

Transformation of the refrigerator market in China

Background

China represents the largest refrigerator market in the world, but during the 1990s the average energy efficiency of refrigerators on the market was quite low. At that time a demonstration project funded by the United States Environmental Protection Agency studied the refrigerator sector in China and identified a range of barriers to energy efficiency. The China Energy-Efficient Refrigerator Project was formulated to address those barriers and to assist China in introducing a range of policy and regulatory measures that could be implemented to improve the efficiency and competitiveness of refrigerators, and at the same time mitigate the environmental impacts due to high electricity consumption. The project received Global Environment Facility grants totalling US\$ 9,860,000, leveraged by over US\$ 31 million in other funding. The project began in December 1999 and was expected to be completed in June 2006.

From 1980 to 1995, residential power use rose from 3 to 12 per cent of total electricity consumption, growing at an annual rate of 16.3 per cent. This growth was driven by an explosive increase in household appliance use, as household income was rising. Within the residential sector, it is estimated that refrigerators alone, found in 70 per cent of urban households in 1999, account for approximately half of all residential electricity consumption. In 1992, there were a total of 39 million refrigerators in service, an increase from only 4 million in 1985, representing an average annual growth of 38 per cent. According to a business as usual scenario, refrigerators produced in China over the next decade would require an additional 601 billion kWh of electricity over their expected lifetimes. This would necessitate an estimated increase in annual power generation capacity of 5,700 MW, equivalent to an annual average of 60 million tons of additional CO₂ emissions. Excessive energy consumption by refrigerators thus was identified as an urgent issue that needed to be solved.

Prior to the China Refrigerator Project, Chinese refrigerators were significantly less energy-efficient than those produced in the European Union, the United States of America or Japan (e.g., the average refrigerator in China consumed up to 2.5 kWh/year per litre of volume compared to 1.5 kWh/year in Europe). There was a clear need to strengthen capacity in China to manufacture and utilize energy-efficient refrigerators. Domestic research demonstrated that the energy consumption by refrigerators in China could be reduced by as much as 40 per cent. However, there were many barriers to the widespread commercialization of energy-efficient refrigerators in China.

The China Refrigerator Project was developed in order to address this problem. The project began in 1989 as a bilateral cooperation project between the United States Environmental Protection Agency (USEPA) and the China State Environmental Protection Administration (SEPA).

From 1989 to 1995, work was conducted in the areas of chlorofluorocarbon (CFC) substitutes research, energy-efficient design options, prototype development, safety testing and field testing. A CFC replacement demonstration was funded through the Montreal Protocol Fund (\$3.5 million) received in two parts in June 1993 and March 1995.

A key factor in ensuring the success of a comprehensive market transformation project is to carefully plan and coordinate activities, and to ensure that all stakeholders are involved in both project planning and execution. This was

particularly true with the China Refrigerator Project, which benefited greatly from active stakeholder involvement in the development and implementation of the project. Please see the box below for a list of key stakeholders.

Project goals

The project's main goal was to reduce energy consumption through promotion of improved refrigerator energy efficiency, contributing to protection of the global environment by reducing carbon dioxide and other greenhouse gas (GHG) emissions caused by household refrigerator energy use in China. An additional project goal was to take advantage of product and production line modifications through the CFC phase-out to introduce energy efficiency modifications.

Project participants

- Twenty-four Chinese refrigerator and compressor manufacturers
- China State Environmental Protection Administration (SEPA) — national executing agency, project Advisory Committee (AC) member
- United Nations Development Programme (UNDP) — Global Environment Facility (GEF) implementing agency, AC member
- China Ministry of Finance (MOF) — GEF country focal point, AC member
- SEPA Foreign Economic Cooperation Office — national implementing agency and home of Project Management Office (PMO)
- United Nations Department for Economic and Social Affairs (UNDESA) — international cooperating agency
- China National Development and Reform Commission (NDRC) — chief energy efficiency regulatory body, AC member
- China State General Administration for Quality Supervision, Inspection and Quarantine (AQSIQ) — issues energy efficiency and other product standards, AC member
- China National Institute of Standardization (CNIS) — provides market assessment, technology review and economic analysis support to AQSIQ in energy use standard development, and was lead participant in GEF project standards and labelling work
- China State Administration of Internal Trade (SAIT) — oversees retail sector; AC member
- China Household Electric Appliance Association (CHEAA) — lead participant in variety of project activities; liaison to industry; maintains project information centre and website
- China Household Electric Appliance Research Institute (CHEARI) — helped develop demo project prototype, provides project technical support and product testing capability
- China Certification Center for Energy Conservation Products (CECP) — responsible for China's endorsement level and will manage information label; key participant in mass procurement programme
- Collaborative Labeling and Appliance Standards Program (CLASP) — key participant in standards and labelling work
- University of Maryland Center for Environmental Energy Engineering (UMd CEEE) — intensive long-term refrigerator design training location
- National and international experts and contractors hired to support implementation of the project

It was originally estimated that in the 10 years following implementation of the project, refrigerators in China could reduce electricity consumption by about 120 billion kWh. If this electricity is all from coal-fired power stations, it would save 7.175 million tons of coal, resulting in emissions reductions of 143 million tons of CO₂. In addition to this significant global environmental benefit, corresponding reductions of SO₂ emissions and other local pollutants would lead to significant improvement of local environmental quality.

Project barriers

During project development, nine barriers were identified to adoption of energy-efficient refrigerators by households. These barriers were:

- *Lack of awareness of the life-cycle economic benefits of high-efficiency refrigerators.* Refrigerator purchasers in China were highly sensitive to the first costs of their purchases, and inappropriately preferred models with low purchase prices and higher electricity costs. They did not fully appreciate that total life-cycle costs, including electricity, could be much lower for high-efficiency models.
- *Lack of reliable, comparative information available to consumers about specific models.* Even where consumers wanted to purchase models with low life-cycle costs, they were unable to make comparisons between models because energy efficiency labels did not exist to provide this information in a consistent and easy-to-understand way.
- *Manufacturer uncertainty about market demand for high-efficiency models.* Manufacturers had access to few, if any, market research studies or data about the potential demand for high-efficiency models in the Chinese market. Due to historically low electricity prices and little emphasis on energy efficiency in the Chinese economy, both producers and consumers were uninterested in energy-efficient products.
- *Manufacturer uncertainty about cost-effectiveness of high-efficiency models.* Manufacturers were also uncertain about the costs of developing and producing high-efficiency models, and about the price premium in the marketplace that high-efficiency models might command. Therefore, manufacturers were reluctant to commit the resources to develop and produce high-efficiency models.
- *Lack of expertise in energy-efficient refrigerator design.* The majority of Chinese manufacturers lacked the engineering and design expertise to develop new energy-efficient refrigerator models or modify existing designs to make them more energy-efficient. As a result, manufacturers did not cultivate the skills and staff necessary for energy-efficient refrigerator design. Secondly, most domestic manufacturers had relied heavily on imported or licensed technology and were therefore at a further disadvantage in developing new energy-efficient product designs. Finally, many domestic manufacturers (and particularly second-tier ones) relied on a limited and unchanging product line for their sales, and therefore had extremely limited experience in product design and redesign. For these reasons, many manufacturers were uncertain of their ability to implement energy efficiency measures without targeted training to impart the necessary skill sets.
- *Higher-efficiency compressors not available domestically.* In order for a Chinese refrigerator manufacturer to design and produce a high-efficiency refrigerator, a higher-efficiency compressor must be utilized. Prior to the project, such compressors were not available in China, and the higher cost of imported high-efficiency compressors was a strong disincentive for domestic refrigerator manufacturers.

- *Dealer reluctance to stock or promote high-efficiency models.* Uncertainty about consumer demand, the need to educate their sales force, and fear of reduced sales due to higher prices on the shelves made dealers reluctant to stock high-efficiency models. Surveys conducted during project development also indicated that sales staff were unfamiliar with the benefits of energy efficiency and unable to provide consumers with reliable information.
- *Lack of an appliance recycling programme.* As China's refrigerator market matures, an increasing proportion of purchases involve replacement of an old refrigerator. Unlike most developed countries, where old appliances are scrapped or recycled, market research indicates that many new buyers in China have kept their old refrigerators. Continued use of these old refrigerators has risked offsetting many of the efficiency gains from the purchase of new refrigerators.
- *Lax efficiency standards.* China's previous refrigerator efficiency standards, promulgated in the 1980s, were established in view of the needs of hundreds of small refrigerator producers. They allowed production of a large number of highly inefficient refrigerators and provided no incentive to manufacturers to increase the energy efficiency of their models.

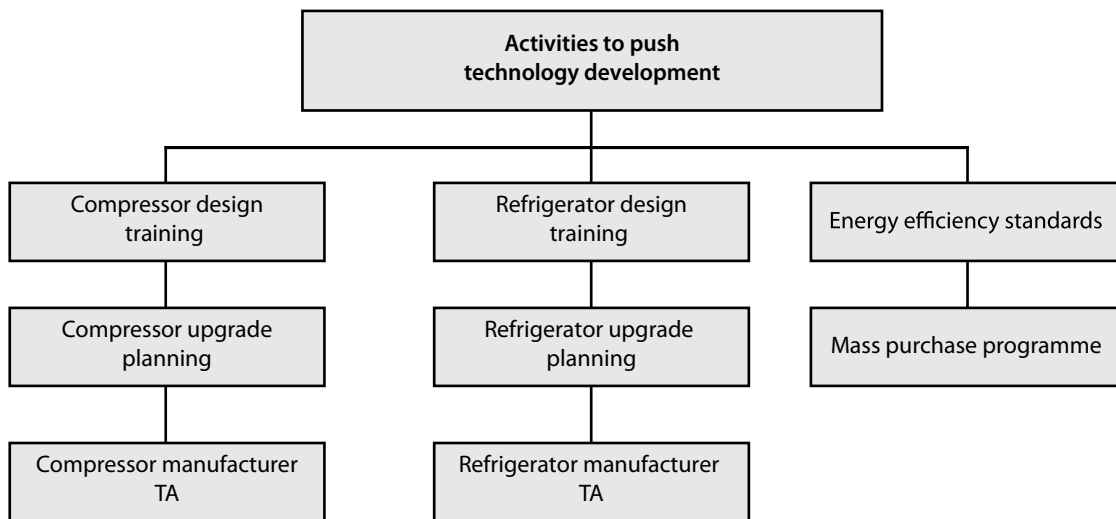
Project activities

A series of coordinated project activities were developed in order to eliminate or reduce these barriers so that a long-term, sustained transformation of China's refrigerator market could be accomplished. These activities can be grouped into two categories. One provided a "technology push" to increase the supply of energy-efficient refrigerators, including technical training, technical assistance, study tours, incentive programmes for refrigerator and compressor manufacturers, and revision of the national energy consumption standard. The other category created a "demand pull" to increase market demand for energy-efficient refrigerators by increasing retailer and consumer understanding of the benefits of energy efficiency and energy-efficient refrigerators.

Technology push

The project's "technology push" activities were focused on manufacturers: the "supply side" of the market transformation equation. First, given that an energy-efficient compressor is an integral component of energy-efficient refrigerators, the project included a range of activities aimed at compressor manufacturers. Through international design training, business planning, technical assistance and technology transfer, the project assisted compressor manufacturers in upgrading their products. Training provided manufacturers with the ability to design more efficient compressors, and an incentive programme provided them with the incentive and the incremental cost funding to make and market them.

Simultaneously, focused training activities aimed at the refrigerator manufacturers increased their capacity to design and manufacture energy-efficient refrigerators. Computer design modelling, international technology training, tours and exhibitions, technical assistance, and intensive energy-efficient design training provided refrigerator manufacturers with the tools to create new energy-efficient model designs. To provide them with the incentives and incremental cost funding to implement efficiency gains, manufacturers competed in a bidding process for incentive programme awards designed to both raise average efficiency levels for all manufacturers and promote development of super-efficient models.



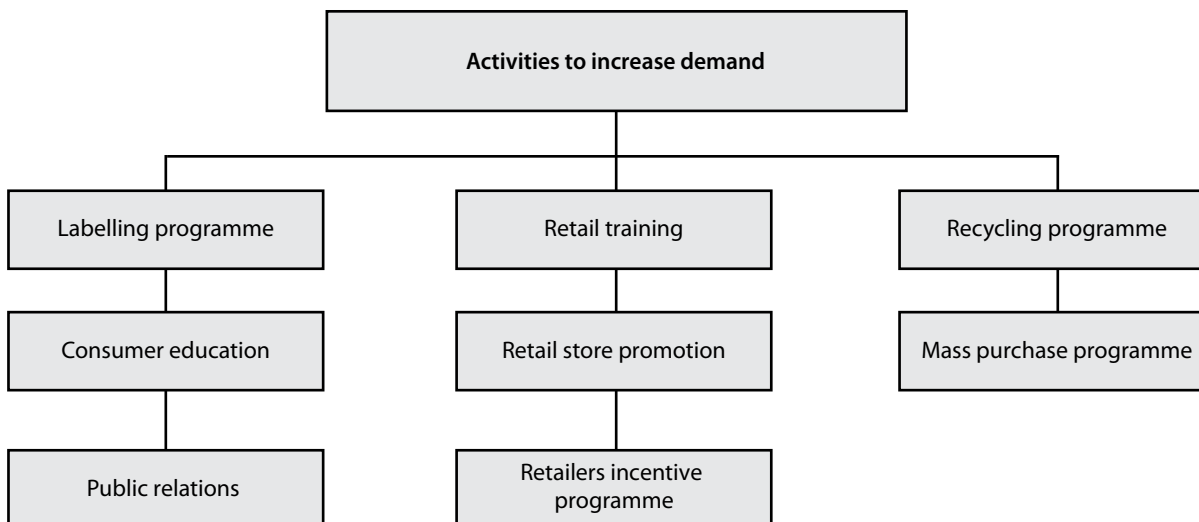
The project also strengthened energy efficiency standards with two rounds of standards revisions during both the Project Design Facility (PDF) and the GEF stages of the project. National standard-setting organizations and staff were also provided with assistance and training in the analytical tools for determining new efficiency standards in order to build national capacity for future standards revision.

Demand pull

The project's demand-pull activities included a number of programmes designed to reduce barriers to consumer acceptance and retailer understanding of energy-efficient refrigerators. During a market survey conducted during the PDF phase of the project, it was discovered that most refrigerators provided the same basic product functions. Instead of functions, other criteria were becoming increasingly important to consumers. The project's consumer awareness goal therefore became making energy efficiency one of those key factors.

In order to generate demand and increase consumers' understanding of the benefits of high-efficiency refrigerators, a consumer education campaign was designed, using television, newspapers, outdoor advertising, magazine advertisements and other media. Consumers were also targeted at retail locations with relevant educational and informational material. To complement this campaign, a public relations campaign was implemented in order to broadly educate the public about the benefits of energy efficiency. In addition, a nationally certified energy label was developed that provided comparable information across models to allow consumers to identify energy-efficient refrigerators easily.

Through the retail education activity, retail staff were trained in the benefits of energy efficiency, and a retail incentive programme was implemented to encourage stores and salespeople to market energy-efficient refrigerators actively in key target markets of China. A mass purchasing programme was designed and launched to promote the purchase of energy-efficient appliances by large-scale purchasers, particularly government agencies. Finally, a proposal was developed and third-party international funding is being sought for a recycle/



buy-back programme to provide financial incentives to consumers to return old refrigerators when they purchase new energy-efficient ones.¹ The project has also provided technical assistance to the National Development and Reform Commission (NDRC) in its development of new nationwide regulations for appliance recycling.

Please see table 1 below for a list of major project activities and budgets.

Table 1

Activity	GEF	Co-financing	Total
1. Compressor factory technical assistance	\$352 500	\$1 579 500	\$1 932 000
2. Refrigerator factory technical assistance	\$1 503 090	\$24 265 000	\$25 768 090
3. Incentive programmes	\$3 595 000	\$660 000	\$4 255 000
4. Consumer education programme	\$2 984 940	\$4 450 000	\$7 434 940
5. Project management, monitoring and evaluation	\$1 181 470	\$335 000	\$1 516 470
Total	\$9 617 000	\$31 289 500	\$40 906 500

Key project results

Overall energy efficiency gains

The China Refrigerator Project has achieved significant results in a variety of areas. First and foremost, the number of manufacturers producing energy-efficient refrigerators and the number of energy-efficient refrigerator models produced have significantly increased as a result of the project. As an intermediate indicator,

¹ No GEF funding was sought for the appliance recycling programme, which was designed as a parallel activity to be funded with third-party international funding.

annual production of energy-efficient refrigerators² went from about 1 million in 1999 to 10.7 million in 2004 and over 14 million in the 12 months ending in June 2005. The average refrigerator energy index³ has improved from 0.794 in 1999 to 0.572 as of June 2005, for a gain of 28 per cent. Production of super-efficient refrigerators (those at least 60 per cent more efficient than the energy efficiency standard) has increased from 400 units in 1999 to 3.3 million during the 12 months ending in June 2005. There are currently 256 models of domestically manufactured energy-efficient refrigerators on the market that meet the energy efficiency requirement of grade 1 of the national standard for refrigerator energy consumption (superior to European grade A).

The project's original target was to promote sales of 20 million energy-efficient refrigerators over a 10-year impact period during and following the project after the project had achieved market transformation. Based on average efficiency gains of 40 per cent relative to the baseline, each energy-efficient refrigerator sold results in CO₂ emissions reductions of 5 tons over its lifetime, for total target estimated emissions reductions of 100 million tons CO₂ equivalent.⁴ Based on sales of energy-efficient refrigerators (all of which are at least 40 per cent more efficient than the energy use standard) or 11.7 million units between 2000 and 2004, it appears that the project goal will be not only met, but also exceeded by twofold. If current sales levels of over 5 million energy-efficient refrigerators per year continue, emissions reductions due to market transformation achieved by the project could reach or exceed 250 million tons CO₂. Emissions reduction cost-effectiveness will likely be less than \$0.05/ton CO₂.⁵

Technical assistance

Under the technical assistance programme, engineers from eight Chinese compressor manufacturers participated in design training workshops, study tours and expert technical assistance. Engineers from 16 participating refrigerator manufacturers received training in international technology options, and modelling of energy efficiency measures, expert technical assistance and in-depth international design training. As shown in table 2, the project provided over 5,000 person-days of training.

Energy efficiency standards revision

China's refrigerator energy efficiency standard was introduced in 1989 (along with standards for washers, air conditioners, fans, rice cookers, televisions, radios and irons). It was revised in 1999 (effective date 1 January 2000) with support from the GEF during the project's PDF phase. The project also supported a second revision in 2003 (GB 12021.2-2003, test standard GB/T 8059.2-1995 = ISO 8187). This revision includes 10-15 per cent energy savings relative to the 1999 standard, with additional 10 per cent savings scheduled to take effect in 2007.

² Unless otherwise noted, "energy-efficient refrigerators" referred to here are those in the top two grades as defined by the new energy efficiency standard, consisting of refrigerators that are at least 40 per cent more efficient than the standard. Production refers to production by refrigerator manufacturers participating in the project.

³ Average refrigerator energy use relative to the standard, so 0.572 in June 2005 means that, on average, refrigerators used 57 per cent of the energy allowed by the standard.

⁴ Energy savings of 220 kWh/year per refrigerator = 5 tons CO₂ equivalent emissions reductions.

⁵ Emissions reductions and energy savings are calculated as 40 per cent lower energy use for approximately 20 per cent of the projected market (2 million refrigerators/year) for a 10-year project impact period at the conclusion of and following the project and with an assumed 15-year average product life. A 40 per cent average efficiency gain for approximately 20 per cent of annual production represents an average fleet-wide efficiency gain of 8 per cent. Actual efficiency improvement achieved 1999-2004 was more than three times that amount, in addition to which greater numbers of energy-efficient refrigerators than projected are being sold.

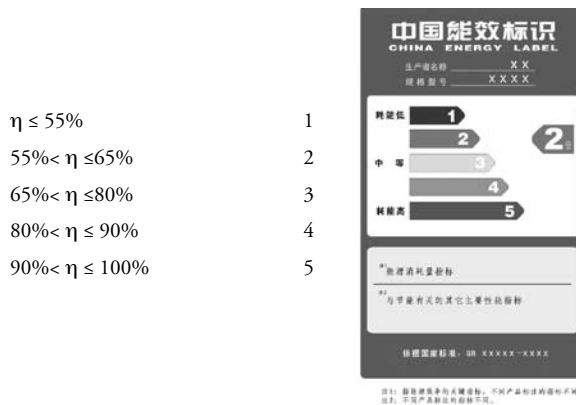
Table 2

#	Description	Trainees	Person-days training
1	In-country compressor training programme (1)	29	174
2	In-country compressor training programme (2)	29	174
3	Overseas compressor study tour (1)	7	7
4	Overseas compressor study tour (2)	8	104
5	TA for compressor manufacturers (1)	54	149
6	TA for compressor manufacturers (2)	60	276
7	ERA design modelling training	38	418
8	Overseas training on refrigerator options for refrigerator manufacturer engineering staff	38	380
9	In-country intensive refrigerator design training	23	506
10	First group of refrigerator factories overseas training of intensive design at the University of Maryland	7	630
11	Second group of refrigerator factories overseas training of intensive design at the University of Maryland	6	546
12	Third group of refrigerator factories overseas training of intensive design at the University of Maryland	7	651
13	Fourth group of refrigerator factories overseas training of intensive design at the University of Maryland	7	651
14	TA for refrigerator manufacturers (1) ^a	110	348
15	TA for refrigerator manufacturers (2)	58	232
16	TA for refrigerator manufacturers (3)	64	243
Total		545	5 489

^a Manufacturer technical assistance consisted of individual visits to 4-6 factories per trip, with calculation of person-days taken into account by dividing by the number of factories visited.

Labelling

The GEF energy efficiency labelling programme is part of a joint effort funded by the GEF, the Energy Foundation and the UN Foundation.⁶ The Collaborative Labeling and Appliance Standards Program (CLASP) is a technical partner. The GEF project's original intention was to include both endorsement and information label components, since both label types make different and important contributions to energy efficiency promotion. However, GEF funds for labelling were limited and China already had an energy efficiency endorsement label, so the decision was made to focus GEF support on development of the information label.



Graphic design and market testing of the new information labelling were completed and a workshop held in March 2003 to announce and evaluate design options. The draft plan for management of the labelling programme was completed at the end of 2003. Regulations to create the energy efficiency label were approved on 13 August 2004 and took effect on 1 March 2005. Refrigerators are the first product to use the label, which will then be applied to other products as well, thus expanding the scope of its impact.

As shown by the illustration above, the information label is similar to the EU label, but with a number instead of letter scale. As shown in the table accompanying the illustration, energy use allowance for each label category is expressed as a percentage of the energy use standard.

Consumer education programme

The consumer education programme's purpose was to make consumers both aware of the advantages of energy-efficient refrigerators and more willing to purchase them. The programme's budget was approximately US\$ 3 million, a significant portion of the GEF project budget and the first time that the GEF had funded a programme of this nature and scope.

Separate contracts for creative content development, media placement, public relations and consumer surveys were competitively bid and contracted. The advertising campaign began in November 2003 and was one year long. It included newspaper and magazine ads, outdoor advertising, in-store advertising, and two television ad pulses (November-December 2003 and June 2004, respectively) timed to coincide with peak buying seasons. The campaign featured the unified dual message that energy-efficient refrigerators protect the environment and save money, with imagery and themes to link those savings to the consumer's everyday life and protection of the environment.

In addition to GEF funds, participating refrigerator manufacturers were required to invest 10 per cent of their advertising budget in promoting energy-efficient products. An expert group site visit to participating manufacturers found that manufacturers met or exceeded that requirement.

⁶ Labelling funding US\$ 145,000 GEF funding, US\$ 178,000 others.

Refrigerator manufacturer incentive programme

For the refrigerator manufacturer incentive programme, basic awards of US\$ 60,000 or US\$ 120,000 (depending on manufacturer size) were awarded to each of the 16 participating manufacturers (exceeding the project's original target of 12 participants) to cover incremental costs of project participation for each manufacturer. These costs included: (a) participation in all training and technical transfer programmes; (b) increasing average energy efficiency by at least 10 per cent; (c) development of at least one new, top-rated energy-efficient product; and (d) investing at least 10 per cent of the refrigerator advertising budget in energy-efficient products. All participants met or exceeded these requirements, some significantly.

The refrigerator principal award was a total award of US\$ 1 million (including the basic award) and was given to the manufacturer who committed to and achieved the greatest total energy savings (relative to the energy efficiency standard) over a 12-month period for a single new energy-efficient model refrigerator freezer. The winner, Kelon, committed to producing and selling 1 million super-efficient refrigerators during the contest period. The model proposed, the BCD-209, uses only 0.42 kWh/day (67 per cent lower than the energy use standard), making it one of the most energy-efficient refrigerators in the world.⁷

The refrigerator principal award was carefully timed to follow the technical training, and allow for large-scale production and sales of new, energy-efficient refrigerators to benefit from the simultaneous consumer education campaign and issuance of the energy efficiency label. However, intense competition between leading manufacturers over the principal award resulted in a political battle, which (along with concerns related to the amount of money involved) delayed finalization of the award contract for several months and reduced some of these benefits.

Three supplemental awards of US\$ 60,000 each were also awarded to manufacturers that committed to and achieved the greatest energy savings relative to their base-year energy efficiency. The three supplemental award recipients (Haier, Xinfai and Kelon) are moving towards completing them.

Compressor manufacturer incentive programme

The compressor manufacturer incentive programme consisted of two awards of US\$ 400,000 and US\$ 100,000, respectively, to the manufacturers that committed to developing and commercializing the most energy-efficient compressor technologies (awards could be split in the event of a tie). For both the principal and secondary awards, proposals were evaluated and scored as follows:

Coefficient of performance (COP) of compressor – baseline COP of 1.4 multiplied by the potential market for compressor(s) of that size range.

Potential awardees for the secondary award received an efficiency bonus of 0.05 if the substitute refrigerant technology proposed differed from the one proposed by the principal award winner in order to encourage development of compressors using a variety of refrigerants.

⁷ In order to account for shipments of energy-efficient refrigerators to retailers that have not yet been sold to final consumers, Kelon and the backup award recipients will receive up to a 15 per cent credit for the delta between wholesale and final consumer sales, such that if Kelon meets its 1 million unit target for sales to retailers, up to 150,000 refrigerators may still be in retailer hands and not yet sold to final consumers. In order to encourage further promotion by Kelon of energy-efficient refrigerators and long-term sales gains, Kelon may receive another 5 per cent sales credit if at least 50 per cent of its advertising during the promotional period is energy-efficiency-related, and another 5 per cent if consumer awareness is raised by at least 10 percentage points during that period.

Three winning manufacturers were selected and committed to developing new lines of more energy-efficient compressors. Huangshi Dongbei won the US\$ 400,000 main prize with a package of 18 highly efficient compressors. Wanbao and Jiaxipera split the secondary prize. Based on site visits and data collected from the bid winners, manufacturer commitments to increase compressor energy efficiency have been met or exceeded. According to independent test results, Huangshi's top model reached COP 1.9; Wanbao's and Jiaxipera's top models reached 1.8 and 1.76 respectively, compared to average efficiency of COP 1.0 in 2000 for all compressor company project participants. All three of the bid winners had met commercialization goals, with significant sales by Jiaxipera and Huangshi (331,000 and 755,000 high-efficiency units, respectively).

Retailer incentive programme

Through the retailer incentive programme, cash payments of over US\$ 250,000 were awarded on a competitive basis to winning stores and individual salespeople. Additional funding of about US\$ 200,000 went for programme administration, an award workshop, retailer education, purchaser awards and in-store consumer education materials.

In addition to the retailer and salesperson awards, the retailer incentive programme also included a lottery-style award for purchasers. This award was designed to give purchasers an additional incentive to buy energy-efficient refrigerators, and to collect additional information (a total of 12,892 information forms were submitted).

A total of 57 top nationwide retailers were recruited to participate in the programme, all of whom signed



contracts committing themselves to achieving programme goals. A sales data collection system was established and in-store advertising materials were sent to each retailer. Retailer education was completed in April 2004 (200 salespeople received training by project staff). The retailer incentive programme contest was conducted from 1 May to 31 October 2004, after which the awards workshop was held to issue incentive funding awards. The first-place retailer award was won by the Shanghai Commercial Center. The first-place salesperson award was won by Ma Haiming from Beijing.

Participating stores and salespeople achieved sales of over 35,000 top-rated energy-efficient refrigerators. While this amount is small compared to total nationwide refrigerator sales, the programme was able to achieve a per-refrigerator incentive cost (approximately \$7 per refrigerator) that was significantly lower than that achieved in comparable rebate programmes in other countries.

Project management and monitoring

In addition to technical and substantive project activities, the China Refrigerator Project established a structure to monitor achievement of project results and manage project activities. An information centre was established (managed under subcontract by CHEAA) to collect product and other technical and financial data from participating manufacturers. A testing centre was established at the China Household Electric Appliance Research Institute (CHEARI) to perform scheduled and random testing of new refrigerators and compressors in order to provide independent test results confirming efficiency gains. A project website

(www.r-gefchina.org.cn/news/en/admin.asp) was constructed and managed by CHEAA in order to provide project- and product-related information to project participants and the public.

Through participation in the project, the project management abilities of project executor SEPA/FECO, the Project Management Office (PMO) and its subcontractors have grown steadily, and good, productive relations have been established among national and international experts and other project stakeholders. The principal structure for interaction among project stakeholders is the Advisory Committee (AC), which includes representatives from all relevant government agencies and NGOs, and which has been invaluable in providing management, guidance and coordination for the project.

PMO staff have also benefited by collaborating with national and international experts in organizing and implementing technical training workshops, as well as participating in project management-related training specifically undertaken to familiarize key PMO staff with project management techniques and practices.

The GEF implementing agency is UNDP. The domestic executing agency is the China State Environmental Protection Administration (SEPA); and the United Nations Department for Economic and Social Affairs (UN-DESA) is supporting the project as an international cooperating agency.

Stakeholder involvement

SEPA and FECO have also worked closely with representatives of the key government agencies involved in the appliance sector in order to ensure the success and sustainability of project activities, in particular the China National Development and Reform Commission (NDRC), the China State General Administration for Quality Supervision, Inspection and Quarantine (AQSIQ), the China National Institute of Standardization (CNIS), the China Certification Center for Energy Conservation Products (CECP), and others.

Most importantly, the project has been successful in working with its most important stakeholders: refrigerator and compressor manufacturers. The strong interest that manufacturers showed in the project and the sustained commitments they made in order to participate are evidence of this success. A total of 16 refrigerator manufacturers (four more than the 12 originally targeted) and 12 compressor manufacturers (double the six originally targeted) requested participation in the project, and made the necessary commitments to participate. In addition to meeting or exceeding their commitment to develop new, energy-efficient products, these manufacturers also invested significant resources in undertaking and completing project activities. Through 2004, participating manufacturers invested co-financing of over US\$ 100 million in conjunction with their participation in project activities. This figure is far more than the committed funds (US\$ 30 million) estimated in the project document. Why did these manufacturers, profit-seeking entities, participate to this extent? Because the project was designed in order to provide incentives for and maximize this participation, and ultimately because manufacturers were convinced (in no small part by project organizers and the technical and marketing research conducted during the project's PDF phase) that participation in the energy efficiency market transformation programme was in their own interest and vital to their competitive positions. This strong level of manufacturer involvement is both a major success indicator and, as a major leverage of GEF funds, a significant success in itself.

Experience and lessons learned

The China Refrigerator Project provides a variety of beneficial experiences and lessons learned for future implementation of other projects. First, during the process of project implementation, great attention was paid to

cooperation and establishment of good relations with government agencies, NGOs and donors, which greatly benefited project implementation. Close coordination with other key project stakeholders, particularly refrigerator and compressor manufacturers and government agencies relevant to the appliance sector, was essential. Coordination requires strong and constant communications with project participants, as well as ongoing monitoring of the progress of project activities, needs and requirements.

The successful implementation of the China Refrigerator Project has shown that project design is very important. As a market transformation project, the project included many more activities and was significantly more complex than a traditional highly focused project, but it was therefore able to achieve larger and more sustainable gains. Moreover, the design proved that the private sector can become fully engaged when it perceives that its marketable products as well as its production capacity can be enhanced through project participation.

The market development of energy-efficient refrigerator products includes two aspects: “pushing” efficient refrigerator production and “pulling” efficient refrigerator sales. In order to promote market development, the project adopted a wide variety of voluntary, mandatory and capacity-building measures. The combination of these measures created the conditions for long-term, sustainable transformation of the market in favour of energy-efficient compressors and refrigerators.

Finally, it is also crucial to conduct international exchange and cooperation. Many countries have significant experience with energy-efficient compressors and refrigerators. Through international exchange, research and cooperation, China was able to draw on that experience, jump-start progress in China and avoid mistakes by organizing a series of international and domestic workshops, study tours and training programmes.

Information sources

General project information is available from the China Refrigerator Project website www.r-gefchina.org.cn/news/en/admin.asp. The demonstration project technical report *Sino-US CFC-Free Super-Efficient Refrigerator Project Progress Report: Prototype Design & Testing, Summer 1997* and technical information regarding the prototype are available at www.epa.gov/appdstar/appd or from the project organizers. Copies of the project proposal, the project document and periodical status reports are available at www.gefweb.org.