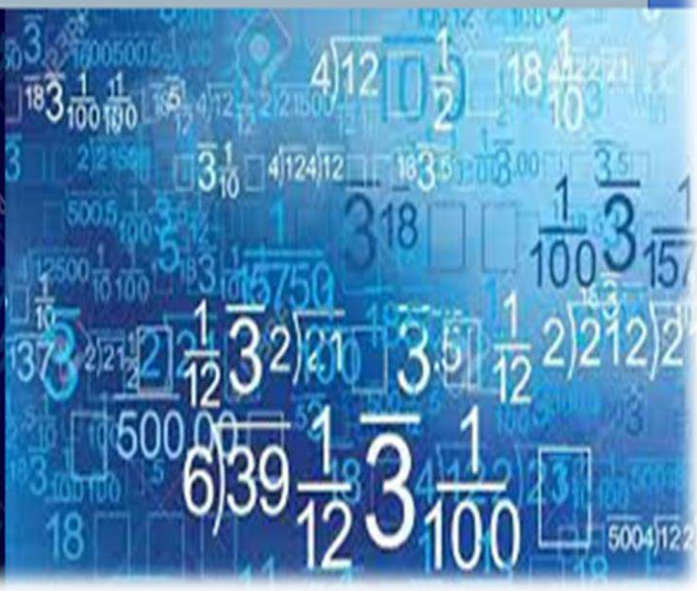
|| Chapter - 7 ||

Energy Balance



CHAPTER 7
Energy Balance

Commodity Balance

The purpose of commodity balance is to show the sources of supply and various uses of particular energy product with reference to national territory of the compiling country. The balance is compiled for any energy commodity provided that the commodity remains homogeneous at each point in the balance.

International Recommendations on Energy Statistics (IRES) recommends that the format of energy balance and all applicable concepts are consistently used in the compilation of a commodity balance to ensure data consistency. The major sources for commercial energy in India are coal, oil products, natural gas and electricity. Non-energy producing sectors derive energy from the resources available in primary form such as coal, crude oil, natural gas, hydro-power and nuclear power. Some of the energy resources are converted into other (final) energy products that are used for purposes other than energy generation.

Coal is also used as a final product or intermediate for power generation. Similarly, natural gas is also used directly or as an intermediate in power generation. Many petroleum products, such as HSDO, Naphtha etc. are used as a final product by the non-energy producing sectors and also used for power generation. This indicates that the same energy source can be used in various forms at various stages of consumption. This creates a possibility of over-estimation or under-estimation of energy consumption in totality as well as for different sources.

Energy Balance

An energy balance is a framework to complete data on all energy products entering, existing and used within a given country during a reference period (e.g., a year). It expresses all data in common energy units, which makes it possible to define a "total" product.

The purpose of compiling an energy balance starting from the various commodity balances are numerous; they are to:

- Provide a comprehensive overview of the energy profile of a country, to monitor energy security, energy markets, relevant policy goals and to formulate adequate energy policies;
- Provide the basis for aggregate socio-economic indicators, as well as for estimates of CO_2emissions;
- Compare data of different reference periods and different countries;
- Provide a tool to ensure completeness, consistency and comparability of basic statistics;

- Calculate efficiencies of transformation processes, as well as relative shares of different sectors or products in the country's total supply or consumption

An energy balance generally takes the form of a matrix of products and flows, with varying levels of disaggregation, although graphical formats also exist (e.g. Sankey diagram).

Two major components of the energy balance statistics are Total Primary Energy Supply (TPES) and Total Final Consumption (TFC) of energy commodity. Within a balance, the total final consumption is disaggregated into sectors, like industry, transport, residential, services and others. However, the level of disaggregation of such energy data is not enough to monitor energy efficiency, as no information is available, for example on the residential or services end uses, nor on the transport vehicle types or segments. The energy balance will therefore be useful to assess the largest consuming sectors within a country where the energy saving potential will have more impact, before starting more detailed collection programme on data for energy efficiency indicators.

A note on Methodology used for Energy Balance

Energy (in KToE) = Quantity of Commodity * Conversion factor

where 1 Toe = 41868 MJ

Therefore, $\text{Conversion factor} = \frac{\text{Net Calorific Value (NCV)}}{\text{Mega joules per ton of oil equivalent}}$

where Net Calorific Value (NCV) is in kj per kg and

Net Calorific Value (NCV) = Gross calorific value (GCV) – (% Moisture Content) [1NCV = 0.9 GCV]

The difference between net and gross calorific values are typically about 5% to 6% of the gross value of solid and liquid fuels and about 10% for Natural gas.

Net Calorific Values are, as recommended by IEA for all commodities.

Sankey Diagram

The concept of data visualization in the digital age has revived interest in a style of chart called a Sankey diagram. This style of diagram makes it easy to see the dominant flows within a system and highlights where losses occur. The Sankey diagram is very useful tool to represent an entire input and output energy flow in energy system after carrying out energy balance calculation. The thicker the line, the greater the amount of energy involved.

The data of Energy Balance (Table 7.2) is used to construct the Sankey diagram, in which flows of energy are traced from energy sources to end-use consumption. The resulting diagram provides a convenient and clear snapshot of existing energy transformations in India which can usefully be compared with a similar global analysis. It gives a basis for examining and communicating future energy scenarios.

Highlights

- In 2020-21 (P), Primary Energy Supply added up to 8,88,523 Kilo Tonnes of Oil equivalent (KToE) (Table 7.2).
- Two major contributors to the total energy supply in the country were Coal which accounted for 64.93% of the total and Crude Oil which accounted for 26.29%.
- In 2020-21 (P), final Energy Consumption (End Use) was 5,53,971ktoe. The industrial sector was the largest consumer of energy in the country with this sector itself using more than half, i.e., 56.22% of the total final energy consumption.
- Within the industry sector, the most energy intensive industries were iron and steel, which accounted for 15.37% of the industrial energy use followed by Chemicals and petrochemicals 4.43 % and construction 1.96%.
- The consumption of the residential, agriculture, commercial & public sectors, non-energy purpose and other sectors represented 34.96% of the total final consumption in the country, whereas, transport sector accounted for 8.82% of Total Final Consumption.

Table 7.1 : Energy Commodity Balance for the year 2020-21(P)

Supply	Coal	Lignite	LPG	Naphtha	Kerosene	Diesel (HSD+ LDO)	Fuel Oil	Lubricants	Bitumin	Petrol/Motor Spirit	Other Petroleum Products*	Natural Gas	Electricity
	(000 tonnes)											MMSCM	(GWh)
Production	716084	36614	12072	19403	2393	101170	7242	1069	5245	35779	49137	28673	1373187
From Other Sources													200000
Imports	215251	19	16476	1199	3	648	6454	2693	2055	1351	12368	32861	9318
Exports	-2945	-150	-452	-6509	-15	-30576	-1177	-15	-7	-11606	-6411	0	-9426
Stock changes	27753	-604											
Domestic Supply	**956143**	**35879**	**28096**	**14093**	**2381**	**71242**	**12519**	**3747**	**7293**	**25524**	**55094**	**61534**	**1573079**
Transfer													
Statistical difference	-50147	1343	-538	8	-583	2326	-7310	350	231	2445	-23000	-21120	3285
Transformation	**580558**	**31439**	**0**	**70**	**0**	**456**	**226**					**10836**	**82000**
Electricity plants	580558	31439	0	70		456	226					10836	82000
Energy industry own use												**18210**	
Oil and Gas extraction												5730	
Petroleum refineries												7911	
Other energy sector												4569	
Distribution losses												**67**	**267364**
Final Consumption	**325438**	**5783**	**27558**	**14030**	**1798**	**73112**	**4982**	**4097**	**7524**	**27969**	**32094**	**11301**	**1227000**
Industry Sector	**325438**	**5783**	**2102**	**14030**	**0**	**3314**	**1966**				**28396**	**555**	**504200**
Iron and steel	69805	25		0		204	666						
Chemical and petroleum	1724	0		11405		156	227						
Non-ferrous metals						21	349						
Machinery						125	19						
Mining & Quarrying			2			1650	92						
Paper, pulp and print	1045	2064											
Construction	6776	1237				1080	140						
Textile and leather	0	748				20	36						
Non-specified	246088	1709	2101	2625		58	438				28396	555	504200
Transport Sector	**0**	**0**	**119**	**0**	**0**	**3262**	**1022**	**0**	**0**	**27969**	**3698**	**9669**	**18500**
Road			119			1375	132			27969		9230	
Domestic Aviation						2							
Rail						1223							18500
Pipeline transport												439	
Domestic navigation						662	890				3698		
Non-specified													
Other Sectors			**25337**	**0**	**1798**	**66536**	**1994**	**4097**	**7524**			**1077**	**704300**
Residential			25128		1587								315000
Comm. And public services					69								102000
Agriculture/forestry			28			586	80					177	215000
Non-specified			180		143	65950	1914	4097	7524			900	72300
Non-Energy Use												**21500**	

(P): Provisional

Statistical Difference is defined as final consumption + use for transformation processes and consumption by energy industry own use + losses - domestic supply

Final consumption = Total Consumption in Transport + Total Industrial Consumption+Consumption by Other sectors+Non energy Use

* Incluse ATF, Pet Coke, Paraffin waxes, petroleum jelly, LSWR, MTBE and reformate, BGO, Benzene, MTO, CBFS and Sulfur etc.

Table 7.2: Energy Balance of India for 2020-21 (P)

All figures in KToE

	Coal	Crude Oil	Oil Products	Natural Gas	Nuclear	Hydro	Solar, Wind, Others	Electricity	Total
Production	4,23,669	31,165	0	26,375	11,214	12,956	13,288		5,18,667
Imports	1,39,274	2,02,469	43,072	30,227	0	0	0	801	4,15,844
Exports	-2,018	0	-59,119	0	0	0	0	-811	-61,947
Stock changes	15,959	0	0	0	0	0	0		15,959
Total primary energy supply	**5,76,884**	**2,33,634**	**-16,046**	**56,602**	**11,214**	**12,956**	**13,288**	**-9**	**8,88,523**
Statistical differences	41,970	14,944	-23,693	350	0	0	0	283	33,852
Main activity producer electricity plants	-3,98,200	0	-764	-9,967	-11,214	-12,926	-12,663	1,18,094	-3,27,641
Autoproducer electricity plants	0	0	0	0	0	-30	-625	17,200	16,545
Oil refineries	0	-2,26,651	2,38,128	0	0	0	0		11,477
Energy industry own use	0	0	0	-16,751	0	0	0	-7,052	-23,803
Losses	0	-21,926	0	-62	0	0	0	-22,993	-44,981
Final consumption	**2,20,653**	**0**	**1,97,625**	**30,172**	**0**	**0**	**0**	**1,05,521**	**5,53,971**
Industry	**2,20,653**	**0**	**46,919**	**510**	**0**	**0**	**0**	**43,361**	**3,11,443**
Iron and steel	47,023	0	850	0	0	0	0		47,873
Chemical and petrochemical	1,161	0	12,637	0	0	0	0		13,799
Non-ferrous metals	0	0	357	0	0	0	0		357
Machinery	0	0	148	0	0	0	0		148
Mining and quarrying	0	0	1,797	0	0	0	0		1,797
Paper, pulp and print	1,174	0	0	0	0	0	0		1,174
Construction	4,846	0	1,251	0	0	0	0		6,097
Textile and leather	308	0	55	0	0	0	0		363
Non-specified (industry)	1,66,141	0	29,823	510	0	0	0	43,361	2,39,835
Transport	**0**	**0**	**38,356**	**8,894**	**0**	**0**	**0**	**1,591**	**48,842**
Road	0	0	31,611	8,490	0	0	0		40,101
Domestic aviation	0	0	3,941	0	0	0	0		3,941
Rail	0	0	1,265	0	0	0	0	1,591	2,856
Pipeline transport	0	0	0	404	0	0	0		404
Domestic navigation	0	0	1,539	0	0	0	0		1,539
Non-specified (transport)	0	0	0	0	0	0	0		0
Other	**0**	**0**	**1,12,350**	**991**	**0**	**0**	**0**	**60,569**	**1,73,910**
Residential	0	0	30,048	0	0	0	0	27,090	57,138
Commercial and public services	0	0	72	0	0	0	0	8,772	8,844
Agriculture/forestry	0	0	714	163	0	0	0	18,490	19,368
Non-specified (other)	0	0	81,515	827	0	0	0	6,218	88,560
Non-energy use	**0**	**0**	**0**	**19,777**	**0**	**0**	**0**		**19,777**
Non-energy use industry/transformatio	0	0	0	19,777	0	0	0		19,777
Non-energy use in transport	0	0	0	0	0	0	0		0
Non-energy use in other	0	0	0	0	0	0	0		0
Elect. output in GWh	**0**	**0**	**0**	**0**	**43,029**	**1,50,651**	**1,54,516**		**3,48,196**
Elec output-main activity producer ele p	0	0	0	0	43,029	1,50,300	1,47,248		3,40,577
Elec output-autoproducer electricity pla	0	0	0	0	0	351	7,268		7,619

* Final consumption refers to End Use Consumption

P: Provisional

Fig. 7.1: Sankey Diagram on Overall Energy Balance in India during FY: 2020-21(P) (in

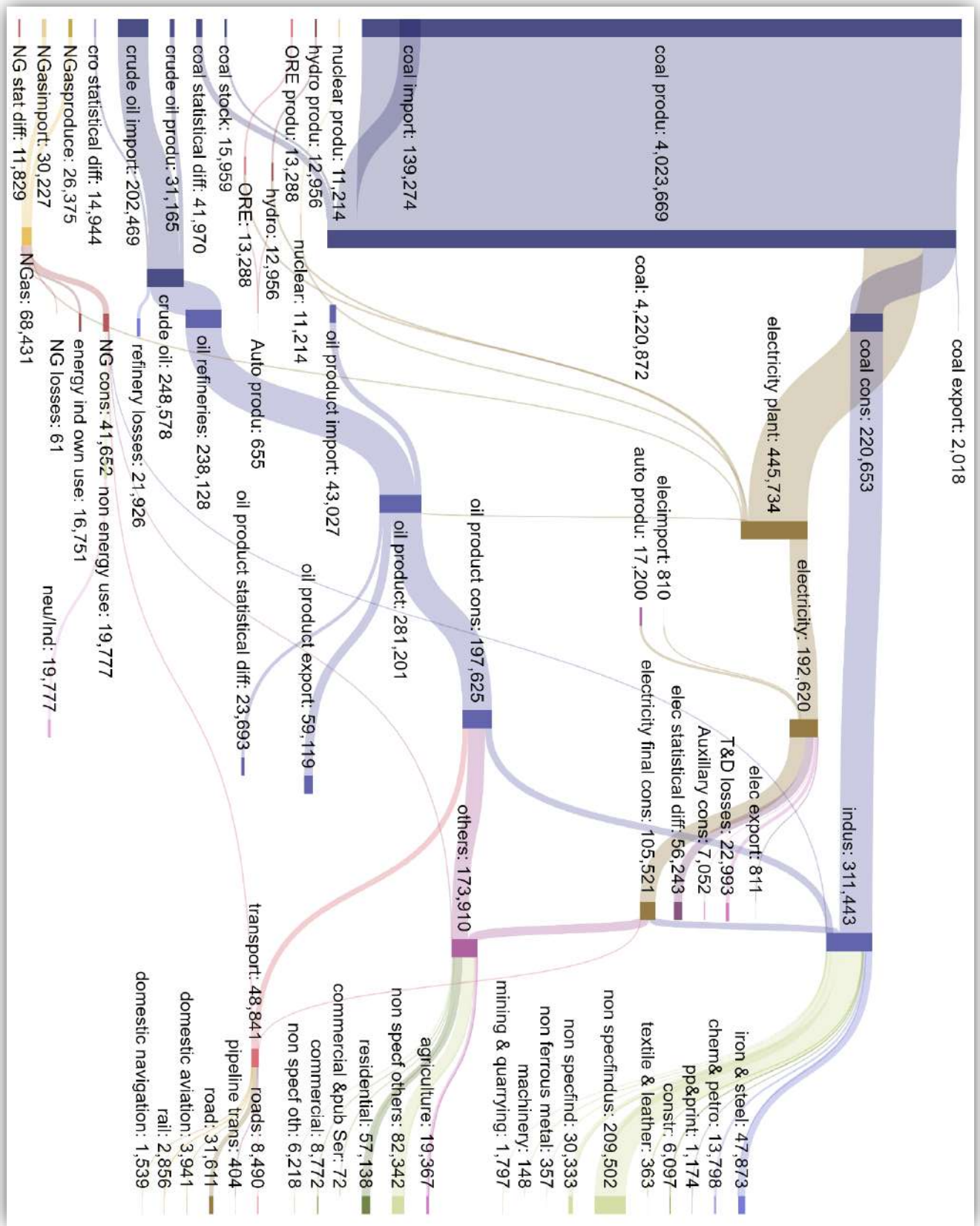


Fig. 7.2: Sankey Diagram on Final Consumption by sectors in India during FY: 2020-21(P) (in KToE)