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Executive Committee of the
Interim Multilateral Fund for the
Implementation of the Montreal Protocol

Seventh Meeting
Montreal, 23-26 June 1992

PROJECT PROPOSAL: TURKEY

PROTECTION OF THE OZONE LAYER THROUGH THE REDUCTION OF THE CONSUMPTION OF OZONE DEPLETING SUBSTANCES

THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET

COUNTRY:	Republic of Turkey	
SECTORS COVERED:	Refrigeration, foams, and other smaller user sectors	
ODS CONSUMPTION IN AFFECTED SECTOR(S): (1991 data-estimate)	Refrigeration:	707 t/y
	Foam:	1,584 t/y
	Aerosol:	200 t/y
	Others:	550 t/y
PROJECT TITLE:	Protection of the Ozone Layer through the Reduction of the Consumption of Ozone Depleting Substances	
PROJECT DURATION:	3 Years	
PROJECT IMPACT:	ODSs PHASED-OUT: 20,000 tons by year 2000	
PROPOSED BUDGET:	$7.85 million	
IMPLEMENTING AGENCY:	World Bank	
COORDINATING NATIONAL AGENCY:	Ministry of the Environment	

PROJECT SUMMARY

Please refer to attached Executive Project Summary

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MONTREAL PROTOCOL
DRAFT EXECUTIVE PROJECT SUMMARY
TURKEY - OZONE DEPLETING SUBSTANCE PHASEOUT PROJECT

Country:	Republic of Turkey
Project Name:	Protection of the Ozone Layer Through the Reduction of the Consumption of Ozone Depleting Substances
Financing:	U.S.$7.85 million (from the Ozone Trust Fund)
Associated Bank Project:	None. Stand alone.
Tentative Appraisal Date:	September/October 1992
Tentative Approval Date:	November 1992
Proposed Peer Reviewers:	Mmes./Messrs. King (ENVFR); Waltz (ENVGC). Pulley (EC1IN)
Technical Reviewers:	D. Rhatigan (LA1EI); L. Kuijpers (OORG Expert from Philips).

1. <u>Purpose of Project.</u> This project has been developed for the purpose of implementing Turkey's Action Plan for the reduction of the consumption of ozone depleting substances (ODS) in order to meet its commitment as a signatory of the Montreal Protocol.

2. <u>ODS Sector Background.</u> The Republic of Turkey's consumption of regulated Ozone Depleting Substances (ODS) in 1991 was 3041 tons which amounted to a per capita consumption of 0.054 kg. All ODS are imported as there are no production facilities in the country. The bulk of the demand is in the industries that manufacture and service domestic refrigerators (approximately 10 million refrigerators are presently in use), in air conditioning and industrial cooling applications and in the foam and aerosol sectors. The 1991 consumption profile for chlorofluorocarbon (CFC) substances is as follows: 707 tons of chlorofluorocarbon 12 (CFC-12) and 11 (CFC-11) in the refrigeration sector, 1584 tons of CFC-11 in the foam sector (including 965 tons used in refrigeration insulation), 200 tons of CFC-12 in the aerosol sector and 550 tons of chlorofluorocarbon 113 (CFC-113) which is used in precision cleaning applications. Usages of Halon 1211 and 1301 (fire extinguishants) and 1,1,1-trichloroethane (industrial degreaser) were relatively small. A summary of recent ODS consumption patterns is presented in Appendix A.

3. <u>Other Country-Specific Background Information.</u> Turkey ratified the Montreal Protocol on Substances that Deplete the Ozone Layer (the Protocol) on

20 September 1991. Given that Turkey has been classified as a developing country for the purpose of the Protocol, and that its consumption of ODS is less than 0.3 kg/capita, it qualifies under paragraph 1 of Article 5 of the Protocol for assistance from the Interim Multilateral Fund for the Implementation of the Montreal Protocol (the Fund). As a prerequisite for obtaining assistance from the Fund, Turkey has undertaken the preparation of its Country Program for the Phaseout of Ozone Depleting Substances (the Country Program) with the assistance of the World Bank. The Country Program is Turkey's proposed Action Plan which comprises the policies, implementation actions and investments needed to initiate ODS phaseout. The Action Plan includes key interventions such as increased use of ODS substitutes, monitoring of ODS consumption patterns to ensure that the required progress is being achieved and public and industry awareness programs to communicate the features of the country's National Ozone Policy. The Action Plan also identifies demonstration and investment projects that meet the Implementation Guidelines and Criteria for Project Selection (the Guidelines) which were approved by the EC of the Fund at its third meeting in April 1991. A key conclusion of the Country Program is that a prompt and timely phaseout of ODS will benefit the Turkish economy as it will reduce the net incremental costs resulting from the phaseout activities. The net incremental cost which would result from the optimum phaseout scenario is $127 million compared to a net incremental cost of $232 million under the allowable scenario (phaseout by 2010). The lower incremental cost resulting from the optimum phaseout is to a large extent due to the early introduction of equipments which use non-ODS refrigerants, therefore decreasing the inventory of capital goods which would be retired early because of the non-availability of ODS for servicing purposes. Prior to ratifying the Protocol, the entire text of the Montreal Protocol was passed as law by the Republic of Turkey.

4. Project Objectives. The overall objective of this project is to assist the Republic of Turkey and private industry to effectively and efficiently phaseout ODS through the adoption of policy, technological and monitoring measures, in compliance with the Protocol, as ratified by the Republic of Turkey, and in accordance with the recommended ODS phaseout strategy and Action Plan in the Country Program. In addition to significantly and promptly reducing consumption, hence emission, of ODS, the implementation of this project will contribute to the reduction of the net incremental cost to the Turkish economy.

5. Project Description. The overall project for the phaseout of ODS has been developed on the basis of the key recommendations made in the Country Program. The proposed project will provide the Republic of Turkey with technical and managerial resources to carry out the actions of the Country Program. The project consists of two distinct sub-components. The first sub-component consists in the Technology Transfer and Development Fund which is proposed as an efficient means of providing the funds to the private sector enterprises which will incur incremental costs as a result of ODS phaseout activities. Projects in the following ODS-using sectors could be funded: refrigeration, foam, aerosols, solvents and fire suppressants (Halons). The second sub-component deals with institutional and organizational issues. The implementation of the first component will proceed in parallel with the second component.

Component 1: Technology Transfer and Development Fund - This Fund will provide assistance for technology transfer and development to the private sector in the key industrial areas where conversion to ODS-free substances is still in the initial stages. The funds will be channeled to private enterprises through a line-of-grant arrangement which will be administered by an appropriate intermediary, notably the Technology Development Foundation. The grant will allow for the efficient processing of numerous project proposals. The grant funds will be utilized to:

i) Fund Specific Demonstration Projects which have a strategic significance from a technological or reduction of net incremental costs point of view (such as the use of ozone friendly blowing agents for flexible and rigid foams; recovery and recycle of CFC-12 in chillers and other stationary air conditioners) and which decrease ODS consumption, in accordance with the following criteria:

- level of ODS consumption reduction
- lowest cost of substitution
- impact on net incremental costs
- replicability

These demonstration projects will serve to introduce the new technologies (such as recovery and recycle units which are used to service mobile air conditioning systems) or alternative products (such as new foam formulations) which are already available on the market but which may involve minor process or equipment changes. These demonstration projects could lead to investment projects which could also be funded by the Technology Transfer and Development Fund.

ii) Fund Investment Projects in the sectors for which net incremental costs are high but which will significantly reduce the use of ODS and contribute to the reduction of economic impact on the Turkish economy. The initial pipeline of projects includes four components, the first three are directed at the refrigeration sector while the fourth is an umbrella-type grant which will make funding available to all industrial sectors which are implementing ODS phaseout projects.

(a) Engineering assistance and training for the testing, design and introduction of a new refrigerant (such as HFC-134a) to replace CFC-12 in the refrigeration loop and a modified foam system to reduce use of CFC-11 in the rigid foam insulation for the refrigerator cavity. Such project could be implemented by an established refrigerator manufacturer, namely Arcelik, who produces 500,000 refrigerators annually (i.e. Arcelik has about 50% of the total refrigerator production capacity in Turkey, including extensive vertical integration into compressor and components manufacturing).

9. Rationale for Montreal Protocol Financing. As per the Implementation Guidelines and Criteria for Project Selection established by the Executive Committee of the Montreal Protocol during its third meeting in April 1991, all technical assistance, demonstration projects, pre-investment and investment activities which lead to reductions in ODS emissions are eligible for financing. The proposed projects are an important part of the Action Plan developed in the preparation of the Country Program.

10. Issues. The Republic of Turkey has received and reviewed the Country Program and participated in the design of this project. It has yet to formaly issue its approval for the project. There are no significant outstanding issues.

11. Environmental Aspects. All components of the project are environmentally sound and will effectively reduce the emission of ODS into the environment. It will be the responsibility of the Ministry of the Environment to ensure that companies being provided assistance under the Montreal Protocol comply with applicable environmental regulations in accordance with Turkish law and the World Bank guidelines. The project is classified as a Category C in accordance with OD 4.01.

12. Project Benefits. The project's major benefit is to assist The Republic of Turkey to achieve its objective of completely phasing out the use of ozone depleting substances as soon as technically feasible while reducing the net incremental costs on its economy, and while maintaining export markets for products that will be required to be ODS-free within a few years. This proposed project is an integral part of the optimum phaseout strategy which has been adopted by the Republic of Turkey and will reduce emissions of ODSs 50% by 1995 and 95+% by 2000. The cumulative effect of the optimum phaseout strategy will prevent the emission of over 20,000 tons of ODSs by the turn of the century. In addition to the reduction in ODS emissions to the environment, the proposed Action Plan, when fully implemented, will reduce the net incremental cost of the complete ODS phaseout on the Turkish economy.

13. Project Risks. The project risks are considered to be medium. The proposed technical aspects will rely, whenever possible and feasible, on proven technologies and processes. The refrigeration sector poses a slightly higher level of risk as the alternative technologies are evolving at a quick pace and scientific debate remains very dynamic on some key issues. The presence of distortions (such as unusually high taxes on alternatives) in the market place could affect the introduction of new technologies. These distortions should be addressed through policy and regulatory aspects in order to provide the required support to the new technologies which otherwise could impede transition to substitutes. It is also planned that funds administration will be handled through the Foundation which has been set up under the Technology Development Project. This Foundation has yet to submit this proposal to its board of directors but it has indicated its interest in the subject.

14. **Staff Review Arrangements.** The following staff is responsible for the Project and for the review:

Task Manager:	Jeremy Oppenheim (EC1CO)
Division Chief:	Paula Donovan (EC1IN)
Bank Technical Advisor:	D. Rhatigan (LA1EI)
External Specialist:	Lambert Kuijpers (from OORG experts group)

15. **Project Review and Next Steps.** The following steps are planned for processing the project:

1) A follow-up mission in May 1992 to Turkey where the Country Program and the project will be reviewed, discussed and finalized for presentation to the Interim Multilateral Fund for the Implementation of the Montreal Protocol (IMLF);

2) Presentation of this Project by the Bank at the June 1992 meeting of the EC of IMLF;

3) Presentation of the Country Program by the Government of Turkey to the Executive Committee (EC) of the IMLF;

4) Following EC approval, project appraisal in September/October 1992.

5) Grant approval: November 1992.

The project is being processed in accordance with OD 9.00.02 which has been developed specifically for Montreal Protocol projects. Project appraisal would follow immediately after the funds have been allocated by the EC of the IMLF. Pre-identified projects such as those with Arcelik would entail early disbursements with most of the funds utilized in the 1993-1996 time frame.

Annex A: ODS Background
Annex B: Project Descriptions
Annex C: Background Information on the Foundation for Technology Development

ANNEX A: SÚMMARY OF RECENT ODS CONSUMPTION PATTERN

Table 2.1
ODS CONSUMPTION IN TURKEY

	1986	1987	1988	1989	1990	1991	1992	1993
REFRIGERANTS								
CFC 11	7	10	13	50	53	57	60	64
CFC 12	593	700	778	509	590	650	683	714
CFC 115	0	0	0	0	14	0	0	0
Total tonnes	600	710	791	560	657	707	744	778
FOAM								
CFC 11	1,430	1,840	1,900	1,246	1,454	1,584	1,614	1,645
CFC 12	0	0	0	0	0	0	0	0
Total tonnes	1,430	1,840	1,900	1,246	1,454	1,584	1,614	1,645
AEROSOLS								
CFC 11	200	260	165	91	46	0	0	0
CFC 12	660	950	865	1,000	937	200	10	0
CFC 114	40	50	20	26	16	0	0	0
Total tonnes	900	1,260	1,050	1,117	999	200	10	0
SOLVENTS								
CFC 113 tonnes	100	125	160	360	518	550	650	700
TOTAL CFCs								
CFC 11	1,637	2,110	2,078	1,387	1,553	1,641	1,674	1,709
CFC 12	1,253	1,650	1,643	1,509	1,527	850	693	714
CFC 113	100	125	160	360	518	550	650	700
CFC 114	40	50	20	26	16	0	0	0
CFC 115	0	0	0	0	14	0	0	0
Total tonnes	3,030	3,935	3,901	3,283	3,628	3,041	3,018	3,123
Total ODP tonnes	3,010	3,910	3,869	3,211	3,519	2,931	2,888	2,983
HALONS								
Halon 1211	15	17	20	0	23	40	70	121
Halon 1301	8	8	9	0	2	4	8	16
Total tonnes	23	25	29	0	25	44	78	137
Total ODP tonnes	125	131	150	0	89	160	289	523
TOTAL CFCs AND HALONS								
Tonnes	3,053	3,960	3,930	3,283	3,653	3,085	3,095	3,260
ODP tonnes	3,135	4,041	4,019	3,211	3,608	3,091	3,176	3,506

Sources

1986–88	World Bank Mission report March 1991
1989–90	Totals from Government of Turkey figures as reported to Nairobi; Sector breakdown from discussions with industry
1991–93	Projections

Figure 2.1 CFC USE BY SECTOR IN TURKEY IN 1990
Total 3,628 tonnes

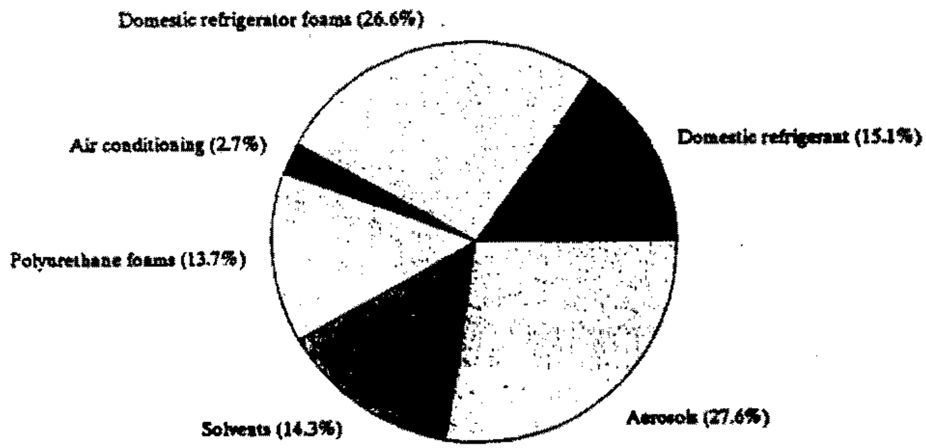
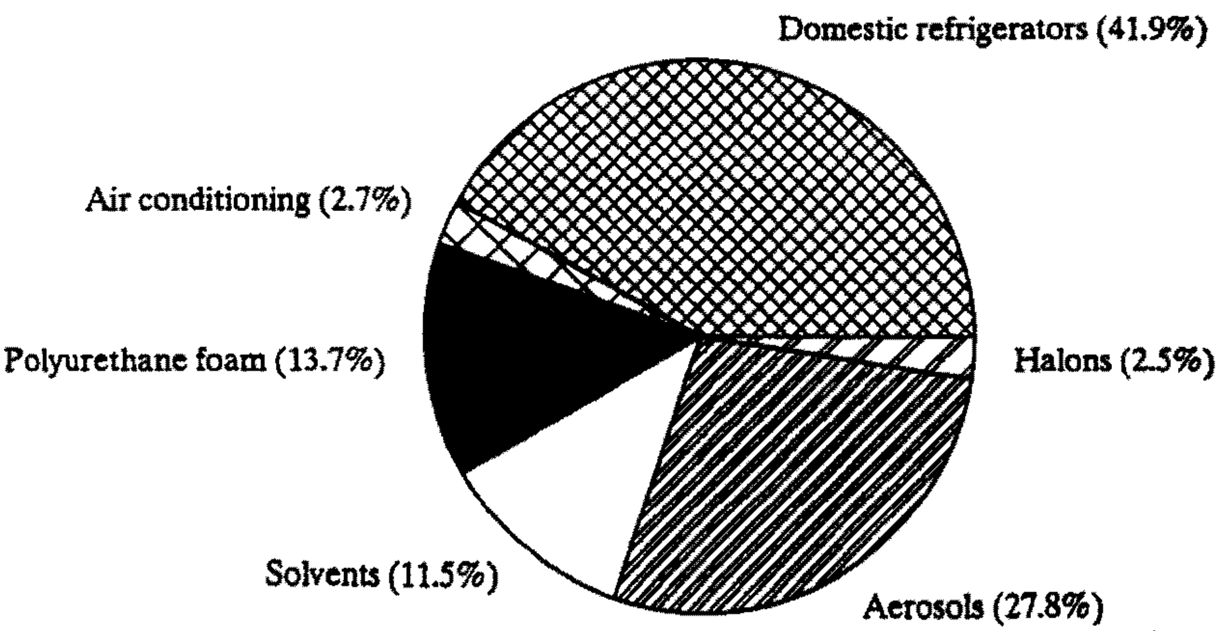


Figure 2.2 ODS USE IN TURKEY IN 1990
Total 3,599 ODP tonnes



ANNEX B: SUMMARY OF THREE REFRIGERATION SECTOR PROJECTS

ANNEX B: SUMMARY OF THREE REFRIGERATION SECTOR PROJECTS

This Annex provides engineering and cost details for those investment projects already identified in the project pipeline. They are projects (a), (b), and (c) under component 1, as presented in para. 5 of the IEPS.

1. Introduction

The projects which have been identified and prepared are as follows:

PROJECT (a) Purchasing of the equipment and technical support necessary to facilitate the switch from CFCs to non-ozone depleting substances (ODS) in the production of household refrigerators.

PROJECT (b) Recovery and reclamation of CFC-12 from household refrigerators servicing activities.

PROJECT (c) Recovery and reclamation of CFC-12 from rework operations in a refrigerator production facility.

In May 1992, refrigeration experts retained by the World Bank defined and costed the three projects for submission to the IMLF. The investment and training requirements and a definition of external technological support and a proposed schedule of project activities in the period 1992-1995 have been outlined. Participants in this process included potential equipment suppliers and current vendors.

Each project cost detail was tested for consistency in qualifying as an incremental cost item as defined by the Montreal Protocol.

The three projects under consideration are mutually exclusive. The single exception is that they share the common goal of providing assistance in carrying out the mandate of the Montreal Protocol. A full scope of project activities including a detailed engineering and cost assessment of each has been carried out.

The project descriptions are being supplemented by a full engineering report which will include equipment data sheets and request for proposal (RFP) documents. This will therefore make the projects fully ready for implementation.

Of the CFC market in existence today, household refrigeration manufacture and service represents 74% of all CFCs, whereas in 1990 it represented only 56%.

CFC CONSUMPTION - TURKEY (METRIC TONS)

	1990	1992 (est.)
TOTAL	3,653	3,090
CFC-12	590	683
CFC-11	1,454	1,614

The impact of the projects being scoped in this mission is readily apparent and the importance is underlined by the significant increase in share that domestic refrigeration now has in the overall CFC situation.

2. Goals

The implementation of these projects will assist in carrying out the mandate of the Montreal Protocol through the Interim Multilateral Fund (IMLF) to phase out the use of ODSs in Article-5 countries in an expeditious and cost effective manner, while conserving critical CFC supplies and eliminating unnecessary emissions.

3. General Background

Country

Household refrigerators and freezers are significant users of CFCs in Turkey. In 1990, approximately 1,000,000 refrigerators and freezers were produced in the country. Each of these units contains 0.20 to 0.30 kg of CFC-12 in the refrigeration system. Approximately 1.00 kg of CFC-11 is used in producing the polyurethane cabinet insulation. The total number of refrigerators and freezers in use in 1990 is estimated to be 10,000,000.

PROJECT (a)

ENGINEERING ASSISTANCE AND TRAINING FOR THE DESIGN, TESTING AND INTRODUCTION OF NON-CFC TECHNOLOGIES IN THE MANUFACTURE OF DOMESTIC REFRIGERATORS

This project provides for the purchase of equipment and technical support to facilitate the switch from CFCs to non-ozone depleting substances in the production of household refrigerators.

A.1 Background

Arcelik is the largest producer of refrigerators in Turkey. In 1990, they produced 537,325 units. This company has been producing refrigerators for over 30 years. During this period they have had technical know-how arrangements with several well-known companies in the U.S. and Europe. It is one of the two companies in Turkey producing hermetic compressors for use in its products. Their depth of manufacturing integration is unusually high. For example, they draw copper wire from rods in the several different diameters necessary for the hermetic motors required for their compressors. The wire is coated with a special electrical insulation enamel used in hermetic refrigeration systems. In addition, they punch out motor lamination, assemble and wind stators and cast aluminum into the motor rotors lamination. The original know-how to make hermetic motors was obtained through a licensing agreement with the U.S. General Electric Company. This agreement is no longer in effect. The technology for the mechanical portion of the compressor has been and is still sourced from the U.S. Tecumseh Products Company of the U.S.A.

Arcelik presently manufactures two series of compressors. The older version is the "AE" series that has been well-known throughout the international market for many years. A more recent design is known as the "AZ" series. This smaller compressor is used on smaller sized refrigerators in moderate climates. This design has not been used extensively in the U.S. and it is reported that Tecumseh is concentrating their alternate refrigerant development work on the larger "AE" model; thus, they may not be able to provide Arcelik with timely technical information ont the "AZ" models.

Arcelik also has a limited manufacturing agreement with Bosch-Seimens, Germany. This agreement covers very specific models of refrigerators (4 in this case) and provides technical information on the current models. It does not provide for assistance on modifications to the models that might involve alternate refrigerants.

In addition to the above agreements, Arcelik has a license agreement with Danfoss (Denmark) under which they produce thermostats (cold controls).

A.2 CFC-12 Household Refrigerator Technology

Since the late 1930's CFC-12 has been the standard refrigerant used in vapor compression systems for household refrigerators. The unique properties of CFC-12, its low toxicity, superior heat transport properties and non-flammability have contributed to its worldwide acceptance as the refrigerant of choice in millions of high efficiency refrigerators. The chemical stability of CFC-12, its compatibility with desiccants, lubricating oils, metallic compressor components and the synthetic electrical motor insulation materials have allowed the production of highly developed heat exchangers, compressors, piping and control systems.

The refrigeration system of a household refrigerator can be compared to a small chemical factory. The refrigerant and its associated compressor lubricant (which circulates around the system with the refrigerant), is subjected to very high temperatures and pressures during the compression stroke while at the same time being exposed to various metallic materials that may act as catalysts for chemical breakdown. The lubricant must be miscible with the refrigerant and it must return to the compressor to insure lubrication and not be trapped in the cold evaporator. Through the years, the household refrigerator industry has seen significant incidents of catastrophic product failures (failures of large groups of products of a discrete design) primarily due to unforeseen chemical reactions, such as carbonaceous deposits on compressor valves, motor insulation deterioration, system component corrosion, obstructions in small bore tubing, etc.

A.3 The Switch to alternate Refrigerant HFC-134a

The change to a refrigerant, such as HFC-134a is a major concern for a refrigerator manufacturer. Because Arcelik manufactures both the electrical motor and the mechanical compressor, it is particularly vulnerable to risk. Those refrigerator manufacturers who purchase compressors from original equipment manufacturers (OEM's) will not have to bear the development cost and warranty risks inherent in the motor and compressor. Due to the somewhat different thermodynamic characteristics of HFC-134a from CFC-12, the compressor displacement and the motor output will have to be optimized for the new refrigerant.

A.4 Use of CFC-11 in Polyurethane Refrigerator Insulation

Polyurethane is the most common material used in refrigerator insulation. It is anticipated that, after appropriate refrigerator performance testing in the temperature controlled test cells, the shift to formulations utilizing 50% less CFC-11 will be possible without significant production equipment modification.

Alternatives such as HCFC-142b, HCFC-22, HFC-142a, HFC-134a, acetone and pentane are being used/considered for various foam applications.

Acetone and hydrocarbons are flammable and have poor insulation values (lambda value, K factor) and are not generally considered the best choices for rigid insulation foam.

The HCFCs containing two carbon atoms can develop decomposition products in the polyurethane/exothermic reaction. This casts some question on HCFC-123, HCFC-141b, and HCFC-142b until more data and solutions are forthcoming from producers.

HCFC-22 has no decomposition problem but needs further study in rigid foams as the insulation values need to be improved.

Considerable work is now in progress by producers and appliance manufacturers in testing HFC-134a which is showing surprising promise.

Bulk storage, mixing equipment and piping will be required for high pressure products, eg. HFC-134c, HCFC-22/HCFC-142b... etc. For flammable products (HCFC-

141b, HCFC-142-b and HFC-152a) additional safety handling and design will be required.

The long-term blowing agent of choice, at the moment is, HFC-134a with HCFC-22/HCFC-142b as a possible intermediate-term candidate. Testing of these products is incomplete and may be 1-2 years before they are ready for commercial use. Hence, the immediate strategy of 50% CFC reduction, as planned by Arcelik, seems prudent.

A.5 Engineering Development

The engineering development work for this project is done primarily at the research and development and product engineering facilities located at Cayirova, Turkey.

The engineering organization has adapted an approach of monitoring international developments in the refrigeration industry through literature searches, attending seminars and conferences in the U.S. and Europe.

The conversion of approximately 15 models of refrigerators for the alternate refrigerant and oil will require extensive performance testing in ambient controlled rooms. This testing will determine the optimum capability restriction and refrigerant charge to provide appropriate refrigerator storage temperatures, minimize energy consumption, attain necessary low voltage, operation and determine ice freezing rates. All of these tests are defined in the International Standards Organization (ISO) documents which establish parameters for refrigerator labeling such as "tropical", "temperate", designations and the requirements for freezer compartment "star" ratings.

This project provides for one additional controlled ambient test cell that will meet the test cell specifications of the ISO standards. This test cell will provide improved test accuracy to identify smaller differentials in performance. While other existing test cells will provide less accurate data, it will be necessary to utilize them in order to complete the extensive evaluation program in a timely fashion.

In the thermal insulation area one of the engineering concerns is the possible reaction of the thermal insulation ingredients with the plastic material which can cause cracking of the liner in service. This project is providing the capability of producing insulation samples in the laboratory for bench testing of physical properties and thermal conductivity as well as foaming cabinet, and liner assemblies, which are then subjected to thermal cycling tests in a chamber that the laboratory now has. The assembly is alternately exposed to low temperatures and high temperatures for several cycles which will accelerate the liner cracking tendency if it is present.

The equipment, personnel and technology transfer provided in this project for Engineering Development will position this organization at a somewhat higher technical capability level where they will have the technical know-how and equipment to qualify their specific vendors of the new substances. Due to the historically well-proven reliability of the currently used products (CFC-12, Mineral Oil, CFC-11), this level of technical capability has not been necessary in the past. Information supplied by their compressor license some indeterminate time in the future will help to evaluate their design and material sourcing decision.

A.6 Manufacturing

Refrigerator manufacture is done at a factory in Eskisehir. It has three assembly lines, each producing different sizes of refrigerators (in 1992 they are also running different models). In order to accomplish a reasonable transition rate to non-ODS and still maintain the required production levels, it will be necessary for them to run refrigerators with alternate refrigerants down the some assembly lines at the some time. As the charging equipment can not be used alternately with the two different oils and refrigerants, this project provides for an additional set of oil and refrigerant charging equipment.

The Eskisehir plant has six polyurethane thermal insulation injection lines. This project provides for the minimum modification required to convert these systems to a high pressure blowing agent with the capability of converting one system at the time such that the phase in can be accomplished over a period of time consistent with the risks involved.

Table B.1 details the equipment expenditures required for this project ($3,486,000). All costs in 1992 US dollars.

Table B.2 outlines the personnel required to implement the project. ($684,000)

Table B.3 shows the make up of technology transfer expenditures. ($481,500)

Total expenditures for Project (a) are therefore $4,652,100.

Individual Equipment Data Sheets (EDS) that provide detailed information on the equipment and its use will be prepared for each piece of equipment. These EDSs will be used to request proposals from equipment suppliers. The cost estimates for major equipment are based on budget prices provided by equipment suppliers. An example of an equipment data sheet and supplier costs estimates are included. the timetable for carrying out this project is also being presented in draft format.

PROJECT (a)

ENGINEERING ASSISTANCE AND TRAINING FOR THE DESIGN TESTING AND INTRODUCTION OF NON-CFC TECHNOLOGIES IN THE REFRIGERATOR MANUFACTURE

TABLE B.1
EQUIPMENT EXPENDITURES (1992 $US)

ENGINEERING DEVELOPMENT:		
MOTOR/COMPRESSOR		
1. Falex text equipment	$ 84,000	
2. Sealed tube test system	$ 48,000	
3. Compressor Calorimeter	$ 354,000	
4. Sealed tube test capability	$ 48,000	
TOTAL		$ 534,000
THERMAL INSULATION		
1. Insulation conductivity tester	$ 98,500	
2. Easy froth polyurethane metering system	$ 62,500	
3. Foam Injection Machine	$ 161,000	
4. Universal foaming fixture	$ 181,500	
TOTAL		$ 503,500
REFRIGERANT SYSTEM		
1. Controlled Ambient Test Cell	$ 303,000	
2. Data Acquisition for Test Cells	$ 132,000	
3. Refrigerator Component X Ray	$ 403,300	
TOTAL		$ 838,300
MANUFACTURING:		
MOTOR/COMPRESSOR		
1. Life test	$ 47,800	
2. Assembly line	$ 200,000	
3. Calorimeter test equipment	$ 305,000	
4. Oil processing equipment	$ 103,000	
5. Oil charging equipment	$ 57,000	
TOTAL		$ 712,800
THERMAL INSULATION		
1. Storage tank (including pump package)	$ 46,000	
2. Easy froth (3) $62,500 x 3	$ 193,000	
3. Pressurized storage tank (6 tanks)	$ 90,000	
4. Piping, blowing agent	$ 6,000	
TOTAL		$ 335,000
REFRIGERANT SYSTEM		
1. Refrigerant transfer unit	$ 125,000	
2. Compressor oil processing system	$ 137,000	
3. Charging stations (6)	$ 96,000	
4. Pipe and valves	$ 15,000	
5. Leak detector (6)	$ 77,000	
6. Recovery from production, 134a	$ 65,000	
TOTAL		$ 515,000
THERMOSTAT		
1. Cleaning equipment	$ 24,000	
2. Charging Board for thermostats	$ 24,000	
TOTAL		$ 48,000
GRAND TOTAL		$3,486,600

PROJECT (a)

ENGINEERING ASSISTANCE AND TRAINING FOR THE DESIGN TESTING AND INTRODUCTION OF NON-CFC TECHNOLOGIES IN THE REFRIGERATOR MANUFACTURE

TABLE B.2
ENGINEERING DEVELOPMENT PERSONNEL REQUIREMENTS FOR THREE YEARS

Number	Description	Costs/yr	# years	Project Cost
1	Project Leader	$45,000	three	$135,000
5	Project Engineers	$27,000 (ea)	three	$405,000
	Assignments: 1 Engr. Compressors 2 Engrs. Refrigerators 1 Engr. Thermal insulation 1 Engr. Chemical laboratory			
3	Technicians	$16,000 (ea)	three	$144,000
			TOTAL	$684,000

PROJECT (a)

ENGINEERING ASSISTANCE AND TRAINING FOR THE DESIGN TESTING AND INTRODUCTION OF NON-CFC TECHNOLOGIES IN THE REFRIGERATOR MANUFACTURE

TABLE B.3
TECHNOLOGY TRANSFER REQUIREMENTS

1. Expenses for project engineers travel outside of Turkey to U.S. of Europe for attendance at conferences, seminars, meetings with consultants education, etc. This is a three (3) year project.

2. Estimated cost per trip:

Transportation	$ 1,000
Living Expenses ($300 x 10 days)	$ 3,000
Other Expenses (conference fees, etc.)	$ 1,000
	$ 5,000/trip

3. Projected number of trips:

For the project leader (3 trips/year)	3	
For each of five project engineers (1 trip/year)	5	
TOTAL TRIPS/YEAR	8	
TOTAL TRIPS/FOR 3 YEARS	24	
COST FOR 3 YEAR PROJECT 24 X $5000		$ 120,000

4. Expenses for project personnel travel within Turkey to suppliers production facilities, Universities, government agencies, etc.

5. Estimated cost per trip $ 1,000/trip

6. Project number of trips

For the project leader (6 trips/year)	6	
For each of five project engineers (3 trip/year)	15	
For each of three technicians (1 trip/year)	3	
TOTAL TRIPS/YEAR	24	
COST FOR 3 YEAR PROJECT 3 x 24 x $1,000		$ 72,000

7. Expenses for outside country consultancy, laboratory testing, etc.

PROJECT (a)

ENGINEERING ASSISTANCE AND TRAINING FOR THE DESIGN TESTING AND INTRODUCTION OF NON-CFC TECHNOLOGIES IN THE REFRIGERATOR MANUFACTURE

TABLE B.3 (continued)
TECHNOLOGY TRANSFER EXPENSES

8.	Estimate cost for outside country consultant For one week consulting:		
	Consultant fee: $700/day x 7 days	$ 4,900	
	Transportation	$ 1,500	
	Living expenses $300/day x 7 days	$ 2,100	
	COST FOR ONE WEEK CONSULTING	$ 8,500/week	
9.	Estimated consultancy needs per year:		
	Refrigeration technology	2 weeks	
	Compressor technology	2 weeks	
	Materials chemistry	2 weeks	
	Polyurethane technology	1 week	
	Measurement technology	1 week	
	Computer software technology	1 week	
	TOTAL	9 Weeks	
	TOTAL COST FOR CONSULTANCY FOR 3 YEARS 9 x 3 x $8,500		$ 229,500
10.	Estimated costs for external project activities such as laboratory analysis, testing, etc.		
	For three years at $20,000/year		$ 60,000
11.	TOTAL FOR TECHNOLOGY TRANSFER PROJECT #1		$ 481,000

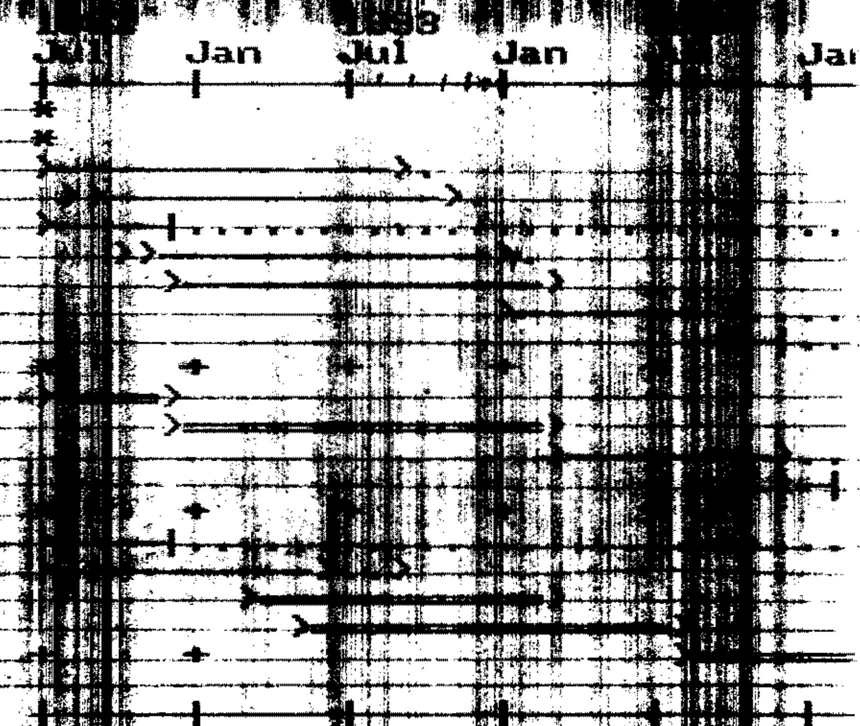
EXAMPLE OF AN
EQUIPMENT DATA SHEET

INDEX NUMBER	II-A-6
ITEM NAME	OIL PROCESS EQUIPMENT
SOURCE OF SUPPLY	PCU - USA
ITEM DESCRIPTION	COMPRESSOR OIL PROCESSES FOR REDUCING THE HUMIDITY RATE
SOURCE OF COST	PCU - USA
INFORMATION	
BASE COST	$ 85,000
LANDED COST AT ARCELIK	---
INSTALLED COST	$103,000
DELIVERY TIME FROM ORDER	7 - 8 MONTHS
TIME FROM ORDER TO OPERATIONAL STATUS	9 MONTHS
USE/JUSTIFICATION	DUPLICATION OF EQUIPMENT IS THE ONLY PRACTICAL WAY TO MEET A YEAR-LONG IMPLEMENTATION PROJECT OF CHANGING THE LUBRICATION OIL.

An Equipment Data Sheet (EDS) will be prepared for each piece of equipment which will be ordered under this project. Budget cost estimates such as that found on the following page have been obtained from equipment suppliers.

TIMETABLE FOR
NON-CFC REFRIGERAT
Rev. 0 16.5.19

1 Start
2 COMPRESSOR
3 Redesign for 134a
4 Prototype production
5 Setting up of test facilities
6 Calorimeter and life tests
7 Evaluation of design
8 Changes on production lines
9 Pilot production
10 INSULATION
11 Setting up of laboratories
12 Testing of alternate
13 Changes in PU production lines
14 Pilot production of
15 REFRIGERATOR
16 Setting up of test facilities
17 Design methodology
18 Design changes of refrigerators
19 Refrigerator tests
20 Preparation of production lines
21 Pilot production of non-CFC refrigerator



TIMETABLE FOR
NON-CFC REFRIGERATOR
Rev. 0 15.5.1992

1995 Jul | Jan | 1996 Jul | Jan

Start	1
COMPRESSOR	2
Redesign for 134a	3
Prototype production	4
Setting up of test facilities	5
Calorimeter and life tests	6
Evaluation of design	7
Changes on production lines	8
Pilot production	9
INSULATION	10
Setting up of laboratories	11
Testing of alternate PU	12
Changes in PU production lines	13
Pilot production of PU	14
REFRIGERATOR	15
Setting up of test facilites	16
Design methodology	17
Design changes of refrigerators	18
Refrigerator tests	19
Preparation of production lines	20
Pilot production of non-CFC refrigerator	21

PROJECT (b)

RECOVERY AND RECLAMATION OF CFC-12 FROM HOUSEHOLD REFRIGERATOR SERVICING ACTIVITIES

PROJECT (b)

RECOVERY AND RECLAMATION OF CFC-12 FROM HOUSEHOLD REFRIGERATORS SERVICING ACTIVITIES

B.1 Background

Recovery and reclamation of CFC-12 from household refrigerators and other refrigeration products utilizing CFC-12 that are being serviced is a conservation and emission reduction measure that can be implemented without delay. Refrigerant recovery and recycling technology is receiving acceptance worldwide.

The technology involved in handling and processing used refrigerant is developing very rapidly. There are many companies in the U.S., U.K., and Europe now producing machines of various types to be used in this field. The Air-Conditioning and Refrigeration Institute (ARI) has issued "Standard for Performance of Refrigerant Recovery, Recycling And/Or Reclaim Equipment" Standard 740-91. In the U.S., the Underwriters Laboratory also tests recovery machines to certify that they meet Society of Automotive Engineers (SAE) specification SAE J1990 for equipment and SAE J 1991 for refrigerant purity.

ARF has also established nomenclature definitions for terms used in this activity. They are as follows:

> RECOVERY. To remove refrigerant in any condition from a system and store it in an external container without testing it or processing it in any way.
>
> RECYCLING. To reduce contaminants in used refrigerant by oil separation and single or multiple passes through devices which reduce moisture, acidity and particulate matter, such as replaceable core filter-dries. This term usually applies to procedures implemented at the field job site or at a local service shop.
>
> RECLAIMING. To reprocess refrigerant to new product specifications by means which may include distillation. Chemical analysis may be required to determine that appropriate product specifications are met such as A.R.I. Standard 740-91 or DIM 8960.

Arcelik has 410 franchised service shops throughout Turkey. They are carefully controlled by company owned regional service centers. The service shops operate 570 service trucks. About 30% of compressor changes are made in the home and the remainder are brought to the shop for repair. There are 90 service shops in the greater Istanbul area that would participate in this project.

The typical compressor replacement procedure is to unsolder the compressor and drier, allowing the refrigerant to be emitted to the atmosphere, resolder the new compressor and drier, evacuate the system with a vacuum pump charge with CFC-12, check for leaks with a halogen leak detector, and operate the refrigerator to check for proper performance.

B.2 Recovery/Reclamation Project Implementation For Product Service Operations

This project provides for the establishment of a central reclamation center and testing laboratory to which recovered CFC-12 refrigerant from service operations will be delivered for reclamation and preparation for reuse. This reclamation center will be initially established and operated by Arcelik receiving recovered refrigerant from some 90 Arcelik service shops in the Istanbul area. After an initial period of operation which will provide opportunities to evaluate the performance of the initially selected equipment, to test out personnel training approaches and establish collection, transportation and distribution systems, the intent would be to turn over the operation of this reclaim center and its associated collection and distribution systems to a consortium which could include government entities such as the Ministry of the Environment, Technical Universities, interested Original Equipment Manufacturers (OEM's) i.e. Arcelik, Profilo, Simtel, Vestel, etc., chemical companies involved with refrigerant sales and distribution, i.e., ICI, ATOCHEM, HOESCHT, DUPONT, MONTEFLUOS, etc. and any responsible operation providing service for CFC-12 equipment. With this approach the recovery program in Turkey can be effectively expanded geographically and provide coverage for any equipment containing CFC-12.

B.3 Initial Implementation Plan

The introductory plan will provide for installing CFC-12 recovery machines in a total of 90 arcelik service shops over a period of 1.5 years. The recovery machines will be introduced in groups of 15 with a time lapse of 3 months between each group during which time instructions in the theory and use of these machines will be given to the service personnel who will be operating the equipment. This program can be accelerated if it is operating efficiently in its earlier stages.

The reclamation plant will be in a central location in Istanbul and will have the capability of reclaiming the refrigerant to meet the specifications for new Refrigeration Institute Specification 700-88. This facility will have a test laboratory that will be capable of testing incoming refrigerant to determine if it is suitable for reclamation (verify that it doesn't contain refrigerants other than CFC-12, or other severe contaminants) and can test the reclaimed refrigerant to determine if it meets specification.

PROJECT (b)

RECOVERY AND RECLAMATION OF CFC-12 FROM
HOUSEHOLD REFRIGERATORS SERVICING ACTIVITIES

A project for the recovery and reclaim of CFC-12 in Service Shops in the Metropolitan Area of Istanbul. This is a two year project.

TABLE B.4

PROJECT EXPENDITURES

1. EQUIPMENT		
- The engineering report to be issued will contain individual detail sheets on the equipment for this project.		
- Recovery machines 90 @ $1,200 ea.	$ 108,000	
- Refrigerant reclaim module	$ 220,000	
- Refrigerant cylinders	$ 2,400	
- Refrigerant bulk storage tank	$ 2,600	
TOTAL EQUIPMENT COST		$ 332,970
2. SERVICE TECHNICIAN TRAINING		
- 90 service technicians @ $500		$ 45,000
3. PROJECT SUPERVISION & TRAINING PERSONNEL		
- One project engineer @ $27,000 per year	$ 27,000	
- Three technicians $ $48,000 per year	$ 144,000	
		$ 171,000
A.4 FOUR CONSULTANTS		
- Four weeks @ $4,000/week		$ 16,000
PROJECT (B) TOTAL		$ 565,000
		$1,565,000

PROJECT (c)

RECOVERY AND RECYCLE OF CFC-12 FROM REWORK OPERATIONS IN REFRIGERATION MANUFACTURING

PROJECT (c)

RECOVERY AND RECYCLE OF CFC-12 FROM REWORK OPERATIONS IN REFRIGERATION MANUFACTURING

C.1 Background

This project implements the recovery and recycle of CFC-12 from domestic refrigerators being serviced or rebuilt at a refrigerator production plant. Commercial equipments are currently available to accomplish such a recovery. Arcelik has already installed such a system. This operation is easily replicated in other manufacturing environments and it is suggested to implement the project with another important refrigerator manufacturer.

The project consists in the purchase of commercially available equipment (recovery machines, pumps, purification unit) and in the cost of installation. The total cost for such a facility has been estimated at $65,000.

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