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COLLECTING COAL-FIRED POWER ENVIRONMENTAL TAX TO PROMOTE WIND POWER DEVELOPMENT AND ENVIRONMENTAL IMPROVEMENT

Yanan Li, Peng Yang*, Huajun Wang

Department of new energy science and engineering, Hebei University of Technology, No. 8, glorious road, Hongqiao District, Tianjin, China.
****Corresponding Author Email: yphebut@163.com***

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ABSTRACT

A large part of air pollutant emissions such as PM2.5 in China is from coal-fired power. At present, the cost of coal-fired power is only calculated the cost of energy conversion and equipment investment, but the environmental cost in generation process is not reflected in the pricing mechanism. This paper puts forward the concept of "coal-fired power environmental tax", which caused by environmental damage and economic losses, and converts it to full cost by the method of "coal-fired power full cost". Only in this concept, it is scientific for comparison between coal-fired power and renewable energy power like wind power. Analysis shows that the full cost of coal-fired power is higher than the full cost of wind power when collecting environmental tax. This paper gives advice of "coal-fired power environmental tax" to promote the development of renewable energy such as wind power and improve the atmosphere.

KEYWORDS:

Coal-fired Power Environmental Tax, Full Cost, Conversion of Environmental Cost, Wind Power Development, Environmental Improvement.

1. INTRODUCTION

China is rich in coal resources and is fully utilized, which has made outstanding contributions to domestic economic development and social progress. However, the environmental contamination problems in its utilization cannot be ignored. At present, the measurement method of coal electricity price mainly covers investment cost in power generation equipment and operation maintenance cost. The environmental cost caused by pollutant emission in coal power generation process is not reflected in the pricing mechanism yet, but is born by the whole society. Not only is it unfair to other energy generation forms, but to cause irreversible damage to human survival of the natural environment [1].

Therefore, the economic loss of environmental damage and human unhealthy caused by coal-fired power generation is converted into the complete cost in the electricity cost as the "environmental tax of coal electricity". Comparing coal-fired power generation to other renewable energy power generation such as wind power has a scientific significance.

1.1 Research background

1.1.2 Coal-fired power generation has become the important source of PM2.5 and other pollutants

Domestic coal-dominated energy structure directly determines the coal-fired thermal power as the main source of electricity in China. So a large part of air pollutants are from coal-fired power generation emissions. Taking PM2.5 as an example, the average concentration of PM2.5 in coal use is 56%, of which about 40% is discharged from coal-fired power plants [2].

1.1.2 China's coal pricing mechanism has not included environmental costs yet

Currently, China's coal-fired power generation price is mainly constituted by the project investment, electricity cost and tax according to the "Guidelines for Economic Evaluation of Thermal Power Generation Project" with reference to the "Reference Design Cost Quota of Thermal Power Project" [3,4].

The main factors that constitute the coal price are fuel and depreciation, which are 60%-65% and 19%-20% [5]. However, the unit price ratio of water fee, desulfurization and denitrification fee and sewage charge, which measure the environmental impact of coal power generation, is only 0.11%, 0.64% and 0.53% respectively. As shown in Figure 1.

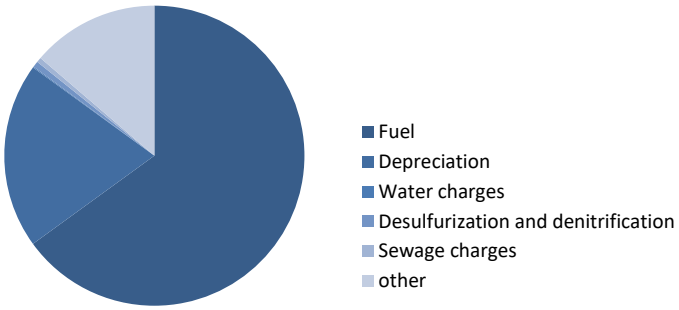

Figure 1: Pricing mechanism of China's coal-fired power at the present stage

Thus, at this stage of China's coal electricity price measurement methods mainly cover the cost of investment in power generation equipment and operating maintenance costs. On the other hand, the environmental cost caused by pollutant emission of power generation process is almost not reflected in the pricing mechanism, but by the whole society to bear the pollution caused by coal-fired power generation.

2. THE CONCEPT AND SIGNIFICANCE OF ENVIRONMENTAL TAX AND FULL COST OF COAL-FIRED POWER GENERATION

2.1 The concept of environmental taxes

Environmental taxes are the economic means of allocating the social costs of the environmental pollution and ecological destruction to the production costs and the market prices, and then distributing the environmental resources through the market mechanism [6].

2.2 The international experience of environmental tax levy

Typical environmental taxes in developed countries include air pollution tax, water pollution tax, noise tax, solid waste tax and garbage tax. The air pollution tax includes the sulfur dioxide levy for sulfur dioxide emissions, carbon tax for carbon dioxide emissions and stuff. In the 1970s the United States began to impose carbon dioxide tax, Germany, Japan, Norway, the Netherlands, Sweden, France and other countries have also levied a sulfur dioxide tax. The Australian government gives tax breaks to the enterprises which reducing carbon dioxide emissions [7].

2.3 The complete cost of power generation in various forms of energy

The latest EU analysis shows that onshore wind power costs around €105/MWh, taking into account air quality, human health and climate change. By contrast, natural gas and coal-fired power generation prices are €164/MWh and €233/MWh [8]. Therefore, the economic loss of environmental damage and human unhealthy caused by coal-fired power generation is converted into the complete cost in the electricity cost as the "environmental tax of coal electricity". Comparing coal-fired power generation to other renewable energy power generation such as wind power has a scientific significance. C_e represents the environmental tax in the form of an energy source, and C_p represents the cost of electricity generation. From the formula (1) can be calculated in the energy form of the full cost of electricity C_c.

$$C_c = C_P + C_e \quad (1)$$

3. CALCULATION METHOD OF COAL-FIRED POWER GENERATION ENVIRONMENT TAX AND FULL COST OF COAL-FIRED POWER GENERATION

3.1 Environmental taxes on coal-fired power generation

3.1.1 Coal production

The damage to environment caused by coal production is mainly reflected in water pollution, air pollution, solid waste pollution and ecological destruction. The accounting results are shown in Table 1 [9].

Table 1: Coal Production Environment Tax

Link	Accounting item	Environmental external cost (ten thousand yuan)	Ton coal cost (yuan / ton)
Coal production	Water pollution	509128	1.57
	Air Pollution	9363111	28.94
	Solid waste pollution	255420	0.80
	Ecological destruction	11964142	37.09
	Total	22091801	68.40

As can be seen from Table 1, the cost of coal production C_{eup} is 68.40 yuan/ton. In the year, the coal consumption in China's power industry is DC = 1.73 billion tons, and the total thermal power generation is P = 3325333.637 million kWh. Therefore, the environmental tax C_{ep} of coal production is calculated by formula (2), C_{ep} = 0.0356 yuan / kWh.

$$C_{ep} = C_{eup} * DC/P \quad (2)$$

3.1.2 Coal transportation

Environmental tax accounting indicators in coal transportation are coal dust pollution and exhaust emission in railway transport, coal dust pollution of water transport loading and unloading, as well as coal dust pollution in the storage process. Use the market value of the above indicators of accounting, accounting results shown in Table 2 [10].

Table 2: Coal Transportation Environment Tax

Link	Accounting item	Environmental external cost (ten thousand yuan)	Ton coal cost (yuan / ton)
Coal transportation	Railway transportation	5557798	35.62
	Port transportation	1046322	9.00
	Year - end inventory	21369	3.90
	Total	6625489	48.52

As can be seen from Table 2, the cost of coal transportation C_{eut} is 48.52 yuan/ton. In the year, the coal consumption in China's power industry is DC = 1.73 billion tons, and the total thermal power generation is P = 3325333.637 million kWh. Therefore, the environmental tax C_{et} of coal transportation is calculated by formula (3), C_{et}=0.0252 yuan / kWh.

$$C_{et} = C_{eut} * DC/P \quad (3)$$

3.1.3 Coal utilization

The calculation of environmental taxes on coal utilization mainly considers the economic losses caused by atmospheric pollutants emitted from coal-fired power generation. The most direct economic losses caused by China's air pollution estimates up to 3.8% based on willingness to pay each year [11]. In 2014, for example, the direct economic loss caused by air pollution was 2418.56 billion yuan, of which thermal power industry emissions of air pollutants accounted for 32.91% of total emissions [12]. So, the economic losses of air pollutants from coal-fired thermal power emissions EL_{2014} is 795.948 billion yuan. China's thermal power generation in 2014 is P_{2014}=4204.9 billion kWh. Therefore, the environmental tax C_{ee} of coal utilization is calculated by formula (4), C_{ee}=0.1893 yuan / kWh.

$$C_{ee} = EL_{2014}/P_{2014} \quad (4)$$

3.2 Environmental taxes on coal-fired thermal power

The above calculation shows that coal-fired thermal power environmental tax C_{efire} is calculated by the formula (5). C_{efire}=0.2501 yuan / kWh.

$$C_{efire} = C_{ep} + C_{et} + C_{ee} \quad (5)$$

3.3 Full cost of coal-fired thermal power

The current national average coal-fired thermal power price is 0.398 yuan / kWh, recorded as C_{pfire}. Coal-fired power generation enterprises denitrification price is 1 cent per kilowatt-hour, and dedusting price is 0.2 cents per kilowatt-hour. So, the cost of coal-fired thermal power subsidy C_{sub} is 0.012 yuan / kWh. Based on formula (1), the full cost of coal-fired thermal power can be calculated by the formula (6). C_{cfire}=0.6601 yuan / kWh.

$$C_{efire} = C_{pfire} + C_{sub} + C_{efire} \quad (6)$$

4. COMPARISON OF COMPLETE COST OF WIND POWER AND COAL-FIRED POWER GENERATION

4.1 Complete cost of wind power generation

4.1.1 Environmental taxes on wind power generation

China Academy of Engineering, "the key to greenhouse gas emissions from different power generation research," the wind energy sub-project team study shows that: wind power emissions of greenhouse E_{CO2} is 16.74gCO_2/kWh. The social cost of GHG emissions per unit C_{eu} is 263.16yuan/t. The wind environmental tax can be calculated by formula (7). C_{ewind}=0.0044 yuan / kWh.

$$C_{ewind} = E_{CO_2} * C_{eu} \quad (7)$$

4.1.2 Complete cost of wind power generation

In January 2015, the National Development and Reform Commission adjusted the benchmark price of wind power, as shown in Table 3. From the formula (8) can be obtained wind power-weighted average tariff C_{pwind}=0.5592 yuan / kWh.

$$C_{pwind} = \left(C_{pwind1} * R_1 + C_{pwind2} * R_2 + C_{pwind3} * R_3 + C_{pwind4} * R_4\right)/(R_1 + R_2 + R_3 + R_4) \quad (8)$$

Table 3: Cost of wind power

	On - grid tariff C_{pwind}(yuan / kWh)	Accounting for land area ratio R(%)	Weighted feed - in tariff C_{pwind}(yuan / kWh)
Category I wind resource areas	0.49	8	
Category II wind resource areas	0.52	18	
Category III wind resource areas	0.56	50	0.5592
Category IV wind resource areas	0.61	24	

Based on Eq. (1), the total cost of wind power generation is calculated by Eq. (9), which is 0.5636 yuan / kWh.

$$C_{ewind} = C_{pwind} + C_{ewind} \quad (9)$$

4.2 Comparison of complete cost between coal-fired thermal power generation and wind power generation

Based on the above calculation results, the complete cost of coal-fired thermal power generation and wind power generation is shown in Table 4.

Table 4: Comparison of full cost between coal-fired power and wind power

Full cost of coal-fired thermal power (yuan / kWh)	Full cost of wind power (yuan / kWh)
0.6601	0.5636

Through the formula (10) can be obtained the complete cost of coal-fired power is 17.12% higher than that of wind power considering "coal environmental tax" which is reflected economic losses caused by environmental damage and human unhealthy from coal-fired power generation.

$$R = (C_{cfire} - C_{cwind})/C_{cwind} \quad (10)$$

5. SUGGESTIONS AND SIGNIFICANCE OF LEVYING ENVIRONMENTAL TAXES ON COAL-FIRED POWER GENERATION

5.1 The necessity of levying environmental taxes on coal-fired power generation

The environmental tax on coal-fired power generation is a mandatory economic means to internalize the cost of environmental pollution from coal-fired power generation to production cost and market price, plus embodies it in the form of tax system. Renewable energy subsidies are incentives for renewable energy power generation enterprises to contribute to the protection of the environment. The two essentially the same meaning, are the embodiment of environmental costs. Therefore, the tax amount of coal-fired power generation environmental tax can be used as a subsidy of renewable energy sources of funding a fundamental solution to the problem of renewable energy subsidies crisis.

The collection of environmental taxes is an economic means of allocating the social costs of the environmental pollution and ecological destruction to the production costs and the market prices and then distributing the environmental resources through the market mechanism. Environmental tax levy mechanism can help to change the environmental protection administrative mechanism as the main idea to solve the problem of restricting the development of China's environmental protection industry, lack of investment funds, inadequate supervision and other issues, so it can play an important role in promoting China's ecological environment.

5.2 Suggestion on collecting environmental tax of coal-fired power generation

The collection methods of coal-fired power generation environmental tax can be determined accordance with the process of "mining - transportation - consumption (power generation)". Meanwhile, it is beneficial for coordinating the relevant departments to establish a computer network based on the environmental tax levy management system to improve the quality and efficiency of work.

Environmental taxes can be determined the level of tax rates based on corporate pollutants in the actual unit pollution control costs. For pollutant discharge behavior, the environmental tax payable is equivalent to the expected marginal cost of technological measures taken by enterprises to control pollution. The tax rate should meet or exceed the level of enterprise pollution control cost. Taking into account the affordability of China's enterprises, the environmental tax levy should not be too high, should be affordable in the enterprise to determine the scope of tax standards.

For the coal-fired thermal power industry, part of the environmental taxes levied is used to control pollutants such as sulfur dioxide, nitrogen oxides, carbon dioxide and dust (PM) emitted by coal-fired thermal power in the production, transportation and combustion power generation sectors. The other part is used to reward the contribution of renewable energy such as wind power and solar power generation to the environment.

Coal-fired thermal power environmental taxes levied reveals that coal-fired power generation prices rising in recent years to a stable value and then declining. The business costs will be increased and industry profits will be affected in a short term. However, it is promoting technological improvements of coal industry to achieve the purpose of energy-saving emission reduction and reducing taxes. So the long-term profits can be safeguarded, it is more conducive to improve the ecological environment overall.

5.3 Elimination of subsidy for wind power and promotion of environmental tax system

China has introduced a wind power subsidy policy in order to promote the development of wind power industry. This is not due to wind power is expensive, but its environmental tax is minimal compared to coal-fired power generation. Wind power subsidies are rewarded for their contribution to the environment, besides are reflected the value of wind power ecological benefits. Wind power subsidies will gradually disappear after the collection of coal-fired power generation environmental tax since the comparison of full cost from various forms of energy generation is more scientific.

The collection of environmental taxes increases the cost of fossil fuels. In the fixed market demand, wind and other renewable energy are relatively cheap so as to obtain more attention and recognition of the whole society to promote the development of renewable energy industry and generate new economic growth point. At the same time, more and more mature wind power technology will trigger more enterprises to research development and manufacture of wind power equipment in order to promote the rapid development of wind power industry and its advanced technology.

Environmental tax levy is not limited to coal-fired power generation industry, but also can be extended to other areas of coal use, such as heating, building materials, metallurgy and other industries. Not only can the coercive economic means solve environmental problems, but can provide special funds for the treatment of environmental pollution, while also promoting the sustainable development of the renewable energy industry.

6. CONCLUSION

The analysis shows that the complete cost with environmental tax of coal-fired power generation is higher than wind power generation, which highlights the economic and environmental benefits of wind power. Wind power subsidies as a reward for wind power contribution to the environment will gradually disappear with the gradual improvement of environmental tax system and the mature wind power industry.

The levy of environmental taxes on coal-fired power generation is the main way to solve environmental problems through economic means. Not only is this mean enable to provide financial support for environmental protection, but to improve the living environment of the human. Moreover, it is enabling to promote wind power and other renewable energy industry development in line with the concept of green development. Furthermore, the levy of environmental taxes lays a solid foundation for leading the fourth industrial revolution and provides effective protection to realize "Made in China 2025" planning objectives.

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