

RADICALLY REDUCING COMMERCIAL WATER HEATING COSTS: EPA VERIFIED 75% ENERGY SAVINGS

Businesses and Institutions at Risk on Energy Costs

Energy prices are high and unstable; global demand for energy is accelerating as populations expand and lifestyles improve; fossil fuel supplies are tight; anxiety over climate change is accelerating; economic productivity is put at risk by OPEC; regulations and incentives to reduce energy consumption and emissions are increasing while businesses and institutions are pressed to reduce their energy cost.

A reliable supply of affordable energy is a high priority of the National Association of Manufacturers.¹ Leaders of industry and institutions recognize that it is imperative to gain more control over their future by increasing efficiency, reducing costs, and adopting sustainable practices wherever possible. Those who retain the old ways remain exposed to volatility in energy prices, in addition to risking the loss of their competitive advantage and the value of their brand. Fortunately, significant savings are now possible in the cost of heating large quantities of water.

Water heaters and boilers are generally out of sight in the mechanical room. They quietly spin the energy utility meter many hours of the day and night. They are not separately metered; therefore, few businesses are aware of their cost to heat water. Even though their operating cost is a major expense for many businesses and institutions, it is overlooked as a controllable cost because a radically more efficient alternative has not been available prior to this time.

It takes a large amount of energy to heat water. The simple experience of heating a quart of water on a stove demonstrates that a lot of energy must be applied for an extended time. Multiply that amount 200 to 400 times and one begins to realize the significant operating cost of a single water heater or boiler in a hotel or institution. Water heating generally represents 35% of energy consumption in the lodging industry, 32% in restaurants, and 18% in health care facilities. Saving 75% of that expense is now possible with renewable energy from the earth.

Managing Energy Risks and Cost

In addition to the current cost of fossil fuels, there are other major issues associated with dependency upon them:

- anticipated higher prices resulting from future increases in demand and scarcity;
- growing regulatory pressure to reduce global warming by curtailing emissions that result from fossil firing to create heat or generate electricity;
- the world's economic productivity is put at risk by increasing scarcity and by a cartel.

Today's highly dynamic and uncertain energy situation demands the rapid adoption of more efficient and reliable measures. The reality is that global demand for natural gas has exceeded supply. In many countries, demand for electricity has likewise surpassed supply. Some utility

¹ http://www.nam.org/s_nam/bin.asp?TrackID=&SID=1&DID=231963&CID=423&VID=2

executives now predict that demand for electricity in the U.S. will soon outpace supply. The chairman of American Electric Power, which serves five million customers, recently stated, “My biggest fear is that we are running out of generation.”

Another CEO, Walter Higgins of Sierra Pacific, said, “People don’t realize how dangerously close we’re to moving to not having enough capacity. I’m worried where natural gas is going to come from for all that generation.”² The North America Electric Reliability Council forecasts that demand will increase through 2015 by 19% in the U.S., but if all committed resources are added, capacity will be increased by only 6%.³

Reducing peak electric system demand has become a major concern in the last decade as peak loads have grown faster than the capacity to generate and transmit power in the U.S. Increasing either generation or transmission capacity is an expensive and lengthy process. However, energy efficiency is a source of energy that is available much sooner and at a much lower cost. Energy efficiency reduces 1) peak demand, 2) year round demand, 2) utility costs and therefore, the cost to all customers, 3) greenhouse gas emissions and 4) fossil dependency.⁴

Limitations of Previous Efforts to Slow the Utility Meter

Energy sources that are in use today for commercial water heating are essentially those developed more than 100 years ago. They use either on-site fossil fuel combustion or electricity. Continued reliance upon these traditional sources ignores lower cost alternatives.

Over 44% of commercial water heating units use electric resistive heating elements, and more than 50% use natural gas combustion. Gas water heater sales have traditionally exceeded those of electric units because of historically lower operating costs. However, in 2006, gas-fired units declined by 5.5% while electric unit sales increased by 7.5%.⁵ This shift in market share to electric heating closely followed wide fluctuations and increases in natural gas prices.

In response to rising energy costs, there have been evolutionary improvements in water heating efficiency during recent years. They include increased tank insulation, gas igniters, condensing boilers that capture residual heat from flue gases, tankless (point-of-use) heaters that reduce standby losses by eliminating storage and reducing piping length. The limited capacity and absence of storage in tankless heaters limits their application in many instances, and they can never achieve 100% efficiency.

Regrettably, none of these improvements enables those systems to deliver 100% of the energy that they consume to create heat. Innovation has been limited by the focus on consuming energy to create heat. Without renewable energy, there are few alternatives to continued exposure to the risk of fluctuating high energy prices and an available supply.

Heat in the upper 100 feet of the earth’s surface provides a readily accessible source of renewable energy that is available worldwide every hour of the year. Energy from the sun and

² *EnergyBiz Magazine*, October 2006.

³ http://www.nerc.com/pub/sys/all_updl/docs/pubs/LTRA2006.pdf.

⁴ <http://www.aceee.org/pubs/u071.htm>.

⁵ *Appliance Manufacturers Magazine*, December 2006.

the core of the earth replenish that heat supply daily. This sustainable source is precisely the type of new advancement that can buffer customers from fluctuations in energy costs.

The benefits of renewable energy, energy efficiency and emissions reduction are numerous, substantial and verifiable:	
*	Operating costs savings lead to quick cost recovery and exceptional ROI.
*	Longer equipment useful life further reduces the life-cycle cost.
*	The cost to harvest renewable energy is relatively stable compared to fossil fuels, so its use reduces the risk of exposure to volatile and rising costs.
*	Emissions reductions result in decreased exposure to the cost of environmental compliance and remediation, Improved corporate image and relations with the public, stakeholders and regulators; and improved morale and safety in the workplace.
*	Renewable energy yields a counter-cyclical benefit that is the greatest during times when high fossil costs result in poor economic performance and businesses are struggling with higher costs and lower revenue.
*	Energy security, economic productivity and national security.

Solutions Emerging in the Market

The search has been underway for many years for systems that can reduce costs and fossil dependency by delivering more energy than they consume to create heat. Solar thermal systems meet that description; however, they are dependent upon access to sunlight, a large solar collector surface, a back-up heat source, and financial incentives to make them viable. Recovery period Thus, relatively few solar thermal systems are in use for commercial applications. Waste heat recovery units are also used to heat water. They are very efficient. However, they must have access to an adequate source of waste heat, such as air conditioning or other refrigeration systems.

Geothermal heat pumps also deliver more energy than they consume. They use a refrigeration compressor to deliver renewable energy from the earth. Water-based geothermal systems collect heat by circulating a water/antifreeze solution through a large plastic ground loop; then transfer that heat through an intermediate heat exchanger into the heat pump circuit; then transfer it from the refrigerant circuit into the water tank. These three heat exchanges, and the need to energize a water circulating pump, essentially limit their electrical efficiency to a ratio of approximately 2.5/1 (250% or a Coefficient of Performance of 2.5).

That level of efficiency does not provide enough savings in operating cost to recover the investment installing the ground loop in less than five years. Therefore, no water-based geothermal heat pump systems are marketed for commercial water heating in the U.S.

The U.S. EPA verified in late 2006 that a newer method of delivering heat from the earth has raised the bar to 400% electrical efficiency.⁶ One-year of monitoring an EarthLinked[®] commercial water heating system confirmed the results of a 1984 Florida Solar Energy Center

⁶ <http://www.epa.gov/etv/pdfs/vrvs/600etv06063/600etv06063.pdf>

test of the same technology in a residential sized system. That test also documented 75% savings in the consumption of electricity as compared to electric resistance heating.⁷

The basic concept of geothermal heat pumps is simple and straight forward. Heat from the sun is stored in the upper surface of the earth and combines with heat from the core of the earth. The amount of that heat that is released into the surrounding air is determined by the median air temperature in the region. At the U.S./Canadian border, the coldest ground temperature below 15 feet is approximately 42°F, and at the extreme southern U.S. is about 78°F. Because those ground temperatures are almost constant regardless of the season, they provide an excellent heat source to evaporate refrigerant for a heat pump system year round.⁸ In fact, geothermal systems are the most energy efficient means of heating buildings in most areas of the United States, and they are the most environmentally clean heating systems according to the U.S. Environmental Protection Agency and the Department of Energy.⁹

Key Considerations When Searching for a Solution	
Important factors to be evaluated in the selection of equipment include working with an established leader that has:	
* At least 15 years of broad field experience in diverse regions.	
* Multiple independent verifications in various climates.	
* Pioneered innovations in the technology as evidenced by patents.	
* The ability to provide solutions to meet your specific needs.	
* The highest efficiency ratings.	
* Equipment that is simple to operate, assures reliability and is compatible with traditional water heaters that can provide storage and temperature control.	
* An installing dealer network that is available for service.	

Developments after OPEC

Indirectly, OPEC did the world a favor before the supply of fossil fuel is depleted. Withholding oil from the market alerted us to our dependency and awakened innovation to regain control of our destiny. In response to the fuel crisis of the mid-1970's, research intensified on renewable energy including wind, solar and geothermal heat pumps. Development began on simpler, more efficient means of harvesting renewable energy from the earth. That energy source is abundant, renewable, free and continuously available.

The only energy consumed by the newer EarthLinked[®] heat pump is used to harvest the energy and operate a small pump to circulate the heated water from the heat exchanger into the adjacent

⁷ Florida Solar Energy Center, 1983 Annual Report, p.10; and unpublished letters to R.W. Cochran, dated July 20 and July 30, 1984.

⁸ Non-ozone depleting Refrigerant 407C that is used in the EarthLinked CWH system boils into a vapor at any temperature above -47°F, and is then capable of transporting energy.

⁹ *Space Conditioning: The Next Frontier*, EPA 430-R-92-004, April, 1993.

tank. The heat exchanger consists of closed earth loops placed in three inch diameter bore holes in the ground. They are shorter (50-100 ft.) and smaller than the heat exchangers of other systems because their copper earth loops transfer heat more efficiently than any other method. The loops can be installed vertically, horizontally, or diagonally, thus making retrofits possible for existing buildings and small spaces. The enclosed compressor unit is small and quiet. This method is more reliable because of its simplicity. With nearly 30 years of field experience, EarthLinked® systems, manufactured by ECR Technologies, Inc, are operating in 14 countries, primarily for space heating and cooling with optional water heating capability.



Water typically enters a building in the U.S., depending upon its location, at a temperature between 42° and 78° F. The most economic application of the EarthLinked® system is to pre-heat water to 110-120°F for large (2,000+ gal/day) users. That temperature is appropriate for lavatories and showers. If hotter water is needed, the heating component of any standard water heater tank can further raise and maintain the temperature. The EarthLinked® unit does not have to replace the traditional water heating unit. It can be connected in the water supply line, next to the tank. In that application, it heats the water to a set point and leaves the control of the ultimate distribution temperature up to the storage water heater tank.

Heating Capacity, Reliability and Control of Water Temperature

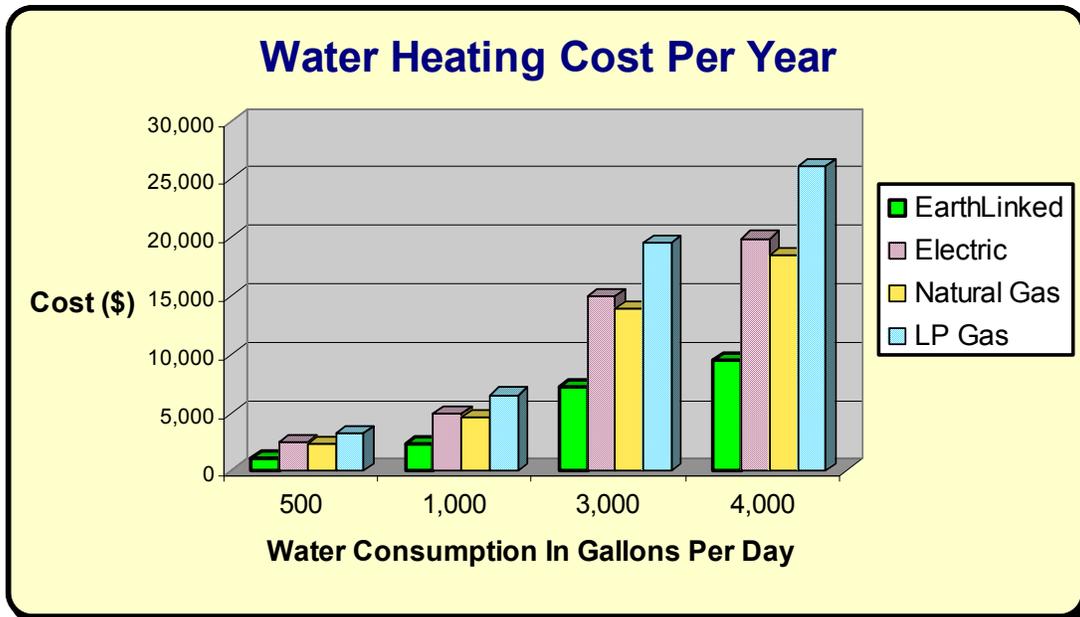
The world relentlessly strives to make yesterday's technology obsolete. Although it is always easier and seems safer to continue using what has worked in the past, the best-performing companies are willing to abandon old methods and adopt more efficient new technologies. Building managers are understandably hesitant to turn over the essential function of water heating to a technology they are not yet familiar with. When a guest, resident or patient turns on the shower, an unlimited supply of hot water must flow at the right temperature.

Reliability is increased through redundancy. Dependability and temperature control are assured when the EarthLinked® system is added to pre-heat water for traditional water heating tanks. Capacity is increased by the addition of the renewable energy unit as a hybrid component. When used to provide preheated water as part of a hybrid system, EarthLinked® delivers the majority of the heat, so most of the energy is from a free, sustainable source. Thus the hybrid system can deliver electrical efficiency exceeding 300%.

Reducing Fuel Consumption, Emissions and Operating Costs: “Dramatic” Savings

After one year of monitoring its performance in a nursing home, the U.S. EPA verified that the EarthLinked® system reduced electric energy consumption by 75%. The savings were described

as “dramatic” by the Director of the Greenhouse Gas Center.¹⁰ That reduction in electrical usage was determined to eliminate the emission of up to 7,000 lbs of CO₂ and 50 lbs of NO_x each year for each ton of heat pump capacity.¹¹ That represents 42,000 lbs of CO₂ and 300 lbs of NO_x emissions avoided annually by each 6 ton system. The savings in energy consumption alone translates into an ROI from 30% to 40%, depending upon the cost of installation and purchased energy. The heat pump is Energy Star listed in its space heating and cooling application, but unfortunately, the US DOE has not established Energy Star criteria for water heating equipment as of this time.



Water heating cost comparison between the EarthLinked® system, electrical resistance at \$0.10/kWh; natural gas at \$1.23/per therm; and LP gas heating at \$2.25/per gallon.

Addressing Climate Change: It Pays to Be Green

Consumers are demanding and supporting social and environmental responsibility from businesses and institutions. Being at the forefront of major developing global trends can be a valuable intangible asset. Decisions to adopt sustainable technologies “show that companies tend to be more strategic, nimble, and better equipped to compete in the complex, high-velocity global environment”, according to Matthew J. Kierman, CEO, Innovest Strategic Value Advisors.¹²

McDonald’s, Starbucks and Office Depot are among those corporations that have entered into collaborations with Conservation International to reduce the environmental impact of their companies and that of their suppliers. Even Wal-Mart, which drives every possible penny out of its costs, has adopted an aggressive environmentally-friendly agenda for itself and its suppliers.

¹⁰ “Nursing Home is Site of EPA Case Study,” EarthToys eMagazine, February 1, 2007:

http://www.earthtoys.com/emagazine.php?issue_number=07.02.01&article=ecr

¹¹ <http://www.epa.gov/etv/pdfs/vrvs/600etv06063/600etv06063.pdf>.

¹² *Business Week Magazine*, December 29, 2006.

GE, HP and DuPont are turning environmental friendliness into a competitive advantage through major corporate initiatives. Not only does that strategy reduce operating costs and risks, it enhances public relations and improves brand equity. Businesses can address global warming proactively, or they can wait to be pulled into compliance through regulations.

Environmental initiatives are a means of value creation; not just cost avoidance. Reducing greenhouse gas emissions by using renewable energy is now a key basis for enhancing a brand and differentiating the company or institution to customers, constituents, stakeholders and regulators. Well run businesses improve profitability through energy optimization, and the use of incentives and tax credits for investment in efficient systems. EarthLinked® water heating can deliver the efficiency needed to accomplish those objectives.

For access to the full EPA report:

- <http://www.epa.gov/etv/pdfs/vrvs/600etv06063/600etv06063.pdf>

For further information on the EarthLinked® system:

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