Renewable and Sustainable Energy Reviews 54 (2016) 15–24

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

Energy-related greenhouse gas emission features in China's energy supply region: the case of Xinjiang

Bin Guo [a,b], Yong Geng [c,*], Huijuan Dong [d], Yaxuan Liu [e]

[a] Faculty of Economics and Social Sciences, Heidelberg University, Heidelberg 69115, Germany
[b] Institute for Eco-Industrial Analyses, Heidelberg 69121, Germany
[c] School of Environmental Science and Engineering, Shanghai Jiao Tong University, Shanghai 200240, China
[d] National Institute for Environmental Studies, Tsukuba 305-8506, Japan
[e] School of Economics, Xinjiang University of Finance and Economics, Urumqi 830012, China

ARTICLE INFO

Article history:
Received 15 May 2014
Received in revised form
12 May 2015
Accepted 22 September 2015
Available online 11 November 2015

Keywords:
Energy-related GHG emission
Fugitive emission
LMDI
Xinjiang

ABSTRACT

Xinjiang Uygur Autonomous Region was selected for studying its energy-related greenhouse gas emission features due to its rich reserve of coal, crude oil and natural gas. First, GHG inventories in Xinjiang were presented in order to provide a holistic picture of its features and trajectories on energy-related GHG emission. Then, transferred GHG emission embodied in exported energy products was analyzed. Finally, the driving forces for energy-related GHG emission increment were uncovered by adopting a time series LMDI analysis. Results indicate that annual energy-related GHG emission increased stably after 2002 and reached 227.71 Mt CO_2e in 2011. Fugitive GHG emission was an important contributor to Xinjiang's GHG emission, accounting for more than 8% of the total energy-related GHG emission in 2011. Transferred GHG emission embodied in exported energy products was up to 8.07 Mt CO_2e in 2011, accounting for 3.54% of the total energy related GHG emission, indicating a shift of environmental pollution from other regions to Xinjiang. Decomposition analysis shows that economic activity effect was the key driving force for energy-related GHG emission increment in Xinjiang during 1995–2011 and intensity effect partially offset the energy-related GHG emission growth. Research findings propose that a comprehensive consideration on all the relevant aspects should be initiated so that appropriate mitigation policies can be raised by considering the local realities.

Contents

* Correspondence to. School of Environmental Science and Engineering Shanghai Jiao Tong University No.800 Dongchuan Road, Minhang Shanghai 200240, China. Tel.: +86 21 54748019; fax: +86 21 54740325.
E-mail addresses: ek9winner@gmail.com (B. Guo), ygeng@sjtu.edu.cn (Y. Geng), donghj1981@126.com (H. Dong), lyx1022@163.com (Y. Liu).

http://dx.doi.org/10.1016/j.rser.2015.09.092
1364-0321/

1. Introduction

To control and mitigate the total greenhouse gases (GHGs) emissions is one of the global environmental challenges. Total energy-related carbon dioxide emissions may increase from 31.2 billion metric tons in 2010 to 36.4 billion metric tons in 2020 and 45.5 billion metric tons in 2040 if no new policies are applied [22]. As the world's top energy consumer and GHG emitter, China faces an increasing pressure on mitigating its GHG emission [10,11,16,21]. In order to respond such a challenge, China's national emission reduction targets were proposed in 2009, namely, to reduce the carbon dioxide emissions per unit of GDP by 40 to 45% in 2020 compared with 2005 levels [8]. In addition, China also set a target of reducing CO_2 intensity per unit GDP by 17% in 2015 compared with 2010 levels in its 12th five-year plan, in which each province was allocated a fixed reduction target by considering its economic development level [14]. Under such a circumstance, all regional governments have to seek innovative measures on reducing their overall emissions by considering the local realities.

Locating in the northwest of China, Xinjiang Uygur Autonomous Region (equal to a province) is the largest administrative region in China with a total area of more than 1.66 million km^2 and a total population of 22.09 million in 2013. Fig. 1 shows its geographical location in China. Xinjiang is one of the key energy resource regions with a large amount of coal, oil and natural gas reserves. According to the third national coal resource prediction and evaluation investigation in 2013, coal reserve in Xinjiang is about 2.19 trillion tons, accounting for 39% of the total coal reserves in China; oil reserve in Xinjiang is about 21.3 billion tons, accounting for 20% of the total oil reserves in China; and natural gas reserve in Xinjiang is 10.8 trillion m^3, accounting for 32% of the national natural gas reserve [25]. Therefore, Xinjiang has become the largest energy supply region in China. With the implementation of China's west development policy, many energy-related industries have been established and promoted in Xinjiang due to its rich energy resource endowment. It leads to not only rapid economic development, but also higher per capita energy consumption and carbon emissions due to increasing household income and higher industrial emissions [28]. Fig. 2 presents GDP and energy consumption trend for the period of 1995–2011 in Xinjiang. It is clear that coal has been the main energy source in Xinjiang and has also been significantly consumed since early 2000 s. Most coal was burned for power generation. For instance, total coal-burning power generation was 73.24 billion kWh in Xinjiang in 2011, around 83.7% of its total power generation [27]. More importantly, Xinjiang's economic development during this period was based upon the larger consumption of fossil fuels. The coupled increasing relation between GDP growth and fossil fuels clearly indicates that such a development model is not sustainable and may result in many issues, such as air pollution, public health and greenhouse gas emissions.

Academically, several studies have been undertaken in order to explore Xinjiang's energy consumption and carbon emission patterns. For instance, Yao and Gao [28] investigated the status, challenges and strategies of Xinjiang's carbon emissions. Li and Liu [13] identified the key influential factors of carbon emissions from Xinjiang's primary energy consumption. Similar studies were also conducted by Su [20] and [29,30]. In addition, Lei and his colleagues (2011) completed a more detailed study on Urumqi city, the capital city of Xinjiang, focusing on its energy consumption

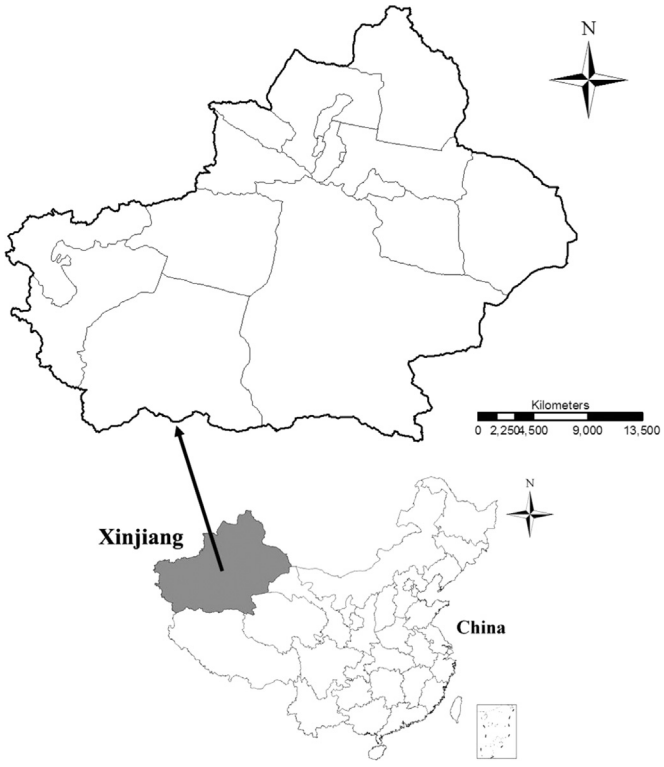

Fig. 1. The geographical location of Xinjiang in China.

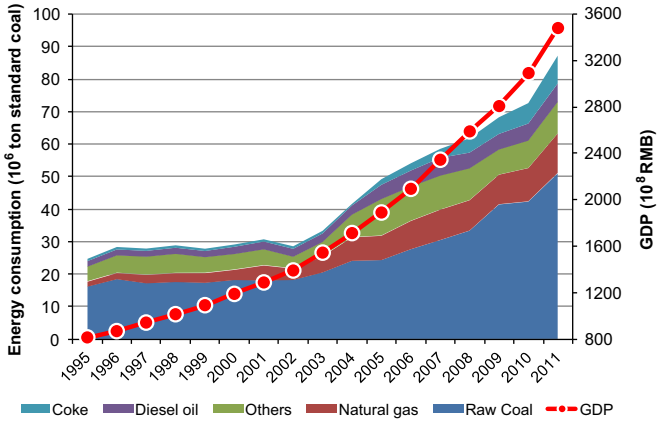

Fig. 2. GDP and energy consumption trend during 1995–2011 in Xinjiang.(RMB is Chinese currency, 1 US Dollar6.129 RMB in April, 2015).