

CLEAN ENERGY ALTERNATIVES

THINGS PEOPLE CAN DO

America's conventional energy policy pollutes air and water, destroys land with strip mining and urban sprawl, and creates major national security risks. It puts consumers at the mercy of predatory multinational energy companies, and is literally changing the climate of the world through global warming.

Most Americans wish they could do something to break away from "conventional" fossil and fissile poisons that have become so common with modern energy use, but are not sure what to do. This article discusses major things you can do to begin to break free. Most of these actions do not require lifestyle changes. In many cases, actual products and services are specified to help the Houston consumer.

If you feel motivated beyond these actions, you can become involved in the political process. (Consider it a lifetime hobby.) But you can make a difference here too.

1. Residential Retrofits (Homeland Security)

The process begins where you live. While every building has different characteristics, it is possible in many cases to save over half the energy you use on heating and cooling by weatherization and use of efficient equipment.

The *Directory* analyzed a 1960s single family home with a 1990s air conditioner and minimal ceiling insulation. With weatherization and an efficient Heating, Ventilation, and Air Conditioning (HVAC) upgrade, the home saved over half its cooling and heating energy at a cost of less than \$4,000 and a payback of about 3 years. Savings can be as high as 68% with a very high efficiency unit, though the payback will be much longer because of increased cost.(1)

In general terms, *duct sealing and balancing* is THE most important energy measure you can employ for an old or new house. You can have the most energy saving air conditioner or heater in the world, but if your ducts leak, you may largely be cooling and heating your attic more efficiently. Ducts in a typical home leak 25% of the condi-

tioned air. This represents most of the air leakage in a house. Some poorly built apartment units can be as high as 45%! With proper sealing, this can be reduced to 10%. "Balancing" air delivery by installing larger ducts to allow more air to enter a room or relief vents that prevent overpressurized rooms improves comfort and lowers bills.

There are air quality benefits of this retrofit as well. Leaking ducts can pull supply air in from a garage that is contaminated with chemical fumes, a yard with pesticides, or an attic with mold or dust.

Ceiling insulation is also important, but each inch of added insulation is less effective than the preceding inch. If you pile on more insulation after a certain point, you will increase comfort but not achieve much energy savings.

Sometimes old insulation has lost part or most of its effectiveness because it has become compressed, matted, or damaged from roof leaks. And in some homes the ceiling insulation does not cover the complete ceiling. Since heat moves towards the coldest place in a ceiling to enter or exit a building, this can eat away at insulation's effectiveness: 80% coverage does not mean 80% efficiency.

Solar screens that filter out the majority of solar heat gain are a huge energy saver in the summer, but they reduce winter gain by almost the same percentage. Despite this, the hot summer climate in Texas assures that homes will generally receive a net benefit from screens. But the optimal course of action would be to remove solar screens in winter.

Efficient heating, ventilating, and air conditioning (HVAC) can achieve phenomenal savings. The national code of 10 SEER (Seasonal Energy Efficiency Ratio) was upgraded to 13 SEER at the beginning of 2006. But units as high as 17 SEER can be cost effective in some applications, and top-of-the-line units soar to 20 SEER for standard air conditioners and even higher for geothermal heat pumps. Today's standard gas furnaces save about 21% over old units, and new air-source heat pumps can save about 50% on space heating compared to old units.

In the Houston area, Centerpoint Energy supports a

ENERGY CONSERVATION CONTRACTORS			
COMPANY	PHONE	WEB SITE	FREE/REDUCED COST SERVICES
Brazos Valley Services	(800) 253-2624	www.brazosvalleyservices.com	Free duct sealing; Efficient AC, solar screens, insulation for compensation
Doctor Cool and Professor Heat	(866) 362-2665	www.doctorcool.com	Reduced-cost HVAC installation and duct sealing
Energy Efficiency Services	(866) 619-2820	www.energyservice1.com	Free duct sealing; HVAC repair for compensation
Energy Misers, Inc.	(877) 571-4203	NA	Free duct sealing, infiltration measures, and compact fluorescent lamps
Forward Business Consulting, Inc.	(361) 232-0894	NA	Free/reduced cost insulation*
Free Lighting Corporation	(866) 484-3519	NA	Free duct sealing, infiltration measures, attic insulation*
Great American Insulation	(956) 424-3193	NA	Reduced cost insulation*
Gulf Coast Windows, Inc.	(713) 849-5454	www.gulfcoastwindows.com	\$25 rebate on energy-efficient, low-e argon "P-2" windows
Habicon, Inc.	(830) 377-5415	NA	Free duct sealing, infiltration measures, attic insulation*
Inerg Savings Solutions	(817) 337-7460	NA	Reduced-cost duct sealing, infiltration measures
Marco Castro	(956) 534-4045	NA	Reduced-cost insulation*
North Texas Conservation, Inc.	(214) 389-5851	NA	Free duct sealing, attic insulation*
Pierce Duct Blasting and Air	(936) 326-9380	NA	Free duct sealing, infiltration measures
Randl Energy Technology, Inc.	(866) 697-1582	www.rlenergytech.com	Free duct sealing, infiltration measures
Sav-Plus, Inc.	(903) 819-6680	www.savplusservices.com	Free duct sealing, infiltration measures
SV & A Enterprises, Inc.	(972) 533-6569	NA	Free duct sealing
Two Rivers Energy Services, LLC	(713) 882-6484	NA	Free duct sealing in mobile homes
Weeks Service Co	(800) 443-3992	www.weeks-service.com	Discounted HVAC Installation

* Mainly installed in buildings with little to no preexisting ceiling insulation levels (0 to 1 inch)



residential conservation incentive program. It is carried out by a list of pre-approved conservation contractors, most of whom are listed on the previous page. For more information on the program, visit Centerpoint's Web site: <http://www.centerpointressop.com/customer.shtml>

2. Unconventional Heating & Cooling Equipment

After upgrading ducts and weatherizing your structure, installing high efficiency HVAC can whittle down comfort conditioning energy use by even larger amounts. In many situations (particularly older buildings), it is literally possible to cut energy use by 50-75% with weatherization, duct sealing, and advanced heating and cooling equipment.

Air conditioner efficiency is often judged by a Seasonal Energy Efficiency Rating (SEER). In 1970, this was estimated to be 7 SEER (or less). In 1990, the national standard became 10 SEER; beginning in 2006, it is 13 SEER. But standard (air cooled) units are now made with SEER levels as high as 20, though these top-of-the-line units carry a high premium. Unconventional units discussed below also have high efficiencies and are often cost effective.

Water-Cooled Air Conditioners²⁾

Modern air conditioners are air-cooled, that is, they take heat from the inside of a building through the evaporator coil and deposit it to the outside of a building through the condensing coils where the heat is released to the surrounding air. This is a relatively inefficient way to dissipate heat. Cooling towers, which cover the condensing coils with ambient temperature water, are much more efficient. Consider how quickly you would cool off if you immersed yourself in 80° water instead of 80° air.

Cooling towers are nothing new. Many large commercial air conditioners use them to dissipate the massive heat buildup they must handle. But residential-sized cooling towers are an uncommon phenomenon, even though they

hold great potential for energy savings. There are now 2 companies that manufacture these smaller water-cooled units, Allied Energy (Austin, TX), and Freus (Vinton, TX).

These units have the capability of raising the Seasonal Energy Efficiency Ratio (SEER) of an air conditioner to as high as 22 (estimated). This represents a 41% savings over today's national minimum standard, and at least a 55% savings over older units. They carry an increased premium of about \$1,000. Thus the payback for a home using 1,500 hours a year of air conditioning is about 4 years. There is a slightly increased water cost, as the unit uses about 2-4 gallons an hour. But this would only add about \$9-18 per year to the cost of operation.

Water cooled systems also have the capability of cooling several air conditioners in sequence in a large home, small business, or apartment building. This type of installation carries an even lower premium because the increased cost is divided over several units.

The units are made of fiberglass and have an automatic purge function to prevent growth of mineral scale. This water can be reused for landscaping, further lowering costs. They do not require freeze protection and use a variable speed fan to match the air conditioning load and maximize efficiency. Water-cooled units often extend the life of an air conditioning system by allowing it to run much cooler. (A doubling of equipment lifetime has been speculated.) Both companies carry 10-year warranties on the compressor. Allied Energy carries a 3-year warranty on parts, while Freus carries a parts warranty of 10 years.

The increase in water use has been a source of concern, particularly in water-short regions of the country. Freus predicts its increased water use in hot climates to be about 7,500 gallons a year. To put this figure in perspective, if every individual residence in the city of Austin where I live were to use water-cooled air conditioners at this rate (many would use less), it would increase the total water use in Austin by 6%. (It would be lower if the purge water were used for landscaping).

The makers of Freus claim the equipment actually conserves water in many cases, since power plants in certain regions use more cooling water per kilowatt hour in the production of electricity than water-cooled air conditioners use onsite. Since municipal water supplies use a lot more infrastructure and energy to process and transport than power plant cooling water, it is hard to draw a direct comparison. But in actual water used, there is often a positive balance with this type of HVAC equipment.

For more information contact:

Allied Energy (512) 443-3938
 1903 Westridge Drive
 Austin, TX 78704
Wholesale and retail contact

Freus (915) 886-9050
8240 Doniphan Dr.
Vinton, TX 79821
www.freus.com
Direct purchase for building owners or contractors

Multi-Split Systems

Ductless or “Multi-Split” systems are gaining popularity, particularly when houses add rooms, and in houses where heating and cooling one room at a time is preferable. These look a little like window air conditioners, but without a window. The only wall or ceiling penetration is for the refrigerant line that attaches to the wall-mounted air handler.

These units allow individual rooms to be selectively heated and cooled as needed, and eliminate duct energy losses from leakage and attic exposure. Moreover, they have variable speed delivery (which supplies less conditioned air when less is needed) and occupancy sensors that can turn conditioned air off in rooms that no one occupies. As such, the equipment “follows the load” and the people around a home to save even more energy.

While the equipment itself is roughly 25% more expensive than conventional HVAC units, there are inherent savings in installation, particularly duct installation and electric wiring (since the equipment can accommodate smaller amperage).

The most efficient unit on the market at this time is made by Daikin: a heat pump with a SEER of 16 and a Heating Seasonal Performance Factor of at least 7.2. The largest unit has up to 1.5 tons of capacity and will supply 2 average rooms at varying levels of temperature with a maximum combined area of 1,000 square feet. The winter heating mode will provide heat down to 5° F below zero. But colder temperatures can be accommodated with strip heat back-up installed separately.

The current Daikin representative for the Houston area is listed below.

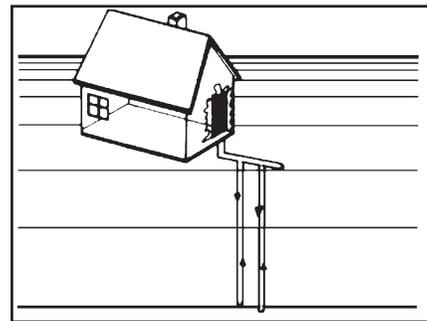
Heat Transfer Solutions, Inc. (832) 328-1010
Darren Bentley
10110 W. Sam Houston Pkwy. S., Suite 100
Houston, TX 77099

Geothermal Heat Pumps

Similar to conventional air-source heat pumps, which move heat from the air to heat or cool a building, geothermal heat pumps move hot or cold temperatures through plastic pipes buried in the earth or submerged under bodies of water such as lakes or ponds. The earth stays at relatively constant and moderate temperatures (50 to 70° F) a few feet below the surface.

These heat pumps greatly reduce energy use. In Austin,

they have a Seasonal Energy Efficiency Ratio (SEER) of approximately 23 compared to the new national standard of 13 SEER and a heating Coefficient of Performance (COP) of about 5 compared to a standard air source heat pump COP of 2 or 3. And ground and water source equipment does not need electric “strip” backup heat, which supplements air-source units when the outside air falls near freezing temperatures, raising winter bills. (Air source compressors function less efficiently as temperatures fall.) Some units can also heat water at this same high efficiency.



Since most homes are not located next to large bodies of water, ground source applications are the most typical use for this technology. Pipe can be laid either horizontally (preferably 5-6 feet below the earth) or vertically, with a water drilling apparatus creating bore holes. Current horizontal technology requires a lot of space, as much as 5,000 square feet per average house. This means that it is basically used in large lot houses, and usually new houses, where there is no landscaping that needs to be replaced. Vertical drilling can go 60 to 300 feet below the surface.

Installing the ground pipe is the major additional cost of the technology. It can add approximately \$1,800 per ton of air conditioning for vertical installations. This amount can be reduced though drilling in volume (such as installing a whole subdivision at once) or apportioning some of the cost to a geothermal heat pump water heater.

The savings are dramatic. This equipment enables air conditioning and heat pump efficiencies almost double that of the 2006 appliance standards.

And they generally have a much longer life than standard air source heat pumps and air conditioners. The plastic pipe buried in the ground or submerged in water carries a warranty of 50 years. And the compressor itself is expected to last much longer due, among other things, to less stress on equipment. Outdoor air temperature extremes of 20° F in the winter and 100° F in the summer are no longer straining the system, as the ground stays a constant temperature year round. Some have predicted double the lifetime.

This technology is not untested in the marketplace. About 100,000 of these units were installed in 2005, and about a million have been installed in the U.S. However, this number represents less than 1% of all central HVAC systems in U.S. buildings.(3)

In regions where utilities have specific programs to promote them, geothermal heat pumps have excellent ratings from residential utility customers - as high as 99%

GEOHERMAL HEAT PUMP CONTRACTORS				
Climatemaster – www.climatemaster.com				
Accurate Air	9745 Bent Oak Drive	Houston, TX 77040	(832) 590-5700	www accuratesystems.com
Dominair Heating & Air	12122 Knigge Cemetary Rd.	Cypress, TX 77429	(281) 855-7418	www.dominair.com
Egan & Hinson	5303 Glenmont, Suite F	Houston, TX 77081	(713) 666-1101	www.eganhinson.com
Geothermal Advantage	23819 Spring Gum	Spring, TX 77373	(281) 353-1488	NA
Jarrar & Company, Inc.	9119 Emmott Road	Houston, TX 77040	(832) 467-4750	www.jarrarandcompany.com
MLN Service Co.	3931 Ann Arbor	Houston, TX 77063	(713) 782-3633	www.mlncompany.com
FL Heat Pump – www.fhp-mfg.com				
Extreme Air	4727 Strack Road	Houston, TX 77069	(281) 580-4239	NA
MLN Service Co.	3931 Ann Arbor	Houston, TX 77063	(713) 782-3633	www.mlncompany.com
Water Furnace – www.waterfurnace.com				
Dominair Heating & Air	12122 Knigge Cemetary Rd.	Cypress, TX 77429	(281) 855-7418	www.dominair.com
Egan & Hinson	5303 Glenmont, Suite F	Houston, TX 77081	(713) 666-1101	www.eganhinson.com
Geothermal Advantage	23819 Spring Gum	Spring, TX 77373	(281) 353-1488	NA
Gulf Coast Air Conditioning	5926 Heffernan	Houston, TX 77087	(713) 644-1861	NA
Trane – www.trane.com				
Air Champions	10014 Gilson Lane	Houston, TX 77086	(281) 440-8077	NA
MLN Service Co.	3931 Ann Arbor	Houston, TX 77063	(713) 782-3633	www.mlncompany.com
Geothermal Drillers				
Enlink Geoenergy (Commercial Only)	16430 Park Ten Place	Houston, TX 77084	(888) 855-6901	www.enlinkgeoenergy.com

fixtures. New “mini” spring or twist lamps can now produce more usable light for their size than older CFs. It is also quite common for lighting companies to make new fixtures specifically designed to use CFs *instead of* incandescents.

There are at least 2,000 CF products on the American market made by about 140 companies. Their use is not limited to conventional fixtures. They can be com-

customer satisfaction. To date, most of these units have been in the service areas of Northern utilities. But they are gaining ground in certain southern regions such as coastal Florida, where the salt air from the ocean can cause accelerated deterioration of outdoor metal compressors.

Geothermal heat pumps are even more cost effective in commercial buildings where heating, cooling, and refrigeration equipment run more hours. Lubbock Christian University has retrofitted 3 of its buildings with great success, and has plans to install these heat pumps throughout the campus. Public schools in North Central Texas have experienced monetary savings on energy bills of as much as 62% compared to schools with conventional HVAC.

One interesting concept devised to avoid the high first cost of these units is to have electric utilities own the underground pipe, and then “lease” it for a small monthly charge to the consumers. This would be an advance on the concept of air conditioner rebates since utilities could recoup all of their investment.

3. Compact Fluorescents

Since the early 1980s, fluorescent lamps have been made that screw into incandescent light bulb sockets. Dubbed “compact fluorescents,” (CFs) they save 66–75% of the energy used by incandescent bulbs. While higher in cost, they pay for themselves in energy savings, lamp replacement, and maintenance time.

There are several reasons why CFs have made only slow increments into the home lighting sector. These included higher first cost, and poor quality from some manufacturers. And many of these lamps had characteristics that did not translate to every application. Most did not work with dimmers. Many did not work inside enclosed fixtures because the high heat build-up shortened lamp life. Some CFs did not even *fit* into various fixtures, and some models that did fit gave lower light levels than conventional bulbs.

But CFs have matured. Costs have come down, quality standards have been established, and some products are specifically made to work with dimmers or inside enclosed

combined with reflectors to replace floodlight (PAR) lamps, which are also used in recessed “can” fixtures. Other new uses include small lamps for bathroom vanities, advertising signs, and even chandeliers.

When looking for these products, the minimum quality standard you should seek is the *Energy Star* label. This is a voluntary rating program run by the U.S. Environmental Protection Agency that grants its approved label to companies whose products pass third-party testing. These products have to meet specifications for longevity, light output over time, color quality, and energy usage.

Consumers can also look for products with special features, including lamps that: 1) work with dimmers; 2) fit inside enclosed fixtures; 3) imitate “3-way” lamps; and 4) closely resemble natural light (see discussion below).

Since these characteristics are not found everywhere, the *Directory* has compiled a chart of unique CF products. This chart does not include every manufacturer, but it does include most of the major ones sold in this region.

While most grocery stores, department stores, and hardware stores will have some models, the sizes and characteristics you seek may not be on their shelves. *When trying to locate special bulbs, it is a good idea to consult the Internet to get the specs that you need (e.g., size, dimming, full spectrum, etc.) and then special order them, or call the retailer in advance.*

This chart includes CFs that best resemble sunlight. Note that the “full spectrum” category lists both Color Temperature (in degrees Kelvin) and Color Rendering Index. Full spectrum light is defined here as a Color Temperature of 5000° K or above and a Color Rendering Index of 88 or above. Some of these lamps also intentionally emit small amounts of ultraviolet radiation to imitate sunlight.

Some of these lamps are also engineered to endure the heat of enclosed fixtures. While lamps listed here are reported by their companies to do this, *consult specs or product labels to be sure.*

COMPACT FLUORESCENT LAMP MANUFACTURER	WEBSITE						RETAIL ACCESS FROM HOUSTON	
		ENERGY-STAR RATED	DIMMABLE	3-WAY	FULL SPECTRUM	ENCLOSED FIXTURE (1)		
AM Conservation Group	www.amconservationgroup.com	√	√	√	NA	√	Web sales only	
American Environmental Products	www.sunalite.com	No	No	No	√+	No	Phone/Web sales. Phone order: (800) 339-9572	
Durotest	www.durotest.com	No	No	√	√+	No	Local: www.naturallighting.com	
Feit Electric	www.feit.com	√	No	√	No	√	Fry's Electric, Lowe's, Walgreen	
Full Spectrum Solutions	www.fullspectrum.com	No	No	No	√	No	Phone/Web sales.	
GE Lighting	www.gelighting.com/na/	√	√	√	NA	No	RETAIL: Ace Hardware, Albertsons, Eckerds, Home Depot, K-Mart, Kroger, Lamps Plus, Lowe's, M&M Lighting, Office Depot, Office Max, Piggly Wiggly, Randall's (Safeway brand), Rexel/Maverick, Target, Tom Thumb (Safeway brand), True Value, Sears Hardware, Staples, United Stationers, Walmart COMMERCIAL: Ace Hardware, American Light, Bulb Man, Crawford Electric Supply, Crescent Electric, Dallas Light Bulb Delivery, Elliott Electric, GE Supply, Grainger, Graybar	
Globe Electric Inc.	www.globe-electric.com	√	√	√	No	No	HEB and amazon.com	
Greenlite Corp.	www.greenlite.ca	√	√	√	No	√	Light Bulbs Unlimited: 281-440-1660; M & M Lighting (713) 667-5611,	
Harmony Lighting	www.harmonylight.com	√	√	√	NA	√	American Light, E Sam Jones Also goodcommonsense.net	
Lights of America	www.lightsofamerica.com	√	Flood	No	No	No	Phone/Web sales, Ace, Costco, Home Depot, Lowe's, Sam's, Walmart	
Litetrionics International	www.litetrionics.com	No	No	No	No	√	Costco, Home Depot (security lighting), Lowe's, Sam's, Walmart	
Lumatech Corporation	www.lumatech.us	No	No	No	No	Flood	Phone sales. Phone order: (609) 689-3122	
Lumiram	www.lumiram.com	NA	No	√	√	NA	Phone/Web sales.	
Maxlite	www.maxlite.com	√	√	√	No	2	Dealers Electric Supply, Light Bulbs Unlimited, and www.naturallighting.com	
Osram Sylvania	www.sylvania.com	√	√	√	No	3	Lowe's	
Panasonic(R)	www.panasonic.com	√	No	No	No	4	See AM Conservation above	
Philips Lighting	www.nam.lighting.philips.com/us	√	No	No	No	5	Commerical: CED, City Electric, Dealers Electric, E Sam Jones Distributor, Hagemeyer, MSC Industrial Supply, Voss Electric, Wesco Distributing, Wholesale Electric Retail: Home Depot	
Prolume	www.halcolighting.com	√	No	No	No	No	Light Bulbs Unlimited, LBU Westheimer, M&M Lighting, East Sam Jones	
Satco	ww.satco.com	√	√	√	6	No	Ace Hardware, American Light, Bering's House Center, CED, Champions Lighting, Custom Lighting, Dealers Electric, Houston City Lighting, Houston Light Bulb, Hughes Supply, IBS Lighting, Light Bulbs Unlimited, The Light House, The Lighting Gallery	
Sunpark Electronics	www.sunpkco.com	√	Torchiere	No	No	√	Phone order: (310) 320-7880, x 200	
TCP	www.tcpi.com	√	√	√	√	√	American Light, E Sam Jones, Voss Lighting	
Ushio	www.ushio.com	No	No	No	No	No	Houston Light Bulb Company, The Light Bulb Depot, Hughes Supply	
Verilux	www.verilux.net	No	No	No	√	√	Phone/Web sales. Phone order: (800) 786-6850	
Westinghouse Lighting	www.westinghouselighting.com	√	Flood	√	√	√	American Light Bulb, Buck Lighting, Ellen Lighting & Hardware, Fan Fair, Freeman Ace Hardware, Harris Lighting, Hughes Supply, Light Bulbs Unlimited, Olsham Lumber, Voss Lighting	

√+ UV emitting

1 Use in enclosed fixtures varies by product. Always check specs for each product.

2 – Premium Mini-Bulb; Not Energy Star Rated 3 – Outdoor Only 4 – GEN IV 5 – Marathon Universal 6 – Sells Verilux

4. Water Heating – A Tankless Job

Water heating is the second largest energy use in a home, only exceeded by air conditioning and heating. It has gotten much more efficient than it was a generation ago. National efficiency standards exist for all conventional water heaters sold in the U.S.

rating for efficiency that greatly exceeds older units. The baseline EF of a normal 40-gallon natural gas tank unit is 0.59, up 9% from the old standard of 0.54 in 1990. You can find energy-efficient upgrades with an EF of 0.62 for about \$50 more if you look. But you have to shop because some plumbing suppliers generally sell standard equipment they order in bulk, and will usually increase the price of variations by large amounts.

New gas water heaters have an “energy factor” (EF)

The baseline EF of a normal 40-gallon electric tank unit

is 0.92, up 5% from 0.88 in 1990. But the top EF sold today is 0.95. Even this 3% change can often save a family of 4 people \$21 a year, with an added cost of about \$50.(4) While electric tanks are technically more efficient at the source than gas units, they cost much more to operate because electric resistance water heating loses about 74% of the initial energy used to produce electricity as waste heat or transmission line losses. In the Houston area, energy costs to operate electric water heaters are typically 3 times as much as gas water heaters, even with the high natural gas costs of 2006.

Other things you can do to save hot water include insulating exposed pipes going from the water heater to the house, buying water saving appliances such as clothes washers, and turning the temperature down. There is no reason to scald yourself at 120-140° F when 100-110° is adequate. Each 10 degree drop in temperature will reduce water heating energy by about 4%.

Instantaneous Water Heaters

An energy-saving alternative to conventional tank-type water heaters is units that heat water as needed. These are called instantaneous or tankless water heaters, and have been common in Europe and Japan for decades. Though more expensive than conventional hot water systems, these units are valued for energy-savings, space savings, longevity, and their ability to supply continuous hot water for a long period of time.

Tankless units are built to use natural gas, propane, or electric heat. However, due to the huge peak demand on the electric supply system and the cost of rewiring part of a home, all-electric tankless units are not recommended or discussed in this article.

The energy factor of these appliances can be 8-56% higher than conventional gas water heaters built to current energy standards; a 40% boost in efficiency is typical. One reason is that the thermal losses through the storage tank walls (which can be up to 20%) are eliminated. The energy savings alone will not yield a quick payback for the additional cost in most residential settings, but some commercial applications may see a good return.

Space: The units are quite compact, with largest units about 2.5 feet high, 1.5 feet wide, and a foot deep. Moreover, many models can be placed outside without any shelter. This allows room for remodeling in existing homes and space and material cost savings in new homes.

Longevity: Tanks in conventional water heaters are vulnerable to scale (which causes them to lose efficiency), and rust (which eventually causes leaks and failure). Neglected leaks can even cause building damage in situations such as when water heaters are placed in attics. Tanks are typically guaranteed for 5-12 years. But several tankless unit manufacturers usually claim the estimated life of their product to be 20 years. (They do not guarantee them for

that long, however.)

Continuous Supply: High-demand water heating situations quickly deplete the water stored, causing a time delay for a conventional unit to heat another batch. Tankless units have no such constraints. (It will take slightly longer to fill a bathtub with tankless units.) And in commercial settings, up to 20 units can be used in a series.

The following page has a list of the tankless units, their characteristics, and suppliers.

5. Food (The Power Breakfast)

Unlike housing or cars, energy used in food production is not metered for consumption. But the energy used to grow, transport, process, package, and prepare food is enormous. America has the most energy-intensive agricultural system in the world. By one estimate, it is 11% of total national energy use, enough to supply electricity to every home in the country.(5) By another, the agricultural sector consumes 17% of total energy use.(6) Consider:

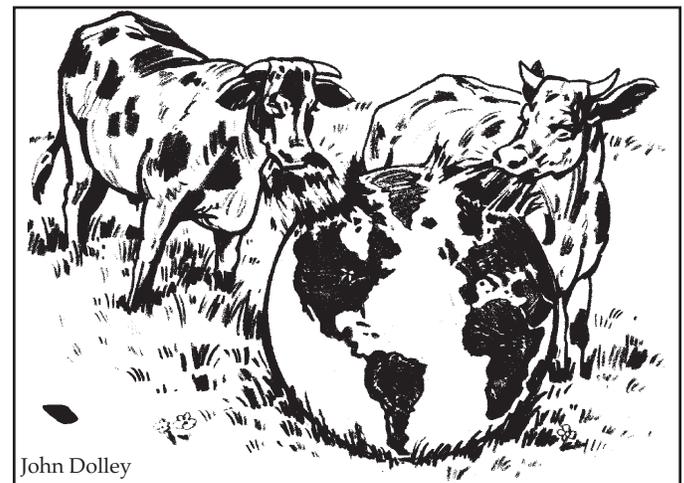
- The energy needed to produce one hamburger is enough to run a 100-watt light bulb for up to 18 hours.(7) The energy needed to produce one hamburger each day for a year is enough power to run a refrigerator for 18 months.

- If you used 1 paper grocery bag each day for a year, the energy used to make them would power a refrigerator for over 2 months.(8)

- The energy used to produce a can of diet soda (including the can) is 2200 times the calorie value of the drink!(9) The energy used in making 3 aluminum cans will run a 100-watt light bulb for 10 hours.

There are at least 4 ways people can save energy in their diet.

- Buy Local Food – The average plate of produce in Houston travels 1,271 miles to get here.(10) Food transport



TANKLESS WATER HEATERS

Make & Model	Inside/Outside Installation (I/O)	Size	Heat Range	Max GPM @ 45° F	Warranty (Years) Heat Exchanger/ Parts	Recovery Eff./ Energy Factor	Features (see codes below)	Houston Suppliers	Freeze Protection
BOSCH		(800) 503-5028							
AquaStar 125B	I	30X18X9	28,000-117,000	4	12/2	82/0.69	NA Ace Hardware		NA
AquaStar 125HX	I	30X18X9	28,000-117,000	4	12/2	82/0.78	1.5 Hardy Hardware (713) 644-1495		NA
Pro Tankless 425HN	I	30X18X9	28,000-117,000	4	12/2	82/0.78	1.5 Lowe's		NA
AquaStar 125FX	I	30X18X9	28,000-130,000	4	12/2	80/0.78	1.2.5 Stocks Hardware (713) 227-0294		NA
Pro Tankless 425EF	I	30X18X9	28,000-130,000	4	12/2	80/0.78	1.2.5 Web Stores America		NA
AquaStar 250SX	I	24X16X9	35,000-175,000	6.4	12/2	87/0.85	1.2.3.5 (www.tanklesswater.com)		NA
Pro Tankless 635ES	I	24X16X9	35,000-175,000	6.4	12/2	87/0.85	1.2.3.5 (800) 334-1494		NA
AquaStar 38B	I	25X11X9	20,000-40,000	1.3	12/2	80/0.64			NA
AquaStar 125BS	I	30X18X9	28,000-117,000	4	12/2	82/0.69	4.6		NA
BRADFORD WHITE		(800) 523-2931							
EverHot IGE-199C-5N	I	24X14X9	15,000-199,000	7.5	5/5	84/NA	16.7 NA		-30 F
EverHot IGE-199R-10N	I	24X14X9	15,000-199,000	7.5	10/5	84/NA	16.7		-30 F
EverHot IGI-180C-5N	O	24X14X9	15,000-180,000	6.8	5/5	87/NA	1.2.6.7		-30 F
EverHot IGI-180R-10N	O	24X14X9	15,000-180,000	6.8	10/5	87/NA	1.2.6.7		-30 F
NORITZ *		(866) 766-7489							
N-T32M (Com)	I/O	30X19X12	21,000-380,000	13.2	3/3	80/0.80	1.3.6 Byars Plumbing Supply		5 F
N-084M (Com)	I/O	24X18X9	21,000-236,000	8.4	3/3	80/0.80	1.3.6 City Plumbing Supply		5 F
N-069M (Res)	I/O	24X14X9	25,000-194,000	6.9	10/5	80/0.80	1.3.6 Universal Plumbing Supply		5 F
N-063S (Res)	I/O	24X14X9	25,000-194,000	6.3	10/5	80/0.80	1.3.6 Waterflow Inc.		5 F
N-084M-DV (Com)	I	24X18X9	21,000-236,000	8.4	3/3	80/0.80	1.3.6		5 F
PALOMA		(800) 432-8373, x4							
Pronto! PTG-42PVN	I	22X14X5	31,500-118,000	4.2	5/3	81/0.81	1.2.5.6 Home Depot		NA
Pronto! PTG-74PVN	I	25X15X11	19,000-199,900	7.4	5/3	82/0.82	1.2.5.6		-30 F
Pronto! PTG-74XN	O	25X15X11	19,000-199,900	7.4	5/3	82/0.82	1.2.5.6		-30 F
RHEEM		(800) 432-8373, x4							
Pronto! RTG-42PVN	I	22X14X5	31,500-118,000	4.2	10/3	81/0.81	1.2.5.6 Church Service (281) 497-8602		NA
Pronto! RTG-74PVN	I	25X15X11	19,000-199,900	7.4	10/3	82/0.82	1.2.5.6 John Moore Services (281) 590-5555		-30 F
Pronto! RTG-74XN	O	25X15X11	19,000-199,900	7.4	10/3	82/0.82	1.2.5.6 S & B Plumbing (713) 665-8692		-30 F
							Village Plumbing (713) 526-6012		
RICHMOND		(800) 432-8373, x4							
Pronto! RMTG-42PVN	I	22X14X5	31,500-118,000	4.2	10/3	81/0.81	1.2.5.6 Ace Hardware		NA
Pronto! RMTG-74PVN	I	25X15X11	19,000-199,900	7.4	10/3	82/0.82	1.2.5.6		-30 F
Pronto! RMTG-74XN	O	25X15X11	19,000-199,900	7.4	10/3	82/0.82	1.2.5.6		-30 F
RINNAI		(866) 746-6241							
2532W	O	24X14X9	15,000-199,000	7.4	10/5	84/0.82	1.2.6.7 See Web site to search by		-30 F
2532FFU	I	24X14X9	15,000-180,000	7.4	10/5	84/0.82	1.2.6.7 zip code: www.rinnai.us/		-30 F
2020W	O	22X14X8	19,000-150,000	5.3	10/5	81/0.82	1.2.6.7		-30 F
2520FFU	I	24X14X9	15,000-180,000	5.3	10/5	82/0.82	1.2.6.7		-30 F
2532WC	O	24X14X9	15,000-199,000	7.4	5/5	84/0.82	1.2.6.7		-30 F
2532-FFU C	I	24X14X9	15,000-199,000	7.4	5/5	84/0.82	1.2.6.7		-30 F
TAKAGI		(888) 882-5244							
Flash T-K2	I/O	24X18X9	20,000-185,000	6.9	7/2	85/0.84	1.2.6 AC Supply (281) 890-8646		5 F
Flash T-KD20	I	24X18X9	20,000-185,000	6.9	7/2	85/0.84	1.2.6 Action Plumbing Supply (713) 466-1966		5 F
Flash T-K Jr.	I/O	20X14X6	19,500-140,000	5.8	7/2	83/0.83	1.2.6 Northside Plumbing Supply (713) 699-5499		5 F
Flash T-K1S	I/O	25X17X8	15,000-190,000	7.2	7/2	83/0.83	1.2.6		5 F
Flash T-H1	I/O	29X19X12	15,000-199,000	10.2	7/2	92/0.92	1.2.6		0 F
Mobius T-M1	I/O	24X18X9	25,000-235,000	9.6	7/2	82/0.82	1.2.6		5 F
A.O. SMITH		(800) 365-0024							
ProStar	I/O	24X14X9	25,000-194,000	6.3	10/3	NA/0.78	1.2.6 American Mechanical (281) 403-1701		5 F
							Polk Mechanical (713) 939-9911		
							Sunrise Mechanical Services (281) 463-3822		
WAIWELA		(800) 605-6542							
PH-28RIFS	I	25X15X11	19,000-199,900	7.4	10/3	84/0.82	1.2.5.6.7 Toole & Company (713) 249-5296		-30 F
PH-28ROF	O	25X15X11	19,000-199,900	7.4	10/3	84/0.82	1.2.5.6.7		-30 F
Features Code	Spark Ignition=1 Power Vent=2 Direct Vent=3 Solar=4 Oxygen Sensor=5 Overheat Sensor=6 Lime Scale Sensor=7 * EF for Noritz is estimated								
Note: State Water Heaters sells the Aurora tankless model. It has the same specs as the A.O. Smith Prostar model.									
Rud Pronto! Tankless model has the same specs as the Rheem model. Its serial number is "RUTG" instead of "RTG."									

consumes at least 1/70th of the energy used in this country.(11) This amounts to enough energy to drive every passenger vehicle in America about 1,000 miles.(12) You can limit this energy by buying from local growers at farmers' markets and farm stands near you (a list is on p. 52), or by looking for Texas-grown products labeled in grocery stores. Buying local food also helps the local economy. And local food usually tastes better because it is fresher.

- **Eat Less Animal Products** – America has the highest per capita intake of animal food in the world. Noted scientist David Pimentel has calculated that the energy to produce a vegetarian diet is about 1/2 of that needed to produce a meat eating diet.(13) The difference is enough to drive every passenger car in America about 3,300 miles.(14)

It takes 5 pounds of grain feed to get one pound of beef, 7 pounds to get a pound of pork, and 3 pounds to get a pound of dairy.(15) Energy to produce this extra grain, plus that needed to slaughter, process, and chill animal food, is much higher than the energy needed for a simpler diet.

There are many health-related reasons to reduce intake of animal fats. And while it would be difficult and in some cases a health risk to immediately switch from animal foods one has eaten since birth to plant-based proteins, a gradual switch will save energy as well as lives.

- **Use Less Packaging** – In 1997, food packaging made up over 10% of all Municipal Solid Waste.(16) And this prodigious waste has a monetary as well as an environmental cost: 8.5% of the total food dollar goes to packaging. The energy used to make this packaging (metal cans, cardboard boxes, plastic bags) is enough to provide hot water for about 25 million American families each year.

Several food stores in Houston make a major effort to sell "in bulk," reducing packaging material while saving money for consumers. Bringing your own containers (such as cloth shopping bags) or reusing paper, glass and plastic containers to purchase bulk products allows you to save energy while reducing solid waste.

- **Reduce Food Waste** – According to one study, over a quarter of all the food in the U.S. is wasted.(17) This can be greatly reduced simply by buying the quantity you need.

Food scraps that are not edible still use energy consumed by solid waste disposal. The average gas-guzzling garbage truck travels to the landfill, where the food scraps are then buried by a gas-guzzling bulldozer. Composting non-animal food waste in your backyard will

save energy, and the compost becomes a great soil amendment for your landscape.

6. Efficient Vehicles

About 40% of all the oil used in the country is consumed in passenger vehicles. If you do not believe you can convert to alternative transportation, the best thing you can do is to buy a more efficient vehicle. Comparing the lowest efficiency passenger vehicles to the highest rated ones, it is possible to increase efficiency (miles per gallon) 20 to 490% depending on the vehicle weight. Below is a summary chart listing vehicle efficiency by weight class.

A complete list of almost all makes and models going back to 1985 is available at the Environmental Protection Agency vehicle emissions Web site: www.epa.gov/greenvehicles/

The Web site displays autos by miles per gallon ratings in each weight class, and has a relative score of each vehicle's air pollution and greenhouse gas emissions in each class. This Web site also allows you to compare the efficiency of specific vehicle models against each other.

A few things to note about these ratings. The most important is that you will probably not be getting the same miles per gallon listed here. The rating methodology is dated, and allows auto manufacturers to select their best vehicles for the tests. And no test can duplicate the driving habits of every individual. However, the standards are a good benchmark for *comparisons* between one model and another.

Another point is that vehicle weight is one of the drivers (pun intended) of fuel efficiency, and buying a lighter, often smaller car is a good way to get energy savings. This is not to say that heavy cars are never needed. Vans are often useful for carpools. And a Hummer is a handy vehicle to carry troops in when you are invading developing countries to steal their oil.

VEHICLE FUEL EFFICIENCY BY WEIGHT				
Weight Class	Lowest MPG	Highest MPG	Average MPG (All Models)	Difference High/Low
Small Car	12.51	73.78	27.93	490%
Midsize Car	13.79	65.78	26.49	377%
Large Car	13.79	32.69	23.47	137%
Minivan	16.84	26.53	23.66	58%
Small Pickup (4-5 cy.)	21.72	30.20	22.86	39%
Mid-Size Pickup (6 cy.)	19.10	23.50	21.34	23%
Large Pickup (8 cy.)	12.98	22.34	18.87	72%
Station Wagon (4-5 cy.)	23.83	38.35	29.62	61%
Station Wagon (6-8 cy.)	19.76	27.24	24.36	38%
Small SUV (4-5 cy.)	23.76	39.53	28.33	66%
Mid-Size SUV (6 cy.)	18.30	36.20	22.74	98%
Large SUV (8 cy.)	13.88	23.07	18.74	66%
Van	16.86	20.27	19.14	20%
ALL	12.51	73.78	24.83	490%



HOUSTON RENEWABLE ENERGY GROUP

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ENERGY YOU CAN LIVE WITH

The Houston Renewable Energy Group (HREG) was established in 1999 to further the development of renewable energy and related technologies with concern for the ecological, social, and economic fabric of our community and state. HREG serves to inform the public, institutions, and governmental bodies, and seeks to raise the level of awareness of sustainable power. Our network of concerned energy consumers, solar energy enthusiasts, engineers and architects provides a pathway to sensible energy conservation and generation, as well as a cleaner Houston.

HREG is a volunteer organization and local chapter of the Texas Solar Energy Society. Our activities include:

- Quarterly meetings held the last Sunday of the month from 2-4 PM (Jan, Apr, July and Oct) at Texas Southern University (TSU) – see Web site for details;
- An e-mail chat group on Yahoo;
- The annual renewable energy home tour, in conjunction with the American Solar Energy Society (October);
- A booth at Earth Days and other community events;
- School education programs;
- Speakers for workshops and seminars.

THE RENEWABLE OPTION

A strong economy relies on sustainable energy. Today, the U.S. leads the world in fossil fuel use. As demand for this limited resource continues to grow, we see rising energy costs, emissions beyond ecological limitations, a soaring trade deficit, and violent international conflicts. The atomic option is too risky. The Energy Crisis in the 1970s started efforts to develop technology for tapping into biomass, hydro, wind and solar resources. However, much more needs to be done.

The renewable energy market is expected to approach \$85 billion per year within the decade. Many countries and some states in the U.S. are dedicated to 20% renewable energy by 2020 and predicting 50% by 2050. Houston needs to recognize this potential and take the lead to maintain its position as the nation's Energy Capital.

Be a part of the exciting energy transformation – join HREG. Membership is FREE at www.txses.org/hreg

RENEWABLE ENERGY IS READY NOW!



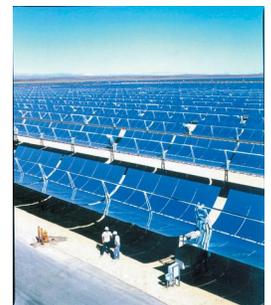
Over 48 Gigawatts of wind capacity was installed world wide by 2005, averaging 30% growth per year over the last several years. Texas reached 2 Gigawatts of wind power in 2006 – enough to supply 600,000 Texas homes with electricity annually. Wind power is now cheaper than a new clean coal or nuclear power plant. Storing wind with Compressed Air Energy Storage allows it to be cost-effectively dispatched whenever needed.

When solar cells were launched on space flights in the 1950s, they cost \$430 per kilowatt hour. Today they are 42¢ per kwh, and expected to fall much further with mass production. All of the power needs for a typical suburban residence could be met by covering half the roof with solar cells. Solar water heating is also a prime option for houses, providing about 70% of annual needs.



Not all solar energy needs to be provided by active machinery. Solar “passive” building design, combined with energy-saving building materials and equipment, can save half the energy used in new buildings, and 80% compared to many old buildings. Such features include natural daylighting, heat-reflective glass and roofs, and solar orientation that optimizes solar gain in winter and repels it in summer. The new SpawGlass headquarters building reduced energy use by 56%

Concentrating Solar Power (CSP) uses high heat from troughs and mirrors to boil a fluid to power turbines. A plant in California's Mojave desert has been producing enough power to provide 55,000 (Texas-size) homes with electricity since 1990. CSP is a good fit for our state since it operates at its peak during the hot summer months. The technology works well in areas such as West Texas, but the cost is high because it is not yet mass produced.



FOOTNOTES

Introduction/Frequently Asked Questions

1 Depletion for conventional oil from revised forecast provided by Colin Campbell, co-founder of Association for the Study of Peak Oil and Gas, dated December 12, 2005.

2 British Petroleum, "Oil – Proved Reserves" and "Oil Consumption – Barrels," *Statistical Review of World Energy 2005*.

3 Derived from special file (Table 19) provided by George Butler, U.S. Dept. of Energy, Energy Information Administration, Washington, D.C., (hereafter referred to as DoE,EIA) from *Annual Energy Outlook 2006*, Years 2003-2030.

4 Gasification plant census from Gasification Technologies Council, Arlington, VA, June 21, 2004.

5 Handwerk, Brian, "Global Warming Fast Facts," *National Geographic News*, December 6, 2004.

6 "Global Warming 101," Union of Concerned Scientists, Washington, D.C., January 27, 2006.

7 "Recent Warming of Arctic May Affect Worldwide Climate," National Aeronautics and Space Administration, Greenbelt, MD, October 23, 2003.

8 Connor, Steve, "Climate of change is here for good," *The Independent*, March 20, 2002.

9 Note 5 and "Global Temperature Trends: 2005 Summation," *GISS Surface Temperature Analysis*, NASA, Goddard Institute for Space Studies, February 2, 2006.

10 Greenland rise (23 feet) from Note 7. Antarctica rise (200 ft.) from *The United States in Antarctica*, U.S. Antarctic Program External Panel (Washington, D.C.: National Science Foundation, April 1997), Ch. 3.

11 Lean, Geoffrey, "The Big Thaw: Global Disaster Will Follow If the Ice Cap on Greenland Melts," *The Independent*, November 20, 2005.

12 Roach, John, "By 2050 Warming to Doom Million Species, Study Says," *National Geographic News*, July 12, 2004.

13 DoE,EIA, *Annual Energy Review*, August 15, 2005, Tables 1.3, 5.14a.b., and c. Data for 2004. Online at www.eia.doe.gov/emeu/aer/

Transportation sector end use from Davis, Stacy, and Susan Diegel, *Transportation Energy Data Book*, (Oak Ridge, TN: U.S. Dept. of Energy, Oak Ridge National Laboratory, December 2004), p. 2-1. Data for 2002.

14 DoE,EIA, "Petroleum," *Monthly Energy Review*, March 28, 2006, Table 9.1.

15 *Final Report of the Federal Trade Commission, Midwest Gasoline Price Investigation*, (Washington, D.C.: Federal Trade Commission, March 29, 2001).

16 Wyden, Ron (Senator), *The Oil Industry, Gas Supply and Refinery Capacity: More Than Meets the Eye*, June 14, 2001.

17 Note 14, "Natural Gas," Table 9.11.

18 Romero, Simon, "The Deal That Even Awed Them in Houston," *New York Times*, November 23, 2005.

19 Gray, D., Tomlinson, G., *Coproduction of Ultra Clean Transportation Fuels, Hydrogen, and Electric Power*, Report #MTR 2001-43 (Falls Church, VA: Mitretek, July 2001).

Evans, Gavin "Solid Energy Investigates NZ\$1 Bln Coal-to-Motor Fuel Plant," *Bloomberg News*, November 17, 2006.

20 Low cost from telephone interview with Bruce Osborn, CEO of Sterling Energy Systems, on September 16, 2005. High cost from speech by Fred Morse, chairman of Solar Energy Industries Association Solar Thermal Power Division, in Austin, TX, February 24, 2005.

21 Onshore wind potential (10,470 Twh) from American Wind Energy Association, "Wind Energy: An Untapped Resource," *Wind Energy Fact Sheet*, Washington, DC (based on 1991 analysis). Total U.S. electric consumption in 2004 (3,953 Twh) from Footnote 13, DoE, EIA, Table 8.5. 22 Estimate of 7 tons per acre X 7,341 BTUs per pound (switchgrass) X 2000 pounds X 640 acres per mile X 2,000 square miles in Harris County. This is divided by national per capita energy use of 351 MMBTUs in 2000 (DoE, EIA) X 3.7 billion people in Harris County. Processing losses of biomass crop are not included.

Petrolistan

1 British Petroleum, "Oil – Proved Reserves" and "Gas – Proved Reserves," *Statistical Review of World Energy 2005*.

2 Introduction–Note 13, Tables 5.1 and 5.4, updated August 15, 2005.

3 Ibid., and Bureau of Mines, *Mineral Yearbook*, Years 1946-1949, U.S. Dept. of the Interior (Washington, D.C.: U.S. GPO, 1948-1952).

4 United Nations Statistics Division," Table 14, Production, trade and consumption of crude petroleum," Energy Statistics Database (1950-2001), United Nations, New York, NY, July 18, 2004.

5 DoE, EIA, "Forecast Comparisons," *International Energy Outlook 2006*, February 2006, p. 112 and Introduction–Note 13, DoE, EIA, Table 6.1.

6 DoE, EIA, *International Energy Outlook 2005*, July 2005. Online at http://www.eia.doe.gov/oiat/ieo/special_topics.html

7 DoE, EIA, "Saudi Arabia," *Country Analysis Briefs*, December 2003.

8 Bureau of Labor Statistics employment database: <http://data.bls.gov/PDQ/outside.jsp?survey=ce>

9 Azerbaijan: "USA plans to expand military presence in Azerbaijan close to Iran," *Alexander's Gas and Oil Connections*, April 13, 2005.

Kazakhstan: Johnson, Chalmers, *Sorrows of Empire* (New York, NY: Metropolitan Books, 2004), p. 184.

Georgia: Antelava, Natalia, US military will stay in Georgia," *BBC News*,

January 18, 2004 and Svetlova, Ksenia, "US seeks Georgian help for Iran strike," *Jerusalem Post*, Feb 20, 2006.

10 "Rumsfeld, Kazakh government hold talk on protecting Caspian oil fields," *Agence France-Presse*, Feb 25, 2004.

Klare, Michael T., *Blood and Oil* (New York, NY: Metropolitan Books, 2004), p. 136-9.

Leupp, Gary, "Train and Equip" for What? Georgia and the "War on Terrorism," *Counterpunch*, May 29, 2002.

"U.S. Central Command Facilities, 2004/5," GlobalSecurity.org, Alexandria, VA, 2006.

11 DoE, EIA, "Persian Gulf Oil and Gas Exports Fact Sheet," *Country Analysis Briefs*, September 8, 2004.

12 Klare, Michael T., *Resource Wars*, (New York, NY: Henry Holt and Company, 2001), p. 92-4.

Toktogulov, Kadyr, "Russian base in Kyrgyzstan to serve security alliance of ex-Soviet republics," *Associated Press*, November 20, 2003.

13 Broad, William, et al., "A Tale of Nuclear Proliferation: How Pakistani Built His Network," *New York Times*, February 12, 2004.

14 Milhollin, Gary and Kelly Motz, "Nukes 'R Us,'" *New York Times*, Op-Ed, March 4, 2004.

15 Nordland, Rod, "The Bombs in the Basement," *Newsweek*, July 11, 1988, p. 42.

16 "Saudi Arabian Special Weapons," Global Security.org, Alexandria, VA, 2006.

17 Ibid., "Manama [Juffair], Bahrain."

18 Ibid., "Royal Saudi Air Force."

19 Note 10, Klare, p. 40.

20 US Overseas Loans & Grants [Greenbook] yearly reports adjusted by inflation factors, from Bureau of Economic Analysis at the Dept. of Commerce. Online at <http://qesdb.usaid.gov/gbk/index.html>

21 Note 19, p. 44.

22 Note 16, "Iran Military Guide, Introduction."

23 Aid from Note 20. Weapons sales from Defense Security Cooperation Agency, Open records fulfillment for Foreign Military Sales, Foreign Military Construction Sales, and Military Assistance Facts from 1950-2002, August 12, 2004.

24 Ibid., Weapons sales.

25 Note 10, Klare, p. 44.

26 Ibid.

27 Cordesman, Anthony and Abraham R. Wagner, *The Lessons of Modern War, Volume II*, (Washington DC: Center for Strategic and International Studies, 2006), Chapter 9.

28 Note 9, Johnson, pp. 158-9.

29 Note 10, Global Security.org.

30 Note 12, p. 59-60.

31 Gilmore, Gerry, "U.S. Troop Levels in Afghanistan Slated to Drop Next Year," *American Forces Press Service*, Dec. 20, 2005.

32 Gerstenzang, James, "Bush Says U.S. in Iraq for Long Haul," *Los Angeles Times*, March 22, 2006.

33 "Active Duty Military Personnel by Service by Region/Country, Total DoD," *Military Personnel Statistics* (Washington, D.C.: U.S. Dept. of Defense, Directorate for Information Operations and Reports, December 31, 2005). Online at <http://web1.whs.osd.mil/mmd/military/mlitop.htm>

34 Studies and years from Introduction–Note 13, Davis, Table 1.8. These were adjusted to 2005 dollars using the CPI.

Cost of Operation Desert Storm from 36 Watson, Russell, and John Barry, "But What About the Next Time," *Newsweek*, October 24, 1994, p. 28 and Hammond, Grant, "Myths of the Gulf War," *Airpower Journal*, Fall 98, p. 6. This was modified by the CPI.

Costs of Operation Iraqi Freedom from Belasco, Amy, *The Cost of Iraq, Afghanistan and Enhanced Base Security Since 9/11*, Congressional Research Service, Washington, D.C., October 7, 2005, Table 3, p. 10. These costs were modified by the CPI and averaged over 3 years.

Barrels of supply and imports from Note 2. Barrels divided by 42 gallons and divided by 0.187 to compensate for manufacturing losses. This compensation factor was derived from ratio of diesel to gasoline (each with different process losses) in *U.S. Highways Statistics 2004*, (Washington, D.C.: U.S. Dept. of Transportation, Federal Highway Administration, 2005), Section 1, Table MF21. Online at <http://www.fhwa.dot.gov/policy/ohim/hs04/index.htm>

Diesel process loss factor is 0.157; gasoline loss is 0.195. From Groschen, Ralph, *Energy Balance/Life Cycle Inventory for Ethanol, Biodiesel and Petroleum Fuels* (St. Paul, MN: Minnesota Dept. of Agriculture, Agricultural Marketing Services Division, undated).

Gallons per car and miles per gallon from Footnote 13, Introduction, Davis, Stacy, op. cit., Table 2.11. Data for 2002.

35 Flavin, Christopher, "Creating a Sustainable Energy Future," *State of the World 1988*, Worldwatch Institute (New York, NY: W. W. Norton & Company, 1988), p. 27.

36 Hammon and Kemper, Vicki, "Counting the Dead," *Common Cause Magazine*, Apr.-June 92, p. 6.

37 Williams, Thomas, "Debate Rages on War Illnesses," *The Hartford Courant*, April 17, 2000, p. A1.

38 From Iraq Coalition Casualty Count. Online at <http://icasualties.org/oif/>

39 From Iraq Body Count Website, updated September 1, 2006. Online at www.iraqbodycount.org/

40 Cost for world derived by using production figures from Note 1, "Oil Production – barrels."

41 Note 35, Belasco, adjusted for inflation.

42 Derived from Footnote 1 and Althaus, Dudley, "High Cost of Energy: Nigeria," *The Houston Chronicle*, Dec. 17, 2004.

43 Miller, T. Christian, "Riding Shotgun on a Pipeline," *Los Angeles Times*, May 16, 2004.

44 Ibid.

45 Derived from United Nations populations projections between 2005 and 2025. Online at <http://esa.un.org/unpp/>

46 U.N. Food and Agricultural Organization, Food Balance Sheet for Cereal Grains for all countries in 2002.

47 Derived from 2002 data in *Agricultural Statistics 2005*, U.S. Dept. of Agriculture, (Washington, D.C.: U.S. GPO, 2005), Ch. 1.

Map of Bases

Most base locations from Note 10, Global Security.org. Online at www.globalsecurity.org/military/facility/centcom.htm Iranian bases from Jaffee Center for Strategic Studies, "Iran," *The Military Balance*, (Tel-Aviv, Israel: August 30, 2004).

Map of Transportation

Notes 1 and 2.

Iraq Pipeline Watch, Institute for the Analysis of Global Security, Washington D.C., March 15, 2006. Online at <http://www.iags.org/iraqpipelinewatch.htm>

DoE, EIA, "World Oil Transit Chokepoints," *Country Analysis Briefs*, April 2004, p. 8.

World Bank, Map Design Unit, *Conflicts in ECA Region* (map), United Nations, ReliefWeb, Office for the Coordination of Humanitarian Affairs, Kobe City, Japan. Online at <http://www.reliefweb.int/>

Fire On Ice

1 Dwyer, Michael, "A prized energy source, or potent terror target? Push to build LNG terminals is under fire," *Christian Science Monitor*, April 06, 2004.

2 Ibid.

3 Ibid.

4 Phone interview with Bill Gwozd, Vice President Gas Services, Ziff Energy Group, on March 7, 2005. New production is about \$3-3.50 per MCF.

5 Speech by Robert Wilson, Sr. Vice President of Tractebel Electricity & Gas, at the 2004 North American Gas Strategies Conference, in Houston, TX, April 20, 2004.

6 Petrolistan–Note 5.

7 Amount of LNG supplied by operational LNG terminals from Gaul, Damien, *U.S. LNG Markets and Uses*, DoE, EIA, June 2004 Update, p. 6. Total gas use from Introduction–Note 13, *Annual*.

8 *Existing and Proposed North American LNG Terminals and Potential North American LNG Terminals*. (Washington, DC: Federal Energy Regulatory Commission, Office of Energy Projects), March 8, 2006.

9 CH-IV International, *Safety History of International LNG Operations*. Millersville, MD: CH-IV International, November 2002, Technical Document TD-02109, pp. 13-18.

10 Ibid.

11 "Algerian gas plant explosion kills 27, injures 72," *Agence France Presse*, January 21, 2004.

12 Kisson, Carolyn, "Explosion at ALNG shakes residents," *Trinidad Express*, June 14th 2004.

13 L. Thomas Tobin, *Liquefied Natural Gas in Vallejo: Health and Safety Issues* (Vallejo, California: City of Vallejo, The LNG Health and Safety Committee of the Disaster Council, January 16, 2003), p. 45.

14 Ibid., pp. 41, 45, 50, 53.

Hightower, Mike, et al., *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*, SAND2004-6258, (Albuquerque, NM: Sandia National Laboratories, December 2004), p. 53.

15 Raines, Ben, and Sean Reilly, "Lawmaker: LNG studies equate to junk science," *Mobile Register*, June 23, 2004.

16 Note 14, Hightower.

17 Raines, Ben, "Report sheds new light on LNG blast in Algeria: Document suggests that deadly explosion was caused by gas vapor, not boiler," *Mobile Register*, April 14, 2004.

18 Note 14, Hightower.

19 Fay, James A., *Public Safety Issues at the Proposed Harpswell LNG Terminal* (Cambridge, MA: MIT, November 5, 2003), p.3.

20 Ibid.

21 Note 13, p. 50.

22 Phone interview with Damien Gaul with DoE, EIA, on July 8, 2005. There is about 18.5% loss from liquefaction, tanker boil-off, and regasification on a ship from Nigeria to Lake Charles, LA.

23 Seven terminals predicted by Bill Gwozd, Vice President Gas Service of Ziff Energy Group, in phone interview on February 25, 2005. Ten terminals predicted by Eldridge, John and Ken Hurwitz, "Open door to LNG imports closes bit as developers seek new sites," *Houston Business Journal*, June 25, 2004.

24 Estimated costs from company Web sites, interviews with company officials, and "US FERC OKs Oxy's \$450 mln Texas LNG terminal," *Reuters News Service*, July 21, 2005.

Date of proposed service from interviews with company officials and *Proposed Texas Onshore LNG Supply Terminal Projects* (Austin, TX: Texas Railroad Commission, March 21, 2006).

Total Texas natural gas production from EIA, DoE, "Natural Gas Gross Withdrawals and Production," *Natural Gas, U.S. Data*, Updated April 27, 2006.

Total U.S. consumption from Introduction–Note 13, *Annual Energy Review*, Table 6.1.

25 Cost figures and percentages derived from Footnote 24 and Burr, Michael T., "LNG Rising," *Public Utilities Fortnightly*, April 2004, p. 39. Texas costs are substantially less than those in other parts of the country, leading to speculation that either material and labor costs are profoundly less in Texas, or companies are underreporting cost estimates.

26 U.S. Environmental Protection Agency, *Toxic Release Inventory*, 2002 data, county and site information.

27 Texas Workforce Commission, quarterly data for 2003 for petroleum refineries, chemical manufacturing, and plastics and rubber products manufacturing.

28 Fenske, Sarah, "Welcome to Fire Island," *Houston Press*, May 27, 2004.

29 Ibid.

30 Phone interview with Pat Suter, Chair of the Coastal Bend Sierra Club, on December 8, 2004.

31 Elder, Laura, "Isle resident sues to stop LNG terminal," *Galveston Daily News*, April 27, 2005.

32 Ibid.

33 All residential population estimates were made by identifying blocks for the 2000 U.S. census using distance measurements. Blocks on the edge of the 1 and 2 mile radius of harm were then reviewed individually to ascertain if their population should be included in the number affected.

Estimates for numbers of people in industries, military bases, colleges, parks, and schools were given by personnel at each institution in 2005. Additional information was given from the Port of Freeport, the Calhoun County Economic Development Corp., and the Village of Surfside.

34 Minutaglio, Bill, *City on Fire*, (New York, NY: Harper Collins Publishers), 2003.

35 "Yemen ship attack 'was terrorism'," *BBC News*, October 13, 2002.

36 Nigeria, Oman, Qatar, United Arab Emirates.

37 "Gas exporters to talk price," April 28, 2005, *Trinidad Guardian*.

Clean Energy Alternatives

1 Analysis using Energy Gauge 2.42 software from the Florida Solar Energy Center. Retrofit measures for 2,000 square foot house include ceiling and duct insulation, duct sealing, infiltration measures, solar screens, efficient furnaces, air conditioners (SEER 15.5), air-source heat pumps, and geothermal heat pumps.

2 Verma, Ram, et. al., *Evaporatively Cooled Condensing Units, Staff Draft Evaluation Report*, CEC-400-2005-052 (Sacramento, CA: California Energy Commission, 2005).

Cal. Energy Resources Conservation and Development Commission, *Evaporatively Cooled Condensing Units Compliance Option*, Sacramento, CA, October 27, 2005.

Telephone interviews with Mac Word, Allied Energy in Austin, TX, in 2006.

3 Telephone interview with Jessica Commins, Communications Manager of Geothermal Heat Pump Consortium, February 3, 2006.

4 Assumes electricity cost of 14¢ per kilowatt hour.

5 Heller, Martin and Gregory A. Keoleian, *Life Cycle-Based Sustainability Indicators for Assessment of the U.S. Food System*, Report No. CSS00-04 (Ann Arbor, MI: University of Michigan, Center for Sustainable Systems, School of Natural Resources and Environment, December 6, 2000), p.41 and Introduction–Note 13, *Energy Overview*, Table 1.1.

6 Pimentel, David, and Marcia Pimentel, eds., *Food and Energy* (Niwor, CO: University Press of Colorado, 1996), p. 8 and Introduction–Note 13, *Energy Overview*, Table 1.1.

7 Carlsson-Kanyama, Annika and Mireille Faist, *Energy Use in the Food Sector*, (Stockholm, Sweden: Stockholm University, Environmental Strategies Research Group, Department of Systems Ecology, circa 2000).

8 Energy use from *Paper Task Force*, Environmental Defense, No. 10B, December 19, 1995, p. 1. Bag weight is 0.12 pounds each.

9 Note 5, Heller, p. 31.

10 Food miles derived from average of weight X miles. Food weights for Dallas (closest city in the report to Austin) as stated in *Fresh Fruit and Vegetable Arrivals in Western Cities, 1998* (Washington, D.C.: U.S. Dept. of Agriculture, Agricultural Marketing Program, April 1999), Table 4B. Miles for domestic U.S. from capital of each state to Austin in road miles. Texas grown produce estimated at 200 miles. Foreign capitals except Mexico in air miles; Mexico in road miles.

11 Note 5.

12 Energy of 1.39 Quads (Note 7, Heller, p. 41) / 228 million passenger cars (Note 5, *Highway Statistics*, Chart VM-1) / 128,000 BTUs per gallon X 21 mpg (Note 6, Davis) / 0.187 process loss.

13 Note 6, p. 147.

14 17,000 Calories (Ibid.) X 4 BTUs per Calorie X 365 Days / 128,000 BTUs per gallon X 21 mpg (Note 6, Davis) / 0.187 (process losses).

15 Durning, Alan, and Holly Brough, *Taking Stock: Animal Farming and the Environment*, (Washington, D.C.: Worldwatch Institute, 1991), p. 42.

16 Note 5, Heller, p. 29.

17 Note 5, Heller, p. 35.