



## INTERNATIONAL WORKSHOP ADVANCES IN CLEANER PRODUCTION

"KEY ELEMENTS FOR A SUSTAINABLE WORLD: ENERGY, WATER AND CLIMATE CHANGE"

# Factors Analysis on Promotion of Cleaner Production in Compulsory Enterprises

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### Abstract

Effects of economy, pollution press and external conditions on promotion of cleaner production (CP) in compulsory enterprises were analyzed by regression method. As results, promotion of CP in compulsory enterprises depend on economy and pollution press presently. This drives greater role of the driving forces are internal, external role to be strengthened. At present, the per capita GDP for each additional 10,000 Yuan increases compulsory enterprises audited rate by 5.9 percent, sulfur dioxide emissions per capita for each additional 10kg will lead to compulsory enterprises audited rate increased by 0.8%. In future, the main power for promotion of CP in compulsory enterprises come from improving external conditions such as relevant systems, regulatory policies, incentives and public participation.

*Keywords: Compulsory enterprises, Cleaner production, Promotion, Factors analysis.*

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## 1 Introduction

Idea of cleaner production was firstly embodied in the policy of putting prevention first and combining prevention with control in the 'Regulations on protection and improvement of environment' published in 1973. Since then, Cleaner production (CP) in China has experienced the formation stage of CP (1973 -1992), the law stage (1993-2002), the institutionalization stage (2003 - ) (Duan, N., et al., 2007). Especially, Cleaner Production Promotion Law was enacted in 2003, marking CP in China into the legal track. By 2007, China has promulgated a number of documents to guide and supervise development of cleaner production in enterprises such as the CP Audit Interim Measures, Compulsory Enterprises of CP Audit Procedures and the Notice on Further Strengthening CP Audit in Compulsory Enterprises (Li, X.M., 2008).

Although CP in compulsory enterprises have made certain achievements (Duan, N., 2003) its implementation and understanding level are far from expected level of relevant policies and regulations. Many researchers focusing on the macroscopic aspects such as the legal, policy and management discussed factors on promotion of

CP in compulsory enterprises (Li, G.J., et al., 2004. Wang, Z.C., et al., 2000. Mou, Q.J., et al., 2003), and less paid attention to the original driving force on promotion of CP in compulsory enterprises on microcosmic aspects. In this paper, survey data on CP audit in compulsory enterprises from 27 provinces and cities over the years were collected. Promotion of CP in compulsory enterprises was evaluated by number of the published, audited and accepted compulsory enterprises. Driving force of promotion of CP in compulsory enterprises was analyzed from economic development, pollution press and external conditions, and deeply discussed the micro-mechanism on promotion of CP in compulsory enterprises as published rate, audited rate and accepted rate three indicators. All of this paves the way to speed up CP in compulsory enterprises.

## 2 Overview of CP in compulsory enterprises

Compulsory enterprises referring to Cleaner Production Promotion Law defined as enterprises whose pollutant emissions exceed national and local emissions standards or exceed total pollutants emission control targets approved by the local people's governments (commonly known as double-excess), and the use of toxic and hazardous raw materials for production or in production of toxic emissions, harmful substances (commonly known as double-production), usually named as double-excess, double production enterprise (Li, X.M., 2008). Definition of acquired, published, audited and accepted enterprises refers to compulsory enterprises with double-excess or double production known by local environmental protection department, published in local media, audited by qualified audit organization and accepted by local environmental protection department, respectively.

### 2.1 General

Promotion situation of CP in compulsory enterprises in China past years was shown in Fig. 1. As shown in Fig. 1, number of published enterprises, audited enterprises and accepted enterprises showed an upward trend, especially after 2005, the rate of increase is even faster, reflecting that CP in compulsory enterprises are pushed effectively.

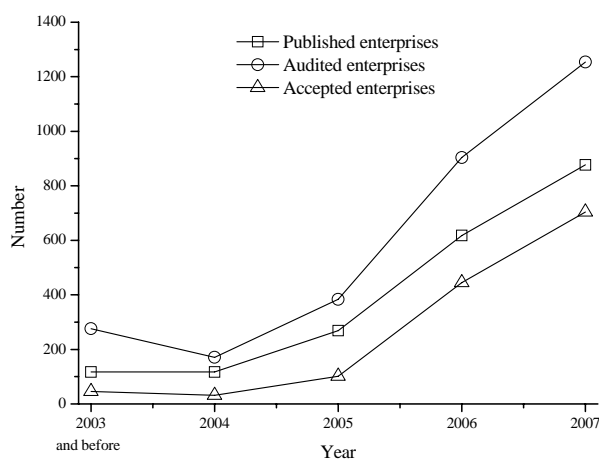


Fig. 1. Promotion situation of CP in compulsory enterprises in China past years

### 2.2 Region features

Number of province with releasing list of compulsory enterprises in six regions was shown in Fig. 2. As for six regions, North China including Beijing, Tianjin, Hebei,

Shanxi, Inner Mongolia (5 provinces, municipalities); Northeast: Liaoning, Jilin, Heilongjiang (3 provinces); East China: Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong (7 provinces and municipalities); Central South: Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan (6 provinces, autonomous regions); Southwest: Chongqing, Sichuan, Guizhou, Yunnan, Tibet (5 provinces and autonomous regions); Northwest: Shaanxi, Gansu, Qinghai, Xiamen and Nanjing, Xinjiang (5 provinces and autonomous regions). Data in blank of Fig. 2 are number of provinces and cities without publishing list of compulsory enterprises. There are big different in release of compulsory enterprises among regions, although CP in compulsory enterprises make good achievement. Now, North China, Northeast and Northwest release better and Central South, Southwest lagging behind.

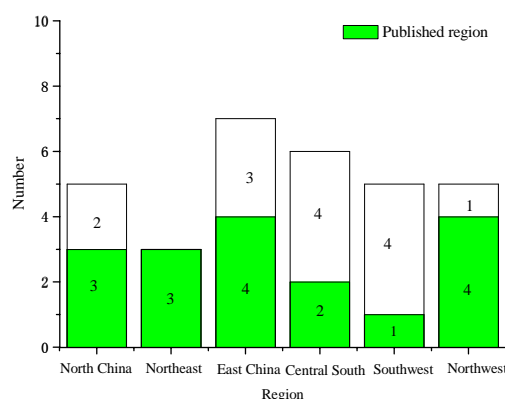


Fig. 2. Number of province with releasing list of compulsory enterprises in six regions

Fig. 3 showed that number of acquired enterprises had big different among provinces, comparing the number of acquired enterprises, number of published enterprises are significantly less. Promotion of CP in compulsory enterprises in China was display by the three indicators published rate, audited rate and accepted rate and the calculation formula as follows:

Published rate = number of published enterprises/number of acquired enterprises × 100%

Audited rate = number of audited enterprises/ number of acquired enterprises × 100%

Accepted rate = number of accepted enterprises/number of audited enterprises × 100%

Based on current available data, published rate was 26.6 percent, audited rate 39.8 percent. The phenomenon that number of audited enterprises exceeds than that of published enterprises indicated that many enterprises did not published its pollution information with the law although they had been audited, at the same time reflected that local environmental protection departments and enterprises were cautious for the published list taking into account the possible adverse effects.

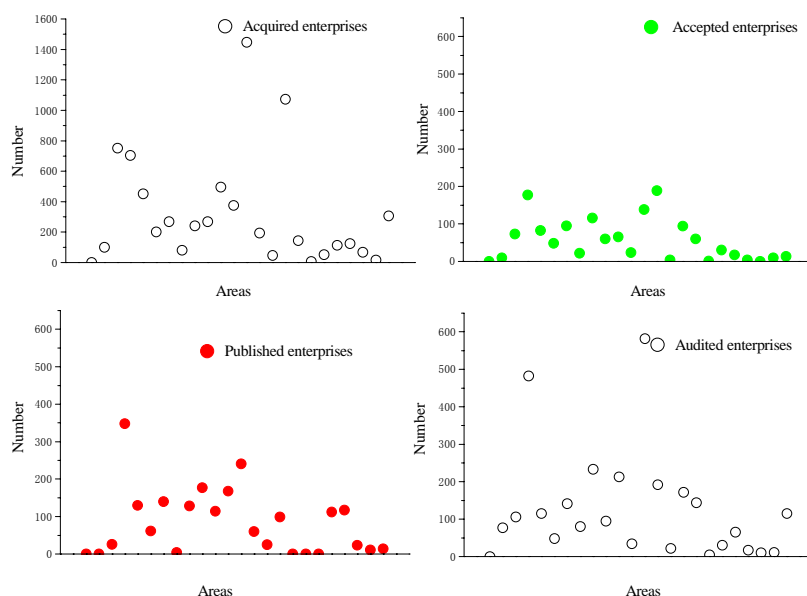


Fig. 3. Number of acquired, published, audited and accepted enterprises in different provinces

### 3 Results and discussion

The above analysis shows that advancing of CP in compulsory enterprises have quite difference resulting from reasons that are both internal factors such as the level of local economic development, pollution constraints and external conditions such as management, attention. The following discussion focused on drive function and mechanism from economic development, pollution stress and external conditions to promote CP in compulsory enterprises.

#### 3.1 Effect of economic development

Solution of many important questions depended on economic development, for example, environment EKC curve revealed the inverted U-shaped relationship between economic development and pollutants emission (Hu, D., et al., 2003). Effect of GDP per capita on promotion of CP in compulsory enterprises was shown in Fig. 4. It can be seen that audited rate increase with the rise of GDP per capita, but a downward trend for published rate and accepted rate. The former show that the relationship between promotion of CP in compulsory enterprises and economic development has a significant positive correlation, economic development are the important driving force to advance CP in compulsory enterprises. The latter's downward trend may be due to local protectionism resulting in un-release, trust of the audited enterprises resulting in un-inspection in better developed area. At the same time, it reflects the audit rate for the indicator is more appropriate than others. Regression of available data showed that GDP per capita for each additional 10,000 Yuan increases compulsory enterprises audited rate by 5.9 percent at the current economic development.

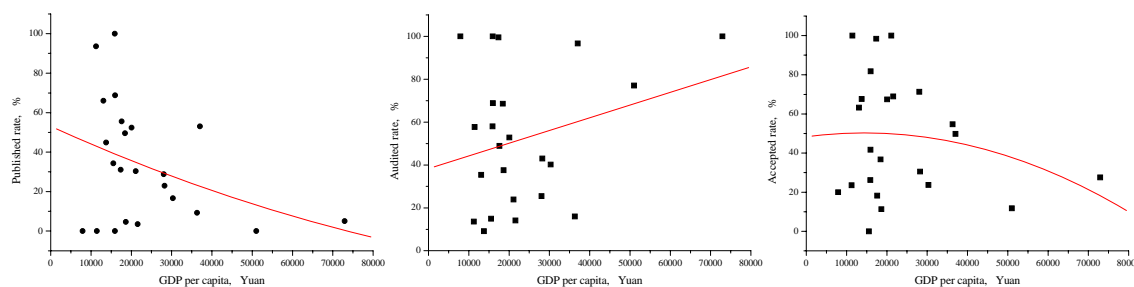


Fig. 4. Effect of GDP per capita on promotion of CP in compulsory enterprises

### 3.2 Effect of pollution press

The fundamental purpose of CP is the removal of pollutants. China's economic development is restricted by problem of pollution significantly. Pollution problems are not resolved that will not be able to sustainable development. On the contrary, pollution press is also important drive power to advancing CP in enterprise. Sulfur dioxide emissions per capita were accepted by indicator to analyze effect of pollution press.

Effect of sulfur dioxide emissions per capita on promotion of CP in compulsory enterprises was shown in Fig. 5. With the increase in sulfur dioxide emissions per capita, published rate, audited rate and accepted rate displayed as rising trend obviously. When sulfur dioxide emissions per capita was less than 35kg / cap, published rate and accepted rate were paid less attention, and higher than 35kg / cap with intensive pollution press, published rate and accepted rate were increased gradually with the rise of sulfur dioxide emissions per capita. With the rise of sulfur dioxide emissions per capita audited rate had been increasing trend, which showed that pollution stress was one power of drive to advancing CP in compulsory enterprises. Regression of available data indicated that at current stage, sulfur dioxide emissions per capita for each additional 10kg will lead to compulsory enterprises audited rate increased by 0.8%.

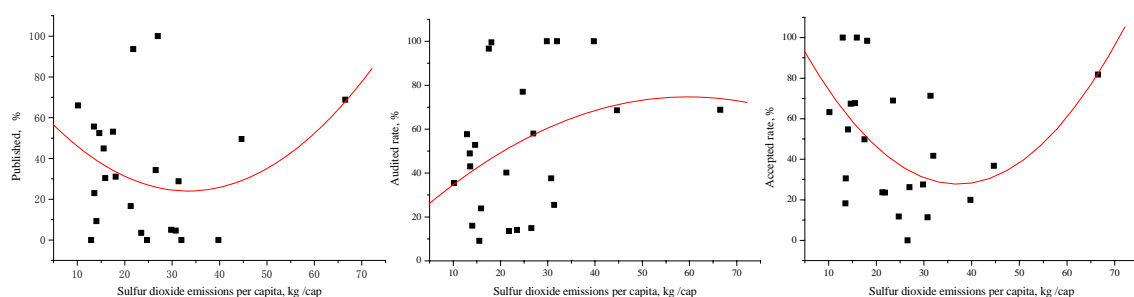


Fig. 5. Effect of sulfur dioxide emissions per capita on promotion of CP in compulsory enterprises

### 3.3 Effect of external conditions

External conditions, such as management policies, staff training, publicity and education are also important impetus on progressing CP in compulsory enterprises. Number of auditor qualification of national CP that was comprehensive indicators reflected the extent of the role of external conditions was adopted to discuss effect of external conditions.

Effect of staff training on promotion of CP in compulsory enterprises was shown Fig. 6. It can be seen that between published rate and staff training has no significant

relationship. But, audited rate and accepted rate was positive correlation trend on staff training. Staff training has a positive role in promoting CP in compulsory enterprises.

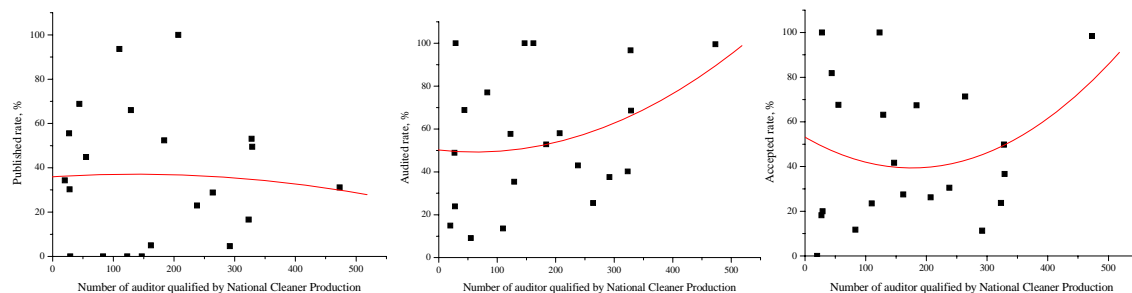


Fig. 6. Effect of staff training on promotion of CP in compulsory enterprises

## 4 Conclusions

Advances on CP in compulsory enterprises can be well presented by published rate, audited rate and accepted rate. Promotion of CP in compulsory enterprises has big different among regions. Taking account into effects of data, external influences and other factors, audited rate will be more appropriate and accurate than the two others to show advances on CP in compulsory enterprises.

Promotion of CP in compulsory enterprises depend on economy and pollution press presently. This drives greater role of the driving forces are internal, external role to be strengthened. At present, the per capita GDP for each additional 10,000 Yuan increases compulsory enterprises audited rate by 5.9 percent, sulfur dioxide emissions per capita for each additional 10kg will lead to compulsory enterprises audited rate increased by 0.8%.

At current stage, promotion of CP in compulsory enterprises is more depend on own internal driving force, such as economic development, pollution stress. As for our serious pollution, such drive mode is passive. In future, the main power for promotion of CP in compulsory enterprises come from improving external conditions such as relevant systems, regulatory policies, incentives and public participation.

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