

THESIS POLITO

Cooperative Energy Clusters



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Cooperative Energy Clusters

Catalogue

Abstract.....	3
Chapter 1. A Brief Introduction Background in China	9
Geography and Population	9
Energy Resources.....	13
Historical Events and Towns Protection	16
Chapter 2. Main Elements	20
Small and Medium-sized Enterprises (SMEs) Analysis in China	20
ICT for Energy Efficiency	23
Definition.....	23
Influence and characteristics.....	25
An industrial example-Huawei.....	28
Industrial Symbiosis.....	33
Definition.....	33
Characteristics.....	36
Challenges	39
Some feasible measures to help build industrial symbiosis.....	40
An existing example	45
Smart Grids	49
Chapter 3. Establish Three Ideal Models in China.....	52
Yongding County	54
A brief introduction	54
Local energy power Station building	58
Local communities	62
A simple draft layout of the local elements distribution	64
Local industrial symbiosis building	66
CE-Cluster creation.....	70
Biancheng Town	72
A brief introduction	72
Local power station.....	76

Local industrial symbiosis building	78
Zhoushan Island	80
A brief introduction	80
Local energy resource.....	84
A new type of energy station	86
Brief Conclusion.....	89

Abstract

The general idea of this topic can be concluded as Smart SME Cluster Organization for Collaborative Energy Management. Based on the idea of sustainable and internal automatically running community. Cooperative Energy Cluster addresses the need of industrial SMEs to transform their business models by integrating key issues of the energy management transition. Cooperative Energy Cluster specifically addresses these challenges for SMEs located in isolated areas, with the ambition to integrate renewable energy system as a key driver of sustainability. The project builds energy management solutions dedicated to SMEs, so as to ensure the best possible balance between locally produced renewable energy system and residual purchase of energy from large distributors. Cooperative Energy Cluster develops a new concept of energy efficient SME Cluster, based on collaborative management principles. Technically the Cooperative Energy Cluster (CE-Cluster) is implemented with an innovative Cyber-Physical-System (CPS) approach where innovative ICT solutions support a decentralized and collaborative management of energy flows for cooperative clusters of local actors, including industrial firms. The energy management system includes a mix of energy sources, oriented on renewables. Three main objectives are developed:

Objective 1: to design and prototype the CE-Cluster, by a Collaboration Framework gathering all the required components to support its deployment. Objective 2: to assess its efficiency and validate the added-value of the associated Business Model by Validation Demonstrators in 2 countries. Objective 3: to support a broad replication of the CE-Clusters across Europe, via a Replication Strategy and toolkit, implemented by 3 Replication Demonstrators. Proving the market replicability of the new business model is essential. It will be proved during the project with two main international orientations: Eastern Europe & India. CE-Clusters will build an efficient strategy together with deployment toolkits to support the European then International replication of CE-Clusters, then to prove the replicability by a set of Replication Demonstrators in Eastern Europe also reinforced by a collaboration with India to launch additional replication initiatives, and a great perspective in China. In this thesis, we analysis the application of CE-Clusters in China and build several typical models with various of different background.

We first consider the locations to be chosen, here we mainly consider the areas which are isolated and with a good natural geographical condition to construct some kinds of power stations, and then we need to figure out how to build a proper energy flow network. In this thesis we introduce the main elements of this system and present

several ideal proposals in China.

China has been through revolutionary development in the recent 20 years. And the whole world is witnessing and being influenced of that. However, practically speaking, the development in China is very uneven. Majority of the population is concentrated in the big cities: Beijing, Shanghai, Canton, Shenzhen etc. Instead, Many countryside areas have been losing their population because of the lack of job opportunities for local residents and the unsatisfactory social and living environment.

The three projects in this thesis aim to solve the above problem in the isolated areas in China, by choosing three typical places with different and various conditions to set some ideal examples for other similar areas. It has a great prospective in the future by doing so. To release the high population and living pressure in the big cities, as well as to help with the protection of ancient cities and towns.

The process of the project can be described as: choosing typical places, analyzing the local natural energy resources and local communities, proposing ideal SMEs (Small and Medium sized Enterprises) for being the partners of the industrial clusters, and building an ideal models of Collaborative Energy Clusters.

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Benefits for SMEs:

1. Financial guarantee from the Government, lower tax, technological support.
2. New model of management and processing, industrial symbiosis.
3. Stable and well-trained employees from local residents.

Benefits for regions and residents:

1. Development of regional economy and society.
2. Maintain local historical and cultural events.
3. People will find more job opportunities in hometown.
4. New living styles, more environmental friendly and eco-friendly.

The core element of the project is to build a new type of Industrial Energy Cluster, which makes possible to establish an innovative multi-actor business model, leading to higher energy autonomy in the isolated regions.

The main goal is to create an Industrial Energy Cluster which is right and good for the local society and more efficient, the local community. To help with the not just the economy, but also to suit for the native culture and tradition.

A general network of the system is as follows:

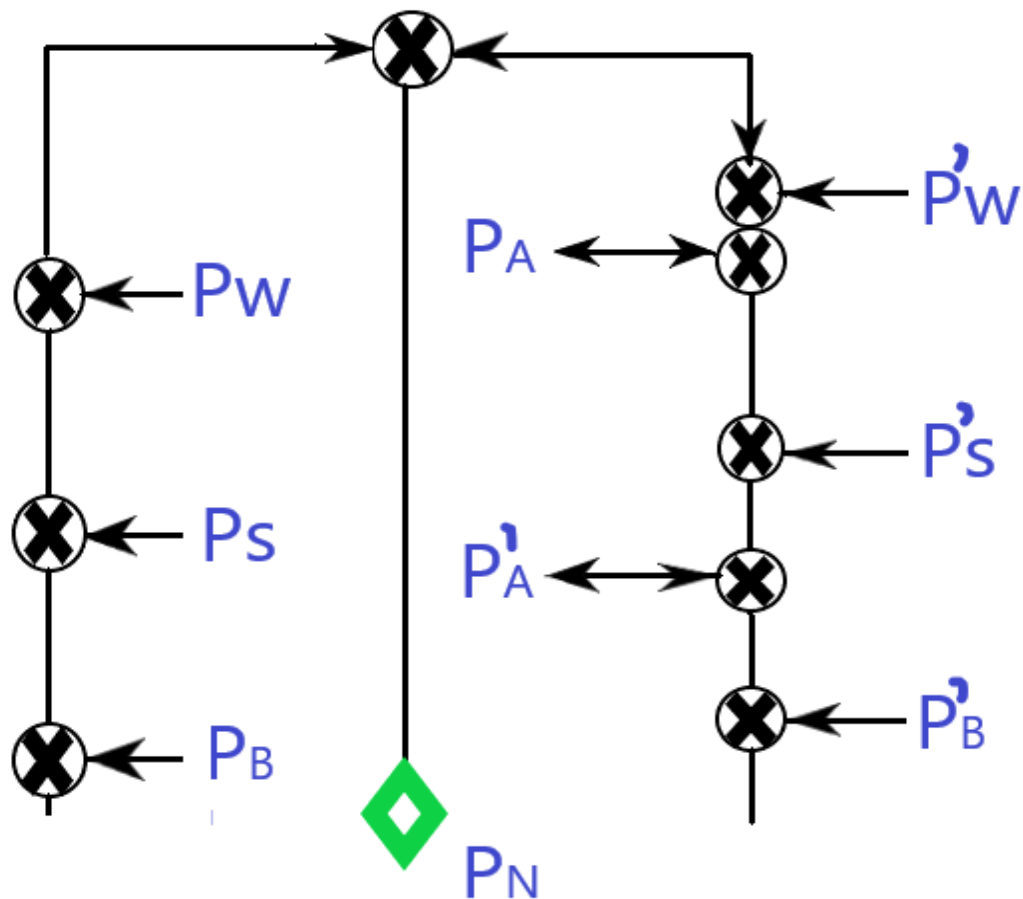


Figure 1-1

P_A : Overall energy consumption within the local network.

P_W , P_B , P_S : Various local energy production flows (wind mills, photovoltaic power station, on-farm biomass energy).

P_N : Energy supply from N/R energy producer.

$$P_A = P_W + P_B + P_S + P_N.$$

Practically speaking, our goal is to improve the efficiency of P_A and to minimize the value of P_N .

Chapter 1. A Brief Introduction Background in China

Geography and Population

The geography in the whole China is more than complicated. And the population in China is distributed very unevenly, large population mainly located in a number of grand big cities such as Beijing, Shanghai, Canton and etc. Instead, thousands of other cities are losing their citizens because of the lack of job opportunities, insufficient public facilities, and then a vicious circle.

Geography in China:

China's terrain is higher in the west and lower in the east, with mountains, plateaus and hills accounting for about 67% of the land area and basins and plains for about 33%. Most of the mountains are from east to west and northeast to southwest, including Altai mountain, Tianshan mountain, Kunlun mountain, Karakoram mountain, Himalayas, Yinshan mountain, Qinling mountain, Nanling mountain, greater Hinggan mountain, Changbai mountain, Taihang mountain, wuyi mountain, Taiwan mountain and Hengduan mountain.

The west has the world's highest Qinghai-Tibet plateau, the average altitude of more than 4,000 meters, which is known as the "roof of the world,". Everest, 8,844.43 meters above sea level, the world's highest peak. To the north and east are Inner Mongolia, Xinjiang, the loess

plateau, the Sichuan basin and the Yunnan-Guizhou plateau. Greater Hinggan ridge, Taihang mountain, Wushan mountain, Wuling mountain and Xuefeng mountain are mostly plains and hills to the east of the coastline. The continental shelf east and south of the coastline contains rich seabed resources.

Millions of years ago, the Qinghai-Tibet plateau uplifted, the earth's history of this major crustal movement formed China's landform. From the air, China's terrain is like a ladder, descending from west to east. Hit by the Indian plate and the Eurasian plate, the Qinghai-Tibet plateau keeps rising, with an average altitude of more than 4,000 meters, known as the "roof of the world", forming the first ladder of China's terrain. Mount Everest, the main peak of the Himalayas, is the highest peak in the world.

The second step consists of Inner Mongolia plateau, loess plateau, Yunnan-guizhou plateau, Tarim basin, Junggar basin and Sichuan basin, with an average altitude of 1000-2000 meters. Across the great Hinggan mountains, Taihang mountains, Wushan mountains and Xuefeng mountains on the eastern edge of the second ladder, heading east to the Pacific coast is the third ladder. The terrain of this ladder drops below 500 meters to 1000 meters. From the north to the south are distributed the northeast plain, north China plain and the middle and lower reaches of the Yangtze river. Further to the east is

the shallow sea area of China's continental shelf, the fourth step, with water depths of less than 200 meters.

Terrain features in China are described as follows:

1. The terrain is varied

In China's vast land, there are majestic plateaus, rolling mountains, vast plains, low and flat hills, and surrounded by mountains, the middle of the size of the basin. All the five basic landforms are distributed in China, which provides a variety of conditions for the development of industry and agriculture in China.

2. Mountainous area

Mountains, hills and relatively rugged plateaus are usually referred to as mountainous areas. The mountainous area of China accounts for two thirds of the country's total area, which is another remarkable feature of China's topography. Mountainous area is vast, bring certain difficulty to development of communication and agriculture, but mountainous area can offer forest product, mineral, water energy and tourist resource, changed appearance of mountainous area, development mountainous area economy offered resource to assure.

3. The terrain is high in the west and low in the east

Terraced distribution of terrain is the general trend of surface ups and downs. The terrain of China is high in the west and low in the east.

The shallow sea continental shelf is the natural extension of the

mainland to the sea. Generally, it has a small depth and a relatively gentle slope, and is rich in Marine resources.

The prominent characteristics of the population are: large population base, rapid population growth and numerous ethnic groups. Rich in resources, but the per capita share of resources is relatively small. China can be divided into four parts: northern region, southern region, northwest region and Qinghai-Tibet region.

China is the most populous country in the world. At the end of 2013, there were 136,072 people living on the Chinese mainland, accounting for about 19 percent of the world's total population. China has an average population density of 143 people per square kilometer, about 3.3 times that of the world. There are more than 200 people per square kilometer in the central region. The western highlands are sparsely populated, with fewer than 10 people per square kilometer.

Energy Resources

Energy resources are the foundation of energy development. Ever since the founding of the People's Republic of China, China has been continuously intensifying the exploration of energy and resources, and organized and carried out many resource evaluations.

All kinds of exploration and development of natural resources in China are controlled by the government, the majority of the energy companies, such as electric power company, petroleum company, gas company, water conservancy company in China are state owned enterprises.

China's energy resources status have the following characteristics:

1. The total amount of energy and resources is relatively rich.

China is rich in fossil energy resources. And among them coal dominates. In 2006, coal reserves totaled 1034.5 billion tons, and the remaining proved recoverable reserves accounted for about 13 percent of the world's total, ranking the third in the world. Proven reserves of oil and natural gas are relatively insufficient, and unconventional fossil energy reserves such as oil shale and coal bed methane have great potential. China is also rich in renewable energy resources. The theoretical reserves of hydraulic resources are equivalent to 6.19 trillion KWH of annual power generation, and the economic exploitable annual power generation is about 1.76 trillion

KWH, equivalent to 12% of the world's hydraulic resources, ranking first in the world.

2. It is difficult to develop and explore energy resources.

Compared with other countries in the world, coal resources in China are in poor geological conditions of resource exploitation, most of the reserves need well mining, and a very small amount can be used for open pit mining. The geological conditions of petroleum and natural gas resources are complex and deep buried. Most of the undeveloped hydraulic resources are concentrated in the mountains and deep valleys in the southwest, far away from the load center. The exploration degree of unconventional energy resources is quite low, areal economic environment is poor, lack of the competitiveness.

3. Energy resources are distributed unevenly.

China's energy resources are widely but unevenly distributed. Coal resources are mainly distributed in north China and northwest China, hydraulic resources are mainly distributed in southwest China, and oil and natural gas resources are mainly distributed in eastern, central and western China and sea areas. China's main energy consumption areas are concentrated in the economically developed southeast coastal areas, and there are obvious differences between the resource occurrence and energy consumption. Large-scale and long-distance transportation of coal from the north to the south, oil from the north

to the south, gas from the west to the east and electricity from the west to the east are the prominent features of China's energy flow and the basic pattern of energy transport.

4. The per capita amount of energy resources is low.

China has a large population and its per capita energy resources are at a quite low level in the world. The per capita amount of coal and water resources is much lower than the world average, only 50% of the world average, while the per capita amount of oil and natural gas resources is only about 1/15 of the world average. Cultivated land resources are even less than 30% of the world's per capita level, which limited the development of biomass energy.

Historical Events and Towns Protection

China's five thousand years of history has given birth to a number of profound cultural deposits and major historical events and the history of the city, many of them have become national famous historical and cultural cities. Some of these cities were once dynastic capitals. Some were political and economic centers at that time. Some have been the sites of major historical events. Some are famous for having precious cultural relics. Some are famous for their fine arts and crafts. Their preservation opens a window for people today to look back at Chinese history.



Figure 1-2

Shuhe ancient town, Lijiang shuhe ancient town, in native language is called "shaowu", meaning "village under the peak", that's because

behind the village there is the Jubaoshan mountain and the shape likes a pile of peak, to the mountain village, spread variation from, is one of the earliest settlements of the ancestors of Naxi in Lijiang river, is also one of the well preserved important market town on the TEA HORSE ANCIENT ROAD. It is also a living specimen of the transition of Naxi ancestors from agricultural civilization to commercial civilization, and a model of market town construction formed by opening to the outside world and horse band activities. Shuhe is an important part of the old town of Lijiang river, a world cultural heritage. It was selected as the "charming town of China" by CCTV in 2005.



Figure 1-3

Huangyao ancient town is located in the northeast of Zhaoping county, Hezhou city, Guangxi province. Huangyao ancient town Originated in the song dynasty, it has a history of nearly 1000 years. There are eight

scenic spots and twenty-four scenic spots in the natural landscape. There are more than 20 preserved temples, temples, temples, pavilions and pavilions more than 10, mostly Ming and Qing dynasty buildings. Famous scenic spots include the old site of Quangxi provincial work committee, ancient opera stage, anle temple, etc."

In February 1982, the concept of 'famous historical and cultural city' was formally put forward in order to protect the important cities and cultural relics that were once the political, economic and cultural centers of ancient times or the sites of modern revolutionary movements and major historical events from destruction. According to the law of the People's Republic of China on the protection of cultural relics, a 'famous historical and cultural city' refers to a city with rich cultural relics and great historical and cultural value and revolutionary significance. From the perspective of administrative divisions, famous historical and cultural cities are not necessarily 'cities', but also 'counties' or 'districts'.

As of May 2, 2018, the state council has listed 135 cities as national historical and cultural cities and given priority to protecting their cultural relics.

In China there exists also thousands of small ancient towns and areas which are quite isolated from the outside world, with terrible public facilities and service, lack of job opportunity, these locations are losing

their population. And it becomes very difficult for the preserving those places and the histories.

This system aims to find a solution for isolated locations to use local energy, improve the energy efficiency, organize the energy clusters, and eventually build a self-sufficient community. There are two main phases to get to this objective:

Firstly, we choose several typical locations where are quite isolated from the national energy supply, then we need find the diversity kinds of energy resources in the specific areas.

Secondly, construct proper local power station and cooperate with small and medium enterprises, build energy connection with also community and farms, eventually build a local smart grid.

In order to relieve the population pressure in big cities, some solutions must be taken. The feasibilities and benefits of this system in China are also various:

In China the main public and social resources are regulated by government, such as electricity, petroleum and gas, and the government always represents the citizens' benefits. Chinese government is now executing several policies to protect the ancient traditional cities and to help with the economy and society for the villages and towns. Under this condition, it is convenient to get the support from government to build the local energy grid.

Chapter 2. Main Elements

Small and Medium-sized Enterprises (SMEs) Analysis in China

Under the current background in China, small and medium-sized enterprises (SMEs) are an important part of modern national economy with a wide range of social and economic bases. Therefore, no matter in developed countries or developing countries, the number of SMEs occupies an absolute advantage.

The short life span of enterprises, the rapid renewal of old and new, small and medium-sized enterprises financing channels are narrow, leading to small and medium-sized enterprises capital shortage, lack of development momentum. Small and medium-sized enterprises have low product quality and technology content, resulting in poor market competitiveness and small market influence. Small and medium-sized enterprises are weak in collecting and analyzing market information, unable to timely identify changes in economic boom, financial environment and industrial situation, and weak in resisting risks. As a result, their life cycle is relatively short. Every year, a large number of small and medium-sized enterprises go bankrupt, and a large number of small and medium-sized enterprises are founded. The renewal speed of old and new small and medium-sized enterprises is relatively fast.

Development of small and medium-sized enterprises in our country still struggling, China's information industry research network released the 2018 edition of Chinese small and medium-sized enterprise development and financing strategy study report data show that, the Japanese, European, small micro enterprise life cycle can reach 12 years, the United States reached more than eight years, and only three years in China, due to immature company operation system.

Under the background of large population, backward economy and poor technical equipment, the small and medium-sized enterprises in China are mainly concentrated in labor-intensive industries and some traditional industries with low technical content. According to the statistical analysis of the absorption of labor force in fixed assets of 418,869 industrial enterprises at or above the township level, 396,515 enterprises with the original value of fixed assets less than 10 million yuan, accounting for 94.66%, absorbed 4.3 times of the original value of fixed assets more than 10 million yuan. Industrial enterprises with the original value of fixed assets of less than 10 million yuan accounted for 20.9 percent of the total fixed assets of industrial enterprises with independent accounting, while the absorbed labor force reached 53.3 percent of the total labor force of industrial enterprises with independent accounting. At the same time, most of China's small and medium-sized enterprises use traditional technology to enter the

traditional industries such as agriculture, animal husbandry and fishing, so the output scale of China's small and medium-sized enterprises are relatively small, the technical content of products is low.

Under the condition of highly unified ownership and management right, enterprise goals are highly consistent with owners' goals, which makes SMEs dynamic and flexible. At the same time, the internal organizational structure of the enterprise is simple, the management is personalized, there are no too many management levels, and the unified management power is concentrated in the hands of the owner. The distance between managers and general practitioners is relatively short, and most of them have certain relationships, such as blood relationship, geographical relationship, etc., so the process of organization, coordination, command and supervision is relatively rapid.

Small and medium-sized enterprises have fast turnover of personnel and lack of high-quality talents. Due to the limitation of their own size and enterprise strength, small and medium-sized enterprises often have difficulty in attracting senior talents and paying high salaries required by senior talents. For talents already possessed by enterprises, small and medium-sized enterprises are often difficult to make full use of due to boss complex, management problems, corporate culture, welfare and other problems. Due to the lack of stable and excellent

working team, SMEs often encounter great difficulties in survival and development.

ICT for Energy Efficiency

Definition

ICT is the prefix combination of three English words: Information Communications Technology (ICT). It is a new concept and a new technical field formed by the fusion of information technology and communication technology.

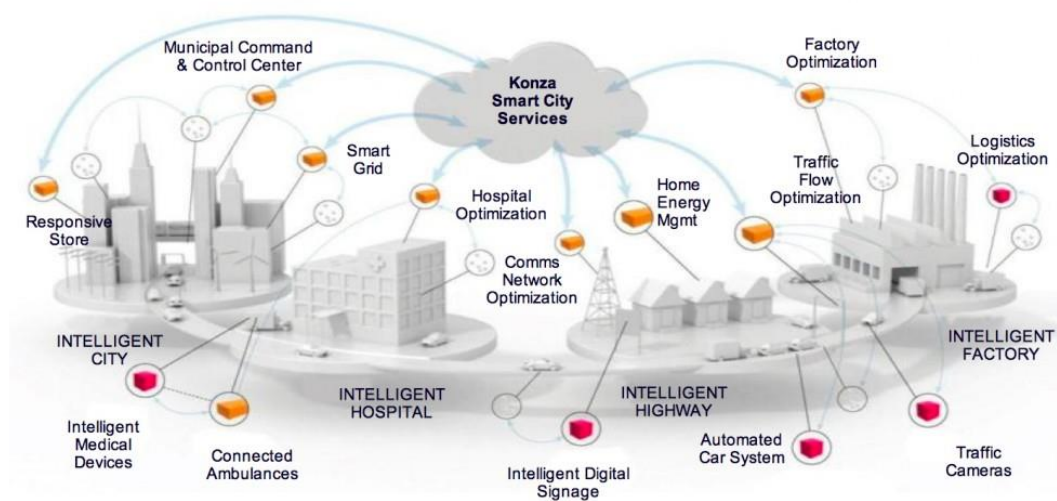


Figure 2-1

Information and communications technology (ICT) is an extensional term for information technology (IT) that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage, and audiovisual

systems, that enable users to access, store, transmit, and manipulate information.

It is a new concept and new technical field formed by the integration of information technology and communication technology. The industry can not only save energy and reduce emissions, but also help other industries including power, coal and manufacturing to improve efficiency and realize green energy conservation.

Influence and characteristics

According to the report, the widespread use of ICT technology could reduce global greenhouse gas emissions by 16.5% by 2020, saving about 1.9 trillion US dollars in energy and fuel costs annually.

According to the introduction, on the one hand, ICT realizes the greening of ICT industry, including green communication, green manufacturing, green logistics, energy-saving network equipment and ip-based technology. On the other hand, the application of ICT products and technologies can be combined with traditional industries to promote the greening of traditional industries, including smart grid and smart buildings. Experts estimate that applying ICT to other industries can save five times more energy than its own industry. ICT technology has driven the whole society to save energy and reduce emissions, which has become one of the important means to realize the green and low-carbon development of China's economy and society.

The ICT industry can play a good guiding role and exert a strong influence in promoting energy conservation and emission reduction by means of informatization. The role and contribution of ICT in helping other industries achieve energy conservation and emission reduction is greater than that of the ICT industry itself.

"The application of ICT in industrial energy management system can

further bring into play the systematic advantages of industry and information technology. According to the requirements of integration of the two technologies, information technology is an important measure to reduce energy consumption in the industrial field. Especially in research and development design, process and production control and other links, the use of information technology to promote energy conservation and emission reduction, to achieve the integration of the two. A participant told reporters.

Abroad, Intel, along with ICT companies and some Non-Governmental Organizations, launched the digital energy solutions initiative in 2008 to influence global environmental policy.

The EU has proposed to promote the overall European economy to achieve low carbon emissions through the research and application of ICT solutions. For example, the energy production and transmission sector consumes one-third of primary energy. Using ICT can increase the efficiency of power generation by 40% and transmission efficiency by 10%, which not only makes grid management more efficient, but also promotes the integration of renewable energy. As we have learned, at present, in China the ministry and other relevant departments are actively organize domestic development digital energy solutions, development of online simulation technology, used for key industries of energy conservation, implement the digital

demonstration plant energy consumption, promote energy online monitoring, research and establish regional industry key enterprises of the trinity of industrial energy detection and warning system.



Figure 2-2

Specifically, a smart city framework will integrate the following four key city services:

Infrastructure services (transportation, utilities, public safety, environment)

Citizen services (access and participation)

City services (city information, planning and development)

Business services (supportive services for local commerce)

An industrial example - Huawei

The year 2016 is regarded as the first year of energy Internet development. While most people are still confused by the large and vague concept of energy Internet, huawei, as the world's leading provider of information and communication technology (ICT) solutions, has begun to build a new ecosystem in the ICT field of global energy Internet.

HUAWEI has accumulated rich experience in the field of ICT, providing comprehensive and efficient ICT solutions for global customers in the fields of energy, government, public utilities, finance, transportation, power, large enterprises and other industries, and helping industrial customers use information technology to enhance their core competitiveness. Today, with the shortage of resources and homogenization of products, HUAWEI implements the optimization of production and management through ICT technology to achieve strategic transformation and development. HUAWEI's energy business is divided into three sectors: power, oil and gas and mines. Electricity accounts for 55% of the total. Due to the wide range of the industry, customers' needs are different and the service is more than expected. customization of customer needs. Huawei established BG as a corporate business to achieve customer success. Compared with the large international companies, HUAWEI can achieve a considerable

level of products in the circumstances, tailored to the needs of customers, better service and meet customers.

Energy business, electricity is big head, HUAWEI in electric power industry provides cover hair, lose, variable, distribution, use, and office of ICT solutions, including power plant based on network, the communication of electric power, the power distribution automation, AML, dispatching automation, data center, collaborative office and solutions, such as electric power customer service center, to achieve "power flow, information flow, business flow," fusion of highly integration, power electric power enterprises to build a strong, self-healing, compatible, economy, integration and optimization of strong smart grid.

In the smart grid transformation, the rapid pace of China southern power grid, and HUAWEI cooperation in the completion of the Zhuhai power distribution automation communication network, to achieve enterprise network dedicated. Compared with the traditional optical fiber network, the construction period of the network is reduced from 270 days to 66 days, and the new access cost of a single user is reduced by 75%. Only 10 base stations can cover more than 50,000 distribution nodes, and the coverage radius of a single station can reach 4 kilometers. It not only carries the "three remote" business seamlessly, but also achieves the 100% success rate of meter reading.

Safety is Paramount:

In an interview with the reporter, Guo Hao, head of the power business department of HUAWEI China, said that the future energy Internet has the main characteristics including: ultra-high voltage network framework and transmission network to build the transmission framework, with clean energy-based power generation system, with the global connectivity of the strong smart grid. In Guo Hao's opinion, the energy Internet will change the existing power grid model, realize regional power grid interconnection, build an intelligent dispatching and control system, and at the same time in the distribution and power consumption links will also change, and these changes have put forward higher requirements for the communication and transmission system. That is, ICT system will play the role of neural transmission system in the energy Internet system -- coordinating the coordinated operation of energy Internet in multiple directions and across regions. Guo Hao said HUAWEI is playing an active role in the global energy Internet blueprint that China is actively advocating. Specifically, HUAWEI is the only council unit in the field of ICT in the global energy Internet development cooperation organization, committed to building an information communication system in the era of energy interconnection.

In fact, whether it is the current power grid system or the future

construction of energy Internet, security is the primary issue. Zhang Yingju, head of MKT and solutions sales department of HUAWEI China enterprise power business department, told reporters that HUAWEI is actively participating in the top-level design of power enterprise security system. The current security threat is not only from the traditional virus or network attack, more and more APT attacks are threatening the security and reliability of electric power. Therefore, HUAWEI will not only provide customers with security protection solutions at the level of ICT infrastructure, but also face security threats together with customers from the consulting level.

Create an open ecosystem:

Tropical rainforests are endless, with its coexistence and co-prosperity, interdependence, inseparable, HUAWEI company is also committed to build an open, harmonious and symbiotic, win-win benign ecosystem, to the general partners achieve resource sharing, communication ability and make more and more innovative, more competitive industry solutions, so as to create value for customers.

In the new era of ICT, by no one company can provide differentiated application service for all industries, HUAWEI is focused on the ICT infrastructure, with innovation of cloud computing, SDN, big data, Internet, mobile Internet and other new technology to build open, flexible, elastic, security platform, with customers and partners to build

a new ecosystem. In this new ecosystem, the change of customer business driven applications, driven by changes in application of further bearing application of ICT infrastructure, which in turn driven development around the needs of customers to develop ICT infrastructure and innovation, at the same time will be integrated into the ICT infrastructure embedded or partners in the application or system, jointly create a healthy and sustainable development of the benign ecosystem.

The current transformation of energy production and consumption mode will bring about the increase of the proportion of clean energy consumption, the transformation of intelligent equipment, the electrification of terminal energy consumption and the reform of electric power trading. In order to promote the development of global energy Internet, HUAWEI said that it will work with its industry partners to promote the healthy and sustainable development of the open ecology of energy Internet and accelerate the digital transformation of the energy industry with "new ICT".

Industrial Symbiosis

Definition

Industrial symbiosis is defined as the process by which wastes or by-products of an industry or industrial process become the raw materials for another, two or more industrial entities develop mutually beneficial relationships, one entity makes the productive use of a material stream is regarded as waste by another entity, shared utilization of specific equipment or facilities and the pooling of resources, with an aim to reduce consumption of resources and amounts of waste and emissions.

Industrial symbiosis is a complete industrial ecosystem. Due to the sharing of similar resources or the complementarity of different resources among enterprises in various industries, symbiosis promotes the improvement of internal or external, direct or indirect resource allocation efficiency, not only brings the increase of enterprise benefits, but also promotes the development of the industry.

Examples of industrial symbiosis are wide ranging and mainly include: the use of sludge from fish farms as agricultural fertilizer, the recovery of car tyre shavings for use in construction materials, and the use of waste heat from one industry to warm greenhouses for food

production.

Industrial Symbiosis: Kalundborg, Denmark

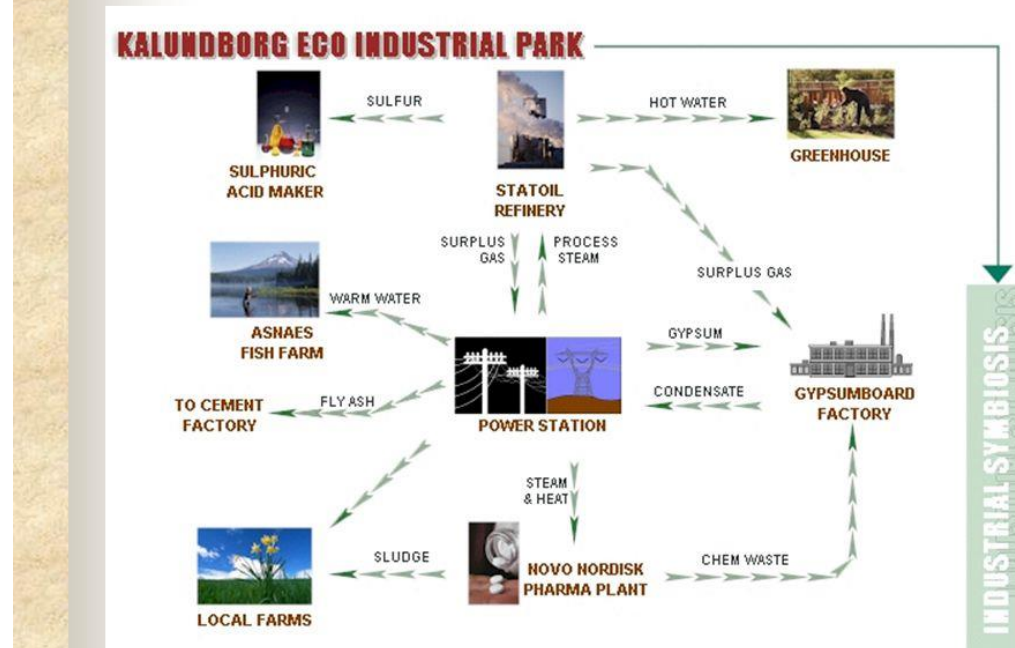


Figure 2-3

Industrial symbiosis belongs to a special and complex economic relationship, which has both economic and ecological characteristics. The symbiotic link between businesses is waste that has traditionally been considered "worthless". It aims to pursue economic value and environmental improvement, and is more strongly affected by policies, regulations and technological changes.

Application of this concept allows materials to be used in a more sustainable way and contributes to the creation of a circular economy. The transition to such an economy is the goal of the European Commission's Circular Economy Action Plan as it will result in the

increase of Europe's economic competitiveness, sustainability, resource efficiency and resource security. It also contributes to the reduction of greenhouse gas (GHG) emissions. Industrial symbiosis creates an interconnected network which strives to mimic the functioning of ecological systems, within which energy and materials cycle continually with no waste products produced. This process serves to reduce the environmental footprint of the industries involved. Virgin raw materials are required to a lesser degree, and the need for landfill waste disposal is reduced. It also allows value to be created from materials that would otherwise be discarded and so the materials remain economically valuable for longer than in traditional industrial systems.

Characteristics

(1). Traditional industrial agglomeration is only a simple superposition of related enterprises in a certain region, which produces correlation effect. Industrial symbiosis has a community characteristic similar to biological community. It consists of several related enterprises cooperating with each other. In particular, industrial restructuring is achieved by means of internal closed material cycle, material reduction and energy decarbonization in the industrial system, so as to optimize the utilization of the overall resources within the community.

In the external form, symbiotic industries are often manifested as different sizes within a certain geographical range, and the mutual combination of industrial groups at different positions in the industrial chain, middle and lower reaches respectively. Community symbiosis refers to several adjacent and complementary enterprises in different kinds of industries. They are based on mutual trust between enterprises in long-term cooperation, which is conducive to the exchange of information between enterprises and the exchange of wastes and resources, with the aim of win-win, so as to obtain economies of scale and external economy.

(2). Industrial convergence emphasizes the location of industrial boundary and takes the formation of new industrial formats as its

fundamental symbol. The integration of industrial symbiosis focuses on the business connection relationship in the process of industrial innovation and value multi-plication. From the perspective of implementation, complementary technologies, supply and demand of products and combination of business modules can all promote the integration from the perspective of symbiosis. Under the framework of industrial symbiosis, integration is the premise of symbiosis, without which symbiosis cannot occur. The integration defined by industry symbiosis is related to the natural attribute of industry value creation and realization. Symbiotic integration is based on the basic premise of value co-creation.

(3). The industrial symbiotic system has the characteristics of circulation. The traditional composed of a product a waste "resources" one-way flow of material production process, refactoring organized into a "resource a product a renewable resources a recycled product" feedback process and "low mining, high utilization, low emission" mode of circular economy, make the economic system harmoniously into the natural ecosystem material circulation process. In this model of industrial development, the waste generated in each production process may become the raw material of the next production process. The main practice of ecological industry is to use the waste of upstream enterprises as raw material and energy for downstream

enterprises, but this does not mean that the upstream enterprises can produce any waste or how much waste. On the contrary, in the symbiotic food chain, the waste of upstream enterprises, especially harmful substances, should be reduced in the first place. That is to say, every link in the system needs to carry out resource reduction, taking into account the degree of resource demand of the whole symbiotic chain and the capacity to accept the pollutant discharge of the symbiotic chain. Otherwise, the symbiotic "food chain" may be out of control due to the maladjustment of one link.

(4). The goal of the industrial symbiosis is to achieve mutual benefit and win-win results on the basis of reducing pollution, saving resources and protecting the environment, and to achieve value-added effects. Industrial symbiont abandons the disadvantages of separating economy and environment in the development of traditional industries, causing conflicts between the two, and truly integrates the development economy and environmental protection organically. The substantial environment and economic efficiency generated by this symbiosis system are the fundamental reasons for its praise.

Challenges

Challenges in implementing industrial symbiosis include:

To manage a close cooperation between governing bodies(related industries), firstly to build a symbiotic system between different kinds of industries might be complicated and critical, to maintain an accepted agreement among all the stakeholders and the general public, and then to achieve public acceptance.

To present proper plans and to illustrate the social, environmental and economic benefits of a scheme clearly can help to overcome this issue. Good waste management strategies may take time and persistence to develop, and there is a need for good waste sorting efficiency at household and consumer level to ensure cost efficiency.

Some feasible measures to help build industrial symbiosis

1. Government support

In a country like China, the government policy plays a vital role for most of the industries, especially for the new concept industries.

The government and the market are two different functions to regulate the allocation of resources. The government meets the needs of society by developing enterprises in the market. The government introduces policies to support the better development of enterprises and make enterprises develop better under the support of the government.

Under the guidance of policies, enterprises can directly and accurately understand the government's guidance and the market to a large extent, so as to produce products more in line with the market demand. Therefore, the relationship between government and enterprises is interdependent.

Preferential support policies of the government involve many aspects, such as department investment attraction, tax reduction and exemption, financing support, environment optimization, employment and talent introduction, which directly or indirectly promote the healthy development of enterprises.

The idea of building industrial symbiosis in this thesis is mainly about the small and media sized enterprises.

Currently in China the government's support policies for SMEs mainly include:

(1). Increasing financial support.

With the support of this policy, to provide financial incentives for industry and research institutes to engage with industrial symbiosis initiatives, such as tax exemptions and industrial symbiosis-earmarked national or EU level public procurement funding.

(2). Implementing and improving preferential tax policies.

By using this particular policy, to explore private sector industrial symbiosis financing models, for example private for-profit platform companies. Build preferential tax policies for the startups of industrial symbiosis.

(3). Further reducing the social burden on small and medium-sized enterprises.

To maintain and develop the symbiotic relationships of the SMEs.

(4) policies and provisions for supporting small and medium-sized enterprises in accelerating technological transformation.

In order to have a stronger cooperation and increase the industrial symbiosis efficiency, with the support of this policy, have advantage to develop new technology. To proceed and to develop the symbiotic relationships of the industries.

Small and medium-sized enterprises (SMEs) refer to enterprises of

various forms of ownership established in accordance with law within the territory of the People's Republic of China that are conducive to meeting social needs, increasing employment, conforming to state industrial policies and belonging to small and medium-sized production and operation scales.

The state council department in charge of the work of the enterprise shall, according to the number of employees, sales volume, total assets and other indicators of the enterprise and in combination with the characteristics of the industry, formulate the criteria for its classification. Such enterprises can usually be composed of a single person or a few people to provide funds, the number of employees and turnover are not large, so most of the operation is directly managed by the owner, less external interference.

2. Build local conditions

With the government support, to build public authorities to promote conditions for industrial symbiosis in urban areas, and facilitate public and private sector interest and capabilities to form industrial symbiosis in urban districts. Advertise regional industrial symbiosis initiatives to international audiences to promote the region's sustainable good practices and image to maximize the potential for transnational collaborations. Encourage the development of long-term regional industrial symbiosis visions and planning support tools through the

development of strategic roadmaps and future scenario plans.

3. Promote influence

Encourage an active leadership role for public authorities in motivating and facilitating collaboration in regional industrial symbiosis clusters and networks, to build trust among different kinds of industries, public institutes, business development organizations and research institutes. Increase efforts to include industrial symbiosis and circular economy activities in regional strategies by mapping areas of regional industrial symbiosis strengths and development potential in entrepreneurial discovery workshops with local experts and local strengths. Disseminate information on industrial symbiosis, best practices to promote learning among regional stakeholders. Have a considerable influence.

4. Create demand

Build increasingly strong links among various local industries, reinforce the cooperation of the industrial symbiosis. Establish stronger links between local industry and research institutes to ensure that industrial symbiosis research, training and business models meet the needs of the private sector.

Encourage public authorities, universities and research institutes to map regional material flows and industrial symbiosis stakeholders. Let the local SMEs witness the unstoppable trend of the cooperation

among the various industries.

Encourage industry to take a leading role in coordinating the development of industrial symbiosis platforms by raising its awareness of the potential benefits of involvement. Have the local SMEs seen the benefits and necessity of being part of the symbiotic system.

An existing example

(1). Kalundborg Symbiosis

One such example is Kalundborg Symbiosis, which is the world's first functioning example of industrial symbiosis. Situated in Kalundborg, Denmark, the symbiosis is based on public-private partnerships, with exchanges of energy, water and materials in closed loops.

Basic information:

Located in Kalundborg, Denmark

6 private partners

3 public partners

Over 5000 employees combined

25 different resource streams exchanged

Collaboration dating back to 1961

Winner of Gothenburg Sustainability Award 2018

Kalundborg Symbiosis is the world's first industrial symbiosis and has evolved over the past 50 years. The cooperation between the companies in the symbiosis provides mutual benefits, economical as well as environmental. The main principle is that a residue from one company becomes a resource in another.

Kalundborg Symbiosis is a private association run by a board. The Kalundborg Municipality's Department for Development handles the secretary and visitors to the symbiosis.

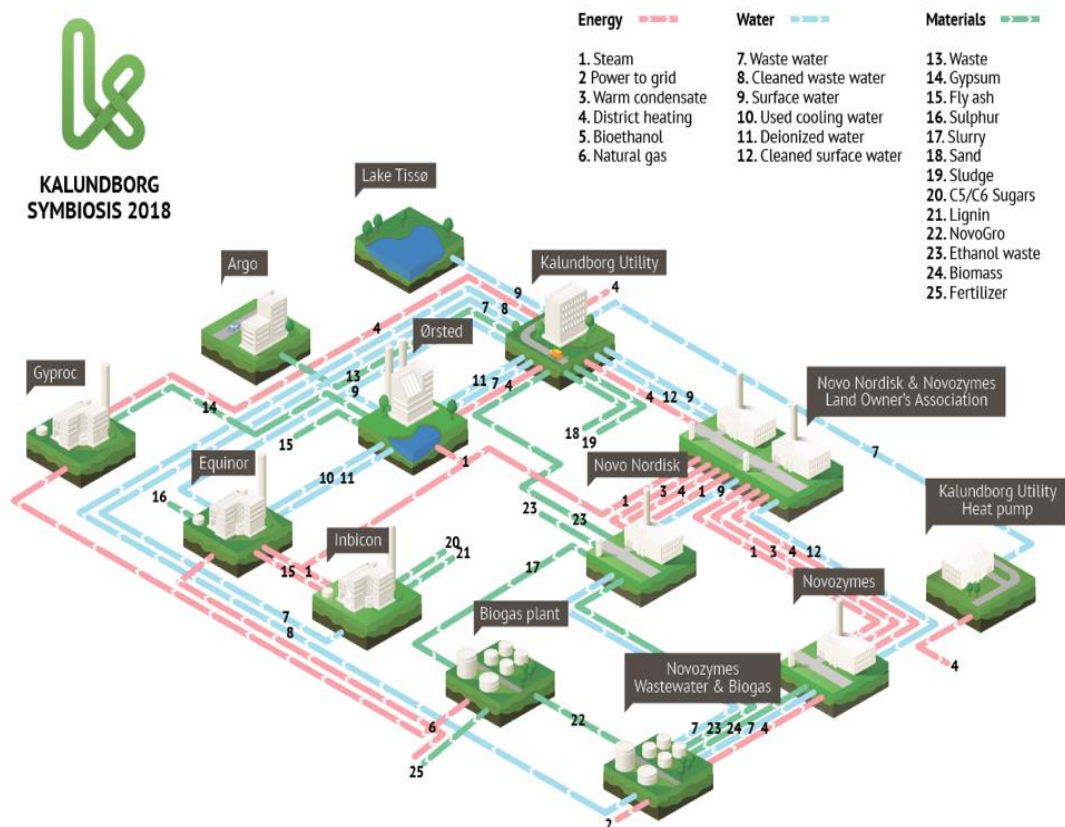


Figure 2-4

Kalundborg Symbiosis is made up of 25 different streams including the material flows (as shown in Figure 2-2), water, and energy. The resource flows come from six industrial areas and other three public sector organizations.

The beginning of the partnerships started in 1961, with the creation of a pipeline from Lake Tissø to the Equinor Refining Denmark (then

ESSO) refinery. While technically not being a symbiosis project, the pipeline was a public-private partnership between Kalundborg Municipality and Equinor Refining Denmark and is still one of the key elements of Kalundborg Symbiosis today, where companies can utilise surface water instead of the more valuable and scarce ground water resource.

The partnership was formalized as a private association called 'Kalundborg Symbiosis' in 2011, structured as a board of directors, where each partner has a member on the board. The association has regular meetings to drive further innovation as well as other matters involving the partners. For example, the association recently decided to map all internal resource flows of the partners, and implement ten new symbiosis projects by 2025

Collaboration between the partners is now very stable and every new decision has been taken by one company will be taken also consideration of the possibilities for and impact on the other partners and the area of Kalundborg as a whole. This mindset is even strengthened by shared values and aided by the fact that none of the companies are in direct competition.

Another key element, also the most visible and recognizable sign of the symbiotic cooperation, is the exchange of high temperature steam from Ørsted's combined heat and power plant, Asnæs Power Station,

to many of the other partners in the Symbiosis. The visibility stems from the distinctive green pipes through which the steam exchange happens. The pipes can be seen running through all of the industrial area and serve as the inspiration for Kalundborg's logo.

Additionally, this symbiotic project changed Ørsted's business model from producing electricity with the excess steam as a by-product, to steam being the primary product and comprising most of their income. This exemplifies that by having the symbiotic mindset, you can change and innovate your business model and reap both economic and environmental benefits.

The case cited from:

<https://www.ellenmacarthurfoundation.org/case-studies/effective-industrial-symbiosis>

Smart Grids

‘A smart grid can be described as an electrical grid which includes a variety of operation and energy measures including smart meters, smart appliances, renewable energy resources, and energy efficient resources. Electronic power conditioning and control of the production and distribution of electricity are important aspects of the smart grid. Smart grid policy is organized in Europe as Smart Grid European Technology Platform. Roll-out of smart grid technology also



Figure 3-1

implies a fundamental re-engineering of the electricity services industry, although typical usage of the term is focused on the technical infrastructure.'

Referred from: https://it.wikipedia.org/wiki/Smart_grid

Smart grid plays an important role in promoting the network of the world economic and social development.

Smart grid construction plays an important role in coping with global climate change and promoting global economic and social sustainable development.

The main performance is as follows:

- (1) promote the development and utilization of clean energy, reduce greenhouse gas emissions and promote the development of low-carbon economy.
- (2) optimize the energy structure, realize the complementarity of various forms of energy, and ensure the security and stability of energy supply.
- (3) effectively improve energy transmission and use efficiency, and enhance the safety, reliability and flexibility of power grid operation.
- (4) promote technological innovation in related fields, promote technological upgrading in equipment manufacturing, information

and communication industries, expand employment, and promote sustainable social and economic development.

(5) realize two-way interaction between power grid and users, innovate the traditional mode of power service, provide users with more high-quality and convenient services, and improve the quality of people's life.

Interactive grid can be controlled by electronic terminals will be formed between users, users, and between the grid company net interaction and instant connection, realize real-time, high-speed, bidirectional power data read from the overall effect, electric power, telecommunications, television, intelligent home appliances control and battery charge integration of multipurpose development, realize the user rich electricity sold back. Data can be integrated in the system and the central power system integration function, effectively protect critical load, realize all kinds of power supply and the client terminal seamless interconnection to the grid, which can optimize the grid management, grid will be promoted to the interactive operation of the new pattern, form a grid brand-new service function, improve the reliability of the power grid, usability, and overall efficiency.

Chapter 3. Establish Three Ideal Models in China

To apply the theory and a complete system with the main elements, and to consider also the variety of the geographic condition, the diversity natural energies and the different living styles in China, after the analysis of the complicate background in the previous chapter(1). In this thesis, 3 different places have been chosen to be considered as the trial places, the most important common characteristic among them is the geographical and social isolation from the outside world. Each of them can represent a typical sample for many similar places. The first place we choose is named Yongding, with a very ancient life style, a particular and typical type of architecture and community. To represent a series of places that are special because of the their unique and ancient history.

The second place has been chosen is named Biancheng town. It is well known because of the novel written by Shen Congwen. From primary school, some pieces of the novel are presented in our textbook, and the image of this small town is also deeply existed in our mind.

The third place chosen in this thesis is named Zhoushan island, The goals of the three different projects are to build a suitable industrial circle for the particular place chosen, to improve the social infrastructure and environment, to help maintain and develop the

local life style, to keep the inherit of native tradition and culture.

Yongding County

A brief introduction

This small town in the map is situated in the south-east of China(Figure 1-1), closed to the ocean. Superficial area 96.1KM², population 24872(year 2014).



Figure 3-1

We have chosen this small town to represent the whole county which is named Yongding, in Chinese, it means the eternal harbor. Yongding County was created in the 14th year of Chenghua Emperor of the Ming dynasty, which has a history of more than 500 years. And it was originally one part of Shanghang County. Yongding is also called the

"southern mining area" and "the town of flue-cured tobacco", with plenty of geothermal resources. Three major rivers flow through this area: tingjiang river, jiulong river, meijiang river, with a total area of more than 100 square kilometers. The local hydraulic power provide a great number of energy. It's cotton beach hydropower plant is the second largest in fujian province.

The buildings in this type of town is one of the most traditional communities in China. With a name of Hakka Earth Building, in Chinese it is called 'Tulou'.



Figure 3-2

Tulou was originally created in the Song and Yuan dynasties (960—1368), and had been developed during the late Ming dynasty, then has been remained and protected till Qing dynasty and the republic

of China. The main materials of this type of building are soil, wood, stone and bamboo as, the houses made of unbaked soil and mixed by a certain proportion of sandy clay and sticky sandy soil are made, and the houses made of two or more layers are rammed with sandwich board.

The ancestors of the area they had suffered a lot from the wars in the ancient days, they believed the only way to be stronger was to be always united together.

From the middle of 17th century to the first half of the 20th century (Qing 清 dynasty, republic of China), the industry of silk, tobacco and tea in this region flourished and the goods are sold not just to the



Figure 3-3

whole country but also to southeast Asian countries. With the

development of economy and the improvement of the understanding of ecological environment, the residents' demands for housing are more urgent and higher. On the other hand, due to the population growth, larger buildings would be built to safeguard the common interests of families, so that many relatives could live in groups of dozens or hundreds, to accommodate the prosperity of the family, and the safety of living. Therefore, the earth tower was built in the style of the hall, as well as in the form of square and round. Its typical characteristics are grand scale, type diversity, exquisite craft design, and gorgeous decoration. In the late period, with the influence of foreign culture was reflected in the construction of some tulou, which was the heyday of tulou in fujian province.

Local energy power Station building

Most of the rivers in yongding district go through inflationary hills and the whole area has frequent storms, falling rivers are greatly affected by topography and climate. Therefore, the rivers are characterized by abundant water quantity, large gradient, fast flow rate and short convergent time. Numerous streams are distributed in a dendritic form and the total basin area is more than 2153 km^2 , accounting for 96.7% of the county area.



Figure 3-4

The picture above shows a typical example of the small power stations in this place and it is also a very typical view of this area, river goes through the hills and is quit fast-flowing, therefore small hydropower stations could be the most ideal type of local energy supply. In

addition, by building series of hydropower stations in different places in this kind of area would be very helpful with the flood disasters, especially during the summer time.

Intricate geographical environment in Yongding leads to the diversity and particularity of natural energy conditions. We could find some areas there which are quite isolated by the mountains, therefore windmill power station could be ideal to be constructed.



Figure 3-5



Figure 3-6

This is the first windmill power station(Figure 1-6) in Yongding named Ninety-nine Dong. This place is named for its ninety-nine small hills.

Wind power refers to turning the kinetic energy of the wind into electricity. Wind energy is a kind of clean and pollution-free and renewable energy. It has long been used by mankind, from a long time ago it has been mainly used to pump water and grind flour through windmills. Now, people are interested in how to use wind to generate electricity.

Currently the energy of the whole world which are provided by burning coal each year is only one-third of the energy that is provided by wind in a year. Therefore, the use of wind power generation has been taken great importance, the development of new

energy. Wind is a new energy source with great potential. The use of wind power is very environmentally friendly, and the amount of wind energy is great big since it comes from the nature and it requires only the natural condition.



Figure 3-7

Local communities

In some large earth buildings in yongding, there are stone pillars, drum-shaped stone pillars, carved beams and painted pillars. There are patios, gardens, rockeries, bonsai and fish ponds. There are even schools that are setted up in the earth building, every building has a



Figure 3-8

particular name, with chinese poems carved on the pillars, such as "zhen cheng Lou", teaching people to abide by the discipline of the society, with heavy moral obligation, and to always forge ahead. All these cultural imprints shine with the spirit of attaching great importance to martial arts, farming, reading and hand down to from generation to generation.

A earth building is a small community. Under the new social environment, it is of great practical significance to explore, as well as

to maintain the beautiful and ancient traditions of Hakka earth building community governance. Firstly to understand the life of the residents of the Hakka community, and advance the reform of the new community governance model of Hakka. Usually in one building there live a group of residents that share the same surname and somehow related to each other. There are not many people still living in traditional Hakka. Most of the young workforce either builds new homes in the village or flows into other areas. Different from the traditional Hakka Tulou community. A community dominated by people is defined as a “new Hakka community”.

A simple draft layout of the local elements distribution

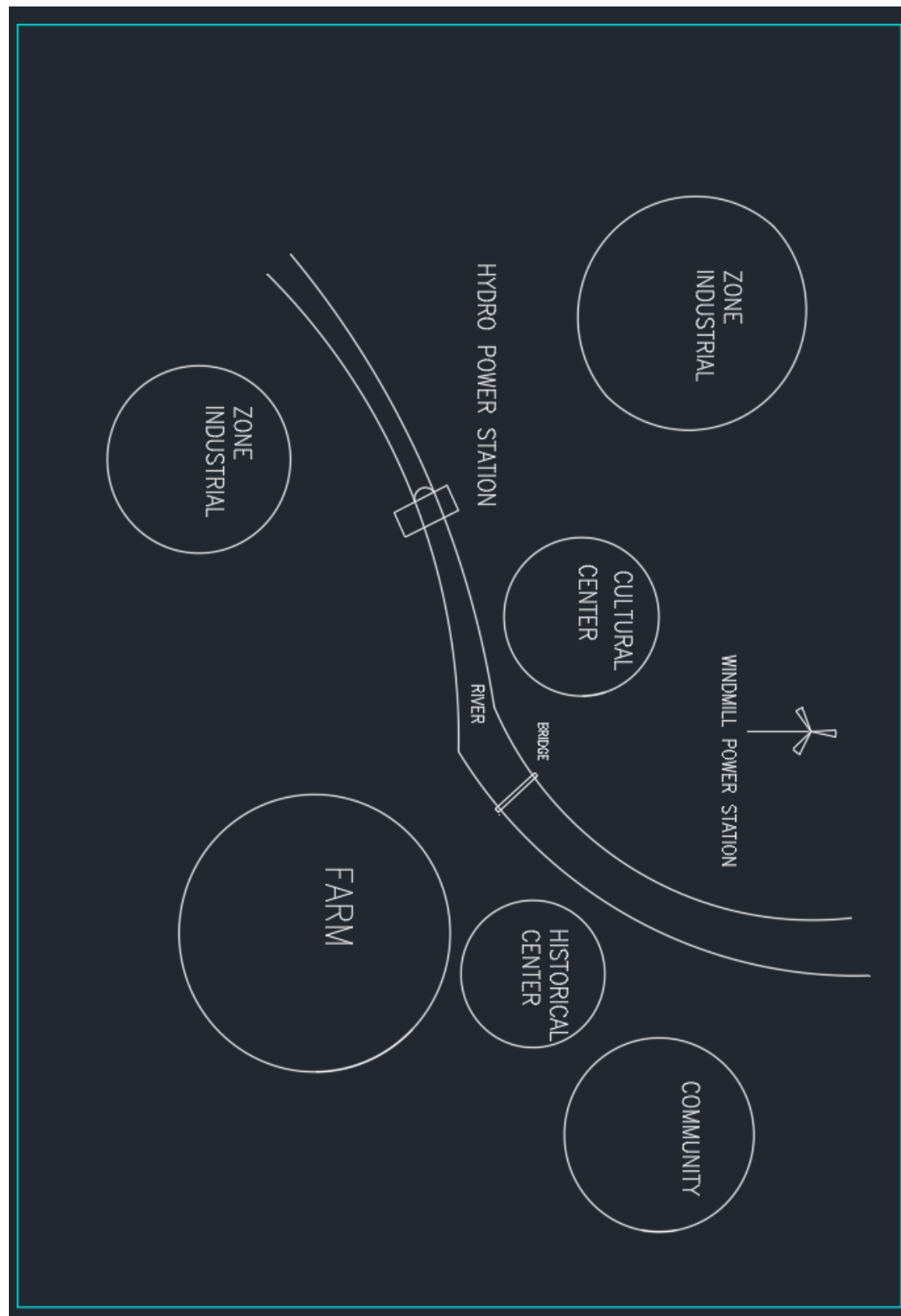


Figure 3-9

This layout is based on the study of this area, taking consideration of realistic local situation, to maintain the local communities and historical events and the particular cultures. Based on this principle, a series of elements can be built step by step.

In this draft layout (Figure 3-9) the main elements are as follows:

Zone industrial, with a group of partner members, the ideal partners will be described in the part of industrial symbiosis in this thesis. And the map of industrial symbiosis as well as its function will be introduced in the next part.

Farm, under the local environmental conditions, a centralized cattle-producing area can be organized, and there could be also some small farms in different separated areas.

Hydro-power station can be built in the downside area along the river, where there the water has a rapid flow. The function of the station will not only be the energy provider, but also the to prevent the flood during the rainy season.

Windmill station, clearly it should be built on the mountain and the area with stronger wind.

Cultural center and historical center, they could be inside the parts of the local communities. In order to gather the historical events and particular culture, a local museum could be built. And eventually become a cultural and historical center.

Local industrial symbiosis building

The industrial zone in Yongding was established in October 2002, which was approved as a provincial industrial park by the government of Fujian province in August 2006. This Park is located in the small town which is named ShiDian Town. It is an experimental construction of comprehensive reform of the industrial development in the county.

This industrial park was planned and constructed in accordance with the high standard and high starting point by using the experience of a closed famous industrial park which is named Longyan economic and technological development zone high-tech park.

The local industrial park covers 12 square kilometers, including 2 square kilometers built in the first phase and 10 square kilometers built in the second phase. It is a professional park focusing on the development of new energy vehicles, machinery manufacturing and optoelectronics industry. The industrial park provides a great number of opportunities for the local industries to progress and develop.

Under this background, we could plan some proposals for a series of particular small and media-sized enterprises to set up factory there. Such as automotive companies, information technological companies, tourist industries and the like. With policy support from the local government, cheaper and more convenient local energy supply, as well as local and stable employees. All those could be really attractive

to enterprises.

Some potential partners of the industrial symbiosis:

Yongding county is rich in agricultural and forestry resources, with six different leading industries, such as animal husbandry, fishery, vegetables, hydropower, forest and bamboo, tobacco, have begun to take shape. Among the agricultural processing enterprises, Yongqiao rattan machinery co, LTD, mainly engaged in the production of rattan, bamboo, wood, grass, willow, metal, paper, ceramic crafts. Hongyang bamboo and wood co, LTD, the company has bamboo floor, bamboo blinds, bamboo mat, bamboo carpet, bamboo charcoal and other five series of more than 200 products. Zijin wood co, LTD, the main products are wooden spoon, wooden shovel, wooden spoon, cutting board, cutting board and other tableware home products.

Yongding has proven coal reserves of 450 million tons. The detailed plan for the first county-level mining area in the province has been completed, and the safety production evaluation has reached the b-level standard. The production scale reaches 4 million tons per year. In the future, the annual output value of the coal industry will exceed 2 billion RMB.

Machinery industry enterprises are private enterprises, the main products are small construction machinery, car bridge casting, wear-resistant steel ball, silicon manganese alloy, stainless steel wire, metal

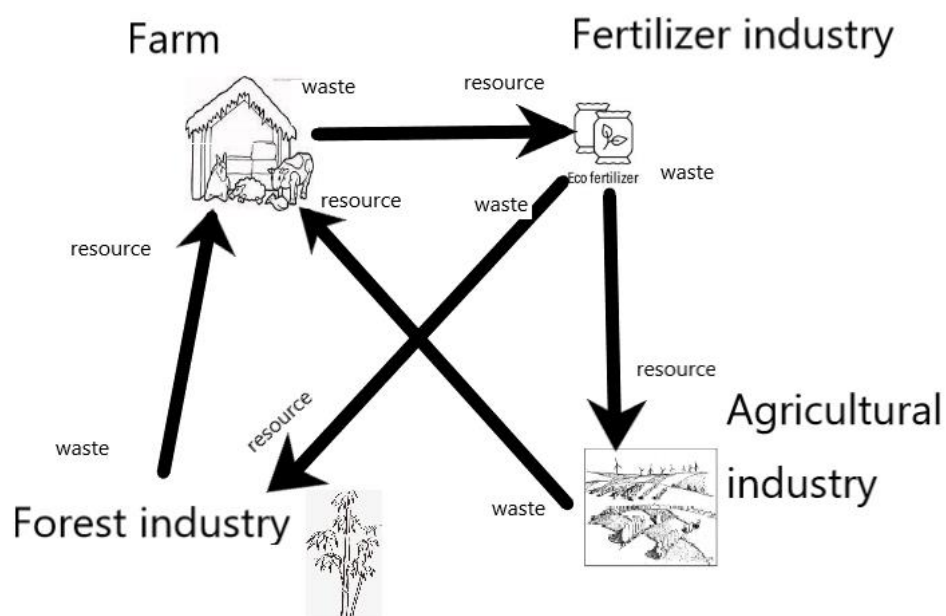
profile. In 2006, the total output value of Yongding machinery industry will exceed 150 million yuan.

Yongding district contains rich granite, quartz ore, iron ore, manganese ore, molybdenum ore, tantalum ore, lead and zinc ore, tin ore, kaolin and other 35 non-coal resources.

Yongding is also rich in tourism resources, including red tourism and green tourism. Tianhou palace in Yongding county Travel, Hakka style tourism. 'Donglou west lake' is one of the eight tourism brands in Fujian province, 'Fujian tulou' has been included in the alternative list of the 28th world heritage, Hakka TULOU folk culture village is a national 4A scenic spot, the cotton beach hydropower station reservoir area has 65 square kilometers of Longhu, the lake-side Wang Shou mountain has been determined as a national forest park. With all these precious resources, relevant tourism trade can be established. Yongding local characteristic products are many, until September 2007, the main famous in local and abroad are tobacco, Yongding red persimmon, June red taro, Yongding dried vegetables, Wanying tea, small American banana, 'Yongding red' granite, Jinde beer, Jinfeng Meite wine. Among them, Yongding dried vegetables is one of the traditional 'eight dried vegetables in west Fujian'. Yongding flue-cured tobacco is known as 'cigarette leader', and is the representative of national Qingxiang flue-cured tobacco.

An ideal small map of the industrial zone based on the system of Industrial Symbiosis:

A simple map of parts of the partners in Industrial Symbiosis



A feasible system based on Yongding local industrial condition

Figure 3-10

CE-Cluster creation

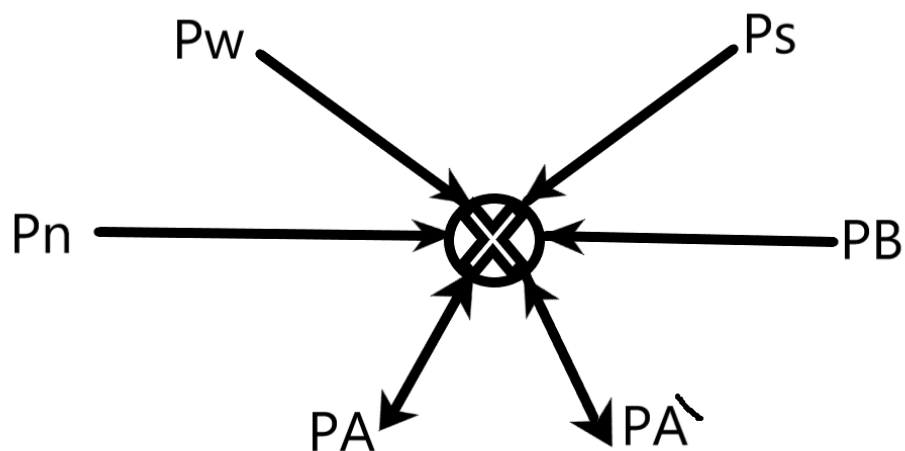


Figure 3-11

Pn : energy supply from National /Regional Energy Producer

Pw, **PB**, **Ps** : various local energy production flows, **Pw**, windmills; **Ps**, hydro-power station; **PB**, on-farm biomass energy.

PA : industrial clusters

PA' : isolated villages

PA+PA'=PO : overall energy consumption within the local network

The ideal operation condition can be conceptually described by the schematic equation:

$$\mathbf{PO} = \mathbf{Pw} + \mathbf{PB} + \mathbf{Ps} + \mathbf{Pn}$$

The aim of the Cooperative Energy Cluster is to maximize the independence of the isolated places (in other words, to minimize the dependence on the national/regional Energy Provider). The detailed goals can be analyzed as follows:

1. Minimize P_0

By using ICT and the Smart Grids, improving the local energy efficiency of the SMEs' production process and the usage of the local villages.

2. Minimize $P_n = P_0 - (P_w + P_B + P_s)$

By balancing in time the utilization of internal electrical power,

3. Maximize $(P_w + P_B + P_s)$

Biancheng Town

A brief introduction

“From Sichuan to Hunan, in the very east there is an official road. This road leads to the boundary of Xiangxi, where there is small town in the mountain named Chatong, a small river, beside the river there is a small white tower, under the tower lives an isolated family, in the family there is only an old man, a little girl, and a yellow dog.”

——Shen Congwen <Biancheng>



Figure 32-1

The original name of this town is Chadong and was changed into biancheng in July 2005, named after the novel "Biancheng" written by shen congwen.

This small town is located in Hunan province, in the center of China.

In the old days it was totally isolated by mountains, became an area with plenty of ancient legends and local mysteries. The superficial area 76.95KM², population 24100 (2010 year) , with a very specific Chinese dialogue.

Bian(边) in Chinese means the side, the boundary, which is the name of this town and represents its very particular location as well. The very west side of Hunan province, the boundary of Hunan province, Guizhou province and Chongqing.

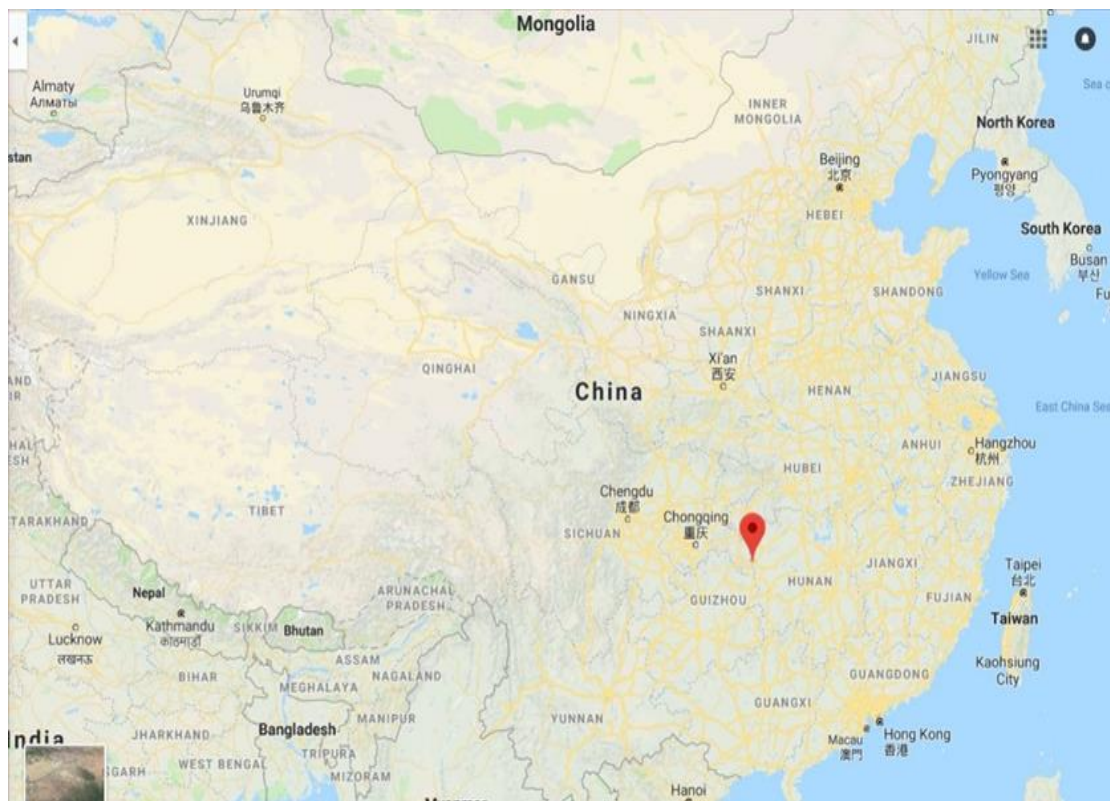


Figure 32-2

Because of the special geographical location, the long and everchanging history, the culture in the area is also very diversiform.

The population of this area consists of three nationalities. The majority

of the population is Han nationality(which is the main nationality in China). The second is Miao nationality, it is one of the most ancient nationalities in the world, their earliest ancestor could trace back to six thousand years ago. Its national language is named Hmongb. And the third is named Tujia nationality(meaning born on the ground and live on the ground), with also a native language which is belong to the Burmese.

The area is surrounded by mountain as well as river. Commonly the community and is distributed down by the river and under the mountain. A very typical example is as follows:



Figure 32-3

In the cloudy days, the imaginary Biancheng town is covered with water, like the pure ink is sprinkled on the slate. The small building on

the slings exudes the long-lasting fragrance of time, which is like the unintentional sun shattered by the pages of the long finger.

In the novel of Shen, he described something like: walking into the real Biancheng town, you don't always know that any scenery you see is a flash that has happened in your long time ago, or it is something just in a dream.



Figure 32-4

The history has brought the vicissitudes of the ancient town, but also added a thin layer of the world, and the ancient face of the small town is still there, even though the local residents have gradually changed their dresses of the Miao decoration to the modern decoration, even though the ancient languages have been gradually forgetting by a generation and another. However, the Lijiang River has not changed, the bridge on the river which has tranquilly witnessed people and

things come and go is still there.

Local power station

Based on the natural geographical condition, with mountains surrounding and river crossing. The hydropower can be a very realistic solution for the local power station. We could consider building several small size hydropower stations in the suitable place along the river. Considering the native needs and capacity. The numbers of the power stations is depended on the size of local community and local industrial circle's usage of energy. According to the real condition, the power stations should be built as far as possible away from the communities and industries.



Figure 32-5

On the other hand, by building dams of the hydropower station, the season blood natural disasters can be efficiently prevented and the regional environment will be better off.

In reality flood happens a lot during the summer, the nearby field and farmland are often destroyed after the flood, causing not just the natural destruction but also the economic damage, more over some contagious disease would happen after the flood.

Local industrial symbiosis building

The residents of Biancheng town deeply realized that the improvement of the society should focus on industrial construction, development of economy, increase people's income and build the brand of tourism town.

First, develop professional cooperative organizations to guide the local farmers with their land and work. The party committee of the local towns vigorously adjusted the industrial structure, developed professional cooperative organizations, adopted various channels to promote the increase of collective and farmers' income, and took it as a new highlight of tourism, planting NUHEER navel orange.

Once the well-functioning transportation system will be built, the problem of people's living will also be solved. However, how to change the concept and realize the long-term increase of people's income?

The development of professional cooperative organizations is a new requirement for systematic participation in efficient agriculture, improvement of agricultural structure, increase of farmers' income and realization of well-off life. At the beginning of this year Biancheng town and ping area under the guidance and help of the government, the area's farmers are actively involved in the association. Now every family in the area has planted navel oranges, the transportation system is good, and the villagers' navel oranges have ushered in a

harvest year.

In 2006, navel oranges in helping area were exhibited in the Hunan agricultural fair and also participated in the Luxi navel orange festival. The area of more than 20,000 mu navel orange has more than 15,000 mu to the peak fruit, the total production of the village in 2006 more than 40,000 kilograms, some businessmen directly to collect, the village navel orange sold a good price. Now this season, the green navel orange and full of branches, this year is a harvest year, foreign tourists, not only can visit the island to appreciate the calligraphy, but also can share with the people, farmers fruit fruits, not only formed a tourist highlight, and increase farmers income · second, tourism drive. The town party committee based on the border city tourism, vigorously do a good job in the service, according to incomplete statistics, "51" golden week, the number of tourists reached more than 20,000, half a year, all over the country to become a tourist tourism 170,000 tourists, tourism income of 8.4 million yuan.· driven by tourism, the annual income of farmers in the town has exceeded 10,000 yuan.

Zhoushan Island

A brief introduction

Zhoushan islands are China's largest archipelago, dotted with numerous islands and reefs, located in the northeast of Zhejiang province. Zhoushan islands are equivalent to 20% of the total number of islands in China, with a sea area of 22,000 square kilometers and a land area of 1,371 square kilometers. Of these, 58 islands are more than 1 square kilometer, accounting for 96.9 percent of the total area of the archipelago.



Figure 33-1

The main islands are Zhoushan island, Qushan island, Liuheng island, daishan island, zhujiajian island, Jintang island, Uranghu island and Lujiazhi island, among which Zhoushan island is the largest with an area of 502.65 square kilometers, which is the fourth largest island in China.

Zhoushan is China's first prefecture-level city with an archipelago system, consisting of 1,390 islands with a coastline of 270 kilometers and a population of 1.1 million. Located at the intersection of the golden coastline of east China and the golden waterway of the Yangtze river, it is the main maritime gateway for the east coast and the Yangtze river basin to the world. On June 30, 2011, the state council officially approved the establishment of Zhoushan islands new area in Zhejiang province. On August 31, 2016, Zhoushan was listed as one of the seven new free trade zones. The main purpose was to implement the requirements of the central government on "exploring the construction of Zhoushan free trade port area", and explore ways to promote the liberalization of commodity trade and enhance the global allocation capacity of commodities.

More than 5,000 years ago, human beings began to live and breed in Zhoushan islands. Since Tang dynasty began to build counties, has already more than 1200 years of history from now.

On July 5, 1840, the British fleet bombed Dinghai county in Zhoushan

islands, China, and the first opium war broke out.

Zhoushan special zone was established in 1950 and Zhoushan city in January 1987. Zhoushan islands are known as the hometown of thousand islands. Zhoushan islands is the only place of China's coastal route. Zhoushan islands port development speed, has become Shanghai, Ningbo water transit satellite port. In 1962, it had jurisdiction over five counties, Dinghai, Daishan, Quxian, Shengsi and Putuo.



Figure 33-2

Zhoushan islands have beautiful scenery and pleasant climate. It has two national scenic spots on the sea. The famous island scenery has the sea day Buddha country Putuo mountain, the sea Yandang Zhu Jiajian, the sea Penglai Daishan and so on. East China sea Quanyin mountain peak green, mountain scenery linked, known as the second



Figure 33-3

famous Buddhist mountains in the east China sea. Strange rocks everywhere on the island, the mountain is shrouded in mist all year round. Yutong write mountain island stone stands, Moya stone carvings everywhere. There are two strange stones on Huanglong island, like two gold ingot falling on the cliff. Ocean mountain island stream through the hole, murmuring water, beautiful spots countless.

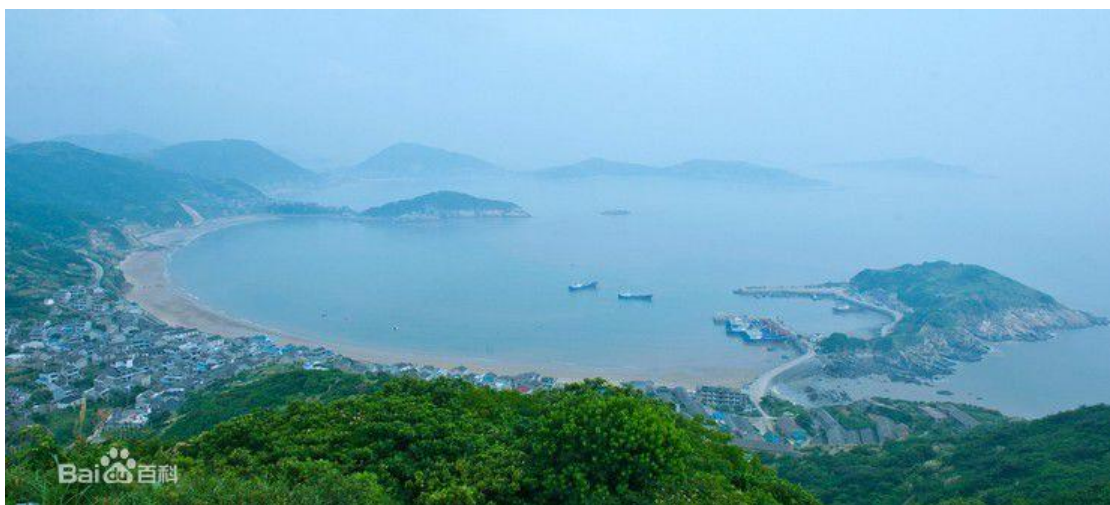


Figure 33-4

Local energy resource

1. Water resource

The meteoric precipitation in Zhoushan city originates from the relative space of the surrounding soil. The spatial and temporal distribution of precipitation is not uniform, the storage conditions are not good, most of the surface runoff is directly into the sea, and the total amount of fresh water resources is not abundant, especially in the northern and eastern islands.

The average annual precipitation was 1108.85 mm, the average annual relative humidity was 78.5 percent, the total water resource was 574 million cubic meters, the per capita ownership was 25.4 percent of Zhejiang's per capita. The amount of groundwater resources is 173 million cubic meters. Outcrop springs are not evenly distributed and seasonal springs are common.

In the gully plain where metamorphic rocks and granites are distributed, groundwater is rich, quaternary diluvial and alluvial sand and gravel belts are abundant, pore phreatic water and artesian water are abundant, and the volume of single well surge is 100 ~ 1000 tons/day. There are plenty of sand and gravel beaches in the Marine plain, but they are less used because of the inconvenience of seawater participation and transportation. Granite fracture zone, underground water quality is good, but the amount of less abundant.

2. Mineral resources

There are more kinds of minerals in Zhoushan. Metal mineral scarcity, non - metallic mineral reserves are rich, mainly building stone. By 2009, the known minerals are iron, copper, lead and zinc, gold and silver, Huang Tie, crystal, graphite, alum stone, marble, granite, sea sand, tuff and mineral water 26 minerals, such as more than 50 place of origin, but most of the mines and mineralization points, basic no industrial production value, and used in granite, tuff used in construction of nonmetallic minerals and sea sand resources is relatively abundant, is the main mineral of Zhoushan's development.

3. Biological resources

The vegetation in Zhoushan city belongs to the north subregion of the subtropical evergreen broad-leaved forest in China

With the change of topography from low to high and soil quality, mud-coated vegetation, sandy vegetation, rocky vegetation and mountain vegetation are formed. There are 544 species of woody plants, li 89 families, 63 species of ancient trees. There are 18 kinds of beasts, which are divided into 6 orders and 10 families. There are 164 species of birds, which are classified into 17 orders and 40 families. There are 8 kinds of amphibians, which are divided into 5 families. There are 24 reptile species, divided into 8 families.

Reference article: <https://baike.baidu.com/item/舟山#4>

A new type of energy station

Xin Ao Zhoushan LNG Power Station

Located in the pilot free trade zone of China (Zhejiang), the new Olympic Zhoushan LNG terminal project is the first large-scale liquefied natural gas (LNG) terminal approved by the National Energy Administration and invested, constructed and managed by private enterprises.



Figure 33-5

On October 19, 2018, after more than two months of successful trial operation, the new Olympic Zhoushan LNG receiving station was successfully tested, with normal operation indicators and entered the formal operation stage. This means that in the upcoming winter

heating season, Zhoushan and surrounding areas have a stronger air source protection capacity.

It only took 33 months for the new Olympic Zhoushan LNG terminal project to be put into operation.



Figure 33-6

In October 2018, the first phase of the new Zhoushan LNG receiving station project was completed and put into operation, including 3 terminals, 2 fully contained LNG storage tanks, 14 tank loading and skidding, high-pressure IFV gasification facilities, high-pressure external transmission, cold energy power generation and other supporting technologies and auxiliary facilities, with an annual capacity of 3 million tons of LNG.

The official operation of the new Olympic Zhoushan LNG terminal further improves the whole oil and gas industry chain of Zhejiang free trade zone. It not only provides high-quality natural gas for Zhoushan residents, industrial and commercial households, but also serves as an important gas source guarantee for Zhejiang natural gas "connecting counties and counties" and emergency supply.



Figure 33-6

It is not only China's first international shipping LNG refueling base, but also the only approved international refueling demonstration project in China! It has created an important opportunity for China to integrate into the global LNG refueling system for international shipping and grasp China's initiative in international Marine clean fuel.

Brief Conclusion

Cooperative Energy Cluster system will generate highly innovative results that will produce real impacts on the local energy systems across the whole country of China, Chinese economy and competitiveness, innovation capacity, environment and social aspects. Especially to create various of benefits for the small and isolated places, which those places account for a great big part in whole China. The development potential of this system applying in China is immeasurable, and the environmental and industrial diversity in different places will also help the development of the system.

From the practical point of view, one of the biggest challenges to build a complete and well-functioning system is how to establish a stable and effective mutual agreement between the different local partners, and then to guarantee their collaboration, especial for the industrial partners, to build an efficient network connecting a group of different industries can be very challenging, furthermore to build a harmony and enduring collaboration might be more difficult. To realize this, we could first analysis the main goals of some potential partners, based on that, support from local state can be very attractive. Since the aim of almost all the industries is to make long-term financial benefits. The continual support from the local state can be a strong guarantee for the local industries.

Another big challenge for building a multielement system is how to attract new SMEs to take part in and to make contribute. With the local economic and environmental restricts, the diversity of the industries which are needed for building a complete and well-functioning system will be difficult to fulfill. To overcome this challenge, firstly, some particular tax policies should be a way out, with the support from local state, some preferential tax policies for these series of industries could be released. For these industries they can have a long-term benefit with these tax policies, and which also means for the new-joining partners they have more resources and time to adjust to becoming the member of the system.

Last but not least, after having organized the ideal series of the industries, partners, the next challenge is how to start a well-placed and efficient system. The point of the project should always begin in small area with several propriate local industries, and then to expand and to attract new immigrated industries to enrich the diversity of the industrial symbiosis, to strengthen the whole system.

On the other hand, applying the Cooperative Energy Cluster system has a great meaning for protecting the Chinese ancient and traditional cities and towns. There are some mutual characteristics in the three chosen isolated places of this thesis:

1. Long history of local culture and tradition, over hundreds of years'

history, each of them has many splendid images to show, and fantastic stories to tell. And it is one of the most important reasons, to maintain those images and stories, to let the future generations to know and remember, have the sense of belongings and the beliefs and spirits from the ancient ancestors.

2. Geographically isolated from the outside world, lack of local job opportunities, especially for young generation, unsatisfactory social infrastructure, with the losing of local population, the traditions and cultures even including the languages are also fading away.

The huge difference in different areas in the whole China makes it difficult to set a standard process and rout for the system. We have to analyze the local condition and launch the projects accordingly.