GEO Einstein Product line

The Green Energy Optimizers LLC Einstein product line is a home heating energy savings and safety solution. Our products implement an innovative patent pending method for reducing heating costs. Just as a smart thermostat allows a home owner to intelligently control their home temperature, the Einstein product adds another layer of efficiency by determining whether the home is occupied and whether the heating conditions demand the full power of the heating system.

What savings can be achieved?

Before we explain how and why we can reduce your energy cost what energy saving can be achieved with the GEO Einstein. The DOE states that "lowering the aquastat temperatures can achieve a 10% reduction in fuel usage[1]". The DOE also states that "lowering the thermostat temperature by 10-15F degrees can achieve a 5-15% reduction in energy cost"[2]. That is a savings of 15-25% achievable. What the DOE does not take into account is the diligence required by the home owner to manage these settings or the discomfort that such a large reduction would cause. The savings any individual will achieve are dependent on numerous factors. ***With the GEO Einstein product the homeowner will be able to achieve a 10% - 25% reduction in their heating costs.*** Unlike constant thermostat changes or manually changing boiler settings GEO is automatic, once installed it continuously monitors the home heating dynamics adjusting for maximum comfort with minimal expense.

Carbon Monoxide safety

According to the CDC (Center for Disease Control) 15,000 people are hospitalized annually due to CO exposure and 500 people die[3]. The primary source for CO exposure is the home heating furnace. The GEO Einstein (CO)

Background

Heating systems transfer energy from a fuel into the home. Fuel costs money. The more energy is needed the more fuel is burned and subsequently the more expense is incurred. Lowering the demand for energy reduces expenses. Heating system efficiency is the measure of how well the boiler or furnace transfer the energy from the fuel into the water or air. The heating system efficiency never takes into account whether there is a need for heat that is the responsibility of the thermostat. In general the heating system has two speeds on and off. Imagine a car that has no accelerator only two speeds standing still and 60 MPH.

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[1] http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12540
[2] http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12720
[3] http://www.cdc.gov/Mmwr/preview/mmwrhtml/mm5402a2.htm

The size of the heating system installed in a home is determined by the square footage of the home and the lowest outside temperature that could be experienced in the homes geographic location. The size of the system determines how much fuel it burns when it is on. The larger the size of the heating system the more fuel it will burn and the more it will cost to operate it.

Insulation and smart thermostats are a great ways to reduce energy consumption and increase comfort in the home. The Geo Einstein works as an adjunct to the smart thermostat and high efficiency boilers. Energy usage optimization requires a complete system approach. The GEO Einstein product adds value to the home owner by bridging the intelligence gap between the thermostat and the boiler.

Theory of operation

The GEO Einstein is an intelligent control system that is installed in the electrical path between the aquastat and ignition of the boiler. The GEO Einstein is installed in such a way as to only allow it to interrupt the ignition. It can never initiate ignition.

GEO Einstein saves fuel by holding off the burning of fuel when it is not needed.

When is the burning of fuel not needed?

- When the home is unoccupied less fuel can be consumed by allowing the home temperature to vary in larger amounts than the thermostat will allow.
- When the home is drawing small amounts of energy from the heating system. When the draw of the home is small because the heating system can maintain the desired heat level with a lower aquastat temperature.

Home occupancy sensor.

GEO Einstein uses two methods to detect occupancy.

Hot Water draw

GEO Einstein can determine that domestic hot water is used within the home. Hot water is used throughout the day when a home is occupied. Hot water is consumed when the home occupants wash their hands, shower, wash clothes, wash dishes etc. If no hot water is drawn within the home for a programmable period of time (1- 36 hours) then GEO Einstein declares the home unoccupied and initiates its energy saving mode of operation. The hot water draw method of presence detects a long period of inactivity.

Wireless presence sensor

GEO Einstein provides an optional key bunch dongles. The dongle looks much like an automobile wireless key entry. The dongles connect to the GEO Einstein controller via a Wireless link. When all the dongles are no longer in wireless range of the Einstein controller 100 ft the Einstein system initiates its energy savings mode. This allows the GEO Einstein to react quickly to the home occupants coming and

going. The system supports multiple dongles. Only when all dongles are not visible does the system declare the home unoccupied. The quick reaction of the system and the automatic entry and exit of energy saving mode will reduce energy consumption.

Load demand

The GEO Einstein FS system monitors the temperature of the water entering and leaving the boiler. The difference between those temperatures is equivalent to the amount of energy transferred into the home. The amount of energy transferred is not simply the difference in temperature but rather a more complex relationship based on the number of heating zones being heated , the size of the home, the volume of water in the heating system, the outside temperature , amount of insulation etc… Geo Einstein uses an innovative method to compute in real time the amount of energy transferred to the home that takes into account all the factors mentioned. Once Einstein computes the load it tracks the load behavior. If the load is seen to increase or is large, Einstein does not interfere and the heating system delivers all the energy it can to the home. If Einstein sees that the load is small or decreasing then the heating system is sending too much energy into the home. It is at this point that the GEO Einstein enters energy saving mode. The GEO system constantly monitors the load and reacts quickly (within seconds) to any changes. This operation of the GEO system is automatic and requires no intervention by the home owner or service people.

Energy Savings Mode

When the GEO Einstein system enters energy savings mode it lowers the maximum temperature that the boiler can reach. Fuel is saved by keeping the boiler at a lower temperature. When the boiler temperature is kept at a lower temperature the GEO Einstein system continually monitors the amount of energy drawn by the home. When the system determines that the home needs more energy it allows the boiler temperature to return to its natural level. This process happens automatically. The decision to lower the boiler temperature or allow it to rise adjusts itself to the number of heating zones demanding energy and to changes in the outdoor temperature.

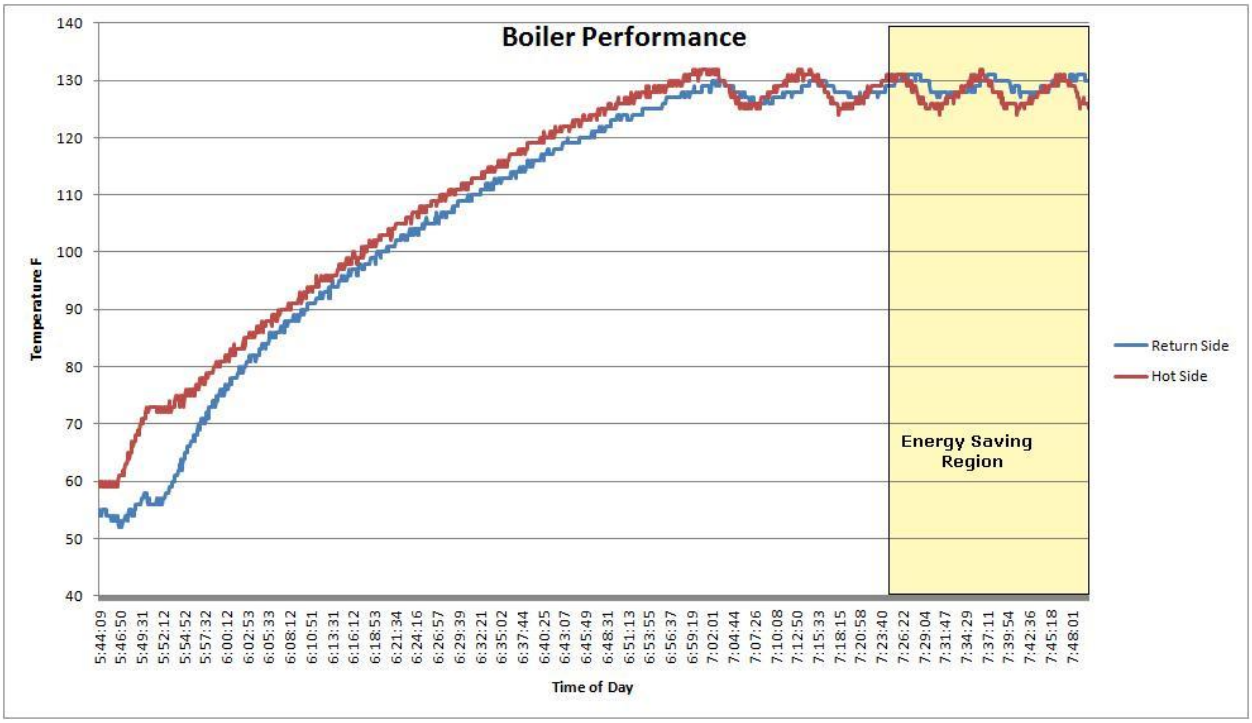

Figure 1 Normal boiler behavior

The figure above shows the behavior of a Rheem 8720 operating without the GEO Einstein system. It is clear that while the system is heating up the house is demanding heat and the boiler is delivering it. At around 7:25 the load of the home has changed, the difference between the hot and cold side has diminished yet the boiler's aquastat is still holding the temperature between 130 and 125 Degrees F. At 7:24 GEO Einstein determines that the boiler has reduced the amount of energy it is delivering to the home, at that point in time GEO enters energy saving mode.

In the energy savings mode GEO holds off the ignition to the boiler. In this mode GEO computes a new on/off threshold temperature that is lower than the programmed aquastat thresholds. The ignition is held off until the hot side of the boiler reaches the new lower threshold temperature at which time the boiler is allowed to turn on. The boiler will turn off at the newly computed high limit aquastat threshold. Forcing the boiler to operate at the new lower temperature range consumes less fuel. There is negligible effect on the home temperature because the home does not need to draw as much energy as it did during the warming cycle.

GEo Einstein Product Line

Einstein (FS) - Fuel Saver controller Hot Water Model.

- Microprocessor controlled base for the Geo Einstein Hot Water heating solution
- Fuel type independent.

- Automatically adjusts to multiple zone heating systems
- Works with one or two stage burners.
- Patent Pending predictive algorithms
- Reduces fuel burning when home is empty.
- Dynamic home heat load computation reduces fuel burning when load changes.
- End customer adjustable settings using LCD with touch panel.
- Enhances the operation of existing smart thermostats, works in concert with the thermostat achieve even greater savings.
- Modular system base “plug and play” connection to other Einstein components.
- 24V/110V/220V power source.
- Can control 24V/110V/220V boilers.
- Uses very little electricity less than 2 Watts.

Einstein (FA) Fuel Saver controller Forced Air Model

- Not yet Available

Einstein (T) – Temperature sensor

- Digital temperature sensor
- Dual redundant design for high reliability.
- Extended temperature range for long life

Einstein (CM) – Carbon Monoxide sensor Interface

- Connects CO sensors to the FS for ‘emergency’ shutdown.
- 1 wire “Plug and Play” connections supplies power to the CO sensor.
- Compatible with top sensor vendors such as GE, 3M, Kidde

Einstein (PR) - Wireless presence receiver module

- Receives the signal from the Key chain dongles.
- System supports multiple of them in the network.
- 1 wire “plug and play” connection provides power and communication.

Einstein (PD) – Wireless presence transmitter (Dongle)

- Periodically sends a beacon to the Einstein-PR
- Key chain dongle for each member of the household.

Einstein (RM) - Circulation pump prioritization.

- For households that supply domestic hot water through the same furnace providing heat
- Prevents undesirable cool down of domestic hot water upon boiler startup.
- Prioritizes and time delays the start of circulators in a multi-zone home. Holds off low priority circulators to allow high priority zones to heat up first heats up the important zones sooner.

Geo Systems

System	Features	Contents
HW-Base	• Fuel usage optimization • Long response resident absence detection (Domestic HW base)	1 – HW 3 - T
Circulation Priority	• Prioritize circulators to prevent cold showers and slow heating	1-PR 1-T
(Option) Wireless Presence	• Short response resident absence detection	1-PC 3–PD
(Option) CO shutoff	• Carbon Monoxide shutdown	1-CS 1-CO
(Option) CO/Wireless Combination	• Fast response resident absence detection • Carbon Monoxide shutdown	1-CP 1-CO 3-PD