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Energy Sources and their Utilization in Service Sector in Selected Cities of Tamil Nadu, India

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Abstract:

In recent years, the population density and socioeconomic variables are the strongest predictors of energy use. The present world energy consumption primarily depends on the conventional fuels such as fossil fuel resources. The utilization of these fossil fuel resources is in increasing trend and therefore it is essential to investigate the existing energy usage, consumption pattern and demand, especially in urban areas of developing countries for efficient utilization and conservation of energy. Hence, the present paper deals about the dynamics of energy end-use in service sector in Madurai and Salem cities, Tamil Nadu, India. We have been examining the energy consumption pattern in the service sector through questionnaire survey and the energy demand has been calculated. Since the energy demand and environmental deterioration are in a rising trend, it is essential to frame the energy conservation measures and moreover shift to the renewable energy sources to overcome the energy demand in the Madurai and Salem cities.

Key words: Energy consumption; service sector; energy demand; energy conservation

1. Introduction

Energy is a basic and essential need to carry out each and every kind of activity in the Universe and also its sustainability. The economic development of a region or country is directly proportional to its energy consumption pattern. Energy demand increases as a consequence of economic growth and change in the consumption pattern, which in turn changes with respect to the energy source and its availability, conversion loss and efficiency of end-use [1]. During the past few decades, the energy consumption pattern in India has changed dramatically both in quantitative and qualitative manner, due to the alarming population growth and the increase of economic activity and development [2]. India ranks second in terms of population with 1210 million, according to the recent census which imposes significant energy and environmental problems viz. rapid depletion of fossil fuel reservoirs and the subsequent environmental degradation. India's energy generation capacity depends mostly on fossil fuels (70%), with coal accounting for 40%, followed by crude oil (24%) and natural gas (6%) [3].

According to the predictions, by 2030, India will be the largest dependence on fossil fuel imports to meet its huge energy demands and this dependence on energy imports is expected to exceed 53% of the country's total energy consumption. Moreover, the world primary energy demand will be increased by 50 percent between 2005 and 2030 and around 45% of this increase will have occurred in China and India [4]. It is worth to mention here that among the 1.6 billion people in the world whose lifestyle is in the absence of electricity [5], more than 1 billion people reside in India and China and the predominant them are in India. One of the largest energy consumers in India is the service sector, which indicates the importance of the service sector in the total national energy scenario. Because of the variation in the energy consumption pattern in service sector of India owing to diverse parameters, it is essential to analyze the energy sources and their consumption pattern to find out the energy demand in the service sector and ways to compensate the same in the near future.

The energy consumption in service sector, mainly depends on electricity generated by using fossil fuels for air conditioning, lighting, space heating, water pumping, cooking and moreover the same energy source is used for the maintenance of essential services. However, the drawbacks associated with the fossil fuels such as air pollution, global warming, and waste disposal problems, land degradation and the depletion of natural resources are changing the reliance on fossil fuels currently. Furthermore, the cheap supplies of oil appear to be running out. These trends are likely to continue and even accelerate throughout the 21st century. The consumers in

service sector have slowly shifted to adopt alternative energy sources with low-cost and environment friendly. However, the energy consumption is expected to increase in future in phase with the population growth, increase in the economy and rise in per capita incomes. Hence, it is necessary to analyze service sector energy consumption patterns in the cities of developing countries like India.

2. Objectives

The present study has the following objectives: i) assessment of energy sources usage in the service sector, ii) quantification of overall energy usage in the service sector and iii) analyzing and comparing type-wise energy consumption and its expenditure in the service sector.

3. Methodology

The methodology followed in this work includes a study area, sampling procedure, study period, data collection, method of analysis and tools of analysis.

- **Study Area**

The areas selected for the present study are Madurai and Salem, which are second and fifth big cities, respectively in the state of Tamil Nadu, India. Both the cities are corporations that are composed of 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 and workforce occupied in these two cities indicate the high-energy consumption in service sector. Based on these facts, the energy consumption pattern in the service sector was examined for both the cities.

- **Sampling Procedure**

Madurai city has 72 wards. For the purpose of primary data collection, the city was divided into four zones viz., north, east, south and west. The wards 1 to 21 are in the north zone, 44 to 59 are in the east zone, 31 to 43 and 60 to 65 are in the south zone, and 22 to 30 and 66 to 72 wards are in the west zone. The number of wards is 21, 16, 19 and 16 respectively in the north, east, south and west zones.

Salem city contains 60 wards. For the purpose of primary data collection, the city was divided into four zones, namely east, west, north and south. The number of wards is 14, 14, 16 and 16 respectively in the east, west, north and south zones.

- **Study Period**

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

- **Data Collection**

The survey was based on personal interview. The schedule was a detailed one consisting of the name of the owner and managers of banks, insurance companies, educational intuitions, cinema theaters and etc. During the survey, the representative person of the above said units was asked to enumerate the energy sources used for different end-uses, viz. air conditioning, lighting, cooking, water heating, etc. The pattern of end-use of each energy source was studied by disaggregating the energy consumption in the service sector according to different energy usage applications. Since the survey contained questions only on the sole energy consumption of each energy sources in the service sector (and not for a particular end-use), the desegregations was done while analyzing the results. The consumption of electricity was higher in summer because of the extensive use of fan, water heaters, and refrigerators and to some extent bulbs and tubes. In the case of LPG, one cylinder utilization duration was ascertained. Electricity consumption data was obtained from the Tamil Nadu Electricity Board after ascertaining meter reading in a service sector.

- **Method and Tools of Analysis**

The service sector was categorized into type wise energy consumption pattern. In order to examine the difference in energy consumption analysis of variants (ANOVA), one-way test was followed.

4. Results and Discussion

In this section, an attempt has been made to analyze the type wise energy use pattern in service sector.

- Type wise energy use pattern in service sector

This section attempts to analyse and compare the energy use pattern in service sector in Madurai and Salem cities. For the purpose of analysis, service sector has been classified under large, medium and small types. Figure 1 and 2 shows the usage of different types of energy in service sector of Madurai and Salem cities.

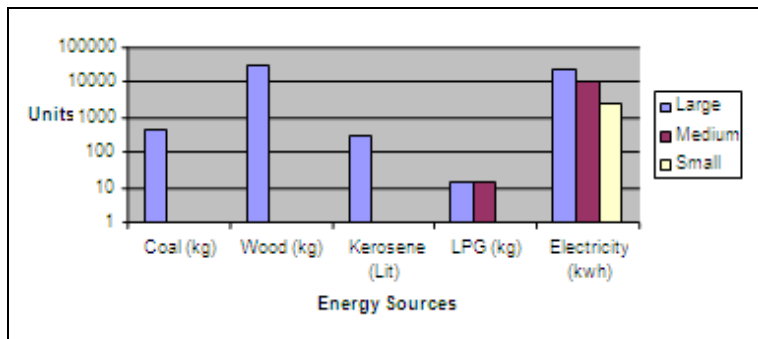


Figure 1: Type Wise Energy Consumption per Month in Service Sector of Madurai City

From Figure 1, it has been observed that in the case of large size service sector in Madurai, maximum of 23536 kwh of electricity, followed by 30475 kg of wood, 480 kg of coal, 302 liters of kerosene and 14.2 kg of LPG were consumed as sources of energy, whereas in the case of medium size service sectors, maximum of 10210 kwh of electricity and 14.2 kg of LPG were consumed as sources of energy. Further, it also shows that in the case of small size service sectors, 2520 kwh of electricity was consumed as source of energy.

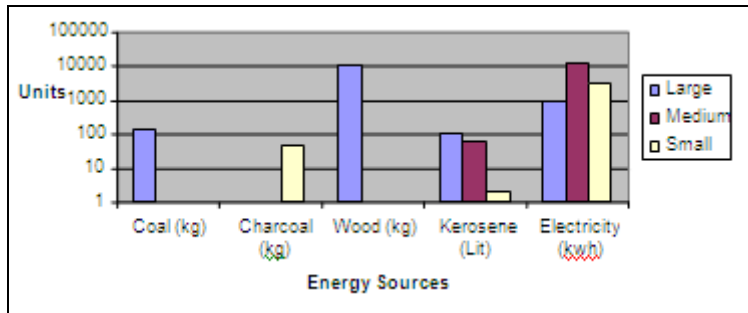


Figure 2: Type Wise Energy Consumption per Month in Service Sector of Salem City

From the Figure 2, it has been inferred that in the case of large scale service sector in Salem, maximum of 10,000 kg of wood, followed by 980 kwh of electricity, 150 kg of coal and 100 liters of kerosene were consumed as sources of energy whereas in the case of medium size service sector, maximum of 12970 kwh of electricity and 60 liters of kerosene were consumed as sources of energy. Further, it also shows that in the case of small size service sector, maximum of 3310 kwh of electricity, followed by 50 kg of charcoal and 2 liters of kerosene were consumed as sources of energy.

Table 1 and 2 shows the type wise usage of different energies (mega joules) in service sector of Madurai and Salem cities, respectively.

Particular	Large		Medium		Small		Total	
	Number of Respondents	Total Energy Consumption	Number of Respondents	Total Energy Consumption	Number of Respondents	Total Energy Consumption	Number of Respondents	Total Energy Consumption
Coal	4	13920	NU	NU	NU	NU	4	13920
Wood	5	451030	NU	NU	NU	NU	5	451030
Kerosene	4	10268	NU	NU	NU	NU	4	10268
LPG	1	633.3	1	633.3	NU	NU	2	1266.6
Electricity	11	84729.6	6	36756	16	9072	33	130557.6

Table 1: Type Wise Energy Consumption per Month in Service Sector of Madurai City (in Mega Joules).

Source: Survey Data

NU- Not in Use

It has been inferred from the table 1 that in the case of large size service sector in Madurai, maximum of 451030 Mega Joules of wood, followed by 84729.6 Mega Joules of electricity, 13920 Mega Joules of coal, 10268 Mega Joules of kerosene and 633.3 Mega Joules of LPG were consumed as sources of energy, whereas is the case of medium size service sector, maximum of 36756 Mega Joules of electricity and 633.3 Mega Joules of LPG were consumed as sources of energy. Further, it also shows that in the case of small size service sector, 9072 Mega Joules of electricity was consumed as source of energy.

Particular	Large		Medium		Small		Total	
	Number of Respondents	Total Energy Consumption	Number of Respondents	Total Energy Consumption	Number of Respondents	Total Energy Consumption	Number of Respondents	Total Energy Consumption
Coal	1	4350	NU	NU	NU	NU	1	4350
Charcoal	NU	NU	NU	NU	1	1400	1	1400
Wood	1	148000	NU	NU	NU	NU	1	148000
Kerosene	1	3400	2	2040	1	68	4	5508
Electricity	1	3528	5	46692	10	11916	16	62136

Table 2: Type Wise Energy Consumption per Month in Service Sector of Salem City (in Mega Joules).

Source: Survey Data

NU- Not in Use

It has been revealed from the table 2 that is the case of large size service sector, maximum of 148000 Mega Joules of wood, followed by 4350 Mega Joules of coal, 3528 Mega Joules of electricity 15 and 3400 Mega Joules of kerosene were consumed, whereas in the case of medium size service sector, maximum of 46692 Mega Joules of electricity and 2040 Mega Joules of kerosene were consumed as sources of energy. Further, it also infers that in the case of small size service sector, maximum of 11916 Mega Joules of electricity, followed by 1400 Mega Joules of charcoal and 68 Mega Joules of kerosene were consumed as sources of energy.

In order to examine the variation in type wise energy consumption in service sector between Madurai and Salem cities, ANOVA test was carried out. The computed results are given in table 3.

Particulars	Madurai and Salem	Sum of Squares	Df	Mean Square	F	Sig.
Kerosene: Cooking, Hot water and Lighting/Lit/,	Between Groups	7212.800	2	3606.400	2.287	.197
	Within Groups	7883.200	5	1576.640		
	Total	15096.000	7			
Electricity Consumption: Average units consumed (kwh)/m	Between Groups	41769980.591	2	20884990.295	8.827	.001
	Within Groups	108832450.797	46	2365922.843		
	Total	150602431.388	48			

Table 3: ANOVA – TEST: Type Wise Energy Consumption in Service Sector

Source: Computed

It is found from table 3 that there was a significant variation in energy consumption namely kerosene and electricity in service sector between Madurai and Salem cities.

- Figure 3 and 4 show the type wise usage of energy expenditure in service sector of Madurai and Salem cities, respectively

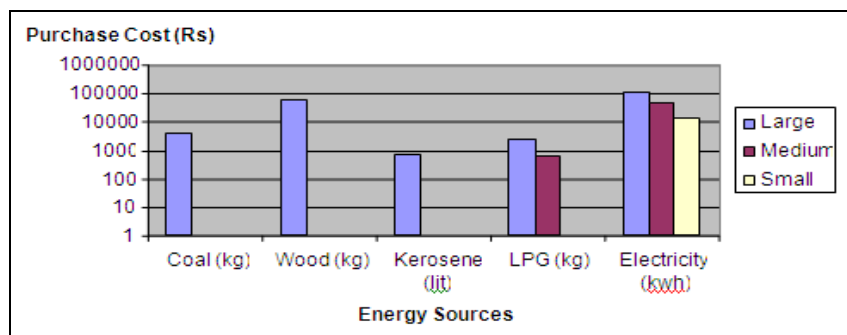


Figure 3: Type Wise Energy Expenditure per Month Service Sector of Madurai City

It has been inferred from the table 3 that in the case of coal as source of energy in Madurai, total of Rs. 63840 was spent in large size service sector, in the case of wood as source of energy, total of Rs. 61050 was spent by large size service sector, whereas in the case of kerosene as source of energy, total of Rs. 655 was spent by large size service sector. Further it also shows that in the case of LPG as source of energy, maximum of Rs. 2400 was spent by large size service sector while Rs. 600 was spent by medium size service sector, whereas in the case of electricity as source of energy, maximum of Rs. 116543 was spent by large size service sector followed by Rs. 50171 was spent by medium size service sector and Rs. 14742 was spent by small size service sector.

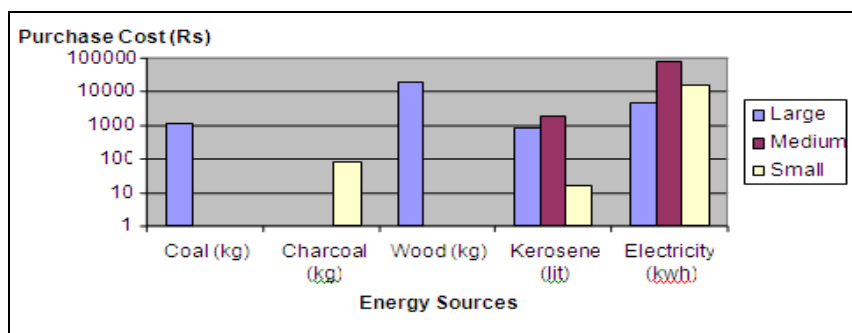


Figure 4: Type Wise Energy Expenditure per Month in Service Sector of Salem City

Figure 4 reveals that in the case of coal as source of energy in Salem, total of Rs. 1200 was spent by large scale service sector, in the case of charcoal as source of energy, total of Rs. 75 was spent by small size service sector, in the case of wood as a source of energy, total of Rs. 20000 was spent by large size service sector. Further, it also shows that in the case of kerosene as source of energy, maximum of Rs. 1900 was spent by medium size service sector, followed by Rs. 850 was spent by large size service sector and Rs. 17 was spent by small size service sector. Whereas in the case of electricity as source of energy maximum of Rs. 72968 was spent by small size service sector and Rs. 4568 was spent by large size service sector.

The ANOVA test was carried out to examine the variation in type wise energy consumption cost in service sector of Madurai and Salem cities. The computed results are presented in table 4.

Particulars	Madurai and Salem	Sum of Squares	df	Mean Square	F	Sig.
Kerosene: Purchase Cost (Rs)	Between Groups	585997.875	2	292998.938	1.643	.283
	Within Groups	891720.000	5	178344.000		
	Total	1477717.875	7			
Electricity Consumption: Average Bill Amount/m	Between Groups	1094780822.989	2	547390411.495	10.383	.000
	Within Groups	2425223009.990	46	52722239.348		
	Total	3520003832.980	48			

Table 4: ANOVA Test: Type Wise Energy expenditure in Service Sector
Source: Computed

It is found from table 4 that the difference in type wise electrical energy consumption cost in service sector was found to be statistically significant between Madurai and Salem cities. But, the difference in consumption cost of kerosene and LPG were not found to be significant between Madurai and Salem cities.

5. Conclusion

In Service Sector, the analysis of energy use pattern revealed that maximum of energy as wood was consumed by large size service sector in Madurai city which was followed by electricity and kerosene. In Salem city, wood was consumed maximum by large size service sector and electricity was consumed by medium size sector. The ANOVA test showed the existence of significant variation in energy consumption namely kerosene and electricity between Madurai and Salem cities. Regarding the energy expenditure, consumption expenditure was found to be high for wood in large size service sector followed by electricity in Madurai city. In the case of Salem city, high expenditure was offered for wood in large size and electricity in medium size service sector.

6. References

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