

Long-Term Climate Change Mitigation Target and Carbon Permit Allocation

He Jiankun, Chen Wenyong, Teng Fei, Liu Bin

Energy, Environment and Economy (3E) Research Institute, Tsinghua University, Beijing 100084, China

Abstract: Long-term climate change mitigation target would highly constrain global carbon emissions in the future. Carbon permit allocation under the long-term mitigation target would impact development space for all countries, involving the fundamental interests. Some developed countries advocate the principle of per capita emission convergence while China and other developing countries propose the principle of convergence of cumulative emission per capita to consider historical responsibility. If the latter is used for carbon permit allocation, CO₂ emissions of developed countries since the industrial revolution have far exceeded their allocated permits. Developed countries' high per capita emissions at present and for quite a long period in the future would continue to occupy emission spaces for developing countries. Therefore, developed countries must commit to deeper emission reduction for the next commitment period at the Copenhagen conference, in order to achieve the emission pathway under the long-term emission reduction target, and to save necessary development space for developing countries. At the same time, developing countries must be enabled with adequate financial and technical support by developed countries as compensation for their excessive occupation of the development space for developing countries, to improve developing countries' capacity to cope with climate change under the framework of sustainable development. On the one hand, we should uphold on the principle of equity to ensure reasonable emission space for our country (China) in the international climate change negotiation; while on the other hand, we should enhance development toward low-carbon economy to protect global environment and to achieve sustainable development.

Key words: climate change; carbon permit allocation; long term mitigation target; accumulative emission per capita; Copenhagen conference

Introduction

To achieve the stabilization target of atmospheric greenhouse gas (GHG) concentrations defined in the United Nations Framework Convention on Climate Change (UNFCCC), various allocation schemes of carbon permits have been successively proposed by research institutions in different countries since the convention came into force. These allocation schemes base on different principles, of which some advocate efficiency, some advocate equity, some are based on reality, and some consider the historical responsibility. Different allocation principles and methods reflect the different interest orientations. Currently facing the arrangements for the post-2012 global emissions

reduction actions at the upcoming Copenhagen conference, G8 Summit re-emphasized the target, that is, the global warming should be limited to 2 °C above the pre-industrial level, and the global GHG emissions in 2050 should be reduced by at least 50%; G8 also committed to cutting the emissions of developed countries at least 80%. In addition, it is observed that an increasing tendency to set 1990 as the base year of emission reduction, and the above long-term global emission reduction targets might be adopted as a resolution at Copenhagen conference. It concerns carbon permit allocation and the fundamental interests of each country to achieve long-term global emission mitigation targets, so that the allocation of carbon permits became a hot point once again.

Received: October 20, 2009

Corresponding author: He Jiankun, E-mail: hejk@tsinghua.edu.cn

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1 Review of allocation schemes of carbon permits

To summarize, various allocation schemes of carbon permits at home and abroad basically can be divided into two categories. One category is on the basis of per capita emission convergence advocated by some developed countries, considering current emissions and long-term global emission mitigation targets, which is based on the equal burden sharing principle but ignores equity. The other is on the basis of cumulative emission per capita convergence advocated by some developing countries, considering historical responsibility and emphasizing equity principle.

The method of per capita emission convergence advocated by some research institutions in developed countries is to set the per capita emissions of the target year (such as 2050 or 2100), and developed countries are decreasing gradually from the base year (such as 1990 or 2000) while the per capita emissions of developing countries are increasing gradually at the same time, and finally both of them are converging to a uniform target in the target year^[1].

Based on the principle of per capita emissions convergence, some research institutions in developed countries also proposed various modified or alternative schemes. For example, the Dutch National Institute for Public Health and the Environment (RIVM) proposed a gradual allocation method for the participation of developing countries, that is, emission reduction commitment should be taken as soon as per capita emissions or per capita income exceeds a certain level. And a multi-stage approach has been developed and includes four stages, i.e., base emissions scenarios stage, carbon emission intensity decrease stage, stabilization emission stage, and reduction stage^[2]. In addition, there are also sector-based bottom-up allocation methods and so on. Stern Review also raised the long-term global GHG emission reduction targets and burden-sharing principle^[3]. To stabilize GHG concentrations under 500 mL/m³ (ppmv) CO₂ equivalent (CO₂e), the report figures out that global GHG emission should be reduced at least 50% below 1990 levels by 2050, and fall to 20 billion t CO₂e with 2 t CO₂e per capita emission, and proposes this way as the principle of national emission reduction commitment.

Most of the allocation schemes of carbon permits proposed by research institutes in China are based on the principle of cumulative emissions per capita. In the 9th Five-Year and 10th Five-Year National Key Science and Technology Projects Reports, Tsinghua University

presented the principle of cumulative emissions per capita considering historical responsibility and two-convergence approach for permit allocation, which have been included into China's National Assessment Report on Climate Change published in 2006^[4-10]. According to two-convergence approach, the per capita carbon emissions in developing countries can increase first and decrease afterwards during the transition period while developed countries need to decrease steadily. In some years of transition period, per capita carbon emissions of some developing countries might temporarily exceed some developed countries to achieve industrialization, then these developing countries will conduct absolute emission reduction and to finally converge to the same emission level as developed countries by the target year. This is a necessary process for developing countries to realize industrialization and modernization, build a sound infrastructure system, improve living standard, and achieve sustainable development (shown in Fig.1)^[4-10].

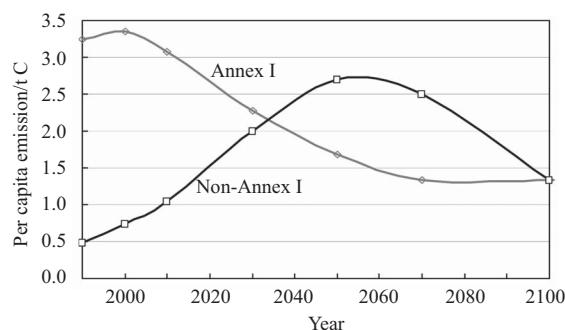


Fig. 1 Two-convergence approach for permit allocation

In 2008, Chinese Academy of Social Sciences (CASS) proposed a carbon budget proposal for meeting the basic needs of human development^[11]. The proposal includes four steps: first, determine the global carbon budget which can meet the long-term global goal in the evaluation period; second, take the base year population as a standard to allocate the initial national carbon budget and consider historical responsibility; third, adjust the national carbon budgets according the climate, geography, resource endowments and so on in each country; fourth, consider the carbon budget transfer.

In 2009, the Development Research Center of the State Council, People's Republic of China, also put forward an allocation scheme based on the idea of equivalent cumulative emissions per capita^[12]. First, establish national emission accounts to calculate the cumulative historical emissions of each country; next allocate the new total emission credits under long-term global emission reduction

targets to national accounts according to the principle of cumulative emissions per capita. Then every country establishes its emissions reduction road map based on emissions credits accounting, and can conduct international emission trading, but all countries have to eliminate the deficit of emission by the target year.

Chinese Academy of Sciences (CAS) also proposed an allocation scheme of emissions permits based on cumulative emissions per capita in 2009^[13]. According to the calculation of emissions permit and remaining emissions space of each country, countries all over the world will be divided into four categories, i.e. countries that hold emission permit deficits, countries that need to reduce their emissions, countries that should decrease their annual emission growth rates, and countries that can keep their growth rates, and thus commitment of each country can be determined respectively.

2 Carbon permits allocation under long-term global emission reduction targets

At present, the GHG emissions in developed countries (Annex I countries) and developing countries (non-Annex I countries) are roughly equivalent. To achieve the 50% emission reduction target, even if developed countries cut their emission by 80%, developing countries as a whole still need to reduce their emissions by 20%, that is, long-term global emission reduction targets essentially specify quantified emission reduction obligations for developing countries. Considering the future population growth, GHG emissions in developed countries will drop from 14 t CO₂e per capita in 1990 to around 2 t CO₂e per capita in 2050, while GHG emissions in developing countries will also drop from currently less than 4 t CO₂e per capita to less than 2 t CO₂e per capita. By 2050, this target will cause that the per capita emissions in developing countries will still be slightly lower than the developed countries, which basically is also the schemes of UNDP and Stern Review based on the principle of per capita convergence or contraction and convergence (C&C).

To achieve the above global emission reduction targets, China and other developing countries will face severe challenges. As far as the CO₂ emission from fossil energy consumption is concerned, global emission is 21.0 billion t, which means that there will only be cut by half to 10.5 billion t in 2050. Even though considering that the global emissions will peak and begin to decline in around 2025, the global emission permits from 2005 to 2050 will only be about 1056 billion t, that is, even if the developed

countries cut by 80%, their cumulative emissions from 2005 to 2050 will still come to 380 billion t and their cumulative emissions per capita is about 266 t, while the emission space left for developing countries will be only 676 billion t and the accumulation emission per capita is 107 t, less than half of the developed countries. Additionally, considering cumulative historical emissions, the accumulation emission per capita of Annex I countries will be 1206 t from 1850 to 2050, while that of non-Annex I countries is only 330 t, accounting for only 28% of the level of developed countries (see Table 1).

Table 1 Accumulative emission per capita under long-term mitigation target (unit: t CO₂)

Period	Annex I countries	Non-Annex I countries	World
1850–2005	940	223	417
2005–2050	266	107	137
1850–2050	1206	330	560
1990–2050	432	147	202

Note: In 2050, the population of Annex I and non-Annex I countries are respectively assumed as 1.5 billion and 7.5 billion

Even though developed countries advocate long-term global emission reduction targets and domestic reduction targets, they will still occupy the emission space of developing countries severely, which will constrain the process of modernization in developing countries seriously. According to the reports of Intergovernmental Panel on Climate Change (IPCC), the future growth of the global CO₂ emissions will mainly come from developing countries, whose CO₂ emissions by 2050 will increase about fourfold of the current level. To achieve the 50% emission reduction target by 2050, only 8 billion t CO₂ emissions space will be left to developing countries. Compared with the emission demand at that time, the CO₂ emissions of developing countries as a whole have to be cut by 80%, which will severely restrict the development space and block the sustainable development of developing countries.

Currently the long-term global mitigation targets and related carbon permits allocation schemes proposed by developed countries are totally against the equity principle of cumulative emissions per capita advocated by China and other developing countries. The so-called cumulative emissions per capita refer to the accumulation of annual per capita GHG emissions in each country since the industrial revolution. Because life time of CO₂ in the atmosphere is more than one hundred years, per capita

emission accumulation since the industrial revolution reflects the historical responsibility of a country, and also reflects the contributions of limited atmosphere space to its own development of urbanization and modernization as well as to domestic infrastructure construction and social wealth accumulation. The world economic development pathway since the industrial revolution shows that the accumulation of energy and resources consumption per capita is required to reach a certain level in the process of industrialization and modernization. Therefore, a certain amount of cumulative emission space per capita is essential to the process of modernization. Cumulative emissions per capita convergence is based on that every citizen in the world has equal rights to use atmosphere space resources. The principle to allocate and use limited global emissions space based on cumulative emissions per capita convergence reflects equality of rights and obligations of all countries.

3 The analysis of long-term mitigation target

Long-term global GHG mitigation targets need to fully assess the relationships among the climate change impacts, adaptation, mitigation and development, need to measure the risk of the loss in economic society and natural ecology caused by different warming ranges, need to evaluate the economic costs for different mitigation targets, and need to consider the risks of blocking development because of development space constraints. Different circumstances in different countries in different stages of development decide the difference of value judgments and interest orientation for addressing climate change, and correspondingly the priority issues concerned and the basic starting point for selecting the warming targets are also different. Developed countries have completed the process of modernization, and economic society tends to be an intensive development, so that their high current per capita emission can start to decline steadily. However, for developing countries which are in the process of industrialization and urbanization, the CO₂ emissions will correspondingly be an ongoing increasing process with the development of economic society and energy demand growth. Therefore, in order to achieve sustainable development, developing countries concern more about the necessary and reasonable emission space, as well as the equity for global emissions space allocation. The historical process of modernization in developing countries is far lagging behind that in developed countries. Moderate increase of energy consumption and emissions in the industrialization and urbanization stage are the

common and insurmountable rules in the modernization process for most of the countries in the world. Developing countries in different development stages demand differently from each other, so that their per capita carbon emissions will peak at different times in the modernization process. Thus we could not simply require that carbon emissions of all developing countries would reach the peak in a relatively short period in the future (2025–2030 for example). And we also could not simply determine that per capita carbon emissions of all countries would arrive at a lower level in a certain year in the future (in 2050 for example) according to the principle of per capita convergence. When the developed countries reduce their emission greatly and continually, the per capita emissions of developing countries might be higher than that of developed countries in a certain period in the future. Therefore, to achieve the long-term global goal of halving emission by 2050, it cannot be required that per capita CO₂ emissions of all developing countries tends to be less than 2 t by 2050. But within the ongoing processes of addressing climate change and technical progress in the world, the peak of per capita emissions in developing countries in the future will be lower than that in the developed countries. Meanwhile, their cumulative emissions per capita will remain lower than that of developed countries. Figure 2 reflects per capita carbon emission pathway of different countries in different development stages. The area under the curve represents a country's cumulative emissions per capita.

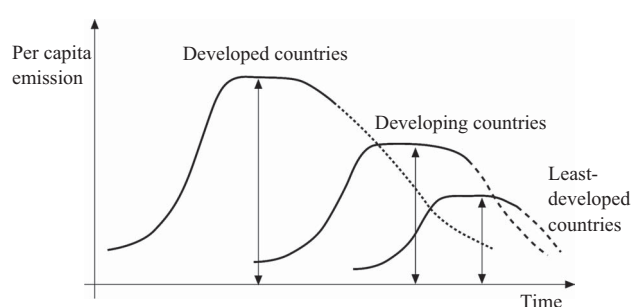


Fig. 2 Convergence pathways of cumulative emission per capita for different countries

China is in the stage of rapid industrialization development. Even if vigorously promote energy conservation, improve energy structure, and strive hard to transform economic development mode, the growth trend of energy consumption and corresponding CO₂ emissions will continue until around 2030, by when CO₂ emissions will reach 10 billion t. Thereafter, with the leveling off of economic growth and large-scale development of new

energy and renewable energy, new increase in energy demand will be likely to rely on non-fossil energy sources in order to realize zero growth of CO₂ emissions. And then about 10 years stabilization period is needed to achieve possible continuous negative growth. Although the total CO₂ emission by 2050 is likely to be lower than that in the peak year, a certain period of time is still needed to decline to 3 billion t (around 2 tCO₂ per capita). Even without considering the cumulative emissions before 2005, China's cumulative emissions per capita from 2005 to 2050 still remain below the average level in developed countries over the same period. If considering the historical emissions, China's cumulative emission per capita from 1850 to 2050 is only 300 t, which is only half of the world average and 1/4 of that in developed countries over the same period. However, the per capita emissions of China cannot be reduced to the convergence level of less than 2 t by 2050.

Convergence of cumulative emission per capita reflects the principle of fair allocation and use of global carbon emissions space. But unfortunately, due to the historical and current global emission patterns, the world has lost the chance of fairly allocating and using carbon emissions space. From 1850 to 2005, global CO₂ emissions had reached 1.1 trillion t, of which 840 billion t CO₂ emissions were released from Annex I countries. In order to achieve the target of halving 1990 emission level by 2050, global emission permits from 2005 to 2050 are only about 1.0 trillion t. Even if 80% reduction could be achieved in Annex I countries, there will still be 380 billion t emissions released from them. This means Annex I countries will occupy 58% of the total emissions space from 1850 to 2050, while their total national population in 2005 accounted for only 20% of the world. And CO₂ emissions from 1850 to 2005 in Annex I countries occupied 40% of the total global emissions space from 1850 to 2050. If calculated by cumulative emissions per capita, the developed countries have already exceeded their deserved permit from 1850 to the end of the 21st century. Under 550 mL/m³ CO₂e or 650 mL/m³ CO₂e stabilization concentration, the amount of cumulative emissions per capita in developed countries from 1850 to 2005 have also exceeded or are about to exceed their deserved permit from 1850 to the end of the 21st century. High per capita emissions of developed countries at present and in quite a long period in the future would continue to occupy the emission spaces for developing countries. The current issue is how to promote developed countries to take their responsibility based on the principle of equity.

From another perspective, the more urgent the GHG

mitigation targets in the future, the lower the value of GHG stabilization concentrations in the atmosphere and the global emission permit. This in fact means that the more emissions permit occupied by developed countries, the smaller development space is left for developing countries. Currently, under the targets of halving global emissions by 2050 advocated by developed countries, no matter how greatly the developed countries reduce their emissions, the development space for developing countries will be too small to support their sustainable development. If the long-term global mitigation target is set to 3 °C warming and the corresponding GHG stabilization concentrations in the atmosphere is 550 mL/m³ CO₂e, then global GHG emissions in 2050 can be stabilized at the level in 1990. If developed countries still reduce 80% below 1990 levels by 2050, developing countries as a whole can increase 80% above 1990 levels, rather than reduce 20% based on the 2 °C target. Even so, cumulative emissions per capita of developed countries are still higher than that of developing countries from 2005 to 2050. Therefore, how to choose the control target of global warming and long-term emission reduction both involve in equity issue. Of course, it is the world's common and kind wishes to control global warming as low as possible and to minimize adverse impacts and possible risks caused by climate change in the future. But in the global cooperation actions, the development demands and equitable development rights of developing countries must be taken into account. The target of controlling global warming requires not only further research from the scientific aspect, but also overall balance among climate change impacts, adaptation, mitigation and development in the international negotiations, and finally a rational choice may be made.

4 Conclusions and countermeasures

(1) In the negotiations of long-term global mitigation targets, reasonable rights and interests should be strived for based on the equity principle reflected through cumulative emissions per capita.

Based on the principle of convergence of cumulative emission per capita, the historical and current high per capita emissions of developed countries have severely exceeded their deserved permit from 1850 to the end of the 21st century to achieve the stabilization target for global atmospheric GHG concentrations. In the climate change negotiations, the responsibility and obligation of different group of countries was not attributed through a top-down emission right allocation regime, but through the principle

of “common but differentiated responsibility” and the principle of sustainable development taking consideration of their historical responsibility and respective capabilities, developed countries should take the lead to reduce their emissions, and should provide financial and technology transfer, and capacity-building support to developing countries in order to improve developing countries’ capacity to mitigate and adapt to climate change. Subsequently, Kyoto Protocol was adopted, in which quantified emission reduction commitments of developed countries from 2008 to 2012 were settled. The upcoming Copenhagen conference at the end of this year will determine the post-2012 global arrangements on emission reduction. Considering there is no subject of the allocation of long-term global emission permit in the negotiation agenda of Copenhagen conference, if the developed countries insist on bringing long-term global GHG mitigation target into the Copenhagen agreement, the idea of fairness in cumulative emissions per capita should be emphasized. As the carbon emissions permit allocation involves very complicated issues, it is difficult to reach a consensus in the short term for the entire international community, while all parties also hope the Copenhagen conference to be successful. Therefore, in the following negotiations, the mandate of the Bali Roadmap should be fully respected to promote the developed countries to commit deeper reduction in the next commitment period and provide adequate, predictable and sustained financial and technical support to developing countries. In addition, how developing countries implement appropriate national mitigation actions under the support of developed countries in the sustainable development framework should also be discussed. Developing countries’ historical cumulative emissions per capita is very low (for example, China’s is only 1/10 of the average level in developed countries and 1/20 of that in the United States), thus they should obtain reasonable room for future development.

(2) The determination of long-term global GHG mitigation target should be related to developed countries’ commitment of deeper emissions reduction in near- and mid-term.

High per capita emissions of developed countries in the history and possibly quite a long period in the future have occupied and will continue to excessively occupy the global carbon emissions space. It will be the primary agenda and task in Copenhagen to determine quantified post-2012 emission reduction commitment for Annex I countries. At present, the GHG emission reduction targets by 2020 of Annex I countries proposed by themselves are to cut

emission as a whole by only around 15% below 1990 levels, including Certified Emission Reductions (CERs) from CDM projects, which is far from achieving the target to cut emissions by half by 2050. The United States and Japan have proposed that by 2020 they will cut their emissions to 1990 level and to 8% below 1990 level respectively, which is still far from achieving the target of 80% reduction by 2050. While developing countries require developed countries to reduce at least 40% below 1990 levels by 2020. On the one hand, developed countries should set a good example to developing countries in low carbon development, to prove that it is feasible to achieve the emission pathways of long-term 2 °C global warming target and to show their decision on emission reductions. On the other hand, emission space further occupied by developed countries in the future should be reduced as far as possible. Whether long-term global GHG mitigation targets could be achieved is highly related to whether developed countries could realize near- and mid-term deep emission reductions which is more urgent and important. Based on the principle of equity, the deep emission reductions in developed countries are their obligations according to the UNFCCC, which reflects the principle of “common but differentiated responsibility” and leaves necessary emission space for the sustainable development of developing countries. That developed countries commit to deeper emission reductions in near- and mid-term cannot be either the bargaining counter to force developing countries to undertake long-term emission reductions or the reason to set up climate barriers and impose carbon tax on goods from developing countries on the issue of trade.

(3) The long-term global GHG mitigation targets should be ensured by the commitments of adequate and quantified financial and technical support from developed to developing countries.

The backwardness of technical level and the shortage of funds are the current obstacles and bottlenecks for developing countries to adapt to and mitigate climate change and to achieve low carbon development. If effective financial and technical support could not be obtained from developed countries, infrastructure and production capacity under construction will still have to use high-emission technologies in developing countries, of which high-emission characteristics will continue for several decades because of the technological lock-in effects. Large-scale financial and technical assistance to developing countries is the responsibility of developed countries according to the UNFCCC, and also is compensation for their overuse of emission space. Long-term global GHG mitigation

targets in the future would constrain emission space of developing countries and this must be connected with additional, adequate, predictable and sustainable financial and technical support from developed to developing countries. Developing countries required developed countries to afford 0.5%–1.0% of their GDP to developing countries to support activities and capacity building for climate change mitigation and adaptation, in order to achieve sustainable and low carbon development while their emission space has been greatly overused by developed countries and the growing adverse impact of climate change was observed.

(4) Long-term global GHG mitigation targets should ensure the sustainable development of developing countries.

According to the requirements of Bali Roadmap, developing countries “take nationally appropriate mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity-building from developed countries, in a measurable, reportable and verifiable manner”. It clearly expresses the differentiated responsibilities and obligations of both developing and developed countries, and shows that nationally appropriate mitigation actions by developing country Parties are on a voluntary basis, and also are concrete actions and project activities in priority areas of sustainable development, which is different from the legally binding obligation of the quantified emission reduction targets committed by developed countries. The requirements of Bali Roadmap reflect the principles of addressing climate change in developing countries in the context of sustainable development. Copenhagen conference should follow the mandate of Bali Roadmap, enhance full, effective and sustained implementation of UNFCCC, and make overall arrangements for mitigation, adaptation, technology transfer and financial support. In the Copenhagen agreement, new and quantified long-term emission reduction obligations should not be imposed to developing countries in the form of determining long-term global GHG mitigation targets. Developing countries are deeply affected by adverse impact of climate change, and also confront challenges in many aspects, such as poverty, hunger, health, education and so on. In the UNFCCC, it is clearly stipulated that the primary and overriding priority task of developing country Parties is economic and social development and poverty eradication. Developing countries need overall consideration and coordination to solve all these issues in the sustainable development framework. The appropriate mitigation actions in developing countries should coordinate with the economic development and poverty eradication.

Developing countries can only address climate change effectively by sustainable development.

(5) Address the challenges of long-term global mitigation targets actively and achieve the win-win solution for climate changes mitigation and sustainable development.

Long-term global mitigation targets will seriously constrain the future carbon emissions space of China. Energy consumption and corresponding carbon dioxide emissions in the rapid industrialization and urbanization process in China have a rapid growth trend, which form an increasingly sharp contradiction with the target of global GHG emissions reduction and global climate protection. The fundamental way of China to coordinate economic development and addressing climate changes is by speeding up technological innovation, developing low-carbon energy technologies, improving energy efficiency, optimizing the energy structure, transforming economic development mode and social consumption pattern.

At present, China’s economic development is more and more restricted by domestic resources availability and environmental capacity. China implements scientific outlook on development, sticks to the fundamental national policy of resources conservation and environmental protection, makes efforts to build a resource-conserving and environment-friendly society and vigorously promotes energy conservation and emission reduction. All of these are consistent with carbon emissions mitigation and global climate protection. Developing low carbon economy, promoting advanced energy technology innovation, and gradually establishing a sustainable energy system with new energy and renewable energy as the main energy sources are the internal needs of national sustainable development as well as the inevitable strategic choices to deal with the challenges for China’s future development space from the long-term global mitigation targets.

Long-term global target for addressing climate change is not only a great challenge for realizing the three-step modernization goal of China, but also an important opportunity of accelerating the transformation of economic development pattern and achieving sustainable development. Therefore, China must adapt to the world’s transformation trend of economic society characterized by low carbon development. We should make efforts to obtain reasonable emission space in the international climate change negotiation, and meanwhile we should consider addressing climate change and carbon emissions mitigation as an important national strategy domestically. We should combine the development of low carbon economy with the concepts, policies and pilot projects being developed such

as recycling economy, ecological economy and green economy, and highlight the construction of ecological civilization with low carbon as a major character. The connotation of environment-friendly society construction should be expanded from simple national environment protection to global environment protection. Low carbon development and carbon emissions mitigation should be considered as one of the major strategic targets and should be incorporated into national and local program for economic and social development in order to achieve the win-win solution for global climate protection and national sustainable development.

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