Energy Policy 50 (2012) 562–569

Contents lists available at SciVerse ScienceDirect

Energy Policy

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

China's industrial energy consumption trends and impacts of the Top-1000 Enterprises Energy-Saving Program and the Ten Key Energy-Saving Projects

Jing Ke [a,*], Lynn Price [a], Stephanie Ohshita [a,b], David Fridley [a], Nina Zheng Khanna [a], Nan Zhou [a], Mark Levine [a]

[a] Energy Analysis and Environmental Impacts Department, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, MS 90R4000, Berkeley, CA 94720, USA
[b] Department of Environmental Science, College of Arts and Sciences, University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117, USA

HIGHLIGHTS

- We conduct decomposition and sectoral analyses of China's industrial energy use.
- Efficiency effect was the primary factor slowing growth of industrial energy use.
- Structural effect had relatively small impact on industrial energy consumption.
- 11th FYP policies lowered energy intensity of energy-intensive industries.
- Contribution of the Top-1000 Program and the Ten Key Projects is large.

ARTICLE INFO

Article history:
Received 11 February 2012
Accepted 31 July 2012
Available online 19 August 2012

Keywords:
Industry
Energy intensity
Decomposition

ABSTRACT

This study analyzes China's industrial energy consumption trends from 1996 to 2010 with a focus on the impact of the Top-1000 Enterprises Energy-Saving Program and the Ten Key Energy-Saving Projects. From 1996 to 2010, China's industrial energy consumption increased by 134%, even as the industrial economic energy intensity decreased by 46%. Decomposition analysis shows that the production effect was the dominant cause of the rapid growth in industrial energy consumption, while the efficiency effect was the major factor slowing the growth of industrial energy consumption. The structural effect had a relatively small and fluctuating influence. Analysis shows the strong association of industrial energy consumption with the growth of China's economy and changing energy policies. An assessment of the Top-1000 Enterprises Energy-Saving Program and the Ten Key Energy-Saving Projects indicates that the economic energy intensity of major energy-intensive industrial sub-sectors, as well as the physical energy intensity of major energy-intensive industrial products, decreased significantly during China's 11th Five Year Plan (FYP) period (2006–2010). This study also shows the importance and challenge of realizing structural change toward less energy-intensive activities in China during the 12th FYP period (2011–2015).

© 2012 Elsevier Ltd. All rights reserved.

1. Introduction

As a result of rapid economic growth, China's total primary energy consumption increased from 17.7 exajoules (EJ) in 1980 to 95.2 EJ in 2010 (NBS, 2010b, 2011c). Industrial energy consumption accounts for about 70% of China's total energy consumption (NBS, 2010a, 2011a, 2011b). The large share of industrial energy consumption is one of the main features of China's energy economy and warrants comprehensive analysis.

Several studies have used decomposition analysis to understand the energy economy of China's industrial sector. Sinton and Levine (1994) analyzed the relative roles of structural change and real energy intensity change[1] in China's industrial sector in the 1980s using a decomposition methodology and found that real intensity change was the main factor accounting for the reduction in industrial energy intensity in the 1980s. Zhang (2003) analyzed China's industrial energy consumption in the 1990s using a decomposition methodology and showed that a decline in real

* Corresponding author. Tel.: +1 510 486 4537; fax: +1 510 486 6996.
E-mail address: jke@lbl.gov (J. Ke).

0301-4215/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2012.07.057

[1] Real energy intensity change is the change in "economic energy intensity of industrial sub-sectors, composed of physical energy intensity change and other non-structural factors" (Sinton and Levine, 1994).

energy intensity was the main contributor to industrial energy savings in the 1990s. Zhang and Sun (2010) analyzed the change in energy intensity of selected industrial sub-sectors using a decomposition methodology and found that improvements in energy efficiency played a dominant role in reducing industrial energy intensity over the period 1997–2007. A recent decomposition analysis (Xu and Zhang, 2011) of China's manufacturing industry shows that structural shift has more or less increased manufacturing industry's energy consumption since 2003 and real energy intensity change[2] is the driving force for energy savings.

In 2010, China published extensive revisions to its official national energy balances for the years 1996 to 2008 (NBS, 2010a, 2010b). These revisions primarily affected the reported numbers on coal production and consumption and, in addition to the 2005 revisions covering 1998 to 2003, basically eliminated what was originally reported as a decline in primary energy use in the late 1990s. The basis of the 2010 revisions was the result of the Second National Economic Census of 2008 (Ma, 2009). For the first time, the census scope was expanded to cover activities below the county level, providing the most comprehensive look at China's economy to date. The results of the census indicated a significant underestimation of energy consumption by enterprises and businesses at the lowest level, leading to an average 5% upward revision of annual primary energy consumption between 2000 and 2007 (NBS, 2008, 2010a). This upward revision was primarily due to increases in coal use in industry; in 2006, for example, coal use in industry was revised up by 130 million tonnes (NBS, 2008, 2010a). In addition to extensive revisions of coal production and consumption, the census also led to adjustments in the structure of reported petroleum product consumption, with a greater proportion of diesel fuel being allocated to transport use. These extensive revisions of China's official energy statistics warrant in-depth reanalysis of China's industrial energy consumption.

Industrial value-added measures the net economic contribution of each industrial sub-sector and thus is ideal for energy economy analysis (Zhao et al., 2010). However, most recent studies used published gross output value data or industrial value-added data for selected years[3] because the industrial value-added data at the sub-sectoral level have not been officially released for 2004 and 2008 onwards. The years for which official data have not been released are critical for the analysis as they correspond to the dynamic and fast changing period of China's industrial energy economy. An in-depth analysis with accurate estimation of industrial value-added is helpful to understand the fast changing nature of China's industrial energy economy.

The main purpose of this study is to (1) examine whether China's industrial energy consumption trends in the 1980s and 1990s continued through the 2000s, especially given the revised Chinese energy statistics and our latest estimation of sub-sectoral industrial value-added; (2) examine whether the efficiency effect (or real energy intensity change) is still the main factor accounting for the energy intensity reduction in the Chinese industry; (3) assess the impact of the two major industry-related energy-saving programs and initiatives during China's 11th Five-Year Plan (FYP) period (2006–2010) on that country's recent industrial energy consumption.

2. Data

The main data used for this analysis are the latest officially[4] revised industrial energy consumption data (NBS, 2010a, 2011a, 2011b) and industrial value-added data by sub-sectors at the 2-digit level of industrial classification (DISNBS, various years; NBS, 2006, 2009, 2010b, 2010c, 2011c, 2011d, various years). Industrial value-added is calculated at 2005 constant prices.

The National Bureau of Statistics (NBS) publishes the *China Energy Statistical Yearbook* (CESY) annually. Final energy consumption by industrial sub-sector can be found in various issues of the CESY. Because coal dominates China's energy economy, China officially uses a coal equivalent calculation for its energy statistics (NBS, 2010a, 2010b). Final energy consumption by sector can be calculated using two conversion methods: the coal equivalent calculation method that includes the primary energy use in power generation and the calorific value calculation method that values electricity at its heat value (NBS, 2010a). In this study, if not otherwise noted, we adopt the coal equivalent calculation method following China's official energy statistics expressed in tonne of standard coal equivalent (tce).[5]

According to official Chinese statistics, industrial enterprises are classified into enterprises above a designated size and enterprises below a designated size.[6] The industrial value-added of the enterprises above the designated size is calculated using the production or income approach[7] (DISNBS, various years), while the industrial value-added of the enterprises below the designated size is estimated using the gross output value and the "industrial value-added rate". The majority of China's industry is comprised of enterprises above the designated size, accounting for about 87% of the total industrial value-added in 2004 (NBS, various years).

The total industrial value-added data can be found in the annual *Statistical Communiqué of the People's Republic of China on the National Economic and Social Development* (NBS, various years). The industrial value-added data at the sub-sectoral level for industrial enterprises above the designated size are usually reported in the annual *China Industry Economy Statistical Yearbook* (CIESY). From 2004 to 2006, China conducted its first national economic survey and published the three-volume *China Economic Census Yearbook* (CECY) 2004 (NBS, 2006) as well as the provincial economic census yearbooks. Because the CECY 2004 already included the industrial sector, the CIESY for the year 2004 was thus not published to avoid redundancy. However, CECY 2004 did not directly provide industrial value-added data at the sub-sectoral level, though it provided a lot of detailed information. Most studies thus used other economic indicators instead. We found that the sub-sectoral industrial value-added could be calculated from the officially released 2004 economic survey data. We adopted the income approach to calculate the sub-sectoral industrial value-added. We compared the total industrial value-added of the enterprises above the designated size calculated using the income approach with the officially published industrial value-added data (NBS, various years) and found that the difference was only 0.3%, which verified the validity of our calculation method. The industrial value-added of the enterprises below the

[2] The term "technical effect" was used by Xu and Zhang (2011) in their paper.

[3] For example, Xu and Zhang (2011) used the arithmetic mean of industrial value-added of a sub-sector in 2003 and 2005 as an approximation of industrial value-added of that sub-sector in 2004.

[4] Some researchers have viewed official Chinese energy and economic statistics with skepticism (Gregg et al., 2008; Rawski, 2001). However, the official statistics remain the only main source of energy and economic data. To be consistent in this study, we primarily use the latest official statistical data.

[5] 1 tce is approximately equivalent to 29.3 gigajoules (GJ).

[6] The designated size is defined as "all state-owned enterprises and those non-state-owned enterprises with annual revenue from their principal business of over 5 million RMB" (NBS, 2010b).

[7] In theory, production approach and income approach would give almost the same results if the data meet the statistical requirements.

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات