



China's oil security from the supply chain perspective: A review



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HIGHLIGHTS

- The development phase of China's oil industry is detailed.
- Risk to oil industry in China is identified along the supply chain.
- Policy aimed at improving oil security is examined.

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ABSTRACT

Oil security has become a major issue in China. This paper analyzes China's oil security from the supply chain perspective, as the country faces challenges from an increasing reliance on imported oil, a fast-growing economy, the Malacca dilemma, and volatile international oil prices. To clarify the issue of oil security, we first review the development phase of China's oil industry and previous research related to its energy security. Then a framework from the supply chain perspective is constructed to identify the current risk from three aspects: energy flow, financial and environmental. Finally, policies aimed at improving the country's energy security are examined and potential problems presented. From this analysis, we conclude that the potential risk arising from China's oil system is inherently interconnected. There is still great potential for the country to improve oil security by strengthening its strategic oil reserves, improving energy efficiency, and developing its domestic oil tanker fleet.

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1. Introduction

China's economy has grown rapidly during the past three decades. Domestic production (GDP) surged from 189,399 million dollars in 1980 to 7,318,499 million US dollars in 2011 [1]. This has resulted in China surpassing Japan as the world's second largest economy [2]. However, this was achieved by tremendous energy consumption, because energy has always been considered the engine and fundamental impetus of social economic development.

According to the U.S. Energy Information Administration [3], China has become the second largest consumer of oil (close behind the United States), and the largest global consumer of energy. Its total energy consumption was 3249.4 million tons of coal equivalent in 2010, of which 68% was derived from coal, 19% from oil, 4.4% from natural gas, and 8.6% from primary electricity (hydro, nuclear and wind) [4]. Although oil is not dominant in the fuel mix of these energy types, it has attracted much more attention in China relative to the other types, for the following reasons. First, the gap between indigenous oil production and demand has widened since China became a net oil importing country in 1993. By the end of 2011, national oil consumption reached 461.8 million tonnes (Mt), about 54.8% of which was imported [5]. Second, although the Chinese government has striven to diversify imported oil sources, its imported oil still originates largely from unstable regions (e.g., the Middle East, Africa, and South America). Third, although oil price is relatively stable in recent years since U.S. energy revolution, the oil price is still mainly manipulated by suppliers. These prices are also sensitive to political issues, natural events, and currency fluctuations. Fourth, the transportation sector is less flexible with regard to oil alternatives, with little prospect for replacement in the short term [6]. Fifth, and related to the second reason, imported oil from the Middle East must pass through the Strait of Malacca, which is considered a chokepoint by the Chinese government, not only because of pirate attacks in this region but also because the strait is a strategic vulnerability region for China. This situation aggravates the risk of international oil supply disruption for China. For the above reasons, even though oil as a strategic commodity does not constitute a dominant proportion of the country's fuel mix, the debate about national energy security has been primarily focused on oil security [7].

Various methods have been applied to analyze the issue of energy security. For example, Wianwiwata and Asafu-Adjaye [8] applied a computable general equilibrium model to assess the role of biofuels in Thailand's energy self-sufficiency and security. Ma et al. [9] studied Chinese energy security using a Sankey diagram, which revealed the pattern of the country's oil flow and identified the driver of its soaring oil demand. Additionally, energy security indicators categorized into two types have been proposed to quantify the energy security levels: disaggregated and aggregated [10,11]. Disaggregated indicators including the reserve to production ratio, net energy import dependency, geopolitical market concentration risk, oil expenditure per GDP, and Hirschman–Herfindahl–Agiobenebo index have been used to evaluate China's energy security [10]. Rather than focusing on one dimension of

security evaluation, an aggregated indicator combines various disaggregated indicators to construct an integrated index (such as oil vulnerability index) [12].

Although there has been much effort toward deep understanding of national energy security, most studies have focused on only one or certain aspects of the oil system. However, oil security as a holistic issue demands description of the complexity of the entire oil system. Therefore, an integrated method could give a comprehensive assessment for various dimensions of oil system rather than focus on one or certain aspects must be used to analyze oil security. Moreover, previous research has highlighted difficulties in exploring the interaction of each component within the oil system because of the fragmented view obtained by concentrating on an isolated piece of this system [8,10–12]. Given this background, a framework based on the supply chain has been developed to identify potential risk to China's oil industry.

The purposes of this paper are as follows: (1) to review the development phase of China's oil industry and papers related to national oil security, and to clarify the concept of oil security in Chinese context; (2) to identify the principal factors affecting oil security from the supply chain perspective; and (3) to examine China's current policies regarding improvements in oil security.

2. Development phase of China's oil industry

We examined the academic literature related to energy security in China using the Web of Knowledge database, retrieving "energy security" and "China" as "topics" (the terms appear in the titles, keywords or abstracts of the papers) (<http://apps.webofknowledge.com>). We also conducted a search on "energy security" and "China" as "topics" in the Chinese core periodicals database

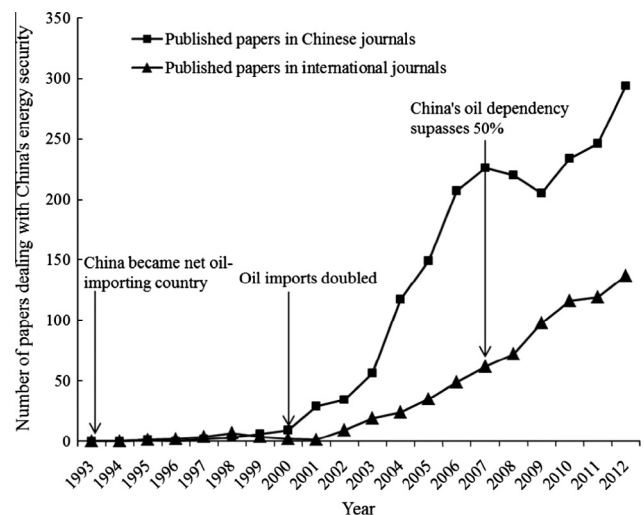


Fig. 1. Number of papers dealing with Chinese energy security, from both international and Chinese journals.

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