ENERGY LABLING SYSTEM FOR RESIDENTIAL BUILDING IN CHINA

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ABSTRACT

Residential Building Energy Efficiency (RBEE) becomes more important in recent years in China. From 1986, Chinese government has carried out a series of codes of RBEE, but for kinds of reasons, the effect is not perfect enough. One important reason is

In order to promote the development of RBEE, an energy labeling system was presented in this paper. In this labeling system, the real estate company was requested to label the energy consumption data of the houses to be sold on the sales documents, and show this data to the consumers. With propagandistic and economical ways, government needs to guide the consumers to select energy efficient houses. In further, the real estate company will be driven by the market to build more energy efficient houses and apartments, and correlative products and research will be promoted. So, the energy labeling system is a system that accelerates the development of RBEE with the power of market.

Some key problems were also discussed in this paper, such as, the scale of the labeling objectives, and the type of label. This paper also point out that the data of label should come from simulation, but not measurement or expert. The operation mechanism was also presented, which include how to do the simulation, how to ensure the accuracy of labeling data, etc.

KEYWORDS

Energy Labeling System, Residential Building Energy Efficiency, Building Simulation, Label, Insurance

INTRODUCTION

Residential Building Energy Efficiency (RBEE) becomes more important in recent years in China. From 1986, Chinese government has carried out a series of codes of RBEE, but the effect is not remarkable. One important reason is the consumer doesn't realize the benefit he can get from the energy efficiency building, which make the real estate companies, the major executants of energy efficiency, have no interest on it.

RBEE involves a lot of fields, includes real estate, manufacture of building materials, building design and research field, so one-sided promotion of government is not enough for the development of RBEE. A series of policies based on market mechanism should be necessary complementarities, such as, the energy labeling system of residential building presented in this paper.

In this labeling system, the real estate company was requested to label the thermal performance data of the houses to be sold on the sales documents, and show this data to the house buyers. With propagandistic and economical ways, government needs to guide the house buyers to realize the benefit of energy efficient houses and select them. In further, the real estate company will be driven by the market to build more energy efficient houses and apartments, and correlative products and research will be promoted. So, the energy labeling system is a system that accelerates the development of RBEE with the power of market.

Some key problems should be solved for the successful implementation of this system:

- The scale of the labeling objectives: A whole building or a single apartment?
- The type of label: Qualitative or quantitative?
- How to get the accurate label data?
- How to make the whole system runs favoringly?

In this paper, these questions are discussed.

THE LABEL OF ENRGY LABELING SYSTEM

Scale, type and contents of label

(1) Scale of label

Most Chinese houses are apartments in urban area, and most present energy efficiency codes focus on the whole building or uptown, but not an individual apartment. It is helpful to the reduction of manage cost and the implementation of the codes. However, in the energy labeling system, the main purpose is to show the relationship between the thermal performance of apartments and the benefit of buyers and guide them to select energy efficient houses. As well known, the thermal performances of apartments located in different position of the building are different widely, even 2~3 times. The average level

of thermal performance of the whole building has no direct relationship with an individual apartment.

In this system, we should focus on one apartment rather than the whole building because usually one family only needs one apartment. Only in this way, the label data is significative to the buyers and can make them pay attention on their self benefits, the whole system can play a role. Otherwise, the 2~3 times uncertainty will make the label to be a misleading tool.

In western countries, the label objectives usually are the whole buildings. This is because that in those areas, the building usually is single-family house. Essentially, the objectives should be “one family”.

(2) Type of label

Generally, the labels have two types: grading and data. The grading label means dividing the objective into several ranks according to its performance parameter and the data label means showing the performance parameter only without any ranking.

The grading label is easier to understand and used widely, but there are some disadvantages on it.

i) Lack of clarity. Buyers usually can’t know the exact meanings of the grading label for the lack of specialized knowledge. When the parameters are very much or difficult to be quantified, the grading label is a better choice. But the thermal performance of house can be quantified well, so the data label is preferred.

ii) Need a strong monitor. For the lack of clarity, the grading label will be inauthentic without monitoring system. If we use data label, buyers can compare the label with the number of their ammeters, which is helpful to ensure the veracity of label.

iii) Hard to find a uniform standard. China is so wide a country that the climates of different area are different widely, which make thermal performance of houses in different area are total different even they are the same. This will make the government difficult to carry out a uniform standard to measure the thermal performance of the houses and rank them.

According to the three reasons above, the data label is more suitable for the energy labeling system.

So in this sytem, we need choose the data label for each family, but not the grading label for the whole building or uptown.

(3) Contents of label

The function of energy label is designed to provide reference information to help the buyers make their choices. The label should show the energy cost of the air conditioner, which can be used to compare with the running expenses and with the data of other houses. The labels presented in this paper are shown in table 1.

Table 1 thermal performance label of houses

Label	Unit	Objective
Annual Energy Consumption for Heating	kWh	per apartment
Annual Energy Consumption for Cooling	kWh	per apartment
Total Hours of the room temperature less than 15°C	Hours	per room
Total Hours of the room temperature higher than 29°C	Hours	per room
Total Hours of Sunshine	Hours	per room

The labels have three parts: energy labels, temperature labels and sunshine label. Energy labels mean the energy cost of air conditioner which is to make a comfortable indoor environment. Temperature labels stand for the indoor temperature status without air conditioner. Sunshine label shows the time that the room can received sunlight directly.

The different labels show the different demands of buyers. People who like air conditioners will concern the energy labels and select the low energy cost house. People who don’t like air conditioners, such as old persons, will focus on the temperature labels. And research shows that better energy performance doesn’t means better temperature performance, so in order to meet the variable demands of buyers, these labels are necessary.

Method to get labels

Because the money and time cost of measurement is too much to be executed, the only possible method to get the labels is by simulation.

For a certain residential building, the thermal performance is influenced by three kinds of factors: the building envelope, the climate and the inhabitant’s behavior. The inhabitant’s behavior means how the people use the house, includes the number of residents, the lights and equipments in the rooms, the operation mode of air conditioners, the open and close of the windows, and so on.

The information of building envelope can be got from the construction documents or some simple measurements, and the climate data can be got from the “Typical Meteorological Year”, which can be made based on the measured historical data. But the inhabitant’s behaviors of different families are variable. Research shows that different inhabitant’s behavior may leads 2~6 times difference of energy labels. In order to get the significative label, we must define a “Standard Condition” as the foundation of simulation. All the labels data are based on the “Standard Condition”, as the oil cost data of cars, which is based on the standard speed, road condition, and so on.

This "Standard Condition" must be able to stand for the average level of the local inhabitant's behavior.

Correction of labels

In real situation, the climate data and inhabitant's behavior will be different with the "Typical Meteorological Year" and the "Standard Condition", which will cause difference between the real data and the label data. So, a correction method is needed to reduce the difference.

With this correction method, buyers can adjust the label data more close to the real data easily. Obviously, simulating the building by buyer is undoable. The possible way is giving a series of corrective coefficients, which include coefficients for inhabitant's behavior and climate data. With these coefficients, buyers can select and correct the label data according to their own behavior and climate data.

The method of correction will be shown with an example of unit area light power. In "Standard Condition", the unit area light power is 4.5W/m2, we may define 4 case in a range that can cover the status of most families (Such as, 2W/m2~15W/m2, the unit area light power of most families in this range), as shown in table 2. Then we can simulate the buildings in these four cases with the same other conditions and get the corrective coefficients. The equation as follow:

$$Coef. = \frac{\text{label data in different case}}{\text{label data in Standard Condition}}$$

Table 2 Corrective coefficients under different unit area light power

Case	Unit Area Light Power (W/m^2)	Coef. for Heating EC (Mid Apart.)	Coef. for Heating EC (Boundary Apart.)	Coef. for Cooling EC
A	2	1.09	1.06	0.97
B	3	1.05	1.03	0.98
C	7	0.91	0.94	1.03
D	15	0.67	0.78	1.11

Because the buyers only can compare the energy labels with their electricity consumption, we only give the corrective coefficients of energy data, not the temperature and sunshine data.

When the buyers get the thermal labels, the corrective coefficients will be sent to them as reference. With these coefficients, buyers will have enough reasons to complain if they find that the real electricity consumption is much different with the corrected label data.

OPERATING MECHANISM OF ENERGY LABELING SYSTEM OTHER SECTIONS

The participants of energy labeling system include: buyers, real estate Company, labeling firm, insurance agent and government. The relationship between them is shown in fig 1.

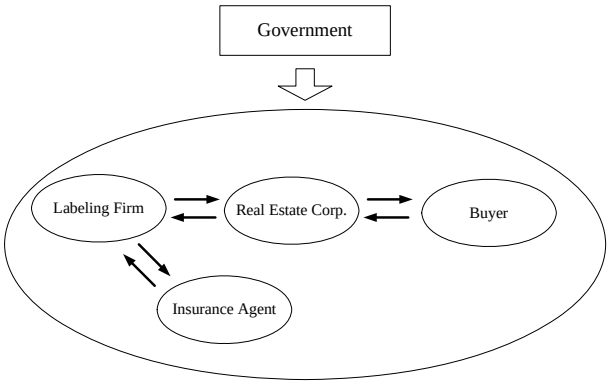

Fig 1 Relationship between participants of energy labeling system

Labeling procedure

The procedure of energy labeling system as follow:

The real estate company should provide the construction documents and test reports of some building materials to the labeling firm. The labeling firm has the ability of getting the label data. They will simulate the building according to the documents from the real estate company and give the label data back to them. In addition, the labeling firm need submit the original simulating files to government as records.

The real estate company needs line out the labels on the sales document as the reference of buyers. The description of "Standard Condition" and the correction method should be provided as attachments.

After a period, buyer may compare the real energy consumption with the label data and claim for compensation if he found the difference is too large. In order to protect the buyer's benefits, the labeling firm needs insure the label data against errors when it gives the data out. When the labeling firm needs to take the responsibility of the inaccurate label data, the insurance agent will compensate to the buyers.

Government is the manager and monitor of the energy labeling system, and doesn't take part in the market behavior. Its role is to carry out regulations, such as, requesting the real estate company to line out the thermal label on the sales documents. Another job is monitoring the work of labeling firm, includes constituting the simulation procedure, censoring the aptitude of labeling firm, dealing with the dissension, and so on.

Dissension settling method

Buyer can claim for compensation if he found the difference between label data and real data is too large. It is the key point that finding who need to take the responsibility. The reasons caused mistakes are as blow:

- Reason 1: The buyer didn't correct the label data with the corrective coefficient according to his real situation or in an improper way.
- Reason 2: The construction documents provided by the real estate company are not consistent with the real building.
- Reason 3: The mistake of labeling firm.

The arbitral institution will find the responsibility taker when there are dissensions. The procedure is shown in fig 2.

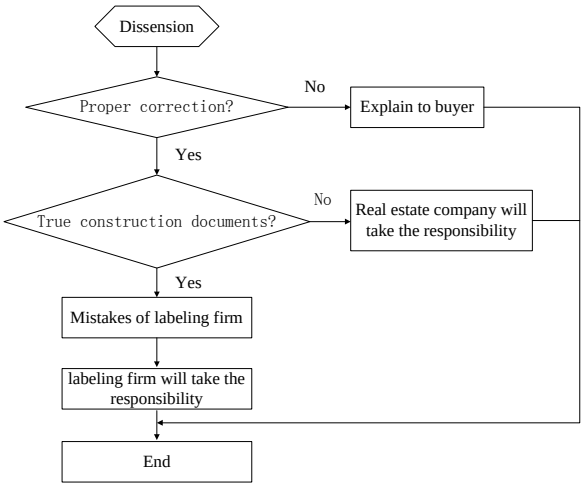

Fig 2 Procedure to find the responsibility taker

i) Firstly, the arbitral institution need investigate the inhabitant's behavior and the COP of air conditioner and check whether the correction method has been properly used. If not, explain to the buyer.

ii) Check whether the construction documents and test reports of building materials provided by the real estate company are consistent with the real building. If not, the company will take the responsibility and compensate the buyer.

iii) If there is no problem in above two steps, the labeling firm need take the responsibility and the insurance agent need compensate the buyer.

Analysis of operating mechanism

According to the description, we can know that the operation of the energy labeling system is driven by market completely. Each participant of the system will be restricted: Buyer can monitor the label data well with his ammeter, and the real estate company and labeling firm will try to ensure the accuracy of the label data in order to avoid compensation.

The insurance system can promote the development of the labeling firm. The labeling firm with higher technical level and better credit will pay fewer fees for the insurance; On the contrary, the higher insurance fee will eliminate the worse firm. Another outcome of insurance system is that the buyer can be compensated while his benefit was infracted.

Therefore, with the power of market, the whole energy labeling system can runs favoringly and promote the development of RBEE in China.

CONCLUSIONS

1. Residential Building Energy Efficiency (RBEE) becomes more important in recent years, and the energy labeling sytem can promote the development of RBEE with the power of market.

2. The thermal label should be data label for individual house or apartment, but not grading label for the whole building.

3. The label data can get by simulating the buildings under the "Standard Condition", which means a representative kind of climate data and inhabitant's behavior. In addition, a series of corrective coefficients are needed to adjust the label data more close to the real data.

4. The operating mechanism is driven by market and all the participants should be restricted to ensure the labels are accurate. The government should be a good manager and monitor of the whole system.

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