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A Study on Environmental Cost of China's Oil Production and Utilization

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Abstract: This paper puts forward the environmental cost of China's oil production and utilization in the aspect of atmosphere. Every aspect of oil production and utilization from exploitation to processing, and petroleum products consumption can produce negative effects on the environment, such as environmental pollution. This paper estimates the environmental cost of China's oil production and utilization in 2015, and the results show that the environmental cost per metric ton of oil consumption is 487.9 RMB. Water pollution and water damage costs are not revealed.

1. Introduction

The production and utilization of oil caused a series of negative effects on environment in China. The environmental cost of oil exploitation and utilization is not fully reflected in the current market system. In order to promote the internalization of oil's environmental costs in China, we analyze the air pollution cost of oil, which refers to the impacts of oil-production, oil-processing, and oil-consumption on the atmosphere and climate, and the monetized environmental costs for the above three areas in China.

2. The Environmental Impact of Oil Utilization

2.1. Oil-production

The oil production process also produces volatile organic compounds (VOCs), sulfur dioxide (SO_2), nitrogen oxides (NOx), particulate matter (PM) and other atmospheric pollutants, which are the important precursors of $PM_{2.5}$ and O_3. In 2015, the emissions of VOCs, SO_2, NOx and PM in China's petroleum exploration industry were 122 thousand tons, 29 thousand tons, 28 thousand tons and 9 thousand tons respectively.

Crude oil is transported mainly via shipping and pipelines, including railways and highways. Marine oil spill accidents bring huge economic loss to fisheries, aquaculture, coastal tourism, marine transportation, and other industries, and causes abnormal changes in the marine ecosystem. China releases about 1.28 million tons of oil into the sea every year (including industrial emissions, oil spills from ships, oil spills from accidents, leakage from undersea oil fields and blowout accidents).

2.2. Oil-processing

Petroleum processing, coking, nuclear fuel processing (Industrial classification for national economic activities), and raw chemical materials and chemical product manufacturing are all also important

sources of atmospheric pollutants. In 2015, the emissions of VOCs, SO_2, NOx and PM in the petroleum processing industry were 1.7 million tons, 0.2 million tons, 0.2 million tons and 84 thousand tons respectively.

In the process of petroleum processing, there are a variety of industrial solid wastes, including waste catalysts, waste adsorbents, waste ceramic balls, etc., as well as coal ash slag and domestic garbage generated by power stations. The petroleum processing industry produces 370 million tons of general industrial solid waste, accounting for 11.8% of total industrial output. The output of hazardous waste was 9.15 million tons, accounting for 23.0% of the total output of industrial hazardous waste.

2.3. Oil-consumption

China's refined oil products (including gasoline, kerosene, and diesel) account for about 53% of total oil consumption, used mainly for motor vehicles and non-road mobile machineries. The exhaust emitted by mobile sources (Mobile sources include motor vehicles and non-road mobile machineries such as construction machinery, agricultural machinery, small general machinery, diesel generator sets, ships, railway diesel locomotives, and aircraft.) contains hundreds of different pollutants, including NOx, VOCs, PM, hydrocarbons, etc., and is an important precursor for $PM_{2.5}$ and O_3. The health effects of air pollution are characterized by the number of premature deaths caused by IHD, stroke, COPD and LC. In 2015, the emissions of NOx from mobile sources were 11.5 million tons. The emissions of NOx from mobile sources (including motor vehicles and non-road mobile machinery) accounted for 98.2%, of the emissions of air pollutants from oil-related industries, respectively.

An air quality model was used to simulate the effects of atmospheric pollutant emissions from oil-related industries on the average annual concentration of $PM_{2.5}$. The results showed that, in 2015, petroleum-related industries accounted for 10.9% of the national $PM_{2.5}$ concentration, with transportation accounting for 9.8% and the petrochemical industry accounting for 1.1%.

Plastics are one of the main products of the petroleum industry. According to relevant research reports, plastic production accounts for 6% of total oil consumption, and its production, consumption, and disposal has negative environmental impacts. Some plastics can be recycled, but most of them are incinerated, disposed of in landfills, or otherwise discarded. Incinerated plastics can result in significant pollution, landfills can destroy soil structure and hinder plant growth, and plastics discarded in the sea can harm marine ecology and affect human health.

3. The Environmental Costs of Oil

3.1. Method of environmental cost accounting

The governance cost method apply to calculate different cost. Here we use the physical and value quantity of air pollution to calculate the environmental cost of oil.

$$C_i = Physical\ quantity * Value\ quantity$$

C is the cost of each subitem, i is air pollution.

Governance method is used to calculate the cost of air pollution. Indicators of each subitem can be found in the next section.

3.2. The Calculation of Oil Environmental Costs

In the oil-producing and processing sectors, the main environmental costs to consider are air pollutant emissions. Water consumption, water pollution, soil pollution, solid waste discharge and the environmental impacts of accidents, for example petrochemical and chemical explosions, were not considered in this article.

The accounting results show that atmosphere environmental cost of China’s oil production and utilization was 487.9RMB per metric ton of oil consumption in 2015.

Table1. Atmosphere Environmental costs of oil

Section	Category	Indicator	Accounting result (yuan/ton) [Note1]
Oil-producing	Air pollution	Quantity of SO_2, NOx, PM and VOCs emissions，Virtual disposal cost of pollutants	2.4
Oil-processing	Air pollution	Quantity of SO_2, NOx, PM and VOCs emissions，Virtual disposal cost of pollutants	33.5
Oil-consuming	Air pollution	Quantity of SO_2, NOx, PM and VOCs emissions，Virtual disposal cost of pollutants	452.0
Subtotal			**487.9**

Note: 1. The environmental cost accounting results of petroleum in the table are amortized to the oil consumption per ton.

4. Policy Suggestions

1. Reduce the environmental impact of oil exploitation and utilization from the source

(1) Strengthen prevention and control of petrochemical and motor vehicle pollution and reduce pollutant discharge.

(2) Strengthen oil transportation safety management and reduce environmental pollution caused by oil leakage.

2. Promote the clean use of petroleum through economic measures

(1) Strengthen the monitoring and restoration of the impact of oil exploration enterprises on the ecological environment, and gradually establish a feasible ecological compensation and restoration mechanism.

(2) Promote internalization of environmental costs through tax measures.

On the production side, research and adjust the structure of tax policies, from taxing individual VOCs to taxing total VOCs emissions. Improve VOCs equivalent value to promote VOCs emission reduction.

On consumption side, improve the fuel consumption tax system to take environmental costs into consideration.

3. Promote public participation to reduce oil consumption

(1) Raise the public awareness of the importance for an oil cap in China.

(2) Promote green consumption and green transportation, lead the public to participate in plastics recycling, and strengthen plastics reduction.

4. Scientific and technical support

(1) Strengthen the development and promotion of new technologies such as green oil exploitation, pollutant emission control and ecological environment restoration.

(2) Promote the development of waste plastics recycling technology and reduce the impact of waste plastics on the environment.

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