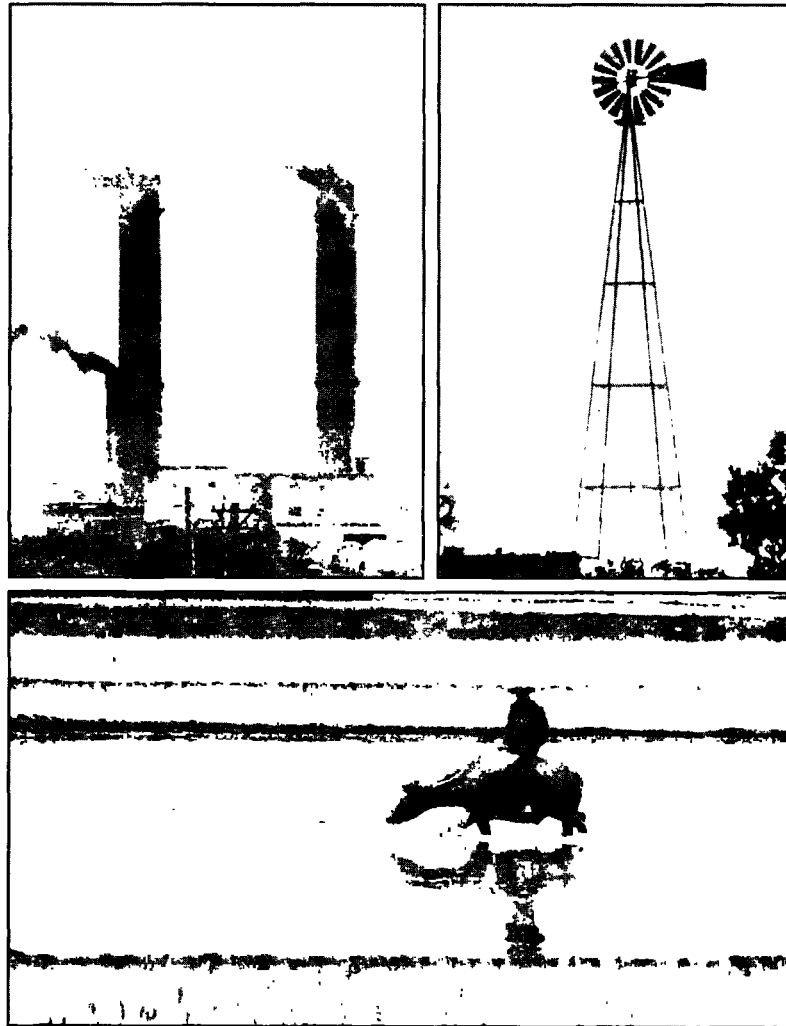


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CHINA

Issues and Options in Greenhouse Gas Control



RESIDENTIAL AND COMMERCIAL ENERGY EFFICIENCY OPPORTUNITIES: TAIYUAN CASE STUDY

SUBREPORT NUMBER 10

Report of a Joint Team of Chinese and International Experts

Edited by Robert M. Wirtshafter

September 1994

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- Energy Demand in China: Overview Report,* February 1995, forthcoming. Report 2.
- Energy Efficiency in China: Technical and Sectoral Analysis,* August 1994, Report 3.
- Energy Efficiency in China: Case Studies and Economic Analysis,* December 1994. Report 4.
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- Pre-Feasibility Study on High Efficiency Industrial Boilers,* August 1994, Report 11.

Foreword

This report is one of eleven subreports prepared as inputs to the United Nations Development Programme (UNDP) technical assistance study, "China: Issues and Options in Greenhouse Gas Emissions Control," supported by the Global Environment Facility and executed by the Industry and Energy Division, China and Mongolia Department of the World Bank. The overall coordinator for this project in China was the National Environmental Protection Agency, while the Shanxi Provincial Planning Commission (SPPC) was the lead agency for coordinating this subreport.

This report is the product of a joint effort of the Shanxi Provincial Planning Commission and the World Bank. The international team, headed by Robert M. Wirtshafter, with the assistance of researchers at the University of Pennsylvania, was responsible for drafting and editing the final report. Assisting in the design and translation of the survey instrument, and data analysis, were researchers from the Chinese Energy Research Institute, under the direction of Zhang Zhengmin. In Shanxi, a Study Expert Group was responsible for coordinating the fielding of the survey and for providing technical information and advice to the international team. The Study Expert Group included representatives from the Shanxi Environmental Protection Bureau, the Energy Economic Research Institute of the Shanxi Academy of Social Sciences, and the Taiyuan Municipal Environmental Protection Bureau.

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CURRENCY EQUIVALENTS
(as of 1993)

\$1.00 = 5.7 Chinese Yuan (Y)

ABBREVIATIONS AND ACRONYMS

CD	-	Central District
CFL	-	Compact Fluorescent Lamp
CO ₂	-	Carbon Dioxide
ERI	-	Energy Research Institute of China
GEF	-	Global Environment Facility
HVAC	-	Heating, Ventilation and Air Conditioning Equipment
kgCE	-	Kilogram Coal Equivalent
km	-	Kilometer
kWh	-	Kilowatt-Hour
LPG	-	Liquified Petroleum Gas
mW	-	Megawatt
NCD	-	Noncentral District
SPPC	-	Shanxi Provincial Planning Commission
tce	-	Ton Coal Equivalent
TCEP	-	Taiyuan City Environmental Protection Bureau
tph	-	Tons Per Hour
TVE	-	Township and Village Enterprise
TWh	-	Terawatt-Hour

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EXECUTIVE SUMMARY

A. THE IMPORTANCE OF THE STUDY

1. While much attention has been devoted to energy use in Chinese industries, energy use in the China's residential and commercial sectors will have a significant impact on the availability of energy resources and the environmental quality in China. As China's economy continues to expand, the urban residential and service sectors are expected to grow from 83 million tce in 1985 to 272 million tce in 2020, an increase of 225 percent. According to these projections, the urban residential portion will grow more slowly during this period, going from 75 to 190 mtce, a growth rate of 2.7 percent per year. These estimates may be low in that the expected growth in energy consumption per household is quite small. More than half of this growth is accounted for by the increase in urban population and not increases in demand per household. At the same time the service sector energy use is rapidly expanding, growing from less than 8 mtce in 1985 to more than 80 mtce in 2020, an increase of 7 percent per year.

2. Controlling the growth of energy in the residential sector, a goal of most Chinese energy plans, will be quite challenging given the increased access of households to energy supplies and the increasing household incomes. China is rapidly constructing new, larger, and more modern housing, and building new district heating and gas distribution systems. Households are purchasing numerous larger energy consuming appliances. This is evident by the growth in electricity that has already occurred. It is expected that this trend will continue. Electricity consumption will rise from 25 TWh in 1985 to 691 TWh in 2020 for the two sectors combined, an increase of almost 10 percent per year.

3. The increased use of energy in the residential and commercial sectors continues to have serious economic and environmental consequences for China. The increased demand in these sectors limits the availability of resources devoted to industrial development. The dependence on coal as a primary energy source has degraded environmental quality in many of China's urban areas. If growth expands as predicted, growth will exacerbate global environmental problems by greatly increasing the release of greenhouse gas emissions.

4. All indications point to the fact that China's residential and commercial sector energy growth will continue unabated. Even with the increases in household use to date, China's per household consumption levels are low, particularly considering the severity of China's climate. Though indoor temperatures have climbed considerably in China, due in part to the increased reliance on central heating, indoor temperatures are still well below those found in developed countries. As China's economy continues to expand, it can be expected that Chinese will purchase additional energy-consuming appliances, and convert

some of their new wealth into increases in household comfort and convenience thus triggering associated increases in fuel consumption.

5. Controlling China's residential and commercial energy growth will be difficult. The control of access to or rationing of energy supplies, policies that restricted use in the past, are less feasible in the open market economy that now exists in China. Other policy options such as taxing fuels or reforming pricing structures could help raise prices and soften demand, but these will slow and not eliminate growth.

6. A more direct approach would be to encourage reductions in demand by improving the efficiency with which energy is used. This study explores the feasibility of substituting a variety of new technologies or changes in operation of energy consuming equipment to determine how much potential exists in the residential and commercial sectors of China.

B. STUDY OBJECTIVES AND EXPLANATION OF CASE STUDY

7. The principal objective of this study is to quantify the potential reduction in coal consumption and therefore greenhouse gases emitted by improving the energy efficiency of China's urban residential and commercial energy use. To quantify this potential it is necessary to understand the levels of efficiency built into the existing building and appliance stock; measure the current use of energy within the two sectors; assess the energy savings potential of new alternatives; assess the potential changes in behavior and attitudes towards the various options available; and determine the impacts on energy use, financial cost-effectiveness, economic viability, pollution reduction, and other factors.

8. In this study, two other factors, the change in occupant convenience and comfort, are major study determinants. A high priority for Chinese families is to increase the quality of life. Warmer apartments in winter and the increased use of time-saving electric appliances are two key ways in which Chinese now strive for life style improvements.

9. China is a vast country with wide variations in climate, behavior, and energy use. Conditions in one or two locations are not representative of the entire country. Taiyuan City, the capital of Shanxi Province, was chosen as a case study for this report principally because local pollution resulting from the extensive use of coal is quite pronounced and harmful. Reduction in coal use would improve local air and water quality in addition to lessening greenhouse gas emissions. As the primary urban center amidst China's largest coal production region, Taiyuan households and businesses have access to inexpensive coal resources. Prices are lower and availability higher than most other places in China. These low prices reduce the cost-effectiveness of alternatives to coal. Accordingly, Taiyuan may represent the worst-case scenario for energy efficiency in China.