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Addendum

PROJECT PROPOSAL: TURKEY

Country Program TURKEY

REVIEW OF THE EXECUTIVE PROJECT SUMMARY
TURKEY's PROJECT FOR THE PHASEOUT OF ODSs WITHIN THE MP COUNTRY PROGRAM

Project Proposals by The World Bank, March 1992

1. **Technology Transfer and Development Fund**
   a. **Fund Specific Demonstration Projects**
   b. **Fund Investment Projects**
      - **Implementation of Engineering Changes Necessary to Facilitate the Switch from CFC-12 to the Alternate Refrigerant HFC-134a**
      - **Recovery, Recycle and Reclaim of CFC-12 in Service Shops (Istanbul)**
      - **Feasibility Study on Recovery and Reclaim of CFC-12 from Defective Refrigerators at a Refrigerator Production Facility**
      - **Other Investment Projects**
2. **Institution and Management Strengthening**

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Eindhoven, 1992 06 09
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UPDATE

REVIEW OF THE PROPOSALS

1. Relevance

The material given in the Draft Executive Summary gives an overview of Turkey as an ODS consumer, however, a somewhat more detailed analysis for the refrigeration sector as a whole may be useful (if possible, at all). It presents an adequate description of the aim of the projects proposed. It would be desirable to give a clear (short term) project strategy, i.e. why priorities are chosen as described (i.e. why priorities are not so much set for the "other investment projects").
Turkey is no special case for the Montreal Protocol or the Fund, it is probably so that Turkey could be a template for a developing country with moderate use of mobile air conditioning and a domestic refrigerator industry producing for a large part for export reasons.

An important question in the case of Turkey (and similar countries) is whether one should focus a lot of attention on new domestic refrigeration products and all uncertainties still involved at present. This aspect will be more extensively dealt with below.
Of course, the the adoption of policies, technological and measuring measures will be useful in efficiently reducing the dependence on ODSs in Turkey. However, from the data in the proposal it can also be derived that substantial efforts will have to be done via "national" programs for small users, in particular in refrigeration servicing and in cleaning/degreasing (although not a major consumer) to reduce ODS dependencies.

2. Consumption Pattern

As can be taken from the ODS sector background information (1991), Turkey consumed 700 tons of CFC-11 and CFC-12 in the refrigeration sector and roughly 2300 tons in other sectors, including polyurethane foam manufacturing.

(Using reasonable estimates for charges contained in refrigerators) annual consumptions of maximum 200 tons of CFC-12 for new refrigerators and maximum 200 tons for servicing existing refrigerators (assuming 500,000 repairs per year and reasonable practice) can be de-

still two options, i.e. HCFC-22/142b and HCFC-141b blowing which imply two different investment scenarios).
Further, as mentioned above, it is recommended to extend the proposal of refrigerator servicing to a wider area of servicing and to describe which measures in the demonstration area and in management strengthening would interfere with an efficient short term reduction (please note, that a start is already made in the proposal).
It should be underlined that under "Project Benefits" it is being stated that the project is part of the optimum phaseout strategy that should lead to more than 95% reduction in the year 2000. More information how this will be done would be of use.

As far as feasibility of implementation, the short term refrigeration investment projects do not raise many questionmarks, the operation of recovery in servicing can be guaranteed for the long term, recovery in production might be shorter term than implicitly assumed.
It is difficult to judge upon the feasibility of the investment project for "other uses", since detailed data are lacking.

It is stated that project risks are medium, since technical aspects will rely on proven technologies and processes. However, the part of the investment projects where it probably concerns proven technologies (other investment projects) with low risks are only marginally dealt with, the part where it concerns higher risks and financial uncertainties (transfer to HFC-134a and to non CFC blowing agents) is dealt with in the most extensive way.

Transfer from CFC-12 to HFC-134a (mainly in domestic appliances) is one of the topics the OORG has to develop further guidelines for. In particular where it concerns eligibility of funds (incremental costs) companies which produce for export and use/do not use licensing contracts. This activity is planned to be completed before October 1992.

SCIENTIFIC AND TECHNICAL MERITS

The project's scientific merits are mainly in the area of the application of the new refrigerant HFC-134a in refrigerators. It could also imply involvement of local universities and engineering centra in the optimization of equipment from the point of view of thermodynamics. However, it is questionable whether the refrigerator and compressor manufacturer should once more go through the entire R&D process that has been done by many manufacturers in the developed world already; it is worth to consider a set up where parts of the R&D (or the entire know-how) are bought in and transferred from the developed world. In this way the process can be accelerated and the financial risks can be kept at a minimum.
From a technical-political point of view the reduction of CFC-11 in foams by using non-CFC blowing agents, and a transfer to HFC-134a at short notice seem recommendable, since it is directly connected to the nations's export economy (however, what should be considered as incremental costs eligible under the Fund needs a clear definition). However, as mentioned above there are differences between the development status of substitutes for the refrigeration circuit and the foam.

There are numerous technical merits in the proposal. In particular where it concerns better handling of refrigerant in the field (in case the recovery shops will deal with the entire refrigeration sector), better handling of refrigerant in the factory (which will also be important for any future refrigerant); this in spite of arguments regarding cost effectiveness.
The right framework of awareness and training should yield maximum effectiveness of the above.

Technical merits can certainly be found where it concerns the application of non CFC techniques in non-insulating foams, propellants, solvents etc. However, as stated above, the project description for "other investment projects" needs refinements.

Conclusions

To my opinion, it is difficult to state whether the project as a whole should be approved, since it contains so many subprojects of different nature, different timescale and different financial risks (the risk may be "medium" as "an average"). Approval could be possible and should be recommended under the conditions that

1. It should be further investigated whether recovery and recycling in refrigerator workshops could also deal with refrigerant that originates from other sectors (commercial etc). First indications have already been given. This by making use of demonstration projects experience, management strengthening, establishment of contact patterns etc (integration of several parts of the total project).
2. The two "subprojects", i.e. one for the reduction of CFC-11 in foams by the selection on non-CFC blowing agents, and the transition to HFC-134a, are "separated".
   More details should be given regarding the projects and the possible savings in consumption in sectors other than refrigeration and rigid foams; here cost effective reductions may well be possible.
3. It should be further evaluated first whether the amounts given for a transfer from CFC-12 and HFC-134a cover all costs and investments for a reliable and low risk switch from CFC-12 to HFC-134a (according to my opinion it would involve higher amounts in case risks would be reduced via license or joint ventures).
   Within the "HFC-134a transition"- framework substantially more efforts are needed to define what would be incremental costs; part of these efforts will be and are already being undertaken

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P.S. This is an update of an earlier review proposal, dated 25 May 1992. More details on the refrigeration sector in Turkey (figures given there are not completely consistent with the latest information given in this review) can be found in an earlier report by the same review author, RWR-570-LK-92237, 1992 04 29.

rived. Together with 50 tons assumed to be needed in stationary air conditioners (chillers) it implies that 30-35% of the total "sector" CFC consumption is used in commercial/ retail refrigeration and mobile air conditioning (low consumption in Turkey). It implies the use of 200 tons for servicing and 50 tons for new equipment (using my average sector figures). Next to the servicing of domestic refrigerators, the commercial service sector therefore needs attention as well, since the improvement of service procedures can decrease CFC consumption at relatively short notice (which aspect can be partially found in the Project Summary, under Fund Investment Projects, part d. It would be good to separate in Figure 2.1/ 2.2 between the foams and the refrigerants in new domestic products, and the servicing amounts, and to add a share of about 8% for commercial refrigeration).

The above yields a consumption pattern of CFCs in refrigeration and air conditioning which is consistent with patterns in other Article 5 para 1 countries.

3. Cost Effectiveness

It is difficult to express the direct benefits of the Fund Specific Demonstration Projects in terms of cost effectiveness. It could (and should in order to be effective) form the start of a much wider national program to reduce the dependency on ODSs.
A number of applications are explicitly mentioned here. It may not be so important to emphasize the use of non ozone depleting techniques for insulating rigid foams since these are still not fully commercialized (e.g. compare the status of HCFC-141b in the developed countries and see further below). Use of low CFC percentages in foams is important at short notice. Next to recovery of CFC-12 in mobile air conditioning systems the recovery of CFC-12 in the servicing of refrigeration (both domestic and commercial, retail, transport etc.) needs more emphasis here.

Cost effectiveness for the Fund Investment Projects is easier to determine. In determining the size of the Multilateral Fund (info from the Fund, Montreal) preliminary figures are used which vary from very low values (aerosols etc.) to USD 6-7 for recovery and recycle programs and USD 14 for switches to non ozone depleting substances in the domestic industry (whether the latter value is correct, is questionable, my estimates would be substantially higher).

1. A switch to HFC-134a in domestic refrigerators is calculated to cost USD 2.7 million (figure derived from the detailed cost estimates given) which includes both compressor redesign and appliance adjustments and all reliability testing). This is being done for one appliance manufacturer, who produces roughly 500,000 appliances per year. Transfer to HFC-134a in domestics is a difficult issue, since, at this moment, this technology related to lubricants and reliability is still not completely mature (in the developed countries) and it concerns certain financial risks.
   It can be calculated from the proposal that costs per kg of ODS phased for the refrigeration circuit are in the order of USD 20-25. My idea is that this is an underestimate and that it would concern amounts in the order of at least USD 50-80 (dependent on whether or not licensing or joint venture agreements with compressor manufacturers are made, which, on its turn, again depends much on the education level of the engineers involved). This would lead to my preliminary conclusion that an amount in the order of USD 5-7 million could be required to convert Arcelik's production to HFC-134a (which relates to 14-15% of Turkey's CFC consumption in refrigeration, and to 4% of the total).
   Once more, my estimate implies the reduction of risks, the estimate given in the proposal relates to the changes to be made and the testing (assuming no proprietary information needed).
2. It is not clear whether there will be explicit costs for reducing the CFC-11 content in the foam, which should be a very cost effective option (without significant equipment modification, as mentioned in the proposal).
   Secondly, the proposal mentions costs for the domestic refrigerator blowing agent substitution (USD 835,000). Here a clear choice is made for a low boiling blowing agent

(such as HCFC-22/142b), the application of which is still under study in most developed countries. Use of this option could imply the forming of toxic byproducts in the foam, for which extra measures in production should be taken. This means that a precise cost estimate is somewhat speculative at this moment. This should be underlined and, after my opinion, the proposal to switch from CFC-11 to non-CFC blowing agents should be separated from the "HFC-134a switch" proposal.
Using only the figures from the proposal, it is clear that the replacement of CFC-11 in foams is an order of magnitude more cost effective compared to the HFC-134a transition; however, there are still substantial uncertainties.

3. In the Project Summary it is stated that recycling of CFC-12 in the manufacturing environment is technically feasible and implementable. Taking the investment of roughly USD 65,000 and the 4,400 kg of CFCs saved per year this yields a value in the order of USD 18 per kg. However, recycling will decrease the cost for the industry involved; dependent on the CFC-costprice level assumed, amortization time is certainly less than 10 years. However, it is a questionmark whether the industry will continue to use CFCs for 10 years; in case of a switch to HFC-134a the unit needs to be changed, retrofitted and cleaned at relatively short notice.
Nevertheless, after my opinion the above arguments should not be prohibitive for installation.
4. Recovery and recycling of CFC-12 via the existing network of domestic refrigerator service workshops is calculated at USD 565,000. My estimate is that the amount of refrigerant recoverable is somewhat uncertain, much will depend on the practices applied in servicing. reasonable figures still yield a very high cost figure per kg of CFC reduction (even higher than the costs of conversion the production from -12 to -134a).
From a cost effectiveness point of view this proposal may make more sense when also recycling of refrigerant from other types of refrigeration equipment would be incorporated in this plan. This is being mentioned as a longer term option, however, it is not clear whether this can be solved from a logistics point of view.
In particular since the amount needed for reclaim, testing, containers and training (not the recovery machines) is in the order of 85% of the total, a set-up of this project for all servicing is recommendable. It will make the project much more cost effective and in principle, I support the remarks made for the longer term set up.
5. The fourth Fund Investment project mentions the introduction of ozone friendly technologies in four other areas and claims USD 2.5 million. Taking into account that Turkey consumes 200 tons in the acrosol sector, 600 tons in foams for non-refrigerator purposes and 550 tons in cleaning, a transfer to hydrocarbons in propellants, and to non CFC solutions in soft foams, as well as a reduction in cleaning by non CFC techniques and better practice, may be more cost effective at shorter notice than the projects given above (under 1, 2 and 3).
Although the Project Summary gives some information, more detailed plans would be needed.

Cost effectiveness of the Institution and Management Strengthening is again difficult to determine. However, taking into account that a substantial reduction in CFC consumption can be achieved by better practices (refrigeration, cleaning) training and awareness have to be emphasized. It seems to me that an amount of USD 500,000 should be eligible for these purposes under the Fund criteria.

4. Adequacy of Project Design, Feasibility of Implementation etc.

The investment proposals for domestic refrigeration relate to a number of projects. It concerns two short term projects (related to recovery and recycling) and one longer term. However, it is recommendable, after my opinion, to separate the substitution to HFC-134a from the substition to non CFC blowing agents, since it concerns two different types of projects, with different technical maturity and different financial risks (e.g. in foam blowing there are