



**United Nations
Environment
Programme**



Distr.
LIMITED

UNEP/OzL.Pro/ExCom/34/17
21 June 2001

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Thirty-fourth Meeting
Montreal, 18-20 July 2001

EVALUATION OF COMPLETED COMPRESSOR PROJECTS IN CHINA

Please note that the evaluation reports on the individual compressor projects visited are available on the Secretariat's web site (www.unmfs.org) in Section 2 entitled 'Executive Committee' (enter the user name and password provided by the Secretariat; subsequently click on the heading 'Evaluation Reports', and then on 'Evaluation Reports of Completed Compressor Projects in China').

1. Context

1. Conversion of compressors for domestic and commercial refrigeration is a necessary precondition for achieving CFC phase out in the refrigeration industry. The larger Article 5 countries have local production of CFC-12 compressors in order to supply the national refrigeration industry, and they want to convert this production instead of importing non-CFC compressors. At the same time, non-CFC compressors are generally based on designs developed in non-Article 5 countries and are more demanding in terms of product specifications and production technology. Therefore, it is not an easy task for compressor producers in Article 5 countries to gain the confidence of clients when switching to non-CFC compressors, given the crucial importance of the continuous and long-term operation of the compressor for the lifetime of the refrigerator, freezer or air conditioner. Continued services have to be provided for CFC-based appliances, which may require the production of a limited number of CFC compressors to replace defective ones.

2. In Decision 31/14, the Executive Committee had requested the Senior Monitoring and Evaluation Officer "to consider, during preparation of the 2001 draft work programme for monitoring and evaluation, the possibility and usefulness of a field evaluation of compressor projects, in the context of ODS phase-out in the refrigeration sector of selected countries." Subsequently, an evaluation of selected compressor projects was foreseen in the Monitoring and Evaluation Work Programme for 2001 and the submission of the final report foreseen for the 34th Meeting of the Executive Committee.

3. Given the 30 approved and 13 completed compressor projects in China, the substantial volume of funding involved, the number of PCRs received, and in view of the fact that China is the only country where four or five more commercial refrigeration compressor projects are under preparation by the World Bank and one umbrella project for domestic refrigeration compressors by UNIDO, China was selected for a country case study. Table 1 below shows the total number of compressor projects and the funding approved and disbursed:

Table 1: Overview of Commercial and Domestic Refrigeration Compressor Projects in China

Agency	No of Projects Approved	No of Projects Completed	PCR Received	Approved Funds (US\$)	Approved Funding including Adjustments (US\$)	Funds Disbursed (US\$)
IBRD	22	7	6	45,599,882	45,599,882	38,322,824
Japan	1			2,507,500	2,507,500	0
UNIDO	7	6	5	9,526,360	9,517,975	8,412,354
TOTAL	30	13	11	57,633,742	57,625,357	46,735,178

4. The evaluation does not limit itself to an analysis on a project-by-project basis, but looks at the compressor sector both in domestic and commercial refrigeration as a whole, attempting to establish a mid-term evaluation of the sector in a situation where most projects foreseen have been approved, several have been completed, and a number of new proposals are under preparation.

5. The individual project evaluation reports (PERs) have been prepared by a consultant who has more than 30 years of experience in the compressor and refrigeration industry. The PERs are available on the Secretariat's web site (www.unmfs.org) in Section 2 entitled 'Executive Committee' (enter the user name and password provided by the Secretariat; subsequently click on the heading 'Evaluation Reports', and then on 'Evaluation Reports of Completed Compressor Projects in China').

6. The present synthesis report was elaborated by the Senior Monitoring and Evaluation Officer based on inputs by the consultant.

2. Compressor production sector in China: overview of phase-out strategy, and projects approved and completed

2.1 Commercial refrigerator compressors

7. The strategy for phasing out CFCs in the commercial refrigeration sector was presented to the Executive Committee at the 17th Meeting in July 1995. The strategy was developed on the following basis: (a) that the industry should be converted to the use of HCFC-22 as a transitional measure phasing out an estimated 13,000 tonnes of CFC consumption per year, mainly CFC-12; (b) non-ODS refrigerants would be ultimately used in this sector; (c) that imported technology should be used as the basis for projects; and (d) to achieve phase out in the commercial refrigeration sector, China would only request financial assistance from the Multilateral Fund to meet the incremental capital costs of compressor conversion; the costs of converting other components and producers of refrigeration systems would be met by the country.

8. According to the "Strategy Study", China will seek Multilateral Fund support for 24 conversion projects while the remaining 49 production lines will either be closed or converted by China. The implementation of the strategy will be supervised and coordinated by the State Environmental Protection Administration (SEPA). Although the sectoral strategy was not approved as such by the Executive Committee, it was used as the basis for approving projects in this sector. Projects were approved in several batches, and not in tranches against reporting on ODS phase-out achieved, as in later 'real' sector approaches, therefore no progress reporting at sector level was requested.

9. The Executive Committee approved so far US \$43.6 million for 19 investment and one technical assistance project to be implemented by the World Bank, covering altogether 20 enterprises listed in the strategy for phasing out an estimated 4,176 ODP tonnes of CFCs. The updated CFC-12 consumption in 1997 of the industrial and air conditioning industries in China was reported to be about 9,500 ODP tonnes (about 16.5% of the overall ODS consumption), 46.3% (4,400 ODP tonnes) of which was attributed to the servicing of existing equipment.

10. Table 2 below shows the number of commercial refrigeration compressor projects and the funding approved and disbursed:

Table 2: Approved Commercial Refrigeration Compressor Projects

Status	Number of Projects	Original Funds Approved (US\$)	Total Funds Approved including Adjustments (US\$)	Funds Disbursed (US\$)
Completed	6	17,001,500	17,001,500	16,245,324
Ongoing	14	26,625,982	26,625,982	20,659,020
TOTAL	20	43,627,482	43,627,482	36,904,344

11. The first project was approved at the 15th Meeting of the Executive Committee, and another four at the 16th Meeting of the Executive Committee in March 1995. An additional four projects were approved at the 20th Meeting in October 1996, another batch of seven projects at the 22nd Meeting of the Executive Committee, and one at the 23rd Meeting (technical assistance). The latest approvals took place at the 28th Meeting, where three projects were approved. The project approved at the 15th Meeting and the four projects approved at the 16th Meeting are completed; the other 14 projects and the technical assistance project are still on going.

2.2 Domestic refrigeration compressors

12. Seven domestic refrigerator compressor projects had been completed by the end of 2000, six of which were implemented by UNIDO and one by the World Bank. Three more projects are on-going, one each implemented by UNIDO and the World Bank and another one by Japan.

13. Table 3 below gives an overview of funding approved and disbursed for domestic refrigeration projects in China:

Table 3: Overview of Funding for Domestic Refrigeration Compressor Projects in China

Status	Number of Projects	Original Approved Funds (US\$)	Total Funds Approved including Adjustments (US\$)	Total Funds Disbursed (US\$)
Completed	7	9,945,360	9,936,975	9,606,994
Ongoing	3	4,060,900	4,060,900	223,840
TOTAL	10	14,006,260	13,997,875	9,830,834

14. In May 1995, a phase-out schedule for CFC-12 compressors was indicated in a strategic study on the phase-out of CFC in the domestic refrigeration sector in China, prepared by the The Office of Household Electrical Appliances Industry. The target was set to reduce the share of CFC compressors in the overall production for the year 2000 to 40%.

15. While many domestic refrigeration companies have converted during the last five years to non-CFC equipment, there are still some which produce CFC-based refrigerators, and there is an important demand for servicing the existing CFC-based refrigerators in case of compressor breakdown. Due to the arrival of new competitors, as well as the expansion of existing production capacities of compressor factories, the competition in the Chinese market has considerably increased and it remains to be seen whether all factories converted with funding from the Multilateral Fund will be able to withstand this competition. In that context, the quality

of the compressors produced and the ability of the companies to apply more stringent production standards required for 134a compressors is of decisive importance.

3. Sample of projects evaluated

16. Four out of five completed commercial refrigeration compressor projects and three out of seven completed domestic refrigeration compressor projects were evaluated. The former have been implemented by the World Bank, the latter by UNIDO (see Table 4):

Table 4: Completed Compressor Projects by Type and by Agency (Sample evaluated in brackets)

Agency	Refrigeration Type		
	Commercial	Domestic	Total
IBRD	6 (4)	1	7 (4)
UNIDO		6 (3)	6 (3)
TOTAL	6 (4)	7 (3)	13 (7)

17. These projects used various conversion technologies, and the sample covered examples of all of them (see Table 5):

Table 5: Conversion Technology in Completed Compressor Projects (Projects evaluated in brackets)

Indirect ODS Replacement	Refrigeration Type		
	Commercial	Domestic	Total
CFC-12 to Ammonia	1 (1)		1 (1)
CFC-12 to HCFC-22	4 (3)		4 (3)
CFC-12 to HFC-134a		5 (2)	5 (2)
CFC-12 to Isobutane		2 (1)	2 (1)
CFC-11 and CFC-12 to HFC-134a	1		1
TOTAL	6 (4)	7 (3)	13 (7)

18. The sample evaluated covered also projects approved in different years (see Table 6):

Table 6: Completed Compressor Projects by Type and by Year Approved (Sample evaluated in brackets)

Agency	Refrigeration Type		
	Commercial	Domestic	Total
1994	1 (1)	1	2 (1)
1995	4 (3)	1 (1)	5 (4)
1996	1	3 (1)	4 (1)
1997		2 (1)	2 (1)
TOTAL	6 (4)	7 (3)	13 (7)

19. Finally, the projects selected for evaluation are situated in various cities, covering the main industrial centers:

Table 7: Projects Selected for Evaluation

Project Number	Location	Project Type	IA
CPR/REF/15/INV/107	Beijing	Commercial Refrigeration Compressors (COM)	IBRD
CPR/REF/16/INV/114	Yantai	Commercial Refrigeration Compressors (COM)	IBRD
CPR/REF/16/INV/113	Nanjing	Commercial Refrigeration Compressors (COM)	IBRD
CPR/REF/16/INV/110	Shanghai	Commercial Refrigeration Compressors (COM)	IBRD
CPR/REF/22/INV/211	Tianjin	Domestic Refrigeration Compressors (DOM)	UNIDO
CPR/REF/18/INV/145	Jiaxin	Domestic Refrigeration Compressors (DOM)	UNIDO
CPR/REF/20/INV/185	Guangzhou	Domestic Refrigeration Compressors (DOM)	UNIDO

4. Main evaluation results

4.1 Production figures and ODS phase-out achieved

20. The baseline production figures given in project documents and project completion reports for commercial refrigeration compressor projects before the conversion and the production figures planned to be achieved after the conversion are much higher than the actual production observed by the evaluation mission (see Table 1 in Annex I and Diagram 3 in Annex II). An explanation could be that these figures have been based on the technical capacity to produce instead of showing actual production figures, and such capacity estimates might have then been extrapolated without taking into account marketing constraints for future sales prospects.

21. Two projects (CPR/REF/16/INV/114 in Yantai and CPR/REF/16/INV/113 in Nanjing) reached 10-11% of the forecasted production volume of non-CFC compressors, the two other projects (CPR/REF/15/INV/107 in Beijing and CPR/REF/16/INV/110 in Shanghai) only 1-2%. According to information obtained from the companies, production volumes are expected to increase only moderately during the coming years. As a consequence of the low actual production figures, the indirect ODS phase-out planned by these projects has largely not been achieved (see Table 1a in Annex I) because the planned numbers of non-CFC compressors were not produced and made available by the funded projects. It should be noted that the accounting of indirect phase-out differs from other types of projects where the ODS phase-out is fully counted as soon as the ODS baseline consumption is eliminated, regardless of the production level reached with the converted facilities.

22. SEPA provided an updated list on the status of the 73 producers of commercial refrigeration compressors foreseen for conversion or closure. In addition to the 19 enterprises with conversion projects funded by the Multilateral Fund, 22 companies are listed as still producing commercial refrigeration compressors for use with CFC, while another eight reportedly converted at their own cost and 24 have stopped producing compressors. Details about production figures and capacities were not available on either group. The list shows the painful process of restructuring and consolidation underway in this industry which is difficult to assess and to forecast.

23. During the evaluation, it was not possible to establish to what extent the current demand for commercial refrigeration compressors in China is satisfied by compressors for use with CFC and by non-CFC compressors. Reliable estimates of the total present demand for commercial

refrigeration compressors in China could likewise not be obtained. Given the growth rate of the economy in general and the construction sector in particular, it can be safely stated though that the demand is rapidly growing. Imports of non-CFC compressors have been liberalized and are rising fast and at the same time, recently established joint ventures with well-known multinationals are capturing increasing market shares, mainly with high quality non-CFC compressors.

24. The planned and actual production figures for domestic refrigeration compressor projects are satisfactory. They were based on real figures and took into account the increasing competition in the sector. The main problem is that large parts of the production are still compressors to be used with CFC (see Table 1a in Annex 1). The average share of CFC compressors in the total production of 16 producers of domestic refrigeration compressors was 57% in the year 2000, compared to the 40% targeted in 1995 by the Office of Household Electrical Appliances Industry. The three projects evaluated had shares of 87%, 46% and 44%, with some further reductions during the first quarter of 2001 (see Diagram 1 in Annex II). This level is largely above the one needed for replacing compressors for CFC-based appliances in service operations. It signals that there is still a substantial share of CFC-based refrigerators being produced, satisfying primarily the demand of price-sensitive customers.

25. Although the evaluation mission obtained figures only for production, not for capacities, representatives from all three domestic compressor projects evaluated stated that the installed production capacity of the domestic compressor industry is significantly larger than its present production level. The growth of production in the domestic refrigeration sector is quite fast, as shown in Table 8:

Table 8: Production Increase of Refrigerators, Freezers and Compressors

Year	Production of Refrigerators	Production of Freezers	Production of Compressors
1995	8,993,346	3,081,417	9,877,813
2000	12,305,783	4,258,869	12,059,294

*Source: SEPA, May 2001

26. The domestic compressor refrigeration production increased substantially by 22% between 1995 and 2001, but did not keep pace with the growing production of refrigerators (+36%) and freezers (+38%), the deficit being made up by imported compressors which are used mainly for refrigerators exported to markets in Article 5 and non-Article 5 countries.

4.2 Capacity of funded equipment / running times

27. The "standard" production equipment requested in the commercial refrigeration compressor projects has been numerical machining centers at a cost of about US \$650,000 each (sometimes three sets per enterprise), as well as other expensive equipment. In most cases, the running times of such costly equipment are too low. One reason is the low level of production compared with production targets indicated in the project documents, but even for the originally planned production level, the equipment is oversized in terms of capacity created. This applies in particular to the number of machining centres and their fast loading systems, designed principally for processing large numbers of crankcases with high productivity.

28. The common principle for the industry is quite simple: the more expensive the equipment is, the more the running time of the machinery must be prolonged. The calculation base for the use of such equipment should be 5-6 working days per week, in 2-3 shifts per day. This principle is accepted in western industrialized countries, including (very strong) labour unions. Compressor production running on five or six days in three shifts per day is not the exception, but rather the rule. It must be organized in such a way that all costly machinery runs as many hours per week as possible, even if other departments (e.g. assembly lines) work only in one shift. Annual running times should be based on the situation in a specific country by using the running times according to Diagram 2 in Annex II as indicative figures.

4.3 Technology supplier, management of technology transfer and local research and development

29. Six of the seven projects experienced problems with the technology supplier. Due to the 50% Zanussi ownership, only one project CPR/REF/22/INV/211 (Tianjin) had direct access to all relevant technical information. The main problems for commercial refrigeration compressor projects were delays of technical documentation, delivery of incomplete drawings and specifications and difficulties with communication. Only a few of many models developed and delivered by the technology supplier are actually produced, while the others are kept in reserve for possible future market demands, which were not actively explored though. For domestic refrigeration, several problems occurred with regard to testing equipment, noise level and energy efficiency of non-ODS compressors, which did not correspond to updated requirements and had to be adjusted, integration of equipment into the production process and adaptation of specifications to local standards and suppliers.

30. The choice of a reliable technology supplier, with the technical ability to support the factory in all relevant issues, seems to be the key factor in all projects. Unfortunately, several contacts with experienced suppliers failed due to the high demand for technology fees, or even due to strategic considerations of potential suppliers. As China is regarded as the most promising market in the world for the cooling industry, the technology suppliers are more interested in gaining their own market share, rather than making Chinese companies more competitive. Solutions in this situation are very difficult to find, particularly with limited funding available, and to accept the excessive technology transfer costs demanded by some leading international compressor producers would be unreasonable.

31. The transfer to non-ODS based technology for compressor production is a complicated process. Generally, it was observed that the conversion was regarded solely as a technical project, without the involvement of commercial and marketing departments. In view of the complexity and limited time available for the conversion, such a project would, according to the experience of the consultant, optimally be prepared in a team-oriented approach involving all stakeholders in the different departments of the company in a task force working temporarily parallel to the established lines of hierarchy and reporting directly to the top management.

32. One commercial refrigerator compressor manufacturer (Shanghai General Machinery Works) successfully developed a design for compressors to be used with HCFC-22, and continues to produce them in larger numbers, and at a much lower cost than the ones based on the imported design. The reason for the high cost of the compressors based on the imported

design is that their production requires the continuous import of very expensive parts. This makes it difficult to sell the compressors and limits the market practically to foreign-owned companies in China. The company explained that the information received from the foreign technology supplier helped to improve its own design. However, a consultant contract for the technological up-grading of their own design, in combination with continued development efforts of the company, using internationally available information and the local network of universities and institutes, might have achieved the same result at a much lower cost and with more sustainable results. By searching in international databases, particularly on patents, and following international publications, conferences and web sites, more than 90% of the information needed to improve local designs could be obtained, provided that companies are ready to provide the necessary manpower and invest relatively modest resources for such activities.

4.4 Disposal of old equipment

33. The existing old equipment (CFC-based) in a compressor factory could be used to a large extent with some modifications in the production of non-CFC compressors, except for washing machines in case of conversion to HFC-134a. Furthermore, the newly funded equipment could also be used to produce compressors for CFC-based appliances.

34. Destroying the old equipment is therefore for most parts meaningless and does not guarantee the sustainability of the phase-out process. Rather than destroying the old equipment, it would be more useful to have a solid agreement guaranteeing the sustainable conversion of compressor producers between the Government of China and the Multilateral Fund. Part of this agreement should also include the definition of the level and the monitoring of remaining CFC compressor production for servicing purposes. This would ensure sustainability of the conversion and would limit the risk that the funded equipment would be partly used for the production of CFC compressors.

35. One way to ensure effective monitoring after project completion would be to request the company to use a management system based on ISO 9001 or ISO 14001. Both standards have technical similarities and identified links. As the conversion to non-ODS based products directly pertains to environmental issues, the preferred system should be ISO 14001. As compliance with ISO provisions is regularly verified at factory level, this would effectively oblige the company to ensure sustainability of the phase out.

4.5 Eligibility of equipment and funding levels

36. For the domestic refrigeration compressor projects visited, the evaluation did not identify any major items as not being necessary for the conversion. Also the volume of funding for equipment was found to be adequate, no significant technological up-grade took place; in one case the level of funding approved for technology transfer and testing equipment, didn't allow for the best choice in terms of quality.

37. For the commercial refrigeration compressor projects the equipment provided, in particular the numerically controlled machining centres and the computerized three-dimensional measuring systems, were found to present a significant technological upgrade and over-

expansion in terms of actual and even of planned production levels (see also section 4.2 above). Funding requested had been approved with a 20 % reduction, in order to compensate for the technological upgrade expected. This reduction was to be made up by counterpart funding agreed upon at the time of approval. However, 20 % proved to be largely not enough to compensate for the over-funding approved on the basis of exaggerated production figures and equipment needs.

38. In the consultant's opinion, an alternative which might have been more appropriate to limit funding to the items essential for the conversion is the following: the more the item (process, equipment, consulting) is directly necessary for the new substitute production, the higher the funding level could be, varying for example between 100% for items considered as essential for the conversion and 20% for items which facilitate the conversion and improve the technical performance and competitiveness of the company but are not essential for the conversion in technical terms.

4.6 Implementation delays

39. The four commercial refrigeration compressor projects have been significantly delayed in comparison to the originally approved completion dates (between 9 and 30 months). The actual project duration varied between 46 and 67 months (see Table 1b in Annex I). The main reasons for these delays are complications during the identification and contracting of foreign technology suppliers. The difficulties continued during implementation when the designs for non-CFC compressors were supplied with long delays. The companies also complained frequently about communication problems and difficulties in adopting the designs to local conditions (see also Section 4.3). Moreover, some delays were reported with regard to the mobilisation of counterpart funding.

40. The domestic refrigeration compressor projects showed variable performance with regard to delays. The first one, project CPR/REF/18/INV/145 (Jiaxin), which was the first hydrocarbon project in China for UNIDO's implementation, had a delay of 25 months and an overall implementation duration of 50 months. In view of its pilot character, the duration had been planned too optimistically. The second one, a conversion to HFC-134a, was completed within 37 months without delay, and the third one, again a conversion to HFC-134a, was completed six months ahead of schedule, in only 19 months, mainly due to the commitment and technical input provided by the strong foreign partner company (Zanussi).

4.7 Government actions

41. Tax incentives, production licenses and import restrictions had been foreseen in the project documents for commercial refrigeration compressor projects but have not been realized so far for various political reasons. Additional measures by SEPA could speed up the phase-out process significantly, particularly in view of the fact that the technical conversion of compressor factories alone will never guarantee the phase out. As long as there is a demand for CFC-compressors, the companies will produce them. Policy measures could be a special price and tax policies, import limitations and production licenses for CFC-based products or promotions for non-CFC based products.

4.8 Quality of the PCR and preparation of evaluation visits

42. The project documentation at the time of project preparation is mainly based on estimates and assumptions and prevailing experiences. Therefore, some deviations from the planned process would not surprise, particularly in a country like China with a rapidly changing economic framework. However, the project completion reports should describe the phase-out process and report facts and actually achieved figures. For commercial refrigeration compressor projects in particular, there was a significant deviation between the PCRs and the situation observed by the evaluation mission. In most cases, the figures for actual and projected production and phase-out were exaggerated, in particular, for projects CPR/REF/15/INV/107 and CPR/REF/16/INV/110 (see also the individual project evaluation reports (PERs), in particular Section 3.13 "Consultant Comments"). The Overall Assessment of Projects in Section 8 of the PCRs is also too positive for these projects. Although these PCRs provide useful information on other aspects, like cost and various implementation problems, they are giving a far too positive report and outlook with regard to the main project results in terms of indirect ODS phase-out achieved, and should be corrected accordingly and re-submitted.

43. While some companies made a well-prepared presentation at the beginning of the evaluation visit, in several cases, considerable time was required to clarify basic facts, e.g. the production figures for the last years. This process could have been much faster with good PCRs in hand and updated figures prepared by the company prior to the visit.

5. Project completion and overall rating of projects evaluated

44. According to Decision 28/2 of the Executive Committee, taken in July 1999, completion of a project means:

- (a) "No further use of CFCs is in evidence;
- (b) that the alternative product is being produced and/or production has begun; and
- (c) that the CFC-using equipment has been destroyed/dismantled/rendered unusable with CFCs."

45. Using this decision as a reference, the new overall assessment scheme was included in the revised project completion report format for investment projects, and also used for project evaluation reports (PERs). It has been designed in a way that 20 points are given for each of the three criteria listed above if they are fulfilled, and 0 points if they are not; in the latter case the overall rating is not applicable. Only two of the seven projects evaluated were declared as completed before the above decision was taken, the others in the progress reports for 1999 and 2000, hence the decision applies to these five projects.

46. For the seven projects visited, the situation observed is shown in Table 1a in Annex I and can be summarised as follows:

- (a) In the domestic refrigeration compressor projects completed in 1998, 1999 and 2000, full ODS phase out as approved has not yet taken place as compressors to be used with CFC are still being produced well above a reasonable level needed for servicing purposes (which was never exactly defined though) and above the level of 40% foreseen to be reached in the year 2000 (see also Section 4.1 above). This renders the projects incomplete and the rating in the PER format non-applicable;
- (b) In one project (CPR/REF/18/INV/145 in Jiaxin), certified equipment destruction had not taken place because it was not applicable due to particular circumstances. In another project (CPR/REF/16/INV/114 in Yantai), the beneficiary company did not have any old equipment to destroy, but seven companies were supposed to close production of CFC compressors. Three of these enterprises were closed, one closed a production line, two others stopped compressor production, and on one, there was no information available. As explained in Section 4.4 above, equipment destruction is generally of limited relevance for compressor projects, but an absence of certified information renders the project incomplete and the overall rating non-applicable;
- (c) Finally, in one case, ODS-free production did not proceed beyond the manufacture of a limited number of prototypes, and by January 2001, production came to a complete standstill, awaiting restructuring of the company (project CPR/REF/15/INV/107 in Beijing). This again makes the project incomplete and renders the rating non-applicable;
- (d) Only three projects have been reported as financially completed so far. In two projects (CPR/REF/16/INV/110 and CPR/REF/16/INV/114), balances are shown, which consist of the three per cent fee for the financial agent, which has been completely disbursed according to the World Bank; the balances should therefore not be shown anymore in the Bank's progress report.

47. A new rating system was developed by the consultant for the evaluation, and six categories reflecting the major issues identified during the evaluation were used for rating the projects:

- (a) Project documents: realistic or not, in particular with respect to baseline production figures and indirect ODS phase-out targets (where applicable, that means for commercial refrigeration compressor projects);
- (b) Conversion achieved: level of actual production of non-CFC compressors and remaining production of CFC compressors, as compared to the planning;
- (c) Equipment funded: oversized or not, sufficient running times, technically adequate;
- (d) Technology supplier: technical ability, respect of time schedules, cooperation with the beneficiary company;

- (e) Quality of PCR: PCR gives a real picture of the project's situation, in particular with regard to the main results achieved;
- (f) Marketing: participation of marketing department in conversion planning, company knowledge of the market for the different non-CFC compressor models planned and produced.

48. The score for each category ranges from six (highly satisfactory) to one (not satisfactory). The total score runs from 36 (best possible result achieved in a project /excellent) to 6 (worst result, project not satisfactory). The overview of this assessment is given in Table 9 below:

Table 9: Rating of Projects Evaluated¹

Project	107 Beijing	114 Yantai	113 Nanjing	110 Shanghai	211 Tianjin	145 Jiaxin	185 Guangzhou
Commercial = COM Domestic = DOM	COM	COM	COM	COM	DOM	DOM	DOM
Implementing Agency	WORLD BANK	WORLD BANK	WORLD BANK	WORLD BANK	UNIDO	UNIDO	UNIDO
R-12 substituted by:	R-22	R-717 ³	R-22	R-22	R-134a	R-600a	R-134a
Project documents	1	3	2	2	6	5	6
Conversion achieved	1	3	2	1	4	4	3
Equipment funded	1	5	2	1	5	4	5
Technology supplier	2	3	3	1	6	3	3
Quality of PCR	2	5	4	3	5	4	5
Marketing	1	4	3	2	5	5	4
Total Score²	8	23	16	10	31	25	26
Rating	Not Satisfactory	Satisfactory	Less Satisfactory	Not Satisfactory	Excellent	Very Satisfactory	Very Satisfactory

¹The rating for each category ranges from 6 = excellent to 1 = not satisfactory

²Total score: Excellent: 30-36
Very satisfactory: 24-29
Satisfactory: 18-23
Less satisfactory: 12-17
Not satisfactory: 6-11

³Ammonia

49. The three domestic projects reached an average score of 28, whereas the four commercial projects showed an average of 14. This assessment, to a certain extent, represents a subjective judgement. However, the differences are quite striking and indicate major problems for three of the four commercial refrigeration compressor projects evaluated.

6. Recommendations

50. The Executive Committee taking note of the findings and lessons learnt contained in the evaluation report might decide:

- (a) To request the Government of China to assess the additional needs for non-CFC domestic and commercial refrigeration compressors over and above the capacities already converted which are partly under-utilized. The assessment should take into account the pace of conversion of the refrigeration industry, the existing and future demand for CFC-compressors for servicing purposes, as well as the financial viability of the would be beneficiary enterprises.
- (b) To consider future proposals in this sector in the light of this assessment;
- (c) To request SEPA to examine, in cooperation with the World Bank, the possibilities for relocating idle or under-utilized machining centres in commercial refrigeration compressor projects to compressor companies with better prospects for achieving a satisfactory rate of capacity utilization and cost-effectiveness;
- (d) To request the implementing agencies to monitor continuously the conversion process of ongoing compressor projects and inform the Secretariat and the Executive Committee about any significant deviations in their progress reports;
- (e) To request the implementing agencies concerned to revise the PCRs and to resubmit them in cases where the evaluation found discrepancies between the PCR and project reality;
- (f) To urge the relevant implementing agencies to take into consideration the findings and lessons learnt presented in the evaluation report when preparing future proposals for compressor projects.

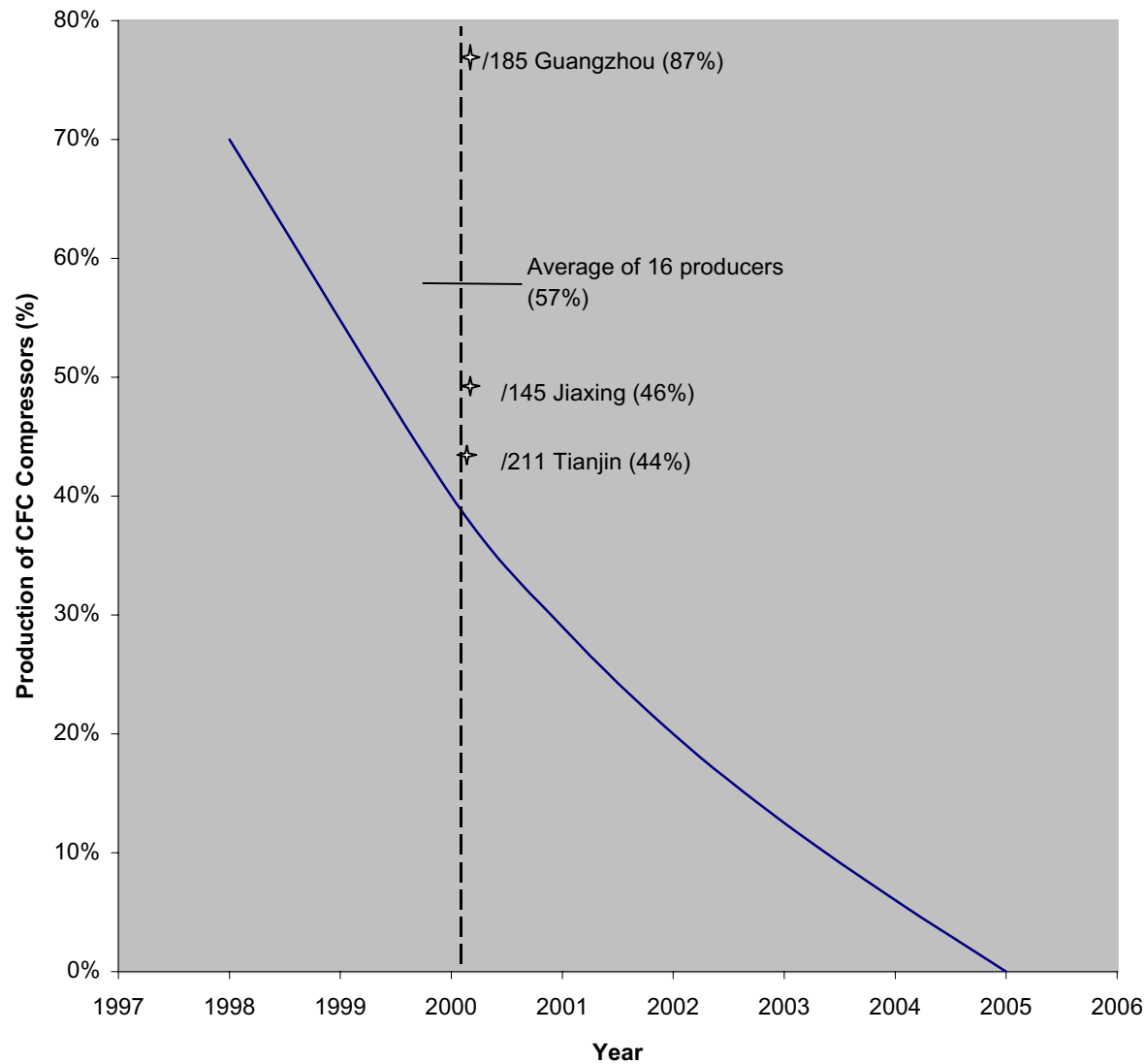
Table 1a: Overview of Compressor Projects Evaluated

Project Number and location	Agency	Dom/Com	MLF Funds Approved	MLF Funds Disbursed	Total Project Cost as per PCR	Total Planned Production Figures according to ProDoc	Total Actual Production Figures according to PCR	Total Actual Production Figures according to Evaluation (units/year in 2000)	Share of non-CFC based production in 2000	Share of non-CFC based production in 2001	Approved indirect ODS phased out ¹ (in the inventory)	Approved ODP to be phased out in the 2000 Progress Report	Actual ODP phased out in the 2000 Progress Report	Actual ODP phased out in the PCR	Total indirect ODS phase out ¹ (in ODP tonnes) as per evaluation	Cost effective-ness grant approved (US\$/kg indirect ODS phase out) as per PCR	Cost effective-ness grant actual (US\$/kg indirect ODS phase out) as per evaluation
CPR/REF/15/INV/107 Beijing	IBRD	COM	3,098,000	2,912,938	3,910,255	15,000 units/year	5,000 units/year	144	26%	All production stopped in 2001	100	245	232	245	2.2	12.3	1,304
CPR/REF/16/INV/110 Shanghai	IBRD	COM	2,710,000	2,628,700	3,386,328	4,000 units/year	not clear; 1,000 units/year were expected for 2000	68	100% (incl. own HCFC-22 models)	100% (incl. own HCFC-22 models)	100	170	161	162	2.7	16.2	958
CPR/REF/16/INV/113 Nanjing	IBRD	COM	2,890,000	2,724,812	3,515,345	10,000 units/year	1,000 units/year in 1999	1,000 (in 1999)	100%	100	150	255	241	242	19.2	11.6	142.2
CPR/REF/16/INV/114 Yantai	IBRD	COM	2,874,000	2,787,800	3,504,715	3,200 units/year	70 units in 1999	358	100% in project, in other companies not known	100% in project, in other companies not known	240	240	240	240	26.9	11.6	103.8
CPR/REF/18/INV/145 Jiaxipera	UNIDO	DOM	1,490,000	1,432,066	1,764,406	1,000,000 units/year in 1995	1,000,000 units/year in 1999	875,200	54%	100% (will be less for all 2001)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CPR/REF/20/INV/185 Guangzhou	UNIDO	DOM	2,250,000	2,137,456	2,919,590	1,250,000 units/year in 1995	1,166,872 units in 2000	1,167,000	13%	33%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CPR/REF/22/INV/211 Tianjin	UNIDO	DOM	962,175	962,175	Not Available	1,200,000 units/year	900,000 units in 1999	1,107,624	54%	No information	N/A	N/A	N/A	N/A	N/A	N/A	N/A

¹Indirect ODS phase-out is applicable in the commercial refrigeration compressor sector in China. Per agreement with the Multilateral Fund, for phasing out CFC in the commercial refrigeration sector, only compressor projects are funded. In case there is a shortfall of production of non-CFC compressors compared to the planned production figures, the respective indirect ODS phase-out is not achieved (in contrast to other types of projects where the ODS phase-out is counted regardless of the production level reached with the converted facilities). In the domestic refrigeration compressor sector, no ODS phase-out is counted (except for small amounts of direct ODS phase-out related to solvents) because this would result in double counting with the numerous domestic refrigeration projects approved and implemented.

Table 1b: Project Duration and Implementation Delays										
Project Number and Location	Agency	Dom/Com	Date Approved	Planned Date of Completion Per Proposal	Revised Completion Date As Per Progress Report	Actual Date of Completion As Per Progress Report	Actual Date of Completion As Per Evaluation	Actual Project Duration (months)	Implementation Delays using Planned Date of Completion Per Proposal (months)	Implementation Delays using Revised Completion Date (months)
CPR/REF/15/INV/107 Beijing	IBRD	COM	Dec-94	Dec-97	Dec-99	Aug-00	Jun-00	67	30	6
CPR/REF/16/INV/110 Shanghai	IBRD	COM	Mar-95	Mar-98	Jun-99	Sep-98	Dec-98	46	9	-6
CPR/REF/16/INV/113 Nanjing	IBRD	COM	Mar-95	Mar-98	Jun-98	May-99	Jun-99	52	15	12
CPR/REF/16/INV/114 Yantai	IBRD	COM	Mar-95	Mar-98	Jun-99	May-99	May-99	51	14	-1
CPR/REF/18/INV/145 Jiaxipera	UNIDO	DOM	Nov-95	Nov-97	Nov-97	Dec-99	Dec-99	50	25	25
CPR/REF/20/INV/185 Guangzhou	UNIDO	DOM	Oct-96	Oct-99	Oct-99	Oct-99	Oct-99	37	0	0
CPR/REF/22/INV/211 Tianjin	UNIDO	DOM	May-97	Jun-99	Jun-99	Dec-98	Dec-98	19	-6	-6

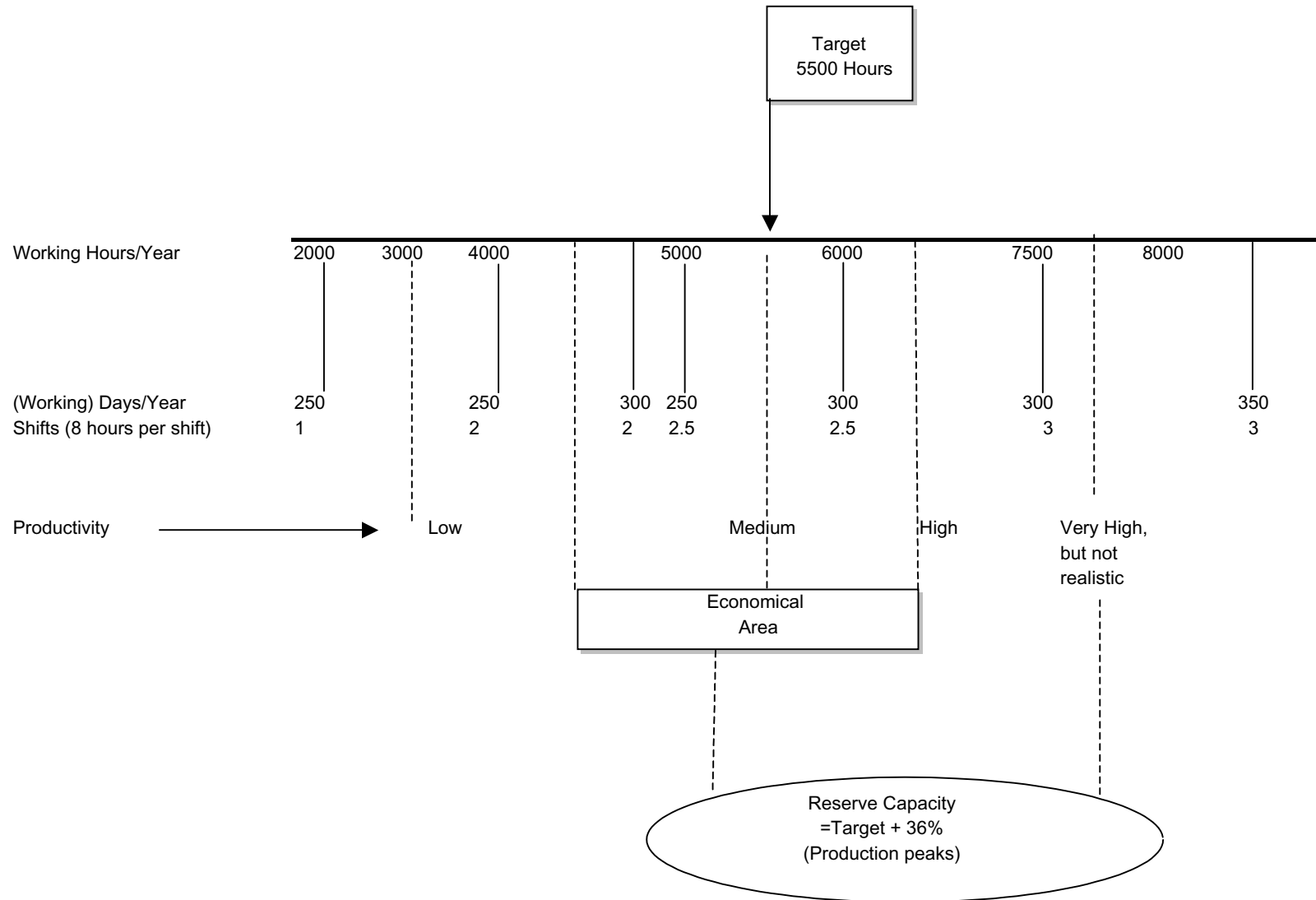
Diagram 1: Predicted Phase-Out Schedule for CFC Compressors for Domestic Refrigeration



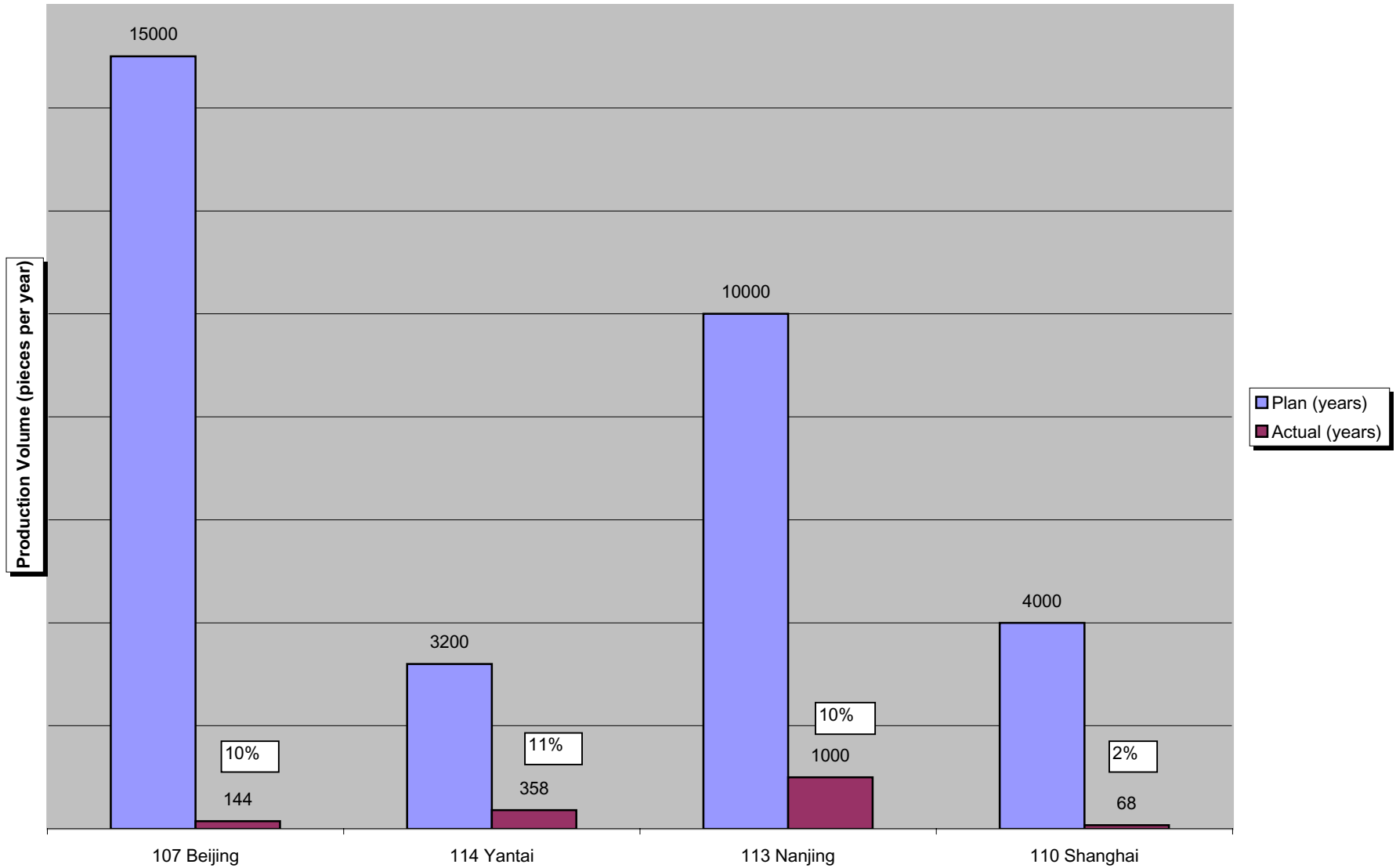
— Predicted phase out schedule according to Strategic Study on the Phase-out of CFC in the Domestic Refrigeration Sector by The Office of Household Electrical Appliances Industry, Beijing, 1995

Note: The 2000 average data for 16 producers and the figures for the three projects evaluated were collected by the evaluation mission.

Diagram 2
Running Times for Expensive Compressor Production Equipment



**Diagram 3:
Commercial Refrigeration**



Source: Planned data as per project documents; actual data provided by beneficiary companies during visits by the evaluation mission.