



**United Nations  
Environment  
Programme**

Distr.  
GENERAL

UNEP/OzL.Pro/ExCom/82/59  
17 November 2018

ORIGINAL: ENGLISH



EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Eighty-second Meeting  
Montreal, 3-7 December 2018

**PROJECT PROPOSALS: THAILAND**

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

Phase-out

- HCFC phase-out management plan (stage I) (annual progress report, 2017 verification report) World Bank and Government of Japan
- HCFC phase-out management plan (stage II, first tranche) World Bank

Refrigeration

- Conversion from HFC to Propane (R-290) and Isobutene (R-600a) as refrigerant in manufacturing commercial refrigeration appliances in Pattana Intercool Co. Ltd. World Bank

**HCFC PHASE-OUT MANAGEMENT PLAN (STAGE I) (World Bank and Japan)**Background

1. On behalf of the Government of Thailand, the World Bank, as the lead implementing agency, has submitted the annual progress report on the implementation of the work programme associated with the fourth and final tranche of the HCFC phase-out management plan (HPMP) and a verification report on HCFC consumption for 2017 in line with decision 80/72(b).<sup>1</sup>

Report on HCFC consumption*HCFC consumption*

2. The Government of Thailand reported a consumption of 376.18 ODP tonnes of HCFC in 2017, which is 59.4 per cent below the HCFC baseline for compliance. The 2013-2017 HCFC consumption is shown in Table 1.

**Table 1. HCFC consumption in Thailand (2012-2017 Article 7 data)**

| HCFC                           | 2013             | 2014             | 2015             | 2016            | 2017            | Baseline         |
|--------------------------------|------------------|------------------|------------------|-----------------|-----------------|------------------|
| <b>Metric tonnes (mt)</b>      |                  |                  |                  |                 |                 |                  |
| HCFC-22                        | 11,988.86        | 11,984.35        | 10,365.31        | 7,920.74        | 5,504.52        | 13,028.60        |
| HCFC-123                       | 113.47           | 136.06           | 142.92           | 134.66          | 118.27          | 159.75           |
| HCFC-124                       | 4.03             | 4.41             | 0.12             | 0               | 0               | 3.41             |
| HCFC-141b                      | 1,817.37         | 1,830.46         | 1,817.68         | 1352.92         | 642.66          | 1,865.93         |
| HCFC-142b                      | 0                | 0                | 0                | 0               | 0               | 1.81             |
| HCFC-225*                      | 37.64            | 39.35            | 8.67             | 27.73           | 5.35            | 54.60            |
| <b>Total HCFC (mt)</b>         | <b>13,961.37</b> | <b>13,994.63</b> | <b>12,334.70</b> | <b>9,436.05</b> | <b>6,270.94</b> | <b>15,114.10</b> |
| HCFC-141b in imported polyols  | 53.86            | 92.29            | 192.03           | 117.03          | 23.45           | 142.50**         |
| <b>ODP tonnes</b>              |                  |                  |                  |                 |                 |                  |
| HCFC-22                        | 659.39           | 659.14           | 570.09           | 435.64          | 302.75          | 716.57           |
| HCFC-123                       | 2.27             | 2.72             | 2.86             | 2.69            | 2.37            | 3.19             |
| HCFC-124                       | 0.09             | 0.10             | 0.00             | 0               | 0               | 0.08             |
| HCFC-141b                      | 199.91           | 201.35           | 199.94           | 148.82          | 70.69           | 205.25           |
| HCFC-142b                      | 0                | 0                | 0                | 0               | 0               | 0.12             |
| HCFC-225*                      | 1.66             | 1.04             | 0.61             | 1.94            | 0.37            | 2.30             |
| <b>Total HCFC (ODP tonnes)</b> | <b>863.32</b>    | <b>864.35</b>    | <b>773.50</b>    | <b>589.09</b>   | <b>376.18</b>   | <b>927.51</b>    |
| HCFC-141b in imported polyols  | 5.92             | 10.15            | 21.12            | 12.87           | 2.58            | 15.67**          |

\*These figures include consumption for HCFC-225, HCFC-225ca and HCFC-225cb.

\*\*Average consumption between 2007 and 2009.

3. In 2017 consumption of HCFC-22 and HCFC-141b had decreased to 45.9 per cent and 35.4 per cent of their 2013 levels, respectively, mainly on account of the conversion of HCFC-22 air-conditioning (AC) manufacturing multinational enterprises, and several locally owned AC enterprises funded under stage I; and enterprises in the foam sector from HCFC-141b to alternative blowing agents with assistance under stage I of the HPMP.

4. HCFC-22 consumption in servicing increased from 4,038.66 mt in 2015 to 5,733.58 mt in 2017 mainly due to higher servicing need for ageing HCFC-22-based AC equipment; HCFC-141b consumption in the solvent sector increased from 187.65 mt in 2015 to 470.3 mt in 2017 due to the increase in its use for flushing and other solvent uses. HCFC-123 consumption in chillers has experienced 5.9 per cent growth, while HCFC-123 consumption in firefighting has remained stagnant. HCFC-124 consumption is nil for the

<sup>1</sup> The fourth (final tranche) of stage I of the HPMP was approved at the 80<sup>th</sup> meeting in the amount of US \$2,663,542, plus agency support costs of US \$186,448 for the World Bank.

period 2015 to 2017; HCFC-225 consumption in solvent applications is decreasing due to changes in the manufacturing process of the multinational companies consuming this substance.

#### *Country programme (CP) implementation report*

5. The Government of Thailand reported HCFC sector consumption data under the 2017 CP implementation report that is different from the data reported under Article 7. CP data is based on estimated consumption according to the survey undertaken during HPMP preparation in different sectors/applications; during the survey process, this was checked with data available at the Department of Industrial Works (DIW). The Article 7 data was based on import and export statistics and verified based on Customs Department data through the national verification process; the consumption difference is mainly in HCFC-22 (354.97 mt), HCFC-141b (75.2 mt) and HCFC-123 (20.51 mt). The World Bank was advised to revise the CP data to ensure consistency with Article 7 data.

#### *Verification report*

6. The verification report has confirmed that the Government of Thailand continued to implement its licensing and quota system for HCFC imports and exports, and that the total consumption of HCFCs for 2017 of 376.18 ODP tonnes was below the target of 834.84 ODP tonnes in its Agreement with the Executive Committee.

#### Progress report on the implementation of the fourth tranche of the HPMP

#### *Legal framework*

7. DIW established an import quota system for HCFCs in January 2013. The DIW issued import quotas for five HCFCs amounting to 779.2 ODP tonnes for 2017, and regulations to prohibit manufacturing of HCFC-22-based air conditioners with a capacity of less than 50,000 BTU/hour<sup>2</sup> for sales in domestic markets effective as of 1 July 2017. The Ministry of Commerce issued a ban on imports of HCFC-22-based AC equipment with cooling capacity under 50,000 BTU/hr (14.5 kW) effective as of 31 March 2018.

8. A ban on the import of HCFC-141b (bulk and contained in pre-blended polyols) as a foam blowing agent except for spray foam applications was issued effective as of 1 July 2017. HCFC-141b contained in imported pre-blended polyols is controlled through import permits issued by the DIW; and is monitored with systems house with the support of the foam industry association. To avoid any diversion of the consumption of HCFC-141b for spray foam to other applications, particularly in enterprises that were not covered in stage I of the HPMP, DIW and the Polyurethane Industry Group will provide technical assistance (TA) through workshops for those enterprises on the use of non-ODS blowing agents without compromising product quality.

9. DIW has provided instructions to allow the use of air conditioners with a cooling capacity of less than 36,000 BTU/hr for safe installation and use with HFC-32. Technical support from qualified engineers is required for the installation and use of equipment with capacity in the range of 36,000 to 50,000 BTU/hr. Currently, no AC units using flammable refrigerants can be installed in buildings in Thailand due to safety standards.

---

<sup>2</sup> BTU/hour is British Thermal Unit per hour.

*Manufacturing sector*

*Polyurethane (PU) foam manufacturing sector*

10. Out of the total 45 sub-grant agreements for the foam sector, 34 enterprises have already completed their conversions. The total phase-out of HCFC-141b by the completed enterprises amounted to 583.10 mt (64.14 ODP tonnes). The remaining enterprises are expected to complete their conversion by the end of 2018. One additional sub-grant agreement for one foam enterprise (Pattana Intercool) with a consumption of 0.54 ODP tonnes was signed in August 2018; this project is expected to be completed by the end of 2018.

11. The systems house, Bangkok Integrated Technology (BIT) that provided HCFC-141b pre-blended polyols to 53 micro-enterprises in 2010, has already signed a sub-grant agreement to provide polyol systems with non-ODS blowing agents to those enterprises, except for spray foam applications.

*Room AC manufacturing sector*

12. To date, the 11 AC enterprises supported in stage I have completed the conversion of their facilities to HFC-32-based equipment, resulting in the phase-out of 63.51 ODP tonnes (1,154.75 mt) of HCFC-22, and have started commercial-scale production. The HCFC-22 baseline equipment items have already been destroyed as per the agreed disposal plans.

13. The project for Kulthorn Kirby to develop HFC-32 reciprocating compressors for AC units, and R-290 and R-744-based compressors for commercial refrigeration, has been completed and the manufacturing facility has been converted. R-290 commercial refrigerator compressors will support conversion of the commercial refrigeration manufacturing facilities under stage II of the HPMP.

14. The Government of Thailand has implemented the following TA activities for ensuring systematic phase-out of HCFC-22 and safe adoption of HFC-32 in AC applications:

- (a) Support the Federation of Thai Industry (FTI) with two study tours to Daikin's facility in Japan (the enterprise that developed the HFC-32 technology for AC) in 2013, to give local AC manufacturers full confidence in the use of the HFC-32 technology and better understanding of the technology transfer agreements; and a technical study tour to Kobe, Japan, in November 2014, to learn about risk assessment of HFC-32 technology for air conditioners with larger cooling capacity (greater than 36,000 Btu/hr);
- (b) Assistance to 12 local residential AC manufacturers to secure non-assertion agreements with Daikin (Japan), to use HFC-32 technology free of charge in their air conditioner production. In 2017, Daikin completed TA activities to local AC manufacturers that converted to HFC-32 technology and finalized detailed installation and servicing procedures for service technicians;
- (c) Support the establishment of an inter-departmental steering committee tasked for providing strategic guidance and legal support for the introduction of non-HCFC-22 AC technologies in Thailand;
- (d) Risk assessment of HFC-32-based AC equipment in 2013 (with financial support from DIW) to enable the steering committee and the Department of Public Works to allow the use of HFC-32 air conditioners with cooling capacity of not more than 36,000 BTU/hr in buildings. In 2018, the Department of Public Works decided to extend the capacity of HFC-32 air conditioners to 50,000 BTU/hr;

- (e) A national train-the-trainer workshop in 2017 for 150 trainers of the Office of Vocational Education Commission (OVEC), and regional training activities (in cooperation with the OVEC) to train its staff in five regions. These activities provided more than 175 trainers with training on AC theories and practical experience related to safe handling and proper maintenance of HFC-32 AC systems;
- (f) Developed training equipment specifications by the technical committee of the OVEC and DIW (May 2018). The specifications are being used for the selection of equipment and scheduled for completion in October 2018. Further, support has been provided for the development of manuals for HFC-32 AC units' installation and servicing to be used by the Department of Skill Development; and
- (g) Support for the procurement and installation of safety devices, and modification of the energy performance laboratory of Electrical and Electronic Institute for testing HFC-32 air conditioners.

*Project management unit (PMU)*

15. In 2018, the Global Saving Bank (GSB) staff is undertaking activities to implement the sub-grant agreements that have already been signed. GSB staff will continue to participate in national and international workshops to be up-to-date on new technologies and on the guidelines/decisions of the Executive Committee.

16. DIW and the PMU reviewed the enterprises' eligibility, disposal plans and environmental management plans, and conducted site visits to verify baseline equipment. These activities were completed in June 2018. DIW will continue to conduct a multimedia public awareness programme to promote non-HCFC refrigerants and highlight the success of stage I of the HPMP to relevant stakeholders through television, demonstration videos, radio, and newspapers.

17. In 2018, DIW, in collaboration with the PU Group of FTI, organized workshops on safe handling of cyclopentane technology for the foam enterprises under stage I of the HPMP and relevant stakeholders including vocational schools.

Level of fund disbursement

18. As of October 2018, of the US \$18,108,630 approved so far, US \$14,809,892 had been disbursed (US \$14,509,880 for the World Bank and US \$300,012 for the Government of Japan), as shown in Table 2. Stage I of the HPMP will be completed by 31 December 2018 and a project completion report will be submitted no later than the first meeting of the Executive Committee in 2019.<sup>3</sup>

**Table 2. Financial report of stage I of the HPMP for Thailand (US \$)**

| Tranche        |           | World Bank | Japan   | Total      |
|----------------|-----------|------------|---------|------------|
| First tranche  | Approved  | 4,817,166  | 302,965 | 5,120,131  |
|                | Disbursed | 3,753,653  | 300,012 | 4,053,665  |
| Second tranche | Approved  | 9,706,154  | 0       | 9,706,154  |
|                | Disbursed | 8,879,085  | 0       | 8,879,085  |
| Third tranche  | Approved  | 618,803    | 0       | 618,803    |
|                | Disbursed | 379,669    | 0       | 379,669    |
| Fourth tranche | Approved  | 2,663,542  | 0       | 2,663,542  |
|                | Disbursed | 1,497,473  | 0       | 1,497,473  |
| Total          | Approved  | 17,805,665 | 302,965 | 18,108,630 |
|                | Disbursed | 14,509,880 | 300,012 | 14,809,892 |

<sup>3</sup> Decision 80/72(b).

## SECRETARIAT'S COMMENTS AND RECOMMENDATION

### COMMENTS

#### *Policies and regulations*

19. The World Bank reported that a quota of 788 ODP tonnes of HCFC has been issued for 2018, which amounts to 85 per cent of the baseline of HCFCs, and in accordance with the maximum allowable consumption target in the Agreement with the Executive Committee.

20. The Secretariat requested for clarification on the ban on HCFC-141b (bulk and contained in imported pre-blended polyols). The World Bank clarified that this prohibition is only for PU foam applications except spray foam, and HCFC-141b can be used in other applications including solvents. The CP data reports for previous years include consumption of HCFC-141b in solvents applications.

#### *Use of flammable refrigerants*

21. Upon request for clarification on possible use of flammable refrigerants in refurbished air conditioners, the World Bank informed the Secretariat that they are not aware of any such retrofitting due to the high cost and potential accidents. The Secretariat also notes that the national safety regulations prohibit the use of flammable refrigerants in air conditioners installed in buildings. The Government is fully aware of decisions 72/17 and 73/34 regarding retrofitting equipment designed for non-flammable refrigerants with flammable alternatives.

#### *Funds disbursement*

22. The Secretariat requested clarification on how the remaining funds linked to balances in TA and PMU components would be used, given that decision 80/72(a)(ii) requires completion of stage I by December 2018. The World Bank informed the Secretariat that there are bills due for payment which are being settled; the Government does not intend to request extension of stage I and would submit a project completion report to the first meeting in 2019 and would return balances after finalization of the financial procedures for closing stage I. Table 3 presents the commitments and disbursements by activity as of 25 October 2018.

**Table 3. Commitments and disbursements by activity as of 25 October 2018 (US \$)**

| Activity              | Approved          | Commitment        | Disbursement      |
|-----------------------|-------------------|-------------------|-------------------|
| Room AC manufacturing | 8,359,998         | 8,110,813         | 7,311,514         |
| Compressor            | 702,630           | 702,630           | 476,315           |
| PU foam               | 6,772,926         | 6,432,679         | 5,651,941         |
| TA – RAC sector*      | 760,060           | 759,356           | 447,382           |
| TA – foam sector      | 213,016           | 449,330           | 34,656            |
| PMU                   | 1,300,000         | 1,300,000         | 888,084           |
| <b>Total</b>          | <b>18,108,630</b> | <b>17,754,808</b> | <b>14,809,892</b> |

\*Including bilateral component from the Government of Japan.

### RECOMMENDATION

23. The Executive Committee may wish:

- (a) To note the 2017 progress report on the implementation of stage I of the HCFC phase-out management plan (HPMP) for Thailand submitted by the World Bank; and

- (b) Further to note that the Government of Thailand and the World Bank would submit a project completion report for stage I of the HPMP to the first meeting in 2019 as stipulated in decision 80/72(b) and would return remaining balances to the Fund by December 2019.

**PROJECT EVALUATION SHEET – MULTI-YEAR PROJECTS**

**Thailand**

|                                |               |
|--------------------------------|---------------|
| <b>(I) PROJECT TITLE</b>       | <b>AGENCY</b> |
| HCFC phase-out plan (stage II) | IBRD          |

|   |            |                     |
|---|------------|---------------------|
| <b>(II) LATEST ARTICLE 7 DATA (Annex C Group I)</b> | Year: 2017 | 376.18 (ODP tonnes) |
|---|------------|---------------------|

| <b>(III) LATEST COUNTRY PROGRAMME SECTORAL DATA (ODP tonnes)</b> |         |       |               |               |           |         |               | <b>Year: 2017</b> |                          |
|--|---------|-------|---------------|---------------|-----------|---------|---------------|-------------------|--------------------------|
| Chemical   | Aerosol | Foam  | Fire fighting | Refrigeration |           | Solvent | Process agent | Lab use           | Total sector consumption |
|  |         |       |               | Manufacturing | Servicing |         |               |                   |                          |
| HCFC-123   |         |       | 0.26          | 0.67          | 1.85      |         |               |                   | 2.78                     |
| HCFC-141b  |         | 27.23 |               |               |           | 51.73   |               |                   | 78.96                    |
| HCFC-22  |         |       |               | 8.02          | 314.25    | 0       | 0             |                   | 322.27                   |
| HCFC-225   |         |       |               |               |           | 0.58    |               |                   | 0.58                     |

| <b>(IV) CONSUMPTION DATA (ODP tonnes)</b>            |        |  |        |
|--|--------|--|--------|
| 2009 - 2010 baseline:                                | 927.6  | Starting point for sustained aggregate reductions: | 943.3  |
| <b>CONSUMPTION ELIGIBLE FOR FUNDING (ODP tonnes)</b> |        |  |        |
| Already approved:                                    | 234.73 | Remaining:   | 708.57 |

| <b>(V) BUSINESS PLAN</b> |                            | <b>2018</b> | <b>2019</b> | <b>2020</b> | <b>After 2020</b> | <b>Total</b> |
|--------------------------|----------------------------|-------------|-------------|-------------|-------------------|--------------|
| IBRD                     | ODS phase-out (ODP tonnes) | 61.90       | 61.90       | 61.90       | 0.00              | 185.70       |
|                          | Funding (US \$)            | 2,017,016   | 2,670,988   | 1,991,352   | 1,741,699         | 8,421,055    |

| <b>(VI) PROJECT DATA</b>                   |      |               | <b>2018</b> | <b>2019</b> | <b>2020</b> | <b>2021</b> | <b>2022</b> | <b>2023</b> | <b>Total</b> |
|--|------|---------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| Montreal Protocol consumption limits       |      |               | 834.84      | 834.84      | 602.94      | 602.94      | 602.94      | 602.94      | n/a          |
| Maximum allowable consumption (ODP tonnes) |      |               | 788.46      | 410.0       | 410.0       | 400.0       | 390.0       | 354.7       | n/a          |
| Agreed funding (US\$)                      | IBRD | Project costs | 1,500,000   | 0           | 2,116,532   | 0           | 174,545     | 0           | 3,791,077    |
|  |      | Support costs | 105,000     | 0           | 148,157     | 0           | 12,218      | 0           | 265,375      |
| Total project costs requested in principle |      |               | 1,500,000   | 0           | 2,116,532   | 0           | 174,545     | 0           | 3,791,077    |
| Total support costs requested in principle |      |               | 105,000     | 0           | 148,157     | 0           | 12,218      | 0           | 265,375      |
| Total funds requested in principle (US\$)  |      |               | 1,605,000   | 0           | 2,264,689   | 0           | 186,763     | 0           | 4,056,452    |

| <b>(VII) Request for funding for the first tranche (2017)</b> |   |                              |
|---|---|------------------------------|
| <b>Agency</b>   | <b>Funds requested (US \$)</b>                                      | <b>Support costs (US \$)</b> |
| IBRD  | 1,500,000   | 105,000                      |
| <b>Total</b>  | <b>1,500,000</b>  | <b>105,000</b>               |
| <b>Funding request:</b>                                       | Approval of funding for the first tranche (2018) as indicated above |                              |

|                                      |                          |
|--------------------------------------|--------------------------|
| <b>Secretariat's recommendation:</b> | Individual consideration |
|--------------------------------------|--------------------------|



## PROJECT DESCRIPTION

24. On behalf of the Government of Thailand, the World Bank, as the designated implementing agency, has submitted stage II of the HPMP at a total cost of US \$4,362,459, plus agency support costs of US \$305,372, as originally submitted.<sup>4</sup> The implementation of stage II of the HPMP will phase out 53.22 ODP tonnes of HCFCs to meet the target of 62 per cent reduction in HCFC baseline consumption by 2023.

25. The first tranche for stage II of the HPMP being requested at this meeting amounts to US \$1,900,000, plus agency support costs of US \$133,000, as originally submitted.

### Status of implementation of stage I of the HPMP

26. Stage I of the HPMP for Thailand was approved by the Executive Committee at its 68<sup>th</sup> meeting to meet 15 per cent reduction by 2018, at a total cost of US \$18,108,630, plus agency support costs, to phase out 234.73 ODP tonnes. An overview of the results achieved so far is included in paragraphs 7 to 18 of the present document.

### Stage II of the HPMP

#### Remaining eligible consumption in Thailand

27. After deducting 234.73 ODP tonnes of HCFCs associated with stage I and 53.22 ODP tonnes proposed for stage II from the starting point for aggregate reduction of HCFC consumption, the remaining consumption of HCFCs eligible for funding for future stages would be 655.23 ODP tonnes, as shown in Table 4.

**Table 4. Remaining consumption eligible for funding for Thailand**

| Substance   | Starting point   |               | Stage I         |               | Stage II (proposed) |              | Remaining after stage II |               |
|---|------------------|---------------|-----------------|---------------|---------------------|--------------|--------------------------|---------------|
|   | mt               | ODP tonnes    | mt              | ODP tonnes    | mt                  | ODP tonnes   | mt                       | ODP tonnes    |
| HCFC-22   | 13,028.55        | 716.57        | 1,233.82        | 67.86         | 370.66              | 20.39        | 11,424.07                | 628.32        |
| HCFC-123  | 160.00           | 3.20          |                 |               |                     |              | 160.00                   | 3.20          |
| HCFC-124  | 3.64             | 0.08          |                 |               |                     |              | 3.64                     | 0.08          |
| HCFC-141b   | 1,865.91         | 205.25        | 1,378.91        | 151.68        | 298.60              | 32.83        | 188.40                   | 20.72         |
| HCFC-142b   | 1.85             | 0.12          |                 |               |                     |              | 1.85                     | 0.12          |
| HCFC-225<br>ca/cb*  |                  | 2.30          |                 |               |                     |              |                          | 2.30          |
| <b>Sub-total</b>  | <b>15,059.95</b> | <b>927.52</b> | <b>2,612.73</b> | <b>219.54</b> | <b>669.26</b>       | <b>53.22</b> | <b>11,777.96</b>         | <b>654.74</b> |
| HCFC-141b<br>contained in<br>imported<br>pre-blended<br>polyols | 142.55           | 15.68         | 138.10          | 15.19         |                     |              | 4.45                     | 0.49          |
| <b>Total</b>  | <b>15,202.50</b> | <b>943.20</b> | <b>2,750.83</b> | <b>234.73</b> | <b>669.26</b>       | <b>53.22</b> | <b>11,782.41</b>         | <b>655.23</b> |

\*Include HCFC-225, 225ca and 225cb.

<sup>4</sup> As per the e-mail of 25 August 2018 from the Department of Industrial Works, Ministry of Industry of Thailand to the World Bank.

HCFC consumption in the manufacturing sector*AC manufacturing sector*

28. The current AC market in Thailand consists of a residential AC segment with cooling capacity of 9,000 to 50,000 BTU/hr, and light commercial and commercial AC with cooling capacity from 50,000 to 240,000 BTU/hr. For the latter, about 7,000 light commercial and commercial AC units per year were manufactured locally. It is estimated that about 105 mt of HCFC-22 was consumed in 2017 in producing these equipment. The current international standards for using mildly flammable and flammable refrigerants are very stringent for larger units that contain a larger quantity of refrigerant. Since the market demand has already shifted away from HCFC-22, most multinational enterprises have already imported R-410A and HFC-32-based light commercial and commercial air conditioners, while domestic manufacturers continue to provide HCFC-22-based units.

29. For the residential air conditioners, the market has already shifted to HFC-32-based air conditioners since July 2017. However, the second-hand market in provincial areas still generates a demand for refurbished HCFC-22-based air conditioners; this market will gradually decrease but it will not be completely phased out before 2030.

30. For the new residential air conditioner market, the demand for inverter air conditioners continues to increase; mainly based on R-410A refrigerant. Due to the success of the introduction of single speed HFC-32-based residential air conditioners, some multinational enterprises have already started introducing HFC-32-based inverter units. The local manufacturers are also expected to adopt inverter units in the future.

*Refrigeration manufacturing sector*

31. Commercial refrigeration equipment manufactured in Thailand includes stand-alone refrigeration equipment (plug-in units) including freezers, display cabinets and customized appliances for convenience stores and supermarkets (e.g., cold rooms, frozen storage rooms, and wine stores).

32. Small stand-alone commercial refrigerators and display units have gradually switched to R-600a (isobutane) and R-290 (propane), as the refrigerant charge size is less than 150 g and safety standards for this equipment are less stringent and can be complied by local manufacturers. For larger units, some manufacturers have already adopted non-flammable R-404A refrigerant (blend of HFC-125, HFC-143a, and HFC-134a with global-warming potential (GWP) of 3,922). Commercial refrigeration equipment using R-600a/R-290 is also imported, and used in the market.

33. Ten eligible enterprises with manufacturing customized commercial refrigeration equipment, from small single-door systems to large systems, are using HCFC-22. Table 5 presents information on these enterprises.

**Table 5: HCFC-22 consumption of commercial refrigeration equipment manufacturers**

| Particulars  | No. of enterprises | 2015 (kg)    | 2016 (kg)    | 2017 (kg)    | Average (kg) |
|--|--------------------|--------------|--------------|--------------|--------------|
| Group 1: small enterprises with >1,000 units; and between 0.5 and 2 mt of HCFC-22 per year | 6                  | 5,975        | 5,083        | 4,325        | 5,128        |
| Group 2: micro enterprises with < 1,000 units; and < 0.5 mt of HCFC-22 per year            | 4                  | 1,919        | 2,356        | 1,399        | 1,891        |
| <b>Total</b>   | <b>10</b>          | <b>7,894</b> | <b>7,439</b> | <b>5,724</b> | <b>7,019</b> |

*Chillers*

34. The majority of large chillers (i.e., central AC units exceeding 300 tonnes of refrigeration (TR) installed) are imported and are mainly using HFC-based refrigerants. Only one supplier is offering HCFC-123-based chillers; however, servicing of the HCFC-123-based chiller is performed by independent contractors and by the chiller owners' technicians.

*Spray foam manufacturing sector*

35. The local spray foam enterprises, except for one, buy pre-mixed HCFC-141b/polyols and isocyanate from six systems houses; one systems house imports HCFC-141b pre-blended polyols from a PU foam systems house in China.

36. The majority of the spray foam enterprises can be characterized as small and medium-size enterprises (SMEs), and can be divided into three groups: SMEs with annual consumption of 10 mt (1.1 ODP tonne) of HCFC-141b or greater; SMEs with consumption between 2 mt and 10 mt; and SMEs with consumption of less than 2 mt. Due to the size of those enterprises and the nature of the business, it is difficult to establish their starting date.

37. A field survey indicates that in Thailand, non-Article 5 owned systems houses are promoting polyol systems based on HFC-365mfc and HFC-245fa blowing agents, and may stop selling HCFC-141b-based systems based on their corporate policy. Locally owned systems houses will continue using HCFC-141b in pre-blended polyols for the spray foam sector as permitted by the Government.

38. Table 6 summarizes the HCFC consumption in the foam sector.

**Table 6. HCFC-141b consumption in the spray foam sector**

| Particulars                 | No. of enterprises | Eligible enterprises* | Consumption** (kg) | Eligible consumption** (kg) |
|-----------------------------|--------------------|-----------------------|--------------------|-----------------------------|
| Group 1: more than 10 mt    | 5                  | 5                     | 216,343            | 216,343                     |
| Group 2: between 2 to 10 mt | 10                 | 8                     | 52,407             | 37,795                      |
| Group 3: less than 2 mt     | 87                 | 58                    | 17,898             | 13,436                      |
| <b>Total</b>                | <b>102</b>         | <b>71</b>             | <b>286,648</b>     | <b>267,574</b>              |

\*Based on establishment dates and records of purchase of polyols.

\*\*Average 2015-2017 consumption.

HCFC consumption in the refrigeration air-conditioning (RAC) servicing sector

39. The RAC servicing sector consists of a diverse range of establishments that provide maintenance services for refrigeration and AC systems. The sector is estimated to employ approximately 35,000 technicians, whose services are dedicated to residential AC equipment, in formal and non-registered workshops. The majority of workshops are small, with one to two technicians.

40. After the ban on the use of HCFC-22 for manufacturing residential air-conditioners in 2017, the servicing sector has consumed most of the imported HCFCs (i.e., HCFC-22, HCFC-123 and HCFC-141b). HCFC-141b is used as a cleaning agent for refrigeration systems; consumption, though cannot be quantified, has significantly increased due to increase in number of RAC equipment in the country.

41. HCFC-22 consumption is mainly for air conditioners (83 per cent of the total consumption) and commercial refrigeration and cold rooms (about 13 per cent). There is significant variation in failure rates of equipment being serviced depending on the knowledge and skill levels of technicians. Furthermore, the age of the equipment has a direct impact on the HCFC consumed. It is anticipated that HCFC-22 consumption will persist, since Thailand has a significant market for second-hand residential air conditioners. Additionally, refurbishing of old HCFC-22-based residential air conditioners is not covered

by the manufacturing ban issued by the Government in 2017 and is expected to continue in the future. There are also HCFC-22 based commercial refrigeration units, and to a lesser degree industrial refrigeration and cold storage.

42. Based on the data from the ODS-alternatives survey, consumption of R-410A and HFC-32 was 9,289 mt and 1,148 mt respectively in 2015; this consumption is expected to grow in future. These new technologies require technology transfer and a familiarization on the part of servicing technicians.

43. HCFC-123 is consumed during the installation and maintenance of centrifugal chillers. The consumption in these applications is seeing a growth of about 7.6 per cent, with 92.3 mt (1.85 ODP tonnes) consumed in 2017.

#### Other sectors

44. About 470 mt of HCFC-141b have been used for metal cleaning processes, cleaning flux in electronic circuit boards, and cleaning for high-precision glasses. The solvent users have limited knowledge of alternatives to HCFC-141b. Thailand also imported a limited quantity of the mixture of HCFC-225ca/cb in 2017 for cleaning electronic products and manufacturing medical devices.

45. There is only one portable fire extinguisher manufacturer producing HCFC-123 fire extinguishers.

#### **Proposed activities in stage II of the HPMP**

46. Stage II of the HPMP proposes investment activities for the conversion of commercial refrigeration and spray foam applications, regulatory actions, TA activities promoting good servicing practices in the refrigeration and AC sectors and the introduction of non-ODS and low-GWP alternatives in solvent cleaning applications.

#### Regulatory actions

47. The regulatory component aims to support the conversion of the spray foam sector and commercial refrigeration manufacturing sector through the introduction of a ban on the use of HCFCs in these sectors, effective 31 December 2023.

#### Activities in the manufacturing sector

##### *Spray foam applications*

48. Stage II of the HPMP proposes to convert 71 spray foam enterprises eligible for funding consuming 267.57 mt (29.43 ODP tonnes) of HCFC-141b to reduced-HFO-based formulations. The incremental capital costs (ICCs) include retrofitting spray foaming units to enable them to handle a higher isocyanate-to-polyol ratio, training, trials and testing, and on-site handling support including air conditioned storage for pre-blended polyols. Table 7 presents a summary of ICCs.

**Table 7: ICCs for spray foam conversion (US \$)**

| Cost components                     | HFO-1233zd     |                |
|-------------------------------------|----------------|----------------|
|                                     | Less than 2 mt | More than 2 mt |
| Retrofitting of spray foaming units | 3,000          | 3,000          |
| Training of spray foaming team*     | 500            | 500            |
| Trials and testing                  | 800            | 1,600          |
| On-site handling of pre-blended HFO | 300            | 300            |
| Contingency (10%)                   | 460            | 540            |
| <b>Sub-total</b>                    | <b>5,060</b>   | <b>5,940</b>   |
| Air-conditioned storage             | 6,000          | 10,000         |

\*Spray foam team includes affiliates to the main enterprises and have spray foam machines to provide local services in different parts of the country.

49. Incremental operating costs (IOCs), based on 60 per cent reduced formulations with HFO-1233zd(E), were estimated at US \$5.37 per kg. However, as per decision 74/50(c)(iv), total IOCs requested was US \$5.00/kg. The summary of total incremental cost calculations is shown in Table 8.

**Table 8. Incremental costs for spray foam conversion (US \$)**

| Particulars                  | Eligible enterprises | Eligible equipment | Eligible HCFC-141b consumption (kg) | ICC (US \$)    | IOC (US \$)      | Requested funding | Co-financing   |
|------------------------------|----------------------|--------------------|-------------------------------------|----------------|------------------|-------------------|----------------|
| Group 1: more than 10 mt     | 5                    | 53                 | 216,343                             | 364,820        | 1,081,714        | 1,446,534         | 79,391         |
| Group 2: between 2 and 10 mt | 8                    | 29                 | 37,795                              | 220,260        | 188,977          | 359,969           | 63,138         |
| Group 3: less than 2 mt      | 58                   | 58                 | 13,436                              | 359,260        | 67,179           | 134,957           | 296,413        |
| <b>Total</b>                 | <b>71</b>            | <b>140</b>         | <b>267,574</b>                      | <b>944,340</b> | <b>1,337,870</b> | <b>1,941,460</b>  | <b>438,942</b> |

50. The project will be completed by the end of June 2023.

#### *Commercial refrigeration manufacturing*

51. Stage II of the HPMP proposes to convert ten enterprises eligible for funding consuming HCFC-22 to HC-based refrigerants (R-600a/R-290). ICCs for conversion has been estimated at US \$328,900 and includes vacuum pumps, refrigerant charging equipment, leak detectors, safety and ventilation systems, and trials, testing and training. IOCs has been estimated at US \$435,383 associated with costs for compressors, refrigerant and components. The total incremental cost was estimated at US \$764,283 as shown in Table 9.

**Table 9. Incremental costs of conversion for the commercial refrigeration manufacturing**

| Particulars  | Small enterprises (6)* |     |                | Micro enterprises (4)** |     |                |
|--|------------------------|-----|----------------|-------------------------|-----|----------------|
|  | Unit cost (US \$)      | No. | Total (US \$)  | Unit cost (US \$)       | No. | Total (US \$)  |
| Vacuum pumps (two stage)                                 | 2,500                  | 2   | 5,000          | 2,500                   | 1   | 2,500          |
| Refrigerant charging equipment                           | 7,500                  | 1   | 7,500          | 5,000                   | 1   | 5,000          |
| Leak detectors   | 2,000                  | 1   | 2,000          | 2,000                   | 1   | 2,000          |
| Testing, trials and training                             | 15,000                 | 1   | 15,000         | 7,000                   | 1   | 7,000          |
| Safety equipment (ventilation systems with four sensors) | 6,000                  | 1   | 6,000          | 5,000                   | 1   | 5,000          |
| Contingency (10%)  |                        |     | 3,550          |                         |     | 2,150          |
| <b>Sub-total per enterprises</b>                         |                        |     | <b>39,050</b>  |                         |     | <b>23,650</b>  |
| <b>Sub-total</b>   |                        |     | <b>234,300</b> |                         |     | <b>94,600</b>  |
| <b>Total ICC</b>   |                        |     |                |                         |     | <b>328,900</b> |

| Particulars                   | Small enterprises (6)* |     |               | Micro enterprises (4)** |     |                |
|-------------------------------|------------------------|-----|---------------|-------------------------|-----|----------------|
|                               | Unit cost (US \$)      | No. | Total (US \$) | Unit cost (US \$)       | No. | Total (US \$)  |
| <b>Total IOC</b>              |                        |     |               |                         |     | <b>435,383</b> |
| <b>Total incremental cost</b> |                        |     |               |                         |     | <b>764,283</b> |

\*Average consumption of 1,891 kg.

\*\*Average consumption of 5,128 kg.

52. Based on a cost-effectiveness of US \$15.21/kg for commercial refrigeration, with an increase of 25 per cent for the adoption of low-GWP technologies and 40 per cent for projects in enterprises consuming less than 20 mt of HCFC, the total cost of funding requested amounts to US \$176,000. The additional amount of US \$588,283 would be co-financed by the enterprises.

#### Refrigeration servicing sector

53. The activities in the refrigeration servicing sector has been estimated at a total cost of US \$1,760,000 to phase-out 363 mt of HCFC-22, and include the following.

- (a) Training of 5,500 technicians and 60 trainers on good service practices and safe servicing of equipment using HCFC free alternatives, including handling flammable refrigerants (US \$ 1,020,000);
- (b) Equipment to 12 training centres with six sets of training tools each, including recovery cylinder, gas evacuation and charging station, leak detector and other tools (US \$360,000);
- (c) Support for training institutions for revision of training syllabus and training materials for the technical institutions for training technicians in RAC trade (US \$ 60,000);
- (d) Introduction and implementation of a certification programme for service technicians, including development of training and testing materials for certification and providing support to training units located in different parts of the country; 12 training centres and 65 provincial training units will assist in certification process. (US \$50,000);
- (e) TA for good servicing practices and awareness creation of new technologies through advertisements and videos (US \$60,000);
- (f) Independent assessment of the impact of the training programme on good servicing practices followed during servicing, including the capacity to handle flammable refrigerants and high-pressure refrigerants (US \$60,000);
- (g) Enabling activities for service technicians and spare-parts dealers on good servicing practices and alternatives in the market in RAC equipment; awareness programme among users and the media on stage II of the HPMP and on the adoption of alternative technologies; training of 45 customs and enforcement officers on monitoring and control; procurement of 15 refrigerant identifiers (US \$120,000); and
- (h) Setting-up a technical team for managing the certification system (US \$30,000).

#### Solvent sector

54. While full phase-out of HCFC use in the solvent sector is not proposed to be addressed in stage II, workshops on alternative cleaning solvents and small demonstration activities as part of TA activities are proposed at a total cost of US \$150,000 as shown in Table 10.

**Table 10. Costs for solvent sector activities**

| Activity   | Number | Unit cost<br>(US \$) | MLF Funding<br>(US \$) |
|--|--------|----------------------|------------------------|
| Workshop on non-ODS and low-GWP solvent uses           | 5      | 16,000               | 80,000                 |
| Activities to promote non-ODS and low-GWP alternatives | 4      | 10,000               | 40,000                 |
| Study tours  | 2      | 15,000               | 30,000                 |
| <b>Total</b>   |        |                      | <b>150,000</b>         |

Project management unit

55. Stage II of the HPMP for Thailand will include HCFC phase-out investment activities in the private enterprises in foam and refrigeration sectors, TA in the servicing sector, and a policy and regulatory framework. It will require technical and project management work to facilitate implementation. The structure of two PMUs, one in the DIW and the other in the GSB, is proposed for project implementation coordination, monitoring and annual verification at a total cost of US \$335,000.

Total cost of stage II of the HPMP

56. The total cost of stage II of the HPMP to be funded through the Multilateral Fund has been estimated at US \$4,362,459, as originally submitted (excluding agency support costs) as shown in Table 11. The proposed activities will result in the phase-out of 53.22 ODP tonnes of HCFCs representing 5.7 per cent of the HCFC baseline with an overall cost-effectiveness of US \$6.52/kg.

**Table 11. Request for funding for stage II of the HPMP for Thailand**

| Sector                         | HCFC      | Consumption phased out (2015-17) |              | Funding requested (US \$) | Cost-effectiveness (US \$/kg) |
|--------------------------------|-----------|----------------------------------|--------------|---------------------------|-------------------------------|
|                                |           | mt                               | ODP tonnes   |                           |                               |
| Commercial refrigeration       | HCFC-22   | 7.02                             | 0.39         | 176,000                   | 25.07                         |
| Spray foam applications        | HCFC-141b | 267.57                           | 29.43        | 1,941,459                 | 7.26                          |
| Refrigeration servicing sector | HCFC-22   | 363.64                           | 20.00        | 1,760,000                 | 4.84                          |
| Solvents (TA)                  | HCFC-141b | 30.93                            | 3.40         | 150,000                   | 4.85                          |
| PMU                            |           |                                  |              | 335,000                   |                               |
| <b>Total</b>                   |           | <b>669.16</b>                    | <b>53.22</b> | <b>4,362,459</b>          | <b>6.52</b>                   |

Activities planned for the first tranche of stage II

57. The implementation plan of the first tranche (2019-2020) includes activities to phase-out consumption of HCFCs in the commercial refrigeration and spray foam enterprises, through workshops on project implementation procedures and eligibility confirmation process and signature of sub-grant agreements with larger enterprises (US \$997,000); TA for the refrigeration servicing sector (US \$743,000); information collection on use of HCFC-141b in solvent sector (US \$32,000); and PMU (US \$128,000).

## SECRETARIAT'S COMMENTS AND RECOMMENDATION

### COMMENTS

58. The Secretariat reviewed stage II of the HPMP for Thailand in light of the implementation under stage I of the HPMP, decision 80/72 relating to stage II<sup>5</sup>, the policies and guidelines of the Multilateral Fund, including the criteria for funding HCFC phase-out in the consumption sector for stage II of HPMPs (decision 74/50), and the 2018-2020 business plan of the Multilateral Fund.

#### Proposed activities in stage II

##### *Remaining eligible consumption*

59. In light of decision 80/72(d), the Secretariat reviewed the remaining eligible consumption of HCFCs in Thailand. The consumption of HCFCs in 2017 of 376.18 ODP tonnes, represents 40.6 per cent of the baseline; further the consumption target in stage II for the years 2020 and 2023 as agreed amount to 410 ODP tonnes and 354.7 ODP tonnes, respectively (60 per cent and 58.8 per cent below the Montreal Protocol targets for the respective years). In view of the above, the Secretariat proposed that the remaining eligible consumption of HCFC could be adjusted to the 2020 target of 410 ODP tonnes which includes 382.46 ODP tonnes of HCFC-22 and 27.54 ODP tonnes for HCFC-141b, HCFC-123 and HCFC-225. The World Bank informed that the Government of Thailand is conducting consultations on this proposal.

##### *Inclusion of the commercial refrigeration and solvent sector component (decision 80/72(d))*

60. The Secretariat requested clarification on the need for the phase-out of 7 mt of HCFC-22 in 10 enterprises in commercial refrigeration, noting that the consumption is less than 0.1 per cent of the total consumption in the country. Furthermore, HC-based commercial refrigeration are just being introduced in the local market, and the availability of HFC-based commercial refrigeration products at competitive prices would pose a challenge in the adoption of HC-based equipment. The World Bank mentioned that these enterprises are likely to adopt HFC-based technologies such as R-404A if they are not assisted and are willing to adopt R-600a/R-290-based technology to gain an early market share. However, after further consultations, the World Bank agreed to withdraw this project component, noting that the proposed ban on the use of HCFC-22 in manufacturing commercial refrigeration equipment would also not be implemented at this stage.

61. The Secretariat also requested a justification on the need for activities for phasing out HCFC-141b consumption in the solvent sector, in light of decision 80/72(d). The World Bank mentioned that the consumption of HCFC-141b in solvents is increasing; therefore, the proposed activities were to provide technical information on alternatives, and to curtail the growth in consumption. After further consultations and in light of decision 80/72(d), the World Bank agreed to defer activities to phase out HCFC-141b in the solvent sector.

##### *Spray foam manufacturing sector*

62. The Secretariat noted that some of the spray foam enterprises could have purchased their equipment after the 21 September 2017 cut-off date. The World Bank confirmed that the eligibility of the enterprises will be reviewed prior to the appraisal of sub-projects and the signature of sub-grant agreements. While acknowledging the difficulty to collect data from very small enterprises at the preparatory stage, the

---

<sup>5</sup> The Executive Committee decided to note that (i) stage II of the HPMP would address the total HCFC-141b consumption eligible for funding in the spray foam sector and up to 20 ODP tonnes of HCFC-22 used in the refrigeration servicing sector, on the understanding that the remaining consumption eligible for funding for Thailand would be reviewed upon the submission of stage II of the HPMP; and (ii) stage III of the HPMP would be submitted no earlier than the last meeting in 2021 (decision 80/72(d)).



Secretariat considers important to have a clear record of enterprises that are receiving Multilateral Fund assistance and their eligibility. In order to address this concern, the Secretariat proposed, as done in other HPMPs and reflected in paragraph 7(c) of the Agreement with the Executive Committee, that the World Bank submits to each tranche a report on the updated list of spray foam enterprises verified for receiving assistance with details on baseline equipment and conversion technology to be adopted, and a list of enterprises found ineligible or stopped using HCFC-141b without Fund assistance. The World Bank agreed to this approach; funding to enterprises that were found non-eligible would be returned to the Fund.

63. The Secretariat requested additional information on how the project will be implemented, noting that a large number of enterprises consume less than 10 mt per annum. The World Bank informed that implementation would take place through a group project approach with support from the systems houses; retrofitting of spray foam equipment would be implemented through a scheme for timely and cost-effective implementation of the project.

64. The World Bank also confirmed the availability of polyol systems using HFO-based formulations from two suppliers, in line with decision 74/20(a)(iii), and that the results of the demonstration project on application of reduced HFO in spray foam<sup>6</sup> would be used in implementing the project.

65. The Secretariat discussed the need for retrofitting spray foam equipment noting that the equipment can be used without change in the configuration based on results of the existing demonstration project on reduced HFO formulations. The World Bank indicated that the retrofit of spray foam equipment is essential given the change in ratio of pre-blended polyol-to-MDI (i.e., from 1:1 to 1:1.4) with reduced HFO-based formulations. The Secretariat reiterated that the results of a demonstration project undertaken for reduced HFO formulations in spray foam, and technical information from experts indicate that retrofitting of spray foam equipment would not be necessary; furthermore, with time and based on the prices of HCFC-141b and HFO, the pre-blended polyol-to-MDI ratio is likely to change. In light of this, it was agreed not to include retrofit of equipment in the conversion costs; the request of funding for AC for storage was removed from the proposal.

66. The Secretariat also discussed costs for trials and testing, and training of spray foam users. The World Bank indicated that technical support and training are required, given the large number of SMEs and that systems houses would provide TA for the adoption of HFO-based technology in these enterprises. Keeping in view the large number of small enterprises, incremental costs were agreed as shown in the Table 12; the cost-effectiveness of the conversion is US \$6.04/kg.

**Table 12. Agreed cost for the conversion of spray foam enterprises**

| Particulars                  | Eligible enterprises | Consumption phased-out |              | Agreed cost (US \$) |                  | Total incremental costs (US \$) |
|------------------------------|----------------------|------------------------|--------------|---------------------|------------------|---------------------------------|
|                              |                      | mt                     | ODP tonnes   | ICC                 | IOC              |                                 |
| Group 1: more than 10 mt     | 5                    | 216.34                 | 23.80        | 24,000              | 1,081,714        | 1,105,714                       |
| Group 2: between 2 and 10 mt | 8                    | 52.41                  | 5.76         | 29,000              | 334,111          | 363,111                         |
| Group 3: less than 2 mt      | 58                   | 17.90                  | 1.97         | 145,000             | 118,773          | 263,773                         |
| <b>Total</b>                 | <b>71</b>            | <b>286.65</b>          | <b>31.53</b> | <b>198,000</b>      | <b>1,534,597</b> | <b>1,732,597</b>                |

\*Including consumption of 2.1 ODP tonnes from enterprises not eligible for funding.

<sup>6</sup> Demonstration project at systems houses to formulate pre-blended polyol for spray foam applications using low-GWP blowing agent (THA/FOA/76/DEM/168), to be completed by September 2018; the final report will be submitted no later than the 83<sup>rd</sup> meeting.

*Refrigeration servicing sector*

67. The Secretariat discussed how the different activities for the servicing sector, would complement and sustain activities that were implemented in stage I, and requested additional information on co-funding. The World Bank explained that the activities proposed relate to training of service technicians and initiating a certification system at the national level; this is essential for ensuring safe adoption of low-GWP alternatives. The training activities would be co-funded through provision of facilities for training, and accommodation of trainee technicians. Customs and enforcement officers training would continue strengthening monitoring and enforcement.

68. The World Bank reported that the Government is aware of decisions 72/17 and 73/34 and does not promote/encourage retrofit of HC-based equipment in the country. The Government is also cautious about the use of flammable refrigerant to avoid any unsafe use and accidents linked to such use.

69. The Secretariat considers the approach presented for the refrigeration service sector, in line with decision 80/72, addresses the priorities identified in stage II and would result in sustainable phase-out of HCFC-22. Based on 20 ODP tonnes of HCFC-22 to be phased out in servicing, the total agreed funding was estimated at US \$1,745,555.

*Project implementation and monitoring unit (PMU)*

70. The Secretariat noted that the PMU activities would be implemented over a period of five years and would involve activities for project management, monitoring and verification. In light of this, PMU funds were agreed at US \$313,025, representing 9 per cent of the total project costs.

Agreed costs for stage II of the HPMP

71. Based on the above, the total incremental costs for conversion were agreed at US \$3,791,077 to achieve phase-out of 286.65 mt (31.53 ODP tonnes) of HCFC-141b and 363.64 mt (20 ODP tonnes) of HCFC-22, as given in Table 13. The cost effectiveness of the project is US \$5.83/kg.

**Table 13. Agreed cost for stage II of the HPMP for Thailand**

| Particulars                       | Substance | Phase-out quantity |              | Agreed cost<br>(US \$) | Cost-effectiveness<br>(US \$/kg) |
|-----------------------------------|-----------|--------------------|--------------|------------------------|----------------------------------|
|                                   |           | mt                 | ODP tonnes   |                        |                                  |
| Spray foam applications           | HCFC-141b | 286.65             | 31.53        | 1,732,597              | 6.04                             |
| Service sector                    | HCFC-22   | 363.64             | 20.00        | 1,745,455              | 4.80                             |
| Project management and monitoring |           |                    |              | 313,025                |                                  |
| <b>Total</b>                      |           | <b>650.29</b>      | <b>51.53</b> | <b>3,791,077</b>       | <b>5.83</b>                      |

72. The agreed amount for the first tranche is US \$1,500,000. These funds would be used to implement activities in the spray foam sector for the large enterprises including communication and outreach workshops and project implementation; initiate service sector activities including technician and enforcement training, initiation of certification process and procurement of equipment for training institutions and implement project management activities for stage II.

Impact on the climate

73. The conversion of the remaining PU foam manufacturing enterprises in Thailand would avoid the emission into the atmosphere of some 207,224 thousand tonnes of CO<sub>2</sub> equivalent per year, as shown in Table 14.

**Table 14. Impact on the climate of the conversion project**

| Substance                | GWP | Tonnes/year | CO <sub>2</sub> -eq<br>(tonnes/year) |
|--------------------------|-----|-------------|--------------------------------------|
| <b>Before conversion</b> |     |             |                                      |
| HCFC-141b                | 725 | 286.65      | 207,821                              |
| <b>After conversion</b>  |     |             |                                      |
| HFO-based formulations   | 3   | 199.16      | 597                                  |
| <b>Impact</b>            |     |             | <b>207,224</b>                       |

74. The proposed activities in the servicing sector, which include better containment of refrigerants through training and the provision of equipment, will reduce the amount of HCFC-22 used for refrigeration servicing. Each kilogramme of HCFC-22 not emitted due to better refrigeration practices results in the savings of approximately 1.8 CO<sub>2</sub>-equivalent tonnes.

### Co-financing

75. The project activities relating to the spray foam sector could involve co-financing by eligible enterprises, besides phase-out by ineligible enterprises based on their own plans; servicing sector will include co-financing by the technical institutions and training centres, which would provide their workshops, classrooms and support for technicians' accommodation during training and certification programmes.

### 2018-2020 draft business plan of the Multilateral Fund

76. The World Bank is requesting US \$3,791,077, plus agency support costs for the implementation of stage II of the HPMP. The total value requested of US \$3,869,689 including support costs for the period from 2018 to 2020 is US \$2,809,667 below the amount in the business plan target for 2018–2020.

### Draft Agreement

77. A draft Agreement between the Government of Thailand and the Executive Committee for the phase-out of HCFCs in stage II of the HPMP is contained in Annex I to the present document.

### RECOMMENDATION

78. The Executive Committee may wish to consider:

- (a) Approving, in principle, stage II of the HCFC phase-out management plan (HPMP) for Thailand for the period from 2018 to 2023 to reduce HCFC consumption by 61.8 per cent of its baseline, in the amount of US \$3,791,077 plus agency support costs of US \$265,375 for the World Bank;
- (b) Noting the commitment of the Government of Thailand:
  - (i) To reduce HCFC consumption by 55.8 per cent by 2019, 57.9 per cent by 2022, and 61.8 per cent by 2023;
  - (ii) To issue a ban on imports of HCFC-141b in bulk and contained in pre-blended polyols in all foam applications by 31 December 2023;
- (c) Requesting the World Bank to include at every progress report and tranche request, the updated list of foam enterprises verified for assistance by the Multilateral Fund under stage II, including their HCFC-141b consumption phased out, subsector, baseline

equipment and conversion technology to be adopted, and the list of enterprises that were found ineligible and/or stopped using HCFC-141b without Multilateral Fund assistance and their respective HCFC-141b consumption;

- (d) Deducting an additional 298.47 ODP tonnes (5,137.85 mt) of HCFCs, which includes adjustment of remaining eligible consumption in line with decision 80/72(d)(i), from the remaining HCFC consumption eligible for funding in Thailand;
- (e) Approving the draft Agreement between the Government of Thailand and the Executive Committee for the reduction in consumption of HCFCs, in accordance with stage II of the HPMP, contained in Annex I to the present document; and
- (f) Approving the first tranche of stage II of the HPMP for Thailand, and the corresponding tranche implementation plan, in the amount of US \$1,500,000, plus agency support costs of US \$105,000 for the World Bank.

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

| PROJECT TITLE   | BILATERAL/IMPLEMENTING AGENCY   |
|---|---|
| (a) Conversion from HFCs to propane (R-290) and isobutane (R-600a) as refrigerants in manufacturing commercial refrigeration appliances at Pattana Intercool Co. Ltd. | World Bank  |
| <b>NATIONAL CO-ORDINATING AGENCY</b>  | National Ozone Unit, Department of Industrial Works, Ministry of Industry |

**LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT  
A: ARTICLE-7 DATA (METRIC TONNES, 2017, AS OF MAY 2018)**

|                  |                         |     |
|------------------|-------------------------|-----|
| Annex F, Group I | mt                      | n/a |
|                  | mt CO <sub>2</sub> -eq. | n/a |

**B: COUNTRY PROGRAMME SECTORAL DATA (METRIC TONNES, 2017, AS OF MAY 2018)**

|                  |                         |     |
|------------------|-------------------------|-----|
| Annex F, Group I | mt                      | n/a |
|                  | mt CO <sub>2</sub> -eq. | n/a |

|   |                         |     |
|---|-------------------------|-----|
| <b>HFC consumption remaining eligible for funding</b> | mt                      | n/a |
|   | mt CO <sub>2</sub> -eq. | n/a |

| CURRENT YEAR BUSINESS PLAN ALLOCATIONS | Funding US \$ | Phase-out (mt) |
|--|---------------|----------------|
| (a)                                    | 330,374       | 40.0           |

| PROJECT TITLE:  | Pattana Intercool Co. Ltd.    |                              |
|---|-------------------------------|------------------------------|
| HFC-134a used at enterprise:                                      | mt                            | 8.78                         |
|   | mt CO <sub>2</sub> -eq.       | 12,555                       |
| R-404A used at enterprise:  | mt                            | 1.648                        |
|   | mt CO <sub>2</sub> -eq.       | 6,463                        |
| R-507A used at enterprise:  | mt                            | 0.04                         |
|   | mt CO <sub>2</sub> -eq.       | 159                          |
| HFC-134a to be phased out through this project:                   | mt                            | 8.78                         |
|   | mt CO <sub>2</sub> -eq.       | 12,555                       |
| R-600a to be phased in:   | mt                            | 3.95                         |
|   | mt CO <sub>2</sub> -eq.       | 12                           |
| R-290 to be phased in:  | mt                            | 0.00                         |
|   | mt CO <sub>2</sub> -eq.       | 0.00                         |
| Project duration (months):  |                               | 24                           |
| Initial amount requested (US \$):                                 |                               | 262,642                      |
| Final project costs (US \$):                                      |                               |                              |
| Incremental capital cost:   |                               | 136,500                      |
| Contingency (10%):  |                               | 13,650                       |
| Incremental operating cost:                                       |                               | 33,364                       |
| Total project cost:   |                               | 183,514                      |
| Local ownership (%):  |                               | 100                          |
| Export component (%):   |                               |                              |
| Requested grant (US \$):  |                               | 183,514                      |
| Cost-effectiveness (US \$/kg) and (US \$/mt CO <sub>2</sub> -eq.) | US \$/kg                      | 20.90                        |
|   | US \$/mt CO <sub>2</sub> -eq. | 14.62                        |
| Implementing agency support cost (US \$):                         |                               | 16,516                       |
| Total cost of project to Multilateral Fund (US \$):               |                               | 200,030                      |
| Status of counterpart funding (Y/N):                              |                               | Y                            |
| Project monitoring milestones included (Y/N):                     |                               | Y                            |
| <b>SECRETARIAT'S RECOMMENDATION</b>                               |                               | For individual consideration |

## **PROJECT DESCRIPTION**

79. On behalf of the Government of Thailand, the World Bank has submitted a request for funding the conversion of three commercial refrigeration manufacturing lines at Pattana Intercool Co. Ltd., from HFC-134a, R-404A and R-507A, to isobutane (R-600a) and propane (R-290) as refrigerants, at a total cost of US \$262,642, plus agency support costs of US \$18,385, as originally submitted. Preparation funding of US \$30,000 was approved at the 80<sup>th</sup> meeting.

80. The submission was accompanied by a communication from the Government of Thailand committing to ratify the Kigali Amendment as soon as possible, agreeing that no further funding would be available from the Multilateral Fund until the instrument of ratification had been received at the Headquarters of the United Nations in New York, and that any amount of HFC reduced as a result of the project would be deducted from the starting point, if the project is approved, in line with decisions 78/3(g) and 79/45.

### HFC consumption in Thailand and sector background

81. Based on the survey of ODS alternatives undertaken in Thailand, 15,667 mt of HFCs was consumed in 2015. Out of the 12 HFCs (pure and blends) imported into the country, only three represented approximately 95 per cent of the total consumption: R-410A (59.3 per cent of the total consumption in mt, and 67.3 per cent in mt CO<sub>2</sub>-eq.); HFC-134a (28.8 per cent in mt, and 22.4 per cent in mt CO<sub>2</sub>-eq.); and HFC-32 (7.3 per cent in mt and 2.7 per cent in mt CO<sub>2</sub>-eq.). Both R-410A and HFC-32 are mainly used in air-conditioning (AC) manufacturing and some refrigeration and air-conditioning (RAC) servicing, while HFC-134a is used mainly in refrigeration manufacturing, mobile AC and RAC servicing, and aerosol manufacturing.

82. Commercial refrigeration is a fast-growing sector in Thailand. With the increasing population and high growth of its tourism industry, there has been a widespread installation of supermarkets, large/small cold rooms, horizontal and vertical medium temperature and low temperature display cabinets, and refrigerated cabinets for the convenience shops. Most of this equipment is manufactured in Thailand using HFCs. Customized manufacturing of commercial refrigeration equipment for restaurants, grocery and butcher shops by small manufacturers use mainly HFC-134a and R-404A refrigerants. A small percentage of the enterprises are still continuing to manufacture appliances using HCFC-22 which would be phased out under stage II of the HCFC phase-out management plan (HPMP).

### Enterprise background

83. Pattana Intercool Co. Ltd., is one of the leading locally-owned manufacturers of commercial refrigeration appliances in Thailand. It manufactures small cooling capacity display cabinets, vertical and horizontal display cabinets, freezers with a range of temperature from -18°C to 2°C, supermarket equipment and cold rooms.

84. The enterprise has six manufacturing lines located at two sites, and plans to convert the three lines located at its Pattana Intercool MMC Plant in Pathumthani in one site. The second site with three manufacturing lines is at planning level only, and no production facility has been established. This plant also has production facilities for HCFC-22-based commercial refrigeration equipment. Pattana Intercool has signed a contract in August 2018 for conversion of their foam manufacturing from HCFC-141b (0.54 ODP tonnes) to cyclopentane technology under stage I of the HPMP.

85. Table 1 shows the production of HFC-based commercial refrigeration equipment and consumption of HFC-134a, R-404A and R-507A at Pattana Intercool in 2017.

**Table 1. Refrigeration equipment manufactured at Pattana Intercool Co. Ltd. in 2017**

| Equipment                                   | Units         | Refrigerant | Refrigerant charge (kg/unit) | Total refrigerant charge (mt) |
|---|---------------|-------------|------------------------------|-------------------------------|
| Display cabinets                            | 10,207        | HFC-134a    | 0.74                         | 7.50                          |
| Customized display cabinets                 | 2,083         | HFC-134a    | 0.60                         | 1.24                          |
| Supermarket cooling equipment               | 5             |             | 4.00                         | 0.02                          |
| Cold room                                   | 5             |             | 4.00                         | 0.02                          |
| <b>Sub-total</b>                            | <b>12,300</b> |             |                              | <b>8.78</b>                   |
| Freezers                                    | 309           | R-404A      | 4.00                         | 1.57                          |
| Customized low-temperature display cabinets | 10            | R-404A      | 4.00                         | 0.04                          |
| Supermarket cooling equipment               | 5             | R-404A      | 4.00                         | 0.02                          |
| Cold room                                   | 5             | R-404A      | 4.00                         | 0.02                          |
| <b>Sub-total</b>                            | <b>329</b>    |             |                              | <b>1.65</b>                   |
| Customized low-temperature display cabinets | 10            | R-507A      | 4.00                         | 0.04                          |
| <b>Sub-total</b>                            | <b>10</b>     |             |                              | <b>0.04</b>                   |
| <b>Total</b>                                | <b>12,639</b> |             |                              | <b>10.47</b>                  |

Project overview and funding request

86. The production equipment of the enterprise is shown in Table 2.

**Table 2. Production equipment at Pattana Intercool MMC Plant**

| Manufacturing components                      | Equipment                              | Quantity |
|---|--|----------|
| Sheet metal-cabinet manufacturing             | CNC <sup>7</sup> machine               | 1        |
|   | Shearing machine                       | 1        |
|   | Bending machine                        | 2        |
|   | Tube bending machine                   | 1        |
| Appliance assembly unit                       | Assembly tools and equipment sets      | 2        |
| Pressure testing and leak detection equipment | Set of pressure gauges                 | 16       |
|   | Nitrogen gas cylinders with regulators | 2        |
|   | Electronic leak detectors              | 2        |
| Evacuation system                             | Vacuum pumps                           | 30       |
| Refrigerant gas charging                      | Manual by measuring back pressure      | 0        |
| Final leak detection                          | Nitrogen and pressure gauges           | 15       |
| Packing equipment                             | Manual (stations)                      | 5        |
| Compressed air                                | Air compressor                         | 1        |
|   | Air dryer                              | 1        |

87. Isobutane (R-600a) and propane (R-290) were selected as the alternative refrigerants to HFC-134a, R-404A and R-507A as these refrigerants have very low-GWP, are proven, cheaper in terms of refrigerant costs, can meet the temperature and cooling capacity requirements, and are available in the market.

88. Given that R-290 and R-600a are flammable refrigerants and have different thermophysical properties than that of HFC-134a, R-404A and R-507A, the overall system, components and process will be redesigned to ensure safe production, installation, operation and maintenance of equipment following IEC 60079-10-1:2015;<sup>8</sup> this would result in reduced charge quantity of refrigerant. The conversion would

<sup>7</sup> CNC: computer numerical control machine.

<sup>8</sup> International Electrotechnical Commission (IEC) standard concerned with the classification of areas where flammable gas or vapour hazards may arise and may then be used as a basis to support the proper selection and installation of equipment for use in hazardous areas.

involve, amongst others, prototype manufacturing, reconfiguration of production process and test runs for producing HC-based products. TA by national and international experts, including component specifications and selection and technical inputs for procurement, will be provided.

89. The incremental capital costs (ICCs) requested amount to US \$298,100, and comprise product redesign and prototype development for eight product categories (US \$24,000), charging equipment including one high-capacity charging equipment and two small capacity charging equipment (US \$85,000), six vacuum pumps (US \$21,000), four leak detectors (US \$11,000), trials, testing and training (US \$65,000), safety certification and safety equipment (US \$65,000) and contingency.

90. Incremental operating costs (IOCs) amount to US \$440,163, and includes cost of compressors, refrigerant and electrical components.

91. The total cost for conversion of three lines is estimated at US \$738,263. The funding request is calculated at US \$15.21 per kg of HFC phased-out increased by 25 per cent for adoption of low-GWP refrigerants and 40 per cent given that the enterprise is a small and medium scale enterprise (SME); based on this and a total consumption of HFCs of 10.47 mt, the request for funding was estimated at US \$262,642; the remaining costs are proposed to be co-funded by the enterprise. Table 3 presents the summary of the costs. The total quantity of HFC to be phased-out amounting to 10.47 mt (19,178 mt CO<sub>2</sub>-eq.) includes 8.7 mt of HFC-134a (12,555 mt CO<sub>2</sub>-eq.), 1.65 mt of R-404A (6,463 mt CO<sub>2</sub>-eq.) and 0.04 mt of R-507A (159 mt CO<sub>2</sub>-eq.)

**Table 3. Total costs for the conversion at Pattana Intercool**

| Item   | Amount (US \$) |
|--|----------------|
| Total ICC  | 298,100        |
| Total IOC  | 440,163        |
| <b>Total (ICC + IOC)</b>                                     | <b>738,263</b> |
| Co-financing from enterprise                                 | 475,621        |
| Request for funding @ (15.21+40% SMEs +25% for low-GWP HCs)* | 262,642        |
| Overall Cost Effectiveness (C/E US \$/kg)                    | 25.09          |

\*The Secretariat pointed out to the World Bank that this is calculation approach is not in line with Multilateral Fund policies.

## SECRETARIAT'S COMMENTS AND RECOMMENDATION

### COMMENTS

#### *Eligibility*

92. The Secretariat has reviewed the project proposal on the basis of the current policies of the Multilateral Fund and decisions of the Executive Committee, decisions 78/3(g) and 79/45 relating to HFC projects, similar approved conversion projects for CFC and HFC phase-out and approved projects to phase out ODS with flammable alternatives.

#### *Maturity of the technology, replicability and sustainability of the project*

93. Upon a request for additional information on the current market structure for commercial refrigeration equipment, the World Bank informed that it consists of two distinct segments: HCFC-22, R-600a and R-290 products; and HFC-134a, R-404A and R-507A products which is much larger. HCFC and HFC-based technologies were adopted over the last two decades when CFCs were being phased out; these products are easy to service and have a low cost. R-600a- and R-290-based products are currently imported from China, and are increasingly being sold in Thailand. Further, with the Government's policy to restrict import of HCFC-22, potential ban on the use of HCFC-22 in the commercial refrigeration



manufacturing sector in the future and demand from food and beverage enterprises for low-GWP technologies, HC-based commercial refrigeration equipment is expected to be adopted expeditiously.

94. On request for clarification on commitment of the enterprise given that it is proposing to have a new plant for manufacturing commercial refrigeration equipment, the World Bank indicated that Pattana Intercool is confident that R-600a and R-290 products will replace its current HCFC-22 and HFC-based equipment. Although there is a plan to establish a second site in the next one to three years and that new facility is expected to be set up as a separate legal entity; technical and operational details of the expansion plan are yet to be finalised. The success of the conversion at Pattana Intercool and other commercial refrigerator manufacturers under stage II of the HPMP, will be taken into account in making technology choice in the proposed new facility.

95. The Secretariat noted that HFC-134a-based equipment production is more than 12,000 units per annum, including some of the large capacity HFC-134a-based equipment. In the case of R-404A and R-507A, the number of equipment produced is less than 500. Further, given that HC-based commercial refrigeration equipment are new in the local market and the current international safety standards provide for sale of commercial refrigeration equipment with less than 150g per unit for open market sale, the Secretariat requested information on why the equipment using R-404A and R-507A are included for conversion in this project, noting that such low volume of production would not yield ICC and IOC as required under decision 78/3(g), and that the production and sale of equipment with high flammable refrigerant charge could face safety concerns for use in the market.

96. The World Bank replied that equipment up to 1.5 kg HC refrigerant charge can be used in commercial refrigeration equipment with the necessary safeguards, and they do not foresee significant challenges in adoption of technology for the larger capacity equipment. While the Government is considering controls on HFC-based commercial refrigeration equipment, it is too early to make any commitments at this stage. Further, the World Bank suggested that conversion of large units to HCs could reduce higher levels of emissions. The Secretariat reiterated the safety concerns associated with the use of equipment with high refrigerant charges, as compared to the smaller equipment where the ease of use is supported by approved standards. After consultations on the conversion need for different products in line with decision 78/3(g), it was agreed that one line that produces stand-alone commercial refrigeration units with HFC refrigerant charge levels of lower than 750g per unit would be considered in this project. Those lines producing other products with refrigerant charge over 750g would not be covered under this project; this approach will provide information required in line with requirements of decision 78/3(g) and would result in sustainable conversion of the production line.

#### *Proposed costs*

97. The Secretariat undertook a detailed review of the project costs based on the existing baseline equipment and conversion needs. The Secretariat clarified to the World Bank that the methodology used for calculating the requested funding contained in Table 3 above was not consistent with the guidelines. After detailed discussions on costs related to assembly line modification, charging and testing facilities, verification costs and costs relating to TA, it was agreed to co-finance the charging equipment (US \$50,000) which was not considered an eligible incremental cost as this was not in the baseline. The overall costs for redesign of five product categories, modification of assembly line, testing facilities, safety equipment and verification costs was agreed at US \$136,500. Based on the above, the ICC was estimated at US \$150,150 (including 10 per cent contingency).

98. The Secretariat reviewed the IOC for refrigerants, compressors and electrical components. Based on information available on similar projects and information from technical experts on these costs, the IOC were assessed as US \$94,257. Of this amount, US \$33,364 was being requested in accordance with decision 74/50(c)(ix); the remaining would be co-financed by the enterprise.

99. The total funding agreed amounted to US \$183,514, to phase out 8.78 mt of HFC-134a<sup>9</sup> (12,555 mt CO<sub>2</sub>-eq.), with a cost-effectiveness of US \$20.90/kg, as summarized in Table 4. The above CO<sub>2</sub>-equivalent emission reduction does not include energy efficiency impact of the conversion.

**Table 4. Agreed costs for conversion of commercial refrigeration manufacturing at Pattana Intercool Co. Ltd.**

| <b>Description</b>                    | <b>Cost (US \$)</b>                         |
|---------------------------------------|---|
| Incremental capital costs             | 150,150                                     |
| Incremental operating costs           | 33,364                                      |
| <b>Total incremental costs</b>        | <b>183,514</b>                              |
| Quantity of HFC-134a to be phased-out | 8.78 mt<br>(12,555 mt CO <sub>2</sub> -eq.) |

100. The Secretariat notes that the purpose of implementing projects under decision 78/3(g) is to gain experience in the ICC and IOC that might be associated with phasing down HFCs. On the basis of the information available at the time of review, the Secretariat considers that the agreed costs are its best estimates of the overall incremental costs of conversion; these estimates, however, might change as more information becomes available and according to the specific characteristics of the enterprise. The Secretariat, therefore, considers that approval of the project at the levels proposed above would not constitute a precedent.

### **Business plan 2018 -2020**

101. This project is included in the 2018–2020 business plan of the Multilateral Fund at a value of US \$330,374, including agency support costs, to phase out 40 mt of HFC. The Secretariat notes that after the adjustments to the costs, the proposal is US \$134,014 less than what has been included in the business plan.

### **RECOMMENDATION**

102. The Executive Committee may wish to consider:

- (a) The project proposal for the conversion from HFCs to propane (R-290) and isobutane (R-600a) as refrigerants in manufacturing commercial refrigeration appliances at Pattana Intercool Co. Ltd, in the context of its discussion on HFC stand-alone project submitted to the 82<sup>nd</sup> meeting in line with decision 78/3(g), as described in the document on the Overview of issues identified during project review (UNEP/OzL.Pro/ExCom/82/31);
- (b) Whether or not to approve the project proposal indicated in sub-paragraph (a) above in the amount of US \$183,514, plus agency support cost of US \$16,516 for the World Bank, on the understanding, if the project were to be approved:
  - (i) That no further funding would be available until the instrument of ratification by the Government of Thailand had been received by the depositary at the Headquarters of the United Nations in New York;
  - (ii) That 8.78 mt of HFC-134a (12,555 mt CO<sub>2</sub>-eq.) would be deducted from the starting point for sustained aggregate reduction in HFCs once it has been established;

<sup>9</sup> GWP of HFC-134a is 1,430.

- (iii) That the project would be completed within 24 months of the transfer of funds to the World Bank and a comprehensive completion report would be submitted within six months of the project completion with detailed information on:
  - a. The eligible incremental capital costs for all equipment and other components including those not funded under the project;
  - b. Incremental operating costs;
  - c. Any possible savings incurred during the conversion and relevant factors that facilitated implementation (e.g. whether any purchased and/or installed equipment or supplies had gone through a competitive quote/bidding process and the details thereof);
  - d. Changes in the energy efficiency of the products being manufactured and any related policies undertaken by the Government;
  - e. Information on the implementation of the servicing component where applicable; and
- (iv) That any remaining funds will be returned to the Multilateral Fund no later than one year after the date of project completion.



## Annex I

### **DRAFT AGREEMENT BETWEEN THE GOVERNMENT OF THAILAND AND THE EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND FOR THE REDUCTION IN CONSUMPTION OF HYDROCHLOROFLUOROCARBONS IN ACCORDANCE WITH STAGE II OF THE HCFC PHASE-OUT MANAGEMENT PLAN**

#### **Purpose**

1. This Agreement represents the understanding of the Government of Thailand (the “Country”) and the Executive Committee with respect to the reduction of controlled use of the ozone depleting substances (ODS) set out in Appendix 1-A (“The Substances”) to a sustained level of 354.74 ODP tonnes by 1 January 2023 in compliance with Montreal Protocol schedule.

2. The Country agrees to meet the annual consumption limits of the Substances as set out in row 1.2 of Appendix 2 A (“The Targets, and Funding”) in this Agreement as well as in the Montreal Protocol reduction schedule for all Substances mentioned in Appendix 1-A. The Country accepts that, by its acceptance of this Agreement and performance by the Executive Committee of its funding obligations described in paragraph 3, it is precluded from applying for or receiving further funding from the Multilateral Fund in respect to any consumption of the Substances that exceeds the level defined in row 1.2 of Appendix 2-A as the final reduction step under this Agreement for all of the Substances specified in Appendix 1-A, and in respect to any consumption of each of the Substances that exceeds the level defined in rows 4.1.3, 4.2.3, 4.3.3, 4.4.3, 4.5.3 and 4.6.3 (remaining consumption eligible for funding).

3. Subject to compliance by the Country with its obligations set out in this Agreement, the Executive Committee agrees, in principle, to provide the funding set out in row 3.1 of Appendix 2-A to the Country. The Executive Committee will, in principle, provide this funding at the Executive Committee meetings specified in Appendix 3-A (“Funding Approval Schedule”).

4. The Country agrees to implement this Agreement in accordance with the stage II of the HCFC phase-out management plan (HPMP) approved (“the Plan”). In accordance with sub-paragraph 5(b) of this Agreement, the Country will accept independent verification of the achievement of the annual consumption limits of the Substances as set out in row 1.2 of Appendix 2-A of this Agreement. The aforementioned verification will be commissioned by the relevant bilateral or implementing agency.

#### **Conditions for funding release**

5. The Executive Committee will only provide the Funding in accordance with the Funding Approval Schedule when the Country satisfies the following conditions at least eight weeks in advance of the applicable Executive Committee meeting set out in the Funding Approval Schedule:

- (a) That the Country has met the Targets set out in row 1.2 of Appendix 2-A for all relevant years. Relevant years are all years since the year in which this Agreement was approved. Years for which there are no due country programme implementation reports at the date of the Executive Committee meeting at which the funding request is being presented are exempted;
- (b) That the meeting of these Targets has been independently verified for all relevant years, unless the Executive Committee decided that such verification would not be required;
- (c) That the Country had submitted a Tranche Implementation Report in the form of Appendix 4-A (“Format of Tranche Implementation Reports and Plans”) covering each

previous calendar year; that it had achieved a significant level of implementation of activities initiated with previously approved tranches; and that the rate of disbursement of funding available from the previously approved tranche was more than 20 per cent; and

- (d) That the Country has submitted a Tranche Implementation Plan in the form of Appendix 4-A covering each calendar year until and including the year for which the funding schedule foresees the submission of the next tranche or, in case of the final tranche, until completion of all activities foreseen.

### **Monitoring**

6. The Country will ensure that it conducts accurate monitoring of its activities under this Agreement. The institutions set out in Appendix 5-A (“Monitoring Institutions and Roles”) will monitor and report on implementation of the activities in the previous Tranche Implementation Plans in accordance with their roles and responsibilities set out in the same appendix.

### **Flexibility in the reallocation of funds**

7. The Executive Committee agrees that the Country may have the flexibility to reallocate part or all of the approved funds, according to the evolving circumstances to achieve the smoothest reduction of consumption and phase-out of the Substances specified in Appendix 1-A:

- (a) Reallocations categorized as major changes must be documented in advance either in a Tranche Implementation Plan as foreseen in sub-paragraph 5(d) above, or as a revision to an existing Tranche Implementation Plan to be submitted eight weeks prior to any meeting of the Executive Committee, for its approval. Major changes would relate to:
  - (i) Issues potentially concerning the rules and policies of the Multilateral Fund;
  - (ii) Changes which would modify any clause of this Agreement;
  - (iii) Changes in the annual levels of funding allocated to individual bilateral or implementing agencies for the different tranches;
  - (iv) Provision of funding for activities not included in the current endorsed Tranche Implementation Plan, or removal of an activity in the Tranche Implementation Plan, with a cost greater than 30 per cent of the total cost of the last approved tranche; and
  - (v) Changes in alternative technologies, on the understanding that any submission for such a request would identify the associated incremental costs, the potential impact to the climate, and any differences in ODP tonnes to be phased out if applicable, as well as confirm that the Country agrees that potential savings related to the change of technology would decrease the overall funding level under this Agreement accordingly;
- (b) Reallocations not categorized as major changes may be incorporated in the approved Tranche Implementation Plan, under implementation at the time, and reported to the Executive Committee in the subsequent Tranche Implementation Report;
- (c) Any enterprise to be converted to non-HCFC technology included in the Plan and that would be found to be ineligible under the policies of the Multilateral Fund (i.e., due to

foreign ownership or establishment post the 21 September 2007 cut-off date), would not receive financial assistance. This information would be reported as part of the Tranche Implementation Plan;

- (d) The Country commits to examining the possibility of using pre-blended systems with low-global warming potential blowing agents instead of blending them in-house, for those foam enterprises covered under the Plan, should this be technically viable, economically feasible and acceptable to the enterprises;
- (e) The Country agrees, in cases where HFC technologies have been chosen as an alternative to HCFCs, and taking into account national circumstances related to health and safety: to monitor the availability of substitutes and alternatives that further minimize impacts on the climate; to consider, in the review of regulations standards and incentives adequate provisions that encourage introduction of such alternatives; and to consider the potential for adoption of cost-effective alternatives that minimize the climate impact in the implementation of the HPMP, as appropriate, and inform the Executive Committee on the progress accordingly in tranche implementation reports; and
- (f) Any remaining funds held by the bilateral or implementing agencies or the Country under the Plan will be returned to the Multilateral Fund upon completion of the last tranche foreseen under this Agreement.

#### **Considerations for the refrigeration servicing sector**

8. Specific attention will be paid to the execution of the activities in the refrigeration servicing sector included in the Plan, in particular:

- (a) The Country would use the flexibility available under this Agreement to address specific needs that might arise during project implementation; and
- (b) The Country and relevant bilateral and/or implementing agencies would take into consideration relevant decisions on the refrigeration servicing sector during the implementation of the Plan.

#### **Bilateral and implementing agencies**

9. The Country agrees to assume overall responsibility for the management and implementation of this Agreement and of all activities undertaken by it or on its behalf to fulfil the obligations under this Agreement. The World Bank has agreed to be the lead implementing agency (the “Lead IA”) in respect of the Country’s activities under this Agreement. The Country agrees to evaluations, which might be carried out under the monitoring and evaluation work programmes of the Multilateral Fund or under the evaluation programme of the Lead IA taking part in this Agreement.

10. The Lead IA will be responsible for ensuring co-ordinated planning, implementation and reporting of all activities under this Agreement, including but not limited to independent verification as per subparagraph 5(b). The role of the Lead IA is contained in Appendix 6-A. The Executive Committee agrees, in principle, to provide the Lead IA with the fees set out in row 2.2 of Appendix 2 A.

#### **Non-compliance with the Agreement**

11. Should the Country, for any reason, not meet the Targets for the elimination of the Substances set out in row 1.2 of Appendix 2-A or otherwise does not comply with this Agreement, then the Country agrees

that it will not be entitled to the Funding in accordance with the Funding Approval Schedule. At the discretion of the Executive Committee, funding will be reinstated according to a revised Funding Approval Schedule determined by the Executive Committee after the Country has demonstrated that it has satisfied all of its obligations that were due to be met prior to receipt of the next tranche of funding under the Funding Approval Schedule. The Country acknowledges that the Executive Committee may reduce the amount of the Funding by the amount set out in Appendix 7-A (“Reductions in Funding for Failure to Comply”) in respect of each ODP kg of reductions in consumption not achieved in any one year. The Executive Committee will discuss each specific case in which the Country did not comply with this Agreement, and take related decisions. Once decisions are taken, the specific case of non-compliance with this Agreement will not be an impediment for the provision of funding for future tranches as per paragraph 5 above.

12. The Funding of this Agreement will not be modified on the basis of any future Executive Committee decisions that may affect the funding of any other consumption sector projects or any other related activities in the Country.

13. The Country will comply with any reasonable request of the Executive Committee, and the Lead IA to facilitate implementation of this Agreement. In particular, it will provide the Lead IA with access to the information necessary to verify compliance with this Agreement.

#### **Date of completion**

14. The completion of the Plan and the associated Agreement will take place at the end of the year following the last year for which a maximum allowable total consumption level has been specified in Appendix 2-A. Should at that time there still be activities that are outstanding, and which were foreseen in the last Tranche Implementation Plan and its subsequent revisions as per sub-paragraph 5(d) and paragraph 7, the completion of the Plan will be delayed until the end of the year following the implementation of the remaining activities. The reporting requirements as per sub-paragraphs 1(a), 1(b), 1(d), and 1(e) of Appendix 4-A will continue until the time of the completion of the Plan unless otherwise specified by the Executive Committee.

#### **Validity**

15. All of the conditions set out in this Agreement are undertaken solely within the context of the Montreal Protocol and as specified in this Agreement. All terms used in this Agreement have the meaning ascribed to them in the Montreal Protocol unless otherwise defined herein.

16. This Agreement may be modified or terminated only by mutual written agreement of the Country and the Executive Committee of the Multilateral Fund.



**APPENDICES**

**APPENDIX 1-A: THE SUBSTANCES**

| Substance   | Annex | Group | Starting point for aggregate reductions in consumption (ODP tonnes) |
|---|-------|-------|---|
| HCFC-22   | C     | I     | 716.57  |
| HCFC-123  | C     | I     | 3.2   |
| HCFC-124  | C     | I     | 0.08  |
| HCFC-141b   | C     | I     | 205.25  |
| HCFC-142b   | C     | I     | 0.12  |
| HCFC-225 ca/cb                                      | C     | I     | 2.3   |
| Sub-total   |       |       | 927.52  |
| HCFC-141b contained in imported pre-blended polyols | C     | I     | 15.68   |
| Total   |       |       | 943.2   |

**APPENDIX 2-A: THE TARGETS, AND FUNDING**

| Row   | Particulars  | 2018      | 2019   | 2020      | 2021   | 2022    | 2023   | Total     |
|-------|--|-----------|--------|-----------|--------|---------|--------|-----------|
| 1.1   | Montreal Protocol reduction schedule of Annex C, Group I substances (ODP tonnes)   | 834.84    | 834.84 | 602.94    | 602.94 | 602.94  | 602.94 | n/a       |
| 1.2   | Maximum allowable total consumption of Annex C, Group I substances (ODP tonnes)  | 788.46    | 410.0  | 410.0     | 400.0  | 390.0   | 354.74 | n/a       |
| 2.1   | Lead IA (World Bank) agreed funding (US \$)  | 1,500,000 | 0      | 2,116,532 | 0      | 174,545 | 0      | 3,791,077 |
| 2.2   | Support costs for Lead IA (US \$)  | 105,000   | 0      | 148,157   | 0      | 12,218  | 0      | 265,375   |
| 3.1   | Total agreed funding (US \$)   | 1,500,000 | 0      | 2,116,532 | 0      | 174,545 | 0      | 3,791,077 |
| 3.2   | Total support costs (US \$)  | 105,000   | 0      | 148,157   | 0      | 12,218  | 0      | 265,375   |
| 3.3   | Total agreed costs (US \$)   | 1,605,000 | 0      | 2,264,689 | 0      | 186,763 | 0      | 4,056,452 |
| 4.1.1 | Total phase-out of HCFC-22 agreed to be achieved under this Agreement (ODP tonnes)   |           |        |           |        |         |        | 20.00     |
| 4.1.2 | Phase-out of HCFC-22 to be achieved in the previous stage (ODP tonnes)**   |           |        |           |        |         |        | 314.11    |
| 4.1.3 | Remaining eligible consumption for HCFC-22 (ODP tonnes)  |           |        |           |        |         |        | 382.46    |
| 4.2.1 | Total phase-out of HCFC-123 agreed to be achieved under this Agreement (ODP tonnes)  |           |        |           |        |         |        | 0         |
| 4.2.2 | Phase-out of HCFC-123 to be achieved in the previous stage (ODP tonnes)  |           |        |           |        |         |        | 0         |
| 4.2.3 | Remaining eligible consumption for HCFC-123 (ODP tonnes)   |           |        |           |        |         |        | 3.20      |
| 4.3.1 | Total phase-out of HCFC-124 agreed to be achieved under this Agreement (ODP tonnes)  |           |        |           |        |         |        | 0         |
| 4.3.2 | Phase-out of HCFC-124 to be achieved in the previous stage (ODP tonnes)**  |           |        |           |        |         |        | 0.08      |
| 4.3.3 | Remaining eligible consumption for HCFC-124 (ODP tonnes)   |           |        |           |        |         |        | 0         |
| 4.3.1 | Total phase-out of HCFC-141b agreed to be achieved under this Agreement (ODP tonnes)   |           |        |           |        |         |        | 31.53     |
| 4.3.2 | Phase-out of HCFC-141b to be achieved in the previous stage (ODP tonnes)   |           |        |           |        |         |        | 151.68    |
| 4.3.3 | Remaining eligible consumption for HCFC-141b (ODP tonnes)  |           |        |           |        |         |        | 22.04     |
| 4.4.1 | Total phase-out of HCFC-141b contained in imported pre-blended polyols agreed to be achieved under this Agreement (ODP tonnes) |           |        |           |        |         |        | 0         |
| 4.4.2 | Phase-out of HCFC-141b contained in imported pre-blended polyols to be achieved in the previous stage (ODP tonnes)**           |           |        |           |        |         |        | 15.68     |
| 4.4.3 | Remaining eligible consumption for HCFC-141b contained in imported pre-blended polyols (ODP tonnes)                            |           |        |           |        |         |        | 0         |
| 4.5.1 | Total phase-out of HCFC-142b agreed to be achieved under this Agreement (ODP tonnes)   |           |        |           |        |         |        | 0         |
| 4.5.2 | Phase-out of HCFC-142b to be achieved in the previous stage (ODP tonnes)**   |           |        |           |        |         |        | 0.12      |
| 4.5.3 | Remaining eligible consumption for HCFC-142b (ODP tonnes)  |           |        |           |        |         |        | 0         |
| 4.6.1 | Total phase-out of HCFC-225 ca/cb agreed to be achieved under this Agreement (ODP tonnes)                                      |           |        |           |        |         |        | 0         |

|       |   |     |
|-------|---|-----|
| 4.6.2 | Phase-out of HCFC-225 ca/cb to be achieved in the previous stage (ODP tonnes) | 0   |
| 4.6.3 | Remaining eligible consumption for HCFC-225 ca/cb (ODP tonnes)                | 2.3 |

\*Date of completion of stage I as per stage I Agreement: 31 December 2018.

\*\* Pending agreement from the Government of Thailand.

### APPENDIX 3-A: FUNDING APPROVAL SCHEDULE

1. Funding for the future tranches will be considered for approval at the second meeting of the year specified in Appendix 2-A.

### APPENDIX 4-A: FORMAT OF TRANCHE IMPLEMENTATION REPORTS AND PLANS

1. The submission of the Tranche Implementation Report and Plans for each tranche request will consist of five parts:

- (a) A narrative report, with data provided by tranche, describing the progress achieved since the previous report, reflecting the situation of the Country in regard to phase out of the Substances, how the different activities contribute to it, and how they relate to each other. The report should include the amount of ODS phased out as a direct result from the implementation of activities, by substance, and the alternative technology used and the related phase-in of alternatives, to allow the Secretariat to provide to the Executive Committee information about the resulting change in climate relevant emissions. The report should further highlight successes, experiences, and challenges related to the different activities included in the Plan, reflecting any changes in the circumstances in the Country, and providing other relevant information. The report should also include information on and justification for any changes vis-à-vis the previously submitted Tranche Implementation Plan(s), such as delays, uses of the flexibility for reallocation of funds during implementation of a tranche, as provided for in paragraph 7 of this Agreement, or other changes;
- (b) An independent verification report of the Plan results and the consumption of the Substances, as per sub-paragraph 5(b) of the Agreement. If not decided otherwise by the Executive Committee, such a verification has to be provided together with each tranche request and will have to provide verification of the consumption for all relevant years as specified in sub-paragraph 5(a) of the Agreement for which a verification report has not yet been acknowledged by the Committee;
- (c) A written description of the activities to be undertaken during the period covered by the requested tranche, highlighting implementation milestones, the time of completion and the interdependence of the activities, and taking into account experiences made and progress achieved in the implementation of earlier tranches; the data in the plan will be provided by calendar year. The description should also include a reference to the overall plan and progress achieved, as well as any possible changes to the overall plan that are foreseen. The description should also specify and explain in detail such changes to the overall plan. This description of future activities can be submitted as a part of the same document as the narrative report under sub-paragraph (b) above;
- (d) A set of quantitative information for all Tranche Implementation Reports and Plans, submitted through an online database; and
- (e) An Executive Summary of about five paragraphs, summarizing the information of the above sub-paragraphs 1(a) to 1(d).

2. In the event that in a particular year two stages of the HPMP are being implemented in parallel, the following considerations should be taken in preparing the Tranche Implementation Reports and Plans:

- (a) The Tranche Implementation Reports and Plans referred to as part of this Agreement, will exclusively refer to activities and funds covered by this Agreement; and
- (b) If the stages under implementation have different HCFC consumption targets under Appendix 2-A of each Agreement in a particular year, the lower HCFC consumption target will be used as reference for compliance with these Agreements and will be the basis for the independent verification.

#### **APPENDIX 5-A: MONITORING INSTITUTIONS AND ROLES**

1. The Thailand National Focal Point for the Implementation of the Montreal Protocol (the National Ozone Unit (NOU)) of the Ministry of Industry (MOI) is responsible for managing and co-ordinating Thailand's overall ODS phase-out programme, including all phase-out activities and measures controlling Annex C, Group I substances (HCFCs). The management and implementation of this Agreement will be undertaken by the HPMP Project Management Unit (PMU) which falls under the direct authority of the NOU.

2. MOI, through its HPMP PMU and the NOU, will collaborate and co-ordinate with the Ministry of Finance (MOF) and the General Department of Thailand Customs to implement the import/control system for HCFCs; review annual HCFC import/export license applications; and establish and publish the annual import quotas for HCFCs for the period 2019 through 2023.

3. In order assist MOI in monitoring and evaluating the progress of Agreement implementation, the PMU and NOU will:

- (a) Update the HCFC management information system (MIS) that captures and tracks all relevant and required data on the importation of Annex C, Group I substances (HCFCs) on an annual basis;
- (b) Update the data on the actual amount of imported HCFCs;
- (c) Monitor and report, in cooperation with Customs Department any incidents of illegal import of HCFCs;
- (d) Monitor progress of HCFC phase-out on the demand side by direct oversight of sub-project implementation;
- (e) Maintain the HCFC phase-out project MIS on HCFC-consuming enterprises and sub-projects;
- (f) Compile periodic progress reports of HPMP implementation and HCFC phase-out achievements for sharing with Customs Department and MOF;
- (g) Prepare Tranche Implementation Reports and Plans according to the schedule set forth in Appendix 2-A;
- (h) Prepare other monitoring reports as required by MOI or other Government authorities and by Multilateral Fund Executive Committee decision, in coordination with the Lead Agency; and

- (i) Carry out safety and technical review of all relevant activities undertaken under this plan.

4. MOI along with its government partner agencies (MOI, the GDC and Ministry of Planning and Investment) will be responsible for reviewing PMU reports and data and instituting control and policy measures which facilitate HCFC control and reductions according to the Agreement.

#### **APPENDIX 6-A: ROLE OF THE LEAD IMPLEMENTING AGENCY**

1. The Lead IA will be responsible for a range of activities, including at least the following:
  - (a) Ensuring performance and financial verification in accordance with this Agreement and with its specific internal procedures and requirements as set out in the Country's HPMP;
  - (b) Assisting the Country in preparation of the Tranche Implementation Reports and Plans as per Appendix 4-A;
  - (c) Providing independent verification to the Executive Committee that the Targets have been met and associated tranche activities have been completed as indicated in the Tranche Implementation Plan consistent with Appendix 4-A;
  - (d) Ensuring that the experiences and progress is reflected in updates of the overall plan and in future Tranche Implementation Plans consistent with sub-paragraphs 1(c) and 1(d) of Appendix 4-A;
  - (e) Fulfilling the reporting requirements for the Tranche Implementation Reports and Plans and the overall plan as specified in Appendix 4-A for submission to the Executive Committee;
  - (f) In the event that the last funding tranche is requested one or more years prior to the last year for which a consumption target had been established, annual tranche implementation reports and, where applicable, verification reports on the current stage of the Plan should be submitted until all activities foreseen had been completed and HCFC consumption targets had been met;
  - (g) Ensuring that appropriate independent technical experts carry out the technical reviews;
  - (h) Carrying out required supervision missions;
  - (i) Ensuring the presence of an operating mechanism to allow effective, transparent implementation of the Tranche Implementation Plan and accurate data reporting;
  - (j) In case of reductions in funding for failure to comply in accordance with paragraph 11 of the Agreement, to determine, in consultation with the Country, the allocation of the reductions to the different budget items and to the funding of the Lead IA;
  - (k) Ensuring that disbursements made to the Country are based on the use of the indicators;
  - (l) Providing assistance with policy, management and technical support when required; and
  - (m) Timely releasing funds to the country/participating enterprises for completing the activities related to the project.

2. After consultation with the Country and taking into account any views expressed, the Lead IA will select and mandate an independent entity to carry out the verification of the HPMP results and the consumption of the Substances mentioned in Appendix 1-A, as per sub-paragraph 5(b) of the Agreement and sub-paragraph 1(b) of Appendix 4-A.

#### **APPENDIX 7-A: REDUCTIONS IN FUNDING FOR FAILURE TO COMPLY**

1. In accordance with paragraph 11 of the Agreement, the amount of funding provided may be reduced by US \$147.14 per ODP kg of consumption beyond the level defined in row 1.2 of Appendix 2-A for each year in which the target specified in row 1.2 of Appendix 2 A has not been met, on the understanding that the maximum funding reduction would not exceed the funding level of the tranche being requested. Additional measures might be considered in cases where non-compliance extends for two consecutive years.

2. In the event that the penalty needs to be applied for a year in which there are two Agreements in force (two stages of the HPMP being implemented in parallel) with different penalty levels, the application of the penalty will be determined on a case-by-case basis taking into consideration the specific sectors that lead to the non-compliance. If it is not possible to determine a sector, or both stages are addressing the same sector, the penalty level to be applied would be the largest.

---