ENERGY ACCOUNTS

Chapter 2

Energy Accounts

Energy Conservation is the foundation of energy independence

-Tom Allen

Introduction

2.1 Energy plays a significant role in human life and is also an important input in the production of goods and services, including food. Another major benefit of the energy sector is its usage in transportation and heating. In fact, energy has been a part of the humanity since the dawn of time. Before the industrial revolution, the energy needs were limited. Heat energy was derived from the sun and by burning wood, leaves and straw. Transportation was mainly through the muscle of the horses and the power of the wind. Water and wind drove the simple machines that helped grinding of the grains and pumping of the water.

2.2 With the low-cost automobiles and the spread of electricity there has been a radical change in the energy requirement patterns of the society. Energy penetrated not only deep into the economies facilitating services such as cooking, heating, cooling, lighting, operation of appliances, information and communication technology, functioning of machines to name just a few. In addition to this, energy addresses several social issues of well-being. Thus, in short, energy drives economies and is an enabler for development of the nation. But, the production and use of energy are a biggest contributor to global warming. The energy sector accounts for about two-thirds of global greenhouse gas emissions attributed to human activity. Knowing very well the adverse consequences of global warming and climate change, it is important to tread the path of sustainable energy which will open up avenues for transforming lives and economies while safeguarding the planet[1].

2.3 Realizing its importance in the power sector[2], in all the progressive countries of the world, power resources are considered as national assets and organizations are set up for the conservation, development and proper working of these resources.

India's Energy Scenario

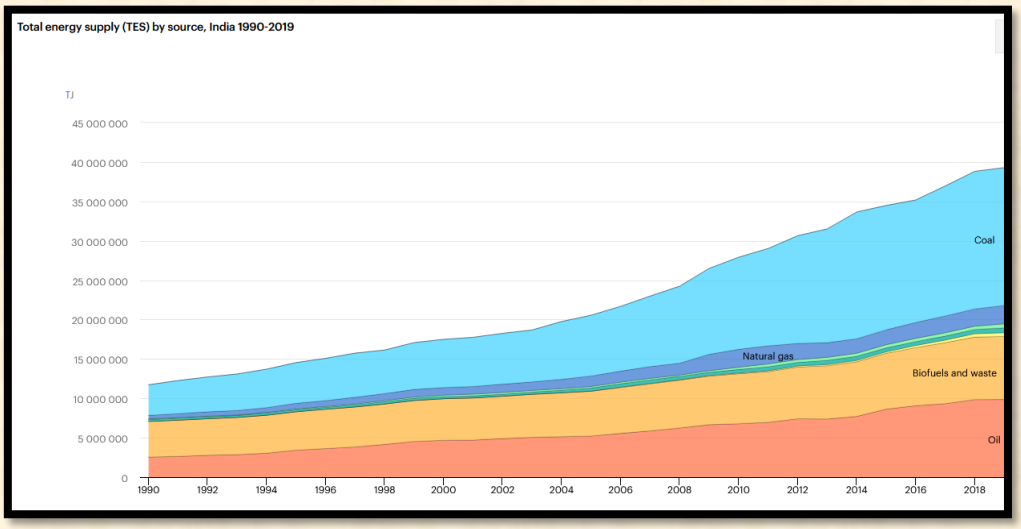
2.4 Energy demand [3] in India is growing rapidly with major implications for the global energy market. India, with a population of 1.36 billion and a fast-growing economy, has seen its energy demand increasing rapidly as the country continues to urbanize and its

[1] https://www.unep.org/explore-topics/energy/why-does-energy-matter
[2] http://lsi.gov.in:8081/jspui/bitstream/123456789/401/1/40059_1961_EIE.pdf
[3] https://www.iea.org/countries/india

manufacturing sector develops. This growing demand is met through various energy sources, with coal being the largest source of energy supply. There is also a requirement to develop the institutional framework in order to attract the investment required to satisfy this growing energy need. Over 80% of India's energy needs are met by three fuels: coal, oil and solid biomass. Coal has underpinned the expansion of electricity generation and industry, and remains the largest single fuel in the energy mix. Oil consumption and imports have grown rapidly on account of rising vehicle ownership and road transport use. Biomass, primarily fuelwood, makes up a declining share of the energy mix, but is still widely used as cooking fuel.

2.5 In 2014, thousands of villages and lakhs of hamlets did not have access to electricity. On 15th of August, 2015, the Hon'ble Prime Minister of India addressed this issue and aimed to provide electricity access to every inhabited village within 1000 days. The target was achieved in a span of 987 days, i.e. 13 days ahead of the target set. Applauding India's efforts, the International Energy Agency (IEA) declared this as the most seminal development in the energy sector in the world in 2018. In addition, with the objective to achieve universal household electrification, the Hon'ble Prime Minister launched the "Pradhan Mantri Sahaj Bijli Har Ghar Yojana – SAUBHAGYA" in October 2017. Under the scheme till date, all willing households have been electrified in the country. Some of the hamlets and households which were unwilling earlier are currently willing to have electricity connections. A total of 2.817 crore households have been electrified since the launch of SAUBHAGYA. IEA mentioned this as the fastest expansion of access to electricity anywhere in the world in the history of the power sector.

Figure 2.1: Total Energy Supply by Source



Source: International Energy Agency

Energy and Climate Change

2.6 India has also been prioritizing access to electricity and clean cooking. The Government of India is continuing to focus on providing secure, affordable and

sustainable energy, while achieving its ambitious renewable energy targets and reducing local air pollution. India's[4] announcement that it aims to reach net zero emissions by 2070 and to meet fifty percent of its electricity requirements from renewable energy sources by 2030 is a hugely significant moment for the global fight against climate change. In a pathway to net zero emissions by 2070, Hon'ble Prime Minister of India has announced more ambitious targets for 2030, including installing 500 gigawatts of non-fossil energy capacity, meeting 50% of the country's energy requirements from renewable energy, reducing the emissions intensity of its economy by 45%, and reducing carbon emissions by a billion tonne. India is pioneering a new model of economic development that could avoid the carbon-intensive approaches that many countries have pursued in the past – and provide a blueprint for other developing economies.

2.7 Several Government schemes[5] have been launched to categorically address the issue of climate change. Since 2014, India imposed passenger vehicle fuel-efficiency standards. Once implemented in 2015, these standards mandated efficiency targets for new cars at the equivalent of 130 gCO_2/km in 2017 and 113 gCO_2/km in 2022. Fuel efficiency labeling for new vehicles has been made mandatory since 2011. As part of the National Electric Mobility Mission Plan (NEMMP) 2020, India developed the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme in 2015. FAME was designed to accelerate the uptake of hybrids and electric vehicles through providing subsidies that reduce the upfront purchase price of these vehicles. India's National Mission on Electric Mobility was launched in 2018. Subsequently, the National E-Mobility programme was launched to promote public procurement of electric vehicles and deployment of charging infrastructure. In 2019, Government of India adopted a scaled-up FAME II scheme, with an outlay of USD 1.4 billion to be used for upfront incentives and for supporting the deployment of charging infrastructure. While the scheme was scheduled to end in 2022, it has now been extended until 2024.

2.8 In order to strengthen the distribution system in rural and urban areas, Government of India launched[6] Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) and Integrated Power Development Scheme (IPDS). Ministry of Power launched Revamped Distribution Sector Scheme (RDSS) to provide reform-based result linked financial assistance to the Distribution Companies (DISCOMs) to strengthen the supply infrastructure. Also, a Liquidity Infusion Scheme was launched to bridge the liquidity gaps. The Ministry launched a web-portal called PRAAPTI (Payment Ratification and Analysis in Power procurement for bringing Transparency in Invoicing of generators) for transparency in monitoring of dues to Generation Company (GENCOs) at the national

[4] https://www.mea.gov.in/Speeches-Statements.htm?dtl/34466/National+Statement+by+Prime+Minister+Shri+Narendra+Modi+at+COP26+Summit+in+Glasgow
[5] https://www.iea.org/articles/fuel-economy-in-india
[6] https://powermin.gov.in/sites/default/files/uploads/MOP_Annual_Report_Eng_2021-22.pdf

level. Another milestone achievement is the development of the One Nation-One Grid which has transformed the country into one unified power market.

SEEA-Energy

2.9 With the enormous potential of India's energy sector, comes a sense of responsibility towards the nation and towards the globe at large. Tapping the energy resources ignoring the environmental concerns will serve good to none. Therefore, the effect of energy supply and use on the environment has emerged as a critical policy issue. Hence, it becomes pertinent to know the proper supply and usage of energy especially in the context of sustainable development. SEEA-Energy provides the framework for the compilation of the physical and monetary supply and use tables and also for having an idea about the stock of energy available in the country at a particular point of time.

2.10 For the purpose of compiling Energy Accounts for the country, the standard framework accepted internationally is the SEEA-Energy Framework. The System of Environmental Economic Accounting for Energy (SEEA-Energy[7]) is a multipurpose conceptual framework for organizing energy related statistical information. It supports analysis of both the role of energy within the economy and the relationship between energy-related activities and the environment. At the core of SEEA-Energy is an accounting approach that records the stocks and flows of energy within the territory of reference. The value added of SEEA-Energy lies in its ability to bring a broader and more structured perspective to bear on the Energy related information already available. Through their coherence with System of National Accounts (SNA), the data in the energy accounts can be easily linked with other information collected for national accounts, which allows for a more detailed and policy-relevant analysis of energy information.

2.11 The capacity of SEEA-Energy to link energy accounts with economic and other environmental accounts underlines its power. Essential to the formulation of a policy response to an environmental issue such as climate change, which is affected by energy-related emissions of carbon into the air, is understanding both human impacts on the physical environment (through determining, for example, which industry is generating the carbon emissions and the energy products involved); and energy needs and possible constraints and solutions (through determining, for example, ongoing energy requirements and what kind of low-carbon energy sources can be utilized). Indicators/statistics generated from SEEA-Energy accounts can also enhance the understanding of issues related to the effects of using economic instruments (such as tradable carbon emission permits) on both the economy and the environment. Those effects may include impacts on energy prices, household spending and business profitability and, crucially, on emissions of carbon generated by domestic producers and as embodied in imports.

[7] https://seea.un.org/sites/seea.un.org/files/documents/seea-energy_final_web.pdf

2.12 SEEA- Energy has a close relationship with IRES (International Recommendation on Energy Statistics)[8], which contributes valuable inputs into the production of the tables and accounts of SEEA-Energy. In particular IRES support the use of the harmonized definitions of energy products in accordance with the Standard International Energy Product Classification (SIEC)[9] and offer guidance regarding data sources and data compilation.

2.13 The Energy Accounts as described in SEEA comprise three types of accounts, namely- Asset Accounts, Physical Supply and Use Tables (PSUT) and Monetary Supply and Use Tables (MSUT).

Asset Accounts for Energy

2.14 The purpose of an asset account is to record the opening and closing stock of the assets and the various types of changes in stock over an accounting period. The asset accounts in SEEA-Energy are compiled only for minerals and energy resources. These accounts provide valuable information to assess the fact whether the current patterns of economic activity are depleting and/or degrading the available mineral and energy resources. In addition, the information on the asset accounts can help in the management of mineral and energy resources.

2.15 Mineral and energy resources within SEEA-Energy include known deposits of oil resources, natural gas resources, coal and peat resources, and uranium and thorium resources, including those with no current economic value. Those resources are defined more broadly than in 2008 SNA, which includes only those inputs that meet the definition of an economic asset. In the SEEA Central Framework, mineral and energy resources include known deposits of oil resources, natural gas resources, coal and peat resources, non-metallic minerals and metallic minerals. In SEEA-Energy, mineral and energy resources are restricted to those resources that can become energy products.

2.16 Known deposits of minerals and energy resources are categorized into three classes, based on criteria from the United Nations Framework Classification (UNFC)-2009[10]:

(a) *Class A*: Commercially Recoverable Resources which includes on-production projects, projects approved for development and projects justified for development

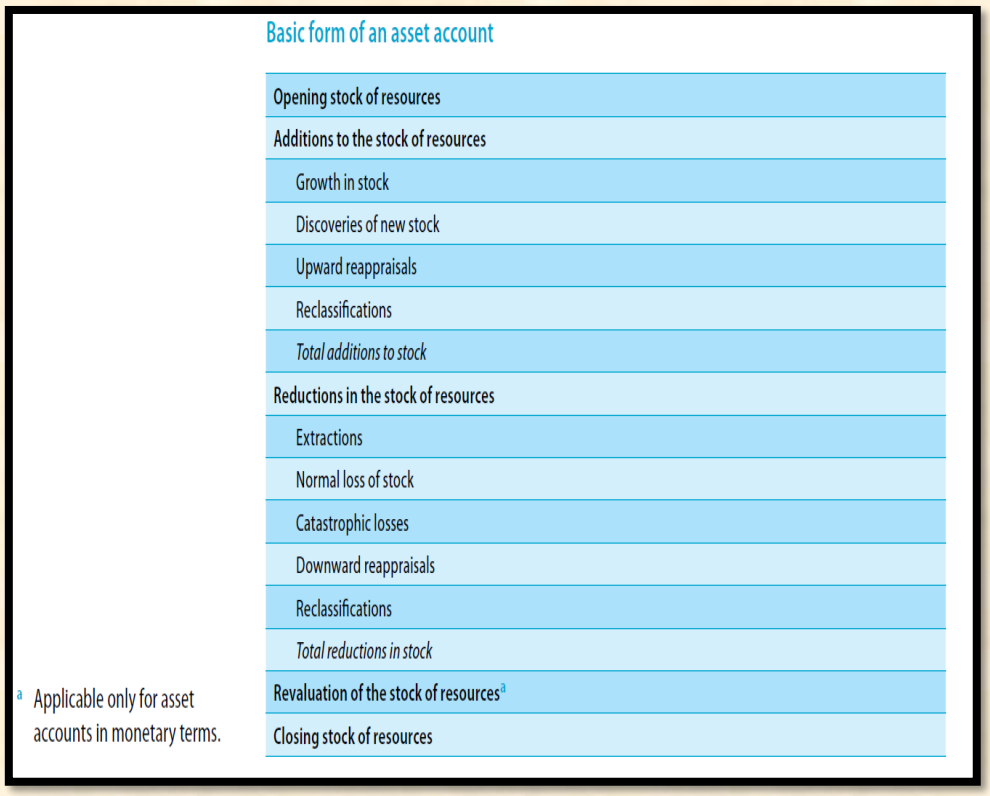
(b) *Class B*: Potentially Commercially Recoverable Resources which includes economic and marginal development projects pending and development projects on hold.

[8] https://unstats.un.org/unsd/energystats/methodology/documents/IRES-web.pdf
[9] https://unstats.un.org/unsd/classifications/Family/Detail/2007
[10] https://unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/unfc2009/UNFC2009_ES39_e.pdf

(c) *Class C*: Non-Commercial and other known deposits which includes unclarified development projects, non-viable development projects and additional quantities in place.

2.17 The basic form of the Asset account is shown in Figure 2.2. It begins with the opening stock of resources and ends with the closing stock of resources. In physical terms, the changes between the beginning and the end of the accounting period are recorded either as additions to or as reductions in the stock. Wherever possible, the nature of the addition or reduction is recorded.

Figure 2.2: Basic Form of an Asset Account



Source: SEEA-Energy

2.18 According to SEEA-Energy, there are 3 types of additions to the stock of the Energy Assets:

- *Discoveries:* Discoveries should incorporate estimates of the quantity of new deposits found during an accounting period. To be regarded as a discovery the new deposit must be a known deposit – i.e. in Class A, B or C. In situations in which a quantity of potential deposits becomes known to a higher degree of confidence, this increase should be treated as discoveries. Discoveries should be recorded by type of resource and by category of resource.
- *Upward reappraisals:* Reappraisals should only pertain to known deposits. They will relate to additions in the estimated available stock of a specific deposit, or to changes in the categorization of specific deposits between Class A, B or C based on

changes in geological information, technology, resource price or a combination of these factors.

- *Reclassifications:* Reclassifications may occur if certain deposits are opened or closed to mining operations due to a government decision concerning the access rights to a deposit. All other changes in the quantity of known deposits should be treated as reappraisals. Reclassifications may conceivably be recorded if asset accounts for energy resources are being compiled by institutional sector.

2.19 There are four types of reductions in the stock of energy assets:

- *Extraction:* Estimates of extraction should reflect the quantity of the resource physically removed from the deposit. It should exclude mining overburden, i.e. the quantity of soil and other material moved in order to extract the resource. The quantity should also be estimated before any refinement or processing of the resource is undertaken. Estimates of extraction should include estimates of illegal extraction, either by residents or non-residents, as these amounts reduce the availability of the resource.
- *Catastrophic losses*. Catastrophic losses are rare for most energy resources. Flooding and collapsing of mines do occur but the deposits continue to exist and can, in principle, be recovered. For example- oil wells that can be destroyed by fire or become unstable for other reasons leading to significant losses of oil resources. Losses of oil and related resources in this situation should be treated as catastrophic losses.
- *Downward reappraisals:* Reappraisals should only pertain to known deposits. They will relate to reductions in the estimated available stock of a specific deposit, or to changes in the categorization of specific deposits between Class A, B or C based on changes in geological information, technology, resource price or a combination of these factors.
- *Reclassifications:* Reclassifications may occur if certain deposits are opened or closed to mining operations due to a government decision concerning the access rights to a deposit. All other changes in the quantity of known deposits should be treated as reappraisals. Reclassifications may conceivably be recorded if asset accounts for energy resources are being compiled by institutional sector.

2.20 Monetary asset accounts for mineral and energy resources provide a market-based valuation of physical stock of mineral and energy resources and the changes in the value of these stocks over time. The same entries are made in monetary terms, although an additional entry recording revaluations of resource stocks is included. This entry accounts for changes in the value of assets over an accounting period due to movements in the price of the resources.

Physical Supply and Use Tables (PSUT)

2.21 SEEA-Energy records the physical flows, measured in physical units of energy content, through the compilation of supply and use tables. These tables are used to assess how an economy supplies and uses energy products, as well as to examine the changes in production and consumption patterns over time. These tables help in the presentation of how the energy flows into the economy, how they are used within and how they leave a country's national economy for a given period of time. The PSUT are expressed in a common energy unit such as joules and expresses the relationship between inputs to and outputs from energy transformation processes.

2.22 The general structure of the PSUT are shown in the Figure 2.3 below:

Figure 2.3: Basic Form of a Physical Supply and Use Table for Energy

Basic form of a physical supply and use table for energy (joules)

Supply table

	Industries	Households	Accumulation	Rest of the world	Environment	Total
Energy from natural inputs					A. Energy inputs from the environment	Total supply of energy from natural inputs
Energy products	C. Output			D. Imports		Total supply of energy products
Energy residuals	I. Energy residuals generated by industry	J. Energy residuals generated by household consumption	K. Energy residuals from accumulation	L. Energy residuals received from the rest of the world	M. Energy residuals recovered from the environment	Total supply of energy residuals

Use table

	Industries	Households	Accumulation	Rest of the world	Environment	Total
Energy from natural inputs	B. Extraction of energy from natural inputs					Total use of energy from natural inputs
Energy products	E. Intermediate consumption	F. Household consumption	G. Changes in inventories	H. Exports		Total use of energy products
Energy residuals	N. Collection and treatment of energy residuals		O. Accumulation of energy residuals	P. Energy residuals sent to the rest of the world	Q. Energy residual flows direct to environment	Total use of energy residuals

Note: Dark grey cells are null by definition.

Source: SEEA-Energy

Monetary Supply and Use Tables (MSUT)

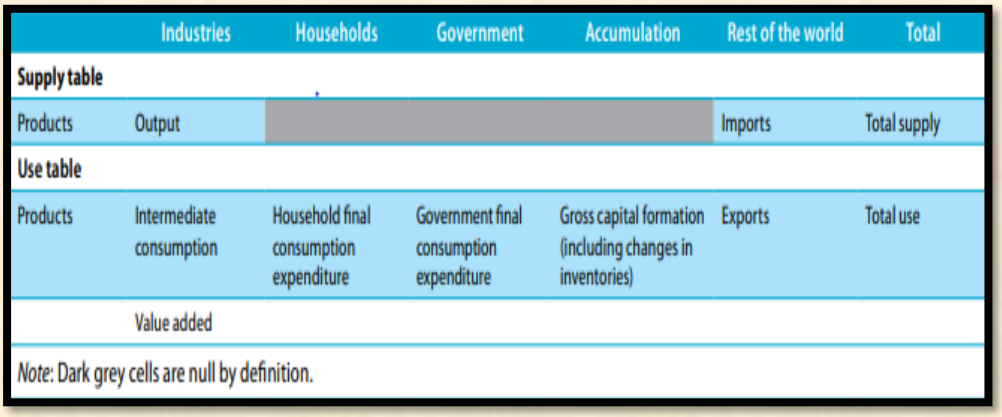
2.23 MSUT fully articulates in monetary terms the flows of energy products in an economy between different economic units. MSUT for energy provides information on the energy sector and the level of activity in this sector. They also provide detailed information on the industries within the economy that are using these energy products. Monetary supply and use tables for energy can readily be linked with PSUT for energy to create a powerful analytical tool.

2.24 Monetary supply and use tables have their roots in economic accounting and utilize the same organizational principles and display the same characteristics as physical supply and use tables. Nevertheless, while the physical supply and use table for energy contains three main types of flows, namely, energy from natural inputs, energy products

and energy residuals, the monetary supply and use table for energy records only those flows related to energy products.

2.25 The general structure of the MSUT is shown in the Figure 2.4 below:

Figure 2.4: Basic Form of a Monetary Supply and Use Table for Energy



	Industries	Households	Government	Accumulation	Rest of the world	Total
Supply table						
Products	Output				Imports	Total supply
Use table						
Products	Intermediate consumption	Household final consumption expenditure	Government final consumption expenditure	Gross capital formation (including changes in inventories)	Exports	Total use
	Value added					
Note: Dark grey cells are null by definition.						

Source: SEEA-Energy

Data Sources for Energy Accounts in India

2.26 Some of the major data-sources for the compilation of the Energy Accounts in India are given as follows:

(i) **Energy Statistics:** Energy Statistics is a regular annual publication of the Economics Statistics Division (ESD) of National Statistical Office (NSO), Ministry of Statistics & Programme Implementation (MoSPI), using the IRES Framework. The data are primarily sourced from Ministry of Coal, Ministry of Petroleum & Natural Gas, Ministry of Mines, Ministry of Power, Ministry of New and Renewable Energy etc. The data pertaining to the energy sector of the economy provided in the publication are in respect of the reserves and potential for generation, installed capacity and capacity utilization, production of energy, foreign trade, availability of energy resources, consumption of energy resources, energy balance and sustainability.

(ii) **Office of Coal Controller, Ministry of Coal**: The Ministry has the vision focused towards sustainable development of the coal and lignite industry with a view to satisfy its obligations towards economic prosperity of the country.

(iii) **Central Mine Planning and Design Institute Limited (CMPDIL)**: It is a Government of India enterprise having its corporate headquarters at Ranchi, Bihar. It is a fully owned subsidiary of Coal India Limited. CMPDIL's corporate responsibilities include assisting Ministry of Coal (MoC) for strategic decisions relating to coal-sector at the national level, eg, through maintaining inventories of coal deposits, coal mining potentials and operations, etc.

(iv) **Geological Survey of India, Ministry of Mines**: Its main functions relate to creation and updation of national geoscientific information and mineral resource

assessment. These objectives are achieved through ground survey, air-borne and marine surveys, mineral prospecting and investigations, multi-disciplinary geoscientific, geo-technical, geo-environmental and natural hazards studies, glaciology, seismotectonic study, and carrying out fundamental research.

(v) **Ministry of Petroleum and Natural Gas**: It is concerned with exploration and production of Oil & Natural Gas, refining, distribution and marketing, import, export and conservation of petroleum products. Oil and Gas being the important import for our economy, many initiatives have been taken by the Ministry for increasing production and exploitation of all domestic petroleum resources to address the priorities like Energy Access, Energy Efficiency, Energy Sustainability and Energy Security.

(vi) **Central Electricity Authority, Ministry of Power**: This has the mission to achieve the vision by performing its statutory function by providing technical support base to all stakeholders in the power sector, to support Ministry of Power for forming policies in the power sector, to make technical standards & regulations, to carry out project monitoring, to disseminate power sector information, to upgrade skills of human resources in the power sector of the country.

2.27 SEEA recommends compilation of the accounts for all 3 types of energy resources (Class A, B and C), both in physical and monetary terms. Even though Class A is included in the core accounts countries are encouraged to compile information on Classes B and C.

Physical Asset Accounts for Energy for India

2.28 The Physical Asset Accounts for energy considering the crude oil, natural gas, coal and lignite has been compiled for India for the years 2015-16 to 2020-21 using data from M/o Coal, M/o Petroleum and NG and Geological Survey of India. The accounts for the atomic energy resources could not be compiled due to the non-disclosure policy regarding confidential information. For the assets such as Coal and Lignite, Geological Survey of India compiles estimates of these in 3 main categories of Proved, Indicated and Inferred.

2.29 Proved resources are Economically mineable part of Measured Mineral Resource. These resources are generally taken to be those quantities that geological and engineering information indicates with reasonable certainty and can be recovered in the future from known reservoirs under existing economic and operating conditions.[11] For Indicated mineral resources, tonnage, density, shape, physical characteristics grade and mineral content can be estimated with reasonable level of confidence based on exploration, sampling and testing information, location of borehole, pits, etc. For Inferred mineral resources, tonnage, grade and mineral content can be estimated with low level

[11] Coal Directory of India, 2020-21, Ministry of Coal

of confidence inferred from geological evidence.[12] However, majority of the extractions take place from the proved category of the resources with around 10% uncertainty. The other categories possess a higher degree of uncertainly. Thus, it would be more appropriate to subtract the extraction estimates from the proved category rather than from the total ('proved + indicated + inferred') while compiling the Asset Accounts. Also, according to a report of the Expert Committee on Road Map for Coal Sector Reforms under the chairmanship of Shri T.L. Sankar, released in December 2005 by Ministry of Coal, GoI[13], a ratio of 1:4.7 is approximately suggested to know the proportion of the coal extracted and coal sterilized during the extraction process (1 unit of Coal extraction involves 3.7 units of sterilization loss). Similarly a ratio of 1 : 4.46 is approximately suggested to know the proportion of Lignite extracted and Lignite sterilized during the extraction process (1 unit of Lignite extraction involves 3.46 units of sterilization loss) as provided by Neyveli Lignite Corporation India Limited.

2.30 So, for assets such as coal and lignite, only the 'proved' category of resources has been used for compilation of the asset account as it has the lowest level of uncertainty amongst the other classes of resources and also because of the fact that most of the coal are extracted from 'proved' resources. The current publication is restricted to only the compilation of the Physical Asset Accounts and Physical Supply and Use Tables. Efforts will be made to compile Monetary Supply and Use Table (MSUT) in consultation with the stakeholders and would be included in the subsequent issues of the publication.

2.31 Year wise asset accounts for coal, lignite, crude oil and natural gas from the years 2015-16 to 2020-21 are provided in the Tables 2.1 (a) to (f). The Opening Stock (Inventory) data as given in the Coal Directory differs from what has been computed in the Asset Accounts. The reason for this is the deduction of the extraction and sterilization loss in the Asset accounts which is not considered in the geological resources by the GSI.

[12] National Mineral Inventory - An Overview
https://ibm.gov.in/writereaddata/files/07072014130440nmi%20overview%20142010_Chapter%2011.pdf
[13] http://www.indiaenvironmentportal.org.in/files/expertreport-1.pdf

Table 2.1(a): Physical Asset Accounts for Energy: 2015-16

Type of Energy Resource				
	Coal (Proved Category)	**Lignite (Proved Category)**	**Crude Oil**	**Natural Gas**
	Million tonnes	Million tonnes	'000 Barrels	Million CuM
Opening Stock of Mineral and energy resources (Geological for last FY) as per National Inventory	**69,818.0**	**2,159.0**	**46,58,874.7**	**12,51,990.0**
Addition in stock:				
Discoveries	11.1		1,79,731.6	43,080.0
Upward Appraisal	6,462.0	359.0		
TOTAL ADDITION TO THE STOCK	**6,473.1**	**359.0**	**1,79,731.6**	**43,080.0**
Total Geological resource	**76,291.1**	**2,518.0**	**48,38,606.3**	**12,95,070.0**
Reduction in Stock:				
Extraction	638.0	44.0	2,70,916.8	32,249.2
Sterilization Loss	2,360.6	152.2		
Downward reappraisals			13,707.1	35,320.8
TOTAL REDUCTION IN STOCK	**2,998.6**	**196.2**	**2,84,623.9**	**67,570.0**
Closing stock of mineral and energy resources	**73,292.5**	**2,321.8**	**45,53,982.4**	**12,27,500.0**

Coal and Lignite data are obtained from Geological Survey of India.
*Sterilization Loss for Coal = Extraction*3.7*
*Sterilization Loss for Lignite = Extraction*3.46*

Table 2.1 (b): Physical Asset Accounts for Energy 2016-17

Type of Energy Resource				
	Coal (Proved Category)	**Lignite (Proved Category)**	**Crude Oil**	**Natural Gas**
	Million tonnes	Million tonnes	'000 Barrels	Million CuM
Opening Stock of Mineral and energy resources (Geological for last FY) as per National Inventory	**73,292.5**	**2,321.8**	**45,53,982.4**	**12,27,500.0**
Addition in stock:				
Discoveries	101.2		1,31,354.0	93,970.0
Upward Appraisal	4,869.3		6,662.0	130.0
TOTAL ADDITION TO THE STOCK	4,970.5		1,38,016.0	94,100.0
Total Geological resource	**78,263.0**	**2,321.8**	**46,91,998.4**	**13,21,600.0**
Reduction in Stock:				
Extraction	655.0	45.0	2,63,944.7	31,896.7
Sterilization Loss	2,423.5	155.7		
Downward reappraisals				
TOTAL REDUCTION IN STOCK	3,078.5	200.7	2,63,944.7	31,896.7
Closing stock of mineral and energy resources	**75,184.5**	**2,121.1**	**44,28,053.7**	**12,89,703.3**

Coal and Lignite data are obtained from Geological Survey of India.
*Sterilization Loss for Coal = Extraction*3.7*
*Sterilization Loss for Lignite = Extraction*3.46*

Table 2.1(c): Physical Asset Accounts for Energy 2017-18

Type of Energy Resource				
	Coal (Proved Category)	**Lignite (Proved Category)**	**Crude Oil**	**Natural Gas**
	Million tonnes	Million tonnes	'000 Barrels	Million CuM
Opening Stock of Mineral and energy resources (Geological for last FY) as per National Inventory	**75,184.5**	**2,121.1**	**44,28,053.7**	**12,89,703.3**
Addition in stock:				
Discoveries	167.6		1,86,841.7	83,740.0
Upward Appraisal	5,562.1		4,283.1	
TOTAL ADDITION TO THE STOCK	**5,729.7**		**1,91,124.8**	**83,740.0**
Total Geological resource	**80,914.3**	**2,121.1**	**46,19,178.5**	**13,73,443.3**
Reduction in Stock:				
Extraction	675.0	47.0	2,61,566.1	32,649.3
Sterilization Loss	2,497.5	162.6		
Downward reappraisals				1,220.7
TOTAL REDUCTION IN STOCK	**3,172.5**	**209.6**	**2,61,566.1**	**33,870.0**
Closing stock of mineral and energy resources	**77,741.8**	**1,911.4**	**43,57,612.4**	**13,39,573.3**

Coal and Lignite data are obtained from Geological Survey of India.
*Sterilization Loss for Coal = Extraction*3.7*
*Sterilization Loss for Lignite = Extraction*3.46*

Table 2.1(d): Physical Asset Accounts for Energy 2018-19

Type of Energy Resource				
	Coal (Proved Category)	**Lignite (Proved Category)**	**Crude Oil**	**Natural Gas**
	Million tonnes	Million tonnes	'000 Barrels	Million CuM
Opening Stock of Mineral and energy resources (Geological for last FY) as per National Inventory	**77,741.8**	**1,911.4**	**43,57,612.4**	**13,39,573.3**
Addition in stock:				
Discoveries	586.4		4,25,213.3	74,020.0
Upward Appraisal	6,240.6	246.8		
TOTAL ADDITION TO THE STOCK	**6,826.9**	**246.8**	**4,25,213.3**	**74,020.0**
Total Geological resource	**84,568.7**	**2,158.3**	**47,82,825.7**	**14,13,593.3**
Reduction in Stock:				
Extraction	729.0	44.0	2,50,709.9	32,873.4
Sterilization Loss	2,697.3	152.2		
Downward reappraisals			8,31,515.2	2,28,030.0
TOTAL REDUCTION IN STOCK	**3,426.3**	**196.2**	**10,82,225.1**	**2,60,903.4**
Closing stock of mineral and energy resources	**81,142.4**	**1,962.0**	**37,00,600.5**	**11,52,689.9**

Coal and Lignite data are obtained from Geological Survey of India.
*Sterilization Loss for Coal = Extraction*3.7*
*Sterilization Loss for Lignite = Extraction*3.46*

Table 2.1(e): Physical Asset Accounts for Energy 2019-20

Type of Energy Resource				
	Coal (Proved Category)	**Lignite (Proved Category)**	**Crude Oil**	**Natural Gas**
	Million tonnes	Million tonnes	'000 Barrels	Million CuM
Opening Stock of Mineral and energy resources (Geological for last FY) as per National Inventory	**81,142.4**	**1,962.0**	**37,00,600.5**	**11,52,689.9**
Addition in stock:				
Discoveries	2,595.4		2,47,094.3	40,300.0
Upward Appraisal	5,261.3	181.6		7,990.0
TOTAL ADDITION TO THE STOCK	**7,856.7**	**181.6**	**2,47,094.3**	**48,290.0**
Total Geological resource	**88,999.1**	**2,143.6**	**39,47,694.8**	**12,00,979.9**
Reduction in Stock:				
Extraction	731.0	42.0	2,35,800.7	31,184.2
Sterilization Loss	2,704.7	145.3		
Downward reappraisals			88,986.2	17,860.9
TOTAL REDUCTION IN STOCK	**3,435.7**	**187.3**	**3,24,786.9**	**49,045.1**
Closing stock of mineral and energy resources	**85,563.4**	**1,956.3**	**36,22,907.9**	**11,51,934.8**

ONGC adopted PRMS system w.e.f. 01.04.2019, hence the above figures also include 2C figures from 2019-20 onwards.
Coal and Lignite data are obtained from Geological Survey of India.
*Sterilization Loss for Coal = Extraction*3.7*
*Sterilization Loss for Lignite = Extraction*3.46*

Table 2.1(f): Physical Asset Accounts for Energy 2020-21

Type of Energy Resource				
	Coal (Proved Category)	**Lignite (Proved Category)**	**Crude Oil**	**Natural Gas**
	Million tonnes	Million tonnes	'000 Barrels	Million CuM
Opening Stock of Mineral and energy resources (Geological for last FY) as per National Inventory	**85,563.4**	**1,956.3**	**36,22,907.9**	**11,51,934.8**
Addition in stock:				
Discoveries	1,608.3		87,813.4	30,250.0
Upward Appraisal	12,099.5	405.0		740.0
TOTAL ADDITION TO THE STOCK	**13,707.9**	**405.0**	**87,813.4**	**30,990.0**
Total Geological resource	**99,271.2**	**2,361.3**	**37,10,721.3**	**11,82,924.8**
Reduction in Stock:				
Extraction	716.0	37.0	2,23,521.7	28,672.4
Sterilization Loss	2,649.2	128.0		
Downward reappraisals			3,225.2	12,945.0
TOTAL REDUCTION IN STOCK	**3,365.2**	**165.0**	**2,26,746.9**	**41,617.4**
Closing stock of mineral and energy resources	**95,906.0**	**2,196.3**	**34,83,974.5**	**11,41,307.4**

ONGC adopted PRMS system w.e.f. 01.04.2019, hence the above figures also include 2C figures from 2019-20 onwards.
Coal and Lignite data are obtained from Geological Survey of India.
*Sterilization Loss for Coal = Extraction*3.7*
*Sterilization Loss for Lignite = Extraction*3.46*

Physical Supply and Use Table for Energy

2.32 A key motivation for accounting for minerals and energy resources is to assess to what extent current patterns of economic activity are depleting the energy resources and how much sustainable the present economy is. Physical supply and use tables for energy aims at comprehensiveness that entails recording all energy flows both within the economy and between the economy and the environment. These accounts along with the

Asset accounts provides necessary granular level information to help identify the policy concern areas.

2.33 In the chapter, the PSUT for Energy has been compiled following the structure of SEEA-Energy. Following accounting identities have been adhered to while compiling the PSUT for Energy.

(i) Total Supply of Energy from Natural Inputs =Total Use of Energy from Natural Inputs

(ii) Total Supply of Energy Products=Total Use of Energy Products (Transformation + End Use)

(iii) Total Supply of Energy Residuals=Total Use of Energy Residuals

Procedure for Compiling Physical Supply and Use Table

2.34 The Methodology for compiling the Physical supply and use tables are as given below:

(i) Energy from Natural Inputs: In the Supply Table, most of the data (for Coal, Lignite, Crude Oil and Natural Gas) have been sourced from the Energy Statistics-2022 publication[14] and the values are shown in the column 'Flows form Environment'. On the use side, industry-wise distribution of these 'Energy from Natural Inputs' have been made. The values in physical units are converted to Petajoules using the appropriate conversion factors. The conversion factors used have been provided in the **Annexure 2.1.**

(ii) Energy Products: Both for the Supply side and the Use side the data has been primarily sourced from the Energy Statistics-2022 publication. Additional data such as Crude Oil Processed have been taken from the MoPNG press release[15]. Entries in the Supply Table and Use Table have been matched energy component wise. After converting all the entries into Energy units, the tables are balanced by making appropriate adjustments in the HH column (Electricity and Biofuels) and in the accumulation column (others).

(iii) Energy Residuals: The distribution loss for Natural Gas and Electricity and the loss in petroleum (flare and other loss) has been taken from the Energy Statistics. Apart from this, loss due to coal reject has been received from M/o Coal.

2.35 In the current chapter, the Physical Supply and Use Tables for Energy for the years 2015-16 to 2019-20 have been compiled. The PSUT for energy for the year 2019-20 has

[14] https://mospi.gov.in/web/mospi/reports-publications/-/reports/view/templateFive/27201?q=RPCAT
[15] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1706564

been presented in **Tables 2.2 (a)** and **2.2 (b)**. For the years 2015-16 to 2018-19, PSUT for energy is given in **Annexures 2.2 to 2.9**. The Energy Accounts compiled in the current publication is at the preliminary stage and have scopes of further improvement with the availability of granular information from the source agencies-especially NIC-wise disaggregated data, data of residuals and losses, data on the accumulations etc.

Figure 2.5 Total supply of Energy in Petajoules

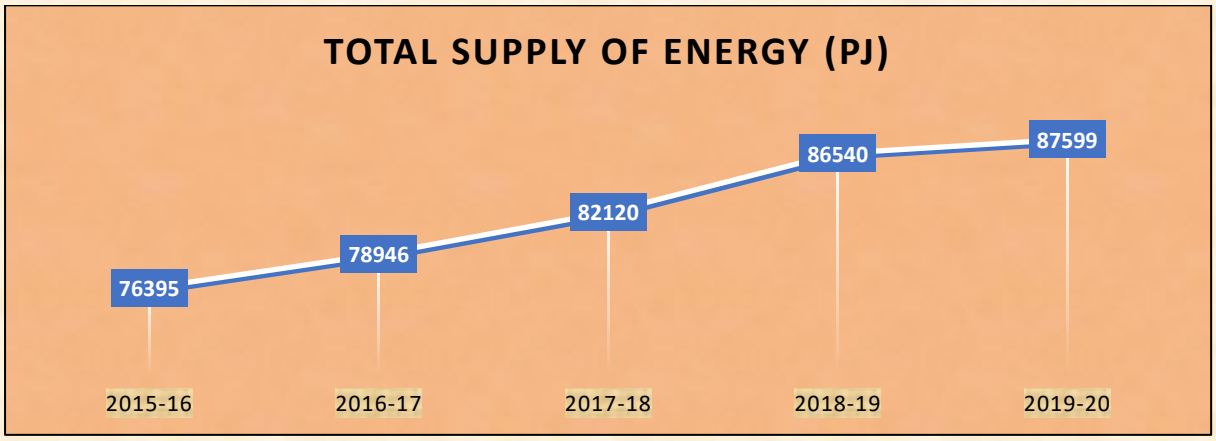
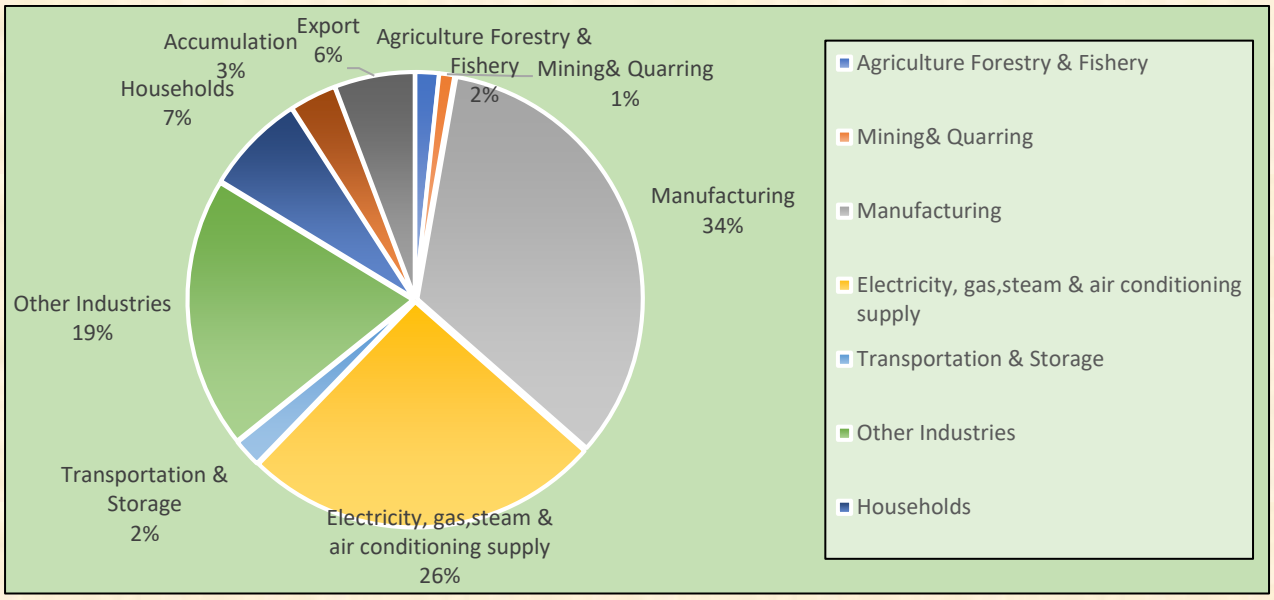


Figure 2.6: Industry-wise use (Transformation and End Use) of Energy for 2019-20



2.36 The Figure 2.5 shows the supply of Energy in Peta Joules over the years indicating an increasing trend. Figure 2.6 shows the industry-wise use of energy for the year 2019-20. The highest share of use can be seen in the Manufacturing and the Electricity sector for the year 2019-20.

Table 2.2 (a): Physical Supply Table for Energy: 2019-20

PHYSICAL SUPPLY TABLE (Unit: PJ)	Production (Incl. household own account) & generation of residuals							Accumulation	Flows from the rest of the world (Imports)	Flows from the Environment	Total
	Industries (by ISIC)						Households				
	Agriculture Forestry & Fishery	Mining& Quarrying	Manufacturing	Electricity, gas, steam & air conditioning supply	Transportation & Storage	Other Industries					
	(ISIC A)	(ISIC B)	(ISIC C)	(ISIC D)	(ISIC M)						
Energy from natural inputs:											
Natural resource inputs											
Crude Oil										1,347	1,347
Natural Gas										1,201	1,201
Coal										11,298	11,298
Lignite										479	479
Inputs of energy form renewable sources (Nuclear)-Electricity										1,250	1,250
Other natural inputs (Biofuels)										54	54
Total										**15,628**	**15,628**
Energy Products:											
Production of energy products by SIEC class:											
Coal		11,058							3,760		14,818
Natural gas		1,201							1,304		2,505
Biofuels	105										105
Electricity				5,843					23		5,866
Nuclear fuels and other fuels				1,250							1,250
Lignite		479							1		479

PHYSICAL SUPPLY TABLE (Unit: PJ)	Production (Incl. household own account) & generation of residuals							Accumulation	Flows from the rest of the world (Imports)	Flows from the Environment	Total
	Industries (by ISIC)						Households				
	Agriculture Forestry & Fishery	Mining& Quarrying	Manufacturing	Electricity, gas, steam & air conditioning supply	Transportation & Storage	Other Industries					
	(ISIC A)	(ISIC B)	(ISIC C)	(ISIC D)	(ISIC M)						
Crude Oil		1,347							9,504		10,851
Petroleum Products			11,011						1,834		12,844
Total	**105**	**14,085**	**11,011**	**7,093**					**16,425**		**48,720**
Energy Residuals:											
Distribution		4		975							978
Extraction		35		84							119
Other Losses (Coal Reject/other residuals)		240									240
Other Energy Residuals	820	491	5,775	862	982	9,470	3,513				21,914
Total energy residuals	**820**	**769**	**5,775**	**1,920**	**982**	**9,470**	**3,513**				**23,251**
Other Residual Flows:											
Residuals from end-use for non-energy purposes											
Energy from solid waste											
TOTAL SUPPLY	**925**	**14,855**	**16,786**	**9,013**	**982**	**9,470**	**3,513**		**16,425**	**15,628**	**87,599**

Note: Grey cells are Nil by definition. PJ: Petajoules Total may not match due to rounding off.

Table 2.2(b): Physical Use Table for Energy: 2019-20

PHYSICAL USE TABLE (Unit: PJ)	Intermediate consumption, Use of energy resources, receipt of energy losses						Final Consumption	Accumulation	Export	Flows to the Environment	Total
	Industries (by ISIC)						Households				
	Agriculture Forestry & Fishery	Mining& Quarrying	Manufacturing	Electricity, gas, steam & air conditioning supply	Transportation & Storage	Other Industries					
	(ISIC A)	(ISIC B)	(ISIC C)	(ISIC D)	(ISIC M)						
Energy from natural inputs:											
Natural resource inputs											
Crude Oil		1,347									1,347
Natural Gas		1,201									1,201
Coal		11,298									11,298
Lignite		479									479
Inputs of energy form renewable sources	52			1,198							1,250
Other natural inputs	54										54
Total	**106**	**14,325**		**1,198**							**15,628**
Energy Products:											
Transformation of energy products by SIEC class											
Coal				9,474							9,474
Natural gas				485							485
Biofuels				52							52
Electricity											
Nuclear fuels and other fuels				1,250							1,250

PHYSICAL USE TABLE (Unit: PJ)	Intermediate consumption, Use of energy resources, receipt of energy losses						Final Consumption	Accumulation	Export	Flows to the Environment	Total
	Industries (by ISIC)						Households				
	Agriculture Forestry & Fishery	Mining& Quarrying	Manufacturing	Electricity, gas, steam & air conditioning supply	Transportation & Storage	Other Industries					
	(ISIC A)	(ISIC B)	(ISIC C)	(ISIC D)	(ISIC M)						
Lignite				413							413
Crude Oil			10,653								10,653
Petroleum Products				8							8
Total Transformed Energy			**10,653**	**11,681**							**22,334**
End-use of energy products by SIEC class:											
Coal			1,302			3,688		340	16		5,345
Natural gas	9	378	916	23	428	184	48	34			2,020
Biofuels							54				54
Electricity	**761**		2,300	778	69	252	**1,671**		**34**		5,865
Nuclear fuels and other fuels											
Lignite			17			51		-2	1		66
Crude Oil			20					178			198
Petroleum Products	50	113	1,221	61	485	5,296	1,740	1,121	2,751		12,837
Total End Use for Energy purposes	**820**	**491**	**5,775**	**862**	**982**	**9,470**	**3,513**	**1,671**	**2,801**		**26,386**
End-use of energy products for non-energy purposes											
Energy Residuals:											
Distribution										978	978
Extraction										119	119

PHYSICAL USE TABLE (Unit: PJ)	Intermediate consumption, Use of energy resources, receipt of energy losses						Final Consumption	Accumulation	Export	Flows to the Environment	Total
	Industries (by ISIC)						Households				
	Agriculture Forestry & Fishery	Mining& Quarrying	Manufacturing	Electricity, gas, steam & air conditioning supply	Transportation & Storage	Other Industries					
	(ISIC A)	(ISIC B)	(ISIC C)	(ISIC D)	(ISIC M)						
Other Losses (Coal Reject/other residuals)										240	240
Other Energy Residuals										21,914	21,914
Total energy residuals										**23,251**	**23,251**
Other Residual Flows:											
Residuals from end-use for non-energy purposes											
Energy from solid waste											
TOTAL USE	**925**	**14,816**	**16,428**	**13,741**	**982**	**9,470**	**3,513**	**1,671**	**2,801**	**23,251**	**87,599**

Note: Grey cells are Nil by definition. PJ: Petajoules Total may not match due to rounding off.

Conclusion

2.37 Several Energy indicators can be derived from the SEEA-Energy Accounts such as Energy Intensity for an industry (Energy intensity is a ratio of energy consumed per unit of economic output (GVA)), energy use per capita, energy use per GDP etc. Changes in the energy intensity can give a fair amount of idea about the efficiency and structural change in industry contribution. In addition, compilation of the Monetary Supply and Use Tables will help in providing additional information which might help in building linkages with the National Accounts.

2.38 SEEA-Energy also bears the direct linkages with the targets under Sustainable Development Goal 7 ("Ensure Access to affordable, reliable, sustainable and modern energy for all"). Besides this, the targets under SDG 12 (specially Target 12.2 which pertains to the material footprint and domestic material consumption and Target 12.c which focuses on rationalizing inefficient fossil-fuel subsidies that encourage wasteful consumption of fossil fuels) can also be compiled with the use of the Energy accounts. Energy accounts provides a myriad of information linked to the social, economic and environmental dimensions.

2.39 As the energy sector plays an integral role in the life of humans, how we use it becomes an essential consideration within the context of sustainable development. There are growing concerns about the impact of rising energy use and of related emissions on local and global environment. At the same time, it is recognized that continuing human welfare and development are dependent upon the benefits to be derived from energy use. Hence the need is to work towards fulfilment of the energy requirements of not only the current generations but to save enough for the future as well. The Energy accounts compiled in this chapter would help policy makers to have a better understanding of each energy component as also the major suppliers and users.

2.40 In this chapter, NSO, India has attempted compilation of the Energy Accounts with the best available information at hand. The Accounts do have a scope of further refinement based on the data availability and further understanding of the concepts and methodology.

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