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Research Paper

Measuring the Behavior and Preference for Energy Saving and Household Carbon Emission Reduction of Urban Residents in Bangkok and Its Vicinities, Thailand

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ABSTRACT

Climate change has become a crisis situation worldwide with great importance attached to mitigation policy and implementation plans towards urban sustainability challenges. Together with rapid growth of urban environments, the Urban Heat Island (UHI) has significantly influenced temperature records whereby the concentration of urban structures and human activity results in a higher air temperature over urbanized areas, especially the metropolitan area of Bangkok, Thailand and its vicinity. This research aimed to assess the behavior and preferences for energy saving and household carbon emission reduction by focusing on residential groups with a survey via face to face interviews. Data from three parts of questionnaires were input into Structural Equation Modeling (SEM) which are; 1) residential location and characteristics of neighborhood zone; 2) energy consumption behavior and carbon dioxide emission activity, and 3) attitudes toward the effects of UHI and Carbon Dioxide emission reduction. The results showed that residents' attitudes influenced their in-house behavior, workplace behavior and travel behavior. Therefore, potential recommendation for heat island mitigation could simply be raising of public awareness on self-adaptive behavior, with more practical knowledge aligned with residents' attitude towards daily activity and lifestyle.

1. Introduction

Bangkok, the capital city of Thailand, is witnessing a fast-growing urbanization, together with inefficient urban planning, evidently signifying the lack of an urban growth plan. The increasing annual rate of urbanization approximately at 1.6% alongside the population growth rate is less than the available rural area. Such rapid expansion of city and its corresponding population growth has resulted into a phenomenon of Urban Heat Island (UHI) (see **Fig. 1**). This phenomenon is reflected in the air temperature, which is higher in urban areas compared to rural areas; where significant temperature differences between inner micro-climates of a city and their neighboring micro-climates can be perceived (Environmental Protection Agency, 2013).

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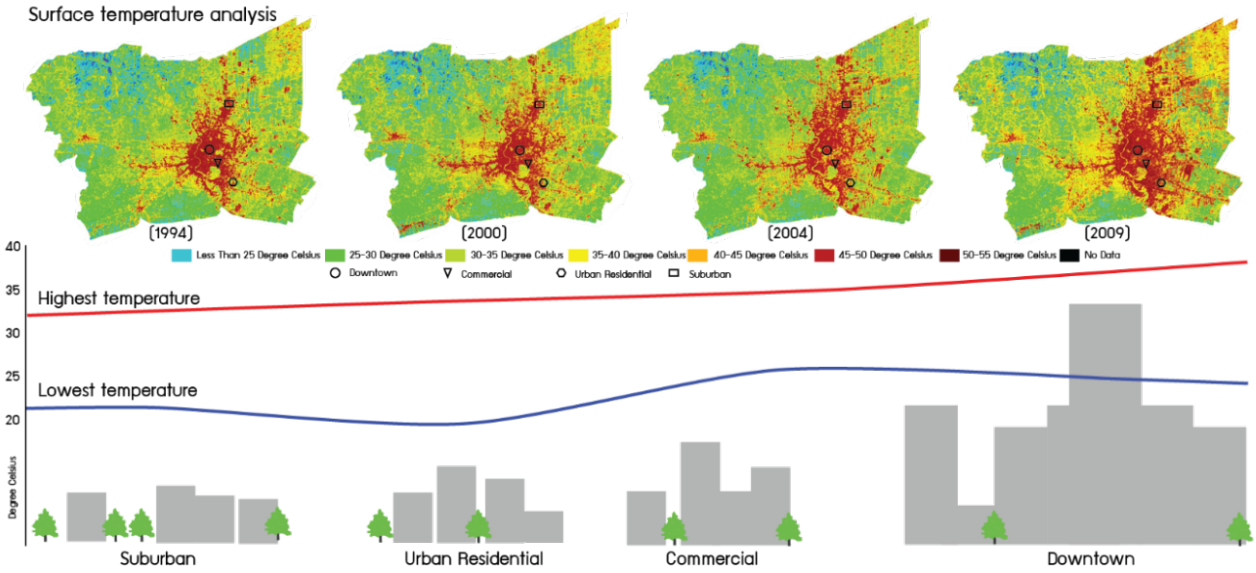

Fig. 1. Rising temperatures in Bangkok, Thailand and its vicinities.
Source: Intergovernmental panel on climate change, 2550 (Voogt, 2000).

A review of the literature revealed that UHI is a growing environmental related problem that deserves appropriate attention, not only with regards to air pollution (outdoor and indoor air quality) but also in terms of demand for energy consumption and potable water (Balling et al., 2008). There is no doubt that the direction of urban development plays a vital role in solving this problem. It can be seen from the trend of urban physical dynamics that these changes are getting worse, particularly the dense building areas and transportation as well as industry and those activities that intensively consumed energy in urban areas (USEPA, 2008). Comparing this with other sectors that release carbon dioxide into the environment, it could be seen that these activities are major contributors to carbon dioxide emissions. However, rising temperatures may also widely affect the health and well-being of urban dwellers. On a negative note, they may shorten human life and promote the spread of diseases (McMichael, Woodruff, & Hales, 2006; Thomas & Chris, 2004). Furthermore, the dynamics of urban movement and increase in human activities is one of the leading causes of climate change, which directly or indirectly impacts the environment and people's lives.

Bangkok, as a metropolis in Southeast Asia, has experienced rapid urbanization with a total urban area of 13 square kilometers in 2009 (Mekvichai, 1998). Although the registered population in Bangkok is more than 5.6 million people; not counting a similar amount of people who are not registered in the city. Thus, with rapid urbanization, this megacity has reached a population of more than 10 million persons. The characteristics of this urban and demographic growth varies according to the rise in land cover, which is in the upward trend (see **Fig. 2**). Rural areas in Thailand are estimated to have a coverage of less than 28% while the urban area is projected to be around 72% within the next 30 years (World Urbanization Prospect, 2014). Urban expansion covering rural areas has caused changes in land cover and urban activities at a high rate of growth (Montavez, Rodriguez & Jimenez, 2000). Considering the impact of this urbanization on urban temperature, average annual temperature level in Bangkok remained constant, but compared to other provinces where there is less urban density, Bangkok's average annual temperature was found higher by about 2 degrees Celsius (Meteorological Department of Thailand, 2014).

This mitigation process can be achieved, for instance, by increasing biotope areas, increasing permeable surface areas, as well as human behavior adaptation. Urbanization plays a major role in activity movement related to urban growth, both directly and indirectly since it consumes more land cover and less green or agricultural space replacing them with built up areas (UNFCCC, 1992). The key consideration in solving UHI is to encourage its actual implementation with the participation of all stakeholders in order to raise public awareness on the importance of finding effective solutions to mitigate it. In order to help alleviate the adverse impact of UHI, heat mitigation strategies should potentially be applied to have a larger population impact, particularly in community engagement with specific intervention in used (Buyantuyev & Wu, 2009; Huang et al. 2011). Following the earlier example, it can be seen that there is significant urban activity movement impacts on UHI and carbon dioxide emissions.

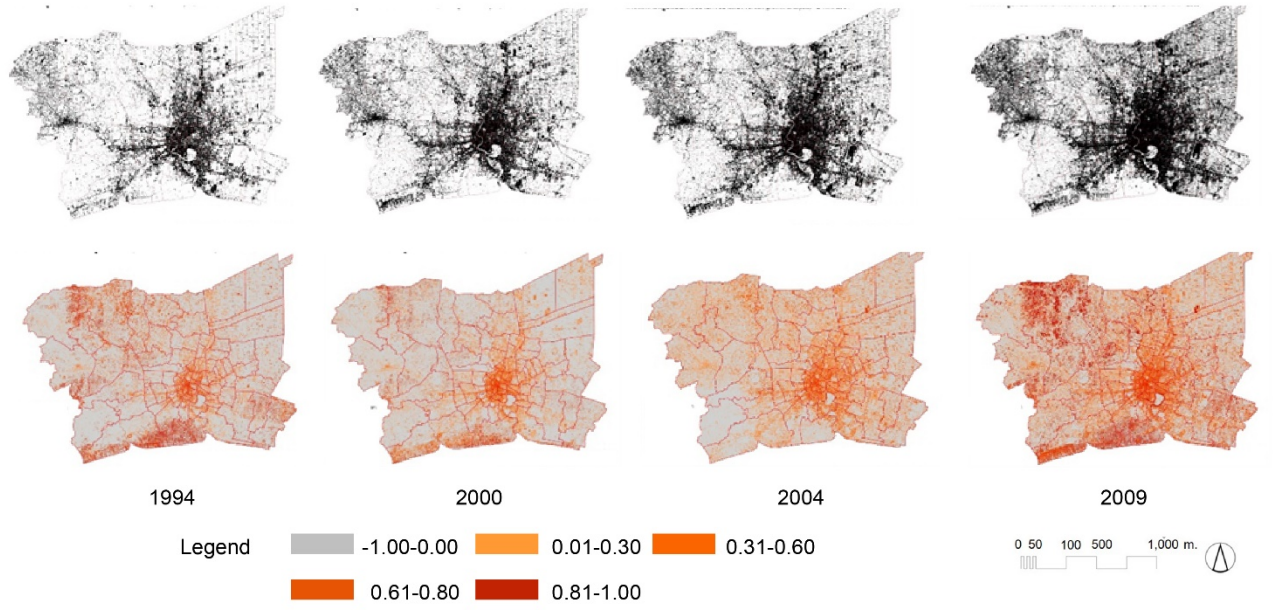

Fig. 2. The expansion and land cover in Bangkok
Source: Landsat 7 ETM Satellite analysis between 1994-2009.

These impacts are based on the urban context together with socioeconomics, behavior, and preferences of dwellers. In light of this, the objective of this research is to identify the relationship between behavior and attitudes relative to UHI and carbon dioxide emissions in Bangkok and its vicinity. A consideration of the behavior and attitude characteristics of different dwellers who directly or indirectly are involved. This will shed light on appropriate solutions for UHI mitigation and the reduction of carbon dioxide emissions, with a view to moving towards low carbon development in future.

2. Literature review

2.1 Climate and global warming change

Human movements, for example, social-economic change and carbon dioxide emissions, have not only affected climate change, but also affect the natural and human ecosystem (International Energy Agency, 2009). Therefore, recommendations for carbon dioxide emissions reduction strategies will help to decrease the risk of its social impact and as well sustain a low carbon society in the future. Climate change reflects a variation or change of climate that has occurred through both direct or indirect human activity distinctable from natural change. This phenomenon also affects the earth's changing atmosphere at the same time (UNFCC, 1992). Global warming is a phenomenon where the average surface temperature of both land and the oceans increase because of a rise in greenhouse gas emissions in the Earth's atmosphere. Such emissions resulting from human activities causes increased amounts of carbon dioxide in the air (Kiehl, 1997; Tan, 2007). For instance, fuel combustion from transportation and industry together with deforestation clearly negates the convenience desired to fulfill human needs (Summary for Policymakers, 2001). Such actions reduce the efficiency of life-cycle carbon; consequently, causing greenhouse gases to absorb and retain heat in the atmosphere. This is partially responsible for climate change witnessed in a heavily urbanized society. In addition, climate change has other several negative consequences on both physical, biological and human systems, as well as other effects such as spreading of disease, changing ecosystems, melting of the poles, rising of sea level and changing of the precipitation patterns which may lead to floods or drought (McMichael, Woodruff, Hale, 2006).

2.2. Urban Heat Island

Urban Heat Island (UHI) is a remarkable issue due to its negative impact on urbanization and human health in the city (Howard, 2007). It is a phenomenon whereby temperature in the urban center is higher than what it is in the outskirts or rural areas by around 1-3 degrees Celsius during the daytime and 7-12 degree Celsius during the nighttime (Liang, 2004). The difference in temperatures between these areas depends on the size and density of the city, and can be seen clearly during daytime and nighttime in both winter and summer months. The main cause of UHI is land use or land cover changes as a result of urban growth, in an area initially suburban or

rural; covered by plantations. Recently, most of the green areas and permeable surfaces are now being replaced with concrete and asphalt. This is a principal component of urban construction in terms of roads, buildings and other structures occasioned by the rise in residential, commercial and industrial areas (Oke, 1997). UHI always have wide-ranging impacts on society that requires infrastructure support for its civilization and development. It does not only impact land use patterns and health, it also affects patterns of human settlement, energy use, environmental quality, and other aspects of infrastructure that influence our quality of life (Balling et al., 2008).

2.3. Causes of Urban Heat Island

There are several causes of UHI, especially the ratio of green area to land cover surface. Several factors can lead to UHI like (Jusuf et al., 2007; Eliasson, 1996; Marsh, 1991):

1. Type of land cover and decreasing plant life in urban areas.
2. Building materials ratio influence on sunlight reflection, heat release rate and heat absorption.
3. The urban shape. This is a significant factor that influences UHI, especially at nighttime. The orientation of buildings and the gap between those buildings as determined by urban shape is a parameter that influences wind speed, energy absorption, and the ability of surfaces to release long-wavelength radar.
4. Energy consumption behavior is also one of the major causes of heat level in the atmosphere. This is because the main energy consumption arises through daily human activities.

2.4. Behavioral Approach in Combating UHI

Human activities taking place mostly in urban areas are responsible for anthropogenic heat release, which causes air pollution that in turn affects cloud cover. The combination of different factors determines the situation of heat formation in the diverse context of the urban environment; expressed as rising temperatures in the urban areas. Significant factors in the formation of UHI is examined as follows:

1) Heat from human activities

The analysis of the amount of heat generated from human activities and energy sources for urban activities, such as heat from buildings, industrial processes, and transportation, can be analyzed by considering the amount of current and future of energy consumption in all sectors: residential, commercial, industrial and transportation. Increasing heat from human activities in accordance with the rise in electricity demand, particularly exhibits excess heat with direct impact on nearly every facet of urban life (Uejio et al., 2010). Therefore, understanding of the behavior and experiences this excess heat has on the environment and the populace is one of the major challenges confronting UHI mitigation. Knowledge of this could help to shape the direction of policy implementation efforts, leading to practical improvements in urban heat responses and foster greater communication among different stakeholders. Meanwhile, local communities need to understand energy conservation awareness such as turning on and off lighting or scheduling the use of electrical appliances, especially those that increases room temperatures by almost 3 degrees Celsius a day when in use like computers. Sustainable technology options such as motion sensors, availability of energy efficient appliances as well as building design itself should be organized in a powerful energy saving platform that will incorporate both environmental and socially planned measures (Levy, 1978).

2) Transportation behavior

Carbon dioxide emissions are produced from a number of trips that are connected to various activities in the urban area, especially by private motorists. Such trips also create traffic congestions, which has undesirable effects on the population of Bangkok and surrounding areas. This problematic situation has continued to worsen in recent years with more heat and air pollution being generated from the dust and smoke. Interestingly, one approach to lower temperatures and to mitigate air pollution problems in urban areas is an efficient transportation plan, which helps to reduce the number of private vehicles on the road and encourage the use of public transport or other forms of non-motorized transport (Coutts et al., 2010).

3) Other factors

Urban growth without corresponding efficient planning to manage the situation will consequently leads to increase in temperatures in the urban areas, resulting from the altered thermal balances in urban spaces. This occurrence has arisen mainly due to the materials and activities taking place in cities; areas which differ considerably to rural areas because of the changes in land cover (Montavez, Rodriguez & Jimenez, 2000). The general lack of vegetation and the low albedo of urban surfaces are strong characteristics of the formation of the heat island effect, and it can lead to changes in the energy balance in urban districts as well as a significant rise in temperature in the urban areas when compared to others (Hinkel & Kenneth, 2003).

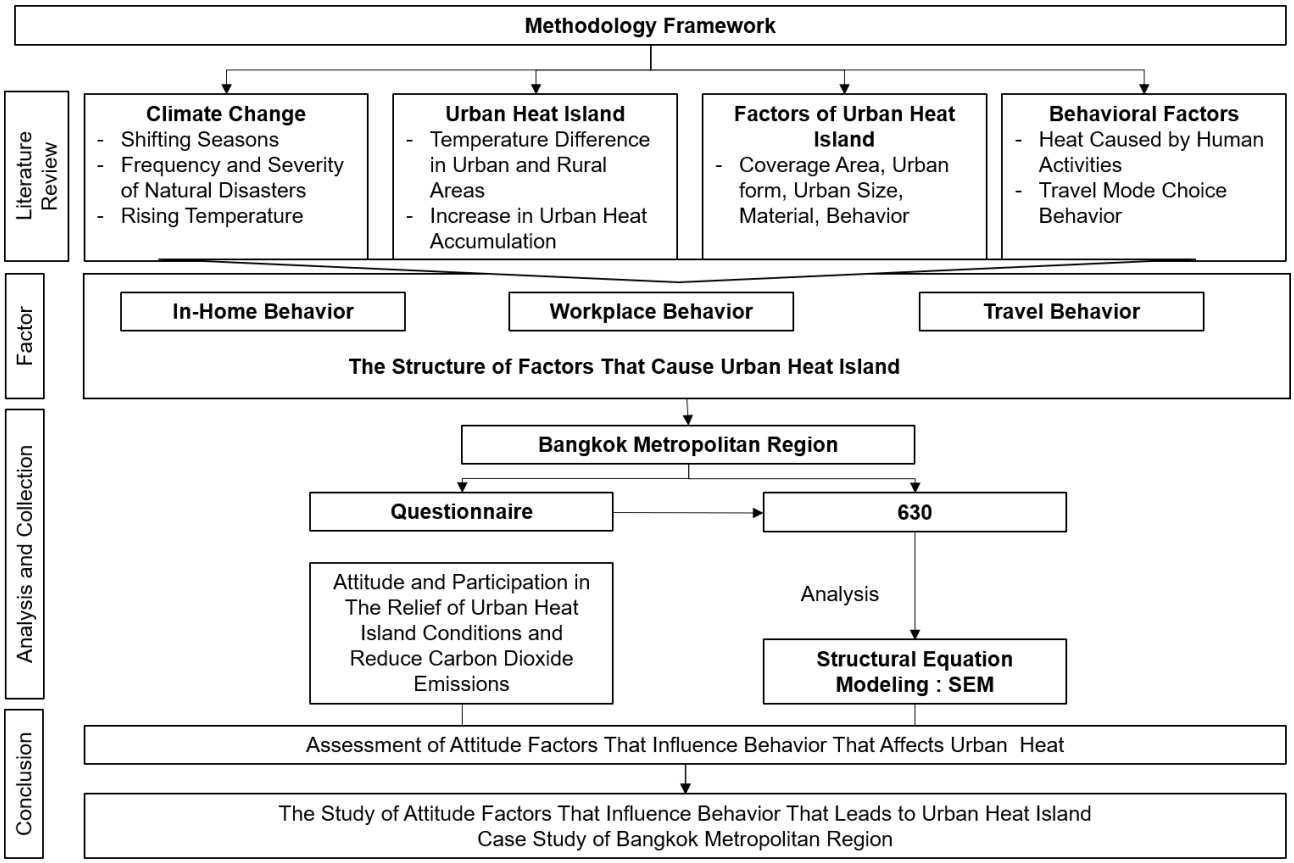

Fig. 3 Framework of study

Table 1. Behavior and Attitude Factors

Latent factors	Observational factors
HO: II-Home Behavior	HO11: Turning off electrical appliances every time it is not in use or setting time to go off to reduce Usage
	HO12: Purchasing electric appliances by comparing the power consumption rate and the energy saving symbol No.5
	HO13: Rejection of difficult biodegradable packaging and using eco-friendly bags instead of plastic bags
	HO14: Sorting materials that can be recycled to reduce waste and save resources
	HO15: Opening curtains to let in natural light or installing specific lighting areas instead of lighting the entire room
WK: Workplace Behavior	WK11: Using stairs for 1-2 floors instead of using elevators in order to save energy
	WK12: Using both sides of paper. Only print or copy necessary documents, otherwise send them via the Internet
	WK13: Shutting down the computer and printer when it is not in use or work is completed
	WK14: When leaving the office as the last person always checking and shutting down electrical Appliances
TL: Travel Behavior	TL11: Choosing gasohol or biodiesel instead of petrol to save and reduce CO_2 emissions
	TL12: Using a shuttle bus service or car sharing to go to work (Carpool)
	TL13: Traveling by public transport (BTS, MRT, BRT, bus etc.) instead of using personal cars or taxis
	TL14 Walking or using a bike when you want to go out for eating, shopping or conducting transactions within a distance of 400 to 800 meters
TK: Attitude toward energy saving adaptation and CO_2 emission reduction	TK11: The use of various energy from human activities that emit CO_2 and contribute to Urban Heat Island (UHI)
	TK12: The benefit of reducing energy consumption, which is a duty that everyone should follow because of its simplicity
	TK13: Reducing energy consumption helps mitigate UHI conditions and improves the environment
	TK14: Threats from Urban Heat Island conditions and climate change are intensified
	TK15: Increasing green spaces and biotope areas helps reduce energy consumption and mitigates Urban Heat Island conditions

Table 2. Index of model consistency

Indicator	Absolute fit measures				Parsimonious fit measures		Incremental fit measures		
	x^2/df	GFI	RMR	RMSEA	PNFI	PGFI	NFI	TLI	CFI
Evaluation standard	<3	>0.9	<0.08	<0.08	>0.5	>0.5	>0.90	>0.90	>0.90

3. Research methodology

The framework of this study was designed according to the reviews as depicted in **Fig. 3**. The factors considered in this study area are illustrated in **Table 1**. The approach adopted for mitigating UHI is to create a sustainable low-carbon society in Bangkok and its vicinity by integrating both the body of knowledge of urban planning and the environment. This study utilized research survey, where descriptive statistics were used to describe the data in order to understand the general characteristics of the policy variable. Moreover, applying Structural Equation Modeling (SEM), the distribution of variables clearly described the result of analysis from the survey. Interviews were conducted through the use of questionnaires, designed based on the specific areas discussed in the literature review.

A total sample of 700 sets was initially selected through random sampling of dwellers residing in Bangkok and its vicinities (Yamane, 1973). Through a thorough screening process, a final sample size of 630 was checked for a complete set of questionnaire data. Behavior and attitude factors were analyzed from factors determined from personal behavior and attitudes in daily life as well as household activities, constituting major sources of carbon dioxide emissions. On the climatic conditions, this research attempted to incorporate social characteristics of residents as the main factors influencing perceptions of heat and its mitigation approach. Thus, individual characteristics such as age, income, residential and community characteristics like poor constructions (housing), and access to air conditioning were included. This study examined the relationships among different sets of policy variables that influence residential attitudes, with a view to recommending policy measures of urban heat island mitigation. The reasonableness of the assumptions depends on whether the hypothesis model is consistent with the empirical data (Schumacker & Lomax, 2010). In this study, there are three hypotheses that were determined as shown in **Fig. 4**.

The hypotheses were tested by using structural equation modeling, which was considered as a primary approach to allow the error data obtained from the measurement of the observed variables. This research considered the normal distribution of variables from the skewness between -3 and + 3, which reflects the normal distribution.

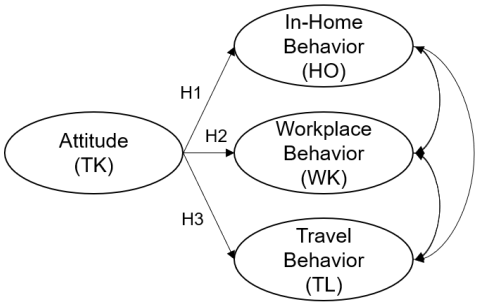

Fig. 4. Research hypotheses

Confirmatory factor analysis (CFA) was also used to examine the relationships between observed variables and latent variables including model consistency checking. However, the modified model was made to be consistent with the empirical data that was performed using the criteria of analysis in **Table 2** (Marcoulides & Schumacker, 2001). The results of the analysis could be useful in leading the way to behavioral change towards the development of a low carbon society, while mitigating the negative effects of UHI, or at a minimum, adapting to it to overcome its effects.

4. Results of the study

In order to examine the relationship among factors that influence residential behavior and attitudes towards the causes of the urban heat island, this study selected Bangkok Metropolitan Region as a case study. A defined set of variables and hypotheses to test the relationship among factors were analyzed on a basis of the application using structural equation (Structural Equation Model). With this statistical technique, the test and estimated rational relationships among different socioeconomic groups is showed in **Table 3**, and the analysis of results is as follows:

4.1 Socioeconomic characteristics

Rapid urban expansion over the past two decades in Bangkok and its vicinities has resulted from a high population growth rate to increased rural urban migration combined with a strong tradition of centralization in the capital, especially the Central Business District (CBD), making this area to have higher temperatures than natural areas.

Table 3. Socioeconomic and urban characteristics

Factors	Proportion		Natural area	Rural area	Suburb area	General CBD	CBD	Main CBD
	N	%						
Education Levels (Chi-Square = 0.051)								
Primary	5	1.03	0.00	12.50	1.31	0.47	0.00	0.00
Secondary	12	2.49	0.00	0.00	6.55	14.22	13.33	0.00
Diploma	57	11.80	0.00	37.50	5.24	17.06	8.33	7.14
Bachelor Degree	352	72.88	100.00	50.00	69.87	63.03	71.67	71.43
Higher Than BD	57	11.80	0.00	0.00	17.03	5.21	6.67	21.43
Number of Vehicles Occupancy (Chi-Square = 0.051)								
1-3	286	77.30	0.00	40.00	76.82	80.00	70.00	69.23
4-6	77	20.81	100.00	20.00	23.18	20.00	25.00	30.77
7-9	7	1.89	0.00	40.00	0.00	0.00	5.00	0.00
Average monthly income (Baht) (Chi-Square = 0.010)								
Less than 15,000	62	11.19	0.00	12.50	11.67	10.19	12.12	5.88
15,000-20,000	90	16.25	0.00	25.00	12.08	23.15	10.61	5.88
20,000-50,000	214	38.63	0.00	0.00	39.17	42.59	33.33	35.29
50,000-100,000	128	23.10	100.00	12.50	29.17	14.81	24.24	41.18
More than 100,000	60	10.83	0.00	50.00	7.92	9.26	19.70	11.76

According to the distribution of socioeconomic data, the results showed that the sample population is mostly located in the CBD and suburban areas. Most of them graduated with a bachelor's degree and are working for private companies (35.3%) or people who have their own businesses (9.5%). Average monthly income ranges between 20,000-50,000 baht and most of them own 1-3 cars per household which reflects how people commonly use their personal motor vehicles. With this human activity or pattern of mobility, a lot of particulates are consequently produced through the burning of fossil fuels, hence becoming one of the main contributory factors of urban heat island.

4.2 Attitudes towards household activity and energy consumption behavior

The characteristics of human activities affects energy consumption behavior relative to climate change, because it causes heat to be released in the atmosphere. In order to alleviate excess heat that occurs within the city, it is necessary to understand that human activity play a major role in substantial heat balance. This needs to be considered in the analysis. The input factors of the hypotheses as specified earlier comprises of 4 main factors and 18 sub-factors to be analyzed. The question of behavior characteristics has a confidence interval value of 0.904 which is acceptable (> 0.80). Extracting suitable data from questionnaires for analysis with KMO and Bartlett's Test (0.898) leads to the model generated in **Fig. 5**. The analysis of the relationship among different policy variables was done by testing and estimating the rational relationship of the hypotheses. The result of analysis is shown in **Fig. 6**, and further details are provided as follows:

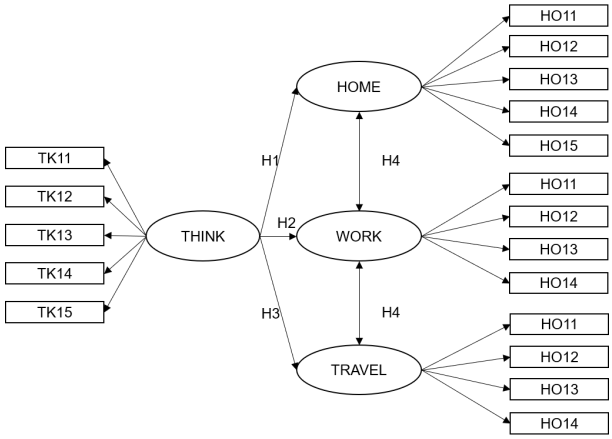

Fig. 5 Structural models and their associated variables

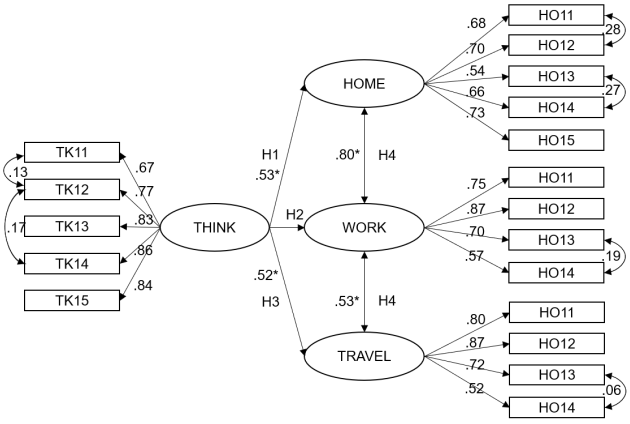

Fig. 6. The results of structural models and their variables

1) Hypothesis 1: Attitudes that affect in-home behavior mitigating urban heat island conditions and reducing carbon dioxide emissions

The hypothesis test of attitude that affects in-home behavior for relieving urban heat island conditions and

reducing emissions was executed. There are 2 latent variables and 10 observed variables, namely HO11:Turning off electrical appliances every time when not in use or setting time to go off to reduce usage), HO12: Buying electric appliances by comparing the power consumption rate and the energy saving symbol (No.5), HO13: Rejection of difficult biodegradable packaging and using eco-friendly bags instead of plastic bags, HO14: Sorting materials that can be recycled to reduce waste and save resources, HO15: Opening curtains to let in natural light or installing specific lighting areas instead of lighting the entire room, TK11: The use of various energy from human activities that emit CO_2 and contribute to Urban Heat Island, TK12: The benefit of reducing energy consumption, which is a duty that everyone should follow because of its simplicity, TK13: Reducing energy consumption helps to mitigate urban heat island conditions and improves the environment, TK14: Threats from urban heat island conditions and climate change are intensified, TK15: Increasing green spaces and biotope areas helps reduce energy consumption and relieves the effects of urban heat island. The result of analysis revealed that effects of in-home behavior variables is in relation to relieving urban heat island conditions significantly (r= .53, p <.001*). The strongest relationships regarding attitudes towards in-home behavior were for daily activities such as opening curtains to let in the natural light or installing a specific lighting area instead of lighting the entire room (.73), and buying electric appliances by comparing the power consumption rate and the energy saving symbol No.5 (.70), meaning that all reached statistical significance (all ps. < .001). Finally, with an attitude of reducing energy consumption, mitigation of both urban heat island conditions and the environment was improved (r = .83, p. < .001).

2) Hypothesis 2: Attitudes that affect workplace behavior mitigating urban heat island conditions and reducing carbon dioxide emissions

This research performed the analysis of the hypothesis test of attitude that affects workplace behavior in relieving urban heat island conditions and reducing CO_2 emissions. Two latent variables and 9 observed variables were obtained, namely WK11: Using stairs for 1-2 floors instead of using elevators in order to save energy, WK12: Using both sides of paper and only printing or copying necessary documents or sending them via the internet, WK13: Shutting down the computer and printer when not in use or when work has been completed, WK14: When leaving the office as the last person, always checking and shutting down electrical appliances, TK11: The use of various energy from human activity that emits CO_2 and causes urban heat island, TK12: The benefit of reducing energy consumption, which is a duty that everyone should follow because of its simplicity, TK13: Reducing energy consumption helps to mitigate urban heat island conditions and improve the environment, TK14: Threats from urban heat island conditions and climate change are intensified, TK15: Increasing green spaces and biotope areas helps to reduce energy consumption and relieves urban heat island conditions. The analysis demonstrated a significant effect of workplace behavior on reducing urban heat island conditions (r= .62, p <.001). The most influential workplace behavior is using both sides of paper and only printing or copying necessary documents or sending them via the internet (r = .87, p <.001) along with using stairs for 1-2 floors instead of using elevators in order to save energy (r = .75, p <.001). Followed by, the attitude of reducing energy consumption would help mitigate urban heat island conditions and improve the environment, including threats from the urban heat island and climate change that has intensified.

3) Hypothesis 3: Attitudes that affect travel behavior mitigating urban heat island conditions and reducing carbon dioxide emissions

The analysis of the hypothesis test of attitude that affects travel behavior for relieving urban heat island conditions and reducing CO_2 emissions was performed. The result showed that there are 2 latent variables and 9 observed variables, namely TL11: Choosing gasohol or biodiesel instead of petrol to save and reduce CO_2 emissions, TL12: Using the shuttle bus service or car sharing to go to work (Carpool), TL13: Traveling by public transport (BTS, MRT, BRT, bus etc.) instead of using personal cars or taxis, TL14: Walking or using a bike when you want to go out to eat, shop, or conduct transactions within a distance of 400 to 800 meters, TK11: The use of various energy from human activity that emits CO_2 and causes urban heat island, TK12: Reducing energy consumption that is beneficial to you. This is a duty that everyone should do and can be easily followed, TK13: Reducing energy consumption helps mitigate urban heat island conditions and improve the environment, TK14: Threats from urban heat island conditions and climate change are intensified, TK15: Increasing green spaces and biotope areas helps reduce energy consumption and relieve urban heat island conditions. The analysis revealed a significant effect of travel behavior to relieve urban heat island conditions (r = .52, p <.001). The strongest relationship with travel behavior is using the shuttle bus service or car sharing to go to work (Carpool) (.87) significantly (p = .001).

Table 4. Consistency examination of the developed model

Indicator	Absolute fit measures				Parsimonious fit measures		Incremental fit measures		
	x^2/df	GFI	RMR	RMSEA	PNFI	PGFI	NFI	TLI	CFI
Evaluation standard	<3	>0.9	<0.08	<0.08	>0.5	>0.5	>0.90	>0.90	>0.90
Modeling result	2.862	0.948	0.029	0.054	0.701	0.632	0.941	0.947	0.960
Fit	Good	Good	Good	Good	Good	Good	Good	Good	Good

In addition, choosing gasohol or biodiesel instead of petrol to save and reduce CO_2 emissions (.80) was also significant with (P = .001) as well as traveling by public transport (BTS, MRT, BRT, bus etc.) instead of using personal cars or taxis (r= .72, p < .001). Therefore, the attitude of reducing energy consumption can help to mitigate urban heat island conditions and improve the environment. Monitoring the consistency of the model is a necessary step needed to be considered in checking the appropriateness of measures in accordance with the empirical data. The structural equation model developed with empirical data was used to examine the consistency index of the model by Chi-square value/Chi-Square correlation Harmonized index. The estimation of error value that was found from the model using the defined hypothesis is consistent with the criteria set as demonstrated in **Table 4**.

5. Conclusions and discussions

The urban heat island phenomenon is caused by several influencing factors that are related to human behavior and activities. The consideration of individual terms causing the urban heat island is a must so as to explore the desired mitigation outcome of all suitable interventions. The increase in heat generated by human activities is consistent with the increase in energy consumption, especially in the urbanized area. This situation revealed how urban planning and architectural design play an important role in regulating thermal comfort, reducing excess heat, and developing more sustainable cities. Considering individual groups of main factors mitigating UHI, the results of the study revealed the strongest attitude factor is threats from urban heat island conditions and climate change is intensified (.86*). Most residents agreed that increasing green space and biotope areas will help reduce energy consumption and relieve urban heat island conditions (.84*). In-home behavior on daily activity to be adapted as a lifestyle like opening curtains to let in natural light or installing specific lighting areas instead of lighting the entire room is 0.73*, and buying electric appliances by comparing the power consumption rate and the energy saving symbol No.5 (.70*). Considering workplace behavior, the activities to be considered to reduce waste generation like using both sides of paper and only printing or copying necessary documents or sending them via the internet is 0.87*, and using stairs for 1-2 floors instead of using elevators in order to save energy (.75*). Finally, travel behavior recommended like use of shuttle bus service or sharing of car to go to work (Carpool) is 0.87* and choosing gasohol or biodiesel instead of petrol to save and reduce CO_2 emissions (.80). Overall attitudes on mitigating urban heat island relative to behavior of energy consumption in-home (.53*), workplace (.62*) and travel (.52*) revealed significant correlations. Therefore, household energy consumption and its related behavior can probably result in a negative direction if people are not aware of these important issues. Moreover, travel behavior plays a key role as a sector that not only contribute to increase in the temperature but also releases carbon dioxide; causing traffic congestion problems, emitting dust and smoke that affect air quality, and human health impacts.

Consequently, raising public awareness and campaigning for energy saving attitudes as a mitigating strategy for urban heat island, can help to improve energy consumption of human behavior in daily life. Furthermore, government and other related sectors should also implement such mitigation measures. This could be done, for instance, by creating tax incentive measures for energy efficiency, enhancing development of public transportation and promoting usage of electric vehicles, including the integration of urban planning measures to control urban expansion and construction of buildings. This is due to the reason that UHI exerts a direct or indirect effect on the health and well-being of urban dwellers, thus focusing on increasing green space and high albedo and light color materials will definitely help to mitigate urban heat island conditions. Finally, saving of energy through decrease in demands, promotion of environmental quality and protection of human health in urban spaces will be possible with sustainable decreas of effects of urban heat island.

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