

**Energy, Emissions and Structural Changes of the Korean Economy:
Implications for a Low-Carbon Economy**

by

Sung-kyun Kim

An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the degree of

DOCTOR OF PHILOSOPHY

Major Subject: Ecological Economics

The original of the complete thesis is on file
In the Rensselaer Polytechnic Institute Library

Examining Committee:

Prof. John M. Gowdy, Thesis Adviser

Prof. Faye Duchin, Member

Prof. Dean A. Nieuwma, Member

Prof. Daniel L. Shawhan, Member

Rensselaer Polytechnic Institute
Troy, New York

May, 2010
(For Graduation August 2010)

ABSTRACT

The dramatic increase in the use of fossil fuels has presented two major challenges: climate change and peak oil. According to climate scientists, climate change caused by human activities is one of the greatest challenges facing us in the coming centuries. The related prospect of peak oil will most likely increase the volatility of energy supplies and prices. These two problems motivate every nation to reconsider their energy and climate policies. While full-scale commercialization of alternative energy sources is well underway, increasing energy efficiency is also considered as a feasible policy option for many economies.

The Korean government has set a voluntary goal to reduce national greenhouse gas (GHG) emissions to 4 percent below 2005 levels by 2020. While there is no binding climate change treaty to replace the Kyoto protocol after 2012, the goal seems ambitious and encouraging. How can Korea achieve the goal? This study explores energy demand and carbon dioxide emission trends of Korea during 1975-2005 using structural decomposition analysis (SDA), which identifies and measures driving forces underneath structural changes within an input-output framework. The SDA results show that an increase in the consumption of non-energy goods and services has driven most of the energy demand increase in Korea. The second largest force, affecting the energy demand increase, was the increase of total direct energy consumption.

On the basis of the SDA results, this study forecasts energy demand and carbon dioxide emissions under business-as-usual assumptions until 2030. Using the BAU forecasts as a reference, the study sets up eight carbon dioxide reduction scenarios to analyze possible paths for achieving the GHG reduction goal and the potential impacts of the goal on the Korean economy. The path and impact analyses suggest that energy efficiency improvement and conservation are feasible ways to reduce fossil fuel use and carbon dioxide emissions. Also, they indicate that coal-reducing policies are particularly effective. But in keeping with the equimarginal principle reduction burden should be shared by all sectors to minimize the overall policy costs. Substitution mechanisms can generate economic stimuli by increasing non-energy energy demand through the backward linkage effect. For the transition to a low-carbon economy, it is necessary to balance conservation mechanisms and substitution mechanisms in climate policy.