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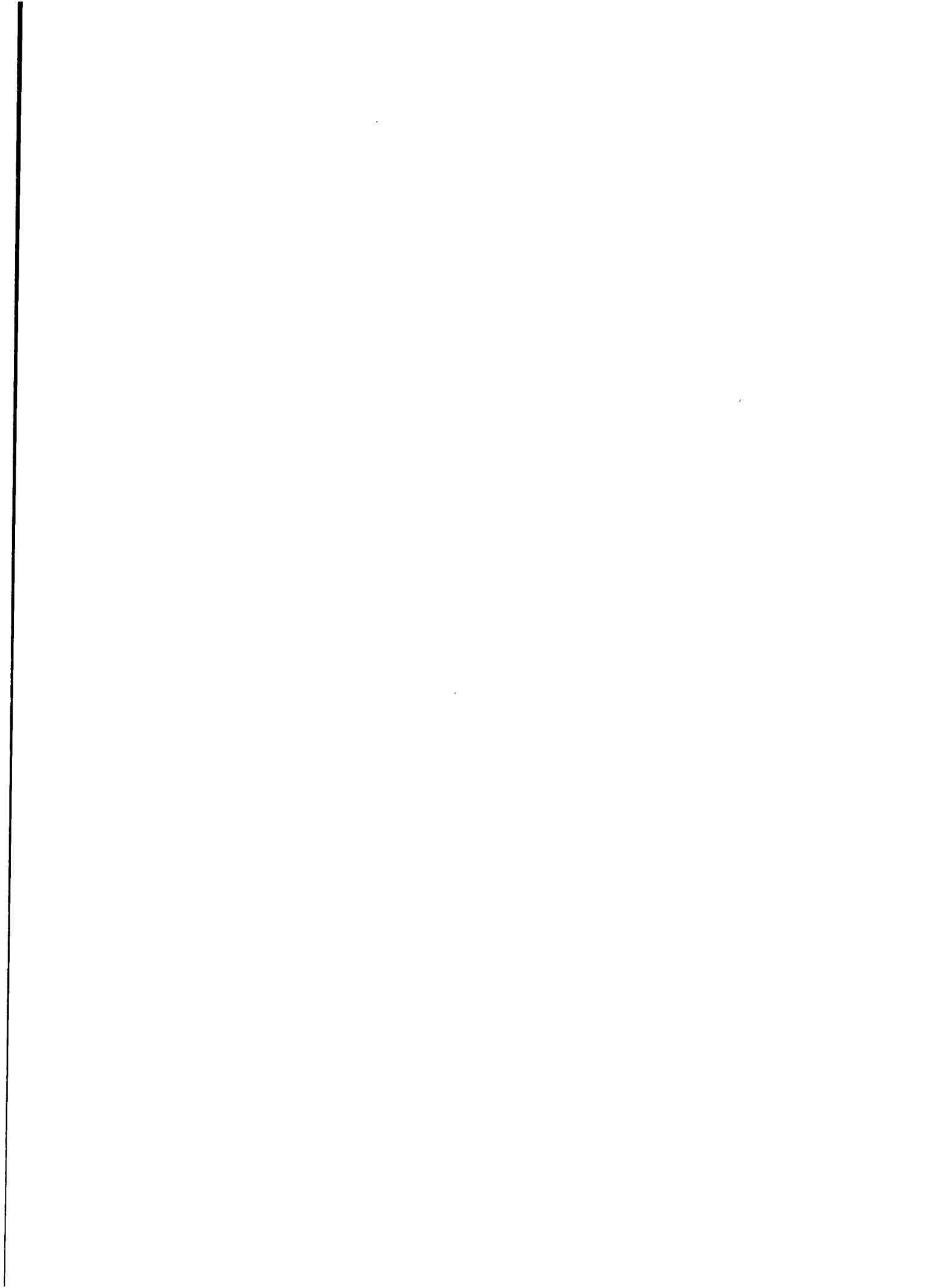
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Energy Structures past 2000

An introduction

By Barbara Praetorius* and Christian von Hirschhausen**

At the turn of the century, energy systems worldwide are facing major challenges. Energy demand is expected to continue rising. Meanwhile, the structure of energy supply is likely to change in many respects, i.e. markets, energy carriers, their geographical origins and technologies used on both the supply and demand side. While fossil resource depletion appears to be a myth at least in the medium term, increasing energy use is associated with significant environmental externalities on local, regional and global levels. At the same time, national energy markets are being deregulated and liberalized. Can technology and innovation reconcile these challenges? Which role will regulation play? And will environmental issues return to the forefront after the euphoria of the Rio Summit has vanished?

This special issue of the *Quarterly Journal of Economic Research* addresses major energy issues both from a theoretical and a policy-oriented perspective. Three broad topics can be distinguished: *resources; energy efficiency and the environment; and regulation*. A survey of structural changes in the industry is provided as an overview in the first paper by *Kübler*, who distinguishes three broad institutional settings: *yesterday*, which was characterized by monopolistic market structures and little concern for the environment, *today*, when we observe the opening of energy markets and a heavy weight put on environmental issues, and *tomorrow*, when energy companies are likely to face both full-fledged competition and environmental constraints. The traditional separation between sectors (such as power generation, oil&gas, coal) will disappear.

With respect to resource availability and options, the future of three of the four traditional fuels are discussed: oil, gas, and nuclear power. *Horn* analyzes whether oil, the dominant fuel of the last century, might run out towards the middle of this century. He states that the growth of oil consumption will accelerate in the decades to come. Developing an argument about resource depletion based on geological theories, *Horn* points at a likely decrease of oil reserves after a peak in two to three decades. Oil prices are then likely to rise further due to increasing dependence on OPEC production. In case that *natural gas* continue its rise to become a dominant fuel, as many

argue today, issues of supply security and market deregulation will have to be addressed likewise. *Heinrich* provides a survey of the European natural gas markets and their likely developments over the next two decades. Western European demand for gas is expected to increase significantly, spurred by liberalization, whereas non-traditional suppliers are unlikely to see their market share grow. The paper then features the perspectives of Russia's Gazprom as the key supplier in the years to come.

Ziesing discusses the perspectives of nuclear energy, both from an economic and a political point of view. The current debate on a forced end of nuclear electricity generation in Germany ("Ausstieg") is indeed representative for worldwide considerations on the sustainability of this controversial resource. *Ziesing* argues that due to high capital costs and advancements in competing technologies such as gas-fueled combined heat and power plants and co-generation, the nuclear option is expected to be phased out for simple economic reasons. On a global scale, the share of nuclear energy in power generation is forecast to fall from about one fifth to one tenth by 2020. *Ziesing* finally stresses the consequences of substituting nuclear by fossil-fueled power plants in terms of greenhouse gas (GHG) emissions.

The next paper of this special issue addresses the heavily debated topic of regulation and market structures in the European power market. *Kreuzberg* and *Riechmann* show that high concentration among generators and technical restraints on cross border trade can preclude competitive market outcomes, of which the currently high wholesale prices in Britain and Spain are an example. They also argue that the current price level, which is based on short-run system marginal costs in the Western European wholesale market are not sustainable. The argument is supported by results from a large-scale electricity market simulation model.

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The following articles are concerned with environmental constraints to energy consumption and the options for a more efficient use of energy resources. *Jochem* considers the startling fact that compared to the physical laws and potentials, the *efficiency* of today's energy systems in industrialized countries is lower than 15%. His analysis shows that from an economic perspective, an increase in efficiency of about 25% appears to be profitable. Jochem inquires into the barriers to energy efficiency and points out options for energy policy to foster efficiency improvements in the future. Energy savings are worthwhile not only from an economic, but also from an ecological perspective. *Matthes* argues that the ultimate constraint to the use of fossil energy resources is not in supply-side resource depletion but rather in the limited capacity of the earth's atmosphere to absorb energy-related CO₂ emissions. Matthes points out that emission trends in most regions move upwards rather than downwards and concludes that emissions reductions are far too small to achieve the mitigation targets stated in the Kyoto Protocol.

Schumacher and *Sathaye* analyze carbon emission trends for developing countries and economies in transition, postulating that these countries' share in global GHG emissions is likely to rise rapidly. Fourteen countries in four regions of the world (Africa, Asia, Latin America, Eastern Europe) are analyzed in-depth as to the contribution of four factors of carbon emissions: population, economic growth, energy intensity and carbon intensity. While economic growth seems to be the major driver, no general trends can be identified, thus pointing to the need for country-specific strategies.

The targets of reducing GHG emissions specified in the Kyoto Protocol require cooperation between developing and industrialized countries. *Millock* argues that transparent and verifiable monitoring and enforcement procedures are a pre-requisite for the success of the flexible mechanisms incorporated in the Kyoto Protocol. She proposes a policy with built-in incentives for monitoring and investigations in the costs of energy use, in which part of the burden of proof of verifying actual emissions would be transferred to the pollution sources. The policy involves an up-front payment that is undifferentiated according to the pollution source, in combination with a subsidy related to the installation of emissions monitoring that is verifiable to an outside party. However, the implementation of joint activities to mitigate GHG emissions has been held up by the problem of measuring a baseline and the actual emissions reductions.

Energy structures past 2000: By the time you hold this issue in your hands, the new millennium will have begun, and energy policy issues will be at least as urgent as they were in the last few decades. We hope that this issue will contribute to the ongoing debate through its multidisciplinary approach and the wide variety of authors and opinions contained herein.

A final word of acknowledgment: this issue of the *Quarterly Journal of Economic Research* also marks the end of Mrs. Edeltraud Martin's work as Managing Editorial Assistant, a demanding job she has carried out for a number of years in an extremely reliable and most unpretentious manner. The Board of Editors would like to thank Mrs. Martin for her excellent work.