Q Solar

advanced technology

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BRIEF:

- We have developed and tested a new solar energy technology that consists of solar air heaters for industry, agriculture, and buildings heating
- This technology can replace a significant part of the overall fossil fuels energy with less expensive solar heat and can proportionally reduce the greenhouse gas emissions
- Through applied research over the past ten years, we have developed tens of very different models, each suitable for a different application in certain conditions
- Their optimised design is difficult and can be done only by our experienced engineers
- They are simple to manufacture, require only basic tools and simply qualified workers
- Our air heaters are very reliable, have long service lives and may be warranted for many years
- These devices can deliver heat at lower prices than heat obtained from fossil fuels

INTRODUCTION

The technology has been developed in Australia, but the new solar air heaters may be economical anywhere in the world if they are properly designed and manufactured.

We observed that heating air is the economic backbone of our society: producing electricity in fossil fuel power plants, melting metals, burning bricks, food industry, agriculture drying, heating of buildings, etc, everything means burning petrol, natural gas or coal to heat the air. That air is then used directly or indirectly (through heat exchangers) for the given purpose.

Heating air with solar energy is much cleaner than heating it with fossil fuels, therefore we have introduced more than ten years ago a new technology that consists in pre-heating the air with solar energy. The resulting heated air is subsequently either used directly, or as pre-heated air to the existing burners that will use this way less fossil fuel. This was not possible until now because the previous solar air heaters could not deliver heat at lower prices than fossil fuel burners.

Since 1999 we have conducted a very large number of experiments, tests and measurements, and in 2002 we succeeded for the first time to make solar heat more economical than fossil fuels heat for any size application. Since 2002, we further perfected the technology by optimising it for different applications. In April 2005 we commissioned our first full-scale industrial solar air heater. After using it for two years, the client reported 25% savings from their energy cost.

This new technology has the potential to replace a significant part of fossil fuel energy with solar energy, to reduce the greenhouse gas emissions, and to allow users to pay only about half the price for that heat. Since for the large size applications most of the manufacturing has to be done at the place of use, we offer other companies or organisations the necessary know-how and our superior materials, so that they can start manufacture, sell and install such solar air heaters.

TECHNOLOGY OUTLINE

The air is heated in the solar collectors and then it can be used:

- as is, in processes that need only low temperature heat
- as preheated air for fossil fuel burners that, this way, will use less fuel
- can be further heated at higher temperature using fossil fuel burners

Solar water heaters are used all over the world, and everybody knows that, in some cases, they succeed to be economical (the user pays less for that heat than for the electricity otherwise needed to heat the water). Apparently, heating air would be as simple as heating water, one would think. In reality, it is not.

In principle, all bodies exposed to solar radiation become warm or hot and they heat the air that is in contact with them. A car left with its windows and doors closed will heat up in the sun, but when one calculates its efficiency as a solar collector, will observe a very small efficiency. We cannot take heat (as quantity of energy) as similar with temperature (energy potential), for the same reason for which the large mass flow of the Amazon river is not similar to a small rate of flow mountain waterfall. Cars are similar with the waterfall of a small mountain stream, so if you open the windows the heat in the car is quickly lost; cars are inefficient and un-economical solar collectors.

The causes for the difficulty of heating the air are its low heat capacity and low specific gravity that make it a very good heat insulator. By contrast, water very readily takes a lot of heat, and this is why solar water heaters technology was more successful previously.
Many researchers tried during the past hundred years to manufacture economical solar air heaters, but they did not succeed. We succeeded by properly considering the thermodynamic properties of air and of different solid materials and by careful design optimisation.

We have developed new solar radiation absorbers, tested and optimised them for diverse applications and designed appropriate solar collectors for different applications, that:

- have high efficiency and are very economical
- are very light and may be installed on any roof or wall or even on the ground

- we have developed a few different classes of solar collectors, each having a few different models (very different one from another) that are suitable for diverse applications
- while others have tried to copy a few of our devices or methods, none has succeeded to produce such inexpensive energy from solar energy
- our solar air heaters may be manufactured in any size, from smaller than a square metre to square kilometres (as for a solar tower)
- can heat the air up to 110^0C
- are basically 100% reliable
- require very little (if any) energy to run
- although they are difficult to properly design, they are easy to manufacture
- require almost no maintenance
- have long service lives (some models may last hundreds of years)
- can withstand harsh weather conditions, even large hail stones
- are made out of environmentally friendly materials

Only a proper design can result in a multi-annual average cost of solar heat that is lower than the cost of fossil fuel heat.

USES

Solar air heaters were not used until now because it was cheaper to produce that heat with fossil fuels. We succeeded to design and manufacture solar air heaters that produce heat a few times less expensive than fossil fuel heat, and this way we opened the doors of industry and agriculture for solar energy. As solar energy can now be used in such large applications, it can make a significant impact to the overall energy budget.

The new solar air heaters can be used in all climates, but their design parameters must be carefully balanced so that they remain economical even if that environment offers little solar radiation and

negative air temperatures. Generally, the availability of solar radiation is more important than the ambient temperature.

The heated air that they produce can be used for:

- **industrial purposes:**
  - air pre-heating for combustion processes, that means thousands of applications
  - drying minerals, coal, paper, bricks, food industry products, etc. Especially the drying of brown coal would be very important for power plants
  - space heating for warehouses, factories, etc
  - power generation in solar tower power plants
- **agricultural purposes:**
  - crop drying: grains, fruit, vegetables, meat, etc. Important benefits can be gained by harvesting the crop early and drying it with solar heat to protect it from rodents, mildew, etc and to free the land for a second, brief crop
  - space heating for greenhouses, warehouses and animal farms
  - generate mechanical energy with a solar tower system
  - fruit and other produce dryers
- **household purposes**:
  - space heating
  - small driers
- **community and commercial purposes:**
  - space heating for public buildings, office buildings, shopping centres
- **camp or camping purposes:**
  - space heating for emergency relief camps or military camps
  - space heating for recreational camping and expeditions in cold climate

A very important application is the pre-heating of air for the industrial burners because this can extend the use of solar energy to many industries and allow it to penetrate the modern industry.

Another important application is drying the brown coal for power plants that this way will use less coal and will generate less pollution. As power plants are large fossil fuels consumers, replacing about 10%

of their fossil fuel consumption with solar energy will mean a significant solar contribution to the global energy balance.

Another potential application for our solar collectors is the solar tower (see: www.enviromission.com.au), for which we have a new and more economical design.

CONTRIBUTION

The '**solar contribution'** is the percentage from the total heat needed by the user that can be replaced by solar heat produced with this technology.

As solar energy is highly variable in time, only few processes can rely entirely on solar energy.

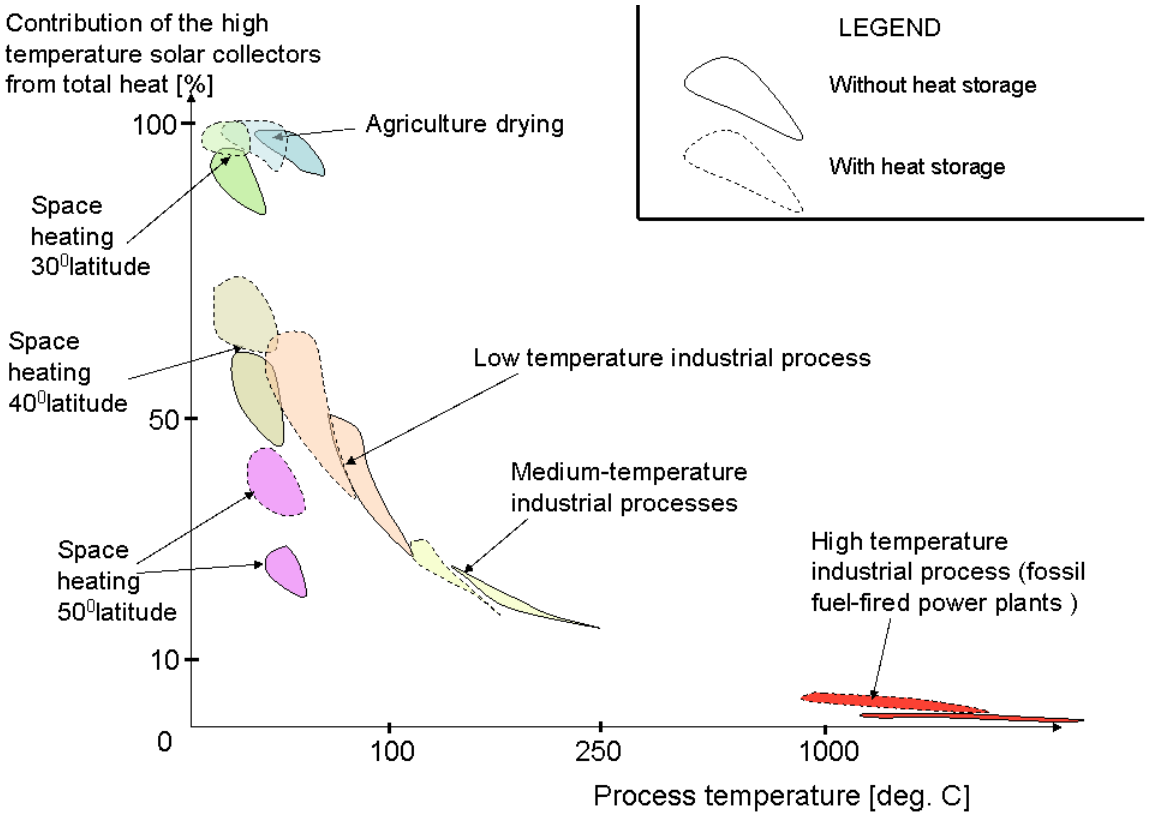
Agriculture drying can generally be done using only solar energy delivered by our economical solar air heaters, therefore in this case the solar contribution can be close to 100%.

However, industrial processes must continue even during the night or cloudy weather, therefore the usual fossil fuel burners will be used at those times when solar energy is not available.

Moreover, most thermal processes in industry require much higher temperatures than those available with this solar technology. For those applications solar energy can provide a fraction of the required heat by pre-heating the air for combustion with solar energy and then feeding it to the fossil fuel burners.

Therefore, solar energy can contribute only a fraction of the total heat requirement of most industrial processes, and the difference will continue to be provided by the fossil fuel burners.

Below is shown an estimation of the solar contribution for different applications



As shown above, the solar contribution of our collectors for agriculture drying is close to 100%, while for low temperature industrial processes (that cannot stop when sunlight is not available) the solar contribution may be in the order of 50%.

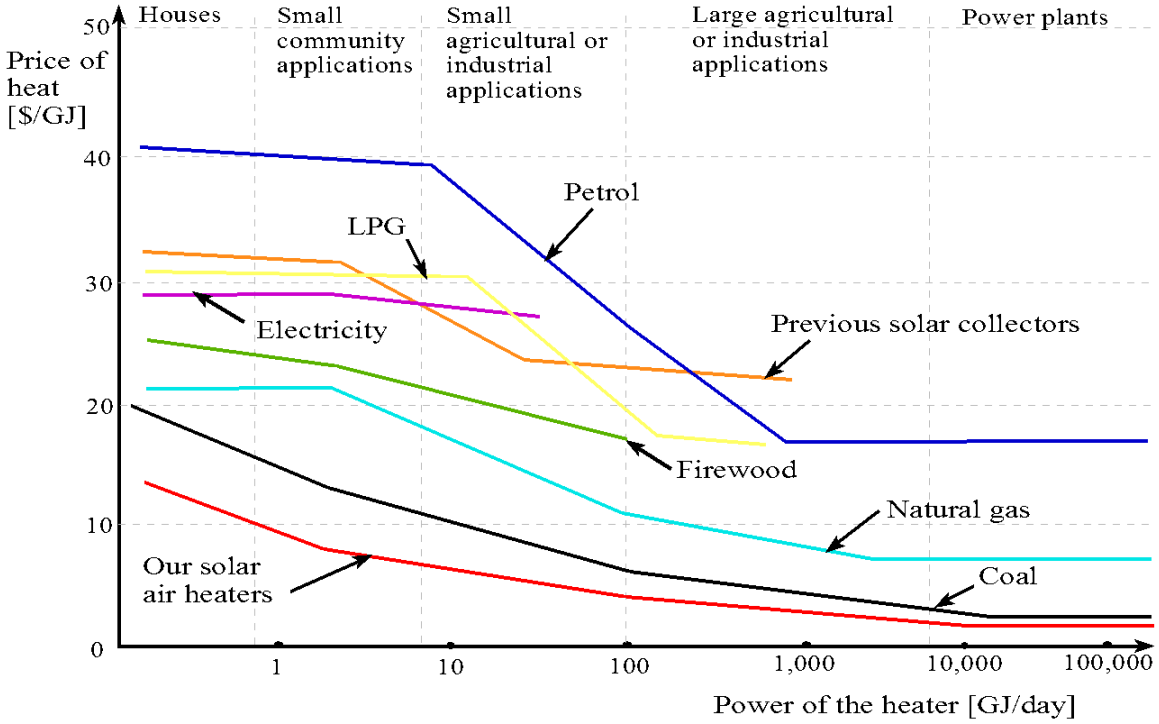
Drying the coal of a power plant with solar energy may make a significant contribution, even if the final temperature of their burner is very high. Brown coal usually has a water content of about 50%; evaporating this water before burning the coal means that about 7% of coal can be replaced with solar energy. An additional important advantage is that the burning temperature can be raised from about 700^{0}C (for wet coal) to more than 1200^{0}C (for dry coal) and this way raise the thermodynamic efficiency of the power plant. The overall result of drying the coal before burning it can mean a more than 10% reduction in fossil fuel consumption of a power plant and an equal reduction in its greenhouse gas emissions.

Many present industrial processes are conducted at high temperatures, while they could also take place at low temperature. For example, good quality paper was (and still is) obtained by drying it at low

temperatures (close to ambient). However, 'modern' paper mills produce high quantities of low quality paper in a process (150 years old) that use burners at more than 500^{0}C to generate steam. If the process would be adapted to use the lower temperature heat produced with our solar collectors, not only would the fuel consumption be halved, but the quality of paper could be increased.
This would be true for many industries, not only for the paper industry.

ECONOMICAL CONSIDERATIONS

The price of heat is different from one country to another, but the differences are not very large since energy is such a valuable commodity and is traded widely.



The generic diagram above takes into account the efficiency of the burners (heaters), their cost, and the auxiliary costs.

Obviously, the price of solar radiation is nil, but the means of transforming that free energy into usable heat (the solar collectors and the accessories) do have a cost, that create a price for the heat they produce.

As seen in the diagram above, besides reducing the greenhouse gas emissions, our solar air heaters can provide heat for the users at about half of the price of heat produced with fossil fuels. This reduction in the price of heat is a necessary incentive that has to be given to most users so that they can be interested in making an investment in the solar air heater.

For example our first large solar air heater was built for an industrial drier; as the solar contribution is 50% and they pay about half of the cost of heat (so another 50% coefficient), it results that they make a 25% reduction from their energy costs. Should they interrupt drying overnight and during rainy weather, they could achieve savings of about 50% from their LPG bill.
For a drier used in agriculture, where the solar contribution is 90%, the user can save about 90% x 50% = 45% from the cost of heat.

Making a similar calculation for a user that heats his house in the central area of the USA or Europe with our solar air heaters, it results that he/she can save about 60% x 50% = 30% of the total cost for heat. In other words, he pays only 50% of price for 60% of the heat he needs.

The cost of the solar device, its economic performance, the benefit to the user and the profit of the manufacturer strictly depend on the quality of the design and manufacture of the solar collector. The design and optimisation depend on the collector's location and purpose, on the user's energy consumption and its work regime, etc. Because of this complexity, we have developed specialised software programs that take into consideration the about 140 parametres needed for an optimised design and integrates our many years of experiments.

The overall cost of heat and the economic performance of the solar air heaters strictly depend on the quality of their design, therefore the copiers (who do not have access to our know-how, our software and our special materials) do not have chances to compete with the licensed manufacturers.

Brief economic characteristics:

- the users can pay about half for solar heat than for fossil fuel heat
- our solar air heaters can pay back their cost in about half their warranty time
- this can be a very profitable business for the manufacturers

ASSESSMENT

Q Solar's new technology has been favourably assessed by independent expert organisations and specialists in this field. Below are presented the conclusions of an assessment made by the CSIRO (Commonwealth Science for Industry Research Organisation):

"Conclusions of the assessment of the performance and usefulness of the solar air heaters of Q Solar Pty Ltd

- The new solar energy technology developed by Q Solar Pty Ltd is very versatile and can supply heated air to stationary applications that have nearby a sunny area for installation of the solar collectors.
- The new solar air heaters can supply the entire requirement of heat for applications that can stop their activity when sunlight is not available, like agricultural driers, solar tower power plants, and some space heaters.
- They can also act as air pre-heaters, so that they can supply part of the heat needed for industrial processes running at temperatures greater than about 100^0C or/and processes that run when solar radiation is not sufficient. The rest of the heat would be provided from the usual fossil energy source.
- Being very light, the new solar air heaters can be installed at any sunny location, on roofs, walls or on the ground. As they have no moving parts, they are very reliable, cost little to operate, and have good efficiency.
- The price of heat that they produce can be substantially lower than the price of heat produced with fossil fuels.
- Besides decreasing the greenhouse gas emissions, the new low temperature solar air heaters can be warranted for periods of time about double their payback time, therefore clients are guaranteed to make a substantial return on their investment.
- For the present distribution of energy consumers in Australia, the new technology could replace about 10% of the fossil fuels currently used, and therefore can help reduce Australia's greenhouse gas emissions by about 10%. "

Q Solar – solar heating

Q Solar is an Australian company that has developed a new type of solar air heating.

The process can deliver heat at a reduced cost even lower than heat generated from petrol, gas or coal applications.

The new, revolutionary solar air heaters can be used in agriculture, in industry, or just for normal application with building heating.

In some situations new solar heaters can deliver all heat required, completely replacing fossil fuels. They can also be installed as air pre-heaters for existing fossil fuel burners.

Producing these solar air heaters has proven to be very profitable for the manufacturers. Q Solar offers to transfer this new technology to international organisations willing to start manufacturing the new solar air heaters.

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