INDUSTRIAL SECTOR ENERGY CONSUMPTION IN SELECTED CITIES OF TAMIL NADU, INDIA

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Abstract

Energy is the universal measure of all kinds of work and its consumption has an increasing trend worldwide. The combustion of fossil fuels like coal, petroleum oils and natural gas generates energy, which is mainly used for the improvement of the quality of life. These conventional fuels are depleted exponentially and so it is imperative to study the existing energy users, consumption patterns and demand especially in urban areas for utilizing the energy efficiently. In this connection, the present investigation is carried out in Madurai and Salem, the second and fifth largest and most densely populated cities in the state of Tamil Nadu, India. The energy consumers are identified in these cities and they are categorized as industrial sectors. The energy demand of these sectors is quantified and the energy consumption for all these sectors is studied. The variations in energy utilization are assessed by adopting cluster sampling method and the results are discussed in this paper. As the energy demand and environmental deterioration are in increasing trend, it is concluded that the implementation of energy consumption that includes the execution of energy conservation measures and utilization of renewable energy sources are essential not only to match the demand and supply of energy but also to safe guard the health and wealth of the inhabitants in Madurai and Salem cities.

Keywords: Energy; industry; consumption;

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Introduction

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever-increasing energy needs requiring huge investments to meet them.[1]. Nowadays, we are

totally dependent on an abundant and uninterrupted supply of energy for living and working. It is a key ingredient in all sectors of modern economics [2]. An integrated approach for (i) providing uninterrupted supply of energy, (ii) promoting energy conservation and (iii) minimizing total energy costs would be the focus of this paper.

The energy industry is primarily controlled and governed by leading countries like USA, France, Russia, China and India. The energy industry comprise of energy sources like biomass, electricity, hydrogen, hydro power, natural gas, coal, nuclear power, petroleum, solar power and power wind. The energy industry is principally dependent on fossil fuel energy sources. Energy industry encompasses all the associated sub industries like petroleum industry, gas industry, electrical power industry, nuclear power industry, and unconventional energy industry [3]

Objectives

The present study has the following objectives: i) Identification of present Energy sources utilized in industrial sector(type wise), ii) Quantification of overall energy usage in the industry sector and iii) analyzing and comparing type-wise energy consumption and its expenditure in the industry sector.

Methodology

Designing a suitable methodology and selection of analytical tools are important for a meaningful analysis of any research problem. This section is devoted to describe the methodology, which includes choice of study area, sampling procedure, period of study, collection of data, method of analysis and tools of analysis

Choice of the study area

The area chosen for the present study are two cities namely Madurai and Salem which are second and fifth big cities in terms of population in Tamilnadu. Both the cities are corporations, which have major industries and trading centers. Another important feature is the significantly higher work force that the cities are supporting in the non-agricultural sector, 40 percent of this work force is occupied by this sector as against 45 to 55 percent in the respective cities. However, on the whole, the population, households, and workforce occupied in these two cities

indicate the high-energy consumption in industrial sector. With this background, the energy consumption pattern was examined for the cities Madurai and Salem.

Sampling Procedure

Madurai city comprises of 72 wards. For the purpose of primary data collection, the Madurai city has been classified into four zones namely, North, East, South, and west zones. The wards 1 to 21 are in North zone, 44 to 59 are in East zone, 31 to 43 and 60 to 65 are in south zone, and 22 to 30 and 66 to 72 wards are in the west zone. The number of wards in each zone is 21, 16, 19, and 16 in North, East, South, and West Zones respectively. 37 industries, like handloom, brick kilns and rice mills.

Salem city comprised of 60 wards. For the purpose of primary data collection, Salem city was classified into four zones namely east (zone 1), west (zone 2), North (zone 3) and South (zone 4). The number of wards in each zone is 14, 14, 16, and 16 from east, west, north, and south zones respectively. 51 industries, like silver factory, rice mill, cotton mill, and others.

Period of Study

The field survey was conducted from September 2012 to November 2013 for the collection of primary data. The reference period of the survey is 2012-2013

Collection of Data

The survey was based on personal interview/questionnaire. The schedule was a detailed one consisting of the name of the industry, industry type like Large, medium and small. type and quantity of the energy carrier used, etc. During the survey, the industry was asked to enumerate the energy carriers used for different end-uses, viz. product manufacturing, water-heating, lighting etc. The pattern of end-use of each carrier was studied by disaggregating the consumption in the industries according to manufacturing, water-heating, lighting etc. Since the survey contains questions only on the sole energy consumption of each energy carrier by the industries and not for a particular end-use) the desegregations was done while analyzing the results. Except in the case of electricity, the consumption of electricity is higher in summer because of the extensive use of high energy manufacturing equipments, fan, water heaters, refrigerators, and to some extent bulbs and tubes. The consumption of energy carriers was

determined as usage per month. In the case of LPG, the number of days a cylinder last was ascertained. Electricity consumption data was obtained from the Tamilnadu Electricity Board after ascertaining meter reading in a industries. Seasonal variations are negligible for other fuel which was confirmed by the response of industries sector.

Method and Tools of Analysis

Keeping in view the objectives of the study, the industrial sector has been categorized into type wise energy consumption pattern. In order to examine the difference in energy consumption analysis of variants (ANOVA) one-way test was carried out.

Results and Discussion

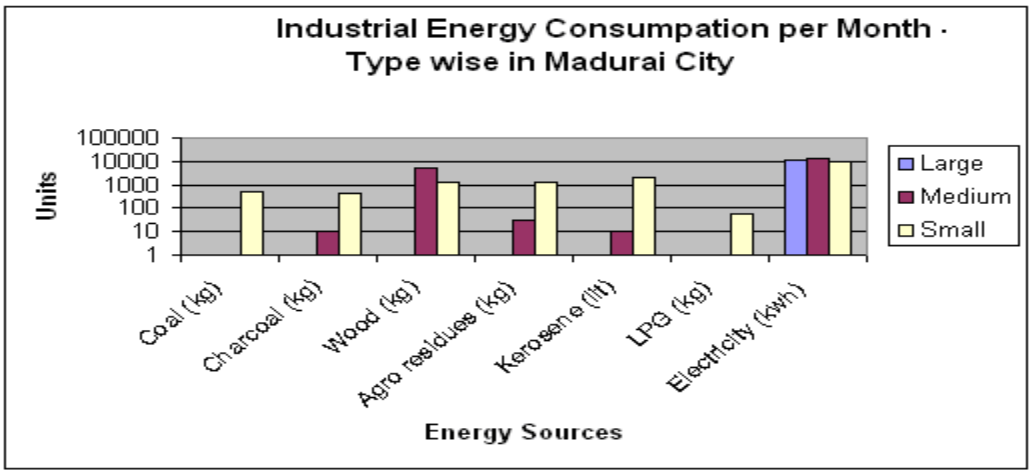
This section, an attempt has been made to analyze the type wise energy use pattern in industry sector

Usage of different energy sources sector type wise

In this section an attempt has been made to analyses the use pattern of different energy sources sector type wise namely large, medium and small in Madurai and Salem cities. Table provides conversion of energy sources into calories of energy.

Figure 1 and 2, give the details relating to type wise energy sources consumed by industrial sector in Madurai and Salem cities.

Figure 1: Industrial Sector: Energy Consumption per Month in Madurai City (Type Wise)



From the Figure 1, it has been observed that in the case of Large size industries in Madurai, total of 12000 kwh of electricity is consumed by Industries in the case of Medium size sector, maximum of 5200 kg of wood is consumed by industrial sector followed by 30kg of Agro residues is consumed by industries and 10 kg of charcoal of 10kg litres of kerosene is consumed by industrial sectors.

Further it also shown in the case of small size sector, maximum of 639 kwh of electricity is consumed by industries plumed by 2149 litres of kerosene is consumed by industries, 1350 kg of wood is consumed, 1300 kg of Agro residues is consumed by industries, 520 kg q coal is consumed by industries, 430 kg q charcoal is consumed by industries and 59.3 kg of 10 kg is consumed by industries respectively.

Figure 2: Industrial Sector: Energy Consumption per Month in Salem City (Type Wise)

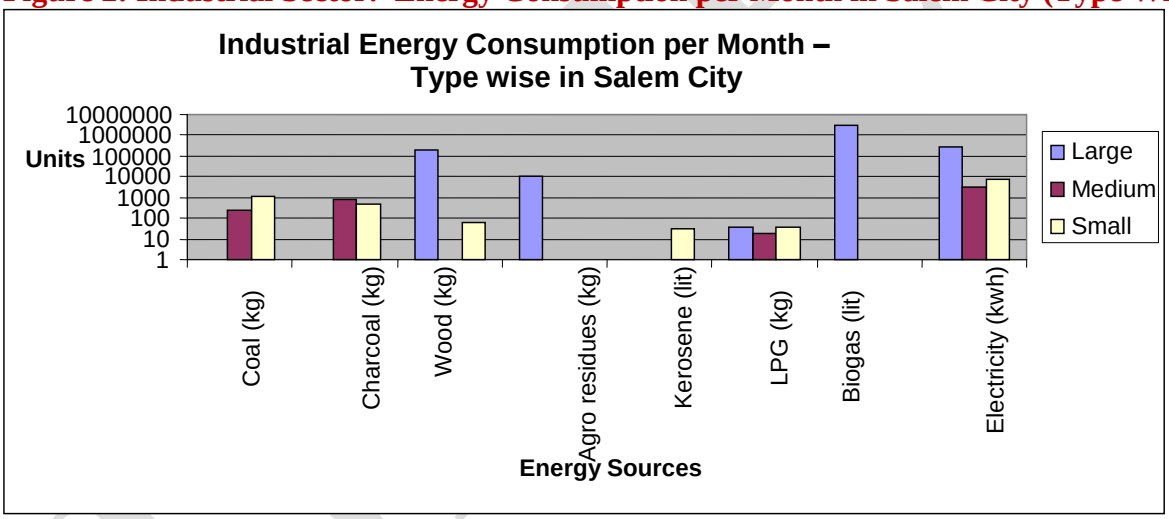


Figure 2 exhibits the type wise energy sources consumed by industrial sector in Salem. From the table 3.B.1.2, it has been revealed that in the case of large size industries in Salem, maximum of 3000000 litres of Biogas is consumed followed by 260265 kwh of electricity is consumed, 202000 kg of wood is consumed, 10000 by of Agro residues is consumed and 38.2 kg of LPG is consumed by the industries whereas in the case of Medium size industries, maximum of 2953 kwh of electricity is consumed followed by 820 kg of charcoal is consumed, 250 kg of coal is consumed and 19.1 kg of LPG is consumed. Further, it also shows that in the case of small size industries, maximum of 7913 kwh of electricity is consumed followed by 1220 kg of coal is consumed, 470 kg of charcoal is consumed, 60 kg of wood is consumed, 38.2 kg of LPG is consumed and 31 litres of Kerosene is consumed respectively.

Table 1: ANOVA Test: Energy Consumption in Industrial Sector Type Wise

In order to examine the variations in different types of energy consumption in different types industrial sector namely Lange, Medium and small between Madurai and Salem, Analysis of variance test has been applied and the results have shown in table 1

Particular	Madurai and Salem	Sum of Squares	df	Mean Square	F	Sig.
Coal: Cooking, Hot water and lighting/kg/m	Between Groups	1371.429	1	1371.429	.024	.883
	Within Groups	286200.000	5	57240.000		
	Total	287571.429	6			
Charcoal: Cooking, Hot water and lighting/kg/m	Between Groups	89491.126	1	89491.126	2.610	.132
	Within Groups	411430.303	12	34285.859		
	Total	500921.429	13			
Wood: Cooking, Hot water and lighting/kg/m	Between Groups	3188172683.333	2	1594086341.667	3.718	.067
	Within Groups	3858922408.333	9	428769156.481		
	Total	7047095091.667	11			
Agro Residues: Cooking, Hot water and lighting/kg/m	Between Groups	68753675.000	2	34376837.500	56.821	.093
	Within Groups	605000.000	1	605000.000		
	Total	69358675.000	3			
Kerosene: Cooking, Hot water and Lighting/Lit/,	Between Groups	17170.417	1	17170.417	.065	.802
	Within Groups	3698229.333	14	264159.238		
	Total	3715399.750	15			
LPG: Cooking, Hot water and lighting/kg/m	Between Groups	6.627	2	3.314	1.266	.356
	Within Groups	13.088	5	2.618		
	Total	19.715	7			
Electricity Consumption: Average units consumed (kwh)/m	Between Groups	6974289342.741	2	348714467.370	30.217	.000
	Within Groups	7962875403.204	69	115403991.351		
	Total	14937164745.944	71			

Source: Computed

According to table 1 it is found that there existed a significant variation in the consumption of electricity in industrial sector type wise. There is no evidence of significant variation in the use of coal, charcoal, wood, Agro residues, kerosene and LPG in different types of industrial sector between Madurai and Salem.

SUMMARY

Industrial sector type wise analysis of energy are pattern industrial sector showed that the large size industrial units has consumed a maximum of energy like wood, agro residues and big as whereas in the case medium size has consumed a maximum quantity of coal and charcoal. Small size units have consumed a maximum of LPG sources in both Madurai and Salem cities.

In order to examine the difference in consumption of energy in type wise between Madurai and Salem city industrial sector, ANOVA is carried out. The results showed that there existed a significant variation in the consumption of electricity alone between Madurai and Salem cities.

Conclusion

It is essential to define an Energy Policy for the nation that will give enough preparation, planning and induction time for all new sources of energy, to mature the technology and to make them economical. For this, a thorough knowledge and study of the prospects, economics, and long term environmental concerns due to implementation of various energy related technologies are necessary.

Considering the dwindling resources of petroleum based fuels it is essential to plan for alternate sources of fuel for transportation. The technology developments in alternate energy sources such as hydrogen, various types of fuel cells, gas-hydrates, methanol, bio fuels, and electric operated vehicles need to be trust. Appropriate level of assessment of switch over process from conventional fuel to alternate fuels is required to ensure economy, easy availability and public acceptance.

A systematic programme for the exploration and exploitation of gas hydrates may meet the ever-increasing requirement of energy for country like ours. On the other hand, it can reduce the environmental hazard, if exploited properly.

It is proposed that a broad based national consultation involving the R & D institutions, industries and the energy utilities be held early to prepare a hydrogen vision and a road map for the next few decades.

Significant technology development in nuclear fusion has taken place worldwide. This is a form of energy generation, which we have to be ready to harness in the future, when all other energy sources become dearer or even inaccessible. A programme for fusion energy needs to be developed in India.

The potential of Nuclear Energy to provide energy in the required form to meet all specific needs, mainly as grid based electricity generation but also for space and water heating, desalination of sea water to make potable water, non-grid based small nuclear power packs to supply electricity and energy at remote places etc. needs to be explored. New types of fuel and reactor configurations need to be evolved to have better performance and economics.

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