University of Helsinki
Faculty of Agriculture and Forestry
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Master ́s Degree Programme in Forest Sciences and Business

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CHINESE UNIVERSITY STUDENTS' AWARENESS AND ATTITUDES TOWARDS FOREST BASED BIOENERGY

Master ́s Thesis

Helsinki, Finland, 2014

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

Aalto University

Tiedekunta/Osasto — Fakultet/Sektion — Faculty	Laitos — Institution — Department
Faculty of Agriculture and Forestry	Department of Forest Sciences

Tekijä — Författare — Author Haiyang Hu

Työn nimi — Arbetets titel — Title

Chinese university students' awareness and attitudes towards forest based bioenergy

Työn laji — Arbetets art — Level	Aika — Datum — Month and year	Sivumäärä — Sidoantal — Number of pages
Master ś Thesis	December, 2014	83 Pages

Tiivistelmä — Referat — Abstract

Forest biomass is considered as one of the most important alternative energy sources across the globe. Growing attention has been given to the studies concerning biomass and related bioenergy and biofuel, and their potential for future development.

This study takes higher education as unique aspect, focusing on the awareness of Chinese university students of Forest Based Bioenergy (FBB) development and how education background / awareness may influence the FBB development in China.

Since FBB is relatively a new concept in China, its development and further utilization are believed to largely relay on the matters of education, social trend and awareness. Students in higher education are considered as a special group: they may be educated related to FBB and will become the future consumers and even decision-makers. This make awareness, attitude and opinions about FBB from the students` point of view significant.

A literature review was made for the background study and quantitative research, plus surveys and interviews were conducted as data collection methods. Objectives of the thesis are to study the awareness of and attitudes towards FBB among Chinese university students and if those opinions were influenced by their studies.

Results indicate that education strongly affects students ´attitudes. FBB development is seen as a positive signal and students are likely to support FBB development. FBB is believed as a new trend of renewable energy development. However, FBB in China will not see a rapid booming in the near future and it has only limited impact towards the traditional fossil fuel domination, but due to its characteristics, governmental recognition and growing awareness, it certainly shall be seen as strong supporter of China ś sustainable development. It also has to be holistically utilized considering environmental, social and economic aspects, to reach its full potential and to support China ś target of sustainable energy development.

Avainsanat — Nyckelord — Keywords

Sustainable development, Energy, Student, Finland, Forest based bioenergy, China, Awareness, Attitude, University education

Säilytyspaikka — Förvaringsställe — Where deposited

Otaniemi Library, Aalto University, Espoo, Finland

Viikki Science Library, University of Helsinki, Helsinki, Finland

Muita tietoja — Övriga uppgifter — Further information

This is a Master`s degree thesis towards Master`s degree diploma at University of Helsinki;

This thesis is co-edited by the Department of Energy Technology, School of Energy Engineering at Aalto University.

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ACKNOWLEDGEMENT

Foremost, I`d like to express my gratitude to Professor. Bo Dahlin at Department of Forest Science, University of Helsinki; as my study line professor and major supervisor, the knowledge, inspiration and supervision that has been provided is fundamental to this thesis work. I`d also want to thank Dr. Mike Starr for having his constructive advice and generous help towards my studies. As University of Helsinki 2013 research grant receiver, I also wish to deliver my appreciation to my university for funding my data collection trip, and it is truly an honor of being supported and working with all nice university staffs.

Besides, I`d love to dedicate my sincere appreciation to Mr. Patrick Eriksson, founder, Senior Advisor, and CEO Mr. Antti Saravuo of Tengbom Eriksson Architects Ltd., whose leadership and the given opportunities, have all become the precious experiences and treasures of my life.

The research topic was initially discussed with Dr. Maarit Kallio from METLA, I wish to thank her for introducing me to Research Scientist Ms. Laura Kainiemi and Research Engineer Mr. Thomas Kohl at the School of Energy Engineering of Aalto University for the further cooperation and study. And hereby I`d like to dedicate the special thanks to Ms. Kainiemi and Mr. Kohl, as my thesis advisors at Aalto University, their essential advices have encouraged me to complete this work with greater confidence.

Deepest appreciation to my family and friends for their resolute supports, and to Ms. Hoàng Thị Mỹ Ngọc, whose support and encouragement is always nearby.

Thanks / Kiitos / Tack / Cảm ơn / 谢谢!

Haiyang Hu
December. 2014
Helsinki, Finland

ABBREVIATIONS

FBB	Forest Based Bioenergy
IEA	International Energy Association
NDRC	National Development and Reform Commission
NFEDRC	National Forestry Economic and Development Research Center
FAO	Food and Agriculture Organization of United Nations
NGO	Non-Governmental Organization
SFA	State Forestry Administration of China
CSC	China's State Council
GHG	Green House Gases
NFI	National Forest Inventory
RCEP	Royal Commission on Environmental Pollution
GM	Genetically Modified
SRC	Short Rotation Coppice
GIS	Geographic Information System

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1. INTRODUCTION

1.1 Background of the Study

Ever since industrial evolution, our society has been constantly driven and transformed by energy: possibly the most essential enabler of all time. Nowadays, the growing concerns of fossil fuel use and the rising scale of renewable energy implementation, stronger social attentions have been seen globally. This current social problem can be seen more strongly in China, the world`s largest developing country and the world's second largest energy consumer and carbon dioxide emitter (FAO, 2008).

The Chinese central government has targeted to promote the development of renewable energy production, energy efficiency and general environment protection, according to the "Medium and Long-Term Development Plan" during China`s 11$^{th}$ "Five-Year-Plan" period, which was approved by the China People ś Congress in March, 2006 (Zhang & Li, 2009). This energy political enhancement was expected to adjust China's energy system. The enlargement of renewable bioenergy use was targeted and it aimed to hold 15% of China`s transportation sector with the general growth of bioenergy use among multiple directions by 2020 (NDRC, 2007).

Enlarging the share of renewable energy might be an important dimension of China's energy system transition. Nowadays more attention has been seen towards bioenergy development, but the facts indicate China is still majorly powered by traditional fossil fuel, with 71% of energy coming from coal and 19% of oil with only 0.2% of renewable energy (EIA International Energy Statistics, 2008). This leaves a large space for growth of renewable energy under the international vision and domestic political attention.

Meanwhile, China is developing by following the concept of sustainable development; aiming to develop society in an environment-friendly and thus economically efficient way, where all aspects of the society could be balanced. In this case, energy is once again acting as an enabler, which leads the trend of reducing fossil fuel consumption. Meanwhile, raising the scale of bioenergy usage is essential to reduce the global fossil fuel shortage, and to improve environmental quality thus controlling the greenhouse

effect, which might serve as one of the effective methods of promoting urban / rural economic and socially sustainable development.

Under this condition, renewable energy, such as Forest Based Bioenergy (FBB) is believed to have bright opportunities since political enhance and support are already in position. Furthermore, the development of forest based bioenergy has seen benefits from rich raw material reserves, policy incentives and the improvement of related technology. New products and facility including biomass pellets, liquid bio-fuels, and high-capacity biomass power generator are also becoming available (IEA Bioenergy, 2005).

1.2 Motivation of the Study

At the moment, China has the potential for forest based bioenergy development, with an emerging, active market for renewable energy. However, there are still various types of issues that may influenced the trend of such development. One of the most critical issues is believed to be the limited awareness and education in forest based bioenergy and sustainability, since the Chinese society has been powered almost totally by fossil fuel. Therefore, it has left public awareness of the forest based bioenergy an uncertain picture; due to the importance of social awareness that holds the key on Forest Based Bioenergy development, which makes the study of social awareness and acceptance essential for understanding how a certain subject could be further developed. Such condition leaves "how forest based bioenergy could be further accepted and developed within the framework of sustainability in China" a practical question and valuable research topic.

1.3 Current Conditions of China`s Forests

Forest is acknowledged as one of the most important natural resources in China, based on the intensive focus on sustainable development and investments on environmental protection, China has been experiencing a constant and fast forest stock growing and

the enlargement of its forest coverage in recent years. The quality of China ś forests has also been improved from certain aspects, for instance, plantation management, landscape management, where the forest structure and condition of land conservation have also been improved. Forests that are not managed by public ownership are rapidly developing.

1.3.1 Forest Governing Bodies and Ownership in China

Forests in China are majorly owned by the central or local government, its structure is indicated in Figure 1 below:

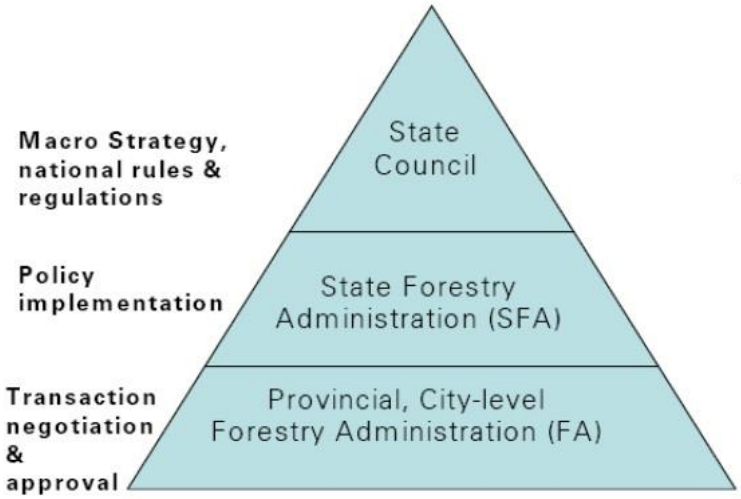

Figure 1. Structure of China ś forestry governing body

(Source: Deutsche Bank. China Forestry Industry. 2007)

State-owned and collective forestry are the two major types of forestry ownership in China. 42.5% of the China's forests are state-owned. 37.5% are preserved for the forest growing stock, which leaves a total 20.3% of forests in China are privately-owned (6th NFI, 2003).

Illustrated by figure 2, the state-owned forests include: State-owned forest enterprises and State-owned forest farms, while Collective forestry contains Collective forest farms and Individual forests or woods. As one of the unique forest management methods, it

was established for over decades and is controlled via contracts between governments and local residents.

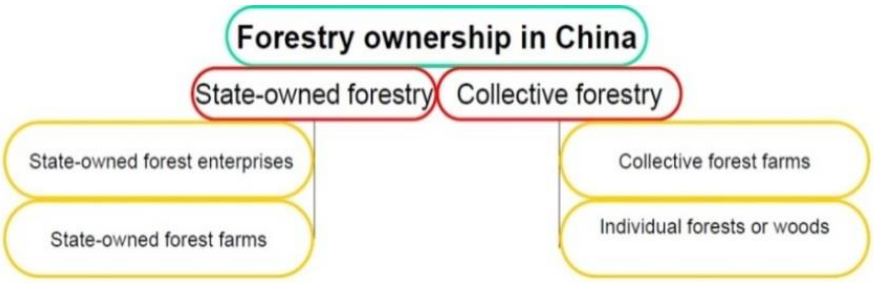

Figure 2. China ś forest ownership structure

(Source: National Forestry Economic and Development Research Center. 2006)

Approximately 70% of China's population is located in rural areas where they rely on collectively owned land as a primary source of income and livelihoods, for example: the products / livestock, job opportunities and production range. (Source: National Forestry Economic and Development Research Center, 2006)

1.3.2 China`s Forest Resource

China has considerably large scale of forest resources, figure 3 below maps the general distribution of China`s forest resources (Li. 2005). China has a great variety of forest types, which can be observed in the different regions.

Figure 3. Distributions of China ś Forest Resources

(Source: Zengyuan Li, Research Institute of Forest Resource Information Technique, Chinese Academy of Forestry, 2005)

The northern area is constantly under considerable cold temperature. It is ideal for coniferous trees, followed by a mixed type of forests which are full of deciduous and broad-leaved trees in the warmer temperate zone. The mild temperate area is dominated by broad-leaved forest, evergreen broad-leaved forest in the subtropical zone while the rainforests are located in the southern area. (Li, 2005)

As the figure 4 indicates, due to intensive effectors and social focuses that have been distributed to China ś recent environmental protection and the natural conservation activities. It also based on the official "11th Five-Year Forest Plan" and the National Long and Medium Term Forestry Development, China ś forest resource has been placed in an ideal and fast growing session in the recent decades.

Figure 4. China`s forest resource growth, 1973-2008

(Source: SAF, 2011)

According to "The 7th National Inventory on Forest Resources", in the end of 2008 Chinese forest area was 0.128 ha per capita. The total forested area in China is 195.45 million ha, which occupies 4.95% of the world ́s forests, making China fifth in the world, measured by forest cover. The coverage of forest was 20.36% of China ́s total land area, where the gross standing stock volume was measured as 13.62 billion m^3 with forest stock volume of 14.55 billion m^3(SFA, 2007). A detailed figures of China ́s forest resource can also be found in table 1 below:

Table 1. The 7th National Forestry Survey Data

(Source: SFA, 2007):

Seven National Forestry Survey data				
Number of National Forestry Survey	Date	Forest area/10^4 ha	Forest cover rate/%	Increment/10^4 ha
1st	1973–1976	12186	12.7	–
2nd	1977–1981	11527.74	12	–658.26
3th	1984–1988	12465.28	12.98	937.54
4th	1989–1993	13370.35	13.92	905.07
5th	1994–1998	15894.1	16.55	2523.75
6th	1999–2003	17490.92	18.21	1596.83
7th	2004–2008	19500	20.36	2054.3

Based on the mentioned trend of development, it is estimated that in the year of 2020, the newly afforested area will reach 29.60 million ha. The forest coverage rate is

expected to reach 23.46% of the total land area. An area of desertification will be controlled under 20 million ha. Meanwhile, urban tree coverage will reach 35% in over 70% of Chinese major cities. The rate of quality seeds in plantations will achieve 65%, and the contribution of science and technology enhancement to the forest economic growth will reach 50% (SFA, 2007).

The main purposes of China ́s forest utilization are divided into four categories: Protective forests 38%; Special purpose forests 4%; Commercial timber forests 56% and Fuel wood forests 2%. Specifically, protective forests are functional to protect against flooding and soil erosion; timber forests are source of round wood and non-wood forest products; the special-purpose forests are reserved for environmental protection and forestry research and the fuel wood forests are sources of the forest based bioenergy productions.

1.4 Current Conditions of FBB in China

Biomass usage has a long term history along with the social development of China. Traditionally speaking, until the middle of 19th century, biomass dominated the national energy consumption, due to the fact that China's economy was still based on agriculture and forestry. However with the trend of indoctrination, fossil fuel usage has rapidly increased, which has largely replaced the biomass based energy production, however biomass energy is still widely used in rural areas.

Recently the fast growing environmental problems, shortage of fossil fuel and food security issues have increased the utilization of biomass, especially forest based bioenergy. Compared to traditional biomass utilization, a biomass energy transition has been made, where continuous development has been made in modern biomass energy technologies; functional biomass energy marketing mechanism is applicable and certain policies with strategies are used to promote national biomass energy production. (Renewable Energy Law of the People's Republic of China, 2006)

China has relatively large amount of forest recourses, the detailed types and quantities of forest based bioenergy in China can be observed from table 2 below:

Table 2. Types and quantities of forest biomass for bio-energy in China

(Source: Caihong Zhang, Resource Potential and developing prospects of Forest Bio-energy in China, Beijing Forestry University, 2008)

Woody biomass types	Available harvesting area (Million hm²)	Available woody biomass technically (Billion tons per year)	Available woody biomass for energy (Billion tons per year)
1.Branches residues from forest production	142.79	0.153	0.04
2.Energy forest	3.03	0.048	0.03
3.Shrubbs coppicing	45.30	0.15	0.05
4.Branches residues from forest thinning	91.00	0.239	0.05
5.Branches residues from economic forest	21.40	0.15	0.03
6.Branches residues from harvesting of bamboo forest	4.84	0.05	0.01
7.Branches residues from trees outside forests		0.03	0.01
8. Branches residues from urban green trees pruning		0.04	0.02
9.Residues from nursery stock pruning		0.015	0.01
10.Discarded wood-based products		0.08	0.04
11. Fruits or seeds from oil plants	4.2	0.002	0.001
Total		0.957	0.298

Also, examples of FBB utilization facilities across China are indicated in the table 3:

Table 3. Examples of forest based bioenergy utilization facilities in China

(Source: Caihong Zhang, Resource Potential and developing prospects of Forest Bio-energy in China, Beijing Forestry University, 2006)

Projects Name	Progress	Investment (Billion Yuan)	Scale (MW)	Types of fuel
Tongliao Naimanqi Forest Bio-power Factory	Trial operation	0.267	24	Forest residues
Maowusu Biomass CHP Factory	In operation	0.241	24	Forest residues
Arxan Forest Bio-power Factory	Feasibility research		24	Forest residues
Jiangxi Boyang Kaidi Bio-power Factory	Trial operation	0.25	24	Forest and agricultral residues
Anhui Chao Bio-power Factory	Feasibility research	0.272	30	Forest and agricultral residues
Shandong Guoneng Danxian Bio-power Factory	In operation	0.3	24	Forest and agricultral residues

Forest based bioenergy is one of the important biomass energy which has been given continuous focus in China. A certain scale of the FBB production facilities is already functional with numbers of FBB projects are under research and constriction.

All kinds of biomass related energy production depends on energy sources, energy production technologies and facilities. As we could clearly observe that listed projects have small productivities in comparison, due to outdated and small-scale equipment of forest biomass harvesting and energy production in China. Under this condition, expected development requires importation of advanced technologies and equipment from developed countries, for example Finland and Sweden, who are expertized in forest bioenergy utilizations.

2. AIM AND RESEARCH QUESTIONS

When new technologies or concepts are created, the educational background, especially the higher education determines public awareness of innovation, and how they might be utilized is critical for a successful introduction and future development of new technologies, products and concepts (Mayfield, 2002). It is believed that with higher educational background, human being has become more civilized and more concern about their longevity, which has been reflected in increasing concern of sustainability. This study takes education as essential factor, meanwhile focusing on social awareness and acceptance of the students.

Within this research a survey questionnaire and interviews are used, concentrated on higher education students` attitudes towards FBB development and the sustainable development. Besides, the main factors influencing awareness and acceptance of FBB among Chinese higher education students is following, and the analysis serves as references for the next step discussion. Meanwhile, the next objective is to understand China`s sustainable development trend with focus on its energy sector and to reveal connection between forestry, forestry education and sustainable energy development.

Finally, discussions of the current FBB development issues together with its connection with university education background will take place; generating answers of how students' awareness and acceptance might be interacting with sustainable energy development and further FBB utilization in China. This research aims to answer the questions concerning how social acceptance could influence and interact with prospects and sustainability of FBB development in China.

3. THEORETICAL BACKGROUND

In this chapter, a review of China`s forest resources is presented in terms of the current status of FBB development. Moreover, the general sustainable development principles are mentioned, along with concepts of social awareness and importance of the social acceptance.

3.1 Bioenergy

Biofuel is one of the alternative / renewable energy sources and is produced from biological materials that are chemically and biologically processed. Nowadays with the massive constructions of bioenergy power plants over the world, electricity generation facilities are able to generate a reliable production of renewable power. Biological material is described as biomass: organic materials that have stored sunlight / solar power in the form of chemical energy. Biomass energy is derived from recently-living organic matter. Mainly, the sources of biomass are from agriculture and forestry, for instance: wood, saw dust, forest residuals, straw, sugarcane, and other byproducts from a variety of agricultural food industries. (Frauke Urban & Tom Mitchell, 2011), where a detailed bioenergy source classification can be seen from the figure 5 blow:

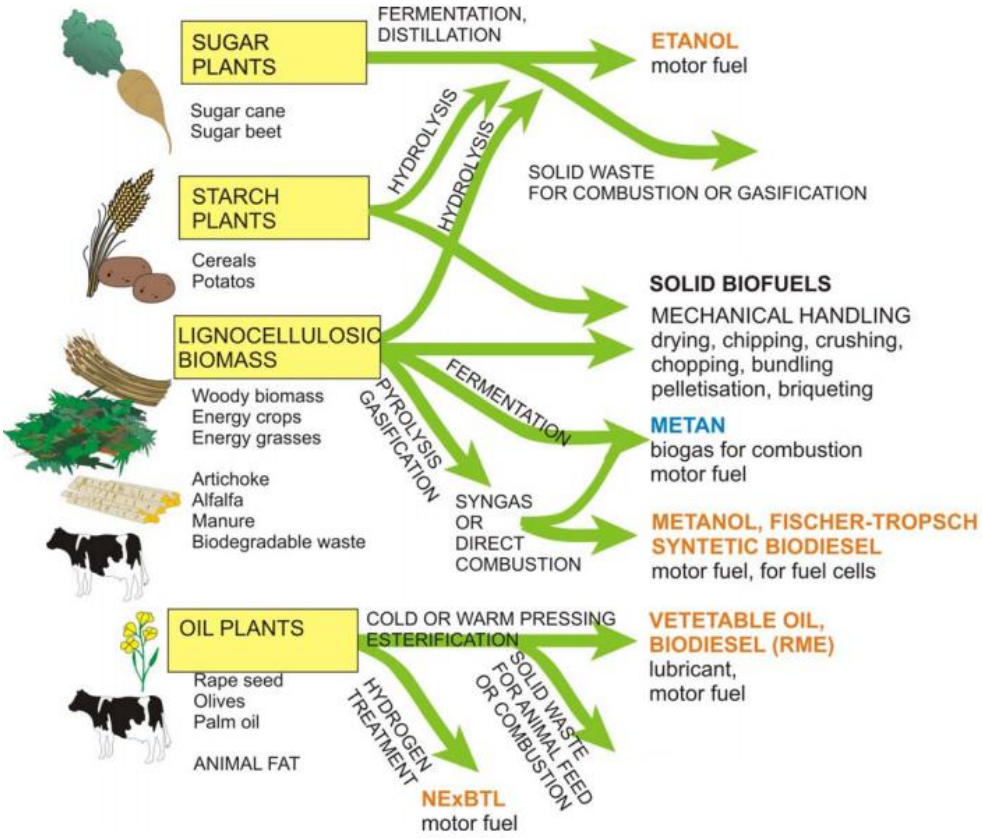

Figure 5. Bioenergy source classification

Source: Eija Alakangas. VTT, 2012

When biomass materials are used for energy generating purposes, they are functionally labeled as biofuel, and the energy / power that is produced via biofuel combustion process is described as bioenergy. Biomass, as the source of bioenergy might be ranked as one of the oldest energy sources in the history. In 2008, 9.9% of the world's energy was generated by biomass (Ontario Power Generation, 2010).

In many parts of the world, wood is used as a primary source of energy for cooking and heating. In the Nordic countries and some other European nations, biomass has already been successfully developed and largely utilized. For the North American region, Russia and China, which are majorly powered by fossil fuels, the trend is to increase the support for the development of bioenergy technology and enlarging the biomass electricity generation scale. The carbon emission cycle for bioenergy use is indicated in figure 6, explaining besides the necessary material and energy input when utilizing, bioenergy is carbon-neutral during the whole life cycle.

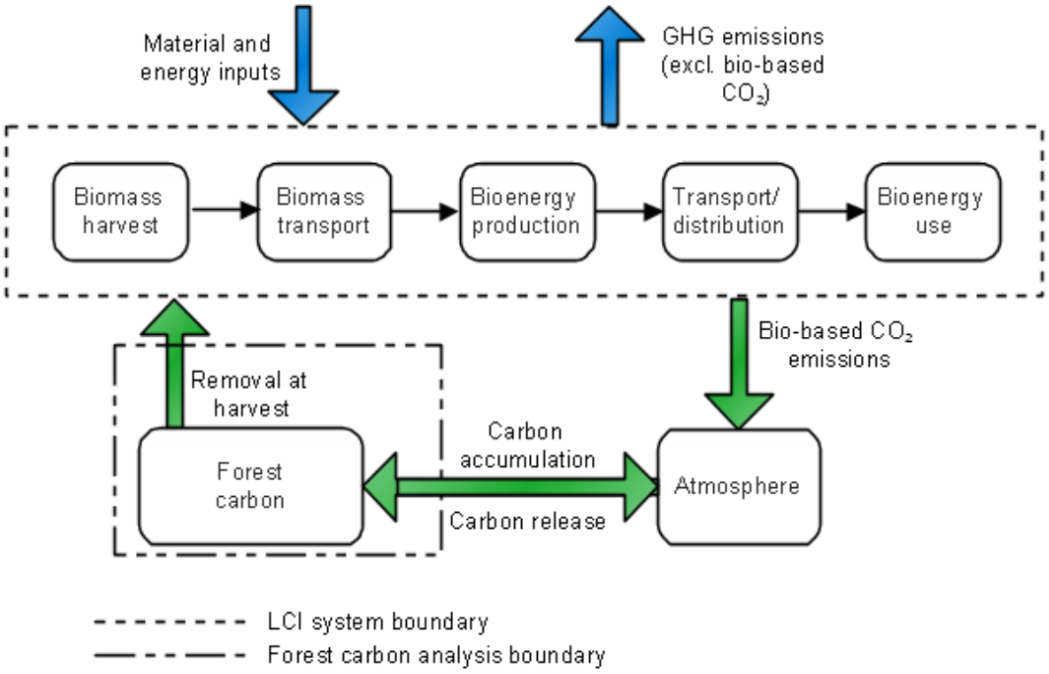

Figure 6. Carbon cycle of bioenergy

(Source: Ontario Forest Research Institute & University of Toronto, 2011)

Sources of biomass, such as forests are able to mitigate the greenhouse gas effects through absorbing and storing carbon dioxide in their living stocks during the life cycle or in dead organic matters afterwards (Larson, E. D, 2006). The stored carbon supports growth of living stock, and provides feedstock for energy production during the bioenergy utilization.

3.2 Forest Based Bioenergy (FBB)

Forest based bioenergy (FBB) is the output from renewable forestry biomass on the energy generation process. Forest biomass is categorized as wide range of plant or tree material produced by forest growth.

Based on the categorizations of forests, several major types of forests are used in the biomass: source of bioenergy productions:

a. Natural or semi-natural forests: This is one of the most commonly used forests for biomass collections. Forests in this condition have been logged or used in some other way before. It is described as a mixed type of functional forests.

b. Tree plantations: The tree plantations are frequently utilized as source of forest based bioenergy productions. Growing interests in using genetically modified tree species have become more productive in the energy biomass accumulation. This type of plantation is widely used in Europe and China. (Madsen, 2002)

c. Short Rotation Coppice (SRC): It is a type of biomass plants that are harvested between every 3-7 years. This type of plants grows faster and can be harvested more frequently than normal tree plantations. Willow and poplar are the mostly used short rotation species (Smeets, 2008).

d. Grass energy crops: This category mostly contains miscanthus and switch grass which are planted for specific usages of biomass production.

e. Traditional coppice: Comparing to SRC, the traditional coppice is harvested between 11-45 years, and standard coppice can be collected every 10-50 years and 110–130 years for the upper level (Hermy, 2007).

f. Coppice with standards: This means that scattered individual stems are able to grow on through several coppice cycles. Another understanding of this type is as agroforestry systems, where agricultural and forestry operations are carried out on the same land simultaneously (Keefe, 2009).

Besides the major forest types that are used for biomass production, as the actual biofuel products illustrated in figure 7, the following types of the forest biomass have widely produced and consumed in bioenergy generation progress:

Figure 7. Pellet, logging residue, bioethanol and waste paper as biofuel

(Source: European Commission, energy sector, 2013)

i. Wood pellet is the most common type of forest based biofuel. Wood pellet fuels are made of compressed biomass. They are mainly made of compacted sawdust or other sawmilling waste. Other woody biomass includes trees, branches and other logging residues be used as the pellets production. Wood pellets are extremely dense with low moisture content, less than 10% that provides this energy source high energy content between 4.7 and 5.2 MWh/ton (Adam Sherman, 2012).

ii. Logging residue: Non-merchantable parts of trees remaining after a forest harvest operation, for instance: limbs, branches, leaves.

iii. Low-grade biomass: Trees that are of low quality for wood products due to age, shape, size, species or other traits.

iv. Forest carbon: The objective is to store certain amount of carbon inside living or dead forest materials. This includes carbon stored in above-ground biomass, belowground biomass and wood products, such as: lumber, and papers.

v. Bioethanol: Bioethanol is a type of alcohol made by the fermentation process; it is mostly from carbohydrates produced in agriculture products such as corn, sugarcane, or sweet sorghum; also from non-food sources, such as trees and grasses.

Considering the carbon dioxide emission, wooden biofuels also produce zero or less amount than what traditional fossil fuels reals during energy production, as the table 4 indicates below:

Table 4. Carbon emission comparison

Source: Eija Alakangas. VTT. 2012

FUEL	gCO_2/MJ	$kgCO_2/MWh$
Wood	0 *(109,6)	0 *(394,56)
Coal	94,6	340,56
Heavy fuel oil	78,8	283,68
Light fuel oil	74,1	266,76
Natural gas	55,0	198,0
Solid recovered fuel	31,8	114,48
Demolition wood	17,0	61,2
Glued or coated wood	2 (0,21 – 4,2)	7,2 (0,76-15,1)
Blend, 70% peat and 20% wood	74,1	266,68

1g CO_2/MJ = 3.6Kg CO_2/MWh * CO_2 factor for wood is zero in GHG calculations.

As it can be seen that wood as fuel produces 0 extra carbon dioxide; however other wooden biofuels do release carbon dioxide, is due to the production procedures, but in general, carbon dioxide released from wooden biofuels are significantly lower than what fossil fuels normally release.

Over all, the benefits of using the forest based bioenergy are mentioned as:

a. Reducing scale of fossil fuel consumption in heating, electricity generation and transportation.
b. Carbon emission reduction (comparing with fossil fuels).
c. Creating a more diversified production chain of local forest industry.
d. Developing rural areas suitable for biomass cultivation.

e. Creating employment opportunities in biomass processing and bioenergy production.

f. Providing high energy-conversion efficiencies, based on combined heat and electricity production from biomass (RCEP, 2004).

3.3 Sustainability and Sustainable Development

Sustainability shall be understood as general capacity to endure. For human society, sustainability offers potential for the long-term maintenance of wellbeing and secured living environment, which is established through ecological, economic and cultural dimensions, which also has been referred to the "three pillars", as figure 8 illustrates:

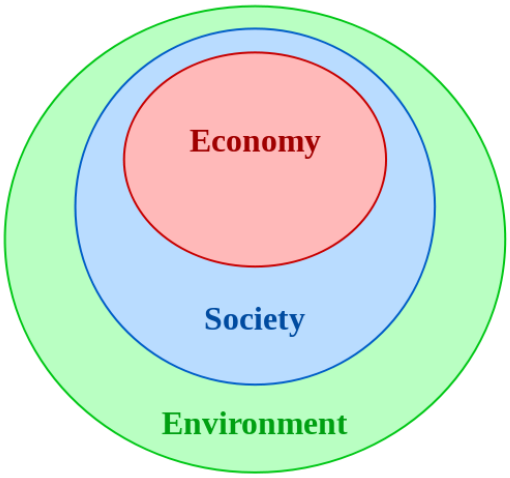

Figure 8. "Three pillars" of sustainability

(Source: Scott Cato, M. Green Economics)

Sustainability depends on interactions of the three pillars, suggesting both economy and society are constrained by environmental limits. Meanwhile, sustainability interfaces are also defined as a complex constructed through the social and environmental consequences of various economic activities.

Based on the principles of sustainability, sustainable development refers to a type of development in the human society in resource use which aims to meet human needs while securing the sustainability of natural systems and the environment. It allows to

establish the continuous process where the current needs can be satisfied, also for further generations to come.

In 1987, United Nations released the Brundtland Report, which has provided one of the most widely recognized definitions of the sustainable development: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (United Nations General Assembly, World Commission on Environment and Development, 1987).

Generally, as similar as sustainability, the structure of sustainable development also follows framework as figure 9:

Figure 9. "Three sphere" definition of sustainable development

(Source: United Nations General Assembly, 1987)

This definition clearly illustrated how the mentioned sustainable development can be created through the contributions from the environmental approach, economic approach and social approach.

Sustainability is comprised of four dimensions: environmental, economic, cultural and social. However, social and culture sections can also be integrally labeled as "Social", which also reduces the four dimensions into three dimensions (Approaches).

- Environmental Approach: The goal of this approach is to ensure the current human activities which are interacted with natural environment can be processed without adding negative environmental impacts.
- Economic Approach: This approach is focused on improvement of living condition, per capita income and general economic trend of the society with basic equality.
- Social & Cultural Approach: Aspects, for example the appreciation of peace, social stability, respect and protection of different cultural identities and institutional development are all considered as values of this approach. (Rio and Burguillo, 2009).

By following the trend of sustainable development, China started to study the code since 1980s, although China didn't face a rapid and serious challenge of food security and energy security back then. But attention paid by the Chinese society has shown a positive picture of accepting the "newly" raised concept. After nearly four decades of significant development, at the current stage, China has become the largest and fastest growing emerging economy in the world.

Correspondingly to the major economic achievements, China has also raised the high-energy consumption requirement: China's primary energy consumption was reported as 961.4 million tons oil equivalent in the year of 1997 and reached nearly 1863.4 million tons oil equivalent by 2007. Moreover, in 2014, China has become the largest energy consumer and carbon emitter, behind the United States (IEA, 2014).

In order to minimize the impact from having been ranked as the world`s 2nd largest carbon emitter, the China's State Council has set the target in December 2009 of cutting carbon emissions by 40 - 45% till 2020 (CSC, 2009). This target combined with the respect of national sustainable development trends for larger and continuous renewable energy utilization, and drawbacks of fossil energy sources with their environmental impacts have together alerted the importance of developing sustainably.

3.4 Essentials of Social Awareness and Acceptance

With modern knowledge and technologies being rapidly created and applied, society has been countlessly changed, which is widely influencing people ́s understanding, attitude, life styles and some other behaviors. Correspondingly people ́s awareness and acceptance, also being labeled as social awareness and social acceptance, generate the power to support such creation and innovation of new technologies.

Knowledge in this case is without doubt acting as a driving force towards the social awareness and social acceptance. Knowledge is needed not only for powering the development of technology, but also as a reflection for the related technological and economic growth. Beck (2009) defined the importance of knowledge thus: "Its (knowledge) role is also essential in monitoring social consequences of technological progress for collective decision making processes." Nevertheless, newer knowledge is also further discovered through the technology development. This "Parallel-process" creates mechanism which is also abstracted from the users' perspective. Under this condition, influence is not only added to the newly developed technologies and objectives; knowledge, social awareness and acceptance are also essential to those technologies or products that need reformation or promotion (Giddens, 1990).

Regarding the mentioned connection, interaction and characteristics of knowledge, social awareness and acceptance, they have become more crucial when understanding the development of new social and industrial sectors, especially the renewable energy sector that requires a strong commitment from the society; particularly in emerging fast growing economies like China, where the bioenergy related field is still considered as new; plus the requirements for newly developed energy technologies and energy sources is significantly high.

4. RESEARCH METHODOLOGY

This chapter defines research methods that have been applied on this Master`s Thesis topic, with also background and descriptions on how data was generated and collected accordingly.

4.1. Quantitative Research and Data Collection Procedure

Based on the research questions, a quantitative approach has been implemented through survey research. Survey research is a scientific approach using sampling and survey instruments in order to collect numerical data which can be used for statistical analysis, by which, the population's features or characteristics can be obtained (Sukamolson, S., 2008). Moreover, in this study, the quantitative approach also allowed the researcher for making the comparison between groups as well as to test the correlation between different factors concerning the causality in participants' responses. Surveying progress was made by distributing the questionnaire (Appendix 1) and holding the Individual Interviews.

The survey questionnaire was designed in December of 2012 and distribution started in February of 2013 and ended in September of 2013. Main method of survey distribution is via email delivery. In addition to the survey questionnaire, personal interview was also in use during the data collection trip to China. All together 10 interviews were made. The data collection received essential support from the students at: Beijing Forestry University (Beijing), Sichuan Normal University (Chengdu), Qilu University of Technology (Jinan), Chengdu University of Electronic Science & Technology (Chengdu) and South China University of Technology (Guangzhou) in China.

In Finland, students at University of Helsinki (Helsinki), Aalto University (Espoo), Lappeenranta University of Technology (Lappeenranta), Saimaa University of Applied Sciences (Imatra) and Åbo Akademi University (Turku) were also invited to participate.

The geographical locations of participating students and universities are indicated in figures 10 and 11below:

Figure 10. Participated students and academic institutions distributions in China

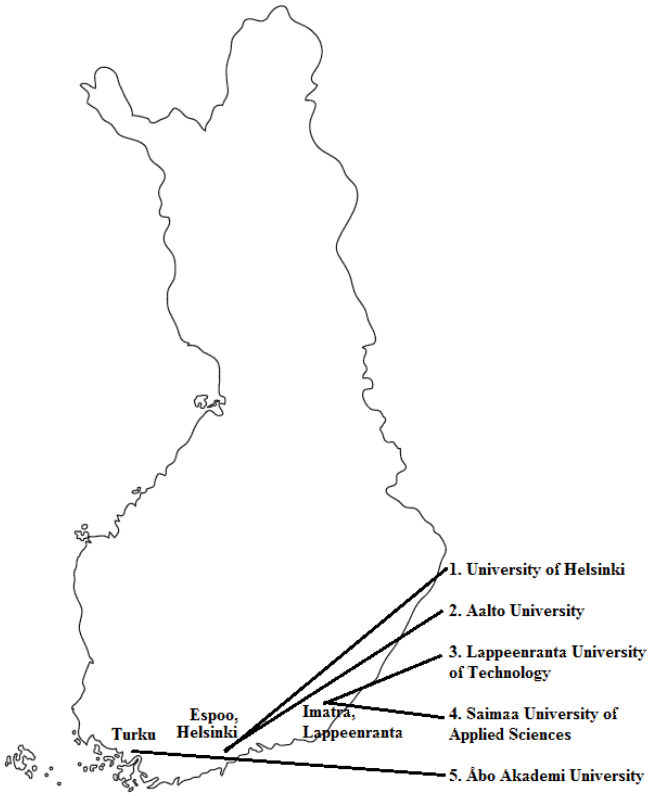

Figure 11. Participated students and academic institutions distributions in Finland

150 questionnaires were distributed via email with 92 retrieved from students across mentioned universities in China and Finland, counting for 61.3% as response rate. However after preliminary evaluation, only 80 were qualified to provide valuable data for the analysis. Besides during the data collection trip to China in May of 2013 and some other visits to China afterwards, a number of personal interviews were also made.

4.2 Data Analysis Methods

A survey questionnaire has been developed as the survey instrument while the data collection has been analyzed by IBM SPSS Statistics v.21 and Microsoft Excel 2013. In which, IBM SPSS Statistics v.21 - the latest version released in 2014 is a scientific mathematical based software program which is originally named Statistical Package for the Social Sciences.

The software is nowadays widely used for statistical analysis and in social science (Kdnuggets, 2013) due to its wide range of options besides its fundamental features of data managements and data documentation. For instance, it is able to provide full sets of statistical tests, wider variety of charts and graphs, accurate result even when some data is missing, to name some of its advantages. Therefore, the SPSS helps researchers with less time consuming options and more productivity when dealing with large scale numerical data sets.

Also, Microsoft Excel has been used for analyses. It is considered that 80% of the data analysis has been generated by SPSS software while the remaining is from the usage of Microsoft Excel.

In relation with the analysis methods, the descriptive analysis have been conducted by frequency tables and calculation of means for variables concerning social demographic background and awareness of FBB. In addition, factor analysis has been used in order to reduce the number of variables in the data sets which is more efficient to obtain the interrelations from data. In the study, factor analysis based on the Maximum Likelihood extraction and the Varimax rotation method in relation with factors concerning the

respondents' awareness and attitudes about FBB development in China. Furthermore, one way analysis of variance (so-called ANOVA), which is a parametric test used to compare the mean values from more than two samples (Anthony, 2011), has been used to compared respondents' background and their attitude toward FBB development in China.

Besides the closed-questions, the survey questionnaire also proposed open-end questions and the interviews which both have been analyzed by documentation, conceptualization, coding and categorizing methods. In this case, qualitative approach was applied modestly in order to leverage further in-depth analysis for this study. The documentation is data noted down during the interview or participants' responses for the open-questions in the questionnaire while conceptualization is to identify and to refine the concepts inside the documentation. And finally, data coding and categorizing helps to present the "multidimensional summary" for the obtained results and even for the further analysis.

Based on the research objectives, the implementation of quantitative research in this project can be illustrated in the figure 12 below:

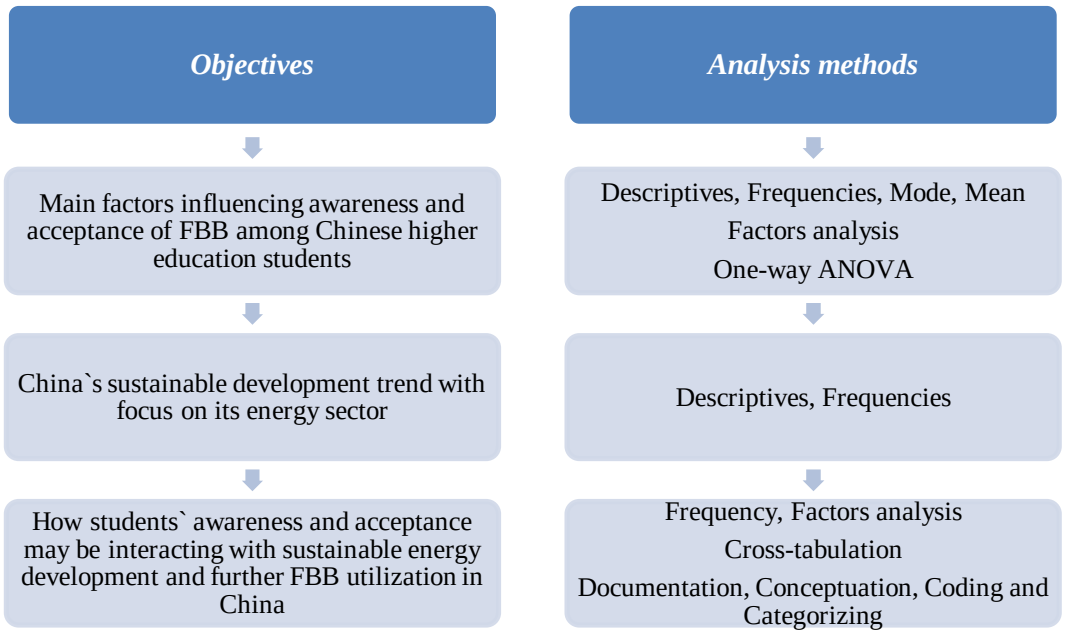

Figure 12. Analysis implementation

The survey questionnaire contains 15 questions in 3 categories:

i) Eight of choice questions; where a single choice or multiple choices can be made to indicate opinions within the pre-fixed ranges.

ii) Two of attitude indications: where the 5-level scale indication (Likert Scales) from "1 (Not affecting at all / strongly disagree)" to "5 (Strongly affecting / totally agree)" is used as reference to define one`s attitude towards certain aspect.

iii) Five of open questions: where opinions can be given freely to reflect wider and more personal considerations of certain questions.

Holistically, following aspects are covered within this survey questionnaire:

1) Socio demographic background of respondents

2) Opinion when choosing / using certain energy sources

3) Awareness of FBB and its characteristics

4) Advantages and drawbacks of FBB implementation

5) Original forest industry meets FBB production

6) FBB utilization status in China

7) Role of higher education and students in FBB development

8) Expectations and concerns of FBB development prospects

5. RESULTS

This chapter describes all data that has been collected from the survey questionnaire and with individual interviews. All data has been collected and recorded electronically, analysis was accomplished majorly on the IBM SPSS v.21 and Microsoft Excel 2013.

5.1 Socio Demographic Background

Question 1 to question 4 acquires socio demographic background of survey respondents. The table 5 indicates the general background of interviewees:

Table 5. General background of the respondents

Variables	Categories	F n=80	%
Gender	Male	34	57.50%
	Female	46	42.50%
Age	20 – 25	54	67.50%
	25 – 30	20	25%
	Over 30	6	7.50%
Education Level	Bachelor	28	35%
	Master	49	61.25%
	Ph.D.	3	3.75%
	Other	0	0.00%
Overseas Study	Yes	29	36.25%
	No	51	63.75%

As result, three age ranges were discovered among 80 interviewees, where 7.5% are over 30 years old, equivalent to 6 respondents. 25% are between 25 and 30, equivalent to 20 respondents. The major part of the respondents (67.5%) was between 20 and 25 years old, equivalent to 54 respondents. In relation with gender distribution, male respondents are the major part which is 57.5 %, equivalent to 46 respondents, which is slightly larger than the number of female respondents.

As one of the most important factors that have been taken into consideration, the study status has been carefully measured within the survey questionnaire. Among the 80 interviewees (with accepted data), 63.8% of total respondents have oversea study experiences while the remains do not have. Specially, all students with oversea study experience has been conducting their education in Finland which is one of the pioneers in bioenergy and FBB production and consumption.

This difference is likely to have some influence on the students` understanding and related development of FBB, together with their degree of studies. Under this condition, totally 49 respondents accounted for 61.25% are currently pursuing the Master`s degree; 28 respondents accounted for 35% are in their Bachelor`s degree education and 3 respondents accounted for 3.75% are in the Ph.D. studies at this moment.

5.2 General Awareness of Energy and FBB

It is important to understand the basic facts of FBB and other types of energy sources before the analysis starts, in this case, survey acquires general awareness of FBB and related understanding from interviewees, as the table 6 indicates:

Table 6. Awareness of energy sources

	Frequency	Percent	Valid Percent	Cumulative Percent
Coal	60	75.0	75.0	75.0
Oil	15	18.8	18.8	93.8
Wind Power	1	1.3	1.3	95.0
Hydro Power	2	2.5	2.5	97.5
Nuclear Power	2	2.5	2.5	100.0
Total	80	100.0	100.0	

According to the result, coal is not only the most largely consumed fossil fuel but also the most well-known energy source, where oil follows. However as for the renewable energy sources of wind and hydro power, the general awareness is quite low, as well as the nuclear power as shown in Figure 13 although China is running a relatively large number of nuclear power stations at this stage (Zhang, 2008).

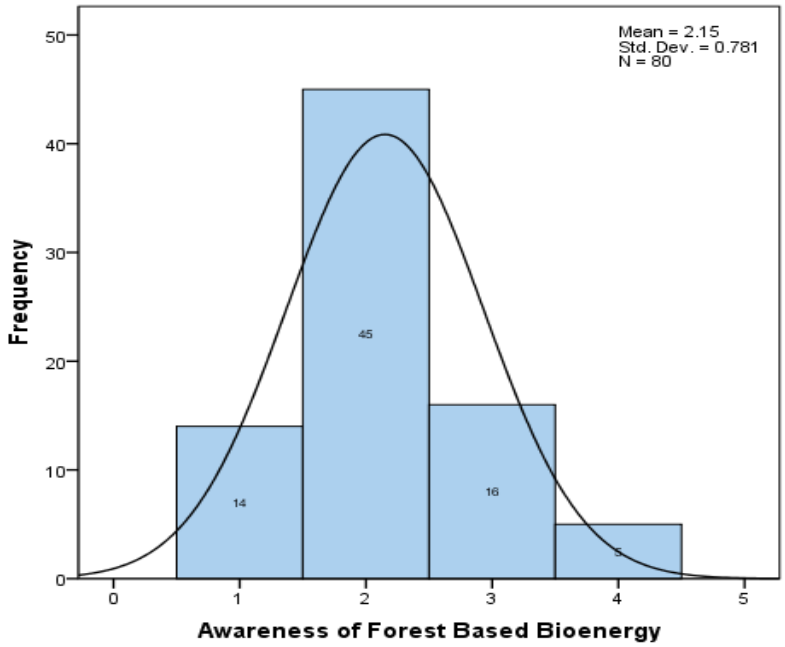

Figure 13. General awareness of Forest Based Bioenergy

Moreover, there is also difference in students' awareness of FBB in relation with their oversea study experiences as shown in table 7 below:

Table 7. Awareness of Bioenergy and Overseas Study Cross tabulation

Awareness of Bioenergy * Overseas Study Crosstabulation

Count

		Overseas Study		
		Yes	No	Total
Awareness of Bioenergy	Never heard	0	9	9
	Somehow heard	15	31	46
	Often heard	9	8	17
	Well noticed	5	3	8
Total		29	51	80

According to the cross-tabulation results, students with overseas study background have apparently obtained better awareness concerning bioenergy. In details, 100% of students with overseas study experience have obtained some knowledge of bioenergy in different level in which, more than half of them chose "somehow heard" about bioenergy while there are five students, equivalent to around 16.6% of respondents in this "studying abroad" group, chosen "well noticed" option.

In contrast, there are about nine students without studying abroad experience chosen "never heard" concerning bioenergy, equivalent to 17.6% of respondents in this group. This result might be generated from the differences in educational program and orientation in China and in other countries that bioenergy knowledge is more accessible to student with study abroad background.

Besides the regular energy sources, awareness of Forest Base Bioenergy was asked, as the figure 5.3 displays above: The answer was mostly distributed in the 2nd option "somehow heard" as can be observed. Within this question an extra option was given, where interviewee could describe the actual type or properties of FBB they have heard. However no specific answer was retrieved.

After the basic background information was acquired in the previous part, hereby the reasons and factors affecting energy selection were asked, results are indicated in the figure 14 and 15:

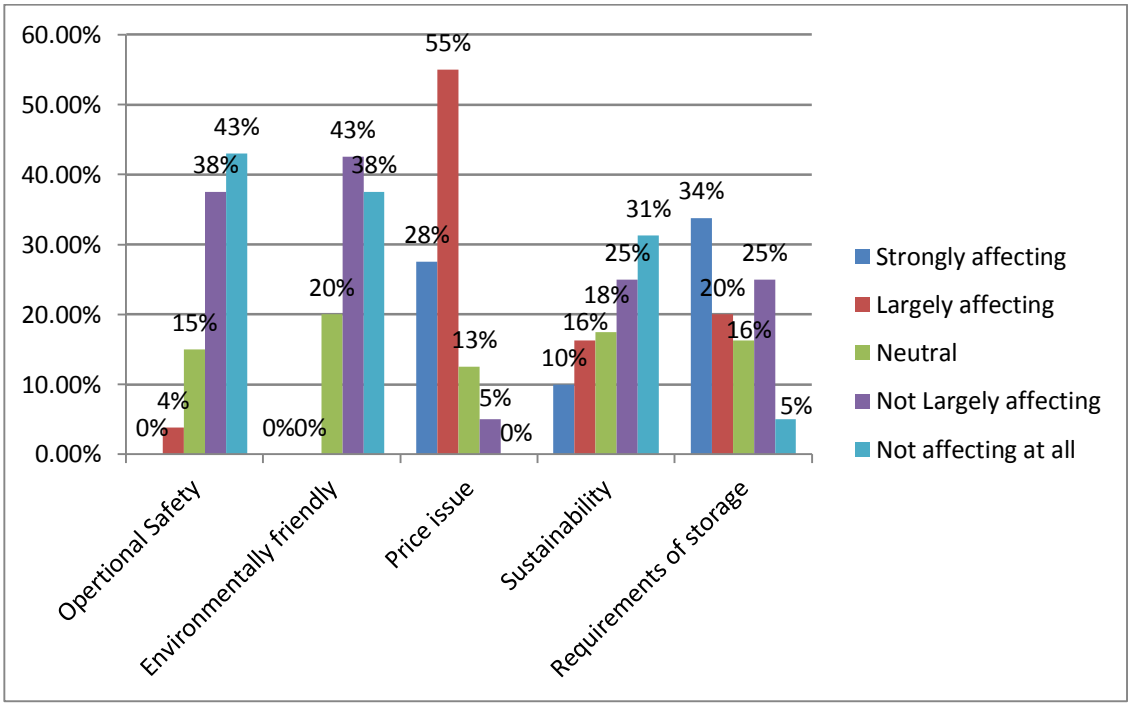

Figure 14. How different factors affect energy selection, part 1

Among the first five factors, the "Operational safety" (mean=4.21) shows not affects the choice largely; the same influence can also be found for the factor of "Environmental friendly" (mean=4.17) and "Sustainability" (mean=3.51). The "Price issue" (mean=1.95) is strongly affecting the choice and in contrast, "Requirement of storage" (mean=2.48) seems not to have large influence on energy selection. The next five factors are showing somehow more significant differences in the figure 15:

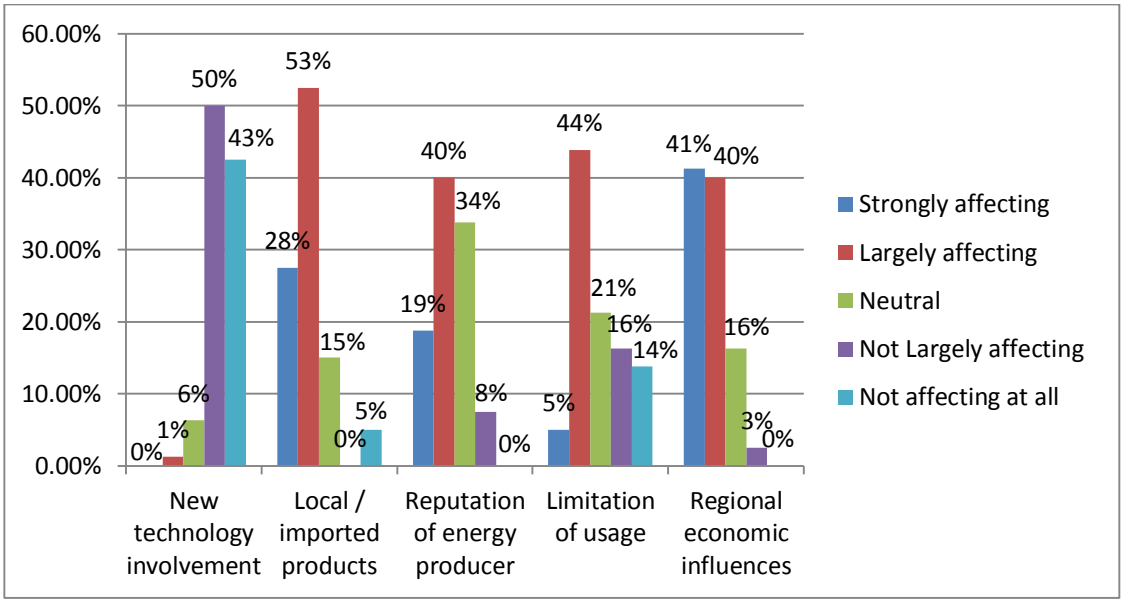

Figure 15. How different factors affecting energy selection, part 2

Factors of "New technology involvement" (mean=4.34) is not largely affecting choice while "Local / imported products" (mean=1.98) played a more important role in usage decision. "Reputation of energy producer" (mean=2.30) shows almost a medium influence on energy selection, the "Limit of usage" (mean=2.90) somehow determines choice and the "Regional economics influence" (mean=1.8) also affects consumers' choices.

By evaluating the distributions of the answers, the price issue was ranked the highest percentage indication compared with other factors, it also appears to confirm a hypothesis of this study that price is critically related to the consumers' selection in the market; the price is also serving as a major enabler of further development of certain product. However, respondents ranked environmentally friendly and new technology involvement as the least important factors.

More detailed information on the 10 factors affecting respondents' selection of energy sources can be seen in the following table 8 and table 9:

Table 8. Total Variance Explained (Extraction method: Maximum Likelihood)

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.050	20.500	20.500	1.166	11.664	11.664	1.515	15.147	15.147
2	1.539	15.394	35.894	.988	9.885	21.549	1.089	10.888	26.036
3	1.303	13.033	48.927	1.494	14.938	36.487	1.055	10.545	36.581
4	1.034	10.338	59.265	.846	8.459	44.945	.836	8.364	44.945
5	.972	9.715	68.980						
6	.812	8.116	77.097						
7	.713	7.133	84.229						
8	.666	6.659	90.888						
9	.578	5.777	96.665						
10	.333	3.335	100.000						

Extraction Method: Maximum Likelihood.

Table 9. Rotated Component Matrix (with highest values indicated)

Rotated Factor Matrix[a]

	Factor			
	1	2	3	4
Opertional Safety		.996		
Environmentally friendly				
Price issue	.826			
Sustainability				.590
Requirements of storage				-.444
New technology involvement	-.751			
Local / imported products				
Reputation of energy producer			.999	
Limitation of usage				
Regional economic influences				

Based on the results, four factors with the highest value loads are selected for the Factor Analysis as table 10 shown below. The high value load implied that these four factors are considered as the most relevant value influencing respondents' decision making process.

Table 10. Variables that composed the factor

#	Variables	Factor	Definition of factor
1	Price issue	1	Price and Technology
2	New technology involvement		
3	Operational Safety	2	Safety
4	Reputation of energy producer	3	Reputation
5	Sustainability	4	Sustainability and Storage
6	Requirement of storage		

Comparing with all ten aspects that are mentioned in the questionnaire, four elements are removed from the factor analysis including environmental friendly, local/imported products, limitation of usage and regional economic influences, since their values of load are significantly lower than 0.40. Under this analysis, four factors were generated. They reveals the most interpretable solutions and representing the aspects including Price and Technology; Safety; Reputation and Sustainability and Storage.

a. Price and Technology

Factor 1, "Price and Technology" represents 15,147% of the variance as in the table mentioned above, which implies that the dimension or the impact on respondents' choice from the Factor 1 is the most influential. These strong value loadings, which are all over 0.7, have also reflected that price and new technology correlate strongly with the extracted factor.

b. Safety:

Factor 2, "Safety" has seen 10,888% of the variance, which reflects principles of consumer about safety. It illustrated that despite the degree of education and fields of study, respondents all place high importance on safety matters. As shown with the highest value loading and communality (0.999), this factor has a strong correlation with the factor 1.

c. Reputation:

Factor 3, “Reputation” contains only one variable of Limit of Usage, with variance of 10,545%. It reflects the connection with the operational safety and new technology as the factor 2 and factor 1 described which also reflected in the high communality value (0.999).

d. Sustainability and Storage:

Factor 4, “Sustainability and Storage” carries 8,364% of the variance and contains variables of Sustainability and Requirements of storage. The reason can be explained that the common energy consumers pay attention to energy storage as part of the operational process; also, local energy products can offer lowest pricing, easing concerns over energy prices. Surprisingly, “Sustainability” is also involved in this factor with storage, which may result from the traditional Asian belief that the more storage capacity, the more long lasting the source of energy.

ANOVA TEST

The ANOVA test determined whether there are differences between groups and within groups of some chosen variables with the ten mentioned factors. The chosen variables are “Degree of Study” and “Awareness of Bioenergy”. The two variables are eligible for ANOVA test, yet the other social demographic background variables because there should be at least three groups in within a variable. In this case, the two eligible variables included “Degree of study” and “Awareness of Bioenergy”. Conducting the ANOVA test in this stage could clarify the importance of chosen factors in different decision making process between groups.

The results of ANOVA test between four factors and the variable of “Degree of Study” have shown as table 11 and 12 below:

Table 11. Result of Post Hoc Test between four factors and "Degree of Study"

Tukey HSD **Multiple Comparisons**

Dependent Variable	(I) Degree of Study	(J) Degree of Study	Sig.
Price and Technology	Bachelor	Master	,201
		Ph.D	,549
	Master	Bachelor	,201
		Ph.D	,190
	Ph.D	Bachelor	,549
		Master	,190
Safety	Bachelor	Master	,966
		Ph.D	,310
	Master	Bachelor	,966
		Ph.D	,250
	Ph.D	Bachelor	,310
		Master	,250
Reputation	Bachelor	Master	,985
		Ph.D	1,000
	Master	Bachelor	,985
		Ph.D	,999
	Ph.D	Bachelor	1,000
		Master	,999
Sustainable matters	Bachelor	Master	,000
		Ph.D	,002
	Master	Bachelor	,000
		Ph.D	,172
	Ph.D	Bachelor	,002
		Master	,172

*. The mean difference is significant at the 0.05 level.

Table 12. Result of ANOVA test between four factors and "Degree of Study"

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Price and Technology	Between Groups	4,085	2	2,042	2,657	,077
	Within Groups	59,185	77	,769		
	Total	63,270	79			
Safety	Between Groups	2,543	2	1,271	1,286	,282
	Within Groups	76,142	77	,989		
	Total	78,685	79			
Reputation	Between Groups	,028	2	,014	,014	,986
	Within Groups	78,892	77	1,025		
	Total	78,921	79			
Sustainable matters	Between Groups	10,827	2	5,414	12,859	,000
	Within Groups	32,417	77	,421		
	Total	43,245	79			

In relation to the difference in degree of study level in ANOVA test, the mean difference is significant at the 0.05 level. The table only shows a significant result in the fourth factor, which indicated differences in "Sustainable matters" between students with different backgrounds, where the fact that students with higher educational background, including Master's Degree and PhD's Degree, which have placed more importance on the sustainability than undergraduate educational level when selecting energy source. Interestingly, combined with the existed result, students with either overseas study background or higher education background reflect higher awareness in environmental related matters.

On the other hand, ANOVA test between four factors and the variable of "Awareness of Bioenergy" showed another remarkable result as illustrated as table 13 and table 14:

Table 13. ANOVA test between four factors and "Awareness of Bioenergy"

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Price and Technology	Between Groups	7.154	3	2.385	3.230	.027
	Within Groups	56.116	76	.738		
	Total	63.270	79			
Safety	Between Groups	.934	3	.311	.304	.822
	Within Groups	77.751	76	1.023		
	Total	78.685	79			
Reputation	Between Groups	7.874	3	2.625	2.808	.045
	Within Groups	71.046	76	.935		
	Total	78.921	79			
Sustainable matters	Between Groups	.327	3	.109	.193	.901
	Within Groups	42.918	76	.565		
	Total	43.245	79			

Table 14. Post Hoc Test between four factors and "Awareness of Bioenergy"

Tukey HSD

Dependent Variable	(I) Awareness of Bioenergy	(J) Awareness of Bioenergy	Sig.
Price and Technology	Never hear	Somehow heard	,308
		Often heard	,992
		Well noticed	,815
	Somehow heard	Never hear	,308
		Often heard	,119
		Well noticed	,116
	Often heard	Never hear	,992
		Somehow heard	,119
		Well noticed	,902
	Well noticed	Never hear	,815
		Somehow heard	,116
		Often heard	,902
Safety	Never hear	Somehow heard	,790
		Often heard	,866
		Well noticed	,973
	Somehow heard	Never hear	,790
		Often heard	1,000
		Well noticed	,998
	Often heard	Never hear	,866
		Somehow heard	1,000
		Well noticed	,999
	Well noticed	Never hear	,973
		Somehow heard	,998
		Often heard	,999
Reputation	Never hear	Somehow heard	,805
		Often heard	,643
		Well noticed	,031
	Somehow heard	Never hear	,805
		Often heard	,950
		Well noticed	,060
	Often heard	Never hear	,643
		Somehow heard	,950
		Well noticed	,201
	Well noticed	Never hear	,031
		Somehow heard	,060
		Often heard	,201
Sustainable matters	Never hear	Somehow heard	,945
		Often heard	,969
		Well noticed	,999
	Somehow heard	Never hear	,945
		Often heard	1,000
		Well noticed	,941
	Often heard	Never hear	,969
		Somehow heard	1,000
		Well noticed	,958
	Well noticed	Never hear	,999
		Somehow heard	,941
		Often heard	,958

*. The mean difference is significant at the 0.05 level.

The table showed that there are two factors reaching a significant level including "Price and Technology" (0.027) and "Reputation" (0.045). However, the mean difference concerning multiple comparisons between factors of "Price and Technology" and "Awareness of Bioenergy" variables is not significant, which has explained graphically as shown in mean plots as figure 16 below.

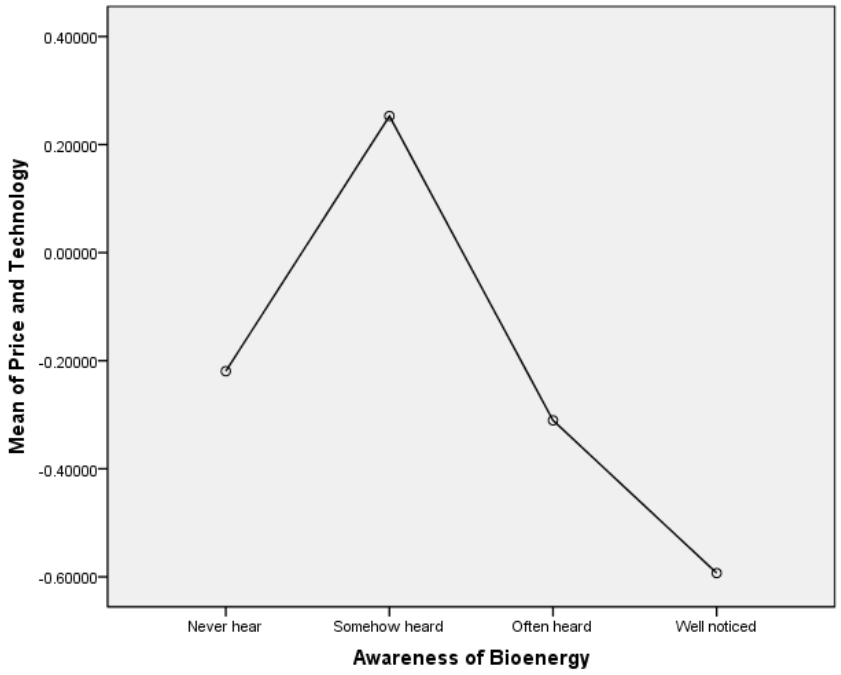

Figure 16. Compare means between "Price and Technology" factor and "Awareness of Bioenergy"

According to figure 16, the better knowledge about bioenergy they have, the more price and technology sensitive they are. The significant difference between consumers with response "Somehow heard" and other groups could be explained based on other variables, which could have not been taken into account in this survey, for instance: study major, personal interest or family wealthy.

In relation with the "Reputation" factor, there is significant difference between different levels of awareness of the bioenergy. In contrast with the "Price and Technology" factor, the greater bioenergy awareness consumers have, the more consideration of producer's reputation they have. Especially, concerning the position mean differences, consumers

with “well noticed” of bioenergy” have more emphasis in quality of producers than other groups as shown in figure 17:

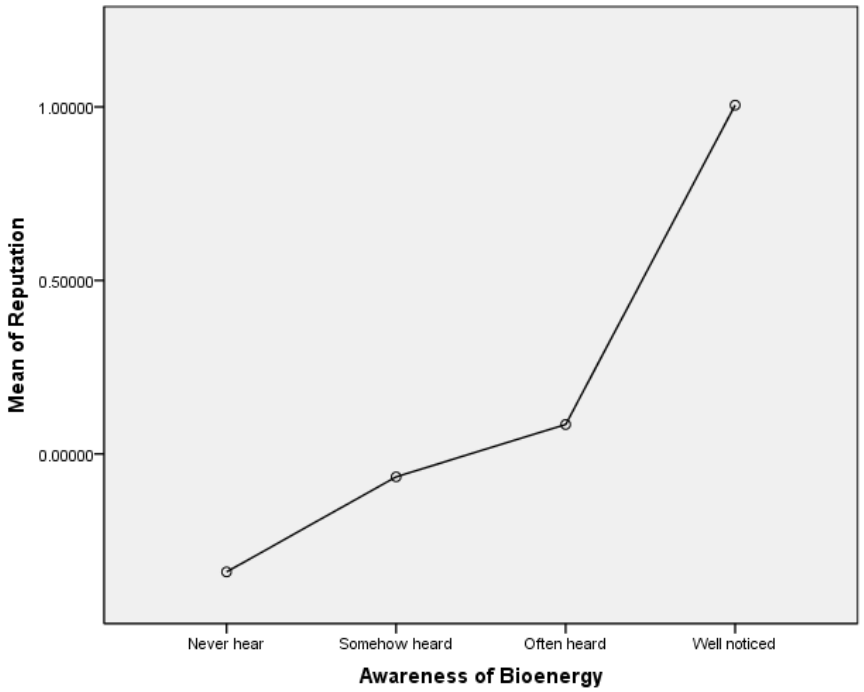

Figure 17. Compare means between “Reputation” factor and “Awareness of Bioenergy”

5.3 Current Condition of FBB in China in Students` Perspective

In this project, the students’ perspective concerning the current condition of FBB in China has considered six major aspects including knowledge for FBB development / acceptance in China, Government action toward FBB development, FBB Development potential in China, FBB compared with Fossil Fuels, FBB production compared with traditional forestry industry and FBB development’s impact on the social, economic and environmental aspects. Each aspect has determined through two or three statements with the five-level scale varying from “totally agree” to “strongly disagree”.

5.3.1 Knowledge toward FBB Development/ Acceptance in China

Table 15 below shows respondents' opinions on how FBB has been perceived in China through their willingness of spreading the image of FBB which was asked from question 8.1 to 8.3.

Table 15. Respondents' opinion toward FBB development/acceptance

	Strongly Disagree	Disagree	Neutral	Agree	Totally Agree	Mode	Mean
Necessary of providing knowledge for society	3.80%	5.00%	32.50%	42.80%	15.00%	4	3.61
Willingness to study bioenergy	0.00%	21.30%	48.80%	25.00%	5.00%	3	3.14
Willingness to share knowledge about bioenergy	0.00%	21.30%	48.80%	23.80%	6.30%	3	3.15

This aspect was determined by the three variables including the necessary of providing knowledge for society, the willingness to study bioenergy and the willingness to share bioenergy knowledge from the respondents. According to the table, the mean of each question varying between three and four implied that the overall acceptance with FBB in China just reached the average point. In relation with the importance of providing knowledge about bioenergy for the whole society, there are more than 50% of the respondents choosing "agree" and "totally agree" options, with the most common answer described as "agree".

Meanwhile, there shows a small proportion of respondents which seems not to agree with the importance of bioenergy knowledge with 3.8% and 5% of received answers choosing "strongly disagree" and "disagree". Result implies an increasing awareness of the importance of bioenergy knowledge among the young generations.

However, concerning to the willingness of studying and sharing knowledge about bioenergy in two remaining variables, even the mean value varies from three to four, the most common choice is "neutral" with 48.8% of total responses. This shows the uninteresting attitudes from young generations about bioenergy topics.

5.3.2 Government Action toward FBB Development

The Government action toward FBB development has divided into three variables including respondents' support in using FBB, respondents' awareness in FBB in relation with sustainable forest management and in the essential of Government support towards enlarging to use of FBB which were mentioned from question 8.4 to 8.6. The results are quite diverse shown in figure 18 below:

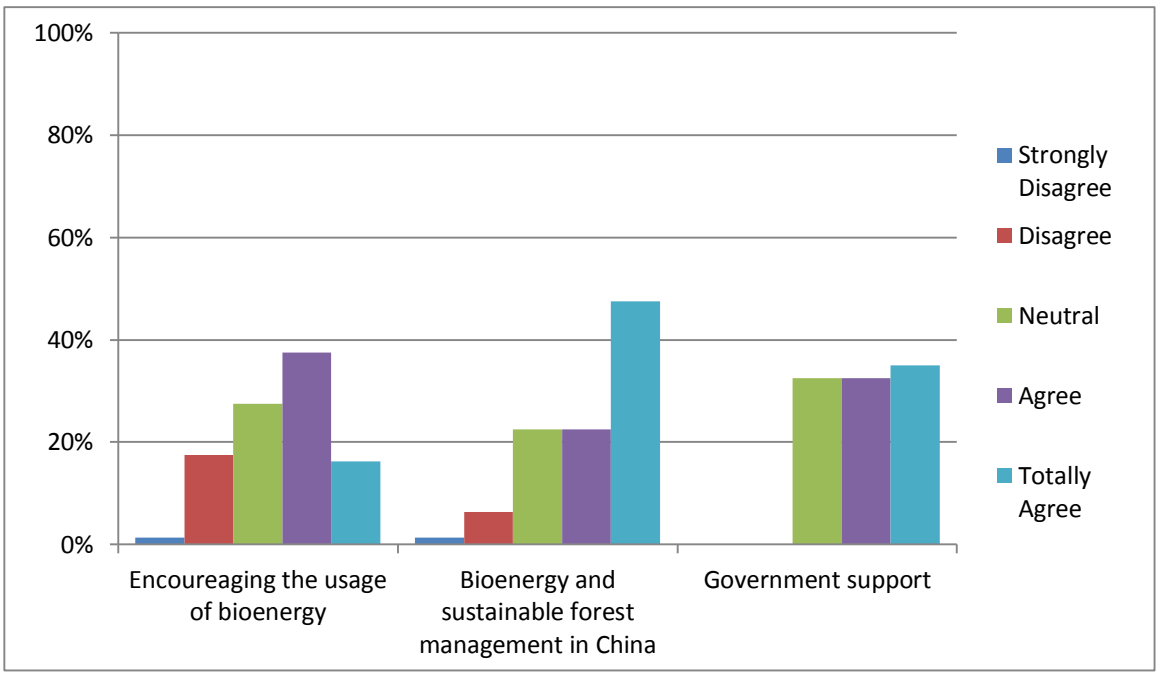

Figure 18. Respondents' attitude of Government action towards FBB development

Respondents' attitude towards supporting FBB and encouraging the usage of bioenergy to other people are quite positive. There are almost 40% of total respondents agreed to support and encourage FBB while there are 16% of respondents "strongly agree" with this idea. There is approximately one third of participants showed "neutral" attitude

while the remaining 20% seems to be not interesting is spreading FBB knowledge. On the other hand, the more positive answers have appeared in the variable concerning the involvement of FBB with sustainable forest management in China through a significant percentage, equivalent to 48% of respondents, have chosen "strongly agree" option. At the same time, answers about the necessary of Government support to FBB shows a strong dependent on Government action to promote use of bioenergy from the young generations. Statistically, there are 32.5% of respondents "agree" and 35% of respondents "strongly agree" on the statement of importance of Government toward the dissemination of bioenergy usage in China.

5.3.3 FBB Development Potential in China

In this study, the potential of FBB development in China is based on how participants' attitude about firstly, how public awareness impacted bioenergy development, secondly, how current public awareness and technologies impact the FBB development in the near future within five to ten years and lastly, how difficulty to develop bioenergy in China with the current conditions. The three aspects were reflected from question 8.7 to 8.9 in the questionnaire. Table 19 below indicates the different choices among respondents towards these issues:

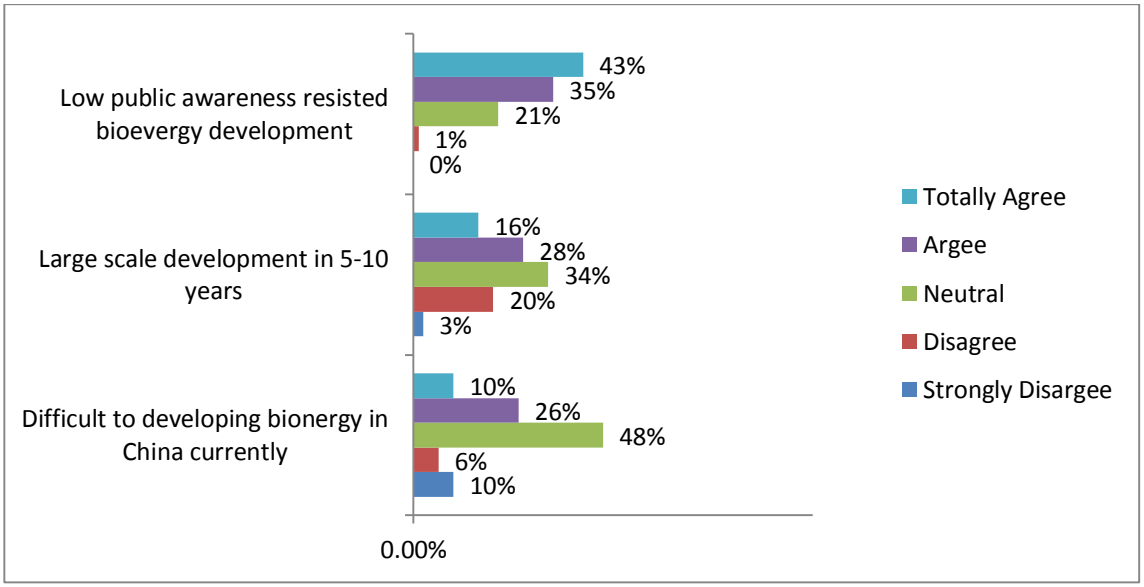

Figure 19. Respondents' attitude towards FBB development potential in China

As result, majority of respondents supported the statements that low public awareness of forest bioenergy resisted its dissemination and development in China with 42.5% of respondents "totally agree" and 35% of respondents "agree". Moreover, concerning the near future of large scale development in FBB in China, there was quite positive prediction from the young generations which reflected in around 43.8% of respondents "totally agree" and "agree".

However, there are more than one third of respondents, equivalent to 33.8%, chosen "neutral" attitude which reflected either uninteresting attitude or a blurry scenario from the respondents' perspective. These reactions have also been reflected in the third statement of "It is difficult to develop forest bioenergy in China under the current conditions". It is obvious that participants chose "neutral" attitude toward this issue, even though there were around 16.3% of respondents shown their optimistic through the answers "disagree" and "strongly Disagree" with the statement of difficulty.

5.3.4 FBB Compared with Fossil Fuel

Participants were asked about the comparison and correlation between FBB and fossil fuel in four aspects in question 8.13 which were illustrated in figure 20 below:

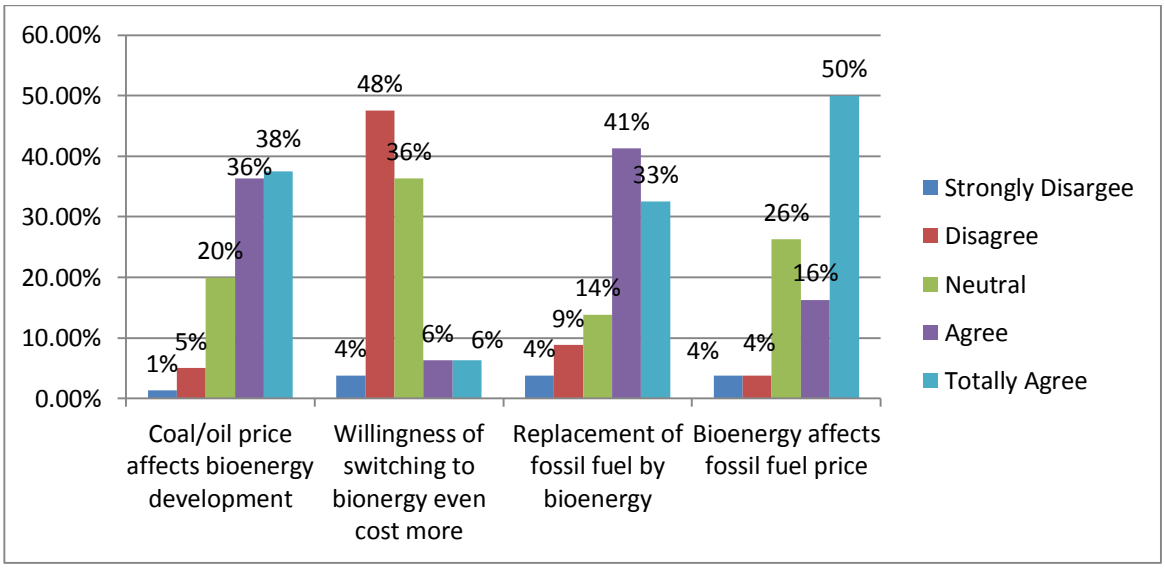

Figure 20. Respondents' attitudes toward FBB compared with Fossil Fuels

Firstly, statement of coal/oil price affecting bioenergy development received a strong agreement from the students. There are 37.5% of respondents "totally agree" and 36.3% of respondents "agree" with this statement. There is a few students show disagreement and 20% of respondents shown "neutral" attitude.

Secondly, as the matter of the fact that price played an important role in decision making process in energy usage, the participant were asked about their willingness of switching to bioenergy even it might cost more. There are more than 50% of respondents chosen "disagree" and "strongly disagree" reflecting their unwillingness of premium payment for bioenergy. There are more than one third of respondents kept their neutral attitude toward this issue while nearly 13% answered "agree" or "totally agree".

Thirdly, concerning the replacement of fossil fuel by bioenergy soon, most respondents (73.8%) had a positive answer with "totally agree" and "agree". Meanwhile, there are more than 10% of respondents still firmly counted on the dissemination of fossil fuel in the near future.

The last statement in relation with bioenergy impacting the price of fossil fuel received a surprisingly strong agreement from the participants including 50% of respondents chosen "totally agree" and 16.3%. Meanwhile, there were a few respondents shown disapproval with this statement with 3.8% "disagree" and "strongly disagree".

5.3.5 FBB Production Compared with Traditional Forestry Industry

Question 8.14 and 8.15 raised some comparisons between FBB and other traditional forestry industry. The results of comparison between FBB production and traditional forestry industry was mentioned in questionnaire with two statements shown in figure 21:

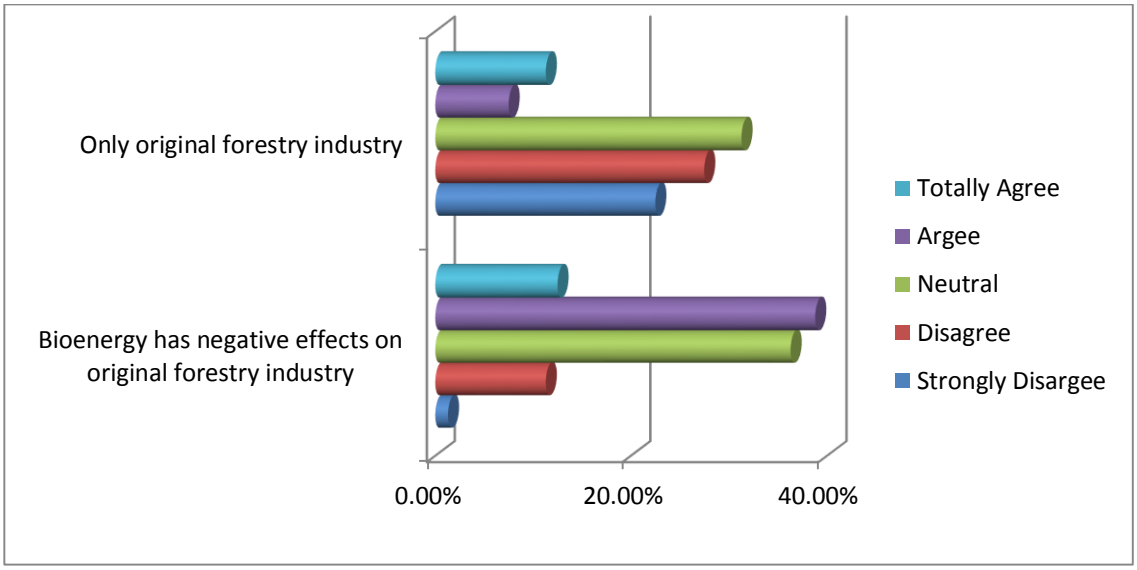

Figure 21. Respondents' attitudes of FBB impacts on original forest industry

The first statement under this point of view is "Forest resources should be used only for original forest industry (timber, paper/pulp production, etc.". There were around 18.8% of respondents chosen "totally agree" and "agree" answers while the majority (50% chosen "disagree" and "strongly disagree") valued forest resources in wider perspective than just only the traditional forest industry.

The second statement considered the possible negative effects from the production of bioenergy to the original forestry industry. As shown in the figure, there are more than 50% of respondents chosen "totally agree" and "agree" shown their anxiety towards this issue while there are only about 1.3% of respondents "strongly disagree" with this statement.

5.3.6 FBB Impact on Social, Economic and Environmental Aspects

In this survey, FBB development has also been determined under the perspective of sustainable development, via its impact on social, economic and environmental aspects which including food security, heating and transportation, employment opportunities and environmental effects.

The statement of "The production of forest bioenergy may harm the food security in certain areas" received quite diverse answers. More than one third of respondents (37.5%) showed a neutral attitude while almost 50% of respondents shown their discomposure in relation of the possible negative impacts from bioenergy production to food security (Figure 22).

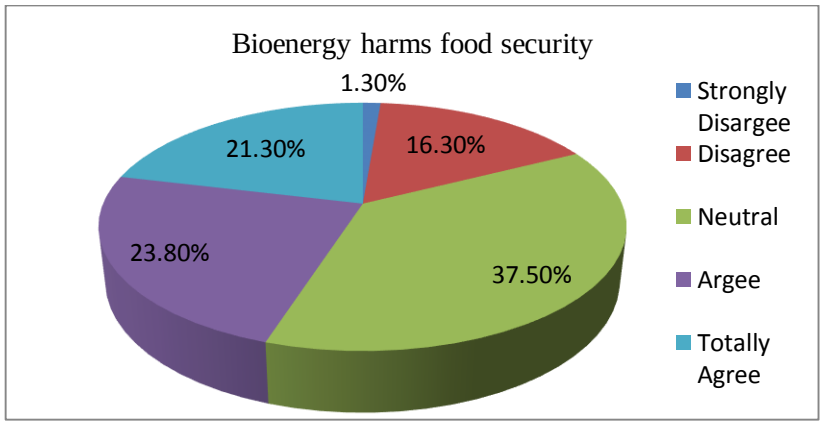

Figure 22. Respondents' attitude towards bioenergy's effect toward food security

The participants were asked for their attitude for the statement that "Forest based bioenergy can be used for heating but also for transportation". This statement received a strong agreement from the respondents with 35% "totally agree" and 41.3% "agree" (Figure 23). Moreover, there was no "Strongly disagree" answer recorded and 1.3% of respondents chosen "disagree". Results reflected participants' concern about multiple usage of bioenergy in different areas only for heating but also for transportation.

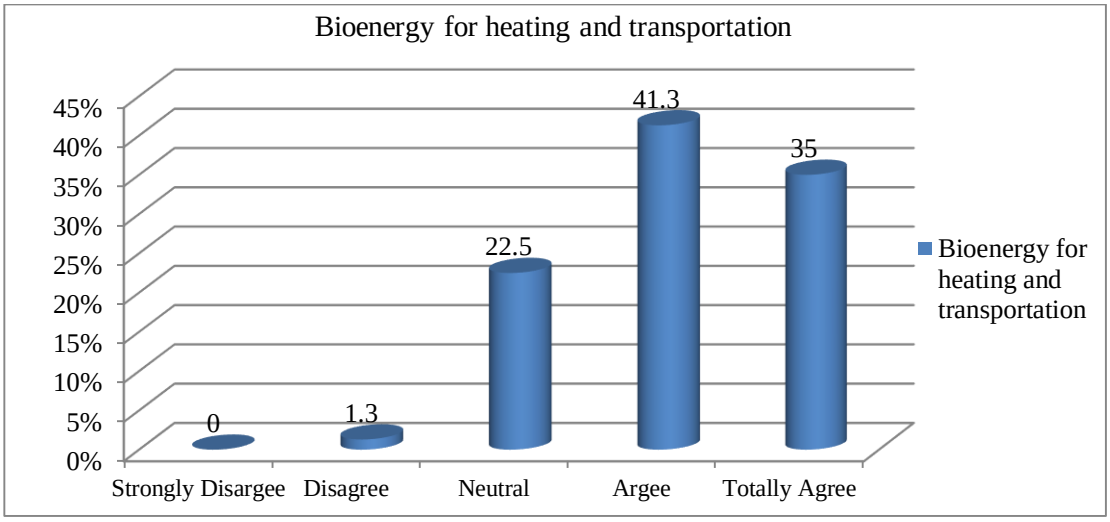

Figure 23. Respondents' attitude about the multiple usage of bioenergy

Employment opportunities were mentioned in the research in order to reflect the benefits of bioenergy production in economic aspect. The statement of "Forest based bioenergy is an industry that offers opportunities of employment" received a significant approval from the respondents with 31.3% "totally agree" and 43.8% "agree" (Figure 24). Moreover, there was absolutely no answer concerning "disagree" and "strongly disagree" in this issue.

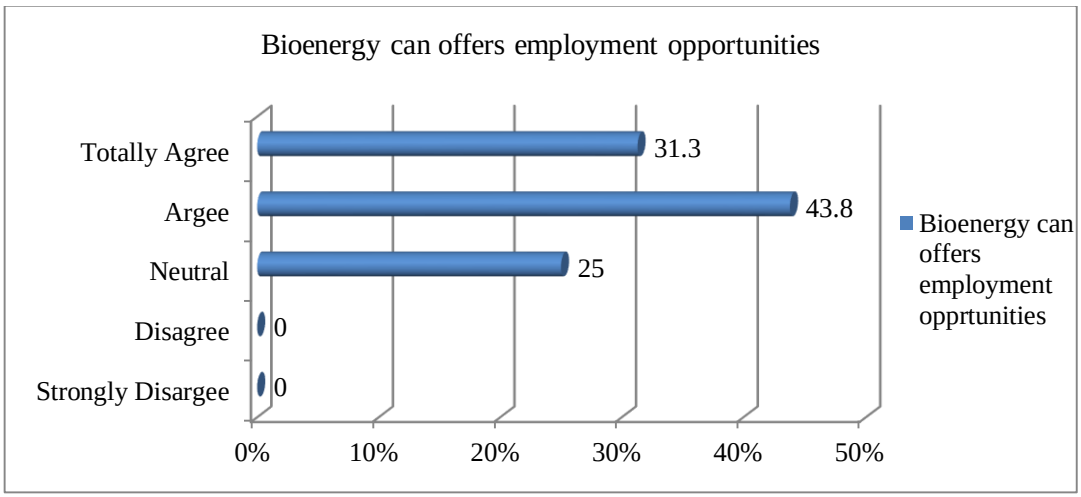

Figure 24. Respondents' attitude about employment opportunities in bioenergy industry

Lastly, the environmental effects were asked with two statements including whether bioenergy is not totally environmental friendly, and whether it is able to minimize the

environmental problems. Despite the benefits that bioenergy can bring forward to the economic aspects, the major part of respondents seems to be skeptical about feature of being environmental friendly (Figure 25). 33.8% of respondents "total agree" and 28.8% of respondents "agree" with the statement that bioenergy is not totally environmental friendly. There was a few given responds (5%) refused this statement. Consequently, concerning to the statement that bioenergy can minimize environmental problems; there were only a small proportion of respondents supported this idea while more than haft of respondents showed their confusion with 51.3% of "neutral".

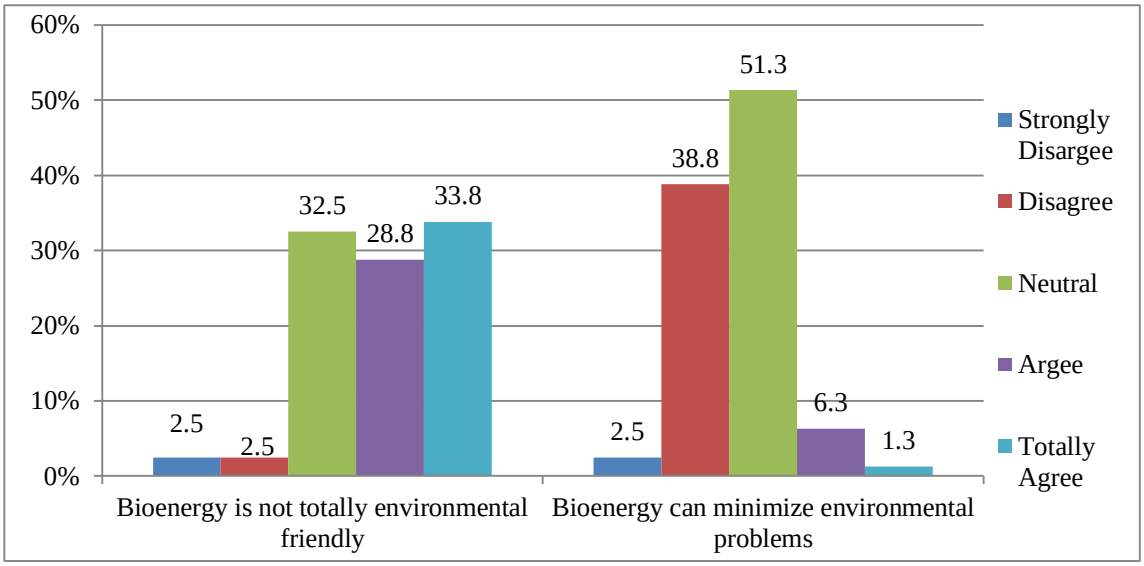

Figure 25. Respondents' attitude about environmental effects

5.4 Willingness to Pay and Motivation for FBB Usage

In this study, the students were asked about their willingness to pay for bioenergy as well as the most concerning reason when choosing bioenergy in question number 9 in the questionnaire. In relation with the extra cost for bioenergy usage, the questionnaire proposed the premium price with six different levels varying within "less than 15", 1-5%, 5-10%, 10-15%, 15-20% and "more than 20%". As shown in figure 5.24, there were only three students, equivalent to 5% of respondents, chosen the extra cost "more than 20%" of original price while there were 24 students, equivalent to 30% of respondents chosen the cheapest answer with the extra cost "less than 1%" of original

price. The chosen answers increased along with the cheaper price including 27.5% chosen “1-5%”, 18.8% chosen “5-10%”, 10% chosen “10-15%” and 10% chosen “15-20%”.

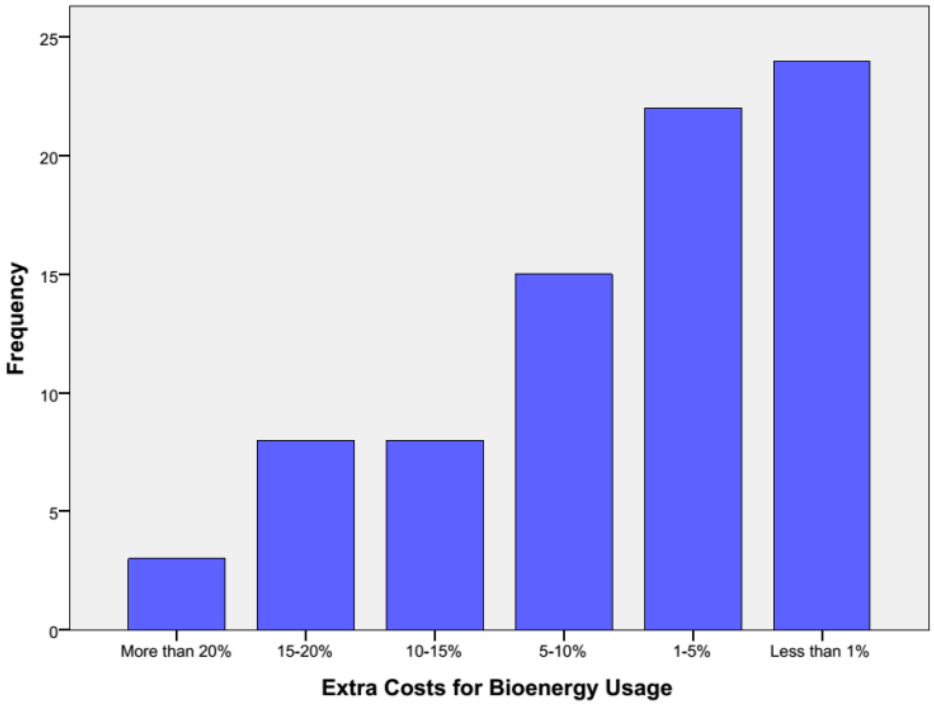

Figure 26. Respondents’ attitude towards extra costs for bioenergy usage

Concerning the most affected aspects when concerning the usage of bioenergy, the questionnaires proposed four different aspects including social trend, personal concerns of environmental issues, Government encouragement and the possible subsidy of bioenergy usage. Otherwise, the respondents could also provide their own motivation of choosing bioenergy. The results are shown in the figure 27:

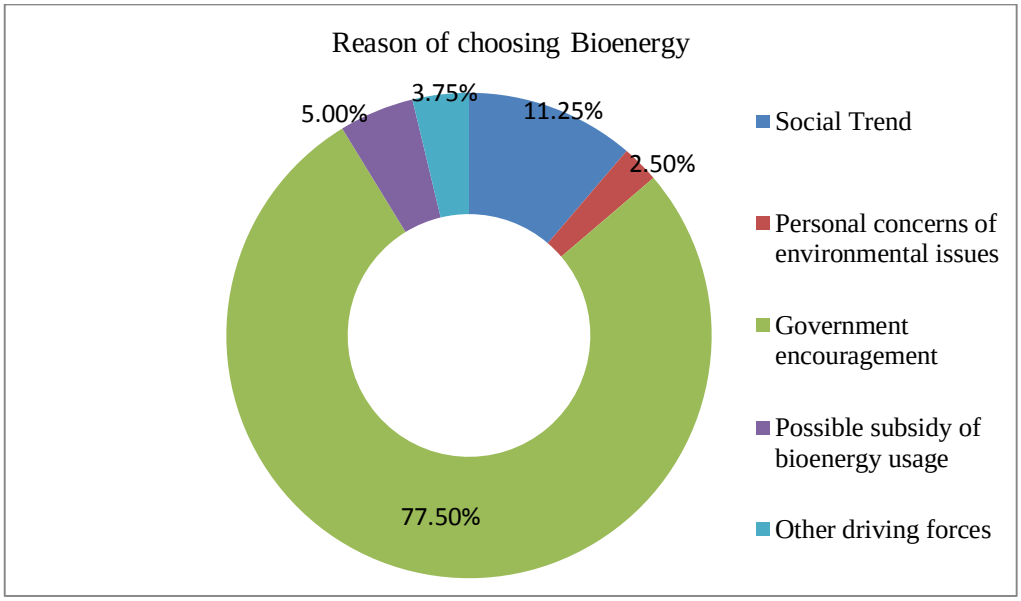

Figure 27. Respondents' motivations toward choosing bioenergy

According to figure 27, the most motivation for bioenergy usage in China is seen as "Government encouragement" which accounted for 77.5% of total responses. The next highest motivation is "social trend" with 11.25% of responses. Meanwhile, "possible subsidy of bioenergy usage" received 5% of responses. Surprisingly, respondents chosen "personal concerns of environmental issues" just accounted for 2.5% of total respondents. Besides, there were also several other driving forces such as "I want to try new energy technology" or "I don't know". Indeed, Chinese government has published regulations concerning bioenergy development, for instance, the 11th National Forest Development Plan (2006 – 2010) and the Medium and Long-term Renewable Energy Development Plan (2007). Furthermore, tax support is offered by the Ministry of Finance, state organization of National Development & Reform Commission, and State Forestry Administration in China specializing in bioenergy and bio-industry (Qu, 2011).

5.5 Awareness of FBB Law and Environmental Friendly Concern

In question number 11, the participants were asked whether they are aware of any law or registrations of FBB industry or renewable energy development in China. As the results shown in figure 28, the major part of respondents (over 80%) have chosen the

option of “yes” implied a widespread awareness among the young generations about FBB law.

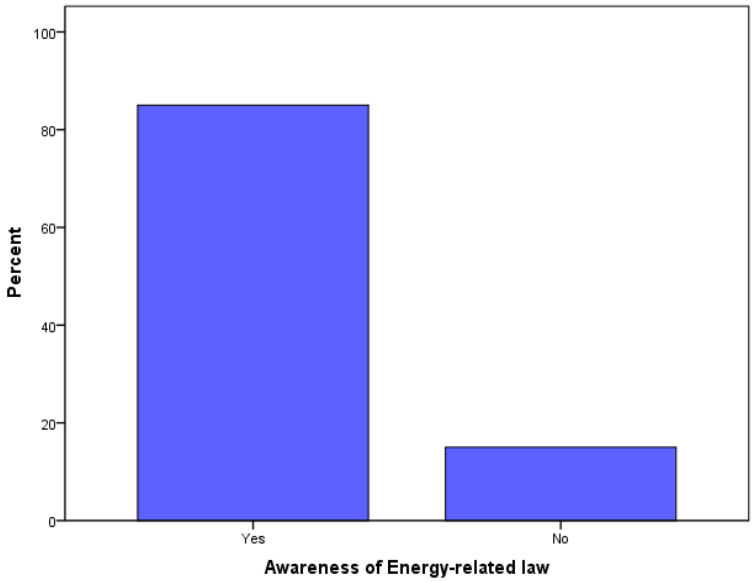

Figure 28. Respondents’ awareness of Energy related law

In addition, the participants were also asked whether they have any doubt concerning the actual environmental friendly aspect of FBB. The results showed respondents’ optimistic of FBB in term of environmental friendly aspect with 85% of respondents chosen “yes” while the remaining is skeptical about the same issues as reflected in the figure 29:

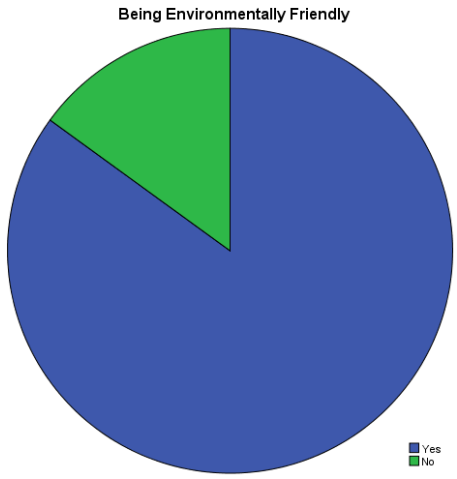

Figure 29. Respondents’ attitude towards environmental friendly aspect of FBB

6. DISCUSSION

6.1 Factors Influencing Students` Awareness and Attitude to FBB Development

As previously mentioned, this study emphasizes the awareness and attitude toward renewable energy and the FBB under the higher education students' perspective. The questionnaire was also designed to reveal how students are thinking and understanding about renewable energy and FBB. The obtained results provided both similarities and differences compared with other previous research.

According to the results, student's awareness toward renewable energy sources and FBB is moderate. Apparently, traditional fossil fuel including coal and oil still remain as China`s most common energy source in daily consumption. Additionally, students who have overseas education background showed a better awareness of factors concerning bioenergy issues, compared with student without any studying abroad experience. Interestingly, all of student with oversea study experience have conducted their higher education in Finland where bioenergy and FBB are perceived a significant attention from both educational and social aspects. Indeed, majority of student in Finland showed a basic knowledge of bioenergy; at the same time, they also implied that educational system and social media have a "significant effect" on their knowledge (Halder, 2011). Therefore, it is considered that supports from educational and social aspects could encourage and improve students' awareness in relation with renewable energy and bioenergy

Generally, just a minority of respondents showed their awareness concerning renewable energy mentioned in the questionnaire such as wind power, hydro power and nuclear power. The popular types of FBB are pellets, wood chips, black liquor, bioethanol, biodiesel. As mentioned, when it comes to the awareness of FBB, even though most students "somehow heard" about FBB, most of students could not name out any type of FBB and not specific answers about different types of FBB in use, which implied

basic knowledge regarding FBB. In this study, the participants are selected based on the random selection process which allowed the highest diversity among the answers.

Therefore, this might cause the differences in awareness toward FBB among the students due to the differences in their study major, geographical residential location or personal interest. This study also showed a similar result as previous survey concerning environmental awareness in China (Qu, 2010). As a clear indicator, students with the agricultural and forestry educational background often show a better understanding as well as greater interests concerning renewable energy sources than students with other study lines. Agriculture and forestry students have got better conditions and tools to access the information sources toward renewable energy and FBB.

Despite the uneven distribution in energy awareness, regarding the energy related law in China, the students have shown high level of awareness. Even though most of them refused to have any comments concerning the energy regulations, some students also supported the regulations with positive attitudes. In this case, it is supposed that students might hear about renewable energy and FBB through the establishment of new regulations, but they did not have either in-depth knowledge or interests in this field. Therefore, when being asked for the reason in face-to-face interview, besides personal interests, most of the students claimed that they have not received proper information or education about renewable energy and FBB.

Moreover, some students also mentioned that renewable energy and FBB have not been considered as priority as other majors, for instance, finance, marketing, construction, in both Chinese education and public awareness which might lead to the unpopular of this field among the young generations. Surely, it is understandable due to the social context in China as a developing country with a fast growing rate, economic and infrastructural related topics are more favorable to the public than forestry issues. This raised several questions about how to promote the knowledge of renewable energy and FBB at the same time with the energy related law.

In this research, students' attitude toward FBB is quite diverse. In relation with the factors influencing energy selection, price remains the strongest influential factor while factors related to environmental issues have been neglected including sustainability and environmental friendly factors. Regarding possible premium price for FBB, students usually choose the lowest price which showed their great concern about the cost when choosing new energy source. Within the environmental issues, students with different education levels also own various concerns, that students pursuing higher degree have more attention on sustainable matters. Referring back to government supports, even though Chinese Government is conducting several programs, as well as publishing regulations supporting bioenergy industry, there is lack of supporting program targeting students and non-business targets. Furthermore, in a study regarding China university student's knowledge about bioenergy, the respondents also emphasized the necessary of teaching forest bioenergy related issues at schools (Qu, 2011)

This phenomenon, again, reflects that education plays a vital role in highlighting the environmental issues. Beside the educational level, different awareness of renewable energy also impacts students' references when choosing energy sources. Students with more knowledge about renewable energy concern more about price, technology and the producers' reputation.

6.2 Situation of FBB Development in China under students` perspective

6.2.1 Promotion and Resistance

According to the results, most of students perceived that renewable energy and FBB should have been received more attention from school and university. When asking about the necessary of teaching and spreading the awareness of renewable energy and FBB, the particularity part of students have chosen the positive answers ("agree" / "totally agree") which are reflecting an increasing consideration about this situation. At the same time, it also implies lacks of environmental related subject in the general educational programs. Meanwhile, students are willing to access the knowledge of renewable energy and FBB despite their limited awareness. Thus, active educational

approach towards the renewable energy related topics is essential and beneficial for encouraging young generations to be more interested in environmental friendly related topics.

Besides educational channels, students emphasize the role of Government to support the development of new energy equipment for the whole society under the context that Government plays an important role in daily life of Chinese society. As shown in results, Government encouragement is one of the most influenced factors of choosing energy source, which is considered as a strong motivation to establish official supporting programs for the forest bioenergy industry. On one hand, through establishing policies, regulations and official information, Government is the most powerful player to remove the cultural barriers, create and support markets for FBB in China; on another hand, Government is also the most efficient propagate channel promoting the concepts and usage of renewable energy and FBB for Chinese citizens.

6.2.2 FBB and Sustainability

Compared with the FBB, the concept of sustainability seems to be more popular and familiar with students. This might somehow help to create the connection between bioenergy usage and sustainability based on students' awareness.

Regarding the ecological aspect, a part of students raised their doubts that whether FBB is truly environmental friendly with different reasons. The most common reasons are concerning about FBB producing and consuming process, in which, the producing process might cause unbalance for soil environment and traditional forestry industries and the consuming process might still expose the carbon dioxide. Even though just a minority of students follows forestry and agriculture study lines and refuses to comment on the characteristics of FBB, remaining students argued that FBB is not totally environmental friendly which reflects multiple perspectives of environmental concerns. It illustrated that students with higher educational background are more critical and cautions for their judgments, especially from an environmental aspect. On the other hand, any students emphasize FBB being beneficial with ecological aspect. Indeed,

students argue: “Bioenergy would certainly be good to the environment and solve the problems brought by the fossil fuels” and “this must be clean energy source and less pollution”. They believe that using new clean-tech energy standards will help reducing pollution and improve the current environmental quality. Meanwhile, the development of FBB can promote sustainable forest development practices which might lead to better utilization of forest resources and reduction of the environmental degradation. However, not all students are enthusiastic toward the usage of FBB.

Regarding economic aspect, students argue that the invention and usage of new energy sources and equipment will directly affect traditional energy source - fossil fuels. They recognize that the development of FBB can offer positive changes to the intensive demand of fossil fuels at the moment, thus, making changes in energy price. Even though FBB might offer higher price than fossil fuels, more energy types will intensify the competition on the energy sector. Therefore, the price level can be optimized. Eventually, consumers will be the most beneficial stakeholders. In addition, students also mention the multiple usage of FBB for both heating and transportation. In this case, the utilization and customization of renewable energy and FBB have been emphasized in order to achieve wider recognition and greater reputation. At the same time, the development of a new energy industry can significantly impact local energy technology industry (Qu, 2011). It is able to attract foreign investments, encourage technology exchange, infrastructure development and even increase the regional average income. Especially, the development of FBB can utilize the local advantage of marginal plans in rural areas in China, where there is abundant resources of forest plantations as well as the local labors.

Regarding social aspect, students show their optimism for positive social aspects which might be offered from the development of FBB in China. Firstly, such development can improve public awareness about current environmental problems and environmental friendly energy source. Secondly, according to students’ attitude, renewable energy and FBB are making new appearance of forest-related industry, which is normally seen as low-technical and labor-intensive industry. Renewable energy and FBB industry is

believed to offer more employment opportunities with higher educational background as well as higher income by which help to improve the average living standards in China.

6.2.3 FBB Advantages and Disadvantages

In the research, students can easily list out several advantages of using FBB, which reflects positive attitudes to the development of FBB in China in the near future. FBB has positive reputation concerning environmental issues among Chinese people. Students believe that FBB is a new generation of the clean-tech product. At least, they supposed that FBB is relatively cleaner and safer then coal and petroleum. Since air pollution is one of the most severe problems in China currently, Chinese people are more and more interesting in green products. Meanwhile, due to its abundant forest resources, China is a potential land to raise the development of FBB that made FBB more interesting product for Chinese people.

Besides environmental friendly, FBB is considered as new factors, which help to diversify the current energy choices and reduce the dependence on fossil fuels. This can be explained that nowadays in China, energy conflicts have attracted much attention from the public due to Chinese people's enormous consumption (Liu et al, 2011). FBB is believed not only enforcing the energy security, but also enhancing the potential of rural economy development, where abundant forest resources are located in China.

As for the disadvantages of FBB development in China, a large share of participated students emphasized mostly in the production cost. As generated in the results, energy price is the most influential factor in decision-making process. Chinese people have become familiar with the price range of traditional fossil fuels, which is relatively cheaper than FBB. Even students with insufficient knowledge of FBB also supposed that FBB is more expensive than the current energy sources. Due to the price concerns, most of students mentioned that FBB might not be able to replace fossil fuels in the near future; yet can be acting as an alternative energy source.

It is proposed that FBB can be developed in remote area with abundant forest resources but not crossing whole China. Furthermore, as a new energy source, FBB have not obtained the confidence and trust from its consumers in China. During the interview, students reflected their concerns of several elements such as safety conditions, usage instruction as well as the limitation of new energy source applications. In this case, students are skeptical about the new energy sources in not only costs but also different aspects which have built the barriers for FBB development in China.

6.2.4 Major Challenges

According to the results, the major challenges of FBB development in China can be listed among three issues: low public awareness, proper national policy support and the technology barriers.

As illustrated clearly in this research, low public awareness has restricted the development of FBB in China. Information diffusion plays an important role in encouraging public acceptance of new product. Even though consumers are becoming more interested in new energy sources, FBB is still not popular in China, that the most popular impressions of FBB within Chinese students are just environmental friendly and costly. It is obvious that shortage of science-based or the technological information is among public awareness. In addition, Chinese citizens were often lack of awareness of energy shortage and the potential of bioenergy production regarding forestry biomass capability (Lv et al, 2005), which also restricted students accessing proper information.

In this case, there is not only the lack of information but also the limited knowledge reserve among the young generations, which is so described as missing of “the sense of environmental citizenship” (Halder, 2011). Environment citizenship could be the result of an education system reflecting the importance of current topics concerning global climate change and sustainable development. It could motivate younger generations seeking and taking environmental related factors into account when choosing energy sources. Government support has been the most popular answer when asking about

major challenges in FBB development in China. As mentioned, Government owns a strong influence in Chinese citizen lifestyles and consumption behaviors, which can help to break the cultural and social barriers for FBB in China. At present, Chinese Government emphasizes on the commercialization aspects of renewable energy and FBB with several supportive regulations (Zhang & Li, 2009). However, policymaking and policy implementation seems to have not reached the public.

"National Renewable Energy Law" and "Medium and Long-term Development Plan for the Renewable Energy Development in China" are the latest two national guidance of the renewable energy development in China (Zhang & Li, 2009); however, during interviews, no student provided either answers or names regarding the mentioned laws. Therefore, the Chinese Government should generate new approaches in order to promote the official information to their citizens.

Furthermore, students emphasize that not only the regulation related issues but also several other aspects such as national funding programs and technological supportive channels should be noticed. Indeed, unlike other renewable energy production such as solar, wind and waterpower, which are operating by state-owned companies, most of FBB production facilities in China are either privacy owned or foreign investments. In order to encouraging the development of FBB production in China, these enterprises should receive more supports from local government, in terms of boosting international cooperation and technology exchange in the bioenergy production.

Technology barriers have also considered as the main factors influencing the energy price and FBB promotion. Some students in the interview believed other renewable energy sources with cheaper production costs compared with FBB such as solar, wind and hydro power. In fact, even though there were several successful bioenergy projects operating in China in recent years (Zhang et al., 2009), facilities of FBB production in China have still been considered as immature industry. Although it is reported that there are abundant biomass resources in China, lack of the infrastructure has strongly limited the FBB industrialization, which consequently leads to the high production costs. For instance, one of the challenges of energy production in China is that there is lack of

transmission lines to reach customer, which might cost around 10 billion USD per year for the upgrading (Staub, 2005).

6.3 Students as Unique Group in Further Development of FBB

According to the respondents, students will play a significant role in the development of FBB usage in the near future. Nowadays, students have better possibilities to access new information as well as to spread their ideas thanks for the development of internet and public media tools. Thus, students are the "live information exchange channels" in the society. Students can also easily access up-to-date knowledge and discard obsolete information.

Meanwhile, internet is highly accessible with different types of devices and networking tools, students are able to publish their judgments and ideas by internet-based tools, for instance Sina Weibo (similar to Twitter) or blogs, throughout the popular and well-accepted social network to share knowledge and opinions without any premium charges. Some FBB-related industries or government also publish educational or official info through social network channels, somehow indirectly enlarge the public awareness and influence of FBB industry and governmental protocols of new energy development.

And not only the FBB related information, but energy related regulations, news in energy related industries and wide range of topics can also be accessed at government websites as figure 30 shows. But a clear improvement could be made to the website, and almost all mentioned channels of spreading energy related information, which is to add the English version to all sites.

Figure 30. China National Energy Administration homepage

In other words, students are considered as channel of information diffusion, which can help encouraging awareness besides the formal education channels at school or other educational institutes.

More importantly, with the age between 18 and 25, participated students in this project represent the young generations with higher educational background in China, who might join the working labor and directly make the changes in Chinese society in the near future. Therefore, they hold active position to be the pioneer for more sustainable lifestyle. Regarding the older generations, students are the refreshment and potential impact towards parents and even grandparents, in order to adjust the traditional concept of daily energy use, and also to receive new energy technology. Meanwhile, students' awareness also directly influences the society's long-term trend towards development of FBB and other renewable energy types. As mentioned, this student generation will distribute efforts to social development in the near future that might include more environmental friendly lifestyle. The challenge is how to increase the interest of student with these issues and their commitment toward a better lifestyle.

Especially, for those with forestry and agriculture study lines, students expressed their hopes that they should be more active in promoting renewable energy and FBB. Students also emphasized that balance between decreasing production costs, increasing efficiency and utilizing other intangible values can be the core element to promote new energy, since consumers have become more critical and considerable in many elements when making the decisions, for instance, new technology involvement and social trend.

6.4 Differences in Awareness and Attitude between Students Studying in Finland and China

As mentioned, the interviewees in this study are domestic Chinese students and Chinese students with an oversea education, in this case, students with a Finnish education were chosen. Based on the research topic on student's awareness and attitudes differ between students in China and in Finland were obtained.

Regarding the basic knowledge and general awareness in FBB, students with Finnish education appeared to have a richer knowledge of FBB, environmental protection and other energy-based technology. In contrast, domestic Chinese students showed less accumulation of knowledge, which led to the conclusion that those who are studying in Finland illustrate a wider awareness of FBB compared to domestic Chinese students.

Furthermore, the level of education does matter considering student' attitudes. In order to clarify the influence on awareness brought by the level of education, the background of selected students was checked. Most of the interviewees had obtained a Master's degree, a small group had a Bachelor's degree, and only a few had obtained a Doctoral degree. According to the results, students studying domestically or overseas (in Finland) have indicated that a higher education level provide a richer knowledge reserve and a greater awareness of the research topic. However, based on data analysis, with the same education level, Chinese students in Finland gave more information describing the nature of FBB, concern about FBB development and energy related policy or law.

Besides awareness having an essential role when talking about the future of a certain object, attitude seems to be even more essential. The data analysis is clearly indicated that both groups (domestic Chinese students and Chinese students studying in Finland) have a positive attitude and promoting insight on the future development of FBB and FBB's potential in China. In this field, the two groups have demonstrated the same level of positivity, which shows that although China is currently less advanced than Finland in FBB technology and production, students, as the next generation of potential buyers, developers and policy makers are accepting of FBB. This could be highlighted as a step towards the future success of FBB in China.

For students, at this stage price seems to be their highest concern. According to the survey, a large amount of respondents mentioned their view of "putting extra money into using FBB". This answer is not as optimistic as the author's prediction that the majority would not be willing to pay extra if FBB requires it. China is mainly powered by fossil fuel which is not ideal for the environment, however, due to its relatively cheap price, the whole society still depends on it. The students reflected this attitude that the extra cost issues blocks the future of FBB. When comparing the submitted data between the two groups, the accepted price level given by the students in Finland was slightly higher than that given by the domestic Chinese students. In this case, although the extra cost is a clear concern of both groups, one sees more benefit in that extra cost.

Not only did the level of the degree affect the attitude and awareness of FBB and related matters, but the specific major or the academic field of the students also affected them. Within the research, the results showed that students from both groups who studying forestry or other technology-based major commonly showed a more positive attitude and greater awareness. However, even with a similar major, students in Finland still provided more knowledge, which might be connected to the difference in the energy sector between China and Finland: China views FBB as a new idea, however, Finland sees it as a common energy source with advanced utilization. Education in Finland has been able to equip students with more up-to-date knowledge in this field.

6.5 Research Limitations

The research process and data collection were done by following the planned schedule and methods, however certain limits and difficulties occurred during this stage:

Schedule Arrangement: Due to the expectations of research method, except for the survey questionnaire, individual interview must also be considered. It has been arranged to proper timing for the interview. (7-day data collection trip, May 2013). As result the planned interview scale was not completely reached but constructive feedbacks were received as compensation.

Survey Scale: Because of the time limit of survey distribution and research finance allowance, only the mentioned universities were contacted, which might somehow cause imbalance of the collected data and results respectively.

Respondent origins: It is clarified that respondents are Chinese students studying at universities in China and Finland, however origins of respondents were not completely traced. As it has been addressed in the previous chapter, the forest resource distribution in China is imbalanced, where correspondently influence students´ awareness of forestry and related matters. This situation is believed to further influence students´ choice of study fields at universities. Ultimately, students from the region with richer forest resources might have obtained wider awareness than those who are from regions with less forest resources. Thus to track respondents´origins has become essential to the creditability of this research. If this could have been completed registered, research may also be able to obtain deeper understanding on impact of FBB awareness brought by the mentioned regional difference.

Language Issue: As the research was made in English and research target is the Chinese students, where language issue must be mentioned as one of the research limits. A part of interviewees have sufficient English skills who could conduct the efficient interview in English. Meanwhile, other students feel more comfortable to express their own

opinion in their native language which made the communication with interviewees was partly done in Chinese. However all the data were record and translated into English afterwards by the author.

Data Validation: As mentioned, there were 92 responses retrieved in total, yet 80 responses were qualified. The qualified responses are considered as the questionnaires which were fully answered. Those incomplete responses were eliminated. Therefore, only 80 qualified questionnaires were selected for data analysis.

Besides, the limitations mentioned above can be improved in the next similar research. Regarding schedule agreement and survey scale, in corporate with the face-to-face interview, online interview can be used to reach more interviewees, at the same time, ensuring the quality as well as quantity of responses. Meanwhile, the language barrier can be solved while by translating the interview protocol into Chinese which would require more efforts from the researchers.

Last but not the least, special attention should be given to execute questionnaires and to communicate with respondents, in order to keep track of the data validation.

Regarding policy and the role of government in FBB development, almost every student from domestic group mentioned awareness of such policies as well as that the central government sets the trend for future development. The Chinese students in Finland answered positively in terms of policy awareness, but did not indicate the power of central government as strongly. The students in each group were aware of the policy and knew that the general trend is in support of FBB and other alternative energy sources being developed. This may demonstrate a difference between the Finnish and Chinese education system, as the Chinese system describes control as coming from the government, but the Finnish system focuses more on spreading the knowledge and academic research.

Besides, in the same age group, the students with a Finnish education could provide more information about FBB and related matters in contrast to the domestic Chinese students. This shows the difference in the awareness level between the two groups. The reason for this could be located in the education systems, since in Finland professional energy-based knowledge has already been provided to students in the first year of their Bachelor's degree study, whereas the first year in Chinese system is normally devoted to general science learning (Mathematics, Physics, Chemistry and Biology).

Overall, domestic Chinese students and Chinese students with a Finnish education background both have a similar, positive attitude concerning the future of FBB in China. However, with their less advanced knowledge of FBB technology and their view of FBB as a new energy source, domestic Chinese students overall have less awareness than those who are studying under the Finnish system.

7. CONCLUSION

The research has been conducted mostly in the Southern & Eastern Finland and the Central & Eastern China where abundant sources of forests as well as most of highly ranked educational institutions in China and Finland are located.

Selected students in this study are assumed to represent China`s young generations with background of higher educational. According to the result, students, or younger generations in China, have showed their positive attitudes toward renewable energy usage, which are similar with several previous studies in other countries (Greenberg 2009, Halder et al., 2010).

This also implies that Chinese students are in the similar perspectives with the global trend toward energy usage and sustainable development. But Chinese students' awareness of renewable energy and FBB is quite moderate which caused confusion in their decision making process. Lack of relevant knowledge has restricted students from diversifying their energy choices. Their first priority when choosing energy source is mostly price while the environmental aspects are neglected compared to the price. Interestingly, even though students predicted that FBB still cannot replace fossil fuels in the near future, they believed that FBB can positively impact the energy situation in China, and it can become a common energy source in areas where forest resources for FBB production are located. The main challenge of FBB development in China is the shortage of public awareness, Government support and technology barriers. In which, public awareness is the most important factor influencing the energy usage in China, while Government support impacts both the promotion in consumption and industrial development and technology barriers decides production costs and infrastructure platforms.

At the same time, the study implied that information diffusion is an important aspect ensuring the efficient implementation of FBB in China. Students emphasized the importance of having more information channels including educational subjects and

public media which can significantly increase the public awareness of FBB in China. Especially at present, students, as the major users of internet and public media, are the core element in the urbanization process, who bring advanced information and vivid lifestyle for the whole society.

Taking a holistic view of the study, the project has captured the overall picture of FBB development situation in China under Chinese students' point of view. The result might provide useful information for policy making process concerning FBB development in China. Further studies can investigate more in Chinese citizen actual behaviors when choosing the energy sources. It is also possible to extend the sample sizes as well as the geography locations in order to receive more diverse and broader range of samples and opinions.

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APPENDIX 1

QUESTIONNAIRE

1. What is your age?

A. >30 B. 25-30 C.20-25 D.15-20

2. What is your gender?

A. Male B. Female

3. Are you (have you been) studying abroad?

A. Yes B. No

4. Which degree are you currently pursuing?

A. Bachelor B. Master C. Ph.D. D. Other:

5. What kind of energy source is the most widely seen / used in your region?

A. Coal B. Oil C. Wind Power D. Hydro Power

E. Nuclear Power F. Solar Power G. Other:

6. Have you heard about forest based bioenergy?

A. Never B. Somehow heard C. Often heard D. Well noticed

If yes, could you mention the forest based bioenergy types that you have heard?

7. How strongly do following aspects affect your opinion when you are choosing energy source?

(1: Strongly affecting; 5: Not affecting at all)

Aspects	***1***	***2***	***3***	***4***	***5***
7.1 Operational Safety					
7.2 Environmentally friendly					
7.3 Price issue					
7.4 Sustainability					

7.5 Requirements of storage					
7.6 New technology involvement					
7.7 Local / imported products					
7.8 Reputation of energy producer					
7.9 Limitation of usage					
7.10 Regional economic influences					

8. How do you think about the following circumstances?

(1: Strongly agree; *5: Strongly disagree)*

Circumstances	***1***	***2***	***3***	***4***	***5***
8.1 It is important to provide / know general knowledge about bioenergy to the whole society					
8.2 I don`t have any / enough knowledge about forest based bioenergy, but I`d like to study it					
8.3 I have forest based bioenergy knowledge and I`d like to share it this with others					
8.4 I support using forest based bioenergy and I also like to encourage others to use					
8.5 Forest based bioenergy production must be involved with sustainable forest management in China					
8.6 It is essential for government to support / enlarge use of forest based bioenergy					

8.7 It is difficult to develop forest bioenergy in China under the current conditions					
8.8 Forest based bioenergy will see a large scale of development with the current technology and social awareness in the next 5-10 years					
8.9 Nowadays low public awareness of forest base bioenergy resists its development in China					
8.10 The development of forest based bioenergy is determined by the coal price and oil price					
8.11 If possible, I`d like to replace my energy source to bioenergy even it may cost more					
8.12 The bioenergy will soon replace fossil fuel in China					
8.13 With the potential development, bioenergy might affect fossil fuel prices in the near future					
8.14 The production of forest bioenergy may negatively affect the original forest industry (timber, paper / pulp productions, etc.)					
8.15 Forest resources should be used only for original forest industry (timber, paper / pulp productions, etc.)					
8.16 The production of forest bioenergy may harm the food security in certain areas					
8.17 Forest based bioenergy can be used for heating but also for transportation					

8.18 Forest based bioenergy is not totally environmental friendly and it may actually harm the environment on certain aspects					
8.19 The usage of forest based bioenergy can effectively minimize the environmental problems					
8.20 Forest based bioenergy is an industry that offers opportunities of employment					

9. If forest based bioenergy electricity brings additional costs, how large the scale is still acceptable for you compared with the original costs?

A. > 20% B. 15-20% C. 10-15% D. 5-10% E. 1-5% F. < 1%

10. What aspect affects you the most when concerning the usage of bioenergy?

A. Social trend B. Personal concerns of environmental issues

C. Government encouragement D. Possible subsidy of bioenergy usage

E. Other driving forces please specify:

11. Do you know if there is any law or legislation concerning the forest based bioenergy / renewable energy development in China?

A. Yes B. No

If yes, how do you think about the laws or legislations that you know?

12. Do you have any doubt concerning if bioenergy is actually environmental friendly?

A. Yes B. No

If yes, please indicate your opinions:

13. In your opinion, which position and attitude should students have to support development and implementation of forest based bioenergy?

14. Could you explain the main advantages and disadvantages of utilizing forests as bioenergy based on your own understanding?

15. What could be the major challenges that resist the development and implementation of forest based bioenergy in China?