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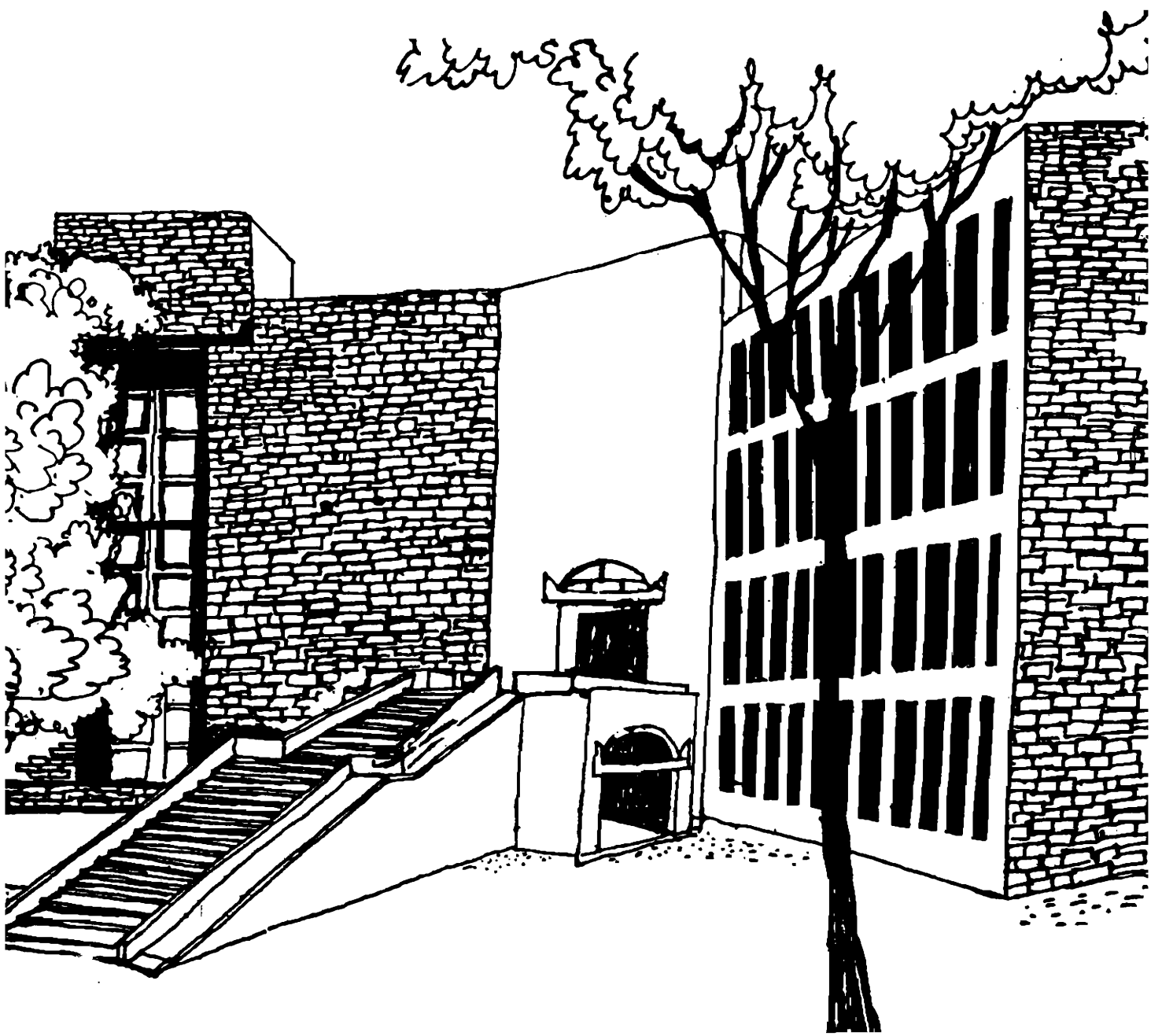

DILEMMAS OF RENEWABLE ENERGY: THE CASE OF THE SOLAR COOKER PROGRAMME IN GUJARAT, INDIA

By

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Abstract

This article presents a set of measures for evaluating a social development programme such as the non-conventional energy programme. The specific case discussed and evaluated here is that of the solar cooker programme. Subsequently, the attempt is to identify key decision areas and raise some questions which may help focus better on the marketing problems confronting the programme.

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1.0 Indian Energy Scenario

The conventional sources of energy available to us are in the form of coal, oil, electricity and nuclear energy. It has been estimated that India has coal reserves which might last from fifty to hundred years. On the oil front India's position is not too sound either. It has been forecast that India would need to produce 56 million tonnes in 2000-04 AD to meet the total consumption provided she imports 38 million tonnes. This would require Rs.450,000 crores to be sunk in oil exploration and and about Rs.20,000 crores in oil extraction and refining. By any standards this is a gigantic burden reaching about 25 % of plan allocations (1). Though there have been sharp increases in natural gas production, significant portions of gas have to be flared up due to nonofftake of committed quantity of gas by the consumers and lack of adequate compression facilities (1).

Having this sombre thought in mind it is with some relief that one turns to the scenario in electricity. The present realistic estimate for hydel power by the end of the seventh plan period (1990) is 64,735 MW. This estimate has to be cautiously looked at when ecological picture is taken into account. Only 18 % of it has been tapped so far, mainly because of capital cost involvement. As such electricity accounts for no more than 20% of the total energy used in our country (2).

Turning to India's efforts towards power generation through nuclear energy sources, in recent times one hears of 10,000 MW of

nuclear power by the year 2000 A.D., which is also going to be elusive (2). Overall, the energy scenario is far from bright and hence there is a need to conserve energy. It is useful at this juncture to analyse the patterns of energy consumption so as to get an idea about the sectors and fuels to concentrate on, for the purposes of conservation.

2.0 Fuels to Target For

Sectorwise, the household demand for commercial sources of energy is to increase from the present 18% to 22% in 2000 A.D.. The industrial and transport sector will be around 39 and 26 percent, while agriculture and other constitute the balance in 2000 A.D (3).

The second category of fuels conventionally used in India are non-commercial sources of energy such as firewood, cowdung and vegetable wastes. Although commercial sources of energy have an important place today, yet it is estimated that 40% of the total energy supplies in India come from non-commercial sources, 65% of which comes from firewood only..Further, it is to be noted that nearly all the non-commercial domestic primary energy production is used by the domestic sector. In equivalent terms this amounts to 250.08 MTCR.

The picture that emerges is therefore as follows (2):

Share of Fuels in Domestic Sector in MTCR Terms (1982-83)

Fuels	MTCR	% Share
Commercial	59.85	19.31%
(1) Petroleum Products	45.69	14.7
(2) Coal	2.19	0.7
(3) Electricity	11.79	3.8
Non-commercial	250.08	80.69%
Total	309.93	100%

The household sector emerges as the largest consumer of energy, accounting for about 50 % of the total energy consumption. Firewood is the most important amongst non-commercial fuels traditionally used. In fact the depletion is so high that for instance in Gujarat only 10 percent of the land is classified as forests as compared to 33 percent recommended for ecological balance (4). Next comes oil (consisting of Kerosene and L P G) - a recent estimate puts the share of LPG in total oil consumption in household sector in 1982/83 at about 9 percent, the rest being kerosene (5).

The census of energy consumption in the households of 28th round of National Sample survey shows that the share of non-commercial energy is over 80 percent in rural areas as compared to 51 percent in urban areas. Further, on an average, in rural areas 89 percent of non-commercial fuels are collected while in urban areas the figure is 16.4 percent.

Thus the sources that we least possess and which are critical ecologically are being most consumed (e.g. firewood and petroleum products). The above analysis underscores the fact that

the domestic sector is the most important target if energy is to be saved. And cooking is the activity of maximum interest.

The analysis also tells us that the fuel which needs to be saved for having a substantial impact is first fuelwood and then petroleum products (consisting of mainly kerosene and LPG). Further the share of LPG petroleum product consumption in the household sector is estimated at 9 per cent. Thus, the two fuels in the household sector which could lead to substantial impact in terms of saving are:

(1) Fuelwood and
(2) Kerosene

Next would be electricity and LPG. And these two are used to a substantially lesser extent in the domestic sector.

3.0 Importance of the Renewable Energy Programme and the Solar Cooker

It is envisaged that conservation of these fuels can be brought about by two paralell and simultaneous (preferably) approaches.

The first approach is to impose (either self or externally) austerity measures. Studies have shown that such measures are difficult to institutionalize (6). Some studies undertaken to gain insight into urban domestic energy consumption have shown that the households felt increasing cost of commercial fuels a problem but did not visualize it as a serious issue related with supply.

Less effective measures like education on energy situation was suggested to control energy consumption while measures like rationing, high pricing etc., were not acceptable. The main

concern or interest in conserving fuels was to keep fuel outlay within their budget and not for the common good of mankind or because resource reserves are depleting fast or because depletion of biomass has adverse impact on nature (6).

By and large there was a lack of cognizance regarding energy issues, energy policies, energy intervention schemes and alternate energy forms and technologies for domestic use. Energy conservation was affected by the household's response towards price increase and attitude towards energy situation. Households, given the option tend to be more committed to energy intensive level of living oriented goals than to energy conservation oriented labour intensive lifestyle (6).

Energy conservation means efficient use of conventional energy as also its replacement by renewable energy sources or use of more energy efficient devices. This is the second approach. This approach is specially important because firstly austerity measures are difficult to institutionalize and secondly about 75 to 80 percent of the energy in the domestic sector is used for cooking, where energy usage is inelastic at lower levels of income (6). This is the route that Gujarat Energy Development Agency (GEDA) has adopted for achieving the objective of energy saving. The role of GEDA is therefore to promote usage of nonconventional energy sources in the state of Gujarat (The national apex body for this purpose, the Department of Nonconventional Energy Sources (DNES), began its operations in 1981-82, whereas GEDA began operations earlier in 1979).

Among the various non-conventional energy sources promoted

by GEDA such as Biogas, Wind energy etc., is a solar energy device called the solar cooker. The solar cooker is a flat plate aluminium box with or without a reflector. The device is simple, easy to fabricate and easy to operate. The box is fitted with aluminium or stainless steel vessels which are painted black so as to absorb heat. A reflecting mirror is often used to reflect heat on to the vessels, thus increasing the incident heat. The cooker weighs 12 kgs and has a capacity of 800 gms. It is required to be installed outside the kitchen in an open courtyard or a terrace where sunrays are directly falling on the solar cooker (7).

The solar cooker programme assumes importance because of a combination of factors. Firstly, devices using replenishable fuels in the household sector especially for the purpose of cooking become critical because of the energy consumption in this sector. Secondly, unlike many of the other projects handled by GEDA (such as windmills and community biogas plants), the solar cooker programme is targetted at the individual and not at the community as an entity. This puts it within the reach of the individual, monetarily. Finally, a solar powered cooking device has the advantage of continuous energy input (at least as long as the sun shines), absence of pollution and greater nutritive value retention (of course, it also carried with it disadvantages such as the inherent problems of solar energy i.e. diluteness and seasonality).

4.0 Solar Cooker Programme : Objectives, Targets and Performance

The broad objectives of the solar cookers program were (7):

1) To promote the use of non-depletable fuels vis-a-vis

depletable fuels.

2) To substitute conventional commercial by non-conventional sources (solar), especially in the household sector.

3) To provide the consumer with a cleaner, safer, more nutritious and more economical mode of cooking than existing modes.

Table 1 provides an estimate in 1980 - 81 by GEDA as to the anticipated energy saving over the next ten years for different kinds of energy sources.

Table 1 : Fuel savings envisaged by GEDA

Type of Fuel	Annual Fuel Saving*	Retail Price in Baroda as on 09-04-1980	Annual Saving (lakh Rs)	Saving over time (lakh Rs)
Firewood	600 * 5000 =30,00,000 kgs	Re 0.30 /kg	9.00	90.00
Coal	500 * 5000 =25,00,000 kgs	Re 1.00 /kg	25.00	250.00
Kerosene	85 * 5000 = 4,25,000 lts	Rs 1.60 /lt	6.80	68.00

* Assuming sale of 5000 cookers for which subsidy would exceed 15 lakhs.

SOURCE : Agency annual report, 1980 - 81

The above targets should be seen in the context of the sectoral energy usage analysis. Since firewood, coal and kerosene are made use of to a greater extent than the other fuels it apparently makes sense to target the solar cooker towards saving these fuels. Thus the objective was to bring about a saving of either 600 kgs of firewood or 500 kgs of coal or 85 litres of kerosene, per annum. The above stated objectives assume that 5000 solar cookers would be sold per annum. As against this the actual sales performance break-up is given in Table 2.

Table 2 : Annual sales break-up categorywise

	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	Percentage of Subsidy* in '87-'88
Tribal	-	-	-	-	-	-	78	606	75%(Rs.175/
Coastal	-	-	-	-	-	-	118	395	75%(Rs.175/
Schools	-	-	-	-	-	-	165	340	90%(Rs. 75/
IREC/IREP	-	-	-	-	-	-	120	184	75%(Rs.175/
General	565	3112	3048	1294	850	1510	2085	1809	50%(Rs.375/
TOTAL	565	3112	3048	1294	850	1510	2566	3334	

* Price paid by consumer is given in brackets
Note : Categories were formed in 1986 - 87
SOURCE : Agency records.

Given the importance of saving energy and the fact that the product is being given such a hefty subsidy, it is critical that we evaluate this programme to see whether there has been overall progress.

5.0 Developing Measures to Evaluate the Programme

Our earlier analysis of the energy scenario points to the fact that the fuels which are most in demand are the ones least available. Replacing one form of conventional energy by another would not serve our purpose. Whatever measure we develop must not only take into account the 'extent of fuel saved' but also the type of fuel being saved.

For such programmes therefore, the first variable to be examined should be 'the fuel which is being substituted'. In this instance, the fuel being substituted depends upon the

profile of (and hence type of fuel usage) people purchasing the solar cooker. Since cooking is a necessary activity, all households would be using some fuel or the other. We need to look at what fuel the solar cooker replaces partially or wholly.

This leads us to the second measure. Does the solar cooker substitute the fuel fully or only supplement it ? We need to know here, the 'extent to which a fuel is being substituted'. In this instance, it depends upon the number of months for which a fuel is being used, the level of usage of the solar cooker (possibly in terms of the number of meals for which used or the extent to which used in each meal and by what proportion of the buyers).

Finally, on a macro level, both the above measures are dependent upon 'the number of solar cookers sold.' This is our third measure.

To summarize, the three measures that we are arguing as essential to evaluating the programme are:

(1) the fuel which is being substituted
(2) the extent to which a fuel is being substituted
(3) on a macro level, the number of solar cookers sold.

The programme needs to be evaluated not on each measure separately but based on a combination of the three measures. Besides being able to evaluate the programme against the objectives, the approach has the advantage of diagnostics too. For instance, the first measure would tell us whether the programme is targetting the fuel which it has aimed at substituting. If not, then we have to decide whether to reposition or to let things be. It might even mean that there

needs to be a change of policy with regard to energy sources such as kerosene,electricty etc., in terms of price or availability.

The second measure would tell us whether the device is a supplement or a substitute (i.e. how much it is being used) and for what purpose (i.e., what sort) of items are cooked using the solar cooker. This could have implications on product policy and communication decisions. For instance if product design or materials is creating problems this may be changed. The third measure would give an indication as to the extent of adoption and diffusion taking place.

We therefore, have a combined measure which can be used for evaluating the programme, and individual measures which provide us with information regarding the direction the programme is taking with respect to the programme objectives. Both the above would be a crucial input to deciding future programme strategy.

Further, the above measures are more client-oriented than organisation oriented. Thus, the strategy would not be reduced to one of selling solar cookers but one of marketing it with a clear segment and position in mind. The first two measures would clearly indicate whether and to what extent the product is satisfying a consumer need.

6.0 Applying the Measures to the Solar Cooker Programme

Market research established that the solar cooker is used on an average for 5.2 months per year (8). Another survey carried out earlier in 1985 pointed to the fact that as much as 65% of solar cooker users use it as a supplement with LPG (9).

our first diagnostic, that is, whereas the solar cooker was targetted to substitute fuelwood and kerosene, it is used as a supplement with mainly LPG.

Further data was also available at another place. For LPG users the saving determined by market research was 30 kgs/annum per user i.e. slightly in excess of two cylinders (8).

Research has also shown that 66% of the users were those who used the solar cooker for at least one meal a day. We therefore have our second diagnostic - the extent of usage is upto a saving of 30 kgs/annum per user for 66% of those who supplement this solar cooker with LPG (8).

The total number of cumulative solar cooker owners in Gujarat at the time of this piece of research was 16,000 (7).

Therefore combining the three measures we have the number of people saving 30 kgs of LPG per annum = 0.65 x 0.66 x 16,000

= 6864.

In terms of savings of any substantial nature we can mention only 6864 cases and these, **not** fuelwood users **but** LPG users.

Now we have a reasonably clear idea as to the direction that the solar cooker programme is taking and its performance with respect to our objectives. The targets set also do not seem to be realistic. It is estimated that the average consumption of kerosene for cooking is 8 litres per month per household (96 litres per annum) and that of firewood is 55 kgs per month (660 kgs per annum). This means that the programme should aim for almost complete substitution, which is not possible given the nature of the product.

There is also the angle of financial returns. To the individual user who purchases the cooker at Rs.375/- and saves 2 cylinders LPG worth per annum, the payback period is 3 years. For other categories it is even lesser. But what of the government ?

Financially, the government expected spending (both DNES and GEDA) works out to Rs.39 lakhs for 5000 cookers (7). For every 5000 solar cookers (using our measures) the amount of saving would be

= 5000 x 0.65x 0.66 x 30 x 4.57 = 3 lakhs

(No. of cookers saving LPG) (extent of saving) (cost)

Thus the financial payback for the government would occur in 39/3 = 13 years. This is an average figure which includes all categories, the projected break-up being 3400 numbers in the normal category, 1000 in schools and 600 in tribal/coastal/IREC/IREP. For the normal category alone, the payback for government would exceed 5 years.

The analysis points out that the solar cooker is used to supplement LPG rather than firewood. There is ipso facto nothing wrong with this except that it was targetted otherwise. Though the programme is saving some energy it is obviously not performing well on any of the suggested measures. Why is this so? Can and should the situation be salvaged ?

7.0 Dilemmas of Marketing Renewable Energy

It might be useful to ask several specific questions regarding the programme and attempt to derive lessons from the

answers. These answers might not relate solely to the solar cooker programme but might have wider implications. For instance, (a) what segment should the device be targetted at, urban or rural? Low income or high income? etc. (b) Should it be positioned as an energy saving device or as a fad ? (c) As a replacement for firewood, coal or LPG ? (d) Also, how should one go about making 'monitoring time' a more salient attribute for cooking than 'cooking time' ? (e) Finally, how can one push through the concept of nutrition ?

These questions reflect three broad dilemmas in the non-conventional energy programme :

7.1 The Portfolio problem

Segmentation and positioning of the solar cooker could be decided based on the portfolio of energy saving devices. The adoption of any such device is likely to be dependent on how much the context favours it. Given the nature of the product, it can only be targetted at the segment whose lifestyle is most appropriate for its adoption.

It might be useful for the planning authorities to look at non-conventional energy sources/devices as a portfolio and target products to markets according to **appropriateness**. Just as an illustration, the biogas plant may be more appropriate for rural areas (ie. to replace firewood) rather than urban, whereas the solar cooker may be more appropriate for urban areas. This could be because of qualitative factors such as appropriateness/inappropriateness of lifestyle, zero cost of fuel etc.(since fuel in rural areas is mostly collected). Again it is

possible that some of these factors change over time thus altering the portfolio. The composite measures would be helpful in these portfolio decisions too since we could compare objectives with performance for each product in the portfolio.

If non-conventional devices were to be conceptualized as a portfolio of products where the two dimensions are :

(1) Extent of energy saving possible in a relative sense and

(2) Receptivity to device of the market in terms of sub-dimensions such as appropriateness of lifestyle, extent of availability of alternate forms of energy.

then each of the products can be fitted into this matrix with each dimension varying from high to low.

In such a scenario, it may not be necessary or for that matter advisable to target all devices to any one market. Also, the evaluation of the programme would not be in isolation but in combination with the other energy saving programmes.

Positioning of the product would depend upon the segmentation decision. For instance, if the segment chosen was the low income segment then it would be more appropriate to position the product as an energy saving device.

7.2 The Communication problem

The second major dilemma is the communication problem. The LPG stove is faster than the kerosene stove in terms of cooking time. The kerosene stove, in turn, cooks faster than the firewood chulha. The solar cooker, on the other hand, cooks very slowly but since there is no danger of overcooking it needs to be monitored to a much lesser extent... much lesser than all other devices. Thus, there is a need to make salient the monitoring

time attribute. There is a need to push through the concept that, if monitoring time is reduced (even though cooking time increases), other household chores can be performed without worrying about the food getting overcooked.

There is also the question as to whether the nutrition angle should be pushed through. In retention of nutritive value, the solar cooker proved to be superior to LPG cooking, saucepan cooking and pressure cooking though there was no significant difference in terms of colour, flavour, texture and taste. Whether, the added nutritiveness (10) of foods cooked by the solar cooker would be incentive enough for the consumer to use it, remains an empirical question. In any case, the use of this aspect in the strategy hinges upon the segmentation decision.

7.3 The Pricing problem

Deciding on the 'right price' for any product is one of the most complex decisions. For a product that must satisfy a national objective and simultaneously appeal to the consumer the decision can be even more complex. Should there be a subsidy element ? And if there is then what should be the extent of subsidy ? More important, what should be the basis of subsidy or differential pricing ?

Another consideration for such a product would be the non-monetary aspect of price, i.e., non-monetary effort and risk (11) which might be as significant a component as the monetary aspect. For instance, the risk of ending up with uncooked food at the end of three hours due to insufficient insolation or the sheer effort of having to plan for a meal much in advance could be

dissuading consumers from purchasing the product. If these elements of the price are more important than the monetary element, it might be necesary to chalk out a strategy to deal with these. In the first case, it might be useful to consider marketing a solar cooker with a compensating mechanism, which delivers sufficient heat to make up for the lack in solar insolation. In the latter case it might be necessary to change attitudes - a more difficult proposition.

8.0 Conclusions

This paper has sought to evaluate the solar cooker programme in the context of the Indian energy scenario. In the process, we have argued that the three measures :

(1) the fuel which is being substituted

(2) the extent to which a fuel is being substituted

(3) on a macro level, the number of solar cookers sold.

are the appropriate indicators to judge the extent of success of the programme. These measures with minor modifications may even be extended to other non-conventional energy programmes. Based on an analysis of the programme three critical decision areas have been identified which when 'properly' tackled may lead to a better perspective on the non-conventional energy programme and possibly to improved performance.

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