

## Research Article

### The Strategic Study on Low-carbon Transformation of Food Packaging Industry of Anhui Province

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**Abstract:** For exploring low-carbon development of packaging industry of Anhui province and abating gradual deterioration of global energy, environment and climate. Based on the related theory of the low-carbon economy, combined with the characteristics of food packaging industry of Anhui Province, the thesis is designed to explore some strategies of low-carbon transition of food packaging industry in Anhui Province from the aspects of constructing low-carbon social atmosphere, the formulating relevant policies and regulations, developing actively low-carbon food packaging technology, training and the introducing advanced food packaging professionals and establishing the evaluation system low-carbon food packaging in order to provide some reference for promoting the sustainable and healthy economic development in Anhui Province.

**Keywords:** Low-carbon, packaging industry, strategies, transformation

#### INTRODUCTION

With the rapid development of economy, energetic, environmental, climatic issues become the focus of attention in the world. Under the threat of worsening environment, the international community tends to be eager to deal with global climate change. In December 2009, UN climate conference is held in Copenhagen for the purpose of tackling global warming, reducing carbon emission, in which a word-low-carbon sweeps the world overnight. At present, countries all over the world are actively developing low-carbon technology, building economic development of low-carbon model and consumption pattern of low-carbon and then low-carbon economy will become an important driving force of the economic structure adjustment and institutional innovation. In China, in September 2007, Chairman Hu Jintao proposes strategic plans of developing low-carbon economy, innovating low-carbon energetic technologies, promoting the development carbon-uptake technology in APCE meeting, (Wang, 2011). In 2010, low-carbon economy becomes one of the most important issues in discussions of the NPC and CPPCC and is included the Twelfth-Five-Year-Plan in China. The development of low-carbon economy has a positive significance for the adjusting the industrial structure and changing the mode of economic growth in China.

As an important pillar of economic growth in China, there are also many problems and challenges in the packaging industry regardless of its rapid development, Data shows that the output of packaging industry in 2008 in China reaches 0.86 trillion Yuan, has reached 1.2 trillion Yuan in 2010, however, the

potential crisis grows behind the rapid development, e.g., the total amount of wastes produced annually is more than 6 billion tons, in China, of which the amount of waste paper is about 0.2 billion tons, while packaging substances account for 30% of the city's solid waste. The annual economic losses of environmental pollution caused by packaging waste reach more than 2 billion Yuan in Anhui Province, while the loss of recycled packaging waste that can not be made full use of is up to about 5 billion Yuan, of which a considerable part is produced by the food packaging. While a low-carbon economy continues to heat up, low-carbon packaging will become the new hot spot for development of packaging industry (Wang, 2011). Therefore, based on the purpose of exploring low-carbon development of packaging industry of Anhui province as well as the research into how to adjust industrial structure, it is very helpful and significant to conduct the research into how to replace the products and production mode characterized by high consumption, high emission and high pollution with the energy-saving and environmental products and clean production mode characterized by low consumption and low emission, which will have great significance in sound and sustainable development of economy in Anhui province.

**Creating a low-carbon social atmosphere, expanding the domestic demand, promoting the low-carbon consumption:** The realization of low-carbon economy is not only the responsibility of enterprises and governments of Anhui Province, but also the responsibility of every individual. We should advocate a sustainable low-carbon consumption pattern to

maintain a high living standard and set the environmental protection and rational utilization of resources as the prerequisite at the same time. Because consumers' choice is the finally deciding power for goods consumption, so there needs to enhance the public education and promote "5R" principles highlighted by low-carbon packaging that are REDUCE (reducing use of materials), REUSE (packaging be easy to reuse), RECYCLE (recycling), RECOVER (Gaining new value), RESOURCE (conserving energy) to encourage the popularization of low-carbon technologic knowledge, create a low carbon social atmosphere and arouse all consumers' desire of low-carbon consumption.

If consumers can form those consumption habits, low-carbon food packaging industry in Anhui Province would have great social demand, low-carbon consumption will be a fashion, so the low-carbon transition in food packaging enterprises of Anhui Province will gradually realize.

**Formulating the relevant policies and regulations, regulating the widespread application of low-carbon packaging technology:**

The development of low-carbon packaging requires the government to strengthen the supporting policy and guide the consumption development, formulate the suitable policy for low-carbon development of food packaging industry in Anhui Province, plays the important roles of all levels of governments in promoting investments, provide certain encouragement and financial support for low-carbon companies with a higher degree of environmental protection, encourage the traditional packaging enterprises to innovate their technology, improve their management models to speed up the pace of transformation and upgrading; meanwhile, there needs to supervise the sources packaging pollution and take feasible measures to control the sources of pollution caused by food packaging enterprises in Anhui Province and order the large polluted enterprises to intensify the speed of rectification; by the environmental legislation and charging system, there needs to make a series of detail systems that are suitable for low-carbon food packaging standard in Anhui Province to standardize and restrain external disadvantages of these packaging activities; by applying mutually compulsory and encouraging policies to punish the enterprises violating the standards or not meeting requirements and praise the enterprises meeting requirements, then to promote the low-carbon producing concept and spread low-carbon packaging technology by the economic stimulus to promote the healthy development of low-carbon food packaging industry in Anhui Province.

**Developing vigorously low-carbon packaging technology to promote the rapid transformation of the food packaging industry in ANHUI province:**

Low-carbon packaging emphases on reducing

Table 1: Carbon emissions by producing common packaging materials

Packaging materials (ton)	Paper	Plastic	Iron and steel
Reduction of carbon emission (ton)	3.5898	5.8324	15.4224

packaging waste from the sources, sets the prior principle of reducing material use, meanwhile pays attention to the whole life cycle of the process of reusing, recycling and biodegradable waste, which not only can eliminate waste, protect environment, but also can recycling, saving resources and promote the sustainable development packaging.

Therefore, low-carbon packaging technology includes recycling, reducing, recycling processing, packaging waste processing technologies, applying and developing non-pollution new materials technology and so on.

**Recycling technology:** Recycling packages can cut down the production of packaging materials and reduce carbon emissions. Recycling technology covers various forms of reusing, recovering and recycling materials, recovering recycling energy and composting.

Commonly used recycling technology is mainly applied for glass and drinking or polyester bottles, while recycling technology is commonly used for the paper products, recycling waste paper to produce corrugated paper by mechanically pulping, which means that recycling wood paper pulp is to produce the superior household paper by the chemical pulping process and adding a certain quantity of virgin wood pulp (Zhan, 2010).

The development of recycling technology not only can reduce the environmental pollution, but also can save resources and reduce carbon emissions. According to scientific calculations, recycling 1 ton of waste paper can produce 850 kg of recycled paper, which means to save 3 m<sup>3</sup> of wood and water, electricity and other energy resources. Using a box of recycled paper is equal to protecting a tree. The reduction of carbon emissions by recovering or saving 1 tons of packing materials like paper, plastic, metal and so on is shown in Table 1.

**Minimization and lightweight of packaging technology:**

Lightweight technology means reducing the consumption of resources and generation of the wastes during the process of packaging production, transportation and use. In order to minimize and lightweight the packaging, firstly it should be avoided the excessive packaging, reduce the consumers' burden and the pressure of the environment caused by the packaging.

Then, on the premise of the packaging quality, it needs to reduce the use of packaging materials, consumption of the resources and the production of the wastes during the process of production, circulation and



Fig. 1: Three-layer colored corrugated paper food-packaging box

consumption by improving and promoting food packaging technology, finally to reduce carbon emissions in the packing producing and using. For instance, the packaging enterprises can improve the thickness of paper and number of layers to lightweight corrugated boxes as the three layers of colored corrugated box shown in Fig. 1; in addition, the boxed food only focus on protecting of the edges and corners, so papers can use as the protective packaging materials for the edges, corners, supporting and protecting the bottom to realize the value reduction of products packaging. The minimizing and lightweight design can bring remarkable economic benefits for the enterprises and also can save natural resources to meet the requirements of low-carbon packaging.

**Waste treatment technology:** The treatment of food packaging waste should be based on the different categories of the specific wastes (such as paper, plastic, metal, glass and other wastes) to degrade, recycle, incinerate and landfill. The polymer packaging materials can be used to degrade the material for ensuring the usages in order to avoid of the environmental pollution; the incineration of packaging waste should be carried out by incinerating devices which meet the requirements of environmental protection and the relevant standards and make it sufficient burning and not produce harmful gases, reduce dust to prevent the second environmental pollution and the standards of waste-gas emission shall comply with GB16297 in the process of combustion; and land filling packaging waste must be decomposed by microorganisms an not cause pollution of soil and groundwater.

**Developing new low-carbon food-packaging materials:** In order to solve the conflicts between the packages and environment, all the countries in the world vigorously develop the low-carbon packaging materials while actively developing low-carbon packaging. Low-carbon packaging materials, the core of green packaging, refer to the materials producing as small environmental burden as possible and as high recycling rate as possible in the entire using process, which not only can reduce or eliminate the environmental pollution and release the pressure on the ecological environment, but also save resources, reduce

the costs of resources, recycle the waste resources. Therefore, all the countries in the world attach great importance to that and pour into a lot of money and manpower to develop and have achieved many significant successes. At present, the development of low-carbon food packaging materials is mainly concentrated in the recycling or renewable packing materials, such as lightweight, thin, fluorine-free, high-performance packaging materials and degradable, edible, natural plant-fiber, transgenic plants packaging materials and nano materials etc. It's reported that a new type of environmentally friendly food packaging material recently is expected to come out in the American, a new food packaging film successfully preventing oxygen ingress to achieve the effect of preservation. Meanwhile, because the components of this kind of material are mainly from the inedible plant fruits, it is the material of natural decomposition, meeting the requirements of low-carbon environmental protection. This material is expected likely to replace the current commonly used polyethylene plastic film and become the main food packaging material in the future.

There are two ways for packaging enterprises to obtain low-carbon technology: one is the independent research and development, the other is the direct introduction of advanced technology at home and abroad. Theoretically speaking, introducing advanced technology has certain advantages, but the introduction of technology requires a large amount of cost and transference of technology is possibly reserved. At present, food packaging technology of low-carbon in Anhui Province is still at a relatively low level, there are also some technical and funding challenges to choose the independent research and development. Therefore, we can apply for institutions or organizations at home and abroad for funds to support the development of low-carbon packaging technology. Therefore, it's the priority for food packaging enterprises in Anhui Province to develop low-carbon food packaging technology and materials of energy saving and environmental protection, popularize the new achievements in low-carbon food packaging, promote the rapid transformation of the food packaging industry, which is one of the important factors for enterprises in Anhui Province to remain invincible in the fierce competition of the market.

**Training and the introducing advanced and professional personnel to improve the technological level of food packaging design and reduce carbon emissions:** In order to train advanced food packaging design professionals and improve technology of low-carbon food packaging design, low-carbon design of food packaging shall be done as follows:

**Choosing low carbon food packaging materials:** Eco-friendly food packaging materials and the targeted

design will reduce the waste of materials; correspondingly, it also will reduce the producing cost and increase the profit, but low-carbon significance is much more than this. In the low-carbon food packaging design, the first concern is the choice of food packaging materials. Low-carbon food packing material refers to the one that can reduce carbon emissions on the basis of protecting food, which has characteristics of minimization, lower pollution, recycling. Low-carbon food packaging materials shall be selected as follows:

**Choosing the new food packaging materials with minimized environmental burden and highest rate of recycling:** Such as paper products, plant fiber products, edible packaging materials, biodegradable plastics, nano based packaging materials and packaging materials of transgenic plants. As in recent years, a new biodegradable packaging material-Poly Lactic Acid (PLA) is discovered, which uses corn and cassava crops as raw materials. It is aliphatic polyester which has common basic characteristics of polymer materials and good mechanical properties. It can be used as most synthetic plastic material for producing food packaging materials or as a biodegradable fiber. When this material is abandoned after a year, it can be degraded completely by microorganism in soil and generates CO<sub>2</sub> and water, which has no pollution to the environment. Therefore, it is identified as the most promising new ecological materials of the new century in industry.

**Choosing lightweight, thin, fluorine free type, high performance food packaging materials:** As for the paper products, it is a common way to realize the lightweight by using high intense paper, reducing paper numbers and paper layers. For plastics, glass and metal materials, the usually strengthen measures is the scientific modification of the components, reasonable structure design, the correct process arrangement and effective surface treatment to achieve the goal of thinning the bottle wall and high strength. Such as the Coca Cola Co's brand "ice dew" issued the environmental lightweight PET bottle packaging (Fig. 2), the new bottle body weighs only 9.8 grams, reduces the weight over 35% compared with the original bottle weight, correspondingly and reduces carbon emissions by 35%. The wall thickness of the bottle is only 0.1 mm, which can save more than 70% recovery space (Yang and Er, 2011).

**Choosing conveniently recycling food packaging materials, trying to avoid using a coating or plating packaging materials:** Because it's very difficult to separate the coating from the substrate of this kind of packaging materials and is not easy to recycle after used, if it really needs to combine with other materials, we should choose materials of good compatibility.



Fig. 2: Bingle beverage environmental lightweight PET bottle



Fig. 3: Guangde County bamboo packaging boxes

There are abundant resources in Anhui Province which is rich in bamboo, straw and other natural materials, so it shall obtain raw material locally, use some low-carbon packaging materials to design and development the packaging. Such as Guangde County in Anhui Province, it uses local grown bamboo to weave bamboo packaging box (Fig. 3) which is environmentally friendly and easy recycling and reused, also meets low-carbon packaging requirements.

**Low carbonization designing of packaging decoration:** Low-carbon packaging design requirements that surface decoration of the package should patterned with guidance and less color (Xu and Guo, 2010), the specific directions as following:

- Noting the name of material, recyclable or not, how to classify and other necessary information in the packaging in order to guide consumers and the relevant departments for classification, recycling, treatment.
- Besides ensuring traditional packaging function, trying to use pure colors for decoration, avoiding the overuse of colors to cause the complex printing process and increase the printing cost and inconvenient product secondary recovery and other problems.
- Trying to avoid the secondary processing techniques like gilding, silver plating, filming, binding and bonding, which may influences its environmental protection and recycling.

**Low-carbon design of food packaging structure:** Food packaging structure design is an important part in packaging design, which plays an important role of in practicality and artistry of packaging design (Zhang,



Fig. 4: Octagonal packaging box



Fig. 5: Packaging box of children low calorie beverages



Fig. 6: The packaging structure of Yening fresh orange juice milk

2009). How to apply the technology into the structure design means to maximize the ratio of the weights of built-in food and packing material based on convenient usage. From the angle of saving resources in low-carbon packing, whether to adopt packaging structure technology is closely related with how many packaging materials are used. Therefore, low carbonization design of food packaging structure will be more conducive to meet the requirements of low-carbon environmental protection. Low carbonization design of food packaging structure should include:

**The minimized design of food packaging structure:**

Perfect design and reasonable structure can not only reduce packaging waste, but also reduce the use of plastic in some cases. To ensure the volume of packaging and packaging strength and under the premise of convenient use, the design of food packaging structure can be ingeniously innovated to realize the maximizing ratio of weights of contents and packing materials, so as to realize the minimizing design. For example, the octagonal box (Fig. 4) can save 10% packaging materials than the square box, which correspondingly reduces the carbon emission by 10%.

**Designing multifunctional food packaging:** The packaging can play its basic function and then use for

other ways by sound design of packaging structure to avoid discarded package. Taking Y Water bottle for children low calorie beverage of Yves Behar (Fig. 5) for example, in addition to bring consumers a vivid image, the beverage bottle can become new intellectual toy after drinking.

**Designing food packaging structure of easy circulation:**

The circulation of a piece of merchandise includes production, transportation, sale and consumption and other procedures. Reasonable circulating design means that the packing scale of product meets the standard and can be matched with the equipments of transportation and loading and it is convenient to unload and fold the packaging, so that this can improve the circulating efficiency, save the time and energy consumption, meets the requirements of low-carbon environmental protection. Such as Yening fresh orange juice milk (Fig. 6), its packaging structure is easy to open and handle.

**Low-carbonization printing technology:**

Low-carbon food packaging is complementary and inseparable with low-carbon printing. Low-carbon printing is mainly reflected: firstly, trying to use new environmentally friendly ink, namely UV inks and water-based ink (Jin, 2000), secondly, trying to use low carbonization printing technology, namely flexo printing, the waterless offset printing technology and CTP direct plate making technology (Run and Chen, 2008). Flexo printing and waterless offset printing technology fundamentally solve the problem of volatilizing organic solvent and other harmful gases, reduce air pollution and Computer to Plate (CTP) using free washing plate greatly reduces the offset pollution. Taking Tongcheng in Anhui Province-the base of China's plastic packaging industry for instance, in recent years, it continuously mends the printing crafts, improves low-carbon printing technology. Its printing technology involves from four to eight, twelve colors, plate making from ordinary plate to imported equipment of electronic color separation and electric engraving, which greatly improves the former condition of high carbon printing, the industry of this base has become the leading and competitive industry in the industrial economy of Tongcheng.

The current situation of food packaging industry in Anhui Province is that food packaging enterprises have low-level technical equipment, the localization of advanced equipment is not enough and mechanical equipments developed by themselves with independent property rights are rare. The reasons for this situation are mainly two aspects. On the one hand, Anhui Province pays insufficient money to the development of food packaging. On the other hand, there is a serious shortage of technical personals in the food packaging industry. Therefore, in order to completely change the situation that Anhui Province lags behind in technology

of low-carbon food packaging, we must increase the input of academic research in the low-carbon food packaging technology; at the same time, we must create a good environment for advanced packaging talents. It is necessary to strengthen the ties with related colleges and universities of Anhui Province, to establish long-term sustainable good relations, provide the related courses and train a large number of high-quality talents from choosing food packaging materials, packaging decoration design, packaging structure design and printing technology for low-carbon food packaging design in Anhui Province. Meanwhile, we also should employ and recruit some best low-carbon packaging designers from the developed area and excellent enterprises in order to improve the technology of food low-carbon packaging in Anhui Province and reduce utmost carbon emissions.

**Establishing the evaluation system of low-carbon food packaging:** Scientific evaluation of low-carbon food packaging refers to evaluating the possible environmental problems in the processes of producing packages, sales, recycling and the damage of people. At present, it generally employs Life Cycle Analysis (LCA) in academics (Yang and Dai, 2009; Dai and Dai, 2006), which is an objective method to “refers to the identification of the raw material consumption and waste emissions to evaluate the burden on environment of a product in the whole process of production and circulation” (Guo, 2004). That is to say, the evaluation of food packaging should be executed from the exploiting natural resources to processing into finished products and then to wastes recovering, disposal and recycling, finally to consuming energies, generating harmful substances and greenhouse gas in the entire closed cycle of the nature.

For the food packaging industry in Anhui Province, the establishment of a relatively scientific and rational evaluation system of low-carbon food packaging as soon as possible will play a guiding and promoting role in low carbonization process of food packaging enterprises in Anhui Province.

## CONCLUSION

In order to achieve low-carbon Transformation of Food Packaging Industry of Anhui Province, we can through formulating relevant policies and regulations,

developing actively low-carbon food packaging technology, training and the introducing advanced food packaging professionals and establishing the evaluation system low-carbon food packaging.

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