



# Climate Change and Sustainable Development

Climate change is one of the most important issues in the international community. It is necessary for mankind to dramatically reduce greenhouse gas emissions to combat global warming, which has already become the mainstream view and the theoretical foundation for relevant negotiations in the United Nations. Meanwhile, climate change is a rather complex issue, involving many aspects, such as climate, politics, economy, energy, and environment. Despite the intense interest game between countries and groups in international climate negotiations, even in academic circles and public sector, there are many different opinions and heated debates on such basic issues as whether climate change itself is a problem or what kind of problem it is.

The climate itself is constantly changing, but now climate change has become a problem mainly because of human's concern that the abnormal climate changes will bring great harm or disaster to mankind. Historically, mankind has been frightened by climate change and its related disasters. Except praying for good weather and harvest, human was largely helpless and let nature take its course. At present, although there are worries about the general abnormal weather and climate change, the international community's concerns about climate change resulted mainly from an anxiety or panic of global warming tendency. So, at present, the core problem of climate change discussed by the international community is global warming.

Most people believe that global warming is associated with human activities, particularly the greenhouse gas emissions from industrialization and the use of fossil fuels. So in order to avoid possible serious consequences and disasters, humans should work together to reduce emissions. Under the multiparty efforts and impetus, international consensus has been gradually reached, many international treaties and agreements were signed, and many practical actions have been taken. Since the beginning of the international climate negotiations in 1992, in more than 20 years, although some progress has been made, substantive breakthroughs have been limited, and some

countries have even reversed their stance. What accounted for this, apart from the differences between the positions of the diverse parties and the interest games, are people's confusion about climate change and the weak foundation of global climate change policies. There is a lack of adequate identification of climate change, which shows that climate change itself is a very complex issue and also related, to some extent to the exaggeration or misinterpretation of climate change made by the parties concerned.

The concept of sustainable development has aroused more and more attention from the international community since it was put forward in the 1970s. Although different countries and groups differ greatly in their definitions and prioritization of the concept of sustainable development, their conceptions are generally more or less related to resource issues, the core of which is whether the world's natural resources can support the sustainable economic growth of mankind and how to explore and utilize resources. In a book published in 1981, *Building a Sustainable Society*, Lester T. Brown proposes to control population growth, protect resource bases, and develop renewable energy resources to achieve sustainable development.

When the contradictions between resource supply and demand and environmental problems become more and more prominent, various viewpoints on saving the earth are gradually getting popular. But in terms of the earth, Richard Watson points out that it is needless to worry for an ice cap, a Brazilian rain forest or a certain height of sea level, because they will rise and fall as time goes by, and the idea that the earth belongs to humans, and, therefore, we should protect the planet is a manifestation of human's extreme arrogance. Earth will protect itself, and no matter what kind of destruction we humans have caused to the earth, the earth will eventually repair itself [1]. Therefore, the core of saving the earth is to save the human itself, and only by changing ideas, perfecting policies and systems, enhancing technology to improve the living environment of mankind, can the sustainable growth and development be achieved as much as possible.



## THE "SKEPTICISM" ABOUT GLOBAL WARMING

There are many conflicting views and arguments on climate change in China and other countries. Only on the issue of global warming, there is a debate of "warming" against "cooling," which can be traced back to early 20th century. In the 1930s, the 1940s, and the 1970s, people were concerned about "the arrival of Ice Age" and "the global cooling."

In 1971, Dansgaard et al., according to the Greenland ice core oxygen isotope spectrum analysis, propose that the earth climate will enter the cold cycle. Bryson, researcher at Environmental Research Institute at the University of Wisconsin, believes that the Earth is slowly moving into another big ice age. A group of well-known European and American scholars met at Brown University in the United States to hold a seminar entitled "When and How to End the Interglacial Period." [2] According to a 1972 report by National Science Board entitled *Patterns and Perspectives in Environmental Science*, the current high-temperature is coming to an end, according to the records of the past interglacial, which will be followed by a long cold period. A number of scholars publish articles on the global cooling in journals such as *Science* and *Newsweek*, and many books, such as *The Weather Conspiracy: The Coming of New Ice Age*, *The Cooling: Has the Next Age Began*, *Can We Survive it?* became the mid-1970s bestsellers [3]. At that time, the prevailing view on international climate change was that the earth's temperature had begun to decline, and if humans did not intervene, warm periods would end sooner, and ice age and corresponding environmental changes would come.

In the 1970s, only a few scientists insisted on global warming. Until 1980s and 1990s, the global climate did not get cold, instead, the view of the greenhouse effect and global warming became the mainstream in the international society. In November 1988, the World Meteorological Organization and the United Nations Environment Program jointly established the Intergovernmental Panel on Climate Change (IPCC). Since 1990, the IPCC has issued a number of assessment reports, gradually verifying the reality of global warming, the relevance to human activities, and the need for emission reduction, which to a large extent has contributed to the formulation of "United Nations Framework Convention on Climate Change" and "Kyoto Protocol."

The main content of the IPCC assessment report is that global warming is an indisputable fact and is mainly caused by human activities, such as fossil energy burning and deforestation, which lead to significant increases in greenhouse gas concentrations in the atmosphere, giving rise to global warming [4]. Global warming will bring a series of consequences, such as sea level rise, the increase of catastrophic weather, and the deterioration of human living environment, which would pose a serious threat to sustainable development. In order to slow down the global warming process, mankind should implement a massive reduction of greenhouse gas emissions as soon as possible. Because of the participation of thousands of

international scientists, the IPCC assessment report has highly authoritative, and the proposed view is not only the main theoretical basis of the relevant negotiations of the United Nations but also widely acknowledged by the international community as the mainstream view of climate change.

But at the same time, some scientists and scholars remain skeptical of IPCC conclusions and theories about greenhouse effect and global warming. They have published articles in academic journals to refute the mainstream view of global warming in light of its scientific uncertainty. In addition to academic debate, some skeptics have also by various means criticized the “climate change threat theory” had controlled the European and American governments and mainstream media, arguing that climate change had been politicized and religious.

In March 2007, the BBC launched a documentary called *The Great Global Warming Swindle* in which several scientists were interviewed and cited a great deal of evidence to deny it was human activities that led to global warming, asserting that it was creating unnecessary panic. At the same time, under the leadership of S. F. Singh and others, climate change “skeptics” formally set up a NIPCC organization in 2007 (Non-Intergovernmental Panel on Climate Change) and launched a report entitled *Rethinking Climate Change*, which proposes several views different from the IPCC report [5].

At the end of 2009, the voices questioning global warming gradually increased, especially the “Email Gate” in the UK climate science academia, which made the long-standing global warming “skepticism” arouse unprecedented attention. In November 2009, the website of UK Climate Change Research Centre suffered a hacking attack, with masses of internal data and nearly thousands of e-mails stolen and released. The research center was found to have been artificially modifying the climate warming data for years in order to exaggerate the impact of global warming, according to related materials.

On the eve of the Copenhagen Climate Conference, “skeptics” held the Global Warming Skeptic Conference in the European Parliament, Brussels. On December 8, 2009, 140 scientists from nearly 20 countries, including Abdul Mashat, the director of the Astronomical Observatory Cosmos Research Office of the Russian Academy of Sciences, issued an open letter to UN Secretary, General Ban Ki-moon, to doubt the saying that “human activities caused climate change.” During the Copenhagen Climate Change Conference, a group of “skeptics” from all around the world organized various types of activities, declaring that “global warming is a lie.”

In late 2009 and early 2010, cold currents and snowstorms hit the northern hemisphere, paralyzing traffic in many countries of Asia, Europe, and North America, with normal lives disrupted and more than 100 people killed. The unusually severe winter once again sparked debate over whether global warming is true. Climate scientists pointed out that global warming stopped and the earth would enter the “Little Ice Age.” Since the 20th century, climate has been warming due to the ocean’s “warm mode,” but now the oceans enter the “cold mode” and the climate will become colder. Because the rarely seen cold weather in the northern hemisphere contrasts sharply with the widespread “global warming” well accepted by the public, “climate cooling” has aroused widespread attention as a result of the media’s race for reporting.

Since the beginning of 2010, the IPCC has been lambasted by outsiders for the detected errors in its assessment report. On January 17, 2010, a report by *Sunday Times* revealed that the IPCC’s assessment released in 2007 on the disappearance of Himalayan glaciers in 2035 was an obvious error [6]. Subsequently, in the report a series of errors were found, among which “climate change will threaten 40% of the Amazon rainforest,” “by 2020, African crop production may reduce by 50%,” and “The economic losses of all the countries in the world caused by extreme weather events sharply increased” have aroused heated debate. They are considered as lacking evidence and obviously exaggerating the impact of climate change. At the same time, the public voices have criticized the IPCC as a political and bureaucratic institution where there are more politicians than scholars, snubbing and even cracking down skeptics, and even the qualifications of President IPCC was questioned. The criticism from all walks of life has brought the IPCC into an unprecedented crisis of confidence and to some extent has further expanded the impact of climate change “skepticism.”



## THE MAIN VIEWPOINTS OF “SKEPTICISM”

The international community gives no unanimous concept of “skepticism” about climate change, but it mainly refers to all kinds of opinions that question and deny the current global warming theory. Those who challenge the global warming theory include many scientists in the natural sciences such as climate, astronomy, physics, and many humanities such as economics and social sciences, and a large number of social and political figures. Their viewpoints are very complex, without unified

theory or content. Some question the truth and seriousness of global warming, and some question the relevance of global warming and human activities and the rationality of the current countermeasures. In general, it mainly includes the following aspects.

Firstly, the truth of global warming was questioned. They argued that global warming has come to an end or the global climate is getting colder. The extent of global warming is negligible, and the climate has been warming and cooling now and then. There has been no final verdict on whether the global climate is getting abnormally warming. According to some analyses, it is too early to judge the earth's "warming" or "cooling" at present. The average temperature of the earth is rising in the last 20 years, but it does not exceed the highest temperature in history. The rise of temperature has slowed down since 1998, and after a 10-year drop in average temperature of  $0.2^{\circ}\text{C}$ , the average temperature in 2008 has become the lowest in the century. German climatologist Moggi Ratif et al. predicted that the earth would enter the "Little Ice Age" as a result of periodic changes in ocean currents, and that the world would enter a colder period in the next 20–30 years. In the past, global warming is a fact, but after the peak period of global warming between 1998 and 2005, then from 2012 to 2015, temperature will begin to fall slowly, and the cold weather will inevitably occur around 2055–60, according to Abdul Mashat, the director of the Astronomical Observatory Cosmos Research Office of the Russian Academy of Sciences.

Doblezov, an expert at the Institute of Geology and Mineralogy at the Siberian Branch of the Russian Academy of Sciences, suggested that ongoing climate change on earth was not global warming but a transition to global cooling. Thomas Crowley, professor of geophysics at the University of Edinburgh, published in *Nature* that the earth was supposed to have entered a new ice age, but the massive emissions of carbon dioxide slowed down the process. Zhao Zongci, a researcher at National Climate Center of China Meteorological Agency, predicted that natural factors would reduce China's average temperature by  $0.8^{\circ}\text{C}$  between 2020 and 2030, while human factors will only increase the average temperature in China by  $0.5^{\circ}\text{C}$ , thus the climate in China getting colder and colder.

Secondly, human activities have very limited impact on global warming, but solar activity cycle is the main cause of climate change. Many scientists believe that the world climate has always been in a state of instability, as affected by the periodic activities of sunspots, so the earth climate also takes an irregular cycle of change. Fred S. Singer and Dennis T.

Avery pointed out that modern warming was moderate and not man-made, because the world's climate has always been in an unstable state. Driven by changes in sunspot activities, there has been a moderate but irregular cycle of climate change every 1500 years, and we were at the current warming stage of the cycle [7]. A new ice age is approaching, and a relatively mild period is ending. According to Abdul Samatov, the global warming was mainly caused by the unusual high luminosity of the sun throughout the 20th century. But now the sun's luminous intensity is falling, it will drop to its lowest point around 2041.

Richard S. Lindzen, professor at Massachusetts Institute of Technology, believes that human activity produces carbon dioxide, less than 1% of the atmosphere's carbon dioxide (less than 0.054% carbon dioxide), and does not pose a direct threat to climate change, and even when the concentration of carbon dioxide in the atmosphere is more than 1000 ppm. Australian geologist Ian Rutherford Plimer believes that climate change is a continuing natural process which is largely determined by solar activities and has little association with human activities. Latif et al. think that the natural cycle of seawater temperature affects the global climate. When the ocean is in "cold mode," the global climate will become colder and when the ocean is in "warm mode," global temperature will rise regardless of greenhouse gas emissions. In his paper, NASA scientists Ryan and Lynt argued that 73% of global warming was caused by natural causes.

Thirdly, the consequences of global warming are not dire and may even be a good news for humans. Fred S. Singer and Dennis T. Avery point out that warm weather will be better and more stable than the cold climate, and the planet may have been able to return to the climate of the previous million years. During the climate cycle in 1500, the last two warming stages were periods of prosperity for humans. For example, both the Roman Empire and China were flourishing during the Roman warm period 2000 years ago. In the past warm period, there was no such a frightening scene as the global warming advocates said. Global cooling can lead to the reduction of agricultural output, famine and ethnic migrations, and cold-related deaths are almost 10 times more than heat-related deaths each year. In China's history, most of the climax of wars and dynastic subrogations occurred in the cold periods.

Andrew Burton, associate professor of Michigan University of Technology and director of the Center for Research at the Center for Climate Change in the US National Climate Change Institute, proposed

that more nitrogen from global warming and atmospheric pollutants would increase forest productivity, and that longer growth period would be beneficial to the timber industry. According to a co-authored report by Robert Mendelsohn and James E. Neumann, *The Impact of Global Climate Change on the United States Economy*, assuming that carbon dioxide doubling in the air increases temperature by 2.5°C and precipitation by 7%, this will result in a significant increase in crop yields, a slight increase in wood production and a limited negative impact on other economic sectors. Overall, the US economy could grow slightly from global warming (GDP increased 0.2%) [8].

Finally, the thinking mode of solving the problems of climate change is wrong, because it is unlikely for humanity to reverse the warming trend. Some skeptics acknowledge the truth and gravity of global warming, but believe that the measures such as current international negotiations and reducing greenhouse gas emissions are powerless to reverse the warming trend. Fareed Zakaria, the international editor of *Newsweek*, notes that even if the world's most ambitious plan is formulated, greenhouse gas concentration will continue to rise in the next few decades, so the international community should learn to adapt to global warming [9]. Kendo Ocox, director of Environmental Program at the International Policy Analysis Network of India, believes that adaptation and economic growth are the best way to deal with climate change, and substantial emission reduction will shift technology resources that should have been applied to improving human adaptation and increasing economic growth to the development of emission reduction.

Dennis Meadows, an American scientist and author of *The Limits to Growth*, argues that considering that mankind has been unable to reverse global warming and that reducing carbon dioxide emissions will not solve the root of climate change, the only thing we can do is to adjust our mindset and find ways to adapt to climate change. Bjørn Lomborg, the author of *The Skeptical Environmentalists* and director of Copenhagen Consensus Center, believes that we should focus on developing clean energy, since emission reduction is expensive and inefficient, and the damage caused by massive emission reduction is even more than the damage caused by global warming. Climate economist Richard Tol says the high global CO<sub>2</sub> tax (aimed at warming up to 2°C) starting at \$68 will lead to a decline in global GDP by 12.9% in 2100, or as much as cutting \$40 trillion each year, which is 50 times more than the expected loss caused by global warming [10].





## THE ESSENCE OF GLOBAL WARMING

In terms of what people clearly observe and perceive, it is an indisputable fact that the global climate has become warmer in recent decades and the emission of greenhouse gases has increased dramatically as a result of the industrialization of human society. The question lies in what the consequences this will bring about and what measures international community should take.

In order to expand the consensus on climate change, some analyses and public opinions are, to some extent, exaggerating the seriousness and harmfulness of climate change. For example, some public opinions describe climate change as a devastating catastrophe like the film “The Day after Tomorrow,” or even the end of the world. To some degree, these public opinions have aroused people’s attention to the climate change, but after some errors in science were disclosed, some people began to doubt and deny the basic facts of climate change, thus going to the other extreme.

Global warming is not an issue of doom-of-world but closely related to what attitudes humans should take and what efforts humans should make in response to it, and also to our policy priorities and future directions of investment. If global warming continues and becomes a doomsday disaster, humans should fight for survival at all costs and put tackling climate change a top priority. If not, the issue of climate change should be taken as one of the challenges mankind is facing and formulate long-term and comprehensive strategies, with many factors taken into account such as cost, efficiency, economy, and politics, combined with the other problems and challenges mankind is facing.

According to the analyses of many scientists, global warming may bring about many harmful consequences ranging from local climate and environmental disasters to some decreased agricultural production, increased diseases, the rise in sea level that may lead to the reduction and even disappearance of some countries’ territory, or some coastal cities and villages and towns facing survival threats, and so on.

If it is not a major human survival crisis that may be triggered by mutation and catastrophe, above-mentioned problems can be solved or mitigated by adaptation, the core of which is to enhance human’s ability to resist against disasters and environmental changes. It can be seen from the current developing countries’ vulnerability to natural disasters and the

larger losses that different levels of economic development lead to a large gap in the capacity of different countries to respond to natural disasters and crises. Many problems in human development that may bring about many negative things can only be solved through further development.

In terms of the common topic of energy conservation, emission reduction, and the development of low-carbon economy, a country's political determination, policies, laws, and international treaties all play important role, and moral constraints are also essential. However, the reduction of carbon emissions and the development of low-carbon economy can only be realized by enhancing energy efficiency and competitiveness of new energy, both of which ultimately rely on the market to achieve. Although political support and moral constraints can play a driving and stimulating role, finally it can only be solved by economic leverage. For example, rising energy prices are often more effective and lasting than some policies and moral constraints in promoting energy conservation, energy efficiency, and developing alternative energy resources.

Energy consumption is one of the main causes of climate change, so changes in energy consumption and its structure may greatly affect whether the climate negotiation goals will be fulfilled. However, fundamentally, the change of energy pattern and structure depends on, to a great extent, the economic development and development stage. With the fast growing of world economy, energy consumption and carbon emissions have increased significantly, but hopefully, it may promote clean energy development and provide positive factors for mitigating climate change. On the one hand, the rise of traditional energy prices will greatly encourage the investment in clean energy and related technologies. On the other hand, governments have relatively sufficient financial funds to support the development of clean energy industry. In the past years, countries around the world attached great importance to clean energy development, with investment increased significantly. Besides government subsidies, continuously elevated oil and gas prices is also an important cause.

Similarly, the world economic recession is a mix of cursing and blessing for climate change. Positively, energy consumption and carbon emissions in many countries significantly slowed down. According to the International Energy Agency, carbon dioxide emissions from OECD countries fell by 0.6% in 2011. Carbon emissions in 2012 dropped to the lowest level since 1994, down by 13% and 10.7% compared with that in 2007 and 2005, respectively. In 2011, the total global carbon dioxide

emissions increased by only 3.2% compared with that in 2010, with total emissions of carbon dioxide in OECD countries decreased by 0.6%. In contrast, the carbon dioxide emissions of the “BRICS” and developing countries increased by 6.1% when the rate of economic growth slowed down. Negatively, the economic downturn and the moderation of traditional energy price have led to the decreased industrial support and intensified trade disputes, which have frustrated the development of clean energy. Since 2011, European countries such as Germany and Italy have cut down clean energy subsidies for the photovoltaic industry. The global clean energy market, especially the photovoltaic market, began to shrink. Some countries stopped constructing new energy power plants, many enterprises went bankrupt. Europe and the United States have launched an anti-dumping and countervailing duty investigation on the exports of Chinese solar and wind power products.



## **CONTINUOUS INCREASE IN GREENHOUSE GAS EMISSION**

Since the international financial crisis in 2008, the global economic recovery has been weak and the growth rate of global energy consumption has slowed down, but the total amount of energy has continued to increase, especially the increase in coal consumption, which has made the target for global temperature control difficult to achieve. According to the *World Energy Outlook 2030*, released by BP in 2012, global population growth will slow down in the next 20 years, but the new population will continue to hit 1.4 billion (0.9% annual growth). Global GDP growth in the next 20 years will increase from 3.2% in 2009–2010 to 3.7% annually. Despite such factors as energy efficiency improvement, the growth rate of world primary energy consumption will continue to reach 1.6% in 2010–2030, and the total amount of global energy consumption will increase by 39% by 2030.

Although low-carbon energy is growing, fossil fuels still dominate global energy consumption. In particular, coal accounts for almost half of the global increment in energy demand over the past decade, even faster than renewable resources. Over the past decade, global power production has doubled, with two-thirds of the increment coming from coal [11]. In January 2013, a report entitled *The Challenge to Keep Global Warming below*

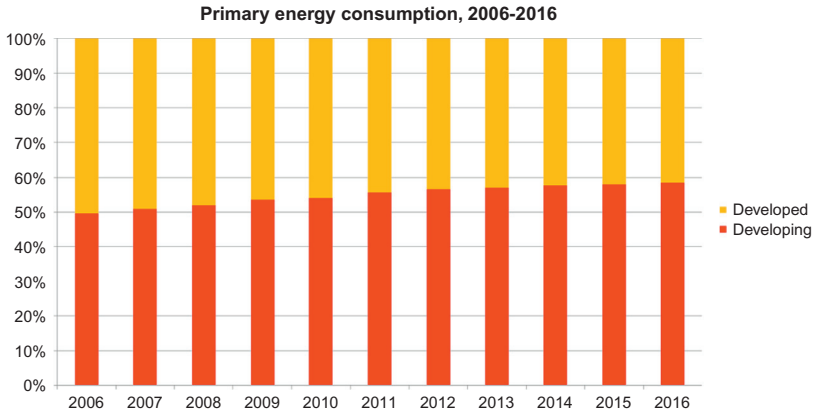
2°C by the UK's Tyndall Center for Climate Change was published in *Nature Climate Change*. The report reveals that global carbon dioxide emissions increased further in 2012, to the record 35.6 billion tons. The 2.6% increase in carbon emissions in 2012 led to a 58% increase in global emissions of fossil fuels above the baseline set by the *Kyoto Protocol* in 1990.

Generally speaking, it becomes harder to achieve the goal of 2°C set for the global warming limit. According to the International Energy Agency, greenhouse gas emissions under “New Policy Scenarios” will increase the global long-term average temperature by 3.6°C, and even in the “energy-efficient world scenario” with global energy demand in 2035 cut in half, there will be 3°C increase for long-term temperature. Around the 2012 Doha Climate Change Conference, The *Emissions Gap Report* 2012, by the United Nations Environment Programme (UNEP), points out that there is a gap between 8 and 13 billion tons of carbon between the different countries’ commitment to reducing emissions and the target of 2°C. Compared with the goal set for 2020, in 2011 the global total carbon emission has already exceeded by 14%. The *World Bank Report* warns that unless more action is taken, global temperatures will rise by 4°C by the end of the century.



## RESTRUCTURING INTERNATIONAL CLIMATE NEGOTIATION

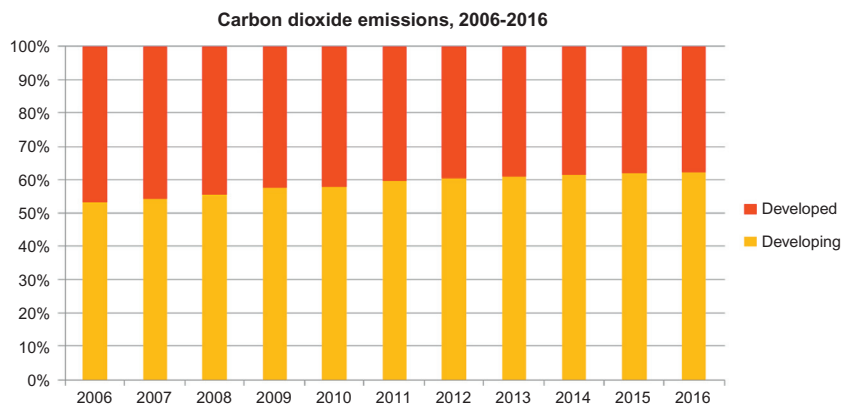
The western developed countries have been moving forward to the postindustrial society, together with the economic crisis, the increasing speed of energy demand slowdown after it came close to the peak, and in recent years the total amount has declined. In 2000–2010, the total annual energy consumption of North America, Europe, and the CIS increased by 0.2%, well below the world average of 2.67% and the Asia-Pacific of 6.34% [12]. In 2005–2015, total energy consumption in North America, Europe, and the Commonwealth of Independent States increased by 0.26% annually, with an average growth of 1.85% in the world and 4.02% in Asia-Pacific region in the same period. In developing countries, energy demand has increased dramatically as a result of accelerated industrialization, population increase, and economic growth. In 1999–2009, the growth of energy consumption in developing countries was 72.9%, accounting for 31.9%–44.7% of the world in total. China’s oil consumption increases 1.7 times more than that in 2005–15.



*From BP Statistical review of world energy 2017, page 8.*

According to BP's forecast, in 2010–2030, the developing country's primary energy consumption will have almost stopped growing (an average annual growth of just 0.2%), with the world's average growth rate of 1.6%. The non-OECD countries have an average annual growth rate of 2.7%, which will account for 54%–65% of the world total consumption. Asia-Pacific Region becomes the center area of global energy demand growth. The International Energy Agency forecasts that Asia's non-OECD country's oil imports will rise from 50% in 2010 to 80% in 2035. Exxon Mobil predicts that by 2040, Asia-Pacific energy demand will account for 43% of the world's energy demand. BP forecasts that India's energy demand growth will account for 53% of global growth by 2030, and India will overtake Japan as the world's third-largest oil importer by 2020.

In the 1990s, emission by the developing countries was less than 30% of the world total emission, and in terms of emission and emission reduction potential, the developed countries accounted for an absolute majority, so it is the global consensus for the developed countries to take the main responsibility for emission reduction and provide financial support for developing countries, with the principle of “common but differentiated responsibilities” as the keynote of international climate negotiations at that time. After more than 20 years, there have been great changes in greenhouse gas emission, emission reduction capacity, and potential and economic strength in the world. The growth of energy consumption in the emerging markets, especially in the Asia-Pacific region has continued to increase greenhouse gases, while the emission of the western developed countries has declined significantly under the influence of economic structure upgrading and financial crisis.



From *BP Statistical review of world energy 2017*, page 47.

At present, the total emission of developed and developing countries is basically equivalent, and the overall emission of developing countries will surpass those of developed countries in the future. It is predicted that carbon emission of the developing countries will reach more than 70% of global emission by 2050. This rise in greenhouse gas emission has led to significant changes in the status of developed and developing countries in international climate negotiations, especially developing countries, where carbon emission has been growing rapidly and gradually, become the focus of global emission reduction. Since *Kyoto Protocol*, three-legged climate negotiation structure shaped by the umbrella group led by EU and the United States, and the “Group 77 plus China” has been strongly impacted, with the main contradictions and the conflicts gradually transferred from the developing countries with the developed countries to the more-emission countries with less-emission countries. In international climate negotiations, the challenges are intensified for the newly emerging markets, especially, the Asia-Pacific countries in increasingly passive status.

The contradiction between more-emission and less-emission countries has been highlighted, which indicates that global climate negotiation will gradually transit from “the north–south pattern” to “the pattern of large–small emission country.” The United States first put forward the division of big and small emission countries and actively promoted the concept of “emission reduction in big emission countries” in various occasions, and gained support from the European Union and some other countries. This division is based on emissions, emission reduction capacity, and potential, which aims, in essence, to highlight the responsibilities of “advanced developing countries” such as China, India, Brazil, and

South Africa. Prior to the Copenhagen conference, the United States proposed the concept of “E8” (eight big emission countries), including China, India, the United States, Japan, and so on. The EU has positioned America and the developing world as big emitters that need to quantify their emission, that is, the so-called “three large emitters” (America, China, and India). After the Durban conference, Europe and the United States further emphasize that the way in the past, in which the countries taking the burden of emission reduction is divided into the poor and rich, should gradually be replaced by the division of large and small emission countries.



## EXPANDING GLOBAL CLIMATE CHANGE CONSENSUS

Global warming, only one of the challenges mankind is facing, cannot only be used to summarize all the issues of climate change but also cannot represent all the environmental issues. At present, the international community, to some extent, deifies climate change, exaggerating its threats and ignoring other environmental and global issues. The *New York Times* columnist Thomas Friedman proposes that the word “global weirding” should be used instead of the word “global warming” and that the rise in global temperature and climate change should be described by “variation” [13]. Dennis Meadows believes that the world’s understanding of global climate change is still very limited. “Global warming” cannot sufficiently describe the global climate problem, the essence of which is that human beings always pursue unlimited development with limited resources on the earth.

The Copenhagen Consensus Center, led by Bjorn Lomborg, conducted a study which proposes a hypothesis that how \$50 billion should be spent to maximize the benefits for humanity. In the last 17 proposals, AIDS, food subsidies for women and children, and malaria control are ranked in the top 3, while *Kyoto Protocol* is ranked the 16th. The study argues that the cost of *Kyoto Protocol* would far outweigh its benefits and its implementation would cost at least \$150 billion a year. The United Nations Children’s Fund estimates that only \$70–\$80 billion a year would be enough to allow residents of all Third World countries to get the most basic clean water, sanitation, basic health care, and education.

In response to global environmental problems, developed and developing countries should strive to eliminate their cognitive differences and jointly promote global environmental governance and related technical cooperation. Because of the different stages of economic development, there are many cognitive differences and misunderstandings between developing countries and developed countries on climate change. In developing countries, some analysts argue that there is a plot behind the theory of climate change, that is, to prevent developing countries from continuing to develop. Some analysts also argue that it is a scheme for some interest groups to seek benefits as well as some scientists to secure more funding. In fact, the developed countries attach great importance to environmental protection mainly out of consideration of their own sustainable development. These countries have developed to the post-industrialization stage, which not only have a strong demand and desire to improve environmental quality but also have adequate economic and institutional guarantees. The developed countries have urged the major developing countries to reduce their emissions, to some extent, to avoid free riding of developing countries, which is a manifestation of international political economy and diplomatic game. If it only boils down to the plot of some countries, it is detrimental to not only the solution of climate change but also to the sustainable development of developing countries themselves.

Similarly, for developed countries, to understand the relation between the stage of economic development and the concept of sustainable development is also necessary for narrowing the cognitive differences and understanding the position of developing countries. The World Bank proposes that although human beings have jeopardized the environment in the early stages of economic growth, they should be constructive in the later stages. Environmental awareness in many countries has been highlighted with the economic growth of the country, and the increase of social wealth and technological progress have greatly enhanced the environmental governance capacity of various countries. The primitive humans did not “live in harmony with nature” as we imagined but develop natural resources in a nonsustainable way. In today's world, many poor people are also to a large extent carrying out slash-and-burn farming, using wood for cooking and heating and killing endangered wildlife [14]. Therefore, the environmental issue is essentially a development issue as well, and the anticipation of the developed countries for developing



countries to reduce emissions should be compatible with the development stage and environmental governance capacity.

At present, the existing climate policies in many countries are more based on considerations of energy security and economic growth, and the importance and the urgency of combating climate change has not yet become the core of their climate policies. The climate change bill, *American Clean Energy and Security Act*, that Obama strongly advocated after he took office, was opposed by many members of the Senate. In the Republican camp, initially there are some individual supports, but their main consideration is not to push the United States to respond to climate change but to respond to clean energy competitions and challenges from the countries such as China. And after they gave up their supports, Obama's climate change bill was naturally doomed to fail.

To make importance and urgency of climate change become a core pillar of all countries' climate policy and safeguard the sustainability of climate policy, it is vital to proceed from expanding consensus on climate change. Countries in the world should objectively and rationally popularize the severity and harmfulness of climate change, avoiding absoluteness and subjectivism and allowing doubts about mainstream views. In the short term, this may cause some people's concern and support for climate change to decline, but it will help reduce the blindness and one-sidedness in the international community in researching and coping with climate change in the long run and make relevant climate policies become more rational cost–benefit analysis rather than fear of the exaggerated dangers and even end of the world.



## **EARTH RESOURCES AND HUMAN SUSTAINABLE DEVELOPMENT**

The sustainable development cannot be separated from the resources and is more inseparable from the renewal of human resource concepts. To achieve sustainable development, the first question to answer is whether resources can support the development of human society. The book *The Limits to Growth* sets forth the physical limits of the earth, emphasizing because of the depleting natural resources and the planet's limited ability to absorb emissions from industrial and agricultural waste, if humans cannot constrain their greedy desires and growth rates, these limits will force growth to cease sometime in this century, and finally go

to an inevitable collapse. Only by lowering the growth rate will the human society be likely to achieve long-term sustainable development.

Inamori Kazuo and Takeshi Megumi put forward in the book *The Philosophy to Save Humanity* that mankind began to plunder nature in order to satisfy his own desires and that the unlimited emancipation of desire is the essence of modern civilization. Even if the growth is suspended, the sustainable development of mankind must also be considered. In their opinion, while plundering and destroying nature, human nature has also been destroyed. Meanwhile, in the process of driving nature as slaves, mankind gradually degenerates into slaves of desires, becoming “desiring people.” The expansion of human desires destroys the environment, leading to the depletion of resources, which threatens the existence of human beings themselves. The explosive population growth needs to consume more energy, food, and so on, which is gradually stepping beyond the earth’s bearing range, and the collapse of the civilization on the planet may start at any moment. Finally, they point out that to get rid of the crisis, human beings must fundamentally change the modern civilization and that the philosophy of saving mankind is to restore “desiring people” to “conscientious people,” “rational people,” and “altruism must become common values” [15].

The author of *Game over: How You can Prosper in a Shattered Economy* also points out that the more advanced the civilization is, the more complex it becomes, and that complex civilizations are most likely to fall into the plight of energy, metal, and mineral shortages. The cost that complication brings about is far more than the imagination of ordinary people. When the resource shortage deteriorates to a certain degree, the complication will collapse because of the unbearable self-pressure, and thus the society will return to its plain and simple state [16]. People’s expectation for convenience is endless, but resources are limited. The more complex the society is, the more costly it will be to develop new energy resources. As time goes by, we will have no means of obtaining energy, and then the only way out for a civilized world is to abandon its own complexity. In ancient times, some ancient communities like Maya culture precisely survived their culture because their social order returned to the simple state [17].

The availability of resources is also a problem that developing countries must face and solve. It is pointed out that it is impossible for all countries in the world to reach or close to the consumption level of the developed countries. Development needs resources to support, but there

are now insufficient resources to support such a huge-scale development. It is simply impossible for the entire world population of more than 7 billion people to live the life of the American middle class today, because the existing resources are not enough to support the economic development to that level. The developing countries have imposed enormous pressure on resources in their progress. If all developing countries are to catch up with average global consumption, middle-income countries will need to triple their consumption and low-income countries to improve 11 times, which means that the overall world consumption will double. If developing countries are to reach the average per capita consumption level of high-income countries, the world's total consumption is six times higher than that in 2005 [18].

Considering the resource availability, substitution, and restriction of demand, the resource problem human is facing for development is not the exhaustion or insufficiency of the total resource, but the relative or local short supply of some specific efficient, clean, and economical energy in a certain period of time. The main or fundamental cause of this relative or local short supply is the market failure caused by government intervention or regulation. Economist Julian Simon points out that history has proved that the saying of so-called scarcity of natural resources is not scientific, and that the reason why we have suffered energy crisis is likely that we have operated a mechanism contrary to the principles of the market. In the past 200 years, with the development of human civilization and the continuous increase of population, resource prices have been falling. "More people" means there will be more resources, not less. Common sense tells us, on a prairie, if there are more cattle and sheep, grass is eaten up more quickly, and thus grass becomes increasingly scarce. However, humans are not cattle or sheep, so as long as utilizing and developing resources rationally, human beings are able to maximize resources and wealth in the limited space [19].



## **UTILIZING RESOURCES RATIONALLY AS THE CORE TASK**

The relative adequacy of resources does not mean that human beings can use or waste resources without restraint. The unbridled use or waste of resources not only violates moral standards but also does not

conform to the law of market economy. Similarly, conserving resources and protecting the environment do not simply amount to reducing consumption or stop development, making humans to return to the self-sufficiency before industrial societies but to improving efficiency and creating more wealth with fewer resources. The improvement of energy efficiency depends not only on technological progress and the renewal of people's views but also on institutional innovation. On domestic level, we should perfect market mechanism, reduce policy errors, and allocate resources as reasonably and efficiently as possible.

On the international level, we should strengthen cooperation to maintain the stability of the international market, thus avoiding confrontations and conflicts related with resources, reducing trade and technological barriers, and promoting the efficient and smooth cross-border flow of clean energy technologies and capital. The true meaning of saving is often distorted by the notion that saving is less consumption. It is well known that one of the three carriages of economic growth is consumption. Consumption (even entertainment) means working or doing, and in energy consumption the saving in the sense of limiting or reducing means the pursuit for an economic recession. The pursuit of higher energy efficiency is the far better goal that government and business policy should aim to achieve than reducing consumption. In comparing 1980 with 1989, energy consumption in the United States increased and oil consumption remained unchanged, but GDP grew by 69% during the period, with the decrease of energy intensity of the economy, the amount of energy required to generate a dramatic increase in one unit, by 44% and oil intensity by 47%. Meanwhile, Japan's energy intensity has fallen by 58% and oil intensity by 64%. This is the energy saving in the real sense, although the absolute value of energy consumption does not drop [20].

In the 1980s, the economic price mechanism made the efficiency of energy consumption significantly improved. Since the 1990s, environmental politics has attracted more and more attention, and international enthusiasm for large-scale reduction of fossil fuels, especially oil and coal, has been higher and higher. But unless it comes at the expense of economic growth, such a reduction in energy consumption cannot be achieved. Surely, people may use other fuels in places where oil and coal are not used. However, what accounts for using oil and coal is that they have an economic advantage over other fuels. Forced replacement of oil and coal will affect costs, which will result in economic consequences that cannot be ignored [21].



## THE LINK OF EXCESSIVE PANIC TO IRRATIONAL DECISIONS

The wrong conception of energy tends to lead people astray. On August 25, 2009, an article by Michael Lynch entitled “‘Peak Oil’ is a Waste of Energy,” published in the *New York Times*, points out that the theory of “peak oil” is advocated by a group of scientists and laymen with ulterior motives, whose conclusions are entirely based on a rough analysis of the data and misinterpretation of technical materials. Oil reserves are still rich at present, but what should be avoided is that the false threat of “oil is disappearing” leads the government to invest in wrong energy schemes or to implement unnecessary and expensive environmental protection measures for the public who have been suffering the economic tough moments [22].

In 1973 and 1979, as oil prices soared in the wake of wide-scale oil supply disruptions, nearly all oil experts believed that energy scarcity was a potential cause and oil prices would continue to rise. The US president at the time, Jimmy Carter, encouraged the exploitation of synthetic fuels such as shale oil, believing that the market was too short-sighted to recognize the urgent need for alternative energy sources. At that time, the United States, as the only largest consumer of petroleum products, formulated the corresponding energy policies based on the assumption that the country and the world would deplete oil resources [23]. Oil reserves are still rich, but that may not prevent the alarmists from persuading policymakers in Washington and elsewhere to believe that oil is limited and its price must be raised. This logic led the Carter administration to set up a synthetic fuel company, a \$3 billion build-up, which never produced a gallon of usable fuels [22].

Worries about oil shortage and expectations for solar energy also prompted President Carter to install a solar hot water system (worth \$28,000) on the roof of the White House. On June 20, 1979, to celebrate the successful installation of the system, a press conference was held on the White House roof, claiming that the White House installation of solar water heaters was one of the greatest and most stimulating pioneering moves by the American people, which marked a new stage in the US’ utilization of solar energy. And it set a grand goal of making solar energy use account for 20% of the US energy consumption by the year 2000 [24]. In fact, however, the total renewable energy in the United States by 2010, including

hydropower and bioenergy, accounted for only 8% of the total energy supply. In 1986, the solar water heating system on the roof of the White House was dismantled due to leaks and eventually most of it was given to a college in Maine as the government surplus and part of it was put into museum.

The crisis itself is sometimes far less harmful than the excessive or improper response to crises. Morris Edelman points out that the impact of the shortage caused by the oil embargo is relatively small at that time. From October to November 1973, total output decreased by 340 million barrels, which is still less than the reserves before. If we take the increase in the rest of the world into consideration, there is no shortage of supply at all. What drives up prices is not the shortage of supplies, but the worry about undersupply [25]. According to relevant figures, the production of Arab oil in September 1973 was 19.4 million barrels. In December, the month with the largest reduction in output, the daily output dropped to 15.4 million barrels and the total reduction was as much as 4 million barrels. In the same period, oil production in other countries increased by 900,000 barrels per day. In other words, the actual maximum output drop is the 3.1 million barrels a day, about 5% of world oil consumption and 10% of global oil trade. This gap was largely offset by the use of inventory at that time. Although the scope of the Arab oil embargo is not very large, but the lack of knowledge about the situation and the confusion over the situation has exaggerated its impact, further exacerbating the global panic [26].

On climate change, we are also in need of wisdom and reason. In recent years, climate change has attracted great attention of the international community. It has become the mainstream view and the reality of the relevant theoretical basis on UN negotiations that human beings need to drastically reduce greenhouse gas emissions in response to global warming. To some extent, global warming has become synonymous with climate change. Because it was found that some of the facts or data related to climate change are exaggerated, skepticism about climate change becomes popular. Skepticism about climate change reminds the international community to avoid blindness and one-sidedness when studying and responding to climate change, to prompt climate policy to be more based on rational cost-benefit analysis rather than the exaggerated risks and even fear for the end of the world.

Many other energy-related risks and challenges are sometimes exaggerated consciously or unconsciously. For example, according to facts and data, the loss caused by a nuclear accident is greatly exaggerated. In the

Three Mile Island accident in the United States, there was almost no death, but some were ill. The data about the Chernobyl accident are much diversified. For example, the death toll released by the International Atomic Energy Agency is 58, while some environmental organizations believe there are 90,000 people, or even hundreds of thousands. But even with higher number of death, on average nuclear power is still the safest. The inspection and review for nuclear power is most stringent.

Comparing nuclear power with other energy sources, the impact of coal is the worst in terms of chronic diseases. In addition to mine accidents, there are thousands of annual silicosis cases. The number is even greater if the resulting lung cancer is considered. This is the problem for all fossil energy applications. Many people do not like nuclear power, but the problems of coal and electricity are more serious. And the wind power that is widely regarded as a clean energy, in fact, has many adverse effects on many birds, ecology, and so on. Considering the whole process and unit power generation, the death rate of nuclear power is 1% of hydropower, about 20% of coal electricity [27].

At present, nuclear power basically does not need subsidies. The general ranking for cost is that photovoltaic is the most expensive, followed by offshore wind power, onshore wind power, natural gas, nuclear power, coal power, and hydropower. The cost of nuclear power has included nuclear waste disposal and security costs. In the future, coal power will become more and more expensive due to the pollution problems, with desulfurization and denitrification facilities required, while nuclear power price will not change significantly, because the third-generation nuclear power will be safer, and the price will drop by around 20%. After Germany shut down seven nuclear power plants, many industrial sectors were already complaining that it was a blow to their industry. In the long run, this may affect the competitiveness of the whole country.



## **ENERGY ENVIRONMENTAL PROBLEMS AS SYSTEM ENGINEERING**

To achieve sustainable development, improving our energy system requires long-term and arduous efforts, unprecedented global collaboration and the coordination of powerful multilateral organizations, and more importantly, a viable policy based on the national conditions. It was

not only impossible for some idealistic, unrealistic ideas to achieve the goal but also can lead to retrogression. Some ideas are contrary to human nature and cannot be implemented, while some ignore the objective economic laws, so in fact, haste makes waste.

China's "Great Leap Forward" in the late 1950's was the performance of optimism, which finally led to a great setback. Only by combining the dynamic free market system with the global collaboration, coupled with the strong concept of social morality, can we realize the sustainable development of energy [28]. There is no quick energy solution in the world, says Fareed Zakaria, editor of *International Edition of Newsweek*. The key is to liberate people from energy chains at all levels, thus diversifying energy supply and developing as much green clean energy as possible. The so-called good ways to solve energy problems are wrong at many levels, and the real revolution that must take place is a revolution in attitudes and views.

Robin Mills, author of the *The Myth of the Oil Crisis*, points out that "Neo-Luddism" expects the impossible changes to happen in our lives, and the "therapeutic schemes" they offered are worse than the "illnesses" itself. Campbell predicts that global emissions of pollutants will drop to 2–4 billion tons in 2150, and he prefers to urge all "immigrants" return to their original places because he believes they now "survive on crime and social security." Assuming that this must be done through the deportation of violence, we are not far from Nazism. According to Odewey's theory, we will return to Stone Age. Heinborg argues that the world population limit is 2 billion, and with an average fertility rate of 1.5 children per couple, this goal can be reached in a century, but he does not explain how this goal can be achieved. Matt Sevina believes that the population must be drastically reduced in order to coexist with nature, and should be reduced to 80–350 million (returning to the population about 500 BC). But Michael Rupert argues that the world population must be reduced by 4 billion if mankind wants to survive.

A relatively mild approach is the *Oil Attenuation Agreement*, or named *Rimini Agreement* that Association for the Study of Peak Oil and Gas (ASPO) advocates. Campbell et al. propose that countries around the world cut oil production and consumption in proportion to "attenuation rates." If this goal can be achieved, this will lead many countries to follow the mandatory planning economy, which reminds us of Brezhnev era of the former Soviet Union. Lowering living standards will inevitably reduce energy consumption but is contrary to human nature. The rescue of the environment cannot rely on unreasonable and dangerous prescriptions [29].



The important premise of maintaining the international energy resources safety and promoting sustainable development is to keep the stability of international energy resource market. Regardless of the amount of pollutions and emissions by fossil energy and the urgency of improving energy efficiency and developing clean energy, in real life, fossil energy such as oil will still dominate human energy consumption for quite some time. Therefore, the stability of the world energy market, such as oil market, is also related to the stability of the world economy and linked with whether all countries in the world have enough incentives and capacities to promote energy efficiency and the development of clean energy, thus to realize sustainable development.

As Daniel Yergin concludes in the book *The Quest: Energy, Security and Remaking of Modern World*, the challenge to the world energy resources and environment not only requires human to take efficient way in energy consumption and make right judgments but also constant energy investments, farsightedness of politicians, and more important, human's mutual cooperation. Creativity is the key resource for mankind to cope with the energy challenges and ensure the security of energy supply and the growth of world sustainable prosperity. Technology needs innovation, and human thinking needs innovation as well [30]. In recent years, China has proposed the energy revolution, which includes both the consuming sector and the producing sector. Equally important, or perhaps more important, is the revolution of energy and outlooks about energy development.



## **ENHANCING SUSTAINABLE DEVELOPMENT CAPACITY AS THE FUNDAMENTAL APPROACH**

Different countries need to make effective coordination and balance among energy security, energy saving and emission reduction, and economic growth in accordance with the different development stages and time-space, and implement strategies for sustainable development and emission reduction suitable for their own characteristics. Thomas C. Schelling points out that the rich countries are generally most worried about climate change, but developing countries will suffer the most damage due to climate change. The more dependent on agriculture a country is, the more it may suffer from global warming.

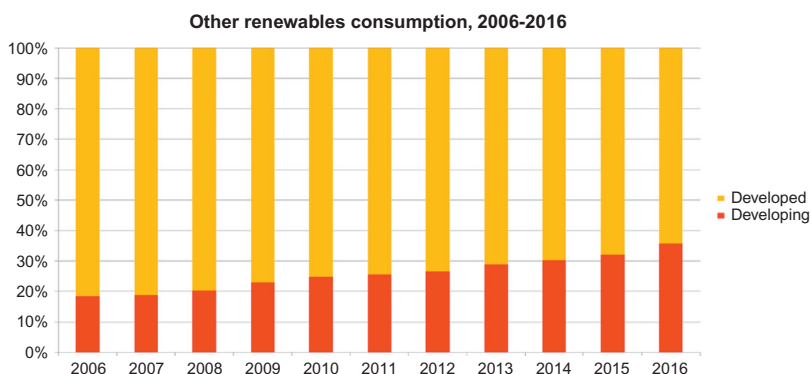
Limited by poverty and technology, these countries have limited capacity to adapt to climate change. Thus, the best way for developing

countries to slow down global warming is by means of economic growth [31]. It is pointed out that when a country's per capita income reaches \$5000–\$8000, more money will enter the environment sector, and demands and capacities for sustainable development will be significantly improved. In recent years, China's progress in developing the low-carbon economy has benefited largely from the growing environmental awareness and the increasing capacity for sustainable development.

Yang Fuqiang, senior adviser on energy, environment, and climate change at the Natural Resources Defense Council of the United States, points out that there are six stages in the world economic development and climate response. The first stage is economic development and energy consumption (carbon emissions) going hand in hand, and energy intensity, carbon intensity, and total energy being in line with economic growth, sometimes even higher than economic growth. The second stage is the decoupling of economic development from energy consumption, the declining trend of energy consumption and carbon intensity, and the decreasing of growth rate for carbon emission per capita and the national. The third stage is the decoupling of carbon from energy, the low carbonization of energy supply, the further declining of energy and carbon intensity, and the further decreasing of the growth rate for carbon emissions per capita and the national. The fourth phase is a drop in carbon emissions per capita, continuous increase in economy and energy consumption, and a slight rise or flat in national carbon emissions. The fifth stage is the decoupling of carbon emissions from the economy, energy, and population, and decreasing of carbon emissions per capita and national in absolute terms. The sixth phase is the ultimate target all over the world. According to the requirement of controlling the temperature rise at 2°C, the global greenhouse gas emission limit is set and the carbon emission limit is set by country and per capita. According to this division, the developing countries in Africa are in the first phase. China is in the second phase. More advanced developing countries like Singapore and South Korea are in the third stage of decoupling their carbon from energy resources. Developed countries are in the fourth and fifth stages. Developing countries should adopt the indicators for carbon intensity or other relative emission reduction, while developed countries should adopt absolute emission reduction indicators.

Efforts to promote global response to climate change should also begin with the consolidation of climate policies. At present, the pillars of existing climate policies in many countries are more based on considerations

of energy security and economic growth. The importance and urgency of tackling climate change has not yet become the core of climate policies in many countries. Excessive reliance on other considerations and objectives as a policy pillar will inevitably affect the stability of climate policy, which indicates that the basis for global climate policy is still weak. Although many countries have developed low-carbon development strategies and take actions to reduce the amount of carbon dioxide emissions, these efforts cannot be attributed to climate change negotiations. We should further enhance the impact of climate policy on energy structure and development prospects in the future, and adopt more effective emission control standards and alternative energy development strategies.



*From BP Statistical review of world energy 2017, page 44.*

In promoting low-carbon economy, it not only requires determination but also effective methods and management. In recent years, the Chinese government has put forward concepts such as scientific development and ecological civilization, vigorously promoting energy conservation and emission reduction. The green economy has evolved from high-end concept to the whole-society actions, and has achieved many achievements and progresses, not lagged behind by developed countries to some extent. However, there are still many problems. The total energy consumption will continue to grow because the energy structure is still dominated by coal, and it is more difficult to improve the future energy efficiency and reduce carbon emission intensity. There are some hidden problems for clean energy industry such as the excessive growth in scale and surplus productivity. The proportion of clean energy in the energy structure is still lower than that in America and European countries, where most of the investments are used for export. In addition, some energy-saving or environmental-friendly

products that the society is generally optimistic about also have pollution potential. For example, hundreds of millions of old-type energy-saving lamps in the whole country are all entering the scrapping period, and if the harmful substances such as lead and mercury are not properly handled, they will cause serious pollution to water and soil.

The 18th CPC Congress proposes the “Ecological Civilization” and “Beautiful China” strategy, demonstrating the determination and courage of China to develop the low-carbon economy. The further step in the future is to strengthen the use of more intelligent and effective methods to carry out the strategies and follow the economic and market laws. At present, in the process of energy-saving, emission-reduction, and low-carbon economy, the traces of planned economy are still noticeable in many aspects. In order to achieve the goal of reducing the energy intensity set by the “11th Five-Year Plan” by 20%, some local governments have even adopted some unsustainable methods such as power rationing, shutting down factories, and so on. In order to promote the orderly advancement of low-carbon economy, we should emphasize the sustainability of policies and the regulation of markets, so as to push forward relevant technology research, development, and innovation. We should further adjust environmental protection thinking, transforming the “government planning” to “public participation” and “industrial evolution.” At the same time, we should actively participate in international environmental governance and promote international cooperation with relevant countries and institutions in related fields.

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