

URBAN HOUSING ENERGY CONSUMPTION ON PEATSWAMP

Case: City dense peatland area in Palangka Raya

By

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Abstract

Population growth in combination with intensive energy consumption is the main driving force in urban area in developing countries that has caused impacts on socio-economic aspects, and environmental systems lead to green house gas (GHG) emissions into the atmosphere. Indirectly, life style and consumption pattern of urban people are also affecting the impacts. Nowadays, the phenomenon of global warming is becoming major concerns in environmental management. Urban planners and policy makers are being to minimize dan reduce the impacts of energy consumption and GHG emission when they are planning the cities. It is important to understand urban form as element in the city planning process and relationship between urban form, energy, and the environmental impacts to establish effective strategies to meet environmental goals (Anderson, 1996). Urban residential density is the main factor contributing to urban form. Therefore, dealing with energy use and carbon emissions related to climate change in urban environment, especially in residential sector is one of the challenges due to its unfavourable effect on the ecosystem. This study aims at determining factors contributing, particularly at the local level and also identifying the responses from citizen and local government regarding to energy consumption and carbon emissions in urban residential development on peatland area. The results will bring some recommendations on better measures for urban residential that will be develop on the peatland area particularly in Kalimantan Tengah, Indonesia related to carbon emission and energy use for present day and for next generation.

Keyword: *Urban housing, Carbon Emission, Energy Consumption, Peatland.*

INTRODUCTION

Urban area has significantly giving to regional climate change whenever it is consistently spreading out some materials to atmosphere, energy consumption, population growth, green house gas (GHG) effect and physical develop couple with natural local vegetation demolishment using some structural materials (Golden, 2003). According to world total population, in the years 2030, will be reaching over 5 billions and a half of them will occupy on urban areas (UN, 2002). One of demografic trends in developing countries is urbanization with fast growth city center expansion to pheripheral areas. Nevertheless, Satterthwaite (2010) said that urban area with population growth and urbanization is not main factor causing climate changes but customer growth and the level of population consumption are the cause.

In several developing countries, economic changes and political will has caused urbanization and also influencing consumption pattern, lifestyle in each household or some persons who live in urban area. Then, high consumption and fast growth consumption in urban area will influence

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climate change. Although, urban area seems to be a problem that caused a serious issue for climate change does not mean that without solving, it can be achieved by providing basic need of service and giving a high quality standard of life for its society (Satterthwaite, 2010). Which mean that it has giving a chance for economic growth, agglomeration, and neighborhood High density and wide area of population concentration on one location in urban area can result a small energy consumption, low emission carbon, and efficiency in using natural resources if it is developed with providing services and lowcost infrastructures, using bicycle, walking activities, as well as using mass transportation to substitute private transportation.

Meanwhile green house gas effect occurs naturally on atmosphere is all resulting of human activities and it mean so close to energy consumption. Urban growth will be followed by housing development that had giving big contribution to CO₂ emission on atmosphere as a result of urban land use change, industrial activity, energy consumption for local activity, and oil for automobile. IPCC (2007) states that CO₂ is a result of those activities being compared to all of total (more than 8%) from total of green house gas effect. Economic development and social communities have encreasing the need of energy consumption and carbon gas emission result. In terms to run sustainable urban strategy through low carbon gas emission in urban and efficient in using energy, is needed an environmental effect that starting from energy consumption and carbon emission. Dodman (2009) states that are important to understand climate change mitigation and its adaptation to urban scale related to local government that having vested interest within filling up their need effectively. Therefore, it is relevant to make assessment related to energy consumption and carbon emission on local level in urban area.

Palangka Raya City (PRC) significantly situated in the island of Kalimantan that consists of peatland about 6.8 million hectares (Kalteng Consultant, 1999). In the last decade, peatland sizes has been decreased sustainably as the impact of land conversion. A large number of Carbon (CO₂) has been released to the atmosphere. Base on LANDSAT data, fullsize peatlands located between the stretch of river Barito and Kahayan approximately 1.8 million hectares (1995), yet the large number of this peatland dramatically decreased as the impact of ilegal logging, land use change caused forest consumption as well as forest fire on it. Base on calculation approximately 1 billion ton carbon has been released to the atmosphere during July-October 1997, from carbon stocks about 2-4 billion ton carbon contained in the region. Meaning that if the condition continues over time will accumulate carbon in the atmosphere significantly.

Research result shown that carbon concentration within tropical forest in Central Kalimantan is the highest value in the world. Average accumulation of tropical peatland forest in Indonesia amounted to 228 to 668gC/m²/year (58% Carbon). This indicated that the erosion occurred in Central Kalimantan would be fatal for climate change around the island of Kalimantan and it also will affect to the carbon content around the world. Which mean that it will be implication to global ecosystem equilibrium (Bohm and Siegert, 1999) if this condition is coupled with energy consumption and carbon emission of the urban population can imagine how much carbon would be released into the atmosphere? This study intends to determine the factors that contribute to energy use and carbon emissions within the growing urban settlements on peatlands.

RESEARCH ISSUES

Increasing carbon emission, particularly CO₂ which charged 85% of the total emission greenhouse effect has implication for developing countries at local level as well as implication for global warming. and It is to be a serious problem to our neighbourhood places which mean that also impacted to social-economic at local level. In several countries including Indonesia, this problem has achieving the highest level with effective adaptation demand and mitigation strategy

as soon as possible. Base on World Resource Institute (2005), in Indonesia, housing sector has giving 16% of total CO₂ on greenhouse effect which was released to atmosphere. Transportation, electricity, and industry are the highest sector in order to give greenhouse effect, around 20% of the total CO₂. On the other hand, land use changing and deforestation in Indonesia, especially in Kalimantan is the highest on greenhouse emission (ADB, 2009). Compared to several other countries which is choice. Total CO₂ emission which is released in Indonesia, particularly from housing sector is the highest, and most of them are result of the electricity use. As comparing can be seen in the table 1 below:

Table 1.
**CO₂ Emission in Indonesia compared to other countries
which is choiced as the highest (2005)**

sectors	Countries					
	Indonesia	Singapore	Thailand	Japan	China	US
Electricity	22.1	37.1	34.6	34.9	44.6	42.3
Other Industry	13.5	14.5	0.7	3.3	4.5	4.6
Manufacture Industry	20.0	3.4	23.7	19.1	29.3	11.5
Internal Transportation	23.0	8.9	27.0	22.1	7.4	30.3
Housing	16.0	0.1	2.7	5.4	6.9	6.3
Others	3.0	0.0	5.3	10.9	5.6	4.7
Total (million metric ton)	290,5	71,8	166,4	1.182,7	3.167,3	5.689.20

Source : World Research Institute, 2005 (<http://www.wri.org>)

Land use change from vacant land to develop land and deforestation giving implication to greenhouse effect. In the context of urban areas, land use change from farmland or open space to become develop land such as housing and trade area should be paid attention related to regional climate change. Most of Indonesian urban land use dominated by Housing includes PERUMNAS and housing which is developed by private sectors. Housing growth be accompanied by human behaviour pattern in urban area has growing fastly in contributing the increase of energy consumption and carbon emission.

Table 2.
**Energy uses by some sectors in Indonesia compare to other countries
which is choiced (2005)**

Sectors	Countries (% dari total konsumsi energi)					
	Indonesia	Singapore	Thailand	Japan	China	US
Industry	19.8	37.4	38.1	35.9	40.0	26.2
Transportation	19.7	43.0	33.7	28.1	9.6	39.6
Agriculture	1.7	0.0	5.4	1.9	4.2	1.0
Commercial	1.8	9.3	4.6	16.9	3.7	12.2
Housing	56.1	5.2	16.1	13.6	38.2	16.6
Others	0.9	5.1	2.1	3.6	4.3	4.5
Total (1000 metric tons of oil equivalent)	117,526	10,605	53,418	342,126	785,435	1,540,623

Source: World Research Institute, 2005 (<http://www.wri.org>)

Energy consumption effect in developing countries could be triggering carbon emission which is to become a serious problem not only for environmental and social-economic but also for human survival includes some cities in Indonesia such as Palangka Raya City. This condition needs an effective management and disciplines. Base on table above, Housing is the biggest costumer in energy consumption viewed to energy quantities which is consumpt then followed by industry and transportation. Compared to other countries, most of industry and transportation is the biggest in contributing to energy consumption. Overcoming the issue has been done, yet so far it looks doesn't effective as seen with the emergence of problems that occurs now, then continues to other urban areas. The reason background why the ineffectiveness of solution made is begin from ineffectiveness of tools and rules which regulate it and do not understand factors and conditions that accompany the issue.

Urban areas can be viewed into two comprehension. Firstly, urban area can be viewed as sustainable development, since the city develops to became the center of economic growth that giving some space for worker, technology, knowledge, innovation, basic service, and infrastructures. The high density of population accompany with the amount of the consumption of the population with integrated service concept has been extracting natural resources effectively and effcently development of urban infrastructure. Secondly, urban area can bring social-economic problem and environmental problem while urban area become the center of high living standart, where the large number of goods are concentrated, limited natural resources exploitation and high volume of greenhouse effect. For these reason, sustainable urban areas in developing countries need special attention to the big cities to address climate change issue, particularly related to energy use and carbon emission.

Therefore, this study intend to determine the relation between carbon emission and energy use in urban housing development, as well as investigating factors which is giving contribution on carbon emission and energy consumption which is used on the local level or urban area, particularly urban housing development invading peatland as built area. By understanding the factors that influence can be seen for the improvement of social-economic conditions to improve the quality of the environment through the suitability of the strategy and management of a wide variety of devices. Alternative strategy which is offered in this study can be implemented starting from lower level such as community in housing neighborhood, private sector until the high level such as local government.

OBJECTIVE OF THE STUDY

The research focuses on developing urban housing such as Palangka Raya, the main objective of the study was to determine the energy use and carbon emissions at the household level by comparing the urban settlement area based on population density.

METHODS.

This study used some methods and data in term to reach the objective. figure 1

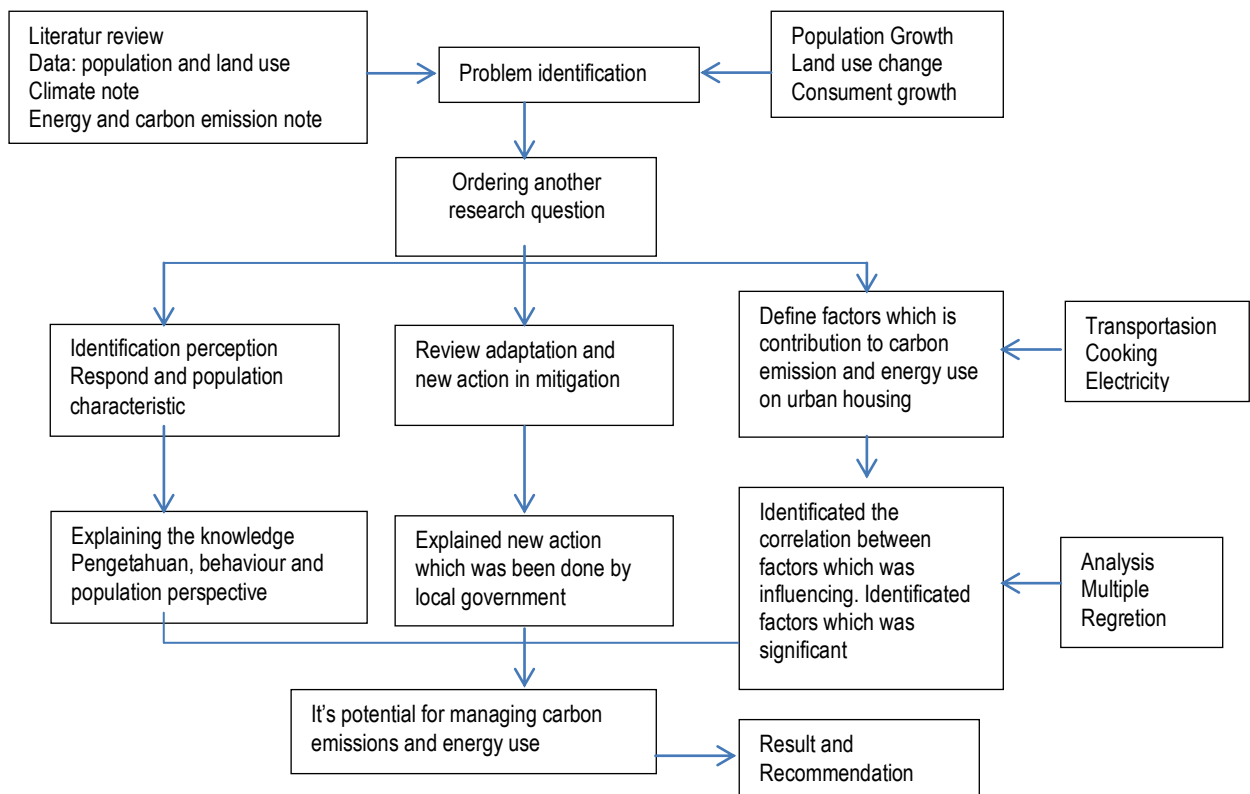


Figure 1.
Method Framework

Research methods begin from identifying issue, ordering research question, objectives and scope of the study, structuring concept and design research methods. Collecting inception data including prime data and secondary data as well as literature review which are parallel as supporting data and source of information. The next step is to define the study area being done when the research methods final, then continued with field investigation. After that, to define factors which are contribution to energy use and carbon emission in urban housing with doing inception research and literature review to find some factors which are influencing energy use and carbon emission. To do analysis factors which are influential in energy use and carbon emission that will be resulted using two methods: energy which is used and carbon emission conversion which is resulted, secondly: multiple regresion analysis.

DATA ANALYSIS

Data analysis in this study uses qualitative analysis and quantitative as well as combination both of them. Qualitative analysis has been used for interview result, some information from quizioner and used for result of discussion evaluation. Quantitative analysis used in order to data processes from quizioner.

Table 3.
Data Analysis Method

Process	Parameter	Variabel	Analysis Method
Correlation between energy used, carbon emission and urban housing on peatland area.	Urban activities, Urban form	Population density, land uses trend, urbanization trend, carbon emission trend which is released and energy used	Spatial/ analysis map, trend analysis, description analysis, ANOVA
Defines factors which are contribution to energy use and carbon emission on peatland housing area.	Energy used (joule), carbon emission (ton)	General information, home material, energy consumption, public transportation, and individual factors	Description analysis, analysis regresion multi variant
Perception and Response dan Respon to energy using and carbon emission.	Increasingly energy use and carbon emission.	Knowledge and behaviour regarding energy use and carbon emission.	Description analysis, multy response analysis, cross tabulation analysis
		Household perception	
		Houshold response	
Amount of energy efficiency which is used and carbon emission which is reducted.	policy	Some Policies, Program, strategy and action plan	Description analysis

The formula which is used to define sample size, the important thing is same (Israel, 2003). Therefore, the formula in this research which is used as follow :

$$N = \frac{N}{1 + N \times (e)^2}$$

where :

n is sample size

N is the number of population

e is error margin

Table 4.
Target and amount of sample

No	Target Area	district	Total sample
1	Low density housing	Jekan Raya : Bukit Tunggal	40
2	Medium density housing	Pahandut : Panarung, Bukit tunggal	100
3	High density housing	Pahandut : Danau Seha, behind Jalan Riau	60
Total			200

Note: total sample which is chosen base on housing area that has been identificated base on location on peatland area.

Energy Consumption Analysis and Carbon Emission on Peatland Dense Housing

This part explains energy consumption analysis and carbon emission on urban housing area which is develop on peatland area base on its density in Palangka Raya including factors which is contribution on energy use and carbon emission with uses multivarian analysis and also comparing with energy use and carbon emission on the other housing that having difference density uses anova analysis.

Energy Using on Household Level in Density Housing.

Explaining about energy consumption on urban housing that having difference density. Energy consumption on this study includes transportation, cooking, and electricity (PLN) begins from urban housing occupant. Energy assumes which is used for private transportation e.g. motor cycles and cars. Energy need which is used for cooking begins from LPG or kerosene. Then, electricity source are from Asam-Asam hydropower in South Kalimantan that is used for household devices switch on. In Palangka Raya electricity source are from hydropower plant. The result base on energy conversion as follow :

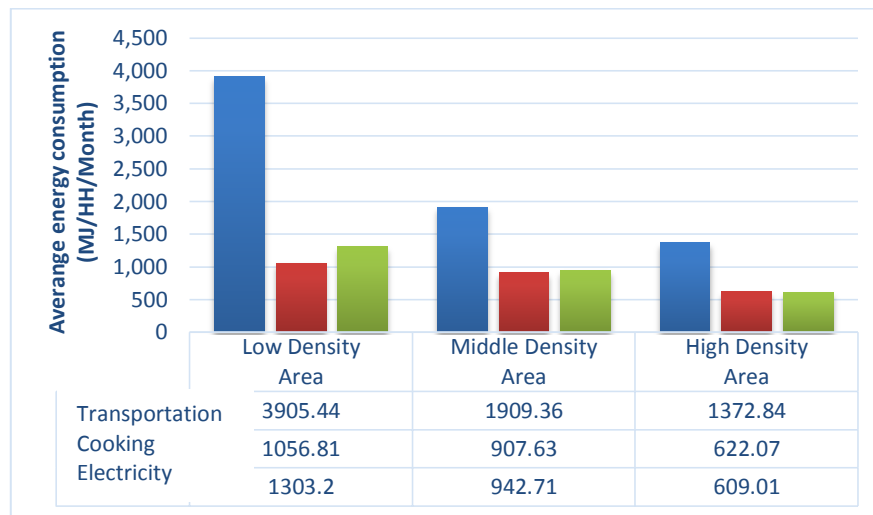


Figure 2.
Energy Consumption on Study Area

Found that each area which is having difference density, energy which is used for transportation has giving the highest contribution of the total energy which is consumpt, then followed by electricity for other needs and for cooking needs. On the other hand, compare between energy which is used for cooking and energy which is used for the other electricity devices, can be seen that urban housing which is not dense and medium, energy which is used for other devices give the highest contribution from the total of energy used. On the other hand, on density housing, energy which is used for cooking gives high contribution compared to energy which is used for other electricity devices. Total average of energy consumption on area of study has been dominated by energy that is used for transportation (2,338.48 MJ/HH/month). Total average electricity using is 914.69 MJ/HH/month and total average for cooking is approximately 853.65 MJ/HH/month.

Related to energy consumption on housing area which is having difference densities found that on low density area higher than medium density areas and high density areas. This can be explained because occupant who lives on low density areas uses more electric devices in their

houses and uses private transportation compare to occupant who lives on medium density area and occupant who lives on high density areas. From the result above can be concluded that energy consumption decrease on urban housing should be focused on energy which is used for transportation.

Household Carbon Emission on Urban Housing Density

On Figure 3. depicted that carbon emission on urban density housing at each household. Carbon emission on urban housing in this study comes from transportation activities, cooking activities, using electronic devices and land covering by buildings. Total average carbon emission on study area that produced by electrical use is equal to 1,646.69 tonCo2eq/HH/month, total average carbon emission that produced by cooking activities is equal to 27.54 toCo2eq/hh/month and total average carbon emission that produced by transportation activities is equal to 130.61 ton CO2eq/HH/month. From research result can be seen that mostly carbon emission produced begin from electrical use activities followed by transportation activities and cooking activities.

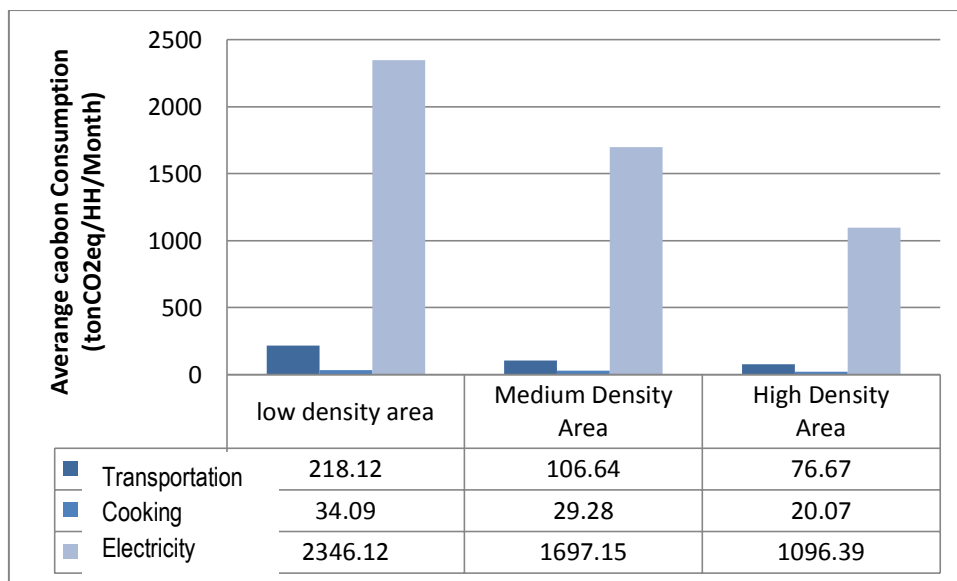


Figure 3.
Carbon Emission in Household on Study area.

Related to residential density area found that the settlements are not solid turns produces more carbon emissions when compared with areas that have moderate density and very dense areas. It can be understood because of their low density areas more use of electronic equipment in his home in comparison with the medium region being more urban and dense region. From the research result can be concluded that focus on reducing carbon emissions in dense urban residential settlement area is a reduction in the activity of the use of electronic equipment.

Carbon emissions due to land cover by the development of urban settlement

Carbon release to air not only by occupant anthropogenic activities of residential in urban area but also by land cover which is impacted by building that develops on it. Relating to the above land cover will also be related to the consumption of water obtained from land covered by housing (Building Covered)

Carbon Emission

Base on Palm et.al (1999) research states that forest carbon stocks in logged-over or secondary forest is equal to 93 ton C/ha (49-144 ton C/ha), meanwhile the tropical forest area that has been used as a settlement area in City of Palangka Raya base density as follow:

Table 5.
Carbon emission and the wide of water cover on urban housing areas that have difference density on area of 500 ha

Density Area		Cover area (ha)	Build area (ha)	Vacant land (ha)	Total Carbon	Total Water
					93 ton C/ha	0.18m ³ /1m/100m ²
High	Behind Jalan Riau, Danau Seha	500	400-450	50	37,200 – 41,850	720,000 – 810,000
Med	Panarung Region	500	200-300	300-200	18,600 - 27,900	360,000 - 40,000
Low	Bukit Tunggal Region	500	Less 200	300	Less 18,600	Less 360,000
Total					81,375 C/ha	1,575,000 m ³

Note: **Coeffisien of water reserve (S):** 0.0018 based on the results of local drilling (each taking 0.18 m³ a decline of 1 m om an area of 100 m²

On the table 5 can be explained that urban housing with high density on peatland occupies shown that carbon emission release to air more than to low density area and medium density area. It was done on sample with area is equal to 500 ha.

Water Consumption

From table 5 can be explained that urban housing with high density area which occupies peatlands shown that the removal of water usage as energy consumption more than the region has a medium density area and low density area. The broader housing area will affect to water usage to be more declines and decreased peatland equal to 1 m of the water coeffisien 0,18m³ on each 100m².

Result

1) High Density Area

Generally, on peatland area with high density, key factors that influence the amount of carbon emission and energy consumption is general factors, energy used, and home buildings. General factor that contribute to the amount of carbon emission turns out negatively correlated to the level of monthly expenditure is low, the number of older people and age. Meanwhile, there is one factor in the general factor that affect the amount of energy consumption positively associated is the number of male family members. It can be explained that low expenditure means that they have no much spend his money for their activities such as transportation, cooking, and electrical home appliances. Therefore, carbon emission and energy use are also decrease. This result explains that if older people are at home no much energy used and carbon emissions released compare to when many young people who stay at home using electricity.

2) Medium Density Area

Associated with the key factor that influence carbon emission and energy use on medium density housing the result shown that general factor (level of high expenditure and the amount of low education), energy use and public transportation condition gives contribution to the amount of carbon emission in this area. It can be assumed that monthly high expenditure has giving effect to carbon emission increase. Very contrasts to amount of low education that live in his house not spend a lot of money and also not too much activity such as working, school, shopping and recreation to other places. So that, in relation with energy use and carbon emission, it becomes negative. One of factors that contributed to carbon emission on this area is public transportation; it can be connected to the location that generally lay between high density areas and low density areas and also by social-economic reason, the residence of area owned medium level salary. The result of the study on this area shown that personal factor such as awareness of energy use efficiently is correlated positively; it shown that residence owned the awareness to energy efficiency influences the increase of total amount of energy used. It explains that people who live on this area actually awareness to the energy efficiency but on the reality they didn't doing that for better within his dailylife related to behaviour factor and attitude of they have.

3) Low Density Area

Base on key factor that influence on low density housing is a group of factor that consist of energy use and personal factor. Obtained that personal factor that use household appliances from electrical devices owned negative attitude to total amount of carbon emission. It explains that residence which is using wisely electrical appliances in his house will switch off the appliances when no more using it because it will decrease the amount of carbon emission in his house. In order to decrease energy consumption, there are some generally factors as follow: length of stay, the total number of female in house and high salary average. Therefore, it can be assumed that the length of stay means will give experiencing and knowledge to residence adaptation for increasing energy consumption with using saving energy appliances in household and increases awareness attitude to saving energy. Meanwhile, high salaries from residence will implication to the total amount of energy consumption in consequence substitutes the household appliances to saving energy devices will decrease the total amount of energy consumption.

CONCLUSION AND RECOMMENDATIONS

These conclusions are result of the study that based on research questions before.

CONCLUSION

- There is relationship between energy user and carbon emissions associated with the shape of the city refers to the density of residential areas of the city. On developing urban area, housing is the central issue refers to fast population growth and urbanization. Resident needs place for living and local government hasn't better management yet to overcome the issues. It can be seen by urban growing area, urban housing sprawls particularly in the city center. This research shown that urban density housing produces low carbon emission and energy user compare to medium urban density and high density housing. On the other hand, if the urban area develops on the peatland area so then energy consumption and carbon emission become more released to the air by high density area compare to other density areas.
- Study result founds that on high density housing, resident have no much using automobile to achieved their purpose and also no much electrical appliances that they use in household. It

can be understood because resident of this area is people who have low salary average. It is will be invers for medium housing density area and low density area whilst electrical appliances at home and private transportation higher. Then, behaviour and costumer attitude on the housing which owns difference densities also influences energy using and carbon emission on urban housing area.

RECOMMENDATION

The result which is found in this study can be said that local government of Palangka Raya do not pays seriously yet to the energy consumption and carbon emission. Then, is important to consider energy efficiency integration and decreasing carbon emission on the urban housing areas related to human activities (antrophogenic) into policy, either with energy integration and carbon emission within urban development or with measured/size integration to decrease energy consumption and carbon emission. Therefore, efforts should lead to support urban development is knowledge regeneration and improves the capacity of communities to understand the problem of energy and carbon emissions, so as to obtain a size/ standard so that policies and programs can be implemented. The efforts should be made by local governments to strengthen the regulatory framework, legal framework, empower agents and a network of development agencies, community capacity building, and creating an effective communication.

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