Renewable Energy 84 (2015) 130–137

Contents lists available at ScienceDirect

Renewable Energy

journal homepage: www.elsevier.com/locate/renene

Analysis on the carbon trading approach in promoting sustainable buildings in China

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ARTICLE INFO

Article history:
Received 4 March 2015
Received in revised form
5 June 2015
Accepted 26 June 2015
Available online 6 July 2015

Keywords:
Energy consumption
Carbon reduction
CDM
Carbon trading
Buildings
China

ABSTRACT

With the high growth urbanization and increasing new urban population, the huge demand for infrastructures and dwellings has become a great challenge for the sustainable development in Chinese cities. The building sector shares one fourth of total energy consumption in the country and plays an important role in reducing the energy consumption and the consequential green house gas (GHG) emissions. Some policies have been issued for promoting the low carbon sustainable development in China's buildings. However, existing barriers especially the investment barriers substantially prevent the low carbon technologies and service from being employed effectively. The carbon trading scheme of cap-and-trade is now widely accepted as one cost-effective way to deal with the climate change issue in the world, and it can be utilized for overcoming the barriers to carbon reduction activities in China's building sector. A new Clean Development Mechanism (CDM) energy performance based method is designed for reducing transaction costs in implementing CDM projects in China's buildings before 2020. And then a "step by step" approach is formed to establish the domestic and international carbon trading mechanism to effectively reduce GHG missions in China's building sector after 2020.

1. Introduction

With the average 9% of annual GDP growth and huge energy consumption in recent decades, China shared 28% of total green house gas (GHG) emissions in the world in 2011, it has become the biggest contributor to global emissions [1]. China's urban population will be 1.2 billion with annual growth rate of 10% which is higher than the global average urban population growth rate (i.e. 8.1%) between 1990 and 2030 [2]. The urbanization in China has significantly enhanced the economic development and social changes. However, some negative influence has been emerged with the rapid urban development in China, that is unprecedented resources and energy needed to support this kind of urban growth rate and scale, and emerging issues of environmental degraded dramatically with this development needed to be tackled. More critically, since the huge amount of fossil fuels are consumed in associating with the process of urbanization in China, billions of tonnes of greenhouse gases (GHGs) and pollutants are emitted to the atmosphere every year, which cause the most serious problems—climate change and environmental pollution. The fossil fuels which the urban development heavily depends on are finite, and their reservation only concentrate on few countries and regions like Mideast and Africa, unstable political and economic situations put the energy supply at risk. These facts make China which needs stable energy supply for supporting the quick urbanization has to face another serious issue – energy security. The environmental issues and energy security have become dominated aspects in the success of China's urban development and its long-term economic growth.

About 15 million people would add to the urban population every year between 2000 and 2030 in China [2], more demand for urban dwellings are needed for matching this quick urban development. GHGs emissions and other pollution will increase with the urban expansion and the constant rise of people's living standards. Urban buildings share only 40% of total building area, but responsible for almost 90% of total energy consumption in the building sector in China [3]. Approximately 2 billion square meters of new buildings appear each year and about 21 billion square meters of new buildings are expecting to be constructed by 2020 in China

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http://dx.doi.org/10.1016/j.renene.2015.06.062
0960-1481/

with the urban development [4], which is equivalent to the whole existing building area in the EU-15 [5]. And also with people's improved living conditions, a continuous increasing energy consumption in China's buildings would last till 2050 [3].

Urban buildings which include residential and non-residential buildings play an important role in overall low carbon sustainable development in China's cities. If considering a building's lifecycle, there are three main stages in terms of energy consumption. They are:

1) The initial embedded energy to produce the building at the production stage;
2) The operation energy at the operation stage; and
3) The demolition energy at the destruction stage.

The energy consumption in these three stages is closely related to other sectors such as the land use, transport, waste and industry sectors. Besides the energy use for maintaining normal operation in buildings and keeping occupies' comfort living conditions, other aspects such as such as the energy consumption for manufacturing process of concrete, steel and plastics, the energy use for transporting materials, consuming water, treating wastewater and waste in the building sector are also important in the lifecycle of building [6]. If considering all these energy consumption, approximately 25% of total energy in the country is used in the building sector [3,7]. Associated with about 2.4 billion tonnes of CO_2 equivalent (CO_2e) emissions were made with this energy consumption in China's building stock in 2013. With about 10% of annual growth of energy consumption in buildings in recent years (Fig. 1), the prediction shows that it would continue to increase in next decades with the growth of urbanization [3]. The energy conservation in the building sector has already been addressed in China's long-term sustainable development strategy.

2. Research method

Energy savings in buildings can be made by utilizing technical measures such as improving energy efficiency (e.g. adopting advanced insulation materials, energy efficiency heating, ventilation, and air conditioning (HVAC) equipments and systems, low energy lighting and appliances). Big potential energy savings can also be made by enhancing the management and encouraging people's behaviour change (so called no-technical measures) [8]. The market-based carbon trading scheme is regarded as one of most cost-effective and flexible environmental strategies to promote the low carbon sustainability [9]. Therefore, with the aim of achieving overall energy conservation and carbon reduction effectively, this paper explores the cost-effective approach of promoting the technology and knowledge development, transfer and diffusion for achieving the sustainability through establishing a carbon trading mechanism in China's building sector.

The qualitative method is mainly adopted for analysing in the paper. Firstly, qualitative information such as the Chinese documents covering polices, regulations and standards relating to the building sector, have been reviewed extensively to check for unrealistic and/or inaccurate descriptions in them so as to identify the potential barriers in promoting low carbon sustainability in China's building sector. In Section 3, the literature review is made for understanding current policies and standards of energy conservation in Section 3. Facing the fact of increasing energy use and carbon emissions in China's building sector, especially the overall energy saving and carbon reducing target could not be achieved, the focus of analysis is given to the barriers which are caused by weak investment incentive, costs of adopting new technologies and maintaining and different benefits of stakeholders in Section 4.

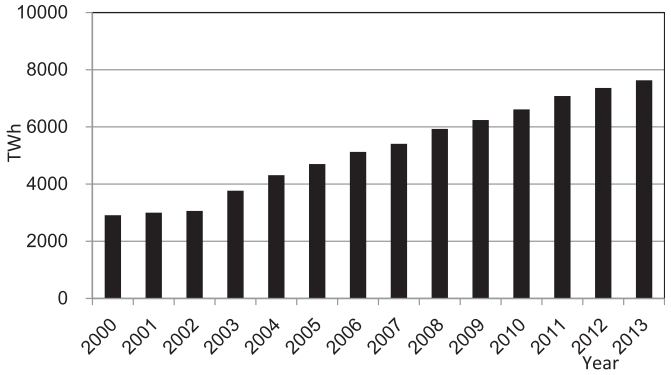

Fig. 1. Energy consumption in the building sector in China between 2000 and 2013.

The carding trading approach, as one of effective solution of overcoming the barriers is introduced and described in detail in Section 5. Firstly, the qualitative data relating to the Clean Development Mechanism (CDM), a typical carbon trading scheme implemented in China and other countries, is used for explaining the basic principles of carbon trading in China's building sector. After presenting the similar carbon trading procedures in EU, Japan and New Zealand, a "step-by-step" approach of establishing domestic and international carbon trading mechanisms to comprehensively enhance the low carbon sustainability to the building sector is recommended. And the technical solutions to build the carbon trading market is also given in this section. Based on the qualitative analysis in the paper, the conclusion is finally made in Section 6.

3. Legislations to reducing energy use and carbon emissions in buildings

One important national development strategy with key policies to the mitigation of climate change is "The Twelfth Five-Year Plan" which was issued in May 2011 with the objective of reducing energy consumption and carbon emissions density per unit of GDP by 16–17% by 2015 compared to the level of energy use and carbon emissions in 2010 in China [10]. The white paper of "China to Address Climate Change Policies and Actions" was issued in November 2010 with a more ambitious objective of cutting GHG emissions per unit of GDP by 40–45% by 2020 [11]. The National People's Congress also approved an important law "The Energy Conservation Law of China" in October 2007, which also includes specific rules on the energy saving in the building sector. Local energy saving regulations and design standards relevant to the building sector shall be compliant to this law [12].

The above policies and laws have fundamental influence on China's overall energy conservation and GHG emissions reduction in all sectors, covering the building sector at both national and local levels. More specific requirements relevant to energy efficiency in the building sector have also been issued by China's central and local governments, including a series of energy saving and efficiency standards. These standards contain mandate energy saving objectives in the building sector. For example, the energy consumption in all new and refurbished public buildings[1] should be reduced by 50% compared to the energy performance in public buildings in 1980s under the standards of GB50189-2005 [13]. Some local municipal governments have also issued their own

[1] Public buildings refer to non-residential buildings, e.g. office, shopping mall, hotel, school, hospital buildings except buildings of factory and plant in GB50189-2005.