THE ADOPTION OF ENERGY CONSERVATION INNOVATIONS IN PRIVATE CARS: CURRENT AND FUTURE SITUATIONS IN BANGKOK

Alisa Verapatanakul

A Dissertation Submitted in Partial
Fulfillment of the Requirements for the Degree of
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The Examining Committee Approved This Dissertation Submitted in Partial Fulfillment of the Requirement for the Degree of Doctor of Philosophy (Population and Development).

Associate Professor...Committee Chairperson

(Chandhana Indhapanya, Ph.D.)

Assistant Professor..Major Advisor

(Preecha Vichitthamaros, Ph.D.)

Associate Professor...Co-Advisor

(Suwanlee Piampiti, Ph.D.)

Associate Professor...Committee

(Jirawan Jithavech, Ph.D.)

Associate Professor...Dean

(Surapong Auwatanamongkol, Ph.D.)

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ABSTRACT

Title of Dissertation	The Adoption of Energy Conservation Innovations in Private Cars: Current and Future Situations in Bangkok
Author	Alisa Verapatanakul
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This research aimed to study the level of accessibility to information, knowledge, perception of different characteristics of innovations and their adoptions, including a study of the relationship between the factors mentioned above and the innovation adoption for energy conservation in private cars for people in Bangkok. The sample was selected from the population age between 20–60 years old by using stratified three-stage random sampling. The data collection was conducted by using questionnaires and the analysis was undertaken by means of descriptive statistics and logistic regression to analyze the relationship between the factors and innovation adoption together with CHAID in order to analyze the relative importance of factors in relation to innovation adoption.

According to 400 respondents, the study found that in terms of energy situations and problems together with energy conservation innovation issues, most people had high accessibility to this information and about half of them had moderate knowledge; for the social support from government and private sectors issue, about half of them also had high accessibility to this information but mostly with low knowledge; regarding to the perception of different characteristics of innovations, it was indicated that most of the people had moderate perception of risk, comparative advantage and complexity, more than half also had moderate perception of compatibility. Concerning with energy conservation innovation adoption in private cars, both at present and in the future from four categories; gasohol,

biodiesel, natural gas and other potential innovations in the future, it was shown that most of the people adopted at least one category in the future. Furthermore, logistic regression analysis showed that there were three factors affecting the innovation adoption, both at present and in the future; i.e. gender, private car user and perception of innovation characteristics in terms of comparative advantage. The result indicated that males tended to adopt innovations, both at present and in the future, 2.008 and 2.292 times more than females respectively; private car users tended to adopt innovations, both at present and in the future, 3.423 and 1.875 times more than non car users respectively; and the perception of innovations in terms of their comparative advantage had positive relationship to innovation adoption, both at present and in the future. The probability to adopt innovation should increase by 5.9% and 7.9% respectively if the comparative advantage perception score increased by 1 unit. On the other hand, CHAID analysis showed that the first important factor to be considered in relation to innovation adoption at present was private car use. Car users tended to adopt innovations more than non car users. The next factor was the perception of innovations in terms of comparative advantage. If this perception score increased, it would affect more adoption of innovations. Whereas, the first important factor related to the innovation adoption in the future was gender. Males tended to adopt innovations more than females. The private car use by males was the next issue for consideration. It was shown that males using private cars tended to adopt innovation more than non car users which was quite different from females as it was indicated that if the perception score increased, so did the innovation adoption as a consequence.

The study results recommended the enhancement of aggressive innovation promotion that was focused on comparative advantage concerning personal and public benefits in order to increase the innovation adoption in females as well as non private car users. Furthermore, there were obstacles of innovation adoption which arose from either the consumers themselves or different social context that might cause damages to the economy, society, environment and public health as a whole, the government should have an integrated supervision system to convince people to adopt more energy conservation innovations, both at present and in the future for the benefits of the people and the country as a whole.

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CHAPTER 1

INTRODUCTION

1.1 Statement of the Problem

Energy is an essential factor leading to all aspects of development. The global economic and the population growth have critically stimulated energy consumption while it has increased 130 times more than the pre-industrial revolution era (Worldwatch Institute, 2005b). The most rapid increase of energy consumption is caused by transportation especially transportation by road, which has been doubled during the past twenty years, using even 70 % of global oil production (United Nations, 2006). It is because the number of vehicles has been rapidly increasing by ten times, particularly private cars, compared with the population growth by two folds at the same period during 1950 – 2000. As a consequence, at present there are almost eight hundred millions cars all over the world (Solar Energy International, 2009). Therefore, the non-oil-producing countries have to depend on members of the Organization of the Petroleum Exporting Countries (OPEC) and inevitably spend a large sum of money for it every year.

Moreover, the huge fossil fuel consumption in transportation sector also affects the general global air quality by, as a main cause, delivering sixteen million tons of carbon dioxide(CO_2) on average daily, representing two-third of CO_2 emission throughout the world. Consequently, as a main cause of climate change, it affects the people's health especially those living in highly populated cities and the environment. The Global Environmental Facility has estimated that, at present, the transportation is the cause of 15% of the total carbon emission and speculated its increase to 50% within ten years (Solar Energy International, 2009).

The world's energy demand is estimated to rise at an average of 2% annually, suggesting the increase up to 70% by 2030. Moreover, the tendency of the global transportation during 2003 - 2030 is still to use fossil fuel as main energy, meanwhile the number of cars will increase by three times more than today. At the same time, the

world's crude oil reserve is estimated to be sufficient for only forty years of consumption and the natural gas and coal are sufficient for only sixty and 100 years of consumption respectively (Energy Information Administration, 2006). Consequently, the world is alerted and enthusiastic to study, conduct research and develop innovations related to energy in all aspects, whether inventions or new ideas and methods to respond consumers' rising demand, as well as to reduce the negative consequences of fossil fuel (Boyle, 2005) by means of biofuel, natural gas, fuel cells, hybrid energy, electricity, solar power etc. So far, eight million cars worldwide have used alternative energy (Worldwatch Institute, 2006b).

Like all other countries, Thailand also uses energy as an indispensable factor for the country's developmental aspects as targeted since the first National Economic and Social Development Plan up to the present. All plans have driven increasingly the country to be an industrialized nation, causing more consumption of natural resources, particularly energy (Energy Policy and Planning Office, 2003).

At present, Thailand accounts for 1% of global energy consumption, and its demand ratio to Gross Domestic Product (GDP) is 1.4 : 1, compared to only 0.8 : 1 and 0.95 : 1 of developed countries like the United States of America (USA) and Japan respectively (Energy Policy and Planning Office, 2003). That expenditure accounts for 1.5 trillion baht in 2008 or 20% of GDP. If the country's economic growth still continues as it has been, the energy demand is estimated to rise by two folds within the next 15 years. So far, over than two-third of energy consumption, particular fossil fuel depends on imports from abroad. At present Thailand's oil intensity index is 1:95, the second in Asia after China whose index is 2 and approximately four times higher than Japan and Germany. This index is the ratio of oil consumption to GDP compared to global average oil use (Anusorn Sangnimnuan, 2008: 14-15). Even though during 2005-2008, the crude oil import was relatively unchanged, when considering its value in 2008, it increased to over than one trillion baht (Energy Policy and Planning Office, 2008a) as shown in table 1.1.

Table 1.1 Thailand's Crude Oil Imports During 2003-2008

	2003	2004	2005	2006	2007	2008
Amount (billion barrels)	776	870	828	829	808	825
Cost (billion baht)	346	487	645	754	716	1,070

Source: Energy Policy and Planning Office, 2008a.

Its energy consumption proportion in transportation sector was the highest, 37%, followed by industrial sector, households at 36% and 20% respectively.

Obviously, Thai transportation sector's energy consumption is remarkably high compared to only 20% on average of developed countries. The land transportation uses the most, representing 80% of total transportation sector consumption (Anusorn Sangnimnuan, 2008: 14-15).

Apart from oil price fluctuation due to the crisis in the Middle East, another major cause that makes Thai people spend a huge sum of money for transportation fuel is the population growth about sixty six millions people, the number at present is expected to be seventy millions in 2016 (The Government Housing Bank, 2008). Furthermore, some Thai family structures have been changed from extended families to nuclear families, resulting in the rising number of Thai households, during 1988-2004 the number rose from thirteen millions households to over than eighteen millions at present (National Statistical Office of Thailand, 2007) and it is estimated to increase to twenty millions in 2015 (Somporn Tanatvanit, Bundit Limmeechokchai and Supachart Chungpaibulpatana, 2003), which causes higher energy consumption accordingly. So far Thai people pay a large amount of money for energy as equivalent to 10% of their income. The consumer spending for energy have increased from 1,826 baht per household in 2004 to 2,788 baht in 2008 mostly from those who live in Bangkok than the rest of the country (National Statistical Office of Thailand, 2008a) as shown in Table 1.2.

Table 1.2 Average Monthly Expenses According to Regions and Administrative
Divisions During 2004-2008

Region and Administrative Division	Energy Expense(baht/month)			
	2004	**2006**	**2007**	**2008**
Bangkok/Peripheral	1,826	2,412	2,343	2,788
Central	1,277	1,577	1,592	2,000
North	830	1,112	1,128	1,396
North-East	698	1,005	1,085	1,331
South	1,061	1,570	1,628	1,976
Across the kingdom	1,066	1,434	1,464	1,780

Source: National Statistical Office of Thailand, 2008a.

Moreover, the improved Thai living standard at present has affected the
continual increase of car number throughout the country from nineteen millions
cars in 1999 to over than twenty two millions in 2008. In Bangkok, the number
of new cars registered is the highest of the country and still continue to increase.
Regarding to the percentage of households' private car ownership according to
regions, those living in Bangkok and surrounding areas own the highest number,
accounting for 22.2%, while the average ownership throughout the kingdom is
only 9.2%. The ratio of private cars in Bangkok is also the top of the first 10
highest regions of the country (Department of Land Transport, 2008) as shown in
Table 1.3.

Table 1.3 The First 10 Highest Private Car Ownership Provinces 2005-2007

order	Province	2005 number	%	order	Province	2006 number	%	order	Province	2007 number	%
1	Bangkok	2,297,872	58.2	1	Bangkok	2,078,247	56.4	1	Bangkok	2,171,826	55.1
2	Chiangmai	130,653	3.3	2	Chiangmai	132,514	3.5	2	Chiangmai	141,393	3.5
3	Cholburi	98,080	2.4	3	Cholburi	98,678	2.6	3	Cholburi	106,811	2.7
4	Nakhon Rachasima	71,083	1.8	4	Nakhon Rachasima	74,351	2.0	4	Nakhon Rachasima	83,100	2.1
5	SongKhla	69,054	1.7	5	SongKhla	72,880	1.9	5	SongKhla	79,991	2.0
6	Nonthaburi	62,399	1.5	6	Nonthaburi	56,614	1.5	6	Nonthaburi	61,625	1.5
7	Khon Kean	56,168	1.4	7	Khon Kean	53,377	1.4	7	Khon Kean	54,475	1.3
8	Phuket	44,448	1.1	8	Phuket	45,727	1.2	8	Phuket	52,221	1.3
9	Lampang	38,267	0.9	9	Lampang	39,838	1.0	9	Lampang	45,052	1.1
10	Rayong	38,187	0.9	10	Rayong	36,492	0.9	10	Rayong	39,532	1.0
	Across the Kingdom	3,942,795	100.0		Across the Kingdom	3,708,259	100.0		Across the Kingdom	3,941,852	100.0

Source: Department of Land Transport, 2008a.

Such high number of vehicles has affected air pollution from fuel combustion, the CO_2 emission in particular is as high as 30% from transportation sector with potential increase of 1.8% annually. The estimated one hundred and ninety million ton CO_2 emission per year in Thailand is considered one of the highest in South East Asia. Furthermore, the greenhouse gas emissions in Thailand are primarily from energy sector, the highest of all others; agricultural, industrial, land use and forestry. The emissions are as high as 56.1% of the country and those from Bangkok are the highest (Energy for Environment Foundation, 2007). When considering environmental issue, the cities in Thailand are among the first of the world threatened by air quality, especially Bangkok, the most seriously affected of all big cities across the country. In 1992, the United Nations Environment Program (UNEP) reported that Bangkok was one of the most polluted cities of the world due to the traffic, which speculatively caused thousands premature deaths and millions of people's illness annually (Janthana Kunchornrat, Rattanachai Pairintra and Pichai Namprakai, 2008). The Bangkok's air quality follow up program by the Department of Pollution Control, the Ministry of Natural Resources and Environment during the past recent years has revealed that air pollution at the roadsides in Bangkok is generally higher than it is in other areas and 40% of all pollutants are from vehicles running in the roads (ThaiEnergy.com, 2009). Early of 1990's, the patients' medical treatment costs were estimated about 8–10% of urban people's income. Such economic losses, resulting from people's illnesses, are estimated to rise to 20% by 2025 (Janthana Kunchornrat, Rattanachai Pairintra and Pichai Namprakai, 2008). Apart from its effects to people's deteriorating health and economic losses, the pollution from transportation sector also causes the global warming subsequently, which will affect water shortage in the Chao Praya basin in Central Thailand, resulting in rising sea water up the Chao Praya river by forty kms. which will impact severely on agricultural lands because of irregular rainfalls, devastating floods from which Bangkok will be inevitably badly affected, hotter weather and more severe droughts in some areas, including extinction of some species (Energy Policy and Planning Office, 2008b).

In order to solve the problems, the government has recently prepared a master plan for alternative energy development until 2022 targeting the total increase of its

uses to 20% of the last stage energy by 2022 (Department of Alternative Energy Development and Efficiency, 2009c) as shown in table 1.4.

Table 1.4 Targeted Alternative Energy Values According to the 15 Year Plan.

	2008	2011	2016	2022
Value of alternative energy	6.4%	15.6%	19.1%	20.3%

Source: Department of Alternative Energy Development and Efficiency, 2009c.

Obviously, the oil crisis has stimulated the worldwide, including Thailand, to focus seriously on the energy innovations by creating new inventions, ideas and methods, so that consumers are able to decrease energy consumption in order to reduce its impact on economics, natural resources, environment and people's health and to promote new industries which increase the employment accordingly.

However, according to the plan implementation in 2008, the tangible alternative energy available; gasohol, biodiesel and natural gas, substituted only 6.4% from the original 8% target of the whole energy consumption (Department of Alternative Energy Development and Efficiency, 2009c). Although their consumption has been rising as a whole, there are still many differences in consumption of different alternative energy than that targeted by the government as shown in table 1.5.

Table 1.5 The Alternative Energy Consumption Target in 2022 and the Real
        Outcome in 2008

Types of alternative energy			
	Ethanol	Bio-diesel	Natural gas	Hydrogen
Target in 2022	9.0 millions liters/day	4.5 millions liters/day	1,035.0 mnscfd	0.1 millions kg./day
Real outcome in 2008	1.0 millions liters/day	1.56 millions liters/day	91.5 mnscfd	-

Source: Department of Alternative Energy Development and Efficiency, 2009c.

According to the National Statistical Office's survey of households' opinions on economic situation, alternative energy adoption, needs for state's assistance by collecting data from 26,000 sampled households throughout the country during January to June 2008, it was found that in order to adjust themselves to the current economic situation in which oil was expensive, most households both nationwide and in each region chose to decrease the expenses in the families as the first method and only a few number of them chose to save energy, such that the energy conservation was the second from the last (from 7 methods listed) chosen by households. Similarly, 71.8% of households in Bangkok chose to reduce families' expenses and only 2.6% chose to save energy. Moreover, the oil price affected 69.6% and 58.5% of those living nationwide and in Bangkok respectively. Concerning their cooperation to save energy in 10 different methods, it was found that they helped turn off the unused lights the most and cooperated in diverting from gasoline or diesel to alternative energy the least of all methods, which was all alike all over the country. Households in Bangkok as high as 98.8% participated in turning off the unused lights as the first method, while diverting from gasoline or diesel to alternative energy as the last method such that their number represented only 35.8% (National Statistical Office of Thailand, 2008c), as shown in table 1.6.

Table 1.6 Percentage of Households Participating in Saving Energy Classified by Regions in 2008.

Items	Nationwide	Regions				
		Bangkok and Peripherals	Central	North	North-East	
Turn off the unused lights	98.7	98.8	98.7	9.0	8.5	8.4
Do not leave the lights turned on	96.4	94.7	96.8	97.5	97.1	95.1
Set the air-conditioner at 25-26 degrees	91.7	93.2	91.8	92.2	88.7	88.3
Always unplug electric appliances	91.0	88.4	90.8	93.2	92.4	87.6
Turn off an electric an appliance by its switch	89.5	87.9	90.0	92.4	89.3	87.4
Not driving over than 90 km./hr.	76.8	75.5	76.8	78.2	77.6	75.6
Good maintenance of all electric appliances	66.2	82.3	73.8	63.4	58.8	56.7
Use public transport	45.2	68.8	38.4	33.9	45.6	36.0
Divert to energy saving light bulbs	35.6	57.3	40.0	33.2	24.4	34.1
Divert from gasoline/diesel to alternative energies	13.0	35.8	14.5	11.1	7.5	6.7

Source: National Statistical Office of Thailand, 2008c.

The alternative energy used by households in their vehicles the most was gasohol, accounting for 8.1%, followed by liquefied petroleum gas (LPG) and biodiesel at 0.8% and 0.5% respectively and the least adopted was natural gas (NGV), accounting for 0.3% (National Statistical Office of Thailand, 2008c) as shown in table 1.7.

Table 1.7 Percentage of Households Using Alternative Energies in Their Vehicles
Classified According to Energy Types in 2008.

Types of alternative energy	Percentage of households
Gasohol	8.1
LPG	0.8
Biodiesel	0.5
NGV	0.3

Source: National Statistical Office of Thailand, 2008c.

Apparently, despite the research on technology to develop different energy conservation innovations, the government's target to replace fossil fuel uses in transportation sector might not be successful without the collaboration and innovation adoption of car users and non car users, especially in Bangkok, the city of the highest number of cars of the country. Such targeted achievement will build energy security leading to the country's sustainable development, as well as people's better quality of life.

1.2 Objectives of the Study

1) To study level of accessibility to information, the knowledge, the perception of different aspects of innovations and the adoption of energy conservation innovations of the people in Bangkok.

2) To study the relationship between demographic characteristics, accessibility to information, knowledge and perception of different aspects of innovations with the adoption of energy conservation innovations among people in Bangkok, both at present and in the future.

1.3 Expected Benefits

To use the study results as a guideline for both government and private organizations involved in policy making and planning to diffuse sufficient information for correct understanding about energy conservation in private cars and to have an integrated improvement of different aspects of innovations which will result in people's widespread adoption, both at present and in the future.

1.4 Scope of the Study

1) The target population in the study was specifically the people living in Bangkok, aging between 20–60 years old, because their car ownership and energy expenditure were the highest of the country. Furthermore, Bangkok was also the most affected city from different consequences.

2) The study of the adoption of innovations for energy conservation was limited only on private cars, as they were the most numerous of all types of vehicle.

1.5 Limitation of the Study

The data of the study was collected during November 2007 to February 2008. Therefore, the study outcome was accomplished before the economic and oil price fluctuation in 2008.

CHAPTER 2

LITERATURE REVIEW

This chapter is about related concepts and research, including conceptual framework of the study, as follows:

2.1 Concepts and theories on communication

2.2 Concepts and theories on perception

2.3 Concepts and theories on innovations and changes

2.4 Concepts and theories on behaviors

2.5 Factors related to the adoption of energy conservation innovations in private cars

2.6 Conceptual framework

2.1 Concepts and Theories on Communication

2.1.1 Definition of Communication

Communication is the information transmitting process from one person, the sender, to another person, the receiver. This process is thus consisted of these components: sender, information, communication channel and receiver with an intention to change the receiver's certain behaviors and to diffuse information which is fundamental characteristic of human relationships in order to maintain and develop them (Berlo, 1960).

2.1.2 Factors Related to Communication or Message Sending

Communication play important role in human's daily life activities. If an agency or society is deprived of communication, it cannot endure. Since communication concerns the mutual understanding among individuals, agencies or societies, therefore, are many factors related to communication as follows:

2.1.2.1 Cognitive materials which are information and facts.

2.1.2.2 Motivational and emotional materials which are atmospheres associated with emotions, attitudes, reactions, loyalty or adversary attitudes, supportive feeling or disagreement

Factors related to communication or message sending have strong effect on individuals and their perception because communication is an art of transmitting information, ideas, and attitudes from one person to another (Simon, 1947).

2.1.3 Stages of Communication Process

Communication is the process by which ideas or information is transmitted from the source to the receiver with an intention to change the receiver's certain behaviors.

Communication process occurs when the receiver encode the message content, i.e. modify the information, ideas, attitudes or any emotions into transferable forms to other people, and send this modified content to receivers via communication channels. The communication process is completed when the encoded content transmitted to the receivers is decoded and the receiver acknowledges that content. However, whether the receiver perceives the information as the sender's intention depends on the receiver' field of experience. In communication process, the feedback is highly important for sender's information as it can be used to consider if the communication is successful (Schramm, 1954).

2.1.4 Components of Communication Process

Its four important components are the sender, information medium and the receiver of the communication process. Communication channel is essential to determine which type of communication channel the sender is to use to be successful in order to create the receiver's knowledge, attitudes and behaviors as desired. Whether or not the sender and the receiver understand the same meaning depends on following factors:

2.1.4.1 Sender

The sender must be skillful in sending information, capable to choose suitable language according to the receiver and has positive attitude toward the transmission, information and receiver. In addition, the level of understanding of information to be sent and the social status of the sender also have influence on the transmission and reception of the message.

2.1.4.2 Information

If containing a clear, understandable content together with interesting form, the information is highly effective for transmission.

2.1.4.3 Medium

It means that selection of appropriate medium capable to access easily the receiver's cognition will enable the message arrive the receiver as desired.

2.1.4.4 Receiver

The receiver must be sufficiently capable in reading, listening, speaking and writing including thinking rationally when analyzing the information. The receiver's social status, as well as existing fundamental knowledge and attitude will influence his/her conceptual framework in interpreting the message received (Berlo, 1960).

2.1.5 Theories on Communication Process

2.1.5.1 Communication theory concerning information reception is a selective process which consists of following stages:

1) Selective exposure. An individual chooses to be exposed to media for information from different sources according to his/her interest and desire, in order to use it to solve problems or respond his/her own needs.

2) Selective attention. Apart from selective exposure, the receiver also chooses to be interested in the received information that is in line to his/her existing attitudes and belief, meanwhile, avoiding to receive the contradictory one, because receiving the message irrelevant to his/her feeling will dissatisfy himself/herself.

3) Selective perception and selective interpretation. When receiving information from any source, the receiver can also choose to recognize and

interpret it according to each one's experiences. The receiver will interpret the received message in accordance to his/her understanding, attitudes, experiences, belief, desire and motivation at the moment.

4) Selective Retention. After choosing to be interested, recognize and interpret the information in ways responsive to his/her own belief, an individual still choose to memorize parts of desirable information into his/her experience, while usually forgetting the message irrelevant to his/her interest.

What determines the interest to open information system to receive information from different media to respond receiver's needs is the motivation to be accepted from other members of society. Such phenomenon is called "seeking for information behavior", which depends on the receiver's role and social status (Klapper, 1960).

2.1.5.2 Theories on effectiveness of mass media and interpersonal medium.

Media ways or methods to convey information to receivers can be divided in to two categories:

1) Mass media channels are information transmission through all mass media; newspaper, radio, television and magazine. Information source can be one person or more who can deliver the information rapidly to a large number of receivers in order spread it widely and to increase their knowledge and to change their long established attitudes such that they can change their behavior (Thompson, 1995).

2) Interpersonal channels are communication among individuals to convey information between sender and receiver. The change may occur if contacting with other people such as opinion leaders; state authorities, sub district leader, village headman etc.; contacts with relatives, friends etc. Mass media is important for providing knowledge but interpersonal communication enables the change in attitude and behavior (Wikipedia, 2009g).

Besides, there are also theories about media influences on individuals' behavioral change as follows:

2.1.5.3 Personal difference theory says that personal characteristic structure differences such as attitude, values and belief, play important role in determining human's different perception or learning events. According to this theory,

mass media has influence in terms of learning or emphasizing what a receiver already knows (De Fleur, 1966).

2.1.5.4 Social categorization theory says that the same group of people are normally receptive and responsive to information containing similar content due to their close relationships. Mass media is therefore influential on the group only when sending information pertinent to their norms (Social Science, 2009).

2.1.5.5 Social relation theory says that informal relationships among people in a group influencing communication. The opinion leaders in a society are influential on spreading the message and the decision-making for innovation adoption of the people in the society. In such case, the media influences individuals in terms of Two Step Flow Theory which also depends on personal influence (Lazarsfeld, 1940).

2.1.5.6 Social norm theory says that personal behavior may be subjected to social norms and environment. If the media conveys information relevant to social norms, it may emphasize existing traditional norms, while building very few new ones. In other word, the mass media supports or emphasizes the existing social norms. It has potential to change individuals' living patterns and behaviors, to help generate new behaviors, but it needs a long period of time (Answers.com., 2009).

2.1.5.7 Interpersonal communication theory says that two way communication enable both receiver and sender to react simultaneously and is effectively convincing. It is the most efficient communication channel to change people's attitudes and behaviors (Wikipedia, 2009g).

2.1.5.8 Multi step communication theory says that most information disseminated to target people usually passes first through opinion leaders, who have more access to media, and are the ones conveying information to large number of people subsequently (Lazarsfeld, 1940).

2.2 Concepts and Theories on Perception

2.2.1 Definition of Perception

Perception is a contact leading a meaningful sensation. The perception is an interpretation of the contact experienced into something meaningful or recognized. The interpretation needs past experiences or prior knowledge. In addition, it can also

be an expression of knowledge, an understanding according to the feeling in one's mind

Perception process consists of:

2.2.1.1 Contact or contact manner.

2.2.1.2 Type and nature of the stimulus

2.2.1.3 Interpretation of the contact

2.2.1.4 The use of old knowledge or experiences to interpret

Human body has many perceptive or contact channels. When it is aroused by environmental stimulation through one or many sensory nerves, the perception arises and the more precise understanding of the subject is processed, which is called concept.

2.2.2 Perception Components

Perception is a process consisted of three main components:

2.2.2.1 The perception must involve the property of the stimulus, which arouses the sense organs to activate and transmit details to the nerves in order to pass them to the brain. This process is called contact.

2.2.2.2 The perception must involve information and details that an individual receives and mixes them other information. This process is called perception.

2.2.2.3 The perception must involve the receiver's properties and characteristics, which means the perceiver's past experiences, motives, attitudes, character and others such as attention (Bem, 1972).

2.2.3 Factors Influencing Perception

Factors influencing human perception are numerous, they can be summarized into two categories:

2.2.3.1 Roles of the inner factors. They are the perceiver's internal properties such as needs, drives, values and interest.

2.2.3.2 Roles of the social factors; attachment, confidence, advice, teaching, which pass from generation to generation. All these factors influence individuals' different perception of stories, events and environment.

Moreover, there are still other factors influencing perception as follows:

2.2.3.3 The perceiver's characteristics. The perceiver's inner characteristics play an important role in his/her perception because they determine the tendency how to deal with the stimulus. These characteristics are need, attitude, character and personal perception.

2.2.3.4 Attention. It arises when a stimulus comes into contact with the readily prepared and responsive body because the attention usually helps an individual hear or see anything before others do. The attention can originate from external and internal circumstances that influence individuals' perception.

2.2.3.5 Preparation for perception. The readiness for perception occurs before being aroused by a stimulus. The preparation will help an individual speculate what will happen, get oneself fully ready, and react appropriately to the situation.

2.2.3.6 Personal character. Important characters for social perception are extrovert and introvert characteristic. The optimists usually see things positively or see two-sided matters differently from the pessimists.

Obviously, all people have learned from experiences they encounter, regardless they acknowledge it or not. All these, somehow, gradually become patterns that individuals keep pursuing eventually. As their surroundings change, so do individuals within themselves (Graham, 1999).

2.2.4 Concepts and Theories Related to Perception

Perception means an individual uses his/her internal system to receive information from external system actively, subjectively and creatively. In the process, there are three stages; selection, organization and interpretation of which there related theories as follows:

2.2.4.1 Social perception theory

An individual's perception is related to himself/herself, other people and society. The society is a stimulus in terms of causing experience, motive, regardless in form of raw feeling or abstract experience.

In addition, an individual' social perception is a process from which the perceiver receive fundamental or raw information for his/her understanding (Bem, 1972).

2.2.4.2 Communication process theory: in receiving new knowledge, there are 5 stages:

1) Awareness stage, meaning an individual receives new knowledge for the first time but still lacks a clear knowledge, including additional information of that science.

2) Interest stage, meaning the person begins to be interested in the new science and try to find out more knowledge.

3) Evaluation stage, meaning the person reviews, considers mentally the advantages and disadvantages of the new knowledge.

4) Trial stage, meaning the individual use the new knowledge for experiment, beginning from small scope to see the result before adopting it.

5) Adoption stage, meaning the decision making stage to fully use the new science.

Apart from different stages before adoption new science, there are factors influencing the adoption as follows:

1) The type of innovation decision.

2) The nature of communication channels.

3) The natural characteristic of social system.

4) The extent of change agents' promotion effort (Rogers, 1962).

Furthermore, perception is a fundamental psychological process in interpreting stimuli as experienced in order to constitute new important experiences to the perceiver. Perception makes individuals different from each other. Nobody has exactly the same perception as any other because when an individual senses a stimulus or perception, he/she will process the perceived message into meaningful experience just for himself (Schermerhorn, Hunt and Osborn, 1982: 409-410) as shown in figure 2.1.

```
                    ┌─────────────────────────────────────────┐
Information  →      │ Reception → Organization → Interpretation │   →   Individual
Input              └─────────────────────────────────────────┘        Action
```
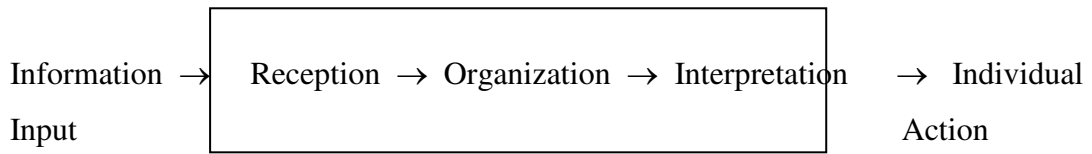
Figure 2.1 Perception Process According to Schermerhorn, Hunt and Osborn, 1982
Source: Schermerhorn, Hunt and Osborn, 1982: 409-410.

      In addition, to understand behaviors of individuals which are different depending on their past experiences, including situations resulted from external effects such as stress, group pressure, role etc., which affect the perception process (Kast and Rosenzweig, 1985) as shown in figure 2.2

```
                 ┌──────────────────────────────────────────┐
                 │              Past experience             │
                 │     Mechanism of perception information   │
Information  →   │     Selectivity          Interpretation   │   → perception
                 │        Closure                           │          │
                 └──────────────────────────────────────────┘          ↓
                 │ Stress                                             Behavior
                 │ Group Pressure
                 │ Interaction
                 │ Role
                 │ Reference Group
                 │ Position and Job
                 │ Reward System
                 │
```
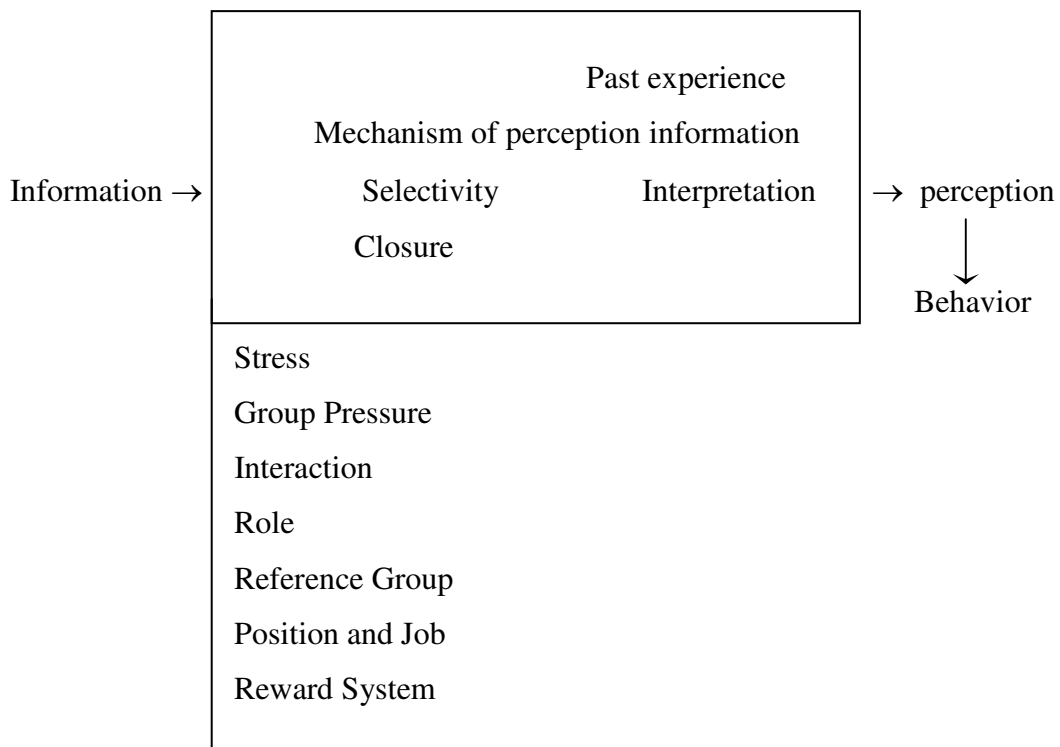
Figure 2.2 Role Perception Process According to Kast and Rosenzweig.
Source: Kast and Rosenzweig, 1985.

In addition, the notions related to perception are derived from perception observation. The process consisted of both external process; the individual's environment such as reference group to contact with other people, past experience in form of different kinds of knowledge, including individual's internal factors, experience gained from education, occupation, income, personal perspective, information reception etc., as well as sensory nerve which are personal physical characteristics. Factors influencing individual's perception are as follows:

2.2.5 Factors Influencing Individual's Perception

2.2.5.1 Characteristic of the entity causes the creation of each group's stereotype of different things from their conclusion and interpretation which can be either positive or negative bias depending on each group characteristic such as nationality, gender etc.

2.2.5.2 Characteristic of person. Different characteristic of individual influencing perception are perspective, emotion, experience or need.

2.2.5.3 Characteristic of the situation. The situations affecting individual's perception are stress, time etc.

Perception is the first step of behavior; however, it is only another variable of behavior. There are in fact many more factors taking part in generating behaviors such as perspective, role, role expectation, motive etc. Nevertheless, perception is important to behavior because if an individual perceives correctly, his/her behavior is expressed in one way; if perceiving wrongly, his/her behavior is expressed in another way. Therefore, the perception takes part in individuals' different behaviors (Ott, 2003).

2.3 Concepts and Theories on Innovations and Changes

2.3.1 Definition of Innovation and Changes

Innovation and changes are usually co-incident occurrence and can be considered into two issues:

2.3.1.1 Innovation

The definition of the Science Department of the Education Ministry coined from the English term is "new activity", which has become, at present, a subject of increasing interest. The seeking for innovation relevant to the rapid change in dynamic society at present and in the future is an essential strategy. The distribution plays important role to spread the innovation to the target population successfully. The innovation has three-stage-operation process; invention, experiment, and take the result to use in general situation (Rogers, 1995).

However, all kinds of innovation is neither effortlessly nor rapidly successful. Some kinds may need a lot of time and effort because an innovation cause changes in many aspects. Therefore, the innovation adoption needs careful consideration in order to decrease problems that may follow.

2.3.1.2 Evolution and Innovation of Energy for cars

Oil is has been used as car fuel since the 18th century, and its consumption has increased continually due to the industrial revolution. The high proliferation of lead from oil due to traffic congestion in big cities affects severely public health as it has an effect on blood, nerve system, as well as liver. Nearly all industrialized countries consequently have reduced the quantity of lead continually since 1970 from 0.4 gram per liter of gasoline to no lead at present, including regulated all new cars installed with catalytic converter in order to reduce hazardous gases from combustion. That is the beginning of innovation about energy (UNEP, 2008).

Later on, many countries have conducted research and developed technological innovations concerning different types of alternative energy, or new types of car to reduce the oil uses, which have been imposed in their plans and policies. For example, the EU member countries have targets to use alternative energy at 5.75% by 2010 and increase to 20% in 2020 (Ramesohl and Merten, 2006), while the U.S.A.'s are 10% and 30% by 2000 and 2010 respectively and India has implemented this policy since 1990 (Cannon, 2005). Countries have invented their different appropriate innovations which can be divided in to three main groups as follows:

1) Biofuel; One of these alternative energy is the mixture of fossil fuel and ethanol or ethyl alcohol obtained from the transformation of carbohydrate and sugar giving plants such as sugar cane, rice, corn, tapioca etc. called gasohol. Another is the mixture of fossil fuels and oils derived from plants or animals such as beans (leguminous plant), palm or pork oil called biodiesel. Many countries use this kind of energy in short-term plan, as it has positive effect on maintaining agricultural product prices used in producing biofuels. Moreover, it helps to reduce hydrocarbon and carbon monoxide (CO) by 20-25% (U.S.Department of Energy, 2009). There are different proportions of the mixture of fossil fuels and plant oil. Many countries, such as Brazil, the U.S.A., Canada, china, India and Thailand, have implemented regulations for biofuel mixture. Brazil, the first country using this energy since 1980, uses pure ethanol without mixing with fossil fuels, has encouraged the production of 100,000 cars using particularly this fuel during 2002-2012. So far, Brazil is the main country using this alternative energy accounting 70% of the uses worldwide, followed by the U.S.A.(23%), while India and Canada have declared ethanol as the mixture in fuels since 2003 and 2004 respectively, and China has a five-year plan during 2001-2005 to promote the use of this fuel (Zhao, 2006). While Europe has set the target since 2003 that each country uses biofuel 2% in 2010. The main countries in Europe, where biodiesel is produced more than ethanol, are Germany, France and Italy. Germany can produce pure biodiesel without mixing with fossil fuels (Boyle, 2005).

2) Natural Gas; It is found together with petroleum deposits in Earth's crust. It is estimated to be main energy source for over than 60 years, so that many countries have either short-term or long term plans to use it as oil substitution due to is good qualities; less pollution producing, cheap, and safe, in contrast to the easily flammable liquefied petroleum gas (LPG) (NaturalGas.org, 2009)

Besides, the original gasoline or diesel engines can also be technologically modified to use natural gas as fuel. At present, there are three widely accepted standards in producing cars using specifically natural gas, including cylinders, which need advanced technology and knowledge in order to reach safety

standard; DIN of the EU members, ASTM of the U.S.A. and JIS of Japan (MSN technology, 2006).

Many countries worldwide encourage the use of natural gas in either short term or medium term plans. Among these countries such as Brazil, Pakistan, India, the USA and members of the EU as France, Germany and Austria, Argentina has cars using this energy the most, nearly 800,000 cars (Wikipedia, 2009b).

3) Fuel cells and hydrogen; These energy are mediums causing electro chemical reaction between oxygen and hydrogen that transforms directly the fuel energy to electricity without combustion. So the engine using fuel cells does not cause air pollution and it is also 1-3 times more effective than normal combustive engine (Wikipedia, 2009d).

At present the countries interested in using these alternative energy in cars, which need substantial investment, are mostly developed countries. For example, the USA has a 1.7 billion dollar plan. Similarly, Japan and European countries have long term plans to use them as energy as they are still in the stage of research and development with modern technology to reduce the problem that might occur. These energy are expected to be brought to the market by 2030 (Ramesohl and Merten, 2006).

4) Electric cars; They are powered by electricity from batteries, so they do not cause pollution to the environment. They are designed to be used easily, with safety measure to prevent short circuit to the drivers. Electricity can be charged only 4-6 hours anywhere if there are electric plugs. The cars can run as far as 70 kilometers at top speed at 50-60 kilometers per hour. They are therefore popular among people traveling in short distance, especially in the U.S.A. and Japan, where they have developed this technology since 1971. However, the problem is that these cars are many times more expensive than ordinary ones (Ahman, 2006).

5) E-hybrids; The alternative energy used in this technology are the combination of two systems of energy working together which can reduce the defectiveness of each system, resulting in the effectiveness in saving fuels, thus reducing pollution. Therefore, this technology has become more popular, especially in the USA, the big market, where it is estimated to have at least

300,000 cars in 2006, or the growth rate at 30-40%. By the way, big leading companies who produce hybrid cars such as Toyota expected to sell more than 400,000 hybrid cars worldwide in 2006. In addition, other companies, namely Honda, Ford and General motors are also to share more in this market (Wikipedia, 2009f).

2.3.1.3 The combination between the concepts of Rogers (1995), Moore (1999) and Egmond, Jonkers and Kok, (2006b) concerning innovation distribution according to receivers' characteristics

The innovation distribution theory (Rogers, 1995) and the marketing theory (Moore, 1999) have common concept concerning behavior of specific segments of target groups in order to select the most effective policy or tools to change their behavior. These groups, which can be called the early market, accept innovations before others. Afterward, the mainstream market will do similarly if those innovations respond exactly their needs. The first and the second group have their unique characteristics determined by their behaviors: the first groups have more vision while the main groups have more practical perspectives (Egmond, Jonkers and Kok, 2006b). Such differences cause the chasm that prevents the distribution of innovation between these two groups (Moore, 1999).

To bridge the chasm, it must begin from the success in distribution innovations to niche market of the mainstream market in order to access the rest by modifying the innovations to respond practical uses (Moore, 1999).

2.3.1.4 Concepts on change

Process of social change can be summarized into five characteristics:

1) Evolutionary change; It is the gradual social change to respond the social environmental effects such as concepts, technological and scientific advances. Such changes follow the pattern called "fell needs", i.e. unplanned non-directed changes. The environment or parts of the system related to changes are usually cooperative or permissive, so that such change can be called social automatic change.

2) Revolutionary change; It is a severe change which normally faces strong social resistances. This kind of change can be directionally controlled.

Moreover, it is often (physically or psychologically) change by using force, showing that the environment or parts of the system related to the change are not free to choose whether to accept it or not.

3) Dialectical change; The parties related to the change get the results different from initially targeted and generally, it is not directionally controlled. The environment or parts of the system related to the change is usually permissive because it is not forceful change.

4) Coercive change; The source of the forceful drive can originate from either inside or outside of the system. This pattern of change is generally planned to control the direction of change of the environment or parts of the system involved.

5) Guidance change or planned change; It is an attempt with care to cause social change without using authoritative force toward the environment or parts of the system involved. This change is thus more permissive to the change than all other patterns mentioned above (Wikipedia, 2009j).

2.3.1.5 Resistance and acceptance to change

When there is a change, the society in a whole does not accept it all every time, but there are three main reactions to the change: acceptance the whole without resistance; partly acceptance and partly disapproval that may or may not cause resistant reaction (the case of partly acceptance usually resorts to time to solve the problem); and the last, no acceptance at all, that is usually accompanied by resistance reaction. Therefore, when there is a change or an innovation introduced in a society, it needs to consider all time the resistance and acceptance in the society by looking at the resistance leaders' characteristics. Generally, the people tend to resist usually have unique characteristics: they tend to look at the negative, dangerous side of the change without considering other aspects, then, reactions and resistance movement follow. Therefore, when there is to be any change, factors related to its resistance and acceptance must be considered.

Factors related to the resistance and acceptance to changes:

1) Specific attitude and values

Specific social attitude and values are important as they are related to beliefs which are important factors to determine whether or not to accept or adopt the change to new things.

2) Demonstrability of innovation

The clearly visible, verifiably demonstrative change is more accepted, which corresponds to the topic 1 that the daily use device innovations are more easily and rapidly adopted.

3) Compatibility with existing cultures

The change that is relevant or compatible to existing cultures is usually successful. However, the facts of changes are that they are mostly different or contradictory to existing cultures due to desire to improve for better things. As a result the change is acceptable but needs time (Sheth, 1981: 1-10).

Apart from those three factors, there are still additional considerations concerning resistance and adoption of change for innovations as follows:

1) The pace of innovation adoption in a society. It is considered when conducting comparative study on social circumstances for innovation adoption. The beneficial realization of the innovations, i.e. easy to use and obviously beneficial innovations, will be more rapidly adopted, as well as those in line with the existing beliefs will be adopted at a more rapid pace than normal. If the change recipient himself/herself sees the benefits, the adoption occurs more rapidly.

2) The needs and the rate of innovation adoption in societies. Each society has different characteristics of innovation adoption. Important factors are usually level of people's education, their acquaintances with mass media and the influences of communities' leaders. All these factors result in different paces of innovation adoption in different communities.

3) Specific properties of innovations. They consist of six factors:

(1) Risk means the possibility of the problem occurrence to an individuals, society or economy due to the innovation adoption.

(2)   Relative advantage means level of innovation adoption provides more advantages than before its adoption. These advantages are generally in economic aspects, more security, state of being more accepted and comfort.

(3)   Compatibility means level of innovation compatibility to communities' or individuals' values. In a sense, an innovation may or may not compatible to a society, culture, religion, need and belief.

(4)   Complexity means the level of easiness to understand and use the innovation.

(5)   Trial ability means the degree an individual feels he/ she can try that innovation despite all restrictions.

(6)   Observability means level of the outcome from innovation adoption as observed by individual (Rogers, 1995).

4)   Characteristics of innovation lovers and those of innovation receivers. Any society or agency whose members are innovation lovers, changes in such society or agency can be done more easily. The innovation lovers tend to prefer and accept novelty easily. Important characteristic similarities of innovation lovers in many societies of multi-cultures are that generally, they are well educated, open minded to accept changes and have well economic with social status. In a sense, societies with population of high educational attainment will accept changes and adopt innovations more than societies with low educated population (Rogers, 1995).

5)   The population's innovation perception and their acceptance of change at first. There should be studies how innovation perception and its acceptance among the people are in the first period such as word of mouth, radio, television, newspaper, studies by one's self etc. in order to apply the study results from successful societies to societies with similarities.

6)   Influences of leaders and innovation distribution. Innovations are invented for changes but whether it will be a success or a failure depends on leaders too. Their essential qualities in leading to change are good economic status, broad minded, good social and political awareness, good listener, always being receptive to information, initiator, knowing and understanding changes. The leaders accepting innovation and changes are normally young, in contrast to the elderly leaders who normally refuse changes and dislike innovations.

7) Properties of communication used in distributing innovations so that the change is accepted. The human's acceptance in changes consists of mental-stage decision-making which begins from hearing, interested in novelty, studying to know more that novelty, then coming to accept the others' knowledge persuasion. At each stage, different media also results in different outcomes.

8) Effects of innovations. To create an accepted innovation of change, one must find out what effects, in which aspects, the innovation will cause which are important components whether there will be acceptance or resistance to the change. Therefore, the speculation results should consist of both aspects, and a study to find a solution for negative results should be done so that it will be more widely accepted (Rogers, 1995).

2.3.1.6 Process of innovation acceptance. There are five stages:

1) Knowledge

2) Persuasion

3) Decision

4) Implementation

5) Confirmation

In innovation adoption process, at first an individual wants to understand that innovation, then persuaded to realize its value, particularly the positive aspects, its benefits or advantages when compared to other things. The attractive properties of innovation vary according to individual's acceptance in the innovation. At the decision-making stage, the person will choose to or not to adopt it and confirm whether the innovation responds his/her needs and expectations (Rogers, 1962).

2.3.1.7 Categories of innovation receivers

Since individuals do not follow the decision-making process to adopt innovations at the same time. So they can be divided into five categories according to their personal characteristics, behaviors, values and attitudes as follows:

1) Innovators representing 2.5% of total innovation adopters

2) Early adopters representing 12.5% of the total

3) Early majority representing 35% of the total

4) Late majority representing 35% of the total

5) Laggards representing 15% of the total (Rogers, 1995)

This categorization of innovation adopters is considered from their economic, social and personal characteristics, characters and communication behavior. The innovators and the early adopters are usually well educated and have more understandings of technology than others (Rogers, 1995). Nevertheless, the innovators of one innovation can be the laggards of another innovation (Sultan and Winer, 1993).

Besides, Moore (1999) has added the notion of "the chasm between the early adopters and the early majority" which derived from different characteristics of two categories of people. That is, the first two categories, the innovators' and the early adopters' minds focus more on advantages or long term benefits in the future than other aspects of innovations. This chasm will narrow down if the innovations, in different aspects, are improved to have better quality to attract the early majority category who focus on the quality and the innovation practical usefulness three times more than the innovators.

The three components of Rogers' innovation theory, (1995) including Moore's (1999) notion about the chasm between two groups are shown together in figure 2.3.

The Innovation – Decision Process				
1. Knowledge	2. Persuasion	3. Decision	4. implementation	5.Confirmation
Adopter Categories					
1.Innovators2.5%	2.Early Adopters12.5%	The Chasm	3.Early Majority 35%	4.Late Majority 35%	5.Laggards 15%
Attributes of Innovations					
Relative advantage	Compatibility	Observability	Trial ability	Complexity

Figure 2.3 Three Main Components of Innovation Theory (Rogers, 1995) and the
　　　　　Notion Concerning the Chasm between Groups (Moore, 1999).

Source: Rogers, 1995 and Moore, 1999.

2.4 Concepts and Theories on Behavior

Interpersonal behaviors in society are complicated. In each situation, behaviors are determined by individuals' perception whether they are appropriate and practicable. Furthermore, the behaviors exhibited may be driven from other pressures or people, the feeling of the consequences and the value of the outcomes etc. Such behaviors concern many variables as follows:

1) Social norms; the belief that the behavior is appropriate or needed, while other behaviors are neither correct nor needed.

2) Roles; they are categorized behaviors, which societies consider appropriate for the persons in such positions to follow and they can be different. These roles can also be dependent on situations, society and cultures.

3) Self-image or self-concept; it is the generalization derived from experiences in life and awareness of one's self about how he/she really is, including the feeling of self esteem or knowing which behavior is appropriate or needed. The persons with high self esteem behave while considering more about himself/ herself than social norms, and those with low self esteem follow the society more. In addition, the person highly interested in society who wants to be part of the group, accepted by the group usually follows social norms than those lowly interested in society.

4) Effect; the effect toward behavior means individual's sensation toward the behavior as a result as of behavioral evaluation, which can be either positive or negative.

5) Perceived consequences; it means the probability an individual speculates the consequences if behave in such ways, while the perceived mentally in advance and the actual consequences may be different.

6) Value of consequences; it means the evaluation, which depends on evaluator's background, of both positive and negative value of consequences. However, the too good or too bad outcome, can lead to similar behaviors (Wikipedia, 2009i).

2.4.1 Consumer Behavior

Consumer behavior means consumer's last behavior in purchase goods and service for his/her own consumption, or for the family. All goods and service buying

consumers for such purpose are altogether called consumer market. Consumers worldwide are different in many population characteristics, for example, age, income, level of education, religion, culture, tradition, values etc., which influence their consumption, purchase behaviors, as well as their feelings related to products differently. Therefore, it results in the differences of good and service purchase. Apart from such population characteristics, other factors also affect the consumption differences as raised by the stimuli and response theory, the so called S-R theory. This theory is derived from observations and experiments of many psychologists such as Parlov, John Watson, Clark Hull and Edward Tolman, for example.

2.4.1.1 Stimuli and response theory

According to the consumers' behavioral model of S-R theory, marketing stimuli are divided into two categories; marketing stimuli and other marketing environments that influence the consumers' decision-making and behaviors.

1) Marketing stimuli; they are marketing compounds or the 4'Ps that are product, price, selling place and marketing promotion.

2) Other marketing environment surrounding consumers are economics, technology, society, politics, law and culture which influence consumers' decision-making.

These stimuli are inputs sent into consumers' black boxes, and result in the response in form of outputs.

3) The black box is virtually gathering container of different factors such as culture, society, personal characteristics, and each consumer's psychological traits. Besides, in the black box there is also the decision making process. When a stimulus enters into the box, all these factors will process it resulting in a response. If it is a positive response, the process of purchase decision will be made, but if it is a negative response, the consumer will not buy it.

4) The response is the outcome of the influence of factors and the process of decision making mechanism in the consumer's black box. If the response is positive, the consumer will choose the product, the brand, the shop, appropriate time and quantity etc. to buy.

2.4.1.2 Factors affecting consumers' behaviors

1) Cultural factors; they affect consumers' behaviors the most. They can be divided into core culture, subculture, and social class.

(1) Core culture exists in every human group or society. It causes values, perception, desire, as well as human behaviors, which, after their occurrences, human beings transfer them to each other. Since each society has its own core culture, it results in different purchase behaviors in different societies.

(2) Subculture means the cultures of sub-groups in main society. The subculture is divided in to four categories; Ethnic subculture, Regional subculture, Age subculture and Occupational subculture

(3) Social class means a number of people with either some or all similarities in these factors; income, occupation, education or lineage. Consumer's social class can be divided as follows:

- Consumers of the same class tend to follow the same behaviors.

- Whether a consumer has a high or low status, depends partly on in which social class he/she is stratified.

- Consumers' social class is stratified according to various variables, for example, occupation, income, wealth, education, values etc.

- An individual can move from one social class to another, either up or down.

2) Social factors; there are many social factors influencing the decision-making process such as reference group, family, role, social status etc.

(1) Reference group; Any consumer's reference group means groups of people that a consumer holds as an consumption model to follow or not to follow, regardless whether he/she is a member of the group or not.

(2) Family. Members of a family consist of parents and children. Each of them has important influence on family's consumption. There are research results affirming that families are important institutions of societies.

(3) Role and status. Status means, individual's economic status, position, and prestige as perceived in society; while role means the duty an individual commits as imposed by societies. As a member of societies, everybody can

have more or less different status, which each society sets up as standard for the distribution of power, duty, responsibility, and rights to its members.

3) Personal factors; Important personal factors that influence consumers' decision-making are age, family life cycle, occupation, income, life style and self vision.

(1) Age. An individual's purchase or consuming decision-making changes naturally over time of his life. During one's childhood, his/her parents are the ones who make decision to purchase nearly all consumption products. During his/ her adolescence, one decides by himself/ herself to buy certain goods, and during adulthood with his/ her own income, he/ she has the most purchase power. When one enters into elderly age, others people such as relatives, children and grand children will have influence on his/her purchase decision again.

(2) Family life cycle means the cycle of family life starting from the beginning of a family life until it finishes at the end of it. During each family life cycle period, consumers' purchase patterns and behaviors are different accordingly. An individual's family life cycle is divided into five main stages:

- Youth and single, living separately from parents.
- Family life.
- Giving birth to children and raising them.
- The children live separately with their families.
- The end of family life cycle.

(3) Occupation: some specific characteristics of occupation make individuals choose to consume certain product different from those of other occupations.

(4) Personal income: An individual's income influences the decision-making process whether or not to purchase. Consumers keep some money for savings, and some, called "disposable income", for buying products necessary for living. With this latter income, the consumers use to buy luxurious goods.

(5) Life style: an individual's life style means his behaviors in living activities, money spending, time use etc. which are expressed repeatedly in four dimensions; demographics, activities, interest and opinion. The last three dimensions are often called AIO demographics.

4) Psychological factors; which influence consumers' purchase decision-making are motivation, perception, learning, beliefs and attitudes.

(1) Motivation means to persuade or convince individuals to believe in something similarly. What is used to persuade is called "motive", showing that there is such tendency already in the person and ready to stimulate him/ her to do something to reach his goals.

(2) Perception means a process an individual choose to receive information or stimuli, and to understand it by using experiences as tools and then followed by responsive actions. Receiving the same stimuli and being under the situation, two consumers can possibly react differently.

(3) Learning means behavioral change resulted from experiences either directly or indirectly. If a consumer has experiences showing that certain product can respond his/her need, or is very satisfying, when the need arises, he/ she will buy the same product again.

(4) Belief and attitude. Belief is an attribute indicating the possible feeling which is specific purpose, regardless it is true or not. The belief may originate from knowledge, opinion, faith, and there may or may not involve emotions.

- Belief causes imagination of the product in consumers' minds, regardless the belief about the product is right or wrong.

- Attitude means a person's thought, understanding, feeling and tendency toward anything, which influence the expression of that person whether in positive or negative ways. Individual's attitude toward anything is difficult to change.

2.4.1.3 Consumers' decision-making process

The process consists of these stages;

1) Problem recognition means the state the consumer knows and understands that his/ her need and reality are different, and that the level of reality is in fact lower than the need. That is the acceptance of the problem, and when the consumer decides to solve the problem, he/ she has to follow the next procedure; searching for information about solving the problem.

2) Information search; Information concerning problem resolution that consumers want to find out is the compounds of marketing from 4 sources: personal source, commercial source, public source and experience source

The outcome of information search will help the consumer receive some marketing compound that will be analyzed and developed to be his/her choice, which is to be assesses next.

3) Alternative evaluation; At this stage, the consumer will set up some criteria to measure and compare the value of marketing compounds already collected. These criteria are details of marketing compound, both desirable and undesirable.

4) Purchase decision. In the last stage, alternative evaluation, the consumer evaluates different alternatives. When he/ she chooses any of them, he/ she generally decides to buy the product evaluated the best.

5) Post purchase behavior; Buying the product and consuming it thereafter, The consumer will learn whether the product can really serve and satisfy their needs. If the consumer is satisfied or very pleased with the product. They are likely to;

(1) buy more product and have a life time product loyalty.

(2) repurchase the product again when the producer newly launches a new product innovation or after the product improvement.

(3) have a positive word of mouth bout the product and the producer

(4) have less interest in other product, quick to the change prices, tell his/her opinion about the product to the producer.

(5) become a permanent user of that product.

In case the consumer is dissatisfied with the product, he/she might keep that negative feelings with himself/herself, or might react by not buying that product again (Wikipedia, 2009c).

2.5 Factors Related to the Adoption of Energy Conservation Innovations in Private Cars

According to literature review, factors related to adoption of energy conservation innovation consisted of four groups; 1) demographic characteristics 2)

accessibility to information 3) knowledge 4) perception of innovation in different aspects.

2.5.1 Demographic Characteristics

Demographic characteristics; gender, age, marital status, income, including private car use were factors related to innovation adoption. Many studies on these factors were undertaken, including the study of Rogers (1995) which was always cited concerning population characteristics of each innovation adopter group according to their personality. It was found that members of the first adopter groups were usually the youth with social status, occupations and income better than the late or even non adopter groups. Other research had many similar outcomes. For example, O'Garra, Mourato and Pearson (2005) studied on awareness and adoption of hydrogen cars in London which found that males had more positive association with hydrogen-powered cars than females, as well as more knowledge about it, because they were more interested in technology and fuel. Age was also found to be associated with adoption, but negatively; only the people between 50 to 60 years old had negative association with those cars. It was also indicated that private car users, especially other clean energy car owner, accepted such cars more than those without cars.

There were also other studies on population characteristics in different aspects. For example, the study on purchase decision on alternative energy cars of American households which found that age of head of the household, income, number of family members, were related to the decision on purchase alternative energy cars (Sheng, 1999). The study on hydrogen powered bus in Stockholm and Sweden also shown that males and high education people had more knowledge about hydrogen energy use in cars than females and those with low education. It was also indicated that females and those aged over 40 years needed more information about it (Haraldsson et al., 2006).

The study on chasm between consumers' attitudes and behaviors toward clean energy powered car purchase in England also found that general population characteristics of the first buyers were usually good education, high income, urban dweller and interested in modern technology (Lane and Potter, 2007).

Besides, studies on behaviors related to environment in eight aspects; for example, the selection in using fuel in cars, electricity saving, water saving or material

recycling also found that population characteristics, especially gender and nationality were associated to those behaviors (Oesterle, 2001).

However, there were also studies with contradictory results; for example, the study on private car purchase in Canada shown that males were not much interested in information about air pollution caused by vehicles, unlike elderly people and those with high education level who recognized its importance when going to buy a new car and chose to buy environmentally friendly fuel cars; males in general had less involvement in reducing effects on environment than females (Teisl, Rubin and Noblet, 2001). On the other hand, the studies on socially responsible behaviors in different aspects such as air pollution reduction, or used material recycling, found that demographical characteristics; gender, income, age, were very little associated with behaviors, while level of education and occupation were not associated with them at all (Roberts, 1996).

Regarding to the study on private car use and energy innovation adoption, some studies were found; for example, Walton, Thomas and Dravitzki's (2004) "Commuters' concern for the environmental knowledge of the effects of vehicle emissions" in New Zealand indicated that private car users were more responsible to environment and the effect caused by private cars than railway commuters. It was also shown that they intended to reduce the uses of the low quality fuel cars, the cause of air pollution, more than those using public transport, and were more willing to support the government's abatement policy in reducing cars using the low quality fuel than those who did not use private cars. Nevertheless, there were studies with contradictory results as well; for example, Golob and Hensher's (1998) "Greenhouse gas emission and Australian commuters' attitude and behavior concerning abatement policies and personal involvement", found that public transport commuters supported the state's policies on reducing greenhouse gas emissions and related policies more than private car users.

2.5.2 Accessibility to Information

Accessibility to information was another factor related to energy innovation adoption in relation to media type, listening frequency and aspects of information presented. For example, while carrying on a publicity, the people who knew and

adopted new technology concerning energy consumption to preserve the environment, the Institute of Energy Research and Development, New York, found that information about technology or innovations, research and development including reliable plans and policies via different types of media had positive effect on spreading innovations or people's technology adoption (Bretschneider and Myung, 1997). Similarly, the study in England was indicated that the adoption of alternative energy car innovation was spreaded by being publicized by reliable media in terms of providing details of innovation in every aspect, which was necessary to consumers' car purchase decision making (Byrne and Polonsky, 2001). Different types of media had their own diversities and the advantage and disadvantage, depending on consumers' selection of accessibility to and belief in what types of media. There were many related studies. For example, the study in China about consumers' response to publicity concerning environment found that media types were significantly associated to consumption behavior with responsibility to environment. Actually, the Chinese received such information from printed matters more than television or radio because they felt that this type of media was more tangible and durable (Chan, 2004). Moreover, in the study research to evaluate the media quality of the air pollution from car abatement campaign project in the Netherlands also indicated that television was the most popular media, accounting 60%, while printed matters were not much interested by people to look for more information (Trijntje, Ree and Cees, 2002).

On the other hand, the study on chasm between consumers' attitude and behavior in clean energy car purchase in England also found that the private car buyers received information from various sources; producers' brochures, the Internet, car magazines, salesman, family and friends including television, radio and newspaper. In England, the Internet was considered as consumers' reliable media for information (Lane and Potter, 2007). Many studies were shown that media played important role in consumers' adoption of energy innovation. However, some studies found that individuals played more important role. For example, the study on factors affecting the use of natural gas in private cars in Italy's big cities found that only 25% of private car users had information about government's promotion in different ways to encourage the people to use natural gas and their information sources were friends

or relatives 74%, while mass media accounted only 16% (Stefano, Femia and Luzzati, 2001).

Similarly, in conducting a campaign to save fuel in cars, the Association of Swedish Consumers indicated that details, clear information with the advantages and disadvantages had an effect on people's adoption. Especially, if they received the information via direct communication in person, they were more effectively convinced than receiving via mass media (Evert, 1999).

Besides, the frequency of media receiving was also another issue affecting the energy innovation adoption. It was shown in a study on the awareness of air quality in order to reduce mobile source pollutants in Colorado. There was a campaign through many kinds of media to use daily air quality advisory, both good and poor quality in high pollution season, stimulated the people's awareness. It was indicated that most of people were aware of it and half of them accessed information via television, followed by radio and newspaper. While other kinds of media, the Internet for example, did not have any role. Furthermore, the frequency of most of these people's reception of information was once a day followed by the less than once a day frequency. Obviously, the frequency was associated with people's awareness as it was found that most of these people with such realization access information at least once a day or more and that it had some influence on their behavioral changes (Blanken, Dillon and Wismann, 2001).

Furthermore, different aspects of information were also related to energy innovation adoption. The study research on information campaign that emphasized on the consequence of using quality car and clean energy in the USA, shown that the information had strongly affected the private car users in California (Flamm, 2007). Similarly, The study on consumers' behaviors in Canada also indicated that the information accessibility concerning environmental situations and problems leaded to environmentally friendly behaviors (Rice, Nittaya and Orose, 1996).

Additionally, in Australia, information related to energy security and the effects caused by fuel uses on environment also affected consumers' car purchase selection, as well as tank refilling by choosing new technological and environmentally friendly fuel of the students of Western Australia University (Abdoolakhan, 2006)

2.5.3 Knowledge

Knowledge was another factor related to energy innovation adoption. It was also associated with behaviors concerning energy and environmental conservation, which covered many issues, such as knowledge about energy situations and problems, energy innovations and social support, both from the government and private sectors. Many studies conducted on these issues. For example, the study on consumers' choice to purchase cars using air pollution quality fuel of the Americans in California also shown that people with high level of knowledge about environment owned cars using effective quality fuel more than those with lower level. (Flamm, 2007). Moreover, the study on adoption of hydrogen power cars in Germany found that females knew very little about it and only a few of them owned this kind of car. Sources of information were schools and media, especially television. Sixty one percent of the people heard about hydrogen cars before. It was also shown that those who knew less about hydrogen fuel perceived more about the risk. However, most of them realized about the pollution emission issue (Schulte, Hart and Van der Vorst, 2004).

Furthermore, the study on consumers' adoption of hydrogen powered cars in the Netherlands found that the creation of consumers' good feelings toward products had to come from acquaintance and the interesting property of the product itself, which, in fact, resulted the understanding about car technology. The process of providing knowledge or education to people in general for their acquaintance with innovations while launching new technology to public was the period of great importance. With such process, people could make decision on advantages and disadvantages of the innovations, if there were more advantages that would lead to the innovation adoption eventually. However, this study shown that even people with high education still had low level of knowledge about hydrogen energy (Haraldsson et al., 2006).

There were also studies on the adoption of fuel cell cars in many cities, such as London, Luxemburg and Perth. At the beginning, it was found that despite strong support from many sectors, consumers still had little knowledge about this technology. There was an obvious difference between genders; males and the people with high education who had higher level of knowledge about hydrogen power than

females and the people with low education. Moreover, females were eager to have more information about it (Haraldsson, 2006).

Similarly, the research on factors affecting the natural gas uses in private cars in big cities in Italy also was found that car users had inadequate knowledge and information about natural gas. Eighty five percent of them knew that natural gas was cheaper than other kinds of fuel but most of them did not know exactly about the price. Moreover, 35% of them did not believe that it was cheap. Only 25% knew that the government supported in many ways to persuade the people to use natural gas and 36% believed that natural gas was not safe enough to use as fuel in cars (Stefano, Femia and Luzzati, 2001).

As a result, in Italy, natural gas in cars was not widely used. That was similar to the finding of the study in England on chasm between attitude and behavior of consumers concerning clean energy car purchase that consumers had low knowledge about technology of nearly all clean energy powered cars. For example, they thought that gas was dangerous, hybrid car had limited speed and gas stations were needed, especially for battery charging etc. in addition, it was shown that the impact on environment that might occur also affected car purchase (Lane and Potter, 2007).

2.5.4 Perception of Innovation in Different Aspects

Perception of innovation in different aspects was another factor related to innovation adoption. Many researcher conducted studies about this issue. Most of them found that the perception in different aspects was consumers' perception, not that of the innovation producers. It was also used to compare the innovations with existing goods or products in terms of risk, relative advantages, compatibility and complexity. All these aspects had the effect on innovation adoption (Schulte, Hart and Van der Vorst, 2004).

The study on obstacles in adopting alternative energy cars for sustainable transport found that infrastructure, such as sufficient number of alternative energy cars, the alternative energy themselves and gas station, maintenance service and the convenience of having traffic lanes provided specifically for alternative energy cars, affected on consumers' purchase decision. Besides, car characteristics; especially

price, quality, safety, fuel refill, maintenance and pollutions were also important as parts of innovation adoption (Byrne and Polonsky, 2001).

As studies in England and Germany on factors effecting hydrogen energy adoption indicated that even hydrogen was an energy the scientists and researchers concluded that it was very high security for cars compared to fossil fuel, some consumers still doubted about it. In fact, it was an effect of the explosion of hydrogen in Hindenburg, Germany in 1937. The risk aspect of innovation was therefore an important factor influencing the consumers' adoption. Furthermore, the consumers' satisfaction in other aspects; car efficiency, quantity or rate of fuel used in relation to distance, noise or vibration, durability and probable cost on it in the future, was also influential (Schulte, Hart and Van der Vorst, 2004).

In addition, the study on pattern of the dissemination of modern technology: the case of fuel cells in the USA found that the research and development for the progress of technology by developing fuel cells in safe containers and durable affected significantly the consumers' adoption. Besides, other factors, such as fuel price, convenient location of fuel station etc. which were the government's subsidies, were also essential (Collantes, 2007).

Many research studies had similar findings. For example, the research on cars and fuel for the future in the USA found that the adoption rate of car technology and alternative energy was lower than the target, its consumption accounting 10% of fossil fuel. It resulted from, at the beginning, alternative energy cars which were expensive; their limited capacity to carry fuel resulted in limited car running distance and unclear understanding about the system. The hesitation was inversely related the innovation adoption which depended on non complexity or easiness to use, subsidies from the government concerning prices or tax deduction and the advantages from reducing the use of natural resources as well as the environmental destruction.

Similarly, the study on factors effecting the adoption of natural gas of private-car users in big cities in Italy indicated that in the future, if the sample bought a new car, 22% of them would buy the car using fossil fuel due to different reasons, 24% would not buy a car using natural gas. About 13% used the same fuel car type because of the acquaintance and 87% did not use natural gas because of its inconvenience and they also thought that gas was hazardous and caused the car inefficient. Meanwhile,

those who owned cars using fossil fuel belived that the fuel helped the cars more efficient and they were accustomed to this kind of this car fuel. About 16% thought that fossil fuel was "clean" energy for environment than diesel fuel; it seemed that fuel brands, such as "eco-diesel" or "green gasoline" and others made consumers confuse. On the other hand, those who used diesel had many reasons which were cheap, good quality, reliable and convenient to refill (Stefano, Femia and Luzzati, 2001). In contrast, the research of Dagsvik, Wennemo, Wetterwald and Aaberge, (2002) on need of alternative energy cars of consumers in Norway and the research of Ewing and Sarigollu (1998) on need of consumers concerning the purchase of clean energy cars found that the alternative energy cars were needed more than cars using fossil fuel. This contradiction resulted from factors, such as sufficient number of cars and gas stations, demographic characteristic differences regarding level of knowledge and perception of innovation in different aspects, which influenced the consumers' adoption of energy innovation in private cars.

A study on families' demand and their willingness to pay for clean energy cars in urban areas of Canada, shown that tax deduction and the abatement on environment impacted households to adopt clean energy cars. In the contrary, other motivation, such as parking without charge or traffic lane specifically provided for, had no significant relationship with the adoption of clean energy cars. Above all, the inconvenience in refilling the fuel was also influential in decision making (Potoglou and Kanaroglou, 2007).

In addition, there were also studies on adoption of energy innovation in the future, which had similar results as follows;

The study on consumers' needs to speculative demand in purchase private cars using alternative energy in the future in South Korea found that consumers still used fossil fuel cars in highest proportion compared to other kinds of fuel. The consumers' purchase this kind of cars first despite the launch of alternative energy cars was a consequence of confident comparison, the readiness of infrastructure concerning fuel refill and repair or maintenance. Anyhow, some of them were still interested in hybrid cars because this car type used high efficiency energy (Kim, Jeong; Ahn and Lee., 2007).

Moreover, the study on the use of alternative energy and alternative energy cars in Thailand in terms of advantage for society indicated that gasohol E10 was a little cheaper than fossil fuel and had a risk for higher car maintenance cost, which was unattractive for consumers. On the other hand, hybrid car produced in Thailand was more interesting for consumers because due to the 10% tax deduction by the government, resulting in its price that could be cheaper than fossil fuel car (Goedecke, Therdthianwong, and Gheewala, 2007).

2.6 Conceptual Framework

From literature review above, the researcher proposed the research concept as shown in figure 2.4, comprising variables affecting the adoption of innovations for energy conservation of the people both at present and in the future as follows:

1) Demographic characteristics; gender, age, marital status, education level, occupation, monthly income and private car use.

2) Accessibility to information concerning; energy situations and problems, energy conservation innovations in private cars and social support.

3) Knowledge about; energy situations and problems, energy conservation innovations in private cars and social support.

4) Perception energy conservation innovations in private concerning: risk, comparative advantage, compatibility and complexity (Figure 2.4).
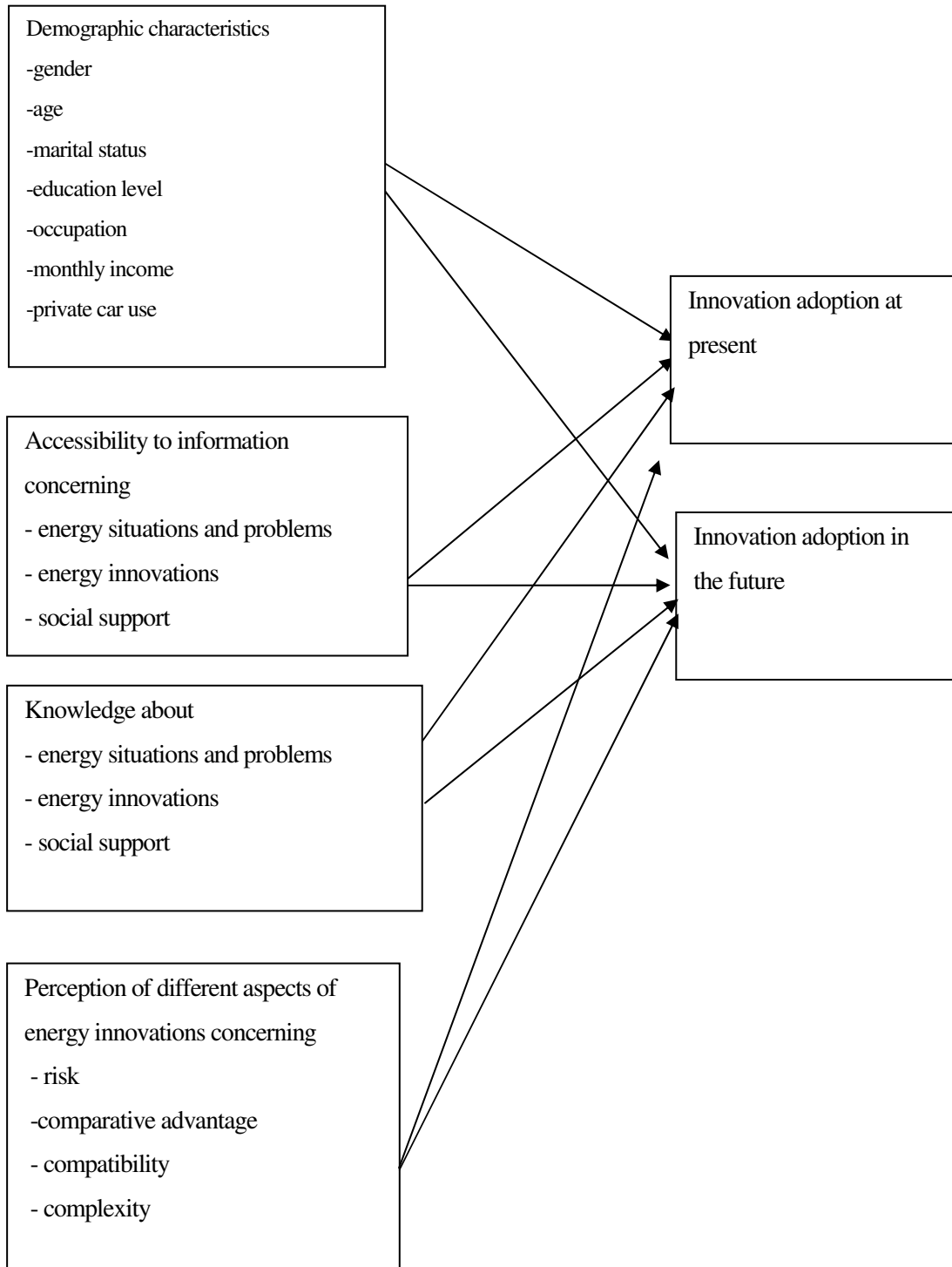
Figure 2.4 Conceptual Framework about the Adoption of Innovation for Energy
Conservation in Private Cars at Present and in the Future of the People in
Bangkok

CHAPTER 3

RESEARCH METHODS

This chapter will go into details about the methods used in the study which consists of research design, sources and types of data, sampling method, data collection, data coding, and data analysis.

3.1 Research Design

This study applied two types of research as follows;

1) Documentary research; It concerned secondary data collected from papers, research studies, theses, from both government and private sectors.

2) Quantitative research; It dealt with sample survey by means of interviewing selected people living in Bangkok age between 20 – 60 years old. The respondents were questioned by using questionnaires as a tool for data collection.

3.2 Population and Sample

To conduct quantitative research, population and sample could be explained as follows:

3.2.1 Target Population

The target population in the study was the people living in Bangkok aging between 20 – 60 years old, both male and female. Total number was 5,716,248 (Department of Provincial Administration, 2007).

3.2.2 Sample and Sampling Method

The sample was selected from the population by using stratified three-stage random sampling which was detailed as follows;

The metropolitan was divided into fifty administrative areas according to their geographical zones:

3.2.2.1 The inner zone consisted of twenty districts ; Pranakorn, PomPrapsatrupai, Sumpanthawongse, Pathumwan, Bangrak, Yannawa, Sathon, Bangkorleam, Dusit, Bangsue, Phyathai, Rajthevi, Hauykwang, Klongteoy, Jatuchak, Thonburi, Klongsan, Bangkoknoi, Bangkokyai, Dindeang, and Wattana.

3.2.2.2 The intermediate zone consisted of eighteen districts; Phrakanong, Prawej, Bangkean, Bangkapi, Lardprao, Bungkum, Bangplad, Pasichareon, Chomthong, Rachaburana, Suanluang, Bangna, Thungkru, Bangkhae, Wangthonglang, Kannayao, Saparnsung, and Saimai.

3.2.2.3 The outer zone consisted of eleven districts; Minburi, Donmuang, Nongjok, Lardkrabung, Talingchan, Nongkheam, Bangkhunthian, Laksi, Klongsamwa, Bangbon, and Taweewattana (Department of Provincial Administration, 2007).

Stage 1: District selection was carried out by using simple random sampling in order to select one sample area from each of those three zones, which resulted in Thonburi, Pasichareon, and Nongjok.

Stage 2: Sub-District selection was carried out by using simple random sampling to select two sub-districts from each selected district, resulting in six sub-districts, as shown in table 3.1

Table 3.1 Sub-District Selection Classified by Using Simple Random Sampling

Zone	Districts	Sub-District
Inner Zone	Thonburi	Samreh and Talaad Plu
Intermediate Zone	Pasichareon	Bang Chak and Bang Waek
Outer zone	Nongjok	Nongjok and Lumpakchee

Stage 3: Respondent selection was carried out by using simple random sampling in each sub district.

The sample sizes were calculated by using Yamane' formula (Yamane, 1967: 886) :

$$n = \frac{N}{1 + Ne^2}$$

when n = Sample Size

N = Population size =5,716,248

e = Error of random sampling = 5%

$$n = \frac{5,716,248}{1 + 5,716,248(0.05)^2}$$

= 400

The sample in each sub district was determined according to the proportion of population size in each sub-district as shown in table 3.2.

Table 3.2 Population and Sample Size Classified by Sub-District

Sub-district	Population (Age 20-60)	Sample Size
Samreh	11,929	73
Talaad Plu	12,328	75
Bangjak	4,367	27
Bangweak	13,336	80
Nongjok	9,071	54
Lumpakchee	15,145	,91
	N= 5,716,248	n = 400

Source: Department of Provincial Administration, 2007.

3.3 Data Collection

Data was collected by means of interviewing respondents, beginning with interviewer's self presentation, explaining objectives of the study and asking for their participation.

3.3.1 The Questionnaire

The researcher developed a questionnaire according to the conceptual framework and divided the questionnaire into four sections:

Section 1: Demographic characteristics; gender, age, marital status, education level, occupation, monthly income and private car use.

Section 2: Accessibility to information and knowledge; level and sources of accessibility to information, level of knowledge in three aspects; energy situations and problems, energy conservation innovations in private cars and social support.

Section 3: Perception of characteristics of energy conservation innovations in private cars in four aspects; risk, relative advantage, compatibility and complexity.

Section 4: Adoption of energy conservation innovations in private cars, both at present and future, and open-ended questions concerning their innovation adoption.

3.3.2 Validity and Reliability of Questionnaire

Before conducting data collection, the questionnaire was tested to find out its validity by experts on energy conservation innovations in private car. After having some proper improvement, it was implemented on thirty people in Bangkok aged between 20 – 60 years old and the data gathering was analyzed to find its reliability by using Cronbach's alpha which was shown in table 3.3.

Table 3.3 Values of Cronbach's Alpha of Independent Variables

Independent Variable	Cronbach's Alpha
Knowledge concerning;	
Energy situations and problems	0.8802
Innovations for energy conservation	0.8468
Social support	0.8759
Perception of innovation for energy conservation in terms of;	
Risk	0.8296
Relative advantage	0.7102
Compatibility	0.8771
Complexity	0.7822

3.4 Operation of Variables

This research was set up to seventeen independent variables and two dependent variables as follows:

3.4.1 Private car user means the driver and owner of a private car

3.4.2 Innovations for energy conservation in private car or innovations mean the kinds of used to substitute or reduce the consumption of gasoline or diesel used in private cars, such as gasohol, biodiesel, natural gas, battery, fuel eells, hybrid engines and solar cells, solar energy and other potentials in the future which are as follows;

3.4.2.1 Innovations at present mean gasohol, biodiesel and natural gas.

3.4.2.2 Other potential innovations in the future mean other types of energy conservation innovations in private cars which might be used in the future, such as electric batteries, fuel cells, hybrid engines and solar cells etc.

3.4.3 Accessibility to information means information received from both mass media and personal communications such as television, radio, electronic media, printed matters, motor show exhibitions, friends, colleagues, state authorities as well as car dealership or gas station employees. The accessibility is divided into three aspects:

3.4.3.1 Accessibility to information concerning energy situations and problems

3.4.3.2 Accessibility to information concerning innovations for energy conservation

3.4.3.3 Accessibility to information concerning social support

3.4.4 Knowledge means factual knowledge in three aspects:

3.4.4.1 Knowledge about situations and problems about energy

3.4.4.2 Knowledge about innovations for energy conservation

3.4.4.3 Knowledge about social support

An information accessibility and knowledge in these three aspects consist of:

1) Situations and problems concerning fossil fuels with regard to:

(1) Fossil fuel sources, both in the country and from abroad

(2) Duration of fossil fuel availability before depleted

(3) Tendency of oil price fluctuation

(4) The country's three highest oil consuming sectors; transportation, industry and household

(5) The country's annual expenditure on oil

(6) Impacts from fossil fuels on the environment and health

2) Innovations for private car energy conservation in terms of:

(1) Types and objectives of innovations for conserving energy in private cars available both in the country and abroad

(2) Advantages and problems that might occur when private cars turn to use gasohol, natural gas and other potential innovations in the future

3) Social support from both governmental and private sectors in terms of:

      (1) government's subsidy for natural gas equipment installation in private cars

      (2) import tax exemption for natural gas equipment

      (3) natural gas equipment production within the country

      (4) training courses for natural gas equipment installers

      (5) the increased number of natural gas installation operators

      (6) the increased number of stations for gasohol, biodiesel and natural gas

      (7) the government's low price policy on gasohol, biodiesel and natural gas

      (8) research and development concerning gasohol, biodiesel, natural gas and other potential innovations in the future

3.4.5 Perception about innovation characteristics means the translation or interpretation of the properties of gasohol, biodiesel, natural gas, including potential innovations in the future, in four aspects:

    3.4.5.1 Perception in terms of risk means the interpretation in potentiality of problems that may occur to individuals or society due to innovation adoption concerning:

      1) shortage of raw materials for the production of gasohol, biodiesel, and natural gas including other potential innovations in the future

      2) production standard of gasohol, biodiesel, natural gas, including other potential innovations in the future

      3) price fluctuation despite government's low price imposed on gasohol, biodiesel, and natural gas

      4) standard of natural gas equipment production

      5) standard of natural gas accessory installation at service points

6) possibility to find spare parts of natural gas equipment including potential innovations in the future

7) repair standard of each service point for natural gas cars and other potential innovations in the future

8) possible decrease of car efficiency or power when using gasohol, biodiesel, natural gas including other potential innovations in the future

9) the car lifetime when powered by gasohol, biodiesel, and natural gas including other potential innovations in the future

10) possible increase of car insurance when using gasohol, biodiesel and natural gas including potential innovations in the future

11) easiness or difficulties in reselling used-private cars using gasohol, biodiesel and natural gas including other potential innovations in the future

12) security when using private car using gasohol, biodiesel, and natural gas including potential innovations in the future

13) convenience of finding stations when using private car using gasohol, biodiesel and natural gas including other potential innovations in the future

14) convenience of finding service points for private car repair when using natural gas including other potential innovations in the future

3.4.5.2 Perception in terms of comparative advantages means the translation or interpretation of increasing advantages if adopting energy conservation innovations compared to the former period in terms of:

1) the decrease of expenditure on the kinds of fuel when using gasohol, biodiesel and natural gas, including other potential innovations in the future

2) the decrease of expenditure due to the government's subsidy in natural gas equipment installation

3) a worthwhile investment after the natural gas equipment installation including other potential innovations

4) low cost repair or maintenance when using gasohol, biodiesel and natural gas including other potential innovations in the future

5) the increase of used car prices for those using gasohol, biodiesel and natural gas including other potential innovations in the future

6) more fuel options when using gasohol, biodiesel and natural gas including other potential innovations in the future

7) more convenient due to alternate-use possibility with fossil fuels when using gasohol, biodiesel and natural gas

8) being praised by other people when using gasohol, biodiesel and natural gas including other potential innovations in the future

3.4.5.3 Perception regarding compatibility means the translation or interpretation of the compatibility of energy conservation innovations in relation to personal belief in case of adoption as follows;

1) decrease dependency on foreign fossil fuel import when using gasohol, biodiesel and natural gas, including other potential innovations in the future

2) decrease the country's expenditure on energy when using gasohol, biodiesel, and natural gas including other potential innovations in the future

3) increase the income of farmers who produce raw materials, the basic ingredient of gasohol and biodiesel

4) reduce natural resource or fossil fuel consumption when using gasohol, biodiesel, and natural gas including other potential innovations in the future

5) reduce pollutions in the environment when using gasohol, biodiesel and natural gas including other potential innovations in the future

6) reduce the people health problems when using gasohol, biodiesel, and natural gas including other potential innovations in the future

3.4.5.4 Perception concerning complexity means the translation or interpretation of the easiness or difficulty to understand and to use innovations for energy conservation in terms of:

1) type and model of private car to use gasohol, biodiesel, and natural gas

2) type and mixture of different gasohol and biodiesel

3) knowledge about the operation of equipment used in natural gas car including other potential innovations in the future

3.4.6 The adoption of energy conservation innovations in private cars at present means the consumption of private car users and the acceptance of non private car users of any existing innovations available at present or those potential in the future

3.4.7 The adoption of energy conservation innovations in private cars in the future means the decision of private car and non private car users whether to consume any innovations available at present or those potential in the future

3.5 Variables and Criteria

Variables used in the analysis consisted of two dependent variables and seventeen independent variables as shown in table 3.2.

Table 3.4 Variables and Criteria

Variables	Value / Code
Innovation adoption at present (PRESENT)	0 = non-adoption 1 =adoption (at least 1 from 4 types)
Adoption of potential innovations in the future (FUTURE)	0 = non-adoption 1 = adoption (at least 1 from 4 types)
Gender (SEX)	0=female 1=male
Age (AGE)	1=20-30 years old 2=31-40 years old 3=41-50 years old 4=51-60 years old
Marital Status (STATUS)	0= single, widow, divorce, or others 1= married
Education Level (EDU)	12= secondary school 14=diploma or equivalent 16= bachelor degree 18=higher than bachelor degree

Table 3.4 (Continued)

Variables	Value/ Code
Occupation (OCC)	1=civil servant
	2=state enterprise's employee
	3=private sector's employee
	4=student
	5=others
Monthly Income (INCOME)	1=less than 10,000 baht
	2=10,000-20,000 baht
	3=20,001-30,000 baht
	4=more than 30,000 baht
Private car use (USECAR)	0= no
	1= yes
Accessibility to information concerning situations and problems (INFSIT)	0= no
	1= yes
	7 questions (0-7 points)
Overall accessibility to information concerning situations and problems	
Low accessibility to information	0-2.33 points
Moderate accessibility to information	Over than 2.33 points– 4.66 points
High accessibility to information	More than 4.66 points – 7 points
Accessibility to information concerning energy conservation innovations (INFINNO)	0= no
	1=yes
	4 questions (0-4 points)

Table 3.4 (Continued)

Variables	Value/Code
Overall accessibility to information concerning energy conservation innovations	
Low accessibility to information	0-1.33 points
Moderate accessibility to information	More than 1.33 points - 2.66 points
High accessibility to information	More than 2.66 – 4 points
Accessibility to information concerning social support (INFSUP)	0= no
	1=yes
	8 questions (0-8 points)
Overall accessibility to information concerning social support	
Low accessibility to information	0- 2.66 points
Moderate accessibility to information	More than 2.66 points – 5.32 points
High accessibility to information	More than 5.32 - 8 points
Knowledge about situations and problems (KNOWSIT)	0=not at all
	1=very little
	2=little
	3=moderate
	4=much
	5=very much
	7 questions (0-35 points)
Overall knowledge about situations and problems	
Low knowledge	0-11.66 points
Moderate knowledge	More than 11.66 points-23.32 points
High knowledge	More than 23.32- 35 points

Table 3.4 (Continued)

Variables	Value/ Code
Knowledge about energy conservation innovations (KNOWINNO)	0=not at all 1=very little 2=little 3=moderate 4=much 5=very much 4 questions (0-20 points)

Overall knowledge about energy conservation innovations
    Low knowledge
    Moderate knowledge
    High knowledge
	
	0-6.66 points
	More than 6.66 -13.32 points
	More than 13.32- 20 points

Knowledge about social support (KNOWSUP)	0=not at all 1=very little 2=little 3=moderate 4=much 5=very much 8 points (0-40 points)

Overall knowledge about social support
    Low knowledge
    Moderate knowledge
    High knowledge
	
	0-13.33 points
	More than 13.33 -26.66 points
	More than 26.66 – 40 points

Perception about innovation property concerning risk (RISK)	0=not at all 1=very little 2=little 3=moderate

Table 3.4 (Continued)

Variables	Value/ Code
	4=much
	5=very much
	14 questions(0-70 points)
Overall perception about risk	
Low knowledge	0-23.33 points
Moderate knowledge	More than 23.33 -46.66 points
High knowledge	More than 46.66 – 70 points
Perception about innovation property concerning comparative advantages (ADV)	0= not at all
	1=very little
	2=little
	3=moderate
	4=much
	5=very much
	8 questions (0-40 points)
Overall perception about comparative advantages	
Low perception	0-13.33 points
Moderate perception	More than 13.33 -26.66 points
High perception	More than 26.66 – 40 points
Perception about innovation property concerning compatibility (COMPAT)	0=not at all
	1=very little
	2=little
	3=moderate
	4=much
	5=very much

Table 3.4 (Continued)

Variables	Value/ Code
	6 questions (0-30 points)
Overall perception about compatibility	
Low perception	0-10 points
Moderate perception	More than 10 -20 points
High perception	More than 20 – 30 points
Perception about innovation property concerning complexity (COMPLEX)	0=not at all
	1=very little
	2=little
	3=moderate
	4=much
	5=very much
	3 questions (0-15 points)
Overall perception about complexity	
Low perception	0-5 points
Moderate perception	More than 5 -10 points
High perception.	More than 10 – 15 points

3.6 Data Analysis

3.6.1 The data gathered from questionnaire was analyzed according to variable characteristics. The initial data analysis was conducted by means of descriptive statistics, using frequency, percentage, average and standard deviation.

3.6.2 Regarding to the study conceptual framework, the logistic regression analysis was used by selecting the Enter method to analyze factors affecting the adoption of innovations for energy conservation in private cars of the people both at present and in the future. Finally, CHAID (Chi-Square Automatic Interaction Detection) was applied to identify the most influential independent variables that affect the adoption of innovations for energy conservation.

Logistic regression was the technique used to describe the relationship between one or more independent variables (e.g., sex, age, etc.) and an outcome (or dependent variables), expressed as a probability that had only two possible values in this study (i.e. "adoption" or "not adoption"). The logistic regression was used for prediction of the probability of occurrence of an event (i.e. adoption of innovations for energy conservation) by fitting data to a logistic curve. Let P (event) was the probability of occurrence of an event. Logistic regression could be written in terms of following function.

$$P \text{ (event)} \quad = \quad \frac{e^z}{1 + e^z} \qquad \qquad \ldots\ldots \quad 1$$

$$\text{and} \quad P(\text{no event}) \quad = 1\text{-}P \text{ (event)} \qquad \qquad \ldots\ldots \quad 2$$

The variable z was defined as

$$Z = B_0 + B_1 X_1 + B_2 X_2 + \ldots\ldots + B_K X_K \qquad \ldots\ldots \quad 3$$

where B_0 was called the intercept and B_1, B_2, and so on, were called the regression coefficients of X_1, X_2, respectively.

In the study, there were two models. The first model used the present adoption of innovations for energy conservation (noted as Present) and the other assigned Z as the future adoption of innovations for energy conservation (noted as Future). The analyses were applied using the Enter method, i.e. all seventeen independent variables were analyzed in both models as follows:

Present $\quad = a_0 + a_1 \text{Sex} + a_2 \text{Age} + a_3 \text{Status} + a_4 \text{Edu} + a_5 \text{Occ}$

$\quad\quad\quad\quad + a_6 \text{Income} + a_7 \text{Usecar} + a_8 \text{Infsit} + a_9 \text{Infinno} + a_{10} \text{Infsup}$

$\quad\quad\quad\quad + a_{11} \text{Knowsit} + a_{12} \text{Knowinno} + a_{13} \text{Knowsup} + a_{14} \text{Risk}$

$\quad\quad\quad\quad + a_{15} \text{Adv} + a_{16} \text{Compat} + a_{17} \text{Complex}$

Future $\quad = b_0 + b_1 \text{Sex} + b_2 \text{Age} + b_3 \text{Status} + b_4 \text{Edu} + b_5 \text{Occ} + b_6 \text{Income}$

$\quad\quad\quad\quad + b_7 \text{Usecar} + b_8 \text{Infsit} + b_9 \text{Infinno} + b_{10} \text{Infsup} + b_{11} \text{Knowsit}$

$\quad\quad\quad\quad + b_{12} \text{Knowinno} + b_{13} \text{Knowsup} + b_{14} \text{Risk} + b_{15} \text{Adv} + b_{16} \text{Compat}$

$\quad\quad\quad\quad + b_{17} \text{Complex}$

Each of the regression coefficients described the size of the contribution of those independent variables. A positive regression coefficient meant that the independent variables increased the probability of the event, while a negative regression coefficient meant that independent variables decreased the probability of that event; a large regression coefficient meant that the independent variables strongly influenced the probability of that event; while a near-zero regression coefficient meant that independent variable had a little influence on the probability of that event (Wikipedia, 2009h).

In addition to logistic regression, the study applied CHAID (Chi-Squared Automatic Interaction Detector) to identify and explain the most influential independent variables that affected the adoption of innovations for energy conservation. CHAID was a type of decision tree technique. It was published in 1980 by Gordon V. Kass (Wikipedia, 2009a).

Using this technique, it was possible to establish relationship between a dependent variable and other independent variables. CHAID did this by identifying discrete groups of respondents and by taking their responses to independent variables and seeked to predict what the impact would be on the dependent variable. The results of analysis were usually presented in the form of trees. Trees were formed by a collection of rules based on values of certain variables in the modeling data set.

1) Rules were selected based on how well splits based on variables' values could differentiate observations based on the dependent variable.

2) Once a rule was selected and split a node into two, the same logic was applied to each "child" node (i.e. it was a recursive procedure).

3) Splitting stops when CHAID detected no further gain could be made, or some pre-set stopping rules were met (Wikipedia, 2009i).

The analysis results of all these variables including the analysis of variables affecting the adoption of energy conservation innovations, both at present and in the future were shown in the next chapter.

CHAPTER 4

ANALYSIS RESULT

This chapter presents the detailed outcome from the analysis of demographic characteristics, accessibility to information and knowledge in three aspects; energy situations and problems, energy conservation innovations and social support; including the perception of innovations in four aspects; risk, comparative advantage, compatibility and complexity as well as factors influencing the innovation adoption of people, both at present and in the future, as follows:

4.1 Demographic Characteristics of the Sample

The study of the sample's demographic characteristics in general found that males were slightly more than half (55.2%) and 43.0% of the sample age between 20-30 years old, followed by those aging between 41-50 years who represented 25.5%. The sample average age was 35.5 years, with the standard deviation 10.8 years; the youngest and oldest were 20 and 60 years old respectively, 40.8% of them graduated with bachelor degree, followed by those with diploma or equivalent 23.5%. The numbers of those finishing their studies from secondary school and those with the higher degree than bachelor were quite close, representing 17.2% and 18.5% respectively.

Moreover, the numbers of the sample working for state enterprises and private sectors were quite similar, 23.5% and 23.0% respectively. The numbers of those earning less than 10,000 baht and between 10,000-20,000 baht per month were also indifferent, 39.5% and 38.3% respectively. Those gaining more than 30,000 baht per month were the least representing 10.5%. Most of them (75.0%) were single, widow and other unclassified category. The most significant number of 72.5% from the sample was private car users as shown in table 4.1.

Table 4.1 Overall Demographic Characteristics of the Sample

Demographic characteristics	Number	Percentage
Gender		
Male	221	55.2
Female	179	44.8
Total	400	100.0
Age		
20 – 30 years	172	43.0
31 – 40 years	87	21.7
41 – 50 years	102	25.5
51 – 60 years	39	9.8
	$\bar{X}=35.5$	SD=10.8
	MIN=20	MAX=60
Marital status		
Single, widow, divorce and others	300	75.0
Married	100	25.0
Education level		
Secondary school	69	17.2
Diploma or equivalent	94	23.5
Bachelor degree	163	40.8
Higher than bachelor degree	74	18.5
Occupation		
Civil servant	80	20.0
State enterprise's employee	94	23.5
Private sector's employee	92	23.0
Student	65	16.3
Others	69	17.2

Table 4.1 (Continued)

Demographic characteristic	Number	Percentage
Monthly Income		
Less than 10,000 baht	158	39.5
10,000 – 20,000 baht	153	38.3
20,001 – 30,000 baht	47	11.7
More than 30,000 baht	42	10.5
Private car use		
No	110	27.5
Yes	290	72.5

4.2 Accessibility to Information and Knowledge

The second section of the study, the researcher studied about the sample's accessibility to information including the frequency of information acquisition from all kinds of media (e.g. television, radio, electronic media, printed matters, motor show exhibition, friends, colleagues, family member, state authorities, automobile dealers and gas stations employees) and their knowledge in three issues:

4.2.1 Energy situations and problems

4.2.2 Energy conservation innovations in private cars

4.2.3 Social support

The study results were as follows:

4.2.1 Energy situations and problems consisted of seven issues:

4.2.1.1 The sources of petroleum both from inside the country and from abroad

4.2.1.2 The duration of petroleum availability before its depletion from the earth

4.2.1.3 The tendency of the oil price change

4.2.1.4 The country's three biggest oil consuming sectors; transportation, industry and households

4.2.1.5 Thailand's annual expenditure on petroleum

4.2.1.6 Impact of using petroleum on environment

4.2.1.7 Impact of using petroleum on people's health

4.2.1.1 The sources of petroleum both from inside the country and from abroad

The study result shown in table 4.2 and 4.3 indicated that most of them (83.5%) received information from different media, while 16.5% of them never got it. Among those receiving information, 46.4% obtained it once a week, followed by 21.8% of those receiving once a month. Among those having and never having acquired such information combined together, 32.0% of them had moderate knowledge about this issue, followed by those with little knowledge, while the people having no such knowledge at all were as numerous as 20.5%. The average score of this knowledge was 2.05 and the standard deviation was 1.34.

From the fact finding above, it could be analyzed that information about petroleum both from inside the country and from abroad was quite widespread as it was basic information. However, it was also presented frequently to the people by different media, resulting in moderate knowledge among a number of people. On the other hand, a nearly similar of number people had little of this knowledge probably because most of the information widely presented was usually about petroleum sources from abroad, i.e. countries in the Middle-East, so that some people have no knowledge about petroleum sources in the country.

4.2.1.2 The duration of petroleum availability before its depletion from the earth

The study result shown in table 4.2 and 4.3 demonstrated that most of the people (70.8%) received information from different media, while 29.2% of them never got it. Among those having information, 31.8% of them got it once a week, followed by those once a month 27.2 %. and it was also found that among those having information and those without information combined, 29.0% of them had neither knowledge nor understanding about this issue at all, followed by those with

little knowledge, 25.8%. The average score of the knowledge was 1.86 and the standard deviation was 1.46.

According to the data, it could be analyzed that even though most of them had information as often as once a week, many of them had no knowledge about this at all. It was probably because information had general content without precise number of years of petroleum availability before its depletion from the earth.

4.2.1.3 Tendency of oil price changes

The result from the study shown in table 4.2 and 4.3 translated that most of the people (91.0%) had this information, while a small percentage (only 9.0%) never received it. Among those having information, the ones obtaining it everyday and those once a week were at very close percentage, 36.8% and 36.2% respectively. While those receiving it only once in more than 6 months period represented only a small percentage, 2.6%. The people with information combined with those without information, who had a moderate and much of knowledge about this were at nearly close percentage, 24.5% and 21.8% respectively. Moreover, the people with little knowledge and without knowledge at all represented the same percentage, i.e. 17.8% each. The average score of knowledge was 2.59 and the standard deviation was 1.60.

Therefore, the result could be summarized that nearly all people accessed to this information and received it frequently resulting in their moderate to much knowledge. Since this information had direct economic impact on the increase of one's expenses, both directly and indirectly, it was the people's selected information exposure. In addition, the energy situations and the tendency of oil price change were continually presented in media as topic of general interest.

4.2.1.4 The country's three biggest oil-consuming sectors; transportation, industry and households

The result from the study shown in table 4.2 and 4.3 indicated that more than half of them, 66.3%, received the information, and 33.7% of the never. Among those receiving information, 35.0% of them received it once a week, followed by 24.1% of those once a month. It was also shown that 35.8% of both recipients and non recipients had no knowledge about this information at all. The average score of this knowledge was 1.65 and the standard deviation was 1.47.

According to the data above, the implications from the result could be explained that only a small number of the people received this information. One-third of the population (35.8%) who received it once a week had no knowledge about this issue at all. On the other hand, the media did not provide them with comparative information of fossil fuel consumption of each sector.

4.2.1.5 Thailand's annual expenditure on petroleum

From the result shown in table 4.2 and 4.3 indicated that most of them (72.8%) had this information, while 27.2% never. Those who had it once a week were the highest number (30.2%), followed by those once a month (27.4%). However, it was also found that 31.0% of both those with and without information combined had no knowledge about this at all, followed by 24.0% of those with little knowledge. The average score of this knowledge was 1.75 and the standard deviation was 1.44.

To a great extent from the data, it could be explained that even though most of the people received the information related to this issue once a week, it was only general information indicating the Thailand oil expenditure each year. As a result, a large number of people or about one-third of them (31.0%) had no knowledge about this information at all.

4.2.1.6 Impact of using petroleum on the environment

The study result shown in table 4.2 and 4.3 demonstrated that most of them 87.2% received this information while 12.8% never. Among those having information, 31.2% received it once a week, followed by 28.0% of those having it once a month. The 25.8% of those with and without information combined had moderate knowledge about this. The average score of the knowledge was 2.27 and the standard deviation was 1.56.

According to our fact finding, it could be elaborated that at present the people were aware of and very much interested in the environment issue because it affected directly to their immediate livelihood and also would continue to impact their future generations and the media sector also vitally focused on the importance of this issue to present to public.

4.2.1.7 Impact of using petroleum on public health

Further more, the result shown in table 4.2 and 4.3 also indicated that most of them (81.3%), had information about this, while a small number of them

(18.7%) never consumed from any source of media. Among the sample obtaining the information, 32.9% of them received it once a week, followed by 23.0% of those receiving it once a month and 26.3% of the people both having received and never received this information had no knowledge about this issue at all and a close number of people (25.3%) had moderate knowledge about it. The average score of this knowledge was 2.09 and the standard deviation was 1.59.

       With the comprehensive data, it could be analyzed that even though most of the people received this information frequently from different media, they did not have much knowledge about it, probably because they were not interested in receiving negative, in depth detailed information presented by media about fossil fuel use causing diseases, whether respiratory diseases or cancer. However, another group of people concerning about their health were particularly interested in this type of information resulting in close numbers of the people in both groups having moderate knowledge and those having no knowledge at all.

Table 4.2 Percentage of Accessibility to and Frequency of Receiving Information
Related to Energy Situations and Problems

Energy situations and problems	Accessibility to information		Frequency of receiving information from media				
	No	Yes	Everyday	Once a week	Once a month	Once every 2–6 months	Once in more than 6 month
1. Petroleum sources, both from inside the country and from abroad	16.5	83.5	14.7	46.4	21.8	9.8	7.3
2. Duration of petroleum availability before its depletion from the earth	29.2	70.8	10.2	31.8	27.2	14.4	16.4
3. Tendency of petroleum price changes	9.0	91.0	36.8	36.2	19.0	5.4	2.6
4 The country's three biggest oil-consuming sectors; transportation, industry and households	33.7	66.3	15.8	35.0	24.1	13.5	11.6
5. Thailand's annual expenditure on petroleum	27.2	72.8	14.4	30.2	27.4	15.4	12.6
6. Impacts of using fossil fuel on the environment	12.8	87.2	19.1	31.2	28.0	7.4	14.3
7. Impacts of using fossil fuel on people's health	18.7	81.3	17.2	32.9	23.0	14.4	12.5

Table 4.3 Percentage of Knowledge Related to Energy Situations and Problems

Energy situations and problems	Not at all	Very little	Little	Moderate	Much	Very much	$\overline{X}$	SD
1. Petroleum sources, both from inside the country and from abroad	20.5	9.5	27.5	32.0	7.8	2.7	2.05	1.34
2. Duration of petroleum availability before its depletion from the earth	29.0	8.5	25.8	24.5	9.0	3.2	1.86	1.46
3. Tendency of petroleum price change	17.8	7.0	17.8	24.5	21.8	11.1	2.59	1.60
4. The country's three biggest oil-consuming sectors; transportation, industry and households	35.8	8.8	23.1	22.1	7.5	2.7	1.65	1.47
5. Thailand's annual expenditure on petroleum	31.0	10.8	24.0	22.7	9.5	2.0	1.75	1.44
6. Impact of using fossil fuel on the environment	21.5	8.5	22.0	25.8	14.0	8.2	2.27	1.56
7. Impact of using fossil fuel on people's health	26.3	9.8	19.5	25.3	12.0	7.1	2.09	1.59

4.2.1.8 Level of accessibility to information
concerning energy situations and problems

The assessment of the level of accessibility to information concerning energy situations and problems from seven issues of which aggregate scores were between 0-7 according to the criteria, showing that most of the people, (62.6%), highly accessed to this information, while 28.6% and 8.8% of them had moderate and low accessibility respectively. The average score of accessibility to information concerning energy situations and problems was 5.5 and the standard deviation was 1.95. The lowest and highest score of accessibility to this kind of information were 0 and 7 accordingly, as shown in table 4.4.

Table 4.4 Summary of Accessibility to Information Concerning Energy Situations and Problems

Accessibility to information concerning energy situations and problems	Level			Total	$\overline{\text{X}}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	8.8	28.6	62.6	100.0	5.50	1.95	0	7

The study result could be summarized as an overview that people had high accessibility to information about situations and problems concerning energy, whereby, most of them apparently had high information from all issues.

4.2.1.9 Level of knowledge about energy situations and problems

The assessment of level of knowledge about energy situations and problems from seven issues of which aggregate scores were between 0-35 according to the criteria, found that 49.2% of them had moderate knowledge, followed by those with low knowledge 39.8%, and only 11.0% of them had high knowledge. The average score of knowledge was 14.2 and the standard deviation was 8.31. The highest and the lowest score were 33 and 0 respectively, as shown in table 4.5

Table 4.5 Summary of Knowledge about Energy Situations and Problems

Knowledge about energy situations and problems	Level			Total	$\overline{\text{X}}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	39.8	49.2	11.0	100.0	14.2	8.31	0	33

The result from the study could be clearly defined as an overview that nearly half, (49.2%), of the people had moderate knowledge about situations and problems concerning energy, followed by those with low knowledge and only a small number of them had high knowledge. The measurement according to each issue demonstrated that the highest number of people who had no knowledge from four out of seven questions at all, while having moderate knowledge about other remaining three questions.

4.2.2 Energy Conservation Innovations in Private Cars

The researcher conducted the research study on the accessibility to information, the frequency of receiving it from media and their knowledge about energy conservation innovations in private cars by means of four issues:

4.2.2.1 Different types of fuels to replace fossil fuel in private cars

4.2.2.2 Objectives for the production of gasohol, biodiesel, natural gas and other potential innovations in the future

4.2.2.3 Advantages of gasohol, biodiesel, natural gas and other potential innovations in the future

4.2.2.4 Possible problems if cars use gasohol, biodiesel, natural gas and other potential innovations in the future

The study results of these issues were as follows:

4.2.2.1 Different types of fuel to replace fossil fuel in private cars

It was indicated from the study result shown in table 4.6 and 4.7 that most of the people (92.8%) received this information, only 7.2% of them never had. Among those having information, 36.6% obtained it once a week, followed by 21.8% got it everyday. The 31.5% of both people with information and those with no information, had moderate knowledge in this issue, followed by 24.3% of those with little knowledge. The average score and standard deviation were 2.52 and 1.42 respectively.

From the finding, it could be explained that the essence of the importance of fossil fuel, the non renewable energy, to the economic system and development of all aspects, especially to transportation system, the invention for alternative fuel was necessary and important issue presented through different kinds of media. The consumers themselves were also interested in this kind of information because of its direct involvement impacted to their livelihood. As a result, most of them consumed this information. However, the information received might not provide adequate details concerning newly invented innovations, such as hydrogen energy, fuel cells or hybrid engines because the information was mostly about alternative energy already available on the market such as gasohol, biodiesel or natural gas.

4.2.2.2 Objectives for the production of gasohol, biodiesel,
natural gas and others, such as electric cells,
fuel cells, hybrid engine, solar cells etc.

From the study result in table 4.6 and 4.7 shown, the indication appeared that most of the people (87.5%) received information about this issue, while 12.5% of them never. Among those having information, 35.4% of them obtained it once a week, followed by those once a month 29.5%. Another 26.5% of those with and without information had moderate knowledge about this issue, followed by 22.5% of those people with little knowledge. The average score and standard deviation were 2.32 and 1.50 respectively.

The above data could be concluded that the cause of the petroleum shortage including situations with the rising fossil fuel prices, as well as the impacts on the environment and people's health, the government had to find a solution by using alternative energy for transportation, which was a widespread issue in all kind of media. Consequently, most people (87.5%) had information about this issue. However, the numbers of people with moderate and little knowledge about this were quite close, probably because of not being provided with information about other innovations, such as electric cells, fuel cells, hybrid engines or solar cells.

4.2.2.3 Advantages of gasohol, biodiesel, natural gas
and other potential innovations in the future

As seen from the result in table 4.6 and 4.7, the indication showed that most of the people (85.3%) received information about this issue, while 14.7% never did. Among those having information, 34.6% of them obtained it once a week, followed by 25.5% of those once a month. The 27.0% of both groups receiving and never receiving this information, had moderate knowledge, followed by those having no knowledge at all. The average score and the standard deviation were 2.31 and 1.57 respectively.

Using the data from the study, it could be expressed that since media frequently provided information of this issue, particularly the advantages of gasohol, biodiesel and natural gas in terms of cheaper price than fossil fuel, which resulted in the reduction of the people's expenses in general, most people then selected to be exposed to this issue. However, they might have general knowledge only about this

issue but unfortunately were not informed about advantages of other issues, such as the decrease of using natural resources, the reduction of dependence on foreign energy or the impacts on the environment and people health, etc.

4.2.2.4 Possible problems if cars using gasohol, biodiesel, natural gas and other potential innovations in the future

The study finding in table 4.6 and 4.7 shown that most of the people (78.0%) received information about this issue, while 22.0% never. Among those having information, 32.0% of them received it once a month and a close number of them (31.4%) obtained the information once a week. The highest number of people comprising of both receivers and non receivers of information, accounting for 28.3% had no knowledge about this at all. The average score and the standard deviation were 1.90 and 1.53 respectively.

Therefore, according to the data, it could be summarized that the people had information about possible problems, particularly about security, such as the effect on car efficiency and additionally, there were occasionally information about the gas explosion in cars, causing anxiety and fear because of its direct effect on people's lives and assets, resulting in the interest of most receivers of information. In fact, it was the perception of the consequences of what happened without revealing the real causes, in which media, due to the lack of time for investigation, might not pursue to communicate to the public for the correct understanding. Furthermore, alternative energy issue involving innovations was something newly invented, therefore, the people might not be sufficiently provided with adequate information.

Table 4.6 Percentage of Accessibility to Information Concerning Energy
Conservation Innovations in Private Cars

Energy Conservation Innovations in private cars	Accessibility to information		Frequency of receiving information from media				
	No	Yes	Daily	Weekly	Monthly	Once during 2 – 6 month	Once in more than 6 month
1. Alternative fuel capable to replace fossil fuel in cars	7.2	92.8	21.8	36.6	21.0	13.2	7.4
2. Objectives for the production of gasohol, biodiesel, natural gas and others such as electric batteries, fuel cells and hybrid engines	12.5	87.5	16.4	35.4	29.5	13.6	5.1
3. Advantages of gasohol, biodiesel, natural gas, and others such as electric batteries, fuel cells and hybrid engines.	14.7	85.3	19.3	34.6	25.5	11.1	9.5
4. Possible problems if cars using gasohol, biodiesel, natural gas, and others, such as electric cells, fuel cells and hybrid engines	22.0	78.0	15.3	31.4	32.0	13.8	7.5

Table 4.7 Percentage of Knowledge about Energy Conservation Innovations
in Private Cars

Energy Conservation Innovations in Private Cars	Not at all	Very little	Little	Moderate	Much	Very much	$\overline{X}$	SD
1. Alternative fuel capable to replace fossil fuel in cars	13.5	7.5	24.3	31.5	15.0	8.2	2.52	1.42
2. Objectives for the production of gasohol, biodiesel, natural gas and others such as electric batteries, fuel cells and hybrid engines	18.5	9.8	22.5	26.5	16.0	6.7	2.32	1.50
3. Advantages of gasohol, biodiesel, natural gas, and others such as electric batteries, fuel cells and hybrid engines.	21.5	9.0	18.3	27.0	17.2	7.0	2.31	1.57
4. Possible problems if cars using gasohol, biodiesel, natural gas, and others, such as electric cells, fuel cells and hybrid engines	28.3	11.5	23.0	21.3	11.3	4.6	1.90	1.53

4.2.2.5 Level of accessibility to information about energy conservation innovations in private cars

The assessment of the level of accessibility to information about innovations for energy conservation in private cars from four questions, of which aggregate scores were between 0-4 according to the criteria, indicated that most of the people (86.0%) had high accessibility to information, only 6.0% and 8.0% had

moderate and low accessibility respectively. The average score was 3.44 with standard deviation 1.06 as shown in table 4.8.

Table 4.8 Summary of Accessibility to Information Concerning Energy
Conservation Innovations in Private Cars

Accessibility to information concerning innovations	Level			Total	$\overline{X}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	8.0	6.0	86.0	100.0	3.44	1.06	0	4

From the study result, it could be analyzed as an overview result that people had high accessibility to information about innovations for energy conservation in private cars as illustrated by the majority of them had information about the topics of all questions.

4.2.2.6 Level of knowledge about energy conservation innovations in private cars

The assessment of the level of knowledge from four questions of which the aggregate scores were between 0-20, indicated that 49.3% of them had moderate knowledge about this, followed by those with low and high knowledge at 35.0% and 15.7% respectively. The highest and lowest score were 20 and 0 respectively. The average score was 9.04 and the standard deviation was 5.20, as shown in table 4.9.

Table 4.9 Summary of Knowledge about Energy Conservation Innovations in
　　　　　Private Cars

Knowledge about innovations	Level			Total	$\overline{X}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	35.0	49.3	15.7	100.0	9.04	5.20	0	20

As seen from the result of the study, it could be concluded that people had moderate knowledge about innovations for energy conservation in private cars as illustrated by answers for each question, showing that most of them had moderate knowledge about three out of four questions.

4.2.3 Social Support

The researcher conducted the study on people's accessibility to information, frequency of receiving it from media and knowledge about social support from both government and private sectors by means of eight issues:

4.2.3.1 Government's subsidy for natural gas equipment installation in private cars

4.2.3.2 Import tax exemption for natural gas equipment

4.2.3.3 Natural gas equipment and its production in the country

4.2.3.4 Training courses for natural gas equipment installers

4.2.3.5 The increase of natural gas installation operators

4.2.3.6 The increase of filling stations for gasohol, biodiesel, and natural gas

4.2.3.7 The government's low price policy on gasohol, biodiesel and natural gas

4.2.3.8 Research and development concerning gasohol, biodiesel, natural gas and other potential innovations in the future.

The study results from these eight issues were as follows:

4.2.3.1 Government's subsidy for natural gas equipment installation in private cars

The result of the study shown in table 4.10 and 4.11 indicated that 60.2% of the people received this information, while 39.8% of them never. Among those having information, 37.7% of them obtained it from different kinds of media once a month, followed by those having it once a week. The 41.3% of both receivers and non-receivers of information combined together had no knowledge about this at all. Only a very small number (2.5%) had most knowledge about this. The average score of knowledge was 1.52 and the standard deviation was 1.50.

Taking the data into the consideration, it could be seen that media did not present this information frequently. Obviously, it might be presented in some state and some other agencies' related websites, in which the interested people who accessed the information were possibly searching for details of equipment installation in order to convert to natural gas user and, as a result, they could find all related information, such as target group, sum of subsidy, and the subsidy period, etc. While the regular people who were not particularly interested or directly involved might not often use this kind of media. Consequently, a large number of people (41.3%) did not have any knowledge about this issue at all.

4.2.3.2 Import tax exemption for natural gas equipment

The table 4.10 and 4.11 shown in the result of the study indicated that more than half of the people (56.7%) never received this kind of information and 43.3% of them received it from different media. Among the information receiving people, 39.3% of them received it once a week, followed by 26.0% of those receiving once a month. More than half of both the receivers and non receivers of information did not have knowledge about this at all and a very small number of them (only 0.4%) had very much knowledge about this. The average score of this knowledge was 1.70 and the standard deviation was 1.38.

Therefore, from our data, it could be explained that the media, particularly television or newspaper, the leading media preferred by the people, did not provide much of this information and its specific details. There were probably only some general websites involving state agencies, such as the Ministry of Energy, or PTT (Petroleum Authority of Thailand) providing information, in which just a

very few small groups of interested people planning to convert to natural gas would search for it. As a result, more than half of the people obviously did not have the knowledge about this crucial issue at all.

4.2.3.3 Production of natural gas equipment in the country

The finding shown in table 4.10 and 4.11 indicated that most of the people (60.0%) received this information from different media and among these people, 33.3% of them received it once a week, followed by 27.9% of those receiving once a month. However, 43.8% of information receivers and non receivers had no knowledge about this issue at all, and a very few number of them (only 0.9%) had a very deep knowledge. The average score of this knowledge was 1.37 and the standard deviation was 1.43.

To translate from the data above, it could be summarized that the information about the sources of natural gas equipment was not widespread, regardless any kind of media, probably with the exception of only media belonging to agencies involving to its production or related to energy, such as websites of the Ministry of Energy or PTT. Consequently, almost half of the people did not know where the equipment derived from, whether it was produced in the country or imported from abroad. This information was not much presented in media because it focused on specific details only. Despite the information about natural gas frequently presented in media, it was usually underlined about the difference of its price from those of fossil fuel in order to convince the people to use it. As a result, a lot of people did not have any crucial information about this at all.

4.2.3.4 Training courses for natural gas equipment installers

The indication of the result from this study showed in table 4.10 and 4.11 that the number of receivers and non receivers of this information were very close, 49.5% and 50.5% respectively. Among the receivers, 34.3% of them received it once a week, followed by 28.3% of those receiving it once a month. More than half of the receivers and non receivers combined (52.3%) had no information about this at all, and a very small number (only 1.0%) had very much information about it. The average score of knowledge was 1.15 and the standard deviation was 1.40.

Therefore, it could be concluded that agencies involved, whether government or private sector, rarely presented this information via media, particularly

via television, radio or newspaper and which was the targeted media for people interested mostly in this particular information and there were a small number of people intentionally searching for details in websites of agencies involved. As a result, more than half of the people had no related information about this at all whether or not the installation operators must have training courses.

4.2.3.5 The increase of natural gas installation operators

As indicated in the result of the study showed in table 4.10 and 4.11 that most of the people (67.0%) received this information from different media. Among the receivers, 39.3% of them had it once a month, followed by 22.0% of those receiving once a week. Both receivers and non receivers, 36.3% of them combined had no knowledge about this at all, and only 0.7% of them had very much knowledge about it. The average score of knowledge was 1.51 and the standard deviation was 1.37.

As the finding from the data above, it could be indicated that the continually rising of oil prices had caused a number of private car users to convert to natural gas. Consequently, the government was obliged to stimulate the increase of number of operators for the convenience of equipment installation. In fact, media, especially television and newspaper, also occasionally presented this information, but despite receiving this information, many people were not well informed about it; for example, the number of the to-be-increased service in prospect, their location, and their opening schedules etc., so more than one-third of the people or 36.3% did not have any information about this at all.

4.2.3.6 The increase of number of filling stations for gasohol, biodiesel and natural gas

As seen from the study shown in table 4.10 and 4.11, it was resulted that most of the people (76.8%) had this information. Among the information receivers, 33.8% of them got it once a month, followed by 26.0% of those receiving once a week. Whether information receivers or not, 29.3% of them had no knowledge about this at all, and only 2.4% had very much knowledge about it. The average score of knowledge was 1.78 and the standard deviation was 1.44.

From our data, it could be implied that because of the continually rising price of oil, a number of private car users had converted to use alternative

energy in order to decrease their expenses. The government had to promote subsequently the increase of gas stations of the alternative energy, particularly natural gas stations of which existing numbers were not enough. When the need of private car users increased, those stations could not service them sufficiently, and occasionally, consumers had to wait for a long time, which caused a real disturbance in daily life for consumers often presented through media. Despite receiving all this information, such as the exact number of the projected stations or their openings, etc., the people were likely lack of knowledge about many details in certain aspect; evidently it was only a small number of people (2.4%) who had much knowledge in dept about this aspect.

4.2.3.7 The government's low price policy on gasohol, biodiesel, and natural gas

The result of the study shown in table 4.10 and 4.11 illustrated that most of the people (76.8%) obtained this information from media, and among the information receivers, 34.8% of them had it once a month, followed by 25.7% of those receiving once a week. Whether information receivers or not, 29.0% of them had no knowledge about this at all. The average score of this knowledge was 1.74 and the standard deviation was 1.42.

According to the data above, it was found that the media, particularly television, radio, and newspaper usually presented this issue depending on the tendency of oil price changes to the naturally interested consumers since it had direct impacts on their expenses. Despite having current information on the issue, most people did not have knowledge nor understanding about it, because they might only know that these alternative energy were cheaper than fossil fuel without knowing the real reasons, where they came from, or the differences of prices of these alternative fuel, including the duration the government's implementation of the low pricing policy on gasohol, biodiesel and natural gas.

4.2.3.8 Research and development concerning gasohol, biodiesel, natural gas and other potential innovations in the future

The result of the study shown in 4.10 and 4.11 illustrated that most of the people (64.2%) obtained this information form different media. Among the information receivers, 33.6% of them received it once a month, followed by 24.9% of

those receiving once a week. Whether the information receivers or not, 40.8% of them had no knowledge about this at all. The average score of this knowledge was 1.38 and the standard deviation was 1.39.

    Through the data analysis, it could be defined that the result from obtaining information about this issue from media, the people were subsequently convinced to have more confidence and trust in these innovations, and consequently accepted and adopted them eventually. Nonetheless, they did not have knowledge about this issues in detail; for example, where about the production of natural gas equipment in the country, agencies responsible for the research and development including the process, progress or results of the research and development of new alternative innovations; for example gasohol or biodiesel with increasing ethanol or vegetable oil as ingredient, such as E 20, E 85, B 20 etc. Furthermore, the advance of research and development of innovation production other than those mentioned such as international standard fuel-efficient car or eco-car which rarely appeared in media.

Table 4.10 Percentage of Accessibility to Information from Media about Social
Support Concerning Energy Conservation Innovation in Private Cars

Social support	Accessibility to information		Frequency of receiving information from media				
	No	Yes	Daily	Weekly	Monthly	Once every 2 – 6 month	Once in more than 6 month
1. Government's subsidy for natural gas equipment installation in cars	39.8	60.2	8.7	31.9	37.7	12.8	8.9
2. Import tax exemption for natural gas equipment	56.7	43.3	8.7	39.3	26.0	15.0	11.0
3. Natural gas equipment production in the country	40.0	60.0	9.5	33.3	27.9	15.8	13.5
4. Training courses for natural gas equipment installers	50.5	49.5	8.0	34.3	28.3	17.6	11.8
5. The increase of natural gas installation operators	33.0	67.0	10.0	22.0	39.3	14.9	13.8
6. The increase of number of filling stations for gasohol, biodiesel and natural gas	23.2	76.8	12.0	26.0	33.8	14.3	13.9
7. The government's low price policy on gasohol, biodiesel and natural gas	23.2	76.8	15.3	25.7	34.8	13.1	11.1
8. Research and development concerning gasohol, biodiesel, natural gas and other potential innovations in the future.	35.8	64.2	6.6	24.9	33.6	19.8	15.1

Table 4.11 Percentage of Knowledge about Social Support Concerning
Energy Conservation Innovations in Private Cars

Social support	Not at all	Very little	Little	Moderate	Much	Very much	$\overline{X}$	SD
1. Government's subsidy for natural gas equipment installation in cars	41.3	9.0	18.3	21.6	7.3	2.5	1.52	1.50
2. Import tax exemption for natural gas equipment	56.5	8.3	14.5	15.0	5.3	0.4	1.70	1.38
3. Natural gas equipment production in the country	43.8	11.0	19.0	17.8	7.5	0.9	1.37	1.43
4. Training courses for natural-gas equipment installers	52.3	9.8	16.8	14.3	5.8	1.0	1.15	1.40
5. The increase of natural gas installation operators	36.3	13.5	20.0	24.0	5.5	0.7	1.51	1.37
6. The increase of number of filling stations for gasohol, biodiesel and natural gas	29.3	11.5	25.8	21.5	9.5	2.4	1.78	1.44
7. The government's low price policy on gasohol, biodiesel and natural gas	29.0	13.5	25.8	20.3	9.0	2.4	1.74	1.42
8. Research and development concerning gasohol, biodiesel, natural gas and other potential innovations in the future	40.8	14.5	20.0	17.3	6.0	1.4	1.38	1.39

4.2.3.9 Level of the accessibility to information about social support concerning energy conservation innovations in private cars

The assessment of the level of the accessibility to the information by means of eight questions of which aggregate scores were between 0-8 according to the criteria indicated that the highest number of the people (46.7%) highly accessed to this information, followed by those moderately and lowly accessed at 32.3% and 21.0% respectively. The highest and the lowest score were 8 and 0 respectively. The average score was 4.96 and the standard deviation was 2.96 as shown in table 4.12.

Table 4.12 Summary of Accessibility to Information about Social Support Concerning Energy Conservation Innovations in Private Cars

Accessibility to information about social support	Level			Total	$\overline{X}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	21.0	32.3	46.7	100.0	4.96	2.69	0	8

In the overview, it was found that people had much accessibility to information as indicated by the majority of them received information from six out of eight questions.

4.2.3.10 Level of knowledge about social support concerning energy conservation innovations in private cars

The assessment of the level of knowledge about social support concerning energy conservation innovations in private cars by means of eight questions of which the aggregate scores were between 0-40 according to the criteria indicating that most of them (62.3%) had little knowledge about this, followed by those with moderate and much knowledge at 32.7% and 5.0% respectively. The average score of knowledge was 11.53 and the standard deviation was 8.81, the highest and lowest score were 39 and 0 point respectively, as shown in table 4.13.

Table 4.13 Summary of Knowledge about Social Support Concerning Energy
Conservation Innovations in Private Cars

Knowledge about social support	Level			Total	$\overline{X}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	62.3	32.7	5.0	100.0	11.53	8.81	0	39

In the overview it was found that most of the people had low knowledge about social support as illustrated by their total lack of knowledge about this issue when asked by eight questions despite their high accessibility to this information, probably because the information they received was not provided sufficiently in full details to create the people's good knowledge.

4.2.4 The Information Received from Media in Three Issues

The study result on information received from media in three main issues were as followed:

4.2.4.1 Situations and problems of fossil fuel in Thailand and in the world

4.2.4.2 Other kinds of energy compatible to fossil fuel in private cars

4.2.4.3 Support from government and private sectors to boost the people's adoption of other kinds of energy to replace fossil fuel in private cars.

Media from which individuals obtaining information was consisted of television, radio, electronic media, printed matters, motor show exhibition, friends, colleagues, members of the family, state authorities, employees of automobile dealers, and employees of petrol stations. Actually, individuals could possibly obtain the three aspects of information from one kind of media more than from the others as detailed below:

4.2.4.1 The accessibility of information about situations
and problems of fossil fuel in Thailand and the world

The study result of information accessibility shown in table 4.14 indicated that most of them (88.2%) obtained it from television, followed by 52.1% of those obtaining from radio and printed matters and 43.5% respectively, while obtaining from employees of automobile dealers the least, only 4.3%.

4.2.4.2 Accessibility to information about other kinds of
energy compatible to fossils fuels in private cars

The study result of the accessibility of information shown in 4.14 indicated that most of the people (88.2%) had this information, only 11.8% had not. Among the information receivers, most of them (85.8%) obtained it from television, followed by those obtaining from radio and printed matters at 52.6% and 43.0% respectively, while those obtaining this information from employees of automobile dealers were the least, representing 5.3%.

4.2.4.3 Accessibility to information about the support in different
aspects from government and private sector to boost the
people's adoption of other kinds of energy to replace fossil
fuel in private cars

The study result of the accessibility of information shown in table 4.14, indicated that most of the people (78.8%) had this information, from which most of them (89.2%) from television, followed by those from radio 49.5%, while obtaining from employees of petrol station the least 3.0%.

The overview of information accessibility of all three issues found that the people from Bangkok obtained information mostly from television, followed by radio, printed matter and the Internet respectively, while those obtaining from employees of automobile dealers and petrol stations were the least informed.

The data was interpreted that at present media recognized the increasing importance of providing the people useful information about energy, particularly fossil fuel in different aspects. Nearly all kinds of media presented it to people due to its importance and impacts to global population including the Thais, in many aspects; economic, social or environmental. Actually, the people themselves were also increasingly aware of and interested in this issue because it had an

economically direct effect on them in particular, so that they selected to be exposed to interesting information for them, a phenomenon called "information searching behavior" (Klapper, 1960). Obviously, television was the most effective media in presenting information in different dimensions simultaneously, both pictures and sound, including its instant presentation of information. Nowadays, apart from routine news presentation, it also presented scoops or special reports of interesting issues.

On the other hand, even though the radio broadcast was only via sound, but also widespread and was able to present information instantly, reaching out to a lot of people who could listen to it all the times, and subsequently becoming the second media the people listened to information of this key issue at most. Besides, printed matters - newspapers in particular were also popular among people searching for information, consequently, they became the third media for the people's information acquisition. Furthermore, the Internet at present also became another type of increasingly widespread media. Regarding media in person of different kinds, it was found that individuals obtained relatively low information of these issues from these kinds of media, probably because within the families or among friends, the conversation was mostly about the rising of oil price as it involves everyday life and affected their expenses directly, while other issues seemed far from themselves, hence neglected. And as salesmen of automobile dealers were motivated to sell their goods, they presented emphatically only information regarding the power or efficiency of their vehicles without giving other information. On the other hand, employees of petrol stations were too busy to talk with car-user clients, doing only their filling duty, and generally, they did not finish from high education level and do not have enough knowledge in these issues to advise other people, as shown in table 4.14.

Table 4.14 Percentage of the Overall Accessibility to Information According to
Media Types about Issues Related to Energy Conservation Innovations

Aspect of information obtained	Media type from which obtaining information												
	Never obtained	Obtained	TV	Radio	Electronic media	Printed media	Motor show	Friends	Colleagues	Family	State authorities	Auto dealer employees	Gas station employees
1.Situations and problems about oil in Thailand and the world	11.8	88.2	88.3	52.1	22.5	43.5	7.0	17.5	18.0	10.5	7.0	4.3	8.3
2.Alternative fuel compatible to replace fossil fuel	11.8	88.2	85.8	52.6	26.9	43.0	8.2	20.4	16.4	13.0	8.2	5.3	6.5
3.Support from governmental and private sector to boost the people's adoption of alternative fuel in private cars	21.2	78.8	89.2	49.5	27.0	42.8	6.9	15.5	14.6	8.2	9.5	4.7	3.0

   **4.2.4.4 Level of accessibility to information, frequency of receiving
     from media and knowledge about three issues**; **energy
     situations and problems, energy conservation innovations
     and social support**

    An overview of study resulted in the level of accessibility to
information, frequency of obtaining it from media, and knowledge about 3 issues;
shown in table 4.15, explained that the first two issues situations and problems of
energy and innovations for energy conservation, most people had highly accessed
information with the once-a-week frequency, nevertheless they had only moderate
knowledge about it. The last issue, social support, the accessibility was also high but
only with once-a-month frequency, and with low knowledge about it. It was probably
because the information content did not have sufficient details of all aspects, because

the media usually communicated only the price change and the shortage of fossil fuel which evidently attracted the people the most as they were affected directly to their everyday lives. Moreover, if seldomly receiving information, an individual could hardly gain sufficient knowledge about this as illustrated by the social support issue to which a large number of them accessed this information but with only once-a-month frequency. Furthermore, the selection to be exposed only to information for preferred individuals which was probably another reason causing the people's low knowledge about this issue.

Table 4.15 An Overview of the Level of Accessibility to Information, Frequency
of Receiving It from Media and Knowledge in three Issues

Issues	Level of accessibility to information	Frequency of receiving it from media	Level of knowledge
Situations and problems of energy	high	Once a week	moderate
Innovations for energy conservation Social support	high	Once a week	moderate
	high	Once a week	low

4.3 The Perception of Characteristics of Energy Conservation Innovations in Private Cars

The researcher conducted the people's perception of characteristics of energy conservation innovations in private cars in four aspects:

4.3.1 Risk characteristics

4.3.2 Comparative advantage characteristics

4.3.3 Compatibility characteristics

4.3.4 Complexity characteristics

The study results of these four aspects were as follows:

4.3.1 Risk Characteristics

To measure the perception of characteristics of energy conservation innovations in private cars regarding risk in different aspects if using gasohol,

biodiesel, natural gas, and potential innovations in the future such as electric cells, fuel cells and hybrid engines consisted of fourteen issues:

4.3.1.1 The scarcity of raw material for the production

4.3.1.2 Production standard

4.3.1.3 The changeable price

4.3.1.4 The standard of equipment production

4.3.1.5 The standard of each service point for the equipment installation

4.3.1.6 Spare parts finding

4.3.1.7 The repair standard at each service point

4.3.1.8 The vehicle power or efficiency

4.3.1.9 Possibility of the decrease of car lifetime

4.3.1.10 Possibility of the increase of car insurance

4.3.1.11 Used car resale

4.3.1.12 Security

4.3.1.13 Convenience to find the fuel refilling stations

4.3.1.14 Convenience to find garage for car repair

Of which the study results were as follows:

4.3.1.1 The scarcity of raw material for the production

The study result shown in table 4.16 indicated that 36.3% of them thought about this issue as low level risk, followed by 35.5% of those thinking as moderate risk, while the people perceiving it as no risk at all was the least, accounting for only 2.3%. The average risk perception score was 2.60 and the standard deviation was 1.09.

Therefore, the data analysis could be explained that the people had perception regarding risk of the scarcity/shortage of raw material for the innovation production as low to moderate level risk due to the government's projects to support the farmers to grow and produce energy producing crops such as corn, tapioca etc. to produce ethanol for gasohol, including other oil producing plants to produce biodiesel such as oil palm, coconut and linseed as well as the procurement of energy sources to produce sufficient amount of natural gas and LPG (Department of Alternative Energy Development and Efficiency, 2009c). However, these projects were still policies

waiting to be implemented, which were subject to change in the future due to their dependence to many factors, such as crop prices or the weather. Moreover, there were also some other alternative energy abroad in the stage of experiment and development such as electric batteries, fuel cells, hybrid engines, etc. of which potentiality to be imported into the country were still unclear. Additionally, the people might have inadequate information from media so that those who knew there was no risk at all accounted for only 2.3%.

4.3.1.2 Standard of production

The study result shown in 4.16 found that 40.5% of them thought that there was a moderate risk, and only 2.8% who perceived as no risk at all. The average score was 2.77 and the standard deviation was 1.08.

The above data showed that even though there were research and technological development to enable the production of standardized and qualified gasohol and biodiesel in many projects such as the Suan Chitlada Royal Project, the Research and Development of Production Project of the Institute of Scientific and Technology of Thailand, etc., as well as multi-million investment in expanding a gas classification plant and standard natural gas production, but the people might not be sufficiently provided with information in detail, while other innovations were in research and developmental stage in order to reach the standard needed to put onto the market in the future, as they were still unclear at the moment, then the people perceiving that there was no risk at all represented only 2.8%.

4.3.1.3 The changeable price

The study result shown in table 4.16, indicated that 35.3% of the sample thought that there was moderate risk, followed by those thinking as low risk 24.3%, and those thinking as very high risk were 11.3%, while those thinking as no risk represented only 2.0%. The average score of this risk perception was 2.93 and the standard deviation was 1.19.

As seen from the data, it could be elaborated that prices of alternative energy were subject to change depending on global oil price. So fuel prices were conditioned by volatile situations depending on many factors such as the oil shortage, the change of the value of U.S. dollar, the producing countries' capacity or even international conflicts. As prices of different types of fuel in Thailand were referred to those in

world market, they were consequently subject to change continually. However, even the government had a policy to alleviate the people's burden by fixing prices of some types of fuel such as natural gas for a certain period and taking responsibility for the difference themselves (The Energy Fund Administration Institute, 2009), the fuel prices were still changeable, so the people perceiving that there was no risk at all represented only 2.0%.

4.3.1.4 Production standard for equipment using with natural gas in private cars

The study result shown in table 4.16 found that 32.3% of the sample perceived that there was moderate risk, followed by those perceiving as low risk. The perception score was 2.73 and the standard deviation was 1.22.

Therefore, we could draw a conclusion from the data that the government managed to produce the equipment by themselves in addition to the equipment imported to be used as prototype for its production, as well as international cooperation's support for technology, knowledge and foreign experts flied into the country for advices. All the personnel involved in training avail themselves to travel to study overseas. All these activities were managed in order to have natural gas equipment produced according to the standard requirements. Regarding the cylinders, they were produced at the production project at the Weapon Production Center in the Military Center of Industries for National Defense and Military Energy by using German technology equipment. Other pressure gauge, gas tube, gas refilling head, automatic safety valve, manual valve were also produced in compliance with legal regulation of the Department of Land Transport according to ISO 155501 as the UN, ECE, RIIO standard or others (MSNtechnology, 2006). Nonetheless, as it was something new and probably be the lack of information in detail, people were not much confident in this technology as a consequence. Moreover, news about explosion of gas cars, though with unclear causes, created anxiety among people. That was why the people who perceived the information that there was no risk in this case representing only 3.8%.

4.3.1.5 The standard of each service point for the equipment installation

The study result shown in table 4.16 indicated that 29.8% of the sample perceived that there was moderate risk, followed by a close number (28.8%) of those perceiving as low risk. The average score of this perception was 2.64 and the standard deviation was 1.23.

From the data findings, the analysis showed that despite state regulations; for example, any installation service point that applied for the standard signboard guaranteeing the natural gas equipment installation from PTT must have already installed it more than thirty vehicles and the service staff must have passed the "installation standard" course arranged by the Institute of Research and Technology of PTT as well. Besides, there were also regulations imposing on service to test the installation to ensure the security before deliver to the third person. In reality, the installation standard must comply with regulations of the Department of Land Transport, the requirement of ISO 1550, the standard of UN, ECE, RIIC, and others, which were included in the state restrictions so that all service had the same standard (MSNtechnology, 2006). However, the people's perception of this still ranging from moderate to low level risk, probably because they did not have such information, and were not sure whether all 100 service stations could comply with state regulations, and whether the government was able to control them all. The people thinking that there was no risk at all represented only 3.8%.

4.3.1.6 Spare part finding

The study result shown in table 4.16 found that 33.0% of them thought that there was a moderate risk, followed by a close number (32.3%) of those thinking as low risk. The average score was 2.59 and the standard deviation was 1.11.

The above data expressed that the government's project to boost the use of natural gas in transport sector, with the target of about 500,000 vehicles by 2010, the country had to import a very large number of CNG cylinders within the five year project that it could risk the shortage of cylinders, resulting in the rising price of cylinders in the future, the Weapon Production Center of Military Industries for National Defense and Energy, the Ministry of Defense, studied the possibility to produce them with the cooperation of many agencies, such as the Office of Energy Policy and Planning and the

Office of the Promotion of Medium and Small Business and nowadays had already partly begun (MSNtechnology, 2006). Besides, there were also problems about the imported second handed NGV cylinders of unknown quantity which were abnormally cheaper than the normal 30,000 baht each for the new unit, then apparently in poor standard if they were not passed the qualifications and approved by the Department of Land Transport (Yenta4, 2008). It involved the risk of finding spare parts, in terms of both quantity and quality. The people thinking that there was no risk at all represented only 3.3 %.

4.3.1.7 The repair standard at each service point

The study result of the perception of the characteristics of innovation regarding to the risk concerning the repair standard at each service point if using natural gas equipment, including other potential innovation in the future, shown in table 4.16, found that 33.0% of them perceived that there was a moderate risk, followed by those perceiving as low risk (25.5%). The average perception score was 2.66 and the standard deviation was 1.21.

Therefore, we could indicated from the data analysis that despite the government measurement to control the service point standard by means of restriction for applicants for standard signboard must have installed already more than vehicles, as well as after sale service to customers with equipment warranty for 1 year, along with in case of damage, the examination must be done by the third party (The Insurance Premium Rating Bureau, 2007), people still had not fully confidence about the standard of every repair service point whether all of them reached the same standard. Even though, there was already installation standard imposed by the government, but there was no tangible standard for the repair. Besides, other potential innovations, began to be available such as hybrid cars, were also something very new so that the people were not confident whether the service operators had adequate capability to deal with these new technologies. Hence, those who thought there was no risk at all represented only 3.8%.

4.3.1.8 Possibility of weakening effect to vehicle power or
efficiency

The study result of the risk perception of the car power or efficiency that might be weakened if using gasohol, biodiesel, natural gas and other potential innovations in the future, shown in table 4.16, found that 29.0% of them thought

that there was a moderate risk, followed by 27.3% of those thinking as low risk. The average score of this perception was 2.62 and the standard deviation was1.22.

Therefore, the analysis derived from the data above indicated that the people were accustomed to 100% fossil fueled vehicles, compared with gasohol and biodiesel that each of which was the mixture of alcohol or vegetable respectively, contributing to diminution of fossil fuel ingredient, nor they were accustomed to natural gas fueled vehicles. On the other hand, a test of the Department of Marine Dockyard found that the engine of vehicles using biodiesel B100 had more powerful at every round speed, followed by vehicles using B40 B20 and B5 accordingly. That meant when using biofuel with higher proportion of vegetable oil, the engine became more powerful. However, this test result was contradictory to the test result of the Department of Pollution Control which indicated that, if using fuel with the mixture of vegetable oil, the engine power was weakened, meaning the more vegetable oil ingredient in biodiesel, the less powerful the engine (Department of Alternative Energy Development and Efficiency, 2009a). That was a stunningly, troubled and confusing contradiction. Besides, other potential innovations in the future were presumably to use other fossil fuel replaceable energy, such as electric energy or hydro energy which were on experimentation stage abroad, but still something new for Thailand. As a result, the people were not fully confident in innovations, resulting in their perception of the risk of engine weakening effect or vehicle diminishing efficiency ranging from moderate to low risk level, and those thinking that there was no risk at all represented only 3.0%.

4.3.1.9 Possibility of the decrease of car lifetime

The study result shown in table 4.16 found that 34.8% of them thought that there was a moderate risk, followed by 23.0% of those thinking as low risk. The score of this perception was 2.62 and the standard deviation was 1.24.

The result from data analysis could be translated that the people might think that other types of fuel, other than fossil fuel, probably had negative effect to the engine, causing its deterioration before time, regardless dealers, PTT for example, guaranteed and taken its responsibility for any engine proven damaged because of using those fuels. However, some research of both governmental and private sector agencies about the effect of biodiesel on engines indicated that biodiesel could be

used with diesel engines, but they were short-period tests, unable to guarantee in the long run (Thaibioenergy.com, 2006). In addition, PTT provided information about biodiesel B5 that it was passed JAMA (Japan Automobiles Manufactures) and could lengthen the vehicle lifetime, and gasohol with friction modifier ingredient could help maintain the engine good performance (Petroleum Authority of Thailand, 2009). Apart from these, there was no explicit information capable to inspire the people's absolute confidence, due to probably the inadequacy or confusion of information, which explained why the people perceiving that there was no risk at all represented only 5.0%.

4.3.1.10 Possibility of the increase of car insurance

The study result shown in table 4.16 found that 30.0% of them thought that there was a moderate risk, followed by 28.3% of those thinking as low risk The average score of this perception was 2.44 and the standard deviation was 1.28.

Therefore, according to the data information it could be analyzed that the cost of car insurance depended on the type of insurance. From interviewing a large insurance company in Bangkok, it was found that the insurance type 1, 2, and 3 are different from each other according to conditions policy of insurance concerning the car owner and the parties in interest, moreover, the cost of insurance also depended on the car lifetime. Regardless to the ingredients in the fuels, either gasohol or biodiesel were not considered in the cost of insurance calculation. Nonetheless, in case of installing cylinders or other equipment for using natural gas, the car owner must notify the insurance company together with presenting the installation guarantee certificate for approval consideration owing to some cases of cylinder explosion, which in general, insurance companies raised a higher cost of insurance by about 1,000 – 2.000 baht. In addition, in the future insurance companies might probably consider for more conditions for vehicles using other kinds of innovations in order to raise the insurance cost. Hence, those perceiving there was no risk represented only 7.5%.

4.3.1.11 Used-car resale

The study result shown in table 4.16 found that 33.0% of them thought that there was a moderate risk, followed by 21.3% of those thinking as low risk. The average score was 2.59, and the standard deviation was 1.29.

From our data findings, we could summarized that the people were likely to distrust that other kinds of fuels other than fossil fuel were needed by other people since fossil fuel have been used for vehicle engines for a long time. In addition, the owners of private cars using gasohol, biodiesel and natural gas or other innovations were possibly only a small group of people who liked fashionable, state-of-the-art technology. And other possible innovations in the future were presumably expensive as produced with high technology. On the other hand, the buyers might consider the negative effects afflicting on cars or the owners owing to alternative energy or innovations themselves, together with the uncertainty about the attitudes or preferences of the buyers-to-be of these cars in terms of their risk perception, comparative advantage, compatibility or complexity. Hence, the people were not confident, causing those thinking that there was no risk at all represented only 6.0%.

4.3.1.12 Security

The study result shown in table 4.16 found that 34.8% of them thought that there was a moderate risk, followed by 27.3% of those thinking as low risk. The average score of this perception was 2.70 and the standard deviation was 1.20.

Consequently, the data showed that news about the possible negative affects of alternative energy either gasohol or biodiesel on engines and vehicle efficiency or occasional car explosions caused the people to lack of the confidence. Actually, such incidents might originate from different causes; for example, the over refilled than the cylinder capacity, the poor standard installation of equipment, or installation from non-standardized without guarantee certificate from the Department of Energy Business (ryt9.com, 2007). Some people might not know the real problem, that why they had no confidence. Hence, the people thinking that there was no risk at all represented only 3.5%.

4.3.1.13 Convenience of finding fuel filling stations

The study result shown in table 4.16 found that 34.8% of them thought that there was a moderate risk, followed by 26.0% of those thinking as low risk. The average score of this perception was 2.73 and the standard deviation was 1.22.

The above data showed that gasohol, biodiesel and natural gas were available in the market already for a period of time, resulting in 700 gas stations of gasohol and biodiesel throughout Bangkok at present, together with 80 natural gas

refilling stations (ThaiPR.Net, 2007). But when considering the proportion of the number of cars with the frequency of refilling particularly, the case of the rather-small-numbered natural gas filling stations, the car users could feel uncomfortable from the small number of stations and the quantity of gas that sometime may not be sufficient, or from having a long waiting to have the car refilled. Furthermore, cars fueled by newly available innovations might face the lack of this infrastructure in time. Hence, the people thinking there was no risk represented only 3.8%.

4.3.1.14 Convenience to find garage for car repair

The study result shown in table 4.16 indicated that 34.3% of them thought that there was a moderate risk, followed by 26.0% of those thinking as low risk. The average score of this perception was 2.69 and the standard deviation was 1.17.

Therefore, we could concluded from the data that fueling cars either with gasohol or biodiesel did not show explicit negative impact on engines; even though, some people might think that ethanol or alcohol and vegetable oil, the ingredient in different proportion of gasohol and biodiesel respectively, would have negative effect by wearing out the engines, however, PTT proposed to take the repair responsibility in the proven case of being damaged by those fuels. Moreover, the government also imposed the increasing service of natural gas equipment installation to provide free service for 1 year (RoadSafetyThai.org, 2008). On the other hand, cars fueled by newly available innovations might face the lack of this kind of infrastructure in time. Hence, the people thinking that there was no risk at all represented only 3.0%.

Table 4.16 Percentage of Perception of Risk Characteristics of Energy Conservation Innovations in Private Cars

Perception of risk characteristics	Not at all	Very low	Low	Moderate	High	Very high	$\bar{X}$	SD
1.Shortage of raw materials for the production of gasohol, biodiesel and natural gas, including others such as electric batteries, fuel cells, hybrid engines etc.	2.3	10.3	36.3	35.5	8.5	7.1	2.60	1.09
2.Production standard of gasohol, biodiesel, and natural gas and others such as electric batteries, fuel cells, hybrid engines etc.	2.8	8.8	25.0	40.5	18.5	4.4	2.77	1.08
3. Prices are subject to change despite the government's pricing policy to make gasohol, biodiesel, and natural gas cheaper than fossil fuel.	2.0	8.8	24.3	35.3	18.3	11.3	2.93	1.19
4. Production standard for natural gas equipment in cars.	3.8	11.0	27.8	32.3	17.0	8.1	2.73	1.22
5. The standard of each service point for the equipment installation	3.8	13.8	28.8	29.8	16.0	7.8	2.64	1.23
6. Spare part finding for equipment in cars using natural gas and other such as such as electric batteries, fuel cells, hybrid engines etc.	3.3	11.5	32.3	33.0	15.8	4.1	2.59	1.11

Table 4.16 (Continued)

Perception of risk characteristics	Not at all	Very low	Low	Moderate	High	Very high	$\bar{X}$	SD
7. The repair standard of each service point for equipment in cars using natural gas and others, such as electric batteries, fuel cells, hybrid engines etc.	3.8	13.8	25.5	33.0	17.8	6.1	2.66	1.21
8. Possibility of weakening vehicle power or efficiency when using gasohol, biodiesel, natural gas and others, such as electric batteries, fuel cells, hybrid engines etc.	3.0	16.3	27.3	29.0	17.8	6.6	2.62	1.22
9. Possibility of the decrease of car lifetime when using gasohol, biodiesel, natural gas and others, such as electric batteries, fuel cells, hybrid engines etc.	5.0	14.8	23.0	34.8	15.8	6.6	2.62	1.24
10. Possibility of the increase of car insurance when using gasohol, biodiesel, natural gas and others, such as electric batteries, fuel cells, hybrid engines etc.	7.5	15.0	28.3	30.0	13.2	6.0	2.44	1.28

Table 4.16 (Continued)

Perception of risk characteristics	Not at all	Very low	Low	Moderate	High	Very high	$\bar{X}$	SD
11. Possibility of more difficulty in reselling the used cars if using gasohol, biodiesel, natural gas and other, such as electric batteries, fuel cells, hybrid engines etc.	6.0	16.3	21.3	33.0	16.8	6.6	2.59	1.29
12.Security in car if using gasohol, biodiesel, natural gas and other, such as electric batteries, fuel cells, hybrid engines etc.	3.5	11.8	27.3	34.8	14.6	8.0	2.70	1.20
13. Convenience of finding fuel refilling stations if cars using gasohol, biodiesel, natural gas and other, such as electric batteries, fuel cells, hybrid engines etc.	3.8	11.3	26.0	34.8	15.5	8.6	2.73	1.22
14. Convenience of finding garage for car repair if using gasohol, biodiesel, natural gas and other, such as electric batteries, fuel cells, hybrid engines etc.	3.0	12.8	26.0	34.3	18.0	5.9	2.69	1.17

**4.3.1.15 Level of perception of risk characteristics of energy
conservation innovations in private cars**

The assessment of level of risk found that most of the people (68.5%)
had moderate risk perception, followed by those with high and low risk perception
respectively. The average score was 37.30 with the standard deviation was 12.31,
while the lowest and the highest score were 0 and 70 respectively, as shown in table
4.17.

Table 4.17 Summary of Perception of Risk Characteristics of Energy Conservation
Innovations in Private Cars

Risk Perception	level			Total	$\bar{\text{x}}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	12.2	68.5	19.3	100.0	37.30	12.31	0	70

According to the study result it could be analyzed as an overview that the
people had moderate risk perception of innovation characteristics related to risk, as
the measurement of all issues indicated that most of the people had this perception at
moderate level.

4.3.2 Comparative Advantage Characteristics

To measure the perception of comparative advantage characteristics of energy
conservation innovations in private cars if using gasohol, biodiesel, natural gas, or
others such as electric batteries, fuel cells or hybrid engines, the research consisted of
eight questions as follows:

4.3.2.1 The decrease of expenses on car fuel refilling

4.3.2.2 The decrease of expenses due to government's subsidy on
natural gas equipment installation

4.3.2.3 A worthwhile investment if installing equipment for using
natural gas or other alternative energy

4.3.2.4 Low cost of repair or maintenance

4.3.2.5 A higher price if reselling the car

4.3.2.6 More choices due to alternatives fuels

4.3.2.7 More convenience

 4.3.2.8 Being praised by others

The study results of these aspects were as follows:

4.3.2.1 The decrease of expenses on car fuel refilling

The study result shown in table 4.18 found that 28.3% of the people had moderate perception, followed by 23.3% of those with low perception and 19.0% had very high perception. The average score of this perception was 2.76 and the standard deviation was 1.37.

The analysis from the data above implied that the government's promotion to boost the people's diversion to alternative energy by means of pricing policy to make their prices cheaper than those of fossil fuel was effectively beneficial to the decrease of consumers' expenses compared to those on fossil fuel. Yet consumers did not have sufficient knowledge about some of these innovations such as electric batteries, fuel cells, or hybrid engines, etc., so they were not certain whether the expenses on alternative fuel were really less or not. Thus their perception of these comparative advantage was mainly concentrated in moderate and low level.

4.3.2.2 The decrease of expenses due to government's subsidy on
natural gas equipment installation

The study result shown in table 4.18 found that 35.5% of the people had moderate perception, followed by 22.5% of those with low perception. The average score of this perception was 2.54 and the standard deviation was 1.24.

The explanation from the data could be summarized that the support of the government and agencies involved such as PTT and some banks for equipment installation in cars by giving discount for those paying in cash, and interest-free credit for those paying by installments if the installation cost was between 35,000 – 65,000 baht was helpful for private car users because those paying in cash did not pay full price and those paying by installments did not have interest to pay (ryt9.com, 2006). Yet they were not certain about for how long the subsidies would last and whether the

amount of subsidized money was subject to change so the people's perception of this comparative advantage was concentrated in moderate and low level.

4.3.2.3 A worthwhile investment if installing equipment for using natural gas or other alternative energy

The study result shown in table 4.18 found that 31.5% of the people had moderate perception, followed by 26.3% of those with low perception. The average score of this perception was 2.62 and the standard deviation was 1.20.

The above data indicated that due to the tendency of the rise in oil price, other kinds of energy were likely better alternatives despite initial investment in installation of equipment or other innovations. But it would be a worthwhile investment because of the payback period afterward. For example, even though the installation for natural gas equipment might initially cost between 35,000 – 65,000 baht (The Energy Policy and Planning Office, 2009c) but it would help reduce expenses considerably because natural gas was much cheaper than gasoline or diesel. However, there might still be insufficient information about whether investment in other kinds of energy was financially worthwhile, but if considering that they caused less negative impacts on environment, it was worth doing. Nevertheless, a number of people might not realize this advantage because of the relatively high initial investment, and might also feel uncertain about the possibly changeable price of each fuel type; if the oil price decreased while that of natural gas rose, such investment would be worthless. Regarding investment in other types of innovations, it was presumably expensive because they are products of cutting-edge technology, so people were probably uncertain about the payback period. Consequently, the people's perception of this comparative advantage was concentrated in the moderate and low level.

4.3.2.4 Low cost of repair or maintenance

The study result shown in table 4.18 found that 33.8% of the people had moderate perception in this aspect, followed by 28.0% of those with low perception. The average score of this perception was 2.35 and the standard deviation was 1.16.

From the analyzed, we found that the people were not certain whether the use of the alternative energy would have positive effect on engines concerning the

decrease of maintenance or repair. Even though there were also some interesting products available, such as a PTT had developed gasohol formula by adding a friction modifier substance which decreased friction and enables more lubricating property in combustion chamber, resulting in fuel saving; or a additive substance with superior cleaning property (TOP Tier Requirement, USA) that helped the engine run smoothly and reduce maintenance cost (Petroleum Authority of Thailand, 2009), there was not enough publicity to boost the people's understanding and confidence. Moreover, other potential innovations in the future were produced with cutting-edge technology, hence their prices were presumably rather expensive, so the maintenance or repair cost was probably expensive as a consequence. Consequently, the people's perception in this aspect was concentrated in moderate and low level.

4.3.2.5 Higher price if reselling cars

The study result shown in table 4.18 found that 32.0% of the people had moderate perception in this aspect, followed by 29.8% of those with low perception. The average score of this perception was 2.11 and the standard deviation was 1.21.

Therefore, the conclusion could be drawn according to the data that vehicles capable to use alternative energy were considered as users' another convenience due to the possibility of instant alternate use with another type of fuels. And cars using other types of innovations were probably desirable for amateurs of modernity, technology or innovativeness, whose number was likely to increase continually. So the car capacity to use other types of alternative energy apart from gasoline or diesel should be a comparative advantage of having a higher price in case of reselling it. Paradoxically, using gasohol or biodiesel could also be disadvantageous, undesirable for others owing to the people's anxiety over security, or negative impacts of these fuels on engines. In addition, innovations that might be available in the future could be generally produced with state of the art technology, thus the price was presumably high, buyers then had to be people of means, but also depending on their values, desire, or in other word, their perception of each type of alternative energy innovations which would be unpredictable. Consequently, the people's perception of this comparative advantage was concentrated in moderate and low level.

4.3.2.6 More choices due to alternative fuel

The study result shown in table 4.18 found that 31.5% of the people had moderate perception in this aspect, followed by 24.0% of those with low perception, while those with very low perception represented a very small number, only 2.8%. The average score of this perception was 2.64 and the standard deviation was 1.23.

Therefore, according to the data it could be analyzed that having other types of fuels available on the market were useful options for consumers to choose according to their values and wishes, which possibly depended on fuel or innovation characteristics in terms of risk, comparative advantage, compatibility, or complexity according to individuals' perception that could be different. Consequently, the people's perception of this comparative advantage was concentrated in moderate and low level.

4.3.2.7 More convenience

The study result shown in table 4.18 found that 33.0% of the people had moderate perception in this aspect, followed by 22.5% of those with low perception, and a close number of them (21.3%) had high perception. The average score was 2.70 and the standard deviation was 1.22.

Therefore, the above data could be translated into having other kinds of fuels as alternate uses with or replacement to fossil fuel was another convenience for car users. For example, in case of being unable to find any refilling station for one type of fuel, individuals could possibly use another type of compatible fuel, or if the engine was dual-fuel type, it could be adjusted instantly to use another type of fuel as needed. Moreover, a recent innovation, "flexible fuel vehicle", equipped with micro computer to detect or identify automatically the fuel type had been already introduced onto the market abroad (ABCESSO, 2009). Thus it was another convenience in addition to different types of alternative fuel available. Nevertheless, all still depended on whether or not individuals chose these alternatives. Consequently, people's perception of this comparative advantage was concentrated in moderate and low level.

4.3.2.8 Praise from others

The study result shown in table 4.18 indicated that 33.3% of the people had moderate perception in this aspect, followed by 28.0% of those with low

perception. The average score of this perception was 2.32 and the standard deviation was 1.23.

Therefore, according to the data it indicated that using other types of alternative energy or innovations the substitute fossil fuel not only helped the country save expenses, but also helped reduce to negative impacts on the environment and public health, reflecting their social awareness that should be appreciated from others in society. Nonetheless, some people might not realize the significance of the issue; consequently, the people's perception of this comparative advantage was concentrated in moderate and low level.

Table 4.18 Percentage of Perception of Comparative Advantage Characteristics of
Energy Conservation Innovations in Private Cars

Perception of comparative advantage of innovations	Not at all	Very low	Low	Moderate	High	Very high	$\bar{X}$	SD
1. The decrease of car fuel refilling expenses if using gasohol, biodiesel, natural gas, or other potential innovation, such as electric batteries, fuel cells or hybrid engines.	4.3	8.3	23.3	28.3	16.8	19.0	2.76	1.37
2. The installation of natural gas equipment in cars costs less due to the government's subsidies.	4.0	9.8	22.5	35.5	18.8	9.4	2.54	1.24
3. It is a worthwhile investment if the car is installed with equipment for using natural gas or other innovations such as electric batteries, fuel cells, hybrid engines.	2.0	9.8	26.3	31.5	20.0	10.4	2.62	1.20
4. Lower cost of maintenance and repair if using gasohol, biodiesel, natural gas or other innovations such as electric batteries, fuel cells, and hybrid engines.	4.0	10.8	28.0	33.8	19.0	4.4	2.35	1.16
5. The car price will be higher in case of reselling if using gasohol, biodiesel, natural gas, or other innovations such as electric batteries, fuel cells, or hybrid engines	7.0	15.3	29.8	32.0	11.3	4.6	2.11	1.21

Table 4.18 (Continued)

Perception of comparative advantage of innovations	Not at all	Very low	low	moderate	High	Very high	$\overline{X}$	SD
6. More options for using fuels if car using gasohol, biodiesel, natural gas or other innovations such as electric batteries, fuel cells, or hybrid engines	2.8	9.2	24.0	31.5	21.5	11.0	2.64	1.23
7. More convenience because of their capacity to be used alternatively with other fossil fuel if the car uses gasohol, biodiesel or natural gas.	2.3	8.8	22.5	33.0	21.3	12.1	2.70	1.22
8. Being praised from other people if the car uses gasohol, biodiesel or natural gas or other innovations, such as electric batteries, fuel cells and hybrid engines.	5.8	11.8	28.0	33.3	14.5	6.6	2.32	1.23

4.3.2.9 Level of perception of comparative advantage characteristics of energy conservation innovations in private cars

The overall assessment of level of perception of comparative advantage characteristics of innovations from eight questions, of which aggregate score was between 0-40 according to criteria found that 76.2% of the people had moderate perception of all these comparative advantage, followed by 13.3% and 10.5% of those with high perception and those with low perception respectively. The highest score and the lowest were 35 and 0 respectively. The average score was 20.04 and the standard deviation was 6.07, as shown in table 4.19.

Table 4.19 Summary of Perception of Comparative Advantage Characteristics of
Energy Conservation Innovations in Private Cars

Perception of comparative advantage characteristics of innovations	Level			Total	$\bar{X}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	10.5	76.2	13.3	100.0	20.04	6.07	0	35

According to the study it could be analyzed as an overview that the people had moderate comparative advantage perception of innovation characteristics, as indicated by all aspect measurement from eight questions that the majority of people had moderate perception in this aspect.

4.3.3 Compatibility Characteristics

To measure the perception of compatibility characteristics of energy conservation innovations in private cars in terms of compatibility to individuals' values and beliefs if adopting innovations, such as biodiesel, natural gas, or other innovations such as electric batteries, fuel cells, hybrid engines consisted of six following questions:

4.3.3.1 The decrease of the country's dependency on foreign countries

4.3.3.2 The decrease of the country's expenses on energy

4.3.3.3 The increase of farmers' income

4.3.3.4 The decrease of fossil fuel use

4.3.3.5 The decrease of pollution in the environment

4.3.3.6 The decrease of public health problems

4.3.3.1 The decrease of the country's dependency on foreign countries

The study result shown in table 4.20 found that 30.0% of the people had moderate perception, followed by 25.5% of those with low perception, and only 4.5% were not aware of this innovation characteristic at all. The average score of this perception was 2.87 the standard deviation was 1.30.

Taking the data into our consideration, it could be analyzed that due to the increasing demand of oil to respond the continually rising consumption every year Thailand, despite its internal production that was far from sufficient, had to import increasingly most part of petroleum from abroad; that was from major producers of the world, countries in the middle east or OPEC. So if it was possible to reduce petroleum consumption in transport sector by replacing it with alternative energy or other innovations in cars, it would help drastically to reduce dependency on foreign countries. Nonetheless, a number of people were still uncertain about at what extent innovations could help decrease of petroleum imports. Consequently, the people's perception of this compatibility characteristic was concentrated in moderate and low level.

4.3.3.2 The decrease of the country's expenses on energy

The study result shown in table 4.20 demonstrated that 34.8% of the people had moderate perception in this aspect, followed by 20.8% of those with very high perception, and only 2.5% with no perception at all. The average score of perception in this aspect was 3.08 and the standard deviation was 1.23.

The above data could be interpreted that as each year the country had to spend a huge sum of money on energy, especially on that in transportation sector, if the uses of petroleum could be decreased by other alternative energy or innovations, such expenses would greatly be reduced. In fact, this kind of information is rather well known and widespread. So even some people did not know the exact amount of money, they could understandably assume the country's huge expenditure annually. Consequently, the people's perception of this compatibility was concentrated in moderate and low level.

4.3.3.3 The increase of farmers' income

The study result shown in table 4.20 indicated that 30.3% of the people had moderate perception of this characteristic and very close numbers of them, 23.0% and 22.8%, had high and low perception respectively. Moreover, it was also found that a very a small number, 1.8% of them, had no perception in this aspect at all. The average score of this perception was 3.17 and the standard deviation was 1.21.

Therefore, the analysis from the above data showed that as gasohol and biodiesel were biofuel energy, using sugar or oil producing plants as raw materials for

mixture ingredients at different proportions, if these alternative fuel were adopted increasingly, the farmers' income would be increased accordingly.

4.3.3.4 The decrease of fossil fuel uses

The study result shown in table 4.20 demonstrated that 30.8% of the people had moderate perception in this aspect, followed by 24.3% of those with high perception, and only 2.3% did not have this perception at all. The average score was 3.14 and the standard deviation was 1.26.

Therefore, according to the data it could be analyzed that each year transportation sector consumed very huge amount of petroleum, both that produced in the country and imported. If fossil fuel could be replaced by alternative energy or other innovations, their consumption might decrease by 10% or 2 million liters daily (ryt9.com, 2005). Consequently, the people's perception was concentrated in moderate and high level.

4.3.3.5 The decrease of pollution in the environment

The study result shown in table 4.20 found that 27.0% of the people had moderate perception in this aspect, and a very small number, 1.5%, did not have such perception at all. The average score of this perception was 3.11 and the standard deviation was 1.23.

Therefore, the above finding could be explained that the impact of fossil fuel consumption in transportation sector was the main cause causing pollution in the environment, whether air pollution, greenhouse effect, or global warming. If fossil fuel uses could be decreased by using alternative energy or other innovations considered as "green energy" or "clean energy", pollution problems in the environment caused by transportation sector would be decreased substantially. Actually, this information was rather well-known and widespread, and the people faced these problems by themselves in everyday life, but a number of them were uncertain about at what extent innovations had the capacity to reduce pollution. Consequently, the people who did not have this perception at all represented only 1.5%.

4.3.3.6 The decrease of public health problems

The study result shown in table 4.20 found that 29.0% of the people had moderate perception in this aspect, followed by 27.8% of those with high

perception, and only 2.3% of them did not have any perception of this issue at all. The average score of this perception was 3.12 and the standard deviation 1.24.

Therefore, an implication drawn from to the data that oil uses in transportation sector was the major cause of air pollution, which affected consequently human health problem, such as respiratory, nervous, optical system or even cancer. So if oil consumption could be reduced by using alternative energy or other environmentally friendly innovations which were products of research and development to minimize impacts on human health, such as the zero emission engine of hydrogen-fueled car, they should be appropriate ways to decrease public health problems (Wikipedia, 2009k). In fact, people faced these problems in daily life, their perception was consequently concentrated in moderate and high level, and only a very small number of them did not have such perception at all.

Table 4.20 Percentage of Perception of Compatibility Characteristics of Energy
Conservation Innovations in Private Cars

Perception of compatibility characteristics of innovations	Not at all	Very low	Low	Moderate	High	Very high	$\overline{X}$	SD
1. Thailand will reduce its dependency on imported oil if using energy conservation innovations in private cars.	4.5	9.0	25.5	30.0	18.5	12.5	2.87	1.30
2. Thailand will reduce its expenses on imported oil if using innovations for energy conservation in private cars.	2.5	7.5	19.6	34.8	20.8	14.8	3.08	1.23
3. To increase farmers' income as their products become raw material for mixture ingredient of energy conservation innovations in private cars.	1.8	5.6	22.9	30.3	23.0	16.5	3.17	1.21
4. To reduce the exploitation of natural resources if using innovations for energy conservation in private cars	2.3	8.3	18.3	30.8	24.3	16.0	3.14	1.26
5. To reduce pollution problems in the environment if using innovations for energy conservation in private cars	1.5	7.0	25.2	27.0	23.5	15.8	3.11	1.23
6. To reduce public health problems if using innovations for energy conservation in private cars	2.3	8.1	19.5	29.0	27.8	13.3	3.12	1.24

4.3.3.7 Level of perception of compatibility characteristics of energy conservation innovations

The overall assessment of the level of perception of compatibility characteristics from six questions, of which aggregate scores were between 0-30 according to criteria, found that 53.5% of the people had moderate perception in this aspect, followed by those 36.0% and 10.5% with high and low perception respectively. The highest perception score was 30 and the lowest was 0. The average score was 18.49 and the standard deviation was 6.34, as shown in table 4.21.

Table 4.21 Summary of Perception of Compatibility Characteristics of Energy Conservation Innovations in Private Cars

Perception of compatibility characteristics of innovations	Level			Total	$\overline{X}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	10.5	53.5	36.0	100.0	18.49	6.34	0	30

The overall study found that a majority of people had moderate compatibility perception of innovations, as answers to all questions showing that people with moderate perception were the majority.

4.3.4 Complexity Characteristics

To measure the perception of innovation characteristics concerning complexity or how practical to understand issues related to gasohol, biodiesel, natural gas, and other innovations, such as electric batteries, fuel cells or hybrid engines consisted of three following issues:

4.3.4.1 The categorization of types and models of engines to be used with gasohol, biodiesel and natural gas

4.3.4.2 The categorization of type and mixture of each type of gasohol and biodiesel

4.3.4.3 The capability to knowledge how natural gas equipment as well as other innovations such as electric batteries, fuel cells, or hybrid engines works

The study results in detail of these three issues were as followed:

4.3.4.1 The categorization of types and models of engines

The study result shown in table 4.22 found that 36.0% of the people had moderate perception in this aspect, followed by 28.8% of those with low perception. The average score of this perception was 2.53 and the standard deviation was 1.13.

Therefore, the data analysis showed that cars capable to be used with fuel mixed with ethanol were those produced from 1995 until now. Their models and brands could be checked in websites of organizations involved, such as PTT and information of cars produced before that could be checked from websites of producing companies (Department of Energy Business, 2009). But people searching for such information were usually only those really interested in such information; while non private car owners would not make themselves exposed to information they were not interested or involved. Consequently, the people's perception in this issue was concentrated in moderate and low level.

4.3.4.2 The categorization of type and mixture of each category of gasohol and biodiesel

The study result shown in table 4.22 found that 41.8% of the people had moderate perception of this complexity, followed by 21.5% of those with low perception. The average score of this perception was 2.72 and the standard deviation was 1.12.

Therefore, the data indicated that both gasohol and biodiesel were divided into different types; for example, gasohol 91, gasohol 95, alias E10, E20, E85 according to the mixture of ethanol and biodiesel, B5, B10 etc. The mixtures of these kinds of biofuel had some ingredients from sugar producing plants or oil producing plants and these ingredient proportions had been continually increased according to research and development in order to minimize fossil fuel uses. Research and development in some country, Brazil for example, had even succeeded in using pure ethanol in vehicles (Bangchak Petroleum Public Company Limited, 2007). Different

types of these fuels might be confusing for consumers, but, on the other hand, resulting on a very small number of them with no perception of this aspect at all.

4.3.4.3 The knowledge about how equipment works.

The study result shown in table 4.22 found that 37.8% of the people had moderate perception, followed by 21.3% of those with low perception, and 17.5% of those with high perception. The average score of this perception was 2.78 and the standard deviation was 1.18.

Therefore, the illustrated data could be analyzed that to understand how each kind of equipment works was relatively difficult for people in general, because natural gas equipment installation could be done legally only by trained and licensed installers (ryt9.com, 2007). Besides, this kind of equipment was produced with modern technology, so rather complicated for the people who did not have such knowledge or provided with this information. Consequently, there were a very small number of people not having this aspect of perception at all.

Table 4.22 Percentage of Perception of Complexity Characteristics of Energy Conservation Innovations in Private Cars

Perception of complexity characteristics of innovations	Not at all	Very low	Low	Moderate	High	Very high	$\bar{X}$	SD
1. The categorization of types of models of cars using gasohol, biodiesel or natural gas	3.3	15.0	28.8	36.0	11.3	5.6	2.53	1.13
2. The categorization of type and mixture of each category of gasohol and biodiesel	2.5	12.8	21.5	41.8	15.6	5.8	2.72	1.12
3. The understanding of how natural gas equipment, or other innovations, such as electric batteries, fuel cells or hybrid engines, works.	2.3	13.3	21.3	37.8	17.5	7.8	2.78	1.18

4.3.4.4 Level of perception of complexity characteristic of innovations in private cars

The overall assessment of level of perception of complexity characteristics from three questions, of which aggregate scores were between 0-15 according to criteria, found that the majority of the people (63.5%) had moderate complexity perception, followed by 18.8% and 17.7% of those with high and low perception respectively. The highest and lowest score were 15 and 0 respectively. The average score was 8.04 and the standard deviation was 3.05 as shown in table 4.23.

Table 4.23 Summary of Perception of Complexity Characteristics of Energy Conservation Innovations in Private Cars

Perception of complexity characteristic of innovations	Level			Total	$\overline{X}$	SD	MIN	MAX
	Low	Moderate	High					
Percentage	18.8	63.5	17.7	100.0	8.04	3.05	0	15

We could see from the data and analyzed that the majority of people had moderate perception of complexity of innovations, as answers to every question demonstrated that the majority of the sample had moderate perception.

Table 4.24 Percentage of Accessibility to Information, Knowledge about Different
Issues and Perception of Different Characteristics of Innovations

Accessibility to information, knowledge about different issues and perception of different characteristics of innovations	Percentage	$\overline{X}$	SD	MIN	MAX
Accessibility to information about					
:energy situations and problems		5.5	1.95	0	7
Low	8.8				
Moderate	28.6				
High	62.6				
:energy innovations		3.44	1.06	0	4
Low	8.0				
Moderate	6.0				
High	86.0				
:social support		4.96	2.69	0	8
Low	46.7				
Moderate	32.3				
High	21.0				
Knowledge about					
:energy situations and problems		14.2	8.31	0	33
Low	39.8				
Moderate	49.2				
High	11.0				
:energy innovations		9.04	5.2	0	20
Low	35.0				
Moderate	49.3				
High	13.7				

Table 4.24 (Continued)

Accessibility to information, knowledge, and perception of different characteristics of innovations	Percentage	$\overline{X}$	SD	MIN	MAX
:social support		11.53	8.81	0	39
Low	62.3				
Moderate	32.7				
High	5.0				
Perception of innovation characteristics in terms of					
:risk		37.30	12.31	0	70
Low	12.2				
Moderate	68.5				
High	19.3				
:comparative advantage		20.04	6.07	0	35
Low	10.5				
Moderate	76.2				
High	13.3				
:compatibility		18.49	6.34	0	30
Low	10.5				
Moderate	53.5				
High	36.0				
:complexity		8.04	3.05	0	15
Low	18.8				
Moderate	63.5				
High	17.7				

4.4 Innovation Adoption: Both at Present and in the Future

The study results of current and future adoption of energy conservation innovations in private cars shown in table 4.25; details were as follows:

4.4.1 The Adoption at present

The study result of the current adoption found that the majority of adoptive people or 61.8% were males, 42.6% of them were between 20-30 years old. The majority (75.5%) were single, divorce and others. Moreover 45.0% had bachelor degree and close numbers of them, 22.5% and 21.8%, were state enterprises' and private companies' employees respectively. Furthermore, those earning between 10,001-20,000 baht were 40.6% and the majority (80.7%) were private car users.

Regarding to the accessibility to information, the majority of the adoptive people, 67.5% and 88.0%, had high accessibility to information about energy situations and problems and to that about energy conservation innovations in private cars respectively, moreover, less than half had high accessibility to information. For knowledge, it was found that almost half, 49.8% and 49.0%, had moderate knowledge about energy situations and problems and of energy conservation innovations in private cars respectively. More than half (57.4%) had little knowledge about social support.

Furthermore, regarding the adoptive people's perception of different characteristics of innovations, it was found that the majority of them, 71.5%, 75.5%, and 65.9%, had moderate perception in the aspect of risk, comparative advantage and complexity respectively, on the other hand, more than half (51.4%) had moderate perception of complexity.

4.4.2 The Adoption in the future

The study result of the future adoption found that the majority of adoptive people (62.9%) were males, 40.7% of them were between 20-30 years old. Almost half (45.2%) had bachelor degree. The majority (75.1%) was single, divorce or others and close numbers of them, 23.5% were state enterprises' and 20.8% were private

companies' employees respectively. In addition, their monthly income was between 10,001-20,000 baht and the majority (75.6%) was private car users.

Regarding to accessibility to information, it was found that most of them, 65.6% and 88.2%, had high accessibility to information in two aspects; energy situations and problems, and energy conservation innovations in private cars respectively. Less than half or 48.4% of them had high accessibility to information related to social support, whereas more than half of, or 51.1% and 50.2%, had moderate knowledge about situations and problems concerning energy, and about energy conservation innovations in private cars respectively, on the other hand, 61.5% of them had low knowledge about social support.

Additionally, concerning the adoptive people's perception of different innovation characteristics, it was found that the majority of them; 71.0%, 76.0% and 65.6% had moderate perception of risk, comparative advantage and complexity respectively. About half of them or 50.2% had moderate perception of compatibility.

Table 4.25 Percentage of Innovation Adoption, both at Present and in the Future

Characteristics	Adoption at Present		Adoption in the Future	
	No	Yes	No	Yes
Gender				
Male	44.4	61.8	45.8	62.9
Female	55.6	38.2	54.2	37.1
Age				
20 – 30 years	43.7	42.6	45.8	40.7
31 – 40 years	23.8	20.5	19.0	24.0
41 – 50 years	25.8	25.3	26.3	24.9
51 – 60 years	6.7	11.6	8.9	10.4
Marital status				
Married	25.8	24.5	25.1	24.9
Single, widow or others	74.2	75.5	74.9	75.1
Secondary school	12.6	20.1	15.1	19.1
Diploma or equivalent	31.1	18.9	30.3	18.1
Bachelor degree	33.8	45.0	35.3	45.2
Higher than bachelor degree	22.5	16.0	19.3	17.6
Occupations				
Civil servant	19.2	20.5	20.7	19.5
State enterprise's employee	25.2	22.5	23.5	23.5
Private enterprise's employee	25.8	21.8	25.7	20.8
Student	17.2	15.1	17.3	15.4
Others	12.6	20.1	12.8	20.8

Table 4.25 (Continued)

Characteristics	Adoption at Present		Adoption in the Future	
	No	**Yes**	**No**	**Yes**
Monthly income (in baht)				
Less than 10,000	43.0	37.3	44.1	35.7
10,001 – 20,000	34.4	40.6	34.6	41.2
20,001 – 30,000	14.6	10.1	10.1	13.1
Over than 30,000	7.9	12.0	11.2	10.0
Private car use				
Private car user	58.9	80.7	68.7	75.6
Non private car user	41.1	19.3	31.3	24.4
Accessibility to information about:				
: situations and problems of energy				
Low	13.9	5.6	14.0	4.5
Moderate	31.8	26.9	27.4	29.9
High	54.3	67.5	58.6	65.6
: innovations for energy conservation				
Low	10.6	6.4	9.5	6.8
Moderate	6.6	5.6	7.3	5.0
High	82.8	88.0	83.2	88.2
: social support				
Low	24.5	18.9	24.6	18.1
Moderate	31.1	32.9	30.7	33.5
High	44.4	48.2	44.7	48.4

Table 4.25 (Continued)

Characteristics	Adoption at Present		Adoption in the Future	
	No	Yes	No	Yes
Knowledge about				
: energy situations and problems				
Low	43.8	37.4	45.3	35.3
Moderate	48.3	49.8	46.9	51.1
High	7.9	12.8	7.8	13.6
: innovations for energy conservation				
Low	37.1	33.7	36.9	33.5
Moderate	49.7	49.0	48.0	50.2
High	13.2	17.3	15.1	16.3
: social support				
Low	70.2	57.4	63.1	61.5
Moderate	26.5	35.8	33.0	31.7
High	3.3	6.8	3.9	6.8
Perception of innovation characteristics concerning:				
: risk				
Low	21.8	6.4	14.5	10.4
Moderate	63.6	71.5	65.4	71.0
High	14.6	22.1	20.1	18.6
: comparative advantage				
Low	15.2	7.6	14.0	7.7
Moderate	77.5	75.5	76.5	76.0
High	7.3	16.9	9.5	16.3

Table 4.25 (Continued)

Characteristics	Adoption at Present		Adoption in the Future	
	No	Yes	No	Yes
: compatibility				
Low	16.6	6.8	13.4	8.2
Moderate	57.0	51.4	57.5	50.2
High	26.4	41.8	29.1	41.6
: complexity				
Low	26.5	14.1	21.8	16.3
Moderate	59.6	65.9	60.9	65.6
High	13.9	20.0	17.3	18.1

4.4.3 An Overview of Private Car Users' and Non Private Car Users' Characteristics

The study result found that there was a significant difference when considering the car use factor. The people adopting innovations, both at present and in the future, were mostly private car users, i.e. 80.7% and 75.6% respectively. If considering overall characteristics of both private car users and non private car users, it was found that:

Among private car users, 70.3% and 60.0% of them accepted innovations at present and in the future respectively and more than half (56.2%) were males, of which the highest number (36.6%) were between 20-30 years old, and those aging between 51-60 years were the least, 11.4%. Most of them (74.8%) were single, widow or others and the highest number (42.0%) had bachelor degree while those with education higher than bachelor degree were the least, 14.5%. The highest number of them, 25.5%, was state enterprises' employees and those earning between 10,001-20,000 baht monthly accounted for 39.7%.

Regarding to the accessibility to information and knowledge related to three issues; energy situations and problems, energy conservation innovations in private cars and social support, it was found that most of the people had high accessibility to information about the first two issues at 65.2% and 87.2% respectively, as for the social support issue, nearly half of them (49.0%) had high accessibility to this information. About half of the people, or 49.0% and 50.7%, had moderate knowledge about energy situations and problems, and energy conservation innovations in private cars respectively. Only about compatibility characteristic of which slightly more than half (53.1%) of the sample had moderate perception.

Whereas among non private car users, there were slight characteristic differences compared to those of private car users. That was their innovation acceptance rate at present and in the future was 40.9% and 42.7% respectively. Slightly more than half of them (52.7%) were males, 60.0% were 20 - 30 years old and the majority (75.5%) were single, widow or others. Those having bachelor degree represented the highest number, i.e. 37.3%, and those having finished from secondary school represented the least, 10.9%. The highest number, 30.0%, were private enterprises' employees. Slightly more than half gained less than 10,000 baht per month.

Concerning accessibility to information and knowledge in those three aspects, it was found that a high majority of the sample (82.7%) had high accessibility only to energy conservation innovations in private cars, while for energy situations and problems, and social support, the finding was that the sample had high accessibility to these issues at 55.5% and 40.9% respectively, and about half of sample or 50.0% and 45.0% had moderate knowledge about energy situations and problems, and about energy conservation innovations in private cars respectively, while 70.0% had little knowledge about social support.

In addition, it also indicated that most of the sample had moderate perception of innovation characteristics concerning risk and comparative advantage, i.e. 63.6% and 77.3% respectively, and only slightly more than half of them, 54.5% and 53.6%, had moderate perception of compatibility and complexity respectively, as shown in table 4.26.

Table 4.26 Private Car Users' and Non Private Car Users' Characteristics

Characteristics	Private car use	
	Private car users	Non private car users
Adoption at Present		
Yes	70.3	40.9
No	29.7	59.1
Adoption in the Future		
Yes	60.0	42.7
No	40.0	57.3
Gender		
Male	56.2	52.7
Female	43.8	47.3
Age (years)		
20-30	36.6	60.0
31-40	24.8	13.6
41-50	27.2	20.9
51-60	11.4	5.5
Marital status		
Single, widow and others	74.8	75.5
Married	25.2	24.5
Education Level		
Secondary school	19.7	10.9
Diploma or equivalent	23.8	22.7
Bachelor degree	42.0	37.3
Higher than bachelor degree	14.5	29.1

Table 4.26 (Continued)

Characteristics	Private car use	
	Private car users	Non private car users
Occupation		
Civil servant	20.1	20.0
State enterprise's employee	25.5	18.2
Private enterprise's employee	20.3	30.0
Student	13.4	23.6
Others	20.7	8.2
Monthly Income (baht)		
Less than 10,000	34.1	53.7
More than 10,000 -20,000	39.7	34.5
More than 20,000-30,000	13.4	7.3
More than 30,000	12.8	4.5
Accessibility to information		
About energy situations and problems		
Low	6.2	15.5
Moderate	28.6	29.0
High	65.2	55.5
Accessibility to information		
About energy conservation innovations		
Low	6.6	11.8
Moderate	6.2	5.5
High	87.2	82.7
About social support		
Low	18.6	27.3
Moderate	32.4	31.8

Table 4.26 (Continued)

Characteristics	Private car use	
	Private car users	Non private car users
High	49.0	40.9
Knowledge about		
energy situations and problems		
Low	38.2	43.6
Moderate	49.0	50.0
High	12.8	6.4
energy conservation innovations		
Low	34.1	37.3
Moderate	50.7	45.5
High	15.2	17.2
Knowledge about		
social support		
Low	59.3	70.0
Moderate	34.5	26.4
High	6.2	3.6
Perception of innovation		
characteristics		
Concerning risk		
Low	10.7	16.4
Moderate	70.3	63.6
High	19.0	20.0
Concerning comparative advantage		
Low	10.7	10.0
Moderate	75.9	77.3
High	13.4	12.7

Table 4.26 (Continued)

Characteristics	Private car use	
	Private car users	Non private car users
Concerning compatibility		
Low	10.0	11.9
Moderate	53.1	54.5
High	36.9	33.6
Concerning complexity		
Low	15.9	26.4
Moderate	67.2	53.6
High	16.9	20.0

Regarding to the relationship between demographic characteristics and other factors such as age and accessibility to information and knowledge including perception of different characteristics of innovations, the findings indicated that when considering the Bangkok people's different age ranges; 20-30, 31-40, 41-50, 51-60 years old, there were some minor differences; of whom it was represented in most of the sample, or 84.3%, 92.0%, 85.3% and 82.1% of each age range had high accessibility to information, and knowledge about energy conservation innovations in private cars respectively. Accessibility to information about energy situations and problems was similar, except for the 51-to-60 year-old age range, of which only 33.3% had high accessibility to this information. And accessibility to information about social support of all age ranges was quite similar; about half or less than half of the sample of all age ranges had high accessibility to this information, except those aging between 51-60 years old of whom only 38.5% had high accessibility to this information. Regarding to knowledge, it was evidenced that at every age range, about half of them had moderate knowledge about energy situations and problems, except those aging between 51-60 years, 76.9% had low knowledge about this information. Considering the social support issue, slightly more than half of them had low knowledge about this, except those aging between 51-60 years, 76.9% of them had

little knowledge. For the last issue; knowledge about energy conservation innovations, also found that about half of every age range had moderate knowledge, while slightly more than half (or 59.0%) of those aging between 51-60 had little knowledge about this, and it was also indicated that only a small number of this age range people (2.6%) had high knowledge in every issue when compared to other age ranges.

Regarding to the perception of different characteristics of innovations, the findings indicated that there was not much difference among all age ranges; most or a large majority of them had moderate perception in every aspect and a very small number of those aging between 51-60 had high perception in every aspect when compared to those of other age ranges, as shown in table 4.27.

Table 4.27 Relationship between Age and Others Factors

Factors	Age			
	20-30 years	31-40 years	41-50 years	51-60 years
Accessibility to information				
About situations and problems				
Low	8.7	3.4	12.7	10.3
Moderate	27.9	21.9	25.5	56.4
High	63.4	74.7	61.8	33.3
About energy conservation innovations				
Low	8.7	5.7	8.8	7.7
Moderate	7.0	2.3	5.9	10.2
High	84.3	92.0	85.3	82.1
About social support				
Low	25.0	17.2	16.7	23.0
Moderate	32.6	28.7	32.3	38.5
High	42.4	54.1	51.0	38.5
Knowledge				
about energy situations and problems				
Low	32.5	32.2	44.2	76.9
Moderate	54.1	54.0	48.0	20.5
High	13.4	13.8	7.8	2.6
about energy conservation innovations				
Low	32.6	27.6	36.3	59.0
Moderate	50.6	51.7	49.0	38.5
High	16.8	20.7	14.7	2.5

Table 4.27 (Continued)

Factors	Age			
	20-30 years	**31-40 years**	**41-50 years**	**51-60 years**
about social support				
Low	61.6	63.2	56.9	76.9
Moderate	34.3	29.9	35.3	20.5
High	4.1	6.9	7.8	2.6
Perception of innovation characteristics				
Concerning risk				
Low	9.3	17.2	14.7	7.7
Moderate	72.7	52.5	66.7	79.5
High	18.0	25.3	18.6	12.8
Concerning comparative advantage				
Low	9.9	9.2	11.8	12.8
Moderate	75.0	72.4	78.4	84.6
High	15.1	18.4	9.8	2.6
Concerning compatibility				
Low	9.3	13.8	7.8	15.4
Moderate	56.4	43.7	51.0	69.2
High	34.3	42.5	41.2	15.4
Perception of innovation characteristics				
Concerning complexity				
Low	18.0	20.7	16.7	23.1
Moderate	65.1	57.5	63.7	62.9
High	16.9	21.8	19.6	14.0

Furthermore, when considering the relationship between education level and other factors, namely accessibility to information and knowledge including the perception of innovation characteristics in different aspects, it found that most people with bachelor degree or higher had high rate of accessibility to information about energy situations and problems at 71.8% and 70.3% respectively, while slightly more than half of those with secondary school, and diploma or equivalent had high accessibility to this information at the rate of 53.6% and 56.4% respectively. Most people, regardless their education level, had high accessibility to information about innovations. Moreover, the number showed that less than half of those with secondary school education, with diploma or equivalent, or with bachelor degree, namely 43.5%, 39.4% and 46.6% respectively had high accessibility to information about social support, while more than half of people with higher than bachelor degree, or 59.5%, had high accessibility to this information. Regarding to knowledge about energy situations and problems, it was clear from our study that about half of the people with secondary school education, or diploma or equivalent, namely 56.5% and 50.0% respectively had low knowledge about this, while slightly more than half of those with bachelor degree or higher had moderate knowledge about this issue. Regarding to knowledge about innovations, evidently there were slight differences between different levels of education; slightly less than half of the sample with secondary school, and diploma or equivalent, or 47.8% and 43.6% of them respectively had low knowledge about this. On the other hand, slightly more than half of those with bachelor degree and those with higher education, or 51.5% and 56.8% respectively had moderate knowledge about this information. Whereas more than half of sample of every education level had low knowledge about social support, especially those with diploma or equivalent, their number rose to even 74.5%.

Concerning the perception of innovation characteristics, it appeared from the findings that there were no significant differences which represented most of the majority of the sample, regardless their educational level, had moderate perception in every aspects, as shown in table 4.28.

Table 4.28 Relationship between Educational Level and Other Factors

Factors	Education Level			
	Secondary school	Diploma or equivalent	Bachelor degree	Higher than bachelor degree
Accessibility to information				
About situations and problems				
Low	5.8	16.0	6.1	8.1
Moderate	53.6	27.6	22.1	21.6
High	40.6	56.4	71.8	70.3
About energy conservation innovations				
Low	10.1	11.7	5.5	6.8
Moderate	8.7	8.5	3.7	5.4
High	81.2	79.8	90.8	87.8
About social support				
Low	17.4	27.6	20.3	17.5
Moderate	39.1	33.0	33.1	23.0
High	43.5	39.4	46.6	59.5
Knowledge				
About energy situations and problems				
Low	56.5	50.0	30.0	32.4
Moderate	36.3	41.5	57.7	52.7
High	7.2	8.5	12.3	14.9
Knowledge				
About energy conservation innovations				
Low	47.8	43.6	27.6	28.3
Moderate	43.5	43.6	51.5	56.8
High	8.7	12.8	20.9	14.9

Table 4.28 (Continued)

Factors	Education Level			
	Secondary school	Diploma or equivalent	Bachelor degree	Higher than bachelor degree
About social support				
Low	65.2	74.5	56.4	56.8
Moderate	31.9	22.3	37.4	33.8
High	2.9	3.2	6.1	9.5
Perception of innovation characteristics				
Concerning risk				
Low	14.5	18.1	8.0	12.2
Moderate	75.4	68.1	67.5	64.8
High	10.1	13.8	24.5	23.0
Concerning comparative advantage				
Low	10.1	14.9	6.7	13.5
Moderate	78.3	77.7	76.1	73.0
High	11.6	7.4	17.2	13.5
Perception of innovation characteristics				
Concerning compatibility				
Low	8.7	17.0	6.7	12.2
Moderate	58.0	55.3	47.9	59.5
High	33.3	27.7	45.4	28.3
Concerning complexity				
Low	20.3	23.4	16.0	17.6
Moderate	55.1	62.8	65.6	67.6
High	24.6	13.8	18.4	14.8

4.4.4 Innovation Adoption According to Their Categories, both at Present and in the Future

The result of the study on the adoption of energy conservation innovations both at present and in the future, according to their types,; gasohol, biodiesel, natural gas and others such as electric cells, fuel cells, hybrid engines and solar cells etc. shown in table 4.26 as follows:

4.4.4.1 Gasohol

The study result shown that at present there are 44.5% and 55.5% of the people accepting or adopting and not accepting gasohol respectively. Among those accepting and having used it, the majority of them (79.2%) used it all the time. Whereas the numbers of adoptive people and non adoptive people at present and in the future, were very close, that is 44.7% and 55.3% respectively.

4.4.4.2 Biodiesel

The study result also indicated that at present there were people adopting or accepting and not accepting biodiesel 20.2% and 79.8% respectively. Among those accepting and having used it, slightly more than half of them, or 50.6% used it all the time, followed by 42.0% of those using it once a month. Regarding the future, the numbers of adoptive and non adoptive were not much different and the number of the latter ones increased from the present that was their number would increase to 29.0%, and the non - adoptive would decrease to 71.0%.

4.4.4.3 Natural gas

The study result found that at present there were people adopting or accepting and not accepting natural gas 28.0% and 72.0% respectively. Among those accepting and having used it, most of them (64.3%) used it all the time. Whereas in the future, the numbers of adoptive people would increase to 36.0%, and the non-adoptive would decrease to 64.0%.

4.4.4.4 Other types of energy innovations

It could be seen from the study result that at present there were 22.5% and 77.5% of people adopting or accepting and not accepting respectively other kinds of innovations in private cars, such as electric batteries, fuel cells, hybrid engines or others. However, there were still people who had never used any kind of innovations at all. However, the acceptance in the future would increase slightly to 25.0%.

Table 4.29 Innovation Adoption According to Their Categories, both at Present and in the Future

Type of innovations	Adoption at present							Adoption	
	Non adoptive (151 persons)	Adoptive	Use frequency of those having used					Non adoptive (221 persons)	Adoptive (179 persons)
			All the time	Once a month	2 – 3 times a month	Once in 6 months	Once in more than 6 months		
Gasohol	55.5	44.5	79.2	11.8	4.3	4.3	0.4	55.3	44.7
Biodiesel	79.8	20.2	50.6	42.0	2.5	3.7	1.2	71.0	29.0
Natural gas	72.0	28.0	64.3	21.4	13.7	0.3	0.3	64.0	36.0
Electric batteries, fuel cells, hybrid engines, solar cells or others	77.5	22.5	0	0	0	0	0	75.0	25.0

The study result could be analyzed that there was a considerable number of people adopting gasohol and biodiesel, especially gasohol, because the Royal Project and other organizations conducted research on and developed different types of biodiesel and introduced them to the market for already quite some time, resulting naturally in the increase of the number of adoptive people. In addition, it was also other reasons: this type of fuel did not cause much change in every life as it was still in the form of familiar conventional liquid fuel, except the proportions of ethanol ingredient that might change; the price of all these ethanol mixed fuel was explicitly, comparatively cheaper than conventional gasoline or diesel; A number of gas stations were increased more than before, thus more convenience; and there were rarely news about the risk or possible dangers. Anyhow, the non adoptive people might feel uncertain about some characteristics of innovations, such as their impacts on engines or on car efficiency, and might be confused about models and brands of vehicles capable to use with these different types of gasohol or biodiesel.

Regarding to natural gas adoption, it was indicated that people accepted it more than when it was first introduced to the market due to government's

pricing policy that imposed its price the cheapest compared to all other fuel; and also due to the government's subsidies on discounting or even exempting the cost of its equipment installation in cars. Therefore, A number of people using gasohol were increased. However, apart from the obligation of equipment installation, which resulted in the decrease the storage space in cars because of the gas cylinder and affected its good looking, some people rejected it despite the government's promotion due to their most important concerned the possible risk and danger that might occur which was in fact the result of frequent news of explosion of cars using natural gas without precise information or causes, making people worried. Furthermore, there were not sufficient gas stations, resulting in long waiting for the service and inconvenience. Somehow, some people still considered the conversion to a new type of fuel from the familiar one was a big change in life, so they did not accept it. Nevertheless, in the future the people would increasingly adopt natural, probably because the prospect of having more research and development for better products with less negative impacts. These people were likely the followers who adopt innovations after the innovators did since the very beginning.

In regard to adoption of other potential innovations in the future, such as electric batteries, fuel cells, or hybrid engines, it was demonstrated that a number of people (22.5%) accepted these innovations, but none of these people had ever used any of them because these innovations were still in the stage of research and development, and just initially introduced onto the market. In other countries, such as USA, Japan and European countries, these innovations were quite widespread at certain level, but for Thai consumers, they might seemingly be something very new. Then adoptive people of these innovations were usually innovators who followed information, preferred new technology and their environmentally friendly property and realized comparative advantage in terms of the decrease of expenses, resource uses, and the country's dependency on foreign energy. Besides, the speculated increase of number of adoptive people in the future was probably because they had confidence in producers' research and development.

The result of this study was similar to the survey on Thai people's opinion about energy conservation and alternative energy use, conducted in 2007 by the National Statistical Office. The target population of the survey was 5,800 people

aging from 18 years old nationwide. The result of opinion survey in different issues showed that 51.3% of the people had high accessibility to information about energy situations and problems related to the impacts of oil price on the country's economy and trade deficit, and 38.1% and 7.6% of them had moderate and low accessibility to information respectively, and only 3.0% of them did not have this information at all. On the other hand 52.2% and 60.0% of the people nationwide and in Bangkok respectively had perceived information about the purchase of used kitchen oil.

Households using private cars who wanted to participate in saving energy, there were many methods; 90.2% of them, were cautious of having constant car maintenance and 29.4% of the people used natural gas for gasoline or diesel, which was the least method taken from all.

Regarding to all different kinds of alternative energy, it was resulted only 15.2% of the people throughout the country used gasohol, whereas in Bangkok, 29.2% of the people used it. The sampled nationwide and in Bangkok, 46.8% and 34.6% stated that the number of gas stations was not sufficiently responsive to the demand.

Whereas biodiesel was found that a very small number of people nationwide, as well as those living in Bangkok used it, that was merely 4.8% and 8.6% respectively; the reason of 52.4% and 58.9% of them respectively was that there were not enough gas stations.

Moreover, people using natural gas throughout the country and in Bangkok were merely 2.8% and 7.8% of them respectively, and both groups of people, 67.8% and 58.6% respectively raised the same reason, insufficient number of gas stations.

Similarly, LPG also faced the same problems; only 4.3% and 3.5% of people nationwide and those living in Bangkok respectively used this type of fuel and more than half of each group of people pointed at the insufficient number of gas stations.

Concerning the people's opinion about using gasohol, biodiesel, 31.6% and 24.7% of them respectively thought that these kinds of fuel did not have any effect on engines, while other people at very close number, 6.8% and 6.6% respectively thought that they might cause the car breakdown. Moreover, 2.2% and

1.8% of the people thought that these two types of fuel resulted in more expenses respectively. Whereas those who did not have any information or were uncertain about these two types of fuels; gasohol and biodiesel, accounted for 59.4% and 66.9% of them respectively (National Statistical Office of Thailand, 2007).

The result of the survey on people's opinions conducted by the National Statistical Office and the result of this study showed similarities of innovation adoption in many aspects. For example, for the people's accessibility to information about energy situations and problem, more than half of the people had this accessibility and even though they were cooperative in energy saving, using alternative energy was, however, the less taken method they resorted to, such that the number of the people using this method was quite small in number, both in Bangkok and throughout the country. One reason given was the insufficient number of gas stations and then their uncertainties about innovation characteristics that might have different effects on their vehicles. Actually, there was still huge inadequate knowledge about this issue.

There were research conducted abroad of which results were similar. For example, the study on the selection of each alternative energy in private cars in Italy found that most people would buy new cars using gasoline and diesel at close percentage, 38.0% and 34.0% respectively, followed by using natural gas 22.0%, and LPG was the less selected, representing only 6.0%. Many reasons were given for such selections, for example, the convenience for refilling fuels which was the main predicament for natural gas adoption because of its insufficient number for the service.

Besides, natural gas was considered "hazard" as well as LPG because car users thought that it might be a potential cause of car explosion, including the decrease of car performance. In contrast to gasoline, car users believed in its advantage to boost car performance and to have better servicing due to the convenience of sufficient gas stations. Moreover, another reason for selecting gasoline was also because of familiarity, as it was found that 25% of the people chose this type of fuel without any particular reason.

There were also other interesting factors about people's car purchase selection. Sixteen percent of them stated that they wanted "clean" energy –any type

that was environmentally friendly. Some people chose gasoline, not natural gas to which they explained "dirty". Actually, fossil fuel producing firms' labels, such as "eco-diesel", "green gasoline" also confused consumers.

In addition, the factors that motivated people to choose diesel cars were performance, reliability and the convenience of fuel refilling.

Regarding to people's accessibility to information and knowledge, it was obvious that the majority of the people (85%) knew that natural gas was the cheapest compared to other fuels, however, 86% of them did not know its exact price. Moreover, 33.0% did not believe that natural gas price could possibly be at that cheap. From the findings, only 25.0% of them had information about social support from the government's part to motivate its adoption, whereas 74.0% of them had information from friends and relatives and only 16% received it from mass media (Stefano, Femia and Luzzati, 2001).

4.5 Analysis of Factors Related to Innovation Adoption, Both at Present and in the Future

The analysis of factors influencing the adoption of innovations for energy conservation in private cars, both at present and in the future, by using logistic regression analysis had the results shown in table 4.30.

Table 4.30 The Results of Logistic Regression Analysis

Variables	Innovation adoption			
	The Adoption at Present		The Adoption in the Future	
	B	Exp(b)	B	Exp(b)
Gender (sex)				
Male	0.697*	2.008	0.830*	2.292
Female	0	1	0	1
Age (age)				
20-30	-0.464	0.629	-0.251	0.778
31-40	-0.952	0.386	-0.162	0.851
41-50	-0.614	0.541	-0.193	0.825
51-60	0	1	0	1
Marital status (status)				
Single, widow and others	0.130	1.139	-0.040	0.961
Married	0	1	0	1
Educational level (edu)				
Secondary school	0.311	1.365	-0.178	0.837
Diploma or equivalent	-0.326	0.722	-0.571	0.565
Bachelor degree	0.567	1.763	0.249	1.283
Higher than bachelor degree	0	1	0	1
Occupation (occ)				
Civil servant	-0.234	0.791	-0.785	0.456
State enterprise's employee	-0.263	0.768	-0.310	0.733
Private enterprise's employee	-0.363	0.696	-0.702	0.495
Student	-0.304	0.738	-0.548	0.578
Others	0	1	0	1
Monthly Income (baht)				
Lower than 10,000	0.004	1.004	0.271	1.312
10,001-20,000	0.113	1.120	0.625	1.868
20,001-30,000	-0.462	0.630	0.682	1.977
Over than 30,000	0	1	0	1
Private car use (Usecar)				
Yes	1.231*	3.423	0.629*	1.875
No	0	1	0	1
Accessibility to information (inf)				
-situations and problems about energy (infsit)	0.137	1.147	0.016	1.016
-innovations for energy conservation (infinno)	-0.039	0.962	-0.067	0.935
-social support (infsup)	- 0.041	0.960	0.000	1.000
Knowledge (Know)				
-situations and problems about energy (knowsit)	-0.006	0.994	0.030	1.031
-innovations for energy conservation (knowinno)	-0.034	0.967	0.000	1.000
-social support (knowsup)	0.023	1.024	-0.005	0.995

Table 4.30 (Continued)

| Variables | Innovation adoption | | | |
| | Current Adoption | | Future Adoption | |
	B	Exp(b)	B	Exp(b)
Perception of innovation characteristic (inno)				
-risk (risk)	0.013	1.013	-0.025	0.976
-comparative advantage (adv)	0.057*	1.059	0.076*	1.079
-compatibility (compat)	-0.001	0.999	0.030	1.031
-complexity (complex)	0.044	1.045	-0.042	0.959
Constant	-2.469		-1.402	
Model Chi-Square	86.773		60.215	
-2 Log Likelihood	443.489		489.884	
Nagelkerke R Square	0.266		0.187	

P-Value < 0.05

The result of the analysis of factors influencing current and future adoption of energy conservation innovations in private cars, shown as follows:

4.5.1 The Results of Logistic Regression Analysis

For the adoption at present, it was found that the -2LL value of the model was 443.489, showing the goodness of fit and the chi-square value was 86.773, with the ability to explain 26.6% of the variation. For the adoption in the future, the -2LL value of the model was 489.884, showing its goodness of fit and the chi-square value was 60.215, which could explain 18.7% of the variation.

There were three similar factors related to innovation adoption at present and in the future as follows:

   4.5.1.1 Gender

   4.5.1.2 Private car use

   4.5.1.3 Perception of comparative advantage characteristics of innovations

The details were as follows:

4.5.1.1 Gender

Gender was one factor influencing the adoption of innovations for energy conservation both at present and in the future; males tended to adopt innovations 2.008 times and 2.292 times at present and in the future more than females did respectively. The study found that, when compared to females, there were more male adopting innovations both at present and in the future at the rate of 61.8% and 62.9% respectively, and it was also shown that, at every age range, males adopted innovations more than females.

It was probably due to gender differences concerning skill and intellectual competence. The study of psychologists Terman and Tyler (1954) indicated that males were physically stronger, more spiritually adventurous and obsessive about masculinity traits, as well as more interested in mathematics, geography and science, with competence in craftsmanship, mechanism or technology more than females. On the other hand, females were characterized by maternal traits, tenderness and feminists, with competence in language or literary skill. Naturally, these gender differences resulted in males' interest in different kinds of energy innovations more than females did, whereas females were probably scared of new technology or technophobia, as well as feeling more anxious, and if it dealt with the future, the matter of uncertainty and change, they were especially more anxious (Brosnan, 1998). As a result, males adopted innovations for energy conservation in private cars more than females did. This study result was similar to the study of Cameron (2006) on the relation between age, gender and experience with technology adoption. It was indicated that gender was related to the adoption, because females were more anxious about changes or the application of new technology than males did. In addition, the study of O' Garra, Mourato and Pearson (2005) on the analysis of the realization and the adoption of using hydrogen as fuel in London found that males were more interested in fuel vehicles using new technology than women.

There were some studies on decision making for buying technological products which were found that gender was related to selection of using technological products that was females worried and felt bothered to use these products more that males did (Gilbert, Lee-Kelley and Barton, 2003). Similarly, a study on psychological effect on the technology adoption shown that due to gender differences that males

were more competent in mechanism, they consequently adopted different kinds of technology more than females did (Brosnan, 1998). Likewise, for the adoption of energy technology or innovations, it was shown that males were more interested in using hydrogen fuel in car than females (Schulte, Hart and Van der Vorst, 2004) and had more positive feeling to hydrogen fuel than females did, as well as tending to use cars using this type of fuel in the future more than females. Apparently, it was probably because females were more anxious and felt uncertain about possible changes in the future more than males (Hickson, Phillips and Morales, 2007).

4.5.1.2 Private car use

Private car use was another factor influencing significantly people's innovation adoption both at present and in the future; the people using private cars tended to adopt innovations both at present and in the future 3.423 times and 1.876 times respectively more than non car users. The study indicated that people adopting innovations both at present and in the future were mostly private car users, accounting for 80.7% and 75.6% respectively.

It could be analyzed that at present private car users accept innovations more than non private car users because they used cars in daily life, thus the selection of fuel and alternative fuel cars had direct effects on their lives, depending on product characteristics in terms of risk, comparative advantage, compatibility and complexity. Once adopting a certain innovation or alternative energy, an individual himself would sense the perceived effectiveness (Eriksson, Garvill and Nordlund, 2008). Besides, there was also personal outcome expectation (Schade and Schlag, 2003), which was positive personal benefit (Joireman,Van, Van, Wood, Leest, and Lambert, 2001) of car users, who were more involved and more participated owing to car use in their daily life. As a result they were more interested in innovations to increase their options both at present and in the future than non private car users.

Besides, energy innovation adoption also affected the economy, society, and environment and public health in general. If still using conventional fuel with high gasoline ingredient, the negative effects would fall inevitably on society as a whole. Thus the adoption of innovations or environmentally friendly alternative energy arose from individuals' social responsibility and social altruistic, as suggested Schwartz Norm-activation theory of altruistic behavior (Schwartz, 1977).

While the non private car users used public transport or other kinds of payable vehicles available, which were basic state provided service, and it was the state that provided vehicle and fuel types without people's participation. Consequently, these people felt less involved in this issue, or felt that it was a faraway issue from them. But they would feel directly more involved to the fee of each type of public transport than to fuel type or alternative energy for private cars; they did not feel directly involved either to private car innovations or fuels for energy resource conservation. Moreover, they were not certain whether they would be able to have their own private cars, and in addition, there was not clear information about cars, different types of fuels to be used in the future in Thailand either.

The result of this study was similar to that of the study on the awareness of the environment and policy adoption of car users in Sweden, which was found that car users agreed with the state to increase taxation for fossils fuels and to use the revenue acquired to subsidize biofuel and other measures that supported other alternative energy, so that there would be better choices of usable fuels (Eriksson, Garvill and Nordlund, 2008). And in a study on people's attitudes toward the environment and their knowledge and understanding of the effect of car pollution on the environment in New Zealand from 1,000 people, both car users and non-car users, the finding was that train commuters felt involved to and interested in the environment less than private-car users (Walton, Thomas and Dravitzki, 2004). Likewise, the study of Garvill (1999) on options of traveling by analyzing factors related to the decrease of private-car use and supporting laws dealing with cars of private-car users in Philadelphia was found that travelers by trains felt less involved and interested in environmental issues, including having less intention to decrease pollution than private car users.

Similarly, various studies showed that private-car users adopted energy innovations in private cars, or tended to adopt them more than those without cars. They also had more environmentally responsible behaviors, such as a study on the responsibility for impacts of private-car use on the environment. It was also found that car users, compared to travelers by other means, were interested in pollution caused by car uses, both pollution and the current global warming, including the possibly severe impacts in the future (Joireman, Jeffrey and Van, 2004). Likewise, a

comparative study on Australian students driving to college and those using public transport, together with those staying dormitories had the same result. That was, those using private cars realized the impacts of private car uses more than those without cars (Collins and Chambars, 2005). Moreover, the study of Shen, Sakata and Hashimoto, (2008) found that among private car users, there was more awareness of the impacts of private car use on the environment than non users.

4.5.1.3 Perception of comparative advantage characteristics of innovations

Perception of comparative advantage was the remaining factor positively related to innovation adoption both at present and in the future. It was indicated that the probability to adopt innovations increased by 5.9% and 7.9% respectively, if the comparative advantage perception score increased 1 unit. When comparing the different levels of knowledge, we could conclude the finding that if the score level of this perception concerning comparative advantage rose, the adoption would rise regardless the score group; whether the score was in low, moderate, or high level, the people in these groups would adopt more innovations to 45.2%, 61.6% and 79.2% respectively, as shown in table 4.31.

Table 4.31 Innovation Adoption at Present According to the Level of Perception of Comparative Advantage

Level of perception score of comparative advantage characteristics of innovation	Innovation adoption at present		Total
	No (151 persons) Percentage	**Yes** (249 persons) Percentage	Percentage
Low (0-13)	54.8	45.2	100.0
Moderate (14-26)	38.4	61.6	100.0
High (27-40)	20.8	79.2	100.0

Similarly, if considering according to the perception level of comparative advantage characteristics, it was implied that if the perception level rose, so would do the innovation adoption in the future, i.e. the adoption of the people with low, moderate, and high perception would rise to 40.5%, 55.1% and 67.9% respectively, as shown in table 4.32.

Table 4.32 Innovation Adoption in the Future According to the Level of Perception
of Comparative Advantage

Level of perception score of comparative advantage of innovations	Innovation adoption in the future		Total Percentage
	No (179 persons) Percentage	Yes(221persons) Percentage	
Low (0-13)	59.5	40.5	100.0
Moderate (14-26)	44.9	55.1	100.0
High (27-40)	32.1	67.9	100.0

It was probably because the comparative advantage characteristics of innovations were the first motivation leading to people's acceptance and adoption. If compared to previous existing products, the new one in general was better, it would consequently be accepted; but if considered worse, the new product would not be accepted. This attitude might arise according to the common sense of people in general, who usually thought mainly of their own benefits, not only at present, but also in the future. People could be convinced to accept innovations more easily if motivated by speculated benefits compared to not using them as before, whether in terms of the decrease of expenses for fuel refilling, maintenance cost or being a worthwhile investment, which might probably render more convenience in life. Moreover, they would be praised by others people, thus raising their images as figures keeping abreast of the times, and were responsible to society.

The results of this study were similar to that of Mohr's (2001) on the adoption of innovations and products using high technology, which was found that consumers assessed innovation characteristics in stepwise manner. Consumers considered comparative advantage as the first issue; if thinking that they would have

more advantage compared to the previous period of not using it, then they would consider the next two innovation characteristics, namely, compatibility, and complexity. These three characteristics were apparently the most influential aspects for purchasing decision making. Likewise, the research of Pujari, Wright and Peattie (2003) on influences affecting the characteristic development of innovations for the environment was found that innovations have two important characteristics; main characteristics and minor characteristics. The main ones were basic benefits responsive to consumers' needs, while the minor ones helped distinguish the products from others, such as easiness or difficulty of application, brand and image. Besides, a study on the process of purchasing cars emitting low pollution in the UK was shown that the purchase depended on factors related to comparative advantage characteristics concerning price, fuel consumption, size, comfort, practical and reliability (Lane and Potter, 2007).

In addition, there were still many other studies related to the adoption of energy conservation innovations of which results were similar. For example, Dagsvik's study (Dagsvik, Wennemo, Wetterwald and Aaberge, 2002) on demand on cars using alternative energy in Sweden was indicated that innovation characteristics that attracted people's acceptance for electric cars or hydrogen cars, or others innovations for cars were comparative advantage characteristics, namely, cheap price, faster speed or higher accelerating rate, fuel refilling convenience, fuel saving in order to reduce expenses. The last mentioned characteristic was the most important aspect of all of consumers' consideration for purchasing innovations. Similarly, a study on appropriate policy for energy conservation of every groups of consumers in the UK also found that the main instrument to make consumers decide to adopt high technology innovations or products for energy conservation should have explicit advantage characteristics beneficial to consumers, such as convenience, good quality, as well as expense saving and energy conservation (Egmond, Jonkers and Kok, 2006a), and it was also indicated that males' decision making to adopt new technology relatively depended on utility consideration, whereas females' consideration was related to their perception of complexity of application (Venkatesh and Morris, 2000).

In addition, the results of this study were also similar to a number of research on innovation adoption in the future. For example, the study of Ricci, Newsholme, Bellaby and Flynn (2007) on the role of hydrogen energy in the future found that individuals' ability to use innovations and perception of innovation advantages both for themselves and for society had influence on adoption of hydrogen energy in cars in the future. Likewise, a study on decision making to use alternative energy cars in the future of South Korean consumers regarding to their competitiveness with cars using diesel and those using hybrid engines available indicated that comparative price was the main factor affecting consumers' purchase decision (Kim, Jeong, Ahn and Lee, 2007). Furthermore, Adamson's research (2005) on pricing guideline of cars using fuel cells for marketing acceptance in the future shown that, in order to maximize the success in selling this car type, the marketing planning for market trend in the future not only had to set the price competitively acceptable for consumers with respect to existing conventional cars on the market, it must also emphasize on optimal benefit of this car type. A study on motivation to choose the type of fuel for cars in Montreal had similar result, indicating that a large number of private car users wanted clean energy cars, electric cars for example, if these innovations would exist in the future and were competitive in terms of better price and other characteristics compared to conventional cars (Ewing and Sarigöllü, 1998).

4.5.2 The Relative Importance of Factors Related to Innovation Adoption at Present by Using CHAID

When considering all three factors together at the same time by CHAID to analyze factors related to innovation adoption at present, it was found that the first factor to be considered was private car use, both among private car users and non private car users. After conducting the comparison, it was indicated that innovation adoption rate among car users was higher than that among non private car users, that was 70.3% and 40.9% respectively. The second factor was perception of innovation advantage characteristics; that innovation adoption among both private car users and non private car users would increase if the perception score of this aspect increased. That was, if the car users' perception score of comparative advantage perception was

18 or less, the innovation acceptance is merely 56.2%; but if the score is more than 18, the innovation acceptance would rise to 79.2%. Similarly, among non private car users, if this perception score was 24 or less, the acceptance was only 32.2%, but if the perception score was more than 24, the acceptance would rise to 73.9%, as shown in table 4.33.

Table 4.33 Analysis of Innovation Adoption at Present by Using CHAID

Relative Importance of factors	Innovation adoption at present					
	Yes		No		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
Private car use						
Private car users	204	70.3	86	29.7	290	100.0
Level of perception score of comparative advantage characteristics of innovation						
0-18	63	56.2	49	43.8	112	100.0
19-35	141	79.2	37	20.8	178	100.0
Non private car users	45	40.9	65	59.1	110	100.0
Level of perception score of comparative advantage characteristics of innovation						
0-24	28	32.2	59	67.8	87	100.0
25-35	17	73.9	6	26.1	23	100.0

4.5.3 The Relative Importance of Factors Related to Innovation Adoption in the Future by CHAID

If considering all three factors at the same time by using CHAID, it was found that, the first factor related to future innovation adoption to be considered was gender. It was found that males adopted innovations more than females; that was 62.9% and 45.8% respectively. Among the males, private car use was the next factor to be considered; males using private cars adopted innovations more than those without private cars, i.e. 66.9% and 51.7% respectively. Whereas among females, comparative advantage perception of innovations was the next factor to be considered, as it was shown that if this perception score rose, the innovation adoption would rise accordingly. That was, if the perception scores were18 or less, the innovation adoption was merely 29.1%; but if this perception score increased to between 19-27 , the innovation adoption would rise to 53.8%; and if the perception scores were over than 27, the innovation adoption would rise to even 80%, as shown in table 4.34.

Table 4.34 Analysis of Factors Related to Future Innovation Adoption by Using
CHAID

Relative Importance of Factors	Future Innovation Adoption					
	Yes		No		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
Male	139	62.9	82	37.1	221	100.0
Private -car use						
Private-car users	109	66.9	54	33.1	163	100.0
Non private car users	30	51.7	28	48.3	58	100.0
Female	82	45.8	97	54.2	179	100.0
Level of perception of comparative advantage						
0-18	23	29.1	56	70.9	79	100.0
19-27	43	53.8	37	46.2	80	100.0
More than 27	16	80.0	4	20.0	20	100.0

When comp aring factors related to the adoption of energy conservation
innovations in private cars, both at present and in the future, three similar factors were
found; gender, private car use and comparative advantage perception of innovations,
as shown in table 4.35.

Table 4.35 Factors Related to Adoption of Innovations at Present and in the Future

Factors related to innovation adoption	Innovation adoption			
	At Present		In the Future	
	B	Exp (b)	B	Exp (b)
Gender				
Males	0.697*	2.008	0.830*	2.292
Females	0	1	0	1
Private car use				
Yes	1.231*	3.423	0.629*	1.875
No	0	1	0	1
Perception of innovation characteristics				
Concerning comparative advantage	0.057*	1.059	0.076*	1.079

*P-Value<0.05

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

The final outcome of the research study on people's adoption of energy conservation innovations in private cars, both at present and in the future, the researcher will present the discussion, conclusion and recommendations derived from the research by dividing them into following issues:

5.1 Conclusion

      5.1.1 Characteristics of the sample

      5.1.2 Accessibility to information and knowledge

      5.1.3 Perception of risk characteristics

      5.1.4 Perception of comparative advantage characteristics

      5.1.5 Perception of compatibility characteristics

      5.1.6 Perception of complexity characteristics

      5.1.7 Current and future adoption

      5.1.8 Factors related to current and future adoption

5.2 Recommendations

5.1 Conclusion

5.1.1 Characteristics of the sample

According to the research outcome of overall population characteristics, it was found that 55.2% of them were males, 43.0% age between 20-30 years old, with an average age of 35.5 years old, and the deviation standard was 10.8 years. Most of them (75.0%) were single, widow and others. Besides, it was also found that 40.8% of them had bachelor degree and for those who worked for private enterprises' together with state enterprises' represented at very close numbers, which was 23.0% and 23.5% respectively, and those earning less than 10,000 baht per month and those earning between 10,000 – 20,000 baht per month were also represented at very close

numbers; 39.5% and 38.3% respectively. In addition, most of them (72.5%) used private cars for traveling.

5.1.2 Accessibility to Information and Knowledge

Concerning the accessibility to information and their knowledge about three issues: energy situations and problems, energy conservation innovations and social support. The findings were as follows:

Regarding to energy situations and problems concerning; fossil fuel sources whether from local production and from foreign import, the duration of petroleum availability before depleted, tendency of the volatile oil prices, the most fossil fuel-consuming sectors of the country, the country's annual expenditure on petroleum, as well as impacts from fossil fuel on the environment and on public health, it was resulted that most of them (62.6%) had high accessibility to information about these issues, while only 8.8% had low accessibility to this information. The average score of accessibility to this information was 5.50 and the standard deviation was 1.95. The highest and the lowest score were 7 and 0 respectively. Most people received information about all these issues once a week from (from the most frequency) television, radio, together with printed matters respectively and there was relatively little information received from either personal communication or other types of media.

Regarding to the knowledge about these issues, it was found that nearly half of the people (49.2%) had moderate knowledge, followed by 39.8% of those with low knowledge. The highest and the lowest score were 33 and 0 respectively. The average score was 14.20 and the standard deviation was 8.31. Obviously, despite the high accessibility to information about these issues, that was, "having heard", but on average, it was only once a week. Only information about oil price tendency was heard with the highest frequency, i.e. mostly everyday. It was probably because both media and receivers were particularly interested in this information the most due to its direct impact on economy or the overall expenses increased. On the other hand, the media presentation of other matters might lack of detailed information or insufficient frequency, which resulted in almost half of the people's moderate understanding of the matter.

The next issue was energy conservation innovations in private cars concerning; type, objective, advantages and possible problems; it was shown that the majority of the sample (86.0%) had high accessibility to information concerning this issue. The average score was 3.44 and the standard deviation was 1.06. The highest and lowest score was 4 and 0 respectively. Most people received information about the issue once a week from different media, run according to their popularity as followed; television, radio, printed matters and relatively low from personal media or other kinds of media.

Regarding to the knowledge about this issue, it was obviously indicated that nearly half of the people (49.3%) had moderate knowledge. The average score was 9.04 and the standard deviation was 5.20. The highest and the lowest score were 20 and 0 respectively. It showed that even almost half of the people had high accessibility to this information, i.e. having heard the information from media once a week but still lacked of in-depth information. Therefore, people's knowledge about this issue was then concentrated at moderate and low level respectively.

For the last issue; social support from state and private sector in terms of government subsidies, import tax exemption, accessorial equipment and its production in the country, training courses for natural gas equipment installers, including the increase number of gas stations, the availability of gasohol, biodiesel together with natural gas price. Besides, there was also related information about research and development concerning gasohol, biodiesel, natural gas and other potential innovations in the future, such as electric batteries, fuel cells and hybrid engines. It was shown that 46.7% of the people had high accessibility to this information. The average score was 4.96 and the standard deviation was 2.69. The highest and the lowest score were 8 and 0 respectively. Most people received information about five from eight issues once a month. They highly received them from television, radio and printed matters respectively, but received relatively low of this information from personal communications or other types of media.

The study also indicated that most of the sample (62.3 %) had low knowledge about the issue, followed by those with moderate knowledge. The average score of this knowledge was 11.53 and the standard deviation was 8.81 respectively. The highest and the lowest score were 39 and 0 respectively. Although most people had

high accessibility to the information, but it was mostly low knowledge, probably because most of them rarely received it only once a month. That was not enough to create sufficient knowledge.

In summary, the overall accessibility and knowledge about two issues; energy situations and problems together with energy conservation innovations indicated that most people 62.6% and 86.0% had high accessibility to this information respectively, and with the once-a-week frequency receiving. Nearly half of them or 49.2% and 49.3% had moderate knowledge about these issues. Regarding to the last issue of social support, it was indicated that nearly half of the people (46.7%) had low accessibility to this information, with mostly once a month receiving, and most of them (62.3%) had low knowledge about it. The information receiving of these 3 issues, run according to its frequency, was from television, radio and printed matters respectively. Obviously, despite the high accessibility to this information, the recipients' knowledge was still moderate and low. It was probably the information receiving was only once a week and once a month for the majority, and the information related to alternative energy or innovations available on the market was mostly about the changing prices of energy and the fuel shortage, while it was not presenting much information about other issues, especially about social support from government sector and private sector, including new energy or cars using new technology, such as electric batteries, fuel cells and hybrid engines. In addition, television or radio might probably not provide in-depth information. On the other hand, even though electronic media presented information with relatively adequate information, still people had low accessibility to the media, only those people with particular interest in this issue who would manage to access these media information. Besides, it was probably because the receivers also selected the kinds of information they preferred (Klapper, 1960). Due to the tension from various problems people faced nowadays, such as economic, social, political problems, they consequently wanted to choose entertaining programs more than other types. Similarly, the result of the Office of National Statistics found that in 2008, programs presented in television and radio in which people were interested the most and with an increasing tendency were entertaining programs, while their interest in news decreased, compared to the

previous survey in 2003, and documentary or general knowledge and critical programs received very low interest (National Statistical Office of Thailand, 2008).

5.1.3 Perception of Risk Characteristics of Energy Conservation Innovations in Private Cars

According to the research outcome, people's perception of innovations about risk concerning the scarcity of raw material for the production, production standard, volatile prices, service point standard in terms of spare parts, efficiency or the probably declining of service, the possibility of increase in insurance fees, convenience in finding gas stations and repair garages, safety and reselling if using gasohol, bio-diesel and natural gas, including other potential innovations in the future, the result was found that most sample (68.5%) had moderate perception of risk characteristics, followed by 19.3% and 12.2% of those with high and low perception respectively. The average score was 37.30 and the standard deviation was 12.30 with the highest and the lowest score were 70 and 0 respectively. It was because most people probably knew partially about alternative energy or other innovations already introduced into the market for sometime. These innovations were ready at certain level or had already supporting infrastructure even though not really completed. Another finding was found that people also perceived about the inconvenience related to the insufficient number of service stations or gas stations which they had to wait a long time for the service. Moreover, there was frequently bad news about life and car safety due to these energy uses without knowing real reasons, for example, explosions of gas in cars might cause some people's lack of confidence. Regarding to the newly created innovations, either fuel or engine systems which had not been available on the market yet and were supposed to use high technology for the production. According to the interviews, it was found that the majority of people were anxious about safety.

5.1.4 Perception of Comparative Advantage Characteristics of Energy Conservation Innovations in Private cars

The outcome of the study on people's perception of comparative advantage of energy conservation innovations in private cars concerning the decrease of expenditures on fuels, the decrease of natural gas equipment installation, a worthwhile

investment, the decrease of expenditures on repair and maintenance, a higher price when reselling the cars, more fuel alternative and more convenience, including admiration from other people resulted that most people (76.2%) had moderate perception about comparative advantages, followed by 13.3% and 10.5% of those with high and low perception respectively. The average score was 20.04 and the standard deviation was 6.07. The highest and the lowest score were 35 and 0 respectively. It was found that the perception of comparative advantage concerning the expense decrease was the highest of all issues. It showed that there were problems about people's perception of other comparative advantages as indicated by moderate and low perception from answers to every question related to a worthwhile investment, and the possibility of being more convenience, including a better individuals' image that was originated from their own sense of responsibility to realize the highest benefits to either themselves or society (Schwartz, 1977) in order to adopt innovations.

5.1.5 Perception of Compatibility Characteristics of Energy Conservation Innovations in Private cars

The study on people's perception of compatibility characteristics of innovations in private cars for the conservation of different energy and individuals' belief that these innovations would reduce the country's dependency on other countries in terms of the decrease in expenditures and oil consumption, including a reduction in the negative impacts on the environment and public health and also increasing the income of the farmers who produced the raw materials for making ingredients of innovations or alternative energy found that 53.5% of the sample had moderate perception of this issue, followed by 36.0% and 10.5% of those with high and low perception respectively. The average score was 18.49 and the standard deviation was 6.34. The highest and the lowest score were 30 and 0 respectively. It was shown that the people had more positive perception about compatibility and belief about changes if adopting energy innovations to substitute fossil fuel as indicated by the moderate and high perception of this issue.

5.1.6 Perception of Complexity Characteristics of Energy Conservation
Innovations in Private Cars

The study on people's perception of compatibility characteristics of energy conservation innovations in private cars which was the definition or interpretation of the difficulty or easiness to understand and the uses of different innovations concerning the categories of car models using gasohol, biodiesel and natural gas including the classification of types of gasohol and biodiesel and their ingredients, and the understanding of how the accessorial equipment used with natural gas works, together with other potential innovations in the future found that most of the sample (63.5%) had moderate perception about this issue, followed by 18.8% and 17.7% of those with low and high perception respectively. The average score was 8.04 and the standard deviation was 3.05. The highest and the lowest score were 15 and 0 respectively. It was indicated that people did not have clear understanding about energy ingredients, how to use and how alternative energy or innovations worked because all of these were new techniques and technology. According to the interviews, it was found that some people, who earlier said that these innovations were difficult to understand, did not have these kinds of knowledge or information, especially when concerning newly produced innovations, such as electric batteries, fuel cells, hybrid engines, etc.

5.1.7 The Adoption of Energy Conservation Innovations in
Private Cars, both at Present and in the Future
5.1.7.1 The adoption of energy conservation innovations in
private cars at present.

The result of the study on overall adoption of energy conservation innovations at present which, comprising four categories; gasohol, biodiesel and natural gas including other potential innovations in the future, found that most people (62.2%) adopted at least one kind of innovations and 37.8% did not adopt any kind of them.

When considering innovations and alternative energy adopted by people according to their categories at present, it was concluded that the adoption and

non adoption of gasohol were 44.5% and 55.5% respectively. Most of those who adopted and previously used it would have used it every time when refilling.

Regarding to biodiesel, its adoption and non adoption were 20.2% and 79.8% respectively. Most adopted people would choose it every time when refilling, while the adoption and non adoption of natural gas were 28.0% and 72.0% respectively. Most of those who adopted or had used it (64.3%) would use it every time when refilling. Besides, the acceptance and non acceptance of other potential innovations in the future, such as electric batteries, fuel cells and hybrid engines were 22.5% and 77.5% respectively. At present, no one had ever used these kinds of innovations whatsoever.

When considering population characteristics, we found that among adoptive sample, most of them (61.8%) were males and 42.6% were between 20 – 30 years old. Most of them (75.5%) were single, widow, divorced or others and 45.0% had bachelor degree. It was also shown that they were state enterprises' employees, private enterprises' employees and civil servants at close numbers; 22.5%, 21.8% and 20.5% respectively, and 40.6% of them earned between 10,001–20,000 baht per month and most of them (80.7%) used private cars.

Regarding to adoptive sample' accessibility to information, our finding was that, most of them 67.5% and 88.0%, had high accessibility in two issues; energy situations and problems, and energy conservation innovations respectively, which nearly half of them (48.2%) had high accessibility to information about social support.

For the knowledge, the finding was that nearly half of adoptive sample or 49.8% and 49.0% of them had moderate knowledge in two issues; energy situations and problems, and energy conservation innovations respectively. Other finding was indicated that 57.4% of them had low knowledge about social support. Besides, most people or 71.5%, 75.5% and 65.9% had moderate perception of different characteristics of innovations, which were risk, comparative advantages and complexity respectively. Regarding the complexity, it was shown that more than half of them (51.4%) had moderate perception as well.

5.1.7.2 The adoption of energy conservation innovations in private cars in the future

The result of the study on the adoption of energy conservation innovations in the future found that more than half of the people (55.3%) accepted at least one type of innovations, while 44.7% did not accept any type.

When considering the types of innovations or alternative energy according to the people's adoption in the future, it was shown that the adoption and non adoption of gasohol were 44.7% and 55.3% respectively and those for bio-diesel were 29.0% and 71.0% respectively. Whereas the adoption and non adoption of natural gas were 36.0% and 64.0% respectively, and the adoption and non-adoption of other kinds of energy innovations were 25.0% and 75.0% respectively.

When considering the population characteristics of the people adopting innovations in the future, the result was found that it was similar to those adopting innovations at present in every issue. That was, most of them (62.9%) were males, and 40.7% of them were between 20-30 years old. Most of them (75.1%) were single, and 45.2% had bachelor degree. It was also shown that 23.5% of them were state enterprises' employees and those working in private enterprises and in other occupations similarly represented 20.8% each. Regarding to those people's income, it was also indicated that 41.2% of them earned 10,001-20,000 baht per month, and the majority (75.6%) used private cars.

In addition, when considering the accessibility to information and the knowledge among the adoptive sample in three issues; energy situations and problems, innovations for energy conservation in private cars, and social support, it was found that most of them, 65.6% and 88.2%, had high accessibility to two issues; energy situations and problems, innovations for energy conservation in private cars. But almost half of them (48.4%) had high accessibility to information about social support. Regarding to the knowledge, it was shown that among the adoptive people in the future, about half of them or 51.1% and 50.2% had moderate knowledge in two issues; energy situations and problems, and energy conservation innovations respectively, while most of them (61.5%) had moderate knowledge about social support.

Concerning the four innovation characteristics, it was indicated that among the adoptive people, they had moderate perception of risk, comparative advantages, compatibility and complexity at 71.0%, 76.0%, 50.2% and 65.6% respectively.

When considering the overall adoption of different kinds of innovations, both at present and in the future, it was concluded that the adoptive people had very close similarities of demographic characteristics, accessibility to information, and knowledge of three issues, including the perception of innovation characteristics in four aspects as well.

5.1.7.3 Innovation adoption of private car users and non private car users, both at present and in the future

When considering the innovation adoption both at present and in the future, it was found that there was relatively much acceptance among private car users. Among these people, 70.3% and 60.0% adopted innovations at present and in the future respectively, while among the non private car users, 40.9% and 42.7% of them accepted innovations at present and in the future respectively. There were some minor differences in each issue between the two groups, as found among the private car users, 56.2% were males, 36.6% were between 20-30 years old, most of them (74.8%) were single, widow or others and 42.0% had bachelor degree, 25.5% were state enterprises' employees, and 39.7% earned more than 10,000-20,000 baht. Besides, concerning accessibility to information in three aspects, it was obvious that most people, 65.2% and 87.2% had high accessibility to information about energy situations and problems, and innovations for energy conservation respectively. Nearly half of them (49.0%) had high accessibility to information about social support. For the knowledge of all three aspects, it was shown that about half of them or 49.0% and 50.7% had moderate knowledge about energy situations and problems, and about energy conservation innovations respectively. Moreover, 59.3% of them had low knowledge about social support. In addition, it was indicated that most of them, 70.3%, 75.9%, 67.2% had moderate perception about risk, comparative advantages and complexity respectively but more than half of them (53.1%) had moderate perception of complexity.

Regarding to the non private car users, 52.7% of them were males, 60.0% of them were between 20–30 years old, most of them were single, divorce and others. Moreover, 37.3% had bachelor degree and 30.0% were private enterprises' employees and more than half (53.7%) earned less than 10,000 per month. Besides, regarding to the accessibility to all three aspects of information, it was found that more than half (55.5%) had high accessibility to information about energy situations and problems and 82.7% had high accessibility to information about energy conservation innovations, and less than half (40.9%) had high accessibility to information about social support. Whereas, the knowledge about all three aspects, the finding was shown that half of them (50.0%), and less than half (45.5%) had moderate knowledge about energy situations and problems, and about innovation for energy conservation respectively, and most of them (70.0%) had low knowledge about social support. In addition, regarding to the perception of innovation characteristics, it was also indicated that most of them 63.6% and 77.3% had moderate perception of risk and comparative advantage respectively, and more than half, 54.5% and 53.6%, had moderate perception of compatibility and complexity respectively.

5.1.7.4 The relationship between age and other factors

Regarding to the relationships between age and other factors, such as accessibility and knowledge, including perception of innovation characteristics, the study was indicated that when considering people according to their age ranges; between 20-30, 31-40, 41-50, and 51-60 years old, there were some minor differences. The accessibility to information and knowledge about energy conservation innovations in private cars, most of all age ranges that were 84.3%, 92.0%, 85.3%, and 82.1% of them had high accessibility to this information respectively. The accessibility to information concerning energy situations and problems was also similar, except the 51 to 60 year age range whose accessibility was only 33.3%. Furthermore, the accessibility to information concerning social support was also similar, as the number of people with high accessibility was about half or less than half at every age range, except the 50 to 60 year old age range, there were only 38.5% of them having high accessibility. Concerning the knowledge, it was found that every age range had moderate knowledge, except the 51-to-60-year-old age range, 76.9% of them had low knowledge. Similarly, when considering about social

support, more than half of them had low knowledge. Finally, the knowledge about energy conservation innovations was shown that half of all age ranges had moderate knowledge about it but more than half or 59.0% of the 51 to 60 year old age range had low knowledge about this issue. It was also indicated that very few samples of this age range (only 2.6%) had high knowledge in all issues compared to other ranges.

Concerning the perception of different characteristics of innovations, it was not much different in all age ranges. The majority of them had moderate perception of all issues, and it was concluded that very few samples age between 51 – 60 years old had high perception of all characteristics when compared to other ranges.

5.1.7.5 The relationship between level of education and other factors

When considering the relationship between level of education and other related factors, such as accessibility to information and knowledge, including perception of different characteristics of innovations, it was found that most of the sample who had bachelor degree or higher had high accessibility to information about energy situations and problems which were 71.8% and 70.3% respectively. Whereas more than half of the people with secondary school and diploma or equivalent, or 53.6% and 56.4%, had high accessibility to these kinds of information respectively. The people of every education level had high accessibility to information about innovations. Besides, the study's finding shown that less than half of those with secondary school, diploma or equivalent, and bachelor degree, or 43.5%, 39.4%, and 46.6% respectively had high accessibility to information about social support, while more than half of those with higher education level than bachelor degree, or 59.5%, had high accessibility to this information. About half of those with secondary school and diploma or equivalent or 56.5% and 50.0% had low knowledge about energy situations and problems, while also more than half of those with bachelor degree and higher had moderate knowledge. Concerning knowledge about energy innovations, there was not much differences between different educational levels which was less than half of those with secondary school and diploma or equivalent, or 47.8% and 43.6% respectively, had low knowledge, while more than half with bachelor degree or higher, or 51.5% and 56.8% respectively, had moderate knowledge, whereas, more

than half of all educational levels had low knowledge about social support, especially those with diploma or equivalent rating at 74.5% .

Concerning perception about different characteristics of innovations, it was obvious that there was a minor difference. The majority of all educational levels had moderate perception of all aspects.

5.1.8 Factors Related to People's Adoption of Energy Conservation Innovations in Private Cars, both at Present and in the Future

The analysis of factors related to people's adoption of innovations at present by using "Logistic Regression Analysis" technique found that the -2LL value of the model was 443.489, showing the goodness of fit, and the chi-square value was 86.773, with the ability to explain 26.6% of the variation. Whereas, the analysis of factors related to people's adoption of innovations in the future by using the same technique found that the -2LL value of the model was 489.884, showing its goodness of fit, and the chi-square value was 60.215, which could explain 18.7% of the variation.

The result of the study showed that factors influencing people's adoption of energy conservation innovations in private cars both at present and in the future were three similar factors; gender, private car use and perception of comparative advantage characteristics of innovations as follows;

5.1.8.1 Gender

It was found that males were likely to adopt innovations at present and in the future more than females at 2.008 and 2.292 times respectively, probably because of gender differences in a skill development and an intellectual competency. Males generally had masculinity characteristics as they were physically stronger, adventurous, risk taking and had more competency in mathematics, geography and science, including having more interest in mechanism and technology, while females carried femininity characteristics with higher ability about languages, writing and arts (Terman and Tyler, 1954). The study result was also shown that most of adopted people of innovations were males.

5.1.8.2 Private car user

This study result was indicated that private car users tended to adopt innovations, both at present and in the future more than those without private cars at 3.423 and 1.875 times respectively. It was probably because private car users were more involved and felt more participation because they already experienced in using cars and expected to continuously use them further in the future, they had especially more interest in innovations which increased their options than the non private car users did because at present this latter group traveled by public transport and were not possibly certain whether to use private cars in the future. In fact, they felt that this issue was far from their reality (Eriksson, Garvill and Nordlund, 2008). Therefore, it was obviously confirmed that most adopted people of innovations were private car users.

5.1.8.3 Perception of comparative advantage characteristics of energy conservation innovations in private cars

The finding was indicated that this perception had positive reaction with people's innovation adoption both at present and in the future. As a result, the probability to adopt innovations, both at present and in the future, would increase by 5.9% and 7.9% respectively if the score of comparative advantage perception increased by 1 unit. When considering the comparative advantage perception according to the increase at each level, it was also explained that the innovation adoption also increased, both at present and in the future. As shown from the study, when considering at the low, moderate and high scores, it was found that the innovation adoption increased to 45.2%, 61.6% and 79.2% respectively. Similarly to innovation adoption in the future, it was shown that at the low, moderate and high scores of perception about comparative characteristics, the innovation adoption would increase to 40.5%, 55.1%, and 67.9% respectively.

It was probably because the comparative characteristics of innovations were the first things that attracted the consumers' interest on deciding to buy new products when comparing with other products in the markets, which if they were better in overall aspects, they would have adopted them, but if assessing and finding that the existing products were better, they would not adopt those innovations (Mohr, 2001).

Moreover, if considering the relative importance of all three factors related to innovation adoption at present by using the "CHAID", which were gender, private car use and perception of comparative advantage of innovations at the same time, it was found that the first factor related to innovation adoption at present to be considered was private car use of both car users and non car users. After the comparison, it was indicated that private car users adopted innovations more than non private car users, at 70.3% and 40.9% respectively. The next factor was the perception about comparative advantages. Both car users and non private car users would adopt more innovations, if the perception score rose. Consequently, if the scores of comparative advantage perception of private car users were less than 15, the innovation adoption would be only 56.2%. Whereas the perception scores were more than 18, the adoption would increase to 79.2%. Similarly, among the non private car users, if the perception scores were less than or equal 24, the innovation adoption would be only 32.2%, but if the perception scores were more than 24, the adoption would increase to 73.9% as well.

Likewise, when considering the relatively importance of all three factors related to innovation adoption in the future by using the "CHAID", which were gender, private car use and perception of comparative advantage of innovations at the same time, it was also shown that the first factors influencing innovation adoption in the future to be considered was gender. That was, males adopted innovations more than females, which was, 62.9% and 45.8% respectively. Among the males, the next factor to be considered was private car use. Males using private cars tended to adopt innovations more than males without private cars at 66.9% and 51.7% respectively. That was different from among the females, whose perception about comparative advantages of innovations was the next factor to be considered. It was concluded that if this perception scores rose, their innovations adoption would increase as well. On the other hand, if the perception scores were less than or equals 18, only 29.1% adopted innovation, but if the perception scores rose from 18 up to 27, the innovation adoption would rise to 53.8%, and if the perception scores were over than 27, the innovation adoption in the future would rise to 80.0%.

5.2 Recommendations

5.2.1 Recommendations from the Study

The study results shown that factors related to people's adoption of energy conservation innovations both at present and in the future, were three similar factors, which were gender, private car use and the perception about comparative advantage of innovations. In order to encourage the people to adopt more innovations both at present and in the future, there were problems to be resolved to decrease obstacles as follows;

5.2.1.1 The research's result was found that males tend to adopt innovations at present and in the future more than female 2.008 and 2.229 times respectively, there would also be additional recommendations to encourage females to adopt innovations more by providing them more information about innovations. In Venkatesh's research (Venkatesh and Morris, 2000), it was found that females concentrated on important information before deciding to adopt innovations than males. In order to increase the distribution of information, it could be communicated through publicity via different types of media, especially television, radio and newspapers, which was found in this research study as the first and the most accessible mean for people. However, woman magazines could be added as well, because most readers were women. The distribution of information must be presented more frequently, especially about social support issue which should be more than once a month. Besides, personal communications in form of reliability, convincing female celebrities should be added in the media for innovations to boost up people's confidence which might attract some increasing number of woman as followers. The publicity should emphasize on the perception of comparative advantages of innovations as both personal and public interest. Because the study result found that the perception of comparative advantages of innovations was another factor related to innovation adoption both at present and in the future, and most females had moderate perception about this issue, moreover, only a few of them (14.5%) had high perception about it, showing that only a few number of women realized the benefits of innovation adoption. In addition, the knowledge about different innovations distributed via media must be increased in content in order to develop women's

knowledge and it might lead to the more perception of comparative advantages of innovations because the study result shown that only a few number of females had high score in every aspect of knowledge, which indicated that only a minority of women were knowledgeable about this issue.

      5.2.1.2 The finding from the study shown that private car users were likely to adopt innovations at present and in the future 3.423 and 1.875 times more than non private car users respectively. Recommendations were as follows;

      1) There should be a publicity to distribute information in all kinds of public transport in order to access target groups directly, the non private car users. It must emphasize on comparative advantages if adopting innovations, both for personal and public interest, as it was found among the people with high perception of comparative characteristics, most of them (73.6%) were private car users and 26.4% were non private car users. It was indicated that this group of people did not quite realize the benefits of innovations. Moreover, its content must focus more on energy situations and problems, different kinds of innovations and social support, as the research results shown that among those with high accessibility to information about these three issues, there were small numbers of non private car users, that was, 24.4%, 26.5%, 24.1% respectively. It was also shown that those without private cars did not receive sufficient information in order to build their knowledge about these issues as indicated by those with high knowledge, the non-private car users were minorities in all three issues. The information distribution should convince even the non-private car users at present to take part in social responsibility as a whole too, if having a chance to choose any energy innovations by themselves in the future.

      2) The government should have demonstration projects and activities to stimulate the society to accept and create confidence among people for their adoption of energy conservation innovations. It should begin with public transport system, for example, public buses that used different types of alternative energy, by probably fixing a lower prices than usual as motivation of comparative advantages and to create their familiarity, particularly, among those without private cars in order to convince them to get more involved, and to have more social responsibility if there was a chance to use private cars.

5.2.1.3 The researcher found that the perception about comparative advantages of innovations had positive relationship to innovation adoption, as indicated that the likelihood to adopt innovations at present and in the future would rise by 5.9% and 7.9% respectively if the scores of comparative advantage perception increased 1 point, the innovation characteristics should be focused on in order to respond comprehensively the consumers' demand which were as follows:

1) Fuel/vehicle cost; according to research in the past, it was found that consumers were willing to pay 10% more for ecologically friendly products compared to existing products (Byrne and Polonsky, 2001). However, the prices had been set at competitive market level when compared with traditional fuel and vehicles. Important was the costs as and when consumers considering fuel cost, fuel saving, running costs, access to repair services, refueling costs and process, maintenance availability and cost and payback period, etc. If it is possible the prices of both fuels and cars should be set cheaper to be attractive.

2) Performance characteristics; they were innovation qualifications about different performances, such as speed, acceleration, and driving range, which were also consumers' other considerations. Modern technology would be able to improve to better qualifications to attract consumers and their decision making.

3) Stylistic; the car appearance was also another related factor. There were study results showing that consumers would not adopt products completely different from traditionally existing products, which resulted from socio-cultural consideration (Byrne and Polonsky, 2001). For example, in the case of natural gas cylinder installation, according to the interviews, it was found that one reason of not using natural gas was because consumers did not want to install cylinders due to their large sizes, which decreased the utility space of the cars and created negative image for the car users.

4) Safety; safety was a very important issue effecting consumers' purchase decision making. Information about innovative fuel and vehicles should be widely distributed in order to stimulate consumers' correct understanding. According to the interviews, it was found that people paid much attention in this issue concerning possible impacts of all innovations.

5) Refueling/ recharging of alternative fuel vehicle in terms of cost and process also effect consumers' behaviors which had to change accordingly; if the car did have a prospect of more convenience as well as a convenience for repair and maintenance, then a consumer could consequently decide more easily to buy it.

6) Availability of maintenance services; the government should provide the consumers having bought alternative vehicle with convenience by arranging after purchase maintenance and repair service training courses in cooperation with producers and additional training courses at private point of service might be arranged in order to respond all demands.

5.2.2 Recommendations about Government Policy

Various research studied on energy conservation innovation in private cars, including this one found that there were obstacles of innovation adoption, which arose from either the consumers themselves or different social context, that obstruct innovations from being adopted as much as it should be, and that might cause damages in the economy, environment and public health as a whole. The government should have an integrated supervision system to reduce obstacles and boost more adoption by the following approaches:

5.2.2.1 According to the study, it was found that more than half of the people, or 58.9%, had moderate and much perception of risk of innovations concerning the convenience of finding gas stations. The government should examine and manage to have the project implementation done according to the plan. For example, a use of natural gas promotion was relatively realized according to the target set in the road map in terms of number of cars and volume of gas consumption, but on the other hand, the number of new gas stations had not met the accumulative number targeted at 355 stations nationwide in 2008., while they were really finished only 272 stations (on 1 December 2008) and 142 stations were in Bangkok and peripheral areas, while there were as many as 122,572 cars using natural gas. As a result, it was insufficient at the moment. According to interviews, the people quoted that they had long waiting queue for services and sometimes the gas station ran out of gas because there were many kinds of vehicles of all sizes at the same gas stations, ranging from small cars to trucks and big buses, particularly in 2008, when oil price was very

expensive (Positioningmagazine, 2009). Similarly, the Office of National Statistics' survey about the opinions of 26,000 households nationwide concerning the use of alternative energy during January to June 2008 indicated that 25.4%, 33.6%, 39.9% and 51.9% of households thought that there were insufficient gas stations according to fuel types, which were gasohol, LPG, bio-diesel and natural gas respectively. Obviously, the majority of them found that there was mostly insufficient natural gas (National Statistical Office of Thailand, 2008c). Likewise, there were 133 gas stations of E20 nationwide and 83 of them were located in Bangkok and peripheral areas, while there were about 100,000 cars using this fuel, these cars users were obliged to use other types of fuel with lower alcohol ingredients instead despite more expensive prices (Energy Policy and Planning Office, 2009b). Actually, the ratio of the number of service stations and cars was 1:100 to be eligible to provide proper services (Byrne and Polonsky, 2001). Despite of the policy, apart from controlling the implementation to reach the goal, the government should also separate the service station types for different sizes of vehicles for consumers' convenience. There should also be fuel quality control so that all different types of fuel were the same standard at every station. As an overview of supporting infrastructure, every section should have interrelation and be well-balanced to prevent the "chicken and egg problem" in the network, which effected directly to consumers' energy innovations.

        5.2.2.2 The study found that 64.9% of people had moderate and very high perception about the risk of changeable prices of innovations, for the promotion of innovative fuel/vehicles, the government should promote and create investment atmosphere to collaborative stakeholders who were also considerably important as well as suppliers, infrastructure providers and market distributors. For example, the recent case of natural gas in 2008, the volatile oil price soared up to 140 dollars per barrel, and then in September 2008, its price decreased continually, which was not only effected the decreasing number of car owners who had their vehicles installed with natural gas equipment to less than 90.0%, from 200 vehicles per month to only 2-3 vehicles per month so that a number of small installing entrepreneurs had to stop the services (Positioningmagazine, 2008). Moreover, the owners of the vehicles already installed with natural gas equipment returned to use gasoline at an increasing number as well. Consequently, the total consumption of gasoline in January 2009,

reached 21.56 million liters per day, an increase of 11.0%, while the total consumption of gasohol accounted for only 12.56%, a decrease of 1.4% compared to the consumption in December 2008. That was the first decreased consumption in seven months, which was probably the effect of the cheaper oil price that made gasoline more preferable for people' use (Positioningmagazine, 2009). As a consequent, it might have better effect in the long run if the government adjusted the natural gas price gradually to certain level in order to reflect its real cost, and to prevent consumers from using it unnecessarily too much, as well as supporting the targeted road map and helping the entrepreneurs to take no losses in case the oil price remained low apart from the economic slowdown. The natural gas price adjustment should be done when oil price was high, by fixing it at around 9.50–10 baht per kilogram, which was lower than the entrepreneur demand in order not to have to much effect on consumers. Actually, the entrepreneurs had to bear financial responsibility in the differences between the natural gas price and fossil fuel because the real cost of natural gas was about 12 baht per kilogram, but the price was fixed at 8.50 baht per kilogram for three years, that made the entrepreneurs lose accumulatively according to the increasing quantity of the natural gas used, which at the end of 2008 year, it might cost more than 4 billion baht (Positioningmagazine, 2009).The natural gas price adjustment by the government would effect the investment on supporting infrastructure as the plan to respond the natural gas demand that might increased in the future if the oil price rose. This infrastructure was like service stations and pipelines that might not be too late, because the entrepreneurs would bear the losses less than without the adjustment of its price.

     5.2.2.3 As social support from the government and private sector for both entrepreneurs and consumers to boost more adoption of energy conservation innovations, the government should undertake a clear and continual policy on alternative energy, which was carried out systematically, in order to build confidence to key industrial stakeholders, such as manufactures, refineries and fuel providers, infrastructure provider, who would invest in new technology only when they were confident of its success because it was a very costly investment. The government must reduce the uncertainty by using suitable and timely measures, legislation and standards, as well as tax incentive. For example, the government resolution on 3rd

June 2008 to accelerate the E85 adoption by reducing its taxation as motivation, which was a good project, but it might affect the manufacturers producing and marketing the eco cars, which the government supported as product champion, along with the pick up for Thai market and export including cars using natural gas and E20 which had previously supported by the government not so long ago. Such accelerating policy caused the import of cars using E85, especially from Europe and the United States because the production in the country needed two years of investment. Actually, the Board of Investment already granted the eco car production to 6 companies including Honda, Toyota, Nissan, Suzuki, Mitsubishi, and Tata with the capital cost over than 200 billion baht. The government's support for cars using E85 at the moment might have effects on these car producers to reconsider whether their eco car investment worthwhile as previously expected. One reason was the taxation beneficial rights might not be convincing enough for the investment, because the government had agreed on the tax reduction of E85 cars to 25%, 30% and 35% according to the engine sizes; for the capacity of engine less than 2,000 cc, from 2,000 – 2,500 cc, and between 2,500 – 3,000 cc respectively, which was similar to that of E20 cars at present, together with the excise tax reduction of E85 fuel from previously 3.685 baht per litter to 2.575 baht per liter, while reducing the excise tax for eco cars to 17% which did not make much differences. The eco car production was obliged in compliance with many standards and conditions, especially the environmental issue set officially. While the E85 car standard was not yet clear, some sectors worried that the eco car production might be stricter. In addition, the taxation structural changes might be unfair for manufacturers who supported state policies, whether eco car project, E20 cars or pick up, that had to compete each other for internal market shares, as the government targeted to have E85 cars as many as 60% by 2011 (Kasikorn Researh Center, 2008). If the government's policy was to accelerate the E85 car use along with other energy or energy conservation innovations, it should consider cautiously in order to build the clarity for investors about policy implementation timing, appropriate excise duty. It must also consider the impact in different aspects on related industries, which were important marketing mechanism to promote the more widespread of innovations.

5.2.2.4 The finding from our result shown that 70.1% of people had moderate and highest perception about innovation compatibility characteristic concerning the reduction of public health problems if using energy conservation innovations in private cars, the government should issue laws on impact of transport and on the environment which would effect public health, for example, laws imposing level of car pollutants, including laws limiting uses of cars using traditional fuels by means of maximum allowable cars' age and subject to be used only in certain areas, because the more aged the car meant for the more emission performance accordingly. It was obviously found that the second reason causing cars unable to pass its condition check in the first quarter of 2009 in compliance with land transport law was pollution from exhaust pipes, such as there was black smoke, hydrocarbon, or carbon dioxide more than permitted, that was 25.66%. According to statistics at the end of 2007, there were 810,295 private cars in Bangkok older than 10 years or 37.3% of all 2,171,826 private cars in Bangkok (Department of Land Transport, 2007).

Table 5.1 Number of Private Cars Classified According to Their Working Ages Until 31 December 2007

Unit (vehicle)

Car type	Service age (year)					
	1-5	5-10	11-15	16-20	More than 20	Total
Private car for less than 7 passengers	962,076	320,921	428,782	130,152	132,810	1,974,151
Private car for over than 7 passengers	54,451	24,073	42,549	39,582	36,420	197,075
Total	1,016,527	344,994	471,331	169,734	169,230	2,171,826

Source: Department of Land Transport, 2007.

According to the Department of Pollution Control's data, Carbon dioxide was likely to become one of the major pollutants in 2007-2008 as it

discovered that there was carbon dioxide more the acceptable standard. The main cause was old cars with untreated engines installed with natural gas equipment. Most people thought that this could reduce pollution but the random check found that substance at very high quantity. It was probably due to the unqualified natural gas equipment installation because safety was normally considered as priority (ThaiEnergys.com, 2009).

    5.2.2.5 As the result from the study, which was indicated that 66.3% of people, had moderate and highest perception about compatibility characteristics of innovations concerning the reduction of pollution in the environment, the government should then consider the support in all aspects concerning the production of alternative energy and its uses in regard to its impact on the environment. That was, at the stage of ethanol production that used agricultural products to pass through biochemical and fermentation process to transform them into alcohol. The fermentation would produce the usable product only 10%, while the remaining 90% of raw materials were transformed into waste for disposal process. In producing 100,000 liters of ethanol, 1,000,000 liters of water were needed, which 900,000 liters would become wasted water needed to be treated because it was contaminated with many kinds of chemicals. If the water was reused in production process, it would affect the process, causing less production of alcohol but more waste water. The existing water purification system could not solve the problem of this low quality water. If it was released into natural water resources, it would cause water pollution. That was an important to the environmental problem, even though there was technology from abroad imported to treat the water in order to make it usable again (Department of Agricultural Extension, 2009).

    Regarding to the government's goal to produce bio-diesel as much as 8.5 million liters per day with the expansion of 5 million rai additional palm plantation lands during 2006-2008, and to increase to additional 10 million rais by 2029, it resulted in the rapid expansion of palm plantation, especially in watershed areas, community's forests and rice fields. Palm was a plant that needed a lot of water, and used it about 5 – 350 liters per tree as it had to be planted in high humidity areas. Besides, palm tree also needed sun light about 6 hour per day, grown well in the areas not higher than 300 meters above sea level, otherwise it yielded very little. There were

also tendencies to expand palm plantation in the North and North-Eastern, which would effect greatly the environment. The used soil already from palm plantation was usually deteriorated in quality, because it was a single crop production system, with intensive use of chemicals. Even there was a promotion to grow the mixed crops plantation, but it could hardly be done in reality because palm trees were so huge so that only twenty trees could be planted in one rai. Their roots expanded far from the trunks and each tree weighed more than three tons, so there were only a few kinds of plants that could grow in palm plantation. To destroy the remaining of palm trees and their wastes was also difficult and required a high cost for digging up the roots and buying chemicals to get rid of them, which would have more impacts on the land as well. Besides, it was estimated that planting one palm tree was creating thirty tons of carbon dioxide. Therefore, palm plantation promotion not only caused the destruction of forests to use lands for growing palm trees or other kinds of energy plants, it also released enormously greenhouse gases into the atmosphere (Department of Agricultural Extension, 2008).

In addition, according to the report of a air quality researcher of the Department of Environmental Quality Promotion on the spread of 10 cabonyle substances in the air in Bangkok by surveying forty nine roadside areas during 2006-2008 after the government's policy to encourage the people to use gasohol, it was found that the intensity value of formaldehyde and acetaldehyde were over than the monitoring standard of the American environmental and health assessing agency which assessed that if there were these substances only 1.23 microgram per square meter or 40 units per one million, people risked to have cancer. At roadsides in many areas, such as at the Monument of Victory, Rama 4 road, Rachadapisek road, Sukhumvit road, and Don Muang, there were formaldehyde five times more than the American risk standard, and 3 – 5 times higher than that in Osaka, Japan and in Ontario, Canada. The cause was from the incomplete combustion of engines. After the pollution was released from a car, when it contacted the light in the atmosphere, it would create more pollutants. It was shown that there was more ozone in the atmosphere, as well as dust particles in Bangkok areas. Besides, it was indicated that in countries that promote the use of gasohol, such as Brazil where 100% ethanol was used, there were lots problems of carcinogens (ThaiEnergys.com, 2009). In Thailand,

the promotion to increase the ethanol proportion use was up to 85% in gasohol E85. Thus, the government must place importance on this issue seriously by using measure to encourage and develop properly, including the examination of all processes, whether the production or the use of alternative energy to prevent subsequently negative impacts on the environment and public health.

5.2.2.6 The result from the study shown that more than half or 51.1% of people had moderate and highest perception about the risk of the shortage of raw materials for alternative energy production, so the government should consider the balance between food plants and plants for alternative energy production, of which many countries had worried about the impacts from using these alternative energy, which were to become new problems when the plants used normally as food were threatened by alternative energy production. At the end of 2007, the Food and Agriculture Organization of the United Nations (FAO) stated that thirty seven countries worldwide were facing food crisis and that cereal prices in world market were high causing already food riots in some countries, because a huge amount of cereal was used in alternative energy production. Previously, the New York Time reported an article stating that in Indonesia there was wide destruction of forest to expand palm plantations as happening in many developing countries who all wanted to enlarge their palm plantations. It showed that while each country focused on promoting alternative energy, they forgot the problems of forest destruction and the expansion of palm plantation into food cultivating land. In some countries, there was movement asking the government to stop such support. Moreover, it was estimated that within the next 10 years, prices of agricultural products would rise by 10 – 12%. Meanwhile, the encouragement to grow plants for alternative energy production in Thailand also had effect on the gradually rising prices of agricultural products. Especially, since May 2008, prices of some vegetables were doubled, and the demand in alternative energy based on agricultural raw materials also increased. In 2008, the gasohol consumption was about 8 million liters per day and 1.2 million liters for biodiesel, which tended to rise continually due to the government promotion. In producing ethanol or agro diesel, a huge amount of agricultural products were needed. For example, the proportion of energy production, such as corn 1 kg could produce 0.313 kg of ethanol, sugar cane 1 ton could produce 67.94 kg of ethanol, dried sugar

cane 1 ton could produce 247 kg of ethanol, rapeseed 1 ton could produce diesel 450 kg, palm seed 100 kg could produce 20 kg of oil. So, obviously, the agricultural products could produce energy in less quantity ranging from 7% to 30% (Energy Policy and Planning Office, 2009a). More demands of alternative energy, the more plantations of raw materials were needed. The goal to plant palm oil in six million rais of land during 2008-2011 was 5 million rais in the country and 1 million rais in neighboring countries. The oil palm plantation was expanded throughout the country in order to use for biodiesel to substitute 10% of diesel import by 2012. On the other hand, cassava growing was expanded into large areas of land to support ethanol production, that would probably impact land uses for other crops, especially in eight provinces in the North-East, including Nakorn Rachasima, Khon Khean, Buriram, Chaiyapumi, Ubon Rachathani, Srisaket, Amnatchareon and Yasothon. The expansion was carried out under such project to increase the tapioca production potentiality in land reformation areas in the North-East during 2008-2009, with over than 500,000 rais of target land, comprising 25,000 farmers, and with production capacity of 1,050,000 liters per day or 346.5 million liters per day. To achieve such amount of production outcome, 6,600 tons of fresh tapioca was needed everyday to feed factories, or 2.2 million tons per year. In addition, the corn price rose to eight baht per kilogram owing to high demand in world market for ethanol production, especially in the United States, resulting in the expansion of its cultivation in countries across the world (Royal Forest Department, 2009). Such expansion might cause Thai farmers to reduce the cultivation of other crops for the more expensive corn order to export increasingly, which might cause the corn shortage for animal feed factories due to being used as raw materials for alternative energy production. Because the more the state and private sectors encouraged the expansion of energy plant cultivation, the more the farmers might benefit from relatively high prices of their products. Agricultural lands would be probably transformed into energy plant plantation rather than remaining food crop cultivation lands. Consequently, the decreasing food growing lands would cause the rising of food prices, and finally, it might cause more problems of forest destruction for land uses. The government had to consider the oil palm cultivation promotion program and the food crop cultivation carefully in order to allocate land uses suitable to the available cultivating lands.

5.2.2.7 Another finding from the study result found that people's perception of innovation comparative advantages had positive relationship to their adoption of innovations the government might motivate them by using legislated encouragement of alternative use in order to convince them to use these types of energy. The government should reduce the special fees for them. In addition, it could also provide special lanes for their convenience and to reduce traveling time for these types of cars as done in many countries, and which was possible to be applied in some areas or some periods of the days when there was not much traffic.

5.2.2.8 The study result found that people's perception about innovation comparative advantages had positive relationship to their adoption of innovations, the government should consequently have policy to provide information to consumers thinking to buy new cars, by imposing the "car labeling system" to show information about fuel consumption and their carbon dioxide emission to help consumers' car purchase decision making as in some countries. Meanwhile, it would stimulate automatically the competition in the market when there were comparisons between products, which would be more beneficial to both consumers and the society as a whole.

5.2.2.9 The study also found that even though people had high accessibility to information of all three aspects; energy situations and problems, innovations for energy conservation together with social support from government and private sectors, they had moderate knowledge about the first two issues and low knowledge about the last one, so the government should emphasize on awareness campaigns about the cause and effect of fossil fuel used in transport sector, including to provide information about other kinds of innovations through different types of media. Moreover, the study found that television, radio and newspaper were the first three most popular, to which the people made themselves exposed for receiving information. Different types of public transport had to also be included, because non-private car use had effect on innovation adoption. Many research studies found that the knowledge about energy problems had effect on energy innovation adoption, therefore climate change issue should also be raised in order to increase public awareness, including motivating consumers and stakeholders to realize the comparative advantage of consumers themselves and those of producers as well.

In addition, there should also be the emphasis on different personal communications as well. Even though the government sector had already imposed to make these personal communications, such as automobile dealers' employees, gas stations' employees to acquire knowledge about related issues to make them capable to advise or answer consumer's questions, but it was still insufficient though. According to this research, it was indicated that the people received information from this kind of media had the least knowledge in every issue compared to that from all other media. Therefore, there had to be an examination of the operation to check the result in order to improve accordingly.

However, apart from motivating people by providing them with knowledge and comparative advantage concerning personal benefits, the public benefits must be displayed too, such as in economic, social, environmental, and health aspect, as well as the decrease of dependency on foreign countries, etc.

5.2.2.10 From a social support to both manufacturers and consumers' more adoption of energy conservation innovations' perspective, the government sector should support increasingly research and development of different energy innovations both in its own sector and in private sector as technological promotion and cost reduction, which would help small and medium size enterprises (SMEs) to have more participation in research and development domain. It would also be the distribution of information to people for their knowledge of work progress as well as their confidence to increase their adoption.

Those recommendations, either the result from the study or the government policy, were to respond to consumers' demand and to reduce the problems and obstacles that might occur. The research and the outcome should be very useful to convince people to adopt more energy conservation innovations, both at present and in the future for the benefits of the people, the society and the country as a whole.

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APPENDIX

QUESTIONNAIRE

The Adoption of Energy Conservation Innovations in Private Cars:
Current and Future Situations in Bangkok

Section 1: Demographic Characteristics

Please ✓ in the blank of your answers, or fill your answers in the blank.

1. Gender   ----------Male   ----------Female

2. Age   ----------years old

3. Marital status   ----------Single   ----------Widow

                               ----------Married   ----------Others

4. Educational level   _____ Secondary school or equivalent

                               ----------Diploma or equivalent

                               ----------Bachelor degree

                               ----------Higher than bachelor degree

5. Occupation   ---------- Civil servant ---------State enterprise's employee

                               ---------- Private sector's employee   --------- Student

                               ---------- Others

6. Monthly income   ----------less than 10,000 baht ----------- 30,001 – 40,000 baht

                               ---------- 10,001 – 20,000 baht----------- 40,001 – 50,000 baht

                               ---------- 20,001 – 30,000 baht

7. At present, do you use private car?

                               ------------- Yes   ------------ No

Section 2: Accessibility to Information and Knowledge

Have your ever received information about these following matters? If yes, how often and how much knowledge have you been informed?

Please ✓ in the blank, and the scores 1 – 5 are run from the least to the most.

Energy situations and problems	Accessibility to information		If yes, how often is the receiving? (approximately)					Knowledge					
	No	Yes	everyday	Once a week	Once a month	Once in 2-6 months	Once in over than 6 months	0	1	2	3	4	5
1.Source of fossil fuel, both from inside the country and from abroad													
2. The duration of the availability of petroleum before being depleted													
3.Tendency of the volatile oil price													
4.Which sector of the country use fossils the most; transport, industry or households?													
5. The country's annual expenses on petroleum													
6. Impacts on the environment from using fossil fuel													
7. Impacts on public health caused by the use of fossil fuel													

Innovations for energy conservation in private cars	Accessibility to information		If yes, how often is the receiving? (approximately)					Knowledge					
	No	Yes	everyday	Once a week	Once a month	Once in 2-6 months	Once in more than 6 months	0	1	2	3	4	5
1. Alternative energies eligible to substitute fossil fuels													
2.Objectives of the production of gasohol, biodiesel and other innovations, such as electric batteries, fuel cells, hybrid engines.													
3.Advantages of gasohol, biodiesel, natural gas, and other innovations, such as electric batteries, fuel cells, hybrid engines etc.													
4.Possible problems if cars using gasohol, biodiesel, natural gas, or other innovations such as electric batteries, fuel cells, hybrid engines etc.													

Social support	Accessibility to information		If yes, how often is the receiving? (approximately)					Knowledge					
	No	Yes	Every day	Once a week	Once a month	Once in 2-6 months	Once in over than 6 months	0	1	2	3	4	5
1. Government's subsidy for natural accessorial equipment installation.													
2. The tax exemption for natural gas accessorial equipment.													
3. The production of natural gas accessorial equipment in the country.													
4.Training courses for the installation of natural gas accessorial equipment.													
5.The increase of service points for natural gas equipment installation.													
6.The increase of filling stations of gasohol, biodiesel, and natural gas.													

Social support	Accessibility to information		If yes, how often is the receiving? (approximately)					Knowledge					
	No	Yes	Everyday	Once a week	Once a month	Once every 2-6 months	Once in over than 6 months	0	1	2	3	4	5
7.The government's pricing policy on fixing the gasohol, biodiesel, and natural gas prices cheaper than gasoline and diesel.													
8. The research and development related to gasohol, biodiesel, natural gas, and other innovations, such as electric batteries, fuel cells, hybrid engines etc.													

Media Accessibility

From which media have you received this information?

Please check ✓ in the blank (more than one answer is possible).

Content of the received information	Never received	Yes	If yes, from what media have you received this information?										
			T.V.	Radio	Electronic media	Printed matters	Motor show exhibition	Friends	colleagues	Family	state authorities	Auto dealer employees	Gas station employees
1. Fossil energy situations and problems of Thailand and the world.													
2. Alternative fuels that can replace fossil fuels in private cars.													
3. Support from the government and private sectors in different aspects to convince the people adopt alternative fuels to replace fossil fuels in private cars.													

Section 3: Perception about different aspects of innovations for energy conservation in private cars

How risky or problematic are these matters in your opinion?

Please ✓ in the blank and the scores 1 – 5 are run from the least to the most.

Risk	0	1	2	3	4	5
1.The shortage of raw materials for the production of gasohol, biodiesel, and other innovations, such as electric batteries, fuel cells, hybrid engines etc.						
2. Production standard of gasohol, biodiesel, natural gas, and others innovations, such as electric batteries, hybrid engines etc.						
3. The changeable prices despite the government's policy to keep them cheaper than fossil fuel prices, if cars using gasohol, biodiesel, and natural gas.						
4. The production standard of accessorial equipment for cars using natural gas.						
5. The standard of each service point for the installation of accessorial equipment in cars using natural gas.						
6. The convenience to find spare parts of accessorial equipment for cars using natural gas, and other innovations, such as electric batteries, fuel cells, hybrid cars.						

Risk	0	1	2	3	4	5
7. The repair standard of each service point for car using natural gas, and other innovation, such as electric batteries, fuel cells, hybrid engines.						
8. The possibility of the car efficiency or power diminution if using gasohol, biodiesel, natural gas, or other innovation such as, electric batteries, fuel cells, hybrid engines.						
9. The possibility of car working life diminution when using gasohol, biodiesel, natural gas, and other innovations such as, electric batteries, fuel cells, hybrid engines.						
10. The possibility of the increase of car insurance fee when using gasohol, biodiesel, natural gas and other innovations, such as electric batteries, fuel cells, hybrid engines						
11. The possibility of more difficulty of car reselling if using gasohol, biodiesel, natural gas, or other innovations, such as electric batteries, fuel cells, hybrid.						
12. The security if cars using gasohol, biodiesel, natural gas, or other innovations, such as electric batteries, fuel cells, hybrid engines.						

Risk	0	1	2	3	4	5
13. The convenience in finding filling stations when cars using gasohol, biodiesel, natural gas, or other innovations, such as electric batteries, fuel cells, hybrid engines.						
14. The convenience to find the repair service points when cars using gasohol, biodiesel, natural gas, or other innovations, such as electric batteries, fuel cells, hybrid engines,						

Comparative advantages

What advantages can you get from these matters in your opinion?

Please check ✓ in the blank, the scores 1 – 5 are run from the least to the most.

Comparative advantage	0	1	2	3	4	5
1. The decrease of fuel refilling expenses when cars using gasohol, biodiesel, natural gas, or other innovations, such as electric batteries, fuel cells, hybrid engines,						
2. The decreased cost of accessorial equipment installation for cars using natural gas due to the government's subsidy.						
3. It is a worthwhile investment if having cars installed with accessorial equipment for using natural gas, or other innovations, such as electric batteries, fuel cell, hybrid engines.						

Comparative advantage	0	1	2	3	4	5
4. Low repair or maintenance cost if cars using gasohol, biodiesel, natural gas, or other innovations, such as electric batteries, fuel cells, hybrid engines.						
5. The car reselling price will increase if cars using gasohol, natural gas, or other innovations, such as electric batteries, fuel cells, hybrids engines.						
6. The increase of fuel options when cars using gasohol, biodiesel, natural gas, or other innovations, such as electric batteries, fuel cells, hybrid engines.						
7. More convenience because being able to use gasohol, biodiesel, or natural gas instantly, and able to reverse to fossil fuels again.						
8. Being praised by others when cars using gasohol, natural gas, or other innovations, such as electric batteries, fuel cells, hybrid engines,						

Compatibility

How much do your agree with these matters?

Please check ✓ in the blank, the scores 1 – 5 are run from the least to the most

Compatibility	0	1	2	3	4	5
1. The country's dependency on foreign oil import will be reduced if cars using gasohol, biodiesel, natural gas, or other innovation, such as electric batteries, fuel cells, hybrid engines.						
2. The country's expenses on energy will be reduced its if cars using gasohol, biodiesel, natural gas, or other innovations, such as electric, fuel cells, hybrid engines.						
3. The increase of farmers' incomes, as their products becomes raw material for the production of gasohol, or biodiesel ingredients.						
4. The decrease of petroleum natural resource consumption if cars using gasohol, biodiesel, natural gas, or other innovations such as, electric batteries, fuel cells, hybrid engines,						
5. The reduction of pollution in the environment if cars using gasohol, biodiesel, natural gas, or other innovations such as, electric batteries, fuel cells, hybrid engines,						
6. The reduction of public health problems when cars using gasohol, biodiesel, natural gas, or other innovations such as, electric batteries, fuel cells, hybrid engines,						

Complexity

How complicated or difficult are these matters in your opinions?

Please check ✓ in the blank, the scores 1 – 5 are run from the least to the most.

Complexity	0	1	2	3	4	5
1. The categorization of types and models of cars using gasohol, biodiesel, or natural gas.						
2. The categorization of types and ingredients of each type of gasohol and biodiesel.						
3. The understanding about natural gas accessorial equipment and other innovations, such as electric batteries, fuel cells, hybrid engines.						

Section 4: Innovation adoption

Type of innovations for energy conservation in private cars, such as

1. Gasohol is a type of fuel using ethanol or alcohol obtained from the transformation of carbohydrate and sugar giving plants, such as sugar cane, rice, corn, tapioca, as ingredient to mix with non-leaded gasoline at different proportions.

2. Biodiesel is a type of fuel using oil derived from beans (leguminous plant), such as peanut oil, physic nut, coconut oil, palm oil, to mix with diesel at different proportions.

3. Natural gas is a type of fuel found together with petroleum deposits in Earth's crust. It can be used with conventional gasoline or diesel engine modified with accessorial equipment.

4. Fuel cell is a medium causing electro chemical reaction between oxygen and hydrogen which generates directly electricity without combustion. It does not cause air pollution and is 1-3 times more efficient than conventional engines.

5. Electric batteries generate electric, causing no pollution, and equipped with security system to prevent the short circuit to the drivers. Battery charge takes 4-6 hours and the car can run about 70 km. long and its top speed is 50-60 km. per hour.

6. Hybrid engine produces energy from combined technologies of conventional fuels and electricity, so it diminishes the defectiveness of each system and is efficient in terms of both fuel saving and pollution reduction.

7. Solar vehicle is an electric vehicle powered by a type of renewable energy, by solar energy obtained from solar panels on the surface (generally, the roof) of the vehicle. Photovoltaic (PV) cells convert the Sun's energy directly into electrical energy. Solar vehicles are not practical day-to-day transportation devices at present, but are primarily demonstration vehicles and engineering exercises, often sponsored by government agencies.

Innovation Adoption at Present and in the Future

1. Have you ever used these kinds of energy in your private cars? If yes, how often and what do you think about the uses of these energies in the future?

Please check ✓ in the blank (more than one answer is possible)

Types of energy		If yes, how often of the use at present?					In the future, you think to…	
	Never	Every time	Once a month	Once in every 2-3 months	Once in 6 months	Once in over than 6 months	use	not use
Gasohol Biodiesel Natural gas Other energies, such as electric batteries, fuel cells, hybrid engines and solar cells								

2. At present, you use these kinds of energy

because…………………………………………………………………………

3. At present, you do not use these kinds of energy

because………………………………………………………………………….

4. You think to use these kinds of energy in the future

because…………………………………………………………………..

5. You think that you will not use these kinds of energy in the future,

because……………………………………………….

6. You are not sure whether to use these kinds of energy in the future

because……………………………………………

7. Do you think there should be law enforcement to use alternative energy to substitute fossil fuel? …………………………..

Because…………………………………………………………………………………

BIOGRAPHY

NAME   Alisa Verapatanakul

ACADEMIC BACKGROUND   1985 B.A.(Banking and Finance)
                                        Chulalongkorn University
                                        1996 B.A.(Mass Communication)
                                        Ramkhamharng University
                                        1998 M.A.(Public Relations)
                                        Chulalongkorn University
                                        2001 M.P.P.M.(Public and Private
                                        Management)
                                        National Institute of Development
                                        Administration

PRESENT POSITION   Air Purser
                                        Thai Airways International
                                        Public Company Limited