Energy Consumption and Carbon Dioxide Emission in Indian Organized Manufacturing Sector

Rahul Ranjan*

Abstract

The continued growth of energy consumption and carbon emission (CO_2) impacts adversely on the global environment in terms of greenhouse effects are focusing to revise the climate and energy policy. This study examines recent trends of energy consumption and CO_2 emission at manufacturing sector along with twenty manufacturing industries at the two digit level for the period 1998-99 to 2011-12. It is observed that energy consumption and carbon emission in absolute form have increased in the manufacturing sector in the last decade and CO_2 emission varies across manufacturing industries. This paper applies a total decomposition analysis to decompose energy consumption into activity, structural and intensity effect. This decomposition analysis shows that Nonmetallic Mineral Products and Basic Metals have low energy efficiency among the highest energy-intensive industry. To improve the energy efficiency among energy-intensive industry the National Mission on Enhanced Energy Efficiency comes under the eight missions of the National Action Plan on Climate Change has been formulated by the government of India.

1. Introduction

India has emerged an important economic power in the world arena. This was mainly on account of the liberalization of Indian economy and growing contribution of the services sector to its GDP. The consequence of a growing economy translates into growing demand for energy, particularly commercial energy. Energy is crucial to the production process and its abundant supply can create favorable conditions for growth, whereas energy scarcity will adversely affect both production and productivity. Commercial energy consumption in India has increased by more than three times during the last three decades[1]. The industrial sector is a major consumer of commercial energy (Kumar, 2003) accounts approximately 40 percent of total commercial energy consumption, whereas it contributes merely 20 percent to the economic growth.

Manufacturing sector consists of two distinct sections, one referred to as the registered sector consisting of factories registered under the Factory Act, 1948 and

*Research Scholar, Jawaharlal Nehru University, New Delhi.
Email : rkrahul555@gmail.com,

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1 *The total energy consumption of India was 143.13 million tonnes of oil equivalent (MTOE) for the year 1971 and that become 457.49 MTOE in 2010 according to IEA data base.*

it is also called as an organized manufacturing sector[2]. The second is an unregistered manufacturing sector or un-organized manufacturing sector. NSSO does not report the quantity of energy consumption by un-organized manufacturing industries and it is available after an interval of every five years. Keeping in view the data constraint for un-organized manufacturing sector this paper primarily focuses on the energy consumption by organized manufacturing sector and not by un-organized manufacturing sector.

The rest of the section follows as; Section II deals with the existing literature reviews. Section III discusses about research questions, data source and methodology. The patterns of energy consumption and CO_2 emission in India manufacturing sector is discussed in section IV. Section V analyses the patterns of energy intensity and emission intensity of manufacturing industries and also estimate the energy efficiency of manufacturing industries. Section VI is for a summary and conclusion of the paper.

2. Literature Review

There are wide ranges of studies those deals with the productivity, growth and employment in the Indian manufacturing sector. But there are only selected literatures on the carbon dioxide emission and energy efficiency in the Indian manufacturing sector or sub-sector of manufacturing industries.

Ray and Reddy (2007) have analyzed the trend of CO_2 emission and energy efficiency in Indian Manufacturing sector along with fourteen manufacturing industries for the period 1992 to 2002 using Centre for Monitoring Indian Economy (CMIE) data base. For the estimation of CO_2 emission they used four types of energy consumption, i.e. coal, electricity, gas and petroleum products. Ray and Reddy reported that there was increasing trend of CO_2 emission in the manufacturing sector. CO_2 emission was at 179 million tonnes in 1992 which increased more than two times and it reached at 310 million tonnes in 2002. The iron & steel industry is the biggest CO_2 emitter among fourteen manufacturing industries followed by chemical, textiles and cement industry and transport while beverage & tobacco industries are least CO_2 emitted. Further, they employed total differential method to decompose energy consumption into activity, intensity and structural changes. The decomposition result highlighted that the structural and intensity effects are negative over a period of time which indicated that the shift of output share of high energy-intensive to low energy-intensive industries.

Pradyot Jena (2009) attempted to analyze the changing patterns of energy consumption and energy efficiency in the Indian manufacturing sector along with six major energy-intensive industries, i.e. Food products, Textiles, Paper & pulp, Chemicals, Nonmetallic minerals and Basic Metals industries for the period 1992-93 to 2001-02 using ASI data base. Jena estimated energy consumption from the consumption of coal and electricity purchased by the industries. The energy intensity of the manufacturing sector as a whole or that of individual sub-sectors were calculated as a ratio of energy consumption to value added. It is found that there was a similar trend between energy consumption and energy intensity in the manufacturing sector. Energy intensity and energy consumption both have increased from 1992-93 to 1995-96 and then both had started declining.

Reddy and Ray (2011) analyzed the physical energy intensity and carbon emission of major industries, i.e. iron and steel, aluminium, textiles, paper, and cement during the period 1991 to 2005 using the CMIE data base. The analysis period further divided into three sub-periods; 1991 to 1995, 1995 to 2000 and 2000 to 2005. The total energy consumption in these industries is the summation of coal, electricity and petroleum products (liquid and gaseous) consumption. Reddy and Ray used energy intensity in physical term rather than monetary terms. Their analysis showed that energy intensity had fallen in iron and steel, paper, and cement whereas it had increased in textiles and aluminium in the period 1991 to 2005. The iron and steel was most emitter industry among five manufacturing industries followed by textile, cement, aluminium and paper industry. Coal contributed about 67% in total CO_2 emissions in iron and steel, aluminium, paper, and cement whereas it contributed only 4% in textile. In the textile industry, electricity contributed around 95% in total CO_2 emissions.

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2 *Organized manufacturing sector means a factor is registered under Factory Act, 1948 under section 2m(i) and 2m(ii). The section 2m(i) means ten or more than ten workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on with the aid of power, or is ordinarily so carried on, or (ii) wherein twenty or more workers are working, or were working on any day of the preceding twelve months and in any part of which a manufacturing process is being carried on without the aid of power, or is ordinarily so carried on.*

Sahu and Narayanan (2013) estimated carbon dioxide emission from fossil fuel consumption in the Indian manufacturing sector as well as in 17 manufacturing industries for the period 2000 to 2011 using CMIE data base. The emission analysis showed that the aggregate emissions in the Indian manufacturing sector had fluctuation over the period with an increasing trend from 2005 to 2011. Sahu and Narayanan reported that there was inter-firm variation in CO_2 emission as well as in emission intensity.

The other authors considered the different energy sources to measure the total energy consumption and carbon emission by the Indian manufacturing sector. Table 1 shows that the selected list of studies has been done so far with their results.

Table 1: List of Selected Studies

Author	Energy Sources	Database/Period	Industry	Results
Ray and Reddy (2007)	Coal, Electricity, Gas and Petroleum	CMIE (1992 to 2002)	Fourteen Manufacturing Industries	The iron & steel industry is the biggest CO_2 emitter among fourteen manufacturing industries followed by chemical, textiles and cement
Mukherjee (2008)	Coal and Electricity	ASI (1998-99 to 2003-04)	Six Major Energy-Intensive Industries	Energy intensity in the manufacturing sector increased over 1998-99 to 2000-01 and declined thereafter.
Ray and Reddy (2008)	Coal, Electricity, Gas and Petroleum Products	CMIE (1990 to 2005)	Five Manufacturing Industries	Coal contributed more than 68% of total energy consumption in the manufacturing sector as well as all five manufacturing industries except textile.
Jena (2009)	Coal and Electricity	ASI (1992-93 to 2001-02)	Six Major Energy-Intensive Industries	Energy intensity and energy consumption both have increased from 1992-93 to 1995-96 and then both had started declining.
Sahu and Narayanan (2010)	Coal, Electricity and Petroleum Products	Prowess database (1990 to 2008)	Nine Manufacturing Industries	The trend of energy consumption seemed like 'U' shape and inverted 'U' shape for energy intensity.
Reddy and Ray (2011)	Coal, Electricity and Petroleum Products	CMIE (1991 to 2005)	Five Manufacturing Industries	Energy intensity had fallen in iron & steel, paper and cement whereas it had increased in textiles and aluminium in the period 1991 to 2005.
Sahu and Narayanan (2013)	Fossil fuel Consumption	CMIE (2000 to 2011)	Seventeen Manufacturing Industries	Aggregate emissions in the Indian manufacturing sector had fluctuated over the period with an increasing trend from 2005 to 2011.

Source: Author's finding

3. Research Questions

This study attempts to provide a more detailed perspective on energy consumption, carbon emission, energy intensity and emission intensity at the Indian organized manufacturing sector for the period 1998-99 to 2011-12, which incorporates twenty manufacturing industries. Specifically, this paper analyzes the following research objectives;

(1) To estimate carbon emission in Indian organized manufacturing sector at the two-digit level.

(2) To examine the more energy-intensive and emission-intensive industries in the organized manufacturing sector.

(3) To estimate the energy efficiency of industries.

3.1. Database and Methodology

Database

The study is based on secondary sources of data and it is mainly focused to the Indian organized manufacturing sector. The data are taken from many different sources such as; Annual Survey of Industry (ASI) (unit level data of ASI for the period 1998-99 to 2011-12), Office of Economic Advisor, Reserve Bank of India (RBI), and International Energy Agency (IEA).

Methodology

For the estimation of carbon emission in India manufacturing sector Intergovernmental Panel on Climate Change (IPCC; 2006) guidelines or methods has been employed. To measure the energy efficiency of manufacturing industries the Total Decomposition Analysis (TDA) has been employed.

Method for estimating CO_2 emission from coal

CO_2 emission from coal consumption is estimated by taking into account the carbon emission factor of coal (25.8), the fraction of oxidized carbon of coal (1) and molecular weight ratio of carbon dioxide to carbon (3.667) using the guidelines of IPCC (2006). The CO_2 emission from the consumption of coal is obtained as;

$CE_c = CFE_c \times EF_c \times F_c \times M_c$

Where, CE_c = Carbon dioxide emission from coal

CFE_c= Conversion Factor for Energy from Coal

EF_c = Carbon emission factor of coal

F_c = Fraction of Oxidized carbon of coal

M_c= Molecular weight ratio of carbon dioxide to carbon

There are two other steps involved before using the above formula to calculate emission from coal. In the first step, unit of coal consumed are converted into million tonnes of oil equivalents (MTOE) and then in second step MTOE will be converted into energy conversion factor i.e. terajoule (TJ). For estimating emission from electricity at first electricity quantity, i.e. kilowatt hour (kWh) is converted into megawatt hour (mWh) then the emission factor of electricity is applied. The emission factor[3] of electricity is taken from Ministry of Power, Government of India.

4. Energy consumption and CO_2 emission in India Manufacturing Sector

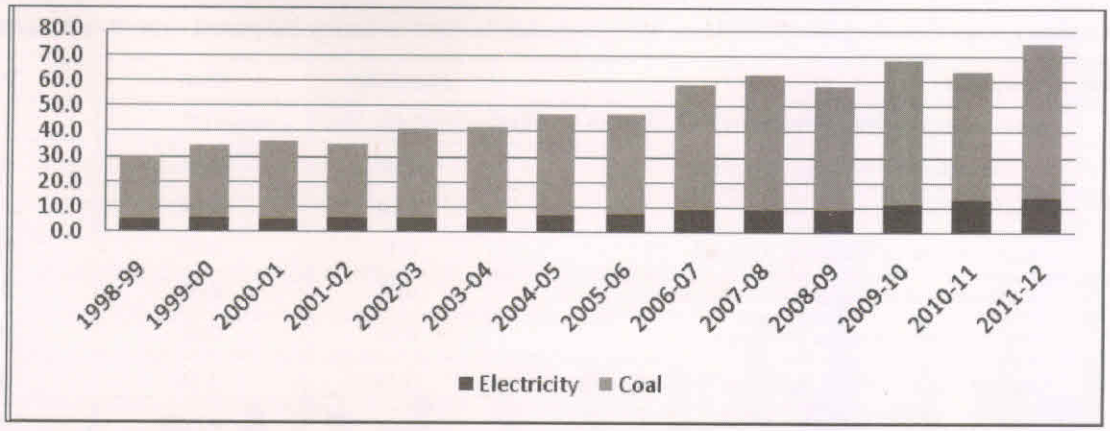
Coal and electricity are considered as a principal source of energy for the Indian manufacturing sector. Though, manufacturing sector also consumes other sources of energy, i.e. oil, gas and petroleum products. But ASI reports only both physical and monetary terms of coal and electricity consumption by the industry. ASI reported the data on fuel consumption by industry for a variety of fuels such as; coal, lignite, gas, and other fuel consumed with their monetary and quantity terms till 1996-97[4]. After 1996-97, ASI has been reporting data on fuel consumption into three broad categories; coal, electricity and petroleum products. For petroleum products ASI only provides data in monetary term not in quantity terms. Electricity data have been reported in two ways by ASI; electricity own generated and electricity purchased & consumed with monetary and quantity terms. If we consider the electricity own generated for the estimation of energy consumption then there will be problem of double counting because coal might have been used for electricity generation. Therefore, this paper only considers the quantity of electricity purchased & consumed and coal consumption to estimate the energy consumption. ASI reported the coal consumption in tonnes and electricity purchased & consumed in kWh. At first all units of energy are converted into million tons of oil equivalents (MTOE) by conversion factor used by IPCC (2006)[5]. The total energy consumption by manufacturing sector as well as manufacturing industries at two digit levels is presented in figure 1 and appendix A respectively.

3 *The emission factor of electricity is 0.86 tCO2/MWH. The emission factor of electricity is taken from Ministry of Power, Government of India.*

4 *For further detail see P. Jena (2009) paper, and Gupta and Sengupta (2012) paper.*

5 *Conversion factor of coal is 0.67 million tonnes of oil equivalent (MTOE) from one million tonnes coal and electricity conversion factor is 0.86 MTOE from 12000 million kWh.*

Figure 1: Energy Consumption (MTOE) in Manufacturing Sector



Source: Author's Calculation

The manufacturing sector is the single largest user of commercial energy in Indian industry (Kumar, 2003). In the last decade, consumption of coal and electricity[6] in the manufacturing sector has been growing rapidly. The consumption of coal recorded more than six percent an average annual growth while electrically recorded at about seven percent during the period 1998-99 to 2011-12[7]. Total energy consumption has been growing rapidly in the Indian manufacturing sector with minor fluctuation i.e. in year 2001-02, 2008-09 and 2010-11. The increase in energy consumption is basically accounted for growing manufacturing output in the economy. Manufacturing output has grown more than eleven percent at an average annual growth rate during 1998-99 to 2011-12 whereas energy consumption in the manufacturing sector has grown about eight percent average annual growth rate during the same period, which indicates that the positive relationship between growth of energy consumption and growth of output in the manufacturing sector.

At the two digit level[8] only few industry groups together consume more than ninety percent of total energy consumption[9] in the manufacturing sector. These industries are Manufacture of Basic Metals (27), Manufacture of Nonmetallic Mineral Products (26), Manufacture of Chemicals and Chemicals Products (24), Manufacture of Paper and Paper Products (21), Manufacture of Textiles (17) and Manufacture of Food Products (15). The Manufacture of Basic Metals (27) is dominating in energy consumption throughout the years (see appendix A). There is an another set of industries which primarily use electricity as a source of energy through these industries are not consuming coal directly as an input, but indirectly they may use coal as their input (see table 2). In another sense, these industries consume electricity more than coal to fulfill their energy requirement. These industries are Wearing Apparel (18), Leather & Footwear (19), Wood Products (20), Publishing & Printing (22), Coke & Refined Petroleum Products (23), Rubber & Plastic Products (25), Machinery & Equipment (29), Electrical Machinery &Apparatus (31), Medical & Optical Instruments (33), Motor Vehicles (34), Transport Equipment (35), and Furniture Manufacturing (36).

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6 *In this study, the consumption of electricity means electricity purchased and consumed by particular industry.*

7 *An average annual growth rate of coal consumption for the period 1999-00 to 2009-10 was 6.49% and that of electricity was 6.90%.*

8 *According to National Industry Classification (NIC) 2004, there are 15 to 37 industry groups at the two digit level come under manufacturing sector. This study only considers 20 manufacturing industries. To have consistency between NIC 04 and NIC 08 two industries (30 and 32 industry group) are dropped. The concordance has been done NIC 08 to NIC 04 which means that the industry specific name or code mentioned in NIC 04 is used.*

9 *Food Products (15), Textiles (17), Paper & Paper Products (21), Chemicals & Chemical products (24), Nonmetallic Mineral Products (26), and Basic Metals (27) together contributed more than 90% in total energy consumption by manufacturing sector as whole.*

10 *Organized Manufacturing sector has 206843 firms in the year 2010-11.*

Table 2: Average Energy Consumption by Manufacturing Industries

Average Energy Consumption (MTOE) by Manufacturing Industries during the period 1998-99 to 2011-12				
NIC Codes	Industries	Electricity	Coal	Total
15	Manufacture of Food Products	0.61	1.27	1.88
16	Manufacture of Tobacco Products	0.02	0.05	0.07
17	Textiles	1.14	2.63	3.77
18	Manufacture of Wearing Apparel	0.07	0.02	0.09
19	Manufacture of Leather & Footwear	0.05	0.03	0.08
20	Manufacture of Wood Products	0.05	0.04	0.09
21	Manufacture of Paper & Paper Products	0.23	3.14	3.37
22	Manufacture of Publishing & Printing	0.04	0.00	0.04
23	Manufacture of Coke & Refined Petroleum Products	0.15	0.04	0.19
24	Manufacture of Chemicals & Chemical products	0.88	4.39	5.27
25	Manufacture of Rubber & Plastic Products	0.32	0.28	0.6
26	Manufacture of Nonmetallic Mineral Products	0.78	13.79	14.57
27	Manufacture of Basic Metals	3.00	15.57	18.57
28	Manufacture of Fabricated Metal Products	0.18	0.17	0.35
29	Manufacture of Machinery & Equipment	0.18	0.07	0.25
31	Manufacture of Electrical Machinery & Apparatus	0.15	0.07	0.22
33	Manufacture of Medical & Optical Instruments	0.04	0.02	0.06
34	Manufacture of Motor Vehicles	0.21	0.01	0.22
35	Manufacture of Transport Equipment	0.08	0.01	0.09
36	Furniture Manufacturing	0.06	0.01	0.07

Source: Author's Calculation

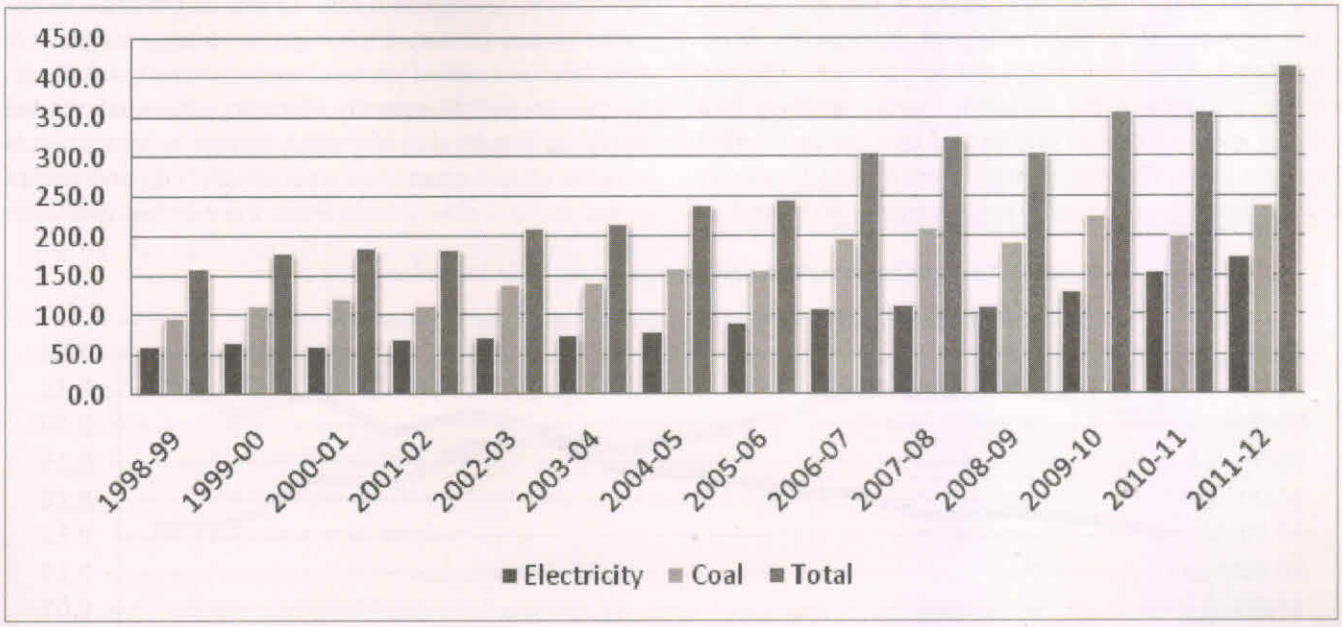
4.1. Carbon Dioxide Emissions in Indian Manufacturing Sector

India is among the leading industrialized countries of the world. The Indian industry encompasses more than two lacks organized manufacturing firms[10]and is the biggest employment creator sector that employs about 13 million people[11]. Therefore, industry will have to grow to meet the basic needs of rising populations. Consequently, the demand of energy in industry sector is going to increase further which lead to carbon dioxide (CO_2) emissions. The manufacturing sector is one of the most energy-intensive sectors in Indian industry, which accounts for about 80 percent of energy related CO_2 emissions (Ray and Reddy; 2008). In the manufacturing sector, food processing, textile, chemical, cement, iron & steel, nonmetallic mineral product and petroleum & coal products are more energy consuming industries. Manufacturing industries emit CO_2 directly via in-plant fossil fuel combustion (use of carbon-based materials) and indirect emissions are associated

11 *12544461 persons employed in the organized manufacturing sector for the year 2010-11.*

with electricity consumption for industrial purposes. For manufacturing sector approximately more than half of the CO_2 emissions comes from direct emissions[12] while the rest is associated with the use of electricity or indirect emission (see figure 2).

Figure 2: Total Emissions (million tons) in Manufacturing Sector



Source: Author's Calculation

Maintaining high economic growth, energy supply is of supreme importance. The energy basket is highly skewed with coal dominating and coal accounted more than 55% (Planning Commission; 2011) of the total energy supply in the country. Coal is the most important and abundant fossil fuel in India. The coal reserve in India estimated from the Geological Survey of India at 293.50 billion tonnes as on 1.4.2012 (Energy Statistics; 2013). Coal contributes 52% and 53% of the total energy supply in 2010 and 2011 respectively (TERI: 2013). In spite of a boom in renewable energy, coal still major source of energy consumption. For every tonnes of coal burned, at least three quarters of a tonnes of CO_2 emission are released. It also indicates that the development of emissions is a main cause for this strong growth in coal. The dominance of Coal continues to attribute to CO_2 emission in India as well as an Indian manufacturing sector[13].

At two digit level Manufacture of Basic Metals (27) industry has become the highest CO_2 emitter industry over the period of time, followed by Nonmetallic Mineral Products (26), Chemicals and Chemicals Products (24), Paper and Paper Products (21) and Textile industry (17) and Manufacturing of Food Products (15). Publishing and Printing (22) is the lowest CO_2 emitting industry amongst the selected list of the industries analyzed followed by Manufacture of Furniture (36), Manufacture of Other Transport Equipment (35), Manufacture of Motor Vehicles (34), Manufacture of Coke (23), Manufacturing of Wearing Apparel (18) and Manufacturing of Medical & Optical Instruments (33). With the expansion of industrial output, emissions by various industries have also been showing an increasing trend during the period of the study.

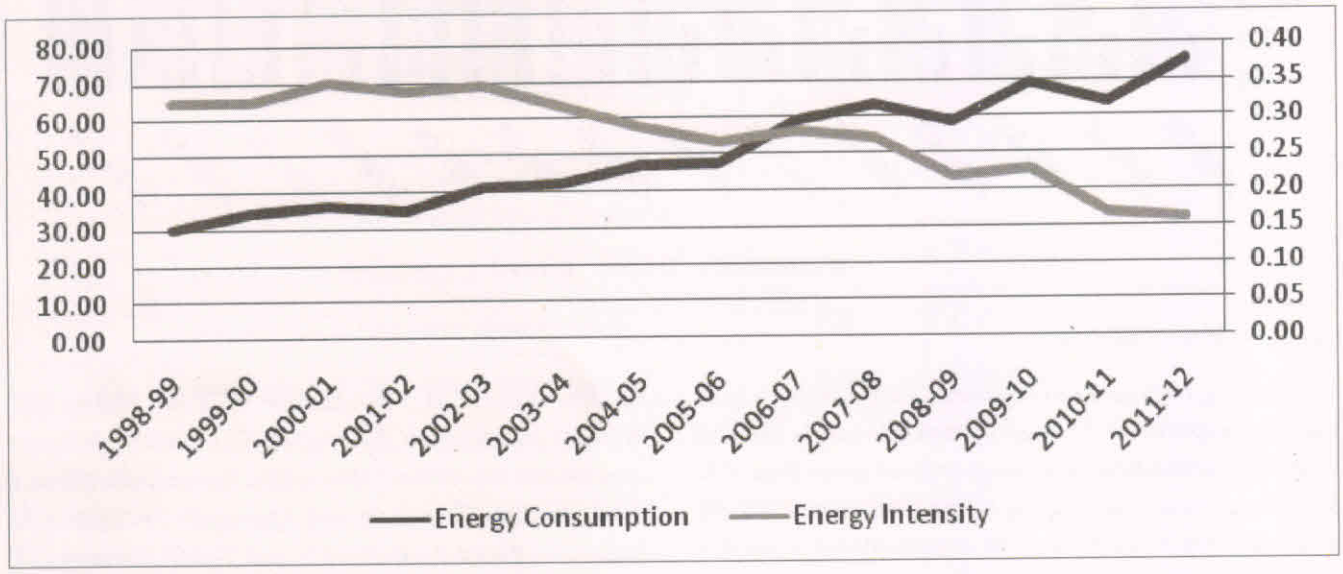
12 *Direct emission is associated with emission from fossil fuel (coal) combustion and indirect emission associated with electricity purchased by particular industry.*

13 *The emission from the consumption of coal has been estimated 1149.63 and 239.68 million tonnes in India and Indian manufacturing sector respectively in 2011-12.*

5. Energy Intensity, Emission Intensity and Energy Efficiency

Energy Intensity is a measure of how efficiently energy used in the economy to produce output. In other words, it is a measure to show how much energy resources are used to produce output. Some author's (Ray and Reddy, 2007, Goldar, 2010, and Sahu and Narayanan; 2010) considered energy intensity is the best proxy to measure energy efficiency of the industry. Energy intensity is a ratio of energy input to output and this can be divided into two parts; Physical energy intensity and Economic energy intensity. Physical Energy Intensity is defined as the physical amount of energy used to produce output. The economic, energy intensity is different from the physical energy intensity because it expresses the energy input and output in terms of monetary value. However, energy intensity can be defined in many ways such as; ratio of energy to an output, energy for industrial production, energy to value added and energy to the value of production. In this paper energy intensity is calculated in terms of physical energy intensity which can be measured as the quantity of energy consumed divided by the deflated value of output. Energy consumption is considered as tonnes of oil equivalent (TOE) and output value of Rs. Lakh. Whole Sales Price Index (WPI) for

Figure 3: Energy Consumption and Energy Intensity in Manufacturing Sector



Source: Author's Calculation

machinery and machine tools at 2004-05 prices are used as a deflector which is taken from the Office of Economic Advisor.

After the economic reforms, energy intensity has been declining in the Indian manufacturing sector and it continues to decrease further (Goldar, 2010). Energy intensity has fallen at the 5% per annum between 1992-93 to 2007-08 and there was no significant decline in energy intensity in the pre reform period, but in the post reform period it has continuously fallen down (Goldar; 2012). Between the periods of our study (1998-99 to 2011-12) energy intensity has declined at the rate 4.87% per annum in total manufacturing sector whereas output grown at the rate 12.24% per annum. On the other hand energy consumption has increased in the manufacturing sector in the same period (see figure 3). The several author's (Sahu and Narayanan, 2010, Sahu and Narayanan, 2011, Ray and Reddy, 2007, Goldar, 2010 and Goldar; 2012) found in their study that energy intensity is fallen and energy consumption has increased in the post reform period.

In general, energy intensity leads to emission intensity. The logic behind this story is that the high energy intensity can be through more energy requirement or low output value. The manufacturing output slightly declined only in two years, i.e. in 2000-01 and 2001-02[14] but after this

14 *During the period of study the output is declined at the rate 2.15 and 0.88 percent in the year 2000-01 and 2001-02 respectively.*

period the manufacturing output has been continuously rising so far. This highlights that high energy intensity is due to more consumption of energy or more energy is required to produce one unit of output. The requirement of high energy further leads to more emission and more emission intensity. However, emission intensity has been declining in the manufacturing sector. The decline in carbon intensity in the last decade is mainly driven by the decline in energy intensity in the manufacturing sector. In similar, the carbon intensity declined at the rate more than five per cent per year during the period 1998-99 to 2011-12. On the other hand energy intensity has also declined at the same rate, about five percent per year for the same period in the manufacturing sector. Therefore, there is a high correlation (0.99) (see table 3) between energy intensity and emission intensity. Table 3 shows that the industry, having high energy intensity also lead to more emission intensity e.g. Manufacture of Nonmetallic Mineral Products (26) has a high average energy intensity (2.35) which also dominates in terms of average emission intensity (10.30). The same scenario exists in the Manufacture of Paper & Paper Products (21), Manufacture of Basic Metals (27), and Manufacture of Chemicals & Chemical products (24) industries and other manufacturing industries (see table 3). The emission and energy intensity has declined in all industries in manufacturing industries over the 1998-99 levels.

Table 3: Average Energy and Emission Intensity by Manufacturing Industries

Average Energy and Emission Intensity by Manufacturing Industries from 1998-99 to 2011-12			
NIC Codes	**Firms**	**Energy Intensity**	**Emission Intensity**
15	Manufacture of Food Products	0.074	0.480
16	Manufacture of Tobacco Products	0.051	0.307
17	Manufacture of Textiles	0.280	1.787
18	Manufacture of Wearing Apparel	0.027	0.274
19	Manufacture of Leather & Footwear	0.046	0.400
20	Manufacture of Wood Products	0.123	0.903
21	Manufacture of Paper & Paper Products	1.318	5.888
22	Manufacture of Publishing & Printing	0.029	0.327
23	Manufacture of Coke & Refined Petroleum Products	0.008	0.083
24	Manufacture of Chemicals & Chemical products	0.238	1.259
25	Manufacture of Rubber & Plastic Products	0.099	0.794
26	Manufacture of Nonmetallic Mineral Products	2.351	10.301
27	Manufacture of Basic Metals	0.787	4.066
28	Manufacture of Fabricated Metal Products	0.067	0.536
29	Manufacture of Machinery & Equipment	0.029	0.271
31	Manufacture of Electrical Machinery & Apparatus	0.030	0.288
33	Medical & Optical Instruments	0.019	0.203
34	Motor Vehicles	0.020	0.229
35	Transport Equipment	0.021	0.222
36	Furniture Manufacturing	0.019	0.171
Correlation between energy and emission intensity is 0.99			

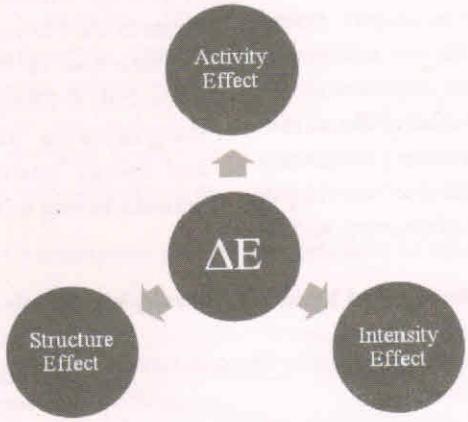
Source: Author's Calculation

5.1.Decomposition of Energy Consumption Change

The decomposition methodology is a process of time series modeling that represents the trend, cyclical and seasonal effect. There are two common methods for energy decomposition analysis; multiplicative decomposition and additive decomposition or energy consumption and energy intensity approach. The energy intensity approach has the advantage of time series analysis because its estimation is expressed in indexes so that easy for interpretation. On the other hand the result of the energy consumption decomposition method is presented in energy units which can be easily

understood by non-specialists. Differences between multiplicative and additive forms are minor for both the energy consumption and energy intensity decomposition method. But multiplicative forms are superior to the additive forms for studying the energy elasticity approach (Kumphai; 2006).

In this paper, we simply use the Total Decomposition Analysis (TDA): the three conventional factor cases. TDA decomposes energy consumption into three components; activity effect, structural effect and intensity effect (see below chart).



Activity Effect (AE): The effect captures the additional energy demand of increased economic activity. In other words, activity effect captures the overall changes in the output of the manufacturing sector.

Structural Effect (SE): The structural effect captures the effect of changing shares of manufacturing output of different manufacturing industries. This effect measures improvement in the efficient energy management, changes in technology and energy efficiency improvement. If this effect is negative, which imply improvement in energy use and positive effect leads to worsening energy efficiency.

Intensity Effect (IE): The intensity effect captures the effect of changing energy per unit output in each manufacturing industry.

The mathematical forms of TDA can be written as;

E= = =

and

Total Effect; $E^T - E^0 = \Delta E_{tot} = \Delta E_{act} + E_{str} + \Delta E_{int}$

Activity Effect; ΔE_{act} =

Structural Effect; ΔE_{str} =

Intensity Effect; ΔE_{int} =

$W_i = E_i^T - E^0_i / \ln E_i^T - \ln E_i^0$

Where,

E = Total energy consumption by the manufacturing sector

Q = Overall activity level (output level) by the manufacturing sector

E_i = Energy Consumption of industry i

Q_i = Activity level (output level) of industry i

S_i = Activity share (output share of industry i in manufacturing sector) of industry i

I = Energy Intensity of the industry I

Table 4: Result of Decomposition Analysis

NIC Codes	Industry	Changes			Share in total effect (%)		
		AE	SE	IE	AE	SE	IE
15	Food Products	3.13	-0.68	-1.36	4.16	-1415.3	4.36
16	Tobacco Products	0.07	-0.04	-0.02	0.10	-90.5	0.05
17	Textiles	5.95	-2.13	-0.02	7.91	-4420.5	0.07
18	Wearing Apparel	0.11	-0.01	-0.01	0.14	-25.1	0.03
19	Leather & Footwear	0.11	-0.03	-0.05	0.15	-67.4	0.17
20	Wood Products	0.10	0.02	-0.07	0.13	39.9	0.22
21	Paper & Paper Products	4.58	-0.84	-2.86	6.09	-1737.9	9.18

22	Publishing & Printing	0.06	-0.02	0.00	0.08	-45.4	0.01
23	Coke & Refined Petroleum Products	0.92	0.60	-0.64	1.23	1248.9	2.06
24	Chemicals & Chemical products	7.55	-3.41	-1.03	10.04	-7054.8	3.30
25	Rubber & Plastic Products	1.15	-0.09	-0.44	1.53	-189.1	1.40
26	Nonmetallic Mineral Products	21.62	0.26	-9.59	28.75	534.1	30.81
27	Basic Metals	27.96	6.16	-13.92	37.18	12767.9	44.68
28	Fabricated Metal Products	0.47	0.08	-0.36	0.62	158.7	1.16
29	Machinery & Equipment	0.39	-0.05	-0.13	0.52	-101.8	0.40
31	Electrical Machinery & Apparatus	0.30	0.01	-0.18	0.40	12.8	0.56
33	Medical & Optical Instruments	0.08	0.05	-0.05	0.11	113.6	0.16
34	Motor Vehicles	0.38	0.14	-0.10	0.50	282.1	0.32
35	Transport Equipment	0.15	0.00	-0.10	0.20	9.3	0.31
36	Furniture Manufacturing	0.12	0.04	-0.23	0.16	80.5	0.74
Total		**75.20**	**0.05**	**-31.14**	**100.00**	**100.0**	**100.00**

Source: Author's Calculation.

Energy intensity has negative impact on changes in total energy consumption and this effect has also negative in all manufacturing industries. The real energy consumption is increased only 43.06 million tonnes, which is less than the increase in energy consumption due to activity level effects. On the other hand intensity effect has more important than the structural effect on changes in total energy consumption. Activity and structural effect have always influenced the consumption of energy while the intensity effect decreases the overall energy consumption. The intensity effect sometimes has an expansive effect and depression effect which means that due to activity effects have depressed the change in total energy consumption during the period of the study.

Activity effect has more among Basic Metals, Nonmetallic Mineral Products, Chemicals & Chemical products, Textiles, Paper & Paper Products and Food Products. Actually, these are highly energy-intensive industries which are affected more as changes in manufacturing output. During 1998-99 to 2011-12 there was a significant improvement in energy efficiency among Food Products, Tobacco Products, Textiles, Wearing Apparel, Leather & Footwear, Paper & Paper Products, Publishing & Printing, Chemicals & Chemical products, Rubber & Plastic Products and Machinery & Equipment and worst performance in terms of energy efficiency among Wood Products, Coke & Refined Petroleum Products, Nonmetallic Mineral Products, Basic Metals, Fabricated Metal Products, Electrical Machinery & Apparatus, Medical & Optical Instruments, Motor Vehicles, Transport Equipment and Furniture Manufacturing.

6. Conclusions

India is third largest consumer of primary commercial energy of the world ranked after China and US. The Indian economic growth is largely associated with the increased energy consumption. More than 50% of total energy need of India is met by only coal and the remaining is fulfilled by other energy sources which include the oil, gas, and non-conventional energy sources also. The study shows that the Indian manufacturing sector is a more dominating sector in terms of energy consumption and carbon emission in the Industry. The Indian organized manufacturing sector contributed about 16% in India's total final energy consumption and 22% India's total emission in 2009. In the manufacturing sector only a group of industries, i.e. Food Products, Textiles, Paper & Paper Products, Chemicals & Chemical products, Nonmetallic Mineral Products, Basic Metals are dominating in terms of energy consumption and carbon emission and they together contributed more than 90% of total energy consumption and carbon emission by the manufacturing sector.

Direct emission of CO_2 in the manufacturing sector amounted to 239.68 million tonnes and indirect emission at 175.56 million tonnes CO_2 indicates that the share of direct and indirect emission in total emission by manufacturing sector was 58% and 42% respectively in 2011-12. Descriptive analysis showed that there is fluctuation in the annual growth rate of energy consumption and carbon emission in the manufacturing sector as well as in manufacturing industries. The changes are not uniform across industries. The few industries have more growth rate than the manufacturing sector. However, the energy consumption and carbon emission in absolute form has been increasing while the energy and emission intensity has been declining in the manufacturing sector in the last decade. Moreover, energy and emission intensities have declined every year at the rate 5.23% and 4.99% respectively during the period of the study.

All high energy-intensive industries (Paper and Paper Products, Nonmetallic Mineral Products, and Basic Metals) do emit carbon emission more through direct sources rather than indirect sources. Basically, these industries have required more energy in the production process or more energy needed to produce one unit of output. On the other hand, the rest of less energy-intensive industries do emit emission more through indirect sources or electricity consumption except textile industry. Therefore, high energy-intensive industries are major carbon emitting industries. This study identified that Textiles, Paper & Paper Products, Nonmetallic Mineral Products, and Basic Metals industries are more emission-intensive industries in the Indian manufacturing sector. The changes in both intensities in the manufacturing sector are mainly due to structural changes, technological improvement and improvement in energy efficiency. It is well established facts that energy efficiency is one of the best instruments to decline carbon emission of the industry. Energy efficiency can be improved through;

- To maximize energy efficiency potential by replacing the old, inefficient processes with current best available/practice technologies.
- Shifting the pattern of fuel consumption to low carbon energy sources.
- To accelerate research on industrial carbon emission captures and rapidly demonstrates integrated industrial emission capture.
- To prevent the use of old and out-dated machines and emphasize the reuse and recycling of material.

A number of policies are required to achieve high energy efficiency in industry, falling into four broad categories; (a) standardized measurement and data capturing protocols are required to improve, (b) to identify barriers and develop approaches to improve energy efficiency technologies, (c) to incentive fuel-switching and more costly abatement options through appropriate financial incentives or regulations and (d) to provide government support to research, development and deployment efforts.

References

- Goldar, B. (2010): 'Energy Intensity of Indian Manufacturing Firms: Effect of Energy Prices, Technology and Firm Characteristics', Institute of Economic Growth University of Delhi, India.
- Goldar, B. (2012): 'Input Substitution and Technical Change in Indian Manufacturing, 1973-2007', The Journal of Industrial Statistics, Vol. 1, No. 2, pp. 169 – 181.
- Kumphai, Wisit. (2006): 'Energy Index Decomposition Methodology at the Plant Level', Ph. D dissertation submitted to the Oklahoma State University, United States.
- Kumar, Alok. (2003): 'Energy Intensity: A Quantitative Exploration for Indian Manufacturing', IGIDR, Working Paper, No.152.
- Mukherjee, K. (2008): 'Energy use Efficiency in the Indian Manufacturing Sector: An Interstate Analysis', Energy Policy 36 (2008), pp. 662–672.
- Ray, B. K. and Reddy, B. S. (2008): 'Understanding Industrial Energy use: Physical Energy Intensity changes in Indian Manufacturing Sector', IGIDR Working Paper-2008-011.
- Sahu, S. K. and Narayanan, K. (2010): 'Decomposition of Industrial Energy Consumption in Indian Manufacturing: The Energy Intensity Approach', MPRA Paper No. 21719.
- Sahu, S. K. and Narayanan, K. (2011): 'Total Factor Productivity and Energy Intensity in Indian Manufacturing: A Cross-Sectional Study', International Journal of Energy Economics and Policy, Vol. 1, No. 2, 2011, pp. 47-58.
- Sahu, S. K. and Narayanan, K. (2011): 'Determinants of Energy Intensity in Indian Manufacturing Industries: A Firm Level Analysis', Eurasian Journal of Business and Economics, No. 4 (8), pp. 13-30.
- Sahu, S. K. and Narayanan, K. (2013): 'Carbon Dioxide Emissions from Indian Manufacturing Industries: Role of Energy and Technology Intensity', Working Paper 82/2013, Madras School of Economics, India.
- Ray, S. (2012): 'Measuring and Decomposing Sources of Productivity Performance in India's Paper and Pulp Industry under Liberalized Regime: A Nonparametric Approach', International Journal of Economic Sciences and Applied Research, Vol. 5, issue. 1, pp. 147-171.
- ____ (2012), 'Teri energy data directory & yearbook', The Energy and Resource Institute, TERI Press, New Delhi, India.
- ____ (2008): 'National action plan on climate change', Government of India, New Delhi.
- ____ (2011): 'Low carbon strategies for inclusive growth: An interim report', Planning Commission, Government of India.
- ____ (2013): 'Energy statistics', Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

Appendix A: Total Energy Consumption by Manufacturing Industries

Total Energy Consumption in MTOE														
NIC Codes	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12
15	1.52	1.34	1.33	1.23	1.45	1.43	1.64	1.85	2.05	2.12	2.28	3.00	2.49	2.61
16	0.04	0.05	0.06	0.03	0.06	0.05	0.06	0.11	0.07	0.06	0.07	0.26	0.06	0.06
17	2.25	2.27	3.15	2.56	2.98	2.97	3.41	3.50	4.11	4.12	5.34	4.45	5.53	6.05
18	0.04	0.04	0.03	0.05	0.04	0.04	0.05	0.08	0.06	0.09	0.10	0.40	0.23	0.12
19	0.06	0.04	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.16	0.08	0.09
20	0.04	0.10	0.03	0.04	0.04	0.03	0.03	0.06	0.05	0.04	0.12	0.37	0.15	0.09
21	2.54	2.84	3.20	3.27	3.50	4.00	3.15	3.37	3.49	3.44	3.61	3.57	3.79	3.42
22	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.05	0.09	0.05	0.10	0.06	0.06
23	0.26	0.09	0.07	0.10	0.06	0.06	0.07	0.07	0.08	0.16	0.13	0.05	0.20	1.14
24	3.48	4.45	4.69	4.91	6.00	5.24	4.81	4.70	5.53	5.58	5.15	6.49	6.18	6.60
25	0.48	0.40	0.38	0.36	0.49	0.48	0.53	0.57	0.47	0.66	0.69	0.81	0.94	1.10
26	8.71	10.53	9.08	10.69	10.71	12.46	14.15	14.07	15.92	19.33	17.90	19.54	19.88	20.99
27	9.80	11.37	13.37	10.77	15.00	14.31	18.20	17.74	25.62	26.13	21.29	25.22	21.20	30.00
28	0.22	0.20	0.22	0.17	0.27	0.22	0.20	0.21	0.29	0.34	0.62	0.89	0.76	0.40
29	0.16	0.18	0.21	0.19	0.22	0.19	0.23	0.23	0.27	0.25	0.23	0.46	0.32	0.38
31	0.14	0.09	0.09	0.10	0.11	0.10	0.13	0.12	0.38	0.16	0.20	0.98	0.30	0.27
33	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.06	0.31	0.12	0.11
34	0.09	0.14	0.14	0.13	0.14	0.18	0.21	0.20	0.23	0.25	0.26	0.23	0.48	0.51
35	0.07	0.06	0.09	0.07	0.08	0.08	0.08	0.10	0.11	0.07	0.08	0.10	0.15	0.13
36	0.12	0.04	0.04	0.04	0.04	0.04	0.04	0.06	0.05	0.05	0.06	0.33	0.05	0.05
Manu	30.11	34.30	36.34	34.84	41.34	42.05	47.15	47.21	58.97	63.07	58.42	69.03	64.01	75.31

Source: Author's Calculation

Appendix B: Total Carbon Dioxide Emission by Manufacturing Industries

Carbon Dioxide Emission (million tonnes) by industry groups at two digit level														
NIC Codes	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12
15	9.38	8.86	8.61	8.29	9.31	9.30	10.53	11.61	12.98	13.63	14.35	19.45	17.03	18.51
16	0.22	0.27	0.32	0.19	0.30	0.29	0.29	0.53	0.39	0.35	0.40	2.39	0.37	0.35
17	15.13	16.26	19.56	16.93	18.82	19.26	21.42	22.94	27.91	27.47	32.26	23.44	35.40	37.80
18	0.37	0.36	0.36	0.41	0.42	0.43	0.54	0.77	0.65	0.81	1.09	4.25	1.80	1.28
19	0.46	0.36	0.45	0.49	0.53	0.51	0.56	0.57	0.63	0.66	0.72	1.47	0.83	0.87
20	0.29	0.46	0.25	0.27	0.27	0.28	0.28	0.39	0.43	0.36	1.01	3.87	1.43	0.74
21	11.64	12.76	14.18	14.33	15.44	17.35	14.07	14.89	15.35	15.48	16.52	15.38	17.81	16.73
22	0.30	0.30	0.30	0.34	0.35	0.34	0.40	0.48	0.54	0.72	0.58	1.13	0.69	0.74
23	2.24	0.98	0.82	1.17	0.65	0.64	0.84	0.86	0.89	1.32	1.29	0.52	2.00	12.14
24	20.18	24.79	24.65	26.55	30.31	27.07	25.43	25.32	28.93	29.70	26.64	32.23	33.09	34.67
25	3.37	3.11	2.98	3.11	3.64	3.81	4.39	4.47	4.52	5.74	6.07	5.63	8.04	9.73
26	38.75	46.57	40.03	46.80	47.12	54.33	60.98	61.12	69.40	84.16	79.02	84.18	88.03	93.40
27	50.14	57.66	65.64	58.90	76.48	74.54	91.39	93.46	129.86	132.90	114.28	128.38	122.29	158.70
28	1.84	1.58	1.72	1.53	1.99	1.73	1.74	1.90	2.59	3.06	4.11	6.90	5.52	4.06
29	1.57	1.70	1.80	1.67	1.81	1.80	2.05	2.15	2.51	2.60	2.43	4.91	3.09	4.26
31	1.29	0.96	0.93	1.08	1.15	1.04	1.21	1.32	4.06	1.74	2.19	6.03	3.37	3.02
33	0.24	0.15	0.16	0.16	0.17	0.18	0.18	0.22	0.22	0.26	0.72	1.97	1.41	1.23
34	1.04	1.59	1.51	1.43	1.59	1.80	2.37	2.31	2.68	3.00	3.08	2.52	5.58	5.78
35	0.74	0.71	0.82	0.72	0.77	0.79	0.89	1.03	1.17	0.87	0.91	1.18	1.53	1.48
36	0.67	0.37	0.38	0.41	0.35	0.37	0.43	0.53	0.50	0.52	0.62	3.91	0.58	0.58
Manu	160.51	180.20	185.99	185.21	211.97	216.44	240.48	247.40	306.75	325.86	306.01	358.30	357.65	415.24

Source: Author's Calculation

Appendix C: Energy Intensity by Manufacturing Industries

Energy Intensity (Energy Consumption 'TOE'/Output Value) at two digit level														
NIC Codes	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12
15	0.091	0.073	0.078	0.074	0.075	0.074	0.079	0.084	0.079	0.072	0.072	0.086	0.056	0.047
16	0.034	0.042	0.045	0.032	0.044	0.042	0.045	0.085	0.053	0.051	0.041	0.141	0.029	0.025
17	0.250	0.222	0.299	0.283	0.311	0.286	0.302	0.282	0.270	0.283	0.365	0.266	0.247	0.249
18	0.022	0.019	0.018	0.028	0.020	0.022	0.022	0.031	0.020	0.030	0.022	0.074	0.036	0.019
19	0.063	0.042	0.048	0.054	0.056	0.049	0.052	0.044	0.047	0.035	0.035	0.060	0.031	0.030
20	0.196	0.375	0.130	0.094	0.118	0.087	0.077	0.120	0.105	0.062	0.060	0.116	0.117	0.067
21	1.614	1.611	1.476	1.730	1.590	1.817	1.366	1.403	1.389	1.094	1.033	0.950	0.771	0.613
22	0.027	0.023	0.022	0.027	0.025	0.025	0.026	0.025	0.026	0.044	0.030	0.053	0.024	0.025
23	0.045	0.013	0.008	0.009	0.004	0.003	0.003	0.003	0.002	0.004	0.003	0.001	0.004	0.015
24	0.213	0.239	0.256	0.291	0.336	0.271	0.225	0.201	0.221	0.211	0.209	0.274	0.213	0.172
25	0.132	0.106	0.118	0.100	0.124	0.108	0.100	0.113	0.078	0.096	0.082	0.076	0.074	0.073
26	2.824	2.610	2.404	2.842	2.711	2.884	2.708	2.640	2.368	2.312	1.732	1.805	1.650	1.420
27	0.943	0.952	1.237	1.022	1.120	0.839	0.732	0.720	0.804	0.715	0.515	0.586	0.397	0.436
28	0.089	0.084	0.088	0.073	0.098	0.068	0.051	0.043	0.045	0.040	0.073	0.097	0.059	0.027
29	0.030	0.033	0.042	0.038	0.040	0.033	0.031	0.025	0.027	0.020	0.016	0.032	0.017	0.018
31	0.039	0.025	0.029	0.031	0.030	0.025	0.029	0.019	0.043	0.018	0.018	0.076	0.018	0.016
33	0.033	0.017	0.022	0.018	0.019	0.018	0.017	0.021	0.017	0.016	0.009	0.037	0.013	0.013
34	0.024	0.026	0.030	0.027	0.022	0.024	0.014	0.017	0.018	0.018	0.018	0.012	0.020	0.016
35	0.033	0.024	0.035	0.023	0.025	0.022	0.019	0.020	0.020	0.015	0.014	0.015	0.016	0.012
36	0.084	0.019	0.030	0.019	0.019	0.014	0.013	0.013	0.009	0.009	0.010	0.024	0.007	0.005
Manu	0.322	0.323	0.350	0.338	0.344	0.315	0.287	0.265	0.281	0.270	0.219	0.228	0.168	0.160

Source: Author's Calculation

Appendix D: Emission Intensity by Manufacturing Industries

Emission Intensity (CO_2 emission/Value of Output 'million') at two digit level														
NIC Codes	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12
15	0.560	0.485	0.505	0.497	0.477	0.481	0.508	0.526	0.503	0.461	0.453	0.555	0.380	0.330
16	0.188	0.208	0.229	0.178	0.227	0.225	0.234	0.408	0.290	0.279	0.232	1.273	0.171	0.153
17	1.682	1.588	1.859	1.873	1.964	1.850	1.899	1.847	1.829	1.886	2.207	1.398	1.579	1.556
18	0.228	0.197	0.190	0.256	0.206	0.235	0.223	0.288	0.230	0.271	0.239	0.788	0.286	0.200
19	0.469	0.349	0.391	0.421	0.469	0.418	0.445	0.386	0.406	0.317	0.343	0.568	0.320	0.294
20	1.378	1.801	0.958	0.720	0.834	0.728	0.670	0.823	0.823	0.573	0.500	1.199	1.087	0.548
21	7.400	7.238	6.550	7.576	7.005	7.878	6.106	6.198	6.110	4.926	4.723	4.096	3.625	3.003
22	0.321	0.268	0.265	0.318	0.297	0.291	0.308	0.296	0.306	0.360	0.351	0.627	0.280	0.291
23	0.387	0.138	0.090	0.102	0.040	0.034	0.035	0.030	0.026	0.034	0.031	0.011	0.036	0.163
24	1.234	1.330	1.345	1.572	1.697	1.402	1.188	1.086	1.157	1.125	1.081	1.362	1.139	0.906
25	0.935	0.812	0.911	0.864	0.923	0.861	0.828	0.878	0.750	0.833	0.717	0.527	0.631	0.649
26	12.564	11.543	10.595	12.447	11.927	12.568	11.671	11.465	10.325	10.067	7.645	7.776	7.306	6.319
27	4.824	4.831	6.074	5.587	5.713	4.371	3.678	3.792	4.077	3.635	2.764	2.981	2.290	2.307
28	0.749	0.658	0.678	0.642	0.724	0.530	0.441	0.386	0.395	0.362	0.482	0.749	0.432	0.272
29	0.292	0.318	0.357	0.336	0.339	0.306	0.279	0.235	0.246	0.206	0.168	0.341	0.169	0.205
31	0.367	0.269	0.298	0.329	0.315	0.276	0.276	0.202	0.456	0.191	0.196	0.467	0.206	0.177
33	0.381	0.197	0.249	0.199	0.215	0.197	0.188	0.223	0.186	0.177	0.104	0.230	0.157	0.146
34	0.272	0.299	0.311	0.307	0.254	0.239	0.163	0.198	0.210	0.210	0.206	0.127	0.225	0.184
35	0.352	0.263	0.322	0.255	0.249	0.228	0.200	0.214	0.212	0.177	0.159	0.172	0.169	0.143
36	0.478	0.177	0.277	0.182	0.177	0.141	0.128	0.123	0.101	0.097	0.104	0.281	0.078	0.053
Manu	1.718	1.697	1.790	1.798	1.764	1.622	1.462	1.391	1.463	1.394	1.270	1.185	0.941	0.883

Source: Author's Calculation

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