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A HYBRID ENERGY INPUT-OUTPUT TABLE FOR INDIA

Computing Sectoral Energy Needs and GHG Emissions

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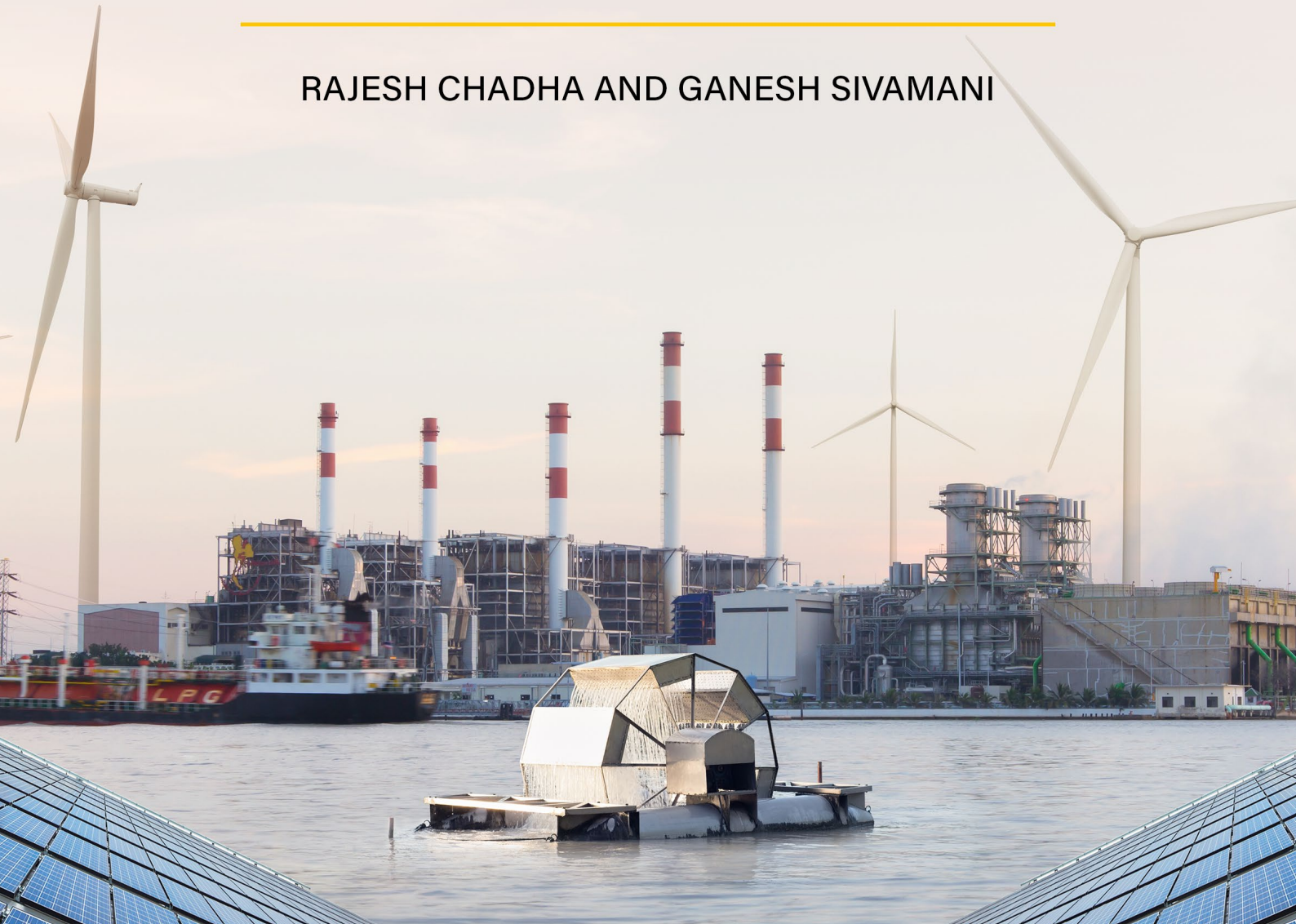

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A HYBRID ENERGY INPUT-OUTPUT TABLE FOR INDIA

Computing Sectoral Energy Needs and GHG Emissions*

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Abstract

In this paper, India's 131-sector Input-Output Table 2015–16 is used to compute the direct and indirect energy consumed and emissions produced by the intermediate production and final-use sectors of the economy through the construction of a 34-sector hybrid Energy Input-Output Table (EIOT). The EIOT contains ten energy sectors: coal and lignite, biomass, crude petroleum, natural gas, combustible petroleum products, non-combustible petroleum products, coal electricity, other thermal (natural gas and petroleum products) electricity, large-scale hydro-electricity, and renewable energy sources & nuclear electricity. Of these ten sectors, three produce emissions when burnt: coal and lignite, biomass, and combustible petroleum products. While the input-output transaction flows are expressed in monetary terms, the flows of energy have been expressed in kilotonnes of oil equivalent (ktoe), and the flows of emissions have been expressed in tonnes of carbon dioxide equivalent (tCO_{2e}). A hybrid unit approach is used by taking the constructed 34-sector EIOT to compute the Leontief inverse matrix in ktoe and tCO_{2e} terms, which provides the coefficients indicating each sector's direct and indirect energy requirements and emissions per rupee of final demand. The data for this research has been sourced from India's Supply and Use Tables, Energy Statistics, Coal Directory, Petroleum & Natural Gas Statistics, Electricity Statistics, Biennial Update Report and IPCC Guidelines for National Greenhouse Gas Inventories. The results of the emissions analysis show that sectors have embedded emissions from their consumption from upstream industries. When making projections for the future growth of these sectors, these should also be considered. Low-emission technologies in the upstream sectors will reduce indirect emissions from downstream sectors – for example, increasing the share of renewable electricity generation will reduce indirect emissions from electricity-intensive sectors. Policies are needed to reduce emissions by adopting more-efficient production technologies and conserving the use of coal and petroleum products.

Backdrop

India is one of the more vulnerable countries to the impacts of climate change. Increasingly common adverse weather conditions will impact communities, the environment, and food security. With its growing population, the country must be prepared to meet the challenges of tackling climate change issues, while also addressing the requirements of increasing national income and meeting other development objectives. The Government of India has made several pledges to deal with climate change; the most recent announcements came during the COP26 Summit: India will increase its share of non-fossil fuel energy capacity, reduce the carbon intensity of the economy by less than 45 percent by 2030 (compared to 2005 levels), and achieve net zero emissions by 2070, among others (Press Information Bureau, 2021). For achieving these goals, India will need to employ a range of policy interventions. It is therefore essential to evaluate the effectiveness of proposed mitigation instruments to decide which policy tools will have the most efficient impact on reducing emissions, while also addressing the needs of a growing economy. This can be done by analysing the impacts of policy shocks on sectoral transactions, energy requirements, and emissions, while also considering the intersectoral linkages of the economy. The input-output framework is therefore a key tool in addressing such questions.

An economy's input-output transactions tables provide information on sectoral production, intermediate and final consumption, taxation, and income levels[1]. They allow for the measurement of the quantum of intersectoral forward and backward linkages, which in turn enables the estimation of both direct and indirect impacts of policy shocks on the economy.

Climate change related issues can also be incorporated into input-output tables. This is referred to as the energy input-output (EIO) table or the environmentally extended input-output (EEIO) table. These frameworks provide information on energy, emissions, or other natural resources flows across sectors of an economy, and measure the quantities embodied within goods and services (Institute for Prospective Technological Studies, 2011).

This paper details the construction of India's hybrid Energy Input-Output Table 2015-16, which has information on the monetary, energy, and emission flows of the economy. Using this framework, linkages, and direct and indirect sectoral impacts are also computed, quantifying the embedded emissions in each sector. This model is then used to measure the effects of selected climate change associated policy actions on the economy.

Literature Review

The CSEP Technical Note titled "Energy Flows through the Production and Consumption Structure of India's Economy," presented the aggregation of the CSEP 131-sector India Input-Output Table (IOT) 2015–16 (Chadha, Saluja, & Sivamani, 2020) into a 22-sector hybrid Energy Input-Output Table (EIOT-1) (Chadha & Sivamani, 2021). The aggregated 22 sectors are aligned with India's *Energy Statistics* data (Ministry of Statistics and Programme Implementation, Government of India, 2017). The EIOT-1 includes five energy-related sectors: three primary sectors (coal and lignite, crude petroleum, and natural gas) and two secondary sectors (petroleum products and electricity).

This paper expands the EIOT-1 sectoral classification and constructs 12 other sectors following the *International Recommendations for Energy Statistics* (United Nations, 2018), by disaggregating some of the 22 sectors into a 34-sector hybrid Energy Input-Output Table (EIOT-2). Five of the twelve new sectors are energy-providing sectors. Four of them have been disaggregated from the five EIOT-1 energy-providing sectors: the petroleum products sector was disaggregated into combustible and

[1] The input-output information can be extended to account for the full circular flow of money and activities—across households, corporates, and governments—through a Social Accounting Matrix (SAM).

non-combustible sectors, and electricity was disaggregated into four subcategories of generation, viz., coal, other thermal (natural gas and petroleum products), large-scale hydro, and renewable energy sources including nuclear. The fifth new energy-providing sector introduced is biomass. The remaining seven sectors have been disaggregated due to their high energy intensities and emissions: aluminium, cement, food and tobacco, non-metallic mineral products, transport equipment, and wood products. In addition, the forestry and logging sector has been extracted from agriculture due to its environmental importance.

Some of the extant literature addresses energy and emissions issues in India within an input-output framework. For example, Parikh and Gokarn (1993) analyse CO2 emissions in the Indian economy and examine policies to reduce them. The analysis is based on a 60-sector 1983-84 India input-output table. Miller and Blair (2012) provide detailed chapters on these issues. Hikita et al. (2007) extended India's input-output tables for 1993–94 and 1998–99 for environmental analysis to estimate CO_2 emissions. Goldar et al. (2011) discuss prioritising India's green export portfolio using the environmental input-output approach. Pohit and Pal (2014) worked on an environmentally extended SAM (or EESAM) for India's climate change policy. Finally, Gupta et al. (2019) constructed the India input-output table for 2012-13 to discuss sustainable development in India along low-carbon pathways.

Energy Statistics of India

Energy-flows data has been sourced from MoSPI's *Energy Statistics 2017*, presenting India's Energy Commodity Balance (ECB) and Energy Balance (EB). These two tables show the sources and uses of various energy products within India's borders and details of the quantities of these products in physical units (ECB)[2] and energy terms (EB)[3]. The energy statistics have two major components for each energy commodity—total energy supply (TES) and total energy consumption (TEC). While these values should be equal, in theory they differ due to 'statistical differences'. For example, while the TES accounts for domestic production, imports, exports, and stock changes, the TEC accounts for intermediate industry and household consumption and energy transformation.

Methodology

Three broad steps were taken to construct the EIOT-2. First, the CSEP 131-sector IOT 2015-16 was aggregated to a 28-sector table based on the UN IRES (2018). Second, various new sectors were added by disaggregating some existing sectors: aluminium (from non-ferrous basic metals), four electricity generation sectors (from electricity), biomass (from forestry, agriculture, and food products), and petroleum products for combustion and non-combustion uses (from petroleum products). Third, the energy consumption of each energy sector was determined using the MoSPI's *Energy Statistics* and other relevant literature.

1. Choice of Sectors

The *Energy Statistics of India* follows the methodology described in the IRES (UN, 2018). However, some consuming sectors are not fully disaggregated, primarily in the industry sector. For example, the manufacture of transport equipment and food & tobacco products are aggregated with the 'non-specified industries' sector in the ECB and EB. In this paper, the EIOT-2 follows the sector list mentioned as the main categories of energy consumers by IRES. The concordance of sectors between the 131-sector IOT and the 34-sector EIOT-2 is given in Annex A.

[2] Coal and petroleum products are measured in thousand tonnes (kt), natural gas in million metric standard cubic metres (MMSCM), and electricity in gigawatt hours (GWh).

[3] Energy flows are measured in kilotonnes of oil equivalent (ktoe). These energy measurements have been computed using accepted conversion factors (net calorific values). 1 Toe = 41,868 mega joules; 1 ktoe = 1000 toe; 1 Mtoe = 1000 ktoe.

2. Construction of New Sectors

2A. Construction of the Aluminium Sector

Due to the energy-intensive nature of the aluminium industry, the sector has been separated from the parent non-ferrous basic metal (NFBM) sector, resulting in two sectors: the aluminium and the *other* non-ferrous basic metals sectors (ONFBM). The parent non-ferrous basic metal sector includes aluminium, copper, nickel, lead, zinc, and tin. The disaggregation was primarily done using the Annual Survey of Industries (ASI) data for 2015-16. Since most of the production of aluminium metal originates in the organised sector, the ASI data should suffice.[4]

The ASI provides data on the inputs, outputs, and GVA of both aluminium and ONFBM. This formed the basis of splitting the NFBM column in the I-O table. In addition, the ASI data have been used to compute the cost structures of the two sub-sectors.

In order to split the rows of aluminium and ONFBM, the products from the aluminium sector (such as unwrought aluminium, ingots, etc.) and the ONFBM sector were identified using the National Product Classification for Manufacturing Sectors (Ministry of Statistics and Programme Implementation, Government of India, 2015). The consumption of these identified products by manufacturing sectors was extracted from the ASI. This data was then used to split the row of non-ferrous basic metals. Two rules were followed to ensure the table remained balanced: first, the sector-wise column sum of the two new rows must give the original row; and two, the output of each new row must be the same as the outputs of the new columns constructed.

The ASI data does not cover the primary and service sectors. Therefore, the cost structure and intermediate consumption of these sectors were computed based on the proportions of output.

2B. Construction of the Electricity Generation Sectors

The electricity sector was disaggregated into the primary modes of electricity generation. The Central Electricity Authority of India provides data on electricity generation by mode – coal, diesel, gas, nuclear, large hydroelectric, and renewable energy sources (RES, which includes solar, wind, small hydroelectric, and biomass). Nuclear electricity generation has been merged with the RES sector due to a lack of data on the cost structure of the nuclear power generation sector. The EIOT-2 replaces the original electricity sector with coal, other thermal, large hydro, and RES.

The input cost structure and GVA were split based on data from the ASI. The outputs in monetary terms of each of the four new sectors were split, based on the electricity generated by each source. This comes with the assumption that the price of electricity is the same for each generation source; this was done as there was a lack of data on the costs (tariffs were available for some states and some sources of electricity generation, but no unified data were found for all-India electricity generation costs). For some inputs where data were not available, the parent electricity sector's cost structure was applied to all the sectors. The same process was followed to compute each sector's GVA and NITs.

Once the intermediate costs and GVA were computed, the table had to be balanced such that the row-wise sum of the new four columns would be the same as the original column. In the case of the other thermal electricity generation sector, the input costs were too high compared to the sector's output, so the values in the column were proportionally reduced, and the reductants were adjusted across the remaining three sectors. Additionally, the net indirect tax value of the hydroelectric sector was reduced to be in line with that of the RES sector. The adjusted NITs were balanced proportionally with the other electricity sectors.

[4] The ASI data provides information on the organised component of the manufacturing sectors.

2C. Construction of the Biomass Sector

Biomass is defined as plant or animal matter used as fuel to produce electricity or heat. In this study, a separate biomass sector has been constructed, which would account for a large portion of total primary energy consumption in the form of heat from the burning of firewood, crop residue, cow dung, and gobar gas – Census 2011 reported that 65.9% of households depend on solid biomass as a primary fuel for cooking in India (Press Information Bureau, 2018). Biomass is also consumed in the renewable electricity sector for bio-power generation (Ministry of New and Renewable Energy, Government of India, 2022).

The biomass sector was constructed by extracting specific proportions from three sectors: agriculture, forestry and logging, and food and tobacco. Certain products of these sectors are used as biomass, and these sectors were split to extract that biomass use component. The row structure of the biomass sector was derived from the row structures of the parent sectors. Informed judgment was used to extract biomass shares from each parent sector.

The forestry and logging sector consists of three sub-sectors in the Supply and Use framework (Ministry of Statistics and Programme Implementation, Government of India, 2016): industrial wood, firewood, and other forestry products. Of these three sub-sectors, it was assumed that all the firewood would be used as biomass. The firewood consumption data was extracted from the forestry and logging sector using information from the Use Table.

The biomass components of the agriculture and food and tobacco sectors are used only by one intermediate sector – renewable electricity generation (RES). The RES and nuclear electricity sector consumes agriculture and food-product waste for biomass power generation. Some of the biomass from agriculture is also consumed by households as cow dung and gobar gas for cooking and heating. The NSS 68th Round Survey on Household Consumption of Various Goods and Services in India 2011-12 (Ministry of Statistics and Programme Implementation, Government of India, 2014) was used to locate the consumption pattern of the two commodities. These figures were then adjusted to reflect the household consumption pattern of 2015-16, where LPG would be more commonly used than traditional fuels.

One biomass product not included in this study is crop residue, which is burnt for energy by some households. However, data was not found on the purchase of crop residue, nor was it mentioned in the Input-Output Table documentation. Further work may extend the biomass sector to include crop residue.

By constructing the row structure of biomass, the parent sectors were left with revised row structures with reduced total outputs. The respective parent columns were proportionally adjusted such that the new columns had the same output as the new row. The differences between the old and new columns of the three parent sectors were allocated to the new biomass sector column (i.e., this became the cost structure of the biomass sector), which ensured the input-output table remained balanced.

2D. Splitting of the Petroleum Products Sector

In both the *Energy Statistics* and IOT, the petroleum products sector refers to various products derived from crude petroleum, including natural gas. In this study, the petroleum products sector was split based on whether the final use of the product was combustion (e.g., diesel, motor spirits, aviation fuel) or non-combustion (e.g., lubricants, bitumen, waxes). Such a split helps to analyse emissions, as it is mainly the combustion use of petroleum products that has greenhouse gas emissions.

To split the energy components of petroleum products between combustion and non-combustion, the consumption of each type of petroleum product and its end-use was considered. Data were taken on the quantities consumed of each fuel (Petroleum Planning & Analysis Cell, Government

of India, 2021) and the net calorific values (NCVs) (Intergovernmental Panel on Climate Change (IPCC), 2006). For most fuel types, the split between energy and non-energy use was clear, such as motor spirit for combustion in engines and lubricants used for machinery. However, some fuels have dual uses, e.g., naphtha and diesel. Table 1 shows the split between the combustion and non-combustion for each petroleum product.

Table 1: Split in the Consumption of Petroleum Products Between Combustion and Non-Combustion 2015-16

Fuel	Total Consumption		Combustion		Non-Combustion	
	kt	ktoe	kt	ktoe	kt	ktoe
LPG	19,623	22,603	19,623	22,603	0	0
Motor spirit	21,847	23,569	21,847	23,569	0	0
Naphtha	13,271	14,382	62	67	13,209	14,314
Superior kerosene oil (SKO)	6,826	7,281	6,826	7,281	0	0
ATF	6,262	6,756	6,262	6,756	0	0
HSDO	74,647	78,167	70,945	74,290	3,702	3,877
LDO	407	426	407	426	0	0
Furnace oil	6,482	6,377	6,482	6,377	0	0
LSHS	150	148	150	148	0	0
Lubes/greases	3,571	3,496	0	0	3,571	3,496
Bitumen	5,938	5,813	0	0	5,938	5,813
Petroleum coke	19,297	15,273	15,438	12,218	3,859	3,055
Waxes	173	169	0	0	173	169
Others	6,179	6,049	5,150	5,042	1,029	1,008
Total	**1,84,673**	**1,90,509**	**1,53,191**	**1,58,777**	**31,482**	**31,732**

Note: Quantities are measured in kilotonnes (kt) and kilotonnes oil equivalent (ktoe).

Sources: Petroleum Planning & Analysis Cell, Government of India (2021), Petroleum Planning & Analysis Cell, Government of India (2020), Press Information Bureau, Government of India (2014), National Association of Manufacturers (2014), authors' calculations.

The share of petroleum products used for combustion purposes has been computed to be 83.3% in ktoe terms and 83.0% in kt terms. The International Energy Alliance's (IEA) *Key World Energy Statistics* (2021) reports that in 2016, approximately 83.8% of global oil consumption was used in combustion applications, which matches with the figure found in India's *Energy Statistics*.

The petroleum products sector was also split in monetary terms between combustion and non-combustion uses. The Centre for Monitoring Indian Economy's ProwessIQ database was used to find the typical shares of combustion versus non-combustion petroleum products used by various industrial sectors. However, due to a lack of data, some assumptions had to be made for certain sectors. For sectors in which combustion dominated (such as households and agriculture), a split of 95% in favour of combustion use was taken. On the other hand, in sectors where non-combustion use was the majority (as in various manufacturing sectors), a split of 5% in favour of combustion use was taken. The sector-wise combustion versus non-combustion shares are given in Annex B.

3. Sectoral Energy Consumption

3A. Computation of Total Domestic Energy Consumption

Total domestic consumption of each energy commodity was taken, primarily from the *Energy Statistics*. 'Total domestic consumption' refers to the total energy consumed by intermediate industries, households, and government. The hybrid EIOT-2 was constructed by allocating total domestic energy consumption – both in physical units and kilotonnes of oil equivalent (ktoe) – in the equivalent IOT monetary domestic consumption proportions. However, due to the variety of coal products consumed (coking coal and non-coking coal), the energy and tonnage of coal consumption were computed separately in alignment with the types of coal used by each sector.

The figures presented in *Energy Statistics* were also verified and adjusted where necessary, using data from the parent sources (*Coal Directory of India, Indian Petroleum and Natural Gas Statistics*, and *Central Electricity Authority General Review*).

3B. Adjustment to Petroleum Products and Natural Gas

India's input-output framework considers the petroleum products sector as the distributor of natural gas products. Consequently, natural gas in the IOT is primarily consumed by the petroleum products sector (for further resale as natural gas products, such as CNG and LNG) and the chemical products sector (for non-energy uses). Due to this, the energy movement of natural gas to petroleum products had to be further included in the total consumption of petroleum products (in both the combustible and non-combustible sectors). Likewise, the physical quantity movement was also adjusted by taking a typical density of natural gas (0.717 kg/m^3 (McGill)) and adding this value to the total consumption of petroleum products.

3C. Computing the Energy of Biomass Consumption

An earlier section described the process of constructing the monetary flows of the biomass sector by considering the consumption of biomass products by industries and households. This study extended this to identify the energy quantities embedded in the consumption of the reported biomass products. Four main products make up biomass in this study: firewood, food waste, crop residue, and animal waste. While data on crop residue consumption is known for intermediate industry consumption, data is not available on household consumption. Therefore, using representative prices and NCVs for each biomass product (shown in Table 2), the total energy consumption of biomass by sector was computed.

Table 2: Biomass Product Prices (2015-16) and NCV

Biomass Product	Price (INR/kg)	NCV (GJ/ton)
Firewood	2.40	21.6
Food waste	2.00	16.0
Crop residue	2.00	16.0
Animal waste	1.50	22.3

Sources: Kumar, Patel, Kumar, & Bhoi (2009), San, Ly, & Chek (2013), Express Web Desk (2021), Times News Network (2020), authors' calculations.

The price of fuelwood in 2015-16 was computed by taking the current prices in 2022 (Connect 2 India, 2022) and adjusting for inflation and trade and transport margins (Office of the Economic Adviser, 2022).

3D. Sectoral Coal Tonnage and Energy Consumption

As the price and energy content of coal varies between the types of coal consumed – i.e., coking coal and non-coking coal – the consumption of coal was computed at the sector level, rather than distributing total consumption in proportion to the IOT monetary values. First, price information for each coal type was taken from the *Coal Directory of India 2015-16* to calculate coal quantities consumed by each sector. Next, the NCV for each coal type was taken from India's "Third Biennial Update Report to the UNFCCC (BUR-3)" (Ministry of Environment, Forest and Climate Change, Government of India, 2021) to calculate the sectoral coal energy consumed. While performing these computations, it was ensured that the total quantity values of coal consumption matched the data given in the ECB. However, the NCVs of BUR-3 do not match the implied NCVs from the EB. The EB reports an average NCV for coal and lignite of 27.3 GJ/t, compared to the 18.13 GJ/t average given by BUR-3. The difference may be due to the EB using IEA recommended NCVs, which are higher than the NCVs of domestic coal. This study used the NCVs reported in BUR-3 to measure coal and lignite energy flows.

3E. Captive Electricity Generation

Various industries have set up their electricity generation facilities to meet their energy needs, which are known as captive electricity generation. The input-output table does not account for the production and consumption of an industry's captive electricity generation, as the commodity is not traded in the economy. However, the industry sells some excess captive electricity back to the national grid, and this information is reported in the IOT[5]. Therefore, the excess electricity sold must also be accounted for in the EIOT.

Table 3: Electricity Flows in the Economy, 2015-16

Electricity Flow	Quantity (GWh)
Generation by utilities	11,67,584
Imports – exports	94
Captive electricity sold to grid	15,853
Auxiliary use by utilities	79,302
Transformation, transmission, and distribution losses	2,40,864
Sold to consumers	8,63,364

Note: Auxiliary use refers to electricity consumed within the electricity sector itself.

Source: Central Electricity Authority, Government of India (2017)

Table 3 shows the flow of electricity in the economy. Electricity losses occur during the transmission of electricity to intermediate sectors and final consumers. In EIOT-2, these losses have been allocated to the users, as the excess electricity had to be produced in order to reach them.

3F. Energy Consumption and Prices

Total domestic energy consumption for each energy sector is given in Tables 4 and 5 in monetary, energy, and quantity terms, split between primary and secondary energy sources in the economy. Primary energy sources are naturally available, such as coal, crude petroleum, and wind. Secondary energy sources convert primary energy sources into other forms of energy, such as coal electricity, petroleum products, and wind electricity.

[5] The commodity x commodity CSEP India IOT 2015-16 follows the industry technology assumption: the sale of captively generated electricity is allocated to the electricity sector using the cost structure of the sector that generated the electricity.

Table 4 shows the consumption of primary energy sources: biomass, coal and lignite, crude petroleum and natural gas. Table 5 shows the consumption of secondary energy sources: petroleum products combustible, petroleum products non-combustible, coal electricity, other thermal electricity, large hydro-electricity, and RES and nuclear electricity.

Table 4: Total Domestic Consumption of Energy by Primary Source

Energy Source	Value (INR lakh)	Energy (ktoe)	Quantity
Biomass	86,42,661	2,12,536	4,18,735 kt
Coal and lignite	2,00,57,983	3,83,464	8,74,600 kt
Crude petroleum	5,75,38,562	2,32,865	2,32,865 kt
Natural gas	50,70,230	44,014	47,849 MMSCM

Source: Ministry of Statistics and Programme Implementation, Government of India (2017), Chadha, Saluja, & Sivamani (2020), authors' calculations

Table 5: Total Domestic Consumption of Energy by Secondary Source

Energy Source	Value (INR lakh)	Energy (ktoe)	Quantity
Petroleum products combustible	8,21,51,496	1,88,799	1,76,592 kt
Petroleum products non-combustible	2,00,72,728	39,067	37,200 kt
Coal electricity	5,19,02,791	78,037	9,07,576 GWh
Other thermal Electricity	28,46,160	4,155	48,325 GWh
Hydro electricity	71,92,061	10,578	1,23,025 GWh
RES & nuclear	61,90,265	8,994	1,04,605 GWh

Source: Ministry of Statistics and Programme Implementation, Government of India (2017), Chadha, Saluja, & Sivamani (2020), authors' calculations

The average basic price of each energy source has been computed using the data in Tables 4 and 5, and presented in Table 6. The prices of all energy sectors matched with the basic reference prices barring that of petroleum products. The EIO shows the prices of petroleum products to be INR 40.92/litre, while the basic reference price given by the IPNGS is INR 24.00/litre. The petroleum products information reported in the Input-Output Table seems to include some taxes and trade & transport margins.

Table 6: Prices of Energy Commodities

Energy Source	Price from EIO		Reference Price 2015-16
	(INR lakh)	INR	INR
Biomass	21 / kt	2.10 / kg	-
Coal and lignite	23 / kt	2300 / T	2100 / T *
Crude petroleum	247 / kt	24,700 / T	23,799 / T **
Natural gas	106 / MMSCM	10.60 / m^3	10.04 / m^3 **
Petroleum products combustible	465 / kt	40.92 / litre	24.00 / litre **
Petroleum products non-combustible	540 / kt	54 / kg	Multiple
Coal electricity	57 / GWh	5.70 / KWh	5.21 / KWh ***
Other thermal electricity	59 / GWh	5.90 / KWh	
Hydro electricity	58 / GWh	5.80 / KWh	
RES & nuclear	59 / GWh	5.90 / KWh	

*Sources: * Ministry of Coal, Government of India (2017), ** Ministry of Petroleum and Natural Gas, Government of India (2021), *** Jaganmohan (2020), Chadha, Saluja, & Sivamani (2020), authors' calculations*

Computing the Sectoral Energy Requirements in the Economy

The details of computing the energy requirements in the economy are discussed in full in CSEP Technical Note-1. A hybrid unit approach is used by taking the constructed hybrid EIO table to compute the Leontief inverse matrix in energy unit terms (i.e., ktoe), which provides the coefficients indicating each sector's direct and indirect energy requirements per rupee output.

For the computation of a monetary unit the Leontief inverse matrix, matrices, and vectors are extracted from an input-output table. **X** is the vector of total outputs, and **F** is the final demand vector. **Zij** is the square matrix of intermediate monetary flows. The direct input coefficients matrix is computed by dividing the monetary value inputs by the total monetary output ($\mathbf{A} = \frac{z_{ij}}{x_j}$). To compute the total requirements matrix, i.e., the direct and indirect inputs required to produce one additional unit of a sector, the Leontief inverse, **L**, is taken:

$$\mathbf{L} = (\mathbf{I}-\mathbf{A})^{-1}$$

The Leontief inverse matrix consists of the Leontief coefficients for each sector. There is a similar setup in the hybrid-units approach, where energy flows are given in ktoes and non-energy flows in rupee terms. In this EIOT, there are 10 energy sectors, and 24 non-energy sectors for a total of 34 sectors in the hybrid table. $\mathbf{X}^*$ is the vector of total hybrid outputs, and $\mathbf{F}^*$ is the hybrid final demand vector (both are 34 x 1 column vectors, representing the 34 intermediate sectors). $\mathbf{Z}^*$ is the 34 x 34 matrix of hybrid intermediate flows in both ktoe and rupee terms. $\mathbf{A}^*$ is computed by matrix multiplication: $\mathbf{A}^* = \mathbf{Z}^* \times (\hat{\mathbf{X}}^*)^{-1}$. Finally, the hybrid Leontief inverse, $\mathbf{L}^*$, is found, to compute the total energy requirements matrix, in ktoe per rupee output terms:

$$\mathbf{L}^* = (\mathbf{I}-\mathbf{A}^*)^{-1}$$

Using the L^* matrix, it is possible to compare the direct energy requirements in ktoes (i.e., as reported by the various data sources) against the total energy requirements, which would include the indirect energy requirements as well. These would be energy requirements per unit of a sector's final demand (the sum of household consumption, government consumption, change in stocks, gross capital formation, and net exports).

To compare the direct and total energy requirements per unit of sectoral final demand, the new sectoral output is computed for an economy with only one unit of final demand in the sector under consideration. The consumption of the energy commodity by the considered sector would give the direct requirements, and the consumption of the energy commodity by all sectors would give the total requirements.

The results are shown in Annex C. The computed ktoe values from the hybrid Leontief inverse matrix are converted into their original quantity terms using the conversion factors derived from Table 4 and Table **5** (i.e., from ktoe values to energy units). Within Annex C, Table 13 shows the direct energy requirements of each of the 34 sectors, Table 14 shows their indirect energy requirements, and Table 15 shows the total energy requirements (the sum of the direct and indirect requirements), all in terms of a unit increase (one lakh rupees in this case) in the respective sector's final demand.

Figure 1 to Figure **6** compare the direct to total energy requirements of primary energy, coal, crude petroleum, natural gas, combustible petroleum products, and total electricity of some of the most energy-intensive sectors, normalised by a unit increase in that sector's final demand. As given in Table 4, the primary energy sectors are biomass, coal and lignite, crude petroleum, and natural gas. However, it must be noted that information on the primary energy supplied to the economy from solar, wind, water and nuclear sources are not included in this set, though these quantities would be smaller than the other primary energy sources accounted for.

Figure 1 shows some of the largest primary energy consumers in the economy, split between direct and indirect usage. The coal electricity sector is the largest consumer of primary energy per rupee of final demand. In addition, industries such as cement, aluminium, iron, and steel are also primary energy-intensive.

These figures show that for a one lakh rupees increase in the final demand of a sector, while there will be direct energy requirements, the indirect energy requirements needed from the economy may be much more. The detailed results are shown in Annex C.

Figure 1: Sectoral Requirements of Direct and Indirect Primary Energy (Most Intensive Sectors)

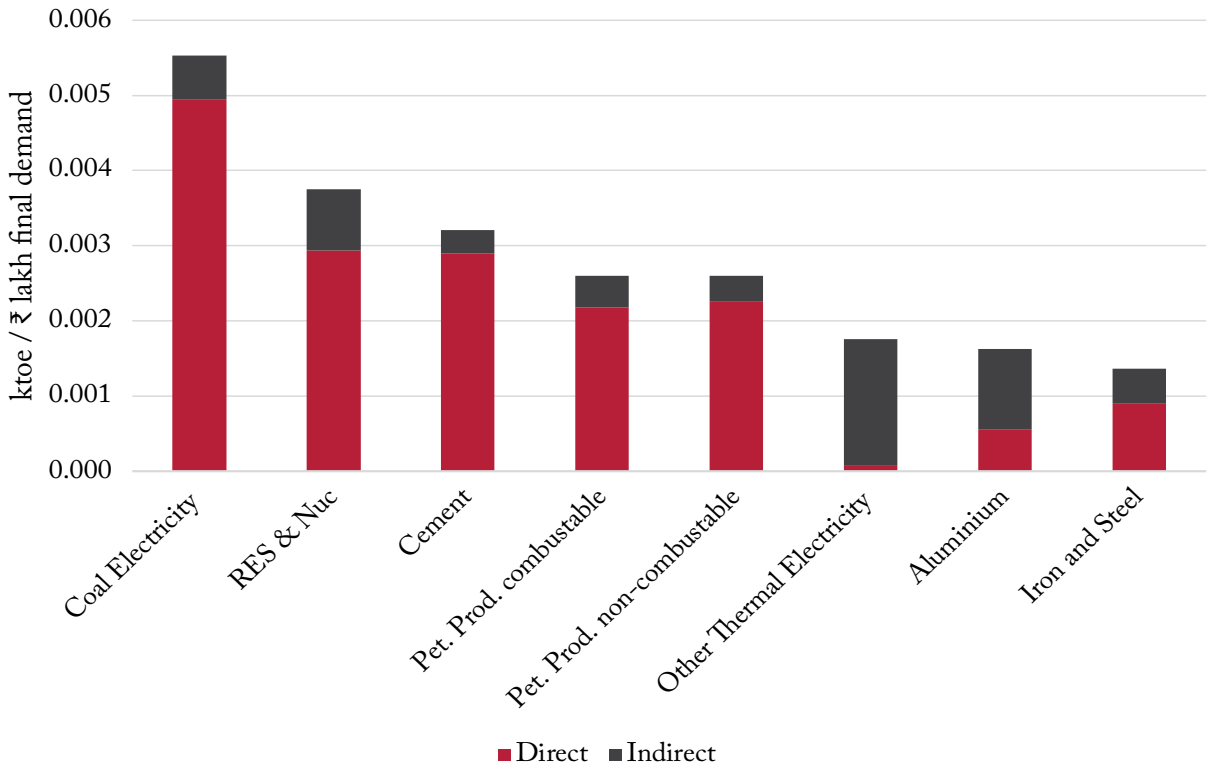


Figure 2: Sectoral Requirements of Direct and Indirect Coal Energy (Most Intensive Sectors)

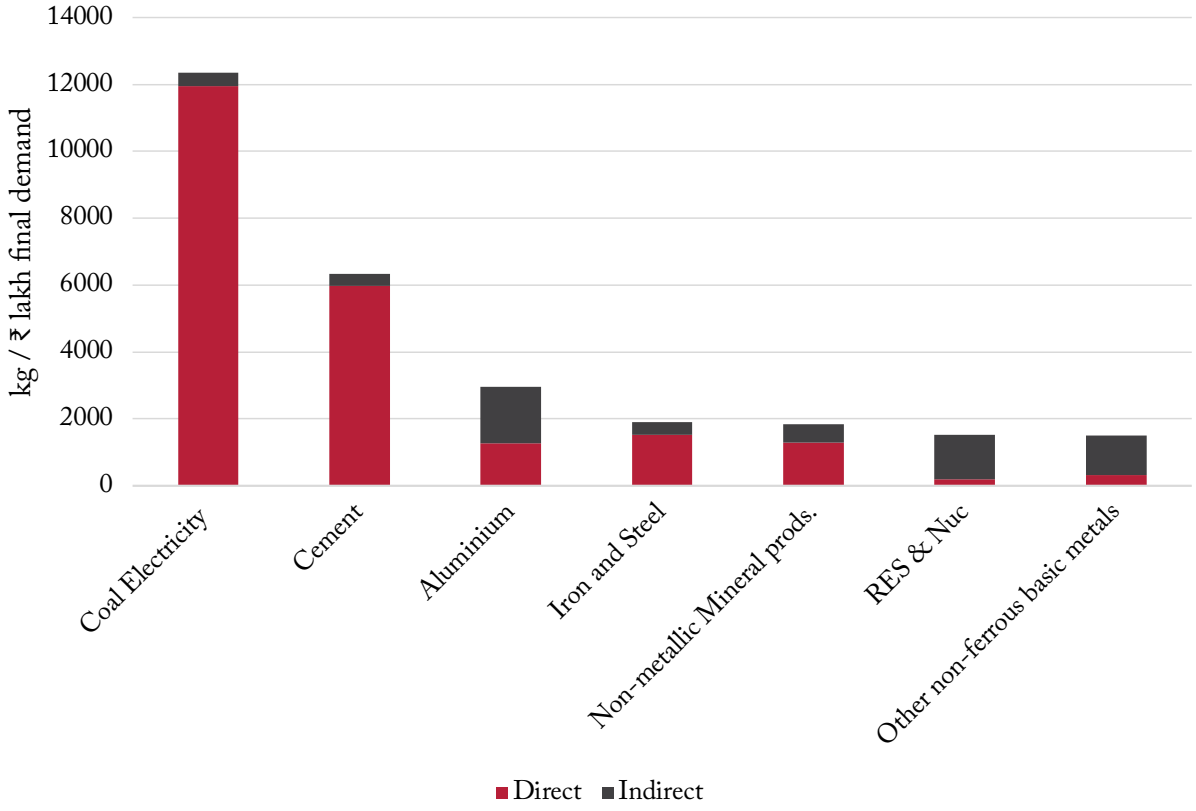


Figure 3: Sectoral Requirements of Direct and Indirect Crude Petroleum Energy (Most Intensive Sectors)

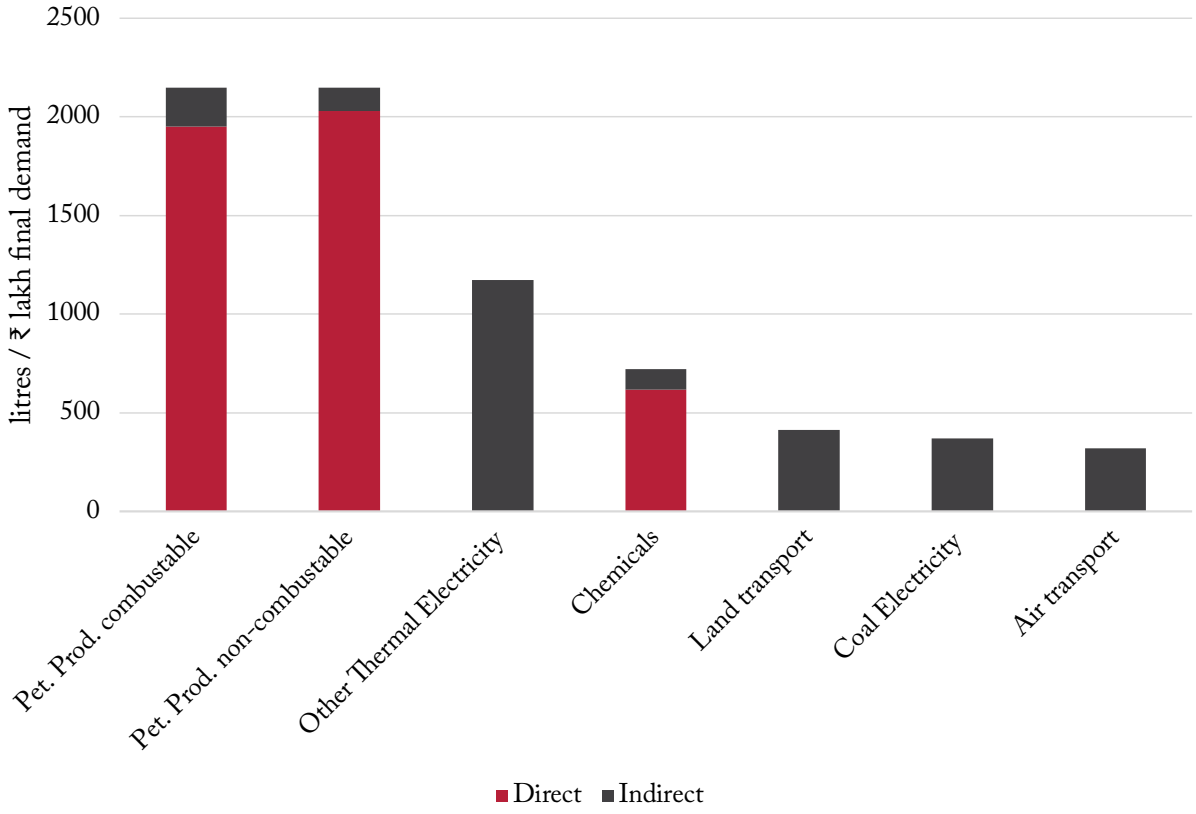


Figure 4: Sectoral Requirements of Direct and Indirect Natural Gas Energy (Most Intensive Sectors)

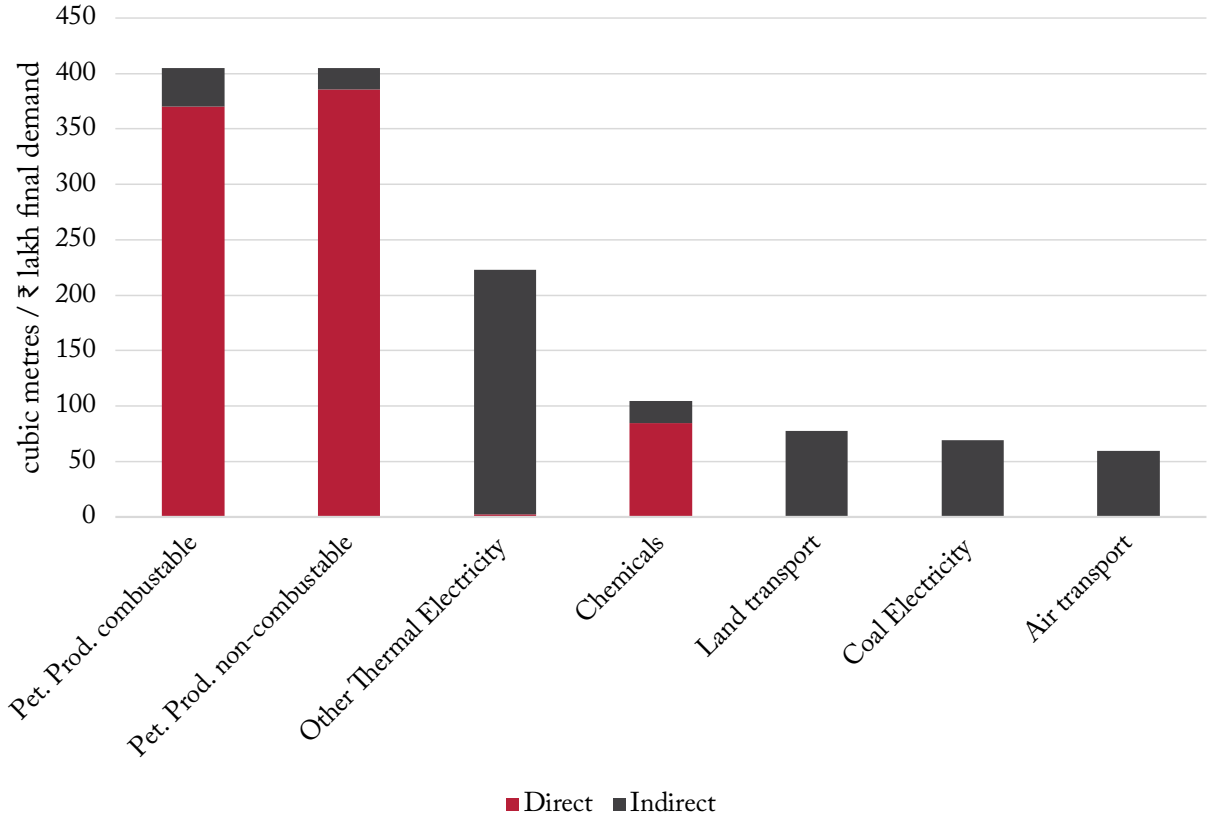


Figure 5: Sectoral Requirements of Direct and Indirect Combustible Petroleum Products Energy (Most Intensive Sectors)

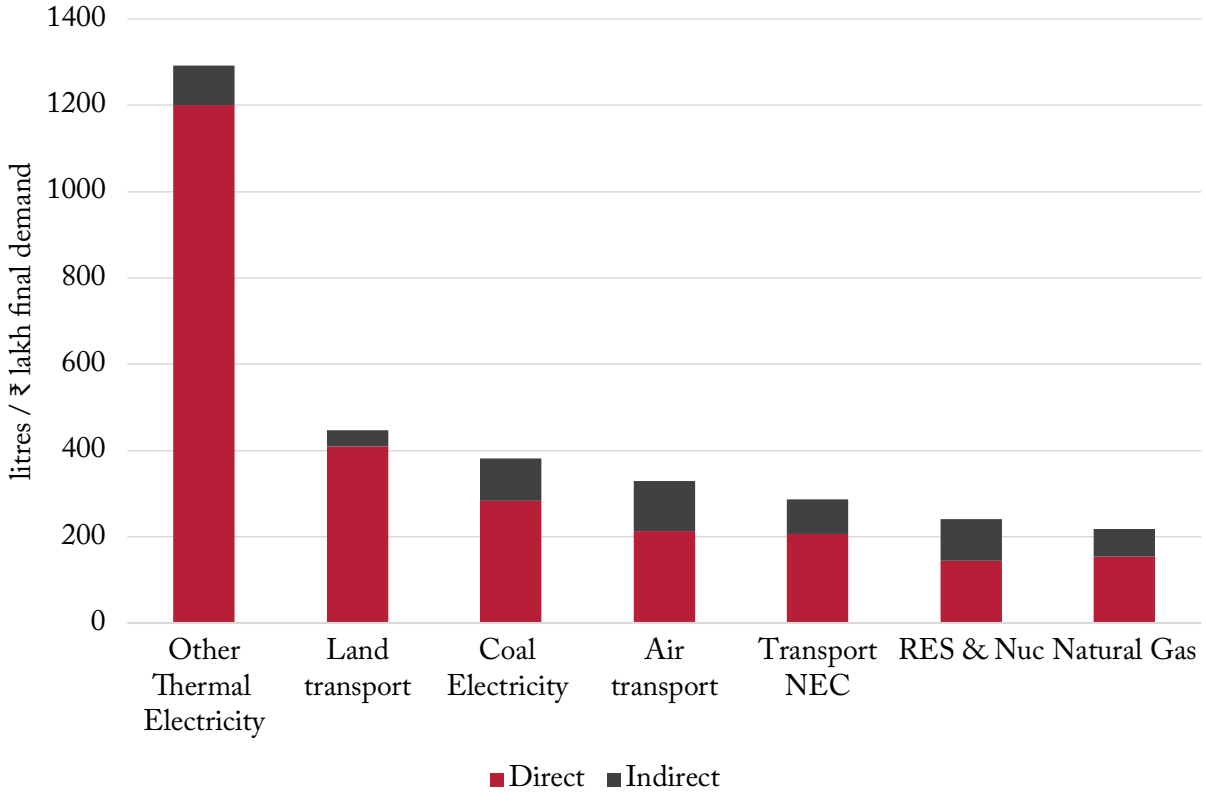
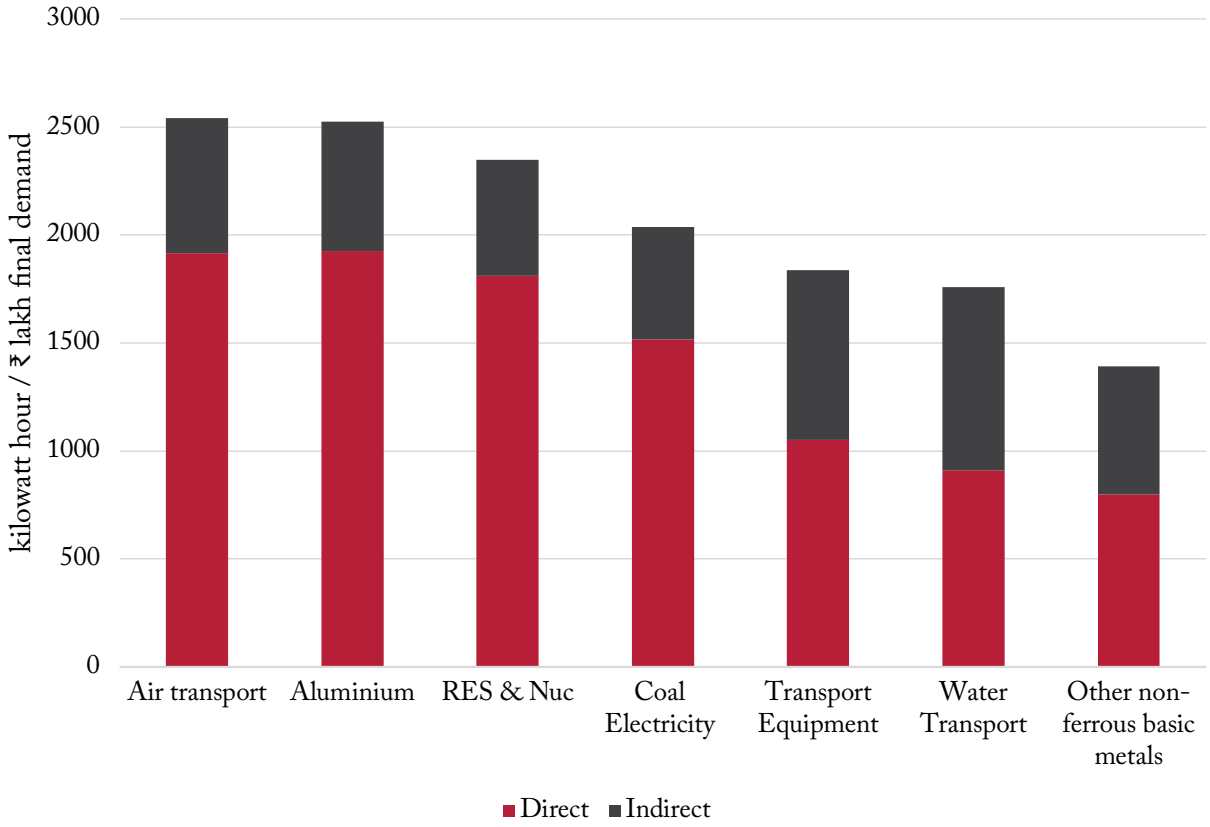


Figure 6: Sectoral Requirements of Direct and Indirect Total Electricity Energy (Most Intensive Sectors)



Computing Sectoral Linkages: Monetary and Energy Units

The EIOT-2 provides information on interindustry use and dependence on sectors and energy. This paper computes monetary forward and backward linkages for the 34 sectors of production. The concept of economic linkages was first introduced by Hirschman (1958). Backward linkages measure the impact of an increase in the output of a downstream industry on demand for commodities from an upstream industry, while forward linkages measure the impact of an increase in the output of an upstream industry on the production of commodities in downstream industries. Backward linkages refer to the demand-pull concept, and forward linkages to the supply-push concept developed by Rasmussen and Hirschman (Commonwealth Scientific and Industrial Research Organisation, 2007).

The Hirschman–Rasmussen key sector identification indices (Rasmussen, 1956) (Hirschman, 1958) were used to compute the backward and forward linkages (also known as the power of dispersion and sensitivity of dispersion indices) as follows (National Council for Applied Economic Research, 2009):

Equation 1 Backward and Forward Linkages

$$BL_j = \frac{\frac{1}{n}\sum_i b_{ij}}{\frac{1}{n^2}\sum_{ij} b_{ij}} \qquad FL_j = \frac{\frac{1}{n}\sum_j b_{ij}}{\frac{1}{n^2}\sum_{ij} b_{ij}}$$

where BL and FL refer to backward and forward linkages, respectively, based on the Leontief inverse coefficients (as computed in an earlier section of this paper), and n refers to the number of sectors (34 in this paper).

This paper introduces the concept of energy linkages (EL), which are computed from the hybrid Leontief inverse matrix. In comparison with the monetary linkages, which measure the impact of

an increase in output of a downstream industry on energy demand, energy linkages seek to measure the impact of an increase in energy supply on downstream industries. The computation of ELs is similar to that of BLs, with the exception that the diagonal entries of the energy sectors (i.e., energy self-inputs) are reduced by one unit each.

Table 7 presents the results of the sectoral monetary forward and backward linkages and the sectoral energy linkages for each of the 34 sectors under four categories:

1. KS: key sectors, where BL > 1 & FL > 1
2. BW: strong backward linkages, where BL > 1 & FL < 1
3. FW: strong forward linkages, where BL < 1 & FL > 1
4. NS: non-key sectors, where BL < 1 & FL < 1

Further, each of the four categories is split between 'energy-intensive' (E) and 'not energy- intensive' (NE), where the EL > 1 or EL < 1, respectively.

Table 7: Sectoral Forward and Backward Monetary and Energy Linkages

FW-NE	**FW-E**
Commerce and public services Crude petroleum Agriculture Land transport Coal and lignite	

KS-NE	**KS-E**
Industry NEC Chemicals Machinery	Iron and steel Combustible petroleum products Coal electricity

Stronger forward linkages →

← Weaker backward linkages

Stronger backward linkages →

NS-NE	**NS-E**
Mining Railway transport Wood and wood products except furniture Forestry and logging Natural gas Biomass (energy) Transport NEC Hydro electricity Fishing & aquaculture	

BW-NE	**BW-E**
Other non-ferrous basic metals Transport equipment Water transport Food and tobacco Paper, pulp, and print Textiles and leather Non-metallic mineral products Construction and construction services	Other thermal electricity Aluminium Air transport Petroleum products non-combustible Cement RES & nuclear electricity

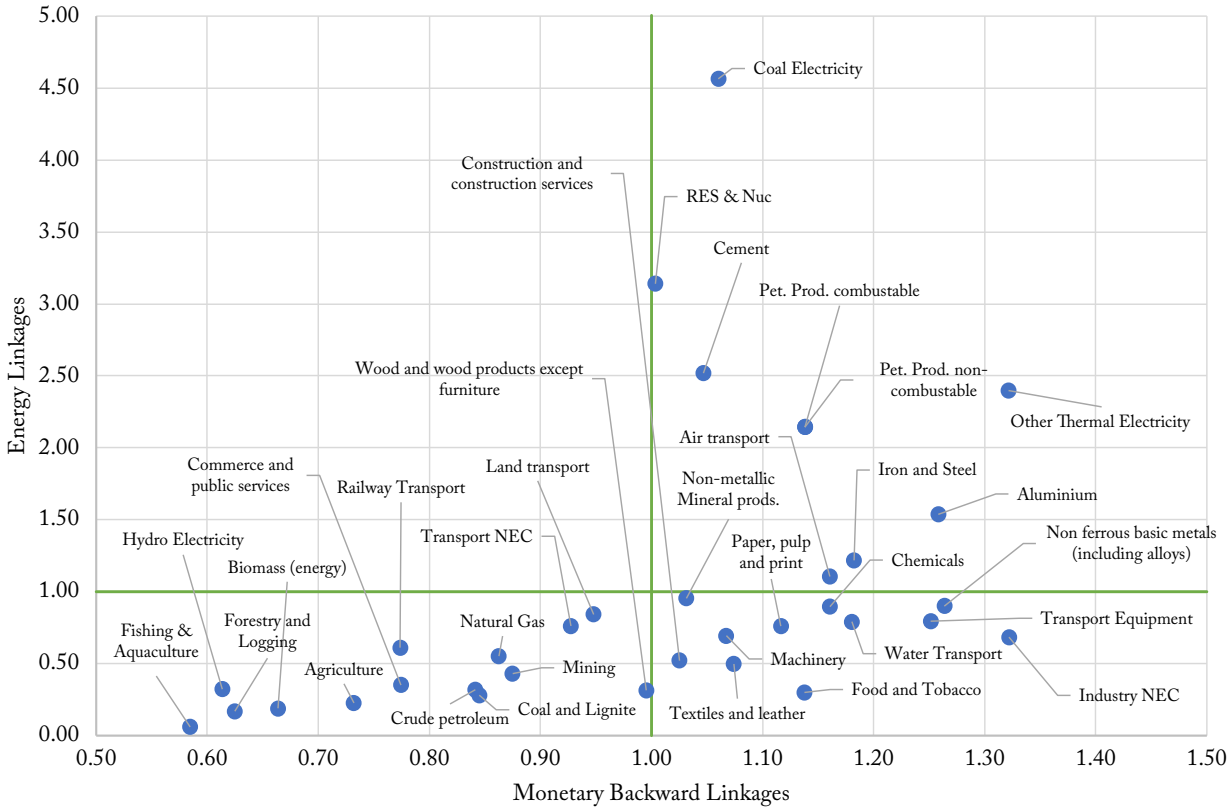
←Weaker forward linkages

Table 8 and Figure 7 compare each sector's energy backward linkage against the sector's monetary backward linkage.

Table 8: Energy versus Monetary Backward Linkages by Sector

	Stronger energy BL →	Other thermal electricity Aluminium Iron and steel Air transport Pet. prod. combustible Pet. prod. non-combustible Coal electricity Cement RES & nuclear
← Weaker monetary BL		Stronger monetary BL →
Wood and wood products Land transport Transport NEC Mining Natural gas Coal and lignite Crude petroleum Commerce and public services Railway transport Agriculture Biomass Forestry and logging Hydro electricity Fishing & aquaculture	←Weaker energy BL	Industry NEC Other non-ferrous basic metals Transport equipment Water transport Chemicals Food and tobacco Paper, pulp and print Textiles and leather Machinery Non-metallic mineral products Construction and construction services

Figure 7: Energy versus Monetary Backward Linkages by Sector



These yield some important policy indications on which are the target sectors, having large backward and forward linkages, for emissions reductions. For example, iron & steel and coal electricity are the key sectors in both monetary and energy terms. Furthermore, most transport sectors (excluding water transport) are non-key sectors in both monetary and energy terms. Finally, sectors like chemicals and machinery are key in monetary terms but cause a relatively low drag on energy use.

Estimating Greenhouse Gas Emissions from Energy Burning

This paper attempts to use energy consumption information from the EIOT-2 to estimate the direct sectoral greenhouse gas (GHG) emissions from the burning of fuels. Three sectors of the EIOT-2 are combusted: biomass, coal and lignite, and combustible petroleum products. Products of the other energy sectors (crude petroleum, natural gas, electricity) are used for transformation and not burning. To compute the emissions from the burning of each fuel, emission factors were taken from BUR-3 and the "IPCC Guidelines for National Greenhouse Gas Inventories", and biomass emission factors from the U.S. Environmental Protection Agency (United States Environmental Protection Agency, 2014). The emission factor of a fuel relates to the quantity of GHG emitted per unit of energy available in the fuel and is given for three key gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These values differ based on the fuel type and the fuel-using sector (e.g., coal burning for electricity generation will have a different emission factor from coal burnt in steel manufacturing).

To find the total emissions from the three key GHGs, the 100-year global warming potential (GWP) of each was taken: 1 for CO_2, 21 for CH_4, and 310 for N_2O (BUR-2). The weighted sum gives the CO_2 equivalent emissions (CO_{2e}). The energy consumptions of the three combustible fuels were multiplied by the respective emission factors to compute the direct sectoral emissions. The estimate from the EIOT-2 computations was compared with various GHG inventory reports for India, as given in Table 9. The estimate from this paper is lower than the estimates from other reports: it is approximately 7% lower than the emissions reported by BUR-3. This may be due to the differing net calorific values or emission factors used. More work may be done to adjust the computations accordingly.

Table 9: Estimates of Total Energy Greenhouse Gas Emissions for India

Name of Report	Year of Estimate	GHG Emissions from Energy Burning (tonnes CO2e)
CSEP EIOT-2 (this paper)	2015-16	1,98,37,95,342
Second Biennial Update Report	2014	1,90,97,65,740
Third Biennial Update Report	2016	2,12,94,28,480
Global Carbon Project	2016	2,29,75,00,000
IEA Greenhouse Gas Emissions from Energy	2016	2,10,00,00,000

Sources: Ministry of Environment, Forest and Climate Change, Government of India (2018), Ministry of Environment, Forest and Climate Change, Government of India (2021), Global Carbon Project (2022), International Energy Alliance (2021)

Using the hybrid GHG emissions data, a similar exercise was repeated as in the previous section to construct the hybrid Leontief inverse matrix and compute the sectoral indirect and total (direct + indirect) emissions normalised by the sector's final demand. Figure 8 and Figure 9 show the sectoral GHG emissions normalised by final demand in direct and total terms. For example, the direct emissions caused by a given increase in the final demand for the aluminium sector would reflect just 43% of the total emissions in the economy to meet this additional final demand.

Figure 8: Sectoral Direct and Indirect Emissions from Coal (Most Energy Intensive Sectors)

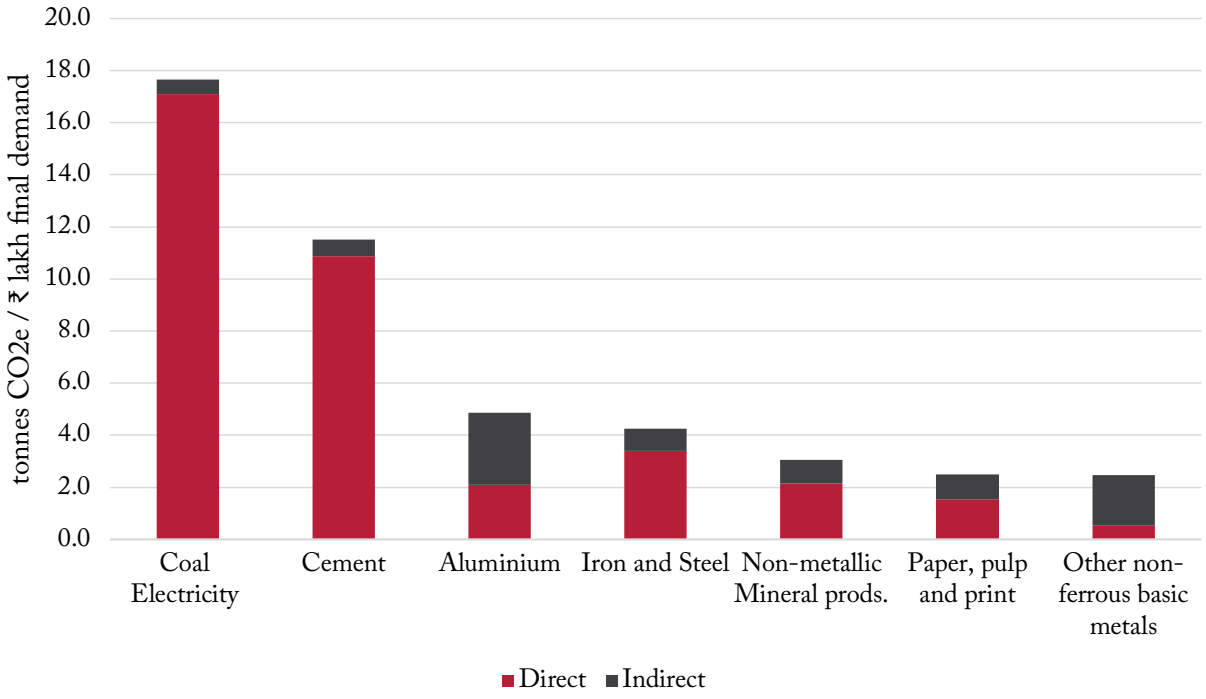
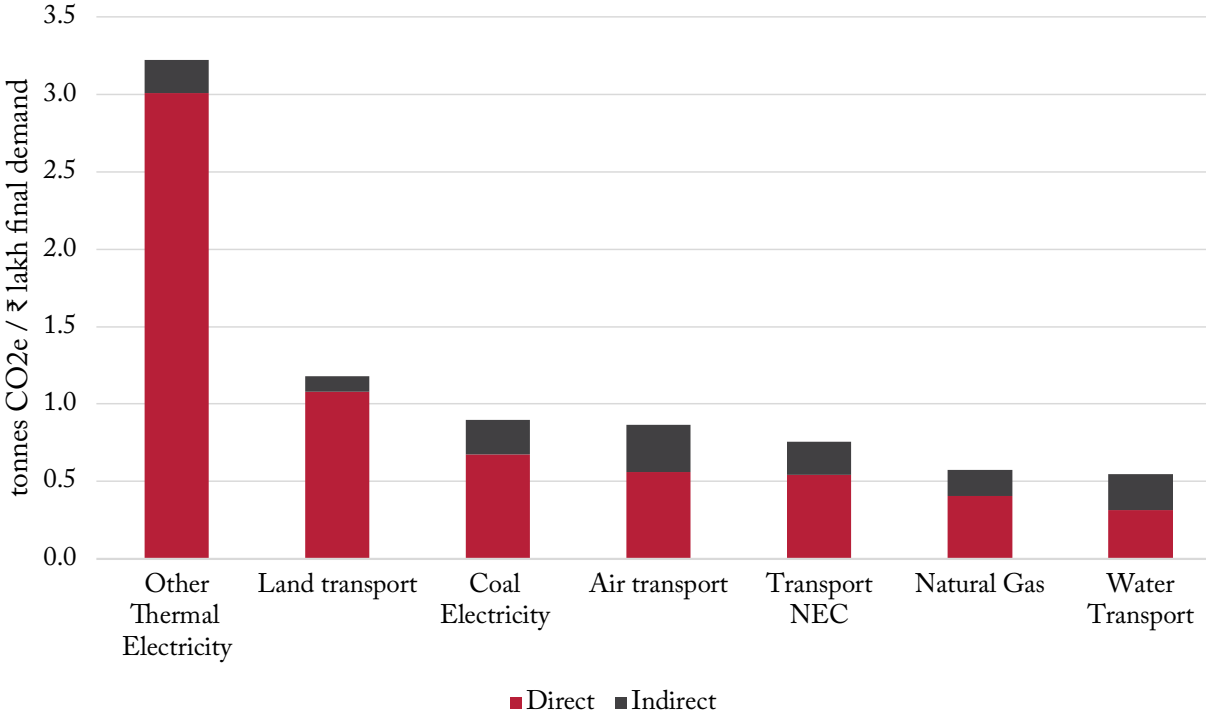


Figure 9: Sectoral Direct and Indirect Emissions from Petroleum Products (Most Energy Intensive Sectors)



There are some sectors in which the indirect emissions far exceed the direct emissions. These include transport equipment manufacturing and construction. Sectors in which electricity forms the major energy consumption tend to have large indirect emissions compared to direct, due to the high emission-intensity in the coal electricity generation sector. The services sector is an example, where the direct emissions-intensity is only 27% of the total emissions-intensity.

The sectoral CO_{2e} emissions normalised by the respective sectoral final demand from each of the three energy sources are given in Annex D: Table 16 shows the direct emissions, Table 17 the indirect emissions, and Table 18 the total emissions. The direct emissions to total emissions ratio can be computed from these results. For example, the commerce sector, which is the second-largest emitter in absolute terms, would emit approximately 3.8 times as much in total emission terms as it would emit directly due to an increase in the sector's final demand (i.e., the indirect emissions are 2.8 times greater than direct emissions).

The textiles and leather sector is similar to the commerce sector, with indirect emissions being 1.9 times the direct emissions; the machinery sector's indirect emissions would be 6.9 times the direct emissions. These sectors consume inputs with relatively high embedded emissions. Annex E shows the ratios of indirect to direct emissions for all sectors caused by a one unit increase in the sector's final demand, in descending order of current direct emissions. The overall economy average indirect emissions to direct emissions ratio is approximately 1.4.

Changes in Emissions Scenarios using the Hybrid EIO Framework

Using the hybrid emissions IOT, three alternative scenarios depicting the change in final demand and production structure have been analysed, and the impact on emissions computed. The three scenarios are:

a. Replacing some petrol-consuming internal combustion engine vehicles with electric vehicles;

b. Replacing part of coal electricity generation with alternative sources of generation; and

c. Changing consumption behaviour as incomes rise.

a) Replacing internal combustion engine vehicles with electric vehicles

In this experiment, 50,000 typical internal combustion engine (ICE) vehicles consuming petrol would be replaced with an equal number of typical electric vehicles (EVs). The vehicle technical details assumed are given in Table 10.

Table 10: Internal Combustion Engine (ICE) and Electric Vehicle Specifications

	ICE Vehicle	Electric Vehicle
Example model	Tata Tigor petrol 2022	Tata Tigor EV 2022
Mileage	20.3 km / litre	11.8 km / kWh[6]
Distance travelled	12,000 km	
Fuel consumption	591 litres	1020 kWh

Sources: Tata Motors (2022a), Tata Motors (2022b), author's calculations.

Replacing 50,000 petrol-consuming vehicles with electric vehicles would result in a 0.0027 per cent reduction in total emissions in the economy (a reduction of 54,000 tonnes of CO_{2e}). However, while less petrol will be demanded (emission reduction), the electricity demand would increase for charging batteries (emission increase). Therefore, further emissions reduction would be expected with the switch from ICE vehicles to EVs once India's electricity generation shifts away from coal (as discussed in the second scenario).

[6] 306 km range per full charge, and a 26-kWh battery capacity

b) Replacing coal electricity with alternative sources of generation

An experiment is run using each electricity generation sector's cost and emissions structures. For example, what if the electricity generation from each non-coal generation sector (i.e., other thermal electricity, large hydroelectricity, and RES & nuclear electricity) were to increase by 1% each and replace the equivalent amount from coal electricity? What would be the impact on emissions in the economy? The results are shown in Table 11.

Table 11: Change in Emissions due to Changing Electricity Generation Profile

New Generation Sector	Net Change in Emissions (kt CO2e)	Net Change in Total Economy Emissions (%)
Other thermal electricity	-401	-0.020
Large hydroelectricity	-1,223	-0.062
RES & nuclear electricity	-1,035	-0.052

A 1% increase in electricity generation from non-coal sources, with an equivalent decrease in coal electricity generation, ensuring constant total electricity generation, results in a substantial reduction in total emissions in the economy. Even switching to other thermal electricity (of which natural gas generation makes up 99%) results in an overall reduction of total emissions in the economy. The net change in emissions clarifies that large hydroelectricity electricity generation leads to emissions reduction, followed by RES & nuclear and other thermal-based generation. It should be noted that the environmental and ecological impact of building new electricity generation plants is not considered in this analysis.

c) Private consumption: Increasing the requirements of secondary and tertiary commodities in contrast with primary commodities

The IOTs published by MoSPI provide information on changing household consumption trends from primary commodities (particularly agricultural goods) to secondary and tertiary commodities. Table 12 shows the changing patterns in household consumption, between 1993-94 and 2015-16 as it shifts away from primary expenditure to secondary and tertiary expenditure.

Table 12: Household Consumption Share in Primary, Secondary, and Tertiary Commodities by Year (%)

	1993-94	2003-04	2007-08	2015-16
Primary	38.1	25.9	23.7	16.7
Secondary	22.9	26.9	26.9	31.6
Tertiary	39.0	47.1	49.4	51.7

Source: Ministry of Statistics and Programme Implementation, Government of India (2000), Ministry of Statistics and Programme Implementation, Government of India (2008), Ministry of Statistics and Programme Implementation, Government of India (2012), Chadha, Saluja, & Sivamani (2020)

A 1% reduction in primary commodities consumption, accompanied by a 0.2% increase in secondary and tertiary commodities consumption, ensures that total household consumption remains constant. In total, this switch in consumer consumption away from primary goods would result in an increase in emissions of 0.070% (1400 kt CO_{2e}), of which there is a -0.038% change due to primary sectors, +0.066% change due to secondary sectors, and +0.042% change due to tertiary sectors. The analysis shows that the move to secondary commodities is relatively more-emitting than tertiary commodities. The limitation of this analysis is that the consumption patterns are valued at current prices. More work needs to be done to repeat such analysis based on consumption pattern changes valued at constant prices.

Policy Implications

This paper provides insights into the sectoral energy use and emissions from fuel burning in the production processes of the Indian economy. Some sectors have relatively high direct energy needs and are strongly linked in both forward and backward monetary terms, such as the iron and steel sector. Some sectors have relatively strong monetary linkages, but not so in energy consumption terms, including the chemicals sector. Therefore, it is important to differentiate between direct versus indirect emissions while developing policy mechanisms to combat climate change.

The results of the emissions analysis show that sectors have embedded emissions from their consumption from upstream industries. When making projections for the future growth of these sectors, these should also be considered. Low-emission technologies in the upstream sectors will reduce indirect emissions from downstream sectors – for example, increasing the share of renewable electricity generation will reduce indirect emissions from electricity-intensive sectors like aluminium and services. Policies are needed to reduce emissions by adopting more efficient production technologies and conserving the use of coal and petroleum products.

The EIOT-2 is conducive for further economy-wide energy and emissions analysis through an extension to an Energy Extended Social Accounting Matrix (EESAM), which would feed into computable general equilibrium (CGE) models for further economic modelling, which may be used in line with India's COP-26 and other climate change commitments. CGE models can be used to estimate the impact of changing consumption baskets, energy requirements, and cropping patterns on climate change. The models can also analyse the climate change implications of changing energy efficiency, renewable energy, electric vehicles, environmental tax reform and carbon leakage, and border carbon adjustment in a multi-country framework.

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Annex A: Energy Input-Output Table: Concordance with India IOT

Sector No.	IOT	Energy Statistics
1	Paddy	Agriculture
2	Wheat	
3	Jowar	
4	Bajra	
5	Maize	
6	Gram	
7	Pulses	
8	Sugarcane	
9	Groundnut	
10	Coconut	
11	Other oilseeds	
12	Jute	
13	Cotton	
14	Tea	
15	Coffee	
16	Rubber	
17	Tobacco	
18	Fruits	
19	Vegetables	
20	Other crops	
21	Milk and milk products	
22	Poultry & eggs	
23	Other livestock products	
24	Animal services	
25	Forestry and logging	Forestry and logging
26	Fishing & aquaculture	Fishing & aquaculture
27	Coal and lignite	Coal and lignite
28	Crude petroleum	Crude petroleum
29	Natural gas	Natural gas
30	Iron ore	Mining
31	Manganese ore	
32	Bauxite	
33	Copper ore	
34	Other metallic minerals	
35	Limestone	
36	Mica	
37	Other non-metallic minerals	

38	Sugar	Food and tobacco
39	Khandsari, boora	
40	Hydrogenated oil (vanaspati)	
41	Edible oils other than vanaspati	
42	Tea and coffee processing	
43	Miscellaneous food products	
44	Grain mill products, starch and starch products	
45	Beverages	
46	Tobacco products	
47	Khadi, cotton textiles(handlooms)	Textile and leather products
48	Cotton textiles	
49	Woollen textiles	
50	Silk textiles	
51	Art silk, synthetic fibre textiles	
52	Jute, hemp, mesta textiles	
53	Carpet weaving	
54	Miscellaneous textile products	
55	Ready-made garments	
60	Leather footwear	
61	Leather and leather products	
56	Wood and wood products except furniture	Wood products
57	Paper, paper products and newsprint	Paper, pulp, and print
58	Publishing, printing, and allied activities	
64	Petroleum products	Petroleum products
65	Coal tar products	Non-metallic mineral prods.
75	Structural clay products	
77	Other non-metallic mineral prods.	
76	Cement	Cement
66	Inorganic heavy chemicals	Chemicals and pharma
67	Organic heavy chemicals	
68	Fertilisers	
69	Pesticides	
70	Paints, varnishes, and lacquers	
71	Soaps, cosmetics, and glycerine	
72	Synthetic fibres, resin	
73	Other chemicals	
74	Drugs and medicine	
78	Iron, steel and ferro alloys	Iron and steel
79	Iron and steel casting & forging	
80	Iron and steel foundries	
81	Non-ferrous basic metals (including alloys)	Non-ferrous basic metals (including alloys)

82	Hand tools, hardware	Machinery
83	Miscellaneous metal products	
84	Tractors and agri. implements	
85	Industrial machinery (F & T)	
86	Industrial machinery(others)	
87	Machine tools	
88	Other non-electrical machinery	
89	Electrical industrial machinery	
90	Electrical wires & cables	
91	Batteries	
92	Other electrical machinery	
93	Electrical appliances	
94	Electronic equipment (incl.TV)	
95	Watches and clocks	
96	Communication equipment	
97	Ships and boats	Transport equipment
98	Rail equipment	
99	Motor vehicles	
100	Motor cycles and scooters	
101	Bicycles, cycle-rickshaw	
102	Other transport equipment	
103	Aircraft & spacecraft	
59	Furniture & fixtures	Misc. industry
62	Rubber products	
63	Plastic products	
104	Medical, precision & optical instruments	
105	Gems & jewellery	
106	Miscellaneous manufacturing	
107	Construction and construction services	Construction and construction services
108	Electricity	Electricity
110	Railway transport	Railway transport
111	Land transport	Land transport
112	Water transport	Water transport
113	Air transport	Air transport
114	Supportive and auxiliary transport activities	Misc. transport

109	Water supply	Commerce and public services
115	Storage and warehousing	
116	Communication services	
117	Trade	
118	Hotels & restaurants	
119	Financial services	
120	Insurance services	
121	Ownership of dwellings	
122	Education and research	
123	Medical and health	
124	Legal services	
125	Computer-related services	
126	Other business services	
127	Real estate services	
128	Renting of machinery & equipment	
129	Community, social and personal services	
130	Other services	
131	Public administration and defence	

Annex B: Sector-wise Share of Petroleum Products Used for Combustion

Sector	Share of Petroleum Products for Combustion (%)
Agriculture	95
Forestry and logging	95
Biomass	95
Fishing & aquaculture	95
Coal and lignite	95
Crude petroleum	95
Natural gas	95
Mining	95
Food and tobacco	89
Textiles and leather	18
Wood and wood products except furniture	5
Paper, pulp and print	98
Petroleum products	5
Chemicals	5
Cement	5
Non-metallic mineral prods.	5
Iron and steel	82
Aluminium	5
Non-ferrous basic metals (including alloys)	5
Machinery	5
Transport equipment	33
Industry NEC	5
Construction and construction services	19
Coal electricity	95
Other thermal electricity	95
Hydro electricity	95
RES & nuclear	95
Railway transport	95
Land transport	95
Water transport	95
Air transport	95
Transport NEC	95
Commerce and public services	95
Households	95

Annex C: Direct, Indirect, and Total Sectoral Energy Requirements per Rupee Lakh Output (Table 13 – Table 15)

Table 13 Direct Energy Requirements by Sector per INR Lakh Final Demand

Sector	Biomass (kg)	Coal and Lignite (kg)	Crude Petroleum (litres)	Natural Gas (m3)	Petroleum Products Combustible (litres)	Petroleum Products Non-combustible (kg)	Total Electricity (kWh)
Biomass	0	0	0	0	26	78	197
Coal and lignite	0	24	0	0	63	312	52
Crude petroleum	0	0	0	0	13	73	161
Natural gas	0	0	0	0	154	1,677	264
Pet. prod. combustible	0	273	1,952	370	8	267,497	159
Pet. prod. non-combustible	0	284	2,030	385	9	278,222	165
Coal electricity	0	11,944	1	0	284	4,416	1,516
Other thermal electricity	0	186	1	2	1,200	59,032	627
Hydro electricity	0	127	0	0	72	279	353
RES & nuclear	7,464	200	1	0	145	1,493	1,810
Agriculture	0	0	0	0	30	114	295
Forestry and logging	0	0	0	0	27	66	167
Fishing & aquaculture	0	0	0	0	5	5	0
Mining	0	19	0	0	87	678	193
Food and tobacco	2	40	0	0	17	212	15
Textiles and leather	0	260	0	0	5	3,701	294
Wood and wood products except furniture	0	35	0	0	1	1,318	48
Paper, pulp and print	0	923	0	0	25	62	620
Chemicals	22	372	617	85	3	33,351	144
Cement	1	5,981	0	0	2	4,266	269
Non-metallic mineral prods.	92	1,296	27	13	3	9,053	173
Iron and steel	0	1,516	0	0	94	3,426	499
Aluminium	0	1,273	0	0	6	25,364	1,925
Other non-ferrous basic metals (including alloys)	0	321	0	0	3	10,459	800
Machinery	0	151	0	0	2	6,362	843
Transport equipment	0	2	0	0	7	2,163	1,050
Industry NEC	2	119	1	0	2	7,164	457
Construction and construction services	0	1	0	0	3	1,516	247
Railway transport	0	353	0	0	95	548	909
Land transport	0	0	0	0	409	7,098	194
Water transport	0	0	0	0	119	1,116	910
Air transport	0	0	0	0	213	2,866	1,917
Transport NEC	0	0	0	0	206	2,330	968
Commerce and public services	0	43	2	0	67	332	503

NEC: Not Elsewhere Classified

Table 14: Indirect Energy Requirements by Sector Per INR Lakh Final Demand

Sector	Biomass (kg)	Coal and Lignite (kg)	Crude Petroleum (litres)	Natural Gas (m3)	Petroleum Products Combustible (litres)	Petroleum Products Non-combustible (kg)	Total Electricity (kWh)
Biomass	10	194	70	12	30	539	149
Coal and lignite	10	234	118	21	33	1,687	269
Crude petroleum	14	434	132	22	53	1,895	292
Natural las	17	467	259	46	63	5,749	286
Pet. prod. combustible	18	460	196	35	72	43,544	437
Pet. prod. non-combustible	18	449	118	20	72	32,818	431
Coal electricity	55	402	370	69	98	12,610	520
Other thermal electricity	35	1,018	1,172	220	93	98,429	616
Hydro electricity	14	316	93	17	25	771	147
RES & nuclear	3	1,327	246	45	96	6,233	540
Agriculture	13	267	90	15	29	737	138
Forestry and logging	8	195	59	11	28	432	131
Fishing & aquaculture	2	55	27	5	17	84	73
Mining	17	388	185	32	45	4,110	363
Food and tobacco	13	258	122	21	74	1,583	416
Textiles and leather	21	400	202	33	66	4,062	333
Wood and wood products except furniture	13	349	149	23	39	2,676	303
Paper, pulp and print	29	572	153	26	66	2,945	366
Chemicals	12	299	104	20	57	9,202	313
Cement	19	348	127	23	62	2,142	299
Non-metallic mineral prods.	17	546	179	31	74	4,517	400
Iron and steel	27	382	208	37	70	4,785	404
Aluminium	70	1,675	290	51	107	9,308	598
Other non-ferrous basic metals (including alloys)	45	1,178	220	39	108	6,632	593
Machinery	39	935	168	30	83	4,304	523
Transport equipment	51	1,239	181	32	102	6,643	786
Industry NEC	32	744	275	45	101	8,462	523
Construction and construction services	26	877	127	23	77	2,702	420
Railway transport	31	581	138	26	46	1,817	263
Land transport	15	435	414	77	38	12,890	358
Water transport	48	1,101	224	41	88	6,690	847
Air transport	68	1,421	321	60	116	9,808	624
Transport NEC	37	784	270	50	80	6,318	393
Commerce and public services	19	357	116	21	32	1,324	163

Table 15 :Total (Direct & Indirect) Energy Requirements By Sector per INR Lakh Final Demand

Sector	Biomass (kg)	Coal and Lignite (kg)	Crude Petroleum (litres)	Natural Gas (m3)	Petroleum Products Combustible (litres)	Petroleum Products Non-combustible (kg)	Total Electricity (kWh)
Biomass	10	194	70	12	57	617	346
Coal and lignite	10	258	118	21	96	1,999	321
Crude petroleum	14	434	132	22	66	1,968	453
Natural gas	17	467	259	46	218	7,426	550
Pet. prod. combustible	18	733	2,148	405	81	311,041	596
Pet. prod. non-combustible	18	733	2,148	405	81	311,041	596
Coal electricity	55	12,346	371	69	382	17,026	2,036
Other thermal electricity	35	1,204	1,173	223	1,293	157,461	1,243
Hydro electricity	14	443	93	17	97	1,050	500
RES & nuclear	7,467	1,527	246	45	240	7,726	2,349
Agriculture	13	267	90	15	59	851	434
Forestry and logging	8	195	59	11	55	498	298
Fishing & aquaculture	2	55	27	5	22	89	73
Mining	17	407	185	32	132	4,787	556
Food and tobacco	14	298	122	21	91	1,795	431
Textiles and leather	21	660	202	33	70	7,763	627
Wood and wood products except furniture	13	384	149	23	40	3,994	351
Paper, pulp and print	29	1,495	153	26	91	3,007	986
Chemicals	34	670	722	105	60	42,553	457
Cement	20	6,330	127	23	65	6,408	567
Non-metallic mineral prods.	109	1,842	206	44	77	13,570	574
Iron and steel	27	1,897	208	37	164	8,211	903
Aluminium	70	2,949	290	51	113	34,671	2,524
Non-ferrous basic metals (including alloys)	45	1,500	220	39	111	17,090	1,392
Machinery	39	1,086	168	30	85	10,666	1,366
Transport equipment	51	1,242	181	32	110	8,806	1,836
Industry NEC	34	862	276	45	103	15,625	980
Construction and construction services	26	878	127	23	80	4,218	667
Railway transport	31	934	138	26	141	2,365	1,172
Land transport	15	435	414	77	446	19,988	551
Water transport	48	1,101	224	41	207	7,807	1,757
Air transport	68	1,421	321	60	328	12,675	2,541
Transport NEC	37	784	270	50	286	8,648	1,361
Commerce and public services	19	399	117	21	99	1,656	666

Annex D: Direct, Indirect, and Total Emissions (normalised by sectoral final demand) (Table 16 – Table 18)

Table 16: Direct CO2e Emissions by Sector Per INR Lakh Final Demand

Sector	Biomass (t CO2e)	Coal (t CO2e)	Pet. Prod. (t CO2e)	Total (t CO2e)
Biomass	0.000	0.000	0.072	0.072
Coal and lignite	0.000	0.048	0.201	0.250
Pet. prod. combustible	0.000	0.453	0.022	0.475
Agriculture	0.000	0.000	0.079	0.079
Forestry and logging	0.000	0.000	0.069	0.069
Fishing & aquaculture	0.000	0.000	0.012	0.012
Crude petroleum	0.000	0.000	0.035	0.035
Natural gas	0.000	0.000	0.407	0.407
Mining	0.000	0.032	0.230	0.262
Food and tobacco	0.000	0.066	0.044	0.110
Textiles and leather	0.000	0.431	0.013	0.444
Wood and wood products except furniture	0.000	0.058	0.002	0.059
Paper, pulp and print	0.000	1.529	0.065	1.594
Pet. prod. non-combustible	0.000	0.471	0.023	0.493
Chemicals	0.000	0.616	0.008	0.624
Cement	0.000	10.877	0.006	10.883
Non-metallic mineral prods.	0.000	2.146	0.008	2.153
Iron and steel	0.000	3.389	0.248	3.637
Aluminium	0.000	2.088	0.015	2.103
Other non-ferrous basic metals	0.000	0.527	0.008	0.535
Machinery	0.000	0.251	0.007	0.257
Transport equipment	0.000	0.004	0.020	0.023
Industry NEC	0.000	0.197	0.005	0.201
Construction and construction services	0.000	0.002	0.009	0.011
Coal electricity	0.000	17.083	0.676	17.759
Other thermal electricity	0.000	0.280	3.008	3.288
Hydro electricity	0.000	0.191	0.179	0.371
RES & nuclear	0.003	0.299	0.360	0.662
Railway transport	0.000	0.585	0.250	0.835
Land transport	0.000	0.000	1.078	1.078
Water transport	0.000	0.000	0.314	0.314
Air transport	0.000	0.000	0.561	0.561
Transport NEC	0.000	0.000	0.543	0.543
Commerce and public services	0.000	0.071	0.178	0.248

Table 17: Indirect CO2e Emissions by Sector Per INR Lakh Output

Sector	Biomass (t CO2e)	Coal (t CO2e)	Pet. Prod. (t CO2e)	Total (t CO2e)
Biomass	0.000	0.327	0.080	0.407
Coal and lignite	0.000	0.474	0.106	0.580
Pet. prod. combustible	0.000	0.770	0.191	0.960
Agriculture	0.000	0.395	0.076	0.472
Forestry and logging	0.000	0.289	0.075	0.364
Fishing & aquaculture	0.000	0.082	0.046	0.127
Crude petroleum	0.000	0.639	0.140	0.779
Natural gas	0.000	0.691	0.167	0.858
Mining	0.000	0.650	0.118	0.769
Food and tobacco	0.000	0.434	0.196	0.630
Textiles and leather	0.000	0.671	0.173	0.844
Wood and wood products except furniture	0.000	0.583	0.103	0.685
Paper, pulp and print	0.000	0.960	0.173	1.134
Pet. prod. non-combustible	0.000	0.752	0.190	0.942
Chemicals	0.000	0.501	0.151	0.652
Cement	0.000	0.640	0.164	0.804
Non-metallic mineral prods.	0.000	0.913	0.196	1.108
Iron and steel	0.000	0.866	0.185	1.051
Aluminium	0.000	2.778	0.282	3.060
Other non-ferrous basic metals	0.000	1.950	0.284	2.235
Machinery	0.000	1.565	0.218	1.783
Transport equipment	0.000	2.076	0.269	2.345
Industry NEC	0.000	1.244	0.267	1.511
Construction and construction services	0.000	1.461	0.203	1.663
Coal electricity	0.000	0.560	0.221	0.781
Other thermal electricity	0.000	1.118	0.212	1.331
Hydro electricity	0.000	0.237	0.049	0.286
RES & nuclear	0.000	0.789	0.165	0.954
Railway transport	0.000	0.978	0.121	1.099
Land transport	0.000	0.648	0.100	0.748
Water transport	0.000	1.630	0.233	1.863
Air transport	0.000	2.107	0.305	2.413
Transport NEC	0.000	1.164	0.212	1.376
Commerce and public services	0.000	0.600	0.083	0.683

Table 18: Total (Direct + Indirect) CO2e Emissions By Sector per INR Lakh Output

Sector	Biomass (t CO2e)	Coal (t CO2e)	Pet. Prod. (t CO2e)	Total (t CO2e)
Biomass	0.000	0.327	0.152	0.479
Coal and lignite	0.000	0.522	0.307	0.830
Pet. prod. combustible	0.000	1.222	0.212	1.435
Agriculture	0.000	0.395	0.156	0.551
Forestry and logging	0.000	0.289	0.144	0.433
Fishing & aquaculture	0.000	0.082	0.058	0.140
Crude petroleum	0.000	0.639	0.175	0.813
Natural gas	0.000	0.691	0.574	1.265
Mining	0.000	0.683	0.348	1.031
Food and tobacco	0.000	0.500	0.240	0.740
Textiles and leather	0.000	1.102	0.186	1.288
Wood and wood products except furniture	0.000	0.641	0.104	0.745
Paper, pulp and print	0.000	2.489	0.239	2.728
Pet. prod. non-combustible	0.000	1.222	0.212	1.435
Chemicals	0.000	1.117	0.159	1.276
Cement	0.000	11.517	0.170	11.687
Non-metallic mineral prods.	0.000	3.058	0.203	3.262
Iron and steel	0.000	4.255	0.433	4.688
Aluminium	0.000	4.867	0.297	5.163
Other non-ferrous basic metals	0.000	2.477	0.293	2.770
Machinery	0.000	1.816	0.224	2.040
Transport equipment	0.000	2.080	0.289	2.368
Industry NEC	0.000	1.441	0.271	1.712
Construction and construction services	0.000	1.463	0.212	1.675
Coal electricity	0.000	17.644	0.897	18.541
Other thermal electricity	0.000	1.398	3.220	4.618
Hydro electricity	0.000	0.429	0.228	0.657
RES & nuclear	0.003	1.088	0.525	1.615
Railway transport	0.000	1.563	0.371	1.934
Land transport	0.000	0.648	1.177	1.825
Water transport	0.000	1.630	0.546	2.176
Air transport	0.000	2.107	0.866	2.973
Transport NEC	0.000	1.164	0.755	1.919
Commerce and public services	0.000	0.671	0.261	0.932

Annex E: Indirect Emissions to Direct Emissions Ratio

Sector	Indirect Emissions to Direct Emissions Ratio
Construction and construction services	147.1
Transport equipment	100.2
Crude petroleum	22.4
Wood and wood products except for furniture	11.5
Fishing & aquaculture	10.4
Industry NEC	7.5
Machinery	6.9
Water transport	5.9
Agriculture	5.9
Food and tobacco	5.7
Biomass (energy)	5.6
Forestry and logging	5.3
Air transport	4.3
Other non-ferrous basic metals	4.2
Mining	2.9
Commerce and public services	2.8
Transport NEC	2.5
Coal and lignite	2.3
Natural gas	2.1
Pet. prod. combustible	2.0
Pet. prod. non-combustible	1.9
Textiles and leather	1.9
Aluminium	1.5
RES & nuclear	1.4
Railway transport	1.3
Chemicals	1.0
Hydro electricity	0.8
Paper, pulp and print	0.7
Land transport	0.7
Non-metallic mineral prods.	0.5
Other Thermal electricity	0.4
Iron and steel	0.3
Cement	0.1
Coal electricity	0.0

Annex F: India Hybrid Energy and Emissions Input Output Table 2015-16

Hybrid Energy IO Table 2015-16		1	2	3	4	5	6	7	8
			Forestry and Logging	Biomass	Fishing & Aquaculture	Coal and Lignite	Crude petroleum	Natural Gas	Mining
Monetary (₹ Lakhs / ₹ 100,000)									
1	Agriculture	30372081	0	364899	634455	0	0	0	0
2	Forestry and Logging	51320	16125	6210	0	0	0	0	0
3	Biomass	0	0	1	0	0	0	0	0
4	Fishing & Aquaculture	0	0	469	289311	0	0	0	0
5	Coal and Lignite	0	0	44	0	14685	0	0	16936
6	Crude petroleum	0	0	0	0	0	76	33	0
7	Natural Gas	0	0	0	0	0	399	107	0
8	Mining	0	0	0	561464	0	283461	217728	0
9	Food and Tobacco	2565202	0	31210	9525	0	0	0	0
10	Textiles and leather	5597	39144	13039	4158	117662	2067	2089	48479
11	Wood and wood products except furniture	306464	28198	12896	6004	542382	6916	2317	684
12	Paper, pulp and print	10108	55546	18538	0	7337	245	75	104596
13	Pet. Prod. Combustible	2667680	178402	90154	28763	347906	76524	318825	689922
14	Pet. Prod. non-combustible	140404	9390	4745	1514	18311	4028	16780	36312
15	Chemicals	10786939	0	125240	45476	288463	1358218	422984	1401330
16	Cement	0	0	0	0	0	0	0	0
17	Non-metallic Mineral prods.	0	0	5	0	0	1	1	602
18	Iron and Steel	0	0	0	0	0	641657	156060	0
19	Aluminium	0	207	69	0	0	0	0	0
20	Other non-ferrous basic metals	0	931	309	0	0	0	0	0
21	Machinery	322138	219367	76495	31590	840040	107945	36207	2450999
22	Transport Equipment	148229	65115	23302	12049	305563	320366	1739	188307

Hybrid Energy IO Table 2015-16		9	10	11	12	13	14	15	16
		Food and Tobacco	Textiles and leather	Wood and wood products except furniture	Paper, pulp and print	Pet. Prod. Combustible	Pet. Prod. non-combustible	Chemicals	Cement
Monetary (₹ Lakhs / ₹ 100,000)									
1	Agriculture	52196738	8195533	13160	39266	123	30	7209956	4
2	Forestry and Logging	1064844	28981	863232	257368	0	0	833127	0
3	Biomass	3696	0	0	0	303	74	41469	256
4	Fishing & Aquaculture	1819590	220	0	37	218	53	657103	0
5	Coal and Lignite	170886	769887	9789	485126	1085723	265283	1318086	2799107
6	Crude petroleum	0	0	0	0	37399043	9138005	10551925	0
7	Natural Gas	0	0	0	0	3458363	845009	705866	0
8	Mining	0	201	2242	1620	165	40	53460	1783446
9	Food and Tobacco	5925933	1256	0	114	41	10	1325929	0
10	Textiles and leather	23256	12822562	31678	10943	50468	12331	1187455	3857
11	Wood and wood products except furniture	32715	31924	1151789	352004	17814	4353	65659	4246
12	Paper, pulp and print	72127	63963	85975	4076475	410798	100374	234528	11592
13	Pet. Prod. Combustible	656436	132606	1487	118517	296642	72481	98230	9433
14	Pet. Prod. non-combustible	85070	616378	28259	2419	5636198	1377137	1866372	179228
15	Chemicals	1632469	10251800	805982	884015	2226842	544102	40723819	12152
16	Cement	6	6	2	1	3452	844	15644	137493
17	Non-metallic Mineral prods.	20242	1488	14715	12893	74879	18296	109552	377588
18	Iron and Steel	63	9053	133056	18346	1580870	386266	490973	1921
19	Aluminium	264	884	53606	140620	12	3	156978	371
20	Other non-ferrous basic metals	861	6782	28836	81996	32	8	424868	786
21	Machinery	357828	1318741	303249	263426	1776790	434137	948443	3362
22	Transport Equipment	55401	254538	5382	55205	513208	125396	502992	79

Hybrid Energy IO Table 2015-16		17	18	19	20	21	22	23	24
		Non-metallic Mineral prods.	Iron and Steel	Aluminium	Other non-ferrous basic metals	Machinery	Transport Equipment	Industry NEC	Construction and construction services
Monetary (₹ Lakhs / ₹ 100,000)									
1	Agriculture	1201	83	0	0	26671	690	946234	3775255
2	Forestry and Logging	0	25592	127	378	61080	7610	1827352	11266402
3	Biomass	51216	0	0	0	0	0	2992	0
4	Fishing & Aquaculture	14	2	0	0	179	0	2492	84
5	Coal and Lignite	1352340	4556497	634281	386742	583325	8494	308426	15133
6	Crude petroleum	134905	0	0	0	0	0	12354	0
7	Natural Gas	30829	0	0	0	0	0	1262	0
8	Mining	1717159	4903461	58413	2142955	2317489	26597	945848	6454960
9	Food and Tobacco	6	4	0	2	1656	616	67610	754
10	Textiles and leather	24336	13384	4244	4272	131447	120222	660196	117521
11	Wood and wood products except furniture	7461	37918	914	3968	149343	201837	909138	711505
12	Paper, pulp and print	23742	63536	2507	8823	178568	42451	670304	78429
13	Pet. Prod. Combustible	27564	1647521	16750	22020	87284	243508	40444	379201
14	Pet. Prod. non-combustible	523708	362192	318245	418371	1658403	492153	768438	1619031
15	Chemicals	1390181	1373901	702180	753168	2293908	1064683	11515903	4098793
16	Cement	401693	25371	0	107352	33955	1666	45523	9768397
17	Non-metallic Mineral prods.	1669567	587566	29476	1123815	511650	58581	402652	18881305
18	Iron and Steel	328716	13280246	1475189	2234013	5640754	5978081	2203655	20002155
19	Aluminium	321305	157600	164369	97263	2184500	3919740	41019	1708
20	Other non-ferrous basic metals	418450	717709	112264	1355643	7969690	4302500	2619331	4759
21	Machinery	516601	1301513	21706	542492	6163059	9480430	1695492	9085230
22	Transport Equipment	212501	69571	0	97488	322443	3657699	224673	2720

Hybrid Energy IO Table 2015-16		25	26	27	28	29	30	31	32
		Coal Electricity	Other Thermal Electricity	Hydro Electricity	RES & Nuclear Electricity	Railway Transport	Land transport	Water Transport	Air transport
Monetary (₹ Lakhs / ₹ 100,000)									
1	Agriculture	90956	41015	12329	0	0	2399042	0	0
2	Forestry and Logging	334	0	45	0	0	0	0	0
3	Biomass	0	0	0	874236	0	0	0	0
4	Fishing & Aquaculture	8702	329	321	831	0	0	0	0
5	Coal and Lignite	3452007	3180	5493	7374	239368	0	0	0
6	Crude petroleum	10390	393	384	992	0	0	0	0
7	Natural Gas	424	661	57	0	0	0	0	0
8	Mining	44407	0	5	493	0	0	0	0
9	Food and Tobacco	5828	145	411	0	0	0	0	0
10	Textiles and leather	183136	6977	6640	1316	145264	375614	32954	238960
11	Wood and wood products except furniture	87	0	11	974	0	0	0	0
12	Paper, pulp and print	856101	32632	30994	168	191043	1270436	35165	222732
13	Pet. Prod. Combustible	5331308	1332555	200850	346148	583312	14461194	107008	725501
14	Pet. Prod. non-combustible	280595	70134	10571	18218	30701	761115	5632	38184
15	Chemicals	14467	5116	852	39189	0	0	0	0
16	Cement	43	0	2	156	0	0	0	0
17	Non-metallic Mineral prods.	184317	6974	6807	17595	364	0	0	0
18	Iron and Steel	3536296	133807	130594	337568	0	0	7	0
19	Aluminium	2694	102	99	257	0	0	0	0
20	Other non-ferrous basic metals	7401	264	315	6162	0	0	0	0
21	Machinery	225289	8525	8320	21506	56568	364530	10069	202130
22	Transport Equipment	1893	67	81	1652	24270	2009364	653371	4837

Hybrid Energy IO Table 2015-16		33 Transport NEC	34 Commerce and public services	IIUSE	PFCE	GFCE	GFCF	CIS	Exports
Monetary (₹ Lakhs / ₹ 100,000)									
1	Agriculture	0	35543994	141863716	106227194	0	406085	1090156	2337322
2	Forestry and Logging	0	334891	16645019	1192442	0	0	0	1151425
3	Biomass	0	0	974244	7370950	0	0	0	0
4	Fishing & Aquaculture	0	364803	3144759	11916419	0	0	0	350831
5	Coal and Lignite	0	1449082	19937297	120686	0	0	0	75406
6	Crude petroleum	0	290062	57538562	0	0	0	0	0
7	Natural Gas	0	27251	5070230	0	0	0	0	0
8	Mining	11	1124202	22639825	0	0	0	858438	879930
9	Food and Tobacco	0	4394815	14331069	86423657	0	0	1376597	10923308
10	Textiles and leather	55153	1856712	18353137	44974350	0	360718	1034718	18410730
11	Wood and wood products except furniture	0	1478526	6068045	1825246	0	0	92202	201016
12	Paper, pulp and print	158884	5018615	14137408	3567751	0	0	273555	768612
13	Pet. Prod. Combustible	1606003	20842790	53784971	28366526	0	0	2804697	14981692
14	Pet. Prod. non-combustible	84526	1096989	18579753	1492975	0	0	685294	3660596
15	Chemicals	0	21567095	116329265	8688654	0	0	4524392	17250372
16	Cement	0	20810	10562416	0	0	0	54803	125033
17	Non-metallic Mineral prods.	0	214553	24325482	446156	0	0	484562	1301925
18	Iron and Steel	8	1669622	60368976	0	0	0	1067088	5324398
19	Aluminium	3	306641	7550315	0	0	0	83979	628820
20	Other non-ferrous basic metals	12	1375469	19435378	0	0	0	376697	2055633
21	Machinery	198145	8632963	48025322	7894893	0	71140272	2559694	14305460
22	Transport Equipment	98563	4619768	14577834	24183182	0	44703251	901887	10153027

Hybrid Energy IO Table 2015-16		Valuables	Less Imports	TFUSE	Supply
Monetary (₹ Lakhs / ₹ 100,000)					
1	Agriculture	0	1479727	108581031	250444747
2	Forestry and Logging	0	2625927	-282060	16362959
3	Biomass	0	0	7370950	8345194
4	Fishing & Aquaculture	0	38309	12228941	15373700
5	Coal and Lignite	0	8938489	-8742397	11194900
6	Crude petroleum	0	42939993	-42939993	14598569
7	Natural Gas	0	0	0	5070230
8	Mining	0	4840493	-3102125	19537700
9	Food and Tobacco	0	11104654	87618908	101949977
10	Textiles and leather	0	4385606	60394910	78748047
11	Wood and wood products except furniture	0	818963	1299501	7367546
12	Paper, pulp and print	0	2962444	1647474	15784882
13	Pet. Prod. Combustible	0	8928824	37224090	91009061
14	Pet. Prod. non-combustible	0	2181651	3657214	22236967
15	Chemicals	0	24219522	6243896	122573161
16	Cement	0	216563	-36727	10525689
17	Non-metallic Mineral prods.	0	1589117	643526	24969008
18	Iron and Steel	0	9807223	-3415738	56953238
19	Aluminium	0	992760	-279961	7270355
20	Other non-ferrous basic metals	0	3158351	-726022	18709356
21	Machinery	0	50203090	45697227	93722549
22	Transport Equipment	0	9833270	70108078	84685912

Hybrid Energy IO Table 2015-16		1	2	3	4	5	6	7	8
			Forestry and Logging	Biomass	Fishing & Aquaculture	Coal and Lignite	Crude petroleum	Natural Gas	Mining
Monetary (₹ Lakhs / ₹ 100,000)									
23	Industry NEC	11719	481229	159802	0	26650	3497	1143	353726
24	Construction and construction services	1651576	77341	44739	0	21339	4213	4264	24037
25	Coal Electricity	2800620	119486	72008	0	30852	100111	58491	163588
26	Other Thermal Electricity	153576	6552	3949	0	1692	5490	3207	8971
27	Hydro Electricity	388076	16557	9978	0	4275	13872	8105	22668
28	RES & Nuclear Electricity	334020	14251	8588	0	3680	11940	6976	19511
29	Railway Transport	526820	19669	12692	4528	60232	326717	134692	155204
30	Land transport	4353283	544638	231899	218032	208087	489846	262058	479678
31	Water Transport	211619	3299	3589	5360	4791	20577	7564	7224
32	Air transport	51463	451	758	105	3726	40709	16653	9956
33	Transport NEC	474162	4944	7229	20723	20816	60593	84353	51405
34	Commerce and public services	17490000	607388	407540	345913	1453974	1622115	209232	1421838
	Total Inputs	75823097	2508231	1730395	2218971	4322461	5501580	1971684	7655971
	NIT	-5293906	165259	-7167	49329	181979	372379	68401	352986
	GVA	179915557	13689468	6621965	13105400	6690460	8724610	3030145	11528743
	Total Outputs	250444747	16362959	8345194	15373700	11194900	14598569	5070230	19537700

Hybrid Energy IO Table 2015-16		9	10	11	12	13	14	15	16
		Food and Tobacco	Textiles and leather	Wood and wood products except furniture	Paper, pulp and print	Pet. Prod. Combustible	Pet. Prod. non-combustible	Chemicals	Cement
Monetary (₹ Lakhs / ₹ 100,000)									
23	Industry NEC	925793	1758439	143094	275346	969172	236806	1884053	509476
24	Construction and construction services	20842	142935	1035	512071	1062202	259536	408889	22058
25	Coal Electricity	63121	846278	13138	317022	613035	149788	496632	122408
26	Other Thermal Electricity	3461	46407	720	17384	33617	8214	27233	6712
27	Hydro Electricity	8746	117267	1821	43929	84947	20756	68817	16962
28	RES & Nuclear Electricity	7528	100933	1567	37810	73115	17865	59232	14599
29	Railway Transport	311068	114945	4133	36675	1448542	353934	471465	58204
30	Land transport	4229602	3586381	52050	530483	1536328	375383	2896595	106085
31	Water Transport	182461	11305	3042	12990	128076	31294	85047	7687
32	Air transport	49471	54879	5061	8729	646752	158026	257796	10107
33	Transport NEC	406673	366440	4905	49915	145573	35569	258268	9424
34	Commerce and public services	15262633	6647320	252296	1250905	5704856	1393913	6413743	433368
	Total Inputs	85589824	48300329	4015302	9893649	66978199	16365316	82850205	6642011
	NIT	-2555653	1163979	21971	348053	6767651	1653594	5990418	89293
	GVA	18915806	29283739	3330273	5543180	17263210	4218057	33732538	3794384
	Total Outputs	101949977	78748047	7367546	15784882	91009061	22236967	122573161	10525689

Hybrid Energy IO Table 2015-16		17	18	19	20	21	22	23	24
		Non-metallic Mineral prods.	Iron and Steel	Aluminium	Other non-ferrous basic metals	Machinery	Transport Equipment	Industry NEC	Construction and construction services
Monetary (₹ Lakhs / ₹ 100,000)									
23	Industry NEC	131229	878904	315194	249603	2957265	10788965	15191845	5857794
24	Construction and construction services	763300	1016222	83172	949725	1231662	868406	1081668	2634
25	Coal Electricity	176030	937272	598576	600293	3159231	3699941	1155790	2869692
26	Other Thermal Electricity	9653	51397	32824	32918	173241	202891	63379	157363
27	Hydro Electricity	24392	129876	82943	83181	437768	512693	160155	397647
28	RES & Nuclear Electricity	20994	111785	71390	71595	376790	441279	137847	342258
29	Railway Transport	320532	496514	40637	356199	463285	260044	1124970	1162811
30	Land transport	1269914	1091993	89373	643652	3034485	3181100	4746600	11164036
31	Water Transport	46305	36343	2974	27915	23054	6684	85401	293789
32	Air transport	100567	140795	11523	90810	407198	275318	312390	95832
33	Transport NEC	86553	98391	8053	54795	218795	204006	397482	1123135
34	Commerce and public services	2272529	5696077	466192	2131879	10400432	10052123	7836237	50245416
	Total Inputs	14375495	39809237	5343518	14591334	53198610	60101011	58205101	159975750
	NIT	1056929	8024434	224443	1044588	3921484	4224858	2767167	8904417
	GVA	9536584	9119567	1702393	3073435	36602456	20360043	13071545	100429800
	Total Outputs	24969008	56953238	7270355	18709356	93722549	84685912	74043813	269309967

Hybrid Energy IO Table 2015-16		25	26	27	28	29	30	31	32
		Coal Electricity	Other Thermal Electricity	Hydro Electricity	RES & Nuclear Electricity	Railway Transport	Land transport	Water Transport	Air transport
Monetary (₹ Lakhs / ₹ 100,000)									
23	Industry NEC	220217	5514	10746	256486	124255	1431098	32192	165199
24	Construction and construction services	2439229	92296	90080	232844	581332	346391	15205	188957
25	Coal Electricity	299736	7319	10419	45577	599403	734676	87712	700431
26	Other Thermal Electricity	16436	401	571	2499	32869	40287	4810	38409
27	Hydro Electricity	41534	1014	1444	6316	83058	101802	12154	97057
28	RES & Nuclear Electricity	35749	873	1243	5436	71489	87622	10461	83538
29	Railway Transport	803289	30395	29665	76680	25050	71420	627	7465
30	Land transport	1127034	42645	41621	107584	195102	1009901	54589	457148
31	Water Transport	116388	4404	4298	11110	4816	101380	308	5726
32	Air transport	27596	1044	1019	2634	1979	14205	405	1555
33	Transport NEC	110853	4194	4094	10582	3751	76327	721	6558
34	Commerce and public services	13468395	509619	497382	1285666	1902398	18955782	394892	3079948
	Total Inputs	32943131	2342596	1107765	3718248	4896392	44612185	1458283	6264335
	NIT	1027963	54735	43114	118480	175008	3493119	6117	56665
	GVA	18102688	458205	6064876	2373930	10043700	41433495	735300	2035000
	Total Outputs	52073782	2855536	7215755	6210659	15115100	89538800	2199700	8356000

Hybrid Energy IO Table 2015-16		33 Transport NEC	34 Commerce and public services	IIUSE	PFCE	GFCE	GFCF	CIS	Exports
Monetary (₹ Lakhs / ₹ 100,000)									
23	Industry NEC	123716	8092765	54572931	13945047	0	10043730	1695073	29790950
24	Construction and construction services	334444	15296814	29871459	0	0	230663187	8935731	600763
25	Coal Electricity	809545	16683199	39141420	12761371	0	0	0	170991
26	Other Thermal Electricity	44392	914846	2146373	699787	0	0	0	9377
27	Hydro Electricity	112177	2311756	5423744	1768316	0	0	0	23694
28	RES & Nuclear Electricity	96552	1989747	4668261	1522004	0	0	0	20394
29	Railway Transport	49227	2279547	11637876	2061931	0	379674	0	1002860
30	Land transport	1101667	19178173	68637047	12558116	0	844529	0	7328336
31	Water Transport	1317	1055224	2553361	344415	0	18880	0	3753577
32	Air transport	4500	2013364	4817376	2466353	0	90940	0	2599259
33	Transport NEC	20319	563290	4992890	9537352	0	2440896	0	2105346
34	Commerce and public services	4618739	122976045	317706784	368504150	142258221	22425730	0	106892401
	Total Inputs	9517903	305584424	1240412545	760859926	142258221	383517893	28899561	259183481
	NIT	172192	10560203	55244480	13269303	456236	11652791	0	13680604
	GVA	9413900	600009856	1243954311	0	0	0	0	0
	Total Outputs	19103995	916154482	2539611335	774129229	142714457	395170684	28899561	272864086

Hybrid Energy IO Table 2015-16		Valuables	Less Imports	TFUSE	Supply
Monetary (₹ Lakhs / ₹ 100,000)					
23	Industry NEC	21760963	57764881	19470882	74043813
24	Construction and construction services	0	761172	239438508	269309967
25	Coal Electricity	0	0	12932362	52073782
26	Other Thermal Electricity	0	0	709164	2855536
27	Hydro Electricity	0	0	1792010	7215755
28	RES & Nuclear Electricity	0	0	1542398	6210659
29	Railway Transport	32759	0	3477224	15115100
30	Land transport	170771	0	20901753	89538800
31	Water Transport	3490	4474023	-353661	2199700
32	Air transport	5637	1623564	3538624	8356000
33	Transport NEC	27511	0	14111105	19103995
34	Commerce and public services	302767	41935571	598447698	916154482
	Total Inputs	22303897	297824187	1299198791	2539611335
	NIT	523812	0	39582746	94827226
	GVA	0	0	0	1243954311
	Total Outputs	22827708	297824187	1338781537	3878392872

Hybrid Energy IO Table 2015-16		1	2	3	4	5	6	7	8
			Forestry and Logging	Biomass	Fishing & Aquaculture	Coal and Lignite	Crude petroleum	Natural Gas	Mining
Energy (ktoe)									
3	Biomass	0	0	0	0	0	0	0	0
5	Coal and lignite	0	0	0	0	144	0	0	166
6	Crude petroleum	0	0	0	0	0	0	0	0
7	Natural gas	0	0	0	0	0	3	1	0
13	Pet. Prod. combustable	6131	410	207	66	800	176	733	1586
14	Pet. Prod. non-combustable	273	18	9	3	36	8	33	71
25	Coal Electricity	3956	169	102	0	44	141	83	231
26	Other Thermal Electricity	211	9	5	0	2	8	4	12
27	Hydro Electricity	536	23	14	0	6	19	11	31
28	RES & Nuc	456	19	12	0	5	16	10	27
Energy (kt, kt, kt, MMSCM, kt, GWh)									
3	Biomass	0	0	0	0	0	0	0	0
5	Coal and lignite	0	0	1	0	326	0	0	375
6	Crude petroleum	0	0	0	0	0	0	0	0
7	Natural gas	0	0	0	0	0	4	1	0
13	Pet. Prod. combustable	5734	383	194	62	748	164	685	1483
14	Pet. Prod. non-combustable	260	17	9	3	34	7	31	67
25	Coal Electricity	46012	1963	1183	0	507	1645	961	2688
26	Other Thermal Electricity	2450	105	63	0	27	88	51	143
27	Hydro Electricity	6237	266	160	0	69	223	130	364
28	RES & Nuc	5303	226	136	0	58	190	111	310

Hybrid Energy IO Table 2015-16		9	10	11	12	13	14	15	16
		Food and Tobacco	Textiles and leather	Wood and wood products except furniture	Paper, pulp and print	Pet. Prod. Combustible	Pet. Prod. non-combustible	Chemicals	Cement
Energy (ktoe)									
3	Biomass	79	0	0	0	8	0	891	6
5	Coal and lignite	1671	7528	96	4743	10616	2594	12888	30053
6	Crude petroleum	0	0	0	0	151358	36983	42705	0
7	Natural gas	0	0	0	0	30022	7335	6128	0
13	Pet. Prod. combustable	1509	305	3	272	682	167	226	22
14	Pet. Prod. non-combustable	166	1200	55	5	10970	2680	3633	349
25	Coal Electricity	89	1196	19	448	866	212	702	173
26	Other Thermal Electricity	5	64	1	24	46	11	37	9
27	Hydro Electricity	12	162	3	61	117	29	95	23
28	RES & Nuc	10	138	2	52	100	24	81	20
Energy (kt, kt, kt, MMSCM, kt, GWh)									
3	Biomass	154	0	0	0	16	0	1728	11
5	Coal and lignite	3789	17068	217	10755	24071	5881	29222	62056
6	Crude petroleum	0	0	0	0	151358	36983	42705	0
7	Natural gas	0	0	0	0	32637	7975	6661	0
13	Pet. Prod. combustable	1411	285	3	255	638	156	211	20
14	Pet. Prod. non-combustable	158	1142	52	4	10445	2552	3459	332
25	Coal Electricity	1037	13904	216	5208	10072	2461	8159	2011
26	Other Thermal Electricity	55	740	11	277	536	131	434	107
27	Hydro Electricity	141	1885	29	706	1365	334	1106	273
28	RES & Nuc	120	1603	25	600	1161	284	940	232

Hybrid Energy IO Table 2015-16		17	18	19	20	21	22	23	24
		Non-metallic Mineral prods.	Iron and Steel	Aluminium	Other non-ferrous basic metals	Machinery	Transport Equipment	Industry NEC	Construction and construction services
Energy (ktoe)									
3	Biomass	1101	0	0	0	0	0	64	0
5	Coal and lignite	13223	38592	3940	2402	5703	83	3016	148
6	Crude petroleum	546	0	0	0	0	0	50	0
7	Natural gas	268	0	0	0	0	0	11	0
13	Pet. Prod. combustable	63	3786	38	51	201	560	93	871
14	Pet. Prod. non-combustable	1019	705	619	814	3228	958	1496	3151
25	Coal Electricity	249	1324	846	848	4463	5227	1633	4054
26	Other Thermal Electricity	13	71	45	45	238	278	87	216
27	Hydro Electricity	34	179	115	115	605	709	221	550
28	RES & Nuc	29	153	97	98	514	602	188	467
Energy (kt, kt, kt, MMSCM, kt, GWh)									
3	Biomass	2134	0	0	0	0	0	125	0
5	Coal and lignite	29981	64811	9022	5501	12932	188	6838	335
6	Crude petroleum	546	0	0	0	0	0	50	0
7	Natural gas	291	0	0	0	0	0	12	0
13	Pet. Prod. combustable	59	3541	36	47	188	523	87	815
14	Pet. Prod. non-combustable	971	671	590	775	3073	912	1424	3000
25	Coal Electricity	2892	15399	9834	9862	51904	60788	18989	47147
26	Other Thermal Electricity	154	820	524	525	2764	3237	1011	2510
27	Hydro Electricity	392	2087	1333	1337	7036	8240	2574	6391
28	RES & Nuc	333	1775	1133	1137	5982	7006	2189	5434

Hybrid Energy IO Table 2015-16		25	26	27	28	29	30	31	32
		Coal Electricity	Other Thermal Electricity	Hydro Electricity	RES & Nuclear Electricity	Railway Transport	Land transport	Water Transport	Air transport
Energy (ktoe)									
3	Biomass	0	0	0	16715	0	0	0	0
5	Coal and lignite	227115	209	361	485	2340	0	0	0
6	Crude petroleum	42	2	2	4	0	0	0	0
7	Natural gas	4	6	0	0	0	0	0	0
13	Pet. Prod. combustable	6252	9062	462	796	1341	33234	246	1667
14	Pet. Prod. non-combustable	546	137	21	35	60	1481	11	74
25	Coal Electricity	4317	105	150	656	847	1038	124	989
26	Other Thermal Electricity	230	6	8	35	45	55	7	53
27	Hydro Electricity	585	14	20	89	115	141	17	134
28	RES & Nuc	498	12	17	76	98	120	14	114
Energy (kt, kt, kt, MMSCM, kt, GWh)									
3	Biomass	0	0	0	43675	0	0	0	0
5	Coal and lignite	548570	505	873	1172	5307	0	0	0
6	Crude petroleum	42	2	2	4	0	0	0	0
7	Natural gas	4	6	1	0	0	0	0	0
13	Pet. Prod. combustable	5848	8477	432	744	1254	31086	230	1560
14	Pet. Prod. non-combustable	520	130	20	34	57	1411	10	71
25	Coal Electricity	50207	1226	1745	7634	9848	12070	1441	11508
26	Other Thermal Electricity	2673	65	93	406	524	643	77	613
27	Hydro Electricity	6806	166	237	1035	1335	1636	195	1560
28	RES & Nuc	5787	141	201	880	1135	1391	166	1326

Hybrid Energy IO Table 2015-16		33 Transport NEC	34 Commerce and public services	IIUSE	PFCE	GFCE	GFCF	CIS	Exports
Energy (ktoe)									
3	Biomass	0	0	18865	187277	0	0	0	0
5	Coal and lignite	0	14168	382284	1180	0	0	0	1361
6	Crude petroleum	0	1174	232865	0	0	0	0	0
7	Natural gas	0	237	44014	0	0	0	0	0
13	Pet. Prod. combustable	3691	47900	123607	65191	0	0	6446	34431
14	Pet. Prod. non-combustable	165	2135	36162	2906	0	0	1334	7125
25	Coal Electricity	1144	23568	60010	18028	0	0	0	242
26	Other Thermal Electricity	61	1255	3195	960	0	0	0	13
27	Hydro Electricity	155	3195	8135	2444	0	0	0	33
28	RES & Nuc	132	2716	6917	2078	0	0	0	28
Energy (kt, kt, kt, MMSCM, kt, GWh)									
3	Biomass	0	0	47842	358482	0	0	0	0
5	Coal and lignite	0	32126	871924	2676	0	0	0	3288
6	Crude petroleum	0	1174	232865	0	0	0	0	0
7	Natural gas	0	257	47849	0	0	0	0	0
13	Pet. Prod. combustable	3452	44803	115616	60976	0	0	6029	32204
14	Pet. Prod. non-combustable	157	2033	34433	2767	0	0	1270	6784
25	Coal Electricity	13300	274094	697915	209661	0	0	0	2809
26	Other Thermal Electricity	708	14594	37161	11164	0	0	0	150
27	Hydro Electricity	1803	37154	94605	28420	0	0	0	381
28	RES & Nuc	1533	31591	80440	24165	0	0	0	324

Hybrid Energy IO Table 2015-16		Valuables	Less Imports	TFUSE	Supply
Energy (ktoe)					
3	Biomass	0	0	187277	206142
5	Coal and lignite	0	126173	-123632	258652
6	Crude petroleum	0	173783	-173783	59082
7	Natural gas	0	0	0	44014
13	Pet. Prod. combustable	0	20520	85548	209155
14	Pet. Prod. non-combustable	0	4246	7118	43280
25	Coal Electricity	0	0	18269	78279
26	Other Thermal Electricity	0	0	973	4168
27	Hydro Electricity	0	0	2476	10611
28	RES & Nuc	0	0	2106	9022
Energy (kt, kt, kt, MMSCM, kt, GWh)					
3	Biomass	0	0	358482	406325
5	Coal and lignite	0	211893	-205929	665995
6	Crude petroleum	0	173783	-173783	59082
7	Natural gas	0	0	0	47849
13	Pet. Prod. combustable	0	19193	80017	195632
14	Pet. Prod. non-combustable	0	4043	6778	41211
25	Coal Electricity	0	0	212470	910385
26	Other Thermal Electricity	0	0	11313	48474
27	Hydro Electricity	0	0	28801	123406
28	RES & Nuc	0	0	24489	104929

Hybrid Energy IO Table 2015-16		1	2	3	4	5	6	7	8
			Forestry and Logging	Biomass	Fishing & Aquaculture	Coal and Lignite	Crude petroleum	Natural Gas	Mining
Total Emissions (t CO2e)									
3	Biomass	0	0	0	0	0	0	0	0
5	Coal and lignite	0	0	1617	0	539168	0	0	621819
6	Crude petroleum	0	0	0	0	0	0	0	0
7	Natural gas	0	0	0	0	0	0	0	0
13	Pet. Prod. combustable	17169921	1127371	601127	185130	2239216	492530	2052047	4440528
14	Pet. Prod. non-combustable	0	0	0	0	0	0	0	0
25	Coal Electricity	0	0	0	0	0	0	0	0
26	Other Thermal Electricity	0	0	0	0	0	0	0	0
27	Hydro Electricity	0	0	0	0	0	0	0	0
28	RES & Nuc	0	0	0	0	0	0	0	0

Hybrid Energy IO Table 2015-16		9	10	11	12	13	14	15	16
		Food and Tobacco	Textiles and leather	Wood and wood products except furniture	Paper, pulp and print	Pet. Prod. Combustible	Pet. Prod. non-combustible	Chemicals	Cement
Total Emissions (t CO2e)									
3	Biomass	79	0	0	0	8	0	891	6
5	Coal and lignite	6274173	28266854	359395	17811686	39862948	9740031	48394260	112851847
6	Crude petroleum	0	0	0	0	0	0	0	0
7	Natural gas	0	0	0	0	0	0	0	0
13	Pet. Prod. combustable	4225004	853487	9573	762810	1909269	466507	632236	60714
14	Pet. Prod. non-combustable	0	0	0	0	0	0	0	0
25	Coal Electricity	0	0	0	0	0	0	0	0
26	Other Thermal Electricity	0	0	0	0	0	0	0	0
27	Hydro Electricity	0	0	0	0	0	0	0	0
28	RES & Nuc	0	0	0	0	0	0	0	0

Hybrid Energy IO Table 2015-16		17	18	19	20	21	22	23	24
		Non-metallic Mineral prods.	Iron and Steel	Aluminium	Other non-ferrous basic metals	Machinery	Transport Equipment	Industry NEC	Construction and construction services
Total Emissions (t CO2e)									
3	Biomass	1101	0	0	0	0	0	64	0
5	Coal and lignite	49651919	144916685	14794472	9020679	21417115	311879	11324046	555610
6	Crude petroleum	0	0	0	0	0	0	0	0
7	Natural gas	0	0	0	0	0	0	0	0
13	Pet. Prod. combustable	177407	10603898	107806	141724	561786	1567282	260309	2440642
14	Pet. Prod. non-combustable	0	0	0	0	0	0	0	0
25	Coal Electricity	0	0	0	0	0	0	0	0
26	Other Thermal Electricity	0	0	0	0	0	0	0	0
27	Hydro Electricity	0	0	0	0	0	0	0	0
28	RES & Nuc	0	0	0	0	0	0	0	0

Hybrid Energy IO Table 2015-16		25	26	27	28	29	30	31	32
		Coal Electricity	Other Thermal Electricity	Hydro Electricity	RES & Nuclear Electricity	Railway Transport	Land transport	Water Transport	Air transport
Total Emissions (t CO2e)									
3	Biomass	0	0	0	16715	0	0	0	0
5	Coal and lignite	867441977	799214	1380437	1852955	8788541	0	0	0
6	Crude petroleum	0	0	0	0	0	0	0	0
7	Natural gas	0	0	0	0	0	0	0	0
13	Pet. Prod. combustable	34313765	8576691	1292728	2227905	3754355	93076218	688735	4669526
14	Pet. Prod. non-combustable	0	0	0	0	0	0	0	0
25	Coal Electricity	0	0	0	0	0	0	0	0
26	Other Thermal Electricity	0	0	0	0	0	0	0	0
27	Hydro Electricity	0	0	0	0	0	0	0	0
28	RES & Nuc	0	0	0	0	0	0	0	0

Hybrid Energy IO Table 2015-16		33 Transport NEC	34 Commerce and public services	IIUSE	PFCE	GFCE	GFCF	CIS	Exports
Total Emissions (t CO2e)									
3	Biomass	0	0	18865	187277	0	0	0	0
5	Coal and lignite	0	53411894	1450391222	4448382	0	0	0	5199206
6	Crude petroleum	0	0	0	0	0	0	0	0
7	Natural gas	0	0	0	0	0	0	0	0
13	Pet. Prod. combustable	10336677	134149920	346174846	182574750	0	0	0	97725663
14	Pet. Prod. non-combustable	0	0	0	0	0	0	0	0
25	Coal Electricity	0	0	0	0	0	0	0	0
26	Other Thermal Electricity	0	0	0	0	0	0	0	0
27	Hydro Electricity	0	0	0	0	0	0	0	0
28	RES & Nuc	0	0	0	0	0	0	0	0

Hybrid Energy IO Table 2015-16		Valuables	Less Imports	TFUSE	Supply
Total Emissions (t CO2e)					
3	Biomass	0	0	187277	206142
5	Coal and lignite	0	473792598	-464145010	986246212
6	Crude petroleum	0	0	0	0
7	Natural gas	0	0	0	0
13	Pet. Prod. combustable	0	58242772	222057642	568232487
14	Pet. Prod. non-combustable	0	0	0	0
25	Coal Electricity	0	0	0	0
26	Other Thermal Electricity	0	0	0	0
27	Hydro Electricity	0	0	0	0
28	RES & Nuc	0	0	0	0

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