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Viability Analysis of the Use of Solar Energy for Water Heating in Brazil

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***Abstract*—**The sun is an inexhaustible source and harness its potential both for heating and power generation is one of the most promising and necessary alternatives, mainly due to environmental issues. However, it should be noted that this has always been present in the generation of energy on earth, only indirectly, since it is responsible for virtually all other energy sources, such as generating source of evaporation of the water cycle, allowing the impoundment and the consequent generation of electricity (hydroelectric power); winds are caused by atmospheric induction caused by large scale solar radiation; petroleum, coal and natural gas were generated from waste plants and animals that originally derived energy required for their development of solar radiation. This paper presents a study on the feasibility of using solar energy for water heating in homes. A simplified methodology developed for formulation of solar heating operation model of water in alternative systems of solar energy in Brazil, and compared it to that in the international market. Across this research, it was possible to create new paradigms for alternative applications to the use of solar energy

***Keywords*—**Solar energy, solar heating, solar project.

I.Introduction

THE bioclimatic architecture aims to harmonize climate and local building features and take advantage of solar energy through the proper use of heat and light or creating microclimates created by appropriate vegetation. It is the adoption of architectural and urban solutions adapted to the specific conditions (climate and consumption habits) for each place, using, for this, the energy obtained directly from local conditions.

II.Theory

The bioclimatic architecture is not restricted to appropriate architectural features. Also, is concerned with the development of equipment and systems that are needed to use the building (water heating, air circulation and water, lighting, food preservation) and the use of materials energy content as low as possible.

A.Photovoltaic Solar Energy

According to [1], photovoltaic solar energy is energy obtained by direct conversion of light into electricity (Photovoltaic Effect). The photovoltaic effect is the appearance of a potential difference at the ends of a structure of semiconductor material, produced by light absorption. The photovoltaic cell is the fundamental unit of the conversion process.

Initially the development of this technology was through the telecommunications industry. The second booster agent was "space race" therefore means the cell is the most suitable to supply power for a long period.

The 1973 energy crisis has renewed and expanded interest in terrestrial applications. However, to make this economically viable form of energy conversion, it would be necessary at that time, reduce by 100 times the production cost of solar cells relative to those cells used in space exploration [2].

In 1993 the production of photovoltaic cells peaked at 60 MWp, with almost absolute in the Silicon "ranking" of the materials used. Silicon, the second most abundant element on earth, has been explored in various forms: monocrystalline, polycrystalline and amorphous. However, the search for alternative materials is intense and concentrated in the area of thin films, where the amorphous silicon falls. Cells film uses less material than that present crystalline structures require a smaller amount of energy in the manufacturing process. [3].

B.Photo Thermal Solar Energy

What matters is the amount of energy as heat that a body can absorb from solar radiation incident thereon. The use of this form of energy entails knowing capturing it and storing it [4], [5]. The most widespread devices with the specific objective of using photo thermal solar energy are known as solar collectors.

The flat solar collectors are today widely used for heating water in homes, hospitals, hotels, etc. due to that provided comfort and reducing electricity consumption [6]-[19].

III.Materials and Methods

A.Principle of Operation

The ASBC system has the same operating principle of traditional systems of solar water heating, differing due to the materials used and the possibility of self.

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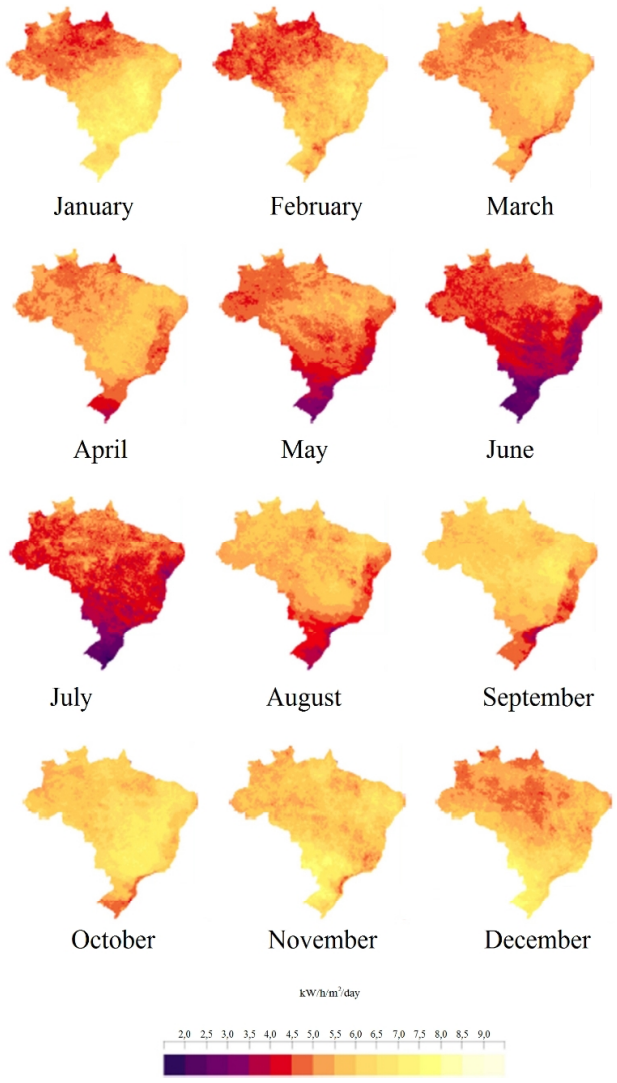

Fig. 1 Monthly solar incidence in Brazil

B.System

The system is composed of the following items:

- Reservoir: its function is to store, in the course of a day, the water heated by the solar collector. You can choose to use the same reservoir of cold and hot water; in this case, the reservoir is a mixed box. The cement boxes, boxes and the thermoplastic resin may be used. Everyone should get an external thermal insulation to minimize heat loss on the sides and top cover.
- Collectors: are manufactured from PVC ceiling tiles and has the function of warm water.
- Hot water mixer and heat support systems: the mixer allows the water heated by solar energy reaches the shower. If the water is heated to, a temperature below the desired heating complements the user by operating a dimmer controller (the energy supplied by the electric shower).
- Hydraulic system: The piping can be made with commercial PVC pipes, considering the limitation of natural thermal solar collector ASBC.

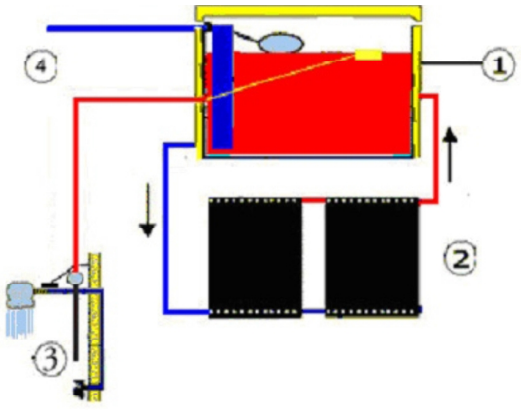

Fig. 2 Operation of (1-tank, 2-sinks, electric 3-shower mixer, 4-Pipe System)

C.Cost

Sizing: hot water consumption is 50 liters / person / day, requiring 1 to 1.5 collectors for every 100 liters of hot water, according to Table I.

TABLE I
Sizing the Number of Collectors

Region	Number of Collectors
Sul / São Paulo D.C.	3
Interior of São Paulo	2
Other Regions	2

IV.Results

- Collector: has approximately 0,78m² and water weighs about 10kg.
- Maintenance: Simple visual inspection with every 1 year and refinish collectors every three years, cleaning out the reservoir
- Investment: approximate cost is $200.00 without considering the reservoir
- Electricity: it is estimated that a reduction of at least 30% with the energy expenses.
- ROI: rotates 4 to 8 months.

V.Conclusion

The technology of solar heating in Brazil presents some barriers to wide deployment. We already know that Brazil has a great potential of solar radiation that qualifies for use of this renewable energy source, in addition, is also known environmental and socioeconomic benefits in using this system, so it is worth mentioning now what are the aspects that barring the development of solar energy in Brazil:

A.High Initial Cost for the System Installation

Although the cost has fallen in the last 20 years that was $ 500 / m² to $ 100 / m², its price remains high compared to the price of the main competing technology: the electric shower. With investment in the sector will be possible to reduce costs in order to make technology accessible. Importantly, although high, investment goes over the years, with a payback time 2-3 years depending on the region and the system design.

B.Competition with Electric Showers

Electric showers are present in nearly 67% of households in Brazil, almost 100% in the South and Southeast regions. It is a device with low initial cost. Virtually all buildings already have plumbing and electrical infrastructure required for their installation.

C.Code of Municipal Works

The Building Codes by not requiring the installation of solar panels in the construction of residential and commercial buildings or renovations do not encourage prospective residents to install thermoheaters. The inclusion of this topic in building codes can be a major public policy to promote this technology, recall the examples of Israel, Berlin and Barcelona. The latter, after inclusion of a law requiring the installation in new buildings and renovations, took in just under three years a leap of 1,1m² / 100 in hab. to 13m² / 100 in hab. solar collectors to generate heat water.

An action of great importance would be to introduce codes of municipal works the obligation of piping hot water, so the new buildings or those that have undergone renovations would be with some of the infrastructure ready and could eventually install the heating system.

D.Problems with Financing

Due to the high initial cost for purchasing this system it would be necessary to have credit lines that would fund the initial investment in the general population, although there are lines of credit, such as the Royal Bank and Caixa Economica Federal, these are extremely bureaucratized, beyond which are not disclosed and have a high amount of interest rates. It is necessary for lenders agents know the advantages and the need to adopt sustainable technologies, and thus may encourage it.

E.Lack of Professional Training

In the professional market still has been some resistance to using unconventional systems. Builders consider solar heating system an expensive and difficult to maintain. The designers have had difficulty accessing information about heat stroke and other technical parameters and architects have not established a repertoire of aesthetic possibilities for incorporation in the collectors and accumulators projects. Fits well, encourage research and courses to train these professionals, many in the attached design issues, such as those related to construction and maintenance of this system.

F.Disinterest of the Electricity Sector

The whole process of unbundling and deregulation and privatization of the electricity sector contributed to the organization in separate small businesses. In this scenario, the distribution companies have no economic motivation for implementing conservation or replacement of end-use energy technology programs, because it implies loss of revenue.

The dealerships only promote the use of thermoheaters by offsets, so it will be necessary to develop negotiation mechanisms between grantees for eventual expansion of the thermo market and utilities, so you can well ensure the revenue distribution. The term can be considered that the distributor's revenue remains stable as consumers can purchase other electronic equipment using resources of the economy with the thermo system. Other factors to consider are a decrease in delinquency, improving the quality of services in overloaded areas, improving the image of the company due to investments in socio-environmental projects and peak load shifting.

There are projects to charge fees as a way of penalty for use in electrical energy during peak periods, by offering rebates for energy consumed outside this period, then this would be another mechanism demand management that can boost the solar market.

G.Absence or Inadequacy Rules

Another factor that obstructs the full development of solar technology is the lack, or in some cases the normative

inadequacy. The national labeling system for energy conservation ENCE was a landmark change in the quality of thermoequipment in the Brazilian market, that allow consumers to have information about the quality of the equipment. However, this form of "tagging" hinders the diffusion of collector systems for heating with alternative technologies, since it compares different proposals without taking into account the costs of acquisition and installation. Thus, we propose a system that takes into account the cost-benefit of equipment. That would be more convenient to the Brazilian market that is sensitive to the cost and has high insolation, thus allow proposals for equipment that have low performance.

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