CHAPTER 4

FEATURES OF INDIAN ENERGY DATA SYSTEMS

Major Chapter Objectives

1. To provide an overview of energy sources and energy flows in India
   1.1 To examine the supply of coal and hydrocarbons
   1.2 To examine the sources of electric power generation
   1.3 To examine the energy demand by various energy consuming sectors

2. To provide an overview of energy data systems
   2.1 To examine the features of coal data systems
   2.2 To examine the features of hydrocarbon data systems
   2.3 To examine the features of power data system

3. To draw conclusions that will be useful in designing and developing an energy balance database for India
CHAPTER - 4

FEATURES OF INDIAN ENERGY DATA SYSTEMS

4.1 Introduction

The previous chapter (Chapter-3) has ended with a methodology for designing and developing an energy balance database. It was felt that the present research will lead to some useful observations and conclusions if the prescribed methodology is applied to actual design and development of an energy balance database for India. As a pre-requisite, this chapter examines the energy sources used in India and the specific features, if any, of the Indian energy data systems.

Preparation of energy commodity balances and their integration into an overall energy balance presupposes the availability of adequate data on energy supplies, their conversion and actual consumption by the various consuming sectors. This knowledge is acquired by a study of the energy sources and energy flows relevant to the Indian context and later a detailed investigation of the Indian energy data systems especially coal data system, hydrocarbon data systems and power data systems.
4.2 Energy Sources and Energy Flows

In India, as in other developing countries, the economy is based on commercial and non-commercial energy sources. The non-commercial sources include fuel wood, crop residues, animal waste etc. for which there is no realistic data on the production and consumption of these energy sources. Hence, this study considers only commercial energy sources.

Commercial energy sources consumed in India include both primary and secondary sources. The primary sources include coal, oil, natural gas and power from hydro and nuclear sources and are either consumed directly or converted into more convenient forms (secondary sources). For instance, a part of the coal produced in India is converted to soft coke and electric power. Similarly, the crude oil is converted to petroleum products such as kerosene, diesel oil and fuel oil which are more convenient to use. Both the primary and secondary sources are consumed by different sectors of the economy such as agriculture, industry, transport etc. The main features of energy supply and demand for commercial energy in India are discussed below.
4.21 Supply of Coal

India is comparatively rich in coal reserves. The production of coal has increased rapidly since 1980 and the coal India Ltd, a public sector company is responsible for over 85 per cent of the total coal produced in India. Owing to high ash content, the coal is of poor quality and hence coal benefaction becomes important. About half of the total quantity of coal produced is converted to electric power in thermal power stations. While India is largely self-sufficient in coal, small quantities of high quality coal is imported for special purposes. Since 1973, there is an integrated development programme for increasing the coal production.

4.22 Supply of Hydrocarbons

The hydrocarbons are the major commercial energy sources. The public sector companies such as the Oil and Natural Gas Commission (ONGC) and Oil India Ltd (OIL) are responsible for the production, refining and distribution of hydrocarbons.

Since 1981, the exploration and production of hydrocarbons have increased but still about two third of the current demand is met by imports. Since 1970s, the capacity for refining crude oil has been increased to keep pace with
the rising demand for petroleum products. The present stock of petroleum and petroleum products in India is estimated to be adequate to meet the demand for three months.

Along with crude oil, India has some reserves of natural gas. While the production has increased in recent times, substantial quantities of the gas is being flared. The natural gas is being used as a chemical feed stock, fuel for power generation and also as a fuel for domestic purposes.

4.23 Power Generation

The main sources of power in India are hydro, nuclear and thermal power stations. The major source of power is the coal based thermal power stations. The supply of power is characterised by peak demand and energy shortages. The hydro power which constitute about one-third of the total production is used mainly for meeting the peak demands. The net contribution of nuclear power is about 2.7 percent only even though India can support a nuclear power programme based on natural uranium and thorium. While the power stations in India operate at a comparatively low efficiency, considerable power is also lost by way of transmission and distribution losses.
Many industries and commercial establishments have installed captive generation facilities. They include cogeneration, and stand-by-captive generation. The total capacity of such captive generation is estimated at 10 percent of the installed capacity. Since captive generation may not be an answer to the energy shortages, an effort is on the way to produce more power from thermal power plants having comparatively smaller gestation period.

4.24 Energy Demand for Agriculture

Indian agriculture is characterised by increasing mechanisation, using power for irrigation and chemical fertilisers. However, little information is available on the energy use in agriculture. The increasing number of tractors and energised pump sets are responsible for increasing the consumption. Indirect energy use through fertilisers can be estimated for inorganic fertilisers only. On the whole, the availability of data on energy demand in agriculture is not satisfactory.

4.25 Energy Demand for Industry

Industry is a major energy consuming sector. The value addition to the industrial products is mainly attributed to energy consumption.
The fertiliser industry accounts for consumption of naphtha, natural gas, furnace oil and diesel oils. Aluminium is an energy intensive industry and the capacity has increased over the last 10 years. The textile industry consumes around 9 percent of the total commercial energy consumed in the country. Similarly, cement industry is a major consumer of coal and electric power. The industrial production is related to power supply and non-availability of power is responsible production losses.

4.26 Energy Demand for Transport

The transport sector consists of road, rail, air and shipping. It is one of the major consumers of petroleum products.

The railway network has expanded considerably since 1960s. The old steam engines have been replaced by diesel engines and electric traction. At present, the railways are going for long distance trains because short distance travel is made possible by road transport.

The road network has increased considerably with a large number of trucks, cars and other vehicles. This has contributed to increasing consumption of diesel and petrol.

While inland water transport and coastal shipping have played an insignificant role in India, the fleet composition
and capacity of airlines have changed. Over the years, the fuel consumption per available seat-Km has reduced, the total consumption of petroleum fuels has increased.

4.27 Residential Energy Demand

The residential sector is a large consumer of energy with significant variation between urban and rural households. The energy consumption mix is changing over time with increasing consumption of commercial fuels. While a comprehensive picture of energy consumption pattern is not available, some efforts are being made to collect the data by sample surveys. It has been found that there is a visible linkage between increasing domestic energy consumption and income levels.

4.28 Energy Demand for Public Services

This sector consists of schools, hospitals, hotels etc. with a very wide variety of energy consuming activities. While there is no realistic studies on the energy consumption pattern, this sector is not considered as a major consumer of energy.

4.29 Summary

The brief account of energy sources and energy flows shows that the Indian economy consumes a large number of
energy sources. To meet the increasing demand for energy and also to meet the demand for specific energy sources, India is converting a part of primary energy sources and producing secondary energy such as electricity and petroleum products. These are supplemented by heavy imports of crude oil and other petroleum products. At present, there is a gradual shift from coal to oil and electricity as in the case of railways.

4.3 Indian Energy Data Systems

The Indian energy flows are complex and they involve several energy activities such as production, imports, exports, transportation, storage, conversion and utilisation by different sectors including industry, transport, residential, commercial and agricultural sectors. The national energy data system originates from these activities and it is an important diagnostic tool, representing in a way the meter for assessing the existing energy situation and planning for the future. The data are generated by or come from energy producing agencies, energy consumers etc. which are monitored and processed by the statutory and executive departments of the government.

The commercial energy data system can be discussed in terms of major energy sources such as coal, oil and
electricity which collectively provide an understanding of the Indian energy situation.

4.3.1 Coal Data System

The coal data system in India has been in existence for many decades. It corresponds to the structure of the nationalised coal industry involving a large number of public enterprises, private industries, government departments and national laboratories in addition to statistical organisations. The data system begins with the resource assessment followed by quality evaluation and all aspects of coal production and demand. They can be studied under the institutional infrastructure, typology of data and statistical publications.

4.3.1.1 Institutional Infrastructure

The data on coal is produced or processed by over 50 organisations such as Department of Coal of the Government of India, Coal Controllers Office, Directorate General of Mines Safety, Central Mine Planning and Design Institute, Geological Survey of India, Central Fuel Research Institute, Mineral Exploration Corporation, Indian Railways, State Electricity Boards and Coal producers such as Coal India Ltd. The exploration of coal is initiated by the Geological Survey of India and quality evaluation made by the Central
Fuel Research Institute. Subsequently, it covers all aspects of coal production and consumption. The Coal Controller is the statistical officer on coal production and consumption in India.

4.3.12 Typology of Coal Data

The coal data system consists of 16 categories of data which are generated or maintained by one or more of the energy planning, producing and consuming organisations.

The geo-data system gives information on coal reserves of India and the data system is updated and maintained by the Geological Survey of India and closely related organisations. The Coal Mines statistics are generated by the concerned coal companies. Similar is the case with coal production statistics. Other data subsystems include manpower data system, mines safety data system, welfare data system, industrial relations data system, coal transportation data system, mine equipment data system, coal consumption data system, finance data system, conservation data system, coal utilisation data system and other data systems covering project investment, environmental protection and perspective planning.

The coal production data system consists of daily production figures at the mine level compiled by the head
quarters of the coal companies. The monthly data on production from open cast and underground mines are prepared out of the same data which are reported to the coal controller and the Director General of Mines Safety.

The coal transportation data are collected by the coal mines and the originating railway stations. The department of coal and the railway headquarters receive these data which are transmitted to the Ministry of Energy. The specific data categories include movement of coal by the type of transport such as rail, road etc. and the quantities despatched by the company.

The coal consumption data system is operated by the coal controller. The data are received by this office from the headquarters of major consumers such as power houses, steel companies etc.

The coal data system is a by product of the management information systems of the coal producers and consumers. It is used mainly for operational and control purposes. However, certain subsystems and data categories such as equipment data system and project data systems are used for planning and evaluation at appropriate levels.
4.313 **Published Sources**

The coal controller in the Department of Coal, Ministry of Energy is the statistical authority for coal data. This office brings out a data compilation entitled "coal statistics" on monthly, quarterly and annual basis. They together provide figures of production, despatches of different varieties of coal with breakdowns by coal fields and geographical sectors. Other specific data contained in these publications are pit head stocks of coal and stocks at consumers, allotment and loading of wagons, despatch by rail, road and costal shipping, exports and distribution by industries and states together with information on prices, plan targets and plan achievements.

Apart from the above publications, coal data are also published in the following reports:

1. Annual coal statistics of the coal controllers organisation, Calcutta.


4.3.14 Gaps in Available Coal Data

There is a time lag of more than one year in publishing the coal data and researchers often depend on personal communications and answers given to questions in the parliament. Apart from this, a discussion on coal data systems has brought out several gaps in the published data.

For example, the economic data for different mining systems are available with the concerned mining units. These data, especially the cost evaluations are not reported as such to head quarters of mining units and hence not available in the published sources.

Similarly, data on economics of different methods of transportation are not reported as such. One has to dig out actual records to find out how much each means of transport costs.

Another gap which is very significant is in the case of coal consumption data. There are significant differences in the lifting of coal and the recorded consumption in different sectors of the industry and economy. It takes a long time to rectify these mistakes.

The statistics on recoveries and conservation appear to be just compilation of the reports sent by the coal
companies. There is no checking on the accuracy of the figures.

Another important aspect of the coal data as available in the published sources is that the calorific value of the produced coal is not reported. There is need for more information on the product mix so that the required quantity of the desired quality of coal can be mined out as per demand.

4.3.15 Summary of Coal Data System

The study of the coal data system shows that the system is constituted by sixteen subsystems covering resource assessment to environmental conservation. These data systems form part of the management information maintained and reported by the coal producers and consumers. Apart from the time lag, there are evident gaps in the published data which may make the data less useful for analytical purposes.

4.32 Hydrocarbon Data System

The hydrocarbon data system consists of data on natural gas, crude oil and refinery products. The department of petroleum, Government of India and the various public sector companies such as ONGC, OIL etc. are primarily responsible for the hydrocarbon data system.
The data system is studied with reference to the functional divisions of the department which is responsible for the development of hydrocarbon sector and the reports and returns received by these divisions. This will be followed by identifying the typology of hydrocarbon data and published data sources.

4.321 Organisational Structure

The department of petroleum, Ministry of Energy consists of five divisions including exploration division, marketing division, refinaries division, pricing division and petrochemicals division. They monitor data related to the spheres of their activities.

For example, the exploration division deals with all matters relating to exploration and production of crude oil and natural gas by coordinating the activities of ONGC and the OIL. Similarly, the marketing division is responsible for assessing the demand, allocation of products for distribution and all matters relating to retail outlets. This division monitors data from the marketing divisions of Indian Oil Corporation, Bharat Petroleum Corporation as well as Hindustan Petroleum Corporation.

The refinery division of the department of petroleum is looking after all matters relating to refineries and
pipelines including operations and expansions. The pricing
division deals with the pricing policy in respect of crude
oil and bulk refined petroleum products. The economics and
statistics cell is concerned with the collection, seruity,
revision and analysis of economic data relating to the
oil sector. The department also controls the Oil Industry
Development Board, Oil Coordination Committee as well as
Petroleum Conservation Research Association.

4.322 Reports and Returns

The department of petroleum receives data by way of
periodical reports submitted by the concerned public sector
companies and research groups. In turn, it also compiles
these data for administrative and other dissemination
purposes. A list of some of the important data compilations
received or produced by the department is given below:

1) Status report on drilling and production (Fortnightly)
2) Information for Cabinet Committee on industry and trade
   (Monthly)
3) Reports on drilling and royalty statements (Monthly)
4) Structure wise, projectwise production and despatches
   of oil and gas (Monthly)
5) Production of LPG from natural gas (Monthly)
6) Crude oil production, gas supplies and LPG production
   (Monthly)
7) Annual reports and accounts for presentation to the parliament.

In addition to the above, the department also receives several other reports and returns pertaining to refineries, consumption and distribution, demand, price as well as foreign trade. Some of these reports are confidential and not available in the public domain.

4.323 **Typology of Data**

The department monitors a large variety of data to meet its divisional requirements. These include:

a) Exploration and Production Data: Reserves of crude oil in million tons and natural gas in billion cubic meters; on-shore data for Gujarat, Assam and Rajasthan and Off-shore data for Bombay High; number of deep drilling rigs owned by the ONGC and OIL; Status of wells company-wise; State-wise achievements by geological and geophysical field parties, drilling of wells; company-wise production of crude oil on-shore and off-shore in tonnes and production of natural gas in million cubic meters.

b) Refinery Data: Petroleum refining capacity; Refinery crude throughput and production of petroleum products on calender/financial years; Refinery-wise crude charged and
total production of petroleum products; Refinery production and pattern of refinery production in India on calendar/financial years.

c) Consumption and Distribution Data: All India total consumption of petroleum products on yearly basis; product-wise consumption of petroleum products on yearly basis; seasonal indices of the sales/consumption of petroleum products; sales/consumption and market participation of oil companies; deliveries made to international/costal bunkers on yearly basis; state-wise sales of selected petroleum products on yearly basis; estimated per capita consumption of selected petroleum products; estimated sector-wise consumption of petroleum products; coastal movement of selected petroleum products; retail outlets and their state-wise distribution; state-wise number of LPG consumers etc.

d) Price Data: Index number of wholesale prices of petroleum products. Petro-based industries; and other energy items in India; prices of indigenous on shore and off shore crude oil in India; basic ceiling selling prices (ex-storare) of petroleum products; retail prices of petroleum products in selected cities; realisation of customs and excise duties from crude oil and petroleum products etc.

The department also maintains foreign trade data on imports of crude oil, total exports and trend in India's
overall trade balance. Thus, the amount of data on hydrocarbons is enormous.

4.324 Gaps in the Data

Mulchandani and Gulati (4) have shown that inspite of the abundance of petroleum data, there are several gaps including the following:

Sufficient reliable information on end use pattern of some of the petroleum products is not documented. A typical example is the quantity of diesel consumed by the agricultural sector.

In the transportation sector, there are no norms for consumption (specific fuel consumption per vehicle per year) for various types of vehicles.

For lubricants, greases and specialities sufficient field data on end use application are not available. It is true especially for industrial oils. Thus, it is pointed out that the petroleum consumption data are highly product oriented where as they should have been also available by end use application.
4.325 Summary

The hydrocarbon data system is perhaps one of the best organised data systems in the Indian energy sector. It is monitored and controlled by the department of petroleum. It brings out a comprehensive annual publication "Indian petroleum and petrochemical statistics" and also a quarterly bulletin of the same title. Certain important information is brought out in monthly publications for restricted circulation. The annual statistical publication gives data on production, imports, consumption of petroleum products, deliveries to bunkers and maximum selling prices. It also includes international petroleum statistics as well as statewise data. The major problem with the petroleum data system is the non-availability of data by end use applications.

4.33 Power Data System

The Indian power sector has expanded rapidly during the last three decades of planning. On the generation side, from a total installed generating capacity of 2,300 MW in 1950, it has increased to over 48,600 MW commissioned until March 31, 1987.
4.331 Organisational Structure

A number of organisations are concerned with planning and management of the power sector. At the apex of the system is the Government of India's Department of Power. The Central Electricity Authority (CEA) which is attached to the Department of Power has a statutory status under the Electricity Supply Act, 1948. The State Electricity Boards are also created under the same act with jurisdiction confined to the respective states. Some private companies are also involved in the power sector and they are partly responsible for the power supplied to Ahmedabad, Bombay and Calcutta.

The State Electricity Boards are independent organisations under the control of the State Governments. They need the approval of the CEA for taking up new projects. They are also grouped under the Regional Electricity Boards (REBs) covering northern, western, southern, eastern and north-eastern utilities.

In the power sector, central organisations such as National Thermal Power Corporation, National Hydroelectric Corporation and Rural Electrification Corporation which are set up with specialised objectives. The Atomic Power Corporation runs the nuclear installations under the Department of Atomic Energy.
The Central Electricity Authority is the heart of the data system, the REBs and SEBs being major data sources. The SEBs feed data to the CEA periodically and the various energy consuming sectors provide information to the Regional Power Survey Office for planning and peak load adjustments etc. The CEA is linked to various central agencies including the Department of Power.

4.332 Typology of Power Data

The Regional Electricity Boards, based primarily on the functioning of the electricity supply network, prepare the following schedules.

a) Preparation of daily sheets for CEA, providing station wise peak demand, generation, imports and exports, reservoir levels etc.

b) Outage details and probable data of return of generators to the power grid.

c) Performance of thermal stations.

d) Preparation of load generation balance reports giving the annual picture of monthly generation, requirements, deficit/surplus and drawing up of maintenance scheduling of generating sets.
e) Drawing up of monthly load flow studies and comparing with actual conditions.

The State Electricity Boards try to collect various information on power as applicable to their respective states. The most important information is a daily account of energy generation and availability as well as consumption and the peak load of the major consumers. The data thus collected by the SEBs include the following:

a) Energy balance
b) Energy sales and purchases
c) Installed capacity and details of capacity added
d) Details of generators, boilers, water turbines etc.
e) Details of generation, derating and fuel consumption
f) Details of transformers, transmission and distribution lines, circuit breakers and capacitors
g) Details of consumers, connected load, energy consumed as well as consumption patterns
h) Details of captive generation
i) Monthly sales and revenue data
j) Details of theft and accidents

The commercial directorate of Central Electricity Authority (CEA) documents various commercial data arriving from different departments and sectors. It collects the electricity tariff schedules from all the SEBs. The other
types of data collected by the directorate include details of tariffs, utilisation of power and energy produced by captive power plants of power intensive industries. Included in this category are power market data such as energy sales, revenue billed etc. on a monthly basis. Apart from collecting and compiling the data, they are also published.

4.3.3 Published Sources of Data

On the whole, the Indian power data system is well documented and published by the concerned organisations. A selection of the published sources of power data in India is as follows:

1. Annual Report 1985-86, CEA.
2. Annual General Review 1985-86, CEA.
3. Twelth Annual Power Survey Committee Report, 1985, CEA.

The annual general review (No. 2 above) is the most comprehensive of all data sources. It is being brought out by the Commercial Directorate of CEA. It contains state-wise information on generation, capacity and aggregate maximum demand, installed plant capacity and generation, transmission and distribution lines, utilisation etc. Progress of electric supply as an industry, financial
statistics and electrical tariffs are also included in the publication. An important gap in the present data system is the large gap of 2 years in publishing the data. Another serious problem is that the electricity sales data are available only by broad consuming sectors.

4.334 Gaps in the Data System

The electrical data system of India, as it is being maintained by the Central Electricity Authority, is very comprehensive and it helps to gain an in-depth knowledge of power situation in India. However,

a) the electricity sales data are available only by broad consuming sector only, and

b) the consumption data is made available after a time lag of nearly two years.

4.335 Summary of Power Data System

This section has provided a broad overview of the nature of data available on the Indian power sector. The data system comprehends electricity both as a primary and secondary energy depending upon its origin i.e. hydro/nuclear and thermal power. The data are collected for the management of the power system at different levels with focus on the state electricity boards as well as Regional Electricity Boards. The published sources of these data are
available with a time lag of one to two years.

4.4 Observation and Conclusions

The investigations on the energy sources and energy data systems have helped the investigator to get familiar with the Indian energy scene which will be useful in designing and developing an energy balance database for India. Based on this chapter, the following observations and conclusions appear to be relevant.

1. As in the case of other developing countries, India does not have adequate and reliable data on non-commercial energy sources. Hence, at this point of time, it will not be realistic to attempt a single energy balance for commercial and non-commercial energy sources in India.

2. In contrast to the non-commercial energy, India has a well developed energy industry which covers coal, crude oil, petroleum products and electric power. Individual energy industries collect and report statistics on their performance which are available within a reasonable period of time. Hence, preparation of an energy balance database, especially in the absence of a regular official effort in this direction, appears to be an attractive proposition.
available with a time lag of one to two years.

4.4 Observation and Conclusions

The investigations on the energy sources and energy data systems have helped the investigator to get familiar with the Indian energy scene which will be useful in designing and developing an energy balance database for India. Based on this chapter, the following observations and conclusions appear to be relevant.

1. As in the case of other developing countries, India does not have adequate and reliable data on non-commercial energy sources. Hence, at this point of time, it will not be realistic to attempt a single energy balance for commercial and non-commercial energy sources in India.

2. In contrast to the non-commercial energy, India has a well developed energy industry which cover coal, crude oil, petroleum products and electric power. Individual energy industries collect and report statistics on their performance which are available within a reasonable period of time. Hence, preparation of an energy balance database, especially in the absence of a regular official effort in this direction, appears to be an attractive proposition.
3. It is found that the energy data available are highly producer or supply oriented rather than demand or consumption oriented. This feature of the Indian energy data may be due to the fact that energy industries are primarily concerned with production and distribution of the energy rather than monitoring how the energy has been consumed.

4. Subsequently, only aggregated data are available for the energy consuming sectors by very broad categories of uses. In the case of domestic power consumption for instance, it is not possible to find out how much of the power is actually consumed say for refrigeration and hot water purposes. If this data are available, probably it will be useful to estimate the potential for fuel substitution. One possibility is the use of coal for water heating so that the high grade power can be diverted for other essential purposes.

5. Within the limitations of the present data systems available in the country, it is felt useful and feasible to prepare an overall energy balance of commercial energy sources for India for one of the recent past years.

In view of the above, the present research study is directed towards designing and developing such an energy balance database for India which form the subject of next chapter.