



## The role of China's renewable powers against climate change during the 12th Five-Year and until 2020

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### ABSTRACT

Climate change has become the most globally concerned environmental issue. As the world's largest carbon dioxide emitter and primary energy consumer, China has strong incentives to change its coal-dominated electricity structure. Various renewable powers such as wind and solar are suitable and necessary options for carbon emission reduction. The 12th Five-Year (2011–2015) and the mid-term until 2020 are critical periods for the development of Chinese renewable powers. In this paper individual renewable electricity sources were introduced based on their characteristics. Based on the introduction, the targets as well as their effects in the medium and long-term were presented and explained; challenges China has to face in the periods were discussed in detail, and emphasis was put on hydro, solar and wind power, which is highlighted in the plans. Also solutions against these challenges were recommended.

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## 1. Introduction

Climate change represents one of the greatest environmental, social and economic threats our planet has to face. Warming of climate system is evident from observation: from 1995 to 2006, eleven years rank among the twelve warmest years since 1850; increase of sea level is consistent with global warming. World-wide average sea level rose at an average rate of 1.8 mm per year over 1961–2003 and at an average rate of about 3.1 mm per year from 1993 to 2003; observed decreases in snow and ice extent are also consistent with warming. At continental, regional and ocean basin scales, numerous long period changes in other aspects of climate such as precipitation have also been observed [1].

The reason for global warming is the presence of greenhouse gas (GHG) emissions led by carbon dioxide, which come from the unrestricted usage of fossil fuel including coal, petroleum and natural gas. International cooperation on emission reduction is necessary to mitigate climate change, and the serial conferences in Kancun as well as in Copenhagen are such attempts.

China has become the no.1 CO<sub>2</sub> emitter in the world, surpassing the US already in 2007 with approximately 8% more emissions [2,3]. Moreover, China is also globally the largest energy consumer, whose position is consolidated by its economic growth mode of government leading and extremely resource-extensive. In 2011, China, reaching an annual GDP growth of 9.2%, alone accounted for 71% of the global energy consumption growth [4]. Meanwhile, China is just in the middle of its industrialization, thus the still low per capita carbon dioxide emission of 5.3 t, compared with that of America, Germany and Japan of 17.5 t, 9.6 t and 9.5 t, respectively [5], makes a large increase in the total CO<sub>2</sub> emission inevitable in the future.

Renewable energy supplies can displace the fossil fuel combustion to reduce carbon emissions from the traditional power plants, and this is especially meaningful for China, the energy matrix of which is coal-dominated, and majority of the power plants of which are coal-fired. This has led to many environmental problems, of which the greenhouse effect is the most serious. Globally electricity production is currently responsible for 32% of total global fossil-fuel use and 41% of energy-related carbon dioxide emissions [6]; while China is roughly in line with that—40% of total CO<sub>2</sub> emissions are contributed by the coal-fired power generation [7].

## 2. Targets of carbon dioxide emission reduction in China

As the pioneer of emerging economies, China's fossil resource consumption rose by 11.2% and 8.8% in 2010 and 2011,

respectively, much faster compared with that of the worldwide growth of 5.1% and 2.5% [8].

Being the front runner of the energy expenditure as well as the carbon emission globally, China is facing ever-growing pressures from both the outside world and the internal environment.

China's high carbon dioxide emission is caused by its large population, fast industrialization and urbanization, coal-dominant energy matrix, but most importantly, the 'extensive way' of economy growth, which heavily relies on fixed capital investment and excessively consumes the valued primary resources.

It is not easy for China to transfer the traditional economic development model to a low-carbon economy. However, the financial crisis in September 2008 seemed to bring an opportunity for China. The storm caused a sharp recession worldwide, and the global primary energy consumption grew by just 1.4% in 2008, the slowest since 2001. To recover the economy, the Chinese government delivered a huge stimulus package of RMB 4000 billion (USD 586 billion) in November 2008, with emphasis on energy-extensive infrastructures instead of energy-saving industries. Thus the chance of economic transition was missing, and Chinese energy consumption growth still maintained a high level of 7.4% in 2008, accounting for nearly three-quarters of global growth [9].

However, this costly economy growth can never be sustained for long. Fortunately the Chinese government has realized this point and has pledged to push forward the transformation of the nation's economic development pattern, and to shift its focus from resource-intensive industries to high-technology ones, of which renewable energies play an important role. However, the global economic depression triggered by the European debt crisis brings a new impulse of fixed capital investment to the government. The officials must firmly stick to the strategy of sustainable and environment friendly development.

The Chinese State Council has announced a "voluntary action" to reduce the intensity of carbon dioxide emissions per unit of GDP in 2020 by 40–45 percent compared with the level of 2005. However, there is no ceiling for the total amount of emissions. The goal will be a "binding" one to be incorporated into the country's medium and long-term national social and economic development plans [10]. More funding will be invested into the research, development and industrialization of technologies for renewable energies, energy saving, and into energy efficiency improvement, clean coal development, advanced nuclear energies, and CCS (carbon capture and storage) to accelerate the construction of low-carbon industrial, construction and transportation systems.

China is now during the period of its 12th Five-Year (2011–2015) Economic and Social Development Program, in which economic, environment and clean energy are emphasized, while

**Table 1**  
Targets in the 12th Five-Year Program and comparison with those in the 11th program.

Targets	12th Five-Year program	11th Five-Year program
Economic	GDP growth	7%
Environment & clean energy	Non-fossil fuel	11.4% of primary energy consumption
	Energy consumption per unit of GDP	16% lower
	CO <sub>2</sub> emission per unit of GDP	17% lower
		7.5% (11.2% actually)
		10% (9.6% actually)
		20% (19.1% actually)
		None

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