

Comprehensive Evaluation of Environmental Policies for Greenhouse Gas and Air Pollution Mitigation by Effective Utilization of Energy

Resources in China: A Regional Study

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Abstract

The unsustainable high reliance on coal to meet increasing energy demand has caused huge amount of greenhouse gas (GHG) and air pollution emission in China. Since coal is important energy resources to meet the rapid economic growth and industrialization, these trends are expected to continue. Substantial dependence upon an ever-growing use of coal will increase costs of environmental remediation. China is already the largest CO₂ emitter in the world and is facing great pressure in the international climate negotiations. Furthermore China will face serious pressure due to the deterioration of the environment such as acid rain, PM_{2.5}, pollution haze and so on. An Effective utilization of different energy carriers to transform the existing coal-dominant energy system into a clean-efficient one could be a practical way to achieve sustainable development target.

Chongqing is a typical area in this respect; it is one of the oldest heavy industry bases of China. Almost all of its energy comes from fossil fuels particularly coal. The proportion of coal to the total energy utilization was 70% in 2010. The reliance on coal for energy supply has caused environmental problems including acid rain which is mainly caused by SO₂ and NO_x emission; and air pollution (such as SO₂, NO_x, PM₁₀, PM_{2.5}) in addition to the rapid increase in GHG emissions. As one of the regions seriously damaged by acid rain, Chongqing was designated as both acid rain and SO₂ control zone by the national government. Chongqing's electricity supply sources mainly depend on coal-fired power (79%) and Hydropower (less than 20%) in 2010. As the increasing demand of electricity and limitation of undeveloped Hydropower resource, Chongqing will be locked into coal-fired power system. It will be much more difficult to Change the coal-dominant electricity supply system and reduce its relative environmental cost in the future if no measures are taken now.

The situation above calls for technology innovation in the electricity supply sector. Renewable energy could be one of the key alternatives to diversify the existing coal-dominant energy system as the technology improved and cost falls in the long term. However, with the exception of the already existing hydropower, the limitation of renewable exploration potential in Chongqing and the high cost of renewable development limit the renewable energy development in Chongqing. Therefore, in addition to renewable energy, practical high efficiency and low emission cleaner coal-fired and natural gas based electricity technology will be introduced in the energy sector to improve regional environmental quality as well as diversify energy supply source and promote energy conservation. These technologies can effectively mitigate the deterioration of the environment and achieve government regulation. However, costs of putting them into practice are higher than current coal-fired technology in Chongqing. In order to promote these cleaner technologies, we propose comprehensive policies of carbon tax and subsidy to diversify the coal-dominant energy system and form a tradeoff system including the economic development, energy conservation and ecosystem balance.

In this research, we focused on analyzing the effects of integrated environmental management policy including promotion of diversity advanced energy technology on improving trade-off between economic development, energy conservation and gases mitigation by transforming the existing coal-dominant energy system. To achieve our research objective, a comprehensive model was designed to simulate the future trends of socio-economic, energy, and environmental development. The model contains one objective function of gross regional product (GRP) maximization, the GHG and air pollutants flow balance model, the energy balance model and the socio-economic model, which are specified to identify key factors reflecting the environmental situation and economic entities activities. The results show an overall benefit on the quality of the Chongqing environment and energy conservation efforts. The study demonstrates that the introduction of regulations without promotion of technological innovation will dramatically affect economic growth. The results also show that innovations in the energy sector alone will reduce both air pollutants and energy intensity to a certain extent. In this regard we must also promote innovation in other economic sectors. Another important finding is the fact that the introduction of regulations will actually curb air emissions and energy consumption. This research provides a strong platform for policy makers to realize the urgency and importance of promoting technology innovation through environmental regulations.