Energy Policy 116 (2018) 337–343

Contents lists available at ScienceDirect

Energy Policy

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

How modifications of China's energy data affect carbon mitigation targets

Heran Zheng[a], Yuli Shan[a,*], Zhifu Mi[b], Jing Meng[c], Jiamin Ou[a], Heike Schroeder[a], Dabo Guan[a,*]

[a] Tyndall Centre for Climate Change Research, School of International Development, University of East Anglia, Norwich NR4 7TJ, UK
[b] The Bartlett School of Construction and Project Management, University College London, London WC1H 0QB, UK
[c] Department of Politics and International Studies, University of Cambridge, Cambridge CB3 9DT, UK

ARTICLE INFO

Keywords:
Mitigation
China
Uncertainty
Data revision
CO_2 inventory

ABSTRACT

Frequent modifications to energy statistics have led to considerable uncertainty in China's ability to achieve its carbon mitigation targets. Here, we quantitatively measure the impact of energy data revisions on China's ability to achieve its mitigation targets. Our results indicate the following effects of data revisions: 1. Mitigation challenges have increased by 5%, and the achievement of national mitigation targets (as well as international pledges) might be postponed by two years. 2. Greater than expected carbon space or emission quota (from 22.94 to 31.31 Gt) will be obtained from 2015 to 2035. 3. CO_2 peak levels may become highly uncertain, with the uncertainty varying from 12% to 29%. In addition to national mitigation targets, data revision has profound implications for key industrial sectors. For example, raw coal consumption by the cement and iron and steel industries has long been underestimated, bringing uncertainty to the achievement of industrial mitigation targets. Our results reveal considerable uncertainty in China's energy data, and this uncertainty suggests that previous mitigation achievements have been overestimated and that the mitigation targets, carbon space values, and peak level estimates proposed by future mitigation schemes may not be reached.

1. Introduction

China's mitigation efforts have become increasingly important for meeting global decarbonisation targets because of China's increasing share of global primary energy consumption and total greenhouse gas (GHG) emissions (Liu, 2015; Shan et al., 2015; van Ruijven et al., 2012). Ambitious mitigation policies have been proposed to reduce the carbon emissions from China's carbon-intensive economy, and rigorous mitigation targets have been set to reduce carbon intensity (CO_2 emissions per unit gross domestic product (GDP)) by 40–45% by 2020 and 60–65% by 2030 compared with the 2005 level and to decrease peak carbon emissions by 2030 as promised in the 2014 China-US joint agreement. These ambitious mitigation targets cannot be achieved without a solid national emission inventory that comprehensively describes China's carbon status quo (Guan et al., 2012; Hong et al., 2016; Mi et al., 2017). Unfortunately, because of frequent revisions and inconsistent energy consumption data, China's emission inventory has suffered from considerable uncertainty, and the reliability of this inventory has long been criticised (Korsbakken et al., 2016; Qi and Wu, 2013; Wang, 2011). These inconsistent underlying energy statistics can lead to over- or underestimations of national CO_2 emissions and cause huge uncertainties in estimates of global emissions (Liu et al., 2015b; Marland et al., 2009), leading to errors in mitigation policies (Bruckner et al., 2014; Gregg et al., 2008; Guan et al., 2012).

Due to the importance of this problem, the inconsistency of energy data has been widely debated (Guan et al., 2012; Ma et al., 2014; Qi et al., 2016). Most studies have focused on the reasons underlying the uncertainty in emission inventories (e.g., under-reporting of energy consumption by small firms and data inflation to fit GDP growth), discussed how to improve the quality of energy data (e.g., employing satellite technology or institutional reform) via different methods or investigated means to verify the reliability of these data in comparison with international sources (Akimoto et al., 2006; Guan et al., 2012; Korsbakken et al., 2016; Li et al., 2016; Liu, 2015; Sinton, 2001). Causes related to institutional factors might be too difficult to resolve in the short term, which also implies that ongoing mitigation efforts will be accompanied by uncertainty in the near future. This challenge mainly arises because in a political assessment system that prioritises GDP growth, GDP data are likely to be inflated, while energy data are often manipulated to match the inflated GDP growth (Guan et al., 2011, 2012; Li et al., 2016). Moreover, the impacts of frequent data modifications on the mitigation targets are poorly understood. Here, we quantify the uncertainty in the estimates of CO_2 emissions and the likelihood of achieving mitigation targets. We briefly illustrate the latest national energy data modification and compile CO_2 emission inventories based on the revised and original data. Using our compiled

* Corresponding authors.
E-mail addresses: Yuli.Shan@uea.ac.uk (Y. Shan), Dabo.guan@uea.ac.uk (D. Guan).

https://doi.org/10.1016/j.enpol.2018.02.031
Received 29 June 2017; Received in revised form 16 February 2018; Accepted 17 February 2018

Table 1
Comparison among the 2015 data, 2010 data, 2006 data and the original data.

Item	Total energy consumption (Mtce)				Raw coal (Mt)			
Year	2015 data	2010 data	2006 data	Original data	2015 data	2010 data	2006 data	Original data
2000	1159	1205	1101	1036	1047	1107	1022	967
2001	1231	1239	1135	1085	1106	1129	1049	1017
2002	1330	1318	1217	1173	1212	1209	1108	1090
2003	1562	1528	1384	1318	1436	1412	1305	1253
2004	1799	1768	1638		1644	1615	1495	
2005	2034	1964	1873		1856	1774	1650	
2006	2243	2151	2053		2053	1953	1803	
2007	2412	2292	2231		2207	2088	1936	
2008	2484	2349			2277	2136		
2009	2671	2458			2448	2241		
2010	2861	2625			2590	2358		
2011	3141	2845			2886	2605		
2012	3258	2939			2978	2669		
2013	3388				3092			
2014	3319				2928			

Note: Mtce = Million tons coal equivalent; Mt = Million tons. Underlined data indicate the revised data for each dataset.

emission inventory, we quantitatively measure the impacts of the 2015 revision on two national mitigation pledges (the 40–45% and 60–65% mitigation targets noted above). Finally, we analyse the effects of the revisions at the sectoral level and their implications for sectoral mitigation.

2. Background: China's energy data revision

China has officially revised its energy statistics three times since 2000 (2006, 2010, and 2015) (Table 1). Such statistics modification is normally periodical in China, following the National Economic Census conducted every 5 years; the National Bureau of Statistics (NBS) uses data from the economic census to validate the historical statistical data collected from the hierarchical statistical system and make adjustments. Each revision has modified the energy balance sheets and final energy consumption by industrial sectors (Guan et al., 2012; Liu, 2015). However, NBS does not officially disclose the reasons for revising energy data or how the data were revised. The revisions might be due to the application of new statistical methods or the validation of historical data within economic census data. We assume that new statistical rules or methods would be carried over until the next revision. For example, the new statistical rules and methods applied in the 2010 revision would be applied to statistics from 2008 to 2012. We consider that data revised in a given revision belong to the dataset up to that revision. For example, the 2015 revision revised data from 2000 to 2012, including the 2010 data. Hence, the 2010 revision affected data within the range from 2000 to 2012. To avoid confusion and facilitate discussion, the data scope of the present research begins in 2000, and energy data provided in the 2015 revision are considered 2015 data (including data from 2000 to 2014); energy data provided in the 2010 revision are considered 2010 data (including data from 2000 to 2012); data provided in the 2006 revision are considered 2006 data (including data from 2000 to 2007); and data provided before the 2006 revision are considered original data (including data from 2000 to 2003).

The data revision details are summarised in Table 1S.

The first energy data revision was conducted in 2006. Based on the first National Economic Census in 2004, NBS revised energy data from 1999 to 2003 in 2006. Compared with the original data, the 2006 data increased total energy consumption by an average of 5% from 1999 to 2003. A major change was observed in raw coal and other petroleum products. In the 2006 data, the former increased by an average of 4%, and the latter increased by nearly 4-fold in comparison with the original data. The second energy revision followed the second National Economic Census in 2008, and energy data from 2000 to 2007 were massively revised by NBS in 2010. The new 2010 data revised total energy consumption upward by an average of 7% from 2000 to 2007, from 3% in 2007 to 10% in 2003 compared with the 2006 data. Compared with the 2006 data, the 2010 data mainly revised the historical consumption of raw coal and coke by average increases of 8% and 3%, respectively. The third data revision was conducted in 2015 following the third National Economic Census in 2013. This revision modified the energy data from 2000 to 2012, with an average increase in the total energy consumption of 2%. The massive revision occurred especially after 2005, as the discrepancy in total energy consumption between the 2015 data and the 2010 data increased constantly from a 4% gap in 2005 to an 11% gap in 2012. In the energy mix, the consumption of raw coal, other washing coal, coke and other gas in the 2015 data was substantially revised from 2000 to 2012, with average increases of 5.9% (1443 Mt), 9.4% (103 Mt), 9.3% (359 Mt), and 129% (360 Mt), respectively, higher than the 2010 data. Notably, the energy data after 2007 were substantially revised in the 2015 data. According to the change rates for raw coal, other washing coal, and coke during the period from 2007 to 2012, the rates between the 2015 data and the 2010 data increased by 9.1%, 17.3%, 11.6%, respectively.

On the industrial level, the energy data revisions mainly revised energy consumption in energy-intensive industries related to raw coal consumption. The raw chemical and cement industries were the most affected. Comparing these industries in the 2015 revision with the 2010 revision, the raw coal consumption in the 2015 revision increased by 41% (434 Mt) and 21.6% (425 Mt) for the raw chemical and cement industries, respectively, from 2000 to 2012, which accounted for 53% of the total raw coal consumption gap from 2000 to 2012 (Fig. 1S). These shifts in energy consumption revealed by the data revision indicated a more carbonised China, which directly affects the emissions and thereby poses a threat to the global mitigation initiative. China has set its own mitigation targets as part of its Nationally Determined Contributions (NDCs), which include two core pledges to reduce its carbon intensity by 40–45% by 2020 (2020 target) and by 60–65% by 2030 (2030 target). However, the mitigation schemes developed in 2009 and 2014 are based on the 2010 data; therefore, large uncertainties in China's mitigation policymaking and implementation might be generated from uncertain energy data, and these uncertainties further undermine China's ability to achieve its mitigation targets. To assess the impact of energy statistics revision on China's mitigation pledge, we focus on the energy data from the 2010 and 2015 revisions. Data from 2000 to 2014 in the two datasets are compared and analysed.