Energy Policy 37 (2009) 4038–4048

Contents lists available at ScienceDirect

Energy Policy

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

Environmental support, energy security and economic growth in Japan

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ARTICLE INFO

Article history:
Received 14 January 2009
Accepted 4 May 2009
Available online 24 June 2009

Keywords:
Emergy
Sustainability
Japan

ABSTRACT

This study investigates the resource consumption of Japanese society since 1979 and its subsequent effects on the economic output of the nation and the environment. In order to quantify resource appropriation and trends in production and consumption, the concept of emergy synthesis is employed. Our results show a significant increase in the total amount of emergy consumed by 66.9% between 1979 and 2003 which comes hand in hand with an increase in the level of environmental stress by 93.7% (quantified as the environmental loading ratio). On the other hand the emergy required to produce 1 USD of economic output has been gradually decreasing which denotes an increase in the efficiency of the conversion of natural capital into economic output. What is most interesting though is the growing dependence of the Japanese economy on imported emergy, increasingly from developing nations, that severely affects the potential for unhindered economic growth. This can prove to be a big barrier that could affect the resource security of the Japanese economy and render it susceptible to risks associated with access to natural resources which in turn can jeopardise its long-term economic sustainability.

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1. Introduction

Japan is currently the second largest economy and home to one of the most affluent populations on the planet (IMF, 2008) achieving this economic prominence in just a few decades. Even though there has been a constant, albeit late, industrialisation of the country since the Meiji period, most of the population was rural until the mid of the 20th Century. The Japanese economy has traditionally been agricultural and what industry existed was heavily damaged during World War II. However, after the end of the war, the Japanese economy grew at unprecedented rates, averaging 9.3% in the 1960s, 5.2% in the 1970s and 4.1% in the 1980s (MIAC, 2008a). In this respect, Japan has been perhaps one of the most successful post war economies.

Japan is also one of the biggest energy consumers in the world. As of 2007, Japan consumed 22087.9 PJ of energy which made it the fifth largest consumer of energy and the third largest consumer/producer of electricity in the world (OECD, 2008a). Even though energy consumption by industry, transport and agriculture/forestry has levelled off, or even decreased, the energy consumed by households and the service sector is increasing continuously (refer to Fig. 1). For electricity generation, thermal processes and nuclear power plants constitute the main sources of electricity in the country accounting for 63.7% and 25.5% of the electricity produced in 2005 (MIAC, 2008b), refer to Fig. 2. On the other hand, renewable sources such as hydro and wind power have remained more or less constant in the electricity fuel mix over the past decades despite the commitment of the country to reduce its greenhouse gas (GHG) emissions. It is interesting to note in Fig. 2 that hydropower constituted the single largest source of electricity until the mid sixties.

However, despite its large energy consumption, the country lacks any significant fossil fuel reserves with inland fossil fuel production amounting to a modest 151.3 PJ in 2005 (OECD, 2008a). At the same time and due to poor planning, the country, unlike other energy poor countries like Italy and France has failed to secure active presence in foreign oil markets through a strong national oil company (Koike et al., 2008). Nevertheless, Japan has managed to become one of the major exporters of petroleum products, chemicals, steel and finished goods, such as cars, exhibiting the third highest account balance in the world as of 2007 (IMF, 2008). Production of these commodities is highly resource intensive which makes the Japanese economy vulnerable to resource supply interruptions. In fact the country experienced negative economic growth on the aftermath of the first oil crisis and an economic slowdown during the second crisis (MIAC, 2008a). This is very interesting considering that this negative economic growth happened amidst the 1970s and 1980s, two of the decades that constituted the so-called "Japanese miracle", when the Japanese economy experienced constant economic growth. Nevertheless the academic community is uncertain whether there is a causal relationship between energy consumption and economic growth in Japan and whether the economic downturn experienced during the two oil crises was a direct effect of the crises themselves. For example, (Soytas and Sari, 2003) and

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doi:10.1016/j.enpol.2009.05.011

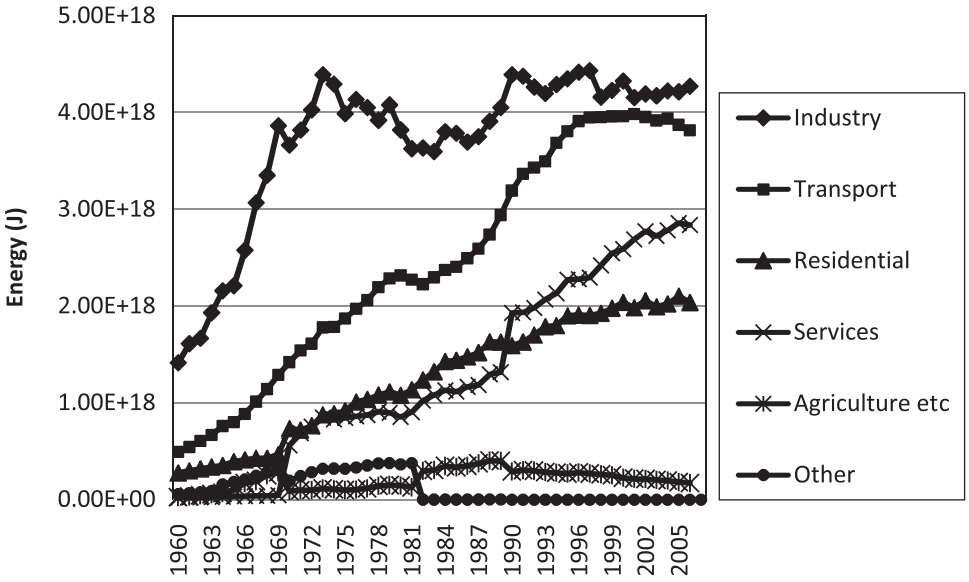

Fig. 1. Consumption of energy (in J) by final demand sector. Source (OECD, 2008a).

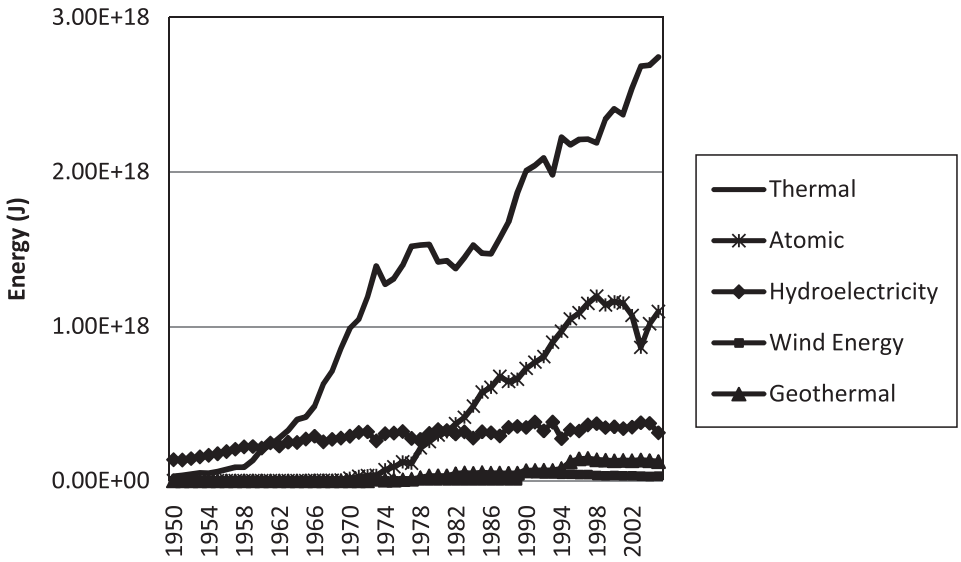

Fig. 2. Generated electricity (in J) by source. Source (OECD, 2008a).

(Erol and Yu, 1987) suggest that indeed greater energy consumption has resulted in a greater economic output for the Japanese economy. Lee (2006) on the other hand suggests reverse unidirectional causality from gross domestic product (GDP) to energy consumption.

Japan is also increasingly becoming dependant on other countries for its food. Since 1960, self-sufficiency ratios for most food categories have significantly decreased, with the exception of rice, (MIAC, 2008c). At the same time, the country's mountainous terrain, large forested area (about two thirds of the country) and high land prices renders the expansion of farm land difficulty. As a result Japan has resorted to (a) intensifying its domestic production and (b) increasing imports of food and foodstuff from other countries. Gadda and Gasparatos, (2009) report strong indications of intensification in the livestock sector and estimate 7.8 cattle per hectare in 2005 (up from 2.4 cattle per hectare in 1970) and 350.5 pigs per hectare (up from 35.5 pigs per hectare in 1970). Furthermore, Food and Agriculture Organization estimates suggest a massive increase of imported food between 1961 and 2003. Japanese food production increased only slightly (by 4.9%) in that period, while imports increased by 521.4% and reached 59442.7 thousand tonnes which was actually more than the entire production of the country for that year (FAO, 2008). Both intensification of agriculture and imports of food make the Japanese society increasingly dependent on other countries both for food products (food and feed) as well as agricultural materials (e.g. natural resources for agrochemicals).

All of the above evidence highlights a highly developed economy that is nevertheless depending on other countries to obtain the natural resources required to fuel its economy. It is no wonder that Japan's overarching energy policy concern as it was laid down in the 2006 national energy strategy is energy security (METI, 2006). Two indicators of this ever growing concern are the facts that Japan, as of January 2008, stockpiled oil equivalent to 151 days of net imports (International Energy Agency (IEA)'s import requirement is 90 days) and the signing of an oil stock agreement with the government of New Zealand (OECD, 2008b).

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