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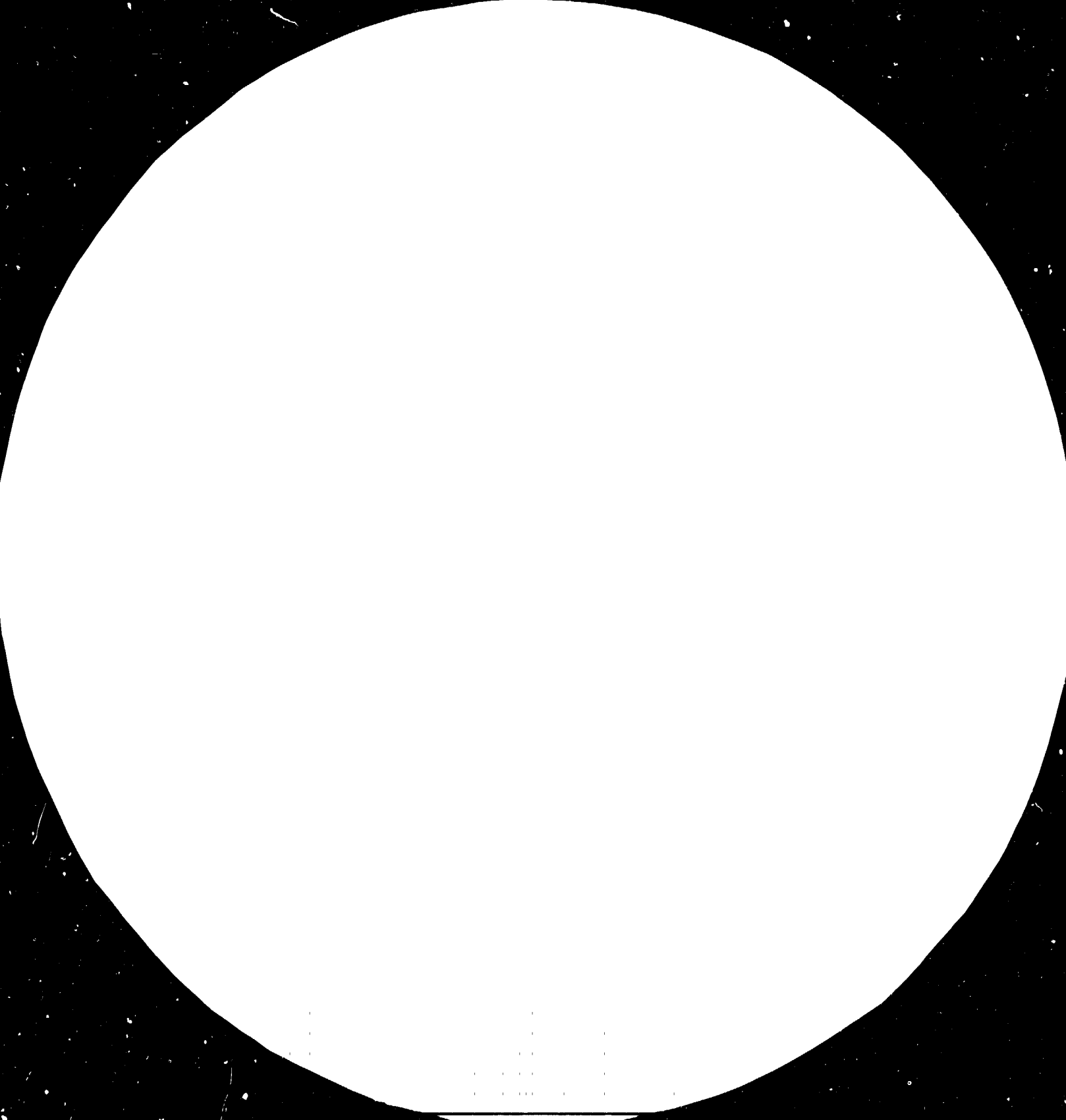
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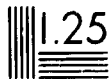
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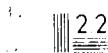
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**ENERGY CONSUMPTION
IN THE DECENTRALIZED INDUSTRIAL SECTOR**

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This paper was prepared by Dr. J. Parikh, Consultant to the UNIDO Secretariat.

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1. Introduction

1.1. Background

Informal or decentralized industries sector provides 15% to 60% of value added in manufacturing industries in a number of the developing countries. Often, it employs more persons than the formal sector. The existence of this sector is primarily due to its possibility of small scale operations with low capital requirement (per operating unit and not always per unit output), employment orientation, maneuverability in initiating it within the constraints of the infrastructure existing in the developing countries, and flexibility to manage it considering a number of daily difficulties that arise in running plants. They often use indigenous raw materials and a strong emphasis on them provides a scope to reduce inequalities in income distribution. If we assume that only the light manufacturing industries could be decentralized (but not necessarily are), Table 1 shows that their share in the manufacturing sector in the developing countries is 45% as compared to 33% in the developed or centrally planned countries.

When and where such decentralized industrial development is more desirable or optimal, compared to the centralized one and for which industries, is not the theme of this paper. It is a complex matter for which energy is only one of the considerations. However, if at least the energy implications are understood, then already a somewhat clearer picture emerges. It suffices to state that this sector is quite large in terms of value added (VA) and will continue to be large for a number of reasons. It is the purpose of this paper to indicate:

Table 1. Percentage Weights and Growth Rates of Value Added in Industries for Three Groups of World Economies

Industrial Activity	Centrally Planned		Developed Countries		Developing Countries	
	Percent. Weight 1975	Annual Growth Rate (1968-80)	Percent. Weight 1975	Annual Growth Rate (1968-80)	Percent. Weight 1975	Annual Growth Rate (1968-80)
Food, beverages and tobacco	11.9	4.5	10.6	3.1	10.3	5.2
Textiles	5.7	4.6	3.0	1.8	5.2	3.5
Wearing apparel, leather and footwear	5.7	5.7	3.4	0.6	2.6	3.9
Wood products and furniture	2.8	5.5	3.4	2.4	1.7	4.4
Paper, printing and publishing	1.7	-	7.0	2.9	2.3	6.4
Paper and paper products	0.9	5.4	3.1	3.1	1.1	5.8
Chemical, petroleum, plastic products	9.4	7.9	12.7	4.9	11.4	7.1
Petroleum and coal products	1.9	6.0	1.8	2.7	4.8	3.3
Rubber and plastic products	1.6	7.9	2.8	5.3	1.6	6.6
Non-metallic mineral products	5.7	6.2	3.6	3.1	2.7	6.7
Basic metal industries	7.1	5.0	6.6	1.6	3.3	6.8
Metal products, machinery and equipment	34.5	10.0	33.7	3.8	11.4	9.6
Electrical machinery	6.8	10.4	7.2	5.6	2.5	12.0
Transport equipment	9.1	9.3	8.7	2.3	3.6	10.3
Light manufacturing	30.9	5.6	29.3	2.6	23.4	4.8
Heavy manufacturing	56.0	8.6	56.9	3.7	28.4	8.0
Manufacturing	86.9	7.6	86.2	3.3	51.8	6.4
Electricity, gas and water	2.7	6.4	7.6	5.3	3.7	10.1
Mining and quarrying	10.4	4.4	6.2	2.7	44.5	3.0
All industries	100.0	7.3	100.0	3.4	100.0	5.2

Source: Yearbook of Industrial Statistics, 1980, UN.

*See the original source for ISIC classification and list of countries under each group.

- what are the energy implications of such an industrial development;
- what are the processes used by decentralized enterprises and what are the extent and nature of energy sources used in a few typical industries. That is, how best to describe energy demand system;
- what structural changes are taking place in this sector and what are its implications for energy use patterns;
- what are the energy sources appropriate for such decentralized industrial development and what can be done to develop suitable energy supply systems?
- The production processes used by them do not get studied enough to identify measures for energy conservation and very little research and development is done. What needs to be done about this?
- What institutions and mechanisms could be used to reach this sector?

1.2. Definitions of the decentralized industries sector

It should be mentioned that a number of terms are used to describe this sector, each of which emphasizes somewhat different aspect of the sector. Some of the terms are "informal sector", "unorganized sector", "unregistered sector", "light industries traditional sector", "small scale industries" or "decentralized industries". The first term is somewhat vague and the second term is used often for employment purposes because the labor used in these enterprises is not organized in unions . However, the concerned entrepreneur is quite often well-organized in production, packaging, marketing and distribution systems. The

term "unregistered sector" is used in India to include those enterprises which are not covered by Indian Factories Act of 1948 employing less than 10 persons with power or less than 20 persons without power. These enterprises, however, may be licensed and registered for other purposes such as income tax, industrial licences for using power connection or for using a premise etc. It would be difficult to use such classification for countries other than India.

The term "light industries" used by the ISIC classification for industrial statistics includes the decentralized industries sector as well as some additional centralized industries to make consumer goods, such as watches, refrigerators, etc., which are excluded in the present case. The term "small scale industries" comes close to the topic of this paper, which sometimes are defined by the amount of investment required in absolute terms per manufacturing unit, or by the output per day above which it is no longer considered small scale. In the present paper the term "decentralized industries" is used to include small enterprises as described above which could be located within rural or urban areas. The scale is an important consideration in distinguishing this sector from the formal centralized sector but it is not the only one. Another major concern is the nature of the alternative technologies used, the amount of energy consumed and the usually negligible R&D efforts put in for better energy management. In this connection it should be stressed that often "modern" and "traditional" are the words used to describe them but this is not how they are defined here. Decentralized industries could also be modern or lend themselves to modernization. Thus, the decentralized industries sector (d.i.s) discussed in the present paper in-

cludes traditional as well as modern small and medium scale industries. In Annex 1 a variety of terms used and importance of this sector is described for various countries.

1.3. Inadequate data base

Unfortunately, the data base concerning the decentralized sector is weak. Precise figures for value added in this sector, types of inputs, outputs and production processes, energy consumption patterns, etc. are not easily available. Therefore, extensive use of data related to India is made where much of the data is documented and analyzed as India pursues a policy of decentralized industrial development more strongly than many other countries except perhaps China for which more data needs to be obtained. However, the lack of data need not be an excuse for not doing something about it. Moreover, as will be shown, there are certain obvious aspects which should and can be dealt with in spite of the lack of a precise data base. The information gaps will be identified and ways to reduce them will be suggested.

2. Factual basis and structural changes

Even though the data base for d.i.s. is weak, some factual basis is necessary to understand the process to determine the relative importance of various industries. These will be considered in two steps.

Very often explicit statistics about which industries fall into the d.i.s. and what is the value added by them are not available except for some countries. Judgements have to be exercised by looking at the type of industrial outputs etc. to determine this.

An attempt was made to assess which industries are small scale in which countries from the UN industrial statistics where number of persons/establishments could be obtained by using the

data for number of employed persons and number of establishments. However, there appears to be a clear bias against reporting small establishments judging from a large number of persons (80 to 200) per establishments that one gets even for industries like food processing, leather and pottery in countries like Bangladesh or India. Therefore, an alternative approach was to consider a country where detailed statistics is available and then take it as a starting point.

Table 2 shows such statistics for India where separate data of production is available for the registered and unregistered sectors. It gives an idea about:

- what industries fall into the d.i.s. categories; or which outputs could be produced by decentralized industries;
- what are their contributions; and
- what are their growth rates.

All of these are important questions for going into more details. It can be seen that there are large contributions which come from unregistered industries, related food products, beverages, textiles, wood products, leather products, chemical products, and non-metallic minerals.

It should be stressed that depending on government policies and other factors described later, some industries could be small scale in one country and large scale in another country. For example, 56% of textiles are produced on small scale handlooms or power looms in India due to government policy for employment (due to Gandhian influence?). Infact, between 1971 to 1981, decentralized sector increased production from 3547 million meters (Mm) to 5060 Mm, whereas production of the mill sector declined from 4055 Mm to 2923Mm during this period. This is achieved by

Table 2. Growth rates of value added in different industries in the registered and unregistered sector (figures in Rs. 100,000 at prices of 1970-71)

Industry Group	Registered Sector				Unregistered Sector			
	1970-71	1976-77	% Share in regist.	Growth Rate 1970-76	1970-71	1976-77	% Share in unregist.	Growth Rate 1970-76
1. Food Products	26815	29084	7.4	1.35	18411	19474	8.4	0.94
2. Beverages, Tobacco, and Tobacco Products	9911	14193	3.6	6.17	10409	14013	6.0	5.08
3. Textiles	59730	76559	19.6	4.22	44611	61621	26.5	7.10
Cotton Textiles	40139	47591	12.1	2.88				
Wool, Silk and Synthetics	9378	12635	3.2	5.09				
Jute, Hemp and Mesta Text.	8780	12294	3.1	5.77				
Textile Products	1433	3808	0.9	17.69				
4. Wood and Wood Products	3094	2601	0.6	(-2.95)	22043	33257	14.3	7.10
5. Paper and Paper Products	14959	16124	4.1	1.26	5106	5227	2.2	0.39
6. Leather and Leather and Fur Products	2260	2010	0.5	(-1.97)	6907	7481	3.2	1.34
7. Rubber, Plastic, Petrol- eum and Coal Products	12890	13346	3.4	0.58	1820	2966	1.3	8.48
8. Chemicals and Chemical Products	36707	52394	13.4	6.11	5837	8753	3.7	6.99
9. Non-Metallic Mineral Products	11399	12992	3.3	2.20	9342	15097	6.5	8.33

Table 2 (continued)

Industry Group	Registered Sector				Unregistered Sector			
	1970-71	1976-77	% Share in regist.	Growth Rate 1970-76	1970-71	1976-77	% Share in regist.	Growth Rate 1970-76
10. Basic Metal and Alloys Industry	28451	42429	10.8	6.89	462	733	0.3	7.98
11. Metal Products and Parts	9454	11292	2.8	3.01	11772	14152	6.1	3.12
12. Machinery, Machine Tools, etc.	19386	32860	8.4	9.19	6375	8679	3.7	3.28
13. Electric m/c	18213	29380	7.5	8.30	3627	4443	1.9	3.44
14. Transport	24396	28832	7.3	2.82	5346	7025	3.0	4.68
15. Misc. Mfg. Industries	18652	14293	3.6	(-4.54)	13258	16530	7.1	3.75
16. Repair Services	6397	9769	2.5	7.31	10603	13346	5.7	3.91
17. Net Value Added incl. Imputed Bank Charges	296317	391288	100.4	4.78	-	-	-	-
18. Less Imputed	1055	1797	0.4	9.28	-	-	-	-
19. Net Value Added	295262	390401		4.77	175929	232797		4.78

Compiled by J. Parikh and A. Chaitanya (1980)

National Accounts Statistics (1979) Central Statistical Organization, New Delhi

giving subsidies, opening service centers for power looms and handlooms and helping them with marketing and distribution. On the other hand, in some countries textiles could be exclusively produced in the centralized factories and transported to rural areas. Similarly, small scale production of soaps from vegetable oil or dyes, resins and gum, is also encouraged for reducing monopoly, transport costs and concentration of wealth. In other countries, these chemical products may not be considered a decentralized industry.

More country-level data such as those given for India for other countries would be most helpful in elaborating this issue further.

However, in the absence of such data for other countries and the need to ensure if the decentralized industries identified for India are indeed the ones which are also decentralized in other countries, industrial statistics were consulted for shares of employment data of a sample of eight countries. It was found that while in Asian countries textiles may be in the d.i.s., it may not be so in Venezuela, and so on.

3. Present patterns of energy consumption in d.i.s.

Unlike the energy consumption in the centralized industrial sector, the energy consumption in the decentralized industrial sector is expected to increase in terms of energy per output as well as energy per value added. This can be seen in Table 3 for India where the energy intensities for coal, oil and electricity are shown for large energy consuming (LEC) industries and non-Lec industries. The LEC industries include steel, fertilizers, cement, textile mill sector, etc. Although this classification is somewhat different than the centralized industries, there is a considerable overlap between the two and the general conclusions are valid. It can be seen that the LEC industries require more energy per value added but their overall expected trend is that of decreasing energy per unit VA.

Table 3. Present and expected energy consumption norms for industry sector of India.

	1976-77	1989-90	2000-01
<u>Electricity (10^9 kWh per Rs. 10^9)*</u>			
LEC Industries	1.39	1.439	1.200
Non-LEC Industries	0.390	0.557	0.600
<u>Fuel Oil (10^6 mt. per Rs. 10^9;</u>			
LEC Industries	0.1126	0.108	0.060
Non-LEC Industries	0.0037	0.0037	0.0037
<u>Coal, Coke, Charcoal (10^6 mt. per Rs. 10^9)</u>			
LEC Industries	1.648	1.666	1.666
Non-LEC Industries	0.421	0.463	0.600

*Includes contribution from non-utilities.

LEC industries include large energy consuming industries.

Source: J. Parikh (1980)

After analyzing the trends of both LEC and non-LEC industries, it was concluded by J. Parikh (1981) that while reduction in the energy consumption by LEC industries will take place essentially because a number of developments and efforts made by the developed countries, the same will not be possible for the non-LEC or decentralized industries sectors because of the following reasons:

- Electricity will be substituted for hard work done manually as and when the wages increase to also increase production and to improve quality control.
- Substitution of commercial energy for non-commercial energy use prevalent at present.
- Lack of R&D efforts in the decentralized industries sector in which developed countries have little interest and only indigenous approaches and solutions suited to developing countries would help.
- Lack of incentives by small establishments because the energy consumed by individual unit may not be significant so as to encourage energy conservation.

Although the above trends are somewhat inevitable, there is still room for a lot of actions and policy measures so as to rationalize the use of energy. Some of them are described in later sections.

What is the prognosis for non-LEC industries? In order to answer this, a break up of inanimate energy consumption of five non-LEC industries could be seen in terms of four major sources in Table 4. It can be seen that as a whole total energy require-

Table 4a. Percentage Distribution of Energy Use by Source for Decentralized Establishments

	Electricity	Liquid Fuel	Coal, Wood & Bagasse	Other Power	Total
Food Products	9%	16%	38%	37%	100%
Beverages and Tobacco	3%	1%	95%	2%	100%
Non-metallic Mineral Products*	negligible	1%	99%	neg.	100%
Metal Products	1%	neg.	99%	neg.	100%
Others	8%	2%	88%	2%	100%
All Industries	6%	10%	62%	22%	100%

Source: Indian National Census (1970)

*Non-metallic mineral products covers brick and glass manufacture, pottery, etc.

Table 4b. Percentage Distribution of Inanimate vs. Manual Energy for Decentralized Establishments

	All Fuels/Power	Manual
1. Food Products	92%	8%
2. Beverages & Tobacco	5%	95%
3. Non-Metallic Mineral Products	19%	81%
4. Metal Products	73%	27%
5. Others	4%	96%
6. All Industries	24%	76%

Note: It is not clear if "manual" power refers to human or animal power. If it is the former then animal power is perhaps included in the "other power" category (Table a).

Source: Notes prepared for Working Group for Energy Policy of India, 1979.

ment is split into 62% heat from coal and non-commercial energy, 10% liquid fuels, part of which may be used for heat and part for motive power, and the rest is 28% in terms of motive power from electricity when strong motive power is required for stationery equipment. In fact, except for food processing industries, the rest of them use exclusively heat, which is often obtained from non-commercial energy. However, supply of energy is discussed later.

In addition to this, substantial animate energy or hard labor is used except in food processing industries. It forms a very large portion of total energy required, justifying the above expectations of increasing energy requirements, when human labor gets replaced by energy consuming machines.

4. Specific industry groups

In the following some of the individual industry groups are treated in more detail. The discussion is illustrative and by no means comprehensive.

4.1. Food processing

This happens to be one of the most important industries in the developing countries because no matter what the level of the development or income, food processing in some form or the other is required in any country at a level of about 0.3t to 0.5t per person. Most of the food commodities require some processing

- either for making them edible, e.g. dehusking rice, milling flour or oil seeds, crushing sugar cane, etc.
- or for their preservation for transporting to urban areas or for storage for later periods so as to extend their use over space and time

- or for making alternate derivatives and precooked foods for consumers' preference, such as cheese, potato chips, tomato ketchup, soups, chocolates, beverages, etc. (It is in this area where the multinationals are active.)

In view of the high commercial energy consumption (see Section 3), high value added and employment, this industry is discussed in more detail compared to others.

Food processing industries include a variety of establishments, such as rice mills, flour mills, oil mills, sugar mills, food processing industries for fruits and vegetables producing a wide variety of products, such as jams, ketchup, pastes, juices, extracts, etc., bakeries for bread and biscuits, dairies for milk, slaughter houses for meat, breweries and so on. Not all of them are small scale but, in principle, they could be for entrepreneurs with small capital.

Table 5 indicates that in Thailand most of the food processing industries are in the d.i.s. and constitute a large number of establishments for a medium sized developing country. Moreover, except flour mills, bakeries and fruit & vegetable preservation factories, most of the food processing industries are located away from Bangkok for obvious reasons. This gives opportunities for employment, investment and income in smaller towns and villages.

Preliminary results from a forthcoming study by FAO (1983) indicate that in 1979 the developing countries* processed 1262 million tons (MT) of food commodities of which 618 MT was sugar cane alone and nearly 400 MT of cereals. If accounted in terms

*This comprises of 90 major developing countries, except China which were included in AT2000 study of FAO. It includes 70 processed commodities

Table 5. Number of establishments in selected food-processing industries in Thailand and Bangkok

Industry	1975	
	Thailand	Bangkok
Preserved, dehydrated, quick-frozen fruits and vegetables	33	21
Animal and vegetable oils and fats	105	22
Husking, cleaning, polishing rice	25868	131
Flour	306	125
Blended grain seeds and roots	81	37
Tapioca	849	4
Bread, cakes, biscuits etc.	126	70
Food from starch	155	25
Coffee roasting	79	58
Flavouring	87	23
Animal and fowl feedstuffs	134	17

Source: A. Bhumiratana (1979), Status of food storage and processing technology in Thailand, in: Appropriate Industrial Technology for Food Storage and Processing, UNIDO, Vienna.

of processed forms, the share of cereals in total volumes processed forms, the share of cereals in total volumes processed is 60%, sugar 10%, livestock and milk 17% and alcoholic beverages 4%. However, since energy consumption is different for the above commodities, the shares of these commodities in the energy consumption change to 20% cereals, 17% vegetable oil, 30% livestock and milk, 27% alcoholic beverage amounting to 17 MT of oil replacement (MTOR) if only commercial energy is considered. Since sugar uses only bagasse, its share is only 3%. If non-commercial energy is included, then the above estimate increases from 17 MTOR to 43MTOR. This large contribution is in spite of the fact that the non-commercial energy is included only after reducing their contributions by the efficiency ratios with respect to oil to account

for their inefficient use of 8% to 15% (oil can be used with 35% to 60% efficiency). To put this in another perspective, this amounts to per capita use of 20kgOR with regional averages being 9, 56, 12 and 14 kgOR for Africa, Latin America, Near East, and Far East, respectively. It is estimated that the share of commercial energy spent for food processing in national or regional energy use of commercial energy amounts to 3% to 5%, half or almost as much as that required for agricultural production.

Having discussed the overall picture of their importance one could ask: How is this energy spent and what could be done about this? This we now discuss in the case of some specific industries.

4.1.1. Rice and flour mills

In the developing countries, including China, 388 Mt of paddy was produced in 1981 as compared to 158 Mt wheat and 160 Mt maize in the same year (FAO 1981). Most of the paddy is milled in small or medium scale rice mills. In Thailand alone, 26 000 rice mills existed in 1975, milling 14 Mt at that time (production in 1981: 19 Mt). Thus, rice is the most important crop. Rice mills located in the remote areas of Bangladesh where no electricity is available, use diesel engines of 20 kilowatt (kW), milling up to 0.5 tons per hour using about 12 liters diesel per ton of rice. They are inefficient compared to the electric mills. Even the old electric mills known as Engelberg mills, which use up to 10kW motor are being replaced in Indonesia by rubber roller mills which give good rice recovery from paddy and handle 8 to 10 tons of paddy per day using 40 kW and above motor. Diseconomies for larger

multi-stage mills (which mill more than 5 tons per hour) are due to energy required to transport paddy and due to the problems of gathering large quantities of paddy from small farms. This often results in low capacity utilization. In fact, in Ghana a large food processing plant set up with foreign collaboration ran at 10% of capacity due to lack of raw materials.

Flour mills for wheat, pulses and coarse grains also follow similar patterns and are not discussed separately. Energy requirements for milled rice, wheat and maize in medium scale mills are 25, 50 and 70 kWh per ton respectively.

Thus, cereals which form a major part of the staple diet have to be processed in large quantities; these mills happen to be in the d.i.s., some of which require to be modernized and they require commercial energy, i.e. oil and electricity. If a review of energy consumption by these mills is made, it may reveal possibilities of savings.

4.1.2. Bakery

Most countries have some form of wheat products which are roasted or baked. Some of them are indigenous products and some are western style raised bread. Some multi-national brand names have replaced indigenous bread-making which undoubtedly require measures of modernization and energy efficiencies. It is estimated that in Kenya wood-fired ovens use 632 kg coal equivalent (kgce) wood per ton of bread as opposed to mechanized processes which use 121 kg. This could be due to lack of insulation and appropriate control of heat in wood-fired ovens. If that is done, perhaps the difference would be much smaller.

In addition, oil mills, sugar factories and many other industries consume energy which is not discussed here.

4.2. Textiles

Next to food, clothing is the most important basic necessity. Textiles appears to have the largest share in terms of employment and also in value added industries.

As mentioned before, in general there are three ways of producing textiles: mill sector, power looms and hand looms. In the case of the countries of Africa and Latin America, there is an increasing tendency to produce textiles in the mill sector but not so in some countries of Asia. In Bangladesh, for example, 67% employment and 35% VA in manufacturing is in the textiles. (However, limitations of these statistics having inadequate coverage of small scale industries are mentioned before, which ought to increase the shares of both for food processing industries.) It should be mentioned that the outcoming products from the various sectors are qualitatively different, e.g. mill sector produces cloth with higher counts. The integration of various processes differs too; mill sector handles all processes ranging from spinning yarns, dying, bleaching, washing and weaving. Handlooms and powerlooms do only weaving after the yarn is provided, which is produced in the c.i.s. Sometimes dying, bleaching, washing, printing is also done in the d.i.s. and requires heat for water and hot air.

Table 6. Output and employment in textile production in India.

	Mill Sector	Power Looms	Hand Looms	Total
Output in 1977-78 in million meters (Mm)	4148	3123	2229	9500
Targets for 1982- 83 (Mm)	4800	3700	3700	12200
Employment in 1977 10 ⁶ persons	1.08	1.11	5.7	7.89

Source: Ministry of Industries (1979) Government of India.

It should be mentioned that in spite of the fact that nearly 55% of the cloth is produced in India on handlooms and power looms, energy consumption for the textiles is one of the highest among all industries and use 4 billion kWh electricity, 277 000 tons of furnace oil, 12 000 tons of hard coke and 2 MT steam coal in 1977-78.

Thus, the textiles sector is a large sector where the decentralized development is possible and where hot water and hot air require energy which could be substituted by solar energy.

4.3. Construction industries and building materials*

Shelter is the most basic necessity of life after food and clothing. The need for building materials for housing billions of people is so large and the production of conventional building materials, such as cement, which is mainly produced in the centralized industries, is so small that unless approached in an altogether different way, the housing problem cannot be solved for many decades. Table 7 illustrates the magnitude of the problem for India and shows that of the 93 million census houses fully three fourths have either walls or roofs which are not "permanent".

A report by an expert committee to search for the ways for cost reduction in building construction suggested the use of alternative mortars e.g. cement sand mortar could be adequately replaced by cement:lime:sand mortar or lime:surkhi mortar. Energy consumption and investment required for producing three equivalent amounts of mortars shown in Table 8 suggest that the use of lime could use less oil and electricity, require less investment and lends itself to decentralized production unlike

*Construction materials are included in non-metallic minerals

Table 7. Distribution of census houses by predominant materials of wall and predominant material of roof.

State/ Union Territory	Total Rural Urban	Total Num- ber of Census Houses	Predominant Material of Wall	Predominant Material of Roof		
				Grass, leaves, reeds, bam- boo, thatch, mud, unburnt bricks or wood	Tiles, slate, Shingle, cor- rugated iron, zinc or other metal sheets, asbestos cement sheets, brick, lime, stone and RBC/RCC	All other materials and materials not stated.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
India	Total	93,041,350	(i) Grass, Leaves, Reeds or Bam- boo, Mud, Unburnt bricks, Wood.	31,791,750	24,915,283	35,668
			(ii) Burnt bricks, G. I. sheets or other metal sheets. Stone, Cement.	7,289,706	25,917,543	33,247
			(iii) All other materials and mater- ials not stated.	11,905	20,263	25,985
	Rural	74,497,418	(i) Grass, Leaves, Reeds or Bam- boo, Mud, Unburnt bricks, Wood.	22,437,467	22,025,059	17,295
			(ii) Burnt Bricks, G. I. sheets, or other metal sheets, Stone, Cement.	5,886,712	14,078,437	15,608
			(iii) All other materials and mater- ials not stated.	10,369	10,683	15,788
	Urban	18,543,932	(i) Grass, Leaves, Reeds or Bam- boo, Mud, Unburnt bricks, Wood.	2,354,283	2,890,224	18,373
			(ii) Burnt bricks, G. I. sheets, or other metal sheets, Stone, Cement.	1,402,994	11,839,106	17,639
			(iii) All other materials and mater- ials not stated.	1,536	9,580	10,197

Source : Census of India 1971 : Part IV(B) Housing Tables.

cement which must be produced in large centralized production.

Bricks are often made in the rural areas using large amounts of non-commercial energy (mainly gathered wood) or coal in improvised kilns and fires. More scientific inputs concerning insulation and controlling fire could lead to 20% to 30% savings and could save large amounts of wood or coal. In 1977, Bangladesh imported 267 000 tons of coal out of which 68% was used for burning bricks.

Table 8. Energy use comparison and investment for equivalent mortars, using cement, cement and lime, and lime and surkhi*

	1:6 Cement sand mortar	1:1:9 Cement lime sand mortar	1:1.5 lime Surkhi sand mortar	
Item	producing one million tonnes of cement per year*	producing 1.33 million tonnes of lime(†) per year	producing 0.56 million tonnes of lime(‡) per year	producing 1.20 million tonnes of surkhi(§) per year
1. Fixed Investment	Rs. 400-450 millions with (15%) foreign exchange	Rs. 4 million	Rs. 1.8 million	Rs. 82 million to burn and Rs. 41 million to grind
2. Fuel consumption				
a. Fuel oil	1,50,000 tonnes	1,40,000 tonnes	65,000 tonnes	
b. Coal (6000 BTU)		Or 3,30,000 tonnes	Or 1,50,000 tonner	2,40,000 tonnes.
c. Electricity	80 x 10 ⁶ Kwh			40 x 10 ⁶ Kwh for grinding

* For a large scale modern plant.

(*) For small scale sector operation.

‡ When 1:2:9 cement : lime : sand mortar (by volume is used instead of 1:6 cement : sand mortar (by volume) 1.33 tonnes of lime is required to replace a tonne of cement.

§ When 1:10:5 lime Surkhi sand by weight of (1:2:8 lime : surkhi : sand) mortar is used instead of 1:6 cement : sand mortar 0.60 tonnes of lime and 1.20 tonnes of surkhi is required to replace one tonne of cement.

Notes:

(1) For equivalence of these mortars see I. S. Code 1439.

*Surkhi is powdered burnt clay often obtained from broken bricks; lime can be a substitute for cement only in masonry work. Unlike cement, it corrodes metal. Cement is essential for making reinforced concrete for roofs and high rise buildings, etc.

Thus, preparation of building materials, which are required in large quantities could be done in the d.i.s. and the heat required could be substantially reduced by appropriate measures. Use of bio-mass for building materials vs. fuel needs to be studied to see if part of the heat could be substituted by solar energy.

These are only some illustrations of the most important industries. Unfortunately, it is not possible to discuss many industries individually that fall into the d.i.s.

5. Other factors affecting centralization and decentralization

What are the other factors besides energy that one needs to consider in deciding if the products should be produced in the d.i.s. or not? If the case of each industry is analyzed rationally--rather than emphasizing one or the other politically--one would most likely end up with a mix of both approaches, especially in developing countries. Heavy industries like steel, fertilizers, cement, metals etc. may require centralized approach due to the complex technological aspects as well as pronounced economies of scale. On the other hand, alternative choices of production exist for textiles, food processing and other industries. Even in the developed countries the march towards the bigger and bigger scale has stopped recently, because of the diseconomies which occur due to management, labor, environmental and bottlenecks of raw materials, transport, etc. This is not the case in the developing countries. Here, transition from medium to large scale is taking place in large countries, such as Brazil, India, Mexico, etc. and low to medium scale in medium scale countries like Indonesia, Thailand, Phillipines, etc. Invariably, scaling upwards reduces energy consumption per output whether one goes from mini steel plants to oxygen furnace steel plants or 300 tpd to 1300 tpd fertilizer plants. However, when altogether

different ways of production exist--such as textile mills and power looms, centrifuge sugar and open pan gur--one enters in a very different debate involving different issues and not just scaling up the same technology and in this case energy consumption may even decline by going to small scale.

Some of the determinants for policy towards or against decentralization are discussed below.

- a) Employment: More often than not, decentralized sector gives more employment per output and per value added. However, the labor required is often less skilled and less paid so as to make costs of the products competitive with those produced by centralized industries. Product-difference is also there so that the outputs are not strictly comparable. For example, gur making from open pan technology requires more labor per output which is paid less than the skilled labor. The same is the case for handloom cloth vs. cloth from mills.
- b) Availability and acquisition of raw materials: Often, the decentralized production is associated with decentralized availability of raw materials. This is the case with food processing industries depending on small farms, small lime kilns, brick factories, etc. Conversely, large farms support large centralized food processing industries and large deposits support large lime kilns and so on.
- c) Urbanization or the demand centers: Analogous to the above factor is the spread (or concentration) of the demand of the outputs which also is a factor determining decentralization. To serve large cities, centralized production may be preferable and vice versa. This depends on not only the factors affecting production but acquisition of raw materials and distribution of final products. This brings one to the next point.

d) Energy for transport: Energy for transporting raw materials and outputs could be sometimes as important as the energy for manufacturing the output. Energy for freight transport in terms of 1000 ton-km transport are indicated in Table 9. It can be seen that most energy-efficient transport is that by railways but would generally be available to the centralized industry sector (c.i.s.). The d.i.s. would have to largely depend on the truck transport which requires 5 to 6 times more energy than the railways. On the other hand, with proper planning the goods produced or used by the d.i.s. do not have to travel large distances. Thus unless otherwise justified, it would be irrational to set up d.i.s. which require transport for large distances or to set up c.i.s. in places where no railways are available.

These are some of the factors which need to be considered in addition to energy consumption in the industries while making choices between the d.i.s. or the c.i.s. The policy instruments for promoting one or the other then could be taxation, subsidies, price controls, licences, wage policy etc.

Table 9. Energy required for transporting 1000 ton-km by different modes.

Mode	Sub-mode	Energy Consumption
Railways	Steam	100 to 140 kg coal
	Diesel	16 litres diesel
	Electric	20-25 kWh electricity
Road	Good road (Asphalt)	50-70 litres diesel
	Bad road	70-150 litres diesel
	Small trucks of 1 ton	140 litres diesel
Water	Barges	10-20 litres diesel
	Coastal ships	

Source: Parikh J. (1981) and FAO (1983).

6. Energy supply for decentralized industries

Energy supply for decentralized industries need not necessarily be decentralized, especially if they are located in the urban areas or towns. However, for rural industries this could often be the case. In order to plan for the supply, a rough break-up of how much energy is required in heat form, how much in motive power (mechanical energy) and how much in electric power is necessary and was shown in earlier sections for one country. When one wants to consider how much of these could be substituted by new and renewable energy sources, even further disaggregation is necessary, e.g. heat in terms of hot water, hot air, steam or direct heat, motive power in terms of revolutions per minute or electric power in terms of kilowatt (kW), or Megawatt, etc. This is because various alternative technologies, such as bio-gas engines, windmills, solar water heaters, etc. have different limitations.

In the following we discuss where presently the energy supply comes from and what are the additional possibilities.

6.1. Energy conservation measures

One unit of energy saved per output reduces the demand by many units of energy over a long period. To that extent, reduction in the energy use is an important option to energy supply planners and therefore is included here.

There is considerable room for conservation in the d.i.s. It seems that there are thousands, if not millions, of improvised "dryers, furnaces, boilers, ovens and kilns" producing, processing or drying tea, paddy, tobacco, charcoal, lime, bricks, metal works, pottery products, timber products, chemicals etc. When nearly

15% to 30% of energy reduction is expected from similar uses in equipment designed by skilled engineers in the cities, it will not be surprising if 50% to 80% energy could be saved if simple principles of only insulation and controlling fire and temperature are applied. Often the so-called kilns are pits in which wood is heaped; potters and black smiths use open fires when they really need enclosed fires, i.e. furnaces or ovens. Numerous diesel engines, cereal mills and other equipment are used in large number and need to be studied for reducing the use of oil and electricity. Thus, present energy utilization needs to be examined closely to find ways to save energy.

6.2. Conventional energy alternatives

Only after examining the existing energy alternatives and their inadequacies could one justify the search for new ones in the future. However, it is stressed that making suitable small changes in the existing energy systems, such as increasing their efficiencies, could be sometimes more cost-effective than starting all over again with new energy alternatives. In some cases, there appears to be no alternative in sight for the existing alternatives, e.g. large scale power from the grid for "large" electricity requirements or even for medium scale establishments like flour mills.

6.2.1. Non-commercial energy: Even though wood, bagasse, agricultural residues are not available free, their supply is unfortunately not planned and managed as a commercial activity of providing raw materials on a sustainable basis. To that extent, they are "non-commercial" fuels. Wood as well as rice husks

and other agricultural residues are used in tea, tobacco, and paddy drying. Large scale use of bagasse which replaces nearly 25 million tons of oil while processing 620 million tons of sugar cane into gur or sugar has already been mentioned.

Brick manufacturing consumes large amounts of wood causing concerns for deforestation and so does charcoal produced from wood often non-commercially in a pit. Charcoal is extensively used for industries ranging from metal products, chemicals, pottery and food processing. Thus, many of the rural industries depend on the supply of non-commercial energy which is unreliable. Moreover, the household sector competes for the same energy resources.

If, however, with input of management the supply can be obtained from organized wood plantation schemes, the rural industries would have assured supply of energy. In fact, if sustainability of the fuels is not assured, survival of some of the d.i.s. may be at stake, let alone their competitiveness.

6.2.2. Diesel engines and generators: At the one extreme in many LDC's the bulk of the heat supply is obtained from non-commercial energy and at the other extreme, the next available alternative for motive power or electricity is diesel used in diesel engines or diesel generators. Supply of diesel, in addition to being irregular in the rural areas, is influenced much more by international factors. This often results in unavailability, inadequate quota or high costs. Some surveys have shown that diesel is used very inefficiently due to inadequate knowledge of matching the engine or motor capacity with the pump capacity and nearly 30% to 40% oil could be saved in the case of diesel pumps for irrigation. Similar surveys for d.i.s., if carried out, may reveal inefficiencies.

6.2.3. Electricity from grid: This is the third major alternative often available to d.i.s. in urban areas and towns. Some rural areas are also connected with lines of 11kV, 33 kV or 66 kV at most which are unable to carry large amounts of power. In cases when large electricity is required, say 5 MW to 100 MW, it seems unlikely that non-conventional sources could be substituted assuming hydro-power to be conventional but renewable energy source. Some alternatives are discussed later.

In addition to the above mentioned major alternatives, there could be local solutions, such as natural gas, coal, peat, etc. but they are difficult to distribute to large numbers of small demand centers.

6.3. Future energy supply alternatives

A number of sources in the literature could be referred for recent developments in some of the energy supply alternatives and the repetition here of what they are and how they work etc. is avoided. The focus here is how to mould these efforts for enhancing industrial development. It should be stressed again that some combinations of existing and new energy supply would be necessary and alternatives could be only increased gradually. Future energy supply alternatives could be classified into two categories:

6.3.1. Specific purpose equipment: These include solar paddy driers or rice husk based paddy driers, solar kilns for timber drying or solar furnace for metallurgical purposes.

6.3.2. General purpose alternatives: Rural electrification, wood based and solar power plants, wind mills for motive power and water pumping, solar hot air and hot water systems etc. provide alternatives. However, upon reflecting the overall picture it appears that many of the specific purpose applications could be developed into more general purpose items, e.g. solar kilns for drying timber could be developed so as to be suitable for bricks, etc. thereby extending their demand to larger markets. On the other hand, some of the general purpose applications could be made more specific so as to suit a particular industry and be integrated in the rest of the industry process. For example, some of the solar hot air and hot water systems will be more utilized if they are integrated in specific industries, such as textiles, chemicals or food processing industries. Due to recent interest in the new and renewable energy sources, a special mention is made below. There are equally good possibilities for using conventional energy alternatives also.

6.4. Substitution of new and renewable sources of energy (NRSE)

To utilize NRSE cannot be a goal by itself but in view of the difficulties of providing oil or electricity in the rural areas, it seems to offer promising possibilities. However, only when a reasonably substantial list of all possible alternative uses for a given technology is made, one could say:

- whether they are worthwhile developing them
- for what purposes and
- under what conditions.

For this purpose a list of the d.i.s. industries as they exist today should be made along with the processes for which energy is required in as detailed and disaggregated a way as possible. For instance it is necessary to know if the heat required is direct, or in terms of hot water or hot air, and at what temperature, i.e. direct heat for metal working or hot water for chemical products and leather industries or hot air for removing moisture, e.g. in drying paddy, chemicals etc.

Thus, in order to appreciate possible impacts of NRSE the heat energy required in the industries needs to be split into the following components:

- (a) Hot water for washing (less than 100°C)
- (b) Hot water for boiling, sterilizing (above 100°C)
- (c) Hot air for drying or reducing moisture (less than 100°C)
- (d) Low pressure steam
- (e) Hot air for drying or baking (ovens above 100°C)
- (f) High pressure steam
- (g) Other heat requirements.

Hot water and hot air systems for (a) to (d) and even solar ovens could be made commercially available with payback periods less than 5 years. If suitable tax incentives could be provided, such systems can be rapidly introduced too. Constraints of the available area in the industries for solar collectors and concentrators in comparison to energy requirements in an industry have to be, however, considered.

In addition, solar boilers, kilns, industrial ovens and furnaces can make important contributions in the small-scale industries. Biomass-based applications, such as gasifiers and

wood kilns, could be used for all of the above. In each case the substitutes will be different.

Mechanical energy of less than 10 kW could be provided by gasifiers or biogas engines, up to 1 MW and beyond by windmills or solar power. Note that here and elsewhere, very large power plants up to 10MW to 100 MW based on solar or wind power planned in the industrialized countries are not thought to be feasible in the developing countries on a large scale. Therefore, the traditional diesel generators up to 20 MW power and rural electrification from grid could be appropriately used for townships having a large number of small decentralized establishments.

7. Institutions and mechanisms for change and action

What could be the institutions and mechanisms for change and action at sub-national or regional level, national level and international levels?

7.1. National level

This is discussed first because the policy level decisions are made here and connections are made at subregional or international levels only through this point. Depending on a number of factors, some of which are mentioned before, national governments would have to decide which industries are suited for decentralized development and for which subregions in their countries. Having selected an industry for decentralized development, the government would need to take steps to ensure its development, adoption of appropriate technologies and efficient operation. If associations or co-operatives exist for individual industry groups, such as those engaged in dairying or oil mills or rice

mill associations etc., then the roles of these existing organizations could be strengthened so as to spread the knowledge of new developments. In small countries, these organizations could be at national levels and in large countries they could be at subnational levels or province level, country level, brigades level etc. Task forces and working groups could be jointly set up with the departments or organizations concerned with industries and energy to look into the needs of specific industries.

7.2. Subnational or regional levels

Regional organizations including a number of non-governmental and voluntary organizations have a useful role to play. Sometimes specific industry may be concentrated in one region, distributed among many small or medium level establishments. In this case co-operatives at regional levels could be most effective in spreading specific use equipment or measures for energy conservation. Other times, a region have have heterogenous activities comprising many different industries. In this case, general purpose energy supply alternatives could be developed. An approach suggested here, where the energy demand is disaggregated in terms of heat, motive power and electricity may be useful to decide which general purpose energy or measures for energy conservation. Other times, a subregion may have heterogenous activities comprising many different industries. In this case, general purpose energy supply alternatives could be developed. An approach suggested here, where the energy demand is disaggregated in terms of heat, motive power and electricity may be useful to decide which general purpose energy alternatives may be useful. In the subregion where production of bricks, metal works etc. are dominant, the use of biomass or

solar furnaces and ovens may be useful. On the other hand, in an agriculture dominated area food processing industries requiring electricity may require different approach. Extension services, demonstration projects may be the most appropriate at this level.

7.3. International levels

It could be expensive and difficult, but not necessarily so in all cases , for an individual country to carry on development efforts for reducing energy consumption or develop energy alternatives. Therefore, mechanisms should be created for exchange of experiences and transfer of technology for dealing with alternative technologies for specific industry groups and for specific or general purpose alternatives of energy supply.

Persons dealing with specific industries should be brought together through seminars, or visits to specific institutions which are in the forefront. **The lack of research and development for decentralized industries has resulted** in inefficiencies of energy use and other material requirements. Thus, there is a need for their upgrading and modernization.

8. Conclusions and Recommendations

It is evident that the decentralized industries sector is not only important from the point of view of employment and incomes generation but that they represent people's solutions (as opposed to government's or large business') to obtain their basic necessities of life, such as food, clothing, housing and related activities. These activities generate industries in the area of food processing, textiles, brick-making, metal works and chemical productions.

The need for industrial activities for meeting the basic necessities such as food, clothing and shelter is so large that

quick and alternative ways of handling them which require less capital per output, short gestation periods and those who utilize indigenous resources are urgently needed. The shortfall of the requirements could not possibly be met by the centralized industrial approach which require long gestation periods, considerable capital, foreign technology and foreign resources or extensive processing of local resources. Moreover, encouraging the d.i.s. may lead to reduction in inequalities of income distribution, a problem in many developing countries. Some of them even use less energy and raw materials than the centralized industries. It is unfortunate that these basic industries do not get the place that they deserve in the strategies for industrial development. This is evident from the lack of data, lack of organized activities, lack of Government policies and investment and want of research and development in this sector. Some of these industries are traditional and have become inefficient in terms of resource-use. This does not mean that they have to be abandoned in favor of centralized industries but that they have to be upgraded and modernized.

Energy is an essential requirement for these industries to flourish. The recommendations emerging from the paper are as follows:

- a) Need for coherent policy and action: Governments should set up special cells for dealing with the decentralized industries sector, if they do not exist already. These cells or organizations can take a view about which industries should fall into this category, how to encourage and organize them and what policies are needed. Having taken a view, some working groups or task forces on specific industry groups

may be necessary to look into further details. In particular, which of them require to be upgraded and modernized.

- b) Information gaps:
 - i) It is clear from the existing industrial statistics that this sector is not covered adequately in the employment, production or value added statistics.
 - ii) In addition, what technologies are used, what are their energy requirements, need to be better understood and documented for which working groups on specific industries groups may be useful.
- c) Energy management: Although in absolute terms these industries use much less energy than the centralized industries, they produce different outputs. Some trend analyses show that while energy consumption norms in the centralized industries such as fertilizers, steel, cement etc. are declining due to extensive R&D efforts put in mainly by the developed countries, the energy consumption in the d.i.s. is increasing due to the changes in output mix, substitution of animate (human & animal labor) and non-commercial energy (wood and waste fuels) and due to lack of research and development efforts. Simple measures of increasing insulation and controlling heat need to be taken for large savings in numerous kilns, furnaces and ovens used for bricks, pottery, metal works, charcoal, etc. Efficiencies of diesel motors and mills also need to be improved through better matching of equipment and maintenance.
- d) Energy supply alternatives: In view of the uncertainties and delays involved in developing new energy alternatives, a combined approach of improving existing and incorporating new alternatives will be necessary:

i) Strengthening existing energy supply alternatives:

- current supply of non-commercial energy needs to be ensured on a sustainable basis which would require that some organization and management efforts be undertaken. Survival of some of the industries depends on this. In this context it should be studied if the biomass used as fuel in the d.i.s. may be better utilized as building materials or fibrous material and heat generated by them could be substituted by solar energy.
- Developing more efficient diesel engines and generators and reducing the energy losses in the existing machinery.
- Increasing efforts for rural electrification which will be more economical than developing separate alternatives for each industry when there exist a critical number or size of decentralized establishments, say in a town or a district.

ii) Developing new energy alternatives:

- Some of the specific purpose equipment could be further developed so as to be more general purpose, e.g. rice husk based paddy driers could be suitably changed to dry other food products, ranging from tobacco, fish and onions, or solar furnace for metallurgical purposes or solar kilns for timber could be modified to suit other industries.
- General purpose energy alternatives: Some of the general purpose alternatives are already available, such as solar water heaters, hot air systems, etc. They need to be integrated in specific industries, such as textiles.

- e) Institutions and mechanisms: It is suggested that upon taking decisions on which industries to encourage for decentralization or vice versa, connections should be made at international level and sub-national levels. It is expensive and difficult for one country to put in the efforts for altering and improving technologies and joint efforts may be necessary. Strengthening and funding of institutions and mechanisms for developing technologies at international levels is needed to transmit the experiences to national and regional levels.
- Seminars, training programs and extension work is required to discuss and explain better ways to use energy.

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ANNEX 1:

More Elaboration on Definitions and Contributions of small scale industries

The following are the excerpts from UNIDO (1979) concerning small scale modern sector manufacturing. It excludes traditional sector, which is included in the present paper, and therefore, its coverage is smaller.

In most developing countries the manufacturing sector has three components:

(a) A modern component, comprising the largest industrial enterprises, using comparatively modern technology and located mainly in urban areas where infrastructure, manpower and skills are available;

(b) A modernizing component, comprising mainly small to medium-sized industrial enterprises, using various intermediate levels of technology and located primarily in urban areas, but also in some rural areas;

(c) A non-modern component, comprising small industrial enterprises and artisan workshops, using traditional and upgraded traditional technologies, located largely in rural areas, but also in urban areas.

Specific definitions to distinguish these components for statistical and developmental purposes lack consistency internationally and also within a country. What is called the "organized sector" or "formal sector" consists of component (a) and part of component (b), in particular enterprises located in urban areas, and what is known as the "informal sector" consists of component (c) and part of component (b), in particular enterprises located in rural areas. This *Survey* largely concerns the formal sector since most statistics on manufacturing relate to it. The discussion that follows is based in part on data that have been reported in terms of the organized or formal sector and informal sector. Hence, these terms are used at times in place of the terms modern sub-sector and traditional or non-modern sub-sector, which are normally employed in this chapter to denote the two components of the manufacturing sector.

Information on production and employment in the sub-sector, from country sources and other reports on individual countries, is provided in the following paragraphs.

In India, a recent assessment of employment in the informal sector of manufacturing indicates that in 1971 there were about 16.52 million persons (77.5 per cent of the total) engaged in this sector, and 4.8 million (22.5 per cent of the total) engaged in the formal sector.³ About 75 per cent of employment in the informal sector is estimated to be in rural areas. About 79 per cent of the employment in this sector, which includes non-modern and modernizing components, is in hand-loom cloth weaving, handspinning and handspun yarn weaving, rural industries, handicrafts, sericulture and coir products; the balance of 21 per cent is in product groups such as power-loom weaving, small-scale industries and industries on industrial estates, the latter two industries covering a wide range of products. The value of production of small industries (the modernizing component),

³Government of India, *Draft Five Year Plan, 1978-83* (New Delhi, Planning Commission, 1978), pp. 97, 176 and 182.

in 1974, was estimated at 38 per cent of the value of production for both large and small industries.⁴ The growth rate of GDP at 1970-1971 prices during the period 1969/1970 to 1976/77 for the registered group was reported as 3.28 per cent per annum and for the unregistered group as 4.20 per cent per annum.⁵

In Bangladesh, small-scale establishments are those employing less than 10 workers. Employment in such establishments was reported to be 23,414 in 1974. Small-scale industries as a whole (including those covered by industrial statistics), however, were reported to have contributed about 45 per cent of manufacturing value added.⁶

In Pakistan, small-scale and cottage industries are defined as those not using power or employing less than 20 persons. It is estimated that factory manufacturing provided only 5 per cent of total employment, household industries provided 9 per cent, and small-scale and cottage industries accounted for the remainder. In 1974/75 the small-scale industries contributed an estimated Rs 3,800 million to GNP, or 3.65 per cent of GNP and 15.65 per cent of manufacturing value added. They also contributed 11 per cent to the value of exports.⁷

In the Philippines, within the organized manufacturing sector, small-scale industries made up over 93 per cent of all establishments and accounted for about 30 per cent of employment in 1974/75.⁸ The capital-intensity of small-scale industries measured both by value of fixed assets and by number of workers, was about one third that of large-scale industries.

In Kenya the informal sector of manufacturing, on the one hand, comprises enterprises with less than 20 employees that are not registered with the Ministry of Labour. On the other hand, small-scale industries (the modernizing component) include establishments with an investment in machinery and equipment of less than KSh 3.5 million. In 1974, these two enterprise groups together provided 60.9 per cent of employment in manufacturing; 57 per cent of this figure was in rural areas and 43.0 per cent was in urban areas. The enterprises in rural areas contributed 21.3 per cent of manufacturing value added.⁹

In Mexico, the registered industry sector includes establishments employing more than 5 persons. This group employed 1.18 million persons in 1966. About 4.8 million persons are estimated to be employed on a full-time and part-time basis in enterprises and artisan activities. The latter activities contribute an estimated 2 per cent to manufacturing value added, and about 75 per cent of the products are exported. In addition to craft workshops, in the rural areas there are a large number of service industries employing 4 to 5 persons each.¹⁰

While the lack of comparable data does not permit a generalization to be made, one fact emerges: the non-modern sub-sector of manufacturing, in particular in rural areas, is sizeable both in terms of employment and to a lesser extent of production volume and value added. Better organized efforts are needed to obtain reliable data on this sub-sector if Governments of developing countries are to stress its development. Reliable and regular data are difficult to obtain because of the large size of this sub-sector in terms of enterprises and employment, its geographical dispersal, the complexities arising out of home versus workshop premises for activities and of full-time versus part-time employment, and the lack of regular record-keeping within each enterprise. In planning decennial censuses the need for sample frames and a control sample for subsequent surveys should be taken into account.¹¹

⁴ Manufacturing value added from organized small-scale industries, included in formal industrial statistics.

⁵ Registered establishments relate to those with 10 or more workers using power or with 20 or more workers not using power. Smaller establishments are unregistered.

⁶ M. T. Haq, "An industrial development profile of Bangladesh", first draft (MTH/02/78), June 1978 (mimeo).

⁷ Luong the Sieu, "Industrialization in relation to integrated rural development in India, Nepal and Pakistan" (ID/WG.257/4).

⁸ Lorna C. Cenon, "Profile of Philippines small and medium-scale industry", *Small Industry Journal*, vol. X, No. 3 (July-September 1977), pp. 16-20.

⁹ Government of Kenya, *Development of Small-scale and Informal Units in the Manufacturing Sector* (Nairobi, The Manufacturing Sector Working Group, Ministry of Commerce and Industry, 1978).

¹⁰ A. Neilson, "Rural industrialization in developing countries" (ESA/SD/AC.5/4).

¹¹ The United Nations is intensifying its efforts and assisting developing countries in organizing household surveys for this purpose.

