THE SWITCH TO LESS ENERGY-INTENSIVE INDUSTRY

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Contents

Summary

Government policies aiming to introduce and promote low energy consumption-type economic structures will become more and more important in the twenty first century. A

low energy economic structure, which imparts a low environmental load and contributes to national energy security, makes it possible to realize sustainable development.

This article deals with how energy savings are realized, focusing on energy consumption in the industrial sector. Improvement of energy efficiency in the industrial sector is derived not only from the introduction of more energy efficient technologies, but also the improvement of productivity, change of industrial structures, and change of products mixture.

For the industrial energy user to attempt constant energy savings, energy conservation policy is essential. Concrete measures of energy conservation policies are composed of: (1) the provision of information; (2) the use of price systems; and (3) mandatory orders. Additionally, the establishment of special organizations for the promotion of energy saving and the support of research and development of energy saving technologies are also necessary. In the long run, the forming of tactical industry policies such as "the advancing industrial structure" should be taken into account in the planning of the future economic structure of a country.

1. Introduction

In the twenty first century, most governments will have to create policies that will lead to a low energy consumption economy. The reason is that this economic structure will contribute to energy security and reduce the load on the environment. Consequently, it promises to result in sustainable development.

Through the two oil crises in the 1970s, everyone learned the importance of energy efficiency. In those days, arguments considering energy saving were focused on how to restrain soaring energy costs and how to manage the limited fossil fuel resources that could possible become a fetter to national growth in the future. In other words, in the micro-economy, energy saving was considered as a measure for reducing cost and in the macro-economy, energy saving policies were adopted due to the necessity for energy security.

However, in the mid 1980s, the situation completely changed as the oil price collapsed, and energy saving trends withered dramatically. The importance of energy saving seemed to have melted away. Then a new factor appeared which reanimated the necessity for energy saving—global warming. On a worldwide level, carbon dioxide, which is produced through consumption of fossil fuel, accounts for a half of all greenhouse gases. Fuel conversion from fossil fuels to renewable energy, and the development of technologies for reducing carbon dioxide emissions are examined as a means of dealing with this issue. However, a more fundamental measure is to use energy as rationally as possible and to save energy. Therefore, energy saving becomes an important policy issue for the future.

In this article, the focus is on energy consumption in the industrial sector and the initiation of policies for a low energy consumption economy. First, the possibility of economic growth with less energy consumption is analyzed, based on empirical and theoretical studies. Next, is examined how a lower energy consumption structure in the industrial sector is brought about, as well as the technological factors that bring about energy saving. Finally, the energy policy that creates a low energy consumption industry structure is clarified.

2. Economic Development and Energy Input

This section examines the trends and characteristics of energy intensity that are used for comparisons of energy efficiency among the countries. This index is frequently used as an indicator of energy efficiency in the macro economy. On the other hand, however, this index sometimes occasionally gives misunderstanding to policy makers. Hence, those using this index should pay attention to the hidden meaning of the figure.

2.1 Energy Intensity per GDP

2.1.1 Energy Intensity

As with the index for energy efficiency, the term of energy intensity is generally employed. It is easily calculated by using an economic variable as the denominator and energy consumption as the molecule. Thus for instance,

$$UCvi = \frac{Ei}{Vi} \qquad (1)$$

where *UCvi* is energy intensity, *Ei* shows energy consumption, *Vi* means an economic variable, and *i* indicates an attribute.

Energy consumption intensity in *i* country is generally calculated using the primary energy requirement (*Ei*) denominated by GDP (*Vi*). This shows how much energy is needed to produce a certain value-added in each country.

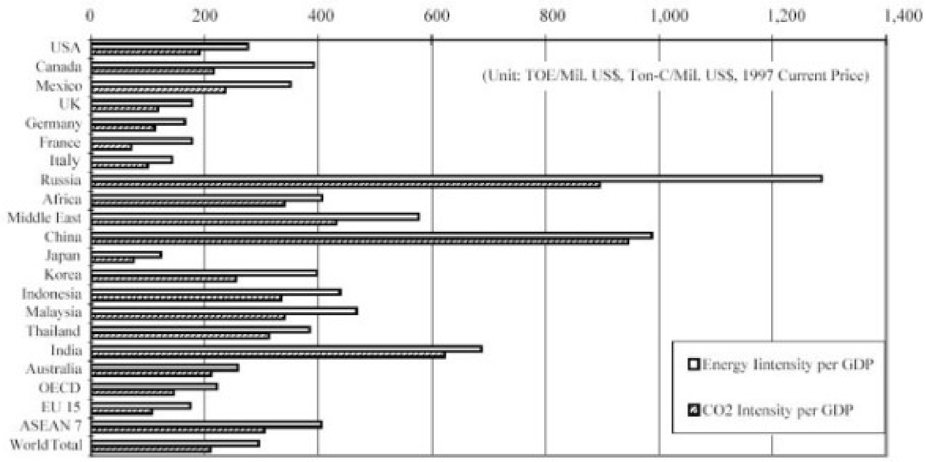
Such energy intensity can be applied in various fields. For example, the value that uses population as the denominator, becomes energy intensity per capita. Also, at factory level, energy consumption per product can be computed. Moreover, in the case of the transportation sector, fuel consumption per car gives a rough estimate of fuel efficiency. Thus, energy intensity is often utilized to show energy saving trends and the index, showing energy efficiency.

2.1.2 Comparison of GDP Energy Intensity among Countries

This section attempts to compare energy intensity per GDP among several countries in 1997 (Figure 1). The figure illustrates that the value of the intensity varies widely according to the country.

For example, the energy intensity of Russia is about 1300 TOE (Ton Oil Equivalent) per million US dollars and China follows with 990 TOE, although the world average is 295 TOE. Among OECD countries, Canada, US, and Australia have relatively high figures, 392 TOE, 276 TOE, and 258 TOE, respectively. The average of OECD countries is 222 MOTE. The figures for Japan and Italy are relatively small, 123 TOE and 143 TOE.

Therefore, the energy intensity of Japan is one eleventh of Russia, one eighth of China, and a half of the US.



(Note) GDP is based on the current price with 1997 exchange rate.
CO_2 is the emission originated by energy consumption.

(Source) IEEJ/EDMC, *Handbook of Energy and Economic Statistics in Japan*, 2000

Figure 1. Energy Intensity and CO_2 Intensity per GDP

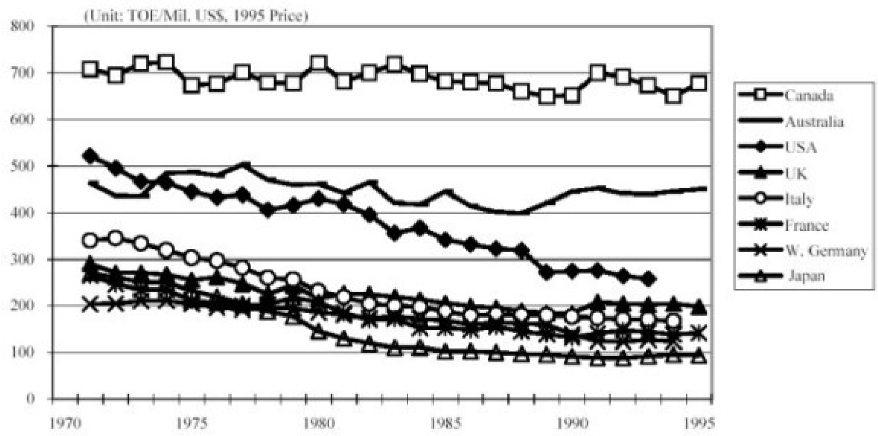
The CO_2 emission intensity of energy consumption (CO_2 emission/GDP) also presents a similar story; the figures differ between countries. The lowest among the OECD countries is France, 70 Tons-Carbon per Million US$. The figure for China is almost 14 times that of France, and almost five times that of the US.

As for the reasons for this difference, it is a fallacy to suppose that it is caused by technical energy efficiency or to assume that country A wastes more energy than country B does. Other factors are involved. In other words, various elements, such as relative prices of production factors (the price ratio of energy, labor, capital, and so on), the industrial structure, weather conditions, geographical circumstances, the transportation system, and so on, which each country experiences affect these differences.

Even if we limit the issue of energy use technology to the industrial sector, many factors are closely related to energy intensity as follows. They are the fuel mix, the efficiency of energy conversion, the technical efficiency of the end use (that is, the technical efficiency of obtaining useful energy), the manufactured products mixture, and productivity such as yield of output, which is the ratio of sellable to manufactured products at a factory.

Hence, the differences in energy intensity per GDP among the countries are not caused solely by the differences in technological energy efficiency. It cannot be said that A is wasteful or B is frugal based on intensities, although it needs to be recognized that the figures do vary a lot between countries. In the same way, it is also a mistake to measure the energy saving potential by comparing the figure of one country with those of other countries.

To avoid the influence of geographical, climatic, and transportation system conditions, only energy use in the industrial sector is used, in an attempt to examine the energy intensity per value-added in the manufacturing industry (Figure 2). There is also variance among the countries for this. As noted above, this variance depends on: differences in the industrial structure; the difference in the product composition in an industry; the relative prices of production factors; the technological efficiency which links final energy and useful energy; productivity; and so on.



(Note) Value added is in 1995 price and same year's exchange rate.
Energy consumption in Germany includes that of East Germany.

(Source) OECD/IEA, *Energy Balances of OECD Countries*
OECD, *National Accounts of OECD Countries*
IEEJ/EDMC, *Handbook of Energy and Economic Statistics in Japan*, 2000

Figure 2. Comparison of Energy Intensity per Value-Added in the Industrial Sector

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Biographical Sketch

Hisao Kibune is Professor of Economics at the Nagoya Gakuin University, Japan. His research interests focus on the energy trade, with particular emphasis on the role of environmental constraints.