

Kotzebue Electric Association
Solar Thermal Alternative Residential Heating Methods

Quarterly Report

3/31/2011

Prepared by Jesse Logan (KEA)

Funding

Denali Commission	\$127,000
KEA ¹ In-Kind	\$5,000
CETF ² In-Kind	<u>\$12,000</u>
Total	\$144,000



Heliodyne Flat Plate Solar Collector.
Jesse Logan (KEA).

Project Summary:

This project will assess the feasibility of solar hot water heating systems on residential units in the NANA Region of Kotzebue. The Kotzebue Community Energy Task Force (CETF) had identified up to ten (10) Elders homes which are most in need of home heating assistance. System design and budget were considered for each home as well as southern exposure. After detailed review of designs and costs six (6) homes were identified to serve as test sites where solar-thermal systems, some using flat plate and some using evacuated tubes, have been installed (see figure below for manufacturer, installation contractors, collector type and system type). If the technology proves feasible above the Arctic Circle, these systems could be installed in homes throughout the region and serve as a model for alternative methods to heat homes without the use of fossil fuels.

¹ Kotzebue Electric Association

² Community Energy Task Force

Manufacturer	Installer	Collector Type	System Type
Viessmann	SES	1 evacuated tube	DHW
Viessmann	SES	2 flat plate	DHW
Heliodyne	ABS	1 evacuated tube	DHW and Space Heat
Heliodyne	ABS	2 flat plate	DHW and Space Heat

A. Administration, Management, and Reporting

KEA is responsible for the short- and long-term management, operations and maintenance of the solar thermal systems, in cooperation with CETF, NIHA³ and NANA⁴. The Alaska Technical Center will have the opportunity to offer hands on training of the operation and maintenance of the installed systems, however only peripheral discussions have taken place so far. No students were available during installation. Additionally, the Chukchi Campus, a University of Alaska satellite campus, has recently developed a renewable energy training program. While no classes were offered at the Chukchi Campus during the semester of installation, discussions have taken place with program directors regarding a possible role for Chukchi's long term involvement with data collection and analysis.

In the spring of 2011 the Bristol Bay campus of the University of Alaska system has offered a distance education class on renewable energy systems. One student of this class is located in Kotzebue and has joined the KEA effort. She has worked closely with the project manager, Jesse Logan, to acquire historical fuel usage for each home with a solar thermal system as well as gathering historical climate data (i.e. heating degree days in Kotzebue) and in developing a matrix for analyzing the data in cost benefit ratio and simple payback schemes.

B. Progress Update

Due to unexpected challenges several of the systems were not operational until March of 2011, see KEA's March Quarterly Progress Report Appendix 1 for details. At present all six (6) systems are operational. Below is a summary of BTUs utilized by each system in April and May 2011.

³ Northwest Inupiaq Housing Authority

⁴ Northwest Alaska Regional Native Association

Preliminary Energy Results for April and May 2011

Susitna/ Viessman Systems (DHW only)

	<u>BTUs</u>	<u>Diesel Equivalent (gallons)</u>
System 3(FP)	2,562,637	20.50
System 1 (EVT)	1,852,878	14.82
System 2(FP)	75,070	0.60

ABS/ Heliodyne Systems (Combined DHW and Heat)

	<u>BTUs</u>	<u>Diesel Equivalent (gallons)</u>
System 5(FP)	3,050,000	24.40
System 6 (FP)	2,650,000	21.20
System 4(EVT)	270,000	2.16

a. Analysis

The production values, above, are below what KEA was expecting to see in the spring months. However, several factors may contribute to the seemingly underproduction and KEA has solicited the advice of both Heliodyne and Viessmann corporate offices as well as the contractors to narrow the possibilities. KEA's main goal with this project is to reduce the use of fossil fuels for residential systems. KEA has obtained historical fuel usage for five (5) of the six (6) homes. KEA will evaluate fuel usage for 2011 later this year.

First, the production values, shown above, are derived from the difference between the temperature of the solar fluid before entering the storage tank and upon exiting the same storage tank. Therefore, the total amount of BTUs that the system produces is not calculated, only what is utilized by the system for domestic hot water (DHW) and space heating. Observationally, the households with a larger number of residents have systems that are reporting higher BTU values. This seems straight forward: A single Elder living alone would have less need for hot water than a household of six (6), so even if the system has enough solar radiation to begin pumping, if there is no call for heat in the storage tank the system will not transfer any heat.

Over the next quarter KEA will be doing household surveys to get a better picture of DHW and space heating needs (use) and may explore options of installing flow meters on the DHW loop

in order to understand the usage for each system. Still, the main criteria for judging the appropriateness of this technology will be reduced diesel fuel use.

Second, KEA, as well as Alaska Battery Systems (ABS) and Susitna Energy Systems (SES), had expected to see greater production from the Evacuated Tube (EVT) systems. However, as shown above, Flat Plate collectors are out-producing the EVTs. One possible reason for this is lower ambient air temperatures during the spring months in Kotzebue. Though ambient air temps have very little effect on the temperature of the collector, frost could contribute to lower production. During the spring months in Kotzebue there is often frosting at night. Flat plate collectors are less efficient and therefore radiate more heat (solar radiation) back into the atmosphere. This would make them frost free earlier in the day. The project manager has observed frost on the EVTs as late as 11am, while the FP collectors were frost free and in full production.

Additionally, it is possible that the thermistor sensors on some of the systems may not be calibrated correctly. This would result in lower production (as the system would not have accurate information to dispatch heat), and also lower production reports. However, KEA feels fairly confident that this is not the case.

Another possible contributing factor to lower than expected production values could be the angle of the collectors. Generally, solar collectors face south and are at an angle near the same as the latitude of the site. However, Kotzebue is above the Arctic Circle and this unique sun angle in the summer has not been tested with solar thermal units. Therefore, KEA has placed two (2) (system 2 and system 3) of the solar collectors at 30degrees, rather than the customary 68degrees, in order to capitalize on the increased angle of the sun during summer months. However, as can be seen with the preliminary data above, system 3 has produced on par with other systems while system 2 has a much lower production value. More production value over the course of the summer and fall seasons is necessary to fully understand this relationship.

C. Conclusion

This demonstration project proved to be somewhat complex due to the coordination of several entities as well as several home owners with different equipment. As with any complex project unforeseen problems arose (see KEA's March 2011 quarterly report for details) and KEA has worked diligently to address each problem in a timely and cost efficient manner.

Preliminary production data is available and will be sent to the Commission via ACEP. There may be several causes contributing to the lower than expected production values. KEA has solicited advice from industry experts and will continue to monitor each system. As well, KEA feels that more observation is needed and that data over the course of a full year will be necessary to fully evaluate the economics of these systems.