CHAPTER 2

DATA : SCOPE, COVERAGE AND ADJUSTMENTS

The analysis of regional variation in fuel consumption is dependent on the composition of four major sectors of the regional economies, viz. agriculture, manufacturing industry, transport and the household sector besides the availability of energy in the region. In the agriculture sector, the fuel consumption depends on the level of irrigation, cropping pattern, and the level of mechanization. In the transport sector, it mainly depends on the mode of transport. The regional variations of consumption in the household sector depend among others on the level of incomes, the density of population, etc. In the manufacturing industry sector it mostly depends on the level of industrialization and the composition of industries.

It would be instructive to study each of the above sectors to assess the magnitude of the differentials and the causes of such variation in fuel consumption across the regions. An in-depth analysis of each sector goes outside the scope of one single study. The present study is limited in scope and confines itself to the regional variation in fuel consumption in the organized large scale industrial sector in the economy of the country.

2.1 Definition of Region

A region can be defined in a number of ways, depending on the nature and purpose of the problem. Broadly speaking there are three approaches in defining a region and are based on the concept of homogeneity, hierarchy of centres and administrative units. These approaches often yield different divisions of the same geographical space.

But, for the purpose of analysing the regional variation in fuel consumption the basis for defining the regions should be the fuel resource endowments and similar other infrastructural facilities. But unfortunately the data for delimiting the country into regions on this basis is not available in the requisite format. Secondly, in view of the policy implications of the present study, it is necessary that the economic region howsoever defined must have matching political and administrative authority. That is, for any policy decision it is always helpful to have the economic region congruent with the administrative region. Therefore, in this study we have taken all the 16 States and the 8 Union Territories as constituting the regions. A list of them is presented in the Table $A_2.1$.

2.2 Scope and Coverage of the Data

2.2.1 Nature of Industrial Sector

The industrial sector is not a homogeneous sector as the size of industrial units has significantly a wide range of variation. On the basis of the size of an industrial unit, the industrial sector is divided into two segments in the statistical reporting system of the country. One part is the registered

or factory sector and the other is the unregistered or household sector. The registered sector is defined to consist of the industrial establishments registered under the Indian Factories Act, 1948. The said Act divides the registered sector into two groups. The first group covers the establishments employing 50 or more workers with power and 100 or more workers with or without power. This group is called the Census sector as data on all units is collected on an annual basis. The establishments with 10 or more but less than 50 workers with power and employing more than 50 but less than 100 workers without power, comprise the second group, termed as Sample sector as data are collected by sampling the units. All the remaining unregistered establishments belong to the household sector.

The difference in these three industry sectors is not only in their employment size, but also in many other vital economic parameters. The capital output ratios, the level of mechanization, the utilization of capacity are different between these three sectors. And these obviously are the important factors which affect the level of fuel consumption in an industrial unit. Hence it is not appropriate to study either regional or industrial variation in fuel consumption for the industrial sector aggregatively. It is useful to study these three sectors separately.

2.2.2 Data Availability

The data relating to the Census or large scale sector is published by the Annual Survey of Industries (A.S.I.). The

classification of industries is based on the NCST basis and data are given upto the seven digit disaggregation level of the said industry classification. The entire economy is divided into 200 seven digit industries. The data reported are tabulated in seven tables, which provide exhaustive information for the industry. In Table 4 of these reports, the data regarding fuel consumption for each type of fuel both in quantity and value terms are given. The fuels distinguished are: (1) Coal, (2) Coke, (3) Coal-gas, (4) Firewood, (5) Charcoal, (6) Avaiation and Motor Spirit, (7) Diesel oil, (8) Other Fuel Oils, (9) Lubricating Oil, (10) Industrial and Power Alcohol, (11) Electricity, (12) Water, and (13) Others. These data are reported at the State level, which is useful for studying the regional variation in fuel consumption.

The Sample sector data are published for the three digit level of industries. The collection of data is based on the sample basis. The results are not given in as many details as for the Census sector at both regional and fuel level. The detailed information regarding consumption is given for Coal, Electricity and Oil products, mainly Diesel Oil, and is available only for regions and not for individual industries at regional level. At the regional level the data for fuel consumption is supplied at aggregate level and only in value terms.

For the household industry sector, data are not available in any prescribed form. But those that are available in adhoc surveys and reports are scanty and insufficient for any worthwhile use.

In view of the above it is clear that only the registered large scale sector is found to have somewhat adequate data base, for an analysis of the regional variation in fuel consumption at both the macro and micro levels. The latest A.S.I. report at the summary level is available for the year 1979-80. The fuel data, reported therein, give aggregate information for all fuels together at the regional level. Further no physical data on energy are available in the report. Hence not even macro level study at the regional level is possible for the year 1979-80. The latest year for which the detailed A.S.I. data, which could be used for both micro and macro level studies, was for 1970 when this work was initiated. Subsequently the 1971 data were released. Therefore, for the purpose of the analysis in this study we have used the 1970 A.S.I. energy data for large scale industrial sector.

2.3 Data Adjustments

The analysis of regional variation in energy consumption can be carried out in two ways. The first is on the value basis and the other one is on the physical requirement basis. Each type of analysis has its own importance. The study made in physical units is useful as it is free from the price effect and the estimates based on them refer to real or physical requirements. But at the same time, the analysis in value terms has its importance, especially in the analysis of cost efficiency as the various fuels are substitutes to each other in many instances, especially when used for the generation of heat energy. In view of the above, the energy studies are normally

carried out in both value and energy units. In the present study also the analysis is done in both the units.

For the purposes of analysis it is necessary to make two types of data adjustments. The first one concerns the nature of the data reported in A.S.I. and the other relates to the conversion of all fuels to a uniform energy unit.

2.3.1 A.S.I. Data Adjustment

The A.S.I. data needs the following adjustments: (1) Adjustment for coverage, (2) Splitting of States, clubbed at the industry level, and (3) Adjustment for Electricity.

(1) Coverage Adjustment : In the A.S.I. Census data returns of 13,542 factories out of 14,083 are received. This means 96 per cent of the units are covered. In terms of output, the coverage would be even larger as it is only relatively the smaller units that might not have reported. Though adjustment for 4 per cent under coverage is necessary, we could not make it as there is no way of knowing the output for the non-reporting industrial units, output being the relevant variable. This non-adjustment we feel is unlikely to affect our analysis as a large part of the analysis is carried out in terms of ratios or shares where the absolute levels do not matter and these ratios or shares are based on as large a sample as 96 per cent of the universe.

(2) Clubbed Data Adjustment: On account of the operation of the secrecy clause in reporting the A.S.I. data, in a situation where one or two identifiable industrial units exist

in a region, the data pertaining to such units are either clubbed with a region of similar nature or the region is not disclosed, reporting the data under the heading 'other states'. On account of this form of reporting there is some loss of information for the regional analysis. To estimate the individual state data at each required industry level is not only tedious but the estimates obtained are also not satisfactory. However, the present study does not require this elaborate adjustment for the following reasons. For comparing the regions at the aggregate industry level, the data for variables such as fuel consumption, gross output are directly given and hence individual industry estimates at regional level are not required. At the individual industry level, the main interest is to study the fuel consumption patterns. Adjusting the clubbed data prorata on any reasonable basis does not serve the above purpose. However, the lack of this adjustment does not become a major shortcoming as the industry, wherever, it is important, is normally reported separately and when an industry is left out its share in output is generally small.

(3) Electricity Adjustment: Electricity, being a non-basic source of energy, is either purchased from outside or produced within the production unit. The Electricity produced in the factory uses the fuel as well as non-fuel inputs which are otherwise used for the industrial production by the factory unit. Therefore a simple addition of the Electricity generated in the unit and the Electricity purchased results in the double

counting of various fuels. Therefore to get an accurate estimate of energy consumption, the Electricity produced in the unit should be added to the Electricity purchased and a part of the other fuels used for generation of Electricity should be subtracted. However for the purposes of analysis in value terms this adjustment turns out to be small and negligible. But, for the analysis in physical terms, we have made the above adjustment as follows. In the absence of the knowledge about the technology of the captive power plant of the unit, on the basis of all India technology, the factor of net addition in energy due to Electricity generated within the unit is estimated as 0.5286 in energy units and is added to the amount of energy purchased. This implies that thousand KWH of Electricity produced within the unit is equivalent to 0.5286 TCR energy units of addition to Electricity consumption.

2.4 Different Energy Units

An important consideration for any energy study relates to the selection of a uniform energy unit of measurement.There is a variety of measurement units for energy, such as kilo-calories (KCal), Kilo-Watt-Hours (KWH), Joules (J), Ergs and British Thermal Units (BTU), etc. But the problem of selecting a particular unit out of them becomes trivial, as there exist conversion factors to express one unit in terms of the other. However, conversion from one energy unit to another with the help of the conversion factors does not obviously imply one form of measurement of energy is replaced with the same

efficiency in its alternative form. So the problem of selecting a unit which apparently looks trivial, does not actually remain so simple. While converting energy from one form of measurement to its equivalent energy in the alternative form, the efficiency factor has to be taken care of. Further, the said efficiency factor varies over time with improvements in technology.

Second important consideration in the choice of the unit relates to the different sources of energy, such as chemical energy which is generated from Coal and Oil or mechanical energy obtained from Water and Wind power and heat energy created by sun. In expressing energy by a single unit, there is a loss of information about its source. These are some of the important considerations for choosing the energy units.

2.5 Choice of Energy Unit

Excluding Ergs and Joules which are not usually found used in energy studies, the choice needs to be made from amongst BTU, KCal, TCE (Tonne Coal Equivalent), KWH and TCR (Tonne Coal Replacement) units. KCal and BTU units give the calorific values of a fuel, which do not give any idea about the physical requirement of energy. A BTU of one fuel is not equivalent to the same of another fuel. The liquid fuels have the same conversion factor in calorific units, while separate conversion factors for almost each liquid fuel are established in terms of physical conversion ratios such as TCR, etc. In addition, the calorific unit has the disadvantage that it is a very small unit. For the purpose of the India Energy studies, a million

million kilo calories (1000 TCal or 10^{12} KCal) will have to be used[1] and this hinders the arithmetic side of the study.

Since 1 KWH was taken as equivalent to 1 TCR unit in India till 1960-61 and Coal is the largest available fuel, the choice between KWH and TCR leads to TCR only. The TCE unit does not reckon with the conversion efficiencies when energy is consumed through devices, appliances and plants. Therefore Indian reports about fuel studies use the TCR rather than the TCE units. The TCR measure takes note not only of the quantity of the heat value available in different fuels, but also the varying efficiency in the appliances. Thus, we conclude that TCR (Tonne Coal Replacement) is the suitable energy unit for the present study. The fuelwise conversion factors in terms of TCR used in the present study are based on the average efficiencies of the different fuels.

2.6 Conversion Ratios

The differences in the purposes of fuel use, the qualities of fuels and the levels of fuel efficiencies are some of the difficulties in deriving uniform conversion ratios for individual fuels. The major source, for the estimates of such ratios, for India, is the Sachadev Committee Report.[2] It provides a detailed estimation procedure of obtaining the conversion ratio for each fuel from its original physical unit to the

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1 India (1965). Report of the Energy Survey of India Committee. New Delhi, p. 390.

2 Ibid.

chosen energy unit viz. TCR. The conversion ratios of some important fuels are noted below.

(i) Coal: Indian Coal has a special problem as its heat content varies from one type of Coal to another. But the conversion between Coal types is avoided to retain the major advantage of Coal replacement unit; namely, to keep the reported data for the major energy source as it is. Also it is not possible to distinguish between the qualities of Coal used on the basis of the data reported. Therefore we have assumed all Coal reported as a homogeneous fuel.

(ii) Electricity: A detailed study has been carried out by the Sachadev Committee for determining the efficiencies of the thermal electric plants. By considering different efficiencies and conversion ratios of the required fuel inputs for Electricity, the ratio of requirement of Coal per unit of Electricity is evaluated for 1960-61. Further, taking into account the factors such as average efficiency of the plant and the reduction in Coal consumption, the future estimates of the conversion ratios for Electricity are made upto the period 1980-81. The TCR equivalent of Electricity for the period 1953-54 to 1965-66 is taken as unity (1 TCR = 1000 KWH) per thousand KWH and for the later period upto 1980-81 it has been worked out as 0.7 TCR. We have adopted this TCR equivalent of Electricity for our purpose.

(iii) Liquid Fuels: Since the conversion ratios for the liquid fuels, viz. Motor Spirit, Diesel Oil, Lubricating Oil, Other Fuel Oils and Power Alcohol, are worked out in terms of

Tonnes and the ASI report their consumption data in terms of litres, an equivalence between litres and tonnes is necessary to derive the conversion ratios of the liquid fuels. Using the NCAER study[3] and Sachadev Committee Report, we have obtained the required conversion ratios of various liquid fuels. The Table 2.1 lists the conversion ratios for different fuels, used in the manufacturing sector.

Table 2.1 : Fuelwise Conversion Ratios between the Original Unit of Reporting and the TCR Equivalent

Fuel	Original unit	TCR Equivalent
Coal	Tonne	1.00
Coke	Tonne	1.13
Coke and coal-gas	000 Cubic metres	0.83
Diesel oil	000 litres	7.4380
Aviation and motor spirit	000 litres	5.2558
Other fuel oils	000 litres	1.7212
Lubricating oils	000 litres	1.7953
Charcoal	Tonne	1.146
Firewood	Tonne	0.95
Power Alcohol	000 litres	0.5116
Electricity	000 KWH	0.70

A comparison of the ratios given in Table 2.1 with the NCST (National Committee on Science and Technology)[4] indicates a difference only in the case of Oil Products which is mainly

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3 Consumption Pattern of Selected Petroleum Products. NCAER, New Delhi, 1971.

4 Report of the Fuel and Power Sector. NCST, Technology Bhavan, New Delhi, 1974.

due to the difference in their assumed consumption compositions within the group of Oil Products. In any case this difference in the aggregate conversion ratio is not of any consequence to us as our study uses each Oil Product at its individual level.

It is also important to note here that though TCR and TCE ratios are different due to efficiency considerations, it is surprising that no such difference is seen in the conversion ratios as given in the above reports in respect of most of the fuels used in the manufacturing sector.

Table A_2.1 : Regions Covered in the Study

Sr. No.	Region	Sr. No.	Region
1.	Andhra Pradesh	13.	Rajasthan
2.	Assam	14.	Uttar Pradesh
3.	Bihar	15.	West Bengal
4.	Gujarat	16.	Haryana
5.	Jammu and Kashmir	17.	Andaman and Nicobar Islands
6.	Kerala	18.	Delhi
7.	Madhya Pradesh	19.	Himachal Pradesh
8.	Tamil Nadu	20.	Tripura
9.	Maharashtra	21.	Pondicherry
10.	Karnataka	22.	Goa, Daman and Diu
11.	Orissa	23.	Manipur
12.	Punjab	24.	Chandigarh