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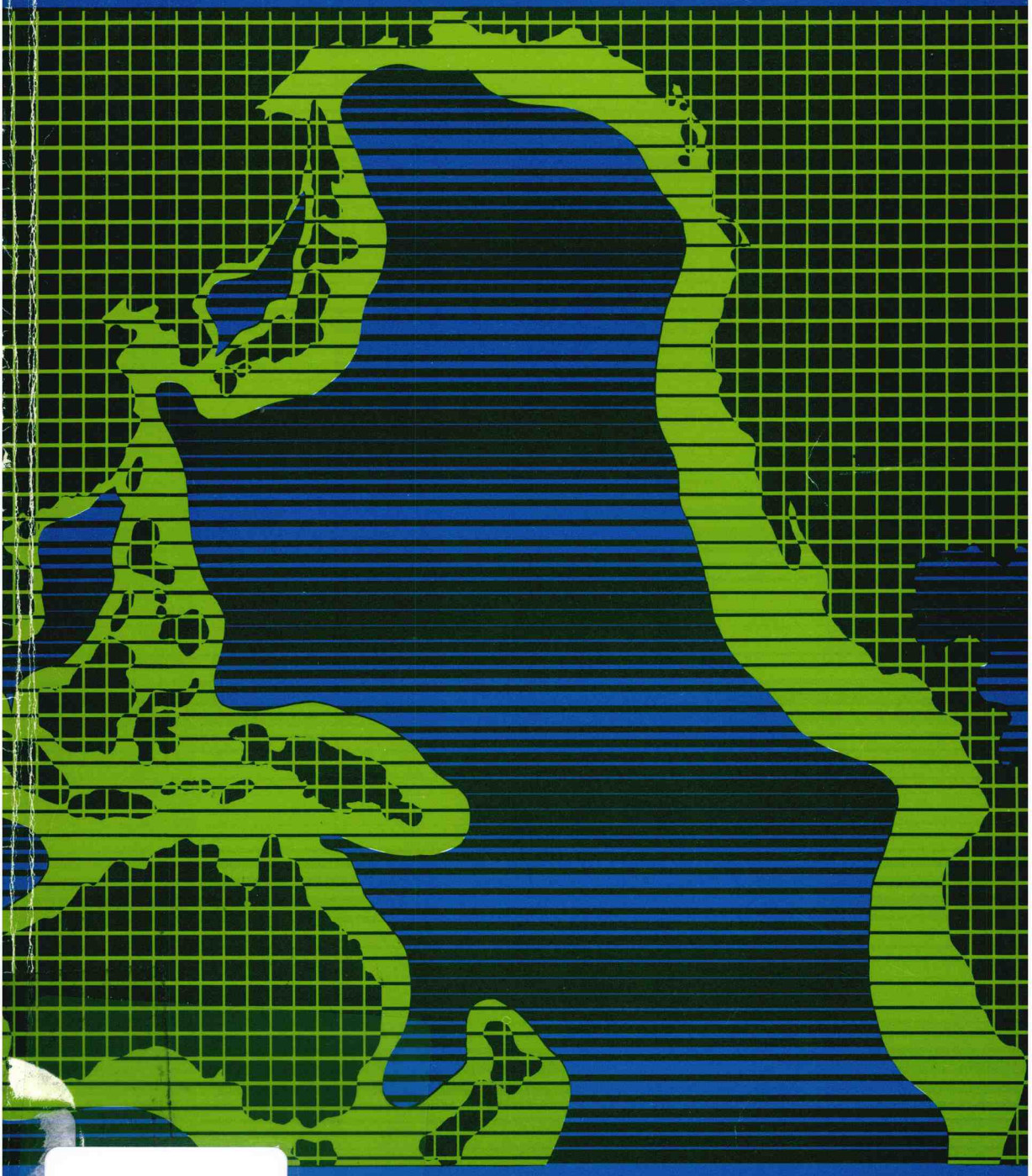
# Renewable Resources in the Pacific

Proceedings of the 12th Pacific Trade and Development Conference, held in Vancouver, Canada, 7–11 September 1981



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**Proceedings of the 12th Pacific Trade and Development Conference, held in Vancouver, Canada, 7–11 September 1981**

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# *Energy Constraints and the Open Economic Strategy in China's Modernization*

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The People's Republic of China is in the midst of transition — opening its doors to the outside world and reorienting its policies toward upgrading the standards of living of its people. The changes are extensive and have profound implications for all sectors, including energy. The major implications are that China will be expanding its exports substantially and increasing production and marketing of consumer goods, especially from light industries. It will be looking to the rest of the world for markets and for technical expertise. The country has a long history of using resources other than crude oil for energy. Sun, wind, biomass, and water power are used extensively throughout the country. Currently, however, energy is being consumed inefficiently. The available resources and some programs to use them effectively are presented in this paper.

La république populaire de Chine vit une période de transition qui se traduit par une ouverture sur le monde extérieur et la réorientation de ses politiques vers l'amélioration du niveau de vie de la population. Il s'agit d'une évolution profonde dont les répercussions s'étendent à tous les secteurs, notamment l'énergie. Les effets majeurs de ce changement impliquent une augmentation considérable des exportations ainsi que l'accroissement de la production et de la commercialisation des biens de consommation, surtout de l'industrie légère. La Chine a l'intention de prospecter les marchés internationaux et de solliciter les conseils d'experts étrangers. Depuis toujours, elle utilise de nombreuses sources d'énergie autres que le mazout; le soleil, le vent, la biomasse et l'eau sont exploités à l'échelle du pays. Cependant, l'utilisation de l'énergie n'est pas toujours fonctionnelle et le présent document propose divers programmes visant à corriger cette situation.

The Sixth Plenum in Beijing recently reviewed economic policy and progress in China since the establishment of the People's Republic. The findings are noteworthy. In presenting them, we will focus on recent problems of economic development, although we do not wish to give the impression that development in new China has been without its achievements. Since the People's Republic was established and throughout the past 30 years, agricultural production and farming methods, for example, have improved markedly. More than 400 000 industry and transportation enterprises have been established, and a relatively integrated system of industry and national economy has been founded. Between 1952 and 1979, the total value of industrial and agricultural production has increased 8 times, fixed assets of state enterprises have increased 21 times, national income has increased 4 times, and the standard of living has doubled, after allowance has been made for inflation. But for all this, China remains a poor country. In 1980, per-person GNP was about U.S. $270.

In the past, the country put forward good ideas for development planning, such as taking agriculture as the foundation and industry as the leading factor; mapping out the national economic plans in the sequence of agriculture, light industry, and heavy industry; giving energetic support to agriculture. However, it implemented many incorrect policies. First was the failure to persevere in modernizing the economy and the failure to bring about improvements in the people's material and cultural life. The scientific bases of economic plans, policies, and measures were ignored — a fact that resulted in waste and losses. The country not only failed to abandon the highly centralized system of management but also pursued unbalanced development, giving priority to heavy industry to the detriment of that of agriculture

and light industry. It also set high targets and sought excessively high rates of investment, well beyond its real capabilities. In addition, the constant transformation in the relations of production slowed progress and greatly damaged the economy. In the past decade or more, the investment rate (including fixed assets and circulating capital) exceeded 30% of national income, a rate much higher than that of many developed countries. Capital, squeezed from agriculture and light industry, was mainly invested in heavy industry. During 1950–80, heavy industry increased its production by 64 times and light industry by 20 times, whereas agricultural production only doubled. Improvements in people's living standards were substantial but were held back by the low level of production of consumer goods.

The first 8 years after the founding of new China witnessed rapid progress in both production and people's livelihoods — a fact that contributed to enthusiasm among the working people. However, the country's economic development suffered two major setbacks: the Great Leap Forward, which lasted 3 years beginning from 1958, and the Cultural Revolution, 1966–76. These two events — along with the high rate of investment in industry — made it impossible to improve people's incomes appreciably. Thus, their initiative in production suffered.

China could have reoriented its economic development after the downfall of the Gang of Four in 1976, but only recently has it fully assessed the damage done during the 10 calamitous years of the Cultural Revolution and the dangers inherent in investing such a high percentage of national revenue in one sector. A number of impractical, overambitious goals and slogans were put forward in 1978, when the savings rate was as high as 36.5% and the appropriation of funds for investment was 50% greater than in 1977. The scale of capital formation was further expanded, particularly as a result of the government's hasty entry into many contracts for imports of equipment from abroad.

Since the Third Plenum of the Central Committee in 1978, the country has been summarizing the experiences and lessons of its economic development since establishment and has identified several mistakes in its past approach; these include overestimating the capability of economic strength, ignoring the actual conditions, neglecting the people's livelihood, and being too anxious to get quick results. By recognizing these weaknesses, it has laid a good foundation for economic readjustment and modernization.

## The Readjustment

Based on the experiences and lessons of the past, the Chinese government, in 1979, put forward a policy of readjusting, restructuring, consolidating, and improving the national economy. This policy aims to build a Chinese model of socialist economic construction. It recognizes, first and foremost, that the aim of socialist production is to satisfy, to the greatest extent possible, the people's material and cultural needs and that production is not for production's sake. A major premise, therefore, was that the former practice of constantly redoubling the production of heavy industry while allowing stagnation in light industry and agriculture and failing to satisfy the basic needs of the people had to be reversed. In future, the government will focus on the relationship between economic investment and the people's livelihood. Peasants account for the greatest proportion of China's population; improvements in their livelihood are the key to stability. Past development efforts neglected improvements in the people's living standard and emphasized savings to the neglect of consumption. In future, investment must be balanced with better living conditions.

With such a guiding theory, the country is now working to readjust the ratio between the various branches of the national economy, slowing the growth of heavy industry, and laying more emphasis on developing light industry and agriculture. Significant progress has been made in this respect. Agricultural production has been developing rapidly over the last few years. Production teams have exercised more decision-making power, and purchase prices for farm products have been raised. Whereas, in the past, the growth of light industry had been slower than that for heavy industry, for the last 2 years it has outstripped the latter. In fact, for 1980, production increased by only 1.4% in heavy industry but by 18.4% in light industry. The people's purchasing power has greatly increased in the past 2 years, and a shortage of commodities has been mitigated by increases in production of consumer goods. The goal of improving the people's livelihood has meant a shift in economic development such that investment production develops in harmony with consumer production. Increases in peasants' incomes have allowed them to purchase not only basic commodities but also some goods earlier considered luxuries, such as watches, radios, and TVs. The increase in the demand for consumer goods has boosted production; both the heavy and the defence industries, after having met their own quotas, shift unused capacity to the

production of consumer goods such as cameras, electric fans, record players, radios, and furniture. Formerly, it was inconceivable to produce such goods in defence industries.

## Energy

The changes do not mean that China is not going to develop heavy industry. Some branches of heavy industry will continue to expand, while the production of others will be scaled down. The energy industries, for example, will receive continued investment, the energy supply in China being rather tight at present. Efforts will reflect large, capital-intensive investments in essential energy and smaller, more labour-intensive investments in noncommercial energy. The latter will include investment in renewable energy resources, which are of considerable importance to the maintenance of adequate energy supplies to the end of this century.

In the past few years, the country has concentrated on fulfilling annual quotas in energy production and has slackened efforts in oil and coal exploration. To set right the disproportionate ratio between extraction and reserve, it will not increase energy production for several years to come. Rich in energy resources, China is the third largest coal producer in the world with an annual output of 600 Mt and is the yearly source for 100 Mt crude oil, ranking ninth in the world.

Huge amounts of energy have been wasted in production. The annual energy consumption in China is roughly the same as in Japan, although the value of total output is only one-quarter that of Japan. There is great potential for increasing efficiency in the use of energy; the shift of emphasis from heavy to light industry will make considerable difference because a given amount of energy can support several times more output of light than of heavy industry.

But, even if China takes advantage of all economic opportunities for increasing output of large-scale commercial energy and for reducing consumption, the energy constraint on modernization will remain. For this reason, and also because energy can directly contribute to raising living standards in rural areas, much emphasis is being placed on the development of renewable, largely noncommercial energy.

Noncommercial energy is already important in China, contributing about 270 Mt of coal equivalent, or 0.3 t per person; these figures compare with commercial energy's contribution of about 567 Mt or 0.6 t per person. Virtually all of the noncommercial energy is from renewable sources, whereas about 10% of the total commercial electricity production is from renewable (hydropower) sources.

Massive utilization of energy sources like biomass, the sun, wind, and water has a long history in China. The people have long depended on cattle for cultivation, firewood for cooking, horses for travel, junks for sailing, water power for milling, wind power for pumping, solar radiation for fire, and hot springs for health treatment. China has abundant hydropower resources. A recent survey indicates that the hydropower potential is 680 000 MW, of which 133 000 MW have been tested. However, 70% of the hydropower resources are located in the sparsely populated southwest. Only 3% of the potential has been utilized. There is, thus, great opportunity to expand hydropower production in China; current plans are to build large hydropower bases in the form of staging stations on some river sections and to complement these by the development of small hydropower stations. At present, 18 large (more than 250 MW) hydropower stations contribute more than 40% of the total hydroelectric capacity. Nearly 90 000 small (less than 12 MW) hydropower stations already exist in China and contribute more than 30% of the total hydroelectric power.

The largest hydropower station in China is Liujiaxia, on the upper reaches of the Yellow River; it has a 1225 MW installed capacity as well as an annual electricity-generation capacity of 5.7 million MW. The Gezhouba hydropower station, being built on the Yangtze River, has an estimated installed capacity of 2700 MW.

Capital and management for large hydropower stations are provided by the central government and for medium ones by the provincial, regional, or central government. Minihydro requires less technology and investment so that small-scale stations are built and managed by the counties, communes, or production teams. The government provides an appropriate subsidy or loan for minihydro and practices a policy of "owned, managed, and profited by those who build them." More than 1500 of 2000 counties in China have built minihydro stations, covering some 40% of rural electricity consumption. Now, about 12 000 minihydropower stations are under construction with a design capacity of 3500 MW.

China's 18 000-km coastline provides tremendous potential for tidal power — an estimated 28 000 MW. However, only a few pilot power stations have been built along the coast of Guangdong, Zhejiang, Jiangsu, and Shandong provinces, with a total capacity of 6.3 MW. The Jiangxia tidal-power station recently built in

Zhejiang province has a designed capacity of 3 MW.

Biomass is also an important renewable energy resource in China; in fact, it constitutes the main source of energy consumed in China's rural areas. In 1978, the total energy consumed in the rural areas was 320 Mt of coal equivalent, of which 84.1% came from biomass resources and 15.9% came from commercial sources. Biomass is commonly burned directly, at a heating efficiency of only 10%. Direct burning causes a loss of organic fertilizers, reduction in soil fertility, destruction of the ecosystem, and pollution of the environment. In some regions, such as Guangdong and Jiangsu provinces, organic matter is fermented to produce biogas as part of the fuel for daily life. In 1975, 460 000 and by 1978 6.39 million small digesters for domestic use were built in various places. Some large digesters for power generation were also available by 1978. The National Leading Group for Biogas Development and National Office for Biogas were set up in 1979. The development of biogas had been incorporated in China's national economy program as an important part of the modernization of agriculture. The present annual output of biogas is about $7 \times 10^8$ $m^3$, a much more environmentally acceptable source of energy than direct burning of biomass. A 10-$m^3$ digester can generate enough gas to satisfy the energy needs for cooking and lighting for a family of five.

Biogas is merely one aspect of the important biomass branch of new and renewable sources of energy. In recent years, China has been cultivating high-energy plants and firewood forests in addition to vigorously developing the biogas program.

In a broad sense, biomass energy resources are one application of solar energy, a resource China has in abundance. With an annual insolation of more than 2000 hours, two-thirds of China has annual solar radiation greater than 140 kcal/$cm^2$.

There is a clear intention to put technologically and economically feasible solar devices into wide use. A great deal of scientific research in solar energy is being carried out. However, the energy technology is still generally in an experimental stage. Its application started in the middle 1970s: two national solar-energy application conferences were held in 1975 and 1979, at which a research and development program was worked out. Since then, solar-energy research has been undertaken in most provinces, and a couple of solar-energy demonstration plants have been established. A number of factories have been set up to produce solar collectors, solar cookers, and photovoltaic devices.

Solar cookers are widely used in rural areas that are rich in sunshine but poor in fuels. These cookers are locally manufactured with local materials. They can be afforded by most peasants. Already there are more than 2000 solar cookers in daily service, and their numbers will be further expanded.

Solar heaters are also becoming popular. In large cities, solar collectors are now being used for hot-water supply to public bathrooms, hotels, hospitals, and offices. There are about 100 000 1-$m^2$ solar collectors in service at present, and various solar dryers are being tested for food drying. Plastic solar greenhouses are being used in vegetable plantations, covering a total 6000 ha. These facilities are both technologically and economically practical and are steadily being expanded.

China has a long history of wind-energy utilization. In central and southern China, some civil transportation networks in the river still rely on sailboats, and about 600 000 t of cargo were transported by junks in 1979. Some small wind turbines have been developed in Inner Mongolia, Gansu, and Zhejiang, with their power varying from 100 W to 0.01 MW. The state of technical and economic development in China suggests that the first priority of government should be to produce simple technologies for energy generation that can be applied by virtually all households in the country. Wind energy is an ideal source for remote regions lacking conventional energy resources. Animal power is also extensively used in the country. Cattle, horses, mules, donkeys, and oxen have played an important role in moving carts, transporting goods, tilling farms, etc. The use of oxen on farms is still quite common in Chinese villages, especially in hilly areas and irrigated farms with varied topography. Most farm products are still transported by horse-drawn carts in the northern rural areas. China's geographical features and technical and economic conditions dictate that animal power will continue to be important for a rather long time, particularly since it would not be possible to meet rural transport needs through the supply of petroleum products. Fifty million draft animals are in use currently, and the number will grow in future in line with agricultural production.

The scale of investment over the past 20 years in China has been larger than capabilities. The level of investment that can safely be undertaken is the portion of a year's aggregate social product that remains after the deduction of depreciation, of public spending including that for administration and defence, and of consumption at a level that allows an appropriate rise in the people's

living standard. Based on this definition, the government, among other things, reduced investment by 40% (it had accounted for 40% of the total budgetary expenditure in the past); defence and administrative spending has also been cut.

The allocation of investment to different sectors of the national economy is set forth in the state plan, increases currently going to agriculture, light industry, communications, and energy as well as the service sectors. Investment in heavy industries other than energy has been reduced. Some increase in expenditures on consumer goods has been necessary in an effort to bring supply in line with demand and to avoid problems that recently have resulted from purchasing power exceeding the supply of consumer goods.

Another readjustment for China is the expansion of the role of the market. A number of concrete steps are being taken. The first is the abolition of the system by which the state purchased and sold all commodities, although some commodities — grain, cotton cloth, and others that are in short supply — will still be controlled by the state. The commercial departments may map out procurement plans according to market demand, and factories will arrange production to conform with the commercial procurement plan. Some commodities can be sold at stores set up by factories themselves. The capital goods rationing system is to be gradually changed, with some goods entering the market for exchange. Other common commodities can be exchanged freely. Remarkable results have already been achieved, some machinery and electric products entering the market in 1979 and easing some of the shortages.

The second step is the abandonment of the system of "sole dealing" where the state acts as sole agent. Under the new system, a producer wanting to sell products may now directly approach customers. The rural communes and the production teams can market their products in city fairs. Many commercial units of collective ownership and a certain number of small private shops in addition to the state-owned commercial departments are being developed. Competition among them is allowed, and the government encourages individuals, especially youths, or families, to set up small shops such as bicycle-repair shops, inns, restaurants, and tailor shops to open employment channels. The service and light industrial sectors have provided employment for 29 million youths in recent years.

The third step is the drafting of a long-term program for price adjustment, within which prices are more flexible. Except for those products allocated by the state plan, local authorities and enterprises will likely be given some flexibility to readjust prices of their commodities. The prices of many goods ought to vary, and seasonal, regional, and quality price differences fulfill a useful social role.

The successful expansion of the role of the market will require adjustments in the arrangements for tax and bank credit. In the meantime, the market administration will be maintained as a necessary control on speculation and prices. More attention will be attached to the development of labour-intensive, energy-economizing, and raw material-saving industries or products that can make use of available resources.

The new economic program emphasizes the control of population growth. Certain privileges will be awarded couples who have only one child — for example, monthly payments of 5 yuan. In the city, such inducements can be effective, but in rural areas traditional attitudes are still powerful. The old adage that "having children is like accumulating grain to ward off hunger" has to be overcome by policies that provide security for old people.

During the current economic readjustment, China must correctly handle the relationship between readjustment and reform. Although both readjustment and reform are intended to place the economy on a more rational basis, during implementation, they supplement and complement each other in some ways and contradict one another in others. As a result, in a period when readjustment is more important, reform must play a supplementary role. It must help the readjustment and not hinder it. The current requirement is to sum up the country's past experience of reform and to analyze and solve the new problems that have appeared during the reforms. In sum, during readjustment, the pace of reform must be slow, steady, and accurate.

## The Open Economy

To achieve modernization, China must adhere to an open policy on foreign economic relations. Both foreign and domestic experience suggests that, under the current global conditions of international production and division of labour and of rapid development of science and technology, the adoption of a closed-door policy will only bring serious harm to the national economy and culture. Therefore, the implementation of an open policy on foreign economic relations is an important long-term decision for China.

The new approach to foreign economic policy will mean that China's relations with the rest of the world will become much more important. The adjustments in domestic policies will have a much greater impact on the rest of the world than did earlier policy changes. China will become a market for goods and services that are necessary for modernization; its foreign exchange will come partly from increased capital inflow but mainly from increased exports of goods and services.

The change in policy over the last few years will generate levels of capital inflow that are larger in quantity and more varied in form than at any time since the establishment of the People's Republic. Substantial commitments of credit have come from foreign governments and international agencies. Joint ventures with foreign corporations have become important: more than 20 joint ventures have been signed with Western corporations for the production of machinery, textiles, tourism, and other services. Four joint-venture contracts have been signed with French and Japanese companies for offshore oil prospecting and exploitation. Compensation trade, processing, and assembling have gained new status as a vehicle for the transmission of foreign capital and expertise, with agreement having been reached on about 350 small and medium-sized compensation trade ventures and more than 8000 contracts for processing and assembling imported materials and equipment. International joint ventures have been established to allow the leasing of equipment.

China's exports over the next few years will expand annually at about 4%, or roughly the expected rate of growth of total world trade. Later, from about the middle of the decade, they will grow substantially faster than world trade, at about an annual rate of 13%.

China's new policy of building on its greatest competitive strengths, and emphasizing light industry ahead of heavy industry, will mean that exports will grow much more quickly for some products than for others. Exports of all mineral products will grow only at 4–5% annually throughout the decade.

The strongest export growth will be for light manufactures. Although much of the increase in production of light manufactures will go to raising consumption standards of China's people, industries will be much more oriented toward export markets. In 1980, only 3% of China's production of manufactures was exported, but, by 1990, exports will be increased to 7%. Exports of manufactured goods are expected to increase at an annual average between 15 and 20%.

Total exports of manufactured goods, mostly from light industry, were valued at about U.S. $5 billion last year. At prices operating last year, these exports are expected to rise to $15 billion in 1985 and $31 billion in 1990. The increase in exports of light manufactures throughout the decade will approach the combined volume of exports from Taiwan and South Korea in recent years.

The changes in the level and composition of investment in the course of the readjustment of domestic policy will profoundly affect China's imports. Processing enterprises that cannot be operated because of shortages of energy and of supplies of raw materials will be closed down, and imports of large equipment will be reduced in the next years. However, there will be increases in the import of materials, technology, and equipment needed for transforming and developing existing industries, especially the industries that have been given high priority. China will be selective in introducing advanced technology and modern managerial methods. The imports of equipment, technology, and raw materials that will add to its export capacity will be given priority. Large amounts of foreign funds and technology are needed for improvements in port, railway, and telecommunications facilities and urban infrastructure, which are lagging far behind the needs for expansion of external trade.

One should not pretend that China's modernization and new open policy can be implemented without problems. In the days shortly after the downfall of the Gang of Four, little attention was given to the feasibility and overall balance of projects set forth in new development plans. The adverse effects became so apparent last October that a thorough readjustment was considered essential for the future of the national economy. Thus, some projects were pared or suspended, although the government adhered to the principle of respecting contracts and commitments.

Another example of problems in implementing the new approach is apparent from complaints by foreign business executives that China has too many departmental and administrative tiers in foreign trade and that responsibilities are not clearly defined, the result being slow response and low efficiency. These shortcomings exist because China was once a closed society, and, when it opened to the outside world, the old management system, its organization, and personnel were not able to adapt. At present, China is trying to establish a foreign economic and trade

management system suited to both international customs and domestic conditions. The general direction of reform in China's foreign trade system is to grant autonomy to enterprises and incorporated entities in foreign trade, within a framework of strengthened central coordination to ensure consistent approaches to foreign trade.

### Conclusions

The success of the new policies will require adjustments not only in China but also in other countries. The cooperation of the industrialized countries, and especially those of the Pacific area, is vital to the new modernization program in several ways. Only through cooperation will China be able to expand light industrial exports that will provide foreign exchange and permit the domestic economic restructuring that is essential for higher rates of industrial growth. Also international cooperation is vital if China is to enlist foreign technology, capital, and expertise in the modernization of large-scale production and transport of energy, and in the modernization of production more generally.

International cooperation in energy development and research is beneficial to the economic development and scientific and technological progress of all participants. China has carried out technological exchange and cooperation in economic and scientific research in energy development with countries who are willing to do so, on the basis of equality and mutual benefit. In the field of renewable energy resources, China has begun building hydropower stations with loans from Japan and is exploring possibilities with the World Bank for cooperation in building other hydropower stations. The United Nations has sanctioned yearly training courses in China for the developing countries and exchanges of technology and experience, with a view to solving the rural-energy problem by promoting the development of biogas in these countries. In cooperation with West Germany, China will establish a village operating on nonconventional sources of energy. Realizing that increased supplies of conventional energy alone will not solve the energy problem, the Chinese government is undertaking research and development of renewable sources and focusing on advanced technologies and experiences from other countries. It is particularly keen to cooperate in these efforts with Asian and Pacific countries.

## *Discussion*

*Jan J. Solecki:* First of all I wish to say how much I enjoyed reading the paper by Li and Luo. Most of you probably are unaware that I was born in China, in fact in Inner Mongolia, and lived there the first 20 years of my life. Last summer, my wife and I (incidentally my wife too was born in China) revisited the country of our birth and were able to see for ourselves the improvements that have taken place during the past 40 years and sense the changes that were taking place that are reflected in the open economic strategy, discussed in the paper.

I am greatly honoured to be called to comment on the Li and Luo paper. I have read it with great care and found it interesting and informative. The most important feature of it is that it contains pragmatic assessment of the current situation in the People's Republic of China and indicates the path of the expected future developments.

The theme of the paper — the energy constraint — is familiar to us in North America, because we too have had to face the problem of energy constraint, although to a lesser degree and in a different form. Our attempts to solve our own problems in many areas parallel those in China, and, for this reason, the present meeting by offering an opportunity to exchange views and experiences is of particular importance. Let us hope that it will help in the organization of systematic exchange visits by scientists and experts, who, by studying on the spot what has been achieved in other countries, will be able to transfer the knowledge to their own country.

Here in Canada we are particularly fortunate that along with being well endowed with resources, through free exchange of information with the United States and other developed countries, we have access to the latest technology, some aspects of which are transferable to China. Similarly, as in China, scientists here have been working on harnessing hydro, solar, tidal, and biomass energy. Efforts have been made at energy saving through insulation (I might say not always to everyone's satisfaction), through novel designs, as for example in the case of houses