

ENERGY EFFICIENCY IN SAN MARCOS, TEXAS:  
IS OUR REBATE PROGRAM UP TO CODE?

HONORS THESIS

Presented to the Honors Committee of  
Texas State University-San Marcos  
in Partial Fulfillment  
of the Requirements

for Graduation in the Honors College

by

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San Marcos, Texas  
December 2011

Home Efficiency in San Marcos, Texas:  
Is our Rebate Program up to Code?

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## **ACKNOWLEDGEMENTS**

Dr. Galloway, thank you for taking me under her supervisory wing,  
encouraging this topic of discourse, and keeping me on point.

Katelynn, thank you for picking up my slack while I've been working on  
this and other things this semester, not to mention promoting my general  
sanity by keeping me smiling.

Dad, thanks for your edits and ideas.

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**Abstract:**

The homes in San Marcos are aging. While new tracts pop up to meet the housing demands of the region, many of the homes near the city's core are over 20 years old. Even when adequately maintained, these older homes experience degradation of energy efficiency, particularly in the heating and cooling systems. Heating and cooling make up approximately 43% of the average electricity bill, so improving their efficiency is paramount in lowering energy use and utility bills. The City of San Marcos offers the Energy Efficient Home Rebate Program to reduce the cost of energy efficient home improvements for residential utility customers. In 2010, \$42,424 in rebates was given, with 68 households receiving at least one rebate. Still, the program falls short, not reaching or educating enough potential customers to bring about significant change. This thesis explores and develops potential improvements to community outreach, education, as well as the rebate program itself, with a prospective goal of reducing the cumulative energy use of San Marcos homes by 1% within a 5-year period.

## **Chapter One – Introduction**

With summer comes hot weather and high utility bills. I hadn't had much experience with paying utilities before this summer. They were always my parents' responsibility or included in rent. This year, when July's bill came along, it was a harsh surprise. Not long after the check was cut, my wife and I undertook a few major household changes. The primary culprit was electricity, costing about \$200 or about two-thirds of the utilities. Soon we began to scold each other for lights left on, but being the forgetful one, I can say that didn't change my habits. Backing away from the inevitable conclusion of corporal punishment, we put up a clothesline, set the thermostat to 80°F during the day and 76°F at night, and curtained every window in the house (among other things). Our energy use decreased and with it our bill, but I was left pondering about what more could be done.

I began to consider the age of my house. It was built in the 1960's or 70's, making it over 30 years old. "Until the oil embargo of 1973 there was little interest in saving heat," writes Dr. William A. Shurcliff, "Architects, builders, money lenders, and home buyers gave the subject little attention. Most of the existing stock of houses had little or no insulation,

and even in the newest houses the insulation consisted, typically, of only 3.5 inches of fiberglass. Also, houses were loosely constructed: cold air could leak in easily through cracks around windows, doors, and sills. Warm indoor air could escape equally easily. On windy days in winter, infiltration and exfiltration could account for as much as half of the house's entire heat loss." <sup>1</sup> Energy was cheap in those days, so people were not yet concerned with efficiency in the heating and cooling of their homes. My house is a prime example of what Dr. Shurcliff wrote about in the above quote. Inadequately sealed single pane windows, terribly inadequate attic insulation, and numerous quirks of the home leave it vulnerable to temperature fluctuations at the whim of Mother Nature.

A great deal of energy is wasted competing with the shortcomings of an old home by over-running the A/C or heater. In San Marcos, many houses fall into the same age range as my own, and many are much older. As such, it isn't a great leap to conclude that many of my neighbors, friends, and fellow townfolk face similar conditions. Some have utilized the city's Energy Efficient Home Rebate Program (EEHRP), which helps residents afford upgrading various constituents of their heating and cooling system. I have yet to use the program, but I am not alone in that regard. Devin Hussey, Conservation Technician and Energy Auditor for the City of San Marcos, relayed to me that just 68 households took advantage

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<sup>1</sup> William A. Shurcliff, "Superinsulated Houses." *Annual Review of Energy* 11 (1986): 1-24

of the rebate program in 2010, saving a total of \$42,424.

The goal of this work is to find and recommend a way to reduce the cumulative energy use of San Marcos homeowners by 1%, while attempting to describe the cost for individual homeowners. This is a multifaceted problem. The San Marcos EEHRP helps already, but how could it be improved to facilitate the decrease? By bolstering programs that educate people about insulation and sealing, a larger audience for the rebate program could exist. Finding a way to break the barriers inhibiting homeowners from improving household energy efficiency, and strategically advertising to the community could be keys to increasing community awareness and cutting down our energy use.

## Chapter Two - Statement of the Problem

### What's the bill?

On the back of the San Marcos Energy Efficient Home Rebate Program pamphlet, the city's Public Services Department displays a pie chart showing typical home energy usage. Table 1 shows the categories, their percentage of energy use, and the monetary cost they may represent.<sup>2</sup>

	Heating / Cooling	Appliances	Water Heating	Lighting	Electronics	Other
Percent of Energy	43.00%	17.00%	12.00%	11.00%	9.00%	8.00%
Potential Cost	\$86.00	\$34.00	\$24.00	\$22.00	\$18.00	\$16.00

This information makes it clear that heating and cooling comprise the largest share of the typical energy bill. What exactly falls under the purview of heating and cooling?

### Air Conditioning

Heating and cooling are actions of interior air conditioning dependent on your heater and AC. Those with gas fueled systems (natural gas, propane, diesel, etc.) will not see as high an electric bill, but will have

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<sup>2</sup> *Energy Efficient Home Rebate Program*. San Marcos, TX: Public Services Department. 2010

to deal with the variability in the market price of fuel. Air conditioners often last between 15 and 20 years if properly maintained, but newer iterations show improved efficiency over their older counterparts. Heater and air conditioner efficiency are rated by the Seasonal Energy Efficiency Ratio (SEER). SEER is the amount of cooling, in Btu's, measured over a season, and divided by the watt-hours of energy used. Btu's, or British Thermal Units, are the amount of energy that it takes to raise the temperature of 1 lb. of water by 1°F. A watt-hour ( $W \cdot h$ ), is a unit of energy. It denotes the amount of electrical power, in watts, used over the course of an hour. For instance, 60 W light bulb running for 2 hours uses 120 $W \cdot h$  of energy. A kilowatt hour ( $kW \cdot h$ ) is 1000 watt-hours. The conditioned air is blown through the ducts, which may or may not be insulated. Joints in the ducts, where two separate pieces meet, may leak air into the unconditioned attic space, resulting in inefficiency. In some cases, ducting is run underneath the house, where it is protected from the heat that is often collected in the attic, but may be vulnerable to cold air in winter. Through the ducts, the conditioned air enters the living areas of the home.

For many people, the main interaction with the AC is through the thermostat. Newer thermostats are programmable, making it more convenient to use less energy during the times you are not home. For optimum system performance, it is a good idea to replace the intake

filter(s) monthly or bimonthly, but they are easily forgotten. A clean filter reduces the amount of work the AC unit has to do to draw in air. Proctor Engineering, in a response to a Home Energy Magazine article written by Michael Blasnik, wrote, "In a recent laboratory test of a high efficiency air conditioner, Proctor Engineering Group found a 7% drop in efficiency when the air flow was reduced by 30%.<sup>3</sup>" Beyond the heating/cooling system itself, there is the conditioned area to consider. Are the walls properly sealed and insulated? Are the windows and doors weather sealed? Good interior circulation saves energy, but temperature exchange between conditioned space and unconditioned space will reduce system efficiency.

Considering all of the components involved, there are many means by which heating and cooling performance could fall below adequate over time. Many homes in San Marcos date back to the 1970's or earlier. Odds are much of their infrastructure has not been updated or even maintained, except in cases of system failure. For many, this neglect is caused by a lack of familiarity with the workings of their household, or the inability to do the work themselves. Some simply lack interest in working towards a more energy efficient home. For many, the primary restriction to improving the energy efficiency of their home is monetary.

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<sup>3</sup> Proctor Engineering. *In Air Conditioning, If Bigger Is Not Better, What Is?*  
<http://www.proctoreng.com/articles/better.html> (Nov. 5, 2011)

## **Rebate Programs**

San Marcos offers the Energy Efficient Home Rebate Program to lower the cost barrier that faces many of the city's residents. The program focuses on the systems associated with the heating and cooling of homes. San Marcos also offers the Energy Efficient Appliance Replacement Program, a federally funded program meant to help low income families replace their older, comparatively inefficient appliances with new, high efficiency models. Funded by the American Recovery and Reinvestment Act of 2009, it is a mix of modern "green" sentiment and the scramble for economic stimulus to help curb the current recession. The argument could be made that many of the people utilizing rebates for the purchase of appliances are not doing so as a result of the rebates, but would be buying the appliance regardless.

For the purposes of this thesis, I will be focusing on the Energy Efficient Home Rebate Program, because it appears to offer the best means to improve efficiency for the City of San Marcos on an impactful scale. Its rebates on relatively low cost needs, such as insulation and sealing, could be cost effective means to reach a large number of people and markedly reduce their energy bills. I intend to investigate the necessary changes which, over 5 years, could reduce the cumulative home energy use of San Marcos by 1%.



## The Benefits of Insulation and Sealing

Energy Star, a program managed by the United States Environmental Protection Agency (EPA) and the Department of Energy (DOE), provides energy efficiency data and ratings for appliances, electronics, and home maintenance practices, in order to protect the environment and save homeowners money on their electricity bills. They estimate, "that a knowledgeable homeowner or skilled contractor can save up to 20% on heating and cooling costs (or up to 10% on their total annual energy bill) by sealing and insulating.<sup>4</sup>" "Sealing and insulating ducts can improve the efficiency of your heating and cooling system by as much as 20 percent — and sometimes much more.<sup>5</sup>"

Heating and cooling comprise around 43% of the average electricity bill. Increasing the efficiency of a home's heating and cooling system could cut energy consumption by as much as 40%, a 17.2% reduction of total energy expenses. Table 2 shows savings estimates that could be achieved through insulating and sealing a home, given a \$200 electricity bill.

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<sup>4</sup> Energy Star. *Air Seal and Insulate with Energy Star*.  
[http://www.energystar.gov/index.cfm?c=home\\_sealing.hm\\_improvement\\_sealing](http://www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_sealing)  
(Nov. 5, 2011)

<sup>5</sup> Energy Star. *Heat and Cool Efficiently*.  
[http://www.energystar.gov/index.cfm?c=heat\\_cool.pr\\_hvac](http://www.energystar.gov/index.cfm?c=heat_cool.pr_hvac) (Nov. 5, 2011)

**(Heating/Cooling Energy Percentage)(Percent of Efficiency Gained) =  
Reduction of Total Electrical Consumption** **Table 2**

H/C Portion of Energy Use	Efficiency Gained	Total Consumption Reduction	Monthly Electricity Bill	Monthly Savings
43.00%	40.00%	17.20%	\$200.00	\$34.40
43.00%	30.00%	12.90%	\$200.00	\$25.80
43.00%	20.00%	8.60%	\$200.00	\$17.20
43.00%	10.00%	4.30%	\$200.00	\$8.60

Insulation and sealing are relatively low cost improvements that, with the help of rebates, can improve the lives of a large number of people in San Marcos. But, in order to improve the rebate program and reach more people, there are several questions that need to be asked:

- ⤴ How does the rebate program serve the city and community?
- ⤴ Are consumers educated on the benefits of insulation and weather sealing?
- ⤴ Is the public aware of the rebate program?
- ⤴ Do people feel the rebate program is accessible?
- ⤴ What barriers limit spending on efficiency?

Beginning with the current San Marcos Energy Efficient Home Rebate Program, this work will lay out the improvements which to help the city reduce cumulative home energy consumption by 1% or more within 5 years of implementation. This may seem a rather modest goal, but it is a step towards a sustainable San Marcos and would increase awareness

about the need of insulation and sealing to reduce local energy use. A measurable 1% increase in efficiency would also exhibit the value of the program, not just to San Marcos, but to other urban areas as well.

### **San Marcos: Location and Climate**

San Marcos is located in south central Texas on I-35 between San Antonio and Austin, a region seeing some of the greatest population growth in the nation. As a result, San Marcos recorded a population increase of 29.3% between the 2000 and 2010 Censuses<sup>6</sup>. The area sits in a climatic transition zone between humid subtropical (Cfa) and semi-arid (Bsh) climates<sup>7</sup>. Under the Köppen Classification, a humid subtropical climate features hot, humid summers with thunderstorms, and mild winters with some rainfall. A semi-arid climate will have hot summers, but on average the amount of precipitation is less than the corresponding evaporation. As a result, San Marcos has hot summers, variable precipitation levels, and shifting levels of humidity and aridity. Table 3 shows average monthly temperatures for San Marcos (°F) over a 30-year period from 1981 to 2010. Table 4 gives the average number of days each month that exceed or fall below a given temperature.

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<sup>6</sup> US Census Bureau. *San Marcos QuickFacts*.  
<http://quickfacts.census.gov/qfd/states/48/4865600.html> (Oct. 21, 2011)

<sup>7</sup> Troy J. Kimmel. "Köppen Climate Classification Flow Chart."  
<http://www.utexas.edu/depts/grg/kimmel/GRG301K/grg301kkoppen.html> (Oct. 21, 2011)

**1981-2010** **NOAA Data<sup>8</sup>** **Table 3**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Avg. Temp.	50.6	54	60.8	68.2	75.7	81.6	83.9	84.7	78.8	70.2	60.5	51.8
Avg. Max. Temp.	62.4	65.9	72.5	79.7	85.9	91.4	94.3	95.8	90	82	72	63.3
Avg. Min. Temp.	38.7	42.2	49.1	56.8	65.5	71.7	73.5	73.6	67.7	58.4	49	40.3

**1981-2010** **NOAA Data** **Table 4**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Days Max. >90°F	0	0.1	0.2	1.5	7.8	19.8	27.2	28.1	16.6	3.1	0.2	0
Days Max. >80°F	0.7	1.9	6.3	16.1	26.6	29.4	30.8	30.9	28	20.8	6	1.1
Days Min. <50°F	27.8	22.6	17	7.2	0.7	0	0	0	0.4	6.4	16	26.3
Days Min. <40°F	18.9	12.2	5.4	0.8	0	0	0	0	0	0.4	6.5	16.1
Days Min. <32°F	7	3.7	0.9	0	0	0	0	0	0	0	1	5.8

San Marcos' climate presents a challenge to the city's inhabitants. Long hot summers beat down on under-insulated/weather sealed homes, dramatically reducing the efficiency of their cooling systems. As a result, many face high electricity bills and potentially uncomfortable houses.

### Demography

According to the 2010 Census<sup>9</sup> the current population of San Marcos sits at 44,894, though that statistic is widely believed to be

<sup>8</sup> NOAA. *San Marcos, Tx Temperature-Related Normals 1980-2010*. www.noaa.gov (Oct. 23, 2011)

<sup>9</sup> <http://quickfacts.census.gov/qfd/states/48/4865600.html>

inaccurate. Patrick George of the Austin American-Statesman wrote on March 3, 2011, "On Jan. 1, the city released a population estimate of 53,023 people. The Texas State Data Center at the University of Texas at San Antonio estimated San Marcos had 55,678 residents in July 2009 and 56,563 in January 2010. Even the Census Bureau's yearly American Community Survey offered an estimate of 53,205 in 2009." Mr. George continued to report that a low census return rate of just 67% plagued San Marcos<sup>10</sup>. According to Jan Klein, Conservation Coordinator for the City of San Marcos, the city's electric utility services 17,784 residential accounts<sup>11</sup>. Between 2005 and 2009, the median value of owner occupied housing units was \$117,000, while the median household income was just \$26,585 and 36.8% of San Marcos' residents were below the poverty line<sup>12</sup>. Table 5 shows data from the Real Estate Center at Texas A&M University<sup>13</sup>. It collects the values at which homes have been selling in San Marcos within the last 6 years. In 2010, homes selling between \$100,000 and \$159,999 made up 48.5% of the homes sold in San Marcos, just under half.

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<sup>10</sup> Patrick George. *San Marcos dealt population blow*. Austin American-Statesman. <http://www.statesman.com/news/local/san-marcos-dealt-population-blow-1296566.html?printArticle=y> (Oct. 21, 2011)

<sup>11</sup> Jan Klein. e-mail to author. Nov. 16, 2011

<sup>12</sup> <p://quickfacts.census.gov/qfd/states/48/4865600.html>

<sup>13</sup> *Market Report 2011: Austin | Round Rock | San Marcos*. Real Estate Center at Texas A&M University. <http://recenter.tamu.edu/mreports/2011/AustinRRock.pdf> (Nov. 9, 2011)

**Price Distribution of MLS Homes Sold, San Marcos Table 5**

Price Range	2005	2006	2007	2008	2009	2010
\$29,999 or less	0	0.5	0.6	0.4	0	0.4
\$30,000-39,999	0.3	0.7	0	1.2	0.5	0
\$40,000-49,999	2.5	1.2	1.8	1.5	1	0.8
\$50,000-59,999	2.5	4.2	3.9	1.9	4.3	2.8
\$60,000-69,999	4	4.5	5.7	4.6	1.9	3.2
\$70,000-79,999	3.3	3.5	3.9	5.8	2.9	5.6
\$80,000-89,999	4.3	8	5.7	4.2	6.2	6.7
\$90,000-99,999	5	2.6	1.5	1.9	4.3	2.8
\$100,000-119,999	13.3	10.8	11.7	8.1	7.1	16.3
\$120,000-139,999	21.9	16.2	15.1	15.8	19.5	15.5
\$140,000-159,999	10.6	12.5	12.3	14.6	10.5	16.7
\$160,000-179,999	9	10.1	6.6	11.2	11.9	6
\$180,000-199,999	5.8	5.4	9.6	8.1	5.2	5.6
\$200,000-249,999	7.8	8.2	7.2	8.8	11.4	4.8
\$250,000-299,999	5.5	6.4	5.1	6.2	7.1	7.1
\$300,000-399,999	2.3	3.5	5.4	3.5	4.8	3.2
\$400,000-499,999	1.3	1.4	2.4	1.2	0.5	2
\$500,000 and more	0.8	0.2	1.2	1.2	1	0.8

### **San Marcos Energy Conservation**

Go Green San Marcos is a recent program supervised by Ms. Jan Klein<sup>14</sup>. Concerned with the sustainability and beautification of San Marcos, Go Green is dedicated to 4 basic tenets: waste reduction and recycling, water conservation, land preservation, and energy efficiency. The energy efficiency heading offers the smart metering project, free

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<sup>14</sup> *Go Green San Marcos*. City of San Marcos. <http://www.sanmarcostx.gov/gogreen/> (Nov. 16, 2011)

energy audits, the distributed generation rebate program, and the energy efficient home rebate program.

The smart metering project began in 2010 and is nearing completion<sup>15</sup>. By the second quarter of 2012, San Marcos utility customers will be able to access energy and water use data on their home computers. Through this portal, they will be able to view daily usage patterns, making it easier to shift away from heavy use during peak hours, which can burden regional energy systems, resulting in rolling blackouts in some cases. Those have not been common occurrences here, but reducing the cumulative peak hour draw would result in less power plant fuel use. That means slower use of our fossil fuel resources and diminished dissemination of greenhouse gasses into the atmosphere. The potential rise in electricity costs could encourage greater customer participation in decreased peak hour electrical usage on an even greater scale. As such many municipalities have experimented with charging a higher rate to customers during peak times in order to dissuade high energy use.

Free energy audits are offered by the city to all electrical utility customers<sup>16</sup>. The auditor, Mr. Devin Hussey, examines electricity bills and various energy efficiency problem areas within the home itself. He will

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<sup>15</sup> *Smart Metering Project*. City of San Marcos.

<http://www.sanmarcostx.gov/projects/AMI.htm>, (Nov. 16, 2011)

<sup>16</sup> *Energy Conservation: Free Energy Audits*. City of San Marcos.

[http://www.sanmarcostx.gov/departments/electric/Energy\\_Consevation.html#FreeEnergyAudits](http://www.sanmarcostx.gov/departments/electric/Energy_Consevation.html#FreeEnergyAudits) (Nov. 16, 2011)

evaluate the home's heating/cooling system and duct-work, ventilation systems, appliances, insulation, windows, doors, envelope, and more, to determine how to reduce energy use. Basically, his job is to save homeowners money through education. It can be a very enlightening experience, even for energy conscious homeowners. Large-scale problems, such as AC inefficiency can represent a large chunk of your electrical bill, but the smaller, more subtle problems can add up as well. Having a professional indicate problem areas and provide an idea of how to fix them is an indispensable tool, especially considering the service is provided free of charge. An energy audit is required information for receiving any of the city's rebates through the Distributed Generation Rebate Program, and the Energy Efficient Home Rebate Program.

The Distributed Generation Rebate Program, implemented in fall 2011, is meant to encourage homeowners to install grid-tied renewable energy generators such as photovoltaic solar panels and residential scale wind turbines<sup>17</sup>. Not off the grid, these systems provide energy to a home, but in the event of energy deficit, electricity is still fed to the home by the utility company. It is unclear if the utility will be paying customers for the excess energy they generate, which would be routed into the grid for community use. In many markets, when energy is fed back into the grid,

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<sup>17</sup> *Energy Conservation: Distributed Generation Rebate Program*. City of San Marcos. [http://www.sanmarcostx.gov/departments/electric/Energy\\_Conservation.html#FreeEnergyAudits](http://www.sanmarcostx.gov/departments/electric/Energy_Conservation.html#FreeEnergyAudits) (Nov. 16, 2011)



the utility will reduce your bill accordingly. The Distributed Generation Rebate Program is a great idea, but its customer base is fairly narrow. The upfront cost, even if reduced by up to \$5,000 through rebates, is too high for the majority of San Marcos residents, even if the savings over time would be significant. The comparatively low cost improvements, made more affordable through the Energy Efficient Home Rebate program, have a significantly larger audience, because they apply to everyone, rich or poor.

## **Ch. 3 San Marcos Energy Efficient Home Rebate Program**

### **Applying for a rebate**

To be eligible for rebates, the homeowner must be a San Marcos Utility customer with an existing home. Customers can schedule a home energy audit through the city. At the time of this thesis, audits can be scheduled by phone at (512) 393-8308 or by email at [dhussey@sanmarcostx.gov](mailto:dhussey@sanmarcostx.gov). Devin Hussey, the San Marcos energy auditor, evaluates the various systems within homes that contribute to energy inefficiency, and the resulting high utility bills. Mr. Hussey makes recommendations based on his observations and provides rebate information. From there, the customer can buy qualifying products (delineated by the rebate guidelines) and if necessary, have them professionally installed. Within 90 days, the homeowner must submit a rebate application as well as their dated and itemized product receipts. Then the city will inspect the installations to confirm they meet the city code. If all of the above steps are followed properly, the customer is issued a rebate check. If the customer uses local contractors for installation, they shall receive an additional 10% rebate bonus.

## Rebates

### HVAC Systems

HVAC stands for heating, ventilation, and air conditioning and the term covers the majority of central air systems found in modern homes. A good AC is necessary to deal with the hot San Marcos summers and through the city. Homeowners can get a rebate on qualifying units. To qualify for the rebate, the HVAC system is required to have a SEER rating of 14.5 or higher and the system may be no larger than 1 ton for every 500 square feet being conditioned. In this case, tonnage does not refer to the weight of the equipment, but rather its capacity to refrigerate. One ton of refrigeration is equivalent to 12,000 Btu's per hour, or 3517 W•h of energy use<sup>18</sup>. To determine the increase in efficiency of the system by SEER rating, divide the current system's rating by the new system's rating and subtract the sum from 1. For instance, replacing a SEER 12 HVAC unit with the same size SEER 14.5 unit will result in an increased efficiency of 17%. The US DOE claims, "Today's best air conditioners use 30%–50% less energy to produce the same amount of cooling as air conditioners made in the mid-1970s. Even if your air conditioner is only 10 years old, you may save 20%–40% of your cooling energy costs by replacing it with a newer, more efficient

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<sup>18</sup> *NIST Guide to the SI*. National Institute of Standards and Technology.  
<http://physics.nist.gov/Pubs/SP811/appenB9.html> (Nov. 28, 2011)

model.<sup>19</sup>

Over-sizing of AC units is also a significant problem that plagues many homes, resulting in discomfort for their residents. An oversized air conditioner can easily bring the temperatures in a home to whatever is programmed into the thermostat, but without resulting in the comfort requested of the system. The oversized unit rapidly cools, with strong cold air currents and does less than a more reasonably sized system to remove moisture from the air. Proctor Engineering writes, "At the beginning of every cycle in hot moist climates, the air conditioner puts moisture into the house as water is evaporated off the inside coil. Since a smaller air conditioner runs longer to keep the house at the temperature set point, it removes more moisture than a larger unit would be able to achieve."<sup>20</sup>

**The exact HVAC rebates are as follows: Table 6**

SEER	AC Rebate	Heat Pump Rebate
14.5	\$75/ton	\$100/ton
15	\$100/ton	\$125/ton
16	\$125/ton	\$150/ton
17	\$150/ton	\$175/ton

A heat pump is capable of both heating and cooling a home, but does so in a different manner than a traditional AC with electric heat. It is similar to how a refrigerator works in that a refrigerant is moved through a

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<sup>19</sup> *Central Air Conditioner*. Energy Savers.  
[http://www.energysavers.gov/your\\_home/space\\_heating\\_cooling/index.cfm/mytopic=12440](http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12440) (Nov 18, 2011)

<sup>20</sup> <http://www.proctoreng.com/articles/better.html>

condenser coil, as the liquid expands into a gas it pulls in heat energy, removing it from the surrounding area. The heat pump blows the cooled air, surrounding the coil into the home. The process is reversed in order to heat during the cooler months. Walter Curtis, writer for Howstuffworks.com says that a heat pump is, "very efficient when the outside temperature is around 45 degrees Fahrenheit to 50 degrees Fahrenheit, but it becomes less efficient as the temperature drops."<sup>21</sup> Considering the local climate, a heat pump may be a good choice for homeowners looking to replace their current central air system.

Window AC units also eligible for rebates if they meet or exceed Energy Star guidelines. An Energy Star rated unit is eligible for a 30% rebate, a CEE Tier I rating will garner a 40% rebate, and CEE Tier II can receive a 50% rebate. To get an idea about the potential cost of purchasing a new AC, I visited [acdirect.com](http://acdirect.com). Table 7 features the cost of a SEER 15 Goodman AC with heat pump and the savings available via the San Marcos Energy Efficient Home Rebate Program. It does not take into consideration the cost of installation. It is recommended to have a professional determine the proper size and type of HVAC system for your home's individual needs.

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<sup>21</sup> Walter Curtis. *How to Troubleshoot a Heat Pump*. How Stuff Works. <http://home.howstuffworks.com/home-improvement/heating-and-cooling/how-to-troubleshoot-a-heat-pump.htm> (Nov. 18, 2011)

**Costs of a Goodman SEER 15 AC/Heat Pump<sup>22</sup>****Table 7**

AC Size (Tons)	Max. Conditioned Area (ft <sup>2</sup> )	Cost	Rebate	Cost after Rebate
1.5	750	\$2,488.00	\$187.50	\$2,300.50
2	1000	\$2,527.00	\$250.00	\$2,277.00
2.5	1250	\$2,856.00	\$312.50	\$2,543.50
3	1500	\$2,922.00	\$375.00	\$2,547.00
3.5	1750	\$3,162.00	\$437.50	\$2,724.50
4	2000	\$3,316.00	\$500.00	\$2,816.00

## Insulation

Attic, wall, and crawl spaces are meant to be kept separate from the conditioned space of the home. They are typically not air conditioned, so the temperatures can get quite high, particularly within the attic. To keep them from infiltrating into the home, insulation and sealing are essential. Insulation and sealing are meant to block off the warm, moving air currents, known as convective heat. Heat is the result of high energy. High-energy air molecules move around and spread out, making hot patches of air less dense than cool patches. The reduced density causes the air to rise. In the confined attic space, heat rises and then hits the ceiling which blocks its ascent. The pitch of the ceiling reroutes the hot air, resulting in a convective air current that flows within the attic. Insulation uses pockets of trapped air to block convective heat from making its way into the conditioned parts of a home. It has a low

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<sup>22</sup> *Heat Pump Tax Credit System: Selection and Pricing*. AC Direct.  
[http://www.acdirect.com/air\\_source\\_heat\\_pump\\_.php](http://www.acdirect.com/air_source_heat_pump_.php) (Nov. 28, 2011)

density to volume ratio and serves well to limit convective air movement.

The efficiency of insulation is measured by the R-value scale. R-value is the measure of a material's thermal resistance. Thermal resistance is the thickness of a material divided by its thermal conductivity. Thermal conductivity is regarded as a constant for a given material in a given state, so as the thickness of the material increases, so does the R-value.

Rolls or batts of insulation are typical of home installations. They are typically 15 inches wide, in order to fit between joists found in floors and walls, though other sizes are available for the other semi-standard framing widths. Batts have a paper or foil facing that serves as a vapor barrier. When installing, it is important to face the vapor barrier facing the conditioned space. If layering new insulation atop preexisting rolls or batts, it is recommended to buy insulation without a vapor barrier. Moisture trapped in insulation drastically reduces its effectiveness and can result in permanent degradation.

Fiberglass is the most common form of household batt insulation. It has an R-value of about R-3.2 per inch. The installation is not difficult, though it can prove uncomfortable due to the propensity of fiberglass to embed itself in the skin of those working with it. Aside from the paper backer, fiberglass insulation is fire resistant and recently a formaldehyde free option has been made readily available on the market. Some manufacturers even use recycled glass for a portion of the material.

Mineral wool (Rock or Slag Wool) has an R-value of about R-3.7 per inch. According to the United States Department of Energy, "This product is denser, fits standard wall cavities tighter, and is somewhat less prone to air convection thermal losses than standard fiberglass batt products." Mineral wool insulation typically contains about 75% postindustrial recycled content, slag left from ore refinement which is heated to about 2900°F and blown through the industrial cousin of a cotton candy machine. The product, aside from the constituent materials, is very similar to fiberglass.

Plastic fiber insulation, which is primarily made from recycled PET plastic (milk bottles and the like), has a high R-value that ranges from R-3.8 to R-4.3 per inch depending on its density. Fire can melt the material, but because it is treated with fire retardant, it will not typically burn. Plastic fiber insulation can be difficult to work with and cut, and may not be readily available for purchase in many areas of the country.

Cotton batt insulation is typically made from 85% recycled cotton and 15% plastic fibers treated with flame retardant. The R-value per inch is R-3.4 and while it may cost up to 20% more than fiberglass, cotton is nontoxic and non-abrasive, meaning no need for protective gear during installation.

Foam board insulation has an R-value of R-3.8 to R-8 depending on the type. It is pretty easy to work with and highly adaptable to whatever



surface needs insulating. While it takes a lot of energy to catch fire, once caught it burns heartily with a thick, toxic smoke. Foam board insulation is significantly more expensive per square foot than the other forms of insulation.

Also common for the attic floor, and sometimes in walls, is loose fill, or blown-in insulation. Loose fill insulation is probably best installed by a professional contractor for safety, as well as quality of installation. It is typically blown in with specialized equipment that can be rented by homeowners skillful and willing enough to put in the effort. Loose fill insulation can be faster to install than batts or rolls, and may be a better choice for unfinished attic spaces, unused by home occupants. That is because, while rolled insulation sits between joists and can be difficult to cut appropriately to fit a space, loose fill blankets everything and settles into the nooks which may go uncovered otherwise. Blown-in fiberglass has an R-value of 2.2- 2.7 per inch and typically is made of 20-30% recycled glass, rock wool has an R-value of 3.0-3.3 per inch, and cellulose has an R-value of 3.2-3.8 and is primarily made of recycled newsprint.

Liquid foam insulation installation is sprayed or poured in and should be handled by a certified professional. Typically, sprayed foam is used to coat attic ceilings. The four main types currently in use are cementitious, phenolic, polyisocyanurate, and polyurethane foams. Earlier foams would deteriorate over time and emit harmful CFCs (chloroflourocarbons), but

nowadays the gases within the bubbles are HCFCs (hydrochloroflourocarbons), which are somewhat less atmospherically volatile. The city only endorses open cell foam with its rebates. Open cell foam is less dense and more vulnerable to moisture intrusion, but may also be better at letting moisture escape a building than closed cell foam.

### **Attic Floor Insulation**

Attic floor insulation is required to meet the minimum standard of R-38, so if one were to use fiberglass batts in an area with no insulation, 12 inches of the R-3.2 insulation would be necessary. The rebate only applies to conditioned spaces, so something like a garage attic is not qualified for rebate funds. For the following calculations, I used the approximate attic area of my 1400 ft<sup>2</sup> house. Several R-values were simulated to provide a range of insulation quality at the outset.

**Rebate = (Attic floor ft<sup>2</sup>)( R-value added)( $\$0.0075$ )** **Table 8**

Attic area (ft <sup>2</sup> )	Current R-value	Value added	Rebate value
1500	5	33	\$371.25
1500	7	31	\$348.75
1500	9	29	\$326.25
1500	15	23	\$258.75
1500	30	8	\$90.00

At Lowe's, a roll of R-30 fiberglass insulation costs \$12.48 and covers an area of 31.25 ft<sup>2</sup>. To insulate a 1500 square foot attic would require 48 rolls, costing \$599.04 before rebates. Following inspection and approval of installation, a rebate of \$337.50 would be due to the homeowner.

## Spray Foam Insulation

For spray foam insulation, it is necessary to remove the insulation currently in place, so the beginning R-value is by necessity R-0. It is unclear in the rebate guide if the rebate goes towards the value added from the R-0 value, or if they are referring to the value held by the previous insulation prior to its removal for the spray foam replacement. The foam must be a minimum of 3.5 inches deep and can be used in both conditioned and unconditioned spaces. Table 9 takes into consideration the area of an attic ceiling, the depth of the sprayed-in foam, and the R-value added. For the purposes of these calculations, polyurethane will be the chosen material, with an R-value of 3.5 per inch.

$$\text{Rebate} = (\text{square feet of application area})(\text{R-value added})(\$0.0225)$$

**Table 9**

Attic ceiling area (ft <sup>2</sup> )	Foam depth (in)	R-value added	Rebate value
1450	3.5	12.25	\$399.65
1450	7	24.5	\$799.31
2000	3.5	12.25	\$551.25
2000	7	24.5	\$1,102.50

## Wall Insulation

The wall insulation rebate applies only to conditioned spaces and requires a minimum rating of R-13. Often, installing wall insulation necessitates the removal of the drywall or paneling that encapsulates the framing. Professionals can cut holes in the wall to blow in insulation,

though blown in insulation may more easily subside, compacting and thus reducing its ability to diminish heat exchange. It is simple to install roll or batt insulation into unfinished walls, but removing and later replacing the drywall or paneling can be an arduous and expensive task. If spray foam is used, it must be open cell.

Table 10 uses a 1500 square foot home as an example. The home is 25x60 ft. and has standard 8 ft. ceilings. Supposing all of the outside walls are to be insulated, the total area of the walls is 1,360 ft<sup>2</sup>. The insulation R-value will be increased to 13, though a homeowner may choose to go higher.

**Rebate = (square feet of wall space)(R-value added)(0.0225)      Table 10**

Wall area (ft <sup>2</sup> )	Current R-value	Value added	Rebate
1360	0	13	\$397.80
1360	3	10	\$306.00
1360	5	8	\$244.80
1360	9	4	\$122.40

### **Radiant Barrier**

Radiant barrier is another type of insulation. Instead of diminishing conductive or convective heat, it is made to reflect radiant heat. Radiant heat is also known as infrared, a band of light unseen by the human eye, which carries thermal energy. Infrared heat can enter a home without much interruption by conventional insulation. Radiant barriers use reflective surfaces to impede radiant energy from entering homes. Some are simple adhesive foils; others may be like reflective bubble wrap. The

latter benefits from R-value, though relatively low, due to the bubble air gap. To qualify for the rebate, the radiant barrier must have a reflectivity of 75% or more. It can be installed in both conditioned and unconditioned spaces. San Marcos will pay homeowners back 15 cents for every square foot of radiant barrier installed.

### **Duct Sealing**

Well-sealed ducting is a necessary component of an efficient HVAC system. Energy Star states that "about 20 percent of the air that moves through the duct system is lost due to leaks and poorly sealed connections.<sup>23</sup>" That 20% loss in heating/cooling efficiency is equivalent to approximately 8% of an average electricity bill. To receive a rebate, duct joints must be sealed with mastic, though foil tape can be used on equipment. The seals must reduce leaks to 12% or lower to receive the rebate of 10 cents per square foot of conditioned space.

### **Windows and Doors**

Windows and doors play important roles as entrances and exits to the home. Unfortunately they are open to more than just people and light, they are also convenient avenues for heat to move through via conduction, convection, and radiation. Energy Star claims that replacing old windows and doors with newer Energy Star approved models can

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<sup>23</sup> [http://www.energystar.gov/index.cfm?c=home\\_sealing.hm\\_improvement\\_sealing](http://www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_sealing)

reduce home energy consumption by 7 to 15%<sup>24</sup>. Doors, which meet Energy Star criteria, are eligible for a rebate of \$1.50 per square foot of coverage. Windows receive the same rebate, though the Energy Star standards they must follow are specific to the Southern Climate Zone. Also available for windows are solar screens and window films. A solar screen is a mesh shade that blocks some degree of light and heat from entering a home through its windows. Many of the solar screens on the market offer 80% or higher heat rejection. San Marcos will rebate 30 cents per square foot of screening used, but it "must be specified as a heat control or heat block product, and must be rated for minimum 60% solar heat rejection."<sup>25</sup> Window films are typically installed on the interior side of window-panes, to reduce the intensity of ultraviolet, infrared, and visible light which enters. To be qualified for a 30 cent per square foot rebate, the film must be rated for 50% or greater heat rejection, as well as designated as a heat block or heat control product.

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<sup>24</sup> Energy Star. *Residential Windows, Doors, and Skylights*.  
[http://www.energystar.gov/index.cfm?fuseaction=find\\_a\\_product.showProductGroup&pgw\\_code=WI](http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=WI), (Nov. 28, 2011)

<sup>25</sup> *Energy Efficient Home Rebate Program*

## **Ch. 4 Surveying the Barriers to Efficiency Rebates**

In order to get an impression of consumer awareness of the San Marcos Energy Efficient Home Rebate Program, an online survey was distributed to contribute to this thesis. The questions were developed to determine what barriers surround the rebate program as well as energy efficient renovations. Twenty-seven people participated in the survey. The questionnaire was created on and made available through Survey Monkey, an online survey application, and the link was distributed by e-mail. All data was collected completely anonymously, behind the veil of the internet, so as not to skew the results. Otherwise, some participants would feel targeted and not truly represent their points of view.

### **The Survey and Findings**

1) Do you live in a house within the city limits of San Marcos?

Of the 27 participants, 19 lived in a home within the city limits of San Marcos. The rest either lived outside of the city limits, or in dwellings such as apartments. In further research, it would be prudent to revise this question to yield more specific results. It is also possible that some participants, living just outside of the city limits, qualify for the rebate program as San Marcos Utility customers, but the question neglected to

include such possibilities. Because utility allegiance is of primary importance to this thesis, the question should have read, "Are you a San Marcos Electric Utility customer?"

When analyzing the following data, the results were split into groups based upon the answer to this question. Some of the questions relating to the rebate program are more specifically pointed toward San Marcos residents, so their answers carried more weight. The rest of the questions are non-geographic and as such weighted equally in the findings.

2) Do you own your home?

Once again, this question could use some polishing. More specificity would have improved its quality, such as asking about the participant's living situation and giving specific housing classifications as choices.

Of the 19 San Marcos residents, 14 own their residences. This is important in determining the ease of which they could access the rebate program. Renters can qualify, but must get written consent from the owner of their home. All 8 of those living outside of San Marcos own their homes.

3) Is your home over 20 years old?

Seventeen survey takers have homes over 20 years old. Nine of them live in San Marcos. This age was chosen because it meets 2 criteria: 1) 20 years is a long enough time for a home and its insulation to settle, reducing efficiency. 2) In the time since 1991, the residential building code



has evolved resulting in higher efficiency standards for homes. Because, the best practices 20 years ago are different from today, it may be of value for homeowners to consider upgrading the many components of the heating and cooling system.

4) How would you rate your electricity bill?

Five choices; unreasonably high, high, medium, low, or don't know; were given. While this question may pertain to one pull factor of the rebate program, it does not relate directly. Also, the question addresses the broader social want of less costly electrical bills. Two rated their bills as unreasonably high, ten as high, thirteen as medium, and just two as low. For almost 50% to rate their bills as high or worse could mean substantial room for improvement in terms of efficiency. In later studies, it would be interesting to further stratify this question, giving specific cost ranges and perhaps pairing them with home square footage data.

5) What are you doing or could you be doing to lower your electricity bills?

This question was meant to determine what people perceive as the best methods of reducing their energy usage. The answers ranged considerably and only two people mentioned using the rebate program as a means of improving their home. Two people cited money as an issue. One wrote, "Need two new A/C units and new windows, there is definitely no money."

Table 11 summarizes the methods considered by those surveyed.

**Table 11**

<b>Methods of reducing electricity use</b>	<b>Number of participants who use or would like to use the method (out of 27)</b>
Efficient lighting	12
Use of a programmable thermostat	11
Reduce appliance use	6
Reduce electronics use	5
Replace inefficient appliances	4
Seal windows and doors	4
Use solar power	4
Improve home insulation	3
Replace the AC	2
Replace inefficient windows	2
Replace inefficient hot water heater	2
Use passive heating and cooling	2
Use geothermal heating and cooling	1
Use wind energy	1
Insulate the hot water heater	1
Put up shutters	1
Get an energy audit	1

The most common answers, by far, were finding more efficient lighting solutions and efficiently maintaining household temperature with a programmable thermostat, however there was no consensus among any of the topics. Ideally, there would be a greater awareness among those tested about the benefits steps to heating and cooling efficiency, such as insulation and sealing.

- 6) Are you planning on any home improvements to lower your electricity bills? What are your plans?

The previous question largely featured hypothetical answers, good ideas, but not necessarily on at the top of participants' to-do lists. Conversely, this question is aiming to find the priority people place on home efficiency. Apparently, the priority is relatively low. Over half of the participants had no plans to make any improvements. From the information gathered, it is impossible to propose exactly why this is the case. The leap could be made that the reason is largely economic, but other barriers such as apathy and inadequate education may also persist. Renters would also answer no, because of their lack of input they have regarding their residence.

Aside from the 14 "no's," participants offered plans such as installing insulation, sealing, replacing windows and HVAC systems, and replacing or insulating windows. Any of these options could result in monthly energy savings, so the question that must be answered is how to move them onto the to-do lists of a large proportion of San Marcos Electric Utility customers.

- 7) Have you heard of the San Marcos Energy Efficient Home Rebate Program?

This question applies strictly to the 19 San Marcos residents. Ten of them had heard of the program, but I am doubtful this statistic carries

over to the whole of the city. Based on how the survey was passed out, it could be reasonably concluded that many of the participants are Texas State faculty, students, or friends and colleagues of the former. This group may have a greater awareness of community programs, particularly those featuring a focus on sustainability.

8) Have you used the rebate program? Why or why not?

Only the answers from San Marcos residents were taken into account in this case, because they would be the only possible beneficiaries of the program. Six answered no, at least one because of his or her status as a renter. Another six were unaware of the program. The final seven answered yes, though three made it evident that they had used the appliance rebate program rather than the Energy Efficient Home Rebate Program.

9) Would you take classes to learn how to increase energy efficiency in your home (and reduce your electricity bills)?

This study recognizes a lack of education as one of the barriers to improving household efficiency. So, supposing the city were to wrap learning opportunities into the greater Go Green San Marcos campaign, it is important to gauge interest for classes. Seventeen of 27 participants expressed interest. Some of the remaining ten may already be educated in the field or perhaps not have the time to participate in such a class. For those with difficult schedules, it could be useful to implement other

strategies to reach them.

10) What do you think uses the largest share of energy in your home?

Three choices were given for this question: Heating and cooling, electronics, or appliances. 24 of 27 answered heating and cooling, showing awareness of the role heating and cooling plays in high energy usage and utility bills. This finding was somewhat surprising, though once again education level may play a role.

## Ch. 5 Improving the Rebate Program

### Calculations

The San Marcos Electric Utility services 17,784 residential accounts. On average, each account uses 1,100 kW•h per month<sup>26</sup>. As a whole, these residences account for the average use of 19,562,400 kW•h of electricity per month, or 234,748,800 kW•h per year. The goal of this thesis is to reduce residential energy use by 1% within five years, which means trimming 2,347,488 kW•h of energy.

Heating and cooling account for about 43% of a household's electrical draw. This amounts to 473 kW•h per month for an average home. Applied to 17,784 residences, heating and cooling use 8,411,832 kW•h per month, accumulating to 100,941,984 kW•h over the course of a year.

In 2010, the Energy Efficient Home Rebate Program helped 68 households, giving out \$42,242 in rebate checks<sup>27</sup>. Forty-three homes had their HVAC systems replaced, 21 had their ducts sealed, 21 improved their insulation, 5 replaced doors and windows, and 2 installed radiant barriers. As a result, approximately 111,669 kW•h per year will be saved by those homes. On average that is an annual savings of 1,642 kW•h per household, which amounts to 29% of a home's typical heating and

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<sup>26</sup> Klein e-mail. Nov. 16, 2011

<sup>27</sup> Devin Hussey. e-mail to author. Oct. 24, 2011

cooling or 12.4% of its cumulative energy use. The result is an electrical bill reduced by 10-12%.

In comparison, the ARRA Appliance Rebate Program returned \$149,050 to consumers and resulted in the savings of approximately 185,333 kW•h per year. These appliance rebates had 3.5 times the budget of the Energy Efficient Home Rebate Program, but resulted in only 1.6 times the energy savings. To illustrate this point, the EEHRP spent just 38 cents per kilowatt hour saved, whereas the ARRA rebates spent 80 cents for the same amount of energy. In terms of energy reduction, the Energy Efficient Home Rebate Program is slightly over two times more cost effective. Separately the two rebates helped to reduce residential energy consumption by 297,002 kW•h in 2010. That is 172,496 kW•h short of the annual goal of 469,498 kW•h necessary to reach a 1% reduction in energy use within 5 years. However, if the ARRA rebate budget were to be rolled into that of the EEHRP, the program would have \$191,292 to put towards encouraging heating and cooling retrofits. If the energy savings remain consistent with 2010's, at 38 cents per kilowatt, 503,400 kW•h could be saved.

## **Breaking Barriers**

### **Education**

Before any other problems can be solved, the people of San Marcos need to be educated. Reaching 50,000 people isn't simple, but

even more difficult is having an effect on them. So much information is shot past us every moment of every day that it has become nearly impossible to break into the white noise. Thus it is imperative that data be made interesting and even fun for it to stand out. Providing the public with bite size chunks of knowledge, coated in humor and filled with relevance should be prioritized in order to encourage locals to seek further education on the topic of home energy efficiency. For this purpose, I propose the "Did You Know?" campaign. Simple, single line blurbs of information developed to ignite interest would be spread through town. This wouldn't be difficult, many businesses would be happy to sport a well-designed little poster in their windows to foster energy efficiency within their city. After all, lower utility bills mean more spending money. The posters could even take advantage of the proliferation of smart phones within our community by including QR codes. These bar codes can be scanned by most modern smart phones and could be used to link access to online educational content and perhaps even contests or incentives. "Did You Know?" spots could even be sent in to the University radio station and disseminated to their audience.

With the foundation firmly in place, it is now possible to relay practical information to the people of San Marcos. To do so, the city could provide workshops to the public, which teach various methods of reducing energy use within the home. Caulking around windows or



replacing weather stripping on doors are skills that just about anybody can learn and imitate, regardless of their skill level. Even more difficult processes, like installing insulation and sealing ducts, could potentially be covered through classes held at the library or demonstrations at the farmer's market. Audience participation could be rewarded with \$5.00 Lowe's gift cards, enough to buy a tube of caulk.

Many of these topics could even be covered online. With YouTube, it is possible to record how-to's and other informational videos in order to reach people who can't make it to classes, or want to learn more at home. Online learning could even be incentivized by testing viewer information retention and rewarding high scores with bumper stickers and other propagandized items.

One concern is that by illuminating the many contributors to energy inefficiency, people will feel overwhelmed and become apathetic. Fusing in simple, easy to follow instructions, removing difficult vocabulary, and pushing the point that every step makes a difference is crucial to reach weary individuals.

### **Awareness**

Armed with knowledge, residents should be more inclined to attack the efficiency problems found within their homes. The San Marcos Energy Efficient Home Rebate Program is meant to further encourage them by reducing the cost inherent in bringing a home up to date. The problem is

much of the town is unaware that this program exists or the extent to which it could save them money. So, how do we spread the good news?

- 1) Every month, every utility customer receives a statement which delineates the cost of electrical, water, and waste utilities. This is a perfect place to advertise rebates. Simply place "Learn how to reduce your energy bill." below the sum of the electricity cost. If they customer receives their bill electronically, this could be a link, connecting them to the rebate program homepage. On a paper notice, it should lead the reader to a footnote briefly explaining the services provided by the city and a URL.
- 2) Next year, the San Marcos Electric Utility will provide its customers with an online portal to view their energy usages. This page provides a perfect opportunity to advertise the rebate program, as well as daily "Did You Know?" blurbs. Since people will be able to keep track of their energy usage, it will give them a window into the direct effects their actions are having on their home energy use.
- 3) If the "Did You Know?" campaign were to prove successful, it could be a simple point of access for residents to gain awareness of the Energy Efficient Home Rebate Program.
- 4) The program itself has to become more proactive. The

Colorado College Energy Audit and Retrofit Program shifted from request based to work to identifying older homes and neighborhoods, particularly in lower income areas and collaborating with neighborhood associations to reach out and encourage neighborhood change<sup>28</sup>.

## **Cost**

Perhaps the most crucial barrier for many people is reducing the cost of retrofits. Rebates do this to an extent, but they don't diminish the cost of purchase, which is prohibitive for many people. Loans seem like a possible solution, but it is unlikely that the city could foot that type of bill. Perhaps, because of the home improvement purpose of retrofits in conjunction with the resultant utility savings, banks would be more inclined to give low interest loans on less costly upgrades.

It may also be prudent to encourage the development of an R&D-I-Y community within San Marcos. R&D-I-Y stands for Research and Develop It Yourself. It was a project started by Britta Riley as a means to spread and evolve her window garden designs. Its popularity exploded, resulting in thousands of people, all around the globe, collaborating in the ever improving design of window gardens. The same concept could be used here. Can't afford retrofits? Make them yourself and then show your design to others. Let it grow and evolve with the added insight of the

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<sup>28</sup> Wierzba, et al., "A study to optimize the potential impact of residential building energy audits." *Energy Efficiency* 4 (2011): 587-597

community.

**Conclusion:**

The climate, aging housing stock, and prevalence of poverty in San Marcos require that attention be paid to home energy efficiency. An inefficient home can be uncomfortable to live in and bear the burden of high electricity bills. Heating and cooling contribute to around 43% of energy consumption within a household. The San Marcos Energy Efficient Home Rebate Program is meant to reduce the cost barrier which may prohibit many people from investing in home improvement. To reduce home energy consumption in San Marcos by 1%, the rebate program must grow both in budget and in scope. If the savings rates attained in 2010 are continued, the program will have to reach almost 2,000 people over a five-year period. By implementing more extensive community involvement and greater proactivity, this goal is not impossible, but will require a great deal of work. Mr. Hussy is going to need some new colleagues.

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