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Disseminating energy-efficient technologies: a case study of compact fluorescent lamps (CFLs) in India

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Abstract

Disseminating energy-efficient technologies, even when they may appear to be technically perfect, is always a tough task, more so in economies with low purchasing power and educational levels. The compact fluorescent lamp (CFL) is one such well-known product that consumes only 20% electricity for the same light output as given out by the ubiquitous incandescent lamp and which, if adopted in a big way, has the potential of reducing peak electric power loads very significantly. However, in India, the CFL sales are still not growing in the expected manner. The current study was accordingly undertaken to investigate the underlying reasons and to determine the most effective ways in which an efficient technology like this could be popularized. The task involved the designing and administering of questionnaires to some 900 respondents from 100 locations representing various socio-economic, educational and professional backgrounds in and around Delhi, and analysing the results in terms of an importance index. Based on this feedback, the authors recommend an aggressive implementation of the formula standing for EDucation, POlicy support, STAandards, Demonstrations and INdustry involvement (EDPOSTADIN) at least for popularizing CFLs.

Keywords: CFL; Lighting; Energy efficiency

1. Introduction

In India in 1999–2000, electricity consumption in the domestic sector was 86.6 billion kWh, accounting for almost 22% of the total electricity consumption, which stood at 395 billion kWh (Statistical Outline, 2000–01). As more and more Indian villages and localities get access to electricity, the proportion is only going to increase further, and should touch 25%, which is generally the norm in countries like the USA (Rocky Mountain Institute, 1997). By using the most efficient sources of electric light in the most effective ways, it may be possible to save at least 50% of this electricity, or almost 43 billion kWh at current consumption levels. This is no mean figure because although the Indian power sector has been growing by about 6% in recent years, it is still characterized by huge gaps between demand and supply; with the peak demand–supply gap in certain regions reaching even 25% (TEDDY, 2000–01).

Normally, the Indian households use incandescent bulbs because of their low initial cost. This device is very inefficient converting only 10% of the electricity consumed into light. A compact fluorescent lamp (CFL), using the principle of passing a discharge arc through a gas in a compact tube shaped fixture, is known to provide lighting very efficiently. A CFL, in fact, consumes 4–5 times less energy for the same lumen output. CFLs now fit the sockets of incandescent bulbs and claim to last up to 13 times more than the standard incandescent.

From the point of view of environmental sustainability also, the use of CFL is desirable since a single CFL reportedly prevents the emission of 500–1000 kg of carbon dioxide, and 4–8 kg of sulphur dioxide every year in the USA (Polsby, 1994). Since the Indian coal has higher sulphur content, and since almost 75% of Indian electric generation comes from coal burning plants, the environmental benefits of using CFLs in the Indian context should only be higher.

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2. CFL experience worldwide

A number of studies have reported the experience of using CFLs in many countries. These deal with a variety of topics; from technical issues of operating conditions, etc. to experiences in doing retrofits, from case studies of utility finance programmes to national campaigns in consumer education and so on (Specifier Reports Abstracts, 1993; Lighting Research Centre, 1998; Parker and Schrum, 1996; Fernstorm, 1994). The studies almost everywhere underline the very important role that governments need to play in this regard. This includes provision of independent information, developing and enforcing of lighting codes and efficiency standards, and providing seed money for research, design, development and widespread adoption. In the USA, the DOE national laboratory system and the EPA Pollution Prevention Programs are already well positioned to stimulate manufacturers and consumers. Some of the major international programmes to promote CFLs have been the Caribbean Islands Residential CFL Lease Programme (WEEA, 1996), ILUMEX, Mexico (GEF, 1994; UNFCC, 1996), the China Green Lights Programme (Yang and Du Pont, 1997), the Poland Efficient Lighting Programme (Younger and Granda, 1998) and the Brazil Residential Lighting Programs (Jannuzzi and Santos, 1995).

There appears to be, however, a serious deficit of studies relating to CFL use in India. A few (Gadgil and Jannuzzi, 1991; Gadgil et al., 1991; Sahgal, 1998) do talk of the enormous potential but the only proposal for implementation titled *Bombay Efficient Lighting Large-scale Experiment or BELLE* could unfortunately remain only on paper (Gadgil and Sastry, 1994; Sastry and Gadgil, 1996). Certainly, a number of lessons from other countries can be extended to the Indian situation, but the peculiarities of the Indian market can be ignored only at great peril. The research efforts in energy conservation in general and the lighting industry in particular have been mostly piecemeal with most studies emphasizing the technical rather than the managerial aspects. In any case, there are very few attempts at any integration of technical with managerial approaches. There are many other challenges, which do not appear to have been addressed adequately.

Other gaps in the existing body of literature appear to be that:

- It does not advise on the strategy to target poor consumers, e.g. those consumers with monthly family incomes of less than $250.
- While it is well known that advertising improves awareness, there is no study suggesting managerial options to fight the peculiar Indian hesitation to use CFLs, even among those who are aware of this product.
- The literature is silent on the major channels of information dissemination about CFLs that should, therefore, be tapped aggressively in the Indian context.
- The studies do not help with the dilemma that if the awareness and usage of CFLs increase with the level of education and income of the consumers, should the higher income and higher education segments be targeted on priority?
- Finally, there is hardly any advice on what should be the India-specific dissemination model for CFLs in particular and energy-efficient illumination devices in general.

3. Ascertaining an appropriate dissemination frame work

In the Indian context, it is necessary to underline that although good quality CFLs cost 10–30 times more than their incandescent counterparts, making the former look exorbitantly priced from an individual's point of view, economy in operation or usage pays well for their high prices. CFLs, therefore, make good financial sense, on a life-cycle basis. The calculations in Table 1 indicate that the extra initial cost of $3.50 ($6.50 for 1 CFL–$3 for 10 equivalent incandescent lamps) can be recovered in about ($3.50/0.006) 583 days, i.e. <2 years if the CFL were to be used at 1 h/day. The savings would, of course, rise in proportion with the increase in the electricity

Table 1
CFL economics for individuals

S. No.	Particulars	CFL	Incandescent
1	Wattage for equal light (A)	20	100
2	Life in hours (B)	10,000	1000
3	Electricity Consumption in 10,000 h (kWh) = [(A) × (B)]/1000 (C)	200	1000
4	Electricity cost at $0.075/kWh (D) = (C) × 0.075	$15	$75
5	Lamp price for 10,000 h (E)	$6.50	$3 (10 lamps at $0.30)
6	Total expenditure (F) = (D + E)	$21.50	$78
7	Net savings per point	$56.50	—
8	Savings per hour of CFL operation for (100–20 =) 80 W at $0.075/kWh	$0.006	—