

Demand Response Emerging Tech

1. Projected Program Budget	\$	528,000
2. Projected Program Impacts		
MWh		76
MW (Summer Peak)		0.14
3. Program Cost Effectiveness		
TRC		0.27
PAC		0.28

4. Program Descriptors

Market Sector: Residential
Program Classification: Local
Program Status: New

5. Program Statement:

Demand responsive devices shows promise for reducing peak load. Research and field trials have shown that improving HVAC equipment and installation practices significantly reduce peak load and annual consumption. As new technologies become available for use in production building, new inspection and evaluation methods need to be developed to ensure correct application. This program seeks to identify key emerging technologies to develop inspection and evaluation processes in residential new construction that will be needed to ensure proper application and recover energy otherwise lost to poor implementation. Using combinations of established and promising technologies, demonstration/test homes will be built at least 30% above 2005 Title 24 code. A final report will capture the benefits and issues of these technologies for both the builder and consumer and include recommendations for implementation of above-code technologies.

6. Program Rationale:

This program examines emerging technologies and will develop recommendations for both practices and evaluation methods. The program will build approximately 50 new homes with various combinations of demand responsive devices and emerging technologies. These technologies are currently available but not commonly installed. Some of the technologies to be evaluated are:

- Demand response thermostats that provide a simple visual indication of current service area load and current home's energy demand, allowing the consumer to control the usage.^{1,2}
- Improved Forced Air Units that have improved aerodynamic design and improved manufacturing tolerances and that use more efficient motors such as electronically commutated motors (ECM) and brushless permanent magnet motors (BPM).³

¹ Demand Responsive Hardware and Tariffs: California's Vision and Reality presentation, ACEEE Summer Study; August 2004; Art Rosenfeld, Karen Herter, Dave Hungerford, Mike Jaske, Pat McAuliffe, Mike Messenger, John Wilson

² SCE Report on Interruptible Load Programs and Demand Response Programs for May 2005

- Computerized evaluation of refrigerant charge and airflow performed by an EPA-certified HVAC installer that will ensure the proper system performance.^{4, 5}
- Improved duct work, buried in insulation, using quick mechanical connections and aerosol type sealants to achieve quick installation and very low duct leakage. This combination of technologies may provide cost savings to the builder and increase the installation of very tight HVAC ducts.
- High IR-reflectivity roof pigments⁶ to reduce peak load.
- Advanced framing techniques such as optimum-value engineered (OVE) framing which using less wood and increases wall and ceiling insulation to reduce annual consumption.⁷

The bidder will generate participation from builders who are willing to research construction techniques to improve energy-efficiency, quality, reduce risks, and potentially simplify field operations. While the main focus of this work will be evaluation of and potential solutions to market barriers, limited field monitoring will be delivered in partnership with BIRA, the DOE Building America research team administered by the bidder. The BIRA Building America team has extensive monitoring skills derived from working with its partners and monitoring substantially above-code homes in the California and Nevada markets.

The bidder will report monthly on program progress and deliverables. A final report on market barriers, consumer surveys and construction techniques and protocols will be generated.

7. Program Outcomes:

The first step in implementing this program will be to secure builder participation. The bidder will identify candidate builders in SCE service territory who are available to build homes demonstrating new, emerging technologies for evaluation. The bidder's compliance staff will analyze plans for the proposed homes to determine feature sets that would make the homes comply with the 30% above code requirements. As the homes are built, the bidder will work with the participating builders to address problems, develop information sheets and protocols for the new technologies, and train the subcontractors using protocols for quality construction. In a small number of the homes, monitoring equipment will be installed to evaluate home performance; this data will be shared with SCE, builders, and homeowners. The bidder will inspect and test 100% of the demonstration homes at rough and final stages of construction. As the homes are sold, a homeowner survey will be conducted to capture consumer factors considered in buying these demonstration homes.

8. Program Strategy:

This program seeks to identify key emerging technologies to develop inspection and evaluation processes in residential new construction that will be needed to ensure proper application and recover energy otherwise lost to poor implementation.

³ Ian Walker Presentation on 2008 T-24 Standards Development; May 16, 2005

⁴ Home Energy Online; EPA reports 72% air conditioners incorrectly charged; Nov/Dec 2000, page 1

⁵ CEC PIER Report: Instrumented Home Energy Rating and Commissioning, Max Sherman, Iain Walker, Craig Wray; page 17 and Attachment I: Guidelines for Residential Commissioning; February, 2004

⁶ Hashem Akbari, Improved Materials for Cooler Roofs: LBNL Fall Newsletter, 2005

⁷ National Association of Home Builders Research Center, Advanced Framing Techniques: Optimum Value Engineering (OVE); Toolbase website 2005

9. Program Objectives:

The program will build approximately 50 new homes with various combinations of demand responsive devices and emerging technologies. These technologies are not readily adopted by the residential building industry so the incentives have been estimated at 80% cost coverage. The bidder estimates the average incentive per home to be \$775. These 50 research homes will generate approximately 75,752 kWh and 142 kW of annual savings.

10. Program Implementation

Upon funding by SCE, the bidder will immediately begin with the following tasks.

Task 1. Identify candidate builders in SCE service territory who are agreeable to build demonstration homes.

The first program area involves developing a list of potential builder partners and obtaining the preliminary commitment from builder partners to build the 50 emerging technology homes. The list of potential builder partners will be developed using the bidder's database of builders selecting those that already build above code and whom have expressed satisfaction with their above-code programs for improving quality, differentiating their homes from competition, and improved sales, as well as those who have queried the bidder regarding other opportunities to differentiate themselves from other builders. The bidder will meet with the target builders to market the Demand Responsive/Emerging Technology concepts to obtain preliminary commitment to build a demonstration home(s). This will likely require numerous meetings to convey the program requirements and to provide the builders with the necessary information. The bidder has developed some potential design packages and has sufficient information to know what types of features are likely to be required and will discuss this with the builder partners.

Prospective builders must be in SCE service territory and be likely candidates, based on current practices of building over code, quality construction practices, and desire to differentiate from other builders based on energy- efficiency and quality.

Deliverable: List of candidate builders

Due Date: 1 month from start

Task 2. Evaluate and document technology.

Each technology will be evaluated to identify any market and/or code barriers. Easy-to-understand marketing materials will be developed to help explain the program, the emerging technologies, and their applications and benefits. Develop preliminary protocols and test procedures for each technology will be developed.

Deliverable:

Marketing Material

Preliminary Protocol and Tests

Due Date: 2 months from start

Task 3. Determine project and obtain commitment from Builders.

Once the preliminary commitment is obtained, the bidder will work with them to develop a design that

will meet the program requirements and that is acceptable to the builder. Much of this work may be performed in the Task 1, because the builders may need to fully understand the increased construction costs before committing to this project. The design process will include discussions with the builder to determine how they typically build, what super-efficiency features are acceptable to the builder and what features are unacceptable. Based on this information, the bidder will use the builder's home plans to develop alternative sets of efficiency features and emerging technology that will produce the desired program goals, including a minimum 30% reduction in Title 24 energy use. These feature sets will be discussed with the builder partners and the team will settle on a final feature set to meet program goals. This will likely require a series of meetings with the builders and analyses to determine the final energy-efficiency package

The bidder will market the emerging technologies to target builders. Evaluate potential builder projects will be evaluated and the bidder will work the builders to determine acceptable energy-efficiency feature sets. Demonstration home designs will be Developed and analyzed to ensure that their energy efficiency packages comply with program requirements. Develop a final commitment from builder(s) to participate in project.

In advance of construction, the bidder will work out any necessary agreements with the local jurisdictions for installation of emerging technologies, if required. The bidder will work with builder and building department to minimize plan-review and field problems due to design. If possible. Benefits will be obtained for projects from building department.

Deliverable:

Design and Analyses for demonstration homes

Any required installation agreements with local jurisdictions

Jurisdiction benefits, if available

Due Date: 3 months from start

Task 4. Construct homes.

During the process of developing the construction package, the bidder will work with builder staff to answer any purchasing or construction issues that arise. This will include details for purchasing, special processes for construction, and improved quality control processes. Once construction begins, the bidder will train the builder field-staff and their subcontractors in any special procedures required by the new features. Field staff will also be trained in improved construction practices that will be required to achieve the required efficiency performance level. Local building officials will be invited to the construction site to be introduced to the technology. Building official involvement is crucial to identify and minimize code barriers. The bidder will work with the builder throughout the construction process to ensure the required features are installed, installed properly and that they are working properly. This will include performing inspections and tests as the homes are built. The work will include inspections of the air sealing features, the proper installation of the insulation, the proper installation of the HVAC duct system, duct leakage testing, blower-door testing, and HVAC airflow testing. Inspections and tests will be performed as necessary to maintain the required level of quality.

The bidder will work with builder to ensure that construction practices specific to each technology are well understood by the builder and subcontractor.

The bidder will assist builders with designations and specifications of emerging technology features.

Where possible, the bidder will identify and solve potential construction issues to minimize any construction issues due to the technologies.

Develop training program for builder(s), subcontractors, and building officials will be implemented. Starting with Comfortwise training program, existing training material will be enhanced with issues specific to emerging technologies. Training materials will be used to train builder field staff and installing subcontractors.

Feedback will be collected on the technology installation and protocols and enhanced as needed for following homes.

Deliverable:

Feature specifications Trained staff Construction feedback

Due Date: 6-12 months from start

Task 5. Monitor a subset of homes.

The bidder has substantial experience in monitoring from its Building America projects. Optimally, the monitoring will allow 15- minute sampling of each, so that both kWh and kW can be determined. The bidder will work with SCE staff to determine the most important monitoring information and the best methods to perform the monitoring within budget. As the homes are built, a minimum of 10% will be equipped with monitoring equipment so that, at a minimum the whole-house energy-use, and the specific emerging technology can be monitored.

The bidder's team anticipates monitoring the demonstration homes to evaluate how they perform compared to the predictions of the design analysis. There are plans to instrument "control" homes that would represent "normal" homes built to just meet code. If SCE is willing to provide electricity-bill data for both the demonstration homes and nearby control homes, the bidder is willing to perform comparison analyses. In this case, the bidder would also relate the data from the monitored homes to the bill data provided by SCE. The goal of this effort is to evaluate both the design process and the designs themselves. The bidder will install monitoring equipment and collect and analyze monitoring data. Results will be provided to SCE, builder's partners, and the homeowners.

Deliverable: Monitoring results

Due Date: 6-18 month from start

Task 6. Inspect homes.

Perform inspections and tests of all energy-efficiency features. Inspections include air sealing, insulation, HVAC, and water heating features. Tests include duct blaster, blower door, and airflows. 100% of the demonstration homes will be inspected and tested to ensure quality and proper functioning. Using preliminary test plans, test all installed emerging technology features. Collect feedback and update test plans as needed.

The bidder will work closely with the builders to ensure that all problems are addressed and that retests are conducted as needed. When the home passes the final inspection, the bidder will enter the results into CHEERS or CalCERTS and the home is then eligible for incentives that will be managed by the bidder.

Deliverable:

Inspection test results Issues and feedback Updates
HERS system

Due Date: 6-12 months from start

Task 7. Homebuyer education.

Develop easy to understand informational and instructional materials on each of the Demand Responsive / Emerging Technology features. These materials will be provided to the builders for the inclusion in the homeowner manual for the new homeowners. These materials could also be used during the sales process.

Deliverable: Informational and instructional material

Due Date: 10-12 months from start

Task 8. Conduct Homeowner Survey.

The bidder will survey the homebuyers to understand the value they place on the installed emerging technologies. The team will attempt to determine the impact of these technologies to the homebuyers' purchase decision, the importance of the technologies since they've moved in, and the impact of the technologies on their level of satisfaction with their new homes.

The bidder will develop a survey instrument for home buyers to assess the importance of the technologies in the buying decision and any impact on customer satisfaction. Information will be collected on ease of use of features, as appropriate.

Deliverable:

Survey instrument

Survey results

Due Date: 12-18 months from start

Task 9. Evaluate and report on technology with feedback from builders and Homeowners.

Using Homeowner feedback, the bidder will assess consumer interest in products, performance from user perspective, and effectiveness of marketing material. Builder feedback will be used to assess installation costs, installation issues, performance issues, potential barriers, training program and materials, and effectiveness of protocols and test procedures. Builder feedback will be used to assess satisfaction with project and additional lessons learned.

Deliverable: Summary report with recommendations and follow-on

Due Date: 18-24 months from start

11. Customer Description:

Builders and manufacturers servicing the residential new construction market in SCE's service territory will be the primary benefactors of this project. Homeowners will also benefit.

The bidder has been working with builders since 1981 providing a full range of services to improve quality control of energy-related features in new homes. The bidder's expertise in all phases of residential construction and its ability to bring new building products and concepts to market has helped it gain recognition as the builders' energy-efficiency expert.

In 2004 The bidder worked with builders on over 600 communities providing systems analyses, code-compliance, mechanical design, value engineering, building commissioning, home energy ratings, testing and verification of field performance in homes and in some cases, leading builders to integrate renewable technologies. The bidder has very strong working relationships with production builders and has demonstrated its ability to drive them well beyond code as their normal building practice as demonstrated by 12,000 ComfortWise[®] homes built in 2004.

The bidder's work leading the Building Industry Research Alliance (BIRA) for one of the U.S. Department of Energy's Building America teams has gained respect from and notoriety for participating builders. The bidder has extensive knowledge of the building and energy codes and its vice president of operations, Eric Borsting, was one of the nine drafting members of the International Residential Code and currently serves on the International Energy Conservation Code Maintenance Committee. Additionally, The bidder staff has served as members of the plumbing, mechanical and energy committees of California State Building Standards Commission. The bidder has trained nearly 1,500 builders, subcontractors and building officials on the new 2005 Building Energy Efficiency Standards in the past year and a half.

12. Customer Interface:

The bidder will generate participation from builders who are willing to research construction techniques to improve energy-efficiency, quality, reduce risks, and potentially simplify field operations. While the main focus of this work will be evaluation of and potential solutions to market barriers, limited field monitoring will be delivered in partnership with BIRA, the DOE Building America research team administered by the bidder. The bidder's sample builder clients include:

- Castle & Cook of California
- Centex Homes
- Del Webb
- KB Home
- Lennar Homes/US Home /Greystone
- Pardee Homes
- Pulte Homes

13. Energy Measures and Program Activities:

13.1. Measures Information:

[®] The bidder, all rights reserved, 1995.

Some of the technologies to be evaluated are:

- Demand response thermostats that provide a simple visual indication of current service area load and current home's energy demand, allowing the consumer to control the usage.^{8,9}
- Improved Forced Air Units that have improved aerodynamic design and improved manufacturing tolerances and that use more efficient motors such as electronically commutated motors (ECM) and brushless permanent magnet motors (BPM).¹⁰
- Computerized evaluation of refrigerant charge and airflow performed by an EPA-certified HVAC installer that will ensure the proper system performance.^{11, 12}
- Improved duct work, buried in insulation, using quick mechanical connections and aerosol type sealants to achieve quick installation and very low duct leakage. This combination of technologies may provide cost savings to the builder and increase the installation of very tight HVAC ducts.
- High IR-reflectivity roof pigments¹³ to reduce peak load.
- Advanced framing techniques such as optimum-value engineered (OVE) framing which using less wood and increases wall and ceiling insulation to reduce annual consumption.¹⁴

13.2. Energy Savings and Demand Reduction Level Data:

Measure Name	Gross Unit Annual Electricity Savings (kwh/unit)	User Entered kW Savings per unit (kW/unit)
Demand Response Thermostats	0	0.65
Brushless Motor; Furnace	571	0.68731481
CheckMe	394.884	0.9873225
Aeroseal	122.122	0.3219766
Cool Roof (Residential)	399	0.48027778
Advanced Framing	685	0.82453704
Combined RCA + Duct Seal (5-ton AC)	499.104	1.2228615

13.3. Non-energy Activities (Audits, Trainings, etc.):

⁸ Demand Responsive Hardware and Tariffs: California's Vision and Reality presentation, ACEEE Summer Study; August 2004; Art Rosenfeld, Karen Herter, Dave Hungerford, Mike Jaske, Pat McAuliffe, Mike Messenger, John Wilson

⁹ SCE Report on Interruptible Load Programs and Demand Response Programs for May 2005

¹⁰ Ian Walker Presentation on 2008 T-24 Standards Development; May 16, 2005

¹¹ Home Energy Online; EPA reports 72% air conditioners incorrectly charged; Nov/Dec 2000, page 1

¹² CEC PIER Report: Instrumented Home Energy Rating and Commissioning, Max Sherman, Iain Walker, Craig Wray; page 17 and Attachment I: Guidelines for Residential Commissioning; February, 2004

¹³ Hashem Akbari, Improved Materials for Cooler Roofs: LBNL Fall Newsletter, 2005

¹⁴ National Association of Home Builders Research Center, Advanced Framing Techniques: Optimum Value Engineering (OVE); Toolbase website 2005

The potential savings of these technologies is huge in the production market, but market barriers exist to their use in a production-home environment. This project is designed to determine the market barriers and explore the next steps in solving the barriers.

13.4. Subcontractor Activities:

None listed.

13.5. Quality Assurance and Evaluation Activities:

While the main focus of this work will be evaluation of and potential solutions to market barriers, limited field monitoring will be delivered in partnership with BIRA, the DOE Building America research team administered by the bidder.

The first step in implementing this program will be to secure builder participation. The bidder will identify candidate builders in SCE service territory who are available to build homes demonstrating new, emerging technologies for evaluation. The bidder compliance staff will analyze plans for the proposed homes to determine feature sets that would make the homes comply with the 30% above code requirements. As the homes are built, the bidder will work with the participating builders to address problems, develop information sheets and protocols for the new technologies, and train the subcontractors using protocols for quality construction. In a small number of the homes, monitoring equipment will be installed to evaluate home performance; this data will be shared with SCE, builders, and homeowners. The bidder will inspect and test 100% of the demonstration homes at rough and final stages of construction. As the homes are sold, a homeowner survey will be conducted to capture consumer factors considered in buying these demonstration homes.

13.6. Marketing Activities:

The Demand Responsive / Emerging Technologies project does not require a marketing campaign, per se. Task 3 of the Scope of work describes the limited marketing to enroll the required builders.