Energy Hogs: The Scale of the Nation's Energy Problem

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Report Number AIGI-NE-101-08

Abstract

The recent downturn in the U.S. economy, combined with record energy prices, has combined to promote energy efficiency as a valid and important consideration for the American consumer. The importance of energy efficiency to the average consumer is evidenced in the precipitous decline in SUV and truck sales. For the first time in sixteen years the highest selling vehicle in America was *not* the Ford F-150 pickup, but a compact and fuel-efficient sedan. This sudden shift in consumer preference has caused the G.M. president to recently comment, "The U.S. auto industry is going through changes probably faster than we've ever seen before." This sea change in the auto industry is, however, merely symptomatic of the increasing importance of energy efficiency to the consumer, a tendency that is likely to affect many other industries as energy costs continue to increase.

This report suggests that a less conspicuous, but perhaps more egregious energy-consuming appliance has slipped under the radar of most consumers: the home HVAC system. This article outlines the scale of the problem of energy consumption by home heating and air-conditioning systems. For example, about one-seventh of all the energy generated in the U.S. is used to air-condition buildings. Further, over half of the energy expended in the average American home is used on heating and cooling. With the effects of what appears, to most scientists, to be anthropogenic climate change, the demand for air-conditioning will increase, and consequently, so will the demand for household energy.

The nation's 89-million air heating-A/C (HVAC) systems have a serious problem: while operating on the average 34-percent below their efficiency standards, they waste nearly 212-billion kWh of electrical energy - enough waste to power 17.2-million additional homes for one year.

In short, the first major culprit to be attacked in order to alleviate the domestic and worldwide energy crunch is the often inefficient and clunky HVAC systems in many American homes. Government standards for the energy-efficiency of home air-conditioning systems have gradually increased over the years, something that would ostensibly address the problem. The increasingly stringent requirements for the Seasonal Energy Efficiency Rating (SEER), however, only affect *new* air-conditioning systems as they are produced, and does little to alleviate the energy use of the vast majority of HVAC systems in use in homes today. Furthermore, the testing of new air-conditioning systems takes place in a lab setting, which cannot take into account the numerous obstacles in real-life environments that adversely affect the efficiency of air-conditioning systems.

In order to address the problem of unsustainable energy consumption, consumers, government agencies, and HVAC industry insiders need to come up with practicable solutions to the primary energy hogs in most American homes, namely the HVAC system.

Introduction

The recent months have seen soaring fuel costs, with crude oil prices surging to a record $138.54 a barrel on 6 June 2008.[1] Economic forecasts are grim: with abysmal unemployment rates, the ever-growing pool of foreclosures, and an anemic dollar, a recession seems more and more inevitable to economists and average Americans alike.

One way that Americans have responded to rising gas prices is to purchase more fuel-efficient vehicles. Last month, for the first time since 1992, the country's top-selling vehicle was a car—the compact Honda Civic sedan—rather than a truck. "In fact," the New York Times reports, "the top four sellers last month were all cars, pushing the current 2008 F-series down to a once-incomprehensible fifth place as its sales fell 33 percent. Sales plunged 38 percent for the 2008 Ram and 44 percent for the Chevrolet Silverado…"[2] The unprecedented and swift change in American automobile preferences caused the president of General Motors Corp. to comment, "The U.S. auto industry is going through changes probably faster than we've ever seen before."[3] America's love affair with mammoth, gas-guzzling vehicles seems to be reaching its end. The backlash from environmentalists over SUVs has been steady over the past decade, such animosity typified by the Sierra Club's labeling the 9,200-pound Ford Excursion as "the Exxon Valdez of Vehicles."[4] But such rapid changes in consumer preference were likely not prompted by the activism of environmental groups. The decline in the market-share held by trucks and SUVs coincides conspicuously with the spike in oil prices this year, a synchronicity that cannot be ignored.

While most American drivers are keenly aware of the rise in fuel prices—a fact that is conspicuously displayed on the fuel pump—most give little thought to the energy expenditure used to keep Americans comfortable in the summer heat. According to the Environmental Protection Agency (EPA) and the Department of Energy (DOE), about one-seventh of all energy generated in the US is used to air condition buildings[5]. In states like California, where air conditioning is crucial to comfortable indoor living, the figures are even higher: Californians use approximately 30% of their electricity on air conditioning, or about 16,000 megawatts per day[6]. It seems the more money Americans have, the more they are willing to spend it on bigger, nicer homes, and on making those homes comfortable. Whereas only 56 percent of American households had air conditioning in 1978, as of 2001 the count had climbed up to 77 percent. That means in all likelihood, well over 80 percent of American households have air conditioning today.[7]

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[1] Reuters, "Oil Prices Jump Nearly $11, Settle at Record $138.54," MSNBC.com, June 5, 2008, http://www.cnbc.com/id/24993747 (retrieved 9 June 2008).

[2] Nick Bunkley, "Detroit Automakers Compete for a Vanishing Truck Market," New York Times, June 5, 2008, http://www.nytimes.com/2008/06/05/business/05auto.html?scp=2&sq=ford+f-150+sales&st=nyt (retrieved 9 June 2008).

[3] David Olive, "The Rise and Fall of the SUV," TheStar.com, 8 June 2008, http://www.thestar.com/Business/article/439398 (retrieved 9 June 2008).

[4] Ibid.

[5] Energy Star, "Central Air Conditioners," http://www.energystar.gov/index.cfm?c=cac.pr_central_ac (retrieved 2 June 2008).

[6] California Energy Commission, "Media Advisory," (CEC, March 25, 2002), http://www.energy.ca.gov/releases/2002_releases/2002-05-23_air_ma.html (retrieved 2 June 2008).

[7] McCook Daily Gazette, "Time to Go on an Energy Diet," McCook Daily Gazette, August 3, 2006, Wednesday; http://www.mccookgazette.com/story/1162859.html (accessed August 12, 2006).

While some may deny the existence of global warming, a recent article noted that there is a resounding consensus in the scientific community of the reality of anthropogenic (or "man-made") climate change. The article, published in *Science*, quoted the Intergovernmental Panel on Climate Change as claiming that "Human activities ... are modifying the concentration of atmospheric constituents ... that absorb or scatter radiant energy. ... [M]ost of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations."[8] If such is the case, then Americans find themselves in an uncomfortable catch-22: the more energy is consumed, the warmer the climate becomes; the warmer the climate becomes, the more energy is consumed on indoor climate control.

The motivations for energy efficiency can come from many sources. In the case of automobile fuel efficiency, for example, the recent shift of consumer preference for compact sedans over trucks and SUVs was likely motivated by economic forces. But whatever the motivation, it is clear that both economic and environmental factors are making energy efficiency an important consideration for consumers. The question is: how should the average consumer curb his or her energy consumption? At least part of the answer lies in the seemingly innocuous and often unseen energy hog in most American homes: the air conditioning system.

Rise of Energy Use in Households

American homes are using more energy today than they ever have. In 2007 homes used 1,311-billion kWh, while HVAC systems accounted for about 586 billion kWh of that energy use. Much of the total energy consumption is used for electric appliances, but by far the biggest energy hole in the home is the heating, ventilation and air conditioning (HVAC) systems. According to the U.S. Department of Energy, heating and cooling account for about 56% of the total energy (electrical, gas/oil) use in a typical U.S. home, making it "the largest energy expense for most homes".[9] And the problem will get worse before it gets better.

A CNN article from 2000 sited America's growing prosperity as the problem. They reported, "With new, bigger private homes going up and half a million new commercial buildings built every year, energy demand is outpacing supply." CNN also predicted that, "By 2007… up to 150 gigawatts (150 billion watts) of new energy capacity will be needed in the United States."[10]

This article's predictions seem to be coming to fruition, as climate events like the 2006 California heat wave pushed the state to a Stage 2 power emergency[11]. On July 24, California air conditioners drove electricity use to 50,270 megawatts—a state record[12]. Californians' were spared rolling blackouts, but not before being pushed to the limit of their power supply. Even without the rolling blackouts, more than a million Californians were without power at some point during the heat wave[13]. With the 2000-

[8] Naomi Oreskes, "Beyond the Ivory Tower: The Scientific Consensus on Climate Change," *Science*, 3 December 2004, http://www.sciencemag.org/cgi/content/full/306/5702/1686 (retrieved 9 June 2008).

[9] U.S. Department of Energy, "Energy Efficiency and Renewable Energy: Your Home," http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm (retrieved 2 June 2008).

[10] Bill Delaney, "Future Energy Shortages Predicted," CNN.com, July 28, 1999, http://www.cnn.com/US/9907/28/power.crunch.crisis/ (retrieved 3 June 2008).

[11] Associated Press, "California Power Supply Pushed To Limit," CNN.com, July 26, 2006, http://www.cnn.com/2006/US/07/25/powerwoes.ap.ap/index.html?section=cnn_us (accessed August 12, 2006).

[12] Ibid.

[13] AP, "California Heat Wave Nears End."

2001 power crisis still fresh on the minds of most of the state's residents, it seemed that history was repeating itself.

The Culprit: Air Conditioning

According to a Department of Energy study, as of 2001 there were approximately 107 million households in America. About 81 million of these homes had air conditioning[14]. That number is not static, but is constantly on the rise. The dramatic rise in energy consumption by air conditioning is due to two primary factors: (a) the staggering number of new homes being built in America (of which an estimated 90+ percent of new homes will have central air conditioning[15]); and (b) the increasing size of new homes means more livable space needs to be cooled.

In the last few years, the number of households in the U.S. grew at an annual rate of about 1.1 million new homes. That means that since 2001 (the year the Department of Energy study was released), about 6.4 million new homes have been added up to the end of 2007. That would mean that at the end of 2007, there were approximately 113.4 million households in the U.S., of which about 89 million had central heating and air conditioning[16]. With numbers like that, it is not difficult to imagine that another energy crisis may be on its way.

Although there have been improvements in the energy efficiency of air conditioners through the years, these improvements have not offset the rise in consumption by these systems. The Department of Energy reports:

> Although there were improvements in the efficiency of the U.S. stock of air conditioners over time, central air-conditioning continued to be responsible for the greatest share of household electricity use. The predominance of air conditioning was due to a significant increase in the number of households with central air-conditioning in the two decades preceding 2001.[17]

In other words, despite improvements in technology, Americans are still paying more to run their homes than ever—about $160 billion annually, of which a majority goes toward heating and air-conditioning costs[18]. That figure, like all others regarding energy consumption, is steadily on the rise.

Besides eating away at the average Americans' pocketbooks, air conditioning depletes our nation's power supply. The California Energy Commission stated, "In California, air conditioners are big

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[14] Energy Information Administration, "Electric Air-Conditioning Energy Consumption in U.S. Households by West Census Region, 2001," (U.S. Department of Energy, 2001), http://www.eia.doe.gov/emeu/recs/recs2001/ce_pdf/aircondition/ce3-12c_westregion2001.pdf (retrieved 3 June 2008).

[15] See appendix

[16] See appendix

[17] Energy Information Administration, "U.S. Household Electricity Report," http://www.eia.doe.gov/emeu/reps/enduse/er01_us.html (retrieved 3 June 2008).

[18] Environmental Protection Agency, "Federal Agencies Partner to reduce Home Energy Bills and Protect Environment," http://yosemite.epa.gov/opa/admpress.nsf/d9bf8d9315e942578525701c005e573c/5c5215fd18dea5e88525703b005157dc!opendocument (retrieved 3 June 2008).

power consumers. Air conditioners use about 30 percent of all electricity in the state during the summer afternoons."[19]

Many states are in the same boat as California with regard to use of air conditioning. But in some areas, the problem of heat and humidity means that air conditioning is even more vital to comfortable living. While most of California experiences hot, dry summers, the humidity of other areas of the country intensifies effects of high heat, making air conditioning vital. Those areas of the country that experience hot and humid summer, residents depend on air conditioners not only to lower the temperature of their home, but also to dehumidify it. Air conditioning is therefore used by many on an almost year-round basis in areas such as the Gulf Coast and Hawaii.

As more and more scientists confirm the threat of global warming[20], it is clear that air conditioning will become an even more intrinsic part of most Americans' lives. This means that the energy efficiency will become a much more vital issue in the coming years.

Running Out of Household Energy

As noted earlier, the demand for energy in America is now outpacing supply[21]. This is a dangerous situation that ultimately results in increased dependence on foreign sources of energy, and an increased danger of slipping into another power crisis. CNN reports that America's growing economy is "increasing electricity demand by about 2 percent a year, without comparable increases in power generation."[22]

We can take the example of California as a microcosm for the rest of America. In the 2000-2001 energy crisis, millions of Californians experienced power outages as rolling blackouts had to be instituted in a stage 3-power emergency[23]. Many predicted future shortages, and in 2006 they were proved right as California was on the brink of declaring another stage 3 emergency[24]. Cutbacks by businesses and agencies helped avoid rolling blackouts in 2006, but what with energy consumption steadily on the rise, many are left wondering what will happen the next time unseasonable heat sweeps through the state.

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[19] California Energy Commission, "Media Advisory," (March 25, 2002), http://energy.ca.gov/releases/2002_releases/2002-05-23_air_ma.html (retrieved 3 June 2008).

[20] Michael Coren, "The Science Debate Behind Climate Change," CNN.com, February 10, 2006, http://www.cnn.com/2005/TECH/science/04/08/earth.science/index.html (retrieved 3 June 2008).

[21] See page 2.

[22] Delaney, "Future Energy Shortages Predicted."

[23] David Lazerus, "Overload: Why the State Can't Keep Up With the Demand for Energy—Even in December," San Francisco Chronicle, December 7, 2000, http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2000/12/07/MN150082.DTL&hw=stage+power+emergency&sn=004&sc=910 (retrieved 3 June 2008).

[24] Associated Press, "Power Shortages Likely if Hot Weather Continues, Experts Say," CNN.com, July 6, 2000. http://archives.cnn.com/2000/US/07/06/power.crunch/ (retrieved 3 June 2008).

Government Response

Air conditioning and heating systems are doing their part to make America's homes the second largest consumer of energy resources nationwide, second only to automobiles. Millions of barrels of oil, tons of coal, and billions of kilowatt-hours of electricity are involved in supplying energy for our homes. This massive strain on energy resources has drawn the attention of both state and federal governments.

In January 2006, the U.S. Department of Energy announced the introduction of 30% higher efficiency standards for air conditioning systems produced in or imported to the United States. The standard would be raised from a Seasonal Energy Efficiency Ration (SEER) of 10 to 13. The rise in efficiency would, according to the Department of Energy, save 4.2 quadrillion BTUs (quads) of electricity over the next 25 years. That is the equivalent of the amount of energy consumed by nearly 26 million American homes annually.[25]

The California Energy Commission encouraged the federal government to tighten energy efficiency standards, saying, "More efficient air conditioners mean fewer power outages and less need for new power plants."[26]

While the government attempts to regulate America out of an energy crisis, the changes are not drastic enough. Saving 4.2 quads of energy over the next 25 years is small when compared to the rise in energy consumption. In other words, government standards are not offsetting our increasing appetite for energy.

Deceptive Efficiency Ratings

The problem is that government standards do not tell the whole story when it comes to the actual energy efficiency of America's air conditioners. The fact that air conditioners must now meet a standard of 13 SEER may look good on paper, but once installed, these air conditioners might only be achieving 10 SEER or lower.

Lab conditions are much different than real life conditions. While many variables that affect actual energy efficiency have been controlled in a laboratory setting, they remain uncontrolled in America's homes. Advanced Energy reports the following:

> When a manufacturer sends equipment to a laboratory to establish its SEER rating, you can bet the equipment is set to perform its best under the test conditions. But real conditions in a home, not controlled lab conditions, determine how equipment will perform…[27]

Field experience often shows that these conditions are not being realized, and the equipment performs lower than its rated SEER. In other words, equipment that is rated to perform at a level of 13 SEER in a lab will most likely fall short of that mark when installed in a home.

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[25] Chris Kielich, "Stronger Manufacturers' Energy Efficiency Standards for Residential Air Conditioners Go Into Effect Today," U.S. Department of Energy, http://www.energy.gov/news/3097.htm (retrieved 3 Jun3 2008).

[26] CEC, "Media Advisory."

[27] Advanced Energy, "Get the FACTS about SEER and Deliver Better Customer Value," 2000, http://www.advancedenergy.org/buildings/knowledge_library/heating_and_cooling/seer_facts_bulletin.pdf (retrieved 3 June 2008).

The bottom line is that there are a multitude of factors that affect actual energy efficiency of air conditioners—so many, in fact, that it would be impossible for the government to mandate standards for all of them.

To simplify matters, these can be boiled down to three main factors that affect energy efficiency of air conditioning systems. These factors are (1) the skills and competency of the equipment installer; (2) inherent airflow restrictions that are built into the equipment; and (3) owner maintenance of installed equipment. While the government can only mandate standards for one or two pieces of the air conditioning system, a vigilant homeowner can ensure that his or her air conditioner is performing at peak levels.

The first factor is vital, because to a large degree, the competency of the HVAC contractor can determine how efficiently a system runs. Certain measures can be taken by a skilled installer so that air conditioning equipment performs even *more efficiently* than its laboratory rating. Advanced Energy reports that a competent contractor "may be able to deliver greater comfort and lower energy costs using SEER 10 equipment than another contractor delivers using SEER 14 equipment."[28]

The second factor, inherent airflow restrictions, is also an important variable. What most homeowners don't realize is that airflow is the lifeblood of an air conditioning system. But even new systems are automatically deprived of airflow because of unintentional blockages that are installed along with the system. Take, for example, the air filter. It is such a simple, harmless looking device. Most homeowners probably think that the more restrictive the filter is, the better. What they don't realize is that the filter's mere presence in the system blocks airflow up to 15% when it is new, and up to 50% when it is loaded with dust and debris[29].

Once the filter and A/C coil start loading with airborne debris (and all units do rather quickly), the restriction becomes severe, dropping efficiency of the overall system by an estimated 35% or more.[30] Further, many of the system's other components can be built-in airflow blockers. Dirty or improperly installed air ducts or registers can hinder the system's performance and greatly lower its efficiency.

The third factor takes some time to manifest itself. If the homeowner doesn't maintain the installed equipment, the efficiency will gradually deteriorate over time. Dust and debris collect on the filter, the coil, and other components so that airflow becomes even more restricted. Air filters are designed to catch dust and debris, so increased airflow restriction is inevitable if the filter is doing its job. Only scrupulous and vigilant maintenance can alleviate this problem. Experience has shown that the vast majority of homeowners do not change their air filters on a timely basis. The result is that airflow within a typical HVAC system is usually lower, not higher, than the manufacturer's recommendation of 400 cfm per ton.[31]

Even a small amount of buildup can mean drastic strain on the system's efficiency. The Environmental Protection Agency has reported that a debris buildup of .042 inches (about the thickness of plastic wrap) on a heating or cooling coil can result in an efficiency decrease of 21

[28] Ibid.
[29] See appendix.
[30] See appendix.
[31] Ibid.

percent.[32] HVAC contractors report that dust and dirt are the cause of almost half of all service calls.[33] Thus a seemingly rather benign problem—dust and debris—has become a major culprit in the deterioration of air conditioning efficiency.

Airflow restriction is based upon two primary factors: (a) an assemblage of built-in parts that affect the airflow efficiency, and (b) the accumulation of restrictive dust and debris during operations at two key points: the airflow filter and the A/C evaporative coil.

This situation is a seemingly insoluble catch-22 in two respects: although a filter is needed to keep dust and debris out of the air, it also drastically degrades an HVAC system's efficiency. And although the A/C coil is needed to cool our buildings, it can load up to a point where it can restrict airflow by 30 percent by itself. It is so buried within the system most residents don't even know it's there.

It is estimated that only about *12 percent* of homeowners pay adequate attention to the replacement or cleaning of the airflow filter[34]. And even fewer keep their A/C evaporative coil clean.

Taking a look at the big picture, the outlook is grim for America's power grid. Most residential HVAC systems are 10 to 12 years old, and are not operating at anywhere near their SEER level standards due to the built-in air blockages and the collection of debris and over the years of operations.

And as we have seen, even newly installed equipment will generally not perform anywhere near optimum efficiency levels. With one-sixth of all electricity being used to air condition buildings[35], it is no wonder that America's energy resources are being stretched to their limit.

If America's biggest energy hogs—her more than 89 million air conditioners[36] —could be made to operate more efficiently than they are, the burden that America's electrical supplies now suffers under would be greatly alleviated.

Because of this, the nation's installed stock of air conditioners is, on average, operating at about 34 percent below its potential efficiency resulting in a waste near 212-billion kWh of electrical energy - enough to power 17.2 million households annually.[37] Thus if the millions of A/C systems in place could be made to operate close to their rated efficiency standards, the electrical energy savings would be huge.

So a major key to alleviate America's power crunch is to address the three factors that affect air conditioning efficiency the most: the installation, airflow restriction, and maintenance of America's HVAC systems.

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[32] Clean Air Service, "Facts About Air Duct Cleaning," http://cleanairserviceinc.com/pagethree.htm (accessed August 12, 2006).

[33] Alliant Energy, "Saving Energy: Heating and Air Conditioning Facts and Figures," http://powerhousetv.com/stellent2/groups/public/documents/pub/phtv_se_he_000608.hcsp#P-4_0 (retrieved 3 June 2008).

[34] See appendix

[35] Ibid.

[36] See appendix.

[37] See appendix.

Appendix #1

Data and Calculating Notes

1) Number of homes in United States

Number of homes in 2001	New homes added in 2002	New Homes added in 2003	New Homes added in 2004	New Homes added in 2005	New homes added in 2006	New homes added in 2007	Total homes as of end of 2007
107,000,000	973,000	1,086,000	1,203,000	1,283,000	1,052,000	776,000	**113,400,000**[38]

2) Number of home HVAC (with air conditioning - can be with either gas/oil or electric furnaces) in United States, 2007

2001 Number of HVAC with A/C component[39]	Estimated Percent Annual Growth Of HVAC During 2001-2007	Number of HVAC Units Added During 2001-2007 For Six Years	2007 Estimated Total Number of HVAC
80,800,000	2% per year	8,000,000	**89,000,000**

3) Electricity consumption in United States 2006 - 2007 by Sector (Megawatthours)

Year	**Residential**	**Commercial**	**Industrial**	**Transportation**	**Direct Use – Generate Own Power**	**Total**
2006 Use[40]	1,351,520,036	1,299,743,695	1,011,297,566	7,357,543	146,926,612	3,816,845,452
2006 % of Total	35.41%	34.05%	26.50%	0.19%	3.85%	100.00%
2007 Use[41]	**1,394,768,677**	1,332,237,287	1,026,467,029	7,438,476	147,661,245	3,908,572,715
2007 % of Total	**35.68%**	34.09%	26.26%	0.19%	3.78%	100.00%

[38] U.S. Census Bureau News, Joint Release, U.S. Department of Housing and Urban Development, Release May 27, 2008

[39] U.S. Census Bureau, American Housing Survey, www.census.gov/hhes/www/housing/ahs/ahs/ahsfag.html accessed July 6, 2008 (they indicate 87,740,000 A/C units in 2001, i.e., central – 57% - and window –25% - A/C units). We take a much more conservative number of 80,800,000, using that number as all central A/C units (includes heat pumps and electric furnaces as part of electric consumption of HVAC-we believe they do not include heat pumps as part of central HVAC)

[40] Source: Energy Information Administration, "Direct Use and Retail Sales of Electricity to Ultimate Customers by Sector, By Provider www.eia.doe.gov/cneaf/electricity/epa/epat7p2.html Accessed: July 2, 2008

[41] Residential electrical use is on the rise faster than other sectors because of increased use of household computers, I-pods, entertainment centers, air conditioning, etc., and the fact people spend more time in their homes. Hence, the estimated *increase from 2006 to 2007:* Residential had an increase of 3.2%; Commercial had 2.5%; Industrial had 1.5%; Transportation had 1.1%; and Direct Use (generated their own internal power) had .5%.

4) 2007 Total U.S Residential Electrical Consumption, Use Per Resident & Total Use for Residential HVAC

Year	Number of U.S Residents (millions)	Total kWh Used In all U.S. Homes (billions)	KWh Per Home Per Year (thousands)	Total kWh Used In Heating/Cooling All U.S. Homes (billions)
2007	113.4	1.395 kWh	12,300 kWh	**624 kWh**[42]

5) 2007 Wasted electrical energy of home heating/cooling (HVAC)

Year	**Total kWh Used In all U.S. Homes (billions)**	**Total kWh Used In Heating/Cooling All U.S. Homes (billions)**	**Operating Below SEER Rating**	**Total National Waste Due to Inefficiency In kWh (billions)**
2007	1.395 kWh	624 kWh	34%[43]	**212 kWh**

6) What the 212-Million kWh of Wasted Energy of HVAC Would Do If Amount Could Be Saved to Power Additional Homes In 2007

Year	**Percent of Wasted kWh compared to Total Residential Use (212 waste kWh/1,395 kWh)**	**Average kWh per home (1.395-billion kWh/113.4 million homes)**	**Average wasted kWh per home (in thousands)**	**Amounted of Wasted Energy Could Power X Homes (in millions)**
2007	15.2%	12,302 kWh	1,870 kWh	**17.2 million homes**[44]

[42] Energy Information Administration, U.S. Household Electricity Report, Release date, July 14, 2005, www.eia.doe.gov/emeu/rep//enduse/er01_us.html, accessed July 7, 2008 (shows 2001 nationwide basic heating-A/C use at 356-billion kWh; electric furnace using 116-billion kWh; electric furnace fans using 38-billion kWh for a total of 510-billion kWh out of 1,140-billion kWh in 2001. Thus total household heating and cooling stands at approximately 44.7% of all household electrical use in kWh. Using the same percentage for 2007, one calculates by using 1,395-billion kWh times 44.7% equates to 624-billion kWh of total HVAC use nationwide. So household electrical use in HVAC is the combined use of all heating and cooling homes, including air conditioning, electric heat, heat pump, geo-thermo, force air fan and blowers.

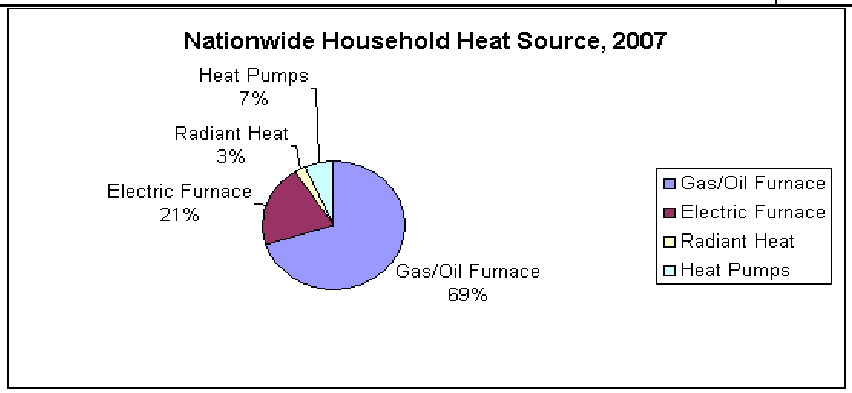
[43] The number often used for inefficient operations of HVAC systems in the United States is 30% - 45% below efficiency standards, with an average of 37.4%. We use a number 34% in calculating wasted energy due to inefficiency.

[44] The number of homes that could be powered by wasted energy of 212-million kWh is determined by using a ratio: 12,302 average kWh per home over 113,400,000 million homes as the base ratio tied to 1,870 of wasted kWh per home over X. The equation looks like this: 12,302/113,400.000 = 1,870/X. Doing the calculations, it shows that 17,200,000 homes could be powered by the wasted energy.

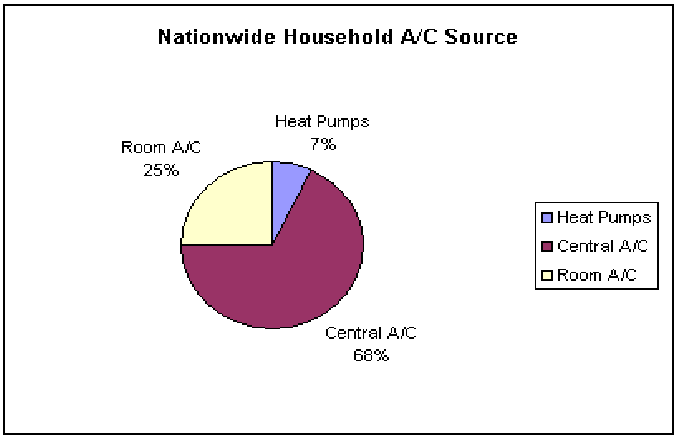
Appendix #2

Home Heating and Cooling Component Configuration Of Nation's HVAC Systems, 2007

2007 Nationwide Heat Source in 113,400,000 Residents	
HVAC	**Heat Source**
Gas/Oil Furnace	**79,210,000**
Electric Furnace	**23,790,000**
Radiant Heat	**3,000,000**
Heat Pumps	**7,400,000**
Total Heat Units	**113,400,000**



2007 Nationwide A/C Source in 113,400,000 Residents	
HVAC	**A/C Source**
Heat Pumps	**7,400,000**
Central A/C	**67,850,000**
Room A/C	**25,410,000**
Total A/C Units	**100,660,000**



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