



ELSEVIER

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

Energy conservation of electrolytic aluminum industry in China

Boqiang Lin ^{a,b,*}, Lin Xu ^c^a Collaborative Innovation Center for Energy Economics and Energy Policy, China Institute for Studies in Energy Policy, Xiamen University, Xiamen 361005, Fujian, PR China^b Newhuadu Business School, Minjiang University, Fuzhou 350108, Fujian, PR China^c School of Economics, China Center for Energy Economics Research, Xiamen University, Xiamen 361005, Fujian, PR China

ARTICLE INFO

Article history:

Received 8 July 2014

Received in revised form

22 September 2014

Accepted 1 November 2014

Available online 3 December 2014

Keywords:

Electrolytic aluminium industry

Energy conservation potential

Co-integration method

Monte-Carlo simulation

ABSTRACT

The electrolytic aluminium industry is a typical energy-intensive industry, and one of the six largest energy-consuming industries in China. The energy consumption of China's electrolytic aluminium industry (CEAI) in 2011 accounted for 0.91% of China's total energy consumption and 22.7% of the total energy consumption of the non-ferrous metal industry. In consideration of the bulk of energy used in the smelting process in the non-ferrous metal industry, CEAI assumes the corresponding obligation of energy conservation and emissions reduction. Using the co-integration method, the long-term equilibrium relationship among the energy consumption of CEAI, output, electricity price and average enterprise scale is obtained. Thereafter the Monte-Carlo simulation is used to forecast energy consumption and energy conservation potential of CEAI under different energy conservation scenarios, and conduct risk analysis. The research shows that increase in the price of electricity and enterprise scale is helpful to reducing the total energy consumption of CEAI. The future energy conservation potential of CEAI is large. According to the result of the analysis the energy conservation potential of CEAI in 2020 will reach 30.51 Mtce under the moderate energy conservation scenario and 49.93 Mtce under the advanced energy conservation scenario. Some corresponding policy suggestions are recommended in this paper.

© 2014 Elsevier Ltd. All rights reserved.

Contents

1. Introduction	677
1.1. China's electrolytic aluminium industry	677
1.2. Researches on energy consumption and China's electrolytic aluminium industry	677
2. Methods	678
2.1. Co-integration	678
2.2. Risk analysis	678
2.3. Data sources	679
2.3.1. Energy consumption (E)	679
2.3.2. Output (Q)	679
2.3.3. Average enterprise scale (S)	679
2.3.4. Electricity price (P)	679
3. Results	679
3.1. Unit root tests	679
3.2. Selection of lag intervals for VAR model	680
3.3. Co-integration model results	680
3.4. Stability test	680
3.5. Model fitting accuracy	680
4. Discussion	681
4.1. Risk analysis	681
4.2. Future energy demand and energy conservation potential in scenario analysis	682

* Corresponding author at: Newhuadu Business School, Minjiang University, Fuzhou 350108, Fujian, PR China. Tel.: +86 5922186076; fax: +86 5922186075.
E-mail address: bqlin@xmu.edu.cn (B. Lin).

5. Conclusions 684
 6. Recommendations 684
 6.1. Close down outdated capacity and encourage merger and acquisition in CEAI..... 684
 6.2. The increase in electricity price promotes industrial transfer..... 684
 6.3. Extend the industrial chain and improve the industrial concentration in CEAI..... 685
 References 685

1. Introduction

1.1. China's electrolytic aluminium industry

The Energy Development Twelfth Five-Year Plan of China [25] was released in 2013. It proposes that the main goal of energy development is to control both the intensity and the amount of energy consumption by 2015. It specifies explicit goals and targets for energy-intensive industries, including the electrolytic aluminium industry.

The electrolytic aluminium industry is a typical energy-intensive industry, and one of the six largest energy-consuming industries in China. China is currently the world's largest producer of electrolytic aluminum and the largest consumer of alumina. In 2011, the output of China's electrolytic aluminium industry (CEAI) accounted for about 40% of world's total output. The rapid development of the economy facilitated a huge demand for electrolytic aluminum in China and enhanced its capacity. In recent years, the production of electrolytic aluminum far exceeded market demand, leading to excess capacity. Since 2003, the capacity utilization of CEAI has hovered between 70% and 80%. In 2012, the production capacity of CEAI is 27.65 million tons while the capacity utilization is only 73%.

The cost of producing one ton of aluminum is 15,000 CNY, while the market price is about 14,500 CNY. This coupled with the problem of excess capacity worsen the situation of CEAI. CEAI was in fact not subsidized nationwide by the central government's grants. However, because of the local GDP, employment, taxes and other benefits, local governments supported the massive expansion of CEAI by introducing preferential electricity tariff and other local favorable policies. As a result, the capacity of CEAI is still expanding rapidly. Despite of this, 93% of enterprises were running in the red at the end of 2013, and the average profits margin was only between 1000 CNY/t to 1500 CNY/t. This situation cannot be sustained and the capacity control by the central government has been tightening recently. In 2011, the foreign dependence of China's aluminium resources reached 47%. Issues such as excess capacity, higher costs, dependence on imported raw materials and protection of domestic aluminum resources require CEAI to strengthen energy conservation and emissions reduction, eliminate backward production capacity and improve energy efficiency. By 2015, China aims to complete more than 15 million tons technical transformation in the electrolytic aluminium industry, which will make direct current power (DC power) consumption of electrolytic aluminium to drop below 12,500 kW h/t.

After the black metal industry and the chemical industry, the nonferrous metal industry is the third largest electricity consumer in China. The electricity consumption of the nonferrous metal industry accounts for 6% to 7% of total electricity consumption in China, out of which the electrolytic aluminium industry accounts for more than 60%. The output of CEAI in 2006 accounted for less than 1% of China's GDP, but its electricity consumption accounted for 4.9% of total electricity consumption. In 2011, energy consumption of CEAI accounted for 0.91% of total energy consumption and 22.7% of the total energy consumption of the nonferrous metal industry. The annual energy consumption of CEAI and its share in

China's total energy consumption are shown in Fig. 1 and Fig. 2, respectively. Both show upward trends.

The electrolytic aluminium industry is an energy-intensive industry and scientific evaluation of its energy conservation and emissions reduction potential could provide some references for optimizing the industry's structure and developing its energy conservation policies. The exploration of the constraints on the energy consumption of CEAI, a power-intensive industry, is conducive for the adjustment of the industry's structure, sustainable development and transition to a low-carbon economy.

1.2. Researches on energy consumption and China's electrolytic aluminium industry

Econometric and scenario analysis methods are commonly used to forecast energy demand. For example, Lin [18] studied the relationship among changes in electricity demand and GDP,

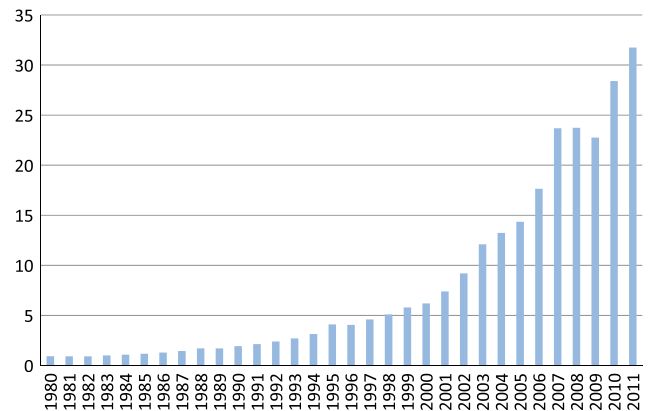


Fig. 1. The energy consumption of China's electrolytic aluminium industry (Mtce). Source: CEIC, China Energy Statistical Yearbook, Yearbook of nonferrous metal industry of China.

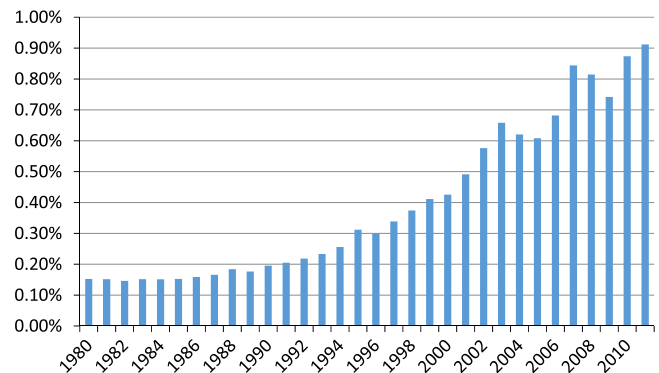


Fig. 2. The share of energy consumption of CEAI in China's total energy consumption. Source: CEIC, China Energy Statistical Yearbook, Yearbook of nonferrous metal industry of China.

Download English Version:

<https://daneshyari.com/en/article/8117854>

Download Persian Version:

<https://daneshyari.com/article/8117854>

[Daneshyari.com](https://daneshyari.com)