Review of Nashik Pilot CFL Program
of
Maharashtra State Electricity Distribution Co Ltd

Prayas Energy Group
Pune

December 2007

Review of Nashik Pilot CFL Program of
Maharashtra State Electricity Distribution Co Ltd

A report by:
Daljit Singh, Girish Sant and Ravindra Kadam

Prayas (Energy Group),
Athawale Corner, Near Sambhaji Bridge,
Karve Road, Deccan Gymkhana Corner,
Pune - 411004. INDIA
Tel: + (91) 20 - 2542 0720, 5620 5726, Fax: 2542 0337
Web-site: www.prayaspune.org

ACKNOWLEDGEMENTS

There are many people who helped in the preparation of this report. We want to thank the staff of MSEDCL for extending their cooperation and providing us with data and information. We also want to thank the personnel of the companies that supplied CFLs for the pilot project for providing us with data on sales of CFLs.

We would not have been able to carry out the surveys of program participants without the assistance of Professor Mahesh Shelar of K.K. Wagh College of Engineering, Nashik and his team of students: Sameep Deshpande; Arun Xavier; Pushkar Bhagat; Vaibhav Shirpurkar; Mayur Mishra; Shrikant Bhaiya; Aniruddha Surve; Balasuresh Umiti; Neerajkumar Jha; Parag Bhoj; Swapneel Kakad; Dattatray Sahane; Dinesh Sonawane; Kiran Bhagat; and Navneet. We are grateful to them for tirelessly carrying out the survey. In addition, we were very fortunate in having Mr. Kuntal Kothavade for computer support; his assistance in the setting up of databases made the analysis of data from the surveys considerably smoother.

We also benefited from the advice and suggestions of several experts on lighting technologies. Last but not least, we want to thank our colleagues at Prayas Energy Group who helped in all stages of the project and in the preparation of this report.

CONTENTS

PART I. BACKGROUND

Section 1. Introduction

Demand-Side Management (DSM) which encompasses energy efficiency improvements, energy conservation and load management is gradually assuming more importance as decision makers are recognizing its benefits in reducing energy requirements without reducing energy services and in reducing emissions of carbon dioxide and thus mitigating global warming.

In Maharashtra, various stakeholders recognized the potential benefits of DSM early on. Since the first tariff revision process of the erstwhile MSEB (now MSEDCL) in 1999, consumer groups and MERC had been insisting that MSEDCL should undertake large-scale DSM programs. MERC had also issued directives on this issue to MSEB/MSEDCL through several tariff orders. In addition, at an MERC hearing on June 6, 2005 to review the progress of DSM schemes of MSEDCL, Prayas had recommended a 10 MW conservation power plant in the form of a pilot CFL program where 3 lakh CFLs would be installed. In response to these impetuses, MSEDCL launched a pilot CFL program in Nashik with the intention of expanding the program to the entire State later. The pilot program was started around November 2005 and went on until about June 2006.

Evaluation of DSM programs is essential for their success but it is often ignored. Evaluation of a program is carried out for two reasons: (1) to assess the effectiveness of the program in order to determine if the objectives were met; and (2) to assess the efficiency of the program to determine if the program can be improved and the objectives met with fewer resources. Impact evaluation addresses the first objective and measures the energy and demand savings realized.. Process evaluation fulfills the second objective by reviewing the procedures, outreach and information processing of the program and by assessing the satisfaction experienced by participants in the program.

Recognizing the importance of evaluation, MERC had insisted on an evaluation of the Nashik pilot project and MSEDCL had said it would carry out an impact assessment. However, not having received any impact assessment report, MERC scheduled a hearing on July 11, 2006 to *inter alia,* review the progress made in the evaluation of the Nashik pilot project. During the hearing, MSEDCL and the Commission asked Prayas to review the CFL pilot program in Nashik.

Subsequently, in the latter half of 2006, Prayas undertook a review of the program. Our review started in early August 2006 and went on until early September 2006. Given the

increasing attention being given to DSM and to efficient lighting programs using CFLs in particular, we decided to release the results of our review in the form of a report. Several utilities around the country have initiated CFL programs and others are considering such programs. We hope that the lessons learnt from the Nashik pilot program will inform the design of these new CFL programs that are being considered around the country.

The review of the Nashik CFL program consisted of four parts: (1) impact evaluation to estimate the energy savings and reduction in peak demand; (2) analysis of issues related to the quality of CFLs such as failure rates, power factor, harmonics, and their impact on the power system; (3) review of the tracking and monitoring system for the project; and (4) process evaluation to see if the program design, procedures, and systems could be improved to increase the impact of the program

In order to carry out these tasks, we carried out a survey of a sample of participants, and we also carried out in-depth interviews with participants, non-participants, suppliers, retailers, BG sales-women, and MSEDCL staff. While carrying out the review, we at Prayas recognized that the Nashik project, like other pilot projects gave an opportunity to test hypotheses and learn from mistakes. Therefore, our focus in the review of the Nashik program was on identifying lessons for utility sponsored DSM programs in India.

This report is organized in three parts: Part I provides a background of the program. It includes basic information on the role of the utility in DSM programs, a description of the program and a brief description of the overall results. Part II forms the bulk of the report and it contains the details of the review. It describes the methods used in the evaluation and presents the results of the study. Part III describes lessons learned from the Nashik project and recommendations for improving the program as it is expanded throughout the State of Maharashtra.

Section 2. Role of the Utility in DSM Programs

The cost to save energy through DSM is often a small fraction of the cost to produce that energy, making DSM a very cost-effective way to meet the service needs of consumers compared to the cost of most generating options. Yet most consumers do not adopt energy saving technologies because of the barriers such as[1]:

- *Incomplete Information* Consumers do not have enough information on energy efficient technologies.
- *Lack of capital* Energy efficient equipment often costs more than equipment generally available in the market. Consumers, particularly from poor sections do not have the initial capital required to finance the higher-cost purchases of energy efficient equipment.

[1] Several researchers have discussed the barriers. One prolific writer on the subject was AKN Reddy. For details and relevant publications see website www.amulya-reddy.org.in.

- *Short payback period*. At least partially as a result of the shortage of capital, consumers require very short payback periods for investments. Because investments in energy efficient equipment often have longer payback periods.
- *Risk Perception*. Sometimes lack of information about the reliability and actual saving potential of equipment can make consumers cautious about claims of higher efficiency of equipment.

Therefore, a utility can play an important role in removing some of these barriers. Some examples of functions a utility can play are given below:

- Increase awareness of energy efficient technologies among consumers
- Reduce initial capital cost requirements of consumers through innovative financing mechanisms, such as lease or deferred-payment schemes
- Reduce price of energy equipment through bulk purchases
- Provide assurance to consumers about the quality of the energy efficient product by: (1) specifying performance requirements in the procurement process; (2) periodically checking the quality of products to ensure they meet the standards; and (3) requiring a sufficiently long warranty period for the energy efficient product so that consumers are assured of a complete recovery of their investment.

Section 3. Description of the Program

Recognizing that lighting is a major contributor to its peak load, MSEDCL focused on promoting the use of energy efficient lighting. It expected that such a lighting program would bring about the following benefits: (1) reduction of the system peak demand; (2) improvement of system load factor; (3) improvement of power quality; and (4) improvement of customer relations[2].

MSEDCL decided that through the Nashik program, it would distribute or help in the distribution of 3 lakh CFLs. While MSEDCL would attempt to bring down the price of the CFLs through a tendering process, it would not contribute financially. Instead, the entire cost of the CFLs would be recovered from participating consumers. MSEDCL would provide support through communications and payment collection.

MSEDCL invited tenders for the State-wide program. Suppliers were selected based on product quality, price, warranty, and retail network. Five suppliers were selected. Expressions of interest for the Nashik program were then invited from the selected suppliers. All except one responded and were selected. However, another supplier did not participate and so finally there were only three manufacturers who supplied CFLs for the Nashik pilot project. We will refer to these companies as Company A, B and C[3].

[2] From *Invitation for Bids (IFB)* (Technical specifications, evaluation criteria, agreements and price bid formats), Maharashtra State Distribution Company Limited, Issued by Chief Engineer, Distribution Special Project Cell, 2005.

[3] We have chosen not to identify the companies by name because the focus of our report is on lessons that can be learnt from the Nashik program, and not on ascribing responsibility for successes and failures to specific players.

The program was open only to residential and commercial consumers. Furthermore, only those consumers who had no arrears on their bills were eligible to participate. Eligible consumers had two choices for procuring CFLs under the program: (1) direct outright purchase; or (2) payments in installments through the MSEDCL billing system. Consumers were limited to a maximum purchase of five CFLs each of either 15W or 20W rating.

Table 3.1 shows the payments that consumers were required to make for the CFLs under the two payment options. Under direct sales, the payments were Rs. 100 for each 15W CFL and Rs. 110 for each 20W CFL. Under the installment plan, payments were to be Rs. 10 per month for eleven months for each 15W CFL, and Rs. 10 per month for eleven months and Rs. 15 for the twelfth month for each 20W CFL. In actuality, MSEDCL used a slightly different and simplified method of calculating the installments. It recovered the total amount owed by consumers for purchase of CFLs in ten equal installments.

Table 3.1 Payment Plans

	15W CFL	20W CFL
Direct Purchase	100	110
Installment Scheme	110	125
Number of Installments	11	12
Monthly Installment Amounts	10	10 (one of 15)

As actually implemented, there were several delivery mechanisms for getting CFLs to consumers[4]. Consumers could purchase CFLs in the following ways:

- At bill collection centers;
- Through to door-to-door sales by '*Bachat Gut*'[5] (BG) women organized by suppliers;
- At retailers' shops;
- At stalls set-up by suppliers at MSEDCL meetings to publicize energy efficiency.

When consumers bought CFLs, they signed a one-page purchase agreement. In case a consumer bought CFLs on the installment plan, the agreement gave the number of CFLs bought of each type (15W or 20W). Further, the consumer agreed that MSEDCL could charge him/her the installment amounts in the bills. In the case of direct sales, the purchase agreement gave the number of CFLs bought of each type.

[4] The description of the program as implemented has been pieced together from documents from MSEDCL and from conversations with various players. In spite of repeated requests to MSEDCL, we were unable to obtain a written description of the how the Nashik program was implemented. We were given a written description of the State-wide program in the form of the IFB and letters of award (LOA) to manufacturers. Much later, in early September, 2006 we were given the letter of award to Company A for the Nashik pilot project. The actual implementation was different even from that given in the LOA for Nashik.

[5] A women's self-help group that assists group members in saving money.

The retailer or BG woman was to collate all the purchase agreements and send them to the Regional Sales Office of the manufacturer periodically. The Regional Sales Office of the manufacturer, in turn, was to periodically submit an invoice which was then to be sent to the sub-divisional office (SDO) of MSEDCL. The data for installment sales submitted to the SDO by the manufacturer was to be provided on CD in a format specified by MSEDCL and called Form B10. It contained the following details:

- Consumer number
- Date on which CFLs were purchased
- Code indicating whether deductions are to be started, stopped, or re-started.
- Company code indicating the manufacturer
- Number of bulbs
- Amount to be recovered
- Down payment, if any

The SDO was to pass the CD onto the MSEDCL Billing and Records Department. The Billing and Records Department would merge this data in its records and then consumers would start receiving bills for the installment amounts.

For direct sales, manufacturers were simply required to provide the "sales figures" to MSEDCL (MSEDCL, 2005a:6). The direct sales data provided by Company A gives the name of the consumer and his/her billing unit, and shows the number of 15W and 20W purchased. However, it does not give the date the CFLs were purchased nor does it provide additional details about the consumer such as the consumer number.

The following table summarizes how the responsibilities were divided between the various players in the Nashik pilot project. It is based on a similar table in the Invitation for Bids (IFB) showing how MSEDCL envisaged the responsibilities would be divided.

Table 2.1 Roles and Responsibilities as Envisaged by MSEDCL

Stakeholders	Roles and Responsibilities
MSEDCL	1. Overall Responsibility for collection of CFL costs through consumer bills 2. Reimbursement of suppliers from monthly collections 3. Program Advertising and Marketing
Suppliers	1. Provision of lamps complying with specs 2. Coordination of replacements under warranty with retailers 3. Submission of invoices to MSEDCL 4. Disbursement of payments to retailers
Retailers	1. Sale of CFLs to eligible consumers 2. Provision of sales documentation to suppliers

Source: MSEDCL (2005), Invitation for Bids

From this division of responsibilities, it can be seen that MSEDCL was to play a facilitiative role only consisting of collecting installments from consumers and passing

them on to the suppliers. Because the delivery mechanisms including sales at retail outlets were organized by the suppliers, sales were the responsibility of the suppliers.

3.1 Program Achievements

In terms of overall sales, the program was a huge success. As Table 3.3 below shows, the total sales exceeded the target of 3 lakhs lamps. In fact, Company A alone sold more than 3 lakh lamps. Table 3.3 reveals some other interesting facts.

1. Sales by Company A were much higher than those by the other two suppliers.
2. Installment sales were much higher than direct sales; in the case of 20W bulbs they were 15 times as high and in the case of 15 W bulbs they were 10 times as high.
3. Sales of 20W bulbs were about three times as high as sales for 15W bulbs.

Furthermore, based on a review of the detailed consumer data, we found that most of the CFLs were sold in poor neighborhoods with more than 70% being sold to consumers whose consumption was below 100 kWh per month. We discuss some of these issues in more detail later in the report.

Table 3.3 Company-Wise Sales in the Nashik Pilot Program

Supplier	Installment Sales by Wattage		Cash Sales by Wattage		Total Sales by Wattage		Total Combined Sales
	15W	20W	15W	20W	15W	20W	15W & 20W
Company A	73,376	234,293	2,124	8,707	75,500	243,000	318,500
Company B	11,996	32,651	1,956	4,194	13,952	36,845	50,797
Company C	300	275	5,000	5,000	5,300	5,275	10,575
TOTAL	85,672	267,219	9,080	17,901	94,752	285,120	379,872

Source: Report on the Nashik Pilot Project by Chief Engineer, Nashik Zone, Dated 13/6/06

PART II. PRAYAS'S REVIEW: METHODS AND RESULTS

Section 4. Components of the Review of the Program

The review of the Nashik CFL program consisted of the following four parts:

1. Impact evaluation to estimate the energy savings and reduction in peak demand.
2. Analysis of issues related to the quality of CFLs such as failure rates, power factor, harmonics, and their impact on the power system.
3. Review of the tracking and monitoring system for the project
4. Process evaluation to see if the program design, procedures, and systems could be improved to increase the impact of the program

In order to carry out these tasks, we relied on two instruments: (1) a survey of a sample of participants, details of which are given in the following paragraphs; and (2) in-depth interviews with (a) participants, (b) non-participants, (c) suppliers, (d) retailers, (e) BG sales-women, and (f) MSEDCL staff.

4.1 Survey Instrument

We developed a survey instrument (questionnaire[6]) in order to obtain data and information in the following five areas:

1. *Basic information.* Information about the consumer and the number and brand of CFLs purchased, and the place of purchase.
2. *Data for impact evaluation*. For each CFL purchased, where the CFL was installed, what it replaced, the power consumption of the replaced item, and the hours and period of operation.
3. *Data on Failures and Replacements* The number of failures and replacements and the duration between failures.
4. *Data on Free-Ridership, Rebound, and Persistence*
5. *Opinion about Program* Consumers opinions about the program, identification of problem areas, and about what motivated them to participate.

Before large-scale application of the survey instrument, we tested it on a few participants and revised it to remove ambiguities in questions and to make it easier and smoother for the interviewer and interviewee. Subsequently, we trained some volunteer engineering students in conducting the survey. We kept in close contact with the interviewers and got detailed feedback after each round of interviews. At the feedback meetings we also gave our comments to the interviewers based on our review of the completed forms in order to ensure that our results were as complete and accurate as possible.

[6] The complete questionnaire is given in Annexure I.

All respondents for the survey spoke in Marathi speaking (local language) Therefore, the survey instrument was written and administered in Marathi to facilitate complete and valid responses .

4.2 Survey Sample

Using the instrument described above, our team surveyed a sample of consumers from both urban and rural areas. For the urban sample, as far as possible, we used stratified sampling with strata differentiated by the level of consumption. We used tariff slabs to stratify consumers according to consumption. Within each stratum, consumers were selected in a quasi-random fashion by selecting participants at fixed intervals from a list of participants. For example, if there were 1000 participants in a consumption slab and a sample of 25 participants was to be selected, then every 40^{th} participant (1000/25 = 40) from the list was included in the sample. Our sample of urban consumers consisted of 202 respondents.

Because MSEDCL could not give us an updated list of rural participating consumers[7], we could not carry out random sampling in rural areas. However, in order to maximize diversity we went to 9 villages in 3 talukas around Nashik. Within each village, surveyors fanned out in different directions and recruited respondents by going from house to house and knocking on doors. Our survey respondents consisted of 202 urban consumers and 47 rural consumers giving a total of 249 respondents. Details of the survey sample are given in Box I.

All the results of our survey are given separately for urban and rural areas. We have chosen not to combine the results for several reasons. We do not know what fraction of the total 3.79 lakh CFLs sold were sold to urban consumers and what fraction to rural consumers[8]. It would be misleading to simply combine the rural and urban consumers because that assumes that the ratio of all CFLs sold in urban areas to all those sold in rural areas is 202/47. Furthermore, because the urban sample is more scientifically obtained, it would not make sense to merge the rural and urban results. But the most important reason to report the urban and rural results separately is that we found significant differences between urban and rural areas which enhance our understanding of the program results..

4.3 Establishing the Validity of the Survey Sample

Tables 4.1 and 4.2 show the patterns of purchases by the consumers in the survey sample. Table 4.1 shows that as with the larger population of participants in the program, sampled

[7] There was a delay in submission of invoices for the complete list of consumers by the suppliers and there was a huge backlog in data entry at MSEDCL. We made several requests for the complete list of consumers who had bought CFLs from Company A, the main supplier, but did not receive it until August 30, 2006. Even those data were not in a form that we could use directly and would have needed considerable additional processing to be of much use to us.

[8] During Prayas's presentation to MERC on the results of the review of the Nashik Program on October 17, 2006, MSEDCL staff said that 80% of the CFLs had been sold to urban consumers and 20% to rural consumers. We did not have data to confirm this ratio.

consumers showed a significant preference for 20W CFLs over the 15W CFLs. About 75% of the CFLs bought by the sampled consumers were of 20W while only 25% were of 15W. The larger population had the same proportion of 20W purchases. Furthermore, 84% of the sales were from Company A which matches the overall sales figures in Table 3.3.

Table 4.1 CFL Purchases by Sample Consumers by Wattage

	Company A			Company B			Both Co's		
	15W	20W	Total	15W	20W	Total	15W	20W	Total
Urban	134	480	614	46	105	151	180	585	765
Rural	55	124	179	3	3	6	58	127	185
Total	189	604	793	49	108	157	238	712	950

Table 4.2 shows the purchases that were made on an installment basis versus direct cash purchases. Once again the data for the sample matches the overall population quite closely with 93 percent of the purchases made on an installment basis. The fact that our survey sample matched the larger population of participating consumers in the pattern of purchases in terms of the (1) product wattage, (2) brand purchased, and (3) direct versus installment basis establishes the representativeness of the sample.

Table 4.2 Direct and Installment Purchases by Sample Consumers

	Company A		Company B		Both Co's	
	Direct	Installment	Direct	Installment	Direct	Installment
Urban	53	561	6	145	59	706
Rural	9	170	1	5	10	175
Total	62	731	7	150	69	881

Having looked at how we gathered data and information for our review, we discuss the details of each of the components of the review and the results in the following sections.

Box I. Details of Survey Sample

- 202 Urban Consumers
  - 181 through stratified random sampling from five billing units (areas) selected which together had 80% of the total participants for whom data was available. (At the time of the survey, data was available for about a third of the total participants.) Stratification on the basis of consumption level.
  - 21 additional consumers consisting of in-depth interview participants and others through "knocking on doors."
- 47 Rural Consumers
  - Three talukas selected and total of 9 villages from them visited and sample generated by four teams going in different directions door-to-door and "knocking on doors."
    - Dindori Taluka
      - Villages – Chandori, Jagori, Jaulke Dindori
    - Niphad Taluka
      - Villages – Mohadi, Dikshi, Mauje Sukane
    - Sinnar Taluka
      - Villages – Naigaon, Shinde, Brahmanwadi
- Total 249 Consumers

Section 5. Impact Evaluation

The purpose of the impact evaluation was to estimate the reduction in peak demand and energy use due to the CFL program in Nashik. These estimates were expected to provide a better estimate of the level of cost-effectiveness of CFLs before the launch of the State-wide program. In this section, we first list the data requirements for estimating the impacts of the program. Because energy saved due to a CFL is heavily influenced by the usage patterns of the light point, we then look at the locations in the house where consumers installed CFLs. Then we discuss the reductions in energy use and peak demand achieved by the program.

5.1 Data Requirements for Estimating Energy Savings and Peak Reduction

What is involved in determining the reductions in peak demand and energy? Focusing first on the reduction in peak demand, we see that :

Reduction in peak demand for a consumer (in kW) =

Sum for all the CFLs installed by the consumer of:

Reduction in power consumed (in kW) during the evening peak hours (6PM to 10PM) by each light which now has a CFL

Similarly,

Reduction in energy consumed by a consumer during a day due to installation of a CFL in a light fixture (in kWh) =

The reduction in power consumed by the light (in kW) x the number of hours that the light is on during the day (in hours)

In order to calculate the reduction in peak demand due to the entire program, the reduction in peak demand for all consumers would have to be added. Similarly, in order to get the total energy reduction in a month due to the program one would have to add the energy savings in a month due to all the CFLs in a household and then add together the results for all households.

From the above discussion one can see that in order to estimate the savings due to CFLs, we need to know the following variables for each consumer:

- The number of CFLs installed by the consumer
- The power displaced (reduced) by each CFL
- The times when each CFL is on

We used data from the survey to obtain estimates for these three variables. We developed engineering estimates[9] of the energy and peak demand reduction estimates per

[9] There are basically two types of evaluation techniques to estimate the impact of a program: (1) engineering methods; and (2) statistical methods. Engineering methods use models or equations to describe energy consumption and use them to estimate changes in energy use based on factors that would change due to the program. On the other hand, statistical methods compare changes in recorded consumption data

month for each of the sampled consumers using the formulas given above. These engineering estimates for each sampled consumer were then used to obtain an estimate of the average peak demand and energy reduction per month per CFL for the urban and rural areas. The estimation of total demand and energy reduction within the urban or rural areas then became simply a matter of multiplying the reduction per CFL for the respective area by the number of CFLs sold to consumers in that area.

We had intended to refine the engineering estimates of energy reduction by using billing data analysis for the sampled consumers. However, we found that the billing data had many cases of average billing which led to jumps in consumer bills whenever a "corrected bill" was issued to the consumer. In fact these jumps in the bills were several times the savings we expected from the CFLs and would have masked the effect for which we were looking. Therefore, the billing data was inappropriate for use in statistical analysis, and we decided to abandon efforts to correct the engineering estimates through statistical analysis.

5.5 Uses of CFLs by Sample Consumers

As discussed earlier, in order to assess whether CFLs were being used appropriately by the program participants, we asked the consumers in our sample where the CFLs were installed and what did they replace. Table 5.1 categorizes the responses. As the table shows, almost 60% of the CFLs in urban areas and more than 50% in rural areas were used to replace fluorescent tubes. Furthermore, only 24 percent of the CFLs in urban areas and 41 percent in rural areas were used appropriately, i.e. to replace incandescent bulbs that ran for at least three hours every day. The fact that about 5-10 percent of the CFLs were used in bathrooms or were stored and not used at all indicates that CFLs may have been "oversold" by the sales-persons. In any case, the small number of CFLs that were used appropriately indicates the need for better communication with consumers regarding the appropriate use of CFLs.

Table 5.1 Variety of Uses of CFLs by Sample Consumers

	Replaced Tube	Replaced "Zero Watt" Bulb	Used in Bathroom	Not Used Yet	Replaced Incand. Bulb in Other Location
Urban	59%	4%	9%	4%	24%
Rural	52%	2%	2%	3%	41%

to estimate the impact of a program. The two techniques can also be combined resulting in hybrid techniques. In our review of the Nashik program, we used simple engineering equations based on the power consumption of the replaced light source and the CFL to estimate reduction in peak demand and energy use. As discussed in the body of the report, we had intended to use billing data analysis (a statistical method) to refine the engineering estimates but had to abandon those efforts because of limitations of the data.

5.4 Energy Savings and Peak Demand Reduction

Using data from the survey on the hours of use, wattage of replaced lamp, and time of use for each CFL used by a consumer in the sample, we calculated the energy saving per month and the expected peak demand reduction per CFL. Those results and other key impacts are shown in Table 5.2. Using these data, we also calculated the annual energy savings and peak demand reduction from the program and they are shown in Table 5.3. These estimates of the total annual impact of the program have been shown as a range because data on the rural-urban mix for the program was not available. The low end of the range in these estimates represents the urban pattern of energy savings and the high end represents the rural pattern.

Table 5.2 Energy Savings and Peak Demand Reduction of Program as Implemented

	Urban	Rural
Number of CFLs sold per participant	3.8	3.9
Average usage of CFLs (hours/day)	4.6	4.9
Energy saving per CFL (kWh/month)	2.5	3.4
Peak reduction per CFL (Watts)	18.2	23.3

Table 5.3 Total Program Annual Energy Savings and Peak Demand Reduction

Total Number of CFLs Sold	3.79 lakhs
Estimated Program Annual Energy Saving	12-16 MU
Estimated Peak Demand Reduction	7-9 MW

The impacts that we have shown above are calculated directly from the effect of the CFLs that were installed without any adjustments (also known as gross impacts). Normally, one would adjust these gross impacts for other effects such as free-ridership and rebound[10] to arrive at the net impact due to the program, i.e. the impact that can be attributed to the program. In our survey questionnaire we asked participants about increased usage of lights after installation of CFLs and almost no one reported increased usage indicating that rebound was essentially non-existent. While we did ask participants would have installed CFLs anyway, an accurate determination of free-ridership would have required more detailed questions, and would have lengthened the already long questionnaire even further. Furthermore, we felt that at this stage of development of DSM programs, energy savings was more important and accurately determining cause and effect less important.

[10] Free-ridership refers to the reduction in energy use that would have occurred even if there had been no program because some people would have installed energy efficient equipment (CFLs in this case) anyway. Rebound refers to an increase in use of an energy service (lighting in this case) because participants may feel that they are saving money due to the program and can thus afford to increase their usage of the energy service.

While our sample of consumers was stratified by level of consumption, we did not see any significant pattern in the energy savings related to consumption level. Therefore, our results are not reported by consumption level but segregated only by type of area – urban or rural. The lack of a significant effect of consumption level on energy savings may be because almost all the CFLs were sold in poor neighborhoods where there were very few consumers with consumption above 150 kWh per month.

5.6 Impacts of Appropriately Used CFLs

Given the high number of CFLs that were inappropriately used, it is natural to ask what would have been the energy savings and peak reduction if all CFLs had been appropriately used. Therefore, we calculated the energy and peak savings for those CFLs only that replaced incandescent bulbs excluding those used in bathrooms and in place of "zero-watt" bulbs. Table 5.4 shows the results. Many consumers were using a CFL that gave more light than the bulb that was replaced and thus were using a higher power CFL than was necessary. We corrected for this fact also and assumed that a 40W or 60W bulb was replaced by a 15W CFL.

Table 5.4 Impact of Appropriately Used CFLs

	Urban	Rural
Number of CFLs sold per participant	3.8	3.9
Number of CFLs used appropriately per participant	0.9	1.6
Average usage of appropriately used CFLs (hours/day)	4.7	5.2
Energy saving per appropriately used CFL (kWh/month)	4.5	5.9
Peak reduction per appropriately used CFL (Watts)	31.6	38.4

Comparing Tables 5.4 and 5.2, we can see that appropriately used CFLs resulted in significantly greater energy savings and peak reduction compared to the average for all CFLs used by the sample consumers. The usage of these CFLs was also longer.

Based on the information gathered from the survey, how cost-effective were CFLs? Table 5.5 answers that question from the perspective of both the consumer and the utility. With the prices paid by consumers for CFLs purchased on the installment plan, the pay-back period for rural consumers was about the same as the warranty period, but the pay-back period for urban consumers was longer than the warranty period. [11]

Table 5.5 Cost-Effectiveness of Appropriately Used CFLs

Consumer Perspective	Urban	Rural
Energy Savings per CFL (kWh/month)	4.5	5.9
Applicable Tariff (Rs/kWh)	2.50	2.50
Consumer Savings (Rs./month)	11	15
Pay Back Period (months)	10-11	7-9

[11] Generally, the warranty should exceed the payback period. This provides an assurance that the consumer's saving in energy bills would be more than his or her investment.

Utility Perspective	Urban	Rural
Energy Savings per CFL (kWh/month)	4.5	5.9
Energy Savings per CFL including 10% losses (kWh/month)	5.0	6.6
Applicable Tariff (Rs/kWh)	4.50	4.50
Utility Savings (Rs./month)	10	13

Note: Savings for the utility have been calculated by taking the difference between the power purchase cost to the utility (Rs. 4.50/kWh) and the amount it recovers from consumers (Rs. 2.50/kWh) and multiplying it by the energy saved including losses.

As can be seen from Table 5.5, the savings to the utility due to use of CFLs were about the same as the savings for the consumer,[12] and the payback time was greater than the warranty period. If the utility is able to bring down the price at which CFLs are procured for the State-wide program, the pay-back would be even shorter. It should be noted that the utility paid nothing but got savings comparable to the consumers, and therefore, the utility should share some of its savings with consumers, to make the program more attractive for them.

This analysis assumes appropriate use of CFLs. If consumers continue to use CFLs inappropriately, then the payback period will be longer (18-20 months for urban consumers and 13-15 for rural consumers), and then the economics for consumers would look much worse. Therefore, in order to make CFLs cost effective for consumers, it is important that the utility ensures that CFLs are used appropriately.

Section 6. Quality of the CFLs

The quality of CFLs in the program has considerable effect on the level of participation and hence on the overall success of the program. Furthermore, poor quality CFLs can sour consumers towards CFLs and thus damage their future business viability. Therefore, it is important to monitor the technical performance of the CFLs. In this section, we look at the failure rates of the CFLs because this performance parameter played an important role in how the Nashik program developed. In addition, we will look at the power factor and harmonics generated by the CFLs and their impact on the power system. As we show later, a poor power factor can negate some of the benefits of energy savings due to the use of CFLs.

[12]Assuming a one year life (same as the warranty period), the cost of saved energy for appropriately used CFLs is Rs. 2 per kWh in urban areas and Rs. 1.50 per kWh in the rural areas. Even with a one-year life, the cost of saved energy is significantly lower than the cost of purchased power for the utility. If we use the specified life-time for the CFLs which is supposed to be 6000 hours (3-4 years), then the cost of saved energy will be much lower.

6.1 Failure Rates

The IFB required that, "The CFLs and TBs shall meet the Voluntary Technical Specifications of Efficient Lighting Initiative (ELI)." The ELI specifications which were also attached to the IFB require that, "CFLs must have a minimum rate lifetime of 6000 hours as defined in IEC 60969. Lifetime shall be clearly indicated in hours on product packaging."

However, we found that not all the CFLs sold through the Nashik program met these specifications. None of the CFL packages said explicitly that the life of the CFL was 6000 hours. CFLs from Company A did not give the lifetime on the package, instead the package had a drawing of one CFL and 6 incandescent bulbs with a caption that said, "Upto 6 Times Longer life." The package for Company B CFLs said that it "Lasts upto 5 years," with small print that said "At 4.5 hours a day," giving a total life of about 8200 hours. We now review the data generated on CFL failures through the survey of participants.

As part of our survey of program participants, we asked respondents several questions regarding their experience with failure of CFLs and the process for obtaining replacements. Specifically, we asked consumers: (1) how many "lights" had failures; (2) the number of failures at each light; (3) the time that a CFL worked before it failed. From the responses, we were able to determine two types of failure rates. First, we were able to determine how many of the initial set of CFLs purchased failed over the period (approximately six months) that the program was operational. Second, we were also able to determine the total number of failures over the six month period of all CFLs used by the respondents including replacements.

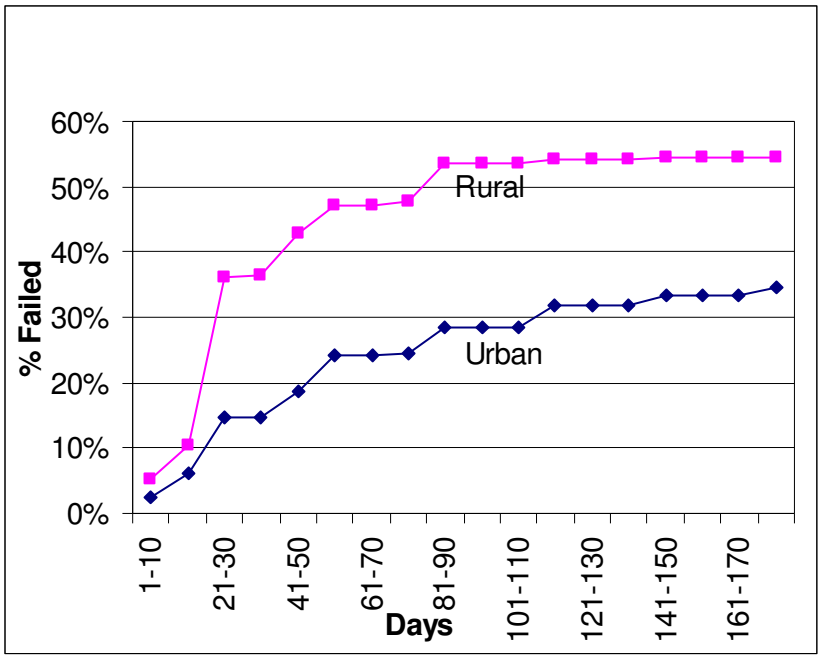
First, as Table 6.1 shows, almost every rural household in our survey (96%) had at least one failure and in the case of urban households about 70% had at least one failure. Table 6.1 also shows both types of failure rates for the CFLs used by the respondents to the survey. The six month failure rate for the initial set of CFLs purchased by the consumers was very high for urban consumers (41%) and extremely high for rural consumers (74%). The failure rate of all CFLs used including replacements was a little lower but still very high for both urban and rural consumers.

Table 6.1 Six Month Failure Rates of CFLs Used by Survey Respondents

	Consumers Who Experienced At Least One Failure of CFLs	Failure Rate of Initial Set of CFLs Purchased	Failure Rate Including Replacements
Urban	69%	41%	35%
Rural	96%	74%	55%

We also examined the data on how long each of the failed CFLs lasted before failure (the life-time) to see how the life-time was distributed. Figure 6.1 is a plot of the cumulative frequency distribution of life-times. Essentially, this figure shows what percentage of CFLs failed within a certain time after being in use. It shows that in rural areas, 50% of the CFLs failed within 90 days (3 months) of being installed. Similarly, about 32% of the CFLs installed in urban households failed within 120 days (4 months). Because these numbers include replacements some of which have been in service for a short time only, the actual failure rate was likely higher.

Figure 6.1 Area-Wise Percentage of Failed CFLs by Days of Usage



We also looked at failure rates by company and Table 6.2 shows the results. The six month failure rates for CFLs from Company A were much higher than the rates for Company B CFLs. It is obvious that the failure rates in the Nashik program were exceptionally high particularly for CFLs from Company A[13].

[13] Company A acknowledged that the failure rates for their CFLs were high and attributed them to a component in their CFLs supplied by another manufacturer that did not meet its reliability specifications. Further, the company stated that it had started a helpline service for replacement of CFLs. It also collected feedback forms from customers and claimed that number of complaints had decreased.

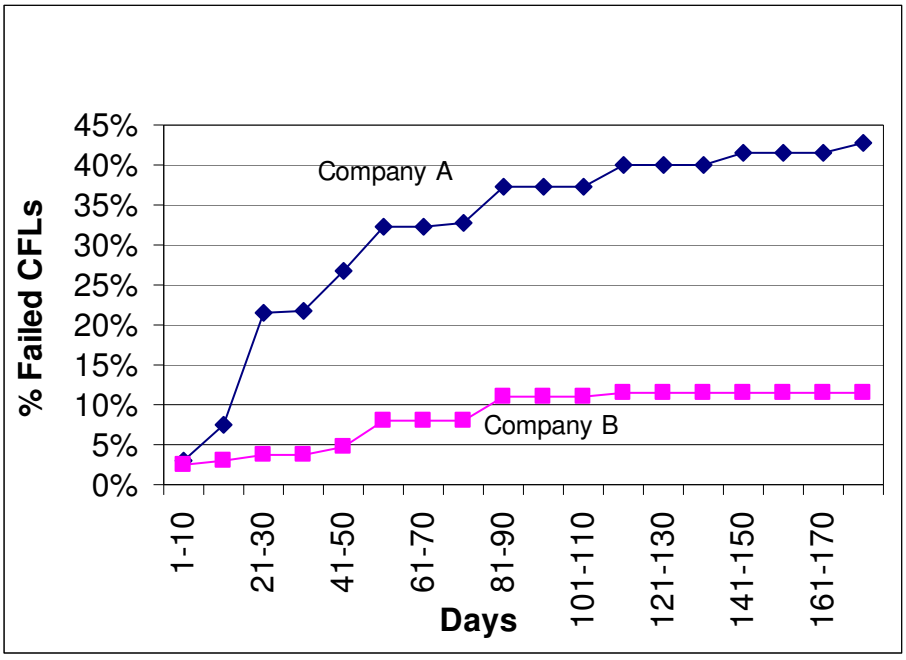
Table 6.2 CFL Failure Rates by Company

	Company A	Company B
Failure Rate of Initial Purchase of CFLs	54%	12%
Failure Rate Including Replacements	44%	12%

Note: These failure rates are based on responses of both urban and rural consumers

These results are further confirmed by Figure 6.2 which shows the cumulative distribution of life-times of the CFLs used by consumers by company.

Figure 6.2 Company-Wise Percentage Failed CFLs by Days of Usage



Note: These charts are based on data for both urban and rural consumers.

6.2 Power Factor and Harmonics

According to the IFB, "The CFLs shall meet the Voluntary Technical Specifications of the Efficient Lighting Initiative (ELI) and/or the relevant Standard issued by the Bureau of Indian Standards for CFLs." These specifications require a power factor of 0.5 or better.

A power factor (pf) as low as 0.5 for CFLs can significantly reduce the benefits of CFLs. While the active power requirements continue to be low even with low pf CFLs, the

current is relatively higher. Therefore, the reduction in distribution losses is not as high as it would be if the pf was high.

An even more important concern of CFLs with low pf is that the low pf is mainly due to the high harmonic distortion in the current drawn by them. Because the current drawn by the CFLs is "peaky" it has a very high third harmonic content. These harmonics can have several damaging impacts on the power system, specifically[14]:

- Overloading of the neutral conductor of LT systems;[15]
- Overloading of delta-connected windings of transformers due to excessive third harmonics;
- Higher core losses in transformers;
- Resonance between power factor correction capacitors and transformer reactances at some harmonic frequencies leading to overloading of capacitors;
- Possibility of malfunctioning of control equipment due to the distorted waverform created by harmonics;
- Possibility of interference with communication circuits.

If a large-scale introduction of CFLs is planned, then we must consider these potential detrimental impacts on the power system in the specifications for CFLs particularly with regard to power factor and total harmonic distortion (THD). It is essential to note that several CFL manufacturers in the country offer products with pf of more than 85%. These CFLs with passive pf correction are expected to cost only marginally more than CFLs with low pf.

It is reported that BIS is planning to require that all CFLs have a pf of 0.85 or more by January 2009. The current standard requires a pf of 0.5 or better. In addition, the Bureau of Energy Efficiency is considering endorsing better grade CFLs, and one of the requirements for the endorsement label will be a pf greater than 0.85. These developments are welcome and will address some of the issues raised in this section.

Section 7. Review of the Tracking and Monitoring System

Tracking refers to the recording of program data while monitoring refers to the general oversight of the program. By providing information on the performance of the program on an ongoing basis both these activities can be thought of as ongoing evaluations and they provide information for impact evaluations and process evaluations. In fact, if the development of tracking and monitoring systems is coordinated with evaluation planning, the need for additional data collection is minimized.

[14] From Pabla, A.S. (1997), *Electric Power Distribution*, 4th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi

[15] This is of special concern in rural areas where household lighting load is a major component of evening peak load

7.1 Review of the System

7.1.1 Design of the Tracking and Monitoring Systems

As we mentioned earlier, the description of the program given in this report deviates from the description given in the IFB[16]. It seems that changes were made in an ad-hoc manner to the procedures given in the IFB. In spite of repeated requests to MSEDCL, we were unable to obtain a written description of the program as it has actually been implemented. While we understand the need to modify procedures, these changes should have been codified. Without any written description of the program as it was implemented, it was difficult for the staff of MSEDCL and others to monitor the program.

In addition to the lack of a clear, written description of the program as it was implemented, there were three other shortcomings in the tracking and monitoring systems that made effective oversight of the program difficult. First, there was no information on failures and replacements in the data that were transmitted to MSEDCL by the retailers and manufacturers. As we discuss later, high failure rates of CFLs were a problem for many consumers, but MSEDCL was not in the information loop. Thus MSEDCL could not monitor, and was not monitoring, this aspect of the program with serious negative consequences for service quality for consumers.

The second shortcoming in the tracking system was that Form B-10 data that MSEDCL received from the companies did not contain explicit information on how many 15W CFLs and 20W CFLs a consumer bought, even though the total number of CFLs bought by the consumer was given.

The third shortcoming in the design of the tracking and monitoring systems was that the data on outright sales provided by the manufacturers was limited. Because it did not contain detailed information on the consumers such as the consumer number, it was difficult to verify the direct sales data. Further, because the date of purchase of CFLs is not provided, it would have been difficult to compare expected savings with billing or metered data.

7.1.2 Huge Backlog in Data Entry

In order to be effective, tools for program oversight, tracking and monitoring systems must remain up-to-date. If data in these systems are incomplete or do not accurately represent the state of the program, then the tracking system cannot provide correct feedback to the program administrators and thus no longer helps in oversight of the program.

[16] For example, the IFB talked only of one delivery mechanism where the bill collection center would give a leaflet giving retail outlets where consumers could buy CFLs. The use of Bachat Gut women and other delivery mechanisms was not mentioned. In fact, there was no written description of the procedures to be used when BG women made the sales. In addition, the installment amounts charged by MSEDCL differed from what was given in the letter of award for the Nashik program, even though the total amount charged to consumers remained the same.

Unfortunately, the data entry at MSEDCL for the Nashik program was heavily backlogged. On August 4, 2006 when we received data from IT department of MSEDCL, data for only 31,579 consumers had been entered. This is about a third of the total number of participants. As of the first week of September, 2006, none of the manufacturers had been paid. Quite clearly, this long delay in entering data had made the tracking and monitoring system useless for oversight of the project.

Section 8. Process Evaluation

Process evaluation involves an assessment of the program design and the associated procedures and systems to see if the program can be improved. Using in-depth interviews with samples of participants, non-participants, manufacturers, and distributors we elicited responses to the following aspects of the program:

- What was the general level of satisfaction with the program? What were the reasons for the satisfaction/dissatisfaction?
- How effective were the marketing and promotional materials and how could they be made more effective;
- What were the reasons for participation or non-participation? What aspects of the program were attractive for potential participants? What aspects acted as deterrents?
- How could the program procedures be made easier for participants?

As part of the process evaluation, we also conducted in-depth interviews with MSEDCL personnel at several levels and examined various documents to understand details of how the program was designed and implemented. We also got the MSEDCL staff's general opinion of the program and how it could be improved.

In this section of the report, we first describe the issues and concerns raised by the interviewees, particularly the participants in the program. Then we discuss the results of our review of three aspects of the program: (1) the bidding process; (2) the program design; and (3) marketing and communications.

8.1 Issues and Concerns Raised by Interviewees

8.1.1 Quality of the CFLs

We take up the quality of the CFLs first because it is the issue that was most often raised by consumers and was also the issue that had raised the ire of consumers. Many consumers had bulbs that failed very soon after purchase. Furthermore, in some cases replacements also failed. This made consumers very angry. In rural areas where the failure rate was even higher, the reaction was stronger.

In addition to bulb failures, a significant number of people complained about the insufficiency of light. This must have been partly due to improper replacement (replacement of tubes). But some also complained about the low illumination compared

to lamps of other CFL manufacturers. Several consumers complained that the illumination of the CFLs from Company A gradually declined over a period of a few months.

Many respondents emphasized the need to improve the quality of CFLs. There were recommendations that the bulbs should be from a "standard" company and their performance should be "guaranteed,". In one village, the local retailer said that consumers were asking for other brands. Since the CFLs were co-branded by MSEB, many consumers assumed that the bulbs under the program were from MSEB and said "private" CFLs performed better. This is an example of how MSEB's or MSEDCL's brand equity is eroded due to poor performance as we discuss later in the report.

8.1.2 Replacement of Failed CFLs

Given the high number of failures, replacement of failed CFLs became an important aspect of the program that needed to be reviewed. As part of the survey questionnaire, we asked consumers whose CFLs had failed whether they had any problems getting a replacement. Table 8.1 shows the responses. A significant number of respondents in the survey particularly in rural areas (30%) had problems in getting a replacement.

Table 8.1 Experience with Replacement of Failed CFLs

	Faced Problem with Replacement
Urban	14%
Rural	29%

Note: The number who faced problems with replacement is given as a percentage of those respondents who had at least one failure of CFLs; that is only those who may have tried to get a replacement.

Comments by consumers either during the survey or during an in-depth interview confirmed that replacements were a significant problem and also provided details on the kinds of difficulties faced by consumers seeking replacements.

- There was lack of information (or lack of correct information) given to consumers regarding replacements. Some consumers told us they did not know that they could get replacements and others who told us they did not know where to go for replacements

- Consumers seeking replacements often found themselves either being shunted from one office to another or making repeat visits to the same location. Perhaps due to the very high failure rate, retailers stalls or collection centers often ran out of CFLs and consumers had to go another time to get a replacement.

- Replacements in the rural areas were particularly difficult for consumers. Many consumers said that they had to travel long distances to get replacements and the travel expenses (up to Rs. 50 per trip) were a big deterrent for them. As one respondent told us, "It is a very long way to go for replacement. Five of my bulbs failed. I went twice. But cannot go every time. Need good quality and long-life bulbs." There were several such examples where consumers just stopped going for replacements because of the time, money, and effort involved.

- However, we did note that in some villages replacements were easier. In these villages, the retailer had an agent in the village usually a small retailer who replaced the bulbs for a small fee of about Rs. 10. But there were some cases of unfair practices by retailers, who sought higher amounts for replacements.

- In addition to the cases discussed above, there were a sizeable number of consumers (about twenty in our sample, constituting about 8% of the sample) who said that they had not gone to get a replacement for the failed CFLs. We were not able to ascertain the reasons for their behavior: Was distance or travel expense a deterrent? Were there other difficulties? Or was it simply inertia?

It is important to note that the distributors made significant efforts to replace failed CFLs, but the extremely high failure rate compounded the problem of replacement.

8.1.3 Overall Scheme

In our survey questionnaire, we asked what people thought of the program and asked them to rank it as good, fair, or bad. As Table 8.2 shows, 60% of the urban respondents said that the program was good and 31% said it was fair. Rural consumers' response was a little more luke-warm with about half the respondents saying it was good and the other half saying it was fair.

Table 8.2 Participants' Perception of Program

	Good	Fair	Bad
Urban	60%	31%	7%
Rural	45%	51%	2%

We also asked those consumers who said the program was either fair or bad why they felt that way. CFL quality was a big concern (51%) for rural consumers but it was an issue even for urban consumers (27%).

Our interaction with consumers in in-depth interviews confirmed this view, with most people liking the program, even though they said that the quality of the CFLs needed to be improved. As one urban consumer said during the in-depth interview, the scheme is good for the poor because it allows payment for the bulbs in installments. He said that the one year warranty was also important. We did have two consumers who gave their

whole-hearted approval for the scheme saying that they were very satisfied with it and the CFLs they had purchased.

8.1.4 Motivation for Participating or Not Participating

In order to understand consumers' motivation to participate in the program, we asked respondents' in the survey about it and gave them several possible motivating factors as options. Reduction in bills was the most cited reason for participating with 80% of consumers saying that it was a motivating factor. The next most cited reason was the installment scheme, followed by the provision of a warranty.

The importance of the warranty was also confirmed in the in-depth interviews. It was interesting that hardly any participant said that price of CFL was lower in the scheme compared to the market price.

We had also interviewed some non-participants to understand why they had decided not to participate. In urban areas, we found that many people did not participate because the program was not offered in their areas. As we discuss later, the marketing efforts were targeted mostly towards poor neighborhoods, and so many middle-class and upper-class consumers were not even aware that the program existed

There were several other reasons why some urban consumers who knew about the program chose not to participate.

- Many such non-participants already used CFLs and felt that the price and warranty offered under the program was not very different from what was being offered in the market for the CFLs of other manufacturers.
- Some non-participants had requirements that could not be met by the CFLs offered under the program. For example, a jeweler required golden/yellowish light not given by the CFLs in the program, and another consumer had fixtures in a recessed space in which the CFLs in the program would not fit.
- Some urban non-participants said that they were aware of the high rate of failures of the program CFLs and therefore chose not to participate.
- In rural areas, many non-participants said that they would have liked to buy the CFLs under the program, but the program had already come to an end or the Bachat Gut sales-women had stopped coming to their village.

8.2 Bidding Process

We include the bidding process in the evaluation of the program because it has a significant effect on the outcome of the project and there may be ways in which it can be improved. During the evaluation of the bids submitted by the manufacturers, the technical proposal was given a weight of 70% and the financial proposal was given a weight of 30%. The technical proposal contained items such as the number of years in operation in India, the annual turnover, the warranty period offered for the CFLs, and

experience in utility lighting program. We think that the offered warranty period could have been included in the financial proposal and the other criteria set up as thresholds for qualification. Then the competition during bidding would have been solely on the financial proposal which would have included the warranty period.

For the evaluation of the financial proposal, the average of the price offered by manufacturers for CFLs that would replace 40W, 60W, 75W, and 100W incandescent bulbs was used. Because replacements for 40W and 60W only were offered in the program (15W and 20W CFLs), it may have more appropriate to use the prices for these products only in the evaluation.

As part of their proposals, manufacturers were required to submit proof of compliance with technical specifications (relevant BIS standards and/or ELI specifications). A quick look at the proposals submitted showed that there was considerable variation in documents that were submitted to comply with this requirement of the bidding process. Some companies submitted test results from approved institutions, others had letters from standards organizations such as BIS giving a license to use certain standards (IS15111 for CFLs of 11-15W ratings). However, some submitted a specification sheet – without even a signature. Despite repeated requests to MSEDCL, we did not receive copies of the relevant sections of the proposals which included documents submitted by the various manufacturers.

8.2.1 Price Comparison

We also found that the prices consumers hade to pay for CFLs bought under the program were not really concessional prices. For example, around the same time, Reliance was able to obtain 15W CFLs for its consumers at Rs. 82 compared to Rs. 100 that MSEDCL's consumers had to pay. Further, internationally one could obtain 15W CFLs for about $1.25 to $1.5 (about Rs. 55 to Rs. 70) if bought in bulk.

In order to see how the prices and warranty offered under the program compared with what was offered in the market, we compared the prices and warranties in Pune for CFLs with terms offered offered in the Nashik program. We found that all manufacturers offered a one-year warranty for their CFLs, implying that a one-year warranty has become the standard for CFLs in the market. For a comparison of prices, please see Table 8.3 which shows the indicative prices in Pune for CFLs from various manufacturers. As can be seen from the table, the prices from the various manufacturers varied widely. These prices were for products that had specifications for life-time, pf, etc. that were comparable to the specifications for the CFLs sold through the Nashik program. It can be seen that the program prices were not significantly lower than prices that can be obtained in the open market. For example, one manufacturer's price for a 15W CFL bulb was lower by about ten rupees from the price offered to consumers in the Nashik program. The manufacturer's price for a 18W bulb were about ten rupees higher than the program price for a 20W bulb.

Table 8.3 Comparison of CFL Prices in Pune with Program Prices

Sr.No	Company	Wattage	MRP (Rs.)	Discounted Price (Rs.)
1	Phillips	14	130	120
		18	170	150
		23	200	180
2	Osram	15		100
		20		140
3	Indo Asian	15	160	130
		20	220	180
4	Orpat	14		90
		18		120
5	Havell	15		110
6	Prompten	20		150
7	Bajaj	25		180
8	Anchor	14	150	120
		18	185	148
		23	205	164
9	Nashik Program	15		100
		20		110

8.3 Marketing of the Program

Even the best-designed program will fail if consumers do not participate, and consumers will participate only if they know about the program and its benefits for them. Thus

marketing of the program to disseminate information to consumers about the program and its benefits is essential for the success of the program.

We found that there was considerable awareness of the savings potential of CFLs among the respondents in our survey most of whom were from poor neighborhoods. Of course, some of this awareness existed even before the program was started. In fact, 47 percent of our respondents said that they were aware of the savings potential of CFLs before the program was started. In addition, many consumers said that they learned about the Nashik program at meetings and events regarding energy efficiency organized by MSEDCL, and they were persuaded to participate on the program based on what they heard there.

While these efforts by MSEDCL to disseminate information in the poor neighborhoods were commendable, we did find that the marketing efforts were not spread out evenly throughout the district of Nashik.

PART III. CONCLUSIONS AND RECOMMENDATIONS

Section 9. Conclusions and Recommendations

In Section 2 of this report, while discussing the role of the utility in a DSM program, we listed four functions it should perform: (1) increase consumer awareness about energy efficiency measures and technologies; (2) lower the hurdle of high initial cost of energy efficient devices through innovative financing mechanisms; (3) reduce the price of energy efficient devices/technologies through bulk purchases; (4) provide assurance to consumers about the quality of energy efficient equipment. Our report shows that in the Nashik project, MSEDCL performed the second function well. The installment scheme helped lower the initial cost burden and helped increase participation considerably.

However, MSEDCL's performance on other aspects of the pilot project left much to be desired. Consumer awareness about CFLs increased through the marketing efforts of the manufacturers. But this also had a negative impact – awareness was geared to maximize CFL sales and not energy savings. The utility was not able to reduce the price significantly relative to the market price even though a large quanitity of CFLs were being purchased by consumers in Nashik. Of greater concern was the poor quality of the CFLs provided to consumers. Consumers, particularly in rural areas, were further burdened by the additional effort and cost of getting replacements. Clearly, the program design and systems for oversight need to be improved. We now look at these issues in more depth and see what lessons we can cull out for other DSM programs in India.

Lessons from the Nashik Pilot Project

CFLs are a cost-effective means for saving energy

As shown in Table 5.5, based on our survey results, poor consumers in Maharashtra that pay low power tariff using CFLs in appropriate locations save about Rs. 11-15 per month per CFL. For consumers paying higher tariffs, the savings will be even more. In addition, the utility too saves about Rs. 10-13 per CFL per month. The program is thus beneficial from the consumer, utility, and societal perspectives.

However, high failure rates can obliterate the benefits for consumers. Therefore, it is important that the specified life of CFLs is ensured through random sample testing by the utility. Further, CFLs with low pf can significantly reduce the benefits because of high harmonic distortion and high currents. Wherever a large-scale introduction of CFLs is planned, these potential detrimental impacts on the power system must be considered in the specifications for CFLs particularly with regard to power factor and total harmonic distortion (THD).

It is reported that BIS is planning to require that all CFLs have a pf of 0.85 or more by January 2009. The current standard requires a pf of 0.5 or better. In addition, the Bureau of Energy Efficiency is considering endorsing better grade CFLs, and one of the

requirements for the endorsement label will be a pf greater than 0.85. These developments are welcome and will address some of the issues raised in this section.

Another enhancement that should be considered is that of non-integral ballasts (ballast and lamp separate). The advantage is in case of failure, the entire unit does not need to be replaced; just the part (usually the lamp) that is damaged. Care should be taken to ensure that the lamp-ballast adapter is standardized**,** so that at the time of lamp replacement, a customer is not bound to use a lamp from the manufacturer of the ballast.

Consumers are keen to participate in DSM programs

The penetration of CFLs through the Nashik program has been impressive. The sale of CFLs of 3.79 lakhs exceeded the target of 3 lakh CFLs set up before the program was started. Furthermore, this penetration of CFLs has occurred in poor neighborhoods, demonstrating that the poor are eager to participate in such programs provided they are made affordable through innovative financial schemes such as the installation plan for this program. The results also show that the poor adopt new technologies rapidly if they are aware of the benefits of the technology.

Utility sponsored programs can be effective if designed carefully

As shown by the Nashik program, utilities can greatly facilitate the penetration of energy efficient technologies by increasing awareness and reducing the barrier of high costs through bulk purchases and installment schemes that make the program attractive particularly for poor consumers.

Utilities can further enhance the success of DSM programs through innovative delivery mechanisms. In the Nashik program, the most successful delivery mechanism was the use of Bachat Gut women to sell the CFLs door to door. The cost of distribution paid to the women was reportedly only a rupee per CFL. This is an attractive alternate channel for large scale targeted distribution.

Utility sponsored programs can be made even more attractive by innovative design of the payment schedule. By extending the period over which the cost of CFLs is recovered from participants, the amount of the installment can be lowered and thus participation can be made more attractive to consumers.

Another area where improvements can be made is in communication with consumers about the appropriate use of CFLs. The survey results for the Nashik pilot program show that many consumers in the sample were replacing tubelights with CFLs and thus not realizing the energy saving potential of the CFLs without loss of illumination. Even those who replaced incandescent bulbs used CFLs of with a higher light output (lumens) and higher wattage than necessary. In order to realize the savings potential discussed above, it is important that consumers be told about the appropriate use of CFLs particularly regarding: (1) use of CFLs in place of incandescent bulbs that are on for at

least 3-4 hours every day; and (2) replacement of incandescent bulbs by a CFL of equivalent lumens.

Evaluation can provide important lessons and ensure success of the program

Evaluation of DSM programs can provide important information for decision makers regarding actual savings. In addition, evaluation can provide feedback that can be used to improve on-going as well as future programs.

We could not use statistical methods for estimating impacts for the Nashik pilot program because good billing data was not available and its requirement had not been considered when designing the program. The data requirements for evaluation should be incorporated into the design of the program so that data is collected when it is most effective to do so. In addition baselines should be set up so that program impacts can be accurately estimated.

The problems experienced by consumers with failures and replacements of CFLs in the Nashik program highlight the importance of a tracking and monitoring system. An effective tracking and monitoring system would have provided information on the performance of the program on an ongoing basis and thus allowed mid-course corrections to the program. Our review of the Nashik program indicates that evaluation including tracking and monitoring should be handled by an independent agency or company or a dedicated team within the utility for both urban and rural areas.

Capacity building and assistance in program design and evaluation would be useful for utilities

Because DSM is a new area for most utilities in India, there is a lack of understanding and expertise regarding these issues in the utilities. The experience with the Nashik program demonstrates the importance of proper program design and on-going oversight (evaluation) in the success of DSM programs. Therefore, the Bureau of Energy Efficiency (BEE) of the central government should institute technical assistance and training programs in DSM for utilities' staff. The training should include monitoring and evaluation of DSM programs.

ANNEXURE
SURVEY QUESTIONNAIRE

मुलाखत घेणाऱ्याचे नाव :					**वेळ :**		**दिनांक :**	
नमस्कार, माझे नाव, मी, प्रयास ऊर्जा गट, पुणे यांच्या वतीने वीज कंपनीने (महावितरण) नाशिकमध्ये राबविलेल्या सीएफएल योजनेचा अभ्यास करीत आहे. ही संपूर्ण राज्यभर राबविण्यापूर्वी तिच्यामध्ये कोणत्या सुधारणा होणे अपेक्षित आहे; यासाठी आम्ही हा अभ्यास करतोय. तुम्ही या योजनेअंतर्गत काही सीएफएल दिवे विकत घेतल्याचे आम्हाला कळले. यासंदर्भात तुमची परवानगी असल्यास मी तुम्हाला या दिव्यांच्या वापरासंबंधी व तसेच या योजनेतील तुमच्या अनुभवांविषयी काही प्रश्न विचारू इच्छितो.								
१		**ग्राहकांचे नाव :**					**ग्राहक क्रमांक :**	
		पत्ता :						
		खरेदी संबंधीचा तपशील	*(योग्य त्या ठिकाणी उत्तराभोवती गोल करा.)*					
२		तुम्ही सीएफएल रोखीने की हप्त्यावर विकत घेतला आहे?	रोखीने	हप्तावर				
३		तुम्ही सीएफएल कोठून (कसा) विकत घेतला?	सीएफएलवरील कार्यक्रमात	अंगणवाडी महिलोकडून	वीजभरणा केंद्र	दुकानदार	इतर	
४		तुम्ही विकत घेतलेला सीएफएल कोणत्या कंपनीचा आहे?	एशियन	हॉलोनिक्स	ओसराम			
५		तुम्ही सीएफएल दिवा कधी विकत घेतला? (महिना/दिनांक)						
६		किती सीएफएल दिवे तुम्ही विकत घेतले? १५ वॅटचे किती? २० वॅटचे किती?	१५ वॅट	२० वॅट	एकूण			
		प्रश्न क्र. ७(अ) सर्व दिव्यांसाठी भरून घ्यावे. नंतर सर्व उर्वरित प्रश्न प्रत्येक दिव्यानुसार भरून झाल्यावरच दुसऱ्या दिव्यासाठी प्रश्न वाचारावे. (उदा. दिवा १ साठी प्रश्न ७ (ब) ते ७ (फ) पूर्ण विचारून झाल्यावर दिवा २ साठी प्रश्न विचारावे.						
			दिवा १	**दिवा २**	**दिवा ३**	**दिवा ४**	**दिवा ५**	
७	अ	तुम्ही सीएफएल कोणत्या जागी लावला आहे? (बेडरूम, हॉल, स्वयपाकघर, स्नानगृह, व्हरांडा, बाल्कनी किंवा इतर)						
	ब	तो सीएफएल किती वॅटचा आहे? (१५ वॅट /२० वॅट)						
	क	कोणता दिवा बदलून हा सीएफएल लावला? (ट्यूब/बल्ब)						
	ड	बदली केलल्या ट्यूब/बल्बचे वॅटेज काय होतं?						
	ई	संध्याकाळी (६ ते १० च्या दरम्यान) किती तास हा दिवा चालू असतो.						
	फ	पूर्ण दिवसात (२४ तास) हा दिवा किती तास चालू असतो?						
८		*प्र. ७ क मध्ये ट्यूबच्या ऐवजी सीएफएल लावला गेला असेल तर प्र. ८ अ विचारा.*						
	अ	बदली केलेल्या ट्यूबचा आकार काय होता? (२ फूट / ४ फूट)						
	ब	या बदलामुळे काही अडचणी जाणवत आहे का?						

९		या योजनेतील सीएफएल खराब झाले आहेत का? किती?	नाही	होय	किती?				
१०		तुम्हाला तो बदलून मिळाला का? *(उत्तर नाही असल्यास प्र. १२ वगळा)*	नाही	होय					
११		बदलून घेताना काही अडचणी आल्या असल्यास कोणत्या?							
		(खराब झालेल्या दिव्यासंबंधीची माहिती भरताना एका दिव्याची पूर्ण माहिती भरल्यानंतरच दुसऱ्या दिव्यासंबंधी प्रश्न विचारा)	**दिवा १**	**दिवा २**	**दिवा ३**	**दिवा ४**	**दिवा ५**		
१२	अ	या दिव्याचा (जागी असलेला) सीएफएल किती वेळा खराब झाला.							
	ब	पहिल्या वेळेस तो किती दिवसानंतर खराब झाला?							
	क	दुसऱ्या वेळेस तो किती दिवसानंतर खराब झाला?							
	ड	तिसऱ्या वेळेस तो किती दिवसानंतर खराब झाला?							
१३		या योजनेपूर्वी सीएफएल मुळे होणाऱ्या बचतीची माहिती होती का?	नाही	होय					
१४		ही योजना नसती तर सीएफएल विकत घेतला असता का?	नाही	होय					
१५		कोणत्या गोष्टीमुळे तुम्ही या योजनेअंतर्गत सीएफएल दिवा विकत घेण्यास तयार झालात असे तुम्हाला वाटते?	हप्त्याची सोय	मराविमं ब्रॅंड	१ वर्षाची गॅरेटी	कमी किंमत	स्थानिक पुढाऱ्याच्या प्रयत्नामुळे	वीज बीलातील कपात	इतर
१६		या योजनेअंतर्गत तुम्ही सीएफएल पुन्हा विकत घ्याल का?	नाही	होय					
१७		या योजनेनंतर एखादा सीएफएल खराब झाल्यास तुम्ही त्या जागी काय बसवणार?	सीएफएल	ट्यूब	बल्ब	सांगता येत नाही.			
१८		सीएफएलच्या अधिक कार्यक्षमतेमुळे व वीज बिलामधील बचतीमुळे तो तुम्ही जास्त वेळ चालू देता का? असल्यास किती जादा वेळ चालू देता?	नाही	होय	जादा वेळ :				
१९	अ	तुमच्या अनुभवावरून ही तुम्हाला योजना कशी वाटली?	चांगली	बरी	वाईट				
	ब	योजना बरी किंवा वाईट ठरवण्यामागे तुमची कारणे कोणती?	कार्यवाही	सीएफएलची गुणवत्ता	जास्त किंमत	प्रकाशाची गुणवत्ता	वीज बिलाबाबत	इतर	
२०		या दिव्याच्या वापराने वीज बील कमी झाले आहे असे वाटते का?	नाही	होय					
२१		दिवे विकत घेतानाची पावती/कराराची प्रत तुमच्या जवळ आहे का?	याबद्दल माहीतच नाही		हरवली आहे.	आहे			
२२		त्यावरील तारीख लिहून घेण्यासाठी मला ती पाहायला मिळेल का?	नाही	होय	तारीख :				
		कराराची प्रत (पावती) पाहून ग्राहक क्रमांक व सीएफएल दिव्यांची संख्या यांची पुन्हा खात्री करून घ्यावी.							

About Prayas :

PRAYAS means determined efforts in a definite direction.

At PRAYAS, we apply our professional knowledge and skills to understand the issues afflicting society especially in the areas of health, energy, resources & livelihoods, as well as learning & parenthood. Further, we strive to translate this understanding in strategic but sensitive responses.

Underlying these responses is our belief that, if equipped with adequate information, sound analyses, and necessary skills, even disadvantaged sections of society can tackle their problems and shape their own future.

Our activities-research, policy analyses, information dissemination, public interest advocacy, skill development, provision of counseling support - are geared to the objective of equipping the disadvantaged and facilitating people's own action.

About Energy Group :

The Energy Group of Prayas has been active since 1990, though Prayas was officially registered in 1994. The group started working in the energy sector, but soon focused its work on electricity sector policies, covering techno-economic, financial, legal, procedural, planning, political, and institutional issues. In the last fifteen years, the group has worked on a wide range of issues and themes such as integrated resource planning, agricultural subsidy, policies of the international financial institutions, power purchase agreements of independent power producers, electricity sector restructuring and reforms, and regulatory commissions.

Our Activities :

A diverse type of advocacy and public-education efforts based on the sound analysis has been the key feature of group's work. The activities of the group include, research, conceptual as well as empirical analysis, public education activities, media campaigns, advocacy, participation in national and international conferences, legal and regulatory as well as policy interventions at the state and national level. At times, the group also works at the international level to contribute to efforts of like-minded people and organizations. Our activities are supported through project-based grants from charitable foundations from India and abroad.