

# A Sustainable Product Design Model

## Inspired by Studies on Everyday Chinese Objects

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**Abstract:** This work proposes a sustainable product design (SPD) model which is inspired by studies on everyday Chinese objects. The goal is to improve energy efficiency of household appliances. This research has been conducted in China, aiming to seek and organize embedded ecological wisdoms in selected everyday Chinese objects. First, a framework for understanding SPD has been proposed with associated criteria for selecting the target everyday objects. This framework is to be continuously improved and refined in our future work. Case studies on selected home thermal appliances, which are found in urban and countryside families, are presented, which investigate useful design insights for designing energy conversion products and build an energy transforming model by studying their philosophic roots. As an extension of the findings, a design model is proposed to provide a practical guide for energy efficient designs. In addition, a tool for searching new design opportunities based on the energy transforming model is also proposed. This research illustrates a structured method for studying everyday objects and investigating design insights. This research method is in testing and refining phase and is to be applied to everyday objects from other cultures.

**Key words:** *Sustainable Product Design Model, everyday Chinese objects, traditional ecological thinking.*

### 1. Introduction

Sustainable design has shifted its focus from promoting industrial ecology in product lifecycle to developing cooperative strategies of social and cultural innovations. The value of traditional wisdoms has been emphasized by many scholars and practitioners. Orr pointed out in *Ecological Literacy* (1992): “the crisis as the result of an evolutionary wrong turn”, “This is not to argue for a simple-minded return to some mythical Eden, but an acknowledgment that earlier cultures were not entirely unsuccessful in wrestling with the problems of life, nor we entirely successful.” Everyday objects refer to those traditional physical objects which are designed and are still being used in everyday contemporary life. They also refer to those abstract objects<sup>1</sup> which imply traditional ecological thinking. Selecting and studying everyday objects to reveal and interpret their embedded traditional

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<sup>1</sup> Herbert (1969) gave a definition of “an object” as “an object is anything that can be indicated, anything that is pointed to or referred to. He classified objects in three categories: (a) physical objects; (b) social objects (different human beings); (d) abstract objects, such as moral principles, philosophic doctrines...

ecological thinking have become a new approach for sustainable product innovation. Those traditional objects can be found in both urban and rural families where the original usage context can be investigated.

Many Chinese design researchers studied Chinese everyday objects, which are equipments, tools and facilities and they pointed out that some of these objects were well designed in providing a smart solution in energy transforming and flowing. Some Chinese traditional cooking wares have been used for hundreds of years with fine functional performance and high energy efficiency. Studying use of energy in everyday Chinese objects has been chosen as the research topic for this paper, where series of sustainable everyday thermal appliances for cooking and keeping warm in Chinese urban and rural families have been selected and studied to reveal their embedded ecological thinking. These objects and related behaviors are shaped by dominant, emergent and residual cultural behaviors<sup>2</sup> with both scientific and ideological values. Philosophic evidence for those traditional Chinese ecological thinking can help abstract and articulate those findings. These findings can be interpreted and organized to solve sustainability problems in similar Chinese situations and contexts. They can also be extended into context free design thinking, patterns, or models to apply in any other cultures.

## **2. Studies on Everyday Chinese Objects**

This research involves looking for emergent patterns, challenges and opportunities that can be addressed by sustainable product innovation. The goal is to provide possible perspectives and inspirations for energy products design and optimization by in-depth understanding of the selected everyday objects from aspects of motivations, design features, and actual usage within their social, cultural and technological contexts. This research is integrated with in-depth objects understanding, contextual research methodologies as participant observation and interview. There are two steps in studying the everyday objects: 1) Select the objects, measure and determine which everyday Chinese objects should be observed and analyzed. 2) Reveal and structure the embedded ecological thinking in those selected objects to guide contemporary designs.

### **2.1. Select the Objects**

A general understanding of Sustainable Product Design (SPD) should be built to select target everyday objects which could implies applicable ecological thinking and design wisdoms. In this research, a systematical review on SPD related literatures, articles, online resources and design practices have been studied. An initial framework of different approaches for design realization has been built and this framework has been continuously tested and updated by emergent leading theories and arguments. This framework consists of four different approaches: systematic thinking, ecological efficiency, ecological aesthetics and human ecology. It can be structured as following pyramid:

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<sup>2</sup> Xin (2006) defined 1) Dominant cultural behaviors reflected through mainstreams lifestyles, are strongly influenced by institutions and mainstream ideologies. 2) Emergent cultural behaviors are often the result of or reaction to new social, economic and technological developments. 3) Deeply rooted in the traditions, residual cultural behaviors often exist as customs, influencing people's daily life naturally and consistently.

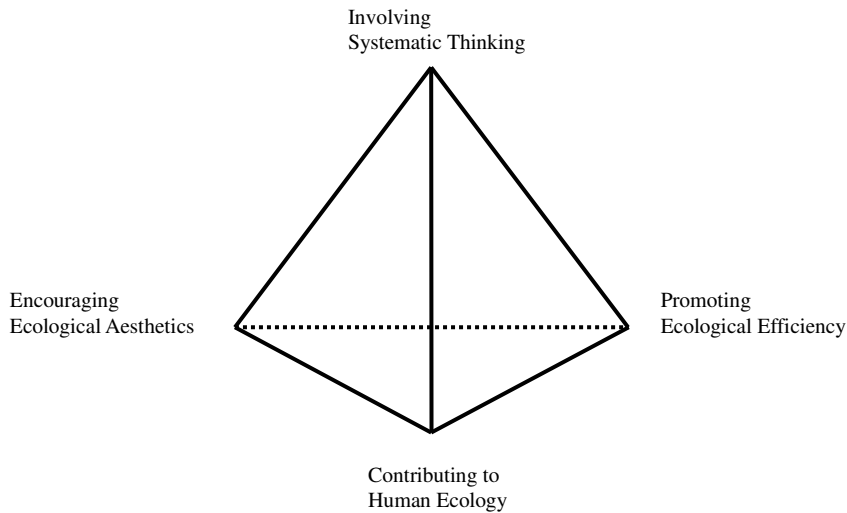


Figure 2.1.1 Framework of Understanding SPD

These four different approaches emphasize four key factors in SPD. 1) Systematic thinking emphasizes on design thinking in material, form, function, process and service. It is the key principle of environmental ecology which considers the environmental things as an integrated system where everything works with each other. 2) Ecological efficiency is the major concern of industrial ecology which aims to improve the materials and energy efficiency while produce less environmental impacts. 3) Human ecology is the ultimate goal of social innovation which aims to provide a harmonious physical and social human life with balanced the life quality. 4) Ecological aesthetics talks about aesthetic durability, upgradability, creativity and diversity from a scope of cultural ecology which is frontier environmental and cultural research discipline. It emphasizes sustainable effectiveness from emotional aspects of the products. These four approaches can work with each other in designing and evaluating a sustainable product and help to place the expectation of the product in a certain context.

To well understand and judge the sustainable everyday objects designed, each approach is presented with associated criteria which were generated as key categories by coding the collected SPD principles and thinking. These selecting criteria will be briefly introduced in this paper with following discussions and also be constantly adjusted by involving updated design theories and thinking. To determine the objects for this research at least one selection criteria should be satisfied in this template. The object should have better potentials for inspiring SPD if more criteria are satisfied.

Approaches	Criteria
1. Involving Systematic Thinking	1.1 Respect the rules of nature system and social system 1.2 Holistic and long--term consideration 1.3 Consider resource and energy transformation 1.4 Product lifecycle and system design 1.5 Cause and effect—interaction between related elements
2. Promoting Ecological Efficiency	2.1 Providing non-toxic solution 2.2 Contribute to ecological effectiveness 2.3 Promote energy efficiency 2.4 Best use of material --proper, minimize, non-toxic or durability 2.5 Smart function--simple solution/ multi-functional/ flexible contextual/universal products

3. Contribute to Human Ecology	3.1 Promote healthy lifestyle 3.2 Promote social harmonious—ethics, social standard, morality 3.3 Appropriate needs and demands—peace and moderate 3.4 Promote to life quality
4. Encouraging Ecological Aesthetics	4.1 Aesthetic durability and updatability 4.2 More creative—celebrate diversity 4.3 True comfort and process—honest product 4.4 Present local aesthetic and cultural identity 4.5 Appreciate natural forms, make nature visible

Figure 2.1.2 Selecting Criteria of Everyday Objects

## 2.2. Everyday Objects Study Method

The method to study the selected everyday objects are developed from contextual methodologies as participant observation and interview which based on gathering field data from users. DeWalt (2002) defined Participant Observation as a method in which a researcher takes part in the daily activities, rituals, interactions, and events of a group of people as one of the means of learning the explicit and tacit aspects of their life routines and their culture. In this research the participant observation method is developed into a practical research process which can lead to an efficient way of getting useful data. The studies of the selected objects have taken in their original context in either urban and countryside families to observe, understand and record the design reasoning, motivation, producing and using of the selected objects.

## 3. A Case Study of Everyday Chinese Thermal Home Appliances

A case study of six everyday thermal home appliances for cooking and keeping warm in Chinese urban (Shenzhen, China) and rural families (Anhui, China) have been selected and studied to reveal their embedded ecological wisdoms in using thermal and other kinds of energies.

### 3.1. Profile of the Selected Objects

These selected six everyday Chinese objects are investigated in the case study as they are more typical in represent different approaches to get a holistic energy consumption solution. Some of the objects are traditional home appliances and others are contemporary ones or immediate solutions. Some of them have fixed names and others are immediately named by their functions. The following objects images which marked numbers are taken in their original using contexts in field studies in different Chinese families.



1) **Chinese Kitchen Stove**--The first everyday object was found in a Chinese countryside family in Anhui Province. It is an integrated stove with fixed iron rounded bottom pan/ pans which are heated by firing wood and charcoal. The bigger iron pan is directly heated by firing fuel and the small one is heated by transmitting leftover heat from the main pans. The small pan can be used to boil a small amount of water and soup while cooking in main pans. This integrated kitchen stove is popularly used in countryside the north and middle China. Sustainable Attributes: 1) Involving systematic thinking-- provide a holistic cooking solution; 2) Promoting ecological efficiency-- locating leftover energies.

2) **Additional Uses of Gas Stove**--The second one is an immediate solution of baking melon seeds by the leftover heat from the gas stove metal surface. It was found in an urban family in Shenzhen south China. This solution was invented by a retired housewife which inspired by her former experience of baking sweet potatoes on traditional stoves. Sustainable Attributes: Promoting ecological efficiency-- using leftover energies provide simple and direct solution.

3) **Charcoal Ashes Warmer**--The third one is furniture and also a home appliance. It locates remnant heat of charcoal ashes after cooking. In traditional China, most people burning charcoal or coal to keep warm in winter. But this charcoal ashes warmer provides a more economic solution. There are different sizes and forms of the warmer which designed to satisfy different needs and using context. Some of them are used as necessary furniture their families. The whole object is made of wood except the removable metal pedal which placed in the barrel to hold feet. In the bottom of barrel, under the metal pedal, a brazier filled with charcoal ashes after cooking act as the resource of heat. The heat can last or more than 5 hours before making the ashes of afterheat charcoal as fertilizer for farming. This object is popular in Anhui rural families. Sustainable Attributes: 1) Promoting ecological efficiency-- good use of remnant energy of charcoal ashes; 2) Involving systematic thinking-- combine function of furniture and keeping warm appliance.

4) **Table Clay Stove**--This small clay stove was found in country market. It can be used to heat a hot pot or standard size soup jar. The heating resource is burning charcoal. For its scientific structure this simply made stove can provide three power levels by adding two inner frames of stove body. This object is portable and high efficiency of energy consumption. Sustainable Attributes: 1) Promoting ecological efficiency-- choosing proper material for product function and form, providing a flexible and efficient way of food heating; 2) Involving systematic thinking-- designing integrated product structures.

5) **Group of Soup Jars**--The fifth one is not a single object but composed by a group of two or more soup jars which can be easily found in Chinese kitchens. This group of different sized soup jars represents an economic way of energy using. People choose different size of jars to boil different amount of soup. Heat will be mostly concentrated in soup. It will be more efficiently in both cooking and energy using. Sustainable Attributes: Promoting ecological efficiency--provide a flexible choices for economically and efficiently solutions of heating foods.

6) **Bamboo Steamer**--The Sixth one is a typical traditional Chinese kitchen ware which widely used in both China and abroad. With the name of "steamer" it cooks food by thermal steaming which saturates through the different layers of steamer. It is traditionally made of bamboo and contemporary made in alloy. It's used to cook Chinese traditional dishes and snacks. Steaming foods cooked by bamboo steamers are good for people's health

than other recipes. It also represents a cultural aesthetics of celebrating Chinese festivals by traditional foods. Sustainable Attributes: 1) Promoting ecological efficiency--high energy using efficiency, able to cook multiple foods at once; 2) Contribute to human ecology-- provide healthy and low calories steaming recipes; 3) Encouraging ecological aesthetics-- represent a distinct natural flavor of cooking and dieting.

### 3.2. Reveal the Sustainable Design Insights

To reveal the embedded sustainable design insights with ecological wisdoms some of the field notes are selected and listed in Figure 3.2. As these everyday objects are grouped to demonstrate an efficient energy using solution the related field notes and abstracted design insights are written in this paper. These objects can also be analyzed from other approaches like material approach to explore related design insights.

Objects	Important Field Notes	Design Insights in Energy Using
<b>Chinese Kitchen Stove</b>	<ol style="list-style-type: none"> <li>1. The stove is integrated designed with a smooth ceramic top and at least one burner.</li> <li>2. It is commonly built as architectural structure of the kitchen.</li> <li>3. One or more affiliated burner which conducts heat from major one can be set in the stove.</li> <li>4. Alloy pipe encircles the major pan to effectively collect leftover energy and conduct it to affiliated pans.</li> <li>5. The sizes of major and affiliated pans are standard made for replacing.</li> </ol>	<ul style="list-style-type: none"> <li>• Integrated product system can help to effectively energy using.</li> <li>• Locate and use leftover energy during working process.</li> <li>• Promote product durability by replace standard made components.</li> </ul>
<b>Other Uses of Gas Stove</b>	<ol style="list-style-type: none"> <li>1. The solution is inspired by user's former experiences.</li> <li>2. It's a natural behavior without ecological intention.</li> <li>3. Leftover heat is effectively used to bake melon seeds or other possible foods.</li> </ol>	<ul style="list-style-type: none"> <li>• Sustainable lifestyle can be inspired by people's former related experiences.</li> <li>• Make proper use of the leftover energy.</li> </ul>
<b>Charcoal Ashes Warmer</b>	<ol style="list-style-type: none"> <li>1. This design is initiated from the concept of using the remnant energy after original purpose for economic consideration.</li> <li>2. Charcoal ash releases gentle warmth that better than using burning charcoal or coal directly.</li> <li>3. They are designed to different forms for different purposes; some portable ones have also been developed for warming hands or drying shoes.</li> <li>4. This object reflects a kind of lifestyle which collected with energy using.</li> <li>5. These similar products shares one single concept that locate and use the remnant energy. It also acts as a philosophy of energy using in this place.</li> </ol>	<ul style="list-style-type: none"> <li>• Using remnant energy after original purposes.</li> <li>• Make proper use for the attributes of the leftover energies.</li> <li>• One creative concept of energy using can be used in many different contexts and by different forms and structures of products series.</li> <li>• Product and user's lifestyle is mutually affected.</li> </ul>
<b>Table Clay Stove</b>	<ol style="list-style-type: none"> <li>1. It is a very honest and simple product without any unnecessary parts or decorations and quite worktable in winter.</li> <li>2. People can also warm their cold hands by this touching outside of the stove because of the thermal insulation of clay.</li> <li>3. It also provides simple solution of thermal control than contemporary electrical products.</li> <li>4. It is a good example of elevating efficiency of unit energy. A standard block of coal can be effective in heating for a meal.</li> <li>5. The process of coal burning can be divided into insufficient burning, sufficient burning and end of burning which provide three levels of heating and fit the process of needs of dish cooking.</li> <li>6. The middle one which acts as transition of the traditional clay stove which totally hand making is standard made and easy to replace the components.</li> </ol>	<ul style="list-style-type: none"> <li>• Innovated additional uses of the product are generated during using process by users.</li> <li>• Design different functions according to energy processing attributes.</li> <li>• Simple solutions make easy and comfortable using experiences.</li> </ul>
<b>Group of Soup Jars</b>	<ol style="list-style-type: none"> <li>1. The jars are made in different sizes with same form and material.</li> <li>2. Users make different options of using which jars for cooking by different purposes.</li> </ol>	<ul style="list-style-type: none"> <li>• Provide different options for energy using scenarios.</li> </ul>

		<ul style="list-style-type: none"> <li>• Make simple and direct solutions.</li> </ul>
<b>Bamboo Steamer</b>	<p>1.It is functioned by transform original energy to different forms.</p> <p>2.The design of bamboo steamer comes from understanding both energy flow and material characteristics. People found steam is a kind of heating energy and it flows upward.</p> <p>3.Bamboo steamers can be located in a metal pot filled with water or add a same sized metal bottom as a part to generate steam.</p>	<ul style="list-style-type: none"> <li>• Energy can be transformed into different forms for different purposes.</li> <li>• Effectively using energy by understanding its physical and processing attributes.</li> <li>• Make simple solutions for changing energy condition.</li> </ul>

Figure 3.2 Reveal Sustainable Design Insights

### 3.3. Explore Philosophical Evidence

As the above design insights are generated from dominant, emergent and residual cultural behaviors, the cultural roots should be explored. Chinese traditional thinking in energy consumption can be referred in many Chinese literatures on philosophies, technologies and sciences. The term “Energy” can be defined as “power”, “vital energy” and “the five elements” in traditional Chinese philosophy. Studying on those terms in traditional Chinese philosophies three leading principles can be concluded to articulate the essence of traditional thoughts of energy consumption.

#### 1) Capture unperceivable energy

Taoists believed the origin of all visible material and the world is generated by invisible energy of “the spirit of the world”. Except visible energy like wind, thermal, light...there are different forms of unperceivable energies. Some unperceivable energy can be described as ‘the energy of life’ in traditional Chinese medicine or the force of different changes in “Yi-jing”. Ancient Chinese people are more advanced in capturing those unperceivable energies by various measures like applying ‘qigong’ or “feng-shui”. The perceivable energy and unperceivable energy can also be considered as the two major principles of the nature.

#### 2) Energy is in continues moving and transforming.

Traditional Chinese medicine is focused on pursuing the inner balance of different life energies which constructing the energy system. The energy system in human body is dynamic. Moving and transforming are the basic two activities of the energy system. Balancing the energy system can make people healthy. In Taoism and Yi-jing, ancient Chinese philosophers emphasized the continued change and moving of energy and everything in the world. There exists unperceivable universal law to guide the moving, developing, and transforming of everything in the world. Energy is also consisted in moving, transforming and regenerating. It has a lifecycle with different phases and status.

#### 3) Different kinds of energies mutually reinforce and promote

This principle comes from the traditional Chinese theory of “the five elements” which represent “wind, dynamic, water, heat, cultivation”. “Yi-jing” introduced these five different elements that are mutually reinforcing and promoting as well as the five reprehensive energies. It asks people to consider those different energies as a system. Using energy should not break the balance of the system and inner dynamic relations.

The above three thoughts can also be supported by contemporary scientific evidences. In physics “energy” is defined as a scalar physical quantity that describes the amount of work that can be performed by a force, an

attribute of objects and systems that is subject to conservation law. There are different energies including kinetic, potential, thermal, gravitational, sound, elastic, light and electromagnetic energy. According to conservation law of energy any form of energy can be transformed into another form and in such energy transforming process the total energy remains the same. In transforming process some usable energy turns into unusable energy or unperceivable energy which causes the drain of usable energy. These theories support the thought of capturing the unperceivable energy for everyday uses. The thought of continues moving and transforming also agrees with the conservation law of energy in physics. The third Chinese traditional thought of the mutually reinforcing and promoting of different kinds of energies can also be explained by the interaction of different physical attributes of energies. Chinese Traditional philosophies provide a more systematic and abstract approach to investigate and apply the relations of different kinds of energies.

#### 4. Findings in Abstracted Level

The design insights with philosophic cultural roots found in these selected everyday Chinese objects can be generally abstracted into an energy transforming model. Base on that a design model for designing energy efficient products can also be developed. A tool for searching new design opportunities will also be introduced according to the energy transforming model.

##### 4.1 An Energy Transforming Model

An energy transforming model can be designed by the above design insights and related traditional Chinese thinking in understanding and using energy. The essence of this model is to understand attributes of the energy and transforming process. According to conservation law of energy, there is no energy lost and all energies are consistently in transforming process. This model can help to understand status, components and rules of energy in transforming process.

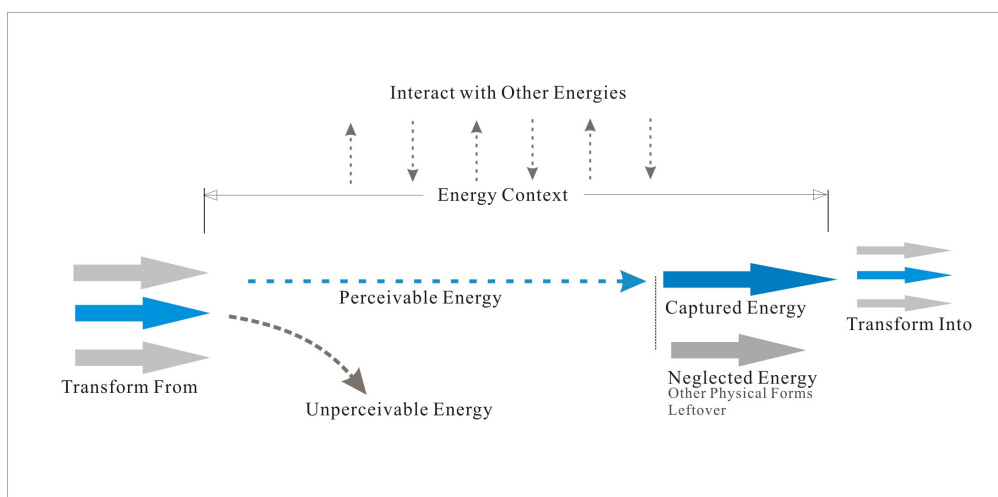


Figure 4.1 An Energy Transforming Model



In this research, the goal of studying Chinese everyday objects and traditional philosophies to reveal their embedded design insights is to develop a thinking pattern to promote the energy efficiency and effectiveness of energy converting products. To organize different design insights there are four principles:

### **1) Consider energy transformation**

As mentioned above, the process of energy using is a process of energy transformation. The kinds and forms of energies in using are transformed from other kinds/ forms of energy which can be also perceivable and unperceivable. In the process of energy using, the effective energy transforms into other forms/kinds of energy. People often neglect the different forms and processes during energy transforming. Many investigated everyday Chinese objects presented considerations on transforming process of using a kind of energy in designing forms and functions. By this consideration energy efficiency can be greatly enhanced and less energy amount will be required to complete a task.

### **2) Provide supplementary solution**

Supplementary solution applies using ineffective energy emissions to provide independent or cooperative functions. As the transforming of energy is consistently happening and products also act as equipment to push energy transforming, different kinds of leftover energy including unperceivable, neglected energies need supplementary solutions to make them effective for other tasks. Supplementary solutions depend on scientific analysis of the energy transforming process. Find the parts of leftover energy can be used in performing additional functions and these functions can be integrated into the main function in a single product of related products group.

### **3) Choose direct and simple solution**

Direct and simple solution can reduce energy transforming processes. The less energy transforming processes in function performing, the less leftover energy will be generated. The energy efficiency will be greatly improved by direct using and simple solution of the function performance.

### **4) Use leftover energy**

Using leftover energy is the ultimate goal of above three principles of design thinking. Considering energy transforming process, providing supplementary solution and using direct and simple solution are different measures to research the goal of use leftover energy.

## **4.2 Building a Design Model**

This energy transforming model aims to provide a practical design model and conceptual tool for designers. Through the descriptions of the four principles and inner logic of the model, a model for designing home energy appliances presents a cooperative solution of energy consumption can be synthesized from the extracted design thinking. The ideal model is: provide cooperative, direct and simple solutions to use the leftover energy during energy transforming process. It can be illustrated in below diagram:

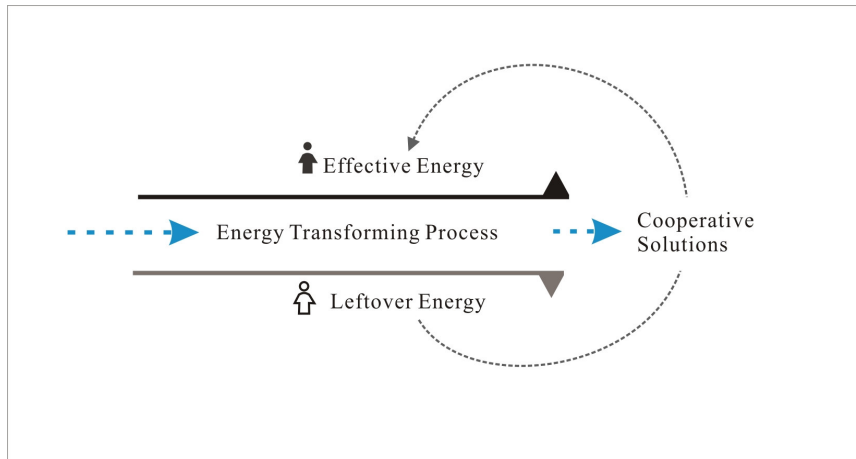


Figure 4.2.1 A Design Model for Cooperative Energy Solutions

Effective energy and leftover energy continuously occur during the whole process of energy transforming. This design model presents a concept of reducing energy transforming processes and making effectiveness of leftover energy by providing cooperative solution of main function and sub-functions.

To apply this design model a design process has been structured to make it easy to use. According to Jones (1992), “process” is a naturally occurring or designed sequence of operations or events over time which produces desired outcomes. Process contains a series of actions, events, mechanisms, or steps, which contain methods. The process of applying the design model contains three key steps:

The first step is to choose proper energy solution to solve the problem in a certain context. The original purpose of designing the product should be primarily satisfied. For example, if the original expectation for the product is to light the bed room and it will become the primary function of the product. This primary purpose should be realized by investigating the using context. There are several key points in investigating the energy using context which including: comparing the possibility of using different assessable energies; the expected product performance and required energy power and amount; whether the primary solution is simple and direct using of energy.

The second step is to make a supplementary purpose according to locate the new design opportunities on energy transforming process. A tool of searching new design opportunities in energy transforming process will be introduced as the last research outcome toward the end of this paper. The new design opportunity is generated by making the use of accessible leftover energy during the energy transforming process. Performance of effective energy can also be evaluated for promoting the original solution.

The last step is to integrate the primary purpose and supplementary purpose into one product or system. Primary function is designed to perform the basic purpose of product performance. The supplementary functions are added to using the leftover energy during the product working process. These functions can be dependent and independent. The product can have better performance in solving primary problems while effectively providing supplementary functions.

The whole design process can be illustrated into following diagram:

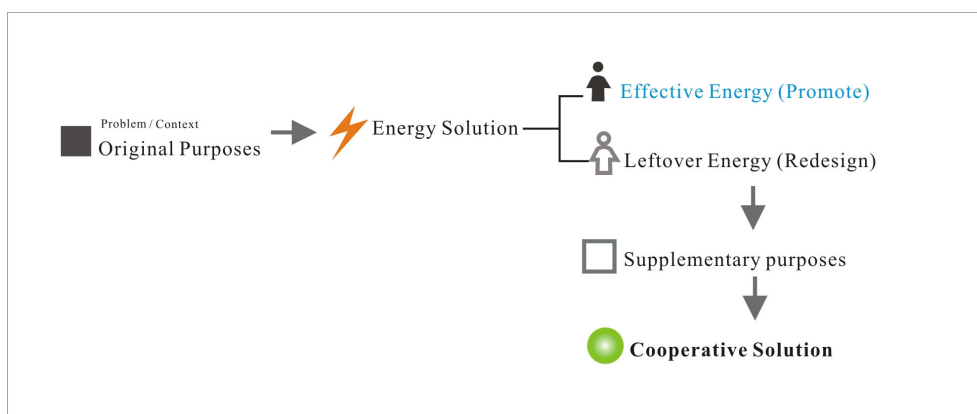


Figure 4.2.2 Process of the Design Model

### 4.3 A Tool for Searching New Design Opportunities

According to the model of energy transforming process, new design opportunities for supplementary function of the product can be located in five positions of the process. 1) During transforming process from original energy type to product adaptable energy type. 2) The unperceivable energy released with the working of effective energy. For example, electromagnetic waves released with flaming. 3) In interactions with other energy in the using environment. For example, the heat released from kitchen stove and light in kitchen. 4) The leftover of effective energy in product working process. 5) Leftover energy after product working process like remnant heat after cooking. This suggested tool can help to check these five positions of energy transforming process to find accessible leftover energies for supplementary uses.

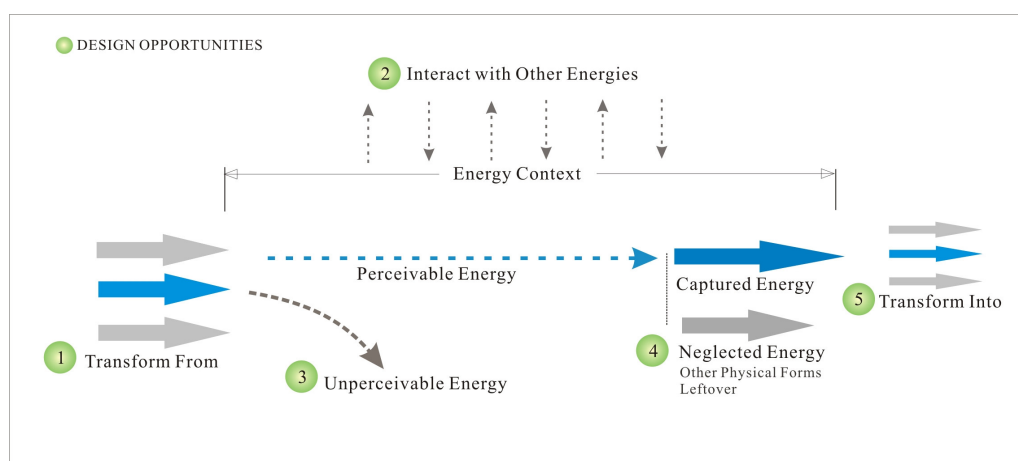


Figure 4.3 A Tool for Searching New Design Opportunities for Cooperative Energy Solution

## 5. Conclusion

This paper is written to illustrate a sustainable design model inspired by studying the selected everyday Chinese objects. Structure of the research has been demonstrated as defining the value of studying everyday objects, the objects selecting and studying method, a case study to reveal embedded design insights and organize insights into a suggested design model with practical process. Besides main findings of the design model for building a corporative solution for energy generating products, the research itself is also a structured research method for investigating design insights from studying everyday objects.

Norman (2004) suggested three emotional levels of design: “visceral” level which embodies the sensory aspects about how things look, feel and sound; “behavior” level, at which users form their perceptions of particular product through use; “reflect” level which the product has meaning for consumers. This paper incorporates a holistic thinking for designing sustainable energy appliances by enhancing cognition and interaction with users and products during the process of using the energy. Users can better recognize the nature of the used energy and its processing. It can eventually lead to build a more sustainable lifestyle in cotemporary world. The cognizing route of recognizing, using and indentifying energy and products is reflected during the interaction of product and users.

As a pilot research of systematically studying and structuring the embedded ecological wisdoms in Chinese everyday objects, the research structure and data analysis methods in this paper will be continuously refined in other case studies under different categories. The design model with process and tools in this research suggested in this paper will be used and refined by conducting design workshops in both design schools and industries in next research phase.

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