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DESK STUDY ON THE EVALUATION OF CHILLER PROJECTS

EXECUTIVE SUMMARY

1. The objective of this desk study is to report on the efficacy of the eight major demonstration projects based on documentation available with a view to improving understanding of progress made, difficulties still being encountered, various attributes and/or shortcomings of the co-funding mechanisms and project approaches in the implementation of chiller projects. The study builds on and updates the finding of a previous 2008 evaluation report. The study stresses that projects with actual replacement of a significant number of large centrifugal chillers completed since 2009 remain few, (103 of 2,544 chillers or 4%)

2. These replacements take place under various conditions and mechanisms with different domestic incentives. It is now much clearer what is causing this slow progress and why certain mechanisms and stimuli are appealing to only a small part of the chiller owners in a country.

3. In many countries energy savings combined with the declining CFC supply were thought to be a sufficient stimulus to drive replacements. This however is not working in all countries and where is working it is not fast enough. A large variety of mechanisms, promotions, incentives, stimuli as described in this report are now being utilized in the eight demonstration projects but these projects have been slow getting started and thus progress reporting to date is very limited; it was noted that with relatively low running time percentages, the financial savings over a relatively short period of 2-3 years was relatively small, much smaller than a loan to pay back 60-80 per cent of the total investment for a new centrifugal chiller plus the necessary ancillary equipment. Based on documentation available, it is not clear as to whether this issue is playing an important role in the reluctance of many owners to replace centrifugal chillers. In addition, there is no data available to update the earlier Desk Study finding that replacement of a centrifugal chiller by smaller non-centrifugal (screw and scroll compressor driven) units are continuing to be a much more attractive choice (even using ammonia in some cases). Documentation on this specific issue remains non-existent. Furthermore, the earlier 2009 Desk Study reported a lack of understanding of whether the chillers are covered by existing NPPs or TPMPs, or whether chillers were

perceived by countries as being outside these umbrella projects. Based on the documents reviewed, this still remains an unknown. Countries are not as yet reporting difficulties encountered in the total phase-out process due to the remaining CFC consumption in centrifugal CFC-based chillers**.** The 2009 Desk Study concluded that it would be logical not to pursue MLF interventions, or those of other financial entities, to provide grants for revolving funds for the replacement of CFC chillers, unless Article 5 countries provided compelling evidence that the impact of such mechanisms could be supported by a list of chillers still in operation (including their operation history) that would be targeted. There was no information available on this aspect to update this observation;

~~4.~~ With the emerging HCFC phase-out in Article 5 countries, the question arose as to whether replacements should be considered for HCFC-22 operated chiller equipment that is smaller in capacity than those using HCFC or HFC, and in which manner this issue should be technically resolved. Without clear solutions, it was concluded that the HCFC-22 equipment should be kept in operation until suitable alternatives could be identified. This conclusion remains in effect.

5. The 2009 Desk Study recommended that bilateral and implementing agencies should continue identifying centrifugal chiller projects for the CDM or VCS recognizing this approach would, however, have administrative drawbacks. This has indeed been the case and the experiences both positive and negative in this regard are set out in this report.

6. Some key observations are as follows:

Financial Arrangements and Incentives

7. Counterpart and ODA grant co-financing options might be preferred for quick results and where the aggregated global need for such funds would be significantly larger than their availability under bilateral ODA. On the other hand, innovative funding arrangements (ODA + private sector and/or carbon funding) possess a clearly superior leveraging capacity, in particular where projects create tangible benefits for the co-financing entities.

8. The demonstration projects show that incentives were provided based upon the rate of return on investment considerations. For the Syria and the European projects, the incentive was determined on a rate of return of investments in the range of 30%. The World Bank's global chiller project provides incentives to chiller owners averaging 20% of the purchase cost of a new chiller, using funds from the MLF and the GEF. Other incentives were the substantially reduced purchase costs of non-CFC based replacement chillers (Eastern Europe and Syria project).

9. In the case of the European regional project an additional incentive was the regulatory pressure derived from the accession by several countries to the European Union and therefore the obligation to comply with the European Community's CFC regulations.

10. There is little need for incentive (and in some cases none) for a replacement decision when large entities, public, private or commercial with funds readily available are involved or in countries where energy costs are high and chillers are rapidly approaching the end of their useful life. Nevertheless, in the case of small business chillers or chillers in marginal profit situations significant incentives are crucial for the success of the project.

11. Allegedly, a high and fluctuating cost of electricity is a strong economic driver for replacement of chillers. However, this assertion is not supported by existing evidence.

Energy Efficiency

12. Although energy savings typically relate to reductions in energy consumption, which alone often make the replacement of old chillers an economically viable option, evidence from project implementation showed that replacements often need additional external stimuli. In addition energy cost savings are not a driver in countries where energy costs are very high. Nonetheless, energy efficiency improvements lead to a savings in emissions of carbon dioxide released during the generation of electricity.

13. An interesting case is Brazil where the chiller project was integrated into a larger undertaking to foster energy efficiency investments in private and public buildings. The emphasis was to demonstrate the energy efficiency potential of non-CFC based chillers by addressing technical and financial barriers. Unfortunately, there is not much information on the progress of this endeavour yet.

Communication

14. Regional networking plays an important role in helping replicate the successful features of well-designed projects into future or on-going projects. During meetings and workshops, project managers and country office personnel discuss both technical and administrative issues, share experiences and best practices, and gain a sense of how the portfolio functions at a regional level. Multi-stakeholder engagement from the onset is necessary for both problem ownership and sustainability of results. Effective communication is also required to dispel an often high degree of initial scepticism of chiller owners, particularly during the start-up phase. Demonstration projects have shown that once the benefits of chiller replacement become clear, the scepticism disappears.

15. The demonstration projects, especially the regional and global projects, have created a wide and often regional dissemination of change agents and observable chiller replacement working examples that bare testimony to efficiency, potential cost savings, validation of payback periods, operating characteristics and other points of interest to chiller owners faced with the need to move away from CFC-based chillers.

16. Widespread outreach and enhanced awareness not only enhances feasibility of Article 5 countries to meet their MP obligations pertaining to Annex A chemicals, but also plays a role in preventing the sustained demand for CFCs which is a stimulus for the creation of illegal markets.

Barriers and Impediments in project implementation and causes of delays

17. Barrier and impediments in the implementation of projects dealing with the replacement of chillers have been attributed to an array of factors such as low energy prices, limited access to capital and high financing costs; and, the high cost of upfront investment.

18. In addition, projects experienced delays when trying to synchronize project cycles and requirements among various implementing and funding entities. Other factors were: the lack of information of the decision makers about financially attractive energy efficiency measures; limited availability of suitably skilled personnel to identify, implement and manage energy efficiency measures and to implement the project.

19. In some cases the absence of energy policy as well as the weakness and/or absence of a regulatory framework and of a strong lead organisation hampered project implementation, as was the absence of a strategy to educate various stakeholders on the benefits of energy efficient chillers. It was noted that, when managers considered chiller replacement in an environment of hard resource constraints, more critical and potential revenue generating projects (for example upgrading the foyer of a tourist hotel) were given priority over marginal cost saving projects (like chiller replacement).

20. Some delays were caused by the time needed for ERPA's (emission reduction purchase agreements) and the signing of grant agreements.

21. A key barrier that needs to be overcome is associated with the preparatory efforts required due to the complex design of co-funding that has reportedly delayed many projects very considerably. Some projects experienced difficulties in the synchronization of project cycles, procedures and schedules among various funding and implementing partners. This implies that further improvements in co-operation and coordination between funding bodies is needed and could reduce delays and facilitate a more timely implementation of projects. Also, the unexpectedly long time required to organize the co-funding has created an additional strain on the working relationships with chiller owners, and therefore on implementation.

22. Almost twenty five years of MP implementation has demonstrated that both supply-side management and demand-side management are needed. However, demand-side management has a prerequisite; namely, an accurate and ongoing assessment of changing demand. Unfortunately, the only available estimate of the global population of chillers was made in 2004 and there has been no further updating of these figures. This lack of quantification precludes an analysis of the outstanding chiller replacement challenge and also precludes reporting in a factual manner on progress and allows only for best and unsubstantiated estimates.

23. In addition, chiller replacement was not the only project outcome expected. Therefore a more detailed and frequent reporting is needed regarding the many other anticipated and positive outcomes as they represent additional success factors.

I. Proceedings for the 2012 updated desk study on the evaluation of chiller projects

24. A consultant, recruited for his experience and knowledge of the subject matter and of the functioning of the Montreal Protocol, undertook the desk study. He analysed individual project documents, reports and comments by the Multilateral Fund Secretariat, Executive Committee meeting reports, summary of decisions, progress reports, agreements made between the Executive Committee and the national governments at the time of project approval as well as further renegotiation of terms. The listing of documents reviewed is set out in Annex I.

25. The consultant prepared a draft report which was discussed with members of the Multilateral Fund Secretariat, bilateral and implementing agencies. The report includes an identification of the main evaluation questions and associated issues that could be pursued via a small number of country case studies.

II. Background

26. In the private sector, there are basically two types of chiller owners: (a) commercial owners with good investment capacities, such as hotels and banks; and (b) private owners with low investment capacities, such as owners of older and often marginally economic local properties. Projects that deal with chiller issues have to take into account, in both design and implementation, these differences between public and private sectors as well as within the private sector.

27. At its 45th meeting the Executive Committee provided a funding of US $15.2 million for the chiller sector. In addition, decision 47/26 of the Executive Committee approved seven chiller demonstration projects (Brazil, Caribbean Region, Colombia, Cuba, East European Region, Syrian Arab Republic[1] and a global chiller replacement project). The funds approved, amounted to US $12.5 million. These, together with external resources of US $16.2 million were to cover the replacement of at least 211

[1] SYR.REF.47.DEM.93. Demonstration Project on the Replacement of CFC Centrifugal Chillers in Bahrain and Syria is mentioned in this document as the "Syria Regional Project"

chillers and the conversion of a further 9 chillers. The Executive Committee also agreed to assign US $200,000 to awareness global technical assistance implemented by UNEP. Furthermore, at the 48th meeting US $2,000,000 was also set aside for demonstration projects in the region of Africa, along with a UNEP-lead amended global technical assistance project. Decisions 55/5(d) and 56/10(a) noted the progress made in all chiller projects.

28. Project approvals came with conditions: external resources associated with the proposals could be used only for activities considered to be part of the project costs; disbursement of the funds would be dependent upon confirmation of the availability of external resources; and, no further funding for chiller replacement would be approved by the Executive Committee.

29. The projects proposed co-financing from a variety of sources, namely, the Global Environment Facility (GEF), Carbon Financing, Canadian International Development Agency (CIDA), the Fonds Français pour l'Environnement Mondial (FFEM) and funding from the implementing agencies and counterparts.

30. A desk study on the evaluation of chiller projects (UNEP/.OzL.Pro/Excom/58/9) was submitted to the 58th meeting of the Executive Committee (decision 58/7) and pointed to the need for a final evaluation of chiller projects, especially of demonstration projects, at some future date to provide an overview of what has been achieved, lessons learned and to assist in providing guidance as to any actions still required.

III. Objectives and scope of the desk study

31. Building on the findings of the 2009 evaluation, the desk study focused on the effectiveness of eight major demonstration projects with a view to improving understanding of:

(a) The progress made in project implementation and in the functioning of the various co-funding mechanism (the success and/or shortfalls of the various co-financing arrangements); What impact they had on the cooperation among institutions and implementation partners and which were the difficulties experienced in the synchronization of project cycles, procedures and schedules among various funding and implementing partners;

(b) Furthermore, the desk study tries to explain the reasons for the delays and how these can be addresses as well as the main barriers and impediments experienced in the project implementation process. It inquires on whether projects have created a specific infrastructure that could or should be replicated for future projects. It also analyzes the efforts made by the implementing agencies (successes and failures) in improving energy efficiency when replacing chillers to reduce the demand for CFCs as well as the promotions, motivations and incentives needed with respect to a successful implementation.

(c) The report listed the issues that might require further analysis via country-specific case studies and recommend which countries for the follow-up.

IV. Main findings

Overview of the co-funding mechanisms

32. Several types of co-financing options have been used in the eight demonstration projects. These are as follows:

(a) Counterpart funds from owners or users of chillers (projects in Eastern Europe and in Syrian Arab Republic and Bahrain);

(b) Climate-oriented Official Development Assistance (ODA) including bilateral ODA (France, Canada) for projects in Cuba and Africa, GEF (projects in South America and the global chiller project); and,

(c) Third party private sector funds through selling of certified emission reduction credits in carbon markets (Clean Development Mechanism (CDM) (global chiller project), or through innovative funding such as mandated contributions from utility companies (Brazil project).

33. As early as of November 2008**,** there were several observations made on these mechanisms:

(a) The time to secure co-financing varies: (i) ODA funds are typically available within three months; (ii) Funds from the GEF were taking up to two years after project approval; and (iii) National private sector funds could be secured on average in about 16 months. Approval of a related globally applicable CDM methodology – a complex but vital step - took about 30 months, but in exchange for the time lag, it created the potential for carbon market funding from verified energy savings in the future.

(b) Counterpart and ODA grant co-financing options might be pursued where quick results are needed – about a three to four year time horizon up to project completion (for conversion/replacement projects). It is also recognized that the aggregated global need for such funds would be significantly larger than their availability under bilateral ODA. Also, innovative funding arrangements (ODA + private sector and/or carbon funding) possess a clearly superior leveraging capacity, in particular where projects create tangible benefits for the co-financing entities. The availability of these funds is limited only by the value of additional benefits the project can generate.

34. The reason why ODA funds are of limited availability is that only a small number of countries are selected by donor countries to receive ODA. The reasons for choice of countries can only be speculated upon but likely takes into account issues such as trade, national defence or security, and other current priorities of the donor country. Such ODA funds typically are made available annually for Developing Country support which means that approved projects can be funded quickly. A key incentive for donor countries to use ODA to fund Montreal Protocol bilateral projects is that such expenditures reduces the amount the country's treasury must pay in its support to the Multilateral Fund.

35. Most of the major donor countries operate on a similar basis. Some contributors to the Multilateral Fond do not participate in ODA-based bilateral projects, perhaps because they believe the transaction costs are too high and outweigh the potential benefits; they do not have the internal mechanisms to administer; or that their contribution is too small to derive enough in the way of collateral benefits.

36. The time needed to prepare projects with innovative funding arrangements has two components: the time needed for principal set-up (example, approval of CDM methodology or developing a financial

guarantee system in the case of Brazil), and recurring preparation needs for each project. Once the principal set-up has been developed, co-financing from the private sector in combination with bilateral ODA might realistically lead to a four to six year time horizon up to project completion (for conversion/replacement projects).

37. The relative urgency of Multilateral Fund projects against short-term compliance deadlines is presently consistent with the step-by-step process of national prioritization ("Resource Allocation Framework") and the GEF project cycle. With the present arrangements, a six-year or more implementation horizon leading to project completion appears realistic (for conversion/replacement projects). A detailed review of the co-financing regimes utilized in the eight demonstration projects is set out in Annex II.

38. As noted in document UNEP/OzL.Pro/ExCom/62/9, despite the obstacles, challenges and time lags, all three agencies (UNDP, UNIDO and the World Bank) were quite satisfied with the various co-funding arrangements they have utilized to date. They recommend replicating the experience in the future.

Progress made since the previous evaluation

Financial mechanisms

39. The projects with a larger scope, namely the global chiller project and Brazil project, have made significant advancements in securing co-financing and, have actually increased substantially the amount of co-financing. As an example, financing for the part of the funding sought from GEF totaling more than US $20 million has been completed. The total level of co-funding for the chiller projects had risen to US $174 million, although seventy-eight per cent of the co-funding was related to one project (Brazil), another 18 per cent to the global chiller project; and the other activities shared the remaining 4 per cent of co-funding

40. Considering that the total funding provided by the Multilateral fund for the chiller projects, amounted to US $14.5 million, the co-funding so far has resulted in a 13-fold increase in the funds available (US $188.5 million).

41. With regard to the amount of funds leveraged from the Multilateral Fund's initial investment, it should be noted that the availability of the funds reported by the agencies as having been raised through co-financing are yet to be confirmed by the Fund Secretariat for a number of projects, namely the global chiller project, the projects in Brazil, Colombia, the Caribbean Region (Dominical Republic, Jamaica and Trinidad and Tobago) and, to a limited extent, for the projects in the Eastern European Region On the basis of agencies' reports thus far, it can be concluded that the amount of funds leveraged varies with the co-financing option used, with the lowest amount of leveraging coming from counterpart sources and moderately higher levels from bilateral agencies.

42. These experiences indicate that the time taken to secure co-financing from counterparts as well as the ODA grants was often moderately short, whereas for projects using innovative funding arrangements, such as the GEF in combination with the CDM or national actors, the process has taken significantly more time. This has translated into a similar pattern with respect to the operational achievements in terms of the number of chillers actually replaced, as the projects that were able to get the funds relatively quickly were naturally able to embark on project activities earlier. However, it is important to note that the projects that secured co-financing after lengthy negotiations in the standard ODA grant and innovative funding arrangement scenarios did so in a relatively new context for the Fund Secretariat, namely, the common ground between achieving energy efficiency and protecting the ozone layer. The successful crafting of a partnership based on this understanding marked an important first step for the Multilateral Fund.

43. The original planned date of project completion for Brazil was December 2008 with the revised completion date four years delayed (December 2012). In June 2011, UNDP reported that as of that date no funds had as yet been disbursed for this project that was approved in 2005. Eventually, the agency reported that the co-financing had finally been obtained and that the GEF project document was signed. An inventory of chillers was reportedly to be undertaken with a view to examining the feasibility of using alternative technologies with low GWP. The progress since mid-2011 remains unknown.

44. The Fund Secretariat has noted that seven or more years after the approval of the funding for most of the chiller projects, progress has been significant, but not fully satisfactory. The expectation was that a far greater number of chillers would be converted and/or replaced by this time. However, across the board the Secretariat has experienced excellent and active co-operation; and, a very high degree of initiative on the side of the implementing agencies.

Replacements process[2]

45. In late 2008 (three years after project approvals in 2005) there were many positive signs on the effectiveness of the replacement of chillers such as an excellent and active co-operation among stakeholders and a very high degree of initiative exercised by the implementing agencies. In addition, when compared to projects with full grant funding from the MLF, the implementation of the eight demonstration projects with counterpart co-financing was hardly slower, and the co-financing by counterparts was significantly higher than the minimum required when approving the projects. Also, despite the short preparation time for the original projects before the 47th meeting, the implementing agencies had, in most cases, been able to advance the projects as foreseen in the original submissions, despite major stumbling blocks such as the introduction of the Resource Allocation Framework (RAF) in the GEF. However, for a number of the projects, three years after approval, the replacement of the first chiller had still not taken place while the CFC phase-out deadline had almost arrived.

46. A total of 2,544 chillers were targeted by these projects. In the progress report (UNEP/OzL.Pro/ExCom/59/10), it was noted that implementation of the demonstration projects had progressed well: a number of chillers had been replaced (Brazil = none; Caribbean = 7; Colombia = none; Cuba = 4 converted and 5 under conversion; Eastern European Region = 10 converted and 1 under conversion; Syrian Arab Republic = 3 converted and 1 under conversion; African Region = 1 converted; global project = none. According to an implementation report (UNEP/OzL.Pro/ExCom/62/9) of November 2010 only 103 of the targeted amount of chillers have been replaced or just 4 per cent. The World Bank, in its 2011 progress report, reported that 11 chillers were replaced in Jordan. As of 2012 the Philippines has installed the first chiller on 8 July 2012. There are 50 more chillers in the pipeline for the Philippines.

47. It is worth noting that the only estimate of the global population of chillers was made in 2004 and there has been no further updating of these figures. This likely suggests an inaccurate total problem definition that makes quantification of actual replacement progress in a global context only the best but unsubstantiated estimate. This data void precludes, and thus renders impossible, an accurate assessment of the continuing global demand for CFCs.

Co-operation and contributions to infrastructure and sustainability

48. Several of the demonstration projects have reportedly made a major contribution to modernizing the infrastructure in the countries and regions where the projects were undertaken, influencing development and market transformation and reportedly charting a less carbon-intensive and more sustainable pathway with a potential spill over effect expected (Brazil, Colombia projects for the whole of Latin America).

[2] Reporting on the progress of the eight major demonstration projects commenced in October 2008 and the results that were documented in response to a Secretariat questionnaire is set out in document UNEP/OzL.Pro/ExCom/56/11. Add.1.

49. Technical assistance (TA) to business and industry associations, chiller manufacturers and industry participants involved hands-on 'learning by doing' training and this was expected to contribute to the sustainability aspects (Colombia, Global chiller projects).

Contributing to stakeholder engagement and partnerships

50. The demonstration projects made a significant contribution in creating the required partnerships among stakeholders. On a very positive note, new and enhanced partnerships have been established with ODA agencies (Canada's CIDA and FFEM).

51. The progress reports submitted to date indicate that many of the projects have created substantial enhanced liaison amongst government agencies, the private sector and other entities. For example, the stakeholders engaged in the Brazil project include: the Ministry of Environment (Prozon); the equipment manufacturers and suppliers association; the Ministry of Mines and Energy; the Ministry of Trade and Industry; the electric utilities; the major suppliers and manufacturers of chillers; the major associations representing chemical companies and supplier of CFC alternative chemicals (ABIQUIM); the Ministry of Finance; and, the banks that offer loan funds.

52. In the case of Cuba, the chiller project has created enhanced liaison and co-operation between: MINTUR – (Ministry of Tourism); MINSAP (Ministry of Health); Polo Científico (the Scientific Council); and, MINCULT (the Ministry for Culture). Interestingly, each of the Ministries operates at least one workshop that repairs and services air-conditioning and chiller systems. In addition, MINSAP has a general maintenance unit that repairs turbo compressors (chillers) in hospitals. They were all part of the awareness outreach.

53. In the case of the Syria regional project, it was noted from the onset that partnership development was needed. In pursuing this goal the project focused initially on awareness creation amongst the appropriate Government entities, end users, and manufacturers. This lead to a functional stakeholder engagement. There were similar experiences in the other projects.

54. Whereas the chiller demonstration projects have identified specific needs for inter-agency cooperation, notably the Multilateral Fund and the GEF, there remains insufficient coordination and agreement to ensure compliance and the needed cash flows in accordance with the tight Montreal Protocol compliance schedules.

Energy efficiency considerations

55. The replacement of existing chillers with the newer more energy efficient chillers results in significant savings in energy consumption (usually in the order of 40 per cent) and thus reduction in energy costs. Cost savings were a consideration in all projects especially with those wishing to secure funds as a result of mitigation of emission and hence reduction of adverse climate change impacts. It was also noted in the November 2009 progress report that that all agencies were focusing on both the replacement of CFC-based chillers and on the anticipated reductions in energy consumption. All of the chiller demonstration projects funded by the Multilateral Fund chose technical and process options taking into account energy efficiency considerations and, in most cases, the resultant payback period.

56. From a progress perspective, the important conclusion is that co-funding has, in most cases, been secured based on the expectation that the new chillers will yield substantial reductions in energy consumption and concomitant reduction of energy costs and adverse climate impacts. The energy savings or associated cost savings have not been quantified as yet. Given that only 103 (as of last data reported) of an estimated 16,000 global population of chillers have been replaced, it is impossible to quantify overall progress in the context of energy cost savings.

57. It has been noted however that energy cost savings are not a driver in countries where energy costs are very low (example, Syrian Arab Republic, Bahrain). Nonetheless, energy efficiency improvements lead to savings in emissions of carbon dioxide released during the generation of electricity.

58. Brazil integrated the chiller project into a larger but closely-related undertaking. The objective of this larger undertaking was to foster energy efficiency investments in private and public buildings. A special emphasis was on demonstrating the energy efficiency potential of non-CFC based chillers, by addressing the technical and financial barriers that exist in the country. In addition, the Brazil project was deemed to have a strong replicability objective. This encompasses capacity building as well as improved access to financing for energy efficiency initiatives in order to "influence, transform, and develop the market for energy-efficient building operations in Brazil and move towards a less carbon intensive and more sustainable energy consumption path in the country."

59. In Colombia, UNDP incorporated additional activities into the original project resulting in a broader initiative aimed at promoting energy efficiency in buildings by removing institutional, legal and regulatory, capacity and technical barriers that presently limit its widespread adoption in the country. Other outcomes expected are establishment and enactment of regulations to promote energy efficiency in buildings and enhanced capacity regarding energy conservation. The private sector is expected to play a key role in the primary outcome, both as the provider of equipment and as the buyer. There has been no progress reporting on this aspect to date.

Promotion, motivation and incentives

60. All projects included workshops and awareness campaigns, to promote and motivate the replacement of chillers. The campaigns targeted all stakeholders but in particular the business community to convince them of the benefits of early replacement of chillers, such as improving energy efficiency and thereby reducing operating and other ongoing costs including those associated with reduced leakage. These stakeholder consultations and workshops did engage the business community who can now act as custodians of the project's sustainability as well as acting as promoters and change agents for future projects based on their positive experiences.

61. For large entities, a public, private or commercial sector, with funds readily available and in countries where energy costs are high and chillers are rapidly approaching the end of their useful life, little incentive (and in some cases none) was necessary to move to a replacement decision. However, the experience has been that there is little or no economic incentive to replace small chillers in small enterprises or chillers in marginal profit situations and where access to funds poses a real barrier or where there is a culture of no loans.

62. In Brazil, a marketing campaign targeted chiller users and reportedly incorporated financial and non-financial incentives. In the case of the European demonstration projects, the incentive deemed necessary for chiller replacement was based on a rate of return on investment in the range of 30 per cent through an innovative financial mechanism. This included a national component through green loans, funds from the Multilateral Fund, in kind contribution and provider guaranteed energy efficiency. In addition, it was reported that in cases where the chiller owner owned more than one CFC-based chiller, the grant was considered as an incentive to convert the remaining chillers. In the case of the Syria regional project, it was reported that the incentive for chiller replacement was to be determined based on a rate of return of investments in the range of 30 per cent through a similar innovative financial mechanism.

63. The counterpart funding option was utilized by UNIDO in its projects in Eastern Europe and in the countries covered by the Syria regional project, where incentives were provided to chiller owners in the form of substantially reduced purchase costs of non-CFC based replacement chillers. The projects were reportedly received with great interest from chiller owners, who were ready to provide co-financing immediately. In some of the Eastern European countries, regulatory pressure is described as having

provided an additional incentive in the context of their accession to the European Union and the consequent need to comply with the European Community's CFC regulations.

64. In the case of Latin America and the Caribbean (LAC) demonstration project, there was reportedly a strong economic driver expected for replacement of chillers in the Caribbean due to the high and fluctuating cost of electricity. (Electricity in the Caribbean is typically fuelled by generators that run on gasoline and electricity prices tend to be tied to the fluctuation in crude oil prices.) Although the replacement of CFC chillers with non-CFC chillers was estimated to result in energy savings of US $20,000 to US $30,000 annually for the public sector and US $40,000 to US $60,000 annually for the private sector, these savings were more than offset by the additional cost of equipment and taxes.

65. The global chiller project was designed to deliver incentives to CFC chiller owners to overcome techno-economic barriers, and achieve the desired outcome of accelerated chiller replacement. The project was approved for implementation in seven countries (China, India, Indonesia, Jordan, Malaysia, the Philippines and Tunisia). The World Bank's activities were initially focused on securing co-financing for the chiller replacement projects in India and the Philippines and then on facilitating replacements. The project aims to provide incentives to chiller owners averaging 20 per cent of the purchase cost of a new chiller, using funds from the Multilateral Fund and the GEF. In return, chiller owners surrender the ownership of future carbon credits to the project. Under the CDM, the revenues expected from these carbon credits are reportedly being used as incentives for replacement of additional chillers, as well as to finance the project's management costs.

Barriers, impediments and reasons for delays

66. UNIDO reports that delays in implementation occurred because the projects depend heavily on the local capacity and knowledge of the existing chiller inventory in the countries. Many countries do not have the means or legislation to monitor the change in the industry nor the change in the number and types of chillers in operation or removed from service.

67. For the majority of chillers in the countries participating in the regional project in Africa, the counterpart-project grant arrangement was not feasible because concerned companies were lacking capital. One of the principal causes of the delay in implementation was the high upfront capital cost of the replacement and lack of co-financing facilities through local financial institutions.

68. The report UNEP/OzL.Pro/ExCom/62/9 (4 November 2010) stresses the difficulty in trying to synchronize project cycles and requirements between GEF, the CDM and the MLF which have different policy frameworks and deadlines. In addition, the RAF, adopted by the GEF Council in September 2005, has added previously unexpected complications, in particular in the implementation of the new processes in the beneficiary countries.

69. The report also outlined the difficulties being experienced in the synchronization of project cycles, procedures and schedules among various funding and implementing partners. This implies that further improvements in co-operation and coordination between funding bodies is needed and could reduce delays and facilitate a timelier implementation of projects. For example the CDM and the GEF request countries and agencies to follow strictly the established procedures, which are not coordinated between these institutions. The preparatory efforts required and the complex design of the co-funding has delayed the projects very considerably.

70. Delays were also caused by unpredictable events such as the insolvency of project beneficiaries, or the withdrawal of financial intermediaries. With an increasing time lag between approval of the original project and implementation, these difficulties tend to increase. The unexpectedly long time required to organize the co-funding created an additional strain on the working relationships with chiller owners, and therefore on implementation. Finally, the national project implementation modalities were

cited as a potential cause for delays. In one country the mechanism chosen by the Government for co-funding did not create sufficient interest among possible beneficiaries, resulting in the need for project redesign.

71. In the case of the Africa regional chiller project, restricted access to financial resources for investment, lack of technical know-how and high capital costs, created a major barrier for the replacement of chillers. There was limited awareness of the need for change and of replacement options. Furthermore, each of the countries in the Africa regional project has foreign exchange constraints, subsidised energy and water prices, energy shortages and there were very few companies with the required skills to design and implement the required chiller replacement.

72. The main reason for the delays in all of the participating African countries including Egypt was the negotiations with local authorities and the Banks needed to identify a suitable co-financing system, as requested in the bilateral agreements. According to UNIDO (UNEP/OzL.Pro/ExCom/64/13 (13 June 2011)), the National Bank of Egypt had been contracted while the agreement with the Nigerian Bank of Industry was still under negotiation. In Cameroon, Namibia and the Sudan a tender for local banks was to be announced in the first quarter of 2011. National workshops were planned for February 2011 but did not take place because of the political situation in the region.

73. While in Europe, Energy Service Companies (ESCOs) have been the ideal partners for such projects whereby they install more energy efficient equipment and accept payment via the future energy cost savings, in Africa these entities do not usually exist or are not qualified, or experienced enough, to handle projects of this scale. At present, the only recognized source of capital was through commercial bank loans, and these institutions have limited experience in handling of credit lines for chillers.

74. With regard to the Syria regional chiller replacement project, the main barriers and impediments noted were the same for all countries: notably the lack of information about the economic benefits of chiller replacement, economic constraints on investment and funding for capital replacement. These impediments were exacerbated by the prevailing culture of reluctance to take on loans.

75. Brazil is an important demonstration project due to the sheer number of CFC chillers in use. When the project was initiated, the chiller population in Brazil was estimated to be approximately 1,250 units (approximately 8 per cent of the estimated global population) with an estimated 750 being in the private sector and 500 in the public sector. It is quite possible that the total number in Brazil exceeds this conservative estimate.

76. The main problems in project implementation were related to the absence of an energy policy to promote energy efficiency in the chillers sector; the weakness and/or absence of a regulatory framework; the absence of a lead organisation to promote energy efficiency; as well as the lack of a strategy to educate stakeholders on the benefits of energy efficiency. Additional factors were: the absence of markets for energy efficiency services for operating chillers, the high initial cost of energy efficiency equipment; and, the lack of specialised trained personnel.

77. The barriers and impediments experienced by the Colombia chiller project were similar to those encountered in Brazil. As of July 2011 only US $167 had been disbursed out of US $1,000,000 approved. UNDP indicated that local experts had been contracted to undertake a technical assessment of existing chillers and an economic study on conversions. The technical assessment of existing chillers that was to be completed by January 2012 has reportedly now been completed. Since the project was approved in 1995, the full range of reasons for such extensive delays remains unclear.

78. The Cuba project was approved in November 2005 and was transferred to UNDP in 2007 at which time co-financing was secured with Canada. The main barriers and impediments to conversion in Cuba was the high cost of up front investment. The role of the private sector is very limited and the

project is focused on the public sector for both replacement and lower cost conversion option. Since the majority of chillers reside under the purview of the Government of Cuba, adequate access to funding to replace this equipment was limited. There was also the "risk of downtime" (the on-site work to convert an existing chiller to a non-CFC chiller requires the modification of all electrical and plumbing arrangements for the building). Over half of the government chillers are located in hospitals which play a critical role in the provision of crucial health services. The lack of specialized knowledge for maintenance and of alternatives; and, the lack of awareness of the Montreal Protocol timetable and thus remaining time for conversions also impeded progress.

79. For the European regional chiller project there was a known history of chiller maintenance neglect especially for the centrifugal chillers along with no preventive measures to avoid leakage. Very few personnel were trained at the time of chillers purchase and, furthermore, many owners declined to allocate monies for regular maintenance, spare parts and timely servicing. Consequently, many chillers were in very poor technical condition working with lower coefficients of performance (COP), having frequent failures and a high refrigerant leakage rate (up to 100 per cent). These factors posed severe impediments in the implementation of this project since this was a grant project: funds from owners (40 per cent) and the Multilateral Fund (60 per cent). Another reason for delays in one country was due to prevailing weather conditions that created a long payback period which served as a disincentive for local ESCO engagement. There were perhaps further undocumented reasons for delay.

80. The LAC regional project encountered similar problems. In addition to the lack of information and understanding of the existence of financially attractive energy efficiency measures, there was limited availability of suitably skilled personnel to identify, implement and manage energy efficiency measures; internal or corporate inertia barriers as well as an "if it isn't broken don't fix it" mentality or "it is not a core business" viewpoints.

81. A problem was the categorization issue of capital versus operation and maintenance (O&M) budgets. Energy efficiency measures are usually categorized as O&M and not capital and therefore face different financial hurdles. The absence of working capital or perverse budget incentives (if you reduce energy expenditure next year's budget is reduced accordingly) were major issues and constraints in the public sector.

82. The global chiller project, encountered impediments related to both common sense and common practice. When managers considered chiller replacement in an environment of hard resource constraints, more critical and potential revenue generating projects (example, upgrading the foyer of a tourist hotel) were given priority over marginal cost saving projects (example, chiller replacement). The marginal return on the investment, coupled with the higher up-front cost, together constituted the major barrier to the more widespread adoption of the energy-efficient alternatives. The Bank allocated funding between 20 to 30 per cent of the total anticipated costs to address this issue.

83. The World Bank also noted that some delays were caused by the time needed for the Emission Reduction Purchase Agreement (ERPA) and the signing of grant agreements.

Progress reporting (submission of reports)

84. UNDP, UNIDO and World Bank were requested to table progress reports on the demonstration projects at the 65th meeting (October 2011). The World Bank submitted their report but there were no detailed demonstration project reports from UNDP or UNIDO. However both gave some overview commentary as part of their general progress reporting, UNDP on progress related to their projects in Brazil, Colombia, Cuba and the LAC region; and, similarly, UNIDO, on the Syria regional project and Eastern Europe and, together with bilateral donors in Africa.

85. Again at the 66th meeting, UNDP and UNIDO were to report on chiller projects but there were no submissions at this meeting by either. UNDP, UNIDO and the World Bank will need to report on the projects at the 68th meeting. The deadline for the submission of these reports, with a view to facilitating circulation was the beginning of October 2012.

86. Looking to the future, progress reporting needs to reflect the successes or shortcomings in the achievement of all project objectives and anticipated outcomes. The only significant and measurable indicator of movement forward is the chillers replaced to date. There is no clear evidence in the progress reports available to clearly assess progress to date in the context of the other key anticipated outcomes. What is needed is a clear and precise statement from the implementing agencies in relation to achievements to date to each specific anticipated outcome as noted in the project documents.

V. Conclusions and recommendations

87. Almost 25 years of Montreal Protocol implementation has demonstrated that both supply-side and demand-side management are needed. However, demand-side management has a prerequisite; namely, an accurate and ongoing assessment of changing demand. Unfortunately, the only available estimate of the global population of chillers was made in 2004 and there has been no further updating of these figures. This lack of quantified data creates a lack of dimensional analysis of the outstanding chiller replacement challenge and also precludes reporting in a factual manner on progress leaving in a global context, only best and unsubstantiated estimates. Parties need to indicate whether chillers are part of their national phase-out management plan (NPP) or terminal phase-out management plant (TPMP); whether an inventory of chillers is available; and, to supply aggregated data to the TEAP to update their 2004 report.

88. The projects so far have not replaced a significant number of large centrifugal chillers beyond those reported in the previous desk study (only 103 of the targeted 2,544 chillers or 4 percent have been reported as being replaced). There is no adequate explanation that why after seven or more years of implementation these numbers are so low. It is recommended that more frequent progress reporting in this regard be undertaken. In addition, there is currently no data available to update the 2009 desk study finding that replacement of a centrifugal chiller by smaller non-centrifugal (screw and scroll compressor driven) units are continuing to be a much more attractive choice (even using ammonia in some cases). Documentation on this specific issue remains non-existent.

89. In many countries potential energy savings combined with the declining CFC supply is not a sufficient incentive to drive replacements. Although a large variety of mechanisms, promotions, incentives, stimuli as described in this report are now being utilized in the eight demonstration projects, these projects have been slow getting started and this is the likely cause of the very limited progress reporting to date.

90. It was noted that with relatively low running time percentages, the financial savings over a relatively short period of 2-3 years was relatively small, much smaller than a loan to pay back 60-80 per cent of the total investment for a new centrifugal chiller plus the necessary ancillary equipment. Based on documentation available, it is not clear as to whether this issue is playing an important role in the reluctance of many owners to replace centrifugal chillers. It is recommended that the IAs be requested to clarify this point with their client countries.

91. The 2009 desk study concluded that it would be logical not to pursue Multilateral Fund interventions, or those of other financial entities, to provide grants for revolving funds for the replacement of CFC chillers, unless Article 5 countries provided compelling evidence that the impact of such mechanisms could be supported by a list of chillers still in operation (including their operation history) that would be targeted. There was no information available on this aspect to update this observation.

92. The global chiller project has four components: GEF funding, carbon market funds, commercial financing and grants from the Multilateral Fund. However, the Fund's grant portion cannot be totally open-ended as total funds available for such projects are limited. One might then question how sustainable is the global chiller project. If this approach becomes very popular, can it be sustained without the Multilateral Fund providing funding?

93. At the time of the 2009 chiller desk study, the question arose as to whether replacements should be considered for HCFC-22 operated chiller equipment that is smaller in capacity than those using HCFC or HFC, and in which manner this issue should be technically resolved. Without clear solutions, it was concluded that the HCFC-22 equipment should be kept in operation until suitable alternatives could be identified. This conclusion remains in effect.

94. Incentives in the demonstration projects under review were provided based upon rate of return on investment considerations. For the Syria regional and the European projects, the incentive was determined on a rate of return of investments in the range of 30 per cent. The World Bank's global chiller project provides incentives to chiller owners averaging 20 per cent of the purchase cost of a new chiller, using funds from the Multilateral Fund and the GEF. Incentives were also provided to chiller owners in the form of substantially reduced purchase costs of non-CFC based replacement chillers (Eastern Europe and Syria regional projects). It is concluded that the incentives required must be determined on a case-by-case basis.

95. Based on the documentation reviewed, counterpart and ODA grant co-financing options should be pursued where quick results are needed and where the aggregated global need for such funds would be significantly larger than their availability under bilateral ODA. Also, innovative funding arrangements (ODA + private sector and/or carbon funding) possess a clearly superior leveraging capacity, in particular where projects create tangible benefits for the co-financing entities. The availability of these funds is reportedly limited only by the value of additional benefits the project can generate.

96. Based on the documentation, the demonstration projects have enhanced communications among stakeholders. Workshops and awareness campaigns were, and are, aimed at all stakeholders, particularly the business community. Private sector personnel are playing a role and can now act as custodians of the project's sustainability as well as acting as promoters and change agents for future projects based on their positive experiences.

97. The demonstration projects, especially the regional and global chiller projects, have created a wide and often regional dissemination of change agents and observable chiller replacement working examples that bare testimony to efficiency, potential cost savings, and validation of payback periods, operating characteristics and other points of interest to chiller owners faced with the need to move away from CFC-based chillers.

98. Although energy savings typically relate to reductions in energy consumption, which alone should make the replacement of old chillers an economically attractive option, these projects demonstrated that such replacements most often do not take place without additional external stimuli. Also, energy cost savings are not a driver in countries where energy costs are very low (example, Syrian Arab Republic, Bahrain, etc.). Nonetheless, energy efficiency improvements lead to a savings in emissions of carbon dioxide released during the generation of electricity and thereby create climate benefits and offer potential future revenue streams.

99. The Brazil project also focused on fostering energy efficiency investments in private and public buildings, with a special emphasis on demonstrating the energy efficiency potential of non-CFC based chillers, by addressing the technical and financial barriers that exist in the country. Progress reporting in this regard is not yet available.

100. Technical assistance in most instances took a holistic view of the market and targeted both the supply and demand side of the chillers market, thereby impacting infrastructure and augmenting the potential for project success and the concomitant impact on reducing energy consumption and greenhouse gas emissions.

101. It was envisaged that some of the later-life chillers that would continue in operation would be serviced by stockpiled CFCs. It is not clear if this is still the case and, if so, are the supplies adequate? If not, the demand could create the stimulus for illegal trade. The stockpile situation in this context needs to be reported upon as well.

102. Trying to synchronize project cycles and requirements between the GEF, the CDM and the Multilateral Fund remains very problematic. This is due in part to the relative urgency of Fund's projects against short-term compliance deadlines. With the present arrangements, a six-year or more implementation horizon leading to project completion appears realistic (for conversion/replacement projects). The private sector is expected to play a key role in the primary outcome, both as the provider of equipment and as the buyer. For example, in the Brazil project, the anticipated spill-over effect, was to positively influence the chillers market in Latin America as a whole since many countries in the region kept a watching brief on the evolution and implementation of this project. It is not clear whether or to what degree this is happening.

103. A key aspect of the Executive Committee's decision to fund chiller projects was to establish the extent to which the project has a potential for replication in the absence of additional resources from the Multilateral Fund. The findings so far indicate that this varies according to the co-financing option that was selected. In the case of counterpart funding, the potential for replication seems to have been limited to, at a maximum, any additional chillers owned by the beneficiaries that they wished to replace. Where standard ODA grant funding was used, there appears to be a more strongly expressed intent that the chiller replacement projects would provide some demonstration value and serve as a model for similar initiatives elsewhere in the country. The potential outcome of this has not been further elaborated in the implementing agencies' submissions and remains somewhat opaque. In contrast, where co-financing was provided through innovative funding arrangements, the replication of the results beyond the initial target represents a core objective. The ultimate aim of these demonstration projects is not just to replace a specified and limited number of chillers, but rather to provide a stimulus that will lead to a transformed market environment where ozone-friendly chillers, and beyond that, energy efficient buildings, become the options of choice.

104. Notwithstanding the fact that the amounts are estimated and still subject to confirmation, a clearly superior leveraging capacity is evident where the co-financing obtained from the GEF is supplemented with co-financing generated by providing profit-based incentives to third party beneficiaries in the form of industry actors or the carbon credit market.

105. It was expected that the project outcomes would play a critically useful role in the development of strategies for country-wide replacement of CFC-based chillers (UNDP projects). It is clear from general statements and observations at the various Montreal Protocol meetings that many of these outcomes have been achieved but progress reports should include evidence of this and point to areas where shortfalls have occurred and identify the reasons why.

VI. Lessons Learned

106. It was reported that one of the key lessons from UNDP-GEF's 14 years of project-level experience is that project and regional networking play an important role in ensuring that the successful features of well-designed projects are incorporated in the design of ongoing and future projects. Through targeted meetings of project managers and country office personnel for specific types of projects, those involved with project management can discuss both technical and administrative issues, share experiences

and best practices, and gain a sense of how the portfolio functions at a regional level. A multi stakeholder engagement from the onset is necessary for both problem ownership and sustainability of results and to ensure the creation of a level playing field.

107. Demonstration projects can play an important role in dismantling false impressions concerning replacement of chillers. Indeed, strong communication activities can convince chiller owners of the benefit of replacement particularly during the start-up phase, One of the key lessons is that project and regional networking play an important role in ensuring that the successful features of well-designed projects are incorporated into the design of ongoing and future projects. A chillers knowledge network was organized under the auspices of the Brazil project to encourage information sharing, effectively market, and facilitate replication of project activities throughout the region.

108. From the results so far, it can be estimated that under the counterpart and ODA grant co-financing options, the length of a project cycle from preparation to completion would be three to four years (for conversion/replacement projects), which is similar to the time horizon currently observed for projects financed solely by the Multilateral Fund. For the private sector component of innovative funding arrangements, the time needed to prepare projects seems to have two components: firstly, the principal set-up (such as approval of CDM methodology, and developing a financial guarantee system in case of Brazil), and secondly, recurring preparation needs for each project.

109. It can be estimated that co-financing from the private sector in combination with bilateral ODA, a combination not used so far, might realistically lead to a four to six year time horizon up to project completion. For innovative funding arrangements using GEF co-financing, the time needed to secure national prioritization suggests a six to eight year project cycle.

110. Different methodologies and replacement schemes, with a high degree of flexibility, are necessary to adapt a programme to the needs in different countries where markedly different local conditions prevail. Support for the replacement of existing chillers, short of funding full replacement, can be provided in a number of different ways such as rebates, loans to the owner or performance contracting; where the technology provider guarantees energy efficiency; national policies regarding the final phase-out of CFCs are not just awareness raising and a needed stimulus, but likely a precondition for a large number of centrifugal chiller owners to pursue replacement projects.

111. The demonstration projects have shown that replacement of CFC chillers can successfully be funded with grants combined with or without loans and various other arrangements. The amount of financial support required for chiller replacement will vary depending on the prevailing national conditions such as tariffs, regulations, energy costs, etc. Co-financing with the GEF has proven to be a key partnership. However, the necessity of synchronizing two major funding sources, the Multilateral Fund and the GEF, can introduce a two to three year project delays but ultimately can create revenue streams that encourage national engagement.

112. Because of their short processing time, and relatively quick on-the-ground results, the counterpart and ODA grant co-financing options lend themselves more easily to situations where early results are needed (for example, meeting imminent phase-out deadlines). The low amount of funds likely to be leveraged in this manner suggests that they would have more impact in smaller scale, short-term projects.

113. By contrast, the option for co-financing through innovative funding arrangements has a much greater potential in terms of generating significant additional funding (Brazil, global chiller project), and replication of the project beyond the initial targets set under the Fund's original project approval. The size of the additional funding is largely due to the significant potential benefits for the co-financing parties, whether in terms of environmental gains (in the case of the GEF) or profit-maximization (in the case of ESCOs and the CDM). Pursuing such a co-financing option is therefore most likely to be successful where there is convergence between the Fund's objectives and those of potential partners. However, as a

considerable amount of time and effort is used to establish a common understanding, a desirable outcome of seeking such arrangements would be an established framework that can be used in future as a basis for multiple projects, or for achieving long-range strategic objectives. The approved baseline and monitoring methodology developed by the World Bank for the CDM, is an example of such an outcome.

VII. Issues to be investigated via country visits

114. There are always additional insights to be gained from direct discussions with the National Ozone Units (NOUs), government ministries and private sector partners pertaining to their perspectives on many of the topics covered by this updated desk study and their chiller phase-out related perceptions. Perhaps the insights needed can best be described via a series of questions.

115. Some of the key questions that could be posed to case study countries are as follows:

(a) Does the country have an inventory/database of all CFC chillers remaining in operation?

(b) What is the age profile of the chillers not as yet converted or replaced?

(c) How many chillers of the total were replaced to date and how many remain?

(d) Is the private sector proceeding with replacements without assistance and if so why? Is it a fear of diminishing CFC supply or other concerns?

(e) What is the CFC phase-out achieved to date?

(f) What is the remaining chiller based CFC demand in your country?

(g) How and when do you expect this demand to trail off?

(h) How is the remaining demand to be met?

(i) Are all of the stakeholders (including government Ministries) engaged that need to be engaged?

(j) Which institution(s) coordinate(s) the chiller replacement (policies and funding)?

(k) Is there a national strategy in place to phase out all CFC chillers?

(l) If so, what is the strategy and why was this management modality chosen and is it working well? If not, why?

(m) What role, if any, did the various demonstration projects play in designing and implementing your chiller phase-out strategies?

(n) Have you contemplated various funding modalities and what were, or are, the potential co-funding sources you have explored? What are the responses you have received? Which do you prefer and why? What barriers or impediments do you anticipate?

(o) Has co-funding been mobilized or is it anticipated?

(p) What formal agreements are/were needed and concluded (why were they needed, with whom, and what is covered)?

(q) Are chiller replacements occurring outside the project, i.e. chiller owners and operators are undertaking replacements on their own initiative? If so, why?

(r) Are the required regulatory provisions to drive the chiller phase-out in place? If not, what is still needed?

(s) With ongoing chiller conversions and replacements have there been barriers and impediments resulting in significant delays? If so, what were these and have they been resolved; and if so, how?

(t) What are the main reasons for public and private sector chiller operators to delay replacement?

(u) To what extent, and how, have they been addressed and overcome?

(v) For the chillers that have been replaced to date, what were the actual chiller replacement costs (relative to expectations) and how were these costs met? (Who paid what share?)

(w) What was the role (or possible future role) of energy savings in both project design and implementation? Can you use ESCOs? If not, why not?

(x) What are the chiller owners' perceptions/views on the efficacy of the various funding arrangements or mechanisms (concessional loans, grants, revolving funds, etc.)?

(y) Were there any CFC recovered from the chiller project(s)?

(z) Is there, or will there be, any monitoring of recovered CFCs?

(aa) Is there is a plan in place to deal with the recovered CFCs? (Re-use or destruction?)

(bb) Are energy savings now a sufficient driver to cause replacements?

(cc) What are the lessons learned from your perspective that may contribute to future policy development?

VIII. Case study country selection

116. Case study evaluations should give greater clarity to the questions and issues that could best assist the Executive Committee in better understanding the country perspectives on a number of key questions that affect the future allocation requirements of the Multilateral Fund. With the absence of up-to-date factual information on the replacement projects in almost all of the developing countries, the selection of case study countries is made more difficult.

117. Overarching Executive Committee questions continue to be: how many Multilateral Fund dollars can likely be made available in future to continue assisting with chiller replacements and for how long? What is the remaining global need for chiller funds provided by the Fund? Or, with the current demonstration projects, will sufficient incentives be in place to catalyse replacements without Multilateral funds? With rapidly declining supplies of regulated refrigerants, for the vast majority of the private sector chillers, will most of this component problem self correct? What about the public sector chiller replacements in countries where funds for chiller replacements are in very short supply?

118. Although the private sector remains important, a critical concern is the public sector where chillers are not a luxury but a necessity (institutions, laboratories, hospitals, etc.). With this in mind, it is

important to undertake a case study of one such country to explore in an in depth manner what can or still needs to be done to address the chiller replacement problem (Cuba).

119. It may also be prudent to include at least one country that has a fully operational chiller replacement project where there are likely many additional lessons to be learned and where the expectation is that the projects underway will serve as a regional model and catalyze early replacements. (Brazil and Colombia).

120. Perhaps another criterion for country selection would be to evaluate a country where there are numerous financial inputs such as commercial, GEF grant; carbon finance credits and the Multilateral Fund grant. This would allow a more detailed evaluation of the efficacy of this approach **(**Argentina?).

121. Taking into account the complex character of these projects and the many influencing factors and circumstances that need to be investigated, the duration of the field visits should be just long enough to allow time to solicit views on project management modalities, performance and impact from a wide variety of stakeholders (various Ministries, Departments, NOUs, PMUs, private sector, associations, training institutes, SMEs, FIs, etc).

122. Due to budgetary constraints only a very few countries can be visited for case study purposes. For the reasons previously noted, it was decided to select Argentina, Brazil, Brazil, Colombia and Cuba for the case study follow-up of this desk study.

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Annex I -- List of Documents

1) IVC.REF.37.INV.17&32-ProjectDocument
2) IVC.REF.37.INV.17&32-ProgressReportRemarks
3) IVC.REF.37.INV.17&32-EvaluationSheet
4) IVC.REF.37.INV.17&32-EvaluationSheet(coor.1)
5) SYR.REF.29.INV.56-ProjectDocument
6) SYR.REF.29.INV.56-ProgressReportremarks.pdf
7) SYR.REF.29.INV.56-EvaluationSheet
8) MEX.REF.28.INV.95-ProjectDocument
9) MEX.REF.28.INV.95-EvaluationSheet
10) MEX.REF.13.TRA.25-ProjectDocument.pdf
11) MEX.REF.13.TRA.25-ProgressReportRemarks
12) MEX.REF.13.TRA.25-EvaluationSheet
13) MEX.REF.08.TRA.19-EvaluationSheet
14) VIE.REF.28.INV.22-ProjectDocument.pdf
15) VIE.REF.28.INV.22-ProgressReportRemarks.pdf
16) VIE.REF.28.INV.22-EvaluationSheet
17) VEN.REF.08.INV.10.PCR.DOC
18) VEN.REF.08.INV.08&09&10&11-ProjectDocument.pdf
19) VEN.REF.08.INV.08&09&10&11-ProgressReportRemarks
20) THA.REF.26.INV.104-ProjectDocument.doc
21) THA.REF.26.INV.104-EvaluationSheet
22) THA.REF.26.INV.104-PCR
23) UNEP/OzL.Pro/ExCom/45/52 (Awareness actions and recovery)
24) UNEP/OzL.Pro/ExCom/46/37 (Modalities (decisions 45/4 (d) and 45/60)
25) UNEP/OzL.Pro/ExCom/46/37(Opportunity Cost Model)
26) UNEP/Ozl.Pro/ExCom/47/20 (Sec. report on experiences gained)
27) UNEP/OzL.Pro/ExCom/47/20/Add.1
28) UNEP/OzL.Pro/ExCom/47/21 (Chiller Demo project proposals)
29) UNEP/OzL.Pro/ExCom/47/21 annex.pdf
30) UNEP/OzL.Pro/ExCom/47/21 a1c1.xls
31) BRA.REF.47.DEM.275-ProjectDocument
32) BRA.REF.47.DEM.275-EvaluationSheet
33) BRA.REF.47.DEM.275-Progress report remarks
34) COL.REF.47.DEM.65-ProjectDocument (Columbia – UNDP))
35) CUB.REF.47.DEM.35&36-(Project Document)
36) CUB.REF.47.DEM.35&36-EvaluationSheet
37) GLO.REF.47.DEM.268-ProjectDocument (World Bank)
38) GLO.REF.47.DEM.265-ProjectDocument (Chiller technical assistance-UNEP)
39) GLO.REF.47.DEM.265- (Technical Assistance) (UNEP/Ozl.Pro/ExCom/48/25)
40) GLO.48.TAS.275-ProjectDocument
41) GLO.48.TAS.275-EvaluationSheet
42) EUR.REF.47.DEM.06-ProjectDocument
43) LAC.REF.47.DEM.36-ProjectDocument
44) LAC.REF.47.DEM.36 (UNEP/Ozl.Pro/ExCom/47/21/Add1
45) UNEP/Ozl.Pro/ExCom/47/21/add1 (Regional Caribbean)
46) CPR/REF/06/TRA/05
47) SYR.REF.47.DEM.93-ProjectDocument
48) SYR.REF.47.DEM.93-EvaluationSheet
49) SYR.REF.47.DEM.93 (Progress report remarks)
50) BRA-COL-CUB-GLO-EUR-LAC-SYR(47th meeting)EvaluationSheet.xls
51) BRA-COL-CUB-GLO-EUR-LAC-SYR(47th meeting)Progress report remarks.pdf

52) BRA-COL-CUB-GLO-EUR-LAC-SYR(47th meeting)EvaluationSheet
53) AFR.REF.48.DEM.34&35&36&37-ProjectProposal
54) AFR.REF.48.DEM.34&35&36&37-ProjectDocument
55) AFR.REF.48.DEM.34&35&36&37-ProjectReportRemarks.pdf
56) AFR.REF.48.DEM.34&35&36&37-EvaluationSheet
57) MAL.REF.18.TAS.77-ProgressReportRemarks.pdf
58) MAL.REF.18.TAS.77-PCR Doc
59) LEB.REF.28.TAS.29&31-ProjectDocument
60) LEB.REF.28.TAS.31-PCR
61) UNEP/OzL.Pro/ExCom/48/25) African fund replacement chillers (AFROC) and Global technical assistance programme in the chiller sub-sector
62) document 48/25, decision 48/24):
63) AFR.REF.48.DEM.34&35&36&37 Progress report remarks
64) UNEP/OzL.Pro/ExCom/48/25 (Regional Africa Chiller demo);
65) Chiller Overview (July 3, 2008).xls
66) UNEP/OzL.Pro/ExCom/56/11 (2008 Report on Implementation of Chiller and other projects with specific reporting requirements);
67) UNEP/OzL.Pro/ExCom/56/11. Add.1 (2008 Report on Implementation of Chiller and other projects with specific reporting requirements)
68) UNEP/OzL.Pro/ExCom/58/9 (First Desk Study – Chillers)
69) UNEP/OzL.Pro/ExCom/59/10 (Report on Implementation of Approved Projects with Specific reporting requirements);
70) UNEP/OzL.Pro/ExCom/62/9 (2010 Report on Implementation of Chiller and other projects with specific reporting requirements)
71) UNEP/OzL.Pro/ExCom/64/11 (UNDP Progress Report)
72) UNEP/OzL.Pro/ExCom/64/13 (UNIDO Progress Report)
73) UNEP/OzL.Pro/ExCom/64/14 (Word Bank Progress Report)
74) UNEP/OzL.Pro/ExCom/65/12 (Report on Implementation of Approved Projects with Specific reporting requirements);
75) UNEP/OzL.Pro/ExCom/65/12.Add1 (Report on Implementation of Approved Projects with Specific reporting requirements);
76) UNEP/OzL.Pro/ExCom/65/12/Add.1(Report on Implementation of Approved Projects with Specific reporting requirements);
77) IND.REF.10.INV.09-ProjectDocument.pdf
78) IND.REF.10.INV.09-ProgressReport.pdf
79) IND.REF.10.INV.09-EvaluationSheet
80) Chillers-Overview (July 25,2012).xls

ANNEX II – Demonstration Projects Co-funding Arrangements

A variety of co-funding and financing arrangements are covered in the eight demonstration projects outlined. These include:

1. AFR.REF.48.DEM.34&35&36&37-ProjectDocument (UNIDO)

Six sources of funding were to be used, Commercial Banks, African Development Bank (AfDB Financing Energy Services for Small-Scale Energy Users "FINESSE" Africa Programme), GEF, Fonds Français pour l'Environnement Mondial or the French Global Environment Facility (FGEF), income from Certified Emission Reductions under the Kyoto Protocol and Multilateral Fund support. For the Japanese bilateral portion of the project, in-kind financial contribution outside the Multilateral Fund was to be made available for the acquisition of new chiller technologies into Africa through the UNIDO investment and technology promotion office in Tokyo. This assistance was to be utilized for alternative chiller technology transfer for the specific investment sub-projects for chiller conversion such as delegate programme. The size of the technology transfer activity depends on requirement of each investment sub-projects in recipient countries, and the contribution amounts to the range of US$ 100,000.

FGEF (French Global Environment Facility) is a bilateral fund created in 1994 and aims at assisting the protection of the environment through sustainable development projects in developing or countries in transition.

A chiller replacement is eligible as a small scale CDM project under the Kyoto Protocol. The energy efficiency gains achieved result in Certified Emission Reductions (CERs) that can be sold to contribute to the financing of the chiller replacement.

The exact amount of support from the MF fund was to vary between 20 to 80 % of the chiller costs. The primary reason for this variation was to be the differences in electricity prices. In a country with high electricity prices, the energy savings result in a high NPV already with a small proportion of MF support. Whereas in countries with low electricity prices and especially with severe foreign exchange constraints, a larger proportion of MF support is necessary.

The exact part of MLF, Japan, GEF and FGEF grant support for each chiller replacement was to be chosen so that the replacement investment has a payback period of three years. This parameter was chosen because it reflects the investment criteria most commonly used**.**

The proposed contribution of the FGEF was to be sufficient to cover the external funding of at least 5% of the project cost requested in decision 47/26; the external resources foreseen in the project document are US $447,876 plus support cost and constitute 19% of the project costs. UNIDO presented several other sources of co-funding, in particular an in-kind financial contribution from Japan through the UNIDO investment and technology promotion office in Tokyo. Because of the non-cash character of this contribution, it could not be taken into account as part of the project funding.

This project was originally designed to include chillers in: Cameroon, Egypt, Namibia, Nigeria, Malawi, Senegal, and Sudan but as per decision 51/14 the Cote d'Ivoire chiller project was transferred to UNIDO in 2009.

2. BRA.REF.47.DEM.275 – Project Document (UNDP)

A Concept Clearance Document for pdf b (GEF requirement) was completed for submission to the GEF Secretariat in order to secure pdf b pipeline entry in 2005. UNDP, through its GEF office, is presently in negotiation with the GEF Secretariat. Pdf b financing that would allow for a 0.35:1: co-financing ratio with the funding request being made of the Multilateral Fund's demonstration (what was the outcome on the pdf b and the final financial arrangements?

3. COL.REF.47.DEM.65-Project Document (UNDP)

Colombia opted to pursue the submission of a pdf A from the GEF. Should the submission bid be successful, MSP financing could allow for up to a 1:1: co-financing ratio with the funding request being made of the Multilateral Fund's demonstration window.

On the finance side, a partial guarantee fund was to be deployed as a cost-effective and market-oriented way of supporting investments in CFC-free, energy-efficient chillers. This approach would aim directly to reduce many of the real and perceived project risks and would effectively ensure a payback period of 3-5 years for building owners who retrofit or replace an old CFC chiller.

4. CUB.REF.47.DEM.275-Project Document (Canada & UNDP)

Cuba's focus for chiller conversions is exclusively public sector chillers and since market data was limited, the financing approach for Cuba's overall chiller sector strategy rests upon matching and in-kind contributions. To implement its government wide chiller sector project, Cuba requested counterpart commitments for funding in the following approximate proportions:

Financing Source for Sector-wide Implementation	**Counterpart commitment**
MLF	12.0%
Government of Canada (Public & Private)*	11.0%
UNDP's Energy Thematic Trust Fund (TTF)	0.5%
Government of Cuba	76.5%

In turn, the Government of Cuba committed to matching counterpart funding by providing approximately 77% of overall funding and/or financing to replace or retrofit chillers not included in the proposed demonstration project and covering costs, such as new electrical and water installations, site re-conditionings, decommissioning of old chillers, and other elements required to replace government chillers to non-ODS technologies.

Funding for the demonstration project will also be approached via a matching grants and in-kind contribution strategy. For the demonstration project alone, the breakdown in monies committed is as follows:

Funding Source for Demonstration Project	**US$ for Demo Project**	**% of Demo $**
MLF – UNDP	$1,000,000.00	32.9%
MLF – Agency Support Costs	$75,000.00	2.5%
Government of Canada (Public & Private)*	$1,000,000.00	32.9%
Government of Cuba**	$1,000,000.00	32.9%
UNDP-TTF	$40,000.00	1.2%
Total	$3,040,000.00	

*A submission has been made for financing in the amount specified. Of the $1 million, $850,000 has been requested for chiller equipment under TEAM (refer to Sections 6.3.2 and 6.4.2) and $150,000 will be donated through the private sector.
** Approximately $1 million in-kind contribution to cover the costs associated with the local commissioning of the chillers, including new electrical and water installations, site reconditioning, decommissioning of old chillers, compensation from down time during conversions, etc.

Thus, demonstration project funds constitute approximately 23% of all funds committed to Cuba's chiller sector project. These funds will be used to catalyze the remaining 77% of the funds required for the replacement or retrofit of all remaining public sector chillers in Cuba.

Additionally, in order to ensure that the retrofits and replacements are performed in accordance to the needs and specifications tailored to Cuban conditions, the Government of Cuba has agreed to contribute approximately $1,000,000 worth of in-kind aide in order to provide for the local decommissioning of the

chillers being retrofitted and replaced. In-kind aide includes but is not limited to new electrical and water installations, site reconditioning, and decommissioning of old chillers.

5. EUR.REF.48.DEM.06-Project Document (UNIDO)

This project includes 60% of the costs for the replacement of 12 centrifugal chillers supported by 40% counterpart co-financing (US$ 2,220,000), costs for administering the funds (US$ 100,000), technical assistance (US$ 100,000), funds for fostering local initiatives for chiller replacement (US$ 50,000) and funds for organizing a regional workshop at the end of the demonstration project to exchange information on the results of the demonstration project with other countries in the region. The assumption was that approximately 20 chillers will be retrofitted and converted in demonstration phase for $3 million and that Cuba will later follow up with conversion and retrofitting of additional 40 chillers remaining in country at similar cost.

Owners of the selected project sites were contacted by the national ozone units to obtain their commitment for co-financing. While some had the money others had insufficient money which withheld their replacement plans, others still needed to allocate the money needed for the replacement. For these reasons many of are considering loan or leasing options. The percentage of co-financing was also discussed. Companies are willing to provide 40% co-financing.

The financial mechanism consists of the following components:

1. Counterpart investment
2. In kind contribution (national)
3. National Co- financing through green loan from a energy fund
4. Contracting (national or international)
5. Provider guaranteed energy efficiency (reference list)
6. International co-financing through GEF and/or CDM mechanism
7. Funds from the MF

A conversion would cost an owner around 14.5 % interest for a three years commercial credit. Taking the low inflation rate of 6.3 % in consideration, the credit costs 8 %. Taking also in consideration that the energy savings may vary by 50 % from case to case, the IRR of the investment should be significantly higher than the rate of debt and reach a minimum of 15 % to sufficiently cover the economic risk. Especially in cases, where the remaining lifetime of chillers is 17 years and more, only the investment in the most modern and energy efficient technology can gain an acceptable financial return.

Without project, the internal rate of return (IRR) for the conversion would be lower or equal the average market discount rate. It is very unlikely that in such case the owners will give priority to the replacement of chillers before other investments with a higher rate of return. Even in the case of higher efficiencies, such as 0.59 kW/TR for new chillers, the rate of return barely achieves the recover of the debt.

In order to initiate the conversion project, an initial grant of around US$ 2.4 million will be requested. This amount will be used to establish ***a revolving fund*** which will, in the first instance, finance the conversion of 12 chillers as a demonstration project. After a lapse of 11 months the pilot project will be evaluated to ascertain its success. If the project is found to be working according to estimate, a second phase will be initiated where a further 80 chillers may be considered for conversion.
UNIDO will formulate the cooperation with the large chiller manufacturers like York, Grasso, Carrier, and Trane. The regional approach is given through the dissemination and translation of the results from the demonstration projects and the national financial mechanism to all European

countries. The conference will be organized right after the demonstration projects had been conducted.

Representatives of the suppliers in the European region were contacted. They all showed interest to participate in the chiller demonstration projects offering various options from giving discounts to options for leasing chillers and "Energy Savings Performance Contracting" (ESPC) which is to repay the cost of the chiller over several years by paying the energy saving cost. In these cases a bank guarantee is required, it is suggested that a governmental institution could support and provide a guarantee because the interest rates of banks in Balkan countries are high (more than 10%) and as guarantee a mortgage with double than real value is required. Formal offers in this connection will be provided through the process of competitive bidding through which selection will take place.

In the sub-projects where large energy saving is expected, an ESPC purchase model should be implemented. An ESPC allows an activity the flexibility of purchasing new energy efficient chillers and systems with no up-front cost. At first, measurement of energy consumption (COP) of old chiller must be carried out. After installation of new more energy efficient chiller and measurement of energy consumption of new chiller, the purchaser re-pays to the supplier (or to ESCO contractor) cost level of energy saving. The measurements have to be verified by a third party, in this case an expert appointed by UNIDO.

Based on the results of the project, a replacement policy for the remaining chillers will be prepared attempting to utilize funds from the Global Environment Facility and possibly preparing a CDM project. The policy will investigate for other possibilities of co-financing from national energy agencies or national energy conservation funds such as:

- Serbia&Montenegro: Energy Efficiency Centre, within Ministry of Mining and energy
- Romania: Romanian Agency for Energy Conservation, within Ministry of Economy and Commerce
- Croatia: Hrvatska Elektroprivreda - ESCO
- Macedonia: Department of Energy, within Ministry of Economy

6. LAC.REF.47.DEM.36-Project Document (UNDP)

A request for approval of a pdf A was made to UNDP-GEF management, in order to allow for preparation of a MSP within the GEF 3 funding window (closes June 2006). The project aimed at removing barriers to energy efficiency development in the Caribbean, with specific emphasis on enhancing energy efficiency in building systems as a whole. Through specific actions to overcome financing barriers, through focus on capitalization of financial mechanisms and access to financing that would allow for provision of partial loan guarantees, as well as related policy, capacity building, enterprise development and awareness barriers, it is estimated that the contribution of energy efficiency to the region’s energy balance can be significantly increased. As chillers form part of building systems, enhancing energy efficiency in this area, through partnership in the context of the MLF demonstration project, would form a logical first step of an overall regional building efficiency programme, as well as serve to build synergy between activities taken to meet the objectives of the Montreal Protocol and those of the UNFCCC. Should the submission bid be successful, MSP financing could allow for up to a 1:1: co-financing ratio with the funding request being made of the Multilateral Fund’s demonstration window.

The demonstration project sought to work in cooperation with the UNDP Energy TTF focal point to mobilize the sum of US $160,000 to support the efforts of the demonstration phase.

7. SYR.REF.47.DEM.93_ProjectDocument (UNIDO)

The project includes the costs for retrofitting 4 chillers and for replacing 7 centrifugal chillers supported by 25% counterpart co-financing technical assistance, funds for fostering local initiatives for chiller replacement and funds for organizing a regional workshop at the end of the demonstration project.

There was to be an innovative financial mechanism consisting of a national component through green loans, funds from the MF, in kind contribution and provider guaranteed energy efficiency. (How was financing achieved?)

The financial mechanism was to be

1. Counterpart investment, 15%
2. Contracting (national or international), 10%

In West Asia, the culture is not very much loan oriented and the owners prefer to contribute in cash to the project. Ministry of Health and Ministry of Tourism were to include in their business plan for 2006-2007 the budget required for co-financing the replacement / retrofitting of the chillers.

Representatives of the suppliers in the Bahrain, Dubai as well as the international offices of the suppliers were contacted. They and were to offer average discounts of 10% or offering technical services free of charge. (What did the suppliers give?) Energy Based Performance Contracting was not a viable option in West Asia because of the highly subsidized electricity and energy rates.

8. GLO.REF.47.DEM.265-ProjectDocument (World Bank)

The financial structure of this project is based on four sources of financing**.** Three of these sources are from international financial instruments (20%) while the fourth, and most important from a financing perspective, is commercial finance (80%). Funds are to be mobilized from the Multilateral Fund (MLF) and the Global Environment Facility (GEF) through an umbrella trust fund (UTF) from which will be made country-specific allocations to country apex financial institutions (CAFIs) selected for this purpose in pre-listed participating countries with large CFC chiller populations, and a pooled allocation to one or two global apex financial institutions (GAFIs) through which the demand of smaller, unlisted countries will be met. The Bank as Implementing Agency will enter into agreements at the CAFI or GAFI level, as the case may be. In the case of CAFI level agreements, there will also be the need to enter into parallel agreements with the country governments concerned, which would be the notional sovereign recipients of the grant funds, pursuant to the relevant treaties and protocols, and back-to-back grantors to the ultimate recipients, the chiller owners, through the financial intermediation of the CAFI in each case. The country and/or CAFI will, in addition, enter into a purchase agreement with a carbon finance fund.

This fund will purchase emissions reductions generated by the chiller replacements. Grants from the MLF and GEF, plus revenues for carbon finance, will be utilized to fund the incentive product which will be offered plus the administrative costs of program administration. For pre-listed countries, the country government and/or CAFI will enter into project agreements with chiller owners, while for unlisted country participants, the relevant GAFI will enter into project agreements with chiller owners.

ANNEX III – List of Acronyms

CAFIs	Country Apex Financial Institutions
CER	Certified Emission Reduction
CDM	Clean Development Mechanism (GEF)
COP	Coefficient of performance (chillers)
ERPA	Emission Reduction Purchase Agreement (WB)
ESCOs	Energy Service Companies
FIs	Financial Intermediaries
GAFIs	Global Apex Financial Institutions
GEF	Global Environment Facility
IA	Implementing Agency (UNEP, UNDP, UNIDO, WB)
IBRD	International bank for Reconstruction and Development (World Bank)
LAC	Latin America and the Caribbean
LVCs	Low Volume Consuming countries
MLF	Montreal Protocol's Multilateral Fund
MLFS	Multilateral Fund Secretariat
MOP	Meeting of the Parties (to the Montreal protocol)
MP	Montreal Protocol
MT	Metric Tonnes
NOU	National Ozone Unit
NPP	National Phase-out plan
ODA	Official Development Assistance
ODS	Ozone depleting substances
OEWG	Open-Ended Working Group meeting (OEWG)
O&M	Operating and maintenance
PMU	Programme management unit
RAF	Resource Allocation Framework (GEF)
SMEs	Small and medium size enterprises
TA	technical assistance (projects)
TEAP	Technology and Economic Assessment Panel
TPMP	Terminal Phase-out Management Plan
UNDP	United Nations Development programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
VCS	Voluntary Carbon Standard
WB	World Bank