

Questions and Answers

Historic Buildings

Q. Do the Title 24 energy standards apply to historic buildings?

A. The extent to which the Energy Standards apply to historical buildings is governed by the State Historic Building Code (SHBC). The intent of the SHBC is to protect California's architectural heritage by recognizing the unique construction problems inherent in historic buildings and by providing a code to deal with these problems. For this reason Section 100(a) of the Energy Standards (Title 24, Part 6), which states what building occupancy groups are covered by the Standards, contains the following exception:

“Exception 1 to Section 100(a): Qualified historic buildings, as defined in the State Historic Building Code (Title 24, Part 8).”

“New work” within an historic property is routinely expected to conform to the requirements of current codes and regulations including the Energy Standards. However, that new work is also governed by the SHBC, so that whenever the historic character or the historic geometry interfaces with new work, the new work is expected to accommodate existing historic conditions.

For additions, which extend the footprint of the historic structure, the mandates of the regular code properly take greater precedence, although the project remains under the SHBC's governance. The reason for this is to again insure—on a case-by-case basis—that the new work does not interact unfavorably, either practically or aesthetically, with the historic property.

The State Historical Building Safety Board (SHBSB) and its staff provide a resource to owners, architects and jurisdictions in helping to formulate the reasonable alternatives and reasonable equivalencies which are key to the SHBC's implementation.

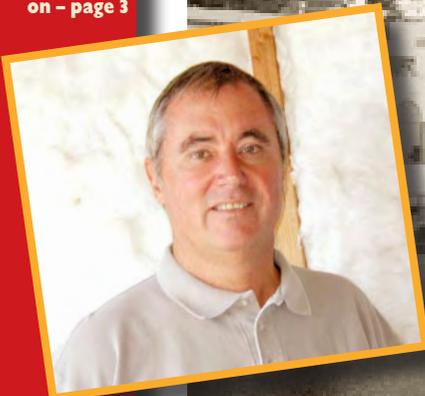
Finally, when necessary, the SHBSB will hear formal appeals and establish formal rulings, which, by statute, are the final administrative authority with respect to interpretation of the SHBC.

Information about the State Historic Building Code can be found on the following web link to the California Division of the State Architect: <http://www.dsa.dgs.ca.gov/StateHistoricalBuildingSafetyBoard/2001chbc.htm>

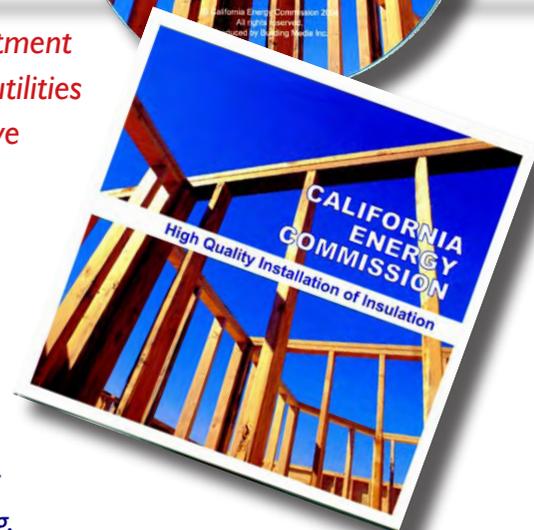
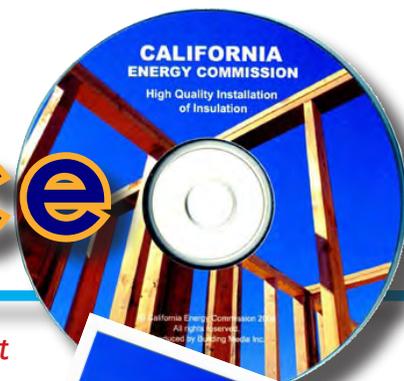


Seeking Excellence

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With
Rick Chitwood
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Seeking Excellence

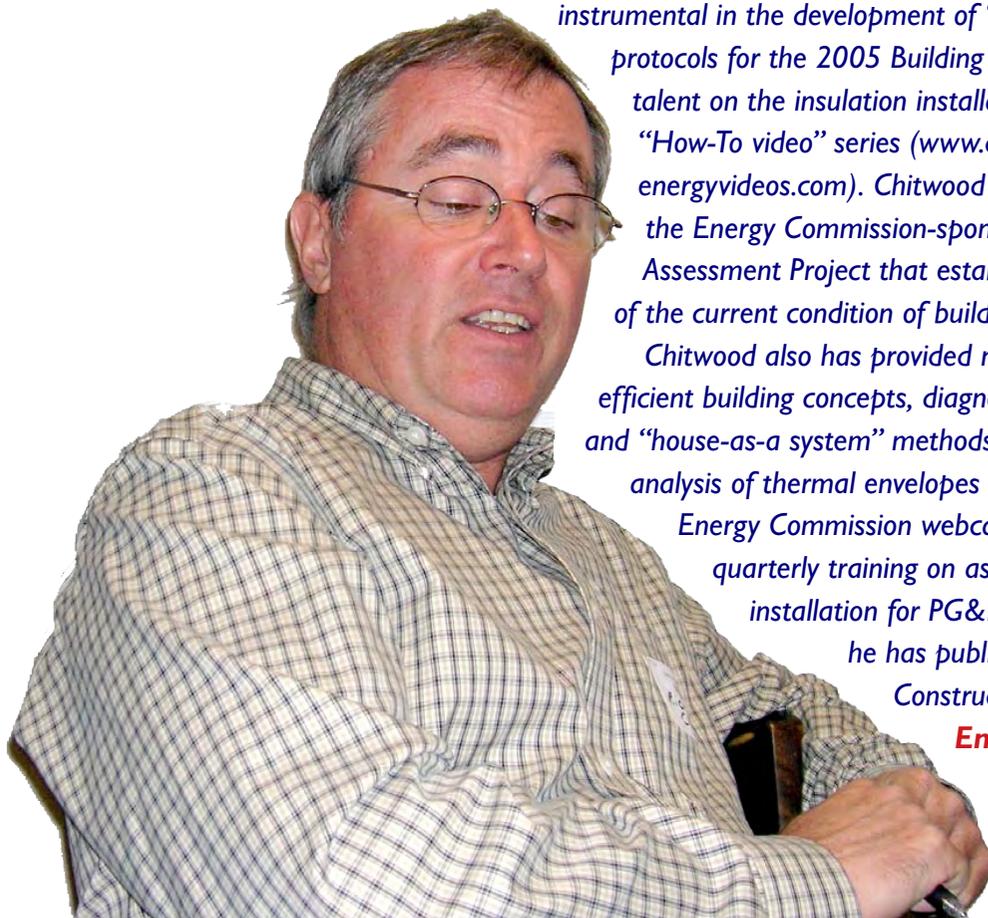


The seventh in a series of articles about building department employees, builders, energy consultants, HERS raters, utilities and others who are making exemplary efforts to achieve energy efficiency in buildings.

Richard (Rick) Chitwood founded Chitwood Energy Management, Inc., as a residential and light commercial HVAC systems installation firm. Chitwood has grown the firm to focus on energy efficient design and installation and performance testing. His business is a consistent leader in quality construction issues and building performance testing.

Chitwood has worked on several projects for the California Energy Commission as an expert in high performance building envelopes. He was instrumental in the development of “quality insulation installation (QII)” protocols for the 2005 Building Energy Efficiency Standards. He is the key talent on the insulation installation videos of the Energy Commission’s “How-To video” series (www.consumerenergycenter.org or www.energyvideos.com). Chitwood also performed extensive field testing for the Energy Commission-sponsored Residential Construction Quality Assessment Project that established an important level of understanding of the current condition of building envelope construction in California.

Chitwood also has provided numerous training sessions on energy efficient building concepts, diagnostic techniques, infiltration control, and “house-as-a system” methods. He conducted training on infrared analysis of thermal envelopes and infiltration control as part of an Energy Commission webcast on the 2005 Standards. He provides quarterly training on assessing insulation performance and proper installation for PG&E’s “See the Heat” training seminar and he has published several articles including the “New Construction Report Card” series in **Home Energy Magazine**.



Why did you become so interested in saving energy? I've always been interested in saving energy. I was first motivated when I was going to school back in the late 70s and early 80s. We had to go through the long lines of the gasoline shortages.

After I graduated in 1983, energy became my sole focus — installing solar domestic hot water systems — maybe an underutilization of my mechanical engineering degree, but it just happened. Since then, I've continued to seek the best way to make homes more energy efficient.

Another pivotal point was in 1994 when Bruce Manclark came to town with one of the early duct blasters. My company and I had been using building performance test equipment and had been testing ducts with the flow hood subtraction method. He was demonstrating the new "Minneapolis Duct Blaster." Together we tested a duct-system on my parent's house. The air leakage was so large that the machine couldn't test it. Almost all of the airflow leaked out. I could see at the time that I still had a lot to learn.

What do you try to accomplish in your business? I focus on trying to make people as comfortable as possible, using as little energy as possible for extremely high comfort levels, low noise levels, improved indoor air quality and guaranteed low utility bills. At that point my company and I feel we are successful.



“One of my biggest disappointments is that so many consumers think that new homes are as energy efficient as they possibly can be.”

— Rick Chitwood

What is the relationship between comfort and energy efficiency?

These are interwoven and go hand in hand. When we take the steps necessary to install a truly energy efficient mechanical system, rather than just install high rated equipment it automatically provides high comfort levels.

When we produce a great, energy efficient thermal envelope, there are also very high comfort levels.

The first thing I always say to contractors is that the secret of energy efficiency is that there is no “silver bullet.” There are a thousand “silver bb's.” I learned this “silver bullet vs. silver bb's” description at an Affordable Comfort conference years ago — and now use it often.

There are many tiny little energy features, like properly installing each fiberglass batt and sealing up every hole, and when

everything is done right, there will be almost immeasurable improvement. Then we get buildings that are two-to-three times more energy efficient because we're doing small improvements in many places rather than just one big improvement.

I don't have a formula for efficient buildings such as, specifying one big energy feature, for instance. We need to pay attention to the numerous tiny, seemingly insignificant things that overall, when done right, have a huge impact.

How important is energy efficiency to your customers? I talk so much about energy efficiency because it is the easiest thing to quantify. Real numbers for energy efficiency can be arrived at, but it is hard to put a real value on, or to truly identify “human comfort.” The value of good indoor air quality and the value of low noise levels are hard to talk about in real numbers. For energy efficiency, if you can do something real like guaranteeing a low energy bill, that is something you can discuss in concrete terms.

Again, it is so easy to have a major impact – significantly better than the trade standard – when you focus on all the factors.

It is easy to install a high efficiency piece of equipment, But when you install that high efficiency piece of equipment, connect it to a high efficiency duct system and the whole system is in a highly efficient thermal envelope with good insulation, air sealing and windows, the reward is that then all of those systems will work well together.

Something I talk a lot about is the “house-as-a-system” concept. Making sure that everything is working well together provides overall an extremely comfortable home with much lower energy operating cost for space conditioning than typical new homes.

You guarantee low energy bills. How does that work? Since the late 1990’s my company and I have been guaranteeing that energy bills won’t exceed a certain dollar amount per year. We use it as a means to help convince people there is real value in paying attention to the energy features. One of my biggest disappointments is that so many consumers think that new homes are as energy efficient as they possibly can be.

California has had one

of the strongest energy codes since 1978, and we do energy efficiency better than any other state in the nation. But there is still a huge opportunity for improvement; it all hinges on all those little opportunities we focus on.

What level of energy bills do you guarantee and how is your guarantee structured?

Our company guarantees that energy bills will be in the range of ten-to-twenty-cents per square foot per year for space conditioning. Of course, to accomplish that, we are not the low bidder. People have to pay us more to do a good job on the thermal envelope and the mechanical system. We convey to the homeowner that it could cost as much as \$10,000 more for big houses like 6,000 square feet. That extra \$10,000 will increase their mortgage payment about \$70 month. On those same large houses, we’re showing savings of \$150-200 a month on their utility bills. So we’re able to show a positive cash flow of \$100 a month from the first month they move in. And the homeowner gets a more comfortable, quieter, cleaner house with easier-to-maintain equipment.

And you also do quite a number of moderately sized houses, like 1,500 3,000 square feet?

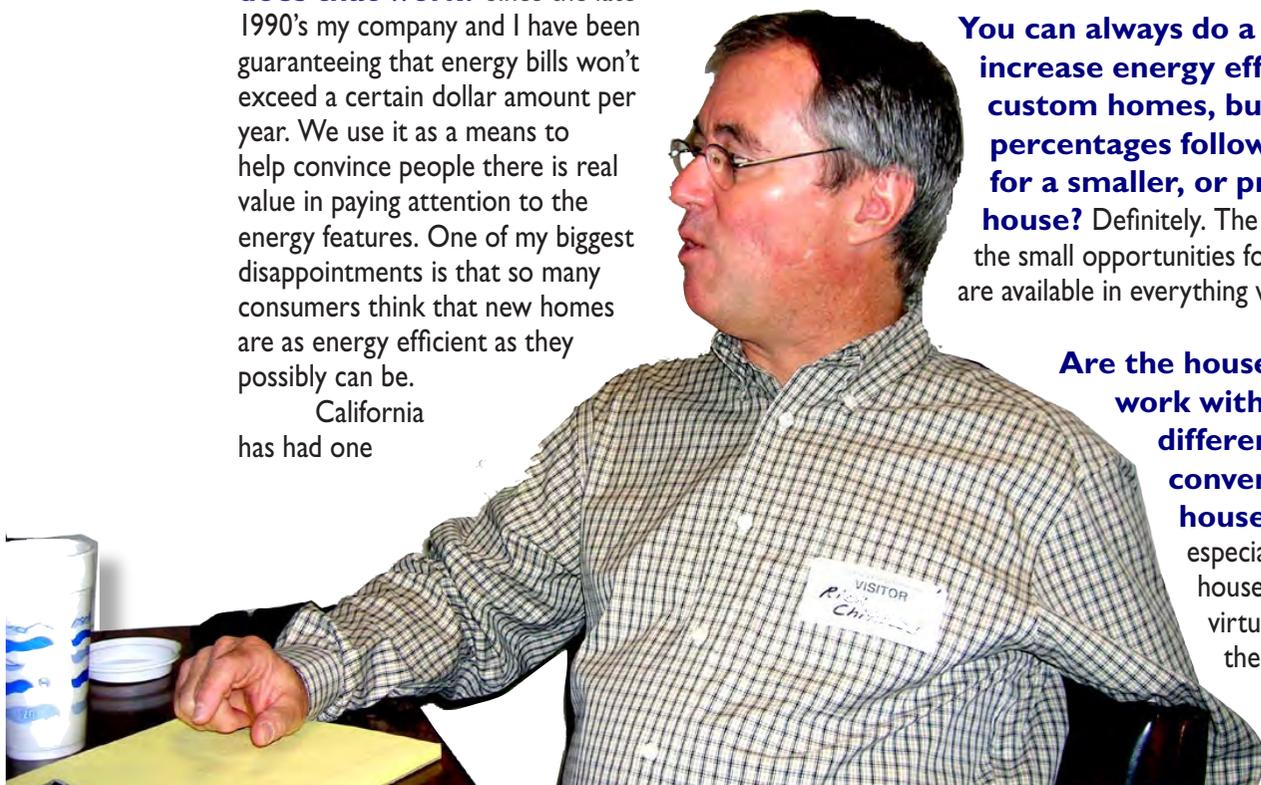
Yes, that is our mainstay — the average house of about 2,000 square feet.

You can always do a lot to increase energy efficiency in custom homes, but do the percentages follow through for a smaller, or production house?

Definitely. The small defects, the small opportunities for improvement, are available in everything we do.

Are the houses you work with that much different from conventional houses?

In general, especially the smaller houses, there is virtually no change in the specified energy features. My



company and I don't use more or special insulation. We use regular 80 percent gas furnaces in the attic and SEER 13 AC, very typical for an average energy feature specification.

When we install fiberglass batts in the walls, we spend about 3 times more time, first caulking and sealing the cavity and then properly installing the batt. So the home ends up with a more airtight, less leaky thermal envelope. We can reduce heating and cooling loads to about half the size of a typical house of that size because we pay this much attention to the thermal envelope. After that, there is this great synergy that occurs.

Once we reduce the loads, we are able to install a smaller furnace, with small ducts, and because the envelope is good, we only need to run the ducts to the closest corner of the room so we reduce the duct surface area and therefore, the conductive losses. We need less fan energy because the ducts are shorter and we are able to use smaller ducts so they are a lot easier to bury in the ceiling insulation. This reduces the loads and furnace size even more.

Our company also specifies the right, energy efficient windows. We use the spectrally selective products, which are several times better than windows used to be just a few years ago.

Don't some builders believe that the air ducts need to run all the way to the outside facing wall, so registers will be over the windows?

There is no reason to run the duct over to the window, because energy efficient windows are so good now. So we can shorten up that run by 10-15 feet and just use the properly selected register in the corner of the room closest to the air handler.

There are so many installation choices now. What do you feel is the best form of insulation?

A couple of things to consider with all the new systems – whether it's the fanciest systems like SIPS – or just some of the insulation systems that can be used in conventional buildings like spray applied cellulose, or fiberglass sprayed behind fabric or spray applied foams, all of which are great systems. The biggest advantage is because they are more immune to installation defects; although their performance isn't that much different than a properly installed fiberglass batt.

I so often see fiberglass batts poorly installed. My company uses fiberglass batts, and

the only thing we do differently is pay careful attention to be sure they are properly installed. We think fiberglass batts are the most cost effective, but only if they are put in correctly. If you couldn't ensure that for whatever reason, then



Rick, is interviewed by Steve Easley for the Energy Commission's online video training series.

one of the other systems should be considered.

You referred a number of times to “properly installed” insulation. What do you mean by that?

Let’s talk about the quality insulation installation of (QII) protocol. The fundamentals of installing fiberglass batt insulation properly are really simple, but to get everyone trained and up to speed to do it correctly in the building industry, takes a little extra effort.

What are these QII protocols and what is it that’s different in properly installing insulation?

The basic installation criteria for insulation is real simple. The difficult part is applying those criteria to the almost infinite number of obstacles you run into in new construction.

In wall insulation, the first thing to do is ensure that the cavity is air tight; second, the batt must be installed so it fully fills, and is in contact with all six sides of the cavity — side to side, top to bottom, and most importantly front to back.

We need to make sure that there are no areas of excessive compression, for instance when there is a big water pipe in the cavity that needs to be worked around. Lastly, there should be no voids or gaps.

New California buildings are becoming more architecturally complex and are filled with more and more amenities. There are more obstacles to install insulation around, so applying simple criteria takes close attention to detail.

We were on a job site with a builder and we were looking at the quality of the insulation. We found a problem caused by the dry wallers. They had come in to do their work, and not realized how important it was to keep batts in contact with the dry wall. They had created voids by leaning against the batts as they lifted the dry wall, and



shoving the insulation in at different spots. Do you hear much of that happening?

Yes, too much. One of the biggest fears we have is coming back to a job after it has been dry walled and seeing three or four fiberglass batts that we knew we had installed properly in the wall now lying on the floor.

That is one of the advantages of building performance test equipment. We can completely troubleshoot for insulation performance by using infrared cameras and blower doors to assess the thermal performance of the insulation and any air infiltration points. We can identify all that stuff and fix it, sometimes even fixing it after the fact.

However, it is seldom cost effective to put back in the batts the dry-wallers left out; you can’t have it perfect. If we install 1,000 batts in a house with a high quality installation and the dry-wallers compress five or six, we still have an extremely high quality job compared to trade standard work.

We look at the situation on the jobsite, like our old grading system in school. In theory we should always be aiming for A+ work. But we think B or B+ work is the most cost effective as long as we are focusing on every single energy feature.

Often some subcontractors are required to provide D- work, since to get the

job they must be low bidder, which means they are aiming for code minimums and not paying attention to installation quality.

Production homes comprise about 75 to 80 percent of all the houses built in California. Do you think it is possible to do high quality installation of insulation and other parts of the “house-as-a-system,” including the HVAC system, windows, and envelope, and still make it cost effective for the builder and homeowner?

It is definitely possible in production homes, and the cost effective opportunity for improvement is clearly there.

The biggest obstacle is that the building industry has many sub trades, and one sub trade really doesn’t know or care what the other sub

trade is doing. So, the plumber and electrician are making it hard to insulate walls, and the dry wallers may be damaging the insulation as they install their product.

There are all these negative interactions, and no one trade is in charge of all these energy features, so that heating/cooling installers don't know how good the job the insulation guys are going to do, yet it is the insulation that is going to keep the heated and cooled air in the building. Due to these difficulties, I choose to do HVAC and insulation work together, so that I have complete control of all the main energy features.

How can we improve existing housing stock? Standards apply to all new homes; however, what can help homes built 20-to-30 years ago?

Two weeks ago, I worked on a 60-year-old home in Berkeley. The owner works for *Home Energy Magazine*. I predicted that with the renovation of her energy features, her space conditioning energy would be reduced by about 78

percent. I gave her 12 envelopes to use to send me her energy bills for the next year to see how close to that prediction I came. Her furnace, dryer, and water heater were replaced. Radiant floor heating was installed in her bathroom, and the entire house and crawlspace were insulated.

What about her walls? The walls were already done. With all those energy features, most of her equipment was 40-60 years old, so she did



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a complete energy upgrade, including a ventilation system, which she didn't have before. All of it was done for under \$10,000.

So what is the expected payback on the project? Hopefully, there will be positive cash flow in the first month. This is where we need to put some value on comfort, because she wasn't comfortable. Now she seldom turns on the heat. For starters, she is going to save about \$300 a year on her gas consumption alone.

Sometimes people who were not comfortable using their AC before, because it did not work well, will end up using it more after they get new highly efficient equipment and the ducts and the system are fixed. How is

that addressed? That is called “take back.” A couple of years ago, I did a retrofit on my father-in-law's house in Stockton.

I brought my whole crew and worked for 3 days installing new AC ducts, furnace, insulation and new lights. I fixed the crawlspace.

He was only spending \$100 a year for AC. He hated using it because when he turned it on, nothing happened because of about 400 cubic-foot-per-minute duct leakage with poorly insulated ducts.

Looking at his bills after we worked on the house, he was still spending about \$100 a year for AC even though the efficiency of the AC system quadrupled, but now he is comfortable. I received a lot of thanks from the family because they like to visit him now.

What do you do that is different from the protocols? Everything we do as a company is in complete compliance with the quality insulation installation (QII) protocol. We differ from the protocol with one notable exception; we have an infrared camera so we can do a more thorough overall performance inspection.

Do you think the protocols are going to work well? One of the obstacles is people not understanding the real value when they look at these credits. The value for them is the trade-off of a compliance credit for more window area, but the overall benefit for comfort, indoor air quality, building durability and reduction in heating and cooling costs is often underappreciated.

Is this the right direction for the Energy Efficiency Standards? What else do you think should be done to increase energy efficiency? Absolutely. The more performance-based work that is either encouraged or required by the Standards is definitely the right direction.

Let's talk about what else needs to be done. I would like to see us move quicker to performance testing the whole-house combined with some sort of utility bill benchmarking. That would give true feedback and there would be a better understanding of the energy savings.

In my perfect world, the keys to an energy efficient building consist of two things: the "house-as-a-system" concept and "performance testing." That is how to learn to make the energy features work together and perform properly. One of the best ways to make those two things happen is by better feedback, which would be a benchmarking system.

Most homeowners don't know what they should be spending to heat and cool their homes, and the costs vary tremendously. On average, homes are good, but there are a bunch with energy use so much higher than the average, it is obvious they really need work.

If I can get the cost down into the ten-

Monitored Building Performance

Chitwood Energy Management has employed building science performance concepts for well over a decade. Even though the company has worked on several hundred homes, there has never been real data on the energy performance of those homes, until now. Building America and Redding Electric Utility provided funding for complete, third party, energy consumption and comfort level monitoring on a home in Redding with energy features installed by Chitwood Energy Management. The results of the monitoring effort are summarized below.

- 1. Air conditioner monitored energy savings, compared to a standard new home, 81 percent total savings; 83 percent reduction in compressor energy consumption, and 68 percent reduction in cooling fan energy use.*
- 2. Heating monitored energy savings compared to a standard new home 49 percent reduction in gas usage and a 65 percent reduction in heating fan energy consumption.*
- 3. The DOE 2 computer modeling that was done for the home under-predicted the benefits of good installation quality – under-predicting performance for heating and cooling by 46 percent and 43 percent respectively*
- 4. This house out-performed the geothermal heat pump used to heat and cool the house next door by about 60 percent in energy consumption and only had ¼ of the cooling peak demand*
- 5. The cost of energy improvements were 0.4 percent of the home's cost, or \$5,139.00.*
- 6. A two-ton air conditioner kept this 3,500 sq.ft. house in Redding at 73°F all summer.*
- 7. This performance was accomplished with conventional energy specifications: batts in the walls, loose-fill insulation in the attic (standard R-38), and ducts in the attic.*

to-twenty-cents per square foot range, I think I've been successful, and the home is more comfortable.

What do you mean by “house-as-a-system?”

Basically, all the pieces of the house and all the different systems in a home will work properly together. Often, there are bizarre and unrelated interactions between different components in a home. For example, the exhaust fan of a clothes dryer or a range hood can backdraft a fireplace and create problems. Often these interactions take place between the work of different subcontractors.

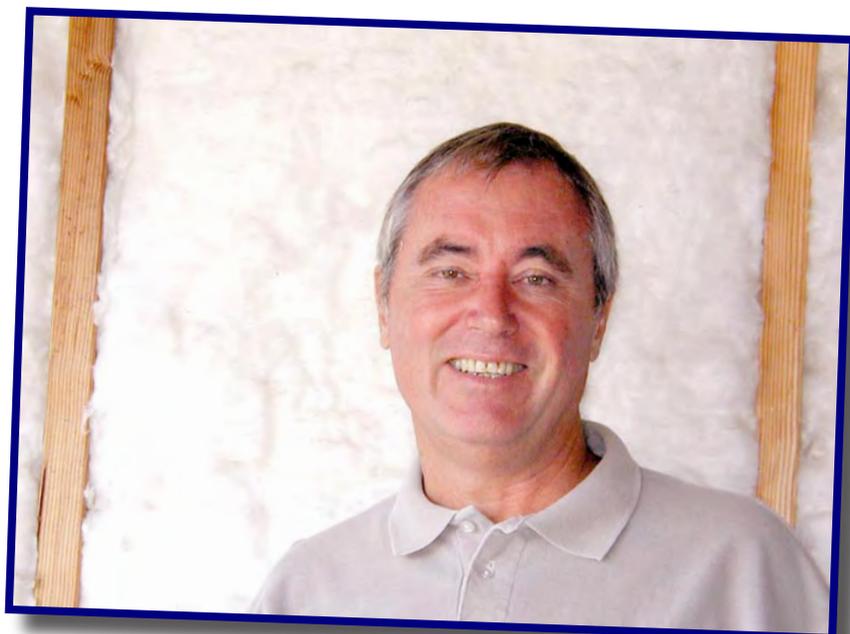
What we want to do is pay attention to the entire house as one system and pay attention to the interactions between different components and make sure they all work properly together.

Regarding the quality insulation installation protocol, you stated that the direction the Standards are taking related to performance testing is a good direction. Do you believe the Standards are going in the right direction in other areas and can you give us an example?

Yes. The thing I don't like is that because California has had the strongest energy code in the nation for over 20 years, many people believe that there is no more opportunity for improvement, that homes are as cost effectively efficient as they can be. They think that when you buy a home, you shouldn't need to invest in any more energy efficiency.

But I feel there is still great opportunity for improvement. Our space conditioning costs, for example should be one-half or one-third of what they are today in new homes. Lighting and appliance improvements are still significant, and of course the 2005 Standards are addressing the huge opportunity in lighting.

What do you see for the future of performance testing? Performance testing is the most important thing we can do. When we test houses that are part of a specific energy program,



we often see that just the performance-tested features that are required by the program, things like duct leakage, are noticeably improved.

We see that those tested features perform well, but when we performance test other features – whether it is insulation performance, or room-by-room air balance, or refrigerant charge, or total airflow across the evaporator – those features don't perform well because they weren't performance tested. In my mind, the more performance testing we do on a home, the faster homes will improve in all areas.

What is your definition of benchmarking? I would like each homeowner to know what they are spending in a year to heat their house, and what will be spent in a year to cool the house. And what will be spent in a year for everything else.

And then be able to compare, on average, what their neighbors are spending in their homes that were built about the same time.

That way they would have some idea of whether the costs are high or low. As an industry, we only look at the averages.

On average, homes are pretty efficient. We're only spending a few hundred dollars a year to heat and cool them, and things are good. But when looking at specific house data, there are variations by a factor of three-to-ten from one house to the next. Some of that is occupant operation, but a lot of it is equipment and envelopes that aren't working well and need to be fixed.

But there is no way to identify those homes. Some form of feedback could have a big impact on energy conservation.

Utilities could provide this service by using simple disaggregation software, so that when it reads the electric or gas meter every month, it can do a simple software calculation, and disaggregate the heating portion of the bill and the cooling portion of the bill.

Those numbers would be reported to the homeowner along with a report on other people's averages, without sacrificing customer privacy issues. That is what I would like to see – for a homeowner to know if he is spending three-to-four times more than he should for heating and cooling than the average home in the neighborhood.

Do you think that at that point the homeowner would take action to improve their home's energy efficiency? For the homeowner to capture that opportunity for improvement, there needs to be better trained technicians in the field. There is very little pride in workmanship these days. We have to bring some of that back with people with better training at installing and fixing energy features.

You've been working hard for a

number of years on this. Where do you see yourself going from here, and are there any new approaches you are taking or things you want to do differently? I'm

constantly excited about the future, because there is such an opportunity to improve energy efficiency in homes. To move things forward, I want to demonstrate to people just how much opportunity there is for improvement.

For example, one of the energy efficient houses we did in Redding – the hot north end of the Sacramento Valley – has a guaranteed cooling bill of only \$76 a year and guaranteed heating bill of only \$250 a year for a 3,500 square foot house. The Department of Energy-sponsored "Building America" program actually monitored the energy performance of this house for a year (see page 8).

Another thing I'm trying to do to move things forward is show people that they really are getting benefits of energy efficiency. In Mount Shasta, I'm building an affordable "net zero energy" multi-family building, a triplex, that will be all electric and won't have any net energy bills. It will produce a little extra electricity this summer using photovoltaics, and then get that back from the utility in the winter. The technology exists today to have houses that are so efficient that they don't need any energy from the grid. That's where we need to get.

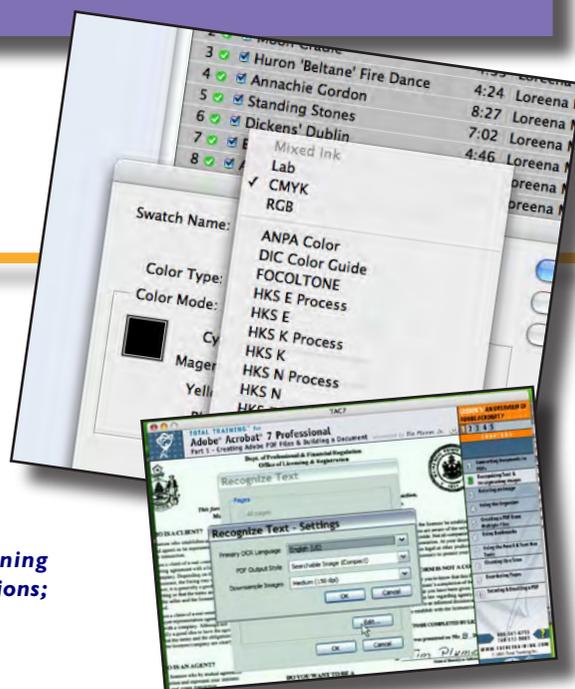
The California Energy Commission does not endorse any products, supplier, manufacturer or builder. The text in this interview is meant to be informational and not all inclusive.

The California Energy Commission's **Energy Code Online Training Website**

<http://www.energyvideos.com/>

This site provides video training on a variety of energy code and related building science issues, and offers guidance on the design and construction of efficient, durable and sustainable buildings in California. Both Residential and Non-Residential topics are covered.

Each "Resource" module is comprised of featured training videos; what the Standard says; and frequently asked questions; additional related links.



Duct Testing and a Satisfied Customer

And the Homeowner is the Ultimate Winner

Recently the California Energy Commission received an e-mail from a homeowner from the San Diego area (Climate Zone 10) about the 2005 Energy Efficiency Standards requirements for residential HVAC changeouts. The letter was about the homeowner's recent experience with the new requirements, and about her dealings with an HVAC contractor and the Home Energy Rating System (HERS) rater during the changeout process.

The new regulations regarding HVAC changeouts, which went into effect on October 1, 2005, state that the contractor must test for leaks in a home's duct system when a new air conditioner or furnace is installed. If the test reveals that a specified percentage of the cooled or heated air flowing through the ducts is leaking, then the contractor must seal the ducts. In addition, a HERS rater must verify that the duct system has been properly sealed. The regulations do, however, offer alternatives to the duct-sealing requirements, such as installing equipment with a high efficiency rating (both a high SEER and EER for an air conditioner).

The San Diego homeowner was aware of the HVAC changeout requirements and alternatives. She decided to replace the air conditioner and furnace with lower rated equipment. The homeowner felt that this was the right decision for her considering that she uses the air conditioner only a few times a year, and believes the reduction in her utility bills due to the higher rated units would not be enough to offset the initial cost of the units.

The homeowner was aware that with the equipment she had chosen, the contractor would have to test for duct leakage and have a HERS rater verify that the ducts have been properly sealed. At first, the HVAC contractor she had hired did not want to comply with the new regulations and perform the duct testing. However, the homeowner insisted and was prepared to file a complaint with the Contractors State License Board if the contractor did not perform the duct testing and seal the leaks.

Consistent with the changeout requirements, a HERS rater came to the home and performed a visual inspection of the duct system and a smoke test after the contractor finished the installation and the duct sealing. The smoke test revealed additional leaks that the contractor had missed and would have to seal. After the contractor sealed the additional leaks, the total duct system leakage was reduced by another 15 percent.

The homeowner was pleased with the end result. She was very happy that she had decided to go with the lower rated equipment and have the home's duct system tested.

Arnold Schwarzenegger
Governor

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Title 24 Energy Efficiency Standards

Links for training on issues relating to California Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24, Part 6) are available on the Energy Commission's website at:

<http://www.energy.ca.gov/title24/training>

The Energy Commission's **Energy Code Online Training**
<http://www.energyvideos.com/>

For training offered by the utilities and other organizations please see the following websites:

PG&E:
<http://www.pge.com/stockton>

SoCal Gas Co.
<http://seminars.socalgas.com/int/default.asp>

San Diego Gas and Electric
<http://seminars.sdge.com/int/default.asp>

SCE:
<http://www.sce.com/RebatesandSavings/EnergyCenters/workshops.htm>

SMUD:
<http://www.smud.org/education/index.html>

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NEW!

Videos and information for building department staff on Title 24 Compliance for **changeouts** and **cool roofs** is available at:
www.buildingmedia.com/calbo/videos_dept.html

BUILDING INDUSTRY INSTITUTE (BII)
<http://www.consol.ws/bect.asp>

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Residential Lighting Design Guide
– Best practices and lighting designs to help builders comply with California's 2005 Title 24 energy code
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