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An Economic Analysis of Household Energy Consumption of Urban Odisha

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Abstract: ***Energy in the household sector is used for various purposes like lighting, cooling, running of electrical appliances, cooking, water heating and running of vehicles etc. Further the amount of energy consumption in the household sector is found to vary with income, family size, age of the family members, and number of literate persons in the family. This paper analyses the impact of income on the pattern of household energy consumption in the urban municipal area of Bhubaneswar, the capital of Odisha. For this the households in the study area were categorised in different income groups. It was found that families having high income consume more energy. Analysing consumption of energy in the household sector it was further found that consumption of electricity for running electrical appliances(for the purpose of cooling, lighting, refrigeration, entertainment and water heating) and consumption of oil mainly for running of vehicles is highest among the households of high income group. While the consumption of fuel in the form of both kerosene and LPG for the purpose of cooking was found to be the highest among middle income group. Households of low income group are the highest consumer of kerosene for the purpose of lighting.***

Keywords: Energy, Household energy consumption, Income, Sustainable development, Economic growth

1. Introduction

Life on earth without energy is impossible. Now-a-days with the process of urbanization people mainly demand energy to maintain a developed standard of living and also to make their life more healthier and prosperous, which results in increase in demand for energy. Our country needs exponential growth of energy because of increasing population growth. By 2035, India is going to become the second-largest country in adding to the increasing energy demand in the World. But increase in production of energy as compared to its demand is impossible with the amount of resources available in the country. Due to this the country plans to increase its renewable and nuclear power industries out of the total energy produced.

Energy consumption in an economy mainly implies consumption of energy by the industrial sector, household sector and transportation sector. Out of the total global availability of energy, consumption of energy by the industrial sector is 51%, household sector is 18% and commercial sector is 20%(British thermal unit, 2011).Energy consumption in the household sector implies consumption of energy mainly for the purpose of lighting, cooling, heating, cooking, entertainment and using of vehicles. In India, 28% of energy is used for the purpose of lighting. For cooling purposes, 34% of the energy is used by fan, 13% by refrigerator and 7% by the air conditioners. For the purpose of entertainment 4% of energy is used by TV and 10% of energy is used for other purpose (Planning Commission, 2011).

Energy sector is the engine of economic growth whose every product is essential for the upliftment or growth of economy. As production of goods and services is impossible without inputs of labour and capital, similarly growth of an economy is not possible without its essential input i.e. energy consumption which has both direct and indirect effect on economic growth. There is a two-way causal relationship between economic growth and energy consumption where increase in one result in increase in the other. Increase in energy consumption results in increase in energy production which further results in development of agriculture and industrial sector and other ancillary trade activities which are the potential driver of economic growth. So, in order to maintain and sustain economic growth of a country, energy growth / production of energy should be an exponential function of energy consumption. To make this possible, the government should have the objective of attaining self-sufficiency in energy sector so that there will be no adverse effect of increased energy use on the sustained development of the economy and also no scarcity of energy for the future generation.

There are different types of energy, out of which the energy that cannot be exhausted is called as renewable energy. Examples of renewable energy are solar power, wind power, hydroelectric power, tidal power and geothermal energy. Whereas the energy which can be exhausted or cannot be replaced easily at a faster rate as compared to the rate at which they are consumed like the natural resources in the form of oil, coal and natural gas are the example of non-renewable energy. Of this the sources of energy that are available at a fixed price in the market for commercial purposes are called commercial energy like coal, electricity and petroleum products .Whereas the sources of energy that are unavailable in the market at a fixed price are called non-commercial energy. For example- solar energy heating water, firewood, crushing of sugarcane. It is the scarcity of these non-renewable sources of energy from fossil fuel like coal, oil, natural gas etc

The demand for energy in the present time is increasing because of continuous industrial development, urbanization and population growth particularly in developing countries like India and China. But there is not much remarkable increase in production and supply of energy as compared to it increasing demand. So, there arises a continuous gap between production of and demand for energy resulting in

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energy deficiency which is going to be further aggravated by 2020.

Another factor that contributes more to the scarcity of energy is the lack of development of other sources of energy. Because if there will be development of such sources of energy then problem of scarcity of energy will be solved and consumers will then have other options which will reduce the dependence on non-renewable sources of energy. Alongside the conservation of energy through saving devices and strategies would to a great extent address the issue of scarcity of resources. For instance, use of CFL's and LED's bulbs which consume less energy in the form of electricity, using technologies of lighting control and going for audit of energy is the way people can conserve energy. Lack of proper governmental mechanism for the efficient use of energy also creates obstacles for countries to achieve the goal of energy conservation which paves the way for sustainable development.

To aid this process of energy conservation, proper policy formulations, strategy implementations and use of suitable technology is required. In the absence of these, the improper utilisation of energy by human beings is resulting in carbon emissions bringing about climatic changes and global warming.

1.1 Objective of the study

The present study seeks to analyse:
1) The pattern of household energy consumption in Urban Odisha.
2) The impact of income on energy consumption by the households.

1.2 Hypothesis

To achieve the above objectives the following hypothesis were framed to be tested.
1) Higher income group consumes more energy than that of the middle and lower income group.
2) Energy consumption has a positive relationship with income.

1.3 Database and Methodology

The sample space for the study is confined to the urban municipal area of Bhubaneswar. The city has a population of 1.4 million of which the male consists of 53% and the females 39% according to the Census of India, 2011. It has a sex ratio of 882 per 1000 and a literacy rate of 93.15%.The study uses both the primary and secondary data for its analysis. The primary data was collected by sampling survey method through questionnaires directly from the respondents in the field of study. The information was collected personally by the interviewer through face to face interview with the respondents. The required information was taken about their location of households, age, sex, marital status, size of the family, monthly income of the family, their expenditure on energy consumption in terms of hours of using different electrical products etc. To remove any bias the spatial distribution was taken care of by selecting the households at random through omitting some discrete number of households after each selection. The analysis is done by using simple statistical tools, descriptive analysis etc as per the requirement. To achieve the above objectives, the paper has been divided into 3 sections which are the pattern of energy consumption in Odisha, the pattern of household energy consumption in the study area and the third section makes a regression analysis of elasticity of per capita household energy consumption.

2. Review of Literature

Dziousbinski and Chipman (1999) made a study on global household energy consumption, which shows that consumption of electricity by the households of Korea increased at an annual rate of over 20% in the 1970s which declined to about 10% in the 1990s. In china, the household sector consume 84 million ton oil equivalent (mtoe) of coal, 14 mtoe of electricity, 200 mtoe of oil and 8 mtoe of other forms of energy during the same time period. In India, in 1995, 77% of biomass, 18% of liquid fuels and about 90% of energy used in the form of electricity for the purpose of cooking and water heating in the household sector. A study in Hyderabad shows that household fuel wood used declined drastically from 67 kg per capita in 1982 to 14 kg per capita in 1994 and it happened due to increased use of both LPG and kerosene (Alam and Sathaye, 1994).Studying the dynamics of energy end-use in household sector in India ,Reddy(2004) finds that out of the total primary energy consumption, 45% of energy was consumed by the household sector, which increased more than 1.5% times during the period from 1980 to 2000.In case of secondary energy use, there is increase in the share of oil and gas for LPG about 3% points each over their levels from 1.13 to 4.22.

Study on energy consumption in different sectors of the economy shows that energy consumption in agricultural sector increased from 4.36 in 1990-91 but increased to 3.85 in 2003-04. Energy consumption in industrial sector declined from 56.01 in 1990-91 to 47.26 in 2000-01 and thereafter declined to 3.85 in 2003-04(Sahu, 2008).During this period India's commercial energy consumption has increased from 130.7 mtoe in 1991-92 to 176.08 mtoe in 1997-98, while its per capita energy consumption increased from to 184.7 kg of oil equivalent from 152.7 kg (DasGupta and Roy).

Studying the elasticity of electricity demand in urban Indian households, (Pachauri, 2004) finds that total electricity consumption in India grew from 44 terawatt hour(Twh) in 1971 to 314 twh in 1999 at an annual rate of growth of 7% for this period. The consumption of electricity per household went up from 7 to 53 kilowatt per hour(Kwh) between 1970-71 and 1994-95.The total household energy consumption in the form of electricity has increased from 446 gigawatt hour(Gwh) in 1994 to 1222 Gwh in 2005 in Gaza Strip(Quda,2006) . On an average 222 Kwh of electricity, 1 litre of kerosene and 17 kg of LPG are the monthly consumption of energy by the households of Gaza Strip.

Wenji Zhou et al(2011) made a study on Energy consumption patterns in the process of China's urbanization which shows that though household energy consumption

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increases with urbanization but the main reason of increase in energy consumption in urban China is the growth of transport sector and materials required for construction which accompanies urbanization. Household energy consumption depend mainly on factors like the amount of income earned by the households, level of urbanization, literacy rate, family size and age of the households (Sreekanth, Jayaraj and Sudarshan, 2011).There has been a constant trend of household energy consumption in Western countries as compared to that of a rising trend in Asian countries (Nakagami et al, 2008).

3. Pattern of energy consumption in Odisha

Among different states of India, Odisha is now one of the fastest growing and high performing states, because of development of various sectors of the economy. As per 2012-13 data, growth rate of agricultural sector is 11.01%, which provides job to more than 60% of the population in the state. The state now dominates in the power sector by bringing reforms in the participation of private sector not only in the generation of power but also in the transmission and distribution of power. Government of Odisha is also able to provide electricity to all because of proper implementation and execution of BijuGrama Jyoti Yojna, Biju Saharanchal Vidyutikaran Yojna and Rajiv Gandhi Grameen Bidyutikaran Yojna.

It has become a favoured destination for Foreign Direct Investments(FDIs) due in its rapidly growing industries due to its rich availability of natural resources like coal, iron ore, buxite, manganese in ample amount in the state. Further rapid industrialization in the state results from the presence of number of profit making industries and organizations like Tata Power, Tata Steel, IPICOL, Nilachal Ispat Limited, Jindal and Maithan Ispat Limited .Presence of small scale industries including handicraft, cottage industries and khadi and village industries contribute a larger portion of revenue to the Odisha's economy.

The Table 1 below shows us the demand for and availability of power in Odisha From 2001-2002 to 2013-14.

Table 1: Year-wise demand and availability of power in Odisha [in megawatt (mw)]

Year	Demand (Estimated)	Availability Of Power From Different sources			Total	Sold To Other States
		State Sector	Central Sector	Purchase From Captive Plants of The State		
2001-02	1343	1271	98	54	1423	0
2002-03	1367	869	440	62	1371	0
2003-04	1500	1296	481	76	1826	0
2004-05	1578	1459	498	69	2025	517
2005-06	1649	1275	525	62	1862	250
2006-07	1760	1543	485	92	2120	207
2007-08	1997	1563	736	82	2381	311
2008-09	2107	1375	763	130	2268	32
2009-10	2240	1157	773	485	2415	50
2010-11	2398	1295	814	729	2838	128
2011-12	2674	1136	1170	225	2599	49
2012-13	2674	1226	1221	239	2776	136
2013-14	2746	2746	1223	89	2900	213

Sources – Odisha power Transmission Corporation limited. Odisha Economic Survey, 2014-15

Table 1 shows that the estimated demand for power has increased from 1343 MW during the year 2001-02 to 2746 MW during the year 2013-14. The availability of power increases from 1423MW during the year 2001-02 to 2900MW during the year 2013-14. The surplus power of 213 MW was sold to other state during the year 2013-14.However this selling of surplus power to the other states may not be sustained due to the internal requirement within the state due to rapid industrialisation.

Table 2: Sector-wise distribution of consumers of power 2013-14 in Odisha

Sector	*Consumers(in lakh)*			*Percentage of rural population to total consumers*
	Rural	*Urban*	*Total*	
Domestic	38.65	10.01	48.66	79.43
Commercial	1.28	1.67	2.95	43.39
Industrial	0.03	0.20	0.23	13.04
Others	0.60	0.41	1.01	59.41
Total	40.56	12.29	52.85	76.75

Sources – All the distributing companies

The Table 2 shows that out of a total of 52.85 lakh consumers of power in the state, 76.75% were from rural areas of the state of which again 79.43% are from domestic sector in 2013-14. Power consumption by the rural household of the state is 38.65% which is higher than that of 10.01% of urban households. As more industries are established in urban areas as compared to that of rural areas of the state, power consumption in the urban areas of the state is 0.20% which is higher than that of 0.03% of rural areas. So, it is evident from the table that power consumption in the household sector is more as compared to that of other sectors of Odisha.

4. Pattern of household energy consumption in the study area

This section analyses the pattern of household energy consumption on the basis of the data collected from our study area. It highlights the consumption pattern of electricity or power, fuel and oil of the households.

The Table 3 shows the amount of electricity consumed for different purposes by the households. The households in all the income groups are found to use electrical bulbs for the purpose of lighting but hours of using the bulbs on an average (avg.) is 320.4 by the HYG which is highest as compared to that of 315.6 hrs. and 187.4 hrs on an avg. per month by the households of MYG and LYG respectively. Thus the households in the HYG consume more energy as compared to the households of LYG and MYG.

The hours of using fan for cooling purposes varies from 17.7hours on an average among the households of HYG which is highest as compared to that of 16.2 hours of use by the MYG and 12.2 hours of use by LYG on an average. Among the LYG, 16.66% of households are using refrigerator for 13.6 hours on an average per month as compared to that of households of 78.18% of MYG and 100% of HYG who are using the refrigerator for 73.6 hours

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and 118 hours respectively on an average. Similarly no household among LYG use AC, whereas 27.3% of MYG are using it for 21.8 hours and it is 40.5 hours on an average per month by the households of HYG.

Table 3: Pattern of household energy consumption

Electricity Used For The Purpose Of Water Heating.	Families using different types of electronic products(in %ge) Per Month Per Family	EH	0	5	7.8	12.8
		WH	0	4.4	15.9	36.2
		EH	0	9.1	37	-
		WH	0	18.2	59.2	-
Electricity Used For The Purpose Of Study, Job, Entertainment	Hours of using these products (in avg.) Per Month	Com/L	0	109.2	133.7	242.9
		WM	8	25.6	35.9	69.5
		DVD	13.3	17	14.4	44.7
		TV	256.3	329.3	335	920.6
		M	22.5	39.9	61.76	124.1
	HHs using different types of electronic products(in percentage)	Com/L	0	40	85.2	-
		WM	5.6	18.2	100	-
		DVD	16.7	61.2	81.5	-
		TV	100	100	100	-
		M	100	100	100	-
Electricity Used For The Purpose Of Cooling	Hours of using these products (in avg.) Per Month Per Family	Ac	0	21.8	40.6	62.4
		Ref	13.6	73.6	118	205
		F	48.8	64.7	70.7	-
	HHs using different types of electronic products(in percentage)	Ac	0	27.2	100	-
		Ref	16.7	78.2	100	-
		F	100	100	100	100
Average Hours of using bulbs for lighting			187.4	315.6	320.4	
Percentage Of HHs using electric bulbs for Lighting			100	100	100	-
Per cent age of HHs In The Sam Ple			18	55	27	-
Income Group			LYG	MYG	HYG	Total

Source: Primary data.

No. – Number, %ge – Percentage, LYG – Low Income Group, MYG – Middle Income Group, HYG – High Income Group, HHs- Households, Avg. – Average, F – Fan, Ref – Refrigerator, M – Mobile, WM –Washing Machine, Com – Computer, Lap – Laptop, WH – Water Heater, EH - Electrical Heater

This analysis shows that the percentage of households of HYG using the electronic products for the purpose of cooling is highest as compared to the other two income groups. Also the hours of using the energy by the HYG is the highest compared to the other two income categories (Figure 1).

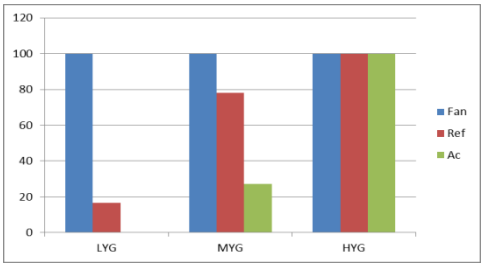


Figure 1: Per cent age of households consuming electrical energy for cooling purposes

All the households in all income groups were found to have access to mobile and televisions for their purpose of study, job and entertainment, though the numbers of hours for which they are consumed varies. The households of LYG are using Mobile and TV for 22.5 hours and 256.3 hours on an average per month respectively. Whereas the households of MYG are using mobile for 39.9 hours and TV for 329.3 hours on an average, compared to that of the highest use of energy for 61.7 hours for mobile and 335 hours for TV on an average per by the HYG. Again in case of DVD, energy is used for 13.3 hours on an average by 16.7% of the LYG as compared to that of 17 hours of energy used by the 61.2% of households of MYG and 14.4 hours of energy used by the 81.5% of households of HYG on an average per month. 5.6% of households of LYG are found to use washing machine for 8 hours on an average per month. Among MYG 18.2% of households and 100% households of HYG were found to use WM for 25.6 hours and 35.9 hours respectively. Energy is also used by the households for using laptops. None of the households in the LYG were found to use laptops. But 40% of households of MYG are using laptop for 109.8 hours on an average per month as compared to that of 133.9 hours by 85.2% of households of HYG. Thus the amount of energy consumed for the purpose of job, study and entertainment by the households of HYG is highest compared to the households in the lower and middle income group (as shown in Figure 2).

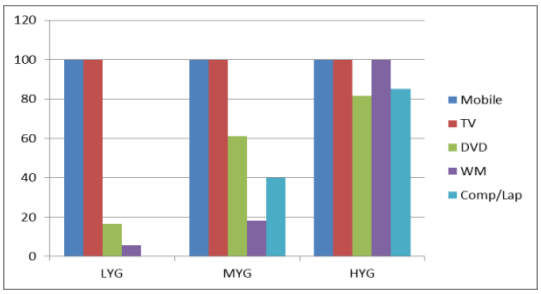


Figure 2: Per cent age of households consuming electrical energy for the of study, job and entertainment

The data also reveals that no households from LYG were using water heater (WH) or electric heater (EH) for the purpose of heating water. Whereas 18.2% of households of

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MYG are using WH for 4.4 hours and 9.1% of households of same income group are using EH for 5 hours on an average per month for the purpose of heating water as compared to that of 31.8 hours of use of energy in WH and 7.8 hours of use of energy in EH by 59.2% and 37% of households of HYG respectively (as shown in Figure 3).

Thus the above analysis shows that the households of HYG consume more energy as compared to that of LYG and MYG, whether it is for the purpose of lighting, cooling, study, job or entertainment or for the purpose of heating water. Thus income is seen to affect the energy consumption of the households as well as the purpose for which they are consumed.

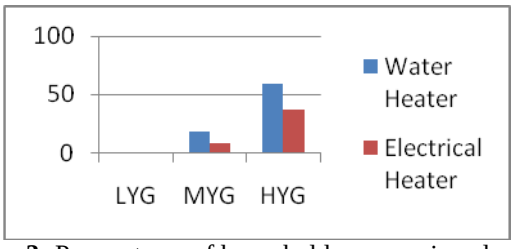


Figure 3: Per cent age of households consuming electrical energy for the purpose of water heating

Here the diagram shows that use of both the water heater and electrical heater is the highest by the households of HYG as compared to that of MYG and LYG.

Table 4: Fuel consumption

Income Group	Percentage Of Households	Percentage of HHs using different types of fuel			
		Fuel wood only	Kerosene only	LPG only	Both kerosene and LPG
LYG	18	11.11	16.67	38.39	33.33
MYG	55	0	0	40	60
HYG	27	0	0	85.19	14.81
Total	100	-	-	-	-

Source: Primary data

The Table 4 shows that with regard to fuel consumption, almost all the households were found to use modern fuel (like kerosene, LPG) and not the traditional fuels (like firewood, charcoal, dung cake, crop residues). This is as expected as the study area is urban Of the three income groups 11.11% of the households belonging to the LYG were found to use fuel wood only as they cannot afford kerosene, whereas 16.67% of the households from this LYG use kerosene only as cannot afford gas chullas. So, use of LPG among other fuels by the households is found to be 38.39% in LYG, 40% of the households in MYG and 85.19% in the HYG use LPG as compared to that of 33.33%, 60% and 14.81% of households of LYG, MYG and HYG respectively who use both LPG and kerosene. So, percentage of household using LPG only is the highest as compared to the percentage of households using both kerosene and LPG. This is because the price of kerosene had increased during this time period. On the other hand, as it is easier to use LPG for cooking than kerosene, most of the households even in the LYG use LPG. This is also shown with the help of pie-chart below [Figure 4(a), (b) and (c)].

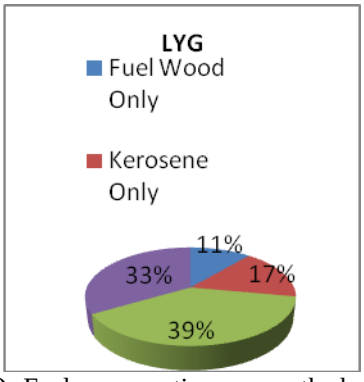


Figure 4 (a): Fuel consumption among the households of LYG

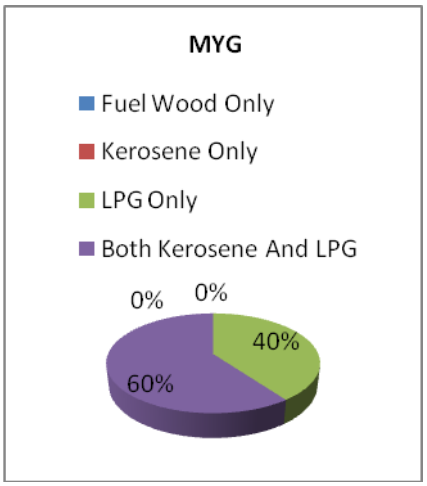


Figure 4 (b): Fuel consumption among the households of MYG

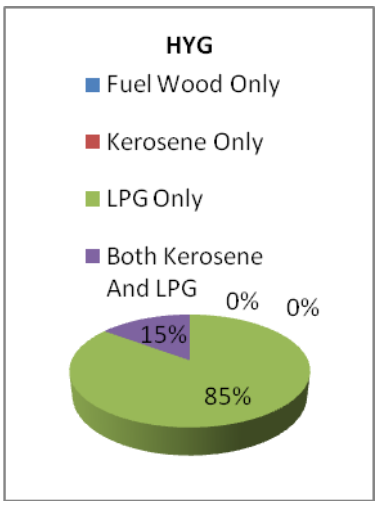


Figure 4 (c): Fuel consumption among the households of HYG

Table 5: Pattern of fuel wood consumption

Income Group	*Percentage Of HHs In The Sample*	*Percentage Of HHs Using Fuel Wood*
LYG	18	11.11
MYG	55	0
HYG	27	0
Total	100	11.11

Source: Primary data

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The Table 5 shows us, that out of the total population of the study area, only 11.11% of households are using wood as fuel. All of them are from LYG and none of the households of MYG or HYG use wood as fuel the consumption of wood has almost being replaced by the superior modes in most urban areas particularly among the higher income group.

Table 6 : Pattern of kerosene consumption

Income Group	Percentage of HHs In The Sample	Percentage of HHs Using Kerosene	Percentage of HHs Using Kerosene For Various Purpose		
			Cooking And WH	Cooking Only	Lighting
LYG	18	44.44	37.5	62.5	100
MYG	55	60	30.3	69.7	75.76
HYG	27	14.81	0.75	0.25	0
Total	100	-	-	-	-

Source: Primary data

The Table 6 shows us that kerosene is used among all the income groups. But percentage of households of HYG using kerosene is 14.81 which is the least as compared to that of 44.44% and 60% of households of LYG and MYG respectively, as they have many other alternatives available with them because of their high income. So, consumption of kerosene is the highest by the households of MYG for the purpose of cooking and for the purpose of lighting is the highest by the households of MYG.

Table 7: Pattern of LPG consumption

Income Group	Percentage Of HHs In The Sample	Percentage Of HHs Using LPG	Percentage Of HHs Using LPG For The Following Purpose	
			Cooking and water heating	Cooking only
LYG	18	72.22	23.08	76.92
MYG	27	100	9.09	90.91
HYG	55	100	7.41	92.59
Total	100	-	-	-

Source: Primary data

The Table 7 shows us that though 72.22% of household of LYG are using LPG but it is the low as compared to that of 100% households of both the MYG and HYG using LPG as fuel. But above all, it is found from the study that consumption of LPG is the highest among other fuel consumption among all the income groups.

Table 8: Pattern of oil consumption

Income Group	Percentage of HHs In The Sample	Percentage Of HHs Using Vehicle
LYG	18	38.89
MYG	55	80
HYG	27	92.59
Total	100	-

Source: Primary data

The Table 8 shows us that use of vehicles by the households of HYG is 92.59% which is the highest as compared to that of 80% of MYG and 38.89%LYG. As a result consumption of oil for the purpose of running of vehicle is the highest by HYG and lowest by the LYG as less number of households of LYG use vehicle. This is shown in the bar diagram in Figure 5 shown below.

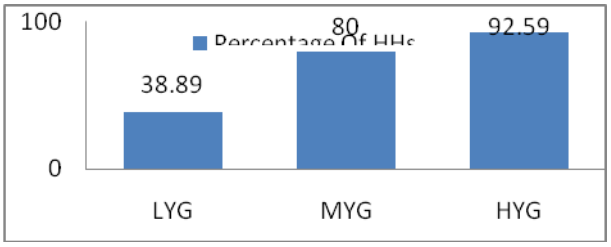


Figure 5: Per cent age of households consuming oil for the purpose of running of vehicle

The diagram shows that HYG are the highest user of vehicles than that of MYG and LYG as the number of vehicles and number of times of using vehicle by them is the highest.

Elasticity of per capita household energy consumption:
To know the significance of income and energy consumption regression analysis has been done by putting elasticity model to the collected data.
log PCHHE = a + b log PCHHY + c log PCHHEE + u
Where PCHE = Per capita monthly household expenditure.
PCHHY = Per capita monthly household income.
PCHHEE = Per capita monthly household expenditure on energy consumption.

Table 9: Regression Result

Regression Result of PCHHE on PCHHY and PCHHEE					
Multiple R	R^2	Adj R^2	Se	Observation	
0.904	0.816	0.812	0.104	100	
ANOVA					
	df	SS	MS	F	Sig F
Regression	2	4.695	2.347	215.536	2.03E-36
Residuals	97	1.056	0.011		
Total	99	5.751			
Log PCHHE = 1.130 + b log 0.537 + c log 0.119 Se (0.129) (0.061) (0.055) t (8.737) (8.851) (2.143)					

5. Results

The regression result of PCHHE on PCHHY and PCHHEE is shown in the Table 9. The R^2 was found to be 81% which is highly determining. The F-test was also found to be highly significant. The elasticity result showed that the PCHE varied by 0.537 for a 1% change in income while it varied by 0.119 for a 1% change in PCHHEE. The t-value of the coefficients is found to be highly significant at 5% level of confidence. Thus the household expenditure is highly determined by the income. However it is not significantly determined by PCHHEE. This indicates that the overall PCHHE is determined by other expenditure of households other than their spending on energy. Because we have already seen that as per 2011 data, out of total global availability of energy, household sector consumes only 18% of the total energy. So, expenditure on energy by the households is very minimal as compared to their other expenditure out of their total monthly income.

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6. Conclusion

Thus the overall energy consumption of any form in the household sector is the highest among HYG than other two income groups. Households of HYG are the highest consumer of electrical energy for various household purposes as they are using more modernised electrical appliances as their monthly earning is higher. They are also the highest consumer of oil for the purpose of running of vehicles as they have more number of vehicles than the MYG and LYG whose income is less relative to the HYG. The consumption of LPG among the other fuels is the highest among all the income groups as the study area is urban.

The present study also found that household income has a positive relationship with energy consumption. As it is revealed from the data collected from the study area that households having more income consume more energy than the households who consume less energy because of their low income.

In the present scenario, there is a continuous increase in demand for energy because of improved standard of living of the households and on-going process of urbanisation and modernisation. But the availability and supply of energy falls short of demand for it, resulting in scarcity of energy, for which conservation of energy for the better life of the future generation is inevitable.

7. Future Scope

The study has been done to make some contribution towards solving the problem of future scarcity of energy by knowing the current household consumption pattern of energy. As the study finds the determining factors behind household energy consumption and also its biasedness towards the higher income group, it throws much light on the concentration of energy consumption. However, the limited area of study as well as the time frame can be a constraint in the wider application of its findings.

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