

Interrelationship between Human Activities and Climate Change

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Abstract: This paper takes carbon dioxide emission as the research object, the impact to human system and other systems by greenhouse effect is analyzed according to the fact that large amount of CO₂ emission has induced greenhouse effect; we collect data of three index concerning CO₂ emission accumulation amount, CO₂ emission amount per capital and per GDP in typical countries from the industrialization starting point until now to explain the historical and current status from different point of view; concerning with the negative impact from greenhouse effect, it is put forward that how to cope with temperature rising from adaptation and mitigation in terms of energy, traffic, industry, agriculture, etc, introduce global cooperation and mitigating measures in China. The analysis will supply basis and support for our international right of speak about carbon mitigation.

Keywords: carbon dioxide, emission, greenhouse effect, adaptation, mitigation

人类活动与气候变化的相互关系

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摘要: 本文以二氧化碳排放为研究对象, 针对其大量排放引发温室效应的事实, 分析了温室效应对人类及其他系统的影响; 收集了世界典型国家从工业化开始至今的二氧化碳累积量、人均二氧化碳排放量以及单位GDP二氧化碳排放量, 从不同的角度说明了二氧化碳排放的历史及现状; 针对温室效应带来的负面影响, 在能源、交通、工业、农业等方面从提高适应能力和减少二氧化碳排放的角度提出了如何应对全球气温的升高, 介绍了全球背景下的合作以及中国的减排措施, 为我国争取国际上碳减排的话语权提供依据和支撑。

关键词: 二氧化碳; 排放; 温室效应; 适应能力; 减少

1 Introduction

The ground temperature rised obviously $0.6^{\circ}\text{C} \pm 0.2^{\circ}\text{C}$ every year after 1860 when there was instrument to record this parameter and from the end of the twentieth century, the topic of global warming attracts more and more attention of international society. The reasons of global warming are complicated such as sun radiation, volcanic eruptions and Green House Gas accumulation. The mainstreaming point reckons that global warming is the outcome of Green House Gas accumulation especially CO₂ emission accumulation.

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GHG includes vapor, carbon dioxide, methane, ozone and Freon, etc. Carbon dioxide is mainly from fossil fuel consumption from industry, traffic and electric power; methane is mainly from wetlands and coal combustion; Freon is mainly from manufacture of extinguisher and refrigerants. The effect of different GHG varies with their different concentration and warming potential, the warming effect of CO₂ is not the strangest in all GHG, but it has become the main factor for global warming because of the amount of it coming from human activities especially fossil fuel combustion which has already accounted for about 56.6% in all GHG in 2004. CO₂ content in atmosphere reached 379 ppm in 2005 which was 35% higher than that before industrial revolution.

Facts show that CO₂ has been the main GHG and it has become the main research object of climate change^[1,2].

The impacts of global warming include sea level rising, endangering the survival of marine life, threatening human food safety, deteriorating living environment of crops and affecting the production of agriculture, forestry and stock raising, aggravating meteorological disasters, harming human health, aggravating the lose of biodiversity,

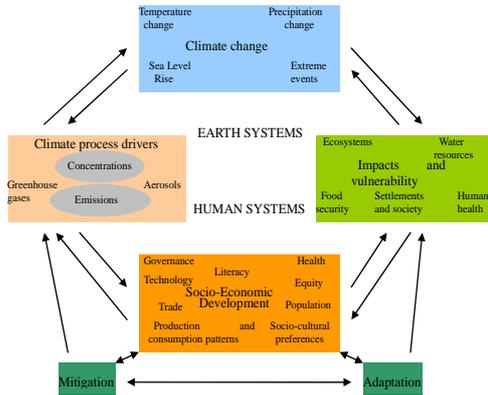


Figure 1. Relationship between human system and earth system

exacerbating water resource shortage, etc. All these phenomena show that the relationship between human and nature has changed from harmony to contradiction. The world has confronted with threat of global ecology crisis, how to ameliorate the relationship between human and nature has been an urgent problem.

The relationship between human and nature is illustrated in figure 1^[3]. To cope with the global warming aggravation, different countries begin to cooperate by signing protocols and exerting CDM projects, technologies for energy consuming are developed and applied, economic measures are established.

2 CO₂ Emission by Humans

Fossil fuels such as oil, coal and natural gas are the main types of energy in the world and their ratio in total energy consumption in 2008 reached 34.8%, 29.2% and 24.1%^[4]. Combustion of fossil fuels makes large amount of CO₂ discharged into the atmosphere and causes global warming. But the energy consumption structure is improving, solar photovoltaic energy, wind energy and bio-mass energy develop very quickly as seen in **Figure 2**. Nuclear energy plays an important role in a few countries especially European countries and Japan, but it confronted technology difficulties nowadays. From a long time point of view, ocean energy, tidal energy and wave energy are promising energy. The usage of renewable energy will help to reduce CO₂ emission and global warming.

Although energy structure is improving, large amount of CO₂ emission from fossil fuels discharged into the atmosphere in past years is a fact. As we said before, CO₂ emission during industrialization process is the main

reason of global warming, we collect CO₂ emission accumulation, per capital and per GDP to analyze the emission status.

2.1 CO₂ Emission Accumulation

Countries with large CO₂ accumulation emission amount include USA, Germany, China, UK and Japan, their starting time of industrialization period are different, China is from 1978 while the other four countries are

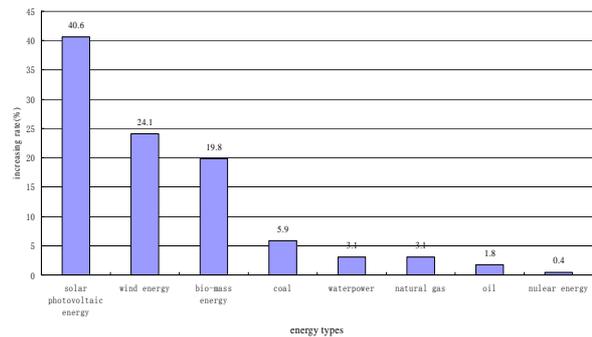


Figure 2. Energy increasing rate annually from 2001 to 2007

Table1. CO₂ emission amount in some countries during industrialization period (1850-2007, 10⁸ tons)

country year	USA	Germany	China	UK	Japan
1850-1977	1861.7	574.4	--	530.5	170.2
1978-2007	1621.6	292.3	857.3	176.4	346.0
Total	3483.3	866.7	857.3	706.9	516.2

from the preliminary stage of 19th century. We illustrate the CO₂ accumulation amount in table1.

Different countries, China is much less than that in USA, almost equal to that in Germany, higher than that in UK and Japan. Besides, this emission amount in China includes the transferring emission^[5] from developed countries to China, the ratio of China export amount to total GDP has been increasing as a whole, which means CO₂ emission in China is increasingly resulted from producing export products. If we talk about the CO₂ accumulation per capital, China's level is much less than the four countries and other developed countries. So China should burden the corresponding responsibility and obligation but not the main responsibility for the climate change.

2.2 CO₂ Emission Per Capital

The developing period and economic level is different to different countries, principles to measure by total emission amount displays justice at the national level but conceal the inter-personal justice. Analysis shows it is more meaningful to talk about justice problem from the personal view.

CO₂ emission per capital is an index concerning with the consuming mode, until now, this index in Australia is

more than USA which is also the highest in the world because of its coal combustion for electric power generation. USA ranks the second and is more than 20 tons^[6], Europe is between 10-15 tons, China is 5 tons, India is 1 ton and it is less to 1 ton in most Africa countries as shown in figure3. The reduction task is very different to reach the aim of reducing 50% in 2050 meaning reduction amount per capital arrives at 2-3 tons. Developed countries should change the consuming mode of high energy consumption and high emission. Developing countries should control the population to try for more emission space.

2.3 CO₂ Emission Per GDP

CO₂ emission per GDP is an index concerning with energy usage efficiency and energy structure. It gives consideration to both economic development and emission reduction. The overall trend of CO₂ emission extent is most obvious in China as shown in figure 4. But per GDP in typical countries is decreasing, the decreasing the current CO₂ emission per GDP in China is still higher than most typical countries, China should reinforce to save energy, lower energy consumption and develop green energy technology while maintain the GDP increase.

3 Measures to Cope with Global Warming

To cope with global warming, adaptation and mitigation are two main measures that can take effect. They are respectively introduced in AR4 report as follows^[3]:

3.1 Adaptation

Water: expand rainwater harvesting; water storage and conservation techniques; water reuse; desalination.

Agriculture: adjustment of planting dates and crop variety; crop relocation; improved land management.

Infrastructure/settlement: relocation; seawalls and storm surge barriers; dune reinforcement; land acquisition and creation of marshlands/wetlands as buffer against sea level rise and flooding; protection of existing natural barriers.

Human health: heat health action plans; emergency medical services; improved climate-sensitive disease surveillance and control; safe water and improved sanitation.

Transport: realignment/relocation; design standards and planning for roads, rail and other infrastructure to cope with warming and drainage.

Energy: strengthening of overhead transmission and distribution infrastructure; underground cabling for utilities; energy efficiency; use of renewable sources; reduced dependence on single sources of energy.

3.2 Mitigation Technologies

Energy supply: improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power; combined heat and power; early application of carbon dioxide capture and storage; advanced nuclear power; advanced renewable energy.

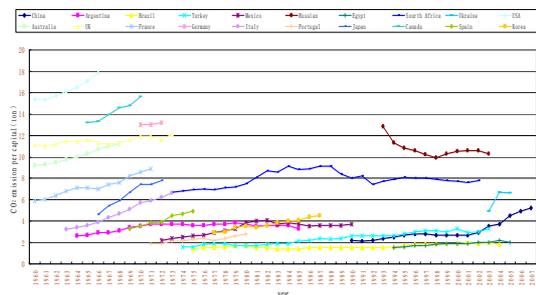


Figure 3. CO₂ emission per capital in typical countries

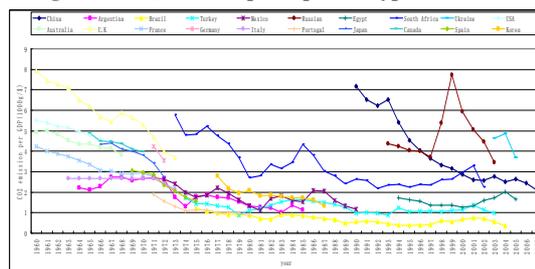


Figure 4. CO₂ emission per GDP in typical countries

Transport: more fuel-efficient vehicles; hybrid vehicles; cleaner diesel vehicles; bio-fuels; modal shifts from road transport to rail and public transport systems; land-use and transport planning; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries.

Buildings: efficient lighting; more efficient electrical appliances and heating and cooling devices; improved insulation; passive and active solar design for heating and cooling; integrated design of commercial buildings including technologies.

Industry: more efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; advanced energy efficiency; carbon dioxide capture and storage for cement, and iron manufacture.

Agriculture: improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH₄ emission; dedicated energy crops to replace fossil fuel use; improved energy efficiency.

Forestry: afforestation; forest management; harvested wood product management; use of forestry products for bio-energy to replace fossil fuel use; tree species improvement to increase biomass productivity and carbon sequestration; improved remote sensing technologies for analysis of vegetation/soil carbon sequestration potential and mapping land-use change.

With the above illustration, the relationship between adaptation and mitigation should be synergies, only by reinforce the adaptation of our mankind and actively exert mitigation measures, we can cope with global warming hopefully.

3.3 International Cooperation

Except for adaptation and mitigation measures taken in

respective countries, international and regional cooperation among different countries develop quickly^[7,8]. On the first global climate meeting in 1979, climate change as an international hot topic was put forward into agenda; in 1990 IPCC published the first climate change evaluation report and based on this report, United Nations set up the intergovernmental negotiating committee to begin the negotiation of framework convention on climate change; in 1992 on the meeting of conference about environment and development in Rio de Janeiro, Brazil, more than 150 countries constituted the framework convention on climate change and more than 190 countries authorized this convention and became one of contracting party; in 1997 the third contracting meeting was held in Kyoto and Kyoto Protocol was passed in which point of GHG kinds, mitigating schedule and quota were prescript; in 2007 the thirteenth meeting was held in India and problems of post Kyoto were discussed in detail, the famous Bali Roadmap was passed and it strengthened the negotiation process of the implement of convention and Kyoto Protocol; in 2008 leaders of G8 reached an agreement about the mitigating aim of GHG and the fourteenth meeting was held in Poland; in 2009 UN climate change conference was held in Denmark and on this meeting international society promised to support assistance to countries which was most easily affected by climate change. Now there are three mitigating mechanisms as JI (Joint Implementation), CDM (Clean Development Mechanism) and ET (Emission Trade), by these three mechanisms, contracting party in appendix I can acquire GHG mitigating index by cooperation with other countries, CDM is the only cooperating mechanism concerning with developing countries^[9].

3.4 Measures in China

In recent fifty years, the degree of temperature rising is a little more than that of the world and according to scientists, climate warming trend in China will aggravate in the future. The climate condition in China is complicated, spatial and temporal distribution of precipitation is unequal, ecological environment is vulnerable, soil erosion and desertification is severe, forest coverage is 18.21% only equivalent to 62% of the international average level, length of continental coastline is as long as 18 thousand kilometers easily affected by sea-level rising. Climate change has brought passive impacts to the agriculture and animal husbandry industries, forest and other ecosystems, water resource distribution, coastal environment and illness dispersion. China has taken many measures to cope with climate change and achieved remarkable results^[10].

The government of China took many measures corresponding to different aspects. Economically speaking, promote the production structure optimization and upgrading, specify to develop service industry, hi-tech industry, electronic commerce and information industry, eliminate

industries with high energy-consuming and high-pollution. From the energy point of view, increase the proportion of renewable energy such as wind energy, hydro-energy, solar energy, biomass energy and nuclear energy. From the point to dealing with soil erosion area, it already reached 1000 billion square meters of the restoring area, accelerate to make comprehensive plans for national water resources and watershed. Strengthen the research and development of science and technology. Enhance the consciousness of the public and management level.

China has large amount of population, many natural disasters and brittle ecosystem, global warming has brought bad effect to its development. If this problem is not paid attention, the victim will be China itself, so the government and people in China will take it seriously and take measures to settle this problem.

3 Conclusions

From the above analysis, global warming as the result of CO₂ emission is a fact and it will bring risk to mankind and other systems. Three indexes of CO₂ emission accumulation amount, CO₂ emission per capital and per GDP were analyzed, analysis shows that the accumulation and emission per capital in China is much less than developed countries, the high CO₂ emission intensity is due to China's economic development, energy consuming structure and energy usage efficiency. To cope with global warming, we should strengthen our adaptation to this trend and take measures to mitigate it. China has instituted positive policies and taken measures to mitigate this trend, and will push the energy-saving and environment friendly mode of production, life and consumption, set up the national economic system with low-cost, high-production, low energy consumption, less emission, recycling and sustainability to make a great contribution to the world.

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