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## Chapter 1

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Since the normalization of relations between the United States and China in 1979, exports of U.S. energy-related equipment, services, and technology have increased dramatically. U.S. policies reflect the expectation that deepening ties can serve U.S. security interests in the region, while at the same time providing market opportunities for U.S. firms and opening doors to mutually enriching cultural and educational exchange.

Some observers, however, worry that the floodgates have been opened too quickly, permitting transfers that the United States or China may come to regret. As Confucius once said: "TO go beyond is as wrong as to fall short." Others, however, see delays in U.S. export administration and other policy-related problems as obstacles to U.S. firms competing in the China market and as evidence that we lack a clearly defined strategy for promoting Chinese energy development. This memorandum addresses the central question of whether (and how) the flow of U.S. energy technology to China can help to serve U.S. foreign policy and commercial interests.

The transfer of technologies that China needs to develop its energy resources requires much more than the sale of equipment. Technology transfer is a process, involving at least two parties, whereby the Chinese firm or organization attains an improved capability to design or produce goods and services.<sup>1</sup> It involves people in a fairly intimate and extended dialog. In this process a number of commercial transactions occur, often simultaneously. These include payments for licenses and patents, provision of sophisticated equipment in which technology is embedded, training, and information exchanges between technical professionals in the China and abroad.

If the Chinese are to effectively select and use energy technologies developed abroad, their engi-

neers and technicians will need specialized know-how to run these energy industries. They will also need to adapt the technology to China's environmental and industrial milieu. Much of the needed knowledge is not in cutting edge high technologies.<sup>2</sup> Instead, it is often more mundane, such as the knowledge needed to make appropriate selections among the more than 30 kinds of pipe connections used in the petroleum industry.

China's need for foreign energy technologies (including management skills) is illustrated by the fact that, in spite of abundant energy resources, the country is experiencing electricity shortages so severe that at times 20 to 30 percent of its industrial capacity remains idle.<sup>3</sup> As the discussion below documents in some detail, although the country has an extensive resource base, its future economic development will be directly and strongly affected by its success in meeting energy production goals. Imports of foreign technology could provide the avenue to accomplish what would take many more years if China had to go it alone. U.S. firms have been world leaders in developing most of the technologies that China needs, though other countries can also supply them.<sup>4</sup>

There is a clear complementarity between U.S. technological capabilities and China's requirements for developing its energy resources, but difficulties have nonetheless arisen in attempting to match these needs and capabilities. In the past, for example during the Cultural Revolution, China sought to limit its purchases to foreign hardware, underestimating the need for ongoing involvement with foreign suppliers. More recently, foreign firms were disappointed by the

<sup>1</sup>See U.S. Congress, Office of Technology Assessment, *Technology Transfer to the Middle East* (Washington, DC: U.S. Government Printing Office, September 1984), OTA-ISC-173, Chapter 2 Analyzing Technology Trade and Transfer. See also Kim Woodard, Background Paper 1, "Technology Transfer and China's Energy Industries," prepared for the Office of Technology Assessment, Apr. 18, 1985, for a detailed outline of the mechanisms for technology transfer to China, including training programs, joint management and production.

<sup>2</sup>China is probably the largest buyer of used American mining equipment. See Thomas N. Thompson, "Selling Used Mining Equipment," *The China Business Review*, May-June 1985, pp. 16-17.

<sup>3</sup>See, for example, David Denny, "Electric Power and the Chinese Economy," *China Business Review*, July-August 1985. See also, Lu Qi, "Energy Conservation and Its Prospects," *Beijing Review*, No. 46, November 1984, for an estimate of 20 percent underutilization.

<sup>4</sup>Secretary of Commerce Malcolm Baldrige has indicated that the Chinese would prefer U.S. technologies over those of the Soviet Union or Japan. See "Chinese Technology Most Touted," *Journal of Commerce*, May 31, 1985, p. 1.

scaling back of Chinese plans in the early 1980s and were also surprised by China's hard bargaining tactics.

The expectations and interests of the U.S. and Chinese enterprises directly involved in the transfers, as well the governments and other affected parties, sometimes diverge. For the U.S. firm with technology to sell and for the Chinese firm that needs the technology, the commercial rationale for technology transfers may be clear, at least in the short run. But from a U.S. Government perspective, questions of national security are raised, particularly when the transfers involve technologies with potential military applications. The potential long-term effects—commercial as well as strategic—must be carefully assessed in developing U.S. export control as well as promotional policies.

The pending agreement for cooperation in nuclear energy between the United States and China embodies many of these policy dilemmas. The risks as well as the opportunities associated with possible nuclear technology transfers have potential implications not only for the United States and China, but also for global trends in the proliferation of nuclear weapons. Congress has an important role to play in reviewing the proposed accord, and in helping to shape the policy context for conventional energy technology transfers to China.

Two congressional committees requested that OTA provide an interim report on energy technology transfers to China. The Senate Banking Committee, one of the requesters, plays a leading role in export policymaking and Members of

the Committee are particularly interested in the proposed agreement for nuclear cooperation between the United States and China. The House Energy and Commerce Committee and its Special Subcommittee on U.S. Trade with China have asked OTA to examine how the U.S. Government might facilitate energy technology transfers while at the same time ensuring that national security interests are upheld.

Because of the keen interest in the area of energy technology transfers to China on the part of the requesting committees, OTA turned to these issues in the first stage of a major research project on "Technology Transfer to China" that will deal with a number of technologies. This memorandum is not meant to be definitive. Instead it raises a number of broader issues concerning U.S.-China relations that will be analyzed in more depth in the full report. The major OTA study was initiated in the spring of 1985 and is scheduled for completion in December 1986.

This memorandum is based on the research of OTA staff and the proceedings of a 2-day workshop held in April 1985 that included experts from academia, industry, and research institutes. The participants are listed in the front of this memorandum. The report is designed to present the policy issues that Congress will confront as it looks at the long-term risks and opportunities associated with transferring energy technologies to China. Five working papers that were commissioned for the workshop and other documents that provide additional information on the subject are included in a separate volume, available upon request to OTA.