# *INDUSTRIAL ENERGY DEMAND IN EUROPE: A DYNAMIC MULTILEVEL MODELLING APPROACH*

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## Overview

It is not an overstatement to say that energy is an indispensable development's ingredient, because its widespread role has become more important in modern economies. This is due to the economies increasing dependence on energy in ensuring sustainable growth and development. Similarly, improvement in energy efficiency is a need to cut energy dependency and meetings security of supply goals. As rapid development of a country requires more energy use and typically results in higher emission, therefore, adequate projections of future energy demand are necessary to understand and address issues related to energy security, resource planning, management growth of greenhouse gases, trans-boundary pollution and investment decisions. The issues of energy security and increased commitments towards sustainable environment have required governments to look for an everlasting solution to reduce energy consumption using reliable estimates to make appropriate predictions about future energy use It is in this context estimated energy parameters become important ingredients in formulating energy policies. Obviously, policies based on wrong estimates are more likely to result in wrong actions. Moreover, research interest in modelling industrial energy demand has increased in recent years and this is not a surprise as energy use in industrial sector accounts for about one third of total global consumption (Greening et al., 2007). However, majority of these studies have focused in estimating aggregate energy demand and subsequently derived their estimates from aggregate energy demand. Although, understanding the general global issues and policy directions requires aggregate analysis but as such analyses fail to capture the specific features and characteristics of a particular unit/sector of the economy and consequently lead to lost of detailed information in formulating specific energy policy such as energy conservation, fuel substitution and technology. In other words, an industry or sector level energy demand analysis provides detailed information in formulating specific energy policies. This paper examines industrial energy demand and attempts to answers these three research questions:

1) What are the main drivers of industrial energy use in Europe? And does energy demand long-run elasticities of the non-multilevel and multilevel models differ?
2) Does country's energy efficiency influence industrial energy use in Europe?
3) Does heterogeneity in industrial energy use more associated with between-industry or between-country differences?

## Methods

This study employs longitudinal dynamic non-multilevel and multilevel models of 34 industries at two- and three-digit level using International Standard of Industrial Classification (ISIC) Rev.2 for 29 European countries over the sample period 1995 – 2007. Data for this study are sourced from World Input-Output Database (WIOD), Penn World Table (PT7.1) and High Resolution Gridded Dataset by Climatic Research Unit and Tyndall.

## Results

First, our results show that income, energy price, capital price, material price, temperature and energy efficiency are the main drivers of industrial energy use in Europe. The long-run price elasticities of the non-multilevel and multilevel models ranged between -0.61 to -1.47, and -0.61 to -1.11 while their long-run income elasticities of the ranged between 0.55 and 1.35, and 0.50 and 0.81 respectively.

Second, there is a strong evidence of technical progress in Europe over the sample period and this in turn reduces industrial energy use.

Third, our results also suggest that larger percentage of the heterogeneity in industrial energy demand could be traced to between-industry differences that accounts for more than 85% of total variation in industrial energy demand.

## Conclusions

Of course, reliable estimates are needed to formulate policies and it is reasonable to conclude that policy based on wrong estimates will be misleading. The long-run estimates from this paper therefore would provide insight in formulating policies related to energy consumption and emission reduction. Our findings also suggest the importance of factor in the influence of other inputs in energy use reduction strategies, as they appeared to be substitutable and complementary to energy. In other words, reduction in energy use cannot only be achievable by increasing energy prices/taxes and carbon taxes but also by adopting strategy that will affect the prices of other inputs. Moreover, a continuing good track record of the improvement of technical progress in production would definitely help in reducing energy use and emissions.

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