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Solar Water Heaters Usage in India – Current Scenario and Vision 2020-Review

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Abstract— India is a country with more than 1.2 billion people accounting for more than 17% of world's population. It is the seventh largest country in the world. It faces a formidable challenge in providing adequate energy supplies to users at a reasonable cost. Thus the energy challenge is of fundamental importance. The objective is to carry out sector and segment-wise market assessment studies and surveys; to gain an insight into the current market for solar water heaters and, to project realizable market potential in each sector and segment till the year 2020. Study the global status of solar water heaters and solar water heaters in India. In 2008, the cumulative solar water heaters capacity across the global market was 15 GHth. Growth in recent years has been 15% per year. There are estimated 40 million households (2.5 % of the total) which were using solar water heaters worldwide in 2004. China is the leader; 10% of Chinese households use solar water heaters; the target for 2020 being 30%. In 2008, 65.6 % of existing global solar water heaters capacity was in China; followed by European Union (12.3%), Turkey (5.8%), Japan (4.1%) and Israel (2.8%). The Indian share was 1.2%. The annual average growth in solar water heaters installations in India during 1995-2008 was 16.8%. Further, this period (1995-2008) can be divided into three phases: in first phase, 1995-2000: The average annual growth during this period was 8.2%. A study reported that in 2001, almost 80% of the solar water heaters installations were in the commercial and industrial sectors. In second phase, 2001-2004: The average annual growth rate in this period was 20.6%. The market for residential systems became pre-dominant and in third phase, 2004-2008: The average annual growth rate this period was 24.6%.

Keywords—Cumulative solar water heaters, Global status of solar water heaters, Solar water heaters potential in India, Solar potential in residential sector, Solar potential in hotel sector.

I. INTRODUCTION

India is now the eleventh largest economy in the world, fourth in terms of purchasing power. It is poised to make tremendous economic strides over the next ten years, with significant development already in the planning stages.

In recent years, India has emerged as one of the leading destinations for investors from developed countries [1]. Economic growth, increasing prosperity and urbanization, rise in per capita consumption, and spreads of energy access are the key factors that would be responsible for substantially increasing the total demand for electricity. Thus there is an emerging energy supply-demand imbalance. According to the potential for renewable energy in India-2012, the anticipated energy and peaking shortage in the country is estimated to be 10.3 per cent and 12.9 per cent, respectively, in 2011 and 2012 [10].

At the same time, a very large proportion of Indian citizens continue to live with no access to electricity and other forms of commercial energy. More than 50 per cent of the population has little or no commercial energy access in their daily lives [10]. Others with access often have to cope with poor and erratic availability and other fuels to complement the shortfall. With constraints in resource availability and in delivery mechanisms, traditional means of energy supplies are falling short. This is likely to be the case in the foreseeable future; energy access will continue to remain a problem.

Renewable energy can make a substantial contribution in each of the above mentioned areas. It is in this context that the role of renewable energy needs to be seen. It is no longer "alternative energy", but is increasingly becoming a vital part of the solution to the nation's energy needs. According to the potential for renewable energy in India-2012 [10], in terms all renewable energy categories, India is currently ranked fifth in the world with 15,691.4 MW grid-connected and 367.9 MW off-grid renewable based power capacities. India is among the top five destinations worldwide for solar energy development.

II. LITERATURE SURVEY ON SOLAR WATER HEATERS POTENTIAL IN INDIA

Chandrasekar and Kandpal [5] have presented a methodology to estimate the potential number of households that can use solar water heaters systems.



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The methodology establishes a relationship between the seasonal and diurnal variations in ambient temperature at a place and the need of hot water for bathing. This has been used to estimate the expected capacity utilization of solar water heaters for different locations in the country. The income levels of the households directly affect their capacity to purchase solar water heaters. In one of the examples presented in the paper, it is estimated that 45 million households in India can use solar water heaters. This translates into a potential of 90 million of solar water heaters in the residential sector. [5]

Pillai and Banerjee have presented a methodology for potential estimation of solar water heaters in an area taking into consideration the factors affecting adoption at the end use level (micro-level factors) and factors that affect the aggregate market (macro-level factors). The methodology can be used to estimate the potential for the individual sectors and also for the target area as a whole. In the paper, the methodology is illustrated for a synthetic area at Pune with an area of 2 sq.km and population of 10,000. The end use sectors considered are residential, hospitals, nursing homes and hotels. The estimated technical potential and market potential are 1700 m² and 350 m² of collector area, respectively. [6]

In the residential sector, there are 0.7 million solar water heaters user households; 65% of which are concentrated in Karnataka and Maharashtra [7]. There is overall satisfaction with product-experience; some concerned being voiced over after-sale support. The use of solar water heaters is mainly for bathing. The average size of the domestic installations that were surveyed is around 150 lpd. Among non-users, in states other than Karnataka/Maharashtra, there is sketchy awareness of the bare concept of solar water heaters. The high demand regions report hot water demand for ≥ 9 months/year, while the lowest end is 4 months/year.

India is a country with more than 1.2 billion people accounting for more than 17% of world's population. It faces a formidable challenge in providing adequate energy supplies to users at a reasonable cost. It is anticipated that India's nominal GDP will exceed US \$ 2 trillion by March 2012. India's nominal GDP crossed the US \$ 1 trillion mark in 2007-2008 which means that the annual growth rate of nominal GDP during the period is stupendous 18 per cent. Thus the energy challenge is of fundamental importance. In the last six decades, India's energy use has increased 16 times and the installed electricity capacity by 84 times [11].

III. OBJECTIVES OF THE STUDY

One of the pre-requisite is to gain a better understanding of the current solar water heater market in the country and identify sectors and geographical areas having high potential for solar water heaters. The present study is aimed at this objective.

The objective is to carry out sector and segment-wise market assessment studies and surveys; to gain an insight into the current market for solar water heaters and, to project realizable market potential in each sector and segment till the year 2022.

Following sectors and demand segments were identified for the study:

- Residential buildings
- Hotels
- Hospitals

IV. METHODOLOGY

The assignment was divided into three phases; (i) Secondary information collection; (ii) primary survey; (iii) assessment of potential. Specific tasks re outlined below:

4.1 Phase I: secondary Information Collection and Planning of Survey

In this phase, secondary information on solar water heating sector in India was collected regarding Products, policies, barriers and markets. This information was collected through literature survey as well as selected interviews with stakeholders. The collected information was used for planning of survey (Phase II) of the study.

4.2 Phase II: Survey (primary data collection)

The primary purpose of the survey and stakeholder interviews was to collect information on:

- Current status of solar water heater markets.
- Local policies and their enforcement.

4.3 Phase III: Assessment of market potential the work under this phase consisted of:

An appreciation of sector-level issues concerning installation of SWH and implications of these in terms of solar water heaters market prospects. This is based on the primary survey and stakeholder interviews done

Putting together a full picture of existing stock for residential building, hotels and hospitals sectors in India and expected growth until 2020.

V. APPROCH TO DEMAND PROJECTION

Solar water heater, introduced in India in 1980's, is at the beginning of the growth phase in terms of product life-cycle. The demand for solar water heaters depends mainly on irradiation availability and hot water requirement. But in real life scenario demands for solar water heaters depends on cost of the system, urbanization, hike in energy price, supply chain improvements, services, demand for energy saving equipment, policy compulsion from the state and central government and incentives for solar water heater installation. The proper data regarding sale of solar water heater are not available over a period of time in region-wise and segment-wise. Uses of solar water heaters are concentrated in South Indian states like Karnataka and Maharashtra.

In view of this, they have adopted the following approach to demand projection.

- Utilizing learning from the primary survey and stakeholder interviews.
- Putting together the present configuration of SWH market (2009).
- Prioritizing market-segment for SWH.
- Estimating the present size of market-segments in terms of hot water requirement and projecting future hot water requirement.
- Estimating SWH-segment-wise and state-wise under each scenario.
- Building alternative market scenarios in terms of performance of key parameters which drive SWH growth.
- Developing SWH growth-estimates, segment-wise, from 2010 to 2022.

The estimation of market-segment volume entailed determining the present stock of customer-base under each segment, projecting growth in such base and establishing hot water consumption norms.

A scenario is envisaged to be a composite, encompassing demographic, economic, demand-condition, supply-condition, product/technology, industry-structure, policy and promotion parameters.

The objective of scenario building is two-fold. First, to project demand corresponding to conditions described under a scenario. Second, highlight the action which the major stakeholders need to organize to accomplish demand under a given scenario of realistic, Likely-optimistic and pessimistic. Three alternative scenarios are realistic (most likely) and two less likely-optimistic and pessimistic scenarios. The demand projection, thus, needs to be viewed in conjunction with a scenario because it is linked to developments summarized under the scenario.

VI. RESULTS AND DISCUSSION

6.1 Global Status of Solar Water Heaters

Use of solar energy for heating water is one of the oldest and most mature renewable energy technologies. The two predominant technologies that are used are Flat Plate Collector (FPC) and Evacuated Tube Collectors (ETC). Solar water heater installations are witnessing a rapid growth through the world (Table 1). Globally, the industry has been growing at 15% annually. China and European Union are the two largest markets of solar water heaters. India accounts for around 1.5 % [3] of the total installed capacity (as shown in Table 2).

TABLE 1: SOLAR WATER HEATERS-GLOBAL GROWTH [7]

year	Installed Capacity (GWth)
2006	105
2007	126
2008	145

TABLE 2: SHARE OF SOLAR HOT WATER (TOP 10 COUNTRIES, 2007 [7])

China	66.60%
European Union	12.30%
Turkey	5.80%
Japan	4.10%
Israel	2.80%
Brazil	2.00%
United states	1.30%
Australia	1.00%
India	1.20%
Jordon	0.50%
Others	2.40%

World-over, the residential sector has the largest market share in solar water heater market. In 2004, around 40 million households worldwide i.e. 2.5% of total 1.6 billion households globally, were estimated to be using solar water heaters. In China, it is estimated that 98% of the annual solar water heaters sales are contributed by the residential sector [3]. Overall 10% Chinese households are estimated to be using solar water heaters; this percentage is expected to grow up to 30% by 2020. In Europe, 90% of the installed solar water heaters capacity is in the residential sector [4]. In Europe, majority of the residential systems are single-family homes, while in China a large number of residential solar water heaters are installed on multi-storey buildings. In China, almost 90% of the solar water heaters are installed in the urban areas.

6.1.1 Solar global market

In 2008, the cumulative solar water heaters capacity was 15 GHth. Growth in recent years has been 15% per year. There are estimated 40 million households (2.5 % of the total) which were using solar water heaters worldwide in 2004.

China is the leader; 10% Of Chinese households use solar water heaters; the target for 2020 being 30%. In 2008, 65.6 % of existing global solar water heaters capacity was in China; followed by European Union (12.3%), Turkey (5.8%), Japan (4.1%) and Israel (2.8%). The Indian share was 1.2%

6.2 Solar Water Heaters in India

The first serious attempts to deploy the technology were made with the formation of Department of Non-Conventional Energy Sources (DNES) in 1982, though the history of research and pilot-demonstration go back to 1960's. The total installed collector area increased from 119000 m² in 1989 to 525000 m² in 2001; and to estimated 3.1 million m² by December 2009.

The annual average growth in solar water heaters in installations in India during 1995-2008 was 16.8%. Further, this period (1995-2008) can be divided into three phases:

- 1995-2000: The average annual growth during this period was 8.2%. A study reported that in 2001, almost 80% of the solar water heaters installations were in the commercial and industrial sectors.
- 2001-2004: The average annual growth rate this period was 20.6%. The market for residential systems became pre-dominant.
- 2004-2008: The average annual growth rate this period was 24.6%.

6.2.1 Solar potential in residential sector

Pessimistic scenario: The cumulative installation of solar water heaters in residential sector is expected to grow from 2.56 million m² in 2010 to 10.23 million m² in 2020.

Realistic scenario: The cumulative installation of solar water heaters in residential sector is expected to grow from 2.58 million m² in 2010 to 15.74 million m² in 2022. The deployment of solar water heaters during 2010-2020 in residential sector would be 13.16 million m². Cumulative solar water heaters deployment in residential sector for years 2010, 2013, 2017 and 2022 for realistic scenario is shown in figure 1.

Optimistic scenario: The cumulative installation of solar water heaters in residential sector is expected to grow from 2.74 million m² in 2010 to 20.28 million m² in 2022. The deployment of solar water heaters during 2010-2022 in residential sector would be 17.54 million m².

Cumulative solar water heaters deployment in residential sector for years 2010, 2013, 2017 and 2022 for Optimistic scenario is shown in Figure 1.

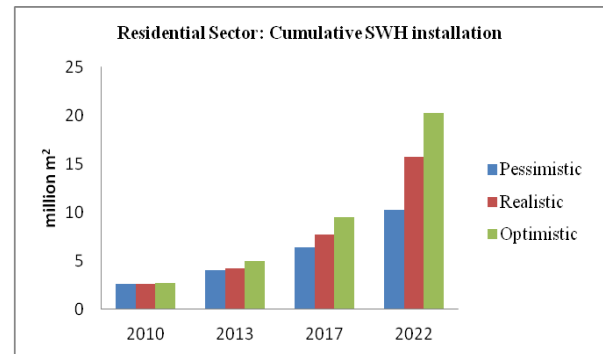


FIGURE 1: YEAR-WISE CUMULATIVE SWH DEPLOYMENT IN RESIDENTIAL SECTOR FOR ALL SCENARIOS

Policy: The highlights of the present policy environment are as follows.

- Several of the municipal corporations have issued orders making solar water heaters use compulsory for new multi-story housing and houses constructed on plots having area more than 500 sq. yards.
- A few of the municipal corporations are offering rebate in property tax.
- A few of electricity distribution companies offer rebate in monthly electricity bills.
- Several states offer upfront subsidy for residential systems.
- IREDA through banks is operating an interest subsidy scheme to offer concessional finance for installation of solar water heaters.

6.3 Solar Water Heater Potential in Commercial and Institutional Buildings

This section covers two important types of commercial and institutional buildings.

6.3.1 Solar potential in hotel sector

Pessimistic: The cumulative installation of solar water heaters in hotel sector is expected to grow, from 1,93,660 m²/year in 2010 to 9,20,340 m²/year in 2022 (Figure 2). The deployment of solar water heaters during 2010-2022 in hotel sector would be 0.727 million m².

Realistic: The cumulative installation of solar water heaters in hotel sector is expected to grow, from 1,93,920 m²/year in 2010 to 9,66,180 m²/year in 2022 (Figure 2). The deployment of solar water heaters during 2010-2022 in hotel sector would be 0.772 million m² [7].

Optimistic: The cumulative installation of solar water heaters in hotel sector is expected to grow, from 1,98,520 m²/year in 2010 to 12,73,200 m²/year in 2022 (Figure 2). The deployment of solar water heaters during 2010-2022 in hotel sector would be 1.075 million m².

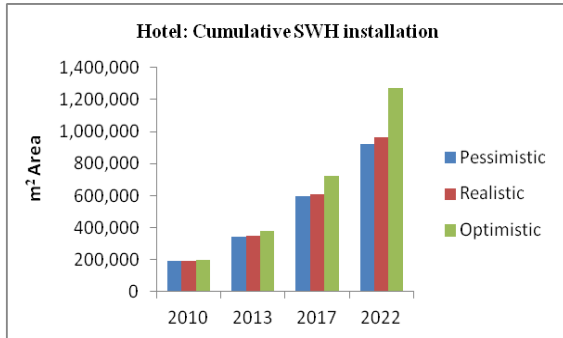


FIGURE 2: CUMULATIVE SOLAR WATER HEATERS INSTALLATIONS IN MILLION M2 UNDER 3 SCENARIOS FOR HOTELS

Policy Environment: solar water heaters for Hotels/Guesthouses.

The highlights of the present policy environment are as follows.

- A municipal corporation order making it compulsory for new hotels to install solar water heaters (SWH) is in force in many cities. Norms, under the order, for SWH sizing, are lax in most cities. Implementation of mandatory use is weak across cities.
- A scheme of loans at the concessional interest rate of 5% pa for SWH is being implemented by Indian Renewable Energy Development Agency Ltd (IREDA) but its delivery and utilization are low-key
- There is accelerated depreciation provision for commercial hotels/guesthouses. The awareness of the accelerated depreciation provision among owners of modest hotels/guesthouse is low and when informed, the appeal seems unexciting.

Other Issues:

The hotel/guesthouse industry expressed the following wish-list.

- Lowering of SWH capital cost.
- Technical solution of the problem of somewhat-staggered-through-the-day demand for hot water.
- SWH delivering hot water round the year.

6.3.2 Solar potential in hospital sector

Pessimistic: The cumulative installation of solar water heaters in hospital sector is expected to grow, from 97,418 m²/year in 2010 to 4,02,625 m²/year in 2022 (Figure 3).

The deployment of solar water heaters during 2010-2022 in hospital sector would be 0.3052 million m² [7].

Realistic: The cumulative installation of solar water heaters in hospital sector is expected to grow, from 97,615 m²/year in 2010 to 4,26,446 m²/year in 2022 (Figure 3). The deployment of solar water heaters during 2010-2022 in hospital sector would be 0.3288 million m².

Optimistic: The cumulative installation of solar water heaters in hospital sector is expected to grow, from 1,03,643 m²/year in 2010 to 9,58,118 m²/year in 2022 (Figure 3). The deployment of solar water heaters during 2010-2022 in hospital sector would be 0.8545 million m².

The following explains demand upsurge in recent years.

- Growth in new urban housing; rising disposable income; increased propensity for consumer durables.
- Arrival of ETC and improvements in supply chain.
- Energy price hike.
- Policy initiatives.

The demand projection, under realistic scenario, implies solar water heaters penetration in 1.78% of Indian households by 2022. In absolute terms, this is 5.25 million solar water heaters using households in 2022; for comparison there were 5.22 million water-purifier using households in India is 2008. In the hotel and hospital segments, solar water heaters penetration will reach 53% and 29% by 2022.

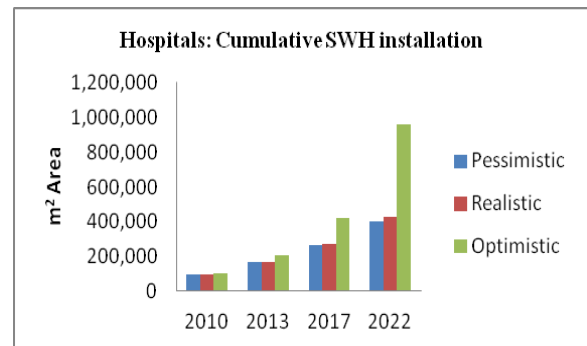


FIGURE 3: CUMULATIVE SWH INSTALLATION IN MILLION M² UNDER 3 SCENARIOS FOR HOSPITAL.

VII. CONCLUSION

Residential sector is the largest sector both in terms of installations as well as sales. As per industry estimates, currently, almost 70-80% of the solar water heater sales occur in the residential sector. In the year 2001, almost 80% of the solar water heater installations in India were in the commercial and industrial sectors, since then, residential sector has overtaken commercial and industrial sectors and has become the main driver of growth in India.



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It is estimated that in 2009 around 7 lakh households in the country were using SWH system. Almost 60% of these households are located in two states – Karnataka and Maharashtra. More than 95% of these households are located in the urban areas.

Globally, the industry has been growing at 15% annually. China and European Union are the two largest markets of solar water heaters. India accounts for around 1.5 %. According to Optimistic scenario, the cumulative installations of solar water heaters in residential sector in India are expected to grow from 2.74 million m² in 2010 to 20.28 million m² in 2022. The cumulative installation of solar water heaters in hotel sector is expected to grow, from 1,98,520 m²/year in 2010 to 12,73,200 m²/year in 2022. The cumulative installation of solar water heaters in hospital sector is expected to grow, from 1,03,643 m²/year in 2010 to 9,58,118 m²/year in 2022.

The following explains demand upsurge in recent years, growth in new urban housing; rising disposable income; increased propensity for consumer durables, arrival of ETC and improvements in supply chain, energy price hike and policy initiatives.

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