ENVIRONMENTAL CONSIDERATIONS IN THE ECONOMIC DEVELOPMENT OF CHINA

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I. INTRODUCTION

Environmental protection efforts are closely related to the level of economic development and the specific social, scientific and political structures of a country. Developed and developing countries have different decision-making priorities. In developing countries, increased economic growth continues to be the number one priority, backed by high expectations for improved standards of living. Significant increases of energy consumption to satisfy the basic requirement of energy service in developing countries is inevitable in the foreseeable future. Before any effective international convention can be issued, governments must spend excessive amounts of time negotiating. Developing countries will find acceptable only no-regret, multi-beneficial measures. Of these measures, the most effective include population control, reforestation, coal substitution and energy efficiency. Energy efficiency, though, is the single most effective no-regret, multi-beneficial and viable measure available that directly addresses global climate change concerns.

II. UNCERTAINTY: ENVIRONMENTAL CONSIDERATIONS IN DECISION MAKING

The voices of Organization for Economic Cooperation and Development ("OECD") countries are becoming much louder. They are asking for more international attention to global warming concerns. Countries are determining how to limit or reduce their greenhouse gas emissions. The Intergovernmental Panel on Climate Change ("IPCC") is actively encouraging developing countries to participate in the mixed chorus. In the United States, climate change concerns have spread from the academic community to planners, politicians, lawyers and the general populace. Despite this growing debate, uncertainty over what actions to take still exists since any decision in this area involves billions of dollars and complex international relationships.

Groups studying climate change issues have published results finding that the climate will change significantly if the amount of greenhouse gases in

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the atmosphere continues to increase. The subject of climate change is too complex to be handled by individual scientists, so only a very few groups in the world are capable of testifying about or repeating such research. At the very least, the scientific community needs more time to achieve a consensus. Additionally, the impact of climate change on specific countries has not been thoroughly explored. Since each country has its own geographic conditions, any damage caused by climatic change will differ greatly from country to country. The economic costs of such damage and the costs to prevent or adapt to the change have not been determined or explored on a country-specific basis. In China, as in many countries, the decision makers, the lay people and the academic community have simply not received enough information about climate change.

Time schedules are another subject of uncertainty. When will the significant climate change affect human life? Time is always a crucial factor in decisionmaking. For most economic activities, problems likely to occur in 50 or even 100 years are too distant to be considered today. Exactly what the present generation should invest for future generations is still an undefined and controversial obligation—especially since such an investment is likely to include some present day sacrifice.

III. ENVIRONMENTAL CONCERNS CLOSELY RELATE TO THE LEVEL OF ECONOMIC DEVELOPMENT

The environmental sciences have made remarkable progress in the last two or three decades. In the beginning, environmental protection meant disposal of on-site emissions. Before the 1960s, treatment of toxic gases, liquids and solid wastes were the main concerns of environmental protection in developed countries. Later, regional environmental problems were addressed. These disussions included acid rain caused by SO_2 emissions and eventually led to expanded consideration of protection of river basins, wildlife and the control of ocean pollution. At that point, direct, instant and on-site environmental impacts as well as indirect, long-term, remote impacts were considered but only in a domestic or regional context. Now, environmental consideration of climate change has broken the barriers between countries and has truly become a global concern.

Changes and progress regarding environmental concerns reflect the achievements of science and technology and economic development. When people are striving for basic provisions such as food, clothes and shelter, they will burn whatever they have available in order to cook, provide heat and operate machines. All the developed countries experienced a period of cutting down forests and burning huge amounts of coal with no regard for environmental damage or pollution. When supplies of food and basic necessities became sufficient, the countries began to pay more attention to

the quality of service, availability of recreation and environmental protection. At the same time, the use of energy continuously increased in both quantity and efficiency.

Most developing countries remain underdeveloped according to economic indicators such as per capita Gross National Product ("GNP") and per capita energy consumption. China, by official statistics, has a per capita GNP of approximately US $300. Many economists argue that the official foreign exchange rate for Chinese currency does not match its practical purchasing power, suggesting that China's financial statistics system differs from that in western countries. In fact, many economists in China and abroad estimate that the per capita GNP in China should be more than US $1000. Regardless of which figure one uses, China's GNP is still much lower than that of developed countries where GNPs range from more than US $10,000 to $20,000.

Developing countries consume less energy than developed countries. When compared with developed countries, the energy service for residential use in developing countries is very low. In China, the per capita energy consumption in 1990 was only 860 kilograms of coal equivalent ("kgce"). In the United States and Canada, such consumption in 1986 was 9,489 and 9,694 kgce, respectively. In 1986, Germany and the United Kingdom had per capita consumption of approximately 5,500 kgce. Comparatively, France and Japan are the most energy-efficient countries in OECD. Per capita energy consumption in France during 1986 was 3,881, and in Japan for the same time period, it was 3,625 kgce.

Energy service for residential use in China remains in primitive stages because of insufficient and low-grade energy supplies. Direct coal burning is the primary means of cooking and heating in Chinese cites, although using town gas and liquified natural gas for cooking in urban areas has developed rapidly in recent years. Firewood, straw and grass are the main fuels for households in rural areas, and even these primitive fuels are insufficient. Air conditioning is an extreme luxury in China. A few years ago, it was prohibited due to an electricity shortage. In general, there is no hot water supply in apartment buildings. Heating is limited in northern China because of insufficient fuel supplies. Along the banks and to the south of the Yangzhi River, an area with a population of more than 300,000, no fuel is available for heating. Thus, indoor temperatures reach as low as 35°F in the winter and higher than 95°F in the summer.

Developed countries experience serious local pollution such as undisposed waste water, dirty flue gas and toxic heavy-metal deposits. For example, London's toxic fog has killed thousands of people, and in Japan, waters polluted with toxic, heavy-metals have caused a curious disease. But after 30 years of efforts to regulate industry and improve technology through tremendous financial expenditures, most of the direct pollution in developed

countries has come under control. Moreover, standards of environmental protection in developed countries are generally higher than such standards in developing countries. For example, when Chinese environmental scientists come to the United States, they immediately discover that the air in the United States is much cleaner than that in China.

In the last ten years, the Chinese government has made great efforts to increase environmental protection and has declared it a basic national policy. Environmental protection authorities have been established at both the national and local levels. These agencies employ millions of people as officials and staff members and have issued hundreds of standards for pollutant emission control. In addition, the Chinese government has promulgated a series of regulations and laws which include protection for the environment, sea, ocean, and wildlife. Unfortunately, pollutant emissions have increased in the last ten years. Rapid increases of production in the basic material industries (such as metallurgy, chemistry and building materials), the light industries (such as textiles, paper and leather), and food processing production have added pollutants to the atmosphere.

Today, the difficult task for China is the disposal of enormous amounts of waste water, flue gas from coal burning, and solid residues. The government recognizes that it is not easy to prevent the slow deterioration of the environment. However, it has concluded that it may be possible to improve the environmental conditions in some of the larger cities within the next ten years. Therefore, the focus of environmental protection in China will remain at the local level for a long time into the future.

IV. EXPECTATION OF ECONOMIC DEVELOPMENT

The current level of development and standard of living in China is low, but the people's expectation of rapid development and improvement of the standard of living is very high. By contrast, in the late 1970s, not only was the standard of living low but the expectation of improvement was even lower. This attitude stemmed from people's lack of knowledge of other countries' standards of living and a resulting inability to make comparisons. However, when China opened its doors to economic reform, the Chinese people discovered the differences between their country and developed countries. The initiative on economic development became an overwhelming criterion for decisionmaking. Rapid development of the economy became a common expectation from the people who eventually determine the political lifetime of Chinese politicians.

The industrialization process in China is far from complete, though. Although the output from industry is already much greater than the output from agriculture (3.12 to 1 in 1990), urbanization is just in its primary stage.

In 1990, 26.5% of the 1.14 billion Chinese—302 million people—lived in urban areas, leaving 73.5% of the population—more than 837 million people—in rural areas. The so-called "township industry" that developed mainly in rural areas absorbed millions of spare laborers from agriculture. This transformation from labor and agriculture to industry constituted the fundamental pressure for rapid industrialization that led to China's high growth rate of economic development. China's approach to economic development, similar to that in many other developing countries, is geared toward growth that requires building more factories, consuming more materials and resources and, consequently, creating new jobs. This approach differs from that in most developed countries where basic materials industries are not likely to ever increase their labor force in the future.

In the 1980s, China's economic development took great strides. The growth rate of China's GNP remained at 9% annually from 1980 to 1990. The total output of industry on average increased by 12.6% annually for the same period. Foreign trade, including imports and exports, increased 11.7% annually, and import and export totals reached $115.4 billion in 1990. Some estimate China's GNP will rise 6% or higher over the next ten years, with an annual projected increase of 5% over the following 30 years. In terms of per capita GNP, China expects to become a moderately developed country by the 21st century.

V. ENERGY PRODUCTION AND CONSUMPTION IN CHINA

Average per capita energy consumption in China is lower than most countries of the world; however, China's total energy consumption ranks third in the world behind the Unites States and the former Soviet Union. In 1990, China ranked first in the world for coal production (1.08 billion tons) and fifth in the world for the production of crude oil (138 million tons). Unfortunately, fewer than 15 billion cubic meters of natural gas were extracted in China in 1990.

There are many significant differences between China's energy consumption and that of developed countries. First, China supplies all of its domestically consumed energy. Its self-reliance for energy supplies and the great role of coal production in total energy produced creates an energy consumption mix that differs from almost all the developed countries and from most developing countries as well. (See Table 1)

TABLE 1
MIX OF ENERGY CONSUMPTION IN 1986*

COUNTRY	TOTAL volume**	Percent Solids	Percent Liquids	Percent Gaseous	Percent Hydro & Nuclear
WORLD	9321.86	33.07	39.70	22.45	4.77
China	808.50	75.82	17.20	2.26	4.71
USA	2278.10	26.23	44.82	24.87	4.08
Japan	440.17	23.68	56.32	12.84	7.16
former W. Germany	344.54	32.64	45.24	17.07	5.04
UK	302.25	37.13	35.22	24.90	2.74
France	212.78	15.06	50.79	18.15	15.99
Italy	184.16	10.60	62.01	22.40	4.99
Canada	249.07	13.59	39.91	29.33	17.16
former USSR	1797.16	28.24	28.99	40.38	2.38
Poland	176.15	81.57	10.49	7.67	0.27
India	210.19	67.82	25.35	3.40	3.43
Thailand	23.56	10.31	67.53	18.89	3.27
S. Korea	68.17	45.66	48.36	0.15	5.82
Brazil	105.35	12.80	61.09	3.57	22.53

SOURCE: 1986 United Nations Energy Yearbook
*only commercial energy calculated
** in millions of tons of coal equivalent

Second, most of China's energy is consumed by industry, and very little is consumed by residential users. In developed countries, residential, transportation fuels and industry uses each amount to about one-third of the total energy consumed. When the standard of living in China improves, the odds are that households will increase their energy use. This potential increase in residential use may be overwhelming. In fact, if every Chinese consumes half the amount of energy that each American consumes for household use and traffic, China will use the same amount of energy as the entire United States. (See Table 2)

TABLE 2
1989 ENERGY CONSUMPTION IN CHINA BY SECTORS

SECTORS	VOLUME million tce	PERCENTAGE
Total	969.3	100.0
Agriculture	47.4	4.9
Industry	662.9	68.4
• mining	73.5	7.6
• manufacturing	566.6	58.5
- chemistry	109.4	11.3
- building material	102.0	10.5
- metallurgy	117.7	12.2
- others	237.5	24.5
Construction	12.7	1.3
Transportation	44.9	4.6
Commerce	12.1	1.2
Other Services	33.4	3.4
Residential Use	155.8	16.1

SOURCE: STATISTIC YEARBOOK OF CHINA, 1991.

Third, Chinese use a low grade of energy compared to residents of other countries. Table 3 shows that at present Chinese households use less electricity, liquid and gaseous fuels. Improvements of the end-use service requires extraction of crude oil and natural gas and more power generation. (See Table 3)

TABLE 3
1989 PER CAPITA ENERGY CONSUMPTION FOR RESIDENTIAL USE IN CHINA

ENERGY	VOLUME	PERCENTAGE
Total	139.3 kgce	100.0
Coal	152.0 kg	78.1
Electricity	35.3 kwh	11.1
Kerosene	1.1 kg	1.1
Liquified Natural Gas	1.4 kg	1.4
Natural Gas	1.5 m^3	1.5
Town Gas from Coal	2.4 m^3	0.7

SOURCE: STATISTICAL YEARBOOK OF CHINA, 1991.

Different institutions in China have developed several forecast analyses regarding China's future energy demand. The present governmental program forecasts that more than 1.45 billion tons of coal equivalent ("tce") of energy will be needed by the year 2000. This energy is predicted to be composed of 1.46 billion tons of raw coal, around 170 million tons of crude oil, 30 billion cubic meters of natural gas and 240 billion kwh of hydro and nuclear powered electricity. Energy demand forecasts for the year 2020 or even beyond are more speculative, but most forecasts conclude that more than 2 billion tce of energy would be needed by the year 2020 and much more by the year 2050. Up to the present time both energy demand forecasts and energy planning strategies have failed to consider the potentially large impacts of global warming factors.

VI. CLIMATE CHANGE IN CHINA

The subject of climate change has become an important topic in the international community. Discussions have spread into economic, political and diplomatic circles—far beyond the field of science and technology. Officially, the Chinese government attaches importance to global warming issues and seeks to remain in close contact with other countries regarding this topic. The highest authority in Chinese government, In-State Council, has established an office in charge of policy integration on global warming issues. Officials and experts from the State Science and Technology Commission, the State Planning Commission, the National Environment Protection Bureau, the Ministry of Energy and many academic institutes are involved in policy and scientific research of climate change and related issues. China is one of the co-chairmen in the Industry and Energy Subgroup of IPCC. Several international collaboration projects on greenhouse gas emissions and climate-change are ongoing between Chinese and foreign government experts, and China has hosted international conferences on the issue. However, considering the many elements and uncertainties associated with global warming, time consuming studies and negotiations will take place before any fundamental policy or convention appears.

Environmental protection is only one objective among many for national level decisionmaking. As discussed earlier, local environmental control is of higher priority than global control based on the great uncertainties surrounding climate change. Moreover, solutions to some local environmental concerns may have a negative impact on similar global issues. For example, treating waste water will consume a lot of electricity. Sulfur scrubbers consume power and lime that will lead to more greenhouse gas emissions. At this time there are almost no sulfur scrubbers equipped for boilers in China, with the result that several provinces are experiencing severe acid rain

problems. For the present and near future, sulfur scrubbers may thus be the next step for air pollution control in China following the on-going concern over flue gas ash disposal.

Numerous studies must be conducted to accommodate policy decisions regarding climate changes. Aside from studies regarding the prediction of continued climate change and its impacts, benefit-cost analyses for each alternative of eliminating or adapting to climate change should be developed. Many energy alternatives call for technical and structural changes in a country's infrastructure. For example, one proposed alternative is to plant biomass and then apply combined cycle gas turbines for power generation. Vast amounts of land will be used for such biomass plantations. This means that technical feasibility and cost-benefit analyses are needed, as are social impact and associated cost studies of the possible changes to the social structure of the rural area. If combined cycle gas turbine technology is to be adopted as a major contributor of power generation, a cost-benefit analysis for such a system change would differ from that calling for a few sets of new machines added to an existing power grid. Of course, these studies are time-consuming and cost-intensive. However, if there is not enough analysis on the economic impact of reducing greenhouse gas emissions, then no serious regulation will occur.

VII. A NO-REGRET MEASURE IS THE ONLY VIABLE ALTERNATIVE

At least for the foreseeable future, developing countries can accept only no-regret, multi-benefit measures assisting economic development, local environmental protection and global climate change. Many measures fall into this category. For China, the following four measures are extremely crucial:

1. *Population Control.* Over-population has already become a great burden for China. In the last twenty years, China adopted a strict population control policy that was very necessary and has achieved great success. Because the population base is so large, the annual population increases are enormous. The average annual population increase was more than 2% from 1950 to 1970; 1.75% in the 1970s; and 1.48% in the 1980s. But, from 1986 to 1990, the population increased 1.55%. If this trend continues, the population of China will be 1.327 billion in the year 2000 and 2.074 billion in the year 2030. To achieve and maintain a low growth rate is not easy, but it is vital to China's goal of limiting energy demand.

2. *Reforestation.* Only 13% of the land in China is covered by forestry. This is a very low figure compared to most countries. Timber is in short supply, land erosion is a serious problem, water resources are almost ex-

hausted and flood control is becoming more difficult in many areas. Reforestation is a remedy for all these problems.

3. *Alternative Energy from Coal.* Coal is the dirtiest fuel. Coal technology in general means lower efficiency, less convenience, and higher emissions of carbon and other pollutants. Unfortunately, coal is the major fuel in China, and absent a fundamental policy change, it will remain so for the foreseeable future. Development of alternative energy such as gas, oil, hydro, nuclear, and other renewables will provide necessary relief from coal dependence. They allow less energy consumption, local environmental protection, improved living conditions and less CO_2 emissions.

4. *Energy Efficiency Improvement.* Increased energy efficiency will alleviate the energy shortage, lessen pollution, reduce CO_2 emissions, provide more security of energy supplies for the world and lead to better technology and management. To some extent, energy efficiency is the most powerful, most multi-beneficial and perfect no-regret measure to deal with energy, economic development, local environmental protection issues and global warming issues.

VIII. CONCLUSION

Academic exchange, technology assistance and transfer, financial support and business cooperation are crucially important to China and other developing countries if the world is going to effectively respond to concerns over climate change and global warming.