

# Comparitive Study of Cost of Cooking Using Solar Energy, Liquified Petroleum Gas (LPG), and Wood

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**Abstract—** In this work, three methods of cooking have been studied using different fuels. Their costs are estimated and the desirability of method of cooking includes the environmental concerns. Recommendations are made to conserve the environment as well as the cost of cooking.

This paper also discusses efficient method of electrical power generation to be used in induction cooking which is recommended as the method of cooking.

**Index Terms—** Induction heating, Liquefied petroleum gas combustion, Cooking on wood

## I. INTRODUCTION

### 1. DEFORESTATION

Today, vast amount of deforestation is taking place due to the use of wood in cooking in underdeveloped countries. This is because the very poor have no choice but to cut the forest to utilize its wood for cooking. They have very little earning.

The government subsidies on the liquid liquified petroleum gas (LPG) does not reach the poor be cause to purchase this gas they require about 900 to 1100 rupees at one time which is very difficult for these people to come up with this sum. The poor people are very short of cash thereby cannot take benefits from the government's subsidies. If, on the other hand, the government provides them with the alternative of cooking using induction stove then this will be economical and practical for these people to use this method of cooking. The details are discussed in the following sections.

### 2. EFFECTS OF DEFORESTATION ON ENVIRONMENT

The trees in the forest help the society in so many different ways. Due to photosynthesis, it converts the carbon dioxide into carbon and oxygen. This way it prevents buildup of carbon dioxide in our environment which is causing global warming. The trees in the forest prevent soil erosion and prevents the land from heating up. It provides shade to the ground so that the environment temperature does not build up. The soil erosion in many countries is causing landslides and loss of life if the trees get cut [1-9].

The high heat in many areas of the world causes frequent storms whose magnitude and frequency are increasing day by day. Due to this increased frequency of storms enormous damage are being done on the villages and the cities and in

many cases - like in Florida the insurance companies have stopped doing business of protecting the homes due to the damages.

There has also been recent change in pattern of rain where large amount of rain takes place within a very short time. This causes sudden floods in the cities and villages where the flood control methods were never designed for this.

## II. COOKING USING INDUCTION STOVE

Figure 1 shows a picture of induction stove for cooking rice, lentils, and vegetables. In the process of induction heating, this supplied energy is mostly transferred to the container by the induction process [10]. This way, the most of this supplied energy is directly transferred to the pot which effectively heats the cooking substances. There is very little energy that is lost due to radiation process. The radiation loss is governed by the equation

$$E = \sigma T^4 \quad (1)$$

where E is the energy given off by the body which is at an absolute temperature T and  $\sigma$  is a constant. Slight increase in temperature will lead to large energy loss.

In the cooking process high temperature is required and hence the energy losses are quite high. In the induction cooking, the temperature of the source involved is not very high hence less thermal energy losses are there.

Figure 2 shows the picture of food being cooked on LPG used as a fuel. The combustion of this gas results into production of carbon dioxide which causes global warming. In addition, the flame is at a high temperature to do the cooking which results in heavy thermal energy losses/

Another point to note is that most of the underdeveloped countries do not have reserves of this fuel. They have to purchase this fuel using hard currency reserves that they do not have in large amount.

On the other hand, most of these countries have solar energy which they can very easily utilize using efficient method of electrical power generation. Having electricity, they can cook the food by induction heating process.

Sad part is that these countries do not have research base to minimize the importation of fossil fuels. These countries have been late in moving towards industrialization and inefficient utilization of energy.

Figure 3 shows food being cooked on wood. The wood causes- upon combustion- lot of smoke emission which

damages eyes and lungs of the person who is cooking the food. In addition, the interior walls of the houses get damage due to smoke. Not only this, the smoke spreads to the environment in an irreversible manner with the flowing air. This leads to the damage to large areas of the country. An example of this is being seen these days in northern India where the farmers after the crop harvesting are burning the stubble in the field itself without any regard to the environmental condition of entire northern India. In such a combustion process small charred bodies of smoke enter into the lungs and blood stream to cause serious illness to the people and animals.

Similarly, combustion of fuels like Diesel and petrol also causes similar small particle emission to damage people's health.

Figure 4 shows a picture of stove which uses resistance element. One can cook the food also on this type of stove but the heat transfer from the source is not as efficient due to the losses from the sides to the environment. Therefore, this method will not be discussed in this paper any further.

### III. EFFICIENT METHOD OF ELECTRICAL POWER GENERATION

Figure 5 shows a photovoltaic panel mounted on a solar tracking system which follows the sun in such a way that the sun's rays are always perpendicular on the solar panel. The perpendicularity can be checked by a pointer mounted on the tracking system. When the sun's rays are perpendicular on the panel then this pointer will not cast any shadow. This condition is maintained right from the sunrise to sunset. This solar panel will generate the maximum electricity only if this perpendicularity condition is maintained otherwise, it will generate only a fraction of the total incident energy.

Figure 6 shows large number of solar panels which remain stationary on the ground. Since the sun is incident on this panel in an oblique manner throughout the day, in most of the cases these will convert about 63% of the incident energy.

The desirability of efficient power generation can be seen in [10-16].

Therefore, this method of power generation (stationary panels) is very detrimental for the development of such countries as the capital invested is not utilized to the maximum.

The solar panels are very costly, and one has to come up with the capital up front which is very difficult for such countries to arrange the finances. Given such situations they ought to utilize their capital invested in these panels in most efficient manner.

### IV. COST COMPARISONS

Table 1 shows the details of cost of cooking on an induction stove. The first column in various rows shows the contents being cooked. The second column shows the amounts of

these substances being cooked. The third column shows the setting of the knobs which can be set on high or low heat. The 4th column shows the time required. The 5th shows the kilowatts required for the corresponding cooking. Then in the next column -the total energy is calculated by multiplying the kilowatt of power with time to obtain the energy consumed. The 7<sup>th</sup> column shows the cost of energy that has been consumed in this cooking. Finally, the total cost is given in the last column.

In the last row of this table - one can see that the total cost of cooking all these items comes to rupees (Rs) 15.77.

Table 2 shows the details of cooking using wood as the fuel. Here, the item being cooked are listed in column 2 whereas their amounts are given in column three. The 4th column contains the time involved in the cooking process and the 5th column shows the cost calculated based on the amount of fuel consumed which was purchased at Rs12 per kilogram. The total cost in this case comes to Rs 25.20.

Table 3 shows the details of cooking using liquefied petroleum gas (LPG). Here, the items being cooked are listed in column 2 and the corresponding masses are shown in column three. The time of cooking is shown in column four and the cost of cooking item-wise is shown in the last column. The cost calculation here is based on the cost of gas in a cylinder is Rs 1100.00 and the gas lasts for 4500 minutes at a medium heating rate. If we multiply the time of cooking an item with the fraction equal to 1100/4500 then we will get the cost of cooking that item. The total cost in this case comes to Rs 25.67.

This way one can see that because of cooking on wood or the liquefied petroleum gas (LPG) are approximately the same.

Looking at Tables 1, 2, and 3 it is very easy to see that one should prefer cooking using induction stove because of economy of cooking as well as the impact on the environment.

The governments ought to come up with favorable policies to adopt the recommended method of cooking in this paper.

### V. CONCLUSIONS

1. Cooking on induction stove is most economical and least damaging to the environment.
2. Cooking on wooden stove is costly and very damaging to the environment.
3. Cooking on liquefied petroleum gas is also detrimental to the environment because of the production of carbon dioxide which causes global warming, and this method of cooking requires - in most of the countries - importation of petroleum gas using hard currency which is scarce in many such countries.

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TABLE 1: COOKING DETAILS ON INDUCTION STOVE

Item	Mass (g)	Wattage Setting (Watt)	Time (Seconds)	Total K-Watts	Energy (KWHr)	Energy Cost Per KW-Hr Rs	Total Cost Rs
Potato-Cauliflower (Potato 237 g + Cauliflower 264g)	502	1,800	420	756.	0.2100	8	1.68
•	•	467	951	444.117	0.1234	8	0.99
Total Potato-Cauliflower	•	•	•	1200.117	0.3334	8	2.67
Rice	500	1,800	1,208	2,174,400	0.6040	8	4.83
Lentil  (Toor or Arhar Daal)	500	1,800	2,067	3,720,600	1.0335	8	8.27
Total	•	•	•	•	•	•	15.77

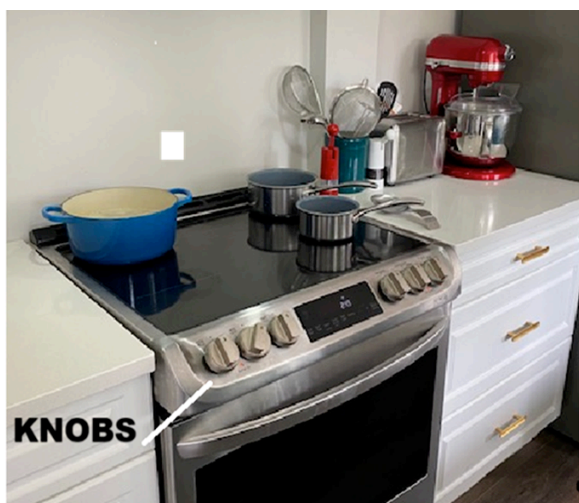
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TABLE 2: COOKING DETAILS ON WOOD

Number	ITEM	MASS (GRAMS)	TIME (MINUTES)	COST
1	Vegetable (Potato 237 g + Cauliflower 264g)	502	33	8.49
2	Rice	500	35	9.00
3	LENTIL (Toor or Arhar Daal)	500	30	7.71
	TOTAL COST			25.20

TABLE 3: COOKING DETAILS ON GAS

Number	ITEM	MASS (GRAMS)	TIME (MINUTES)	COST
1	Vegetable (Potato 237 g + Cauliflower 264g)	502	30	7.33
2	Rice	500	15	3.67
3	LENTIL (Toor or Arhar Daal)	500	60	14.67
	TOTAL COST			25.67



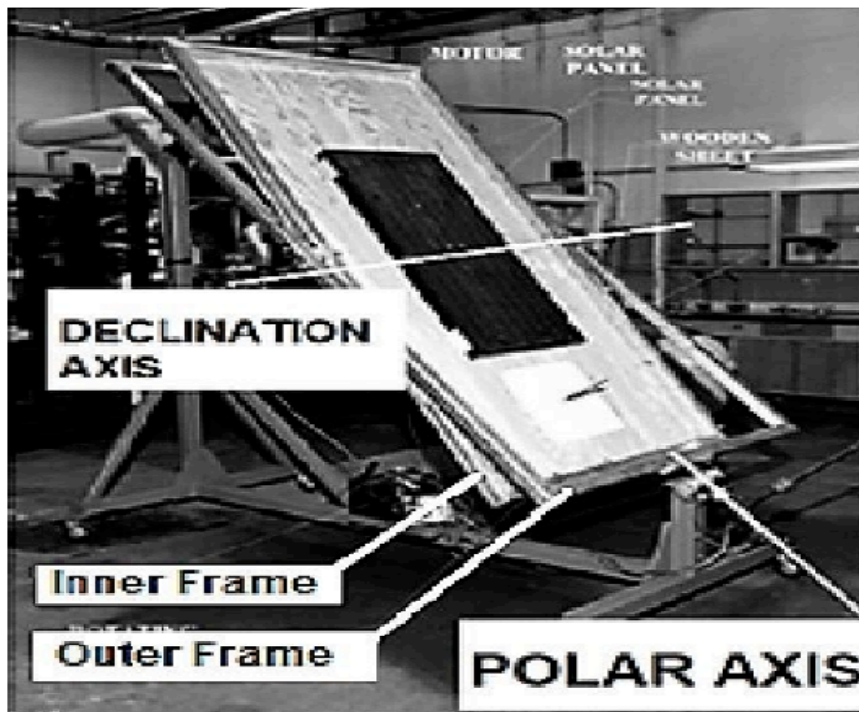
**FIG 1 INDUCTION STOVE WITH KNOBS TO CONTROL HEATING**



**FIG 2 LPG GAS COOKING**



**FIG 4 COOKING ON ELECTRIC STOVE WITH RESISTOR ELEMENTS**



**FIG 5 SOLAR TRACKING MECHANISM FOR PHOTOVOLTAIC ELECTRICAL POWER GENERATION**



**FIG 6 CENTRALIZED SOLAR ELECTRICAL POWER GENERATION**