

Emphasizing Utilization of Solar Cooking Alternatives: Approach with an illustrative Case Study

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Abstract – *The concerns for the climate changes and its impact on life under the Sun have always been linked to adopting and implementing various policies promoting sustainability.*

Most part of India enjoys Sun for more than 275 days a year, with average solar window period of 6 to 8 hours per day. The abundant solar radiation, clean characteristic of solar energy, high cost of fossil fuels and their adverse effects on environment are the key drivers for the strong focus on the development of solar thermal applications in India. The dependency on crude oil import, limited reducing resources of cooking gas within the country and the appeal by the Honourable Prime Minister of India to ‘Give it up’, are the major reasons to search for the alternative fuel for domestic cooking.

In spite of this, solar cooking is not much popular in India. The wind and solar PV has always been the centre of attraction in case of use of renewable energy in India. Promoting “solar cooking” seems to be an issue of little interest. However using solar cooking and popularizing it, will certainly narrow the gap between LPG demand and supply.

The author himself is practicing solar cooking for many years. The experiences regarding solar cooking and solar cooked food are shared in this paper as a case study. The paper also discusses impedances in effective implementation of solar cooking and suggests few remedies to overcome it.

Keywords- *LPG, Firewood, Need for alternative cooking method, Solar cooking, solar parabolic concentrator*

INTRODUCTION

Whatever on the Earth, is borne out of Sun. Sun is the source of life on this planet. In India, Sun is worshipped as God. We name Him as Surya, Aditya, Mitra and with many more names. He is closer to our hearts and shines in our lives for more hours than any part of the world. This inexhaustible energy resource is available for us throughout the year with few days of exception. Among the renewable sources of energy, solar energy has a huge potential for power generation in Maharashtra. There are 250-300 days of clear sun with an available average radiation of 4 to 6 kWh/sq.metre over a day. There is a capacity to generate 1.5 million units/MW/year through solar photovoltaic systems & up to 2.5 million units/MW/year through solar thermal systems. ^[1]

India imports more than 75% of the oil, it consumes. With crude oil prices in the world increasing exponentially, solar cooking will definitely help in saving kerosene and cooking gas. One estimate

suggests that even if five percent of India’s population opts for solar cooking then foreign exchange worth more than Rs. 25000 million per year can be saved. Though the use of renewable sources of energy in India is gaining importance, there is still huge amount of untapped potential. Also, the current trend is concentrated on wind and solar PV technologies.

The renewable energy ministry seems to be only concentrating on these two sources. Table 1 illustrates this fact. The table is available on the website of the ministry.

Table1 Cumulative Achievement in Renewables ^[2]

Sector	FY- 2016-17		Cumulative Achievements (as on 31.12.2016)
	Target	Achievement (April - December, 2016)	
I. GRID-INTERACTIVE POWER (CAPACITIES IN MW)			
Wind Power	4000.00	1922.99	28700.44
Solar Power	12000.00	2149.81	9012.66
Small Hydro Power	250.00	59.92	4333.85
Bio Power (Biomass & Gasification and Bagasse Cogeneration)	400.00	101.00	7856.94
Waste to Power	10.00	7.50	114.08
Total	16660.00	4341.22	50017.97
II. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN MW_{EQ})			
Waste to Energy	15.00	4.47	163.35
Biomass(non-bagasse) Cogeneration	60.00	0.00	651.91
Biomass Gasifiers -Rural -Industrial	2.00	0.00	18.34
	8.00	4.30	168.54
Aero-Generators/Hybrid systems	1.00	0.38	2.97
SPV Systems	100.00	98.50	405.54
Water mills/micro hydel	1 MW + 500 Water Mills	0.10 MW + 100 Water Mills	18.81
Total	187.00	107.75	1429.46
III. OTHER RENEWABLE ENERGY SYSTEMS			
Family Biogas Plants (in Lakhs)	1.00	0.30	49.40

It can be seen from Table 1, that the ministry does not even recognise the contribution of solar thermal technology. Solar thermal technologies are equally

effective and efficient with very little complications in initializing and maintaining.

It is well said that 'energy saved' is 'energy generated'. The limited resources of LPG in India are causing difficulties in bridging 'demand and supply' gap. The subsidy on it is further making more difficult to keep the economic balance. In view of this, solar cooking seems to be the best possible alternative. Solar cooking not only preserves forests by saving firewood but also reduces air pollution. In rural areas, children 'shoulder the responsibility' of collecting firewood. Solar cooking will relieve them from this work and help them in enjoying school days. Adoption of solar cooking technology will not only increase India's energy security but also generate many employment opportunities. It will open new gate way in areas of skill development.

NEED FOR SEARCH OF ALTERNATIVE COOKING METHODS

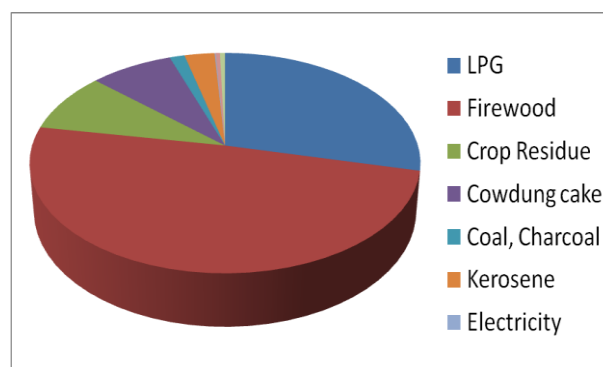


Fig.1 cooking method used in Indian Household ^[3]

Seventy years after Independence, nearly 700 million people in India depend on the firewood for household cooking.

60% people in rural India depend on the firewood while same percentage of people from urban area depend on LPG for cooking. The price of LPG is increasing day by day and the honourable Prime Minister has also appealed for 'GIVE IT UP'. In this regard, it is necessary to respond to the call.

Fig. 1 does not find any mention of solar cooking. The use of solar cooking will reduce the use of firewood in rural areas as well as the use of LPG in urban area. It will benefit the society in many ways. The percentage of school dropout in rural area will reduce as they will no longer wander in search of firewood for daily cooking. The health of rural ladies will improve. It will also help in saving trees and will serve in environmental protection.

The use of solar cooking method in urban areas will automatically reduce the burden of 'demand and supply' of LPG. This will help in remapping the LPG supply to rural areas. The scope of Concentrated

solar technologies for solar cooking was never been questioned. The ministry has itself recognised its scope on its official website stating that.

The scope of CSTs and Cost/Fuel savings Dish solar cookers ranges from Individuals, Mid day meal schools, Tribal areas, Aanganwadis, Army Border Posts, Road side dhabas etc. for saving mainly LPG/firewood. A dish solar cooker of smaller size can cook food for about 10-12 persons and may cost around Rs. 6,000. It may be able to save around 8-10 LPG cylinders in a year on full use. Bigger size cookers may cost Rs. 30,000 approximately and may be able to cook food for about 40 people. It should be able to save around 30 LPG cylinders in a year on full use. An indoor cooking system may use dish of 7 to 16 sq. m. area and could cook food for 50 to 100 people depending on size. It may cost Rs. 75,000 to 1.6 lakh depending on size and may be able to save 30 to 65 of LPG cylinders in a year. Solar steam systems Scope Community kitchens in Institutions, Hostels, Hospitals, Hotels Ashrams, Para-Military / Defence establishments, prisons, cooking Industries, hotels, hospitals etc for solar cooling, laundry and many other applications for saving LPG/Electricity/Diesel etc.^[4] The need of the hour is to utilize it.

BENIFITS OF SOLAR COOKING

**रूप रस गंध समायुक्तं पौरुष कांतिदायकं
सूर्यपक्कान्न महाऔषधि न किचिदपि संशय ॥**

(Yājñavalkya Rishi appreciates solar food as “Suryapakwanna Mahaushadhi”)

The food cooked by solar radiance is lovely in appearance and possesses excellent flavour, taste and retains aroma. It is ultimate medicine (Amrita) for a “manly” vigour and glorious skin complexion. [Yājñavalkya Smṛti]

Sun cooked food improves cellular health and longevity. It strengthens health and mind and removes three major physical disorders (Tridosh) related to digestion, blood circulation and respiratory system.

Most of the vitamins, minerals and antioxidants are preserved in solar cooked food. Vitamins and minerals increase the nutrition value while antioxidants protects from Cancer. Solar cooked food is easily digestible. It gradually relieves stomach disorder, constipation.^[5]

Boiling and Steaming type of food diet protects from most of the diseases as compared to frying, grilling and microwaving. The solar cooking is more healthy way of preparing our foods for consumption as opposed to gas, smoky open fire, microwave etc. There are no chances of explosion or

fire while using Solar Cooker. The environment inside the closed compartment is bacteria free, air tight utensils leave the air odourless and aroma of food remains intact. There are no energy losses while cooking on Solar Cooker whereas cooking on LPG, Kerosene and wood leads to 80-90% of energy losses.

PRACTISING SOLAR COOKING

Various types of solar cookers are available in the market for domestic use. Earlier box type cookers were used for solar cooking. These cookers use flat plate collector. The time required for cooking is more and the temperature inside the box is limited. Due to these reasons, people are reluctant to use such type of cookers.

The concentrated type cookers have really made the evolution in solar cooking. The parabolic dish type cooker has a concentrated focus at which the temperature may rise above 150⁰ C.

The author uses a variant in the parabolic concentrator shown in Fig.2



Fig.2 Solar Parabolic Concentrator (PRINCE Model)

The solar cooker shown in Fig.2 is a modified version of parabolic concentrator.

It consists of anodized aluminium sheets with high reflectivity index. A provision is made at the focal point to keep the vessel containing food. The concentrator is kept in open area facing the Sun. The adjustments for facing the Sun is simple. A small projection (nail) pointing towards sky is provided at the side of the concentrator. This decides correct positioning of solar concentrator. An image of this nail

can be seen on the background in Fig.3. It means that, the concentrator is not focused correctly.



Fig.3 Concentrator not focused

The body of the concentrator can be tilted along the horizontal axis and also the whole body can be revolved around such that no image of the nail is seen in the background. This is demonstrated in Fig 4. This is the correct position of the concentrator.

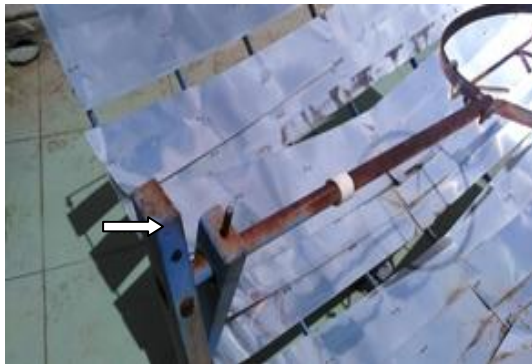


Fig. 4 Concentrator focussed

The adjustment on both axes is quite simple and easy. A housewife can easily do this once demonstrated. Adjusted solar concentrator is shown in Fig.4 After adjusting the solar concentrator; it is ready for use now. A pressure cooker can be directly placed in the ring provided at the focal point of the concentrator as shown in Fig.5



Fig.5 Positioning Pressure Cooker

In normal day time around 11 am, rice and dal/vegetable for a family of 4/5 persons is cooked in about 30-45 minutes. During this time, one has to adjust focus 1 or 2 times.

In illustrated case, I used to consume 1 cylinder per 45 days in normal circumstances. After I started using solar concentrator, the consumption rate lowered to 80 days. So instead of purchasing 8 cylinders, now I require only 4 to 5 cylinders per year. The savings is about 3 to 4 cylinders per year which almost makes me rich by around Rs.2000 per year. This is quite substantial savings for me. The cost of solar cooker is around Rs.7000. This gives me a payback period of around 3 ½ years. Apart from that, one can save LPG and help the needy. Moreover, using solar concentrator helps reducing air pollution, satisfying oneself of using renewable energy, contributing for the betterment of the society and hence strengthening the nation. It also keeps oneself healthy.

The use of solar cooker is not limited for daily cooking. One can use it at his own advantage. The Sun is available for 6 to 7 hours per day and focus can be obtained during any day time on a clear sky.



Fig.6 Cooking can be Fun

Even it can help you for your breakfast with idlis as seen in Fig. 6. The groundnuts can also be roasted without burning from inside, retaining the taste.

IMPEDIMENTS IN IMPLEMENTATION

- 1) Though the cost of solar cooker is affordable, people are mainly unaware of its benefits. Apart from the economics, the benefit of using solar cooker lies in quality of solar food.
- 2) The requirement of open space is another hurdle. In urban/metro cities, people living in flats/ apartments face this problem. But a balcony model of such cooker is also developed by some manufacturers which is handy. Also, people from such apartments can start using common terrace top and overcome these problems.
- 3) In some cases, especially in case of 'working couples, it becomes difficult to spare time for solar cooking. But, they can use solar cookers on holidays. Cooking on solar concentrator is really fun. This will help them enjoy their off days and also relieve them

from the stresses incurred during working days.

- 4) Higher level of ignorance and unawareness regarding renewable energy technologies even in educated people is one of the major causes of solar cookers not being so popular.
- 5) Poor implementation of renewable energy strategy and policy in the past is also one of the causes of hindrance.

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CONCLUSION

Recent strategy of the Government to promote renewable energy is highly appreciable. But still it seems to be centred on wind and solar PV technologies. Equal involvement is needed for solar thermal technology. This will help in developing technology and the initial cost of the equipment can be reduced further. Demonstrations of solar cookers can be held in schools, colleges, universities and various other centres to illustrate its benefits. The electricity cost is increasing. This has already forced urban people to switchover to options like solar water heaters. However not even 5% of the potential in this area is tapped as yet. If they are convinced through such activities, it will create a big opportunity. There is a huge availability of technical unemployed youth. This resource can be trained and diverted for productive use. Manufacturing parabolic solar cooker requires meagre capital for which new entrepreneurs can afford to take small risks. As almost all market is untapped, risk is negligible. Manufacturing and sales of these cookers can be linked with the new concept of “skill development”. This will provide more entrepreneurial opportunities. This is certainly a “Make in India” project which will help in nation building.

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