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Climate change and energy development: implications for developing countries

Xia Cao *

Shanxi Financial and Economic University, Taiyuan, Shanxi 030006, PR China

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Abstract

The burning of fossil fuels emits greenhouse gases (GHGs), especially CO_2, possibly causing climate change. Environmentally friendly energy development has enormous implications for developing countries as major emitters due to their rapid economic and population growth. This paper presents an overview of developing countries in their efforts to reduce GHG emissions by reforming energy pricing, promoting energy efficiency, and using renewable energy sources. Then the paper focuses on the challenges facing developing countries, such as contradictory objectives, unrealistic emission standards and rigid incentives, and public environmental unawareness. With some possible options, the paper concludes that the reduction of emissions can only be achieved when policies are supportive and well targeted, standards and incentives are realistic and flexible, and the public is actively responsive to environmental degradation.

Keywords: Climate change; Energy development; Developing countries

Introduction

Energy is vital to economic development. It means material comforts to industrialized countries but the way to alleviate poverty in developing countries. The last three centuries have seen mankind's substantial dependence upon an ever-growing use of fossil fuels (coal, oil and gas) for industrialization and urbanization (Reddish and Rand, 1996). As a consequence, the combustion of the fuels has emitted greenhouse gases (GHGs), especially carbon dioxide (CO_2), possibly leading to climate change—'potentially the most devastating result of the modern energy use' (World Bank, 2000: p. 30); and at the same time threatening human health and settlement, ecological system, agriculture, and water resources as well. The most significant change in the earth's atmosphere began with the industrial revolution early in the last century and has picked up speed ever since. The industrial countries are not only responsible for their initial emissions of CO_2 during that period but also for the increased level of emission because of growing consumption especially of fossil fuels. Developing countries, on the other hand, have unarguably constituted a bigger emitter (see Fig. 1) given their rapid population and economic growth.

World population now is about 6 billion. According to the 1992 World Bank projections, world population will more than double by 2150. Two-thirds of the increase is projected to occur by 2050, of which 95% of growth would take place in developing countries (World Bank, 1992: p. 26). Population growth increases the demand for energy and implies increased environmental damage as well. The World Energy Council forecasts that on current trends the energy demand in developing countries will grow at 2.6% annually until 2020, compared with 1.4% for the world and 0.7% for OECD countries (World Bank, 2000: pp. 20–21). If the reliance on fossil fuels for economic development remains unchanged, much higher levels of CO_2 will be produced particularly from developing countries (see Fig. 1).

Compared with developed countries, the scenarios of population and economic growth have more significant

* Tel.: +86-351-7666026.
E-mail address: caoxia_502@163.com (Xia Cao).

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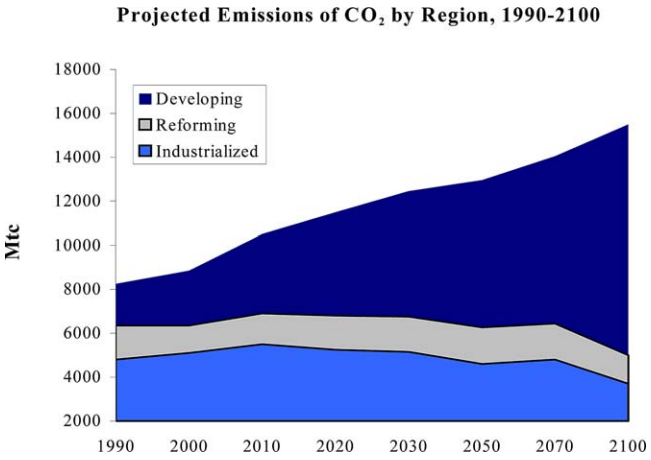

Fig. 1. *Source*: Johansson and McDade (1999: the World Bank: p. 69).

implications for developing countries to achieve economic growth to feed increasing population without intolerably devastating the environment, since the latter have less favorable economic circumstances, weaker institutions, less effective implementation of policies, limited financial and information resources. This paper begins by describing current practices in developing countries, such as energy pricing reform, promotion of energy efficiency as well as exploration of renewable energies in an attempt to curb CO_2 emissions. The second part addresses issues facing developing countries in the process of mitigating CO_2 emissions and suggests some possible policy options. The final part draws the conclusion that emissions abatement can only be achieved with supportive and well-targeted policies, realistic and flexible emission standards and incentives, and active public participation.

Integration of efforts

Energy pricing reform

Elimination of negative subsidies

Energy pricing is largely based on social and political principles rather than market values in developing countries (Sanderson and Islam, 2000). Energy products like coal in China, India, Poland and Turkey have been heavily subsidized (World Bank, 2000: p. 25), which leads to inefficient use of energy as well as serving as a disincentive to controlling emissions. The World Bank estimates for 1993 showed that developing countries and transition economies spent more than $ 230 billion per year on subsidizing energy. Over half of the air pollution in the Former Soviet Union (FSU) countries and Eastern European countries was attributable to these price distortions, and their removal of subsidies alone would sharply reduce the growth in energy consumption and could also cut world carbon emissions by 10% (World Bank, 2000: p. 41).

Developing countries are showing a move towards a 'more businesslike environment' in their recent developments (Asian Energy News, 1999). Between 1990–1991 and 1995–1996, total fossil fuel subsidies in 14 developing countries, making up 25% of global carbon emissions from industrial sectors, dropped 45% from $ 60 billion to about $ 33 billion (World Bank, 1997: p. 125).

In the case of China, with over 10% of the world total primary energy supply, the average energy subsidy is nearly 11% of reference price (Asian Energy News, 1999). China has emitted more than 3 billion tons of CO_2, accounting for 13% of global CO_2 emissions (ibid). Starting in the 1980s, China substantially reformed its energy pricing, with coal subsidies decreasing from 37% in 1984 to 29% in 1995, and oil subsidies falling from 55% in 1990 to 2% in 1995 (Reid and Goldemberg, 1998: p. 235). From 1990 to 1999, total world CO_2 emissions were 338.9 million tons. China produced 54.8 million tons, accounting for 6.2% (Davies, 2000)—a dramatic decline.

During the past 6 years, countries ranking among the top 25 industrial CO_2 emitters, like India, Mexico, South Africa, Saudi Arabia and Brazil, have also made efforts to cut energy subsidies. According to the World Bank estimates based on price elasticities of demand and inflation-adjusted internal fuel prices, 26 million tons of carbon savings per year can be achieved from energy price reforms in these countries (Munasinghe, 1998: p. 42).

Internalization of externalities

Energy pricing reforms have resulted in prices more or less reflecting production costs, but most prices are still far from reflecting social costs. Energy production and consumption produce both benefits and environmental costs, with the latter beyond market forces. The application of economic incentives, such as emissions charges, has proven to be effective in adjusting market prices to reflect externalities. For example, the introduction of a gasoline tax, along with other measures in Mexico, has dramatically reduced GHG emissions coming from transportation (World Bank, 1992: pp. 74–75). China has been experimenting with a discharge permit or license system (Panayotou, 1998) since 1991, which specifies allowable pollution levels for air. A non-compliance fee is charged on those discharging above the set level. Coupled with subsidies initiated in 1993 to encourage installment of desulphurizing equipment in the power sector, polluting behavior has been significantly controlled in many Chinese urban areas. As of July 2003, a more scientific mechanism for charging discharge fees has been introduced on a basis of combined total emissions and polluting inputs, signaling even greater endeavors by China to combat CO_2 emissions.

However, the majority of economic incentives in developing countries have not led to change in polluters' behavior either because they are set too high, following often the OECD countries (World Bank, 1992: p. 13), and leading to continuous gamekeeper-poacher games (ibid, p. 14), or because they are poorly and selectively implemented (World Bank, 2000: p. 45). This will be further discussed in the following section.

Promoting energy efficiency and renewable energy

Promotion of energy efficiency

The reduction of CO_2 emissions can also be achieved by more efficient use of energy. Raising energy prices up to market values helps to minimize energy overuse and reduce emissions. High prices substantially exert incentives to conserve energy and reduce consumption and thus reduce emissions. Equally important is the fact that low prices for power transmission and distribution have led to high levels of losses, though partly due to thefts: 31% in Bangladesh, 28% in Pakistan and 22% in Thailand and the Philippines, compared to only 8% in the US and 7% in Japan. These losses represent a loss to developing countries of approximately $ 30 billion a year through increased supply costs (World Bank, 1992: p. 117).

In China, all large industrial boilers are required to be converted to congeneration facilities. As a result of this action by the end of 1993, 12% of China's installed electrical generation capacity—14.6 GW of electricity—was produced through congeneration (Reid and Goldemberg, 1998: p. 235). Along with the quota management system—a series of standards covering energy intensity amount and type of energy use, as well as energy savings—China successfully improved energy efficiency and pollution control.

The recent closure of 30,500 small inefficient and polluting small coal mines (China Coal News, 1999) with an amazing 25% reduction in coal consumption led to a negative growth of CO_2 emissions in 1999 alone by 101.9 million tons compared with that of the whole world by 44.9 million tons (Davies, 2000). Similarly, China closed down a number of small, coal-fired, heavily polluting power plants with high operating costs and low efficiencies.

Mexico has developed energy efficiency standards for new boilers, refrigerators, small air conditioners, buildings and electric motors. Voluntary programs with industry for energy conservation and energy audits were introduced. Additionally, India and Brazil, likewise, have launched specific energy efficiency programs (Reid and Goldemberg, 1998: p. 235).

The success of the promotion of energy efficiency largely depends on the adoption of energy efficient and low-emission technologies. In this regard developing countries can benefit from technological co-operation with industrial nations.

Promotion of renewable energy

In the long run, the mitigation of carbon emissions rests upon the use of renewable energy including hydro, solar, wind, biomass and other forms of renewables, which are more environmentally friendly than conventional fuels. Many people hold that, with further innovations and economies of scale in manufacturing and marketing, renewable energy will meet a substantial share of the world's energy needs while dramatically reducing emissions of carbon dioxide (Anderson, 1999: p. 68). Many developing countries enjoy significant comparative advantages in renewable energy resources. For instance, solar isolations are about 6500 times the annual consumption of commercial energy (World Bank, 1992 : p. 123), which are 2–3 times higher in developing countries than in the northern regions of the industrial countries and have much lower seasonal swings (Anderson, 1999: p. 68). Based on IEA statistics for non-OECD countries, renewable energy in 1997 accounted for 11% of developing Asia's (excluding China) total primary energy supply (TPES). In China alone, renewable energy made up about 20% of TPES (Asian Energy News, 1999). In terms of hydropower, there is still much potential for further development in developing countries, especially in South America, Africa and Asia (Hodgson, 1999: p. 46).

A number of developing countries have programs promoting renewable energy. In Brazil, 62% of the fuel used in transport devices is from alcohol extracted from sugar cane, replacing 100,000 barrels of oil per day (ibid, p. 46). Biomass is being produced from animal dung in Nepal, India, China and Philippines (Asian Energy News, 1999). Thailand launched the Small Power Producers scheme in 1992, encouraging private investment for the development of a grid-based power generation by using residues and wastes from agro-based industries (ibid, 2000).

The effectiveness of promoting environmentally benign renewable energy lies in appropriate financial incentives to encourage applications, market perfection, and continued R&D to lower renewable costs, as well as environmental taxes on fossil fuels to favor renewable energy.

Challenges and policy options

Developing countries, while varying in size and population, political system, economic structure, bear many similarities. They are facing less favorable economic circumstances, worsening environmental degradation and challenges in curbing climate changes. The present paper only focuses on the issues of contradic-

tory objectives, unrealistic standards and limited public participation.

Contradictory objectives

Policy makers in developing countries are well aware of the importance of environmental protection. However, more often than not, they are placed in a dilemma when left to balance between economic growth and environment. Conflicts often rise between social, environmental and economic objectives (World Bank, 1992: p. 14). The headlong pursuit of economic growth is the cornerstone of developing countries (Hertsgaard, 1997). A top Chinese environmental official accepted that economic growth must take precedence over environmental protection for years to come because the former is not only of great importance to maintaining political stability but also to funding the environmental clean-up (ibid). This very contradictory objective in developing countries is well materialized in the implementation of 'Polluter Pays Principles' (the PPP), the value of which is dramatically belabored. A good example can be found in the way the governments deal with state-owned enterprises (SOEs) in emissions abatement.

SOEs make up an important part of the mining, petroleum, basic metals, and chemicals sectors in Argentina and Brazil. SOEs contribute 94% of mining production in India. In Turkey, 95% of mining output, some 60% of chemicals production and 70% basic metal production come from SOEs (World Bank, 1992: p. 130). Most of them are inefficient, with obsolete and polluting technologies and equipment, and poor environmental management and regulations (World Bank, 1992: p. 84; Hughes and Lovei, 1999). They are 'the most persistent violators' of emission standards (World Bank, 1992: p. 14). Because of the very magnitude of the SOEs as well as the huge involvement of the various interest groups both in number and strength, governments tend to assure sufficient supplies into the SOEs even at the expense of the environment. In newly independent countries (NICs) in Eastern Europe and Central Asia, the governments have continued to shield their SOEs from market forces through indirect subsidies, including loans from government banks, and by tolerating large tax and payment arrears (Hughes and Lovei, 1999: p. 3). Like private sector monopolies, when sheltered from competition, they do not face the same pressures to minimize costs as do competitive private firms (World Bank, 1992: p. 130). Thus, in the game of environmental protection the contradictory objectives give the players a lever on which to act. The 'gamekeeper' either makes his audits in an unsustainable way (World Bank, 2000: p. 45), or renders the 'poacher' waivers for pollution charges (Hughes and Lovei, 1999: p. 3), undermining the emissions standards. The latter, knowing well the game rules, may choose to pay a lower punitive fine through negotiations as some of the Chinese cases, or default payments as exemplified in NICs above, leading to continued emissions. Bayan Obo pays US$ 11 M per year in pollution fines and gets US$ 11 M per year from the government for pollution abatement—both sides look good and nothing happens. Thus it can be seen that, under contradictory objectives, and more importantly without contingent liability for 'polluters' actions, the PPP is perhaps the least acceptable means of trying to achieve environmental integrity.

The challenge facing developing countries is to identify the tradeoffs between economic development and environmental protection and make a careful assessment of the benefits and costs of the tradeoffs. According to the hypothesis proposed by Simon Kuznets in his environmental curve known as the EKC, when economic growth produced financial surpluses, there would be a decrease in the use of resources and emission of pollutants (Munasinghe, 1998: p. 60). In practice, the industrial world generally fits this hypothesis in that a shift is observed in an increasing ability and willingness to pay for a better environment, improved internalization of environmental externalities, with an increasing awareness of the impacts of environmental degradation, resulting in reduced environmental degradation. But the key questions are whether developing countries can afford to wait to be rich and what is the cost of waiting since developing countries are both the agents and the victims of globally degraded environment.

Environmental degradation harms human health, spoils amenities and reduces economic productivity, e.g. agriculture production (World Bank, 1992: p. 44). However, protecting the environment is a vital part of improving economic productivity as well as improving the well-being of people today and tomorrow. The evidence shows that the gains from protecting the environment outweigh the costs in the long run (ibid, p. 1; World Bank, 2000: p. 41). While there is still uncertainty as to the extent and the physical effects of climate change, the costs of not taking actions may well be greater than the costs of preventative actions taken now, especially when the absence of action today may lead to irreversibly undesirable environmental consequences (Taylor, 1991 cited in Hanley and Shogren, 1997: p. 5; Kelly and Kolstad, 1999: p. 191). To sum up, for developing countries, great importance should be attached to the acceleration of environmentally responsible development rather than following the past, and arguably the present, path of the industrial world in pursuit of 'unrestricted economic growth without considerations to its effects on the natural environment' (Biggs, 1993: p. 93).

Due to varying energy profiles, developing countries need to have local, national or regional environmen-

tally benign energy policies. As an example, Asia's strong energy demand combined with abundant reserves of coal indicates that the burning of coal as the primary source of energy will remain unchanged in the foreseeable future. It also indicates that the Asian energy sector is likely to continue to be a major and increasing contributor to CO_2 emissions (Sanderson and Islam, 2000: pp. 43–44, In the short term, increasing efficiency is an optimal choice by making efforts to reform and restructure SOEs, by fully eliminating subsidies to coal production investing in clean coal technologies. The encouragement of the use of renewable energy resources is another option in the medium and long run. In addition, deepened and continuous reforms of SOEs, especially energy intensive enterprises, are imperative. Removing subsidies and distortionary incentives to those enterprises, rendering them more autonomy with appropriate environmental monitoring and compliance would make them more responsive to competition and more responsible for their environmentally unfriendly performance, resulting in large economic savings and reductions in pollution. There is no doubt that the reduction of pollution from energy use can only be achieved in the long term with supportive and well-targeted policies.

Unrealistic standards and rigid incentives

Unrealistic discharge standards and rigid incentives constitute one of the obstacles for developing countries to reducing emissions. According to World Bank (1992), many countries are following OECD standards, most of which are too high to be applicable to developing countries. Unrealistic, inflexible standards and incentives 'have wasted resources, facilitated corruption and undermined the credibility of all environmental policies' (World Bank, 1992: p. 13). Some enterprises may pollute less than others because of different local conditions or because of differences in the relative availability of low versus high polluting inputs (Hanley and Shogren, 1997: p. 94). If all are charged the same depending on their emissions amount, polluters with high polluting inputs will have an advantage over the ones with low polluting inputs by paying lower charges, which possibly induces an increase in high polluting inputs. Using western environmental experience to form pollution control strategy demands that it be thoughtfully interpreted to meet local conditions and prerogatives (Nielsen and McElroy, 1998: p. 3). The Katowice Government in Poland levied emissions fees at a rate twice the ones set by the national government for the rest of Poland throughout the 1980s. Moreover, they were seldom revised even when prices rose. Industrial plants complained about the tight emissions permits and thus often were exempted from paying fees and fines. The city's air quality still suffered. Things have changed since 1990, when emissions permits were adjusted to acceptable levels coupled with a threat of closure and a 10-fold increase in fees and fines; the enterprises now are considering and actually investing in environmental controls. Air quality of the city has significantly improved since then (World Bank, 1992: p. 131).

Poland's experience might indicate that appropriate emissions standards and flexible incentives are conducive to discourage pollution. The important point for policy makers is to set realistic specific standards according to characteristics and sources of the pollution, and also to the cost of monitoring and enforcement. 'Emissions standards need to be set in the light of a balance between the marginal costs of the damage caused by the main pollutants and the marginal costs of reducing such emissions' (World Bank, 1992: p. 129). For those with high-polluting inputs, emission standards could be initially set lower but with a high percentage of discharge fees and fines. Gradually tight standards on a phase basis might be practiced in line with the enterprises' performance. What really counts is that charging systems need not be complicated so long as they encourage enterprises to make progress in innovations that reduce the total volume of emissions and discourage the discharge of highly concentrated effluent (ibid, p. 131). The crucial consideration must be to ensure that the standards are clear and easily enforced.

A combination of a carbon tax with charging systems would be more flexible and effective than the latter alone in controlling emissions because fossil fuel use is so pervasive that few people will escape the burden of controlling CO_2 emissions. A carbon tax is a possible way to internalize the environmental and economic externalities resulting from the excessive use of fossil fuels. Moreover, a double dividend might be achieved through the introduction of such a tax, i.e., generating revenues to be used for governments to control the pollution and decreasing other taxes such as VAT and income taxes, leading to a less distorted tax regime (Sanderson and Islam, 2000: p. 45). However, it is important to set the tax on an incremental basis, with an initial low tax, and incrementally increasing (ibid), to allow for adaptation of the enterprises takes place.

Whatever instruments are chosen, they must be compatible with the administrative capacities of the regulatory institutions. Standards or fines are worse than useless when they are unenforced and uncontrolled. They undermine confidence in environmental controls and induce enterprises to look for means of avoiding penalties rather than trying to reduce pollution. Experience shows that the following five prerequisites are essential to effect the enforcement of standards and instruments (World Bank, 1992: p. 130).

- A sound local framework for negotiation between polluting and polluted parties;
- A clear and publicly accessible statement of the standards set and agreements reached;
- A means of monitoring and spot-checking pollution;
- A means of personalizing defaulters; and
- Fair and equal application of the laws and regulations to all parties.

Public environmental unawareness

Public unawareness of environmental impacts presents a serious impediment in developing countries to effectively implementing environmental policies. Frequently decisions are made in the absence of environmental information in these countries (World Bank, 1992: p. 85). In addition, environmental impacts are normally exposed to the purview of selected environmental departments, and offices in charge, and expert researchers. The public tend to be left in the dark about the seriousness of the worsening environment they are living in, the costs to their health and quality of life, and the opportunity of helping policy-makers to improve the environment. The lack of environmental awareness has resulted in indifference to environmental degradation, an absence of self-regulating motivation and, above all, a lack of enthusiasm to be involved in monitoring polluting operations and enterprises. Public participation could be a cost-effective method of implementing environmental policy (ibid, p. 89), especially for those countries chronically short of funds and trained human resources. The US has set a good example by authorizing private citizens to seek injunctions and financial penalties in some cases against companies that violated the terms of their operating permits in the 1970 Clean Air Act. Thus, enforcing environmental objectives is no longer the government's exclusive responsibility (ibid). There are serious repercussions to an economy from an overly litigious society, and to be consistent it requires a well-established rule of law, rather than the norm in most developing countries. Notably, Armenia actually has a provision for 'Environmental Police' taken from the citizenry.

Public participation could help augment official enforcement. This is well illustrated by the recent closure of a highly polluting state-owned smelter in Liao Ning Province, China. Once one of China's 500 SOEs in the 1980s, leading the country in production of gold, silver, copper, lead and zinc, the smelter contributed an unacceptable share of pollution to Shengyang, the capital of the province. Intolerably, the affected community organized themselves and staged several protests to the provincial government against the polluting performances of the smelter. The result was a declaration of insolvency to the smelter by the provincial court (chinaenvironment.com). Another example has been found in a survey of enterprises in Bangladesh where riverside villages have proved surprisingly willing and able to negotiate agreements with upstream polluters on monetary compensation and first-stage effluent treatment (World Bank, 1992: p. 130). Though the two cases represent painful enforcement of the PPP, it is fairly encouraging that public environmental concern and active involvement in environmental protection will, to a large extent, supervise and facilitate the implementation of the PPP on the one hand, and stimulate 'best practice' from polluting enterprises on the other hand. With better information as well as legal support, such agreements could provide cost-effective means to support governmental policy and regulations and to hold enterprises accountable for the environmental damages.

Ignorance is an important cause of environmental damage and a serious impediment to finding solutions (World Bank, 1992: p. 85). Therefore, it is extremely necessary for policy makers to improve environmental information and education. Possible ways are:

- Establishing specific environmental facts according to practical damage with a careful cost-benefit analysis. Well-informed of both cost and effect a particular project will produce, the citizens are most likely to involve themselves actively in facilitating the operation of the project and in playing their monitoring role from an environmental perspective;
- Regularizing publication and distribution of environmental reports in a comprehensible form;
- Improving environmental education through mass media and especially educational institutions;
- Making use of community and independent commissions that can help to depoliticize decision making by analyzing tough environmental issues and providing recommendations for policy action. The latter can also audit public agencies and thus make them more responsible (World Bank, 1992: p. 87); and
- Giving citizens more power to challenge polluters, whether public and private and encouraging public comments on the draft environmental documents.

Conclusion

The burning of fossil fuels has adverse environmental consequences and might cause climate change. Developing countries are likely the most vulnerable to this change because of their less favorable economic circumstances, weaker institutions and more restricted access to capital, technology and information. Given rapid growth of economies and populations, there are a number of implications for developing countries that indicate a need to curb GHGs and thereby to lessen the impact of climate change. Great efforts have been made in reforming energy pricing, promoting energy efficiency and the use of renewable resources. However,

efforts of controlling emissions have been affected by the contradictory objectives, unrealistic standards and rigid incentives, and a lack of public environmental awareness. Challenges facing developing countries are, however, far more extensive than the preceding. In particular, financial shortages present major pressures on developing countries in their attempt to control emissions. This could possibly be solved through the encouragement of private investment and the expansion of the cooperation with international monetary organizations, such as World Bank and IMF. But most important of all, developing countries should have clear priorities based on careful cost-benefit analysis of the tradeoffs between economic growth and environmental protection, well-targeted environmental policies, appropriate standards and incentives with sound enforcement mechanisms, and active public participation with strong environmental awareness.

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Xia Cao holds an LLM in Mineral Law and Policy from the Center for Energy, Petroleum and Mineral Law and Policy, University of Dundee, UK and is Associate Professor in Shanxi Financial and Economic University, Taiyuan, Shanxi, PR China.