

# Environmental Technology Management towards Energy Saving for Transportation in Bangkok, Thailand

Pastraporn Thipayasothorn, Suparb Trethanya, and Jintana Nokyo

**Abstract**—The purpose of Bangkok's urban community designing guidelines in order to save energy is to study the physical environment of the urban community in Bangkok and to study the travel forms from residential area to an activity area. The study led to an urban environmental designing technology suggestion in order to save energy. The research studies from the sample people who regularly travel in Bangkok even the inner, middle and outer city. 400 people was collected the data by observations and questionnaires then the data were analyzed followed the research format.

The result of the research found physical environment of community model in Bangkok and accessing community behavior. They ran the project of Bangkok's urban community designing guidelines in order to save energy. The successful outcome of the research will be effected the environmental management of urban energy-saving efficiency. From policy development and environment preservation, there is proper city development for saving energy and sustaining the city.

**Index Terms**—Urban community environment, travelling and energy saving.

## I. INTRODUCTION

Countries developing grew up the economic and social rapidly. Bangkok is the province which was developed and grew up a lot both in the industrial section and commercial and residential section. The development made less density of housing and the scattering effect people to desire traveling in more distance between the residential area and activity area. As agricultural land price is cheap, it affect to infrastructure of landing usability. It was not related with the expansion of urban development. One major problem of Bangkok is the city transportation. Most of the road system need to rely on car. While city and transportation planning is inefficient, the environment was impacted. For example, the consumption of utilities and infrastructure, traffic congestion, noise and air pollution and Carbon dioxide increasing. Due to the use of gasoline-powered vehicles, it increases the global warming problem. Moreover, the expansion of the resident area is causes the demand of travel services and facilities when they need to travel in a distance. By the way, the public transport system is not effective enough. The form of city landing usability is clustering in the inner city which effects the use of energy to be raising.

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Pastraporn Thipayasothorn and Jintana Nokyo are with the Faculty of Industrial Education King Mongkut's Institute of Technology Ladkrabang Bangkok, Thailand (e-mail: pastraporn.th@kmitl.ac.th, knjintan@kmitl.ac.th).

Suparb Trethanya is with the Department of Public works Bangkok, Thailand (e-mail: kpratcha @kmitl.ac.th).

The energy factor is an important factor in transportation sector, industrial sector and Livelihood of the people. When the world oil price is higher, the fuel price in the country is higher. Thai imported energy from abroad each year which the value is greater than the total value of gross domestic product in the country. The country has lost stuffs in trading. Transportation sector's energy consumption of the country is about 80 percent by 78.4 is used for land transportation. In 2013, the ratio of private car was up to 1,039 cars / day in Bangkok [1] if considering the proportion of oil consumption in Bangkok, there are 9,446 million liters or 40.3 percent of the whole country [2]. If we reduce the amount of oil consumption in Bangkok, we can reduce the costs significantly. The relationship between land usability and energy consumptions is very important to the local level through regional level. The forms of city landing usability indicate the level of energy consumption. Moreover, landing usability policy is an indicator of power consumption in the future. While the government has several issues to reduce energy consumption and promote energy conservation widely. They also guided the policy for urban sustaining development. The main point of the research involved the relationship between the pattern of the city and energy consumptive density, that's to say, the difference of city size impacted on travelling pattern and energy demanding. There is a factor related to the land position, social and economic characteristics, city size and density of the city. Moreover, facilities, services and environment affects behavior in travelling and energy consumption in residential area.

The purposes of Bangkok's urban community designing guidelines in order to save energy are to analyze the environmental community characteristic related to the current power consumption includes travelling behavior to access the services in urban areas. Moreover, the purposes are also to contribute the Bangkok's urban community designing guidelines in order to save energy, to plan process of utilities and facilities in the future. By the way, It can be a master plan of community's environmental city in the region.

## II. RESEARCH OBJECTIVES

The purposes of Bangkok's urban community designing guidelines in order to save energy are these following;

- 1) To study the physical city's environment
- 2) To study the travel forms from residents to an activity area
- 3) To recommend the urban environment d guidelines for energy saving

### III. LITERATURE RELATED TO TRAVELLING

The city pattern which was expanded based on land usability consistent to the pattern of activity in each area. It found that relationship between city forms and travelling pattern is not related to the any travelling form [3], but dispersion of land usability is associated with transportation. Moreover, there is economic and social factors explained that the form of the city during 1850 is only pedestrian which the density of land usability is only about 5 kms away. During industrial revolution, there is transport expansion such as train and tram. Each station is far about 20-30 km, and during the 1950s the city became a city of car. This is to say, the city form is expanded about 50 km and low density.

They found that the format of the city has relationship with the physical position characteristics and energy usability in the city's transportation. For example, size, density and empty space affect to the travelling patterns. According to TEI study, they said that the city form affected to transportation's energy consumption. Also, it affected the amount of fuel consumption to be higher related to the distance of the journey. Moreover, traveling time and distance related to the income and the density of population which are far from the center of the CBD. The type of housing is separated from the activity area and land usability. The rate of travel per household is related to the duration of the trip, household size and type of travel and it's depending on the rate of vehicle ownership.

According to the study of Somchai Kongsin [4], the study found that increasing in the cost of travelling has contributed to the decision to travel. For example, Lowry Model suggested that a different or associated activity decreased the round of the trip. From analyzing the utility system of the housing area, the residential area is far from the center of employment affecting the cost of energy to be rising. According to Sopark Phasukniran [5], he gave the hypothesis of residential characteristic and household members include ability to access city's facility. By the way, resources and service are concentrated in the center of the city and CBD affected to the energy use. The residential buildings has uncomplicated labor group as the facilities are concentrated in the city center which raised the cost of energy. In the model of Roman's Model found that greater the density of housing, the greater influence to the heat in household areas. Also, affected to the distance of the journey up from the center of town.

Lacking links to land usability and the city types affected the layout of the city with the travelling energy [6]. Density of housing can measure from the average amount of building and total space for using energy efficiency within the structure. The impact of the power structure changing is a factor of oil prices changing as a indicator of total workforce of the city. There is a very important hypothesis which occurred from the person behavior. It affected space structure which was changed and controlled.

The control area responded as expected. The public response to oil price which increased or fuel which is difficult to find, It is a must to understand the actual behavior with deep understanding. "What raise the fears of power lacking" [7]. The effort without a clear definition that

no any details before making decision, led to the process of energy consumptive controlling in the city forms. They need to consider the possibility of marketing's impact. The energy consumption of housing affected to the spatial structures.

The change of power is unavoidable caused by the heat of the area (and coolness in some seasons) which can be the rate of household's energy consumption. The household is related to the spatial structure directly which affected the possibility of changing the spatial structure. The heat condition is more complicated than travelling. We can use renewable energy instead of using the fuel in larger space and less density. The response of households to the rising prices (or the few amount of supplying), the vary changing of the fuel reduce the amount of total energy. In the long-term, the price will change followed the power requirements of residential [8]. Especially, changing of characteristics of individuals who effected to the change in the fuel price for heating in the area, such as the renewable fuel.

Accepting in the lower temperature or eliminating unnecessary power consumption affects the spatial pattern. Yet the advantage of energy-efficient buildings can be accepted and also the size of the community and related other factors, such as the weather in the region, layout of the building and buildings with energy savings. Awareness of using solar energy in the building can reduce half of the cost of energy used for making heat (light). The relationship of energy and a small city affect the energy needs to build a construction, and relocation may occur which affect the style and the density of the new buildings. These evidences supported the future changing of the city center or the raising landing price's theory. For example, the area where received the solar light and the hot water can return the half of total lost energy, and also affected the economic. Migration is supported but still being conflict with the low dense area which will affect the appearance of the building, the layout and density of new buildings. If there are good manage and prepare to handle the consequences may occur, from the survey of some areas, such as southern California; the buildings responded to the needs of developing solar energy which Influenced toward applying in the new.

### IV. METHOD

The research of Bangkok's urban community designing guidelines in order to save energy is an inexperiment study. Part of the population who were randomly chose to study used the equation of  $n = N / 1 + N (0.05)^2$ . We used the method of probability sampling by all the population is likely to be randomly choosing as well.

The instruments are divided into two categories as following;

- To collect quantitative data by using survey and observation followed the plan. The researcher would design and plan the work followed the process. By the way, the questionnaire is the physical data which would be analyzed with the observation of the first part.
- To collect qualitative data by using questionnaire for asking the opinion of the sample group in the inner, middle

and outer city. The researchers would study and design the tools to collect the information as detailed below.

Chapter 1 General information of the respondents.

Chapter 2 Traveling patterns of housing area to the activity area.

Chapter 3 The problem of getting access to the activity area.

Chapter 4 Approaches of urban community development for energy saving.

The data of the sample group who are normally travelling in inner, middle and outer city is an personal opinion data to the approaches of urban community development for energy saving. The researchers would be analyzed the data with the survey and observation data.

- Collecting data location is Bangkok area, inner, middle, outer city.

- 1) Inner city consists of 22 districts, Pra Nakorn, Pomprap Sattruphai, Samphanthawong, Pathumwan, Ratchatevi, Dusit, Phra Khanong, Bang Phlat, Bangkok Noi, Bang Yai, Sathon, Yan Nawa, Bang Ko Laem, Bang Sue, Khlong San, Thon Buri, Jatujak, Huai Khwang, Din Daeng, Klong Toey and Watthana.
- 2) Middle city consists of 22 districts, Don Muang, Lak Si, Bang Khen, Sai Mai, Lad Phrao, Bang Kapi, Bueng Kum, Wang Thong Lang, Khannayao, Saphan Sung, Phra Khanong, Bang Na, Prawet, Suan Luang, Taling Chan, Thawi Watthana, Phasi Charoen, Bang Khae, Nong Kham, Rat Burana, Thung Khru and Jomthong.
- 3) Outer city or suburban area consists of six districts, Min Buri, Khlong Sam Wa, Lat Krabang, Bang Khun Thian, Bang Bon.





Planning of studying data analysis by analyzing qualitative data from surveys and observing the physical characteristic of urban community in Bangkok, and processed the data via related computer program, such as Photo Shop, Microsoft Excel, 3D Auto Cad. Also, analyzing the quantitative data by collecting data from questionnaires of the sample group in the sense of behavior patterns of traveling into the urban communities, and processed the data by related computer program includes designed the urban community in travelling for saving energy. With the above background information, the study evaluated the urban community environmental design for energy-saving trip in inner, middle and outer city to present the findings of the study.

## V. RESULT

According to the survey and observation, we summarized the comparison of each area characteristic, facility for travelling and, facility for utilities to determine the travelling pattern from housing area to activity community area as shown in Table I.

TABLE I: SHOWS THE SURVEY AND OBSERVATION DATA OF THE PHYSICAL AREA IN INNER, MIDDLE AND OUTER CITY

Study areas	Results
Inner city	- Highest density - Various transportation - Comfort with all utilities

		
Middle city		- Fair density - Various transportation - Spreading utilities
Outer city		- Free and wide space - Facility for travelling, road with light. - Close to utilities

According to the data from the survey and please noted in Table II; physical environment in inner, middle, and outer city, found that occupation area in urban Bangkok is located in the inner city. The living area is spread in all areas. Inner city is highest density and less in the outer city, so the habit of travelling into the urban activities areas are the network of radial and ring to the inner city of Bangkok. From exploring the behavior, there are individual findings. Travelling purposes and distance are shown in Table II.

TABLE II: TRAVELLING FACTORS FROM HOUSING AREA INTO ACTIVITY AREA IN URBAN COMMUNITY

Travelling factors	Criteria (Percent)					Total
	Highest	High	Fair	Less	Least	
1. Distance	4.9	6.6	16.4	45.9	26.2	100.0
2. Time	14.3	0.0	9.5	52.4	23.8	100.0
3. Density	8.2	7.9	12.3	57.5	14.2	100.0
( $\chi^2$ )	Sig.=0.208, df=8					

According from the table II, Travelling of person and travelling patterns which are three patterns; cars, public transportation and walk or riding bike have relationship with the city's shape and landing usability. The factors of speed and time are the criteria of decision to getting in the activity areas in urban community.

## VI. RESULTS AND DISCUSSION

Public facilities is result in travelling patterns, from housing areas to the activity area in urban community, and changing of urban environments affected the energy consumption to be more. According from the researcher's purposes, difference of density and size of city and short distant travelling affected the travelling patterns that reduced energy consumption. While the behavior of the traveler to access the services of the city affected the use of private cars on the road. To reduce the amount of energy consumption, oil and physical density, the size of the different cities influenced people's attitudes towards the quality of life in the city and outer city environments, and it impacted energy consumption in various ways.

From the Fig. 1, Travelling from the urban community led to urban community designing for saving energy to travel into the inner, middle and outer city. It shows the physical

environment of urban Bangkok and travelling behavior into the activities community. The technology designing is shown in Fig. 2.

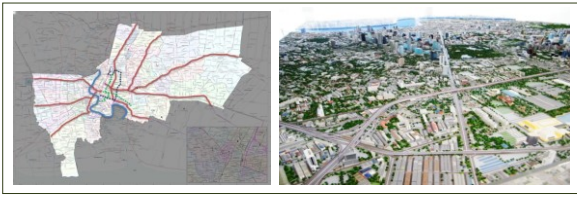


Fig. 1. The pattern to travelling into downtown.

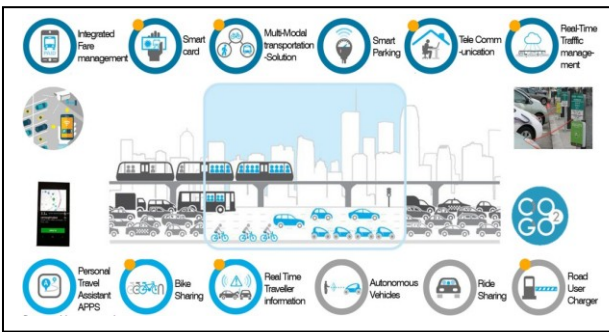


Fig. 2. The design of the urban environment in order to save energy in travelling.

Fig. 2 the design of the urban environment in travelling can create the technology design to save energy in the urban environment. These are advantages;

- 1) Changing of to the ecological environment and urban community design in order to save energy.
- 2) The creation of awareness on urban environmental conservation for saving energy.
- 3) Conserve the area where is economically important in urban community includes environmental protection.
- 4) Restoration and enhancement of economic importance from urban areas.
- 5) Technology for reducing pollution and environmental impact from the activities areas.
- 6) The management of the urban environment for saving energy efficiency.

The technology design to save energy in the urban environment proposed the travelling policy development. Also, preserve the city environment to propose the guidelines of city form development for saving energy and sustaining cities.

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**Pastraporn Thipayasothorn** is an assistant professor in urban environmental management, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand (Tel: 6687 0744488). Her research areas include in architecture and building design, project feasibility study, housing policy and management, housing development, urban policy and management, urban planning and design, sustainable urban development, urban environmental management, energy efficiency in cities.