Chapter 2

Technology Transfer and U.S.-China Relations

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The normalization of diplomatic relations between the United States and China that occurred in 1979 set the stage for rapidly expanding technology transfer and trade. The two countries have signed **25** protocols for cooperation in science and technology. More than **12,000** students from the People's Republic are now studying in the United States. The United States is China's third largest trading partner, after Japan and Hong Kong.

Energy has been a major focus of economic interaction between China and the United States. In the first quarter of 1985 U.S. firms sold *$64.8* million in mining and well drilling equipment to China. Occidental Petroleum recently signed an agreement to develop an open-pit coal mine in China that will be one of the world's largest. An agreement for cooperation in nuclear power, a priority energy development sector for China, was initialed in 1984 and recently signed on July 23, 1985.[2] This chapter examines the role of technology transfer in the bilateral relationship, and highlights opportunities and risks from the U.S. perspective.

[1] See *China Business and Trade*, vol. VI, Issue 21, May 9, 1985, p. 1.

[2] The text of the agreement (included in the appendix) was first made public in July 1985. Congress is currently reviewing the document. The agreement may become effective in the fall of 1985, unless Congress adopts a joint resolution of disapproval (See chapter 5.)

THE FOREIGN POLICY CONTEXT FOR TECHNOLOGY TRANSFER

The United States and China are important countries whose expanding relationship is potentially significant in global geopolitics. Officials in three U.S. Administrations have concluded that the United States and China share parallel interests in many areas. It is also true that their goals and approaches naturally diverge in some cases. While Taiwan, arms transfers, and textiles remain areas of disagreement, Washington and Beijing may be able to pursue complementary policies in Korea, Indochina, and other parts of Asia.

U.S. policies toward China are based on the expectation that closer relations can contribute to economic progress in China and peace and stability in Asia. ' Although rapprochement in the early 1970s was stimulated primarily by the threat of Soviet expansion in Asia, other, more positive, themes of U.S. China policy emerged during the Carter and Reagan Administrations. In addition to counterbalancing the Soviet Union, major goals of U.S. policies include assisting China in its modernization efforts, opening trade opportunities to U.S. firms, and establishing rapport with the next generation of Chinese leaders.

On the surface, these goals complement China's own concerns about Soviet hegemonism in Asia and the PRC's economic modernization aims. In order to modernize its economy, China has instituted sweeping domestic economic reforms to improve economic decisionmaking that also increase local and even individual enterprise, China has also opened the door to foreign participation by setting up special economic zones, enacting a patent law and approving joint ventures, more than *700* in *1984* alone.[4]

But there are also points at which Chinese and U.S. interests seem to diverge, as one would expect for two countries with different economic and political systems. China's policies toward both the United States and the Soviet Union have gone through twists and turns. Taiwan remains a problem in relations with the United States, ' and some

[3] See Atlantic Council, *China Policy for the Next Decade* (Washington, DC: 1983), p. 20.

[4] See ' China Approved 700 New Joint Ventures in 1984, " *China Trade News*, May 1985, p 3.

[5] See Robert Sutter, "The United States, ' *Chinese Defense Policy*, Segal and Tow (eds.) (Chicago: University of Illinois Press, 1984), ch. 13.

Association of Southeast Asian Nations (ASEAN) countries friendly to the United States view China's modernization with apprehension. The very success of China's modernization poses new challenges to the U.S.-PRC relationship. Conflict over trade in textiles is a notable example. While Chinese leaders stress their enduring commitment to independence as the cardinal principle in their foreign policy, they have also expressed their view that technical cooperation with the United States has not yet reached the desired level.' All the while, China insists that it cannot be "bullied" by foreign countries that hope to force political concessions in exchange for advanced technology.[7] Despite its growing involvement with foreign countries and firms, China continues to value self-reliance.

During the past 6 years, expectations for a widening relationship have run high in the United States. In spite of considerable achievements, translating the general objectives of U.S.-China policy into concrete measures has, at times, proved difficult. U.S. export controls illustrate these difficulties. The United States loosened its controls on exports of dual-use technologies (with military and civilian applications) in 1983 by moving China to category V on the Commodity Control List (CCL).[8] As a result, the process of license review was to be expedited. But, as discussed in more detail in chapter 5, disagreements continue both within the U.S. Government and among Cocom[9] countries about the guidelines for such exports. U, S. exporters and the Chinese as well have complained about delays and uncertainties in U.S. license reviews. U.S. energy technology transfers to China have, nevertheless, grown from an estimated level of $20 to $30 million in 1973-*80* to $100 to $125 million in 1980-85.[10]

In the wake of a dramatic transformation in U.S.-China relations during the past few years, the time may be ripe for a more careful definition of areas of mutual and competing interest in relations with China. U.S.-PRC cooperation in energy development is one area where such a reassessment may be particularly timely, Energy problems are a major constraint on China's modernization program, and the energy sector therefore is of strategic importance. The United States has considerable expertise to assist China in developing its energy resources and may make significant gains as a result, In addition to opportunities for benefits, however, there are also risks. Both the long-term opportunities and risks associated with energy technology transfers thus must be evaluated.

[6]Chen Muhua, State Counselor and Minister of Foreign Relations and Trade, made this statement in "Prospects for Sine-U. S. Economic Relations, " *Beijing* Review, No. 17, Apr. 23, 1984.

[7]See Zheng Weizhi, "Independence is the Basic Canon –An Analysis of the Principles of China's Foreign Policy, " *Beijing Review*, No. 1, 1985.

[8]In 1980 the United States authorized sales to China on a case-by-case basis of items and technolog, on the U.S. munitions list.

[9]Cocom (the Coordinating Committee) is the informal multilateral organization through which the United States, Japan, and West European countries control exports of technology and strategic goods to the Communist world.

[10]These estimates are found in Woodard, op. cit., p. 22.

LONG-TERM OPPORTUNITIES AND RISKS

Assessments of risks and opportunities associated with energy technology transfers hinge on perspectives concerning trends in Chinese economic development and prospects for U.S.-China relations. During the past *30 years* there have been dramatic changes in both areas. Whether Chinese reform policies succeed, China's ability to absorb U.S. technology, and the capabilities of China's own R&D system are some of the questions that influence assessments of opportunities and risks. Such assessments are also contingent on whether China is viewed by the United States as a potential ally, a friendly nonallied nation, an unpredictable neutral country, or a potential enemy.

Opportunities

U.S. policies are today predicated on the notion that the United States has much to gain from transferring energy and other technologies to

China. Expanded cooperation in the energy sector has been seen as a key avenue for the United States to participate in, and even help shape, China's economic modernization. At the same time, the United States restricts exports of technologies that have significant military applications, such as certain nuclear technologies and very powerful computers.

1. Contribution to Friendly Bilateral Relations

Cooperation in the energy sector is a symbolic as well as a practical demonstration of U.S. expertise and commitment. Because energy development is intimately connected with economic and social change throughout China, it is an area where U.S. influence may be particularly important. Energy, in other words, holds a key to Chinese economic development, and U.S. technology can contribute to the modernization process. The Chinese, furthermore, clearly want U.S. technologies.

Opting out of Chinese energy development would at best disappoint the Chinese and at worst cause serious problems in U.S.-China relations. Other Asian countries could also be affected by such developments. Japan, for example, expanded its relationship with China after U. S .-China relations began to improve. A stable, working U. S.-China relationship is an important element in Japan's own strategic policies. " In light of these and other factors, forgoing participation in China's energy development hardly seems a viable alternative for the United States.

2. Trade Opportunities

The China market may not be the bonanza once hoped for, but it is now a significant one, and holds the potential for expanded imports of energy equipment, services, and technologies in the years ahead. In a period of rising U.S. trade deficits, China offers opportunities for expanded exports. " Unlike many developing countries, China has a foreign exchange surplus, and although the surplus is diminishing, China is still able to pay for its imports.

In fact, China is making significant strides in developing its energy resources and will undoubtedly continue to do so with or without U.S. help. In most cases Japan and West European countries can supply similar energy exploration and production equipment, services, and technology if U.S. firms do not. U.S. technology is apparently highly regarded by the Chinese, but U.S. firms compete for contracts with other suppliers such as Japanese firms that have considerable experience in the China market and official financing support. In some cases, such as hydropower projects, the availability of supplier government financing can be a key factor in selection of foreign participation.

3. Potential Geopolitical Gains

There are also geopolitical benefits from closer U.S.-PRC cooperation in energy. In an earlier period, China cooperated with the nations of the Soviet bloc in energy, and conceivably could do so again if its technological needs cannot be met by the West. For instance, China and the U.S.S.R. have discussed the sale of nuclear powerplants to China. While such sales need not compromise U.S. interests, it may be more in the U.S. interest to reinforce the trends of the last decade toward fuller Chinese involvement in the Western energy system.

4. **Asian Energy Supplies**

If China is successful in developing its energy resources, it can also make a contribution to regional energy supply stability. The availability of Chinese energy resources to other nations in the region could provide greater assurance of supplies for energy-poor countries in the Pacific, and would offer an opportunity for these countries to diversify their supplies. China's ability to meet more of its requirements with domestic resources would also lessen its competition with the energy-poor nations for regional energy resources.

5. Technical Exchange

Finally, as a people-to-people process, technology transfer provides avenues for mutually en-

[11] See Denis Simon, Background Paper V, "Energy Technology Transfer to China: The Downside Risks, " prepared for the Office of Technology Assessment, May 17, 1985, p, 28.

[12] In 1984 [l, S.-China trade was in balance, with exports from the United States of $3.4 billion and imports to the United States of $3.3 billion (official Department of Commerce statistics, July 1985).

riching cross-cultural exchanges. As Chinese technicians visit U.S. laboratories, assembly lines, and libraries and as U.S. professionals travel to China, they have the opportunity to form long-lasting relationships that forge ties between representatives of this core industry in the two countries. U.S. firms and organizations involved in Chinese energy development have the opportunist y to help China shape its economic future, and possibly further improve their technology and perfect their expertise in international technology transfers.

Risks

The United States stands to gain much in energy technology transfers to China if these potential opportunities are realized, but there are also certain risks or uncertainties that pertain to national security as well commerce that must be considered.

1. Diversions to Military Applications

The ultimate risk is that a future China that may be hostile to the United States would benefit militarily as well as economically from certain energy-related technologies transferred by the United States today. Concerns for Chinese military benefits are associated with the transfer of "dual-use" technologies (some of the seismic, calibration, and computer technologies used in energy development) and aspects of nuclear technology (discussed separatel$_y$ in a later section).

China's current leadership appears committed to domestic economic reform and to opening itself to foreign investment. China has stated that it values cooperation with the United States as part of this process. It is, however, difficult if not impossible to predict policy shifts that might occur a decade in the future. U.S. policymakers must therefore take into account the possibility that dramatic shifts could occur, since under such circumstances we could regret the dual-use transfers we make today.

We know enough about the organization of Chinese R&D, and China's considerable science and technology capabilities, not to be careless about dual-use transfers. Some Chinese scientists and engineers who have studied in the United States will return to serve in China's military or their know-how will benefit military development indirectly, Over the long run, it is impossible to "compartmentalize" technologies in terms of their impacts on an economy.

In the near term, however, there are a number of factors that limit the military risks associated with civilian energy technology transfers to China. Many energy technology transfers do not include sensitive dual-use items, and therefore do not directly pose problems for U.S. national security. China's ability to apply such technologies is also limited by the slow pace of Chinese military modernization. In the intermediate term, however, China will be able to absorb increasingly sophisticated dual-use technologies. Therefore, if economic modernization proceeds apace, over the longer term China's growing technological expertise can be expected to make significant contributions to its military.

In theory, the U.S. export control system provides a mechanism for constraining the transfer of sensitive technologies, The United States can and does attach conditions on the transfer of dual-use equipment (leasing, operation by U.S. citizens) that limit the diffusion of sensitive technologies to the military sector. Such controls are costly, not welcomed by the Chinese, and certainly do not completely rule out the possibility of diversions, China can also obtain (and reportedly has in some instances) U.S.-manufactured dual-use technologies in Hong Kong and third countries.

Another possibility is that dual-use technologies transferred to China might fall into the hands of unfriendly countries. But China today has little incentive to transfer sensitive technologies to countries such as Vietnam or the U.S.S.R. because doing so would create security problems on its own borders. In addition, U.S. firms set limits on retransfers through written contracts (which the Chinese seem to honor) and through their option to forgo further transfers if violations occur. In the case of nuclear technology, there are special problems (discussed below) surrounding retransfers to third countries related to the potential spread of nuclear weapons.

2. **Geopolitical Risks**

If China succeeds in modernizing its economy through the application of imported technology and other means, it will be in a position to play an increasingly important role in Asian politics and markets. Some observers in ASEAN countries, as well as Taiwan and other Asian countries, view this prospect with concern. A vibrant China could exert considerable influence through nonmilitary means on its neighbors. In light of traditional animosities and current military conflict between China and some countries such as Vietnam, there is a legitimate concern that China's emergence as a regional and even global power could create new and aggravate old conflicts in Asia.

There is also a potential for regional conflict in Asia as China develops its energy resources. Territorial disputes have impinged on offshore oil and gas development. There have been reports that the U.S. firms ARCO and Pennzoil exploring for oil in the South China Sea have been harrassed by Vietnamese gunboats.[13] While conflicting territorial claims may not be sufficient to *provoke* military conflict, political and military disputes between China and Vietnam, for example, may be played out in a struggle over potentially energy-rich territories.[14]

Particularly relevant from the U.S. perspective is the fact that private companies participating in joint ventures in China incur investment risks. These firms could suffer financially if China were to scale back its development plans (as it did a few years ago). U.S. firms involved in China's offshore oil and gas development have made large preliminary investments, indicating considerable financial risks, but such investment risks are primarily the concern of the firms. The U.S. Government, however, insures some U.S. firms investing in China against political risks through the Overseas Private Investment Corporation. The U.S. Government also provides information to U.S. investors concerning domestic political and economic developments in China.

3. China Trade Competition and the Alliance

The United States has commercial interests at stake in energy technology transfers to China. China is both a significant market and potential competitor. Today, competition among suppliers for shares of the China market poses more immediate and significant U.S. policy issues than does China's growing role as an exporter of energy-related commodities, equipment, and services.

As firms from many countries compete for sales in China, supplier governments may be tempted to provide extraordinary support for domestic firms, through financing, aid programs, and representation of business in negotiations. This can also happen when Cocom members attempt to manipulate the process to the benefit of their own domestic firms. While there is room for legitimate disagreement in many instances about whether or not such government actions provide "unfair" advantages, the result is to raise the stakes of supplier competition.

From the U.S. perspective, these problems are reflected in debates about Export-Import Bank financing, U.S. approaches to Cocom, and U.S. export controls. At stake here, among other things, is the capability of U.S. firms to compete for sales in the China market.

4. **The Terms of Technology Transfer—Intellectual Property**

As U.S. firms transfer energy technology to China there is the potential risk that technology developed in the United States may be appropriated without adequate compensation to the originator. China's recent enactment of a patent law and recent promulgation of technology transfer regulations, however, are positive signs of its intent to honor technology transfer agreements. The law, however, does not cover software and certain chemical processes, and it is not yet clear how China will implement the new legislation.

5. **China as an Economic Competitor**

It does not appear likely that Chinese energy-related exports will seriously compete with those

[13] See House Committee on Energy and Commerce, Special Subcommittee on U.S. Trade with China, *China's Economic Development and U.S. Trade Interests*, report, May 1985, p. 16.

[14] See, in particular, Selig S. Harrison, *China, Oil and Asia: Conflict Ahead?* (New York: Columbia University Press, 1977), for a discussion of the potential for conflict over disputed offshore territories between China and neighbor countries such as Vietnam.

from the United States, There is no energy technology or equipment area in which China will be a significant exporter in the near term. China, however, is selling small-scale hydropower technology and may be exporting some energy equipment after 1995. In the next century China could emerge as an exporter of large reactors and coal conversion technologies, but this is only conjecture. More likely, China's ability to satisfy its energy demand through the use of U.S. technology will enhance the performance of its economy generally, and the export sector in particular. The possibility of China becoming a competitor in certain industries such as consumer electronics is no longer far-fetched.

China is already an actor in Asian energy trade, and may become a major energy exporter during the next decade. Chinese oil exports can help to offset the dependence on OPEC of some countries like Japan. At the same time, China will certainly compete with other countries in Asian energy markets. To cite one example, both China and the United States want to sell coal to Japan. Japan is helping China develop its coal resources and has long-term coal and oil supply agreements with China. While China has not met its targets for coal exports to date, its coal exports will jump if just one of the major coal development projects is completed. To cite another example, China is already exporting more than 500,000 barrels per day of oil and may increase exports significantly during the next decade .15 Indonesia's oil industry sees itself as competing with China in oil sales to Japan.

No importer of Chinese energy, Japan included, is likely to become dangerously "dependent. "[16] But there are regional dimensions to China's emergence as an energy exporter. Chinese energy development may not seriously jeopardize energy development in other Asian countries, but it will certainly compete for investment capital and other resources. A major area of uncertainty is China's future role in regional markets and institutions, '7 the nature of its integration into the Pacific Basin.

The logical outcome of technology transfers is that China will more efficiently produce energy, equipment, and services for both its internal market and for export. Some U.S. firms may find that sale of proprietary technology through licensing and patents is their only avenue for participating in the China's energy development. More commonly, the U.S. firms that transfer energy technology also sell equipment and technical services. Over the long run, U.S. firms that transfer energy technologies will need to further develop these and other technologies in order to remain competitive.

6. U.S. Policymaking Inadequacies

There are also potential risks stemming from the U.S. policymaking process itself. Each high-level U.S. Government mission is challenged to bring back tangible evidence of success in the form of new protocols and agreements. At the same time, disputes among various parts of the U.S. Government (and even within departments) reflect the absence of a clear U.S. strategy on export controls. The danger is that as U.S. policies concerning technology transfer are built on a case-by-case basis, we may lose sight of overall U.S. goals. Furthermore, there is evidence that U.S. policy *declarations* raise Chinese expectations which are then dashed at the policy implementation stage.

7. Technology Transfer Failures

Although there are risks associated with participating in China's energy development (including the possibility that the United States might be blamed for projects that fail), the risks to the United States could be even more significant if China fails to meet its energy development goals. An economically stagnant China could see domestic political instability and might play a hostile

"See FereidunFesharaki, et al., *Critical Energy Issues in Asia and the Pacific* (Boulder, CO: Westview Press, 1982), p. 36, for a forecast that China will be exporting 500,000 to 1.5 million barrels per day of petroleum by 1990.

[16]Japan imported 4.4 percent of its total coal imports and 5.2 percent of its crude oil and refined products from China in 1983. See Richard K. Nanto and Hong Nack Kim, "Sin(>Japanese Relations, " CRS Paper, November 1984. For a detailed projection of Chinese energy production, see Kim Woodard, "Development of China's Petroleum Industry, " prepared for East-West Center Workshop on China Energy, Apr. 25-26,1985. Woodard concludes that it will be difficult for China to sustain the current level of crude and product exports through the end of the decade, let alone increase exports by significant margins.

[17]The Asian Development Bank has not admitted China, but the issue is under debate,

role in the Asian region. Foreign technology may not be the key variable in China's energy equation, but foreign assistance could significantly help China to meet its goals.

The gains associated with energy technology transfers appear clear and compelling, as discussed above. In contrast, the risks are in some instances vague and uncertain, particularly over the long term. But while the gains outweigh the risks associated with transferring U.S. energy technology to China, there are significant risks to be managed. These include the risk that the dual-use technologies (including nuclear) that the United States transfers to China could be used in ways that pose security problems for the United States. Intense competition among supplier firms and governments to outdo one another in financing also involves risks to the U.S. Government. Uncertainties associated with China's entry into Asian energy trade also pose challenges to U.S. policies.

TECHNOLOGY AS A TOOL OF U.S. FOREIGN POLICY

Science and technology have already been used as tools of U.S.-China policy. Since the Carter Administration, science and technology have been highlighted in U.S.-China relations. There has, however, been no explicit or coherent strategy for the use of technology as a tool in U.S. policies toward China.

Identifying the instances where technology has been an important instrument for U.S. policies toward China could be a first step in improving policies. In the face of the opportunities and risks discussed above, the question now is how technology can be used more effectively as a tool of foreign policy.

The ability of the U.S. Government to extract political or other concessions from China by denying sales of U.S. energy technologies is quite limited, even where U.S. firms hold a technological lead (oil and gas exploration, for example). This is because Japan and West European countries are ready and eager alternative suppliers, and U.S. technological leads (where present) in energy technologies are not so great that other suppliers cannot compete.

Sequencing (gradual expansion of trade in technology as bilateral relations improve and experience deepens) is another approach that might be effective if pursued systematically. In some cases, sensitive dual-use technologies may make up only a minor portion of the dollar value of an energy development project, but these technologies can be absolutely critical to the project. Under the export administration system, decisions to loosen restrictions on export of the more sensitive energy technologies are made within the executive branch, and have oftentimes been controversial. Interagency reviews and low key dialog with Chinese end-users to check the strength of their commitments to abide by U.S. stipulations, if properly pursued, can ensure that risks associated with dual-use transfers have been taken into account and steps taken to minimize them. But, in practice, disagreements within and between various branches of the U.S. Government (and within Cocom) have precluded the systematic implementation of a technology sequencing strategy.

Most of the technologies that China seeks to develop its energy resources are not sensitive dual-use technologies. In these areas, technology transfers could serve U.S. interests by contributing to China's energy development and economic modernization. Private sector U.S. firms are the locus of this technology, and they have generally been willing to provide it independently of any U.S. Government programs. But some of the technology that China needs is not being provided because U.S. suppliers are not informed about these needs or because they do not see these as attractive business opportunities. Efforts by the U.S. Government to further encourage private sector participation in Chinese energy development would be viewed positively by the Chinese and probably contribute to friendly relations. Technical and management training programs supported by the U.S. Government, such as the one in Dalian, are another avenue for positive participation.

Among the primary explanations for the difficulty of using technology as a finely tuned instrument of U.S. foreign policy is the fact that the private sector rather than the U.S. Government is the holder of the technology. Export controls, the major mechanism for controlling the international flow of technology, have been used to limit certain kinds of U.S. trade with China. But technical exchange and technology transfer are less susceptible to such regulations. The Government's ability to manipulate technology transfer to serve foreign policy goals in particular cases is often quite limited. However, conditional access to technology has been used as an element of U.S. policies toward other developing countries when a strong consensus exists on a U.S. policy goal (such as nuclear nonproliferation) and when other suppliers have been willing to cooperate.

Our ability to use technology as an instrument of foreign policy is often dependent on how technology is "packaged" with other enabling resources. In the energy area, financing is a particularly important example of the latter. Energy development in China is a mammoth and extremely costly undertaking. Helping to finance the costs of this development may be necessary if the full benefits of technology in foreign policy are to be realized.

Over the long term, technology can be an important asset to U.S. China policies, but perhaps not a finely honed tool. Government-to-government science and technology cooperation agreements, for example, set the stage for technology transfers by private sector firms. But it is virtually impossible to isolate the effects of such government policies and programs on China's energy development. In this sense, the transfer of U.S. energy technologies to China generally supports (and derives from) increasingly friendly bilateral relations. While the U.S. Government is not directly involved in most of these transfers, its policies are nevertheless critical because they set the parameters for U.S. technology transfer.