Possible Breakthrough in Solar Thermal Costs for Industrial Process Heat

Posted by Gail the Actuary on March 3, 2010 - 10:12am
Topic: Alternative energy
Tags: glasspoint, rod macgregor, solar thermal [list all tags]

In solar thermal applications, there are three different heat ranges, with different uses. According to Wikipedia,

> Low temperature collectors are flat plates generally used to heat swimming pools. Medium-temperature collectors are also usually flat plates but are used for creating hot water for residential and commercial use. High temperature collectors concentrate sunlight using mirrors or lenses and are generally used for electric power production.

The possible breakthrough I want to discuss comes in the middle range (or perhaps upper middle range)--100 to 400 degrees centigrade. According to Rod MacGregor, CEO and founder of GlassPoint, the company has developed a new solar thermal methodology that, in that range, is **cheaper than burning natural gas**. The heat generated using the new technology can be for a variety of industrial processes, including making steam for enhanced oil recovery (EOR) and for drying gypsum wallboard.

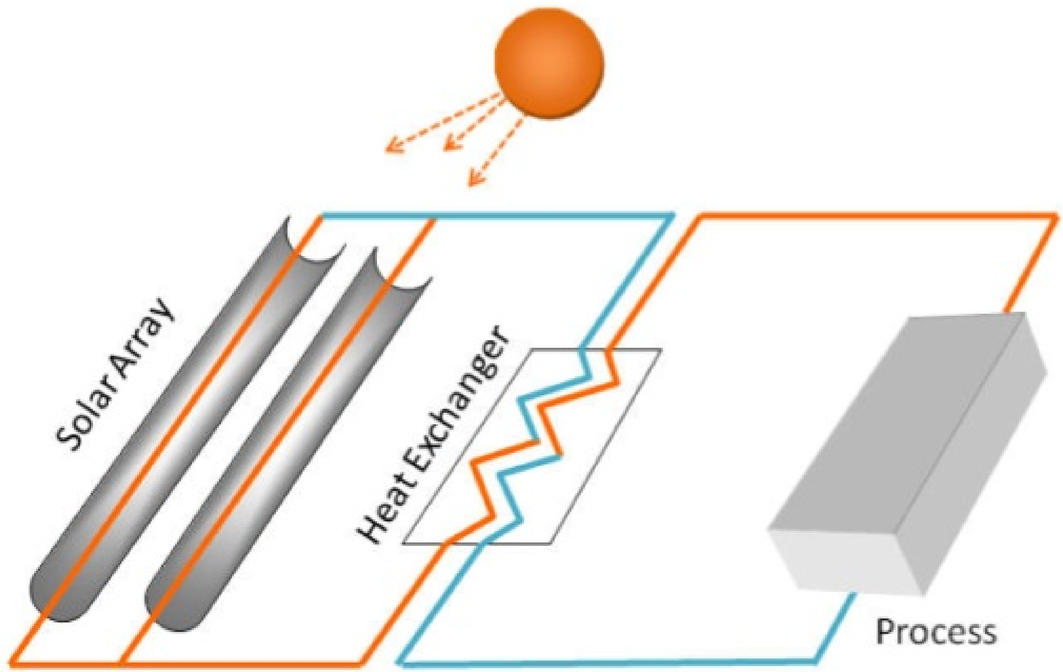
If what MacGregor says is true, companies that are currently burning natural gas for heat (100C to 400C or 212F to 750F) and have space for solar thermal collectors may be able to economically replace part of their natural gas use with solar thermal generated heat.

Glasspoint is a small, privately held company, so even under the best of circumstance, is unlikely to change the world overnight. But the approach does seem to have possibilities, so I thought I would tell you a little about what the company says about it.

How does the process work?

According to MacGregor, if one wants to produce solar thermal output that can be used to economically run steam boilers to produce electricity, one wants very high temperature output, and this requires very expensive mirrors for solar concentration. But if what one is looking for is more a mid-range of temperatures, cheaper mirrors can be used. According to the GlassPoint website:

Heat from the sun is concentrated by mirrors onto stainless steel pipes carrying thermal oil. The thermal oil heats up to 750°F and it is then pumped directly to the industrial process. If the process uses a working fluid other than thermal oil (e.g. air or steam) then a heat exchanger can be used to transfer heat to the desired fluid. Cool fluid is returned to the solar array to be heated once again.



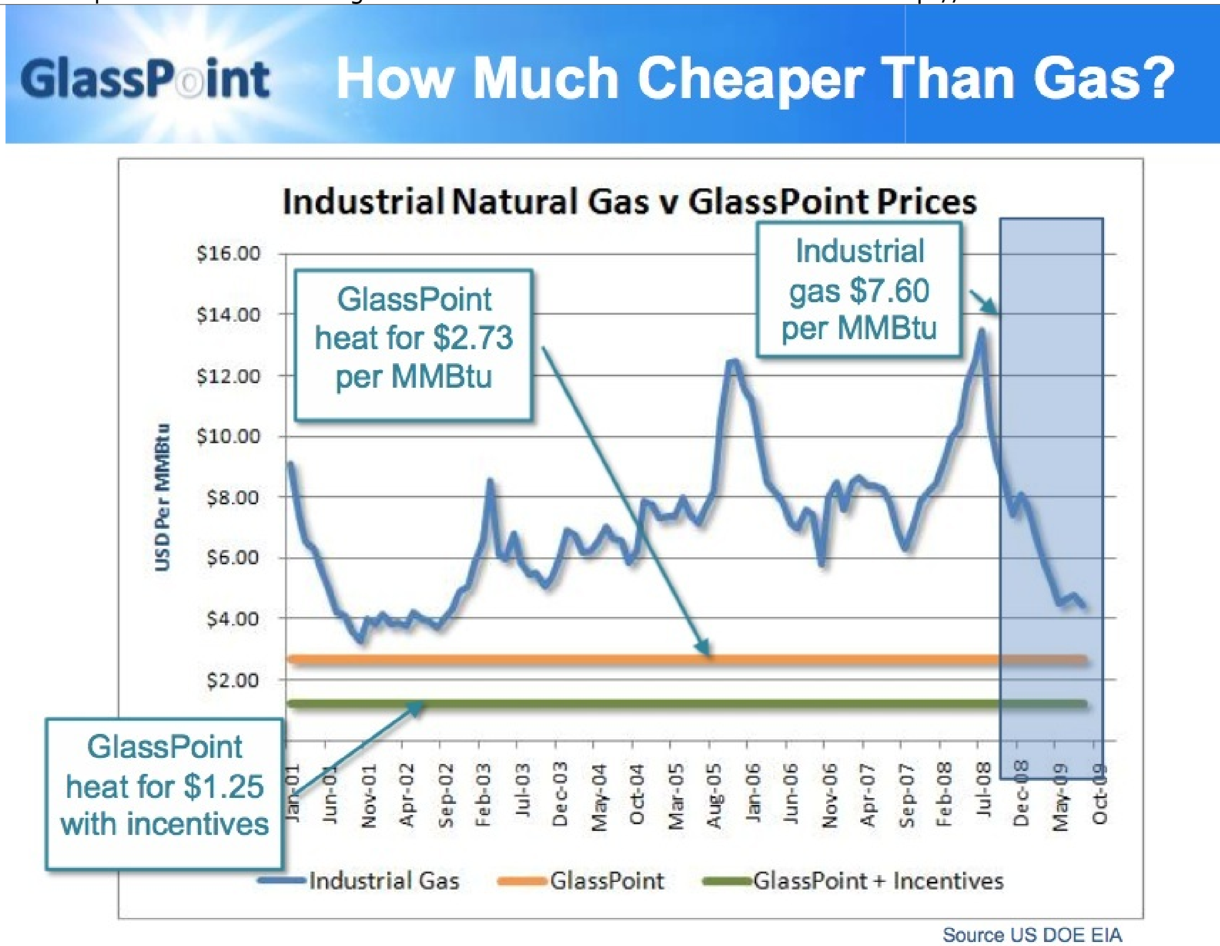
The above image indicates the GlassPoint's methodology uses solar concentrating mirrors which appear not to be movable. MacGregor indicated that nearly the entire ground surface is covered by the mirrors, since the mirrors are relatively cheap, and shadowing by other mirrors is not a concern. He also indicated that the mirrors incorporate some sort of self-cleaning mechanism.

This approach is quoted to be 55% to 60% efficient, since there is no intermediate step of making electricity in the process.

GlassPoint has a number of competitors, including Brightsource Energy, austra, and eSolar, but these companies all make systems that are high-enough powered to generate electricity as well. The pictures on their web sites seem to indicate large numbers of movable mirrors. Brightsource indicates that for industrial processes, its systems are "competitive with fossil fuels" which is pretty good, but not as good a claim as GlassPoint's "cheaper than natural gas".

To keep costs down, MacGregor indicated that the units are made in China, and assembled there.

How much does this approach cost?



According to the material I was provided, the cost of heat is $2.73 per MMBtu, using NREL's 30 year level cost of energy calculation. With incentives, the cost is quoted at $1.25 per MM Btu, but I am not certain how the latter price is calculated. One incentive is a Federal tax credit of 30% available of installations begun in 2010. In California, there are also salable credits associated with California Cap and Trade laws. Since there are no carbon emissions, it avoids EPA regulation.

When this type of application is used, typically solar heat replaces only 20% of the natural gas that would otherwise be used, because sufficient solar energy to produce solar thermal heat is only available 20% of the time in sunny climates. If this application were used in a not-too-sunny climate, it would replace less than 20% of the natural gas used.

In order to really get this price, one would need the steam for the full 30 year period. If one does not have the cash, one would also need a way of financing the purchase. In the current credit environment, long-term loans may not be readily available.

Regarding space requirements, the material provided indicates:

> GlassPoint's solar arrays are modular and occupy less than one quarter the land area of traditional solar thermal solutions. Although the power output varies by geographic location, a general rule of thumb is that one acre of GlassPoint solar field produces an average of 10,000 MMBtu per annum.

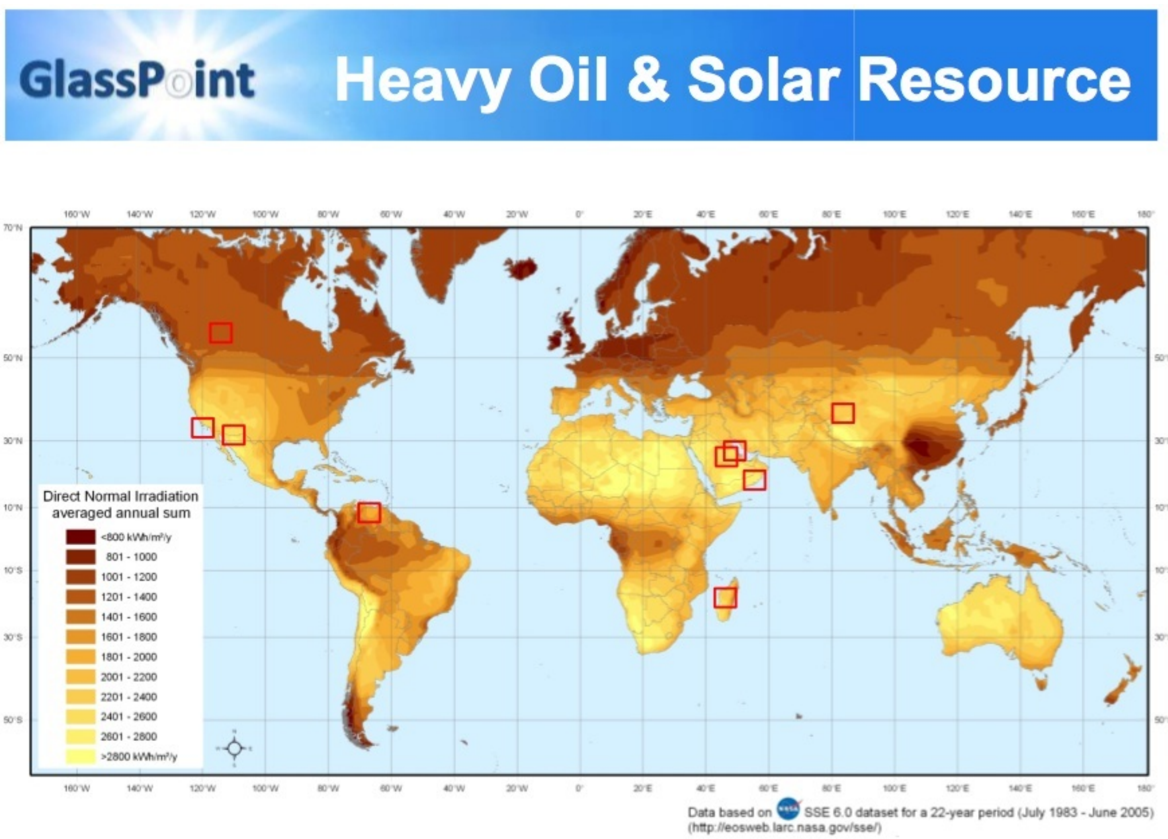
Applicability to enhanced oil recovery

The GlassPoint solar thermal approach was originally developed for drying gypsum wall board. It is now being marketed for EOR applications, but it is not clear to me that any units have yet been sold for EOR purposes. The GlassPoint system is said to produce over 50 barrels of steam per acre.

The idea of using solar thermal heat for EOR has been tested in the past, though. In the 1980s, ARCO tried one method of EOR in the Kern County area, and more recently, Chevron tried a second method of solar thermal EOR. Now, on the third attempt, GlassPoint believes that its approach is better.

If solar thermal can indeed be implemented cheaply, it would seem to make sense for enhanced oil recovery wherever there is heavy oil and there is still a long life contemplated in the field. Since solar thermal is only available 20% of the time, it would only replace 20% of natural gas that would otherwise be used, but it would be a step in the right direction. It would seem like solar thermal could even be used by itself, if operators would be willing to wait 5 times as long for full oil recovery, and if the melting and congealing were not too bad a problem (perhaps in locations where the oil is not too heavy to begin with).

GlassPoint provided the following map showing areas where heavy oil is currently being produced, together with solar resources. There are no doubt other areas where heavy oil is available but not being produced.



The Kern River area has been pumped for a very long time, and may be nearing the end of its life. If this is the case, Kern River may not be the best place to test solar thermal. But if this approach really works, it seems like there would be many areas of the world where it could be beneficially used.

Discussion

It may be that the biggest use for a cheaper solar thermal process would be in a variety of industrial processes (besides EOR) that burn natural gas for heat. Many factories in sunny areas burn natural gas to produce heat for their processes. If solar thermal heat could be used as a supplement, costs might be reduced. If it could be used as the only source of heat (where heat is needed only intermittently), the costs might be quite large.

If this approach really works as well as indicated, I would expect that there would soon be a number of other companies offering a similar product. So use may spread more quickly than availability from a single manufacturer might suggest.

For an industrial process used by an individual company, a 30 year planning horizon is a long time. Availability of natural gas for 30 years at reasonable prices is not something all Oil Drum readers would expect. But in some ways, this is exactly the same issue as evaluating how beneficial wind would be as partial substitute for natural gas in electricity production over the long term.

With capital budgets constrained, there really is a significant difference between a process which needs to be bought up front and one which is available to be purchased as needed. This constraint, plus the lack of available nearby land for solar collectors, may be the biggest constraints in implementing an idea of this type widely.