

## Madonna Homes Case Study

**Site:** Madonna Homes, 722 N. Huron St., Toledo, OH

**Owner:** Catholic Diocese of Toledo

**Design & Installation firm:** Dovetail Solar and Wind ([www.dovetailsolar.com](http://www.dovetailsolar.com))

**General Information:** this is the largest commercial solar thermal domestic hot water system in Ohio. It provides more than half the hot water heating for a 5 story, 171 unit low-income/senior housing facility.

The project was funded by a \$62,000 grant from State of Ohio, funds from the Federal Dept. of Housing and Urban Development (HUD), and the Toledo Catholic Diocese.

The solar thermal system was installed 2008 in conjunction with an extensive building renovation. Madonna Homes was originally built in 1970 with 194 units. During the renovation, this was reduced to 171 units, enlarging many of its rooms. The renovation included many energy efficiency improves, including a new insulated, white membrane roof, upgraded stoves and Energy Star refrigerators. New amenities to improve the atmosphere and living experience were added, including updated computer labs, a new lending library, and appealing landscaping. The community room was refurbished, the kitchen updated, and a laundry room on each floor was provided with energy efficient washers and dryers. "To see the change from what it was to what it is now ... it's like a whole new place," says Tracey Franklin, Building Manager for Madonna Homes.

**Major system components:** The solar thermal system utilizes qty. 48 of Heliodyne GOBI 410 4x10 ft. flat plate solar collectors. These are mounted on the building's flat membrane roof in portrait mode at a 35 degree tilt facing south. Dovetail installed roof curbs to anchor the collector racking structures. The 48 collectors are divided into 6 arrays of 8 collectors each. Each set of 8 collectors are plumbed together in series to form an array. Then the 6 arrays are plumbed together in parallel to feed the solar heat to the building below.



*View of roof top solar collectors. Portions of 4 of the 6 arrays, each with 8 collectors are visible.*

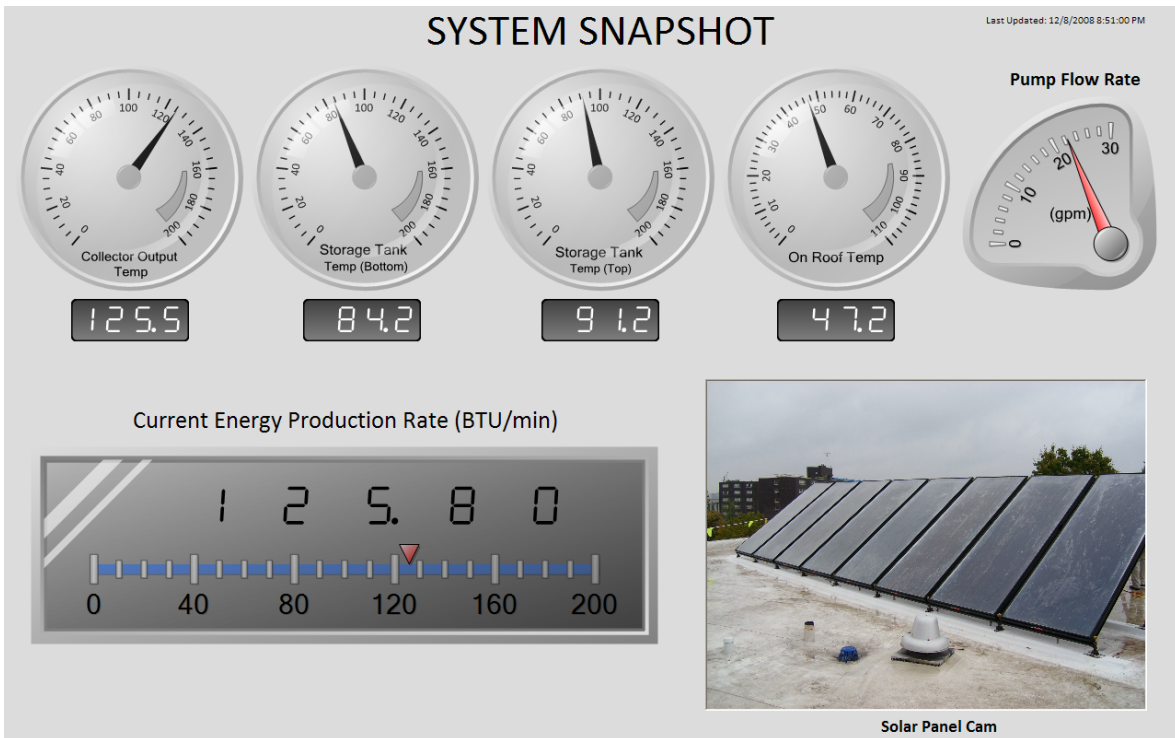
It is an active closed-loop solar thermal system. Three inch insulated copper pipe is used to carry the solar heated Dyn-O-Flo heat transfer fluid from the roof array down five stories to the building's Mechanical Room. There it passes through a double-walled, high capacity heat exchanger. The heat energy is transferred to potable city water. The heat transfer fluid is then returned to the roof array for reheating. The heated potable hot water from the other side of heat exchanger is pumped to an external 2,150 gallon solar storage tank. This tank is interconnected to, and used in conjunction with an existing 830 gallon hot water tank located in the Mechanical Room. Supplemental heat is provided by the existing 1,620,000 BTU/hour natural gas-fired boiler.

A Heliodyne Delta-T Pro solar controller monitors a number of system temperature and flow sensors. It turns on a circulation pump for the solar collector loop when it determines that heat is required and solar heat is available. Other major system components include a 32 gallon Amtrol SX-60V expansion tank, two circulation pumps, temperature sensors, gages, and numerous valves to isolate and service various system elements.

The system is projected to produce 340.91 million BTUs per year (53.2%) of the 640.64 million BTUs required annually to heat city water to the desired 120 degrees for DHW.

“This will save so much money on our heating and it is a really big deal since Madonna Homes will be one of the first sizeable solar hot water installations for a subsidized property in Northwest Ohio,” says Franklin.

An exciting feature of the system is its production monitoring and display subsystem. Dovetail, Heliodyne and Vistula Management (the building management firm) assisted a team of University of Toledo students who developed this Solar Energy Monitor subsystem for their senior engineering project. The Solar Energy Monitor communicates with the Heliodyne Delta-T Pro controller and once every minute logs sensor values, BTU heat production, and other system parameters to a computer database. It also logs weather data and solar irradiance information. A 42” flat LCD flat panel display in the Madonna Homes lobby continuously cycles through 3 display screens. The first screen displays real-time information from the solar thermal array. This includes temperature of the coolant at the solar collectors, temperature of the water residing in the 2,150 gallon solar storage tank, pump flow rates, the current energy collection rate in BTUs/min, and provides a live view of the solar panels via a network camera on the roof. The second screen displays current weather conditions along with a 72 hour forecast. The third provides a summary of historical energy performance. This screen displays the total amount of BTUs generated over several time intervals, dollars saved, average dollar savings per day, and equivalent greenhouse gas (CO<sub>2</sub>) reductions.

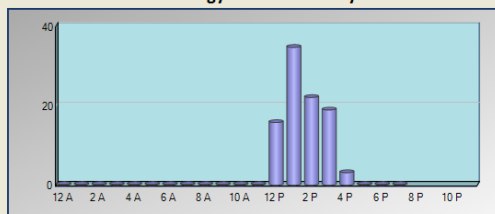


*System Snapshot display screen*

# ENERGY GENERATION HISTORY

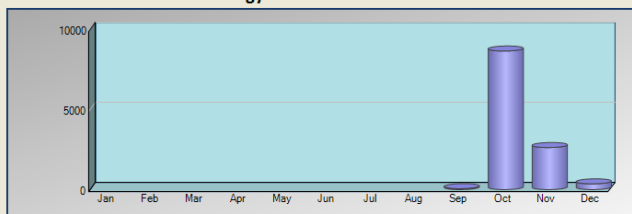
Last Updated: 12/8/2008 7:46:40 PM

Energy Collected Today



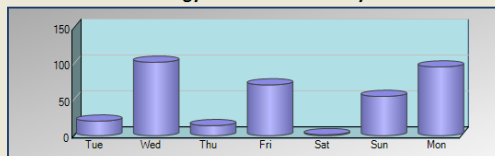
Total kBTUs: 95.7 Ccfs: 0.93 (\$1.33)

Energy Collected Last 12 Months



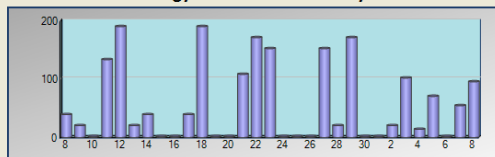
Total kBTUs: 11657.7 Ccfs: 113.18 (\$149.72)

Energy Collected Last 7 Days



Total kBTUs: 359.2 Ccfs: 3.49 (\$5.00)

Energy Collected Last 31 Days



Total kBTUs: 1823.7 Ccfs: 17.71 (\$25.39)

## ENERGY SUMMARY



	kBTUs	Ccfs	Amount	Avg/Day
Today:	95.7	0.93	\$1.33	
Last 7 Days:	359.2	3.49	\$5.00	\$0.71
Last 31 Days:	1,823.7	17.71	\$25.39	\$0.82
Last 12 Months:	11,657.7	113.18	\$149.72	\$2.08
Since Inception: (11/17/2008)	11,657.7	113.18	\$149.72	\$2.08

## EMISSION REDUCTIONS



	Road Miles	lbs CO <sub>2</sub>	lbs CO	lbs NO <sub>x</sub>
Today:	10.21	11.15	0.004	0.009
Last 7 Days:	38.33	41.84	0.014	0.033
Last 31 Days:	194.63	212.47	0.073	0.168
Last 12 Months:	1,244.09	1,358.18	0.466	1.073
Since Inception: (11/17/2008)	1,244.09	1,358.18	0.466	1.073

Energy Generation display screen

The Solar Energy Monitor subsystem also includes a web reporting interface that enables authorized users the ability to query the historical data over any recorded time period. The lobby monitor displays can also be viewed remotely via an Internet web browser.

An open house was recently held with performances by two local high school choirs, tours of the newly refurbished building, a presentation about the new solar thermal system and speeches by Mayor Carty Finkbeiner and Bishop Leonard Blair from the Catholic Diocese of Toledo to mark the momentous occasion.