

## **Research on Statistical and Investigating Methods of Utilizing**

### **New Energy and Renewable Energy in Beijing**

Wang Leqiang, Zhou Rui , Zhang Qilong, Fang Xiuyu, Li Xin, Lai Weichen, Xue Ting\*

Beijing Municipal Bureau of Statistics, Beijing, China,

[roberta.xue@gmail.com](mailto:roberta.xue@gmail.com)

#### **Chapter 1 Introduction**

At present, human beings are facing the double crises of exhaustion of resources and environment pollutions and the enormous emission of green-house gas led by consumption of fossil energy is the main cause for the changes in global climate. Therefore, it has been the trend of the times to vigorously promote the application of new energy and renewable energy. In Beijing, the modern metropolis, the contradictions between the human beings, economic development and the resource and environment have been increasingly serious and the pressure over the energy-saving and emission-consumption has been heavier and heavier. Developing the new and renewable energy with the green concept and character of low-carbon is the important part in optimizing the energy-consumption structure and building up the scientific Beijing and green Beijing. Thus, it has been an urgent subject for the research over scientific system by the statistic method of renewable energy.

In light of the superiority and actual utilization of renewable energy of Beijing, this subject, through assessment of the classification, methods of utilization and process of manufacture of the renewable energy to grasp the features of the utilization and transformation, builds up the statistic index system and further conduct systematic research over the relevant statistic range, object, channels and methods, designs the forms of statistics and report-making principle and the explanation of index and launches the pilot investigation.

#### **Chapter2 Establishment of statistic index system of renewable energy**

##### **I. General concept and classification of renewable energy**

Renewable energy refers to the energy that could be cycled and sustainably used, which is against the non-renewable traditional fossil energy. According to the *Renewable Energy Sources Act*, renewable energy refers to the non-fossil energy like wind energy, solar energy, hydraulic energy, biomass energy, geothermal energy and ocean energy. Versus the traditional energy, new energy is the energy with new type of utilization. The meaning of new energy changes against the time. Clean energy, from the environmental influence of energy consumption, refers to that the energy is consumed with no pollution or little pollution to the environment. At present, the major renewable energy refers to the new energy and clean energy, and their relationship is showed in Chart 1. The range covered by this research involves the new energy and renewable energy, but since the applied new energy in Beijing belongs to the renewable energy, the description is concise and new energy will also

be called as renewable energy.

**Chart 1 Division of renewable energy and new energy**

Division	Renewable energy	Non-renewable energy
New energy	Solar energy, Biomass energy, Wind energy, Hydraulic power, Geothermal energy, Tidal energy	Nuclear energy
Traditional energy	Burning fuel wood and straw	Coal, Petroleum, Neutral gas

International energy agency divides the renewable energy into 10 kinds which are wind energy, hydraulic power, geothermal energy, solar power, tidal energy, industrial refuse, household refuse, solid, liquid and gas matter. According to the literature research and fieldwork investigation, we have two-level classification, i.e. the first level classification is divided by energy kind and second level classification is conducted by the actual utilization of energy, which divides the energy into solar energy, biomass energy, geothermal energy, hydraulic power and wind power and initially determine the eight kinds of utilization, i.e. the photo-thermal utilization of solar energy, PV, gas and solid utilization of biomass energy (See Chart 2).

**Chart 2 Classification of renewable energy utilization**

1st classification (species)	2nd classification (utilization)	Specific forms
Solar energy	Photo-thermal	House-used solar water heater, sunshine bathroom, centralized water supply system, sun room heating system, solar thermal power generation, sunlight greenhouse.
	PV	PV roofs, PV power station, solar energy lamp lighting
Biomass energy	Gas utilization	Two-gas projects of village, power generation by biogas
	Solid utilization	Solid forming fuel, suspend ondol, generation by garbage, agriculture and forest biomass, heat-supply
Geothermal energy	Deep level geothermal water	Bath and hot spring
	Shallow level ground source heat pump	Thermal dynamic heating system like ground source, underground water source, sewage source, etc.
Wind energy	Wind turbine generation	Large-scale wind farm
Hydraulic power	Hydroelectric	Hydropower station

Here, the solar energy what we focus on is the solar energy in narrow sense, i.e. the photo-thermal, PV and photo-chemical transformation in radiation of solar energy. The utilization of photo-thermal energy is mainly focus on the use of solar thermal collecting device. The use of PV is to generate the current by the photovoltaic effect of solar battery.

Biomass energy in this research refers to not only the agriculture and forest biomass, but also the excrement of livestock and urban refuse which can be classified as utilization of gas and solid. On one hand, utilization of gas generates biogas by the anaerobic fermentation of biomass, which could be used as the non-pollution gas to replace the liquefied gas or used to generate or supply heat by burning; on the other hand, the biomass is gasified by thermochemical conversion of biomass. Solid utilization refers to that the agriculture and forest wastes and urban garbage are used fuel for the second time and can be used to generate or supply heat.

Geothermal energy refers to the enormous natural heat inside the earth which exists as vapor or hot water. The exploitation of geothermal energy is limited so far. According to the actual circumstance, the geothermal energy could be classified as the deep level geothermal and shallow level geothermal. The former is to extract the geothermal water in the geothermal well and usually recharge and the latter is to supply heat in winter and refrigerate in summer by heat transformation of heat pump by using the shallow ground energy, like soil, underground water and reclaimed water of municipal sewage, as the cold and heat resource.

The wind and hydraulic power are used as generation. The wind energy project is to transfer the kinetic energy into electrical energy by power generated from the windmill; the hydraulic power project is to transfer the potential energy of water into the kinetic energy of hydro turbine by falling water, then into the electrical power.

## **II. Principle of index selection**

**1. Principle of materiality.** It is more realistic to conduct the research over the actual amount usable of renewable energy.

**2. Principle of integrity.** The index system should cover all varieties and utilization to achieve systematic, soundness, non-duplicate and non-omission.

**3. Principle of brevity and maneuverability.** The comprehensive ability of respondents and operative difficulty should be adequately considered when selecting quantitative index. The selection of qualitative index should take the current standard system or common sense inside the industry as the basis.

**4. Measurable principle.** Generally we select the indexes that could be accurately measured. However, other indirect measurable indexes and relevant conversion coefficient should also be considered.

**5. Expandable principle.** The index system should be maintainable and expandable and be improved with the development of renewable energy.

## **III. Selection of index and design of frame**

After varieties of extensive fieldwork investigation, expert consultation, relevant information collection and repeated argument, we determine that there are 43 statistic indexes of 3 classes in the final design. Taking the second classification (i.e. the method of utilization) of renewable energy as standard, the first index, as the core index, reflects all varieties of renewable energy utilization; the second index is selected by taking the operate parameters of facilities in actual utilization as the basis; the third index is used to calculate the first and second indexes or express other important information of renewable energy in light of the data-collection conditions in grass root.

## **IV. Research of relevant conversion coefficient**

A series of conversion coefficients shall be used in calculating the standard energy consumption for the special energy transformation and utilization of renewable energy. In the index systems above, some first indexes should be calculated by second and third indexes and relevant conversion coefficients. Thus, researches over relevant coefficient are a part of the design of index system.

## Chapter 3 Research of statistical survey on renewable energy

### I. Research of statistical range and subject

#### 1. Features of main subject of renewable energy in Beijing

Generally, the renewable energy relies on the appropriate renewable resources. It also has the realistic demand for renewable energy. At present, the renewable energy project mainly depends on the advancement of government with the supplement of independent construction of unit. The renewable energy is extensively applied by the rural residents in all outer suburbs and villages, which make the villagers the largest group that utilizes the renewable energy in Beijing.

#### 2. Determine the survey subject through investigation of project

According to the research above, we could primarily confirm that the survey subjects or renewable energy could be divided into two categories, i.e. the construction project of renewable energy and the residential utilization.

The project of renewable energy, according to the present statistical method of regular energy, should be reported by the juridical person of project as the basic survey subject. However, for the lack of statistical basis of renewable energy and the numerable types and resources of projects, the confirmation of survey subject is the major part of this subject. Thus, the subject team conducts the large-scale investigation research of renewable energy project to clarify the survey subject of renewable energy and confirm the survey channel to establish the project information base of renewable energy.

**Chart 3 Investigation results of renewable energy projects**

Projects of photo-thermal	Generation project	Projects of earth source heat pump	Projects of direct utilization of geothermal water	Projects of solar energy lamp	Manufacturing briquette	Total
284	43	332	85	151	5	<b>900</b>

Through investigation, we confirm that 900 renewable energy projects could operate regularly. These projects belong to 794 enterprises which directly constitute the survey subjects of renewable energy projects. And we could confirm the list of enterprises and public institution that install the renewable energy projects. However, the renewable energy could be applied not only in the construction projects, but also in the daily life and agriculture. To guarantee the integrity of statistical survey, we include the daily life of residents into the survey subjects of renewable energy.

### II. Statistical channels and survey methods

The present *Energy statistic system* specifies that the impersonal entity should report according to the principal of juridical person management. The statistic channels of renewable energy mainly refer to the present energy statistic channel and method and make innovations according to the real situation of survey subjects.

For the construction projects of renewable energy, the utilization of renewable energy should be reported by the juridical person or manufacture institute through further survey according to the investigation results.

For the utilization of renewable energy by rural residents, we select the method of overall survey that the form could be reported level by level by all village committees

together. This could adequately take advantage of the centralizing grass-root effect of village committee. Moreover, the village committee has the experience in filling report-forms. Thus, this statistical channel can be well-operated and reliable.

### **III. Design of report-forms**

For two channels of project and village, we design two report-forms. The Form 1 of statistical survey of energy of Beijing (SSEB) is reported by the institute (or juridical person or industrial activity) to which the renewable energy belongs; while the Form 2 of SSEB is reported by the village committee of administrative villages. On the design and selection of index, we have filtered and simplified the index system established in early days and finally design 26 and 18 indexes respectively in Form 1 and Form 2 (specified forms are in Appendix 2).

What we need to note is that considering the numerous varieties of renewable energy projects and numerous kinds of utilization, we design a subject on the top of Form 1 for distinguishing the variety of projects, which is good for reporting other data of the form and searching for and finding the institutes with multiple-projects to facilitate the classification and summary in later period.

### **IV. Study of the calculation**

#### **1. Calculation of the energy-utilization quantity of some varieties**

The study could calculate and summarize the utilization of all varieties of renewable energy by the standard coal coefficient, in which some of the renewable energy could be calculated by the relevant indexes of the form. The followings are the relevant calculation formula:

- The photo-thermal utilization of heat collector (tce) = the area of heat collector  $\times$  conversion coefficient of photo-thermal of heat collector  $\times$  annually average operative months of heat-collector/12
- The photo-thermal utilization of green-house (tce) = construction area of green-house (floor area)  $\times$  conversion coefficient of photo-thermal of green-house
- .....

#### **2. Study of conversion coefficient of some varieties**

When the utilization of different varieties is converted by the standard coal, we need to use a series of conversion coefficient. In this study, conversion coefficients of some varieties have been provided in the Energy Statistical System and can be directly used; while some conversion coefficients are the newborn things, like the conversion coefficient of heat collector of solar energy, we obtained the scientific reference value of Beijing through consulting the experts. Coefficients are included in Appendix 3.

## **Chapter 4 Analysis of investigation data**

There are totally 900 institutes and 3396 administrative villages involving renewable energy projects reporting the data of utilization of renewable energy in this pilot project. Finally, 2,330,000tce of renewable energy was used in Beijing in 2010.

**Chart 4 Utilization of renewable energy**

Varieties and utilization method	Utilization of energy (10 000tce)	%
1. Solar energy	145.8	62.4%
Photo-thermal utilization	145.5	62.2%
PV Utilization	0.3	0.2%
2. Geothermal energy	23.6	10.1%
Heat pump of shallow earth source	21.3	9.1%
Utilization of deep level geothermal water	2.3	1.0%
3. Biomass energy	43.0	18.4%
Gas utilization	3.2	1.4%
Solid utilization	39.8	17.0%
4. Wind power	8.3	3.6%
5. small hydropower station	13.1	5.6%
<b>Total</b>	<b>233.0</b>	<b>100.0%</b>

In 16 counties and development area in Beijing, the utilization of renewable energy in development area is the smallest, only 1,000tce in 2010; the utilization of renewable energy in the new development area like Daxing, Tongzhou, Shunyi and Changping districts is larger, about 300,000 tce. The total utilization of renewable energy of ten counties and districts reach 1,925,000 tce, accounting for 82% of the total utilization, which shows that the utilization of renewable energy concentrates in suburb area.

According to the international grouping methods by the utilization form of terminal, the quantity of renewable energy for generation in 2010 in Beijing reaches 4,240,000 tce, generating 970,000,000 KWH of green power. While the quantities of renewable energy used for direct heat-supply and terminal fuel are respectively 1,692,000 and 214,000 tce. The utilization of renewable energy in Beijing intends to supply heat.

## Reference

1. *Renewable Energy Law of the People's Republic of China*
2. Guidance of development and utilization of solar energy industry in Beijing
3. Beijing 12<sup>th</sup> 5-Year period of new energy and renewable energy development plan
4. Xu Xiaohong (2008). Construction and evaluation of circular economy system of statistical indicators. *Zhejiang Statistics*. 12.
5. Liu Shumao (2008). Research on Beijing landscape system of statistical indicators. *Beijing Forestry University Thesis*.
6. Wu Zhijian (2006). *The use of new energy and renewable energy*. Mechanical Industry Press.
7. Li Aixian (2003). Development and current situation of renewable energy standardization in China. *China Standardization*.
8. *Renewable Annual Questionnaire 2006 and Historical Revisions*, IEA, 2006
9. J. Garcia. *The Statistics of Renewable Energy*. Energy Statistics Division of IEA