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## Industrial Transformation and Low-Carbon Development of Resource-Based Cities: Taking Ordos City as an Example

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### Abstract

The industrial transformation pattern of resource-based cities can be analyzed from the industrial life cycle as to determine the optimal industrial transition period. To carry out the initial investment, the cities need to analyze the essential elements of industrial development, so that the cities can achieve sustainable development. The paper put industries into four categories: Resource-based high pollution industries, resource-based low pollution industries, non-resource-based high pollution industries and non-resource-based low pollution industries. Finally, the paper proposes that industries need low-carbon technology and the cities need to support optimal industries.

**Key words:** Resource-based cities; Industrial transformation; Low carbon development

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### INTRODUCTION

Ordos is a typical resource based city in the west of China, which accounts for about 1/6 of China's total coal reserves, and about 1/3 of China's natural gas reserves. The economic development of the Ordos Basin mainly

depends on the exploitation of mineral resources. The second industry accounts for 52.2% of GDP in 2013, and 68.7% when highest. With the adjustment of China's macro economy, the speed of economic development and the decline of energy prices, the economic development of the region has encountered a bottleneck due to single economic development structure. This paper mainly solves the problem that the industrial transformation of resource-based cities in the west of China and the path of low-carbon development.

Scholars agree in the necessity of transformation of resource-based cities, while opinions vary on patterns of transformation. Wang and Li (2012) hold the view that the economic transformation of resource-based cities should be based on the principle of economic sustainable development, public service equalization, and ecological environment. Zhao and Zhang (2009) advocated the principle of sustainable development, the principle of coordinated development, the principle of stable development, the minimization of industrial conversion cost, and the principle of comparative advantage. Liu and Yang (2011) put forward three measures: the industrial transformation, the implementation of the "science and technology city", the development of circular economy. Xu and Li (2010) put forward the low carbon model of circular economy, with low energy consumption, low emissions, low pollution and high efficiency, and high profit as the basic characteristics. The model also calls for the development of energy structure adjustment and industrial mode optimization, as well as technology system innovation and a strong policy system that support low carbon development.

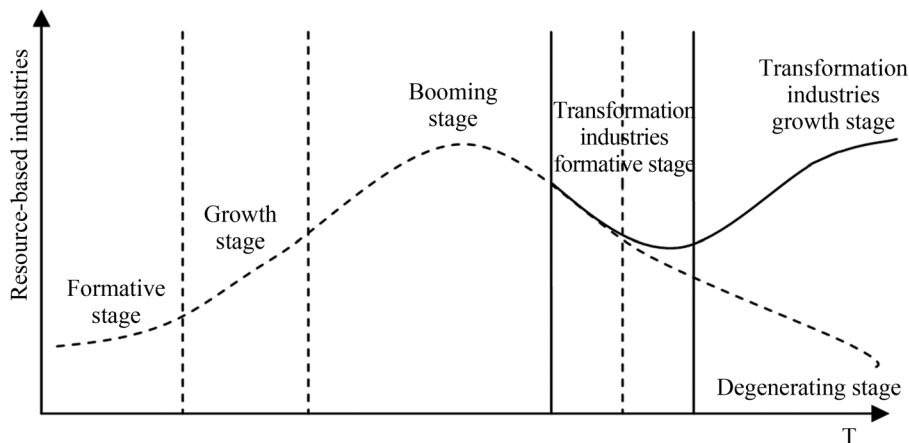
### 1. INDUSTRIAL TRANSFORMATION OF RESOURCE-BASED CITIES

Since the industrialization was taken place earlier in the western civilization, the western industrialization can

be a precedent to the resource-based cities in China now. For example, Detroit the city of abundant mineral resources fell into the plight of economy after a boom period. Ruhr region in Germany once prospered from its pillar industry of coal, iron and steel, chemical, and machinery manufacturing, however due to the falling of coal prices, stepped into a long period of stagnation. We may learn from the two cases that once the resource-based cities met resource related problems, the cities can not recover in a short period of time. In summary, the ultimate way of the development of resource-based cities is one of the follows: with the depletion of the resources, the city decline; or with the resource depletion, the population start to migrate; or to carry out industrial restructuring and upgrading and step into sustainable development stage.

### 1.1 Analyzes of Life Cycle of Resource Based Cities

Basing on the fact of the actual situation of resources and population, China's resource-based cities must take the road of sustainable development of industrial restructuring. Some scholars have introduced the life cycle theory that if the resource based cities start industrial transformation before the period of decline, it will avoid the recession of the urban economy. If the cities appropriately extend the industrial chain of resources, for example the development of downstream industries (such as coal chemical industry), the prosperity of the resource-based industries will be superimposed with the prosperity of transformation industries (see Figure 1). We can see from Figure 1 that the transformation of the industry in the early period is negative to the economy due to the input of factors. As the industry grows, it will gradually bring benefits to urban economic development.



**Figure 1**  
**The Life Cycle of Resource-Based Cities and Resource-Based Industries**  
 Note. Modified and sorted out according to Zhang.

Zhang (2012) believes that the growth period and the booming stage of the resource industries are the best time for the economic transformation of resource-based cities, in which the advantages of natural resources, talents and technology can be used to develop the industries. If you enter the transformation period in the downturn, you may be facing with the gradual disappearance of the advantage of the abundance of resources, for industry restructuring costs will gradually increase. Therefore, resource-based cities need to start the industry transformation under the leading of the government, relying on the market and technological innovation (Duan, 2009). Figure 1 describes the state of the transformation industry for the resource-based cities when all goes well, while ignoring the possibility of failure of the transition. The possible factors of the failure may be the location, the environment, the lack of the intrinsic innovation, the technology, the talents, or the increasing production cost. From the perspective of the life cycle theory, a delay of industrial transformation may lead to a failure due to insufficient capital, thus

industrial restructuring can not successfully enter the period of development. What's more, more transformation cost factors will be needed when the urban economy goes into a recession, which may make industrial transformation a failure. Therefore, we may analyze the environmental bearing capacity as a key factor in the transformation of the industry.

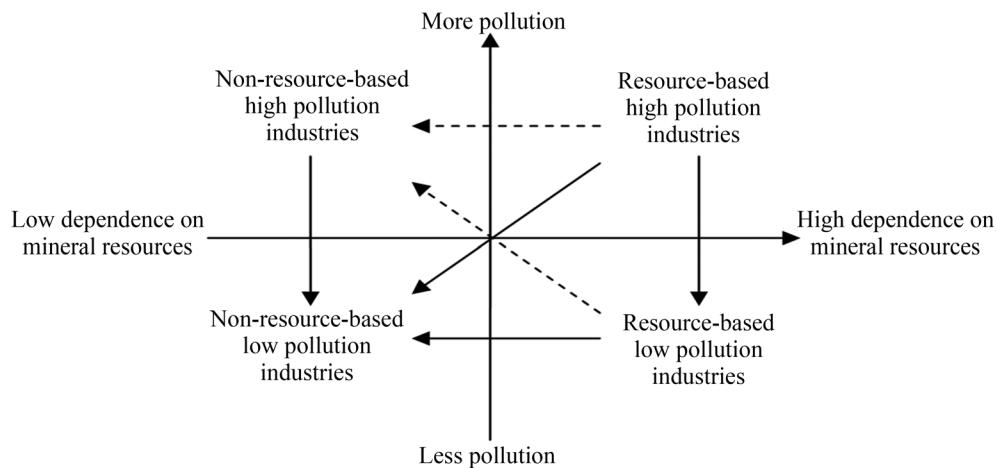
### 1.2 Analysis of Industrial Transformation Type of Resource-Oriented Cities

The industries can be classified according to two dimensions: Resource dependence and environmental pollution. The types include: resource-based high pollution industries, resource-based low pollution industries, non-resource-based high pollution industries, non-resource-based low pollution industries (see Figure 2).

According to Figure 2, the ideal transformation steps can be: resource-based high pollution industries→resource-based low pollution industries→non-resource-based low pollution industries, resource-based high pollution

industries → non-resource-based low pollution industries, non-resource-based high pollution industries → non-resource-based low pollution industries. In a certain period of time, several stages may exist at the

same time. However, with the exhaustion of resources and the deterioration of environment, the industries will finally be of a non-resource-based low pollution stage.



**Figure 2**  
**Industry Classification**

As for the industry history of Ordos, in the preliminary stage, the city relied on extensive way of production, that is resource-based high pollution way of production. In the growth stage, the city employed intensive way of production that reduces pollution. Later, Ordos city developed tourist industry and manufacture, and gradually formed dozens of non-resource-based low pollution industries. At present, three stages exist in Ordos, which can be called industry transition stage.

## 2. LOW CARBON DEVELOPING PATTERN OF RESOURCE-BASED CITIES

According to the actual situation of China's resource-based cities, Guo, Zhou, Li, and Wang (2013) believes that it is difficult to promote coal resource-based economic restructuring due to the strong market forces of the coal market. Therefore, the government should promote the low carbon industry transformation by technological innovation and institutional innovation, the development of low carbon industries, and promote low-carbon development concept, meanwhile the government should support the traditional non resource-based low pollution industries.

(a) Increase governmental support of low-carbon technology innovation. The practice of resource-based cities has proved that the simple development of resources based economy without seeking innovation, is no way out (Shi, 2012). The low carbon transformation can not be successful without low-carbon technology, especially the technology of energy saving and emission reduction, clean energy development and application technology. Therefore, the support and guidance of the government who may accelerate the replacement rate of the traditional

high carbon industry are undoubtedly necessary.

(b) Start to develop low carbon and sustainable industries with the advantage of resources. Resource-based cities can take advantage of the local resources, and gradually realize the low carbonization of industrial development. In the preliminary stage, it is wise to extend the industrial chain and develop alternative industries that may rely on resources while making less pollution. In the late period, it is necessary to actively introduce the alternative industries that are not relying on resources at all, especially those eco industries of high-quality projects. In this way, the cities may gradually throw off the shackles of resource industries.

(c) Set up the idea of ecological civilization and promote the concept of low-carbon development. At the micro level, enterprises should implement low carbon operation, and the public should conduct low carbon life, which requires "education and media institutions to carry corresponding social responsibilities, and strive to improve public ecological consciousness and knowledge of low carbon life" (Xu, Wang, & Gao, 2014). At the macro level, it is necessary to form a good social low carbon culture atmosphere, formulate policies and regulations for low carbon transformation, and to promote social organizations to participate in and supervise the development of urban industries and low carbon process.

(d) Support the traditional non-resource-based low pollution industries. The excessive prosperity of the resource-based industry can result in the outflow of labors, talents and capital from the traditional industries, resulting in the slowness of the development of the traditional industries. Therefore, in resource-based cities, the traditional industries must be supported by

the government. Taking the practice of Ordos City as an example, cashmere industry has been a local pillar industry, however after the rising of the resource-based industries, a large number of local talents and funds left the cashmere industry. Therefore, in the market of this kind, it is necessary for the government to support the traditional industries in the region.

## CONCLUSION

The development practice of the Ordos City has proved that it is hard for the resource-based cities that simply rely on the energy industry to realize stable and sustainable development pattern. Only through the extension of industrial chain, relying on the advantages of resource endowment and the development of non-resource-based low pollution industries that the cities can achieve sustainable development pattern. It is needless to say that the development of low carbon economy is a trend of the industry transformation in the future. The key to the low carbon economic development of coal based cities is “production concept” and “market guide”, “low carbon education”, “low carbon products return” and “low carbon consumption consciousness”, “low carbon planning” and “low carbon law” (Fu & Shang, 2012). The government should encourage and guide enterprises to develop low-carbon products, help enterprises to develop the market, to promote the concept of low-carbon consumption, and improve the low-carbon laws and regulations and policies. This should also be a basic model for the development of all resource-based cities.

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