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## Economic Instruments for Environmental Transformation of Shanxi Province

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DOI: <https://doi.org/10.32782/2707-8019/2022-1-4>

**Abstract.** *The paper examines the features of the ecological transformation of the economy in the Shanxi province. The author has developed an analytical assessment of the practical use of economic tools for the implementation of the environmental transformation of the Shanxi province. To improve the process of ecological transformation of the national economy in Shanxi province, it is necessary to take into account the following directions: improving the use of ecological and economic tools, active development of the national economy in the direction of increasing the degree of processing of raw materials, reducing production waste, increasing the level of recycling of materials, expanding the ecological sector of the economy, increasing investments in the field of scientific environmental research. The paper proposes a system of criteria for assessing environmental and economic policy instruments.*

**Keywords:** *environmental and economic instruments, environmental transformation, environmental economics, economy of the PRC.*

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### 1 Introduction

The economy of Shaanxi Province is one of the most competitive and fastest growing provinces in China. At the same time, important economic achievements are often accompanied by negative externalities in relation to the natural environment.

Currently, there is a tendency in China to synthesize ecological and anthropocentric approaches to the environment. We are talking about the concept of sustainable development, according to which the immediate benefit from the use of natural resources should give way to a long-term program for the preservation, firstly, of those functions of the natural environment that humans use, and secondly, of nature itself, since it is untouched nature, being part of the natural heritage may be a necessary condition for human life. Thus, the determination of the destructive impact of industries and the formation of recommendations for improving the conduct of the national economy is an important scientific issue.

The scientific direction of the implementation of the policy of environmental transformation (ET) and certain applied issues are investigated in works of: Balatskiy O. F., Wang Wanshan, Gang Sun, Liu Chi, Melnyk L. H., Pakhomova N., Pigu A., Ping Tsuo, Jong Weiwei and others.

At the same time, a significant number of scientific problems regarding the formation of an effective economic mechanism for the ecological transformation of economic systems and its adaptation to the conditions of China remain unresolved. In particular, one of the important factors in ensuring the transition of society to a sustainable development model is to increase the environmental and economic efficiency of economic activity. We are talking about the need to reduce the use of natural resources, which are spent per unit of production, to reduce the amount of pollutants, waste, the formation of which is associated with the production of a unit of production of each of the sectors of the national economy and the economy in general.

This paper raises questions of the implementation of the environmental transformation of the Shanxi province in order to develop a system of measures for making managerial decisions.

The economy of the province Shanxi specializes mainly in the "old" industries - coal and chemical industries, ferrous metallurgy, heavy and transport engineering, thermal energy, production of cement and other building materials, mining of iron ore and bauxite, railroad transportation. Since the 2000s, the Chinese authorities have carried out a series of reforms, reducing excess capacity and closing

outdated factories, which has positively affected the overall level of environmental pollution. In 2018, the gross domestic product of Shanxi province grew by 6.7%, according to the human development index (0.750), Shanxi was in 16th place, referring to the category of "medium" provinces.

The province's gross regional product in 2019 was 2.579 billion yuan, 14th in China; Shaanxi is ranked 12th in terms of GRP per capita (66.649 yuan). Shaanxi is estimated to have the richest resource base in the country. In particular, the province has significant reserves of oil, natural gas and coal. In terms of oil and gas production, Shaanxi ranks first in the PRC (35.4 million tons and 47 billion cubic meters in 2019, respectively). In terms of added value, the secondary sector of the economy (industry) in Shaanxi surpasses the tertiary sector (services), which indicates the role of the extractive industry in the economy of the region. Oil and gas deposits are located in the north of Shaanxi. In the central part, the economic center of gravity falls on the Xi'an agglomeration; the metropolis of Xi'an itself produces about 36% of the province's GRP.

As of 2019, passenger rail traffic through Shanxi province reached 81.53 million (+ 2.5% year-on-year), while freight traffic reached 913.21 million metric tons (+ 7.1%). Shanxi province is connected by 50 regular freight rail routes with the countries of Central Asia and Europe. The main hubs are Zhongding Logistics Park and Taiyuan International Mail Exchange Bureau in Taiyuan.

Shanxi has 86 development zones with a total area of 7186 square kilometers, including 67 industrial development zones with a total area of 2853 square kilometers, 12 agricultural development zones with a total area of 1490 square kilometers, and 7 ecological and cultural tourism zones with a total area of 2843 square kilometers.

In the economy of Shaanxi province in 2011 year.. (the first year of the "12th Five-Year Plan") significant economic results have been achieved: the province's GDP reached 1239130 billion yuan (US \$ 1≈7 yuan), an increase of 13.9% over the previous year. Shaanxi Province maintains a simple GDP rate that exceeds 10% for the 10th year in a row (Figure 1). At the same time, the added value of primary industry amounted to 122,090 million yuan, an increase of 5.9%; secondary industry 683,627 million yuan, an increase of 16.9%; other industries – 433,413 million yuan, an increase of 11.7%.

In the structure of production, gross value added for 2005–2013. in Shanxi province, in terms of economic activity, the most important place is occupied by agriculture 21%, mining

industry – 14%, manufacturing industry – 11%, electricity production – 16%.

Studies have shown that Shaanxi consumes about 24.6% of the water resources of its territory, with an average world value of 8–10%. Thus, the economic sphere of Shaanxi province during 2000–2013. shows positive changes in the dynamics of the main macroeconomic indicators, which creates a positive basis for ensuring the transition of the country's economy to sustainable development.

## 2 Methodology

It is proposed to take into account the following parameters as the basic criteria for assessing the effectiveness of economic instruments of environmental transformation: cost efficiency, reliability, information requirements, feasibility, long-term impact, flexibility, fairness, minimum uncertainty.

Based on the above considerations and on the basis of research (Liu Zhi, 2007), the following methodology for assessing and selecting priority tools has been developed in order to ensure the use of a control method of influence, based on a group examination:

Familiarization of government representatives, enterprise management (or leading employees) and other interested persons with the theoretical and methodological foundations of the formation of control actions on the sectors of the national economy and a complex of economic instruments with their essence and forms of implementation.

Conducting a group examination of the selection of economic instruments and methods based on the selected criteria. The experts are divided into subgroups of 8–10 people each. Each expert is given a table containing a list of tools and methods, and columns for fixing the expert's assessments according to the criteria (cost efficiency, reliability, information requirements, feasibility, long-term action, flexibility, fairness, minimal uncertainty). During the examination process, each expert evaluates each strategy as follows:

- $r^s = 1$  – low level of use (by criteria);
- $r^s = 2$  – average level of use (by criteria);
- $r^s = 3$  – high level of use (by criteria).

The results of the group examination are processed for each criterion. Total levels  $R_k^s$  are determined in accordance with the expression (Liu Zhi, 2007):

$$R_k^s = \frac{1}{m} \sum_{l=1}^m R_{lk}^s \left( \sum_{j=1}^n \frac{1}{n} r_{jk}^s \right), \quad (1)$$

where  $r_{jk}^s$  – the level of assessment given to the  $S$  instrument by the  $j$ -th expert, according to the

**Table 1** Indices of natural intensity of GDP by areas of activity from 2004 to 2009

Item No.	Economic activities	Energy capacity of GDP	Material consumption of GDP	Water capacity Gdp
1	Agriculture	0.79	0.96	0.85
2	Extractive industry	0.81	0.9	0.69
3	Manufacturing industry	0.42	0.86	0.41
4	Woodworking industry	0.22	0.59	0.29
5	Food industry	0.45	0.61	0.19
6	Chemical production	0.53	0.73	0.47
7	Mechanical industry	0.42	0.5	0.18
8	Construction	0.12	0.43	0.1
9	Tourism	0.15	0.12	0.1
10	Transport	0.12	0.32	0.21
11	Power generation	0.91	0.96	0.92

Source: (calculated by the author based on (Melnyk L., Karintseva O., 2004))

$k$ -th criterion;  $R_{lk}^s$  – the average level of assessment  $S$  of the instrument by the  $l$ -th group of experts according to the  $k$ -th criterion;  $R_k^s$  – the average level of assessment  $s$  of the instrument for all groups of experts according to the  $k$ -th criterion;  $m$  is the number of expert groups ( $l = 1, \dots, m$ );  $n$  is the number of experts in the group ( $j = 1, \dots, n$ );  $z$  is the number of evaluated instruments (methods) ( $s = 1, \dots, z$ );  $r^s$  – the number of levels of assessment of the instrument (method) ( $r^s = 1, 2, 3$ ).

The generated data of the average assessment levels for each instrument is measured using a weighting factor and presented in the form of a summary table. Thus, the integral degree of effectiveness of this instrument is calculated for each criterion based on the formula:

$$E_i = \sum_{i=1}^n K_i \cdot R_k^s, \quad (2)$$

where  $K_i$  is the coefficient of significance of the  $i$ -th instrument according to the  $n$ -th criterion,  $E_i$  is the degree of effectiveness of the  $i$ -th instrument.

The table containing the list of instruments is sorted by the degree of decreasing scores  $E_i$  and is submitted to special authorities for analysis and the final choice of control action, taking into account other applied methods.

Of course, the proposed list of criteria can be supplemented and adjusted according to the specifics of the industry or enterprise, market characteristics, etc. The values that characterize the degree of weight of a particular criterion are determined on the basis of existing experience or by the method of expert assessments (in the absence of retrospective experience).

### 3 Results

The introduction of an environmental management system is a complex and dynamic process that affects the economic, production, management, social, psychological, educational and other aspects of the activities of both individual enterprises and corporations, and regions, countries in general.

The economic support of ET can be realized primarily at the expense of the industry's own funds. Among the most promising areas for raising funds should be highlighted:

- obtaining international grants for environmental activities;
- use of a part of internal and external investments;
- receiving funds (benefits) within the framework of state and regional targeted environmental programs, programs of socio-economic development.

It is believed that ET is a process in which human economic activity in the environmental sphere is improved in accordance with the goals of sustainable development. To improve the process of ecological transformation of the national economy in the province Shanxi, it is necessary to consider the following areas:

- *improving positions on the use of environmental and economic tools.* The main means of achieving the goals of ET is government policy, although environmental and economic tools are used, they mostly play the role of “collecting” funds. In the current political situation, the administrative order is clearly very effective. But dependence only on administrative resources (closure of enterprises) strongly hinders

the innovative, ecologically oriented development of the national economy;

– *active development of the national economy on the basis of a reproductive economy.* Recycling economy is a trend in the development of the national economy around the world, which is based on the efficient and recyclable use of resources, characterized by clean production, highly efficient waste management and resource regeneration. The main principles are to reduce the amount of resource use, reuse and intensify resources. This system does not at all mean the elimination of the traditional model of improving and developing the economy, but shows the features of the concept of sustainable development. It is realized through the use of new environmentally friendly production technologies, resource saving, efficient means and equipment to reduce emissions;

– *formation of an environmentally friendly sector of the economy.* In the process of managing ET in Shanxi province, it is necessary to focus on the main environmentally friendly industries identified as a result of assessing the environmental level of production impact. Effective distribution of strategic directions of management influence is of decisive importance in the entire ET system. The formed ecological sector of the economy will contribute to the development of the "green GDP" accounting system in the country;

– *increased investment in environmental scientific research.* Environmental science research is the most important prerequisite for doing ET in the province. This work not only contributes to the solution of technical work in the field of mastering new production technologies and equipment for environmental protection, as well as the establishment of new tasks and goals for the implementation of the sustainable development strategy.

At the same time, according to the indicators of the natural intensity of GDP, the Shanxi province significantly and exceeds the world average indices (Table 1).

The index of natural intensity of GDP for the main types of economic activity was calculated as the arithmetic mean of the indicated indicators. This calculation was performed using the Excel program on the basis of statistical data, as well as scientific developments (Shaanxi Provincial Statistics Committee, 2012).

#### 4 Conclusion

The paper examines the features of the ecological transformation of the economy in the Shanxi province, offers an analytical assessment of the practical use of the ecological and economic mechanism for the implementation of ET in the Shanxi province.

To improve the process of ecological transformation of the national economy in Shanxi province, it is necessary to take into account the following directions: improving the use of ecological and economic tools, active development of the national economy in the direction of increasing the degree of processing of raw materials, reducing production waste, increasing the level of recycling of materials, expanding the ecological sector of the economy, increasing investments in the field of scientific environmental research. For the effective implementation of ET, it is recommended to comprehensively select environmental and economic tools for management influence. To substantiate management decisions, a system of analytical assessment of the priority of certain economic and organizational tools is proposed. As criteria for evaluating tools, the following are proposed: cost efficiency, reliability, simplicity of information requirements, feasibility of implementation, long-term action, flexibility, fairness and minimal uncertainty.

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