ED03493 Issue 1

KaR-R8145

Modern Energy: Impacts on Micro-enterprises

Phase 1, Task 1.2

A Literature Review into the Linkages Between Modern Energy and Micro-Enterprise

A report produced for UK Department for International Development

Kate Meadows, AEA Energy and Environment
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Title	TASK 1.2: LITERATURE REVIEW Modern Energy: Impacts on Micro-enterprises
Customer	UK Department for International Development
Customer reference	R8145
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File reference	j:fes/projects/international/dfid kar/microenterprise ED03493
Report number	AEAT/ENV/R/2420
Report status	Issue 1 unclassified

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1 Introduction

This literature review has been commissioned as part of a study entitled "Modern energy: Impacts on micro-enterprises in Southern Africa and India." The study aims to test the following hypothesis:

> *"the provision of modern energy services is a key element in enabling the poor to improve their standard of living." (AEA Technology, 2001)*

The objective of this document is to provide an overview of the current state of knowledge with regard to the impacts of modern energy on micro-enterprise and to discuss the nature and extent of linkages that have been found to exist between modern energy and micro-enterprise activity. The preparation of this review has been restricted in terms of time and it cannot, therefore, purport to be a systematic review of the literature on this subject. Rather, it presents some of the trends in thinking about energy and enterprise issues, together with some illustrative examples from the field of international development in order to serve the purposes of the DFID project "Micro-Enterprises and Modern Energy".

We also include in section 5 brief Country Profiles for South Africa and India to provide context for the field research.

2 Context

Reports of improvements to quality of life and livelihoods as a result of access to modern energy and the associated potential for income-generating activities via micro-enterprise are fairly common, particularly in discussions about the benefits of electrification (e.g. Rana-Deuba, 2001; Sengendo, 2001; Covarrubias *et al*., 2000; Keyun, 1995). Indeed, the potential for modern energy to function as a driver for poverty alleviation has been closely associated, by some observers, with the need to ensure that such energy is used productively, as is illustrated by the assertion in Lucas et al (2001) that: "The vicious cycle of energy poverty will only be broken by combining improved energy services with end uses that generate cash income."

Despite such assertions, data to back up these specific claims is limited. Moreover, substantial quantified data on the broader benefits of modern energy for micro-enterprises and sustainable livelihoods for the poor is hard to come by. This review sets out to examine what evidence there is to suggest that modern energy can play an important role in facilitating and supporting the establishment, development and growth of micro-enterprise activities. Various aspects of the energy-enterprise relationship are examined, including the value of energy for enterprise, gender impacts of energisation in the enterprise context and the relative developmental importance of energy by comparison to other micro-enterprise enabling factors.

3 Definition of Terms

3.1 MODERN ENERGY

The term “modern energy” as used in the literature can be taken to refer to a variety of energy sources including LPG, kerosene, petroleum and electricity, either grid or off-grid electricity (whether generated by burning fossil fuels or by using alternative, renewable sources such as solar, biomass, hydro or wind). Generally speaking, however, modern energy is most commonly associated with, and sometimes used as a synonym for, “electricity” or “electrification”.

3.2 MICRO-ENTERPRISE

The term “micro-enterprise” refers to “a very small business that produces goods or services for cash income” (Allerdice et al, 2000). Micro-enterprises can be identified on the basis of a number of characteristics. For example, they usually operate in the informal sector of the economy, require little in the way of initial start-up capital and have few employees (usually defined as less than ten, although the definition used by Rogerson (1997) considers micro-enterprises to have, at most, one to four employees). Micro-enterprises are often home-based (Karekezi, 2002a; Rogerson, 1997) and as a result, micro-enterprise employees are usually family or household members employed on a casual basis (sometimes unwaged). It is also often difficult to distinguish between household expenditure and that of the micro-enterprise.

In organisational terms, micro-enterprises have been characterised as having low levels of organisation and informal accounts, if any (Karekezi, 2002a). According to Karekezi (2002a) the primary legal feature of micro-enterprises is that they are not registered with a Registrar of Companies, nor recorded in official or tax records. Such businesses may or may not have the necessary licences to operate (Karekezi, 2002a, p.1021) and as a result of their low-profile, informal nature they are not usually tracked by official government statistics (Allerdice et al, 2000).

Micro-enterprises operate in a number of economic sectors, including commerce (e.g. retail and trading in new and second-hand goods); manufacture (i.e. production activities) and service (including personal and non-personal services). The distinction has also been made between “survivalist” micro-enterprise businesses and “flyers” or “potential flyers” which typically have different needs (Heeks et al, 2001) and, in the case of the latter, greater potential for growth and development.

Some examples of micro-enterprise activities include:

- Making and/or selling craftwork, e.g. carpentry, pottery, knitting, crocheting, weaving and clothes-making / tailoring.
- Small-scale agricultural activities such as dairy processing, bee keeping, vegetable growing, poultry farming and goat keeping.
- Food preparation and processing, such as bakeries, beer brewing, honey processing, edible oil / butter processing (e.g. palm oil/cassava), grain milling, fish smoking, ice-making and food kiosks.

- Hospitality activities, such as guesthouses, hotels, restaurants and tea shops.
- Medical services, such as traditional healers (sangomas/nyangas), homeopathic medicine production, herbal tea production.
- Small scale mining and processing activities, such as tinsmiths, blacksmiths and goldsmiths.
- Energy-related enterprises that come into being because modern energy is available but are also essential to its availability. These include battery charging and distribution of components for PV systems, manufacturers and repairers of electrical appliances and machinery, wiring contractors, energy retailers such as LPG or oil fuel dealers and, increasingly, 'ESCOs' (electricity supply / service companies), which retail electricity from large scale suppliers.
- Technology generated business, especially relating to information and communication technology (ICT), e.g. internet cafes, faxing, emailing and telephone bureaux.
- Transportation activities for people and goods, including rickshaws, pushcarts, auto-rickshaws, taxis, ropeways, busses and lorries as well as related activities such as cycle hire, cycle and car repairs, and spare parts dealers.
- Trading, including fixed and mobile hawkers or vendors, market stalls, small shops, peddlers, and home-based retailing activities.
- Other specialist activities, such as leather treatment, candle wax manufacture, laundries, mechanical/electrical repair workshops, welding, soap-making, brick making, panel beating, hairdressing and furniture making / dealing.

Micro-enterprises are often grouped in discussions about small-scale business with other smaller-scale business activities by incorporation into acronyms such as SMMEs (small-, medium- and micro-enterprises). For the purposes of this review, the term "micro-enterprise" is assumed to include and/or be synonymous with the terms "small business"; "small scale enterprise (SSE)"; "small micro-enterprises (Sm_cE)"; "household enterprise" and (small) "family business".

4 Findings of this Review

4.1 THE EXTENT OF THE LITERATURE

Micro-enterprise development and the developmental impacts of modern energy are two major areas of study in the developmental world but seldom are the two studied simultaneously, with the result that most references to this topic are limited to general statements about the capacity for impact that programmes such as rural electrification can have on productive uses, income-generation and associated enterprise development.[1] Referring specifically to the case of electrification and rural SMME development, Rogerson (1997) notes that when it comes to enterprise development and the impact of rural electrification "few studies seek to directly link together these two strands of work" (Rogerson, 1997, p.1). Furthermore, even in the case of electrification programmes, few research studies have undertaken empirically rigorous comparisons of the pre-electrification situation and post-electrification impact on enterprise development. Reasons for this appear to relate to the complexity of development processes and data gaps that make such studies difficult to conduct (Rogerson, 1997).

Similarly, in their discussion of technological development among micro-enterprises, Platt et al (1999) point out that "the experiences of the millions of very small, or micro-scale entrepreneurs, who are invariably poor, self-employed, home-based, and operating in a way commonly described as 'informal' as compared with 'formal' sector enterprises have been less studied" (p.394). It has also been pointed out, "information about manpower employed, wages, income levels etc. in the SME sector is scattered, scarce and often unreliable" (RWEDP, 1999: p.4). And in terms of the environmental impact associated with micro-enterprises and the adoption of "clean" energy technologies Blackman et al (1998) state that there has been "no rigorous empirical research on why informal (or even small-scale) firms do and do no adopt them" (p.1).

The developmental impact of modern energy for micro-enterprise development is further discussed here with reference to the following:

- Modern energy as a catalyst for micro-enterprise;
- The value of modern energy for micro-enterprise;
- Energy-related enterprise;
- Barriers experienced by micro-enterprises and critical enabling factors; and
- Gender specific impacts of modern energy in micro-enterprise.

[1] Indeed, a keyword search of the UNDP's bibliographic database on energy related publications (the "Energy for Sustainable Development Library") yields a disappointing 19 results and only 9 sources for the keywords "modern energy" and "micro-enterprise" (and variations thereof), with most of these references being indirect and not dealing specifically with the issues under discussion here.

4.2 MODERN ENERGY AS A CATALYST FOR MICRO-ENTERPRISE

Support for the notion that modern energy can and does act as a stimulus for the emergence, growth and continued development of micro-enterprises is relatively strong in the literature (Fakira, 1994; Foley, 1990; Karekezi et al, 2002a). Fakira (1994), for example, maintains that "energy is one of the critical resources needed to liberate micro-enterprises from low value, low productivity and low income activities" (p.1) and Allerdice et al (2000) suggest that "access to even limited amounts of electricity for micro-enterprises in non-grid-connected areas can be important to the establishment and growth of those businesses" (p.3). Other observers are more cautious, suggesting that the provision of efficient and affordable energy *could* lead to the improved performance of the informal sector (Hosier, 1994 cited in Karekezi et al, 2002a; emphasis added). Rogerson (1997) is particularly sceptical regarding claims made about the benefits of modern energy for micro-enterprises, and points out that such claims are often exaggerated, sometimes being based on "extraordinarily flimsy empirical evidence" and can therefore lead to disappointment (Rogerson, 1997).

Anecdotal evidence is commonly used to support the argument that modern energy can and does play an important role in stimulating micro-enterprise. For example Rana-Deuba (2001) suggests that access to modern energy produced by micro-hydropower in Nepal has been found to result in or contribute to the establishment of bakeries, photo studios, grocery stores, agricultural and saw mills and small-scale agricultural activities such as poultry farming and goat keeping. Dube (2001, cited in Karekezi et al, 2002a) suggests that the security lighting on masts in poor urban areas of South Africa has resulted in the urban poor setting up small enterprises in the evenings.

There is also evidence from India that a significant proportion of "unofficial" users of electricity, who steal power by "hooking" to transmission lines or taking unofficial connections from other non-metered users, use their power for business purposes. Over one third of the unofficial users in a 1996 survey of consumers in Orissa were using some of the power they stole for commercial purposes. Unofficial consumers tend to be poorer than others, and this suggests that electricity is important to them as an aid to income generation as well as to improve their living conditions (Xavier Institute of Management, 1997)

Habtetsion et al (2002a) illustrates the demand for modern energy as an input for micro-enterprise with figures such as the installation of 31 solar PV systems by Telecommunication Services of Eritrea "purely for income generating activities". Similarly, demand for modern energy and the resulting business potential of modern energy service supply is credited by Enersol with stimulating micro-enterprise activity in Honduras. The organisation's website indicates that the number of PV systems installed by local entrepreneurs in Honduras grew from 60 systems to 300 in 1994 and 550 in the first 6 months of 1995, and that the numbers of energy entrepreneurs grew from zero in 1992 to more than 20 in 1995. (See section 4.3 for more on energy-related enterprises).

More convincing, perhaps, are the results of a review of studies on the impact of rural electrification on SMME development presented by Foley (1990, cited in Rogerson, 1997). This study reports increased economic activity and higher living standards following electrification and concludes that "the arrival of an electricity supply in certain areas seems to be a crucial factor in precipitating decisions by local entrepreneurs to invest in a variety of productive enterprises".

Nevertheless, there are conflicting reports and differences of opinion in the literature regarding the impact that modern energy can and does have on entrepreneurial activities, and hence its developmental importance. Several authors have offered explanations for these differences. One view is that modern energy is one of a number of critical enabling factors necessary for micro-enterprise development. So, for example, Barnes (1998) reports finding greater numbers of businesses in rural areas with electricity than in those without it, but also highlights that there were complementary local conditions such as “ready availability of adequate credit finance and access to markets” and Nyabeze (2001) maintains that “energy becomes a relevant input to income-generation only when a certain economic capacity beyond sheer subsistence is reached” (Nyabeze, 2001).

Another perspective is that the primary impact of modernising energy supply and service is felt by survivalist micro-enterprises and those that are already relatively well established businesses, and is not so much a contributing factor in the emergence of new micro-enterprises. Following a literature review of international work on rural electrification Rogerson (1997) concludes that access to electricity encourages the “modernisation” of existing rural SMMEs and has an impact on survivalist activities, but “it exerts only a modest stimulus for the growth of new enterprises” (Rogerson, 1997).

Furthermore, as was alluded to in the above definition of micro-enterprise, some observers emphasise that while the term “micro-enterprise” may be useful to describe a broad spectrum of similar income-generating activities, the businesses themselves are not homogenous but often have different characteristics and different needs. When it comes to discussing the impact of modern energy on micro-enterprise, therefore, it is inevitable that there will be differences in the degree to which access to modern energy affects each micro-enterprise. This perspective is well illustrated by Vaughan and Xaba (1996, p.12): “access to electricity for business purposes is not relevant or necessary for some sub-sectors (of the SMME economy) but lack of access is a significant constraint to those in other sub-sectors.”

There is, therefore, some debate about the validity of studying small or micro enterprises separately, with some arguing that a sub-sector approach is more useful. It may be more relevant, for instance, to look at milling or perhaps metalworking businesses (see, for example, Kabecha, 1999), irrespective of their size. Modern energy may be good for some sub-sectors, neutral for others, and perhaps, negative for yet others. (Dawson (1994) discusses the impact of structural adjustment, not energy, but makes the point that to look at the impact on a size rather than activity basis was misleading).

4.3 THE VALUE OF MODERN ENERGY FOR MICRO-ENTERPRISE

Assessments of the value of modern energy for micro-enterprises can be made using a number of indicators, such as amount spent on obtaining energy; time spent utilising energy; changes in productivity indicators following changes in energy consumption patterns and effects of loss of energy supply.

Quantitative data on such indicators for energy and micro-enterprises in the African context is provided by Habtetsion et al (2002a) using data collected from surveys of businesses in Eritrea. The SMEs surveyed included blacksmiths, grain mills,

bakeries, pastry makers, goldsmiths, wood and metal works, brick and lime manufacturers, hotels, restaurants, bars, snack shops, tea shops, and those making injera (traditional drink). The findings of this study demonstrated the point made above that some businesses are more energy intensive than others, and will therefore depend more heavily on energy inputs. So, for example, bakeries were found to be the highest energy consumers (using 28% of the total energy consumed by the SMEs surveyed) followed by brick and lime manufacturing (12.5%); traditional drinks (12.3%); restaurants (9.8%) and; tea shops (8.2%). Together, these micro-enterprises accounted for 71% of total energy consumption but only 55% of the SMEs surveyed.

Among the various micro-enterprises surveyed, the total energy cost as a percentage of total production cost was found to be highest for grain mills (65%), followed by brick and lime manufacture (21%); blacksmiths (19%) and goldsmiths (18%) although the average among all SMEs surveyed was significantly lower, at approximately 10%. Interestingly, although bakeries were found to be the most energy intensive industry, the total cost of energy as a percentage of production costs for these micro-enterprises was only 11%, marginally higher than the average.

Comparative statistics for agricultural enterprises in the Ala Plain and Agordat region of Eritrea have been found to be as much as 17.6% and 46.6% respectively (Habtetsion et al, 2002a). Irrigation and the associated electricity charges borne by agricultural enterprises have been found to make up a large proportion of operation costs, in some cases as much as 80% of the annual costs of some schemes (as was the case in Andhra Pradesh, in India). This high figure was in spite of the heavily subsidised cost of power, but the costs did not include any capital charges for the scheme itself because it was provided to farmers on a grant basis by the State government. If the enterprise is viewed as the farm, however, rather than the irrigation scheme alone, the cost of power falls to as low as 5% of farmers' incremental income from irrigation (Harper, 2001). This figure varies according to how "thirsty" the crop is, and data for wheat and sugarcane farmers in Maharashtra show that power amounted to between 2% and 5% of farmer' gross yields (Brewer et al. 1999).

Another example of the cost of energy supply to micro-enterprises is provided by Karekezi et al (2002a) who report on the results of a survey of micro-enterprise businesses in Nairobi, Kenya. This study found that 20% of those surveyed spent between 20% and 50% of profits on energy; while 40% spent between 10% and 20% of their profits obtaining energy (Karekezi et al, 2002a). It is unclear as to whether or not these figures included owner's wages or not, but what they do illustrate, as do figures provided as percentages of production costs, is that micro-enterprises can and do spend a significant amount of finance obtaining energy supplies for their activities.

A further illustration of the importance of energy costs for small businesses is provided, in a very different context, by the location incentives offered by the Energy Cost Savings Programme (ECSP) of New York City. In order to encourage small firms to move out of congested areas, the ECSP offers to subsidise electricity costs by 45% and natural gas costs by 35% for eligible firms, in addition to covering 90% of actual moving costs. This is the only incentive the programme offers (NYC Department of Small Business Services).

As far as changes to energy use patterns are concerned, the study reported by Habtetsion et al (2002) indicates that the use of modern energy (including LPG,

paraffin, oil and electricity) among micro-enterprises was found to have increased from 24% in 1995 to 50% in 1998, with the remainder still being provided by biomass fuels. However, figures for the effect of this change in energy supply on productivity are not provided. By contrast, Allerdice et al (2001) do give some indication of the productivity benefits of modern energy for micro-enterprises. These authors report on the experiences of farmers in Indonesia who have benefited from the introduction of wind-powered community water pumps by Winrock International's Wind for Island and Non-governmental Development (WIND) Programme. They cite examples of increases in crop yields, income of up to fourfold, and reduced labour input from 1040 to 100 hours per season (Allerdice et al, 2001). While these figures are interesting from a productivity perspective, they also point to other knock-on effects that modern energy can have, in terms of environment (the effect of energy-assisted water pumping on the level of the water table, for example) and society (the effect of modernization on reducing labour needs).

Similar productivity benefits have been followed the introduction of micro-hydropower in Peru where the agricultural El Tinte co-operative reported an increase in the purchase price of milk per litre from US dollars 0.06 to 0.11 following the improved quality and better hygiene associated with refrigeration of the milk (Intermediate Technology Development Group, Allerdice et al, 2001).

Other reports on the value of access to modern energy and technology for small business include those cited in Mensah (2001); Khan (2001); Nyabeze (2001); Barua (1998) and Bayes et al. (1999). Mensah (2001) reports on the improvements to Shea Butter Production in Ghana following the introduction of improved ("modern") technology using animate (human) power. Use of the improved machinery was reported to result in a 5% higher rate of efficiency; 200% increased production capacity and consumer preference for products produced using the "modern" process. Khan (2001) emphasises the potential for increased income-generation following the introduction of electrical lighting services (using battery operated lamps) and the potential for extending business hours in the evenings, citing an example of tailors who worked for four more hours and thereby increased their revenue by 30%. Opening hours for shops were also found to increase by an average of three hours a day and in terms of new business, Khan concluded that adequate lighting is a "deciding factor" in whether people opened a home-based business. Another example is provided by Nyabeze (2001) who quotes figures from India indicating that energy-intensive enterprises which were financed by micro credit mechanisms to obtain their access to modern energy achieved enhanced income levels of 30-40% more than enterprises not featuring significant energy inputs.

The Grameen Phone initiative of the Grameen Bank has provided rural villages with a means of communication and has also created thousands of very small but profitable micro-enterprises for the women who run the mobile phones. The phones themselves have to be re-charged daily, and applicants for phones have to have electrical connections before they can start (Bayes et al., 1999). The consumption is small, but electricity is a necessary condition for this service. Customers of Grameen Shakti (a division of the Grameen Bank dealing specifically with renewable energy) have also used their PV systems for a variety of entrepreneurial activities, including heating soldering irons for radio and TV repairs, extending working hours, selling power to other local shop owners (for lighting) and operating solar powered computers, which in turn has improved their working ability (Barua, 1998). Several case studies from Grameen Shakti's PV programme illustrate well the value of modern energy to such enterprises. For example, the direct financial impact of investing in a solar lighting systems at a diesel powered saw mill was estimated to be

about US$20 while for a local appliance repair shop, using solar power to undertake repairs was believed to increase income by US$ 25 a day. A lamp-renting enterprise which rented out 5 solar lamps earned an extra US$ 12.50 a month, and the operation of a solar powered cellular phone system earned the owner an estimated US$ 30 a day extra. Extended working hours at a local barbershop using solar lighting was found to increase income by US$5 a day. In addition to these financial indictors, other direct impacts experienced by these enterprises included better work quality and efficiency, a better working environment and greater income from ancillary sales associated with attracting customers in the evenings. In addition, the indirect impacts of these enterprises using solar systems were identified as greater customer satisfaction, increased income for workers, increased social status of owners and customers, increased living standards for locals, and increased employment opportunities.

Micro-enterprises benefit from modern energy supplies, but the energy suppliers also benefit from the increased and relatively steady sales of energy to such businesses. The ESKOM Foundation, an offshoot of the South African electricity company, operates a special small business development department in order to encourage the establishment and growth of energy consuming businesses. The department guarantees loans to small and micro-businesses, and they also offer a range of training and other programmes (ESKOM, 2002).

The micro-hydropower initiatives in Nepal are well known, but it has become clear that such installations are not viable for domestic lighting alone; there have to be additional consumers to cover the costs (Irvine-Halliday and Crane, 2000). These consumers are likely to be small or micro-enterprises, which also provide employment, and services, to remote communities. The Enterprise Development Programme of the Butwal Power Company in Andhi Khola offered a range of training and other support to promote new businesses in areas where electricity was newly available, and some 62 businesses, employing several hundred people, were set up as a result of their efforts (Bastakoti, 1999).

Also, in some instances modern energy alternatives are rejected by entrepreneurs in favour of traditional energy sources combined with modern energy technology. An example is provided by de Miranda et al (2001) whose case studies on the adoption of improved cook stoves by food vendors in Nicaragua include the observation by one tortilla maker that although she had tried LPG stoves such an energy source was not viable because of the cost of the gas.

4.4 ENERGY-RELATED ENTERPRISE

There are many micro-enterprises which owe their existence to the availability of modern energy, but which also themselves play a vital role in the use or delivery of the energy. Fisher and Mahajan (1997) point out that in India employment in small-scale enterprises manufacturing electrical equipment grew by an average of 20.6% per year between 1978 and 1988, which was the fastest growth rate of any industrial category. Clearly this was only possible because electricity was available.

Hankins (2000) reports that private provision of PV systems in Kenya has created opportunities for micro-entrepreneurs to become importers, wholesalers and retailers. To date, between 10 and 12 importing SMMEs, some with turnovers in excess of US$ 500 000, have been established as well as “hundreds” of other retailers (e.g.

appliance vendors or hire purchase agents) and local manufacturers who assemble parts and sell PV components.

In Bangladesh, 35 rural women from the southern island of Char Montaz are engaged in operating a micro-enterprise for the construction and sale of efficient, fluorescent DC (direct current) lamps to households and fishing boats (Khan, 2000). An ESMAP project aimed at providing low cost and affordable off-grid lighting for rural households and markets, it has grown to include a diesel powered micro-grid service for battery charging and a micro-credit scheme for purchasing of batteries. The enterprise was also reported to be exploring the potential for offering household electrification services using solar home systems.

Barney et al (2001) describe the 'micro-privatisation' experiment in Orissa in Eastern India, where village electricity committees (VEC) have been set up to manage the interface between the power suppliers and rural consumers. These committees are in some sense micro-enterprises themselves, although largely run on a volunteer basis by local people, but each VEC also appoints a village contact person (VCP) who is paid by the power supplier to read consumers' meters, to distribute bills and to facilitate cash collections. The VCPs are paid only a few dollars a month, but many of them have made use of the simple training they receive, and their privileged access to power consumers, to start local wiring and electrical repair businesses (Harper, 2001).

The South African pre-paid metering system has made the purchase of electricity much more convenient and controllable for almost three million consumers, particularly for micro-enterprises. It has also created large numbers of totally new enterprises, since consumers have to buy their power from a local vendor, one of which is needed for every 1000 customers or so. This vending business can be reasonably profitable in its own right, but it also attracts customers who buy other goods, so that a small grocery or restaurant business which would not be viable on its own becomes profitable. This creates jobs and also improves services in small communities (Cunningham, 1996).

The Luz do Sol photovoltaic rural electrification programme in North East Brazil provided power to 1500 homes through the creation of 50 independent and profitable electricity supply businesses between 1997 and 1999, and was expanding at a rate of 10 more businesses and 300 home connections per month. The businesses were financed from the local development bank, and the on-time repayment record was 100%. This was achieved in spite of the withdrawal of the United States company which had initiated the programme and had invested two million dollars in it. Local entrepreneurs were able to create viable businesses by supplying power to their neighbours (D'Addario, 2000).

The introduction of photovoltaic electrification had similar effects in Indonesia. Sudirama Energi Surya, a major manufacturer of photovoltaic panels, set up a network of sales and service centres, and there are also several hundred other independent dealers which sell and install systems from this company and its competitors. There was initially a very small subsidy to start off the programme, but the financing and operations of the dealers and the equipment is now wholly on a commercial basis (Anderson et al. 1999).

Battery charging for domestic use is already a substantial enterprise, such as in Sri Lanka, where it is said that there are some 300,000 batteries used for household lighting, radio and television. It has also been suggested that small wind powered

generators can be the basis of a profitable battery recharging business, and experiments are being undertaken in Sri Lanka to investigate the possibilities (Dunnett 1999)

Renewable energy systems can also produce valuable by-products as well as providing power and creating employment. Biogas digesters produce fertiliser which is more productive and more conveniently handled than the original feedstock, and some systems are self-contained, in that they facilitate the production of their own feedstock. A prototype biomass gasifier plant in Hosahalli in India produces power for domestic use but also for irrigation, which enables farmers to grow mulberry for sericulture. The mulberry stalks provide feedstock for the gasifier (Kartha & Leach, 2001).

4.5 NEGATIVE IMPACTS OF MODERN ENERGY

It is important not to neglect the damage that an improvement in modern energy supplies can do to some people, sometimes, particularly to the most vulnerable people who may be displaced and for whom there may be no alternative sources of livelihoods. Such damage may be an unavoidable part of the 'price of progress', but it may sometimes be mitigated.

Routine household tasks such as weaving, milling or other forms of food preparation can be converted to income generating activities when they are mechanised so that the scale of their output is dramatically increased. This can have damaging effects, however, since it displaces traditional labour, and may replace large numbers of unskilled and often female home-based workers with smaller numbers of men. Such social damage is often explained as a regrettable but inevitable part of the modernisation process, but market distortions which reduce the cost of capital can mean that such displacement is premature (UNDP 2000).

Clark (1994) refers to the transition from handloom to power-loom weaving in the United Kingdom during the first part of the nineteenth century. A British Government survey of 1840 found that handloom weavers, like those in South Asia today, could work when they wished, and generally spent from 4 to 14 hours a day at their looms. Power-loom weavers had to work in factories, and were compelled to work 12 hours a day, regardless of their personal convenience. Thousands of Indian power-loom operators work at home in rural areas, but they too are forced to work the hours dictated by the technology; in this case, the few hours of the day or more often the night when power is available.,

Batliwala and Reddy (1996) show how the replacement of hand-milling by small-scale motorised mills meant that the poorest people in rural villages were often deprived of the few wage-earning opportunities which were available to them, and similar findings are reported from Bangladesh (OTA 1991) and Indonesia (Timmer 1998).

One of the more 'modern' forms of energy is the industrialised use of biomass for fuel. Goldemberg (1988) describes how the development of sugar cane plantations in Brazil for ethanol production displaced large numbers of small farmers and reduced the production of subsistence crops.

4.6 BARRIERS EXPERIENCED BY MICRO-ENTERPRISES AND CRITICAL ENABLING FACTORS

Many of the examples cited above seem to suggest a common conclusion in the literature, namely that modern energy is neither the only nor even necessarily the most important factor influencing micro-enterprise development. Evidence to this effect is provided by Rogerson (1997) who reports on the findings of a study which asked micro-enterprise businesses to rate the various constraints to their business (EYBMR, 1995). The findings showed that on a scale from 0 (completely satisfied) to 100 (completely dissatisfied) lack of electricity received a rating of only 12 and was ranked 34th out of the 46 possible business problems listed by the survey. Platt et al (1999) also report on SME entrepreneurs' responses regarding constraints experienced. This study highlights the importance which those surveyed assign to "demand, access to credit, particularly for equipment, raw materials and other production inputs, and the price and availability of hardware and other inputs, prioritising them as the most significant factors effecting their performance." (Platt et al, 1999: p.394).

The international literature suggests a number of other critical enabling factors for micro-enterprises. A key enabling factor, and one that is frequently discussed, is access to financial resources, especially credit for raw materials, fixed assets and working capital (Rogerson, 1997; Allerdice, 2000; Nyabeze, 2001; Abdullah, 2000). Indeed, it has been contended "access to credit is probably the most frequently cited constraint across the SME sector" (RWEDP, 1999: p.18). And the importance of micro-finance to development and enterprise has recently gained prominence with institutions such as the World Bank giving attention to micro-finance in its development policies, and drawing on the experiences of organisations such as the Grameen Bank in Bangladesh. The value of micro-finance to modern energy supply has also recently been highlighted as a result of the World Summit on Sustainable Development. See, for example, Pierce & Ekins (2001) who discuss the role of international financial institutions in promoting sustainable development and use the example of a "typical project" in which credit is provided to low-income households for the purchase of solar PV systems "for applications such as household appliances, water pumping, residential lighting and community health clinics." On the other hand, Kabecha (1999) reports that a study of innovation among micro-entrepreneurs found that "talent, experience, social linkages and daring are more critical to success than a specific cash outlay." (Owens & Nandy (1978) cited in Kabecha, 1999: p.119).

Thus, there are other factors affecting micro-enterprises, many of which are not necessarily energy-related. Other examples of such factors include information gaps, lack of security of tenure, competition from larger and more established business, low-income and/or location-specific target markets, lack of customers, lack of suitable sub-contracting arrangements, poor business planning and country-specific variables, such as the legal framework, government stability, and the national economy. Thus, some of the factors deemed to act as critical enabling factors for micro-enterprises include:

- Availability, affordability and reliability of appropriate equipment, tools and machinery;
- Available and qualified human resources and/or skills training (for technical and business skills, for example);

- Markets (including sufficient demand for product or service, increased quality and production); and
- Institutional support (to provide access to business development training, infrastructure and market development, expanding product offerings, and assistance with legal issues, for example).

In discussing the technological capability of micro-enterprises in Kenya's informal sector, Kabecha (1999) identifies a number of internal and external constraints to the growth and innovativeness of the informal sector (see Box 1). This author points out that lack of access to modern energy, and electricity in particular, imposes a "severe constraint" on the level of technology that can be adopted by entrepreneurs.

Box 1: Constraints for micro-enterprise growth and innovation (from Kabecha, 1999)

Internal

- Lack of entrepreneurial ability
- Historical underdevelopment of the micro-enterprise sector
- Entrenchment of expansive private foreign capital
- Lack of organisation (although this is sometimes not called for, given the need for flexibility and improvisation)

External

- Technological gaps
- Heavy dependence on foreign sources of equipment
- Low levels of education and training
- Limited markets for products
- Lack of space and infrastructure to expand operations
- Lack of suitable premises
- Lack of electricity and water – found to impose a severe constraint on the level of technology that can be adopted.
- The uncertainty of the informal sector environment is not conducive to investment

However, access to modern energy itself is also not the only significant issue in considering the effect of modern energy on micro-enterprise, it also needs to be reliable and affordable to be an effective enabling factor for micro-enterprise (Kittelson, 1998). Osunbitan et al (2000) illustrate the importance of energy supply reliability in their examination of the energy used to power machinery in agro-allied micro-enterprises, in this case cassava and palm oil processing. They found that despite the availability of electricity via gird connection in urban and semi-urban areas of Nigeria, the processing centres studied did not depend on or use electric engines because of unstable power supplies, preferring instead to rely on diesel engines. An unreliable energy service was cited by micro-entrepreneurs in Uganda as one of a number of common energy-related problems that they encountered (Kyokutamba, 2000). Others included unstable voltage (which necessitates use of voltage stabilizers to protect equipment from damage during surges), non-transferable power connections (resulting in situations where new tenants inherit the previous tenant's bill), having to pay bribes to get connected to power, the assumption of ownership by the utility company of infrastructure such as poles (and subsequent connection of others who didn't invest in the poles iniitially) and high tariffs. Karekezi et al (2002a) also report on tariffs, and the fact that in Zimbabwe, the tariff categories for electricity supply are "particularly unfavourable" for micro-

enterprises. These authors conclude that the provision of modern energy to SMEs and the agricultural sector could be enhanced by "liberalisation of distribution and tariff setting".

In some cases, lack of access to modern energy that is reliable and affordable modern energy may act in concert with and/or contribute to the occurrence of some of the other barriers to micro-enterprise discussed above. So, for example, the benefits of information and communication technology (ICT) such as computers and the internet for obtaining information and reaching markets are restricted to users with access to an effective electricity supply (see Duncombe et al (2001) and Heeks et al (2001) for a discussion about the relationship between ICTs and small enterprise). Similarly, getting the goods or services to the market requires transport, which in turn requires energy. Thus, as Rogerson (1997) suggests, the effect of technological constraints and inadequate infrastructure in limiting modern energy services for micro-enterprise is but one of the "myriad constraints" that confront micro-enterprises.

4.7 GENDER SPECIFIC IMPACTS OF MODERN ENERGY IN MICRO-ENTERPRISE

A common theme in the development literature, and particularly in work that deals with issues of gender and the empowerment of women, is the positive impact that modern energy and/or technology can have in terms of reducing the drudgery, saving the time and improving the livelihood strategies of women. This is especially the case in rural areas where the gendered division of labour and the collection of fuel and water resources directly from the environment creates a situation in which women spend most of their time and energy obtaining and using these to meet the basic needs of their households. Furthermore, the resulting liberation from tedium is often described as operating in tandem with energy services such as lighting in order to generate further "empowerment" benefits, such as opportunities for education and income-generating activities in the evening.

However, while there is some anecdotal evidence to support these assumptions, empirical evidence regarding the effect of modern energy on the empowerment of women, and especially the role of women in micro-enterprise, is scarce with the result that "the role of energy in the sustainability of women's enterprises is not well understood" (Clancy, 2001). Nevertheless, some general trends have been observed. For instance, when women do choose to engage in income-generating activities, they are usually home-based (Karekezi et al, 2000b; Clancy, 2001). The nature of these activities is also often restricted to a relatively narrow range and they usually centre around often gender-specific roles such as food preparation and dress making (Clancy, 2001). So, for example, a description in Mensah (2001) of women's energy needs for productive purposes indicates that power is needed for grain threshing, milling and tuber peeling; water pumping; and lighting, refrigeration and other such applications.

Disaggregated data on the participation levels of women in micro-enterprise are rare, and although Clancy (2001) maintains that, in most countries, the majority of small and medium scale enterprises are "owned and operated by women, with women making up the largest proportion of the work force" she provides no figures in this regard. On the other hand, the findings of a study conducted by the Zimbabwe Environmental Resource Organisation (ZERO) and reported in Karekezi et al (2000b) would appear to justify this claim. This study found that women were the major

players in rural micro-enterprises, with the majority of micro-enterprises having a mixture of men and women. Interestingly, the study reported a predominance of one gender in certain types of micro-enterprises. So, for example, women dominated in owning or managing bakeries (89%) and beer brewing activities (95%) while commercial brick making, on the other hand, was found to be male-dominated. However, the study also reported that when brick making was undertaken for domestic purposes, it was the women who once again dominated.

It has also been suggested that because of the nature of the micro-enterprise activities undertaken by women, they are usually more energy-intensive (Karekezi et al, 2000b; Clancy, 2001). This point is well illustrated by the figures reported here for bakeries – they are amongst the most energy intensive of micro-enterprises and women usually predominate in this sphere. And it is significant when considering the potential impact of modern energy on women in micro-enterprise because it means that if, as is often the case, women are reliant on biomass fuels, their participation in income-generating activities can be significantly enhanced by access to efficient, modern energy services and/or technologies; not only because of the potential for improved productivity of micro-enterprise but also because this can reduce the negative impacts associated with collecting and using biomass fuels.

Although most of the literature dealing with the topics of energy, gender and development emphasises the significant potential poverty alleviation and income generating benefits of modern energy for participation of women in micro-enterprise, there are many studies to show that once a reproductive activity becomes a productive activity (or profit making micro-enterprise) men begin to control this activity. It does not necessarily follow, therefore, that supply of modern energy/improving women's access to energy will mean that they are empowered to turn their activities into profit making concerns in which they control the assets/profits. And this pertains not only to the shift from 'reproductive' to 'productive' but also moving from low tech to high tech production. Indeed, there have been cases where electrification, meaning mechanisation, has further marginalized women.

Furthermore, as Rogerson (1997) and Clancy (2001) point out, there are sometimes unintended negative impacts on women, whose exploitation in existing household relationships may continue and/or worsen. As Clancy notes: "women in male headed households may not wish to increase their workload by becoming full scale entrepreneurs" (Clancy, 2001). In other words, does access to modern energy add to the burden of a woman's working day? The difficulty, as Clancy (2001) observes, is that "women should be able to act upon energy choices open to them and this is linked to decision-making within households [and often] this requires social and political changes." So it is that Rogerson (1997) warns that "even where new rural production SMMEs have been observed, these must not necessarily be viewed as signals of an emergent new prosperity because where linkages occur in the form of exploitative subcontracting arrangements, these can be manifestations of a deepening rural poverty, particularly for rural women."

Cecelski (2000) demonstrates the differences in home lighting and connection point preferences between women and men with data from a village biogas project in Ghana where the women were found to want home lighting in the kitchen, work room and back of the house (near the bathroom area), to make their work easier and more productive. The men, on the other hand, sought lighting for the front of the house (where they hosted friends) and were mainly interested in the entertainment values of electricity (in this case specifically for music and TV). On the other hand, assumptions that see women as only ever interested in utilising modern energy for

income generating purposes are also misleading, as illustrated by an interesting observation in a Namibian study which showed that when modern energy was available for lighting, women stayed up later than men, not working but socialising (Wamukonya and Davis, 1999 cited in Clancy, 2001) .

5 Research Context: Country Profiles

5.1 SOUTH AFRICA

South Africa is both a developing and developed country as a result of which it offers a diverse range of energy and micro enterprise activities and opportunities for study. It has also recently undertaken a major electrification programme among the urban poor and such projects are still in progress affording rare research opportunities. Poverty, unemployment and a youthful population also provide a pressing challenge for micro enterprise and livelihood creation. With many energy provision projects and enterprise development initiatives operating across a range of divergent cultures, even within a few square miles around any of the major conurbations, a rich research universe exists in which to enquire, analyse and understand the complex inter relationships between energy, micro enterprise and other livelihood enablers.

5.1.1 Social aspects

South Africa is a diverse country in terms of geography, culture, climate and socio economic development. It is also a country of stark contrasts with modern infrastructure, a highly affluent minority with a sophisticated economy on the one hand but with the majority of the population being poor, marginalized and without access to a full range of modern services. It may be regarded therefore both as a developed and yet developing region of the world suffering high levels of poverty, unemployment and limited access to services such as household water supplies and modern energy.

With a population of more than 42 million the demographics are 73% Black, 8% Coloured, 16% White and 3% Indian. Some 57% are urban dwellers with the balance living in rural areas. It is estimated that some 25% of the population live in either shacks or back yard rooms in urban areas with a further 17% living in traditional huts in rural areas. In addition some 21% live in low cost or so-called “matchbox” houses in urban township areas. In terms of household incomes there is widespread poverty with an estimated 30% of the total population living on less than R500 per month. Unemployment is a major challenge with estimates of the long-term unemployed being in the region of 45% although reliable statistics are scarce and complex especially with a highly flexible informal sector that is outside the tax net. Poverty is on the increase. South Africa is also suffering from a major AIDS pandemic with the increase in the number of AIDS orphans estimated to raise to 3 million by 2010 if current trends continue. The current demographic profile of the country is already heavily skewed toward the young with 45% of the population being under the age of 18 years. In terms of education only 42% of the population have anything beyond a primary education (i.e. Grade 7). Although education is receiving major attention from the SA Government, around 22% achieve a matriculation certificate and around 13% of the population hold post matriculation qualifications.

In terms of culture and language South Africa is highly diverse. There are 11 cultural and primary language groups in the country with the largest group being Zulu primary speakers at 21% of the population, 19% Afrikaans, 18% Sotho, 17% Xhosa, 15%

English and 7% Tswana. Many South Africans are bilingual and even trilingual with English being the primary language of commerce and government.

The major cities of Johannesburg and Pretoria (Gauteng) in the north, Durban, East London and Port Elizabeth on the east coast, Bloemfontein in the hinterland and Cape Town in the south-west have been characterized by large-scale migration from the rural areas, especially in the last 10 years, since the new political dispensation and the ANC Government came to power. Large informal settlements have rapidly formed near all the major urban centres of South Africa where there are a range of formal ("matchbox") and informal (shacks and back room) households. These settlements plus large parts of the rural areas are where the greatest concentrations of poverty are to be found. It is estimated that there are some 9 million households, in total, in South Africa.

5.1.2 The energy situation in South Africa

From an energy perspective, the stark contrasts evident throughout South Africa are similarly evident. The affluent, mainly white population living in well-established formal housing enjoy grid electricity, mains water supply and the full range of modern day services. But services are still limited for the urban and rural poor, although there are exceptions. These include the largely urban electrification programme that has now achieved some 90% penetration in urban areas, some significant progress in providing clean water (generally via community taps): and, massive provision of telephones (and widespread use of cellular phones). Nevertheless, despite major reconstruction and development projects in the last 10 years, today only 40% of dwellings have running water in the dwelling, only 38% have water-borne sanitation and some 2.5 million rural homes still lack access to modern energy and rely on wood, cow dung, candles and paraffin.

South Africa is a major primary energy producer with a large coal industry and highly sophisticated liquid fuels and electricity generating sectors. The electrification programme undertaken by Eskom, the integrated electricity parastatal, has been one of the largest upliftment via electricity projects in human history, with in excess of 300,000 household connections per year for the last decade. Despite this there are still major imbalances in energy access, affordability and choice among all the citizens of South Africa. One illustration of this is the limited access to LP Gas, a fuel widely used in other developing regions of the world. Paraffin, by contrast, is still freely available and is subsidized by the Government as an acceptable fuel for the poor despite the associated health and fire safety risks. Devastating fires caused by paraffin stove accidents frequently happen in the many informal shack settlements causing loss of life, destruction of hundreds of shacks and residents' meagre belongings, and misery. Children are particularly hit by these tragedies with many fatalities among babies and the young.

5.1.3 The informal economic sector

The informal economic sector in South Africa is of necessity large. Employment in the formal sector has been dwindling as industry and commerce strive for greater efficiency and economies of scale. It is estimated that there are some 720,000 in home or micro enterprises in South Africa ranging from retail/sales at around 40% including electricity prepayment vending, liquor outlets at 16% and 13% clothing manufacturing. Other micro enterprise includes transport, artists, building, services

such as hairdressing; and administration and professional services. Small manufacturing is estimated to be in the region of 40,000 businesses ranging from brick making, metal work, mats, food and craftwork. Some 58% of these small businesses only employ one person with only 11% employing four or more people. The demographic profile of micro enterprise is around 70% black and 20% white owned with the balance being owned and operated by Indian and Coloured entrepreneurs. It is estimated that some 30% of micro enterprises operate in rural settlements, 20% in informal urban settlements and around 45% in formal urban areas with the average monthly turnover of micro enterprises being R3,500. Over 90% of micro enterprises in South Africa have never received any assistance from any other organization and only around 10% of these businesses are members of a larger organization or trade group. In terms of help needed to achieve their business goals the two single most important areas most often quoted by micro entrepreneurs are loans and financial assistance, and business training.

5.2 INDIA

India is a giant south Asian country with huge cultural diversity and variations in the energy consumption pattern across the breadth of the country. Certain parts of the country are privileged enough to use the modern energy available, for high-tech applications such as information technology (IT) and IT-enabled services. In sharp contrast to this there are also some regions that are not electrified at all! There are thus many levels and contexts in which the linkage between modern energy and micro enterprise development can be studied.

5.2.1 Social aspects

India is the second most populous country in the world. Population density is highly uneven, with the country's three largest states located in the north. Although cities such as Bombay and Delhi are home to more than 10 million persons each, the vast majority of the population lives in rural areas. Average population density in the country is about 520 per square mile. Indian demography is one of the diverse in the world. About three-quarters of India's population is of Indo-Aryan origin. Smaller percentages are of Dravidian or Mongol descent**.** India is predominantly Hindu (83%), but Muslims (11%), Christians (3%), Sikhs (2%), Buddhists, Jains and Jews represent important minority religions. Hindi is India's official language and is spoken by approximately one-third of the population. There are more than a dozen "official" languages in India. English is an "associate" language, but is the primary language for business, commerce, and politics. At least two-dozen languages are spoken each by a million of more persons.

Although industry and commerce constitute the basis of the Indian economy, agriculture employs the majority of the labour force (About 70% of the labour force is engaged in agriculture and cultivation). Important Indian industries include textiles, chemicals, food processing, steel, transportation equipment, machinery, cement, coal, and oil.

5.2.2 The energy situation in India[2]

As it can be observed from the following sections, the energy scenario paints a serious shortfall of "energy " in India. As the international energy outlook 2001(1) points out, the current energy supply is well below the demand. The situation is expected to aggravate in the coming years as the population of the country is expected to reach 1.15 billion by 2010.

Oil accounts for about 30% of India's total energy consumption. The majority of India's roughly 4.8 billion barrels in oil reserves are located in the Bombay High, Upper Assam, Cambay, Krisha-Godavari, and Cauvery basins. The offshore Bombay High field is by far India's largest producing field, with production of 210,000 barrels per day (bbl/d) in 1999. India's average crude oil production level for the first ten months of 2001 was estimated at 640,000 bbl/d. India had net oil imports of over 1.1 million bbl/d in 2001. Future oil consumption in India is expected to grow rapidly, to 3.4 million bbl/d by 2010, from 1.9 million bbl/d in 2001. India is attempting to limit its dependence on oil imports somewhat by expanding domestic exploration and production. India's prospects for s sharp increase in oil production as no major new finds have been made in recent years. Analysts consider it likely that most of India's easily recoverable oil has been discovered.

Indian consumption of natural gas has risen faster than any other fuel in recent years. From only 0.6 trillion cubic feet (Tcf) per year in 1995, natural gas use was nearly 0.8 Tcf in 1999 and is projected to reach 1.3 Tcf in 2005 and 1.8 Tcf in 2010. Increased use of natural gas in power generation is to account for most of the increase, as the Indian government has been encouraging the construction of gas-fired electric power plants in coastal areas where they can be easily supplied with liquefied natural gas (LNG) by sea. While EIA's current forecast in the International Energy Outlook 2001 (1) predicts a robust 6.5% annual growth rate in natural gas consumption.

Coal is the dominant commercial fuel in India, satisfying more than half of India's energy demand. Power generation accounts for about 70% of In dia's coal consumption, followed by heavy industry. Coal consumption is projected in the International Energy Annual 2001 (1) to increase to 427 million short tons (Mmst) in 2010, up from 348 million in 1999. India is the world's third largest coal producer (after the China and the United States), so most of the country's coal demand is satisfied by domestic supplies.

India is trying to expand electric power generation capacity, as current generation is seriously below peak demand. Although about 80% of the population has access to electricity, power outages are common, and the unreliability of electricity supplies is severe enough to constitute a constraint on the country's overall economic development. The government had targeted capacity increases of 47,000 megawatts (MW) during the period covered by the current Five-Year Plan, between 1997 and 2002, and 107,000 MW by 2007. As of January 1999, total installed Indian power

[2] Sources for this section include: Business Line; CIA World Fact-book 2000; Dow Jones News Wire service; Economist Intelligence Unit; Financial Times; Hindustan Times; India Today; Oil and Gas Journal; Petroleum Economist; Petroleum Intelligence Weekly; Press Trust of India wire service; Times of India; The Statesman; U.S. Energy Information Administration; DRI/WEFA Asia Economic Outlook, World Gas Intelligence; World Bank India Economic Report.

generating capacity was 103,445 MW, and it appears that the increase will fall far short of expectations during the plan period ending in 2002.

5.2.3 Modern energy and micro-enterprise linkages reported in the Indian literature

The contemporary Indian literature lacks any specific references to the improved micro-enterprise activities because of the availability of modern energy. However, almost all the rural electrification and bio-gasification project reports end with very generalised notes on the improved business activities in that region. They clearly lack the statistics. This is probably because as pointed out by Chanakya H.N. (1986), most of the Indian authors believe that, benefits of the rural electrification projects are clearly established. (It is also one of the unstated assumptions in rural electrification projects). Given the size of electrification projects in India , there is an urgent need to test such assumptions. A clear positive sentiment can be observed in the Indian literature on this issue as illustrated by the following excerpts.

> Villages such as Malanganj and B.N.Pura flour mills have flourished because of the availability of power. As observed by Ravindranath and Chanakya (1986).
>
> Bhat and Ravindranath (1994) noted that electrification from biomass in Sirsi village of Karnataka led to small scale enterprise development such as rise parboiling, roofing tiles and tobacco curing.
>
> Bose R.K, Puri C and Joshi .V noted that in three unelectrified villages in Eastern Uttarpradesh, the electrification increase the business activities of the people by 20%. The electrical sewing has become part of night time activities of rural women.
>
> A village entertainment enterprise such as movie tent, community TV etc were also observed in certain villages after electrification by Bowonder et. al. (1985).
>
> Availability of power was deciding in establishment of groundnut – decorticating industry, coir-industry and biomass briquetting industry near Chikka Nayakan Halli (N.H. Ravindranath et.al) (1993).
>
> Small radio, TV, fan, food mixer usage after electrification led to the development repair and serving shops in a village as observed by Bowonder (1985).
>
> Power based threshing and winnowing activities increased in certain villages as noted by Dutt. G.S and Ravindranath N.H (1993).
>
> Food processing industries which needed cold storage facilities were also possible in certain villages (NCAER (1992)).
>
> In Ungra village in South Indian District of Tumkur the electrification resulted in increase in mechanized post-harvesting activities such as cleaning , milling etc.

Increase of under ground water pumping activities was observed in Uttar Pradesh and has led to development of small enterprises for repairing, servicing and retailing of spare parts in the same region.

In Hosahalli village rice milling activities were observed during 7 to 9 p. m in night, which was previously sleeping time for villagers. The rice mill activities also led to the development of associated enterprises such as plate grinding shops, motor winding shops

6 Key Findings and Conclusions from the Literature

In terms of linkages between modern energy and micro-enterprise, the literature reviewed to date indicates that:

a) Modern energy can, but does not necessarily, affect the emergence, development, productivity and efficiency of micro-enterprise.

b) While lack of access to modern energy is often characterised as a barrier to micro-enterprise development, removing this barrier (through, for example, energy developments such as electrification) does not necessarily result in micro-enterprise development. Rather, modern energy should be viewed as one of a suite of critical enabling factors that act individually and/or in concert to create a suitable environment in which micro-enterprises can operate. It is therefore important to assess the significance of modern energy in terms of the hierarchy of other enabling factors needed for micro-enterprise development, for specific types of business, in particular circumstances.

c) The linkages between modern energy and micro-enterprise, and the effects of the former on the latter, can have a gender-specific dimension.

Other areas that still require further investigation include:

a) The energy needs of specific types of micro-enterprises, and the role of modern energy in meeting these needs efficiently and effectively;

b) The contribution of micro-enterprise to economic and social development, particularly with regard to poverty alleviation in developing countries; and

c) The environmental impact of micro-enterprise, including energy-related impacts.

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