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A model approach for analysing trends in energy supply and demand at country level: Case study of industrial development in China

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Abstract

Ideally, national energy supply and demand choices would be based on comprehensive models and predictions of the energy sources, energy transformations, energy carriers and energy end-uses expected to play major roles into the foreseeable future (20–40 years). However, in many cases, the necessary detailed, high quality, consistent and timely data is not available for such comprehensive models to be constructed, in particular in large and complex developing economies expected to be major energy users in the near future. In the developing countries that are the focus of UNIDO's work, attention has been concentrated on making progress simultaneously on two fronts: (a) a dramatic decrease in energy intensity, particularly in activities linked to industrial production and (b) a major increase in the contribution of local renewable energy to limit growth in fossil fuel use. National policies need to be oriented towards a strict and strategic monitoring of the respective energy matrices with a simultaneous focus on both fronts. Robust assessments of industrial development trends throughout the whole 20–40 year transition phase are needed to achieve both objectives. Until more comprehensive energy-related models can be built up, to overcome the limited availability of data at country level it is proposed that a simple energy supply and demand model analysis consisting of three phases be used for identifying the consistency of future scenarios and corresponding policy requirements. This model analysis, which is a dynamic exercise, consists, first, of an analysis at aggregate level of the current and future national energy matrices; secondly, an analysis of perspectives for decreasing the energy intensity of the most inefficient systems or industrial sectors; and thirdly, an analysis of perspectives for increasing the supply and cost-effectiveness of sustainable energy sources. As an illustration of this model approach, the case

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of China is analysed with emphasis on the industrial sector, followed by a discussion of some of the structural change policies indicated for China to reach its planned energy supply and demand objectives for 2020.
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Keywords: Energy-related models; Structural change policies; Industrial development

1. Introduction

There are a number of key challenges underway in the global, regional and national energy supply and demand situations. The need to make deep cuts in greenhouse gas (GHG) emissions is gathering force. An immediate impetus is the Kyoto Protocol, which sets binding targets for most developed countries for 2008–2012, and the discussions now underway as to the size and distribution of future GHG cuts from 2013. The Clean Development Mechanism (CDM) and European Emission Trading System (EU ETS) are making GHG reductions a growing cash flow component of renewable energy projects worldwide. New approved methodologies being developed for CDM will start to give industrial energy efficiency projects in developing countries a similar extra cash flow component, to help unlock this huge and highly cost effective, but complex, potential.

In many developing countries there is often a strong reliance on oil for industrial electricity generation and process steam supply, although the efficiency of captive generation plants can be as low as 16% (ADB, 2005). Hence the recent increase in oil prices has a disproportionate impact on their industrial sector profitability. Oil prices, however, are expected to remain volatile, partly from difficulties in maintaining output levels, and partly from the huge capital investments required to expand oil supply and refining (IEA, 2006a). The impact of higher gas prices is also affecting the manufacturing of major industrial petrochemical products such as urea fertilizer (ADB, 2006a). Coal is plentiful and widely distributed, but growing business-as-usual conventional coal use is clearly incompatible with global GHG reduction goals.

There are a number of mature renewable energy technologies now widely available, in particular hydro and wind. Bio-energy and photovoltaics are growing strongly and look likely to make a major energy supply contribution in coming decades. In the longer term, the hydrogen economy, based on renewable energy, shows promise (Gielen and Simbolotti, 2005), although mobile applications may prove challenging (Doty, 2004).

The next 20–40 years will have to be a global transition period to more sustainable energy supply and demand patterns. This demands pursuing two major courses: a considerable decrease in energy intensity, particularly in activities linked to industrial production and a major increase in the contribution of renewable energy to limit use of fossil fuels and corresponding emissions of GHG and local pollution. In line with these, national policies need to be oriented towards a strict and strategic monitoring of energy matrices, with a focus on radical improvement in the efficiency of energy systems, particularly in manufacturing, in key developing economies, combined with sustainable and cost-efficient use of national energy resources.

UNIDO's main concern is sustainable industrial development, with energy as one of the key inputs, for healthy industrial and, ultimately, economic development. For UNIDO, energy supply and use are perceived as part of overall industrial development, rather than as ends in themselves. Therefore, although fundamental, the assessment of the energy status of UNIDO Member States is considered only as one group of variables in a broader assessment of the perspectives for sustainable industrial development. However, when assessing the energy status in some of the countries assisted by UNIDO, it became clear that the energy data availability, quality and

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