REToolKit Case Study

China Renewable Energy: A Programmatic Approach

Renewable Energy Partnership

Renewable Energy Development Project (REDP) and

China Renewable Energy Scale-up Program (CRESP)

1. Overview

China has long been a major user of renewable energy, particularly small hydro plants supplying power to rural towns and villages, household biogas digesters providing energy for cooking and micro-wind generators for nomadic tribes.

Under the Renewable Energy Partnership, the World Bank and other multilateral and bilateral agencies began collaborations with the Government of China to expand and accelerate the development of renewable energy based electricity as part of its 10th Five-Year Plan (2001–2006). These efforts were also intended to promote cooperation between the various government ministries that shared responsibility for promoting development of renewable energy technologies and applications. These partnership efforts were the beginning of a long-term programmatic approach, which led directly to the China Renewable Energy Development Project (REDP), which at the time was the second largest renewable energy project the World Bank had yet approved.

The REDP was executed by the China National Development and Reform Commission (NDRC) and supported by the World Bank and the Global Environment Facility. The Bank provided US$13 million in loan financing, and the Global Environment Facility provided US$27 million in grant funds for the US$205 million project.

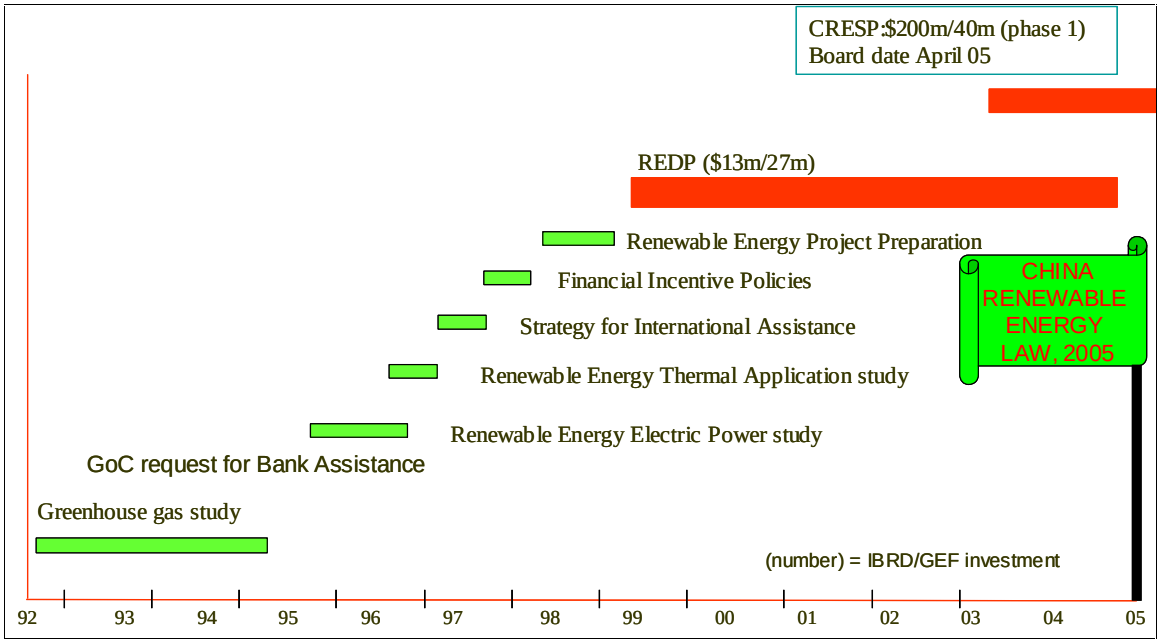
The REDP began implementation in December 2001 and provided financing for 20 MW of wind farms in Shanghai Province, about 10 MWp of PV systems (about 350,000 units) for installation in the northwestern provinces, and included grants for technology improvement, capacity building, and project management.

The partnership efforts also supported the development of the China Renewable Energy Scale-up Project (CRESP), in which the Bank and GEF will support efforts by the Government of China to continue (and expand) its promotion of renewable energy into the 11th Five-Year Plan (2006-2011. The program places major emphasis on the development of mature grid-connected renewable energy technologies, such as wind, small hydro, and biomass.

CRESP was approved for financing in the amount of US$ 87 million from the World Bank and a grant of US$ 40 million from the Global Environment Facility. In addition to wind, biomass and small hydro project components, CRESP will include technical assistance for institutional development and capacity building for scaling-up renewable energy investments and supporting provincial demonstration projects.

2. Programmatic Approach

The need for a programmatic approach is grounded in the recognition that the World Bank is a relatively small player the energy sector. Countries must secure significant additional resources from the public and private sectors and to accomplish this both the capacity and enabling environment must be improved. To have an impact on the fast growing energy sector, the Bank must be a catalyst. A programmatic approach can be used to create the right enabling environment, build capacity, mobilize resources and catalyze investments in both the power sector and end use sectors. The experience in China has also shown that a programmatic approach also helps the Bank to provide sustained attention during implementation and encourage good governance. The figure below illustrates how the Bank projects in China moved towards a programmatic approach and were instrumental in the implementation of China's Renewable Energy Law in March 2005.



3. Renewable Energy Development Project (REDP)

The Renewable Energy Development Project for China aimed at developing sustainable markets for wind and photovoltaic (PV) technologies in order to increase the supply of electricity in an environmentally sustainable way and improve the access of isolated rural populations to electricity services. The project was designed with three components, consisting of installing grid-connected windfarms in four provinces; supplying photovoltaic systems to households and institutions in remote areas of six northwestern provinces; and supporting technology upgrading to improve performance and reduce the costs of windfarms and solar PV technologies. The project was co-funded by the GEF (Global Environmental Facility) under its Operational Program 6, supporting the promotion of renewable energy by removing barriers and reducing implementation costs. The REDP was executed by the China National Development and Reform Commission (at that time the State Development and Planning Commission) and supported by the

World Bank and the Global Environment Facility. The Bank provided US$13 million in loan financing, and the Global Environment Facility provided US$27 million in grant funds for the US$205 million project.

The REDP began implementation in December 2001 and eventually provided financing for 21 MW of wind farms in Shanghai Province, about 10 MWp of PV systems (about 350,000 units) for installation in the northwestern provinces, and included grants for technology improvement, capacity building, and project management.

3.1 Grid-Connected Wind Farms

The grid-connected wind farm component of REDP initially included 170 MW wind farms in three northeast provinces, including Inner Mongolia, and Shanghai municipality. This component of the project was designed to achieve economies of scale through large wind farm implementations. When REPD was designed, the incremental cost of the wind farms was expected to be shared over customers of the large regional power grids. However, as part of electric sector reform, the State's regional grids were broken up into smaller provincial grids. This made it hard to sell the relatively high-priced wind power on the small northeast grids, especially the Inner Mongolia provincial grid, which has the best wind resource. Unfortunately, no agreement could be reached on how to spread the incremental costs more broadly, and the REDP was restructured to remove the 170 MW of wind farm component and cancel $87 million of the Bank loan and $8 million of the GEF grant.

This project experience highlighted several barriers to renewable energy scale-up. Most critically, no mechanism existed to spread the incremental costs broadly across provincial grids. The Inner Mongolia grid had too few customers to absorb this cost, especially as primary customers for this power were outside the province. This is illustrative of a more general issue in China, where the main markets for renewable energy are the environmentally or socially conscious cities and provinces, while best resources are in poor western provinces. Also, the installed costs of wind farms in poor provinces, such as Inner Mongolia, are high because of lack of capacity, insufficient competition, and weak manufacturing and service industries.

The REDP wind farm component did succeed in developing two utility-scale wind farms in Shanghai municipality, China's largest city. The wind farms, which have a total capacity of 21 MW started operation in 2004, are located on the far end of Chongming Island and in the southeastern region of the city in the Nanhui district. The wind farms consist of fourteen 1.5 MW wind turbines and will help the Shanghai Municipal Government promote renewable energy in the region and to help meet China's stated goal of creating 20 GW of new renewable energy by 2020.

Given cancellation of the Inner Mongolian wind farms, a portion of the project focus was shifted to assistance in preparing renewable energy implementation policy, and resulted in a recommendation for a mandated market share (MMS) policy in energy 10th Five Year Plan in 2001. MMS policy is legal requirement that a share of electricity should come from renewables, with the motivation being local environmental protection and industrial development. Further support was provided for training, introduction of fiscal and other incentives for investors, streamlined arrangements for project development (e.g. concessions) and sale of power (PPAs, pricing), mechanisms for trading renewable electricity among regions, e.g green certificates and local technology cost reduction and quality improvements.

3.2 Stand-Alone PV Systems

The REDP offered grant assistance to qualified participating PV companies to establish and sell high-quality PV systems on a commercial basis to rural customers scattered throughout the provinces of Tibet, Qinghai, Xinjiang, Gansu, Sichuan, and Inner Mongolia. Establishing low-cost but responsive sales and service operations is particularly difficult to achieve in these sparsely populated and rugged northwestern provinces where population densities are less than 40 people per square kilometre.

A principal goal of the PV market development component is to strengthen the capacities of the PV companies to allow them to sell higher-quality products at lower unit costs, while functioning more effectively and efficiently as businesses and providing their customers with responsive service. A summary of the current project results is provided here with the reference document[1] providing more details.

The direct grant of US$1.50 per Wp of PV system capacity is provided to support the development of sales and service operations. Any PV system that meets quality standards and is sold by a qualified participating company is eligible to receive the grant after sales are confirmed.

In addition to providing US$15 million in direct grants for PV sales, the REDP provides another US$10.5 million in grants for management, capacity building, technology improvement, and piloting financing schemes related to stand-alone PV applications.

By mid-2003, the number of participating PV companies had grown from 17 to 25. Between December 2001 and April 2003, PV sales eligible to receive GEF grant support were about 60,000 with aggregate sales of about 1.2 MWp. Sales are averaging about 4,000 units per month. The majority of the sales are undertaken by about eight companies. Average unit size is 19 Wp, although unit sizes may range from 10 Wp to 500 Wp. PV system retail prices range from US$6 to US$10 per Wp, depending on the type and number of end-use appliances provided.

Sales are usually made through company-owned sales outlets and independent dealers. By the time the project ends in 2007, the pace of SHS sales must more than double if the target 10 MWp are to be installed.

3.2.1 Quality in the Supply Chain

For a PV systems business to be sustainable: all participants in the supply and service chain must make a profit or see an acceptable level of benefits. The supply and service chain includes component suppliers; system integrators; distributors and dealers; and sales, installation and service organizations; as well as customers. Financing is also a critical part of the system and affects every aspect of the supply chain.

The first step to strengthening the capacities of all providers along the chain to deliver consistently good quality products and services was performed before the project started. Several quality-related problems were observed to be occurring with enough frequency to be of special concern.

First, many smaller SHS were being sold without controllers as a way of keeping costs down. This invariably shortens battery life and can considerably raise the life-cycle cost of the system to the user. Second, because of the lack of after-sales service, when components failed or needed routine replacement, the system was out of service for a

[1] Strengthening PV Businesses in China, A World Bank Renewable Energy Development Project, Anil Cabraal, RENEWABLE ENERGY WORLD, May–June 2004.

long time until the user could obtain new or replacement parts from a supplier. Users often had to go a considerable distance to obtain such parts, and their satisfaction could be considerably dampened by this inconvenience. Third, the quality of uncertified PV modules was uncertain, and their power ratings were not always accurate. This was also true of other components. Inaccurate or missing labels further compounded the problem. While such problems are similar to the ones experienced in other countries, and it was recognized that if such problems persisted they would eventually inhibit market growth.

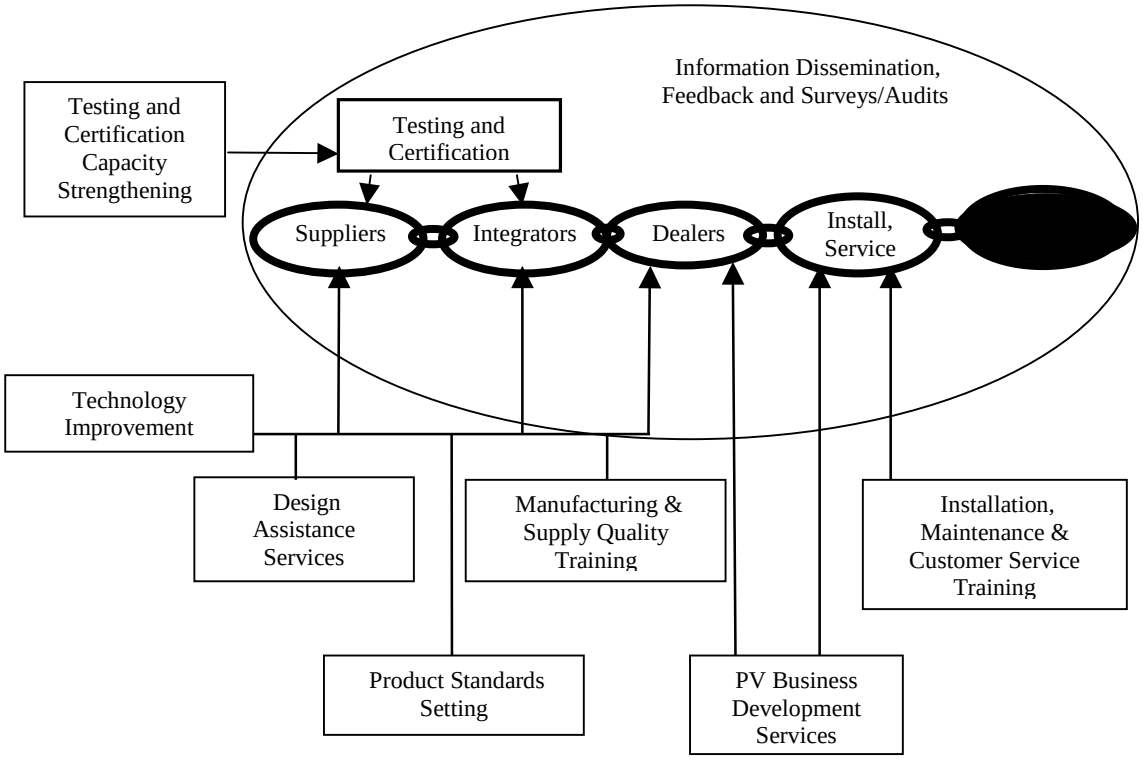
3.2.2 Capacity Building and Quality Improvement Support

In response, REDP focused its attention on five areas of capacity building and quality improvement support.

1. Improving the commercial capability of the participating companies to expand and sustain their PV businesses.
2. Assisting in developing and enforcing standards.
3. Improving the quality of products and services available to consumers.
4. Enhancing the access of suppliers, dealers, and consumers to information.
5. Improving access to financing.

A variety of capacity building, training and technical assistance activities were conducted with the aim of bringing about these improvements. They are depicted schematically in Figure 2, which shows the elements of the supply chain and the technical assistance and capacity building services that are being provided.

During project preparation, business development assistance was provided in the form of training and tailored assistance with business planning for participating PV companies. It included assistance with planning for the opportunities and demands of business expansion—financial planning, financial controls, inventory management, extending sales and service networks, developing warranty documents and marketing materials, and setting up procedures for quality assurance.



The project also conducted a market survey for PV systems in four of the northwestern provinces[2] to give companies better information about their potential customers. The survey gathered information about the characteristics of PV purchasers and their preferred payment patterns. The survey results helped PV companies design appropriate and effective marketing strategies.

During project implementation, a Market Development Support Facility[3] (MDSF) was developed to provide matching grant assistance to participating PV companies to improve their business and market development capabilities. Experience in other countries has shown that business and market development support for companies should be provided not only at start-up, but also during implementation of a project. Such support should be demand driven and meet priority needs that the companies have identified and for which they are willing to share fully in the costs. The MDSF offers a 50% cost-shared grant and up to US$10,000 per year per company for eligible market development support activities.

[2] Link to: Assessing Markets for Renewable Energy in Rural Areas of Northwestern China, World Bank Technical Paper No. 492, December 2000.

[3] Link to MDSF documents in the document library

3.2.3 Setting and enforcing standards

To guarantee quality, the REDP has supported the development of national technical product standards that were prepared through a participatory consensus-building process during project preparation. The process involved key Chinese research and testing organizations, along with PV module and balance of systems manufacturers, as well as some assistance from international experts.

These standards built upon standards prepared for other World Bank and Global Environment Facility–sponsored projects, such as the Indonesia Solar Home Systems and Sri Lanka Energy Services Delivery Projects. The resulting technical standards were then disseminated to local and international companies about a year before the project became effective.

It is noteworthy that two of the technical standards and test procedures for inverters and controllers have since been accepted by the Global Approval Program for Photovoltaics (PV GAP) as PV Recommended Specifications. Since PV GAP has a liaison status with the International Electrotechnical Commission (IEC), they will submit these recommended specifications to the IEC for consideration as new global standards. This is an excellent example of how national and international standards for PV can be harmonized.

The project also supported PV product certification in China. Four Chinese testing institutes now provide product testing services to manufacturers, and the REDP has given a grant covering 50% of the cost of testing, but only for products that ultimately are qualified (to discourage companies from irresponsibly submitting products for testing). The end result was that when the REDP began implementation, a range of products was available on the market that were tested and found to be in compliance with the standards.

3.3 Lessons Learned

The REDP experience has reinforced the evidence (accumulated over some 20 years) that a complementary set of coordinated and focused policies are necessary to develop and sustain markets for renewable energy. The most important lesson is that reducing cost and improving technology and quality, standard setting and awareness are pre-requisites for scaling up of renewable energy. Supply-side policies alone, which provide capital subsidies and support equipment supply and service industries are not sufficient to develop a market, which most importantly needs to be based on a national policy. This was illustrated in the REDP where the wind component had to be restructured from 190 MW to 20 MW because of the institutional problems encountered in spite of the strong support from sponsoring government agencies.

Lessons learned indicate that sustainability requires: (a) development of a competitive environment in the renewable energy sub-sector to reduce technology and project development costs; (b) maintaining flexibility with respect to changing market conditions, such as restructuring and deregulation of power sectors; (c) minimal reliance on administrative procedures; and (d) development of exit strategies as soon as barriers are removed.

Lessons learned from renewable energy assistance in China include: (a) the renewable energy resource for individual projects must be carefully assessed and checked; (b) attention must be paid to arrangements for procurement and construction that are in line with international best practice to ensure rapid and effective implementation; (c) key

principles of all agreements that are essential to the project functioning as envisaged (for example power purchase agreements – PPAs and voluntary pilot schemes) should be established before project appraisal; and (d) technical assistance must be coordinated with the construction of the physical parts of the project to ensure that the implementing agencies have adequate and timely knowledge of construction, operation and maintenance.

The programmatic approach enabled full engagement of all concerned Chinese agencies and supported the incorporation of these lessons learned into the design of the CRESP.

4. China Renewable Energy Scale-Up Program (CRESP)

The China Renewable Energy Scale-Up Program (CRESP) aims at enabling commercial renewable electricity suppliers to provide energy to the electricity market efficiently, cost-effectively and on a large scale. The program is in line with Global Environment Facility (GEF) Operation Program (OP) 6: promotion of renewable energy by removing barriers and reducing implementation costs.

Approved by the Bank in April 2005, CRESP includes a loan of US$87 million for the financing of the Renewable Energy Scale-up Program, supplemented by a grant of US$40.22 million from the Global Environment Facility (GEF). It is expected that CRESP will contribute to the goal of displacing coal in power generation, thereby reducing environmentally damaging emissions and contributing to the Government of China (GoC) strategy of economic development in the western provinces, since much of the renewable energy is in those areas.

The CRESP aims to create a legal, regulatory, and institutional environment conducive to large-scale, renewable-based electricity generation, and to demonstrate early success in large-scale, renewable energy development with participating local developers in two provinces. CRESP has two main components: Institutional Development and Capacity Building and Support for Wind, Biomass and Small Hydro in Pilot Provinces.

4.1 Institutional Development and Capacity Building

This component includes a $40 million GEF grant and $78 million in cost sharing, and it is designed to meet national priorities and the needs of the pilot provinces to initiate the scale up of renewable energy.

At the national level there are three sub-components:

- ③ MMP research and implementation support. Studies on further development of the MMP and its implementation, particularly on targets, tariff levels, policy development, sharing of incremental cost, credit trading and carbon trading and long term planning and preparation of implementing regulations. The main counterparts for these activities will be government bodies and the main outcome will be legislation and regulations leading to sustained scaling up of renewable energy;
- ③ Technology improvement for wind and biomass. This will cover technology development based on important local investments leveraged by small grants, cost-shared grants or both, for wind and biomass. In addition, for wind it will cover preparation of standards, putting in place certification and establishing a testing center. Beneficiaries will be Chinese wind and biomass equipment and

related service suppliers, government bodies dealing with standards and testing and accreditation agencies.

- ③ Long term capacity building. Support will be provided to selected universities to enter into twinning arrangements with leading international universities to develop post graduate level or specialist renewable energy engineering courses and to offer fellowship programs to support more senior engineers studying abroad.

At the province level, technical assistance will also be provided to support pilot implementation of the MMP; ensure the successful design, procurement, construction, operations and maintenance of the investment projects; assess renewable resources for each of the pilot provinces, conduct feasibility studies for renewable energy projects; and provide capacity building for market participants (on a cost-sharing basis).

Three or four provinces will be selected, preferably on a voluntary basis, to pilot the development and implementation of a mandated market policy, including putting in place the required certification and compliance monitoring procedures at provincial level. Provincial governments would be offered incentives such as: assistance to set up the monitoring systems and enforcement procedures; early grant assistance for resource assessment and, if required, feasibility studies to develop renewable energy according to international best practice.

4.2 Support for Wind, Biomass and Small Hydro in Pilot Provinces

This component, which has a total cost $343 million, with Bank financing of $222 million, is designed to increase local capacity to develop, finance, construct and operate renewables on a large scale in four pilot provinces. It links policy, legislation and capacity building while also developing the renewable resource and providing benchmark costs for renewable technologies country-wide. The subcomponents are as follows:

- ③ In Fujian, a 100MW wind farm at Changjiang'ao, Pingtan Island. The Pingtan wind farm will consist of wind turbines, associated civil and electrical works, an extension to an existing control room, a switchyard and a 15 km, 110 kV transmission line from the wind farm to Beicuo. The design, equipment selection and construction of the project will be decided through competitive bidding. The sponsor, and currently implementing agency, China Long Yuan Power Group (Long Yuan) intends to create a special purpose company for the implementation and operation of the project. Total cost of the wind farm is expected to be $106.39 million, of which $67 million is to be financed by the Bank.
- ③ In Inner Mongolia, a 100MW wind farm at Huitengxile, Wulanchabu County will consist of wind turbines, associated electrical and civil works including a substation, switchyard and control room; a 15 km, 110 kV transmission line to Desheng town; and upgrading of the existing 110 kV substation there. The design, equipment selection and construction of the project will be decided through competitive bidding. The Inner Mongolia Wind Power Company (IMWPC) is the implementing agency. Total cost of the wind farm is expected to be $101.66 million, of which $81.78 million is to be financed by the Bank. IMWPC plans to identify a source of carbon financing, and is currently developing a proposal for consideration by the World Bank.
- ③ In Jiangsu, a 25MW straw-fired biomass power plant at Mabei Village, Rudong County will consist of one 110 tonne/hour high-temperature, high-pressure straw-

fired boiler, and one 25 MW steam turbine, and associated mechanical, electrical and civil works. The plant will require 176,000 tons of straw from rice and other crops drawn via collection stations from farms within a radius of 25 km from the project site and transported to the plant by road and water. The plant will be connected to the grid by a short line to the nearest transformer. The sponsor, and currently implementing agency, Jiangsu Guo Xin Investment Group (Guo Xin) intends to create a special purpose company for the implementation and operation of the project. Total cost of the power plant is expected to be $35.71 million of which $20 million is to be financed by the Bank.

③ In Zhejiang, the Bank will finance part of the provincial small hydro new build and rehabilitation program. Eighteen individual projects have been selected based on criteria agreed in advance, and to be confirmed at appraisal. The province will make sub-loans to county governments and thence to owners/developers of individual projects with guarantees from county governments. It is expected that most owner/developers of rehabilitation sites will be the public sector (including the counties themselves) while most new build will be sponsored by the private sector. Eleven plants will be rehabilitated with a combined output of 34 MW, an incremental gain of 10 MW. The combined capacity of the new plants will be 74 MW. Total cost of the projects is expected to be $99.15 million, of which $53.28 million is to be financed by the Bank.

Bank financing is expected to play a catalytic and demonstration role by financing a few projects in the pilot provinces. However, the vast majority of facilities developed under the mandated market policy are expected to be financed commercially with no involvement of the Bank or GEF.

Over its lifetime, CRESP is expected to induce an increased capacity of renewable electricity of more than 20 GW, reduce carbon emissions by about 800 million tons, total suspended particulate emissions by more than 800 million tons, sulfur oxide emissions by more than 30 million tons, and nitrogen oxides emissions by more than 6 million tons.