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Sustainable Development of Industrial Parks

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Sustainable Development of Industrial Parks

Editors

Robert Holländer

University of Leipzig,

WU Chunyou

Dalian University of Technology,

DUAN Ning

Chinese Research Academy of Environmental Sciences, Beijing.

University of Leipzig
Faculty of Economics and Management
Institute for Infrastructure and Resources Management
Grimmaische Str. 12
04109 Leipzig
Germany
e-mail: hollaender@wifa.uni-leipzig.de
e-mail: wucy@dlut.edu.cn
e-mail: duanning@craes.org.cn

Introduction

In May 2007 in Beijing, the Chinese Research Academy of Environmental Sciences, the Institute of Eco-Planning and Development of the Dalian University of Technology and the Institute for Infrastructure and Resources Management of the University of Leipzig held the second International Sino-Chinese Workshop on Sustainable Development of Industrial Parks. After the first workshop on Sustainable Management of Industrial Parks which was jointly organised in 2004 in Leipzig by the Institute of Eco-Planning and Development of the Dalian University of Technology and the Institute for Infrastructure and Resources Management of the University of Leipzig this second workshop attracted even more participants from several universities and scientific institutions, from European and Chinese companies, from local, regional and central environmental protection authorities and from development agencies. Scholars, practitioners and administrators discussed “General Aspects of Sustainable Development”, “Sustainable Operation of Companies in Industrial Parks”, and “Sustainable Development of Industrial Parks”.

While the proceedings of this workshop are published separately* the present volume contains a number of short contributions which were made on the occasion of the workshop by junior scientists from different institutions and by practitioners as well on new issues and practical experiences. These papers are presented here because they offer an impressing overview of the state of discussion and emerging scientific issues related to the sustainable development of industrial parks in China. In order to provide this overview all papers are kept short. Some papers present already results, others just derive and develop an issue for further research. Comments or questions pertaining to specific research aspects or results are of course very welcome and may be straightly directed to the authors or to the editors who will be pleased to give further information.

June 2009, Leipzig

Robert Hollaender,
for the team of editors

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I

General Aspects of Sustainable Development

Circular Economy Promoting the Development of Industrial Parks in China: Case Study of TEDA

Zhu Tan

College of environmental science and engineering,
Nankai University, Tianjin City, 300110, China

1. General Introduction of Circular Economy in China

In May of 1984, Chinese government made a policy of opening 14 seaport cities, and at the same time authorized the establishment of an Economic-Technological Development Area in each of these cities, which was the beginning of the development of industrial parks in China. Up to the year of 2006, China has established 54 state economic-technological development areas [1]. Data provided by the Chinese Commerce Department tell that they have achieved a GDP of 1013.7 billion RMB, an industrial added value of 741.4 billion RMB, and revenue of 157 billion RMB[2]ⁱ.

Chinese economic-technological development areas keep pursuing the win-win situation of economy and environment. The development areas in Tianjin, Dalian, Yantai established territorial ISO14000 environmental management system to standardize the territorial environmental management. In 2001 State Environmental Protection Administration of China and UNEP co-organized the project of Environmental Management in Chinese Industrial Park. The concept of Eco-industrial Park was first introduced in this project, and it has taken pilot projects in Tianjin, Dalian, Suzhou, Yantai. Eco-industrial Parks are started in these development areas, and Chinese circular economy was also firstly put in practice in these parks.

2. Case Study of the Development of Circular Economy in TEDA

2.1 An Overview of TEDA

Since its establishment by the approval of the Chinese central government in 1984, Tianjin Economic and Technological Development Area (Abbreviated TEDA) has achieved a great increase in economy. In 2006, TEDA achieved a turnover of 78 billion RMB. The total gross industrial output was 303 billion RMB, with a rise of 23.7 percent annually. The exports reached 16.5 billion RMB, which accounted for more than half of the whole city's exports. The government finance revenue amounted to 18.07 billion RMB, expanding by 27.8 percent.

Along with the development of economy, TEDA has advanced the idea of construction continually and regards the environment as foundation of it all the time.

2.2 The Practice of Circular Economy Development

2.2.1 The Advanced Awareness of Circular Economic Development

TEDA gradually implements new and advanced knowledge and management technology by means of cooperating with national and international programs. It established the district ISO14001 environmental management system in 2000 took part in the pilot project of Environmental management in Chinese industrial parks and set up the development strategy of Eco-industrial parks in 2001.

2.2.2 A Good Institutional Environment for Circular Economic Development

Since its establishment, the committee of TEDA, as the administrative institution subjected to Tianjin government, has been searching for an innovative government management mechanism instead of traditional planned economy of China. After confirming the developing strategy of eco-industrial Park and circular economy, TEDA began its development under new conceptions. Through forming a circular economy promoting committee and cleaner production advance office, expert management bodies to perfect government function were gradually established.

2.2.3 The Policy Supporting Circular Economic Development

On the basis of strengthening regional environmental protection and industrial development policies according to “TEDA provisional methods for new water resource management”, “TEDA water pollution control methods”, the TEDA Management Committee will promulgate “TEDA provisional regulations for promotion of energy saving and reducing consumption, and development of circular economy”. These will include the promulgation of a “TEDA list of key projects for energy saving, and development of recycling economy” in batches.

2.2.4 The Circular Economic Development in Principle of Market Economy

During the past more than two decades, TEDA always adhered to the principle of market economy. As a result, 59 multinational companies which are listed in the Fortune 500 initiated 129 investment projects. Circular economy behaviors in corporations such as cleaner production, application of fine management and wastes exchange and resources reusing among plants are the main power to promote the distinct circular economy construction.

2.2.5 The Integrated Resource System in TEDA

TEDA is trying to construct the model of material cycle of industrial park by means of perfecting the industrial chain and enhancing the resource efficiency. It welcomes projects with low energy consumption and low pollution, and gradually forming the industrial symbiosis including the electronic industry, the mechanical industry, the food and beverage industry and the pharmacies industry.

TEDA develops energy industries and environmental industries with its own characteristics. As far as the energy industry, the famous companies such as Vstas and Jintci have invested in TEDA, which drove the development of energy industry. As far as the environmental industry, the waste recycle industry was gradually formed with the investment of some recycling companies.

In order to achieve the recycle use of garbage all of Tianjin province, TEDA invested to construct “Shuang gang” garbage power plant, which can deal with 50% of all garbage in Tianjin. About the industrial waste, TEDA carried out the strategic research of the management system of industrial waste based on the EU-China Environmental Management Program, and implemented the waste minimization Club and waste exchange activities.

TEDA pays attention to saving energy and to constructing clean energy systems, and encourages companies to use the clean and renewable energy. In 2006, the energy consumption per industrial added value achieved 0.17 ton standard coal, which was close to the level of advanced countries.

2.2.6 Enhancing Efficiency by Developing Circular Economy

TEDA develops circular economy with the principle of insisting on efficiency, and cooperating with other districts around. Comparing with 2005, the energy consumption per 10 thousand Yuan gross value added reduced 5.1%, the energy consumption per 10 thousand Yuan industrial added value reduced 8.4%, the electric usage per 10 thousand Yuan gross value added reduced 6.7%, the flesh water usage per 10 thousand Yuan gross value added reduced 7.1%, the flesh water usage per 10 thousand Yuan industrial added value reduced 9.6%, the quantity of SO₂ discharge reduced 2.8%.

3. Opportunities of Circular Economy in Chinese Industrial Parks

3.1 The Sustainable Investment Environment

All industrial parks in China, such as TEDA, pay increasing attention to the sustainable development. They will provide more integrative establishments that can provide more stable and healthy investment environment for foreign investors.

3.2 The Opportunities of High-Tech Industry

The industrial parks in China are paying more attention to optimize the industrial structure when they develop circular economy. Some of them published some policy to encourage the high-tech industries' development, which will provide more opportunities for foreign investors.

3.3 The Commercial Opportunities of Consulting and Service Industry

The Chinese industrial parks are trying to perfect the service system, enhance the service ability in field of manufactory techniques, environmental management and business management when they develop the circular economy. On the other hand, the Chinese industrial park hope more and more foreign consulting and service companies invest there and support the circular economic construction there.

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The Prospects, Problems and Countermeasures of Developing Venous Industry in China

Wan Nianqing^{1,2*}, Qiao Qi¹, Ouyang Zhaobin¹

1. The Chinese Research Academy of Environmental Sciences, Beijing, 100012
2. The School of Environment & Natural Resources of Renmin University of China, Beijing, 100872

Abstract: Developing venous industry is an effective method to solve the contradiction between the economy development and environmental protection, and it is also a way to realize circular economy. But the venous industry in China lags because there are still some insufficiencies on understanding, mechanism, etc. This article variously discusses the prospect and suggestions to develop venous industry in China and five countermeasures and suggestions are put forward.

Key words: Circular economy; Venous industry; Countermeasures and Suggestion

1 Overseas and domestic situations

In the middle stages of 1980s, R. Frosch et al. put forward the concept of industry metabolism^[1] while studying the environmental effect of raw material and energy flows in a certain economical movement. There are two kinds of metabolic types in the industry ecosystem, named product metabolism and waste metabolism. The venous industry is one kind of the waste metabolism^[2] In recent years it obtained a quick development all over the world.

1.1 Present overseas situations

After having formulated the law of waste disposal in 1972, Germany carried out many practices of developing venous industry in the packing, automobile industries, etc. In 1996 Germany put forward a new law named "Circular Economy and Waste Management Law", which regarded the waste disposal as a way to develop circular economy^[3].

* Corresponding author: Wan Nianqing , Associate Professor, Ph.D candidate of School of Environment & Natural Resources of Renmin University of China, engaging in the study of cleaner production and circular economy, Tel: +8610-84914202, E-mail: wannq@craes.org.cn

In Japan the venous industry also obtained a remarkable achievement. In 1989, the sales of renewable resources amounted to 1,046 billion Yen, while it amounted to 2,744 Yen in 1999^[3].

In addition, many other countries also positively advance the circular economy. For example, In the US^[4], the trash recycling industry has been the quickest developing industry since 1990's. in France, Holland, Austria, some related goals and targets were formulated in the waste recovery, circulation and reuse^[5].

1.2 Domestic present situations

From 1950-60's, the Chinese government promoted with great effort to be industrious and economical, collected the old utilization or waste, and established a fairly perfect waste recovery system. Since the 1990's, in order to reduce the environmental pollution, China successively has promoted a series of preferential benefits support policy, which brought a quick development in renewable resources recycling industry. At present, there are more than 5,000 renewable resources recycling enterprise in China, and 50 million tons renewable resources were recycled every year^[7].

Along with the scale of the renewable resources recycling, handling and reusing expanding, its technical level also unceasingly enhances. At the same time, many modernized methods and the equipments were used, causing the recycling processing technologies gradually to enhance.

Some cities like Qingdao, Shanghai, Suzhou, Tianjin and others, have constructed or are constructing venous industry parks. The Qingdao Xintiandi venous industry park has passed the evaluation, organized by the State Environmental Protection Administration in March, 2006 in Beijing.^[11].

2 Existing problems of developing venous industry in China

Although the venous industry development has made very big progress in China, it relatively lags, compared with the developed countries such as Japan, Germany. Some existing problems in developing venous industry in China can be seen as the following aspects:

2.1 Fetters from the industrial management institutions

At present, the waste disposal is still regarded as a commonweal work. The city life waste, industry waste, medical waste, building waste, are separately managed by the environmental sanitation department, the environmental protection department, the medical department and the city management department. Each of the above departments has its own collection and the

processing system. These departments not only are the supervisor but also the concrete implementation unit, which lacks the enthusiasm of independent management. As a result, it limited the development of venous industry in China.

2.2 Insufficiency of related management laws, regulations and industrial standards

There are still deficiencies in a set of nationwide laws and regulations to comprehensively use renewable resources, which lead to a lacking of a set of powerful and long-term drive and restriction mechanism. Furthermore, China has not formulated the waste classification standards and technology standards. As a result, the waste recycling market is disordered in China, which resulted in wasting a great deal of renewable resources. More importantly, the quality of renewable resources can not be guaranteed.

2.3 Slow progress in technical developments

The investment from the central and local government is insufficient, and the technologies are backward. At present many recycling enterprises still primarily use the manual labor and the technical processes are backward, which cause serious second pollution.

2.4 Weak public awareness

At present, in China the public has a weak awareness of the venous industry, and many people regard the venous industry just as “picking up the waste”. Once more, there are seldom plans for venous industry in the cities’ planning. Influenced by the traditional ideas, some governments and enterprises still neglect the value of the waste. Furthermore, the products made from the waste can hardly be accepted by the users in China now.

3 Countermeasures and suggestions

Fast development of the venous industry in developed countries brings some inspiration for China, It confirms that the venous industry in China has a huge potential growth in the future.^[8]. With the rapid economic development and relatively insufficient resources, it’s very important for China to actively develop the circular economy and cultivate the venous industry.

3.1 Improve and perfect the system of development of the venous industry

First of all, relative regulations should be formulated with the scientific concept of development so as to guide the venous industry to develop smoothly. Furthermore, the government should strengthen the legislation and use the financial policy to support the venous industry.

3.2 Advance developing venous industry in a park

Advancing the industries to develop in a park is in conformity with the rules of economical development. By this way, it can make the enterprises in the park use the land intensively, utilize resources efficiently, and assort the industry systemically.

3.3 Develop and promote new technologies

The technologies being comparatively backward is one of important factors which limit the venous industry development in China. Therefore, it's necessary to help developing the technologies related to venous industry, add the R & D investment and lay emphasis on studying the harmless-disposal technologies.

3.4 Emphasize to establish the mechanism of the environment risk evaluation and emergency preparedness and response of the venous industry

The own characteristic of the venous industry shows that there are certain environmental risks, which can cause serious secondary pollution if not dealt with appropriately^[5]. Establishing the environmental risk emergency mechanisms will reduce the influence of possible environmental risk to a relative low degree.

3.5 Strengthen the propaganda of venous industry, encourage the public to participate

It's necessary to enhance the propaganda about the circular economy and the venous industry, and to encourage the public participation in the venous industry. For example, by encouraging the public to collect the waste separately and encouraging the social agency and the information consultant organization to carry out some socialization service of the venous industry.

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Renewable Energy Strategy for Eco-industrial Development in China

Li Xingguang¹

1. School of Management, Dalian University of Technology,
2. PetroChina Dalian Marine Shipping Company ; Liaoning, 116001

Abstract: Industries are playing a more and more important role for Chinese sustainable development. Eco-industrial parks (EIP) development is one of the most prosperous strategies to achieve sustainable industrial development. As one of the key aspects for EIP, energy consumption and renewable energy (RE) development strategies are mainly discussed in this paper. Suggestions are given in terms of how to promote RE in EIPs in China in a long-term run.

Keywords: Renewable Energy, Eco-industrial parks, Sustainable Development

1 Introduction

China is the most populous country in the world and the second largest energy consumer after the United States. Production and consumption of coal, its dominant fuel, is the highest in the world. Coal makes up 65% of China's primary energy consumption, and China's coal consumption in 2003 was 1.53 billion short tons, or 28% of the world total.

One of the key strategies in China's Circular Economy (CE) initiative is to use eco-industrial parks to help generating a much higher productivity and efficiency of resource utilization. The Circular Economy approach to resource-use efficiency integrates cleaner production and industrial ecology in a broader system encompassing industrial firms, networks or chains of firms, eco-industrial parks, and regional infrastructure to support resource optimization [1]. There are two kinds of solution that are suitable for China to build an eco-industrial park. One is to redesign the existent industrial parks and build the network of byproduct exchange to connect the enterprises with each other so that the park can achieve the low energy and material consumption. The other is to build a new eco-industrial park with one or several anchor companies.

¹ Li Xingguang is an accountant for PetroChina Dalian Marine Shipping Company and also a Ph.D candidate in School of Management, Dalian University of Technology. Email: uussaa911@hotmail.com.

There are some successful EIPs in China in the past few years. For instance, Zaozhuang EIP initiative in Shandong Province in North China, with key feature of transforming a traditional industrial zone to eco-industrial park; and Nanhai EIP initiative in Guangdong Province in South China, with key feature of developing environmental protection industry in a green field.

2 Renewable Energy Developments: Advantages and Difficulties

Renewable energy can not totally replace the conventional fuels in the industry park due to the technology. Renewable energy can only be used as an assistant energy resource in the industrial park, but it can reduce the fossil fuel consumption and environmental impact. There are also some successful examples in the world, for instance the Dyfi Valley Community Renewable Energy Project which is located in United Kingdom. This project aims to benefit the community's 12,500 or so residents by encouraging the local people to engage with energy issues, establishing some community-based renewable energy installations. Furthermore, the project wanted to improve understanding and support for renewable energy by maximizing the local benefits. The total installed capacity of completed renewable energy schemes was 205 kW electrical capacity (hydro, wind, solar) and 150 kW heat capacity (solar, wood, heat pump). And now the people in the valley do not need to buy any energy from the other companies outside the park.

As we analyzed, there are two types of industrial Park that are suitable for China. Comparing these two types of IP, the second one is easier to achieve because the most important and difficult problem is to build deep trust among the companies and the investment for the construction of exchange network is also a problem for the first type. Normally the investment will be provided by the local government. But for the second type, the anchor company can provide the technology and finance support for the eco-industrial park. At the same time, the company can also apply for the finance support from the government because this industrial park is a good sustainable solution for China's circular economics. Furthermore, Himin Group is a great company whose main production is the solar energy system in China, which is another advantage to build the IP with renewable energy as one of the energy recourse.

For advantages, these two kinds of industrial parks can both reduce fossil fuel consumptions. In the eco-industrial park, the energy can be saved by increasing the energy use efficiency, but in the industrial park with solar energy, the fossil fuel consumption can be reduced by being replaced by the solar energy. Furthermore, they are both friendly to the

environment. For disadvantages, the eco-industrial park is much harder to achieve than the industrial park with solar energy.

Eco-industrial parks have been primarily described in the industrial ecology literature as a means of managing material and energy flows with attention to the possibility of particular chemical linkages. So the companies that located in the park must have the capability to be connected by the industrial network according to the chemical linkages. These companies are sometime hard to find and to be collected together to build an eco-industrial park. Some companies are not used to work “in community” and may fear the interdependence this creates.

On the other hand, the old Industrial parks IPs have been aroused to make rational adjustment in the distribution of small and medium enterprises (SMEs) in towns or cities in China since 1980s. Over the years two kinds of IPs have been developed in the country. The first is the parks with one or several anchor companies. The second is the parks composed of SMEs from many distinct business sectors but without anchor enterprises, which account for the main part of the total IPs.

The challenges of guiding the second IPs onto eco-industrial parks might be that a series of obstacles, e.g. irregular layout of enterprises site, less available mass-byproduct-water for reuse, short of the conditions for energy cascading use and weak in information exchange among the enterprises and park administration. Furthermore, companies using each other's residual products as inputs face the risk of losing a critical supply or market if a plant closes down. This will break the whole industrial network so that the park will not survive any more, which will lead a big economic loss.

3 Conclusions and Strategies

From the above discussion, China's energy consumption development follows the developed countries' experience. The change of energy supply structure, however, is not exactly the same. The structure of energy supply in developed countries generally experienced two transformations that from firewood to coal, and from coal to petroleum. The developed countries are now moving toward diversification of energy for the third transformation, where the renewable energy resources will prosperously substitute the fossil energy to become the dominant resource [2]. For the time being, China has completed its first energy transformation, just entered the rapid development of oil and natural gas. Energy diversification structure is far from being formed. The energy situation that China is facing, however, is very different from the developed countries. Considering the conditions of the domestic energy resources, the unstable international oil market, as well as the deterioration of the environmental pollution

problem, China is difficult to complete the second energy revolution in the similar way that the developed countries experienced, to form an energy consumption structure, which is dominated by oil and natural gas. In other words, China will remain a coal-dominated energy structure in quite a long time, which will make the air pollution even worse. Vicious circle shaped as demands pressures result in more resource pressures, and resource pressures result in more environmental pressures, owing to lower energy efficiency indeed. Therefore, China must jump over the second energy revolution, and should focus on the development of renewable energy, which is the strategic choice for China to sustain energy supply and environmental carrying.

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Implementation of Input-output Flow Analysis to the Eco-Industrial Development

Ding Yuliang¹, Shang Hua¹, Shang Yue²

1. School of Management, Dalian University of Technology, Liaoning Province, China, 116024, 2. Institute for Landscape Designing of Fushun City, China, 113008

Abstract: Environmental problems have become global problems, which have affected human's health and living. So, when developing industries, we should consider the factor of environment. This paper firstly illustrates the current status of eco-industry; secondly introduces the Chinese eco-industry and analyzes the input-output flow; and lastly gives suggestions to develop eco-industry to finish the whole paper.

Keywords: eco-industry; input-output analysis; China

1 Introduction

Over the intervening years, the notion of sustainability has been a most important aspect of social development. Frosch and Gallopolous (1989) popularized the idea that ecological systems could be analog for industrial systems, suggesting that manufacturers who take in raw materials, generate products and emit wastes could optimize their energy and materials consumption, minimize waste generation and be more responsive to total environmental concerns by acting more like a living eco-system^[1].

Eco-industry imitates the natural eco-system to establish a high efficient industrial system according to eco-economical principles and the knowledge of economy disciplines, induced by ecological theory, based on eco-system capability, implying eco-engineering to the social activities, and integrates the prevention, eco-efficiency, environmental strategy and life cycle^[1].

Meanwhile, industrial ecology, as a young scientific discipline emerging from North America, Europe, and Japan over the last decade, may obtain unprecedented opportunities for testing its methodological robustness and further development of its theory and tools given the size, dynamics, and diversity of China's industrial activities.

Hence, this paper firstly tries to introduce the industrial ecology in China; secondly, gives a brief introduction of input-output analysis; thirdly introduces the implication of input-output analysis in China; and lastly concludes the whole paper.

2 Input-output analysis

2.1 Eco-industrial development in China

Eco-industrial development was first proposed in China in the early 1980s. This helped bring about a wave of eco-agricultural development in China starting in the mid 1980s. The 1996 article “Industrial Ecology: New Opportunity for the Private Sector” in the Chinese version of United Nations Environment Program’s (UNEP’s) magazine, Industry and Environment Review, introduced a new wave of industrial ecology concepts into China. To date, research on and practice of such core constituents of industrial ecology as life-cycle assessment (LCA), design for environment material flow analysis (MFA) and eco-industrial parks (EIPs) or industrial symbiosis have reached varying levels of development. Social science institutes have not been involved in the debates except for several management schools. Only over the past two years have a few governmental officials and industrial practitioners started to show interest, principally in the topics of EIPs and the closed-loop economy.

2.2 Material Flow Analysis (MFA)

MFA is even less developed in China. Collaborative research between Beijing University and a consortium of European institutions, led by the German Wuppertal Institute and funded by the European Commission, has catalyzed a preliminary material input analysis of China (Chen and Qiao 2001)^[1]. The Beijing municipal government has also sponsored a consortium of Beijing Polytechnic University and Peking University led by Tieyong Zuo, president of Beijing Polytechnic University, to carry out an MFA for Beijing and establish related material flow databases.

2.3 Applying Ecological Input-output Flow Analysis to Material Flows

Material and energy flows are fundamental to the discussion of environmental issues in industry. We investigate input-output analysis in this research as an approach for modeling conserved flows in industrial systems at a given point in time (with both material and energy flows being types of conserved flows). The uniqueness of input-output modeling is derived from its ability to trace all direct and indirect flows through a system. In this statement the most important relationship for MFA has been asserted: inflow equals outflow.

Input-output analysis is a modeling approach originally applied to model the monetary transactions between industrial sectors of an economy. In this article, however, "the economy is viewed as a set of transformations of physical materials from the raw state through successive stages of extracting and processing to goods and services, and finally to return flows consisting of wastes (which may or may not be recyclable)" (Ayres 1978 5)^[1]. All of these applications are categorized in Figure 1. Three main subsets of input-output approaches are represented in it.

In Figure 1, region A stands for approaches that include material and/or energy flows, region B stands for approaches that are focused on environmental issues facing industry, and region C stands for approaches that are neither economic nor industrial-sector based. The work presented in this article is located within all three subsets.

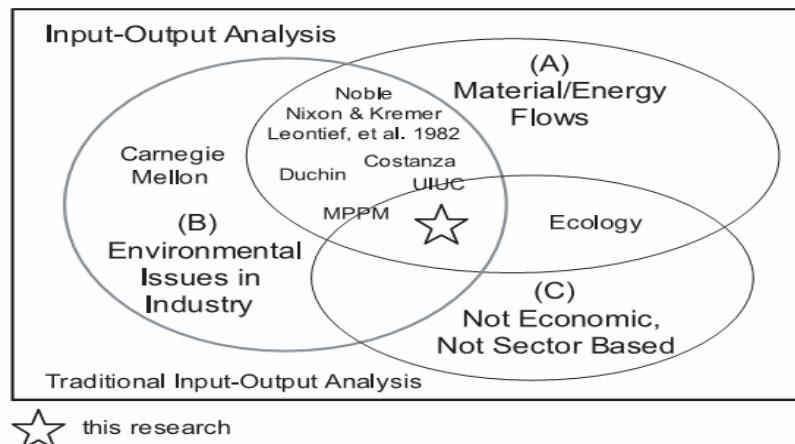


Figure 1: Classification of input-output approaches

A common problem of most of the analysis on the material and energy extensions to input-output is that they always deal with the process from economic factors only. Approaching environmental concerns in industry with ecological input-output flow analysis has great potential impact; this potential has not been explored intensively yet. In this paper, we focus on extending the ecological input-output approaches to industrial systems. A brief summary of the mathematics is as follows:

- (1) A system of balanced flows is constructed and represented in matrix form with the production matrix P .
- (2) Flows in the production matrix are converted to ratios of the total flows through each process in a model.
- (3) One of the most powerful aspects of flow analysis, namely, its ability to consider all direct

and indirect relationships among flows in a system is rooted in the inversion of the identity matrix minus the matrix of ratios where the inverted matrix (N^* or N^{**}) represents an infinite series.

(4) Analysis on environment is derived from N^* and N^{**} to formally trace the origins and destinies of each flow in a model.

(5) The production matrix is a quantitative representation of the conserved flows over a given time (i.e., instantaneous flows) in a system. Given a physical system, the production matrix represents observations of that physical system that are mathematically dissected using this analysis.

3 Conclusions

This paper tries to introduce the development of eco-industry in China by analyzing the material flow, proposing the input-output analysis to the development of eco-industry, and giving the flow metrics. Suggestions are given on how to consider the ecological and environmental problems as industry is being developed.

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Strategic Management in the Process of Eco-housing

WANG Yan, WU Chun-you

School of Management; Dalian University of Technology; Dalian 116024; China

Abstract: The scarcity of resource or energy and the environmental problems all over the world have been central issues of public debate. As the huge manual work, architecture has the far-reaching impacts on our environment; it is one of the main consumers and polluters of environmental resources. The development of eco-housing based on regional sustainable development puts forward a feasible practice of strategic innovative management in construction.

Keywords: Strategic innovative management; regional sustainable development; eco-housing

1. Introduction

Mankind is suffering from a resources and energy crisis as well as from the pollution of the environment, and is finally learning about the importance of a harmonious relationship between human development and nature. Hence, people have to re-examine their former production behavior and life style from the viewpoint of the ecosystem, and have to change traditional production modes accompanied by high pollution and high consumption.

At present, being a developing country, whenever China's economic development and ecosystem environment conflict, people usually sacrifice environment for economic development. So, to get a sustainable development, China must pay more attention to the balance between developments of economy and protect of environment.

2 Status of construction enterprises

Construction is mankind biggest activity to influence the natural resources and environment. Construction enterprises belong to a high energy consuming and high polluting industry. According to the related data, construction enterprises used about 50% of all energy consumed all over the world. Also, according to lots of researches, the construction enterprises also have great pollution to environments, which includes air pollution, water pollution, light pollution and solid wastes produced during or after process of construction. To solve the problem, people begin to use ecology theories in the process of construction, to integrate building system into the natural system and to get a result of virtuous cycle so as to set up a new eco- building system.

The process of construction will consume a great deal of natural resources and energy, and will bring about different environment pollution. The traditional building always consumes huge resources and energy during the manufacturing of building materials, building design, construction and utilizing. Some studies showed the building energy consumption accounted for 27.54% of China's total energy consumption in 2004^[5], which were about 2-3 times of it in the developed countries^[6].

In addition, most of energy consumed by buildings is primary energy, whose utilization will result in heavy environment pollution. On the other hand, the use of primary energy, which is known as non renewable energy, will aggravate resources crisis.

3 The turn of the eco-housing in the construct

To understand what eco-housing is, you have to know about the “4 Rs”: Reducing, i. e. decreasing building material and various resources which are not renewable; Renewable, exploitation can renewable energy and material; recycling, i.e. making use of a recovery material; Reusing, i.e. reusing of old material under circumstances that the structure allows. Therefore, ecosystem building makes effective use of resources and energy, protects the environment, fits demand of the nature, and can satisfy requirements of comfort, health, safety of building from people.

Secondly, comfort and healthy are foundations of an eco-building, because the aim of buildings is to improve people's living environment and raise people's living quality. To reach the purpose of comfort and healthy, people must make use of various technology means to raise architectural thermal comfort, light comfort and voice comfort etc.. But comfort can be thought equal to healthy. For example, though the system of air conditioner can raise thermal comfort, but it will result worsened indoor air quality, cause the so called air conditioner comprehensive disease). The expansion of the ecosystem buildings will gradually change characteristics of tradition building industry, which are high energy consumption and high waste produce. This means during the whole life cycle of buildings, including process of construction and utilization, there will be fewer energy consumed and fewer wastes produced, also, level of comfort and healthy of buildings will be improved.

4 Strategic management of eco-housings

4.1 Technique innovation strategy

Since China has joined the WTO, the adjustment of strategic economic structure and progress of techniques have provided rare opportunities and have also produced huge

competition pressure on the traditional industry. Therefore strengthen technique innovation will help eco-housing to be a reality earlier. These innovations include technological innovation in the materials used in the buildings and also in the process of construction as well as in the policies made to control energy consumption of buildings

4.2 Management innovation

To accelerate the development process of eco-housing, there must be certain management innovations beside technological innovations. Here the management innovation includes not only innovations from the enterprises level but also includes innovations from the state and provincial level. Construction enterprises must recognize their roles in environment protection and make more practical strategies to avoid environmental pollution during the construction of buildings. Meanwhile, the state and provincial governments must pay more attention on the energy use control in the utilization of buildings. Also, governments should support construction enterprises to research and design new materials which can help protecting environments.

5 Conclusion

Eco-housing is gradually a new focus of debate of people who caring about environment protection. Unit building is now consuming more energy than developed countries in China. To protect our environment as well as make sure the buildings can supply comfort and healthy surroundings, some technological and management innovations must be made in China. Here innovations include innovations on the materials used in the buildings and also include innovations on the control methods of energy using in buildings which has been put into operation.

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Management of Eco-Industrial Parks

Zhao Shigang

School of Management, Dalian University of Technology, Liaoning Dalian, 116023

1 Introduction

A campaign of eco-industry development is currently being spread out in both industrial and developing countries. Eco-industry is a whole living system, a natural and human-made unity with economically productive and ecologically efficient industry, systematically responsible and socially harmonious culture, and physically beautiful and functionally vivid landscape. Essentially, the eco-industrial park is an important way to achieve sustainable development using rules of energy saving, pollution reducing and efficiency increasing. So, to make eco-industrial parks more efficient, appropriate management methods are necessary.

2 Problems in the development of eco-industrial parks

At present, most eco-industrial parks in China mainly pay attention to economic growth instead of environment protection. They are very interested in exploitation of new resources but always ignore recovery of wastes which are byproducts of production. This can be expressed in detail as following:

- (1) Though there are several enterprises that have adopted clean production and have got ISO 14000 authentication in China, there is still a lack of long-acting mechanisms which can make clean production be a basic requirement of enterprises in eco-industrial parks.
- (2) Theoretically, eco-industrial parks should be composed of enterprises which can be coupled in their production, but the output value or profit and tax are always indexes used to estimate enterprises which can be allowed to enter parks instead of some ecological indexes.
- (3) The scale and land use of eco-industrial parks are constantly expanding all these years without thinking about improving of utilization ratio of resources. This usually results in exceeding of environment capacity.

3 Basic hardware of eco-industrial parks

Through development of eco-industrial parks more than ten years, it is recognized that prevention should be the main method for pollution abatement instead of pure end-of-pipe treatment. Reduce, recycling and hazard-free treatment should be advocated. So, the first requirement for enterprises in eco-parks is they must be able to execute clean production constantly through the whole process of their production. Second, to make best use of everything, enterprises should be contacted through their production line extensions. Or a key enterprise should be introduced into the eco-industrial park. Third, innocent treatment should be implied on wastes which can't be used anymore. Discharge of pollutants should be controlled in the range of environment capacity to avoid environment pollution. Fourth, there should be necessary information strategy which can manage and support development of eco-industrial parks.

4 Indexes for supervision and administration of eco-industrial parks

As we all know, a production process includes input of materials and energies together with output of products and byproducts. Byproducts include materials and energies which can go back to the nature directly, such as CO₂, vapor, N₂, calcium phosphate and calcium carbonate. These are products that fit the natural circulation and can be seen as products after innocent treatment. The other part of byproducts can be defined as available resources, which include some pollutants which should be controlled strictly such as SO₂, compounds of nitrogen and oxygen, COD and BOD. So, there are three utilization rates we can use to evaluate the production process: ratio of total output to the total input which is called resource utilization rate, ratio of materials, that go back to the nature directly to total input called resolution ratio, ratio of available resources to the total input which is called available resources utilization rate. These three indexes, together with common social economic indexes, can evaluate the current situation and development of eco-industrial parks.

5 Some technical matters which need further studies

The technical matters need further studies mainly include some evaluating indicators. Some of them need to be defined more clearly or to be unified. These indicators include:

- (1) Calculation of total input. This includes transformation from materials to energy, e.g. electric energy consumed usually transformed to amount of coals consumed.

- (2) The air usually is treated as a kind of resource which can enter the material balance while calculation of amount of the air is still unclear.
- (3) What kind of materials can be classified into materials that can go back to the nature directly is still not clear.

II

Development and Trends of Eco-industrial Parks

Trends and Prospects of Eco-industrial Parks

Development in China

Zhaobin Ouyang, Qi Qiao, Nianqing Wan, Chaojun Lu, Yang Yao

Center of Cleaner Production and Circular Economy Research,
Chinese Research Academy of Environmental Sciences, Beijing, 100012

Abstract: The current status of eco-industrial parks development in China was represented in details in this paper. It pointed out that the trends of eco-industrial parks development in China were to develop venous industry by arterial industry and strengthen the management of eco-industrial parks. In accord with the orders of 11th five-year plan of China government to reduce 10% emission amount of chemical oxygen demand (COD) and sulfur dioxide (SO₂) respectively, the futures of eco-industrial parks development in China were prospected.

Key words: Eco-industrial; Eco-industrial Park; Circular economy

1 Introduction

With the intensified global environmental crisis, mankind is facing the dual pressure of economic development and environmental protection. It has been well-known that the main cause of contamination is industrial activities. Thus, the method of end-of-pipe management has long been adopted to solve the industrial environmental problems. However, this leads to a serious situation represented by heavier pollution and resource scarcity, which forces people to seek for new environmental management methods and tools. Since the 1990s, the eco-industry has gradually emerged as one kind of systematized and integrated emerging environmental management [1].

The principle of ecology and system engineering are usually used to imitate the matter circulation pattern in a natural ecosystem. It shall take into account of all the raw material, products and waste in enterprise, and then build the cooperation and symbiosis relations among different enterprises concerning their material recycling, energy using and sharing [2, 3]. In such a method as eco-industry, it will enable the industrial system to raise its resources

* Corresponding author: Q. Qiao, Tel. +86 10 8491 5107, Fax: +86 10 8491 4626;
E-mail: qiaoqi@craes.org.cn (Q. Qiao).

First author: Z.Ouyang, Associate Professor, Tel: +86 10 8491 4202, Fax: +86 10 8491 4626;
E-mail: ouyangzb@craes.org.cn

productivity, reduced the local environmental burden, decreased the treatment cost of waste and exploitation raw material, enhanced the economic growth quality, and alleviated the contradiction between the environmental pollution and economic development, which will finally achieve “double-win” of resources, environmental protection and economic development.

Eco-industrial Park is the main practice form of the eco-industry theory and it is developed guided by the theory of circular economy and the principle of eco-industry to develop of cleaner production [4, 5]. It can link different factories and enterprises through the flows of material and energy, which will improve symbiosis relations formation by sharing resource and exchanging waste among different enterprises, and establish a circle as “producer to consumer to disintegrator” in which the waste of one factory can be used as the raw material or energy by another one. In this way people can achieve the closed circulation of materials, the multistage use of energy with minimum waste.

2 Development of eco-industrial parks in China

The industrial parks in China have two development periods, with the first period named “the economic development zone” and the second one called “the high-tech development zone”. The second period is represented by the application of high technology in enterprises, which reveals the feature known as knowledge economy. Along with the global green economic tide, the third period of industrial parks, namely Eco-Industrial Parks, has been generated. Eco-industrial parks have overcome the common limitation of the above mentioned two kinds of parks, in which the enterprises are run independently, lacking effective flows of resource and energy without cooperation among the enterprises, and usually causing a low material productivity with serious environmental pollution.

Eco-industrial park demonstration is an important method to implement circular economy in China. Since 1999, China has carried out the construction of eco-industrial parks. The first state eco-industrial demonstration park was issued by State Environmental Protection Administration of China (SEPA) in Guanxi Guigang, which indicated that the construction of eco-industrial parks in China accomplished a new level. The establishment of such pilots and their demonstration role will accumulate more experience and create necessary conditions for the comprehensive advancement of eco-industry in China. By the end of February, 2007, SEPA has authorized construction of 29 state eco-industrial demonstration parks, including 9 sector-specific eco-industrial parks, 19 sector-integrate eco-industrial parks, and 1 venous industry based eco-industrial park. There are also several eco-industrial parks being planned. Along with the revelation of the economic and environmental benefits of such demonstration,

people will gradually acknowledge the ideas of eco-industry and circular economy, so the construction of the eco-industrial parks in China will certainly enter the widespread development phase.

3 Development Trend of Eco-industrial Parks in China

At present, the arterial industry is the main form of eco-industrial parks in China, they emphasize the linkage between different arterial industries. They try to combine two or more production systems or units together to integrate and optimize the material and energy flows, which can finally form an industrial symbiosis network by sharing resources, extending product chains and exchanging by-products.

In order to enable demonstration and promotion of venous industries around China, it is necessary to set up the frame and indicator system of venous industry based eco-industrial parks for its development. Therefore, SEPA had issued *Standard for Venous Industry Based Eco-industrial Parks (On trial)*, which were enforced September 1, 2006. It has played an important role in promoting venous industries development in China. According to the actual situation and characteristic of China, the technical method for developing venous industries can take a two-step route as adopted pilot firstly, then its expansion and promotion. The zones with better economic foundation can be chosen as the demonstration for state venous industry park. At present, Qingdao, Tianjin and Suzhou are carrying on the plan for the construction of venous industry. At the beginning, the arterial industry can be used to boost the development of venous industry, and then it gradually forms a mechanism in which the arterial and venous industry, and park can develop harmonically, thus to impetus the development of venous industry.

Now the majority doesn't fully understand the idea, connotation, and function of eco-industrial parks, it will be more convenient for its popularization and promotion if we just simplify its content with simple indexes, which will be more popular and acceptable. The index system will refine different aspects of the construction of demonstrations into detailed indexes, which can be easily measured and compared. The index system can reveal the characteristics of the eco-industrial parks in a whole. Along with the continuous expansion of eco-industrial park construction, the management of it will be implemented into the government management under the supervision of corresponding department. The full understanding of the detailed condition and level of different eco-industrial parks should be basis for the management department to make policies in China. It can also facilitate the supervision and guidance of such parks. Such index system can act as a common inspection tool and provide useful information for management department.

4 Prospect

Along with the advancement of sustainable developmental strategies, the development of eco-industry and the establishment of eco-industrial parks have been adopted as an important methodology by developed countries to realize the coordination of environment and economy. China now is facing a tremendous pressure from resources shortage and environmental pollution, with the industrial production still playing a key role for economic growth. The eco-industrial park has been counted as an important solution to alleviate the contradiction between the economic growth and resource shortage and environmental deterioration. It is also considered as the aim for the development of industrial systems in the 21st century, and is a necessary measure for the sustainable development of China. The 11th five-year plan of the Chinese government has explicitly put forward that the total emission amount of chemical oxygen demand (COD) and sulfur dioxide (SO₂) should be reduced by 10% respectively. To achieve this target, the eco-industrial park will fully display its exemplary role while the large-scale and mainstay enterprises in the park will act as the lead, which will reduce the emission amount of pollutants to the lowest degree.

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Current Development and Typical Cases Analysis of Virtual Eco-Industrial Parks

**Yu-ru MAO, Ying-ru WANG, Qi-hong SUN, Peng SHEN, Yan-ping LI, Qi QIAO, Ning
DUAN**

Center of Cleaner Production and Circular Economy Research,
Chinese Research Academy of Environmental Sciences, Beijing, 100012

Abstract: Virtual Eco-Industrial Parks (VEIP) will be one trend of the development of Eco-Industry Park in China because it isn't restricted to a neighborhood area and an administrative region which will save expensive costs of lands and equipments. There are few domestic and abroad systematic studies focusing on VEIP theory at present. The progress and development state of VEIP are introduced in the paper. The typical evolution processes and its characteristics of symbiosis network are analyzed by means of Brownsville, Tianjin Hangu and Shaxi Littoral Region cases, which would support theoretical study and experiences of VEIP.

Key words: Virtual Eco-Industrial Parks (VEIP), Circular Economy, VEIP cases

1 Introduction

Eco-Industry Parks (EIP) is a new type of industrial park which is designed and constructed according to cleaner production requirement, Circular Economy idea and industrial ecology theory. EIP obeys 3R (reduce, reuse, recycle) principles of Circular Economy. There are three main types of EIP: New EIP, Rebuilt EIP and Virtual EIP (VEIP)^[1].

New EIPs and Rebuilt EIPs are not fitting for China due to lack of resources, severe environmental pollution and strain land. VEIP is becoming possible with modern vehicle, fluent transportation network and developed information system. VEIP isn't restricted to the neighborhood area which will save the expensive cost on lands and equipments and avoid factory's relocation^[2]. Transportation cost may be raised during to distance increase.

2 Current Development of R & D

Brownsville VEIP and Research Triangle Park VEIP are typical cases cited in literature. In 1997, David Cobb prepared a personal computer-based model which designed to find outlets for reusing materials based on generic descriptions of candidate companies. Research Triangle

Park has been constructing VEIP, which includes more than 1382 factories and companies. More than 1249 materials are in exchange^[3].

Some researches have been focusing on the key problems for VEIP of operation conditions and patterns through Brownsville VEIP practice, and they believed that the key point for VEIP was material flow efficiency, pathway and boundary scale. A model of economy-environment for VEIP was developed from Research Triangle Park and Indigo Development^[4]. Brown, J. et al believed that VEIP could be constructed for cities, regions or the entire world if economical transportation cost for waste flow^[1]. T.E. Graedel et al believed that the successful key point for constructing VEIP was the cooperativity for resources in and out^[5].

The research and practice of VEIP abroad were mainly through establishing model and database, but systematic study of VEIP theories is absent.

Compared with some developed countries, China's VEIP research and practice is low starting, but rapid progressing. Tianjin Hangu and Shaxi Littoral Region planed to construct VEIP^[6]. Tianxi Han analyzed the necessity, compose and operation condition of VEIP construction^[9]. Nanping Feng analyzed the functional pattern of VEIP suitable for the development of small and medium enterprises, Yuru Mao raised four typical networks of VEIP^[10].

3 Typical Cases

3.1 Brownsville VEIP Case

Brownsville is located on the southern tip of Texas in the Rio Grande Valley which is often referred to as a city "on the border, by the sea", The possibility of establishing a VEIP was examined at Brownsville, Texas. This could also be described as regional industrial symbiosis. Planning for Brownsville VEIP has focused on identifying firms that could benefit from participating in regional industrial symbiosis. Rather than contact one another through waste exchanges, industrial enterprises located in the same locations constantly adding new members on the basic of the original members to play the role of "Net Patching" for industrial ecologic nets

The endeavor was failed for the shortage of money to improve computational procedure identifying possible exchange relations and the lack of enterprise benefits^[7].

3.2 Shaxi Littoral Region VEIP case

Shaxi Littoral Region VEIP is composed of three parts, such as Sanming City, Shaxian County and Yong'an area, with the center Sanming City. Shaxi Littoral Region VEIP is benefit to develop Sanming City, exert centralizing and driving efficiency, promoting sustainable

development, also could be a model for other littoral regions^[8].

Every part is formed by one or several core enterprises in existence which is almost extra large enterprise in petrifaction, smelting, mechanics and energy industries. Many medium and minor enterprises separately surround such core enterprises, sufficiently utilizing waste and materials. The VEIP include product metabolism chain providing materials for core enterprise and waste metabolism chain, usually the main chain, utilizing waste from core enterprise.

4 Prospect

It is evident from this paper that the idea of VEIP is at an early stage of development. Subsequent examples indicate that initiatives based upon the interchange of wastes and energy are few in number and difficult to organize.

Promotion of VEIP and integration of existing industries into an ecological and aesthetic plan can serve as the central theme for future development in China. Such a unified vision could rightly be termed a sustainable development plan for China that would further integrate firms into the natural environment and the progressive community. This vision will offer most area a significant competitive advantage versus other communities.

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III

Improved Management of Eco-industrial Parks

Eco-efficiency Estimation of Ecological Industrial Parks

Based on Energy Analysis: A Case Study

Zuo Li , Wu Chunyou

School of Management, Dalian University of Technology, Dalian 116023, China

Abstract: How to estimate the balance between economy and environment for an eco-industrial park has become a major problem to the local government and research organizations. This paper introduces energy analysis method and puts forward an eco-efficiency estimation system, taking all sub-systems into account, to accomplish the assessment of sustainability of an eco-industrial park. The Dalian D-D Port is discussed as an example in the paper. The results show the feasibility of this eco-efficiency estimation system on the basis of energy analysis.

Key words: Energy analysis; ecological industrial park; eco-efficiency; estimation

1 Introduction

The estimation of eco-efficiency and sustainable developing ability for an eco-economic system has become a major problem with the foundation and development of ecological industrial parks all over the world. This estimation will also provide a scientific basis for the ecological transformation of traditional industrial parks as well as the establishment of new eco-industrial parks. Three principal methods are popular: Substance analysis, Value analysis and Energy analysis.^[1] These methods are likely to be taken in effort either individually or together.

2 Theoretical Structures

The theory of Energy Analysis is a kind of eco-economic value theory and systematic analysis method, established by American ecological scientist H. T. Odum ^{[2]-[5]}in the 1980's, on the basis of system ecology, energy ecology and eco-economic theory^[6]. The Energy indices of the ecosystem include energy self-support ratio (ESR), the energy investment ratio (EIR) the energy yield ratio (EYR) the environmental loading ratio (ELR) and energy sustainability index (ESI/EYR/ELR), as shown in table 1^[7].

Table 1: Energy indices of the ecosystem

Indices	Equation	Definition
EYR	Y/F	The ratio of energy yield to energy input of the system
ELR	(N+F)/R	The ratio of the sum of outsourcing energy and input energy to the regeneration energy
EIR	F/(N+R)	The ratio of input energy to system energy
ESI	EYR/ELR	The ratio of the energy yield ratio to environmental loading ratio

3 The Eco-efficiency Assessment of Dalian D-D Port Industrial Park

3.1 Background of D-D Port

The D-D Port is a new industrial park founded in 2000, with an area of 20 square kilometers. D-D means “Digital” and “DNA”, implying the information technology and life science.

3.2 Energy Indices of D-D Port

The energy flowing conditions of D-D Port in 2004 can be obtained through the energy analysis, and hence the energy indices can be calculated, as shown in Table 2.

Table 2: Energy Indices of D-D Port in 2004

Energy Indices	Equations	Estimated Values
Energy current		
Em _R (sej)		1.0500E+18
Energy input Em _{IMP} (sej)	Em _{IMP} =Em _R +Em _{N1} +Em _S +Em _F	1.8182E+21
Em _{R1} (sej)		3.2000E+20
Em _{N1} (sej)		8.7400E+19
Em _S (sej)		4.9800E+20
Em _F (sej)		9.1284E+20
Total energy Em _U (sej)	Em _U =Em _R +Em _{N1} +Em _{IMP}	1.8193E+21
Output energy Em _O (sej)	Em _O =Em _Y +Em _W	2.1244E+21
Yield energy Em _Y (sej)		2.1200E+21
Waste energy Em _W (sej)		4.3900E+18
Structural Indices		
Regeneration energy ratio	(Em _R +Em _{R1})/ Em _U	17.6470%
Nonregeneration energy ratio	(Em _{N1} +Em _S)/ Em _U	4.8041%
Product and labor energy ratio	Em _S /Em _U	27.3734%
Functional Indices		

ratio of energy to GDP (sej/\$)		8.7579E+12
net energy yield ratio, EYR	Em_Y/Em_{IMP}	1.1660
energy amplifier ratio, EAR	$(Em_{Y2}-Em_{Y1})/(Em_{IMP2}-Em_{IMP1})$	79.0649%
energy investment ratio, EIR	$(Em_S+Em_F)/(Em_R+Em_{R1}+Em_N+Em_{N1})$	3.4541
yield energy per (sej/person)	Em_Y/P	2.0385E+17
energy density (sej/km ²)	Em_Y/A	1.0600E+20
<hr/>		
Eco-efficiency Indices		
ELR	Em_{IMP}/Em_R	1731.6550
ELR'	$(Em_N+Em_{N1}+Em_S+Em_F)/(Em_R+Em_{R1})$	4.6667
	Em_W/Em_U	0.2413%
ratio of waste to yield, EWR	Em_W/Em_Y	0.2071%
ESI'	$EYR/(ELR' \times EWR)$	120.62

3.3 Energy Analysis and Estimation of D-D Port

Three energy indices show that the D-D Port is a technology-oriented industrial park. And the fact that the component product and labor indices are much larger than the regenerate and unregenerate energy ration can be explained as the high product, labor and information input.

The excellent infrastructure and economic performance can be concluded by studying the functional indices. The ratio of energy to GDP is large because the D-D Port is at the beginning of its development. The middle level and stability of the net energy yield ratio (EYR) indicates the fine economic performance. The high energy investment ratio (EIR) shows that the industrial park is high developed and depends less on the environment.

4 Conclusion

This paper has established an eco-efficiency estimation and sustainable ability assessment system basing on the study of energy indices of eco-industrial parks, and taking D-D Port as a case study. This eco-efficiency estimation system takes such factors into account as energy current, substance current, currency current and other eco current to assess the eco-efficiency and depict the eco performance of an industrial park. As the development of an eco-industrial park would enhance its eco-efficiency, the eco-efficiency estimation system based on energy indices analysis would help the eco transformation of a traditional industrial park.

Two constraints also exist in the study. One is the limitation of energy analysis method, which can not reflect the substances with less relevance with solar energy. And it is also difficult to measure the people's demands to the service of eco system. Another limitation results from the case study, which only analyzes D-D Port in 2004. Future research should pay

more attention to the successive long-term data to improve this energy indices estimation system.

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Research on the Establishment of Virtual Eco-Industrial Parks

Zhou Fuzhan, Wang Dagang

School of Management, Dalian University of Technology, Liaoning, 16024

Abstract: In recent years, Eco-Industrial Parks have been developed prosperously as a new type of industrial organization. Because of the restriction of land resources, the input of infrastructure, movement costs and some other aspects, many regions and enterprises cannot adopt the Eco-Industrial Parks properly. Virtual Eco-Industrial Parks it possible for enterprises to realize the function of Eco-Industrial Parks on the basis of the current spatial layouts. From this aspect, this paper analyzes the necessity and operational patterns of the Virtual Eco-Industrial Parks and discusses some key problems in the process of the establishment.

Keywords: Eco-industrial parks, Virtual, Model of operation

1 Introduction

Eco-Industrial Parks can be understood as communities that are composed of both manufacturing and service enterprises in/of a certain region. In this community of enterprises, more profits are made due to the circular use of resources than the optimal production of a single enterprise. Eco-Industrial Parks are production organization patterns that are conducted under the idea of circular economy on the basis of exchange mechanisms of material, energy and information among enterprises. Virtual Eco-Industrial Parks do not need independent spatial layout and closed region. Once the eco-industrial chain is formed on the basis of “3R” principle and is economically feasible, the Virtual Eco-Industrial Parks can be formed among related enterprises. The essential difference between Virtual Eco-Industrial Parks and centralized entity Eco-Industrial Parks embodies on the spatial distance between enterprises. Because the spatial distance is beyond the critical value, enterprises on the eco-chain often face complex problems such as the material transportation and the match of industrial production rhythm. Centralized enterprises in the park can realize in-time low-cost wastes transmission along the eco-chain through pipeline systems and short-distance transportation, while Virtual Eco-Industrial Parks need middle- or long-distance transportation systems to

replace these functions, thus they will face more complex requirements on technology and management and coordination ability.

2 The operation model of Virtual Eco-Industrial Parks

The information integration and sharing system is the “central headquarter” of the Virtual Eco-Industrial Park. Because of the limited transportation radius among enterprises, they negotiate on the internet in advance to contract in reality thereafter. The information integrating and sharing system comprises three systems: the core system, including waste resources flow information system, transportation planning system and trading system; the park support system, including technologic development integrating system and credit management system; and finally the basic information system, including entrance checking system and enterprises’ information system.

(1) Core system. It is the most important part of the information integrating and sharing system. Waste resources flow information system: following the circle idea to integrate waste resources, confirm the demand and supply relationship between the upper position and backward position along the eco-chain and decide the direction, number, time and quality of the waste resources; transportation planning system: one of the defeats of the Virtual Eco-Industrial Parks may be that it pays too much for transportation. That’s also one of the factors for enterprises to decide whether to take the membership of the Virtual Eco-Industrial Parks.

(2) Support system. This system plays the role of supporting the whole park. Technologic development integrating system: technology is the key factor to enhance the efficiency of resource utilization. It is the most important one of the four factors (technology, capital, labor and natural resource) of the circular economy. The real measure for economic output is no more the number of the product, but the quality and value of the final service that is provided to customers. To be guided by the technology and to design the product with high additional value is the very requirement of the eco-industry. The product can be designed in the direction of circular utilization through building a R&D department in the park, combining exploiting foundation and sharing technology and making eco-improvement. Reuse of wastes should be focused to reduce customer’s use cost and enhance the value of the product. Credit management system: the system stores members’ credit records and relative information of waste resources.

(3) Basic information system. The system includes basic information such as enterprises’ entrance checking and their relative information. Checking system: it is used to analyze and check enterprises’ production and the waste resources in the inviting process to make sure

whether they could be a part of the eco-chain and form a closed material circle with other enterprises in the park.; enterprise information system: it mainly stores members' relative information such as their product information, basic financial information, production process and environment performance. The aim of building the system is to share information among enterprises.

Under the conduct of integrating and sharing, enterprises integrate their needs, technology and resource information together. They do not only share material and information, but also the deeper level service such as design, logistics and R&D. Efficiency of total resource using is enhanced through information sharing and co-planning.

3 Conclusion

Enterprises in the Virtual Eco-Industrial Parks should adopt cleaner production technology, decrease the amount of emissions and reduce environmental pressure as far as possible. Cleaner production is a newly created idea, which applies the entirety of preventive environmental strategies to the production process, products and services to increase the eco-efficiency and to reduce human and environmental risks (the definition is proposed by UNEP).

In a Virtual Eco-Industrial Parks, there should be one or more core enterprises. The resources they use and the industry they embody must be stable and have optimistic development prospect. In the region, there should be special resource advantage and industrial advantage and could form multi-class industrial structure. In that case, core resources and core industries can be formed to be the dominant chain. Other types of industries can be connected on the basis of the dominant chain to form the eco-industrial internet system.

The distance between enterprises in the Virtual Eco-Industrial Park should not be too large. To build a Virtual Eco-Industrial Park must bring enterprises some costs, mainly including searching cost before building the park and the transportation cost. If the distance between enterprises is not too large, that will not only save visible cost, but also is good to exchange information, coordinate and consult to solve the problems that happen in the cooperation.

Enterprises in the Virtual Eco-Industrial Park are required to be able to form an eco-industry chain. Inside the Eco-Industrial Park (include closed style and virtual style), following the natural eco-system operation model, eco-industrial chains can be formed between business-related enterprises. In the chain, the wastes that are discharged by one enterprise can be reused by others.

Stable alliance should be formed among enterprises to ensure the parks' sustainable running. After the achievement of the trading negotiation, what deserves to be focused is the

stability of operation. Therefore, enterprises in the park should sign relative agreement to form stable alliance to ensure the sustainable running of the park..

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The Empirical Study of Eco-industrial Park

Social Support System

SUN Qihong, SHEN Peng, MAO Yuru, LI Yanping, QIAO Qi

(MEP Key Laboratory of Eco-Industry, Chinese Research Academy of Environmental Sciences, Beijing 100012)

Abstract: Eco-industrial Park (EIP) is designed and established based on cleaner production, circular economy and industrial ecology concepts. It is generally composed of mass-flow system and support system, and the establishment and improvement of a support system is the important safeguards for the development of various EIPs. Based on Shanxi Antai EIP as a case, the design features and requirement of EIP social support systems was carried out, including the establishment of organizations and operation mechanism, environmental management, policy support, park culture and technical support subsystems. The research could be the reference for similar EIP planning and construction in China.

Keywords: eco-industrial park; social support system; empirical study; Shanxi Antai Group Company

1 INTRODUCTION

Social support system is an important factor in establishment of an Eco-industrial Park. E. A. Lowe (1998) stated the policy formulation, financial support, education and training, and park management strategy during the EIP exploitation.^[1] B. R. Allenby (1999) discussed the eco-industrial policies, regulations and measures.^[2] SEPA (2003) published the "Eco-Industrial Demonstration Park Planning Guideline (Trial)", and raised the requests to green management (including policies and regulations system indicators, management and awareness indicators), enterprise incubators, organizations and other safeguards requirements^[3]. Qiao Qi, et al.(2006) carried out the support system connotation of EIP establishing, including policy measures, organizations, technical support system, capacity building, public participation, education and environmental management tools, etc.^[4] Based on the case of Shanxi Antai National Eco-industrial Demonstration Park (SAEIP) planning and design, this paper discusses the components and specific requirements of EIP social support system.

2 THE OVERALL STRUCTURE OF SAEIP

SAEIP is located in North China's Shanxi Province which is famous for its large coal reserve. The leading enterprise of the park is the Shanxi Antai Group Company. It processes coal and related resources and with recycling as the main line, forms a circular economy industrial chain, including coke, iron and steel, power generation, cement and fine chemical industries. SAEIP is composed of a mass-flow system and a support system. The *Mass-flow System* includes products metabolic system and waste metabolic system. In the products metabolic system, the main goal is to establish circular economic system with two leading industries (coking and steel-making) and construction materials electricity industries, to promote regional resource recycling and waste minimization, form the pattern of enterprises linkage, industrial cycle; the waste metabolic system promotes the recycling of regional water, gas, waste heat and steam, and solid waste. The *Support System* includes the ecological building system, infrastructure system and social support system (Figure 1).

3 PARK SOCIAL SUPPORT SYSTEM DESIGN

3.1 Organizational structure and operating mechanism

Although SAEIP has an enterprise group as the core, EIP construction should involve the wider regional area and consider mass flow within its surrounding areas. Therefore, the EIP steering group was established there, composed of the leader from Jinzhong municipality government, Jiexiu city government, Antai Group and the representatives from Jiexiu city development and economic, construction, land resources, environmental protection, safety supervision and power supply departments, etc. The aim is to strengthen the leadership and coordination for park construction. Antai Group centers, plants and the functions are the specific working units.

The efficient and viable operation mechanism was also highlighted to have the government, enterprises and the public play their due roles. The government should take the closed ecological park management with import market competition mechanisms and carry out an open management model. The enterprises are to adopt the recycling economy and ecological industrial approaches. The public are encouraged to practice green consumption, green community construction and raise awareness of the ecological environment.

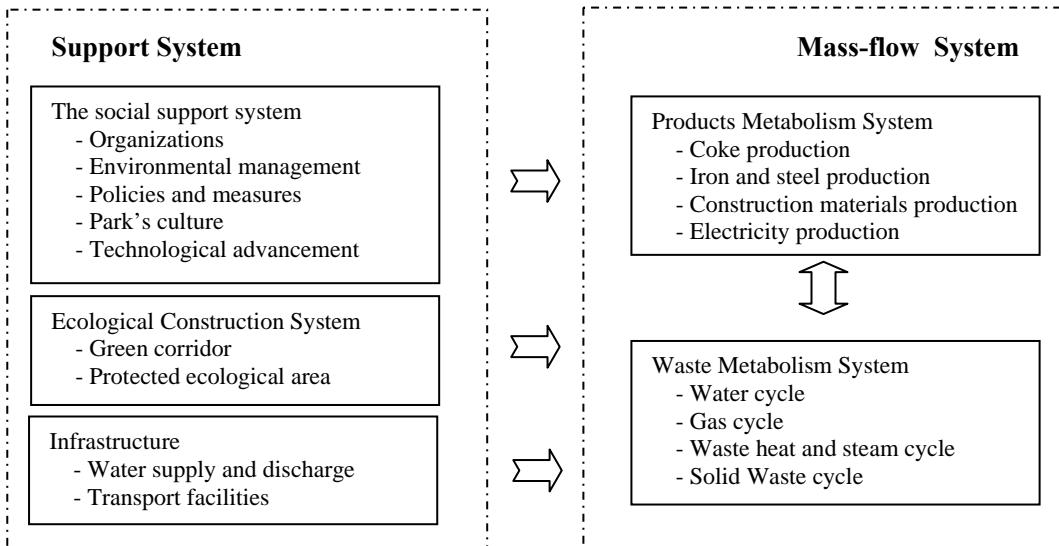


Figure 1: Overall framework of SAEIP

3.2 Environmental management subsystem

(1) *ISO14000 EMS and cleaner production audit.* As early as in 2000, the Antai Group has established the "two systems" and introduced "the three regulations" to guide and standardize the company's production and operations. The two systems are a quality management system and an environmental management system based on the ISO standards, while the three ordinances are an "Equipment Management Regulation", a "Cleaner Production Regulation" and a "Safety Production Regulation", which asks all units to promote energy conservation and cleaner production. On these bases, the encouraging policies should be developed and implemented.

(2) *Community environment friendly program -- ecological disclosure.* To promote the enterprises' environmental management and enhance green image and market competitiveness, the Eco-Performance Disclosure (EPD) System should be established. The EPS program is divided into two levels: the overall level of the park ecosystem management announcements, including regularly publishing local atmosphere, water quality and soil pollution situation; the level of enterprises on their environmental behaviors, including the pollution emissions, enterprise ecological image, green signage products classified bulletin for interior enterprises of the park.

(3) *Solidwaste lifecycle management.* The following measures were suggested: First is "Reductions First Principle" to minimize the generation of waste in the production process. Second is to develop related program to comprehensively utilize the main solid wastes, such as coal gangue, boiler slag and fly ash. Third is to strengthen the garbage classification and recover re-useful resources.

3.3 Policy Support Subsystem

(1) *Internal staff incentive policies.* The staff is the driving force of enterprise business development. The measures include: providing statistics of the energy and material consumption and the water consumption for main links, and then carry out economic incentives to excellent management staff; encouraging the technical exploration and innovation in the fields of clean production, energy consumption and waste reuse by carrying out economic incentives to people who with great contributions; and implementing the assessment of the staff and give economic incentives to outstanding personnel to raise staff labor and creative enthusiasm.

(2) *Inter-enterprises economic incentives policy.* Enterprises development should combine with the local regional economic development, and Antai should give the leading function and sponsor function to promote and stimulate Jiexiu City in coking industries to high-tech and chemical development. To ensure the development of fine chemical raw material sources, Antai could supply finance guarantee for a number of related applications for bank loans and government funding guarantees, such as the enterprises that provide coal tar materials to Antai, and so on, actively support its development, but also supply basis for Antai future development.

3.4 Park Cultural Subsystem

(1) *Ecological culture.* It is understood that *ecologicalization* should be the only way to achieve SD in SAEIP. The park could use various forms of cultural publicity and education, for example, the use of brochures, propaganda slogans, brochures, tour books, signs warning of sentences, inspiration boards, etc. The ecological culture must melt into the enterprise culture, thereby extending the corporate culture and establishing a good corporate image.

(2) *Green community, green site, and green area.* It is planned to develop green residential community activities, and on this basis to upgrade, up to state and local government green community standards. Strictly control the dust, noise, and solid waste and wastewater pollution in the course of construction. Create green model units, creating smoke-free buildings and smoke-free offices, using green office furniture, low radiation computer, strengthening lab safety management and labor protection, and training staff the enterprise eco-civilized behavior.

3.5 Technical Support Subsystem

Technical progress is the driving force to promote the development of circular economy. An ecological industrial R&D base was suggested to establish to enhance Antai's technological innovation capability in ecological industry, based on existing the Antai Technology R&D Institute and the Antai Technology Center.

4 CONCLUSIONS

Establishment and improvement of the EIP social support systems are key guarantee to the development of various EIPs. The establishment of social support system should address to the park's specific features. The planning and construction of the social support system in SAEIP could be the reference for similar EIPs in China.

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The Application of Environmental Performance Evaluation in the Administration of Eco-Industrial Parks in China

Yang Yao, Qi Qiao

Engineer, Center of Cleaner Production and Circular Economy Research,
Chinese Research Academy of Environmental Sciences, Beijing, 100012

Abstract: An Eco-industrial park is the implemented carrier of the circular economy philosophy based on the region level. There have been carried through large numbers of investigations of the theory and practice regarding Eco-industrial parks in China up to now. The methods and representations, showing systematically the environmental benefit through ecologic construction of Eco-industrial parks, are the important parts of the Eco-industrial park administration system. Environmental performance evaluation could systematically manifest the whole configuration of construction of Eco-industrial parks, from different points of view: from park administrators, enterprises, and the public. This paper discusses the significance of environmental performance evaluation for Eco-industrial parks in China, and introduces the current application status and development trend of environmental performance evaluation in the administration of Eco-industrial parks in China.

Keywords: Eco-industrial park, environmental performance evaluation, environmental administration

Introduction

Since the 21st century, along with a continuously accelerated industrialization progress, and a fast economic development, China has been facing an unprecedented pressure on resources and environment. Rough development mode with high usage of substances, high consumption of energy and high pollution and terminal disposal as the way of environmental protection, are the main reasons of engendering lack of resources and environmental exacerbation. Circular economy, as the economy development mode which most efficiently utilizes resources and protects the environment, focusing on the highly efficient and circular resource utilization, is the significant approach to ultimately convert rough economy development mode and decrease the environmental pressure.

An eco-industrial park is the implemented carrier of circular economy conception based on the region level and it is the new type of industrial park based on cleaner production requirements, circular economy conceptions and industrial ecology theories. It regards industrial produce as a close system similar to ecosystem, thereinto the “trash” or byproduct produced from a unit, is the “nutrient” and raw material to the other unit. The core conception is through reasonable, efficient configuration and circular utilization of water, energy sources, raw materials and trash in the industrial park, to achieve maximum economic benefit and minimize resource consumption and environment expenses finally[1].

1. Development of Eco-industrial park Administration in China

To convert a rough economy development mode and radically decrease the environmental pressure, the Chinese government brought forward a proposal which urged the circular economy development and Eco-industrial park construction to actualize the regional sustainable development in the year of 1999. In August, 2001, the first demonstration project of state eco-industrial park - Guangxi Guigang State Eco-Industrial (Sugar Refining) Demonstration Park- was issued by State Environmental Protection Administration of China (SEPA). Whereafter, the construction of eco-industrial parks had been diffusely developed. Inner Mongolia, Jiangsu, Shandong, Zhejiang, Liaoning, Guangdong, Tianjin, etc respectively developed the experimental eco-industrial park. Within few years, eco-industrial parks in China have experienced the process from inexistence to existence, theory to practice. By April of 2007, SEPA has authorized 24 state eco-industrial demonstration parks.



Figure 1: the distribution of national eco-industry demonstration parks in China

To cooperate with the demonstration of eco-industrial parks, much effort has been made in the administration of eco-industrial parks. In December, 2003, SEPA promulgated *Application, Nomination and Administration Rule for The State Eco-Industrial Demonstration Park (On trial)*. According to the rule, in June of 2006, *Standard for Sector-specific Eco-industrial Parks(On trial)[HJ/T273-2006]*, *Standard for Sector-integrate Eco-industrial Parks(On trial)[HJ/T274-2006]* and *Standard for Venous Industry Based Eco-industrial Parks(On trial)[HJ/T275-2006]* have been promulgated.

The promulgation of eco-industrial park standards is significant not only for national eco-industrial park development, but also for better administration of eco-industrial parks. Based on experimental eco-industrial parks and the theoretical basis of industrial ecology, the established standards have connected theory with practice [2].

2. The Significance of Environmental Performance Evaluation in the Administration of Eco-industrial parks

The significance of environmental performance evaluation to the eco-industrial park could be mainly expressed as follows: First of all, it could be regarded as important references to estimate ecological construction for the administrators Secondly, it could be regarded as the target of the sustainable development of industry parks. Thirdly, it could effectively display the performance and the environmental melioration of the eco-industry demonstration park, which is significant to promote the ecological construction and amelioration of eco-industrial parks in our country.

3. A Few Kinds of Main Environmental Performance Evaluation System

At present, the main worldwide environmental performance evaluation systems include the WBCSD Eco-Efficiency Indicator System, IS014031 Environmental Evaluation System, and Factor X Indicator System [3,4].

3.1 WBCSD Eco-Efficiency Indicator System

The conception of eco-efficiency was brought forward by the World Business Council of Sustainable Development in the 1992 Earth World Summit. The WBCSD believes: “Eco-efficiency is achieved by the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's

estimated carrying capacity.” Eco-efficiency is the concept of improvement of the economic and environmental performance, which indicates the decrease of ecological impacts and resource consumption, while describing the economic achievement created by the economic system.

3.2 IS014031 Environmental Evaluation System

The IS014031 environmental evaluation standard is a systematic procedure of measuring and evaluating the environmental performance. Environmental performance evaluation system is defined as a tool of examining the economic system environment to tell if its goal has been achieved [or not]. The information of environmental performance evaluation could improve decisions, consequently achieve the environment policy and goals, and also properly communicate with people who are beneficially-related. It could validate the potential risks, opportunities and the reasons of bad environmental performance evaluation in the economic system.

3.3 “Factor X” Ecological Efficiency Evaluation

The measurement of “Factor X” ecological efficiency evaluation is an amelioration of existing ecological efficiency evaluation measurements, which is based on this principle: while we continually improve the convenience of our daily lives, we must reduce the usage of natural resources. The goal of using “Factor X” ecological efficiency evaluation is that no matter whether administrators or people have professional environment knowledge or not, by utilizing the alteration of “Factor X” ecological efficiency valuation, they could always know how much impact the products made to the environment and the contribution of a particular technique to the improvement of environmental-friendly products.

Conclusion

- (1) For eco-industrial parks this kind of economy system which stresses on both environment amelioration and economy development, developing of environmental performance evaluation is especially important.
- (2) Introducing environmental performance evaluation is urgent in the administration system of eco-industrial parks.
- (3) At present, only few environmental performance evaluation studies of eco-industrial parks are available, moreover, actual research on environmental performance evaluation methodology, evaluation indicators, evaluation procedures is not sufficient.
- (4) In order to develop the environmental performance evaluation, the scientific, systematic, operational and universal environmental performance evaluation system, based on

environment, economy and industry structure should be implemented which is constructive to the administration of eco-industrial park in China.

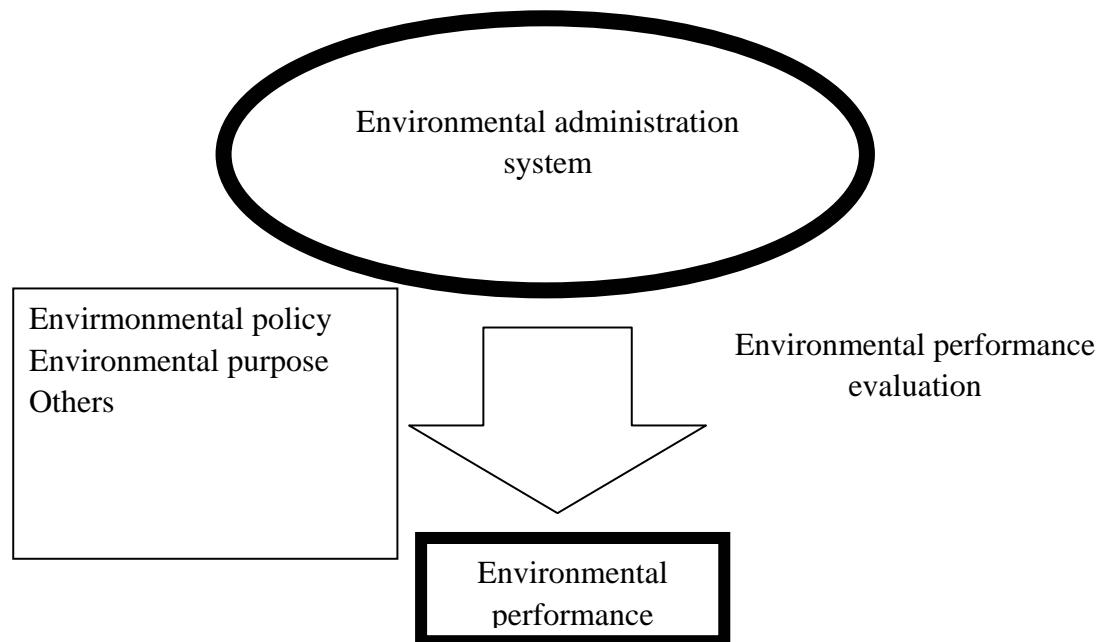


Figure 2: the relation between Environmental administration system and Environmental performance

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New Measures on Energy Saving and Water Saving in Industrial Parks

Yan Xu

(Environmental Protection Bureau, TEDA, Tianjin, P.R.C.)

Abstract: Saving energy and reducing pollutant emissions were set forth in the 11th Five-Year Plan. Meeting these two mandatory targets is very important and China must work resolutely to reach them. Indeed, the effort has been started in 2006 and the whole country realizes that serious problems of resource and environment are the bottleneck in the process of society development. As a vivid crucial industrial complex, industrial parks (IPs) carry out a serious strategy.

Keywords: Energy Saving, Water Saving, Industrial Parks

1 Introduction

1.1 Condition of Chinese energy consumption

Energy intensity is one of important indices which are used widely to evaluate energy efficiency and opportunities of energy saving. Currently, China is in the phase of rapid industrialization and demands dramatic energy volume annually. At the same time, energy and other resources are allocated by market economy. Therefore, energy intensity becomes more important to demonstrate the overall energy utilization and reduce inefficiency. In 2005, the average rate of Chinese energy efficiency is about 30%, which performed poorer compared to some advanced nations. This indicates that the economic structure needs to optimize as well as more room for energy saving exists.

1.2 Governments' Voice

Chinese government stressed energy saving and set forth two mandatory targets in the 11th Five-Year Plan. Namely, with the year of 2005 set as the baseline, energy intensity should decrease by 20% and the total pollutant emission should be reduced by 10% in 2010. In addition, fresh water consumption should decrease by 10%. To meet these targets, the task has been assigned to different levels of Chinese governments and key entities.

1.3 General Information on IPs

The economic contribution accounts for about 5.2% of the nation's GDP and the workforce makes up about 1.7% of total employment population. Obviously, IPs are situated on the front edge in the whole country. That is why they are described as development engines or green engines in different regions.

Tianjin Economic and Technological Development Area (TEDA) has been the best IP for nine years according to the statistics data which is offered by the Ministry of Commerce. Also it is very typical with four pillar industries, namely, electronic and information industry, bio-pharmaceutical industry, machinery industry, food and beverage industry. Similar to other ETDZs, its economy is kept on booming. Its productivity is continued to enhance, and comprehensive performance is improved sustainedly. In addition, both the TEDA government and society hope to increase resources efficiency while decrease the pollutants output and emissions, in order to improve the environment. Hence, on the background of state energy saving, TEDA has started to learn energy conservation, finished its energy conservation plan, and pushed all works running.

2 New measures and practice

2.1 Clarify major bodies and their roles

Governments act as an engine and mainly induce others to engage in energy saving. Its responsibility covers policy making, administrative management, disseminating information and establishing communication exchanging platform.

Industrial sectors act like players in the match. In order to meet targets, they need to adopt advanced technology and clean energy, improve producing processes and management methods, decrease energy intensity, increase productivity. Currently, they need to warm up and be ready to run.

The third party, such as institutes and the energy service company, act as the enzyme in chemical reaction. They could offer their support to governments and industrial sectors, seek approaches and technologies , provide improvement plans and reports, and implement reconstruction programs, and so on. Community will be responsible for information disseminating and taking action.

2.2 Carry out an index system

In 2005, TEDA energy intensity was 0.15 ton per 10,000 RMB, which is much better than that of Tianjin and the national average level, but not as good as of the peer group's. From 2006 to 2010, the energy saving targets are 4.4%, 4.4%, 5.0%, 5.0% and 3% respectively.

2.3 Establish a management system

Before 2005, none of the IPs had a systematic energy administrative management system in this field across China. In order to promote energy conservation effectively, TEDA establishes a leader group and a general office to coordinate. Meanwhile, there are three bureaus working together to sharpen the function.

Public affairs bureau is responsible for implementation of programs, management and dissemination. Environmental protection bureau is responsible for reducing pollutant emission and supervision. Development and plan bureau is responsible for carrying out targets, assigning tasks, statistics and evaluation.

2.4 Set forth an energy saving and water saving plan

Plans are a common way to induce administrative management. TEDA spent almost one year to finish its plan. The framework of this plan includes: (1) Identifying the current situation and tasks and seeking common ground; (2) Potential analysis, recognizing crucial aspects; (3) Targets and indices in the 11th Five Year period; (4) Determining energy saving programs and aspects; (5) A Support system.

2.5 Release a new policy

TEDA finished the promotion on energy saving, developed temporary rules for a circular economy with a list of major promotion programs. Firstly, a fund will be set which the main source is from government revenue. Excellent performers could enjoy awards. Second, determine water resource optimum, energy optimum, resources recycle, and pollutant emission reducing will be the key field. All entities are encouraged to adopt new water sources, energy diagnosis and cleaner production methodologies due to saving energy and water. Third, clear requirements show that purchasing energy efficiency products is necessary during government procurement. Finally, building an effective policy support system to create stable and friendly development conditions will be an urgent task that the government should produce.

2.6 Focus on key fields

TEDA has determined that energy saving industry, water saving industry, and water saving landscape are the most important topics. Compared to the National Ten Energy Saving

Programs and Tianjin Six Energy Saving Disciplines, TEDA concentrates on narrower goals due to its relatively simple industrial structure and its characteristics. For example, TEDA chose water saving landscape as a major target because of water shortage, salty land which means more water needed over maintaining gardens, and the amount of landscape water use is up to 6%-10% totally.

In detail, energy saving industries will apply different approaches, such as energy audit, backward facilities substituted, cleaner production, energy monitoring, supervision system, and so on. Industry water saving will focus on In-Site recycling, cleaner production, cascading use, integrated grey water reuse system, water balance measuring, and supervision system. In the aspect of landscape water saving, pipeline upgrade, water saving irrigation, selecting local plants and better combination of vegetation will be crucial strategy to implement.

2.7 Strengthen cooperation

Taking advantage of international cooperation experience, TEDA will engage in all kinds of cooperation programs in order to learn from advanced ethics, approaches and measures. Nowadays, two projects are carried out. One is Finland Eco Two plan, which will exhibit the picture of a future city based on renewable energy designed and wider used. The other is about working with Japanese institutes to spread their technology and approaches. Besides, the existing platform will be continuing to expand, and the third party, such as energy saving association and waste minimization club, could gain fruitful outputs via more efforts.

2.8 Dissemination

There are some successful stories here. Typically, Kraft Tianjin Ltd. has decreased its fresh water consumption by 25% after developing activities. Novozym Tianjin Plant released a newsletter to demonstrate how to make the best use of everything. TEDA Landscape Company irrigates about 0.5 million square meter lands with ground water and grey water. All of such cases will be disseminated by media, news releases, workshops, and so on. TEDA public utility bureau will carry out a plan to encourage all entities to learn from experience.

3 Conclusion

The main task will be done by industrial sectors in the field of energy management. Considering the current situation governments will be responsible for planning, organization, control and management. To reach the two mandatory targets, governments should establish a management system, set forth an energy plan, identify the major tasks, and offer effective policy systems, infrastructure, training, etc. Firmly, energy management and energy saving will expand the concept of IP management.

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IV

Examples and Case Studies

The Construction of Suzhou High-tech Eco-industrial Park

Wang Aixian

Suzhou National New& Hi-Tech Industrial Development Zone, Jiangsu, China

Abstract: Based on the development of Suzhou National New& Hi-Tech Industrial Development Zone, this article discussed the method of the construction of Suzhou High-tech eco-industrial park from government, enterprises, industries and public.

Keywords: construction,eco-industrial park,government,enterprises

1 Introduction

With a total area of 258 sq km Suzhou National New& Hi-Tech Industrial Development Zone (SND) borders Suzhou old city which has a long history of more than 2500 years.

SND is a manufacturing base of export-oriented and hi-tech products. The local economy keeps at a high increasing rate since construction has started in 1990. In 2006 the total industrial output was 47 billion Rmb and the local budget income was 3.04 billion Rmb. The total industrial output was 150.4 billion Rmb while the foreign investment was 80 million US dollars. The environmental protection and ecological construction are going harmoniously with the economic development. In 1991 SND was permitted by China's central government as a “national new and hi-tech industrial development zone”^[1]. In 2001 it set up the first national environmental protection industrial park. In 2004 it became one of the first batches of national ecological park. In 2005 SND was approved by state development and reform committee as one of the first national circular economies.

2 Detailed Measures

2.1 Promotion of government

SND established a promotion committee for the construction of ecological industrial park. The main leaders from SND administrative committee was the chief director with personnel from the environmental protection bureau, the construction bureau and the planning bureau. Additionally, the SND committee held a mobilisation meeting and delivered documents to promote people to develop circular economy^[2].

The government investigated over a hundred enterprises and set down the overall planning of SND's ecological industrial park construction. The first “china international circular economy exposition” was held in suzhou and the circular economy technology display, circular economy example exhibition were held here.

2.2 Promotion of enterprises

The enterprises try to realize “zero discharge” during the production process and waste destabilization. The first measure we adopted was to reduce the pollution from the very origin by ecological design. For example: the companies have considered environmental protection since the very beginning of product design. The new products came to the market with a totally new outlook with power-saving and low discharge. The second measure was to carry out green purchase and to reduce production waste. There were about ten enterprises in SND that adopted green purchase. The third measure was to use the waste comprehensively. The recycling became the highlight in the construction of circular economy. Suzhou kaolin company is a company with 50 years of kaolin production^[3]. It became a payoff company through carrying out circular economy. The company set up two new production lines to produce different quality bricks. The fourth measure was to reuse the waste water. For instance suzhou Fukuta company set up pure water recycling treatment equipment to collect and reuse the waste water. It saved water of about 0.7 million tons every year.

2.3 Purify industrial structure

We encouraged new ecological industrial chains. Besides “Panasonic electronic board chain”, “Fukuda waste water metabolism chain”, we attracted Japanese Towa Co. The new chains like recollecting etching have settled the comprehensive use of electronic waste

We also strengthened business attraction to conduct a “chain strategy”. We encouraged the industries like automobile fitting, environmental protection and fine machinery as the supplementary chain for ecological industrial park. At present the automobile fitting park, an international automobile park and environmental protection park have developed very well.

2.4 Public promotion

SND set up several ecological parks. We carried out activities such as green residential areas, green families, green schools, green enterprises, green hotels and green consumption.

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A Study on the Construction Modes and Practices of Ecological Industrial Parks in Typical Regions of Jiangsu Province

Wang Huizhong, Chen Ting

Jiangsu Provincial Academy of Environmental Science, Nanjing, 210036

Abstract: In Jiangsu province, a great number of resources are taken up and the pollution is brought forth heavily. This research is conducted on the three development zones. Based on the clean production and aimed at energy-saving and consumption-reducing, the dynamic chain system of enterprises as well as the recycling and reusing system of water, energy and solid waste are set up. The three construction modes of ecological industrial park in the development zones are discussed.

Keywords: construction modes, Jiangsu Province, ecological industrial park

1 Introduction

Jiangsu is one of the provinces which develop most quickly in China. However, some development problems do exist: 80% energy from outside and resources related to heavy pollution. The resource and environment problems which Jiangsu faces are general in the whole country. These problems are caused by vicious competition of the economy over a long period of time in the country. The construction in the ecosystem industrial park can resolve problems above-mentioned. The ecosystem industrial park can organize several business enterprises, becoming a shared resources and by-product industrial ecosystem network..

2 Ecological industry construction mode of development zones

with large-scale enterprises as the center

Most of the industries in our province, which take the large-scaled enterprise as the core mainly, belong to this kind of park area, such as the international metallurgy industrial park, the Nanjing chemistry industrial park etc.

The industrial park carries on an ecosystem industry reform, which takes the single business enterprise as the center and should take the internal material flow of the business

enterprise as the starting point. According to the characteristics of the dominant industry, we can begin with the part which has mature technology and notable economic performance with modest heat energy and water consumption, including utilization of reclaimed exhaust gas from the furnace coal gas using industry waste residue as construction material products. In the next step we should pay attention to utilize material which has low poisonous side-effects and includes renewable resources. On this foundation we develop a continuous utilization of an industrial discard, gradually forming "closed circulation" of various resources^[1].

3 Ecological industry construction mode of development zones of the same kind of large and medium-sized enterprises

The products of large and medium-sized enterprises in development zones are placed in upstream and downstream of the supply chain. We should seek a certain big central business enterprise with large-scale influence in this kind of ecosystem industrial park. Attracting investment by the key enterprise ,and relating industries to extend an industry chain as long as possible. The Zhangjiagang bonded zone is this type.

4 Ecological industry construction mode of various types of high and new technology

Kunshan economic and technical development zone, Nanjing economic and technical development zone,.and others have transformed from single industry industrial parks into diversified industries parks in the course of development. The enterprises share a variety of channels of physical distribution, energy distribution, technology and information flow in the park. Waste exchange between enterprises takes the form of trade.

Energy processes, water processes and processes of various original materials of main industrial enterprises in the development zones need to be investigated in detail. The infrastructure in parks must be transformed to central heating, centralized treatment of industrial wastes, medium water recycle in order to reach the requirements of ecological industry park gradually. The enterprises in the development zone should be divided by function. On the one hand, it is favorable to get maximum use of heat. On the other hand, it is also favorable to minimize the delivery distance of materials between enterprises.

5 Conclusion

Three construction modes of ecological industrial park in Jiangsu's development zones include large size enterprises of as the center, cluster industry and various high and new technology, which are set up based on different industry construction and bring forth good influence on the local development.

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Presentation



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The 2nd International Chinese - German Workshop on Sustainable Development of Industrial Parks

2007 Beijing, P.R. China

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International Safety Management in the Chemical Industry

Dr. Hans-N. Rindfleisch, Managing Director

TÜV SÜD Chemie Service



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Globalization of Chemical Industry



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New Markets

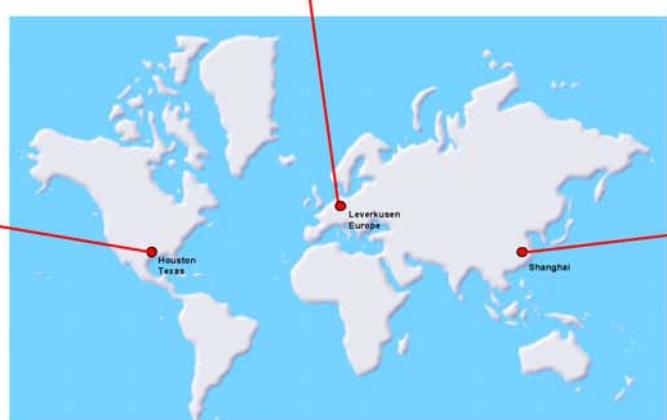


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Global Operating Companies



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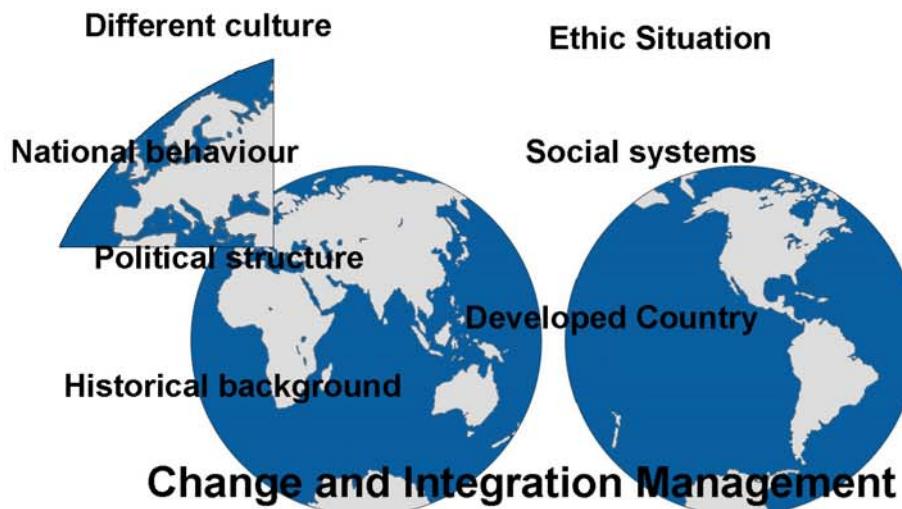


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Challenges of Globalization



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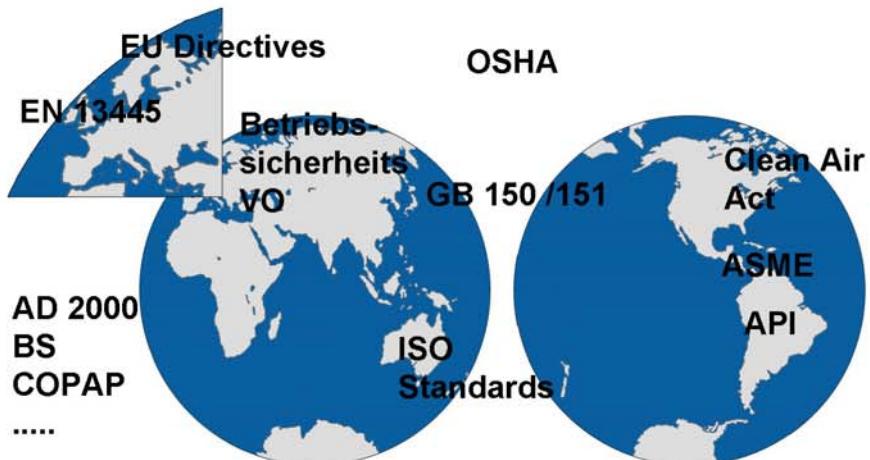


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International Character of Safety



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Requirements for new equipments



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PED / EN 13...

Uniform requirements (ESR) for new pressure equipment intended to be placed on market on a legal basis

Considerable advantages for manufacturers and operators concerning **manufacturing**



ASME / API

Uniform code for design, fabrication and inspection of non-fired pressure equipment

Same basic conditions for **manufacturing and operation**



Uniform requirements for new pressure equipment

GB-Code 150 / 151

Same basic conditions for **manufacturing and operation**

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In-Service Inspections in Europe



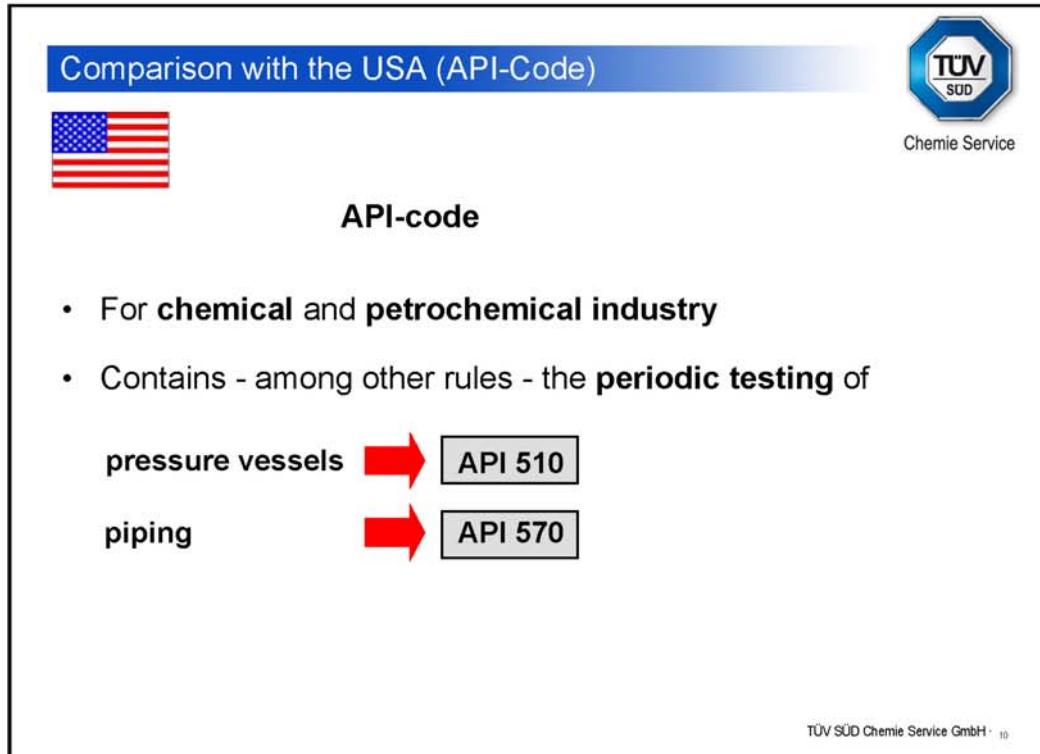
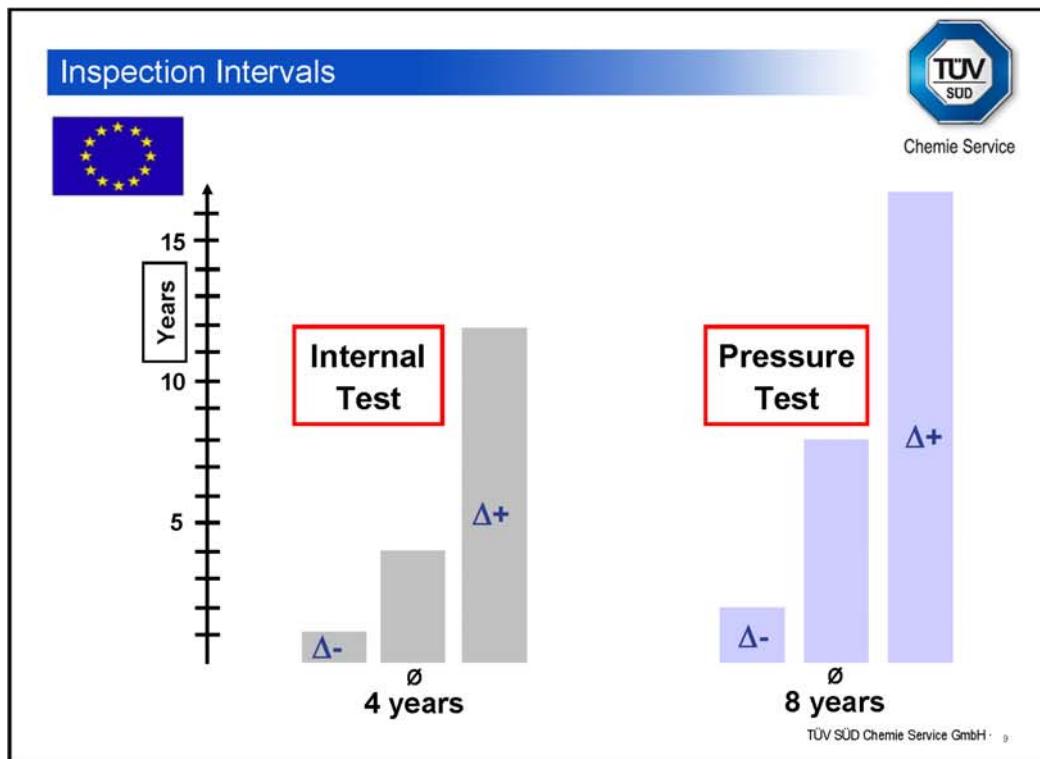
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Non uniform national procedures for In-Service:

- Usage of criteria of conformity evaluation only in a **simplified way or not at all**
- **Special rules, exceptions and requirements**
- Differences in **frequency and intensity of testing**
- **Different view of owners responsibility / Third Party inspection requirements**

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Comparison with the USA (API-Code)

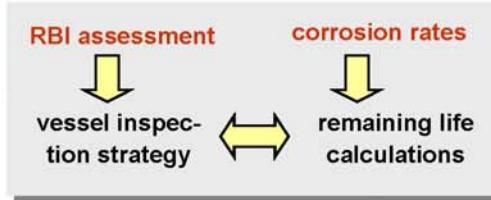


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- **No classification into inspection categories, inspection is a general requirement** (exceptions for small-scale equipment)

- **Guide values instead of fixed inspection intervals**

- Intervals are **risk-based**



- Inspection by

- **authorized specialist personnel of inspection bodies** (high hazard potential) and
- Inspection/maintenance engineers of user for inspections in process industry

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Legal System of Safety Supervision



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Legal System of Safety Supervision



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Administrative Regulation

- Regulations on Safety supervision of Special equipment

Regulations of departments (Ordinances)

- Safety and Quality Supervision Regulations Special Equipment
- Administrative Punishment Rules for safety supervision of Boiler, Pressure Vessel, Pressure Piping and Special Equipment
- Rules on Manufacture Supervision and Administration for Boiler and Pressure Vessel
- Safety Supervision Regulations for Gas Cylinders
- Safety Supervision Rules for Pressure Pipelines

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Legal System of Safety Supervision



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Safety Technical Code

- Rules for Qualification and Administration of Pressure Vessel and Pressure Piping Designers
- Rules on Registration and Administration for the Use of Boiler and Pressure Vessel
- Rules on Registration and Administration for the Use of Pressure Piping
- Safety Technical Supervision Regulation for Organic Fluid Heaters
- Rules on Periodic Inspection for Boiler
- Technical Supervision Regulation for Pressure Vessels
- Rules on Periodic Inspection for Pressure Piping

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Legal System of Safety Supervision



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Adopted Standards by Regulations

- GB 150/1998 Steel Pressure Vessel
- GB 12241/89 Safety Valves – General Requirements
- GB 3323 Methods for Radiographic Inspection and Classification of Radiographs for Fusion Welded Butt Joints in Steel
- GB 11345 Method for Manual Ultrasonic Testing and Classification of Testing Results for Ferritic Steel Welds

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In-Service Inspection

according to Supervision Regulation on Safety Technology
for Pressure Vessel -1999



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Equipment Description	Type of inspection				Frequency	Responsible	
	internal	external	Hydraulic test	leak test		User	Authorised Third-party
Pressure Vessel (First Running Period)	x	x			max. 3 y		x
Pressure Vessel (Safety Class III)		x			max. 1 y	x	x
	x	x			max. 3 y		x
			x	x	max. 2 per 6 y		x
Pressure Vessel (Safety Class II)		x			max. 1 y	x	x
	x	x			max. 6 y		x
			x	x	max. 2 per 12 y		x
Pressure Vessel (Safety Class I)		x			max. 1 y	x	x
	x	x			max. 6 y		x
			x	x	max. 2 per 12 y		x

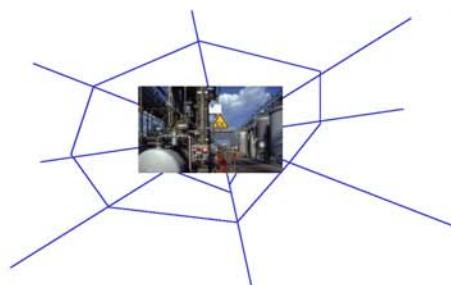
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Processes and the Phase Model



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- Plant Safety
- Reaction Safety
- Process Safety
- Occupational Health & Safety
- Fire Protection
- Environmental Protection
-



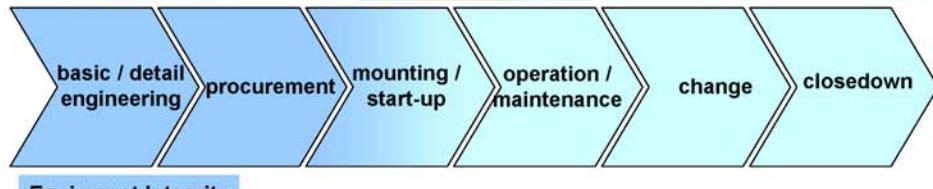
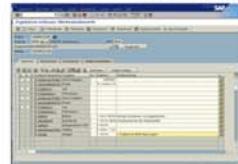
Safety Network

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Safety and Plant Life Cycle



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life-cycle support along the process chain of the plant / installation
customised on-site service packages from a single source

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Tools and Systems



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- HAZOP
 - FTA
 - FMEA
 - Risk evaluation
 - Dynamic simulation
- Equipment quality assurance
 - Inspection strategies
 - Inspection management
 - Documentation tools
 - Management of change

basic / detail engineering

procurement

mounting / start-up

operations

maintenance

change

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Documentation Tools



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Modern technical plants need to meet a vast range of requirements.

TIDOC maps our customers' testing cycles efficiently, comprehensively and clearly.

TIDOC Technical Inspection Documentation

Whether legal regulations, safety certificates or quality assurance are involved – necessary and compulsory testing needs to be scheduled, carried out professionally and documented properly.



Documentation Tools



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TIDOC offers the total process integration – directly networked and clearly presented

Our SAP®- based software allows you to integrate everyone involved quickly, efficiently and easily.

TIDOC offers you results-driven communication thanks to its:

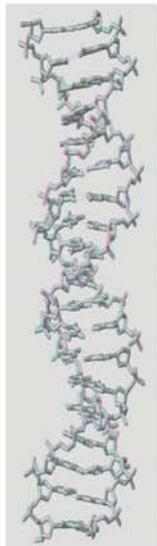
- comprehensive process management and common master data
- fast data exchange
- high levels of data consistency
- implementation into the customer's system
- complete absence of interface problems



From general to specific



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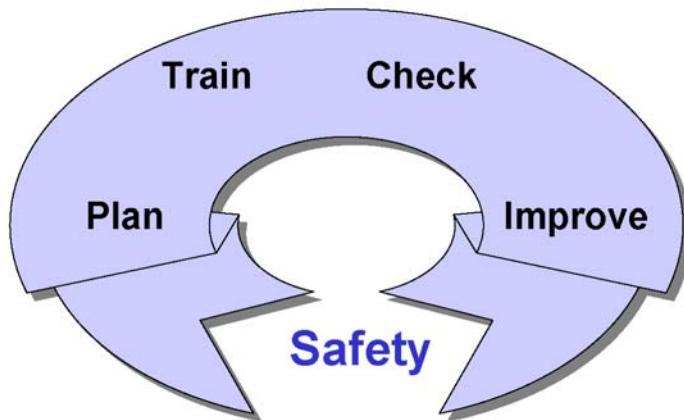


- Chemical hazards and risks
- Basic and detail engineering
- Material, design, and calculation of plant equipment and piping and their testing, evaluation and inspection
- External factors like windload and earthquake
- Manufacturer qualification and certification
- Fixed inspection frequencies or knowledge based inspection
- National laws and regulation and international standards

Continuous Improvement Process



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