5.0 Hot Water Alternatives

The water system designed for the site includes three natural gas fired water heaters to serve the hot water demand for the building. The following section discusses the possibility of using solar energy to meet some of this demand.

5.1 Solar Water Heating

A solar energy analysis was conducted at the site to see if the water heating loads could be met or reduced within a reasonable payback period by this technology. There are three main types of solar collectors on the market that are capable of providing solar hot water heating: flat plate, glazed flat plate, and evacuated tube. Energy models for these three configurations were set up using RETScreen International's Solar Water Heating analysis program. The tilt on the collectors was decided to be set equal to the latitude line for Houston, TX at 30^0 for maximum exposure to the sun. The collectors are oriented directly south and are located on the building's flat roof.

The next part of this energy model was an estimate of how much load LA Fitness has a demand for. The building was modeled as an 800 person school with showers to decide the hot water demand at the site, because this configuration most closely resembled the building's hot water usage estimation. The building demand for hot water requires 63.28 MMBtu to be delivered for one year of operation.

5.1.1 Flat Plate Collector

An unglazed flat plate solar collector is the most basic type of collector that is widely used to collect the sun's energy. These collectors are made of a black polymer. There is no selective coating on the surface, and typically no frame or insulation on the back. As a result of these imperfections, thermal losses to the environment are significant; this is particularly the case when there are prevailing winds. These collectors are better used for energy delivery at relatively low temperatures.

The flat plate collector used in this energy analysis was an unglazed Heliodyne Mojave 410. Using the simulation software, it was found that using seven collectors at the site would be optimal to balance first cost against the amount of energy delivered. The five collectors have a total gross area of 200 ft^2 and deliver a total of 18.94 MMBtu for one year of operation. This configuration will be able to reduce the energy necessary from the water heaters by 29.9% over the course of a year.

Unglazed flat plate collectors are the most primitive of the three methods studied. However, this type of collector is also the least expensive regarding first cost. The first cost of the installed system is $4,752. This system would provide savings and has a fairly attractive payback period of 8 years. A full breakdown of the energy demand, energy delivered, and economics for this system is included in Appendix E.

5.1.2 Glazed Flat Plate Collector

A glazed collector is very good at collecting energy from the sun due to the selective coating that is applied to the polymer. Also, these collectors are superior to standard flat plate collectors because they are better insulated; they have a glass cover on top of the coating and an insulation panel behind it. Unlike a standard collector, the efficiency of this configuration is almost independent of wind.

The glazed collector used in the energy model is a Heliodyne Gobi 408. This simulation showed that it would be optimal to use five collectors to balance the system's energy collection and capital cost. Using five collectors will result in a total gross collector area of 160 ft^2 and would deliver 33.94 MMBtu over the course of a year. This technology would provide 53.6% of the entire energy needed to heat the water for the building for one year.

The first cost of the glazed collector system is $5,589. The glazed flat plate collector provides the most attractive payback period of the three models studied. The payback period for this model is 5.3 years. The breakdown for this system's energy demand, energy delivered and economics is included in Appendix E.

5.1.3 Evacuated Tube Collector

Evacuated tube collectors also have a selective coating; however, this coating is enclosed in a sealed, evacuated glass tubular envelope. The distinguishing characteristic feature of these systems is their incredibly low thermal losses to the environment. The efficiency of these systems is said to be independent of wind. The typical way in which these systems operate is by the means of a sealed heat-pipe on each tube to extract heat from the absorber. Liquid in contact with the heated absorber is vaporized and then recovered at the top of the tube while the vapor condenses and the condensate returns by gravity to the absorber.

The model used for simulation of the evacuated tube solar technology is the Thermomax Mazdon 20 – TMA 600S. This system is the most efficient of the three models studied. The seven collectors have a total gross area of 228 ft^2 and are capable of delivering 43.26 MMBtu over one year of operation. This correlates to 68.3% of the energy used by the water heaters in a year.

The first cost of this energy efficient system is $16,669 and the payback period is 11.6 years. The breakdown of the energy and economics for the evacuated tube system is included in Appendix E.