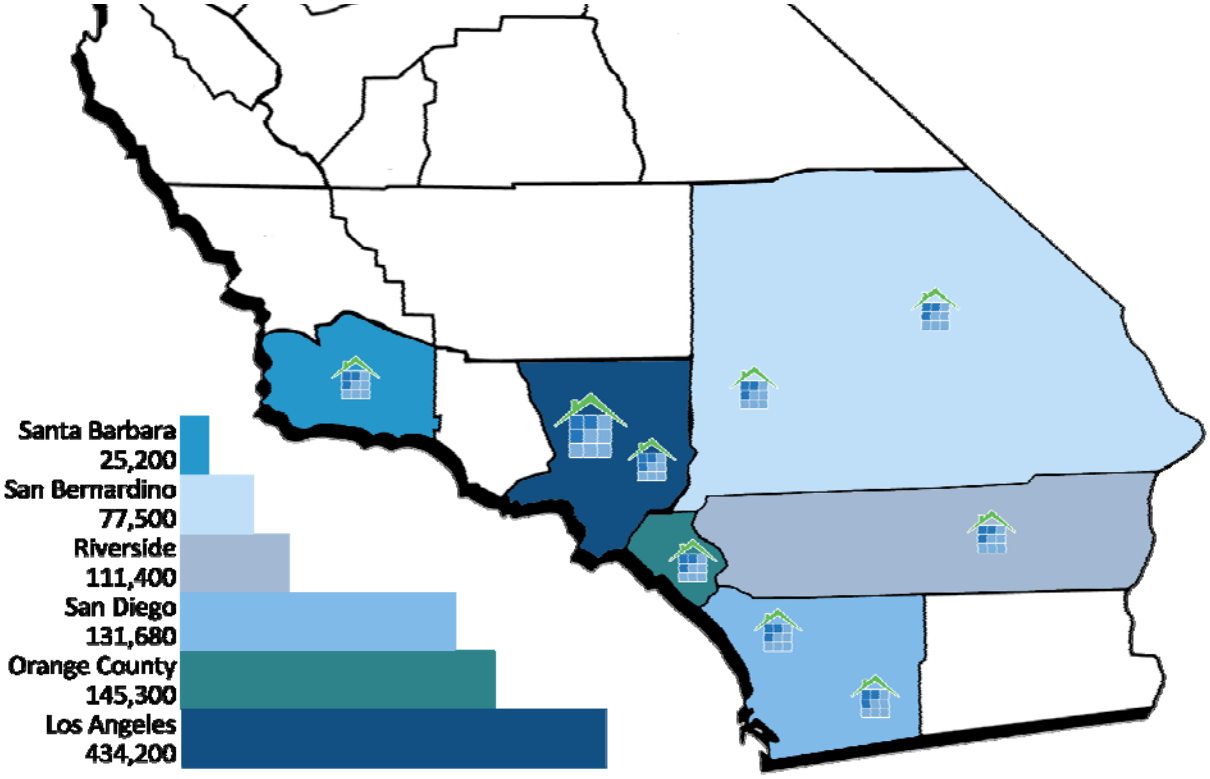


Figure 8: Market Potential and Expansion. EnergyRubix will expand using a nexus-node model. The Los Angeles nexus office will serve as the managerial hub while the nodes will focus on delivering the EnergyRubix service.

1.7 MANAGEMENT TEAM AND ORGANIZATIONAL STRUCTURE

Santa Barbara Nexus Office

The first EnergyRubix office, located in Santa Barbara County, will begin operations and will test all market dependent aspects of our service. Each team member will continuously be asked to provide feedback about the service and protocols so that the executive team can engineer the ideal systems for the entire service.

Expansion

In 2011, EnergyRubix will move its nexus office to Los Angeles and make the Santa Barbara office the first node. All nodes will consist of the following operations team:

- Four energy assessors/sale specialists
- One BPI certified general contractor
- Web assistant
- Account Manager

The Nexus office in Los Angeles will serve as the central management office and will coordinate financing, operations, and marketing strategies. This office will consist of the following Chief Officers:

- Chief Executive Officer (CEO)—manages expansion and company strategy.
- Chief Operations Officer (COO)—manages the home energy assessment, master bid proposal, and home upgrade plan aspect of the EnergyRubix service.
- Chief Financial Officer (CFO)—manages the sales and marketing aspect of the EnergyRubix business.
- Chief Technical Officer (CTO)—manages the EnergyRubix website.

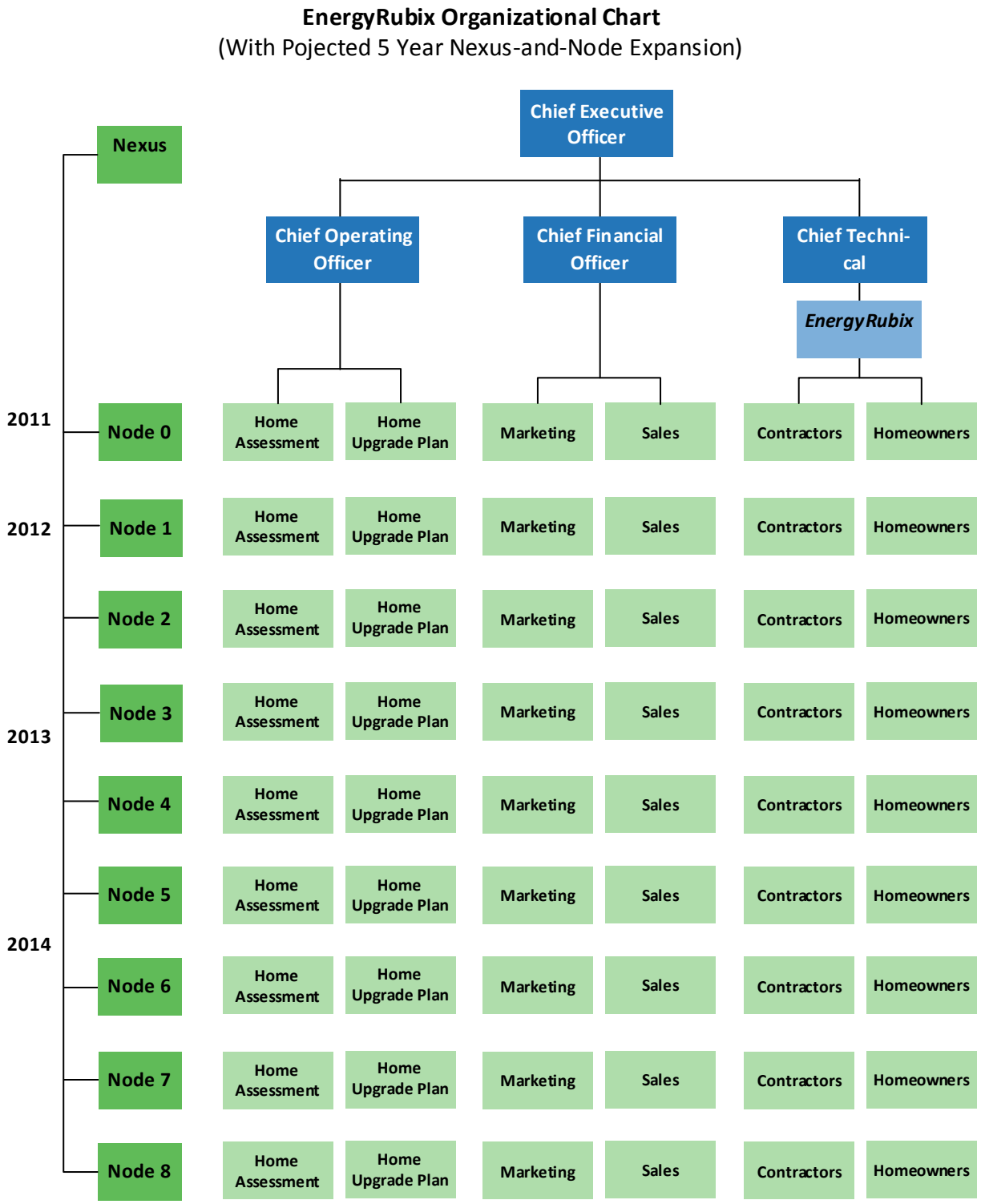


Figure 9: This schematic illustrates the operational chart for EnergyRubix. Each node will have the same structure and will be responsible for assessments, sales, and completing projects while the nexus office in Los Angeles will run the businesses internal operations and manage the company.

1.8 THE ENERGYRUBIX TEAM

Linda Halabi—Project Manager

Linda received a Bachelor's Degree in Physical Geography from San Diego State University in May 2008. During her undergraduate career, Linda held internships with the San Diego Regional Water Quality Control Board and the U.S. Environmental Protection Agency where she worked on environmental projects in the San Diego region and the U.S.-Mexico border region. Linda was recruited to the Bren School of Environmental Science and Management in fall 2008 with the Gayle and Craig Cummings Award. At the Bren School Linda focuses her studies on corporate environmental management and sustainable energy and resource use. As part of a summer internship in 2009, Linda composed greenhouse gas emissions inventories for two cities in San Diego County as part of the San Diego Regional Climate Protection Initiative which works with local governments to address their energy use and contribution to climate change. Linda is now working as a student research assistant for the Institute for Energy Efficiency at UCSB and will be graduating with a Master's Degree in Environmental Science and Management in June 2010.

Andrea Lamartin—Policy Expert and Financial Manager

Andrea received a Bachelor of Arts in Environmental Science with a focus in Biology and a Minor in Spanish from Towson University, Maryland. Growing up on the Chesapeake Bay and spending her summers in Northwest Spain spurred her interest in environmental issues and to expand upon her philosophy that realizing the intersection between science, business, and policy will lead to better decisions regarding energy use and energy efficiency. At Bren, Andrea is pursuing a Master's of Environmental Science and Management with a focus in Corporate Environmental Management. Andrea has interned with the Santa Barbara County Office of Long Range Planning and will join the Santa Barbara Redevelopment Agency Team this winter where she will implement energy efficiency projects in Isla Vista.

Anna Lin—Web Manager

Anna is completing her graduate degree at the Bren School of Environmental Science and Management with specialization in Corporate Environmental Management. She also has a degree in Business Administration and Management from Aletheia University in Taiwan and a degree in Asian Studies from University of California, Santa Barbara. Anna has worked in the architecture, logistics, and semiconductor industries, which developed her interests in emerging technology and sustainable architecture. Anna is currently the Program Coordinator for the California Chapter American Planning Association, Central Coast Section, and she is working towards developing a U.S. market for phase change materials (PCM) in the building industry.

Adam Rohloff—Product Development and Client Liason

Adam Rohloff is a Class of 2010 Master's student at the Bren School of Environmental Science & Management. He specializes in Corporate Environmental Management, and is helping to develop the EnergyRubix business plan as part of the eco-entrepreneurship program. He has gained specific expertise in carbon and energy analysis, life cycle assessment and green building through a number of research positions and internships during his education at the Bren School. Before coming to the Bren School he worked in the Biotechnology industry, as a research associate for a molecular diagnostics company, and holds a Bachelors of Science in chemistry from McGill University in Montreal, Canada.

Aaron Wdowin—Business Development

Aaron Wdowin is currently a candidate for a Master's of Environmental Science and Management, focusing in Corporate Environmental Management with specialization in Eco-Entrepreneurship. He will also be receiving a certificate for the Graduate Program in Management Practice (GPMP) through UCSB's Technology Management Program (TMP) in June. Prior to attending the Bren School, Aaron worked as an environmental consultant with SCS Engineers at their corporate headquarters in Long Beach, California. He was fortunate enough to earn his Bachelor of Science in Environmental Science from Brown University in 2005 and says he is looking forward to his 5 year reunion in May 2010.

Product Development

II. PRODUCT DEVELOPMENT

2.0 PILOT PROJECTS

The EnergyRubix team completed three pilot projects to learn about the complexities customers face when completing a retrofit project. Throughout each individual project, the EnergyRubix team honed customer consultation methods and established professional relationships with the clients to assess their feedback and guide them through the assessment, report, and retrofits.

2.1 PILOT PROJECT 1

Location: San Ramon, CA
Building Size: 2,776 ft^2
Year Built: 1984
Assessment Date: August 2009
Assessment Type: BPI

The homeowner was interested in reducing energy use through energy efficiency retrofits, as well as completing several aesthetic improvements. The greatest concerns were uncomfortable rooms and high utility bills. The upstairs bedrooms in particular experienced significant temperature differences from the rest of the home.

EnergyRubix collaborated with Kevin Beck, a BPI certified professional who and CBPCA member, to complete our first Home Performance Assessment, which included a blower door test, duct blaster test, infrared camera photographs, a visual inspection, and combustion safety testing.

The homeowner and the EnergyRubix team both received copies of the official BPI assessment results report. The report was lengthy and data-filled, making it difficult to comprehend results and identify solutions. EnergyRubix redesigned the report into the Home Assessment Report (Appendix 3).

After presenting the homeowner with the informative HAR and gathering their feedback, EnergyRubix placed the homeowner in contact with two contractors recommended by Kevin Beck. Each contractor individually visited the home and submitted bids detailing the proposed work scope and pricing. The EnergyRubix team realized how difficult it was to compare bids since formatting, level of detail, and cost breakdown were dramatically different. EnergyRubix developed the Master Bid Proposal to alleviate this difficulty.

The homeowner selected one of the recommended contractors and the retrofit process is currently underway. The scope of the retrofits is quite extensive and includes:

- Lighting and electrical upgrades (new ballasts and fixtures)
- Replacing all old ductwork
- Replacing old furnace with combined hydronic heating system
- Replacing old air conditioner unit with smaller and more efficient unit (SEER 16)

- Bathroom Ventilation replacement
- Attic Insulation and side attic insulation
- Extensive air sealing and weather stripping to make very tight building shell

The expected completion is mid April with energy savings of about 40%.

2.2 PILOT PROJECT 2

Location: Claremont, CA
Building Size: 1,200 ft^2
Year Built: 1951
Assessment Date: November 2009
Assessment Type: HERS

The homeowner of the second pilot project, experienced in HERS methodology, helped the team in its first hands-on experience. The homeowner had installed a solar photovoltaic system and solar thermal water heater without improving the building's energy inefficiency, mainly the building's leaky air seal and insufficient insulation. The solar water heater was not yet functioning properly even though it was professionally installed.

EnergyRubix team rented a blower door and thermal infrared camera from Southern California Edison. The blower door test indicated high air leakage; the house was not maintaining desired temperatures. Poor circulation between the attic and basement (attic and basement air was circulating throughout the house) could cause health concerns for residents.

The backwards work order (solar before efficiency) and the huge energy efficiency improvements needed to the home to maximize savings indicated the importance of EnergyRubix's approach.

EnergyRubix provided the homeowner with a HAR outlining the assessment results and recommendations for opportunities for increased efficiency. After implementing these recommended improvements, the use of the solar photovoltaic system will be optimized as the home's energy use decreases, therefore decreasing reliance on the electric grid.

2.3 PILOT PROJECT 3

Location: Santa Barbara, CA
Building Size: 2,600 ft^2
Year Built: 1982
Assessment Date: December 2009
Assessment Type: HERS

Our final pilot project represented a typical home in our target market and initial climate zone.

The homeowners were concerned about the temperature differences between the lower and upper stories and moisture levels in the lower story. Within the past year, the homeowners had installed double pane windows and French doors, sealed the lower story leaks, and added a new seating area in the master's bedroom through a balcony expansion. As a result of these retrofits and replacements, the homeowners were disappointed to find that temperatures were still unevenly distributed.

EnergyRubix worked with local HERS certified professional, Tim Broderick, to complete an HPA. The assessment included data collection of lighting and appliances, window and door measurements, a blower door test, duct blaster test, and infrared readings.

The lower story was consistently colder for a number of reasons. First, the house was built against a cool, damp hill. Since the lower level rooms were located farthest away from the furnace, warm air had to travel the longest distance to these rooms. The natural rising of warm air added to lower level room discomfort. Missing, inefficient, and outdated attic insulation added to overall home discomfort.

EnergyRubix has provided the homeowners with a Home Assessment Report (Appendix 4) outlining the findings above. A local contractor, Vance Harris, a member of Built Green and Santa Barbara Contractors Association (SBCA), has generously agreed to work with EnergyRubix and the homeowners to implement the suggested improvements.

2.4 ENERGY MODELING APPLICATIONS

The EnergyRubix team was able to expand the HPA results of Pilot Project 3 using EnergyPro[23]. EnergyPro is the state approved building modeling program used for Title 24 compliance and HERS verification. We simulated the hourly energy load of the home for a full year to determine the energy intensity of the different building systems (cooling, heating, lighting, appliances), We then simulated the change in energy use resulting from s series of proposed retrofits to the house, to determine which retrofits would result in the greatest energy reductions (**Appendix 6**). We were also able to generate a HERS score (**Appendix 5**), which is useful, because it is anticipated that many incentives for energy efficiency will only be available to HERS certified homes. Refer to Appendices 5 and 6 for examples of one of the calculations generated by EnergyPro and a Greenpoint rated HERS score.

[23] EnergySoft. *EnergyPro*. Computer Software. Vers. 5. Web. http://www.energysoft.com/main/page_energypro_ep_information.html

Supporting Research

III. SUPPORTING RESEARCH

3.0 BACKGROUND

Building Sector Energy Use and Greenhouse Gas Emissions

The buildings sector uses the largest amount of energy in the United States, accounting for 48% of nationwide energy consumption.[24] Similar proportions can be seen for California and for Santa Barbara County.[25] According the Department of Energy's *Energy Efficiency Trends in the Commercial and Residential Buildings* (2008) report, U.S. buildings are responsible for 9% of global CO_2 emissions.

The residential sector includes single detached homes, attached homes, apartments, and mobile homes.[26] Homes built prior to 1991 are responsible for 81.56% of residential energy use in the United States.[27] New homes comprise less than 2% of national building stock, reiterating the importance of increasing energy efficiency in the existing building sector.[28]

In Santa Barbara County, residential buildings account for nearly 20% of County energy use. In the residential sector, lighting accounts for the greatest energy use followed by heating and ventilation, most likely due to the County's mild climate.[29] A 30% reduction in energy use would translate into a savings of 20% of energy demand in the building sector in Santa Barbara County.[30]

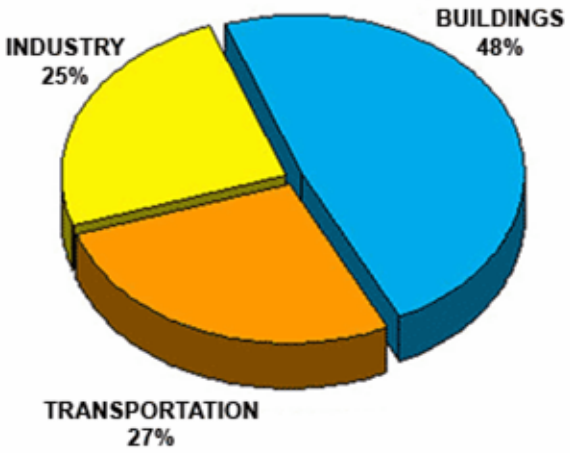


Figure 10: Building energy use accounts for nearly half of United State energy consumption. (Image Source: Architecture 2030.)

According to the local Community Environmental Council (SB CEC), the residential sector uses the greatest amount of energy when compared to industrial and commercial building use. The CEC also expects building energy use to increase by nearly 1,000 gigawatt hours by year 2020. The majority of homes in Santa Barbara were built prior to 1990 when Title 24 energy efficiency building standards were improved. As a result there is a significant opportunity for increased energy efficiency.

Santa Barbara County Climate

EnergyRubix was developed in Santa Barbara for a number of reasons including: large stock of old, inefficient homes, generally environmentally conscious residents, and progress local policies.

[24] Architecture 2030 (© 2006-2009). The Building Sector: A Hidden Culprit. Retrieved November 30, 2009 from http://www.architecture2030.org/current_situation/building_sector.html.
[25] IBID
[26] U.S. Department of Energy (2008 October). Energy Efficiency Trends in Residential and Commercial Buildings. Retrieved December 7, 2009 from http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/bt_stateindustry.pdf.
[27] National Association of home Builders (NAHB) (2007 April 30). Residential Greenhouse Gas Emissions. Retrieved November 30, 2009 from http://www.nahb.org/generic.aspx?genericContentID=75563.
[28] IBID.
[29] Community Environmental Council (2007, November 30). Santa Barbara County Renewable Energy Blueprint: Chapter 2: Reducing Energy Use in Buildings. Retrieved November 30, 2009 from http://www.cecsb.org/storage/communityenvironmentalcouncil/documents/ch2_reducing_energy_use_in_buildings.pdf.
[30] IBID

Santa Barbara County is comprised of three building climate zones: zones 4, 5, and 6 as delineated by the California Energy Commission (CEC). It is important for EnergyRubix to consider the variant climates throughout the County because of the potential impacts on market demand for energy efficiency retrofits, heating and cooling needs, and potential return on investment for homeowners.

Average climate throughout the County is temperate and characterized by mild temperatures. Inland temperatures are often higher during the day and lower at night than those along the central coast. Most of the County lies in Zones 5 and 6, characterized by mild temperatures, while areas of North County in the Santa Ynez Mountains fall within Zones 4 and 5; temperatures can be up to 15-20 degrees warmer in these areas.[31] Areas along the south coast in Zone 6 require little heating and cooling compared with interior areas. The entire Central Coast region is optimal for solar, as the sun shines xxx days in the year.

The Contracting Industry

In Santa Barbara County, contracting jobs have declined by 22%, from 10,800 in 2007 to 8,400 in 2009.[32] Santa Barbara County estimates that 350 jobs could be created from retrofitting just 1% (1,500) of the County's existing housing stock.[33] The EnergyRubix framework will create a network that saves individual contractors time and money by helping them to find and complete jobs. The entire contracting industry will benefit from the streamlined approach that allows contractors to retrofit homes, rather than focus on the marketing and selling required to win bids.

[31] Santa Barbara County (2009 November 2) Municipal Energy Financing District Feasibility Study.
[32] IBID.
[33] IBID.

3.1 POLICY ANALYSIS

Policy analysis has been divided into Federal, State, and Local policies and initiatives related to climate change and energy efficiency. While many important policies related to building efficiency exist and are being developed, only those that are most relevant to the goal of this project and have direct implications for the EnergyRubix business have been included.

Federal Legislation

The American Recovery & Reinvestment Act (ARRA)
The American Recovery & Reinvestment Act (ARRA), or economic stimulus, has promoted energy efficiency projects throughout the country with the intent of spurring a national green economy. ARRA, signed by President Obama in February of 2009, totaled $787 billion of which $65 billion were designed as tax credits for residential and industrial building energy efficiency projects and $42 billion were directed towards energy efficiency and renewable energy projects. ARRA has spurred national interest in energy efficiency projects and created momentum for such projects to continue.

As of October of 2009, California has received over $21 billion in funding and according to Recovery.gov, the official ARRA tracking site, over 70,200 jobs have been created in the State.[34]

HR 2454: The American Clean Energy & Security Act of 2009 (ACES)
The national ACES bill was introduced in 2009 to combat climate change, transition to a clean energy economy, and establish energy independence. ACES would establish a national cap-and-trade program and includes provisions for renewable energy, carbon sequestration, and energy efficiency incentives for homes and buildings. H.R. 2454 requires a 17% reduction of GHG emissions from 2005 levels by 2017.[35] The bill's passage, which has not passed at the time of this writing, would establish a national home energy efficiency program and spur business development in the home energy retrofit sector, which positively impacts the profitability of businesses such as EnergyRubix.

S 1733: Clean Energy Jobs & American Power Act
SB 1733 is the counterpart bill of HR2454 and was introduced by Senators John Kerry and Barbara Boxer.[36] The bill calls for 20% reduction of GHGs from 2005 levels by 2020 and 83% by 2050 through a cap-and-trade system. Like ACES, this bill stresses the creation of American clean energy jobs, efficiency standards for buildings, and a strong renewable energy portfolio. Both ACES and S 1733 set a cap level for the years 2012, 2030, and 2050, reducing GHG emissions from covered sources from 2005 levels by 3%, 42%, and 83%, respectively.[37] EnergyRubix will rapidly position itself in several communities to take advantage of the national energy efficiency campaigns we expect to see as the deadlines for these goals approach.

HOME STAR
Home Star, also known as "Cash for Caulkers", is a proposed federal program that would provide direct incentives to homeowners who invest in improving the energy efficiency of their homes. This program

[34] Recovery.gov
[35] Environmental Protection Agency Office of Atmospheric Programs (2009 October 23). Economic Impacts of S. 1733: The Clean Energy Jobs and American Power Act of 2009. Retrieved December 5, 2009 from http://www.epa.gov/climatechange/economics/pdfs/EPA_S1733_Analysis.pdf.
[36] IBID.
[37] IBID.

will provide homeowners with up to $2,000 for implementing at least two prescriptive upgrades from a list of qualifying measures and up to $3,500 for at least four.

Further performance-based incentives are available as reductions in energy consumption are demonstrated. Projects that reduce energy use by 20 percent are eligible for up to $4,000 plus $1,500 for each additional 5 percent reduction with a cap at 50% of project costs.[38] The Obama administration supports HOME STAR as it will potentially create thousands of jobs for contractors, save homeowners 20% on their energy bills, and could result in GHG reductions equivalent to removing half of automobiles off the roads.[39]

California Legislation

California has a track record of passing innovative and environmentally motivated legislation. In recent years, Governor Schwarzenegger has passed significant laws mandating GHG reductions, providing incentives for renewable energy and efficiency projects, and feed-in-tariffs. These policies have had, and will continue to have, significant impacts on the energy industry, utilities, and "green" businesses.

AB 32: The Global Warming Solution Act
Signed in 2006, AB 32 establishes a market based and regulatory framework to reduce greenhouse gas emissions in the state of California. AB 32 calls for a 15% reduction of statewide GHG emissions by 2020 and an 80% reduction by 2050.[40] The Scoping Plan (written by the California Air Resources Board) lists actions to be taken in a number of areas, including green building and energy efficiency. While the main scope of AB 32 measures are for state owned and commercial buildings, the Act sets a precedent for further actions aimed at the residential building sector.

AB 811: Establishment of Financial Districts for Renewable Energy & Building Energy Efficiency
AB 811 allows jurisdictions to create special financing districts where property owners can take out low-interest loans to complete solar installations and/or energy efficiency retrofits. Recently passed AB 474 legislation expands AB 811 financing to cover water conservation measures. Loans are paid back through a lien on the homeowner's property tax. This structure affords customers and contractors a great deal of flexibility in completing custom energy efficiency retrofit work while softening the upfront costs associated with such projects.

Aiming to reduce energy use in the building sector, AB 811 is a critical and innovative piece of legislation that will help meet California's GHG emission reduction goals while simultaneously generating demand for residential energy efficiency and creating workforce opportunities. This Bill has already dramatically increased business for contractors and solar installers throughout the state.

Title 24
Title 24 of the California Code of Regulations CCR, also known as the California Building Standards Code, sets regulations that govern the design and construction of all buildings, associated facilities and equipment. Title 24 standards were first adopted in 1978 and are updated periodically. The 1990

[38] Efficiency First. The HOME STAR Program. www.efficiencyfirst.org/home-star/
[39] Leonhardt, D. (2009 November 17) A Stimulus that could Save Money. Retrieved January 14, 2010 from http://www.nytimes.com/2009/11/18/business/economy/18leonhardt.html.
[40] Santa Barbara County (2009 November 2). Santa Barbara County Municipal Energy Financing District Feasibility Study.

standards set more stringent energy efficiency levels; most homes in Santa Barbara County were built prior to the 1990 standards, and are much more inefficient than newer homes.

The most recent 2008 standards went into effect on January 1, 2010 and include changes to accommodate a number of California's needs, including compliance with AB 32. California's building efficiency standards (along with those for energy efficient appliances) have saved more than $56 billion in electricity and natural gas costs since 1978. It is estimated the standards will save an additional $23 billion by 2013[41]. A draft of new 2010 standards, known as the CALGreen code, is currently under review.

California Public Utilities Commission (CPUC) CA Long Term Energy Efficiency Strategic Plan
In September of 2008, the CPUC released the California Long Term Energy Efficiency Strategic Plan (CLEESP) listing strategies and specific target goals for various economic sectors, including the residential building sector, to improve their energy efficiency. Energy consumption in existing homes will be reduced by 20% by 2015 and 40% by 2020 through universal demand for highly efficient homes and products.[42]

CLEESP establishes programs to help achieve these energy efficiency goals and including making improvements HVAC systems, the building envelope, lighting, heating, water heating, and electronic and appliance plug loads.[36] Strategies include carbon labeling systems, financing options, enforcing compliance of updated Title 24 standards, and designing home rating system projects based on the CEC Home Energy Rating System (HERS).[43]

As the CPUC and other California agencies work to achieve these goals, it is anticipated that incentives and rebates for energy efficiency and building scale renewable energy generation will be increased, upfront costs will be lowered, consumers will become better educated, and financing options will be provided.

Local Efforts

Local policies can have significant impacts since they are targeted towards the specific conditions, needs, and economics of an area. Santa Barbara County is developing policies and programs targeting and promoting energy efficiency, GHG reductions, and financing mechanisms.

emPOWER SBC
The emPOWER SBC Program is Santa Barbara's Countywide AB 811 financing district. The program is one of a few financing districts of any scale to be established in the State of California. emPOWER SBC will offer homeowners and business owners the ability to obtain 7% interest loans for energy efficiency, renewable energy, and water conservation projects. By eliminating upfront costs, emPOWER will help spur demand for home energy efficiency improvements and renewable energy.

[41] California Energy Commission. California's Energy Efficiency Standards for Residential and Nonresidential Buildings. www.energy.ca.gov/title24/
[42] California Long Term Energy Efficiency Strategic Plan. September 2008. Retrieved April 29, 2009 from http://www.californiaenergyefficiency.com/docs/EEStrategicPlan.pdf.
[43] IBID.

Santa Barbara County Climate Action Strategy

Santa Barbara County's Climate Action Strategy (CAS) is a communitywide plan to reduce greenhouse gas emissions through a number of actions and measures including those targeted at increasing the energy efficiency of the residential sector. The plan is currently in development and according to Santa Barbara County Office of Long Range Planning staff, emPOWER SBC could serve as a major initiative of the plan.[44]

Table 12: Overview of relevant policies and impact

POLICIES AND IMPACTS								
Policy	**Description**	**Status**	**Scope**			**Impact**		
			Fed	State	Local	Contractor	Homeowner	EnergyRubix
American Recovery & Reinvestment Act (ARRA)	Federal stimulus package: major focus on energy efficiency & green economy	Passed 2009	√			√		
HOME STAR	Up to 50% financing for residential retrofits	Senate Review 2010	√	√		√	√	√
The American Clean Energy & Security Act (HR 2454)	Climate bill: national cap & trade, renewable energy	Not passed	√			√	√	√
Clean Energy Jobs & American Power Act (S 1733)	Climate bill: 20% GHG reduction by 2020, cap and trade	Not Passed	√					
Global Warming Solutions Act (AB 32)	California GHG reduction goals with market based, regulatory strategies	Passed 2006; Scoping Plan 2008		√	√	√	√	√
Assembly Bill 811 (AB 811)	Loans for renewable energy and home efficiency tied to property taxes	Passed 2008		√	√	√	√	√
CaliforniaFIRST (AB 811)	Statewide AB 811 financing mechanism	Passed 2009		√		√	√	√
California Long Term Energy Efficiency Strategic Plan (CLEESP)	Energy efficiency strategies with residential sector goals	Passed 2008		√				

[44] Imgrund, H. (2010 January 8) Email communication with Planner Heath Imgrund from Santa Barbara County Office of Long Range Planning.

3.2 INCENTIVES

Various incentives exist for energy efficiency work at the federal, state, and local levels. Incentives can take the form of energy efficient mortgages, tax credits, tax breaks, and rebates. Incentives are critical funding opportunities for homeowners because they help alleviate financial constraints that may prevent extensive energy efficiency improvements. EnergyRubix will assist homeowners navigate incentives available to them to optimize funding.

CaliforniaFIRST

CaliforniaFIRST offers member jurisdictions administrative guidance for AB 811 financing. Property owners can take advantage of financing through CaliforniaFIRST after their local government joins the Program. The statewide property assessed clean energy (PACE) program enables local governments to finance renewable energy and energy efficiency projects by providing loans to residents of member jurisdictions to be paid back as a line item on their property tax.[45]

Energy Efficient Mortgages (EEM)

An energy efficient mortgage (EEM) allows homeowners to receive loans when refinancing a home to help pay for energy efficiency improvements or upgrades.[46] EEMs are usually granted when purchasing a new home. The cost of the improvements are spread out over the period of the mortgage or loan itself, reducing the upfront cost of the project, that is EEMs "[credit] a home's energy efficiency in the mortgage itself".[47,48] In order to qualify, the financed upgrades must be cost-effective; the utility bill savings realized from the efficiency upgrades must be greater than the added cost of the EEM.[49] Since utility bills are typically lower in energy efficient homes, homeowners can qualify for larger loans.[50] In order to attain the loan, a homeowner must obtain a HERS report or be able to ensure that the home meets Energy Star criteria.

Tax Incentives

A tax credit is a highly desirable incentive since it "reduces tax dollar-for-dollar" instead of just reducing taxes by a percentage (like a tax deduction).[51] The federal government provides a number of tax credits for qualifying homeowners and energy efficient work. The list below highlights several current tax credits and the types of projects included:[52]

[45] Renewable Funding (n.d.) CaliforniaFIRST Local Government Information. Retrieved January 17, 2010 from http://www.renewfund.com/node/221.
[46] Community Environmental Council (CEC). (2010 January). Five Steps: Get Started with Home Performance. Retrieved January 19, 2010 fromwww.cecsb.org.
[47] Energy Star (n.d.) What is an Energy Efficient Mortgage? Retrieved December 29, 2009 fromhttp://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.energy_efficient_mortgage.
[48] Community Environmental Council (CEC). (2010 January). Five Steps: Get Started with Home Performance. Retrieved January 19, 2010 fromwww.cecsb.org.
[49] IBID.
[50] Flex Your Power (© 2009). Financing an Energy-Efficient New Home. Retrieved December 29, 2009 from http://www.fypower.org/res/efficient_homes/financing.html
[51] U.S. Department of Energy (n.d.) Consumer Energy Tax Incentives. Retrieved December 29, 2009 from http://www.energy.gov/taxbreaks.htm.
[52] Energy Star (2009 December 18). Federal Tax Credits for Consumer Energy Efficiency. Retrieved December 29, 2009 from http://www.energystar.gov/index.cfm?c=tax_credits.tx_index.

- 30% of cost up to $1,500
  - Biomass stoves, HVAC, insulation, roofs, water heaters (non-solar), windows and doors
  - Expires December 31, 2010
- 30% of cost
  - Geothermal heat pumps, residential wind turbines, solar energy systems
  - Expires December 31, 2016
- 30% of cost to $500 per 0.5kW power
  - Fuel cells
  - Expires December 31, 2016

Home Performance with ENERGY STAR

Home Performance with ENERGY STAR is a national program through the U.S. EPA and U.S. DOE that offers a comprehensive, whole-house approach to improving the energy efficiency and comfort of homes. The program provides information on home performance and energy efficiency measures to homeowners and contractors.

In California, there are various county-level and local programs that promote green building and energy efficiency. These programs vary in scope by county, but they are critical for homeowners to help them cover high costs of improvements and achieve the overall goal of AB 32. Listed below are several existing incentive programs throughout the State.

Green Building and Utility Incentives

A number of municipalities and counties in California have established or are developing incentive programs for green building and energy efficiency projects. For example, Southern California Edison and other local utility providers offer rebates toward the purchase of efficient appliances, water heaters, furnaces, and insulation.[53] This section highlights several existing programs.

Home Energy Efficiency Rebates

Home Energy Efficiency Rebates provided by Southern California Edison (SCE) are aimed at helping homeowners purchase and install energy efficient appliances and equipment. These rebates are provided at the time of purchase at participating stores, as well as an online and mail in rebate service. Some current rebates include:

- ENERGY STAR® qualified refrigerator ($50)
- ENERGY STAR® qualified room air conditioner ($50)
- Electric water heater ($30)– Whole house fan ($50)
- Ducted evaporative cooler system ($300-$600)
- Two-speed and variable-speed pool pump and motor system ($200)
- Attic and wall insulation ($0.15 per sq/ft)

[53] Community Environmental Council (CEC). (2010 January). Five Steps: Get Started with Home Performance. Retrieved January 19, 2010 fromwww.cecsb.org.

Comprehensive Home Performance Program (CHPP)

The CHPP is a joint program between Southern California Edison (SCE) and Southern California Gas (SCG) resulting from state Comprehensive Home Energy Performance (CHEP) legislation. Under this program, SCE provides contractors with incentives for training to conduct audits, develop a comprehensive improvement package, perform energy efficiency retrofits, and verify the overall results through a test out. SCE works with BPI certified contractors that go through CHP (comprehensive home performance) training. Under CHEP homeowners can receive up to $3500 for installations and improvements in the form of rebates, given proven energy savings.

Home Energy Efficiency Survey

Southern California Edison has offered free surveys that collect energy use information from homeowners through a phone interview, mail in, online survey, or a house visit. The surveys gather information focused on appliance use and provides the homeowner with information and a customized report explaining energy use, and links customers to rebates and incentives provided by the utility.

Southern California Gas Company Energy Efficiency Incentives

Southern California Gas Company (SoCalGas) offers funding opportunities similar to AB 811. Customers can take out low-risk loans from the utility, up to $20,000 to pay for the following improvements: water heaters, cooling, windows, ceiling and attic, insulation, roofing, spa and pool, plantation shutters, and natural gas barbecue grills.[54] SoCalGas also puts customers in contact with a list of contractors in the area. While this program allows for simple home improvements, it is important to note that SoCalGas does not require an energy assessment prior to retrofits. Without testing the house first, work may be done that does not fully address an existing problem or make the most of the energy efficiency opportunities. Additionally, homeowners must attempt to determine which contractor is best for them as SoCalGas does not provide personal consultation services.

[54] Southern California Gas Company (n.d.) Home Energy Upgrade Financing sponsored by The Gas Company℠. Retrieved January 12, 2010 from http://www.socalgas.com/residential/savemoney/refinancing.html.

3.3 BUILDING SCIENCE AND HOME PERFORMANCE

Energy efficiency ensures that appliances and integrated systems, such as HVAC, are properly sized to meet cooling, heating, and ventilation needs. An energy efficient home serves as a healthy and safe living environment for the occupants by improving air quality and comfort of the home while reducing monthly energy costs. A high performance building should be durable and properly insulated to maximize endurance and minimize air leakage.

Common Practices

There are myriad options for improving a home's energy use. These options vary in style, functionality, cost, and energy savings potential. This section introduces several effective and common practices, but is by no means an exhaustive list.

Exterior improvements can include cool roofs and roof overhangs. Cool roofs are painted a light color or made of highly reflective material to reduce the amount of solar heat absorbed. Since attic temperatures can typically range between 100-120^{o}F, cool roofs can reduce these temperatures and decrease the amount of cooling required in a home. Roof overhangs help block sunlight. This is an important feature for rooms facing the sun for extended periods of time since the overhangs help reflect solar radiation (heat). This again, helps reduce cooling needs.

Interior energy efficiency retrofits can be as simple as weather stripping doors and windows or as invasive as resizing ducts. Common retrofits include windows, lighting, and insulation improvements. The impacts of retrofits vary with the building condition, lifestyle, and retrofit items themselves.

Building Envelope

It is critical that building envelopes are completely sealed; the interior conditioned space must be isolated from the outside to maintain temperature and moisture. Envelope leakage is a major contributor to both high energy bills and the inability to keep the home at a comfortable temperature. Air infiltration can account for 30% or more of a home's heating and cooling costs and contribute to problems with moisture, noise, and dust.[55] Sealing holes and seams with caulk, gaskets, or foam sealants creates air barrier to prevent infiltration of outdoor air seeping through cracks and openings into the interior of the building.

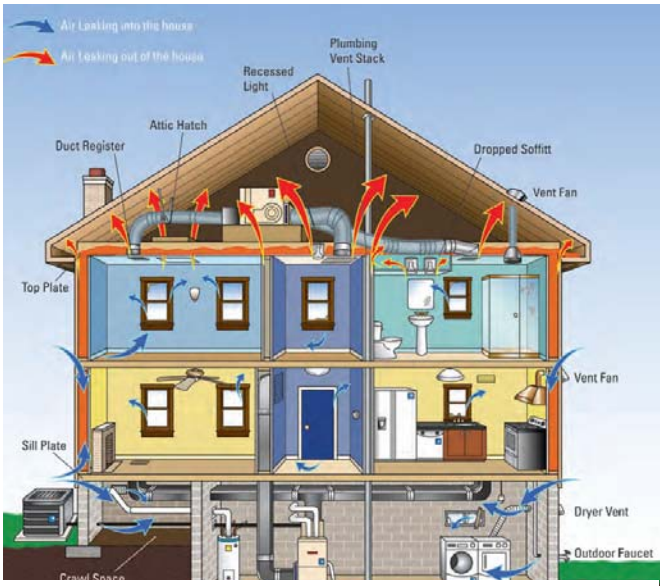


Figure 11: Leaks in the building envelope allow outside air to enter the home and conditioned air to leave the home, resulting in lower comfort and higher utility expenses.

As heated air rises, it leaks out of holes in the building envelope, escaping into the attic and out of the building. This rising air creates low

[55] Energy Efficiency and Renewable Energy Clearinghouse. (2000 February) Air Sealing: Seal Air Leaks and Save Energy! Retrieved October 21, 2009 from http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/26446.pdf.

pressure in the lower part of the home which draws cold unconditioned air into the house. Replacement air is often drawn from the crawlspace, basement, and wall cavities which can increase moisture levels and cause indoor air quality issues.

The largest holes in building envelopes are usually hidden from view in areas connecting the ceiling, crawlspace, or basement. Common leakage sites include, but are not limited to, ductwork, plumbing chases, attic accesses, pull-down stairs, recessed light fixtures, holes in mechanical room closets, and wiring penetrations of top plates of walls and through ceilings. These areas represent the majority of openings between the attic and conditioned space. Major areas of leakage into the crawlspace or basement occur around the tub drain, plumbing, HVAC, and wiring penetrations through floor decking and bottom plates of walls.

Sealing air leaks reduces heating and cooling loads. Additional savings are realized as heating and cooling equipment can be downsized as a result of envelope improvements. Furthermore, a tightly sealed building envelope helps reduce problematic issues such as pollutants, insects, and rodents entering the home, which ultimately improves building durability and creates a healthier indoor environment.

Upgraded window performance can reduce energy use and utility costs, improve indoor comfort, decrease condensation, increase indoor natural lighting, and lower HVAC costs. Window retrofits can include glazing, frame improvement, low-emittance (low-E) coating56, spacers, double pane, and operable windows (can be operated by users). Glazing and low-E coating help suppress radiative heat flow, while spacers and double panes can help reduce interior condensation. Operable windows can aid in indoor passive cooling and increase ventilation of fresh air that travels in and out of the building.

Insulation

Properly insulating your home will not only help reduce your heating and cooling costs but also make your home more comfortable. By providing an effective resistance to the flow of heat, proper insulation can result in up to 20 percent savings on heating and cooling costs.[57]

Insulation performance is measured by R-value—its ability to resist heat flow. A higher R-value mean more insulating power and different R-values are recommended for walls, attics, basements, and crawlspaces, depending on location. In order to ensure optimal performance it is important to seal air leaks before installing insulation as it functions best when air is not moving through or around it.

Figure 12: Insulation helps keep your house warm in the winter and cool in the summer by preventing the free flow of air between your house and outdoors.

Unless your home was specially constructed for energy efficiency, you can usually reduce your energy bills by

[56] Efficient Windows Collaborative. Window Technologies: Low-E Coatings. Retrieved October 21, 2009 from http://www.efficientwindows.org/lowe.cfm.
[57] U.S. Environmental Protection Agency. Energy Star. "A Guide to Energy-Efficiency Heating and Cooling." August 2009.

adding more insulation. Many older homes have less insulation than homes built today, but adding insulation to a newer home may also pay for itself within a few years.[58]

Roof insulation is one of the most cost-effective energy upgrades. It improves comfort by reducing heat loss in winter and heat gains in summer. Basement insulation can furthermore effectively block out cold temperature and moisture generated from soil. It also eliminates the threat of insect infestation.

Commonly used insulation techniques for existing homes include loose-fill, sprayed foam, foam board, and blanket (batt and roll) insulation. Materials for insulation often include fiber, cementitious, phenolic, polystyrene, polyurethane, cellulose, fiberglass, and mineral (rock or slag) wool. Cellulose is usually made from recycled wood fiber (primarily newsprint), fiberglass contains 20 to 30% recycled glass, and mineral wool is produced from 75% post-industrial recycled content.[59] Although costs vary, cellulose, fiberglass, and mineral wool are usually more affordable and provide better coverage than batt installation.

Loose-fill insulation is a good choice for finished buildings; the materials and method used can conform to any space without disturbing structures or finishes. Sprayed foam insulation is another good choice for finished buildings; the liquid foam material can be sprayed, foamed-in-place, injected, or poured. Foam boards are rigid panels that can be used to insulate almost any part of a building, from the roof down to the foundation.[60]

Foam board insulation provides good thermal resistance by using insulation sheathing to reduce heat conduction that penetrates through structural elements, such as wood and steel studs; it adds structural strength to buildings as well. Blanket insulation is the most common and widely available type of insulation; the costs are also lower than other methods. Standard fiberglass blankets have high thermal-resistance (R-value) and high performance (density). Batts with special flame-resistance facing are also available in the market.

Maximum thermal performance of insulation depends heavily on proper installation. It is also important that insulation materials should be slit, cut, or notched to fit tightly around obstructions and should be fluffed to full thickness. It is best to have certified technicians complete the project.

HVAC and Ductwork

Heating and cooling is one of the largest energy expenses for most homes, and can account for half of the energy used in a home. In addition, many heating and cooling systems have certain supporting equipment in common, such as thermostats and ducts, which provide opportunities for saving energy.

If your heating equipment is more than 10 years old or not keeping your house comfortable, consider replacing it with a unit with an ENERGY STAR rating. Before buying a new furnace or boiler or modifying an existing unit, it is important to improve the energy efficiency of the home by sealing air leaks and adding insulation for example. Energy-efficiency improvements will save money on a new furnace, because you will likely need a smaller, and a properly sized furnace will also operate most efficiently. A

[58] U.S. Department of Energy. Insulation and Air Sealing. Retrieved October 21, 2009 from http://www.energysavers.gov/your_home/insulation_airsealing/.
[59] IBID.
[60] U.S. Department of Energy. Insulation and Air Sealing. Retrieved October 21, 2009 from http://www.energysavers.gov/your_home/insulation_airsealing/.

system that is too large will not keep your home comfortable because of frequent 'on/off' cycling. Incorrect sizing can also put stress on system components and shorten the equipment's life.

Ducts are used to distribute conditioned air throughout houses with forced-air heating and cooling systems. In typical houses, about 20 percent of the air that moves through the duct system is lost due to leaks, holes, and poorly connected ducts.[61] This results in an inefficient HVAC system, high utility bills, and difficulty keeping the house comfortable.

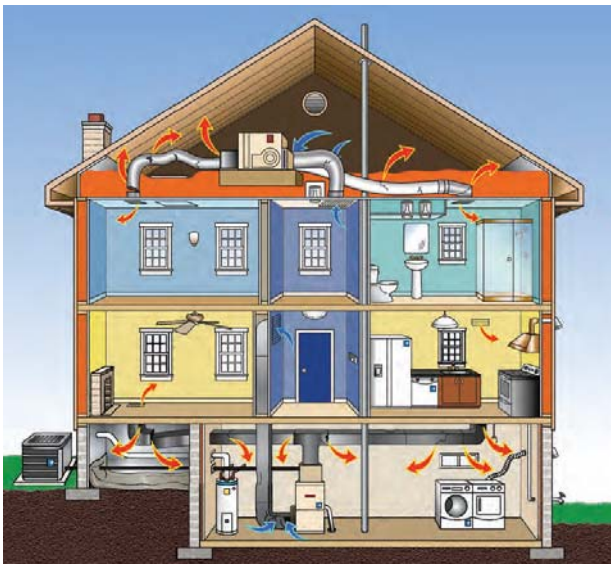


Figure 13: Common duct problems include leaky, torn, or disconnected ducts, kinks, poorly sealed registers and grilles, and leaks at the furnace. (Image Source: U.S. Environmental Protection Agency. Energy Star. "A Guide to Energy-Efficiency Heating and Cooling". August 2009.)

A duct system generally includes a collection of tubes that run within walls, ceilings, and floors through various rooms, leaving an opportunity for unnoticed leaks. Ducts can make a big difference in both cost and effectiveness of heating and cooling a building; it can also have important health effects on occupants through the distribution of indoor air pollution.

Air leakage occurs when ducts have cracks or poorly connected duct joints. Heat conduction occurs when the air ventilating attics or crawl spaces comes from outdoors. The temperature inside the ducts (used to heat or cool the building interior) is usually different than the temperature outside the ducts (air from outdoors); therefore, energy is lost due to conduction activity penetrating through duct walls.

Leaky ductwork can be problematic due to the potential of transporting unhealthy air from the attic, crawl space, or garage into the home; heated or cooled air (generated by HVACs) may also mix with outdoor air and decrease the efficiency of HVAC systems. This leads to the common oversight of choosing oversized HVAC systems.

Improved duct efficiency can be achieved by sealing off and/or minimizing the surface area of ducts outside the conditioned space. This method helps maintain the heated or cooled air temperature inside duct pipes (less convection through duct walls). Other practices include repairing cracks and properly connecting duct joints. Changes and repairs to duct systems should always be performed by qualified professionals. Well-designed and up-kept ductwork, along with properly-sized HVAC systems can help maintain indoor air quality, ensure comfort and safety, and reduce energy use.

Ventilation is essential to reduce odor and stuffiness. Simple strategies include operable windows and exhaust fans (spot ventilation in kitchens and/or baths), while more complex systems incorporate whole house fans. A whole house fan cools the house by drawing cool air in from windows and exhausting hot air out through the attic. The system is virtually a hole in the ceiling; therefore it must be properly installed, fully sealed, and adequately insulated so it does not pose as a potential for energy loss. In

[61] U.S. Environmental Protection Agency. Energy Star. "A Guide to Energy-Efficiency Heating and Cooling". August 2009.

addition, most building codes require roof vents to expel moisture that damages and reduces insulation effectiveness, and some evidence show attic ventilation not beneficial for all climates; therefore, local code requirements should be referenced before undertaking any renovations.

Lighting and Appliances

Artificial lighting consumes almost 15% of a household's electricity use. Use of new technologies can reduce lighting energy use in homes by 50%–75%.62 Lighting energy use can be reduced by selecting more efficient lighting sources and by installing lighting controls.

Lighting modification can often be the simplest and lowest cost method to reduce electricity usage, and can achieve noticeable results. Additionally, traditional incandescent bulbs give off substantial heat and burn out more frequently than other alternatives. Compact fluorescent lights or CFLs lasts 10 times longer than incandescent and typically use 75% to 80% less energy than an incandescent bulb.

If you live in a typical U.S. home, your appliances and home electronics are responsible for about 20% of your energy bills. Look for ENERGY STAR and EnergyGuide labels when purchasing appliances. ENERGY STAR labels appear on appliances and home electronics that meet strict energy efficiency criteria established by the U.S. Department of Energy and U.S. Environmental Protection Agency. The Federal Trade Commission requires EnergyGuide labels on most home appliances (except for stove ranges and ovens), but not home electronics, such as computers, televisions, and home audio equipment. EnergyGuide labels provide an estimate of the product's energy consumption or energy efficiency. They also show the highest and lowest energy consumption or efficiency estimates of similar appliance models.

Many appliances continue to draw a small amount of power when they are switched "off." These "phantom loads" occur in most appliances that use electricity, such as VCRs, televisions, stereos, computers, and kitchen appliances. Most phantom loads will increase the appliance's energy consumption a few watt-hours. These loads can be avoided by unplugging the appliance or using a power strip and using the switch on the power strip to cut all power to the appliance.

[62] U. S. Department of Energy. Energy Savers: Lighting. Accessed on February 22, 2010 from www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=11980.

3.4 RATING SYSTEMS

Building performance, energy use and efficiency, and overall functioning can be assessed and measured through various existing rating and certification programs. Table 4 below highlights several programs, how to become a certified tester, and how much verification costs.

Building Performance Institute (BPI)

A Building Performance Institute (BPI) has established a rating system and offer training to help contractors become certified. Training focuses on comprehensive whole home assessments that view the building as a system, encompassing health, safety, comfort, and energy concerns. The BPI approach focuses on equipment measurements using the blower door test and duct blaster test. Additional testing includes combustion testing and extensive pressure testing in individual rooms. Building energy efficiency retrofit and weatherization standards developed by BPI are widely used and cited by DOE and EPA's Home Performance with Energy Star program.

Home Energy Rating System (HERS) and HERS II

A Home Energy Rating System, or HERS, home assessment is a tool to diagnose problem areas in a home and to ensure 2005 Title 24 compliance in energy efficiency requirements. A HERS rating involves field verification and diagnostic testing including a blower door and duct test. The results of the assessment are analyzed using an energy efficiency software package, such as EnergyPro, to generate a HERS index score for the home. While HERS raters are not explicitly trained to make recommendations on the energy efficiency improvements needed to meet ENERGY STAR performance guidelines, they work with builders to do this.

A more comprehensive HERS program, HERS II, has been released by the CEC to provide better information to homeowners regarding their homes' performance. Unlike HERS, which simply diagnoses a home's problem areas, HERS II will score a home's energy performance along a scale of 0 through 250, where 0 is a net zero energy home and 250 is a very energy intensive home. The average home scores a 155. Figure provides a sample score sheet. A HERS II rating examines the building envelope, distribution system, lighting and appliances, heating, cooling, water replacements, and considers solar photovoltaics.[63]

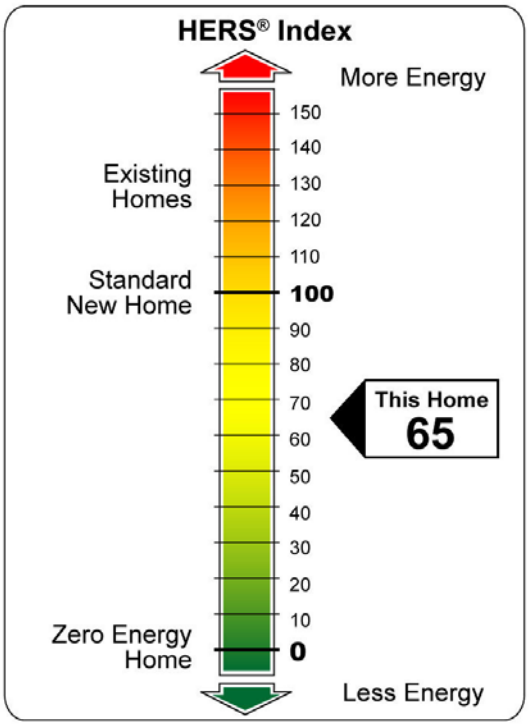


Figure 14: The HERS II score card will rate a home's energy use. The Greater the number, the greater the energy use. A score of 0 indicates zero net energy, meaning the home does not use more energy than it produces.

[63] Pennington, B. (2009 May 20). California Home Energy Rating System Program Phase II; Local Government Training. The California Energy Commission. Retrieved December 29, 2009.

There are three organizations that have been certified by the CEC to train HERS raters: the California Building Professional Contractors Association (CBPCA), the California Certifies Energy Rating & Testing Services (CalCERTS), and the California Home Energy Efficiency Rating Services (CHEERS). In addition to offering HERS training, the CBPCA also offers home energy performance training that teaches contractors to analyze and remediate, as well as diagnose the energy performance of a home.

HERS Certification

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Built Green

The Santa Barbara Contractors Association (SBCA) developed the Built Green environmental building program for County contractors, designers, and architects. Built Green building certification consists of fulfilling specific requirements and an assessment is completed through a checklist process. Built Green is not as in-depth as HERS or BPI and does not focus primarily on assessing problem areas, but it does promote such practices as efficient water heating, efficient household appliances, and advanced framing.[64]

Energy Star

Energy Star is mainly recognized as a label promoting efficient appliances. Energy Star is also a federal green building designation for new homes and provides tools and resources for improving the energy efficiency of existing homes. It promotes many of the energy efficiency features recommended by HERS such as building envelope efficiency and improved air circulation.[65] Since the Energy Star program is administered at the federal level and has a national scope, it does not involve an in depth home energy assessment. Homeowners can gather information and estimate potential energy savings and improvements, but with lack of a proper diagnosis, “behind-the-scenes” improvements may be missed.

[64] SBCA (n.d) Built Green Features. Retrieved December 28, 2009 from http://www.builtgreensb.org/features.html.
[65] Energy Star (n.d.) A Green Home Begins with ENERGY STAR Blue. Retrieved December 28, 2009 from http://www.energystar.gov/index.cfm?c=new_homes.nh_greenbuilding.

Table 13: Energy Efficiency Rating Systems.

Program	Providers	Purpose	Assessment Costs	Training	Training Costs
BPI	Building Performanc e Institute, Inc.	Focus on house-as-a-system concept to achieve the goals of health, safety, and comfort of a home.	Varies from $600-$1000.	Rigorous training, written exam, and field exam in: building analyst, air conditioning/heating, envelope, multifamily.	$400 and up
Green Point Rated	Build it Green	Healthy, energy- and resource-efficient building practices in California; third-party rating system.	Varies from $750-$1000.	Rigorous training classes in: plan check, rough inspection, final inspection, supporting documentation review, and performance testing.	$400 and up
HERS	CalCERT CHEERS CBPCA	To provide reliable information to differentiate the energy efficiency levels among California homes and to guide investment in cost-effective home energy efficiency measures.	National Average: $492.	In-class training; length varies on certification type and training level.	$675 and up
HERS II	CHEERS CalCERT CBPCA	Provides whole-house energy ratings, energy efficiency label, and evaluation of cost-effectiveness.	Varies	Unknown	Unknown
Built Green	Santa Barbara Contractors' Association (SBCA)	Promotes environmental design, construction, and resource efficiency	Varies	Unknown	$100/SBCA members, $250/non-members
Energy Star	U.S. EPA	Energy efficient and new green homes	Varies	Organizations/individuals can become partners via website	Unknown
LEED Existing Buildings	U.S. Green Building Council (USGBC)	Addresses whole-building cleaning and maintenance issues, including chemical use, recycling programs, exterior maintenance programs, and exams	Varies	The LEED Professional Accreditation program is managed by the Green Building Certification Institute (GBCI). Certification process includes training programs and exams.	Unknown

3.5 HOME ENERGY MODELING

To get more precise estimates of potential energy savings reductions, as well the upfront costs and payback on retrofits, it is necessary to use energy modeling of some kind. Recently a number of building energy and heating load software has been developed specifically for the residential sector. These energy software packages are important tools for generating information to be presented to homeowners in the Home Assessment Report. EnergyRubix used EnergyPro 5 to model home performance data for one pilot project and will continue to use this software until more advanced versions are developed. The following table is a comprehensive list of the available programs and construction cost data, as well as their specific purpose and cost to purchase.

Table 14: Various Energy Modeling Programs exist, each providing different tools and benefits.

ENERGY MODELING PROGRAMS		
Modeling Program	**Attributes**	**Cost/ Availability**
EnergyPro v5	Designed for residential energy modeling with modules for Title 24 compliance, HVAC sizing, Build It Green GreenPoint rating, and CalCERTS HERS rating. Is becoming the standard for HERS raters.	Ranges from $480-$970, depending on modules
EnergyPlus v4.	Primary software tool used for energy performance analysis of commercial buildings. Energy analysis and Thermal load simulation program. Requires GUI add-on.	Free (PC/MAC)
Retscreen	Development of a suite of models to evaluate energy efficiency measures for residential, commercial and institutional buildings; communities; and industrial facilities and processes. Not ideal for existing residential upgrades.	Free
Energy-10	Used in very early stages of the design process for residential and commercial buildings under 10,000 SF. Whole-house tradeoffs can be considered evaluating energy and cost savings	$375
REM/RATE	User-friendly, residential energy analysis, code compliance and rating software developed specifically for the needs of HERS providers. REM/Rate calculates heating, cooling, hot water, lighting, and appliance energy loads, consumption and costs for new and existing single and multi-family homes. Based on national HERS standards.	$327 per license for REM design. REM/RATE is licensed to HERS raters only.
MicroPass v8.0	Approved by the California Energy Commission (CEC) to show Title 24 residential EE standards compliance, Allows you to take full advantage of energy conserving features and arrive at the most cost effective building design. Simple interface. Does HVAC sizing. Advanced features included database management, and parametric run generator.	$795
eQUEST	DOE-2 based software ideal for commercial scale schematic and design development stages of new building construction, as well as employing energy efficiency measures. Not suitable for existing buildings or individual homes.	Free
RS MEANS	Comprehensive residential construction cost data on all kinds of remodels/repairs and home improvements.	$105

Appendices

4.0 APPENDICES

Appendix 1. City-Wide Housing Data for Santa Barbara County[66]

Greater Area	Santa Barbara	% total	Santa Maria	% total	Lompoc	% total
Income						
Total households	71,528	100%	39,290	100%	17,882	100%
Less than $10,000	4,181	6%	1,708	4%	778	4%
$10,000 to $14,999	3,515	5%	2,617	7%	1,006	6%
$15,000 to $24,999	6,239	9%	3,823	10%	1,785	10%
$25,000 to $34,999	6,685	9%	4,832	12%	2,104	12%
$35,000 to $49,999	8,630	12%	6,164	16%	2,919	16%
$50,000 to $74,999	12,880	18%	8,457	22%	3,698	21%
$75,000 to $99,999	7,778	11%	5,170	13%	2,662	15%
$100,000 to $149,999	10,816	15%	4,248	11%	2,243	13%
$150,000 to $199,999	4,537	6%	1,363	3%	316	2%
$200,000 or more	6,267	9%	908	2%	371	2%
Median	**$61,361**		**$51,001**		**$52,410**	
$100,000 or more	**21,620**	**30%**	**6,519**	**17%**	**2,930**	**16%**
Housing Age						
Total housing units	77,560	100%	41,442	100%	19,132	100%
Built 2005 or later	587	1%	931	2%	247	1%
Built 2000 to 2004	2,913	4%	4,433	11%	863	5%
Built 1990 to 1999	4,996	6%	5,745	14%	1,935	10%
Built 1980 to 1989	7,898	10%	9,592	23%	3,407	18%
Built 1970 to 1979	15,873	20%	6,794	16%	3,201	17%
Built 1960 to 1969	18,151	23%	6,678	16%	5,658	30%
Built 1950 to 1959	11,695	15%	4,255	10%	2,665	14%
Built 1940 to 1949	5,010	6%	1,116	3%	751	4%
Built 1939 or earlier	10,437	13%	1,898	5%	405	2%
Before 1990	**69,064**	**89%**	**30,333**	**73%**	**16,087**	**84%**
Housing Size						
Total housing units	77,560	100%	41,442	100%	19,132	100%
1 room	2,316	3%	449	1%	154	1%
2 rooms	6,633	9%	1,117	3%	602	3%
3 rooms	11,928	15%	3,242	8%	1,220	6%
4 rooms	16,340	21%	7,614	18%	4,116	22%
5 rooms	14,066	18%	10,605	26%	4,597	24%
6 rooms	10,715	14%	9,256	22%	4,472	23%
7 rooms	8,339	11%	5,208	13%	2,657	14%
8 rooms	3,728	5%	2,415	6%	826	4%
9 rooms or more	3,495	5%	1,536	4%	488	3%
6+ rooms	**26,277**	**34%**	**18,415**	**44%**	**8,443**	**44%**
Housing Structure						
Total housing units	77,560	100%	41,442	100%	19,132	100%
1-unit, detached	38,319	49%	27,970	67%	12,236	64%
1-unit, attached	6,395	8%	1,889	5%	1,695	9%
2 units	3,553	5%	604	1%	426	2%
3 or 4 units	5,375	7%	2,171	5%	1,380	7%
5 to 9 units	7,884	10%	2,208	5%	1,441	8%
10 to 19 units	5,491	7%	1,443	3%	370	2%
20 or more units	7,386	10%	1,890	5%	683	4%
all 1-units	**44,714**	**58%**	**29,859**	**72%**	**13,931**	**73%**
Housing Ownership						
Occupied housing units	71,528	100%	39,290	100%	17,882	100%
Owner-occupied	**35,297**	**49%**	**24,503**	**62%**	**9,587**	**54%**
Renter-occupied	36,231	51%	14,787	38%	8,295	46%

[66] American Community Survey 2007. http://www.sbcag.org/census.html

Appendix 2. County-Wide Housing Data for Santa Barbara, Los Angeles, San Bernardino[67]

County	Santa Barbara	% total	Los Angeles	% total	San Bernardino	% total
Income						
Total households	140137	100%	3,136,279	100%	528,839	100%
Less than $10,000	6996	5%	330,000	11%	47,943	9%
$10,000 to $14,999	7316	5%	203,819	7%	34,849	7%
$15,000 to $24,999	13357	10%	398,292	13%	68,754	13%
$25,000 to $34,999	14553	10%	381,066	12%	66,513	13%
$35,000 to $49,999	19137	14%	472,306	15%	88,239	17%
$50,000 to $74,999	26795	19%	558,550	18%	107,689	20%
$75,000 to $99,999	17119	12%	318,521	10%	56,907	11%
$100,000 to $149,999	19047	14%	276,972	9%	41,333	8%
$150,000 to $199,999	7067	5%	87,864	3%	9,619	2%
$200,000 or more	8770	6%	108,889	4%	6,993	1%
Median	**$57,059**		**$42,189**		**$42,066**	
$100,000 or more	**34,884**	**25%**	**473,725**	**15%**	**57,945**	**11%**
Housing Age						
Total housing units	150,711	100%	3,270,909	100%	601,369	100%
Built 2005 or later	2,009	1%	NA (2000 census data)		NA (2000 census data)	
Built 2000 to 2004	10,171	7%				
Built 1990 to 1999	13,832	9%	224060	7%	104099	17%
Built 1980 to 1989	22,958	15%	403,184	12%	165,036	27%
Built 1970 to 1979	28,222	19%	509,695	16%	120,138	20%
Built 1960 to 1969	32,175	21%	583,178	18%	82,983	14%
Built 1950 to 1959	19,763	13%				
Built 1940 to 1949	7,601	5%	1,129,007	35%	105,412	18%
Built 1939 or earlier	13,980	9%	421,785	13%	23,701	4%
Before 1990	**124,699**	**83%**	**3,046,849**	**93%**	**497,270**	**83%**
Housing Size						
Total housing units	150,711	100%	**3,270,909**	100%	**601,369**	100%
1 room	3,047	2%	285,396	9%	13,390	2%
2 rooms	9,255	6%	440,384	14%	39,476	7%
3 rooms	17,177	11%	569,280	17%	73,996	12%
4 rooms	29,602	20%	512,747	16%	98,742	16%
5 rooms	31,403	21%	534,555	16%	120,458	20%
6 rooms	27,447	18%	431,193	13%	115,017	19%
7 rooms	18,251	12%	253,341	8%	75,720	13%
8 rooms	7,970	5%	134,947	4%	39,241	7%
9 rooms or more	6,559	4%	109,066	3%	25,329	4%
6+ rooms	**60,227**	**40%**	**928,547**	**28%**	**255,307**	**42%**
Housing Structure						
Total housing units	150,711	100%	**3,270,909**	100%	**601,369**	100%
1-unit, detached	88,489	59%	1,593,516	49%	416,121	69%
1-unit, attached	10,638	7%	241,571	7%	26,833	5%
2 units	4,684	3%	89,608	3%	9,842	2%
3 or 4 units	9,353	6%	197,916	6%	29,046	5%
5 to 9 units	12,035	8%	269,122	8%	21,681	4%
10 to 19 units	7,525	5%	263,319	8%	14,905	3%
20 or more units	10,136	7%	559,236	17%	41,107	7%
all 1-units	**99,127**	**66%**	**1,835,087**	**56%**	**442,954**	**74%**
Housing Ownership						
Occupied housing units	140,137	100%	3,133,774	100%	528,594	100%
Owner-occupied	**76,347**	**54%**	**1,501,078**	**48%**	**340,943**	**65%**
Renter-occupied	63,790	46%	1,632,696	52%	187,651	36%

[67] 2000 US Census. http://quickfacts.census.gov/qfd/states/06/06037.html

Home Assessment Report

September 2009

Prepared for:

_____ Residence
San Ramon, CA 94583

EnergyRubix
Home Energy Solutions

September 2009

Dear _____ Residence,

Congratulations on your decision to improve the comfort and energy efficiency of your home! Completing a thorough home performance assessment is the first step to ensure improvements are achieved in the most effective way with maximized results.

Our objective is to find cost effective and practical solutions for your home that can:

(1) Reduce your utility bills
(2) Improve the overall comfort in your home
(3) Improve the 'health' of your home by addressing health & safety issues, indoor air quality, and durability issues associated with your house
(4) Reduce your carbon footprint without compromising any of the above

EnergyRubix understands that completing a home assessment and subsequent energy retrofits can be a daunting process. Our team has created this personalized, comprehensive report presenting the results of the home performance assessment as well as recommendations to guide you through the decision making process. Should you continue on with our services we will be with you all the way to ensure the entire home improvement process runs smoothly while saving you time, money, and energy.

The findings and recommendations presented in this report are organized by different aspects of the home (i.e. building envelope, insulation, heating system, distribution system, and lighting and appliances). The Energy Assessment Overview table has been designed to abbreviate the assessment results and recommendations to clearly lay out issues and opportunities for improvements. This table describes the recommended work to be done, typical costs, and expected energy savings. Certain retrofits combine to achieve all of the above objectives simultaneously, and should be considered a priority. Please keep in mind that many retrofits work better together and can be difficult to quantify precisely as individual components. For your convenience, the building science section at the end provides background information on different house systems and how general improvements can be made in order to increase energy efficiency and comfort.

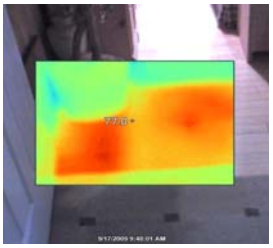
We hope you find this report informative and useful. Please feel free to contact our team with any questions.

Sincerely,

The EnergyRubix Team
energyrubix@bren.ucsb.edu

Table of Contents

Building Envelope



Findings:	Whole house shows high level of air leakage: recessed lights, doors and windows, stairs
Recommendations:	Weather strip doors; seal front porch, windows, baseboards, attic, and outlets
Estimated Cost:	$ 6,470
Additional Notes:	Porch ceiling should be removed and re-installed.

Insulation

Findings:	Insufficient attic insulation; missing insulation; attic access hatch not weatherstripped
Recommendations:	Insulate knee wall and attic; replace existing attic insulation
Estimated Cost:	$ 6,000
Additional Notes:	Cellulose R-48 insulation recommended

HVAC

Findings:	Furnace failed combustion safety test and is oversized; leaky, uninsulated, damaged ducts
Recommendations:	Install smaller furnace; seal and insulate ducts, replace where necessary
Estimated Cost:	$ 15,800
Additional Notes:	Hot water system needs new pipe insulation

Lighting & Appliances

Findings:	Most lights use incandescent lightbulbs; no motion switches or dimmers
Recommendations:	Install new canned lighting; Replace with CFL or LED lightbulbs
Estimated Cost:	$ 2,200
Additional Notes:	Consider motion sensors and energy efficient appliances

FINDINGS AND RECOMMENDATIONS

Building Envelope

It is critical that building envelopes are completely sealed; the interior conditioned space must be isolated from the outside to maintain desired temperature and moisture efficiently. Air infiltration can account for 30% or more of a home's heating and cooling costs and contribute to problems with moisture, noise, and dust.[68]

Sealing air leaks reduces heating and cooling loads. Additional savings are realized from lower heating and cooling equipment costs by downsizing necessary equipment. Furthermore, a tightly sealed building envelope helps reduce problematic issues such as pollutants, insects, and rodents entering the home, which ultimately improves building durability and creates healthier indoor environment.

Whole House Leakage Test (Blower Door Test)
The Blower Door Test measures overall air tightness of the entire house. The higher the number, the more air is leaving your house every minute. That means your heating and cooling systems have to work harder to continually condition outside air.

Existing Air Flow: 3248 cubic feet per minute (cfm) @ 50 pascals (CFM50): very leaky
Potential Air Flow: 389 cfm @ 50 pascals

Envelope Tightness Target Minimum Air Flow Standard (ASHRE 62-1989): 389 CFM50
The recommended industry standard (ASHRE 62-1989): 035 ACHn (Natural Air Change Rate)—a measure of the air change inside and outside the house.

Conditioned Space

Leakage was identified in the following areas using a thermal infrared camera and visual inspection:

- Recessed lights in ceilings
- Baseboard to floor connections
- Exterior doors & windows
- Ducts
- Plumbing penetrations- Jacuzzi
- Stair assembly

Image 1: Hole allows air to flow in and out between living room and garage.

[68] Energy Efficiency and Renewable Energy Clearinghouse. (2000 February) Air Sealing: Seal Air Leaks and Save Energy! Retrieved October 21, 2009 from http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/26446.pdf.

Recommendations

- Use foam board and expanding foam to seal leaks around larger penetrations
    - Shower and tub penetrations
    - Misc. plumbing and electrical penetrations
    - Top plate, where accessible
- Use clear latex caulk to seal accessible cracks in wall assembly joints, including;
    - Plugs & switches
    - Baseboard to floor connections
    - HVAC supply and return boot penetrations
    - Interior trim work
    - Interior door assemblies
    - Window trim
- Weather strip exterior doors
- Keep fireplace damper closed when not in use
- Close bath windows after mechanical ventilation is installed

Insulation (Thermal Envelope)

Attic Space

Sealing all attic spaces is one of the most important steps to take before moving on to insulation in order to achieve maximum comfort and energy efficiency.

The following areas in the attic had significant leakage:

- Attic access hatch is not weather stripped
- Open truss to vented soffit area – *major leakage!*
- Insulation not in contact with air barrier
- Missing ceiling insulation (side attic doesn't have proper insulation)
- Missing insulation at eaves (no baffles)

Image 2: Poor knee-wall air sealing.

Recommendations

- Remove existing attic insulation
- Air seal attic/ceiling assembly
- Install new eve baffles
- Secure wires and cables
- Remove ducts from exterior chase and insulate side walls of chase
- Install new cellulose insulation to R-50+
- Cover and seal over interstitial spaces in the attic
- Weather-strip attic access hatch and attic access door

Crawlspace

Because your ducts and water pipes are located in the unconditioned crawlspace, it is important for them to be properly sealed and insulated for energy efficiency purposes as well as pest prevention and home durability. Additionally, the crawlspace can be an important issue in terms of moisture control.

The following problem areas have been identified:

- Air sealing needed at penetrations in crawl space/basement
- Duct work in crawl space/basement is damaged (both air seal and insulation)
- Vapor barrier is unsecured
- Water pipes are uninsulated
- Signs of past pest intrusion

Recommendations

- Replace duct work
- Re-insulate water pipes
- Complete air sealing at penetrations
- Secure vapor barrier
- Remove pest debris

HVAC

Furnace

The combustion safety test identified certain safety issues regarding your furnace that should be addressed. While your furnace is located in your garage, points of leakage were found between your garage and your main home which could be bringing unhealthy air into your conditioned space. Your current furnace was also found to be substantially larger than necessary to meet your home's needs, and presents an opportunity to address health and safety concerns, comfort issues, and energy reductions all at once.

Image 3: Miss-match of vent pipe against draft-diverter.

The following specific furnace issues were identified:

- Unit failed draft pressure test
- Unit failed static pressure test
- Some corrosion on furnace draft hood
- Dirty furnace blower
- Leaky return platform

Recommendations

- Consider new furnace installation with newer, more energy efficient model designed with Air Conditioning Contractor's of America (ACCA) Manual "J" calculations to optimize the system to your home's needs
- Re-seal platform
- Install new programmable thermostat

Domestic Hot Water System

The combustion safety test identified a safety concern associated with an incorrectly sized vent pipe, but overall your hot water costs are fairly low so it will likely not pay off to replace the entire unit.

The following specific hot water issues were identified:

- Draft failed smoke test possibly due to miss-match of vent pipe and draft diverter
- Supply pipe insulation needs fixing
- Vent pipe not screwed together
- Water Pipes in crawlspace need insulation

Recommendations

- Repair venting issues on water heater to address safety concern
- Fix insulation at water heater
- Insulate water pipes under house
- Install re-circulation pumps under vanity sinks activated by motion sensors

Duct System

Leaky ducts can be a major problem as they make your heating and cooling systems work much harder to deliver the same amount of conditioned air to your living space. After air sealing your home and fixing duct leaks, you will likely find that the size of your AC and furnace can be much smaller and therefore less energy intensive. Leaky ductwork can also be problematic due to the potential of transporting unhealthy air from the attic, crawl space, or garage into the home.

Image 4: Aluma-Flex is susceptible to damage.

Duct Blaster Leakage Test

A duct blaster test examines air leakage in the duct system that can lead to inefficiencies in the air distribution system.

Existing Duct Tightness: 503 cfm @25 Pascals or *42% Duct Leakage* in your system

Duct Leakage Reduction Goals: 60 cfm @ 25 pascals to minimize leakage to *less than 6% duct leakage.*

The following specific duct issues were identified during a visual inspection:

- Uninsulated duct connections
- Uninsulated supply and return plenums
- Unapproved duct tape that is failing
- Duct work in crawl space and attic is damaged (both air seal and insulation)
- Ducting above furnace reveals years of duct leakage.

Recommendations

All work should be tested to confirm meeting the duct leakage goals.

- Install dampers on the individual duct runs
- Room by room flows should be adjusted with the goal of less than a 3 degree room to room temperature difference
- Seal all ducts, boots and plenums with mastic and test for duct leakage
- Assess location and proper size of return grill and ducts
- Reroute any ducts with sharp bends
- Properly support HVAC ducts
- Replace any damaged ducts
- Clean out return system
- Seal return boxes and insulate
- Insulate any un-insulated ducts and boots
- Install New 2 inch high performance pleated filters, accessible from return grill

Supply Grille Flows

The home's HVAC system supplies air to various parts of the home through supply grilles. The duct blower test can individually measure the amount of airflow coming out of each of your supply grills. If certain supply grills have higher air flow than others, the conditioned air will not be evenly distributed throughout the house. This can result in hot and cold rooms, causing significant discomfort as well as increased energy usage as the heating and cooling systems are operating inefficiently. The goal is to even out all airflows.

Recommendations

Room pressures should be kept below 5 Pascals across a closed room door when the HVAC system is in the cooling mode. There are several methods that can be employed to control these building pressures:

- Install new Shoemaker supply grills, sized based on the actual CFM and Velocity of the room by room flows
- Transfer grills between the room and the main body of the house
- Large door undercuts, about 1 ¼", can keep pressures within limits
- Jump ducts between the room and the main body of the house
- Add a return to each room with a supply grill

Ventilation & Exhaust

Using a vent flow blower test, insufficient ventilation flows were found in all exhaust fans. The master bath presents the most significant problem, especially since it is likely commonly used. Additionally, in certain rooms, the fan and light are operated under a single switch, so when you leave a room and turn off the light, the fan turns off before it is able to remove sufficient moisture from the space.

Recommendations

- All exhaust fans are undersized for the rooms they serve. We suggest replacing them when you are ready to have additional insulation installed in attic.
- Install new exhaust fans in bathrooms and install timers on bath vent fans, this allows moisture to be removed after the occupant leaves

Lighting & Appliances

Lighting

Lighting modification can often be the simplest and lowest cost method to reduce electricity usage, and can achieve noticeable results. Additionally, traditional incandescent bulbs give off substantial heat and burn out more frequently than other alternatives. Compact fluorescent lights or CFLs lasts 10 times longer than incandescents and typically use 75% to 80% less energy.

Image 5: Lights in ceiling add to air infiltration

- Most lights still have incandescent light bulbs
- Rooms do not have motion switches and/or dimmers

Recommendations

- Install new ICAT rated light cans in upper floor ceiling
- Replace incandescent bulbs with compact fluorescents

Plug Loads

Based on the utility bill analysis (see following section), even after subtracting heating and cooling loads, electricity use is still fairly high. This is likely due to a combination of lighting, appliances, and electronics. Even when not in use, “phantom loads” result from all appliances attached to an outlet.

Recommendations

- Use power strips to kill phantom loads
- Consider energy efficient appliances when making new purchases

UTILITY BILL ANALYSIS

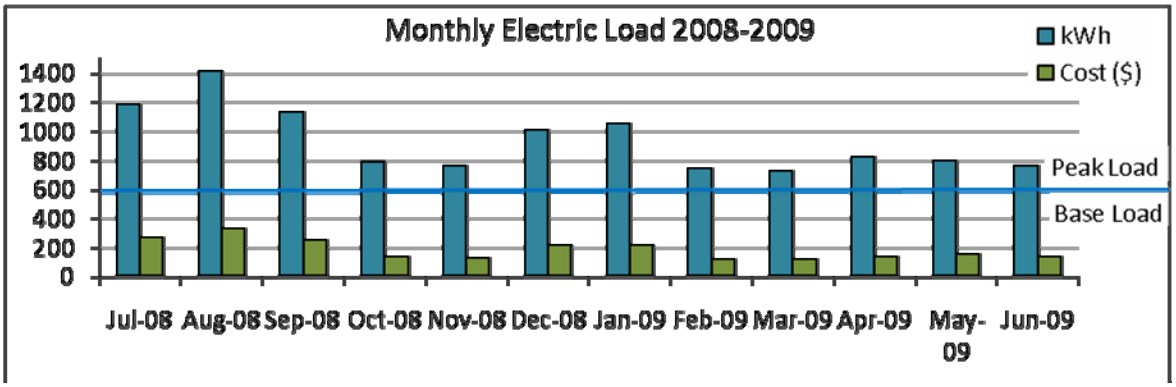


Figure 1: Electricity use from July 2008 through June 2009. Electricity use is fairly stable throughout the year with a slight increase in the peaks of summer and winter when heating and cooling systems are likely used more often.

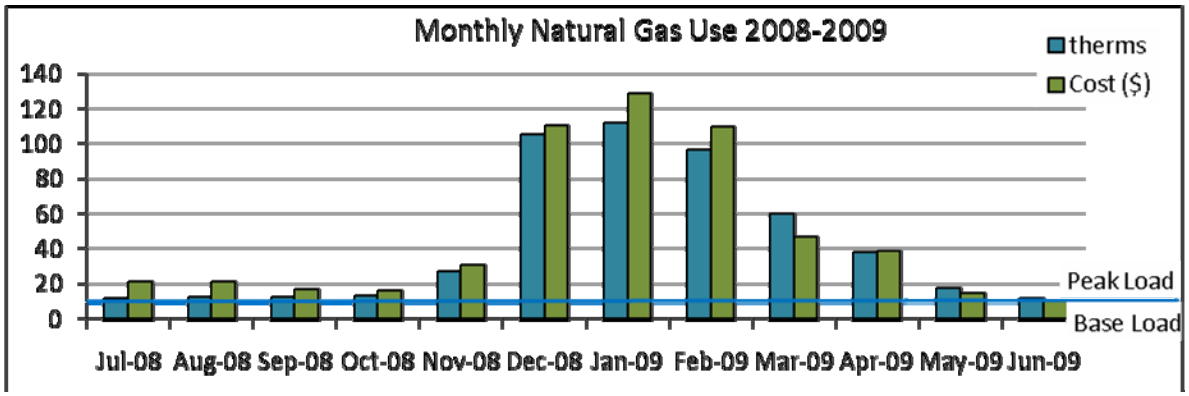


Figure 2: Natural gas use from July 2008 through June 2009. Highest gas use occurred during winter months as is expected.

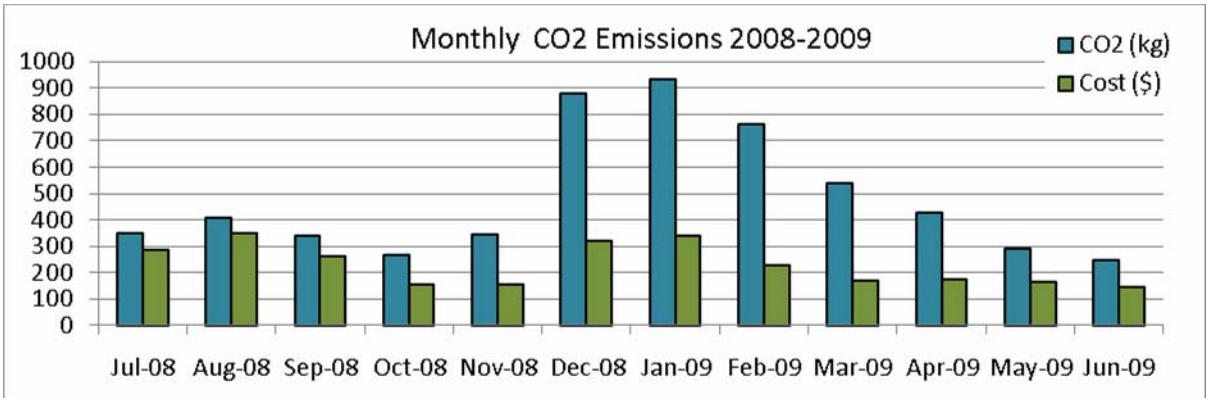


Figure 3: CO_2 emissions resulting from electricity and natural gas use from July 2008 through June 2009. Based on California Public Utilities Commission (CPUC) approved ClimateSmart electric emissions rate of 0.524 lbs CO2 per kWh electricity and 13.446 lbs CO2 per therm natural gas. Costs represent total monthly electricity and natural gas costs combined.

Appendix 4. Home Assessment Report (HAR)—Pilot Project 3

Home Assessment Report

February 17, 2010

Prepared for:
_____ Residence
Santa Barbara, CA 93103

February 17, 2010

Dear _____ Residence,

EnergyRubix understands that completing a home energy performance assessment and subsequent energy retrofits can be a daunting and time consuming process. Our team has created a simple report outlining some issues that can be addressed and improve the comfort and energy efficiency of your home. Although the installation of double pane windows and doors has already improved the energy efficiency and likely comfort of your home, there are still a few things that can be done.

*Our **objective** is to find cost effective and practical solutions for your home that can:*

(1) Reduce your utility bills
(2) Improve the overall comfort in your home
(3) Improve the 'health' of your home by addressing health & safety issues, indoor air quality, and durability issues associated with your house
(4) Reduce your carbon footprint without compromising any of the above

The findings and recommendations presented in this report are organized by different aspects of the home (i.e. building envelope/insulation, heating system, distribution system, and lighting and appliances). The Summary table in Section A has been designed to abbreviate the assessment results and recommendations to clearly lay out the options in order to ease the decision making process. This table describes the recommended work to be done, typical costs, and expected energy savings. Certain retrofits combine to achieve all of the above objectives simultaneously, and should be considered a priority. Please keep in mind that many retrofits work better together, and can be difficult to quantify precisely, as individual components. For your convenience, the building science section at the end provides background information on different house systems and how general improvements can be made in order to increase energy efficiency and comfort.

We hope you find this report informative and useful. Please feel free to contact our team with any questions.

Sincerely,
The EnergyRubix Team
energyrubix@bren.ucsb.edu

Table of Contents

Building Envelope

Findings:	Air leakage around french doors, electrical outlets, and recessed lights
Recommendations:	Add weather-stripping to french doors; seal cracks and recessed lighting
Estimated Cost:	$ 700
Additional Notes:	Both fireplace dampers should be closed when not in use to prevent air leakage and ash transport

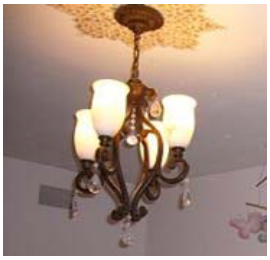
Insulation

Findings:	Only half of attic is insulated; existing insulation old and insufficient
Recommendations:	Remove existing insulation and install a layer of R-30 insulation on attic floor
Estimated Cost:	$ 2,000
Additional Notes:	Other options include installing insulation where missing and adding a layer of insulation above the existing

HVAC

Findings:	Duct leakage; lower story supply grill and location of furnace near bedrooms cause uneven heat flow
Recommendations:	Perform maintenance on duct system; relocate downstairs supply vent; seal leakage
Estimated Cost:	$ $5,000
Additional Notes:	The lower level remains cold because it is farthest away from the furnace and the warm air received rises up the

Lighting & Appliances



Findings:	Most lights use incandescent lightbulbs
Recommendations:	Replace with CFL or LED lightbulbs
Estimated Cost:	$ 100
Additional Notes:	Paybacks seen immediately

FINDINGS AND RECOMMENDATIONS

Building Envelope

A building infiltration test, also known as a blower door test, was used to determine how much air can leak in and out of the house. This test provided a reading of 2370 CFM @ 48 PR/FL, which indicates a high amount of air leakage to the outside. Leaky homes will tend to have more hot and cold spots and require more energy to heat and cool.

Image 1. Additional weather-stripping may reduce air leakage.

Windows and Doors

Although the French doors in the living room are double pane, the thermal camera revealed air leakage around the edges. Also, the window in the living room above the piano is single pane, as is the skylight above the dining room.

Recommendations

- Additional weather-stripping on the bottom of the French doors may help avoid air leaks.

Leakage

- The skylight in the laundry room may increase air leakage.
- A crack was found on top of the counter space/dishwasher in the kitchen which may serve as another source of air leakage.
- The electrical outlets in the home are leaky and allow cold air to enter the house; air loss was physically felt with the blower door test.
- Recessed can lights are essentially holes in the ceiling. If not properly sealed and insulated, each can light is an open hole for air leakage.

Image 2. Fireplace damper should be closed when not in use.

Recommendations

- Use clear latex caulk to seal crack over counter space in kitchen.
- Both fireplace dampers should be closed when not in use. This prevents outgoing air leakage as well as incoming air that may transport ash around the house.
- Seal recessed lighting with insulation and latex.

Insulation (Thermal Envelope)

Attic Insulation

Approximately half of the attic is not insulated and existing insulation is insufficient, old, and incorrectly installed. The east-facing knee wall (short wall) in the attic has no insulation at all. For a home of this size, at least R-30 insulation is recommended for the attic. With new and thicker insulation, the interior of the home will be able to retain heat much better, resulting in greater comfort and less demand on your heating system.

Recommendations

- Replace existing and missing insulation with a new layer of R-30 or higher fiberglass insulation on the attic floor

Or

- Add blown-in cellulose insulation where missing and add insulation to areas that currently have insufficient insulation for a total of at least 12 inches of depth

Or

- Insulate the interior of the roof and knee walls. Since your heater is located in the attic, it should be treated as part of your conditioned space. Currently, heat from the ducts and furnace located in your attic is being lost because your attic is treated as unconditioned space. By insulating the roof and walls of your attic, even less heat will be lost to the outside and you may not have to further insulate your attic floors.

Image 3. Existing attic insulation shows old age and discoloring. Much of it is missing.

Wall Insulation

- The wall above the hallway closet by the main entrance does not have insulation, resulting in possible heat loss.
- The electrical wiring inside the hallway closet penetrates through the ceiling, providing an opening for warm air to travel through to the attic and out of the house.
- In the master bath, the bathtub wall is incompletely insulated as a result of the shelf design.
- The infrared camera inspection revealed that the walls in the lower level were insulated, but with cold soil against the wall, the room is naturally cooler than others.

Recommendations

- Add insulation above the hallway closet.
- Seal off hallway closet leakage around electrical wiring.
- Additional insulation in the lower story walls may help with stabilizing interior temperature.

HVAC

Heating System

Unlike cooling systems, which circulate outdoor and indoor air, heating systems circulate air internally. The furnace is located in the attic near the two children's bedrooms. Warm temperatures experienced in the girls' bedrooms are most likely the result of three factors:

(1) The supply ducts in the girls rooms are the closest to the return plenum and the furnace (located directly above the rooms). The girls rooms are most likely getting much greater hot air flow through their supply grilles than any other part of the house because of this shorter distance (especially as compared to the downstairs).
(2) The hallway and the girls' rooms are also located at the highest elevation of the house, and as warm air rises, it is likely to gather here.
(3) The rooms are most heavily exposed to direct sunlight and naturally stay warm during the day.

The vent in the lower level guest room[69] is located behind the bedroom door, facing the stairs, which results in warm air traveling to the upper story since warm air rises. Additionally, although the vent is releasing warm air, the electrical outlet facing the room around the corner is leaking cold air into the home, which may cancel out some of the heating.

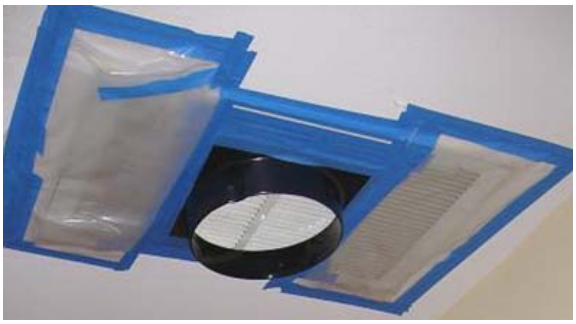


Image 4. Return duct

Recommendations

- The supply vent opening in the children's bedrooms could be narrowed to balance the air flow and reduce the amount of heat entering when the heater is on.
- Relocate the downstairs guest room supply vent to face the room, rather than the stairs.
- Seal off electrical outlets to help reduce air leakage downstairs.
- Check leakage from ducts leading to the downstairs and seal off any leakage found.
- Balance air flow distribution throughout house by adjusting duct and supply vent sizes.
- Relocate return plenum away from the girl's rooms.

[69] The vent opening is broken and can not close.

Duct System

The duct blaster test provided a reading of 350 CFM, indicating a duct leakage of approximately 25%. This means that 25% of the conditioned air being heated by your furnace is not being delivered to the intended rooms, and instead is either being lost to the outside, to your attic, or to other unconditioned spaces.

Recommendations

- Seal off any visible duct leaks while continually duct testing, until duck leakage is reduced to at least less than %10.

Lighting & Appliances

Lighting modification can often be the simplest and lowest cost method to reduce electricity usage, and can achieve noticeable results. Additionally, traditional incandescent bulbs give off substantial heat and burn out more frequently than other alternatives. Compact fluorescent lights or CFLs lasts 10 times longer than incandescents and typically use 75% to 80% less energy. Most of the light bulbs in the home are currently incandescent, which are inefficient and give off considerable heat.

Image 5. Incandescent bulbs use more energy

Recommendations

Replacing incandescent bulbs with compact fluorescent light bulbs (CFL) is one of the most cost effective ways to obtain energy savings.

UTILITY BILL ANALYSIS

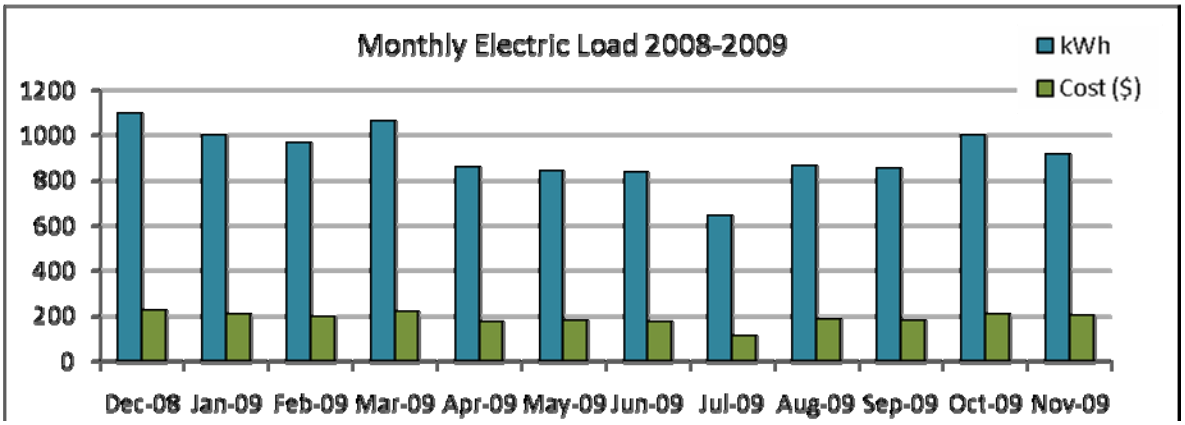


Figure 1: Electricity use from December 2008 through November 2009. Electricity use is fairly stable throughout the year with a slight increase in the peaks of summer and winter when heating and cooling systems are likely used more often.

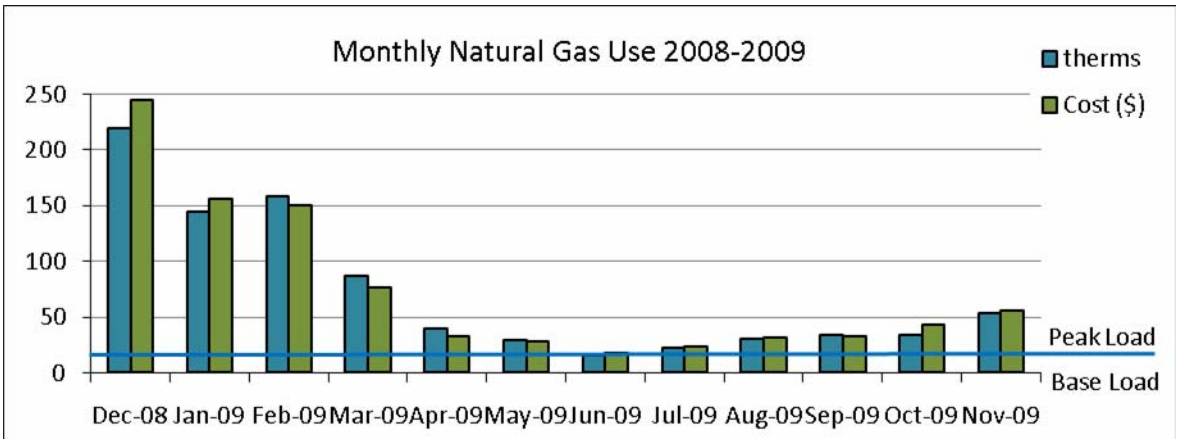
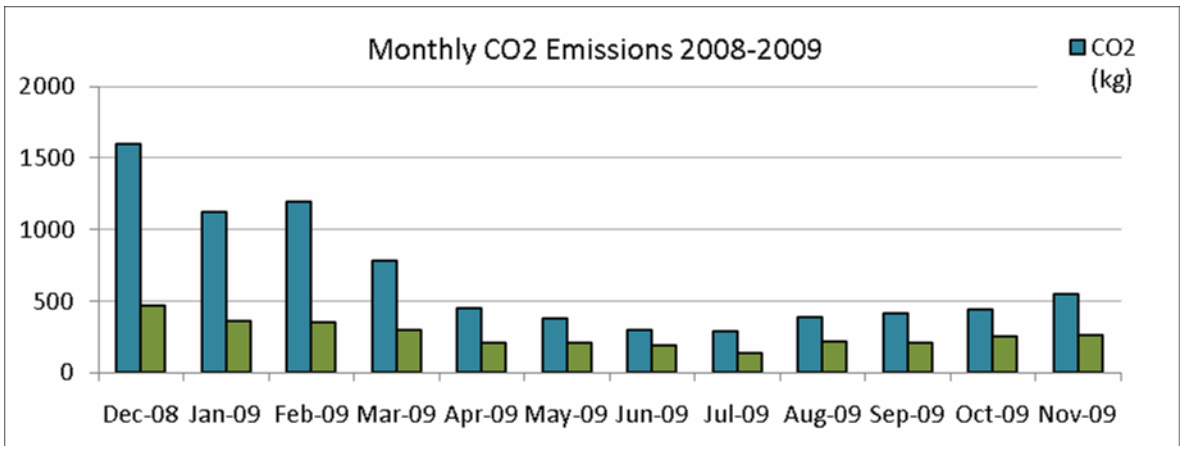


Figure 2: Natural gas use from December 2008 through November 2009. Highest gas use occurred during winter months as is expected.



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Appendix 5. GreenPoint Rated Score (Modeled for Pilot Project 3 with EnergyPro 5 software)

PERFORMANCE CERTIFICATE: GreenPoint Rated (Part 3 of 5) GPR-1R

Project Name	Building Type	Date
Education Version for Instructional Class Ass	☑ Single Family ☐ Addition Alone ☐ Multi Family ☐ Existing+ Addition/Alteration	*3/2/2010*

ANNUAL ENERGY USE SUMMARY

TDV (kBtu/ft²-yr)	Standard	Proposed	Margin
Space Heating	16.04	15.96	0.08
Space Cooling	0.18	2.09	-1.91
Fans	2.74	3.26	-0.52
Pumps	0.00	0.00	0.00
Domestic Hot Water	14.66	14.66	0.00
Indoor Lighting	6.56	9.71	-3.15
Outdoor Lighting	0.73	1.59	-0.86
Appliances	22.08	23.33	-1.25
Ancillary	0.00	0.00	0.00
Renewables	0.00	0.00	0.00
Totals	62.99	70.60	-7.60

GreenPointRATED
A PROGRAM OF BUILD IT GREEN

Meet GreenPoint Energy Threshold (J3a):	0
GreenPoint Rated Energy Score (J3b):	0
Improvement over GreenPoint Threshold:	-12.1 %
HERS Index:	117

Site Energy Usage	Standard	Proposed	Difference
Electricity (kWh)	5,444	6,470	-1,026
Fuel (Therms)	588	588	0

BUILDING DOES NOT MEET GREENPOINT ENERGY THRESHOLD

		Ext. Walls/Roof	Wall Area	Fenestration Area
Building Front Orientation:	(W) 270 deg	(W)	729	58
Number of Dwelling Units:	1.00	(N)	506	212
Fuel Available at Site:	Natural Gas	(E)	729	61
Raised Floor Area:	0	(S)	506	62
Slab on Grade Area:	2,634	Roof	2,643	20
Average Ceiling Height:	8.8		TOTAL:	413
Fenestration Average U-Factor:	0.71		Fenestration/CFA Ratio:	15.7 %
Average SHGC:	0.73			

REMARKS

STATEMENT OF COMPLIANCE

This GreenPoint Rated Energy Compliance Certificate lists the building features and specifications needed to comply with the GreenPoint Rating System. The requirements for compliance with the California Energy Commission HERS Phase II Draft requirements. The HERS Index provided in this compliance is consistent with those protocols.

The documentation author hereby certifies that the documentation is accurate and complete.

Documentation Author

Company
Address — Name
City/State/Zip , — Phone — Signed — Date

Designer or Owner (per Business & Professions Code)

Company
Address — Name
City/State/Zip , — Phone — Signed — License # — Date

GreenPoint Rated is a program of Build It Green

Name: Build It Green, a nonprofit organization
Address: 1431 University Ave, Berkeley, CA
Telephone: (510) 845-0472 — Signed — Date

Appendix 6. Energy Use Modeling Results of Pilot Project 3

Current energy use of the Santa Barbara pilot project home and potential energy savings resulting from retrofits (proposed changes) modeled using EnergyPro 5. All energy values are in kBTU/ft^2-yr . The current home has a total modeled energy usage of 70.6 kBTU/ft^2-yr or 183,560 kBTU per year. If all proposed changes were implemented, a 15.4% energy reduction could be achieved. Because gas and electric rate schedules are tiered (higher tiers pay a larger per kWh price), this will result in an even greater % reduction in actual utility bills.

	Heating	**Cooling**	**Interior Lighting**	**Appliance**	**Fans**	**Domestic Hot Water**	**Total**	**HERS Index**	**% Energy Saving**
Current Home	15.96	2.09	11.3	23.33	3.26	14.66	70.6	117	0.0%
Proposed Changes									
Roof Insulation	14.1	0.69	11.3	23.33	2.68	14.66	66.75	111	5.5%
Wall Insulation	13.98	1.87	11.3	23.33	2.97	14.66	68.11	113	3.5%
Duct Sealing	15.14	1.99	11.3	23.33	3.13	14.66	69.55	116	1.5%
Duct Insulation	15.55	2.05	11.3	23.33	3.2	14.66	70.08	117	0.7%
Air Sealing	15.51	2.12	11.3	23.33	3.21	14.66	70.13	117	0.7%
Indoor Lighting	16.02	2.09	8.8	23.33	3.26	14.66	68.16	113	3.5%
TOTAL									**15.4%**