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EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Sixty-second Meeting  
Montreal, 29 November - 3 December 2010

**PROJECT PROPOSAL: TURKEY**

This document consists of the comments and recommendations of the Fund Secretariat on the following project proposal:

Foam

- Umbrella project for the phase-out of HCFC-141b from the PU rigid foam production in the manufacturing of PU insulated sandwich panels and the phase-out of HCFC-142b and HCFC-22 in the manufacture of XPS boardstock

UNIDO

**PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT  
TURKEY**

**PROJECT TITLE(S)****BILATERAL/IMPLEMENTING AGENCY**

(a) Umbrella project for the phase-out of HCFC-141b from the PU rigid foam production in the manufacturing of PU insulated sandwich panels and the phase-out HCFC-142b and HCFC-22 in the manufacture of XPS boardstock	UNIDO
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**NATIONAL CO-ORDINATING AGENCY**

Ministry of Environment and Forestry

**LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT****A: ARTICLE-7 DATA (ODP TONNES, 2009, AS OF OCTOBER 2010)**

HCFCs	609.9		

**B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, 2009, AS OF OCTOBER 2010)**

Chemical	Aerosol	Foam	Fire fighting	Refrigeration		Solvent	Process agent	Lab Use	Total sector consumption
				Manufacturing	Servicing				
HCFC-123				0.02					0.02
HCFC-124									0.00
HCFC-141b		197.13							197.13
HCFC-142b		116.44							116.44
HCFC-22		65.88		190.90	39.63				296.41

**CFC consumption remaining eligible for funding (ODP tonnes)**

n/a

**CURRENT YEAR BUSINESS PLAN  
ALLOCATIONS**

Funding US \$

Phase-out ODP tonnes

(a)	2,354.540	27.9
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<b>PROJECT TITLE:</b>	
ODS use at enterprise (ODP tonnes):	213.2
ODS to be phased out (ODP tonnes):	213.2
Project duration (months):	30
Initial amount requested (US \$):	14,291,691
Final project costs (US \$):	
Incremental Capital Cost:	6,033,600
Contingency (10 %):	402,960
Incremental Operating Cost:	1,276,930
Total Project Cost:	7,713,490
Local ownership (%):	100
Export component (%):	0
Requested grant (US \$):	7,713,490
Cost-effectiveness (US \$/kg):	2.78
Implementing agency support cost (US \$):	578,511
Total cost of project to Multilateral Fund (US \$):	8,292,001
Status of counterpart funding (Y/N):	n/a
Project monitoring milestones included (Y/N):	Y
<b>SECRETARIAT'S RECOMMENDATION</b>	<b>For individual consideration</b>

## PROJECT DESCRIPTION

1. On behalf of the Government of Turkey, UNIDO has submitted to the 62<sup>nd</sup> Meeting of the Executive Committee an umbrella project to phase out 2,772 tonnes (213.2 ODP tonnes) of HCFC in the manufacture of polyurethane (PU) insulated sandwich panels (HCFC-141b), and extruded polystyrene (XPS) boardstock (HCFC-142b and HCFC-22). The cost of the project as submitted is US \$14,291,690 plus agency support costs of US \$1,071,876, for the conversion of nine enterprises: four sandwich panel manufacturers converting to n-pentane technology, and five XPS boardstock manufacturers converting to HFC-152a/dimethyl ether (DME) technology and carbon dioxide (CO<sub>2</sub>)/ethanol technology (one enterprise). The project is scheduled to be completed in 30 months.

2. The HPMP preparation in Turkey is still in progress and thus the project has been submitted in accordance with decision 54/39(d).

### PU foam enterprises

3. The project proposes to replace 900.3 metric tonnes (99.0 ODP tonnes) of HCFC-141b used in the manufacture of continuous panels by four enterprises with hydrocarbon-based technologies, as shown in Table 1.

**Table 1. PU foam enterprise covered by the umbrella project converting to n-pentane**

Enterprise	Production process	HCFC-141b consumption	
		Metric ton	ODP tonnes
Mepan Panel	One continuous PU sandwich panel line	76.3	8.4
Nuhpanel	Two continuous PU sandwich panel lines	233.0	25.6
Aluform	One continuous PU sandwich panel line, one continuous mineral wool sandwich panel line, two discontinuous PU sandwich panel lines.	288.0	31.7
Assan Panel	One PU sandwich panel line	303.0	33.3
Total consumption		900.3	99.0

4. The selection of n-pentane as the alternative technology was based on an assessment of flammability issues, insulation performance, costs, suitability for production lines, and climate impact. Based on the production equipment in the baseline, conversion to n-pentane involves installing a hydrocarbon storage unit and accessories; retrofitting existing foaming machines for the use of pentane; safety-related systems; electrical and civil works; trials and training. The total cost of the conversion is US \$4,690,124 (Table 2), with a cost-effectiveness of US \$5.21/kg.

**Table 2. Total cost for the conversion of the PU foam enterprises covered by the umbrella project**

Enterprise	Cost (US \$)		
	Capital	Operating	Total
Mepan Panel	377,300	707,043	1,084,343
Nuhpanel	754,600	565,100	1,319,700
Aluform	873,400	595,416	1,468,816
Assan Panel	366,300	450,965	817,265
Total	2,371,600	2,318,524	4,690,124

### XPS boardstock foam enterprises

5. XPS foam is produced by injecting a blowing agent in the molten polystyrene before it reaches the extrusion die. As this mixture exits the extrusion die, the blowing agent vaporizes, expanding the molten resin into foam and creating a fine cell structure. CFC-12, which was originally used as the blowing agent, has been replaced by a mixture of HCFC-142b (60 per cent) and HCFC-22 (40 per cent).

6. The project proposes to replace 1,872.0 mt (114.2 ODP tonnes) of HCFC-142b and HCFC-22 used in the manufacture of XPS foams panels by four enterprises with a mixture of HFC-152a/DME and to CO<sub>2</sub> by one enterprise, as shown in Table 3.

**Table 3. XPS foam enterprises covered by the umbrella project (2009) converting to HCFC-152a/DME**

Enterprise	Production line	HCFC-22/HCFC-142b consumption	
		Metric ton	ODP tonnes
Pakpen	One 800 kg/hr line; one 400 kg/hr line	316.0	19.3
ODE	One 400 kg/hr line; one 200 kg/hr line	692.0	42.2
Yalteks	One 500 kg/hr line	211.0	12.9
BZ Insaat*	One 1,500 kg/hr line	197.0	12.0
BTM	One 280 kg/hr line	456.0	27.8
Total		1,872.0	114.2

\*To be converted to CO<sub>2</sub> technology.

7. Selection of the alternative technology was based on an assessment by the five XPS manufacturing enterprises of the environmental impact (including ozone depletion and climate), market availability, toxicity, cost, the possibility of maintaining the existing production capacity following conversion, and several other technical issues. Three alternative technologies were considered: CO<sub>2</sub> and ethanol (or other additives), hydrocarbon, and HFCs (mixture of HFC-134a and HFC-152a). Methyl formate and HFO-1234ze, currently the subject of demonstration projects in China and Turkey respectively, are considered to have insufficient industrial acceptance and are not yet certified or accepted by regulatory bodies. Based on these considerations, HFC-152a/dimethyl ether (DME) technology was selected by four enterprises and CO<sub>2</sub>/ethanol by one enterprise.

8. Turkey is requesting funds for equipment that has already been purchased and installed or is about to be purchased and installed for the conversion to go ahead. Based on the production equipment in the baseline, conversion to HFC-152a/DME includes retrofitting the screw and the barrel of the extruder, retrofitting motors, installing a new blowing agent supply system, and installing safety systems for the use of flammable substances, electrical and civil works, trials and training. The total cost of the conversion is US \$9,601,566 (Table 4), with a cost-effectiveness of US \$5.13/kg.

**Table 4. Total cost for the conversion of the XPS foam enterprises covered by the umbrella project**

Enterprise	Cost (US \$)		
	Capital	Operating	Total
Pakpen	1,451,010	620,163	2,071,173
ODE	1,451,010	1,289,018	2,740,028
Yalteks	838,640	408,887	1,247,527
BZ Insaat	838,640	383,983	1,222,623
BTM	1,451,010	869,205	2,320,215
Total	6,030,310	3,571,256	9,601,566

#### Implementation arrangements

9. The Ozone Unit would be responsible for overall project coordination and assessment. UNIDO will be responsible for the financial management of the grant, and for assisting the enterprises with equipment procurement, technical information updates, monitoring the progress of implementation, and reporting to the Executive Committee. Financial management will be conducted according to UNIDO's financial rules and regulations.

## SECRETARIAT'S COMMENTS AND RECOMMENDATION

### COMMENTS

#### HCFC consumption

10. The 2009 HCFC consumption of Turkey is presented in Table 5. In 2009, Turkey exported 73.2 metric ton (mt) (4.0 ODP tonnes) of HCFC-22. Also in 2009, about 280.0 mt (30.8 ODP tonnes) of HCFC-141b were imported in pre-blended polyols, which were not reported under Article 7 of the Protocol. Due to the competitive prices of the local systems houses, it is expected that the import of pre-blended polyols will not increase.

**Table 5. Sectoral consumption of HCFCs in Turkey in 2009**

HCFC	Foam	Refrigeration		Total
		Manufacturing	Servicing	
<b>Metric ton</b>				
HCFC-22	1,197.8	3,471.0	720.5	5,389.3
HCFC-141b	1,792.1			1,792.1
HCFC-142b	1,791.4			1,791.4
HCFC-123		1.2		1.2
Total metric ton	4,781.3	3,472.2	720.5	8,974.0
<b>ODP tonnes</b>				
HCFC-22	65.9	190.9	39.6	296.4
HCFC-141b	197.1			197.1
HCFC-142b	116.4			116.4
HCFC-123		0.0		
Total ODP tonnes	379.4	190.9	39.6	609.9

#### HPMP strategy

11. The Government of Turkey has agreed to establish the starting point for aggregate reductions in HCFC consumption as the 2009 HCFC consumption reported under Article 7 of the Protocol of 610.0 ODP tonnes plus the 30.8 ODP tonnes of HCFCs contained in imported polyol blends, for a total of 640.8 ODP tonnes.

12. The Government of Turkey has decided to implement an accelerated phase-out of HCFCs in the manufacturing sub-sector in advance of the Montreal Protocol schedule. With regard to the refrigeration servicing sub-sector, the proposed reduction and phase-out are foreseen to be achieved by the date of Turkey's accession to the European Union. At present, the legislation has not introduced HCFC restrictions applicable to refrigeration servicing activities, as in the case of the manufacturing sub-sector, except for the licensing and quota allocation to reach the freeze in consumption. The strategy for addressing HCFC consumption in the servicing sector will be presented in the HPMP to be submitted to the 64<sup>th</sup> Meeting.

13. Although Turkey could meet the 2015 control level by addressing only HCFC-141b, the Government is proposing to phase out 99.0 ODP tonnes of HCFC-141b and 159.1 ODP tonnes of HCFC-22 and HCFC-142b used in the foam sector. On this issue, UNIDO indicated that the circumstances for achieving the phase-out targets established under the national legislation are correlated with the future accession of Turkey to the European Union and the ongoing process of harmonizing national legislation with the European Union's regulatory system. The reason that the project phases out several HCFCs rather than just HCFC-141b is that the ban in place on HCFC use in the foam sector will apply from 1 January 2013. The umbrella project includes the largest locally owned foam manufacturing

enterprises, which have already selected an alternative technology, initiated conversion of their facilities and are willing to co-finance the conversion.

14. For the conversion of the XPS foam sector, the industries selected HFC-152a/DME as replacement of HCFC-142b/HCFC-22. UNIDO discussed and assessed with the Government of Turkey and the representatives from the enterprises the issue of introducing an HFC-based technology, given that HFCs are among the gases controlled by the Kyoto Protocol and that the Parties to the Montreal Protocol are considering including these gases under the Protocol. The stakeholders concluded that HFC-152a/DMW was the best available technology; HFC-152a has a very low GWP and zero ODP values.

15. Through the implementation of the umbrella project covering four PU and five XPS foam enterprises, the Government of Turkey will complete phase-out of HCFC consumption in the foam sector that is eligible for funding, as the remaining consumption of about 2,000 tonnes is used by foreign-owned manufacturing enterprises. In line with the prioritization given by the Government of Turkey and the eligibility criteria of the Multilateral Fund, the HCFCs consumption in XPS sector used by enterprises with foreign ownership (i.e., 1,320 mt equivalent to 80.5 ODP tonnes) will be deducted from the starting point for aggregate reduction in HCFC consumption.

#### Cost-related issues for PU foam

16. Several technical and cost-related issues were discussed by the Secretariat and UNIDO regarding the PU foam enterprises. These included: the limited information provided regarding the baseline equipment, the methodology used for calculating the incremental costs where a “typical” line approach was used for all the enterprises, irrespective of the size of the enterprises, the baseline equipment and the age of the equipment; the need for rationalizing equipment items that could be used in those enterprises operating more than one line and the need for rationalizing technical support, trials, testing and training given the number of enterprises in the umbrella project. The request for a 10 per cent increase in foam density used in the calculation of the incremental operating costs was also considered where the enterprises believed that foam density was not an issue. All these issues were satisfactorily addressed by UNIDO. A detailed cost breakdown of the capital and operating costs was provided for each of the PU foam enterprises. The total cost of the conversion as agreed between the Secretariat and UNIDO is US \$2,447,897 (Table 6), with a cost-effectiveness of US \$2.72/kg.

**Table 6. Total agreed cost for the conversion of the PU foam enterprises**

Enterprise	Cost (US \$)		
	Capital	Operating	Total
Mepan Panel	377,300	172,712	550,012
Nuhpanel	587,400	145,345	732,745
Aluform	847,000	161,552	1,008,552
Assan Panel	55,000	101,588	156,588
Total	1,866,700	581,197	2,447,897

#### Demonstration project approved for the XPS sector in Turkey

17. The Executive Committee approved funding for the preparation of three projects to demonstrate the use of hydrocarbons (China), methyl formate (China) and HFO-1234ze (Turkey) in the production of XPS foam. It is the Secretariat’s view that these demonstration projects are critical in order to identify and fine-tune the most appropriate, environmentally sound, economically sustainable, and preferred replacement formulations that could be applied successfully. Therefore, the submission of the XPS foam projects ahead of the results of such strategically funded demonstration projects was premature. UNIDO pointed out that the five enterprises had already partially invested in converting to the HFC-152a/DME technology. The equipment required for the HFC-152a/DME technology could also be used for

HFO-1234ze without further modifications, if the results of the validation are positive. Therefore, the enterprises would have access to both technologies.

18. Addressing a question of whether the latest developments in emerging technologies such as methyl formate in the foam sector were discussed with major stakeholders, UNIDO indicated that enterprises still felt that it was premature to use methyl formate for the large-scale production of sandwich panels and for refrigerator manufacturing. Not all chemical suppliers directly support the use of methyl formate, which requires both willingness and financial capacity on the part of the enterprise.

#### Cost-related issues for XPS foam

19. Several technical and cost-related issues were discussed by the Secretariat and UNIDO regarding the XPS foam enterprises. These included: limited information on the baseline equipment, the “typical” line approach methodology used for calculating the incremental costs (as was done for the PU foam enterprises); safety-related equipment needed to upgrade the enterprises to use a flammable substance; and the need for rationalizing equipment items, technical support, trials, testing and training. Similarly the request for a 10 per cent increase in foam density and the incremental amount of fire retardant, used in the calculation of the incremental operating costs, where the enterprises considered that foam density was not an issue was also addressed. All these issues were satisfactorily addressed by UNIDO. A detailed cost-breakdown of the capital and operating costs was provided for each of the XPS foam enterprises. The total cost of the conversion as agreed between the Secretariat and UNIDO is US \$5,265,593 (Table 7), with a cost-effectiveness of US \$2.81/kg.

**Table 7. Total agreed cost for the conversion of the XPS foam enterprises**

Enterprise	Cost (US \$)		
	Capital	Operating	Total
Pakpen	947,000	124,466	1,071,466
ODE	947,200	227,500	1,174,700
Yalteks	517,780	78,526	596,306
BZ Insaat	896,940	89,857	986,797
BTM	1,260,940	175,384	1,436,324
Total	4,569,860	695,733	5,265,593

20. UNIDO also indicated that the total funding invested by three of the enterprises so far to allow for the conversion is US \$1,617,000

#### Climate impact

21. A preliminary calculation of the impact on the climate of HCFC consumption through the PU and XPS foam projects in Turkey, based only on the GWP values of the blowing agents and their level of consumption before and after conversion, is as follows: 900.3 mt of HCFC-141b, 1,123.2 mt of HCFC-142b and 748.8 mt of HCFC-22 will be phased out; 553.0 ton of n-pentane and 1,273 ton of HFC-152a will be phased in, and 4,355,311 ton of CO<sub>2</sub> that would have been emitted into the atmosphere will have been avoided (Table 7). It is to be noted that an additional 2,628,173 tonnes of CO<sub>2</sub>-equivalent would not be emitted into the atmosphere through the conversion of the XPS enterprises that are not eligible for funding (with an associated total consumption of 792 mt of HCFC-142b and 528 mt of HCFC-22).

**Table 7. Calculation of the impact on the climate**

Substance	GWP	Ton/year	CO <sub>2</sub> -eq (tonnes/year)
Before conversion			
HCFC-141b	713	900.3	641,914
HCFC-142b	2,270	1,123.2	2,549,664

Substance	GWP	Ton/year	CO <sub>2</sub> -eq (tonnes/year)
HCFC-22	1,780	748.8	1,332,864
Total before conversion		2,772.3	4,524,442
After conversion			
n-pentane	25	553.0	13,825
HFC-152a	122	1,273.0	155,306
Total after conversion		1,826.0	169,131
Net impact			(4,355,311)

#### Adjusted 2010-2014 business plans

22. The total level of funding for HCFC phase-out activities in Turkey included in the 2010-2014 consolidated business plan of the Multilateral Fund as noted by the Executive Committee at its 61<sup>st</sup> Meeting is US \$10,793,000 including agency support costs, with the following breakdown: US \$9,385,000 for UNIDO, US \$1,313,000 for UNDP (including US \$180,000 for the XPS demonstration project already approved), and US \$96,000 for UNEP.

23. The agreed cost for the phase-out of HCFCs in the PU and XPS foam sub-sectors is US \$8,292,001. This amount is US \$2,500,999 below the indicative amount for phase-out activities in the consolidated business plan. UNIDO has also indicated that no further funding would be requested by UNIDO during the 2010-2014 period.

#### **RECOMMENDATIONS**

24. In total, 213.2 ODP tonnes of HCFCs will be phased out through the conversion of the PU and XPS foam enterprises covered under the project proposal plus an additional 80.5 ODP tonnes used by XPS foam enterprises not eligible for funding. The total HCFC phase-out of 293.7 ODP tonnes represents 45.8 per cent of the starting point for aggregate reductions in HCFC consumption (640.8 ODP tonnes). Noting the Government of Turkey's firm commitment to accelerate the phase-out of HCFCs, in particular in the foam sector; that the agreed level of funding of the foam project is below the indicative level in the business plans; and that counterpart funding has already been provided to initiate the conversion process, the Executive Committee may wish:

- (a) To consider approving the umbrella project for the phase-out of HCFC-141b from the polyurethane (PU) rigid foam production in the manufacturing of PU insulated sandwich panels and the phase-out of HCFC-142b and HCFC-22 in the manufacture of extruded polystyrene (XPS) boardstock in Turkey at a cost of US \$7,713,490 and agency support costs of US \$578,511 for UNIDO;
- (b) To note that the Government of the Turkey agreed at the 62<sup>nd</sup> Meeting to establish as its starting point for sustained aggregate reductions in HCFC consumption the 2009 HCFC consumption reported under Article 7 of the Protocol of 609.9 ODP tonnes plus 30.8 ODP tonnes of HCFCs contained in imported polyol blends, for a total of 640.8 ODP tonnes;
- (c) To deduct 293.7 ODP tonnes (3,100.0 metric tonnes) of HCFCs from the starting point for sustained aggregate reductions in eligible consumption; and,
- (d) To request UNIDO to provide to the Secretariat, at the end of each year of the sector plan's implementation period, progress reports that address the issues pertaining to the collection of accurate data in line with the objectives of decision 55/43(b), and to include those reports in the implementation reports on the HPMP, once it had been approved.