MONTREAL PROTOCOL

ON SUBSTANCES THAT DEPLETE

THE OZONE LAYER

UNEP

Technology and Economic Assessment Panel

SUPPLEMENT TO THE
MAY 2011 TEAP REPLENISHMENT REPORT

"ASSESSMENT OF THE FUNDING REQUIREMENT FOR THE REPLENISHMENT OF THE MULTILATERAL FUND FOR THE PERIOD 2012-2014"

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The text of this report is composed in Times New Roman.

Co-ordination:	**TEAP and its Replenishment Task Force**
Composition:	Lambert Kuijpers
Layout:	Lambert Kuijpers and Ozone Secretariat, UNEP
Reproduction:	UNON Nairobi
Date:	October 2011

Under certain conditions, printed copies of this report are available from:

UNITED NATIONS ENVIRONMENT PROGRAMME
Ozone Secretariat, P.O. Box 30552, Nairobi, Kenya

This document is available in portable document format from
http://www.ozone.unep.org/

Printed in Nairobi, Kenya, 2011.

ISBN: 978-9966-20-006-8

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ACKNOWLEDGEMENTS

The UNEP Technology and Economic Assessment Panel and the Replenishment Task Force co-chairs and members wish to express thanks to all who contributed from governments, both Article 5 and non-Article 5, to the Multilateral Fund Secretariat, to the Ozone Secretariat, to all Implementing Agencies, as well as to a large number of individuals involved in Protocol issues, without whose involvement this supplementary report to the original assessment would not have been possible.

The opinions expressed are those of the Panel and its Task Force and do not necessarily reflect the reviews of any sponsoring or supporting organisation.

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1 Introduction

1.1 The Process

Decision XXII/3 of the Twenty-second Meeting of the Parties requested the Technology and Economic Assessment Panel (TEAP) to prepare a report for submission to the 23rd Meeting of the Parties (Bali, November 2011) and to present it through the Open-ended Working Group at its 31st meeting (Montreal, August 2011), to enable the 23rd Meeting of the Parties to take a decision on the appropriate level of the 2012-2014 Replenishment of the Multilateral Fund. Decision XXII/3 specified the issues the Panel should take into account and directed the TEAP, in undertaking this task, to consult widely with relevant persons and institutions and other relevant sources of information deemed useful. The TEAP established the 2011 Replenishment Task Force (RTF) to prepare the report on the 2012-2014 replenishment of the Multilateral Fund, in consultation with the full TEAP membership.

The final TEAP replenishment report was published by UNEP in May 2011 as part of the TEAP Progress Report (Volume 2) /RTF11/.

1.2 The Contact Group on Replenishment

During the 31st meeting of the Open-Ended Working Group, the TEAP RTF presented its report on the Funding Requirement for the Replenishment of the Multilateral Fund for the triennium 2012-2014. After consideration of the report by the plenary, the co-chairs of the OEWG decided to set up a Contact Group to consider the report, and to possibly formulate additional requests for a supplementary study.

The Contact Group included representatives of many non-Article 5 and Article 5 Parties and was co-chaired by Ms. Laura Beron (Argentina) and Mr. Jos Buys (Belgium). The Contact Group had a number of open sessions, which were attended by members of the TEAP RTF and by representatives of the Multilateral Fund Secretariat, as resource persons.

All members of the Contact Group expressed their satisfaction at the clarity and transparency of the TEAP Report and the presentations thereon. During the discussions, the members of the Contact Group received clarification and additional information from TEAP RTF members. The Contact Group then discussed a number of topics and agreed on a number of issues that they believed should be clarified and elaborated in a supplementary report.

On the basis of the discussions in the Contact Group, the Open-ended Working Group agreed to ask the TEAP to elaborate a specific group of issues in the form of a report supplementing its May 2011 Replenishment Report. The specific elements for which elaboration was requested, were given in the

report of the 31st Meeting of the Open-ended Working Group; they are attached to this document as Annex 1.

1.3 Procedure for the completion of the Supplement Report

The TEAP Replenishment Task Force has prepared this supplementary report to address the issues agreed by the 31st Meeting of the Open-ended Working Group. This report has been structured in such a way that specific groups of requests for further study could be dealt with in a separate chapter.

The requests to (1) study the impacts of all relevant Decisions of the Parties and the Executive Committee, including those taken at the 64th ExCom meeting and to (2) study the impact of various strategies to address to address production closure funding, have been the most time consuming ones.

This report was reviewed by the RTF and the TEAP in the period 29 September-3 October 2011; all comments received were discussed before they were inserted. The report was subsequently submitted to the UNEP's Ozone Secretariat at the end of the first week of October 2011 for placing it on its web-site.

2 General observations

2.1 Calculations in the May 2011 RTF Report

In the RTF report of May 2011 /RTF11/, the funding requirement for the triennium 2012-2014 was presented for six funding scenarios as indicated in the table below.

Funded reductions from baseline	Funding requirement for triennium 2012-2014 for three levels of funded baseline reductions and two sub-sector reduction packages (foam-refrigeration/AC-servicing) (US$ million)
Sub-sector reduction package 75-15-10%	
10%	**306.1**
15%	**481.3**
20%	**653.5**
Sub-sector reduction package 90-0-10%	
10%	**245.2**
15%	**386.1**
20%	**529.3**

The most likely funding outcome, comprising funding for both consumption reduction and production closure, was in the mid-range of the scenarios presented. *For instance, the average of the scenarios above with a 10% spread was US$ 390.2-477.0 million for the triennium 2012-2014.*

The funding ranges for the succeeding two triennia were indicated as US$ 572.9-US$ 686.6 million for the triennium 2015-2017 and US$ 611.4-US$ 776.1 million for the triennium 2018-2020.

The approach chosen was to calculate the funding requirement for the full four-year period 2011-2014. The funding estimate for the triennium was obtained by subtracting from the four-year figure the funds approved at the Executive Committee's 63rd Meeting and the balance of funding available for expenditure in 2011 in the Consolidated Business Plan (at the time, US$ 252.7 million).

After an analysis of the Stage I HPMPs then approved for non-LVC countries, the Task Force decided to calculate funding requirements for three different levels of HCFC phase-out, namely 10, 15 and 20 percent of the estimated baseline of the relevant country. Noting the differences between sectoral distributions in approved Stage I HPMPs, the Task Force also selected two cases for the composition of 'reduction packages', firstly: 90% foam, 0% RAC manufacturing and 10% servicing, and secondly: 75% foam, 15% RAC manufacturing and 10% servicing. Together with the three options for funding

of reductions from the baseline, this yielded the six scenarios for HPMP funding indicated in the table above.

Production phase-out of HCFC-22, HCFC-141b and -142b was assumed to occur in parallel with the consumption phase-out through separate plant closures, commencing in 2013, the first year with frozen or reduced production levels. A value of US$ 3.0 per kg of HCFC-141b and HCFC-142b phased out, consistent with costs for the CFC production sector closure, resulted in a total cost up to 2015 of between US$ 123 and US$ 240 million.

It was noted that phase-out of the production of HCFC-22 in Parties other than China would have only a small impact on total production sector funding. Production in other countries takes place solely in swing plants that have already been funded for the closure of CFC production. No compensation for these plants was included.

In the absence of detailed technical information, production sector analysis was of necessity empirical in nature. For example it was not possible to take account of exports from Article 5 and non-Article 5 countries and corresponding imports. Nonetheless, the estimate for the first triennium is highly sensitive to assumptions for production sector costs, which comprised 20 to 30% of the total 2012-2014 triennium funding estimate.

2.2 Status in September 2011

An additional 21 Stage I HPMPs were approved at the 64th Meeting of the Executive Committee at a total cost of US$ 340 million including support costs (for all triennia, not only for the 2011 tranches). 6 HPMPs were for non-LVC countries at a value of about US$ 331 million, including the Stage 1 HPMP for China (itself US$ 265 million, excluding agency support costs, or US$ 274 million with support costs only for the year 2011)[1]. As a consequence of these approvals, the funding for some 80% of the HCFC consumption reductions required to meet the 2015, 10% Protocol reduction target has been established (it should be noted that a large number of LVC countries have agreements to meet the 2020 reduction target). Importantly, any changes to funding estimates for phase-out costs arising from variations to the reduction package, funded reductions from the baseline or cost-effectiveness assumptions for countries that are yet to receive approval for Stage I HPMPs will apply to less than 25 percent of the total funded reductions (US$ 338 million for 2011 and 2012-2014 and US$ 160 million for 2012-2014). The funding estimate for the consumption part of the 2012-2014 triennium is now also less sensitive to reassessment of the parameters used in the Task Force's analysis. For example, a 15% variation in estimated cost for all of the

[1] This excludes the China solvent sector (HCFC-141b) program at US$ 5 million

remaining HPMPs to be approved would result in less than a 5% variation to the total consumption sector cost estimate for the first triennium (existing plus new HPMP costs).

Because the level of consumption sector funding for the first triennium is now subject to less uncertainty, emphasis in the supplementary report has been placed on re-examining assessments for the consumption sector in the subsequent two triennia and in the production sector for all three triennia.

Emphasis has also been placed on examining options for reducing the imbalance in funding levels across the three triennia. This was already mentioned in Decision XIX/6, paragraph 5, in the year 2007: "*To agree that the funding available through the Multilateral Fund for the Implementation of the Montreal Protocol in the upcoming replenishments shall be stable and sufficient to meet all agreed incremental costs to enable Article 5 Parties to comply with the accelerated phase-out schedule both for production and consumption sectors".* This imbalance has been exacerbated by the relatively high levels of expenditure for Stage I HPMPs that has been committed in the current year (about US$ 178 million, or 43% of total project costs including support costs), thereby removing a significant proportion of consumption sector funding from the requirements that would otherwise have been addressed in the first triennium, 2012-2014 and in the first year of the second triennium, 2015. Additionally, consumption sector funding is proportionately higher in the subsequent two triennia because the reductions targeted will be 15% or more of the baseline consumption compared to 10 % in the first triennium for all except two non-LVC Article 5 countries

2.3 Production closure funding

It was assumed in the May 2011 report /RTF11/ that ODS quantities to be phased out in the production sector were equal to the total levels of consumption phase-out for which funding would be provided in Stage I HPMPs. Analysis subsequent to the 64th Meeting reveals that the actual levels of phase-out funded in all approved HPMPs is substantially higher than estimated in the report. Therefore, while production closure costs comprised 20%-30% of the total estimates for scenarios in the first triennium, they will now amount to some 40% of the total triennium cost estimates. There are two key implications: firstly, this reduces even further the impact of minor reassessments of cost for the 20% of consumption remaining to be addressed in Stage I HPMPs; secondly, it increases the requirement for examination of the parameters which may influence the increasing level of costs for the production sector, in both the first and subsequent triennia.

2.4 Approaches for production closure to achieve more stable funding levels

The Parties have requested that the impact of funding options for swing plants be investigated. In this regard it is noted that the level of production from

swing plants in recent years as reported in Article 7 data amounts to only about 18% of total HCFC-22 production in Article 5 countries, thus limiting the sensitivity of overall production sector funding to changes in swing plant funding levels. It is also noted that all swing plants in Article 5 countries have received funding for cessation of CFC production.

Additionally, total HCFC production in Article 5 countries other than China amounts to less than 10 percent of total Article 5 HCFC production, including HCFC-141b and -142b, all of which is produced in China. Thus, over 90% of the total production sector phase-out activity will be associated with production in China.

Parties have also requested the investigation of options to shift production sector funding tranches to later years. The front loading of approved Stage I HPMPs has already reduced the consumption sector funding requirement in the first triennium relative to the second and third triennia. Additionally, average cost-effectiveness levels in the second triennium, which is already required to support a 15% reduction in baseline consumption, may be higher (since foam is being addressed extensively in the first triennium). The implications are that shifting funding for production closure to later years is likely to exacerbate imbalances in funding levels across the three triennia.

In view of the above, the Task Force has examined the financial implications of the following approaches to the assessment of the value of funding options for production sector closure:

- the adoption of different funding approaches for HCFC-141b/142b and HCFC-22 production phase-out
- the adoption of reduced funding levels per kg of phase-out, again, differentiated by substance
- consideration of funding criteria different to those adopted in the May Report, in particular, phase-out quantities based on Montreal Protocol reductions from total reported baseline consumption, rather than the total quantity of HCFCs being funded for phase-out in the consumption sector.

It may be possible to consider a scenario in which HCFC-22 does not attract any closure funds. All swing plants in Article 5 countries have already received funding to phase out CFC production.

Subject to technical evaluation, all HCFC producers in China may over time be able to be converted for feedstock production, the requirements for which might exceed the reduction in emissive uses over the next 15-20 years. In this circumstance, production sector funding would be determined solely on the basis of reductions in the consumption of HCFC-141b/-142b. It might also be appropriate to consider further smoothing of the funding profile, by spreading HCFC-141b/-142b closure funding over 6 years, not only per triennium.

Finally, basing production sector compensation on Montreal Protocol reduction levels would enable the assessment of costs for funding the closure of 10% of total production capacity, potentially spread over the first two triennia, that is, in the period 2012-2017. Under this scenario, it would be necessary to address the subsequent 25% reduction step in the triennium 2018-2020 and the following triennium. Production sector funding would increase in the final triennium, but this is sufficiently far in the future that cost-effectiveness for HPMPs could be expected to have further decreased.

The financial implications of the above concepts are developed further in subsequent sections of this report.

2.5 Cost-effectiveness

A significant number of HPMPs approved at the 64th Meeting incorporate cost-effectiveness values significantly lower than those assessed by the Task Force for use in the May report /RTF11/. Overall, cost-effectiveness in approved Stage I HPMPs is some 15-30 percent lower than the values initially predicted. The Task Force has therefore had to consider what values might be adopted for its supplementary analysis. The principal considerations include:

- the historical record of project approvals in the Multilateral Fund which, in general, does not support an increase in cost-effectiveness levels over time
- the lack of equity in providing additional funding through increased cost-effectiveness values for projects yet to be considered
- the prospective increasing technical difficulty of later projects, supporting a cost-effectiveness increase, on the basis that the most cost-effective projects were selected for Stage I HPMPs.

A generalised assessment of the sectoral cost-effectiveness of the Stage I HPMP approved for China at the 64th Meeting (in the absence of specific data on sectoral phase-out quantities) indicates cost-effectiveness values some 15-40% lower than the values used in the May report for PU foam and for refrigeration and air conditioning, and about a factor of two higher than the one assumed for XPS foam (a comparison with other approved Stage I HPMPs is difficult to make because foam cost-effectiveness has been significantly lower in some other HPMPs). The package for China is comprised of 51% foam, 46.5% R/AC and 2.5% servicing (expressed in tonnes). The relatively high level of phase-out in the R/AC sector could typically be expected to increase overall cost-effectiveness values. This being the case, and noting China's very high levels of consumption relative to all other Article 5 countries, it appears unlikely that the sub-sectoral cost-effectiveness values emanating from China's Stage I HPMP would be valid for any other developing country, even in triennia beyond 2012-14.

2.6 Composition of reduction packages

A significant number of Stage I HPMPs approved to date have involved only the foam and servicing sectors, frequently with widely varying relative percentages. Some projects have been confined entirely to the foam sector. While the two reduction packages selected for analysis in the May report were based on logical assessments of likely phase-out scenarios, and included a foam and servicing only option, it is clear that actual projects are likely to span a much wider variety of reduction packages. Equally clearly, the cost of different package combinations varies substantially, noting that cost-effectiveness in approved projects has varied from about US$ 2/kg in the foam sector to US$ 10/kg in the RAC sector.

Thus the composition of reduction packages is a key variable for consideration in the present report. In particular, for many countries, a percentage of 90 (in the reduction package 90-0-10) cannot be extended over triennia, because the foam sector consumption will have been full addressed, and consideration must be given to packages with substantially less activity in the foam sector.

As the percentage of activity in the foam sector decreases, the cost of reduction packages will increase significantly. Hence it can be expected that in the two subsequent triennia, average unit costs for additional phase-out of consumption will increase.

As well, increased activity in the R/AC sector will result in increased phase-out of HCFC-22 (compared to HCFC-141b/142b) with potentially higher costs for phase-out in the production sector. Thus the objective of achieving the best outcome for an even funding requirement across the triennia will introduce pressures to minimise cost-effectiveness in the R/AC sector and also to consider additional concepts or modalities for funding production sector phase-out.

2.7 Conclusions

In the consumption sector, a number of variations on estimated costs can be obtained through adjustments to reduction packages including, for instance, the percentage of low-GWP technologies in the RAC sector. For the small amount of phase-out remaining to be addressed in the 2012-2014 triennium this has little effect on total replenishment estimates.

Noting that terms of reference refer to ‘indicative’ estimates for future triennia, there are significant constraints associated with the development of funding requirements beyond 2014. The principal factors influencing consumption sector costs will continue to be the composition of the reduction packages and the overall cost-effectiveness likely to arise in Stage II HPMP projects.

Notwithstanding the above, costs and timing for the production sector phase-out will continue to be the single factor exerting the most influence on the quantum and spread of replenishment requirements for the next three triennia. The principal constraints are future policy decisions about the modalities (and thus the cost) of compensation for closure of HCFC production facilities and the current absence of technical detail, mostly in relation to facilities in China, that will be needed to inform policy discussions.

3 Revised calculation of funding requirement 2012-2014 and subsequent triennia

3.1 Baseline data

The Replenishment Task Force checked all Article 7 HCFC consumption data that were submitted for the year 2010 to the Ozone Secretariat. An impression of the 2010 data that were submitted is given in Table 3-1.

Table 3-1 Submission of 2010 HCFC Consumption data by 1 September 2011

Submission		Consumption	Consumption level
86 Parties	>100 ODP t/yr	<100 ODP t/yr	large consuming Parties
	14 Parties	72 Parties	5 cons. > 2009 (2-20%)
			9 cons. < 2009 (2-20%)
59 Parties did not submit	6 Parties (incl. China, India)	53 Parties	

The 2010 data submitted by LVC or other low-consuming countries did not change the baseline for any country to the extent that the classification had to be changed (from LVC to non-LVC, or the other way around).

The 2010 data were taken into account in the calculation of the funding of Parties in the triennium 2012-2014, which had no HPMPS approved after the ExCom-64 meeting. Since the majority of Parties had HPMPs approved before or at ExCom-64, the adjusted baseline consumption (compared to the baseline used in the May 2011 report /RTF11/) has virtually no influence on the total funding requirement.

3.2 Revised funding requirement for the period 2012-2014

This section gives the estimated requirements for individual expenditure categories other than HCFC phase-out (both consumption and production) as was done in the May 2011 report /RTF11/ (with minor adjustments). These funding requirements were combined with the agreed HPMP funding for the four-year period 2011-2014. They were also combined with estimates for the funding requirement for those Parties that had no agreed HPMP when this report was drafted (i.e., after ExCom-64).

Where the funding agreed for a large number of Parties was considered as fixed for the period 2011 and is listed under commitments, the funding estimates for the Parties without HPMPs were calculated for a total of six funding scenarios (as done in the May 2011 report /RTF11/):

- three HCFC phase-down levels (10, 15 and 20% reduction from the baseline consumption) and, for each phase-out level,
- two reduction packages addressing different combinations of HCFC consumption in the foam, refrigeration and AC manufacturing and

servicing sub-sectors (90-0-10% and 75-15-10% in ODP tonnes, respectively).

Table 3-2 below demonstrates the calculation of the total funding requirement for the "constant" part, i.e., the part not related to the funding of HCFC consumption and production phase-out. The contents of Table 3-2 are as follows:

- Funding commitments already approved by the Executive Committee for the remainder of non-HCFC phase-out (both consumption and production funding commitments);
- Funding commitments methyl bromide consumption and production;
- Funding estimated for destruction projects;
- Estimated project preparation funding for stage II HPMPs;
- Technical assistance funding;
- Existing commitments for HCFC phase-out for 2011-2014 approved prior to 2011 and approved at the 63rd and 64th Executive Committee meeting for 2011 and also for the triennium 2012-2014;
- Funding for Institutional Strengthening for 2011;
- Other non-investment funding for 2011 estimated on the basis of current practice (see Chapter 7 in the RTF May 2011 report).

Table 3-2 Elements that determine the 2011-2014 total funding requirement (US$ million)*

Funding Elements for 2011- 2014 **(***incl. agency support costs where appropriate)*	**(US$ million)**
Commitments for non-HCFC phase-out	2.36
Commitments for MeBr phase-out in consumption and production	11.26
Destruction (including project preparation)	15.25
Preparation of stage II HPMPs	4.80
Technical Assistance (TAS)	1.25
Existing commitments for HPMPs (for LVCs and non-LVCs) and individual HCFC phase-out projects*	337.71
Institutional Strengthening	32.73
Other non-investment funding for 2011-2014:	
-CAP	41.99
-Agencies' Core Unit Costs	24.30
-Costs for ExCom and Secretariat	26.09
-Treasurer	2.00
Subtotal	**498.24**
Plus remaining new HPMPs	Funding requirements as per scenarios in Table 3-3
Plus production sector closure costs	Funding requirements as per scenarios in Table 3-3

Note *: based on actual approvals up to and including at the 64th meeting

The above costs are added to give a complete 4-year funding requirement for each scenario. To obtain the funding requirement for the triennium 2012-2014 it is necessary to deduct from the total four-year estimate for each scenario the funding approved for all categories of expenditure at the 63rd and 64th Meetings plus the funding available for the balance of 2011 (US$ 93.13 million), the number provided by the Fund Secretariat.

This is demonstrated in Table 3-3 below for each of the six scenarios studied. The table presents in columns (b) to (e) the estimated 4-year funding costs under each scenario for new HPMPs, HCFC-141b/142b production closure, HCFC-22 production closure and the established costs as indicated in Table 3-2 (constant for all scenarios). Column (g) indicates the funding for 2011 committed by the Executive Committee at its 63rd and 64th meeting. Column (h) indicates the deduction for the remaining business plan funding for 2011. This amount is also constant for each scenario. The estimated funding requirement for each scenario appears in the final column of Table 3-3.

Table 3-3 Total funding requirement for the triennium 2012-2014 for six scenarios, (three baseline consumption reduction levels (in percentages, ODP tonnes) and two sub-sector reduction packages) (US$ million)

Reduction from Baseline **(a)**	New HPMPs (b)	Production Closure HCFC-141b/-142b (c)	Production Closure HCFC-22 (d)	Established costs from Table 3-2 (e)	Total 4-year funding requirement per scenario (f)
Sub-sector reduction package 75-15-10%					
10%	57.81	90.56	104.01	492.73	745.55
15%	80.30	96.52	108.95	492.73	779.07
20%	106.93	103.43	114.74	492.73	818.37
Sub-sector reduction package 90-0-10%					
10%	50.62	92.43	100.71	492.73	736.97
15%	68.60	99.56	103.61	492.73	765.07
20%	89.63	107.81	107.01	492.73	797.77

Reduction from baseline (a)	Total 4 year funding per scenario (f)	Funding in 2011 committed up to ExCom 64 (g)*	Planned funding available for the balance of 2011 (h)	**Total funding requirement for 2012-2014 for the six scenarios**
Sub-sector reduction package 75-15-10%				
10%	745.55	(186.27)	(93.13)	**471.7**
15%	779.07	(186.27)	(93.13)	**505.2**
20%	818.37	(186.27)	(93.13)	**544.5**
Sub-sector reduction package 90-0-10%				
10%	736.97	(186.27)	(93.13)	**463.1**
15%	765.07	(186.27)	(93.13)	**491.2**
20%	797.77	(186.27)	(93.13)	**523.8**

*Note: This excludes MB, CFC, a large portion of IS, all CAP, Core funding, ExCom/Secr. costs in 2011

3.3 Consideration of the Six Scenarios

It can be observed from Table 3-3 that the amounts for HPMPs for Parties that have so far no HPMPs varies between US$ 50 and $106 million dependent on the reduction from the baseline and the reduction package assumed. The funding for HPMPs approved to date by the Executive Committee for the triennium 2012-2014 amounts to about US$ 160 million (of which the funding for China is US$ 101 million without support costs). This implies that the funding estimated for remaining new HPMPs for the triennium 2012-2014 will be 1/3 to 2/3 of the funding agreed. However, it should be borne in mind that an amount of almost US$ 178 million has so far been approved in 2011 (and is to be disbursed in 2011), which brings the total amount to US$ 337.7 million, and the amount estimated in new approvals to 15-30% dependent on assumptions made. This illustrates that the majority of the HCFC consumption for the phase-down in stage 1 HPMPs has been addressed.

For a study of the funding required for new HPMPs the cost-effectiveness factors as in the May 2011 report were again applied (US$ 7.27 and 2.56 for PU foam and XPS foam, and US$ 11.1 for refrigeration and air conditioning, US$ 4.5 for servicing).

It needs to be once more underlined here that a large percentage of the total funding requirement (both consumption and production) calculated for the period 2012-2014 stems from approved HPMPs and the consequences of the level of funded reductions in consumption for the HCFC production phase-down. It is useful to analyse the numbers with and without production.

Table 3-4 Funding requirement with and without production, and amounts involved in the phase-down, expressed in ODP-tonnes and Mt CO2 equivalent (assuming 25% low GWP replacements in RAC) (in US$ million)

	Total funding 2012-14 without production	Total funding 2012-14 With production	Consumption phased out **(ODP tonnes)**	Tonnes phased out expressed (Mt CO_2 eq.)*	Funding difference for different low GWP percentages
Reduction package 75-15-10%					
10%	277.2	471.7	5004	54.93	0.67
15%	299.7	505.2	5293	58.93	1.10
20%	326.3	544.5	5628	63.62	1.58
Reduction package 90-0-10%					
10%	270.0	463.1	5005	55.18	-
15%	288.0	491.2	5295	59.39	-
20%	309.0	523.8	5631	64.32	-

* Note: Consists of savings from approved HPMPs and from estimated future non-LVC HPMPs

Table 3-4 shows that for each scenario the funding requirement including production closure is about US$ 200 million greater than the requirement without production closure funding (or even more for the scenarios with a 15 and 20% reduction package).

The amounts in ODP tonnes phased out are given in Table 3-4 for the different reduction packages; they include the approved HPMPs plus the new HPMPs assumed to be approved. Also the amounts in Mt CO_2 eq. are given in the table for the sum of both types of HPMPs (see further section 3.5.2, which mentions 48.88 Mt CO_2 eq. from approved HPMPs for the triennium 2012-2014). In ODP tonnes phased out there is, of course, no difference between the scenarios because the percentages are expressed in ODP tonnes. In climate terms (Mt CO_2 eq.), the 75-15-10 reduction package yields 1 to 2 percent less CO_2 reduction, always assuming 25% low-GWP replacements).

There are good grounds for suggesting that the most likely funding outcome, comprising funding for both consumption reduction and production closure could lie in the mid-range of the scenarios presented. The average of the two scenarios with different reduction package compositions with a certain spread[2] would yield the range of **US$ 459.5-539.5 million** for the triennium 2012-2014 (or rather, **US$ 500 million +/- 8%**).

Compared to the funding requirement assumed in the May report /RTF11/, the funding requirements in the production sector are now much higher. This is because estimates for production sector compensation are based on the level of phase-out for which funding is provided in HPMPs. The phase-out obligations contained in the Agreements associated with approved Stage I HPMPs for larger consuming countries are generally (but not exclusively) limited to meeting their 2015, 10% Protocol reduction targets. However, the levels of phase-out for which funding has been provided range up to 30% of the relevant baseline for a country. The average level of phase-out funded in approved HPMPs for non-LVC countries has been significantly higher than the levels assumed in the assessment contained in /RTF11/, leading to a corresponding increase in the re-assessed costs for the production sector.

It is noted that the actual levels of HCFC consumption in Article 5 countries in 2011 and 2012 will not be published before October 2012 and 2013, respectively. Thus corroborative data for establishing levels of compensation for production sector phase-out will not be available until after the mid-point of the 2012-2014 triennium.

[2] The spread is calculated from the 10% spread assumed in the production closure funding (US$ 204.5 +/-20.5 million (10%) and a smaller spread in the other funding which has a large fixed component (due to approved HPMPs, supporting activities) and is equal to US$ 295.0 +/- 19.5 million (6.6%)

It is also clear that (as mentioned in /RTF11/), the level of triennium funding for the production sector is also very much dependent on the level of HCFC production plant closure funds that might eventually be approved and disbursed in the triennium 2012-2014.

3.4 Three additional reduction packages

In the request for additional information (the so called "Co-chairs Suggestions" note) Parties have asked for numbers concerning the impact of a higher percentage of refrigeration and air conditioning or servicing than that previously used (the 75-15-10% reduction package). Parties suggested a package of 75-5-20% and one of 70-20-10% for further study.

Due to the large amount of HCFC reduction in the foam sector (particularly in the PU foam sector), and also due to the large percentages of foam assumed in the reduction packages of 90-0-10% and also 75-15-10%, reductions in future triennia (both 2015-17 and 2018-20) cannot solely focus on foams, but have to take into account the refrigeration and air conditioning sector to a higher degree.

In calculations using a package with too high a percentage of foam, foam sector consumption would become negative for many Parties either in the triennium 2018-20 or, in some cases, in the triennium 2015-17. Following implementation of the Stage I HPMPs approved, in particular, in 2011, the consumption of foam remaining in many countries, while still significant, will be substantially lowered after 2014.

For this reason a different reduction package of 55-20-25% has been used to estimate the funding requirements for all countries for the triennia 2015-17 and 2018-20. This package has also been investigated for the period 2012-14 as one of the options for those countries in which it has an impact on the funding requirement for this triennium.

The results of calculations for the three additional packages are given in Table 3-5 below. The ODP tonnes reduced are 5004, 5294 and 5630, respectively, for the three baseline reductions, similar to what has been given in Table 3-4 (the packages are equal in ODP tonnes, so only the reductions from baseline will yield different amounts of ODP tonnes).

The saving in climate terms is composed out of the savings in climate terms of the approved HPMPs together with the new HPMPs dependent on reduction package and percentage reduction from baseline (see for further analysis section 3.5.2, compare also Table 3-4).

Table 3-5 Total funding requirement for the triennium 2012-2014 for the 75-15-10% reduction package and nine additional scenarios, (three baseline consumption reduction levels (in percentages) and three additional sub-sector reduction packages)* (*values in US$ million)

Reduction from baseline	**Assessed costs for the triennium 2011-2014**					**Total Funding requirmt for triennium 2012-2014 for each scenario**
	New HPMPs	Production Closure HCFC-141b/-142b	Production Closure HCFC-22	Mt CO_2 saved/yr	**Funding requirmt 2012-2014 without production**	
75-15-10% reduction package						
10%	57.81	90.56	104.01	54.93	277.18	**471.7**
15%	80.30	96.52	108.95	58.93	299.68	**505.2**
20%	106.93	103.43	114.74	63.62	326.31	**544.5**
75-5-20% reduction package						
10%	54.11	90.56	104.04	56.06	273.49	**468.1**
15%	74.24	96.52	109.02	60.75	293.62	**499.2**
20%	97.87	103.43	114.82	66.25	317.25	**535.5**
70-20-10% reduction package						
10%	60.20	89.93	105.08	54.80	279.58	**474.6**
15%	84.25	95.50	110.07	58.73	303.63	**509.2**
20%	112.71	101.96	117.32	63.33	332.09	**551.4**
55-20-25% reduction package						
10%	61.85	88.05	108.43	56.09	281.23	**477.7**
15%	86.84	92.47	116.17	60.86	306.22	**514.9**
20%	116.41	97.57	125.19	66.43	335.79	**558.6**

The results of calculations for the three additional packages are given in Table 3-5 above. The ODP tonnes reduced are 5004, 5294 and 5630, respectively, for the three baseline reductions, similar to what has been given in Table 3-4 (the packages are equal in ODP tonnes, so only the reductions from baseline will yield different amounts of ODP tonnes). The saving in climate terms is composed out of the savings in climate terms of the approved HPMPs together with the new HPMPs dependent on reduction package and percentage reduction from baseline (see for further analysis section 3.5.2, compare also Table 3-4).

If one would calculate the costs (averaged) of the savings in ODP terms or rather, in tonnes, the cost would amount to US$ 19-30 million for a 5% reduction in the different packages (using cost effectiveness values for the triennium as mentioned). The saving on the basis of climate calculations (assuming US$ 10 per tonne of carbon dioxide) would be US$ 40-50 million.

It is again clear that the differences in funding between the various scenarios are quite limited (the reduction packages are equal expressed in ODP tonnes, however, not in tonnes). The higher the percentage refrigeration and air conditioning in the reduction package the higher the costs without production closure costs. The maximum differences are about US$ 7 million for a 10% reduction from the baseline and about US$ 18 million for a 20% reduction from the baseline (with a range of US$ 16-23 million). These differences will remain when the funding requirement for the triennium 2012-2014 is calculated, because committed funding is the only factor that is added. The relative differences become smaller. If production closure funding is added, the differences change since parallel production phase-down is assumed and different consumption reduction packages imply different amount of tonnes of HCFC-141b/142b and HCFC-22. In these cases, the lower ODP of HCFC-22 leads to a calculation of more tonnes, therefore higher production closure costs.

The 55-20-25% reduction package is the (only) package that will be investigated for the triennia 2015-2017 and 2018-2020, because of the lower percentage of foam consumption remaining to be addressed.

The 55-20-25% reduction package is more costly because of the large amount of HCFC-22 addressed in refrigeration and AC manufacturing, the high servicing amount, and, as a result the high HCFC-22 amount addressed via closure funding.

The impact of different concepts for closure funding will be further addressed via scenario investigations in chapter 6.

3.5 Varying the proportion of low-GWP solutions

3.5.1 Funding aspects

In the request for additional information (the "Co-chairs Suggestions" note, see Annex 1) Parties asked that the impact of varying proportions of low-GWP applications in commercial refrigeration and air conditioning be investigated.

The cost-effectiveness applied in the calculations for refrigeration and air conditioning for the triennium 2012-2014 is US$ 11.1 per kg (including the 25% additional funding for an average 25% penetration of low-GWP solutions). This implies that the cost-effectiveness without any low-GWP applications would be US$ 10.45 per kg. Capital costs would remain the same (see Table 5-7 in the May 2011 report /RTF11/), IOC costs are capped via ExCom Decision 60/44).

This analysis does not apply to Stage I HPMP already approved since costs have already been fixed. Even if this were not the case, the approved HPMPs

concern packages with different proportions of HCFC reductions in the various foam, refrigeration and servicing sectors.

For Stage I HPMPs remaining to be approved, zero penetration of low-GWP solutions would result in a saving of US$ 0.6-1.6 million, which is negligible in comparison to the total funding requirement; this is shown in Table 3-4. Using the ICC and IOC costs indicated above, application of low-GWP solutions to 50% of the RAC sector consumption would increase the funding requirement by US$ 0.6-1.6 million.

Estimates for all funding requirements are based on the actual costs incurred and year 2011 prices.

3.5.2 Impact expressed in MtCO_2 equivalent

The amounts of HCFCs consumed as baseline (the average of the years 2009 and 2010) can be expressed in Mt CO_2 eq. This can be divided into a global LVC and a non-LVC baseline value:

Non-LVC countries:	745.07 Mt CO_2 eq
LVC countries:	37.02 Mt CO_2 eq
All Article 5 countries:	782.09 Mt CO_2 eq

In HPMP approvals as of 2011 a certain amount for foams, refrigeration and air conditioning and HCFC-22 servicing has been approved.

The total amount of reduction in HPMP approvals for non LVC countries equals:

Servicing:	6.03 Mt CO_2 eq
Foams assuming 95% low-GWP:	32.51 Mt CO_2 eq
Refrigeration and AC assuming 20% low-GWP:	8.27 Mt CO_2 eq

In HPMP approvals for LVC countries for the year 2015 (10% reduction, only some countries are on a faster track) 2.6 Mt CO_2 eq

Not all LVC countries have HPMPs approved, this is the reason why the saving is less than 10% of the baseline value in Mt CO_2 eq.

In total a reduction per 2015 has been approved of ***48.88 Mt CO_2 eq.*** This is less than 20% of the baseline value because of several aspects:

a. not all LVC and non-LVC countries have HPMPs approved

b. the savings in refrigeration and AC are based on a 20% GWP reduction, which is being realised by conversion of part of the manufacturing to hydrocarbons, and a part to HFC-32 (which implies a two thirds saving).

Any conversion to R-410A does not yield a saving (slightly higher GWP, slightly smaller charge)[3]

c. Approvals may have been large in case of certain countries in the sense of ODP reduction, but this has been mostly reduced in foam using HCFC-141b. Since the GWP of HCFC-141b amounts to 717 versus 1790, the GWP for HCFC-22, the relatively small amount approved in HCFC-22 drastically reduces the saving in Mt CO_2 eq., expressed in percent of the baseline total amount.

For information, the saving by applying low GWP solutions in all approvals that have occurred in refrigeration and AC would have been zero for non low-GWP solutions, 38.8 Mt CO_2 eq. for all low-GWP solutions.

Table 3-6 Reductions in $MtCO_2$ for different reduction packages and for different reductions from the baseline for HPMPs still to be approved for non LVC countries; reductions are given for application of 0, 25% and 50% low GWP solution in refrigeration and AC, this being the sector where the percentage low GWP solutions varies significantly dependent on application

2012-2104		**Reduction from baseline**		
Reduction package		**10%**	**15%**	**20%**
75-15-10%	50% low GWP	6.55	10.89	15.98
	25% low GWP	6.05	10.05	14.74
	0% low GWP	5.55	9.21	13.50
90-0-10%	No R/AC	6.30	10.51	15.44
75-5-20%	50% low GWP	7.31	12.12	17.75
	25% low GWP	7.18	11.87	17.37
	0% low GWP	7.04	11.63	16.99
70-20-10%	50% low GWP	6.60	10.99	16.12
	25% low GWP	5.92	9.85	14.45
	0% low GWP	5.23	8.71	12.78
55-20-25%	50% low GWP	7.90	13.12	19.22
	25% low GWP	7.21	11.98	17.55
	0% low GWP	6.53	10.84	15.88
45-25-30%	50% low GWP	8.38	13.93	20.40
	25% low GWP	7.51	12.49	18.30
	0% low GWP	6.64	11.05	16.20

[3] Important saving (large part in the 20% saving) comes from the conversions in the R/AC sector in China (in particular to hydrocarbons, some to HFC-32); information was obtained from project documents available

The saving in refrigeration and AC conversions in the HPMPs still to be approved have been investigated by studying different packages and different reductions from the baseline (see Table above). These scenarios have already been described above.

Dependent on the percentage refrigeration and AC in the package the difference between 50% low-GWP and 0% low-GWP applications will be bigger. The numbers given for 10, 15 and 20% reduction from the baseline do show a deviation from the linear relationship. This is due to the fact that a number of countries, which have so far no HPMPs approved, had projects approved in 2010, which have been taken into account. These projects often reduce consumption by 0-15%, however, with growing reductions from the baseline more ODP reductions have to be addressed in the (new) HPMP, which will then lead to greater reductions in Mt carbon dioxide terms for the HPMP as such.

3.6 Funding Requirement for Subsequent Triennia

As requested, indicative funding requirements for the triennia 2015-2017 and 2018-2020 have also been reassessed. The values are described as indicative because the assumptions for composition of the reduction package and for cost-effectiveness values continue to be subject to significant uncertainty.

In the first instance, the reduction package 55-20-25% has been investigated. Values have also been determined for slight variations to this package.

A large number of HPMPs has been approved in 2011 for the triennium 2011-2014 in order to facilitate achievement of the Protocol baseline reduction of 10% by 2015. As previously indicated, cost-effectiveness figures in approved projects are significantly lower than those assumed in the original analysis of the triennium 2012-2014. Accordingly, for the revised analysis cost-effectiveness figures have been adjusted downwards by about 15%. However, the cost-effectiveness for XPS conversion needed to be increased; the value of US$ 2.56/kg originally was found to be too low, and was adjusted to US$ 4.85 per kg (see chapter 4). This adjustment has been checked against the values in approved Stage I HPMPs for which calculation of sectoral cost-effectiveness has been possible, including the China HPMP. In this way the revised calculations have been correlated as closely as possible with the trend established in projects approved in 2011.

The following cost effectiveness values have been used for the analysis of replenishment requirements in the second and third triennia. Additional supporting information on the selection of these values is provided in chapters 4 and 5):

PU foam, *US$ 6.11 per kg.*
XPS foam, *US$ 4.85 per kg.*

Servicing: *US$ 4.5 per kg (ExCom decision 60/44).*

Refrigeration/AC (25% low-GWP alternatives for all triennia): US$ 8.8 per kg (see chapter 5), together with the 25% addition for 25% low-GWP applications for both commercial refrigeration and AC: *US$ 9.35 per kg*[4].

Table 3-7 Elements that determine the 2015-2017 total funding requirement (US$ million) for one (sub-sectors) reduction package

Funding Requirement for the period 2015-2017	**US$ million**
Existing Commitments HPMPs (for LVCs and non-LVCs)*	59.24
Destruction	0
Institutional Strengthening	25.76
Non-investment funding for 2015-2017:	
-CAP	34.86
-Core	20.26
-Costs for ExCom and Secretariat	20.96
-Treasurer	1.50
New Stage II HPMP for larger consuming countries (non-LVCs) using a 55-20-25 reduction package	410.75
Estimated commitments for Stage II HPMPs for LVCs	8.12
Production closure HCFC-141b/-142b	73.23
Production closure HCFC-22	135.39
TOTAL	**790.1**

*Note: this includes support costs for the 2015-2017 triennium for China (at 7.88%)

Table 3-7 above gives the calculation of the total funding requirement for the period 2015-2017. Table 3-8 below contains the same information for the triennium 2018-2020. The tables contain:

- Estimated funding requirements for HCFC phase-out via HPMPs from commitments and from estimates for new approvals
- Funding estimated for destruction projects
- Funding for Institutional Strengthening

[4] So far, the proportion of commercial refrigeration projects in the RAC sector of approved HPMPs has been very small, compared to servicing and AC assembly. Consequently, the cost effectiveness values used relate more to the conversion of AC equipment (however, since the cost effectiveness for both commercial refrigeration and AC was estimated to be the same, practical observations are not important for the funding requirements calculated. For further cost effectiveness considerations see Chapter5)

- Non-investment funding estimated on the basis of current practices
- Estimates for the cost of stage II HPMPs for large consuming countries
- Production closure funding for HCFC-141b/-142b and HCFC-22
- Totals for all elements for the reduction package (55-20-25)

In the period 2015-2017, the remaining funding commitments for HPMPs for non-LVC countries and LVC countries that were approved in 2011 are still substantial (about US$ 59 million, including the commitment from the HPMP approval for China, including support cost). IS and non-investment funding values have not changed compared to the numbers in the May 2011 report.

The funding for the HPMP approvals assumed for the non-LVC countries using the reduction package of 55-20-25% for a further 15% reduction from the baseline amount to US$ 410.8 million (apart from LVC country funding at US$ 8.1 million). Production closure for the various HCFCs phased out amounts to US 208.6 million, bringing the total funding requirement for this triennium to US$ 790.1 million (this will achieve 4890 ODP tonnes reduction, or 80 Mt CO_2 equivalent reduction, see further section 3.7.2). The value for the funding requirement excluding the production closure funding amounts to US$ 581.5 million.

The funding requirement was also recalculated using reduction packages of 55-15-30% and to 55-25-20%, that is, increasing or decreasing the percentage of refrigeration and air conditioning versus servicing. This yields "comparable" values of US$ 774.1 and US$ 806.4 million respectively including production closure. It yields funding values of US$ 565.5 and US$ 597.8 excluding production closure. Production closure scenarios will be further investigated in chapter 6.

On the basis of the numbers given above, the indicative total funding requirement for the triennium 2015-2017 is assumed to be **US$ 790 million** including production closure (and **US$ 582 million** excluding production closure).

Noting that the funding requirement for the period 2012-2014 lies in the range US$ 460-540 million (including production closure), and that the indicative requirement for 2015-2017 is some US$ 790 million mentioned it will be clear that replenishment levels for the two triennia cannot be considered in isolation from each other.

Neither can implementation of the "stable and sufficient" funding concept --introduced in Decision XIX/6 of the 2005 Meeting of the Parties-- be achieved simply by averaging the assessed requirements for the two triennia. For instance it is no longer possible at this stage to consider the approval of

additional consumption reductions for Stage I HPMPs (which could otherwise have led to a range US$ 605-685 million for each triennium). Therefore, it will be necessary to examine the funding implications of differing options for both consumption and production for these two triennia. This will also be done in chapter 6.

Table 3-8 below gives the estimate of the total funding requirement for the period 2018-2020. The main elements are the estimates for the costs of Stage II HPMPs for large consuming countries as well as the production closure funding for HCFC-141b/-142b and HCFC-22, plus Institutional Strengthening and non-investment costs.

Table 3-8 Elements that determine the 2018-2020 total funding requirement (US$ million) for one (sub-sectors) reduction package

Funding Requirement for the period 2018-2020	**US$ million**
Commitments for HPMPs (for LVCs and non-LVCs) agreed in 2011, or estimated to be agreed	5.11
Destruction	0
Institutional Strengthening	23.30
Non-investment funding for 2018-2020:	
-CAP	38.09
-Core	22.14
-Costs for ExCom and Secretariat	22.23
-Treasurer	1.50
New Stage II HPMP for larger consuming countries (non-LVCs) using a 55-20-25 reduction package	452.07
Estimated commitments for Stage II HPMPs for LVCs	3.69
Production closure HCFC-141b/-142b	80.55
Production closure HCFC-22	148.18
TOTAL	**796.9**

In the period 2018-2020, the funding commitments for Stage I HPMPs for non-LVC countries either approved or remaining to be approved in 2011 amount to about US$ 5 million. IS and non-investment funding values are the same as those used in the May 2011 report.

The funding for the HPMP approvals for the non-LVC countries using the reduction package of 55-20-15% for a further 16.5% reduction from the baseline in this triennium is estimated at US$ 452.1 million. For LVCs the new commitments estimated amount to US$ 3.7 million. Production closure for the various HCFCs phased out amounts to US 228.7 million, bringing the total funding requirement for this triennium to US$ 796.9 million (this will achieve 5365 ODP tonnes reduction in this triennium, or 87.9 Mt CO_2

equivalent reduction). The funding requirement excluding production closure amounts to US$ 568.1 million.

The funding requirement was again recalculated using reduction packages of 55-15-30% and 55-25-20%, that is, increasing or decreasing the percentage of refrigeration and air conditioning versus servicing. This yields values of US$ 784.2 and US$ 819.8 million including production closure; it yields funding values of US$ 555.4 and US$ 591.0 excluding production closure. Production closure scenarios will be further investigated in chapter 6.

On the basis of the numbers given above, the indicative funding requirement for the triennium 2015-2017 is assumed to be **US$ 797 million** including production closure (and **US$ 568 million** excluding production closure).

As indicated above, to further investigate the concept of "stable and sufficient" funding (mentioned in Decision XIX/6) it will be necessary to consider funding options across all three triennia, with particular emphasis on 2012-2014 and 2015-2017. This is addressed in Chapter 6.

3.7 Varying the proportion of low-GWP solutions

3.7.1 Funding aspects

In the request for additional information (the "Co-chairs Suggestions" note, see Annex 1) Parties asked that the impact of varying proportions of low-GWP applications in commercial refrigeration and air conditioning be investigated.

For the period 2014-2020, the cost-effectiveness applied in the calculations for refrigeration and air conditioning is US$ 9.35 per kg (including the 25% additional funding for an average of 25% penetration of low-GWP solutions). As mentioned, the starting point for the cost-effectiveness without any low-GWP applications is US$ 8.8 per kg. Capital costs would remain the same (see Table 5-7 in the May 2011 report /RTF11/), IOC costs are capped via ExCom Decision 60/44).

For reductions to be funded after 2014 (in the triennium 2015-2017), zero penetration of low-GWP solutions would result in a saving of US$ 11 million, 50% penetration would result in an increase of US$ 11 million. Both values are small in comparison to the total funding requirement, however, one should realise that the ICC and IOC cost of the low-GWP option is not changed compared to the non low-GWP option (this may not be consistent with reality). The same holds for the triennium 2018-2020 (with a 10% higher reduction from baseline assumed). Zero penetration of low-GWP solutions would result in a saving of US$ 12.1 million, 50% penetration would result in an increase of US$ 12.1 million.

Estimates for all funding requirements are based on the actual costs incurred and year 2011 prices.

3.7.2 Impact expressed in $MtCO_2$ equivalent

The impact of the reduction package 55-20-25% can be easily derived for the two triennia expressed in MtCO2 eq., for application of 0, 25 and 50% low-GWP solutions. Numbers are given in Table 3-9.

Table 3-9 Reductions in $MtCO_2$ equivalent for one reduction package (as applied for the two triennia after 2014 (for 15 and 16.5% reduction from the baseline, respectively), for the application of 0, 25 and 50% low-GWP solutions in refrigeration and air conditioning

Triennium		2015-2017	2018-2020
Reduction package 55-20-25%		15% reduction	16.5% reduction
50% low GWP		87.65	96.41
25% low GWP		79.91	87.90
0% low GWP		72.18	79.40

3.8 Alternative growth rates

The Co-Chairs' summary included a request to examine alternative growth rates for HCFCs between 2009 and 2013 taking into account available Article 7 data up to September 1, 2011. The Task Force sought to address the concept of possible growth beyond the baseline by basing its analysis on the estimated levels of consumption for which phase-out was actually funded in Stage I HPMPs approved at the 63rd and 64th ExCom meetings. The levels of phase-out actually funded in approved HPMPs exceed in most cases the levels needed to achieve a 10 percent reduction in baseline consumption by 2015.

As indicated earlier in this chapter the revised analysis has taken into account all additional Article 7 data. As also indicated elsewhere in this report some 80% of consumption to be addressed in Stage I HPMPs has now been funded in HPMPs approved by the ExCom, including in the highest consuming country, China. Thus, possible variations in maximum levels of consumption between 2010 and 2012, the last year prior to the freeze, for those countries that have not yet received Stage I HPMPs will not have a significant impact on the overall funding requirement for the replenishment in the first or subsequent triennia.

4 Foam cost-effectiveness

The following is an update of the information provided in the May 2011 RTF report /RTF11/. Tables and cost-effectiveness calculations have been adjusted so that they can also be applied for the triennia after 2012-2014.

The cost-effectiveness (CE) for polyurethane (PU) foams mainly depends on the chosen HCFC phase-out technology and the size of the enterprise. The selection of the technology is greatly influenced by the specific market subsector (integral skin, domestic refrigeration, commercial refrigeration, discontinuous and continuous panels, spray, etc.) and the size of the company to be converted. There can be barriers to the adoption of more complex technology options in smaller enterprises that can include higher costs. These factors are included in the assessment below.

There are relevant uncertainties associated with the estimation of ICC and IOC for a given option and size of the enterprise. These include the extent of product development within an enterprise, the status of patents and technology licenses, the range of models manufactured by the company and the geographical location.

A comprehensive description of the technology options to replace HCFCs in PU foams can be found in the 2010 UNEP FTOC Assessment Report published in April 2011.

Table 4-1 presents the estimated maximum penetration values in Article 5 countries for various HCFC options based exclusively on technical and cost considerations. The alternatives were identified as “current” when they are applied at the present time whereas “longer term” implies that the technology is anticipated to be available within the next 3-5 years. This table is the basis to build the scenario of preferred alternatives by subsector and factory size (table 4-2).

Based on this information and the data of approved and submitted projects the cost-effectiveness values -by subsector and company size- were estimated in Table 4-3. Specific consideration was given to the participation of non-Article 5 capital in the most globalised subsectors (domestic refrigeration, continuous lamination).

To calculate a weighted average, Table 4-4 --describing the estimated market distribution, in percentage, by subsector and company size-- was prepared. Combining the tables 4-3 and 4-4, the weighted cost-effectiveness averages can be calculated for the sub-sectors: US$ 6.17 for rigid foam and US$ 11.0 for integral skin. The global weighted average for PU foam resulted in US$ 6.41/kg).

Table 4-1 Estimated maximum penetration values for various blowing agent options

Subsector	Option	Current	Longer Term	Key constraints
Rigid Foam				
Domestic Refrigeration	Hydrocarbons	100	100	
	HFC-245fa, HFC-365mfc	10	0	Operating Cost, high GWP
	Unsat. HFCs (FEA-1100, HBA-2, etc.)	0	10	Cost, blended with HC
Domestic refrigeration consists of companies with an HCFC consumption >50 tonnes per year making HCs a cost- effective solution				
Commercial Refrigeration	Hydrocarbons	50	80	Capital Cost
	HFC-245fa, HFC-365mfc	5	0	Operating Cost, high GWP
	Optimised Water systems	20	20	Operating Cost, Performance
	Methyl Formate	15	15	Operating Cost, Performance
	Unsat. HFCs (FEA-1100, HBA-2, etc.)		5	Operating Cost
Commercial refrigeration consists of companies with an HCFC consumption up to 30 tonnes per year				
Continuous Panels	Hydrocarbons	90	90	Fire performance
	HFC-245fa, HFC-365mfc	10	0	Operating Cost, high GWP
	Optimised Water systems			
	Unsat. HFCs (FEA-1100, HBA-2, etc.)		10	Operating cost
Discontinuous Panels	Hydrocarbons	20	70	Capital Cost, Pre-blended HC
	HFC-245fa, HFC-365mfc	10	0	Operating Cost, high GWP
	Optimised Water systems	20	20	Operating Cost, Performance
	Methyl Formate	20	20	Operating Cost, Performance
	Methylal			
	Unsat. HFCs (FEA-1100, HBA-2, etc.)	0	5	Operating Cost
Spray	HFC-245fa, HFC-365mfc	20	0	Operating Cost, high GWP
	Optimised Water systems	50	70	Performance
	Methyl Formate	5	5	Fire performance
	Unsat. HFCs (FEA-1100, HBA-2, etc.)		20	Operating Cost
Integral Skin (shoe soles)	Hydrocarbons	10	10	Capital cost, pre-blended HC
	HFC-245fa, HFC-365mfc, HFC-134a	40	0	Operating Cost, high GWP
	Optimised Water systems	50	50	Performance
	Methyl Formate	40	50	
	Methylal	30	40	Flammability
	Unsat. HFCs (FEA-1100, HBA-2, etc.)		10	

Table 4-2 Preferred Technologies by subsector and company size

	Size of the production lines		
Foam sub-sectors	ODS>40 MT	10 MT<ODS<50 MT	ODS<10 MT
Integral Skin		Water & Methyl Formate & Methylal & Pre-blended HC	Water & Methyl Formate & Methylal
Rigid Foam			
Domestic Refrigeration	HC	HC	
Commercial refrigeration	HC	Pre-blended HC	Water (alone or modified with formic acid, methyl formate, etc.)
Continuous Panels	HC	Pre-blended HC	
Discontinuous Panels	HC	Pre-blended HC	Water (alone or modified)
Spray			Water & HFC-245fa & Supercritical CO2

Table 4-3 Estimated Cost-effectiveness by subsector and company size

	Size of the production lines		
Foam sub-sectors	ODS>40 MT	10 MT<ODS<50 MT	ODS<10 MT
Integral Skin		6.00	16.00
Rigid Foam			
Domestic Refrigeration	5.00	8.80	
Commercial refrigeration	8.50	9.20	3.00
Continuous Panels	4.00	6.00	
Discontinuous Panels	7.00	7.40	3.00
Spray			4.00

Table 4-4 Market Distribution by Foam Subsector and Companies Size (%)

	Size of the production lines			
Foam sub-sectors	ODS>40 MT	10 MT<ODS<50 MT	ODS<10 MT	Percent of Total Market
Integral Skin		50	50	5
Rigid Foam				95
				Percent of Rigid Foam
Domestic Refrigeration	80	20		30
Commercial refrigeration	5	75	20	20
Continuous Panels	90	10		10
Discontinuous Panels	5	80	15	20
Spray			100	20

Table 4-5 Average Cost-effectiveness by Sub-sectors

Foam sub-sectors	**By Sub-sector**	**By Sector**	**TOTAL**
Integral Skin	10.50	10.50	**6.11**
Rigid Foam		5.88	
Domestic Refrigeration	5.76		
Commercial refrigeration	7.93		
Continuous Panels	4.20		
Discontinuous Panels	6.72		
Spray	4.00		

Regarding the cost-effectiveness variation with time two tendencies with opposite effects should be considered. Meanwhile the values will tend to go down as consequence of the technology optimization the need to start addressing the enterprises with smallest size -along with the inflation rate- may neutralize the cost reduction. For polyurethane, the cost-effectiveness of US$ 6.11 per kg has been used in the calculations for the triennia 2015-2017 and 2018-2020.

In the case of XPS board foam, there are three main technologies available to replace HCFCs, listed in decreased order in terms of thermal insulation performance: High GWP HFCs, hydrocarbons (isobutene) and CO_2 (with and without DME)[5]. Bearing in mind that the great majority of the factories

[5] In the May 2011 RTF report it was mentioned that (where the original submitted project cost-effectivenes values (in US$/kg) were 3.11 (isobutane), 5.21 (HFC-152a/dimethylether), and 7.66 (isobutane), the final approved values were US$ 1.21, 2.81 and 3.55, respectively. At

located in Article 5 countries is relatively small (HCFC consumption around 50 tonnes per year) the analysis of the incremental and capital costs associated to the conversion to any of these options provide an average CE of US$ 4.85/kg. In case of conversion to hydrocarbons or CO_2, a significant capital investment is required, meanwhile, when the transition is done to HFCs, the IOC component is the most relevant portion. All these options require major R&D efforts for a successful substitution process.

The cost effectiveness number can be adjusted further, when information from more XPS projects in Article 5 countries will become available.

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that time it lead to the choice of the weighted average value of the approved projects, US$ 2.56/kg, as the cost-effectiveness for the conversion cost calculations.

5 RAC cost-effectiveness

5.1 Some qualitative comments to the requests

In the "Suggestions by the co-chairs" (see Annex 1) paragraphs (g) in the second part of the document and (d) in the third part of the document mention a number of elements. These are commented on below.

(g) Changes in cost-effectiveness figures and their consequent impact on the next three replenishments, taking into account:

Possible economies-of-scale in large consuming countries;

- The RTF deemed it not possible to adjust CE values according to economies-of-scale within large consuming countries. Given the various parameters that influence the ICC and the IOC, whilst it can be argued that on an enterprise level larger production lines would benefit compared to smaller lines, this cannot be applied to country level. Furthermore, if it is expected that there is, with the exception of China, no clear relation between the level of consumption and prevalence of large (or small) enterprises, then it would not be possible to apply a reduced cost effectiveness to larger consuming countries.

Possible improvements in cost-effectiveness over time;

- Within the original RTF report /RTF11/, improvements of cost-effectiveness over time were included for in the long-term relative to the short-term scenarios. Depending upon the subsector, the reduction in CE is approximately 5% to 50% resulting in an overall reduction of about 20% for all R/AC sectors for the long-term. This reduction arises through, for example, the spread of trained trainers, the lower refrigerant and system component costs as production quantities increase and reduced costs for product development and redesign. Some aspects are not possible to quantify, for example, costs for production line equipment. However these costs tend to reduce over time, as observations of the CFC phase-out have shown, simply because many conversions take place in a short period of time, technical knowlege increases, implementation techniques improve and the large market supports competition.

Possible improved cost-effectiveness for those HPMPs that go beyond 10% reductions;

- Considering the implications of cases where HPMPs go beyond 10% reduction in consumption, it was deemed not possible to quantify improvements, if any. In the first case, the issue is complicated as a result of not knowing what proportion of reductions additional to 10% is

allocated to each sector (foams, R&AC, servicing) or indeed sub-sectors. Were a country to implement a significant reduction in a sector (i.e., approaching 100%) over a period of time ,it could be argued that improvements in CE may be realized towards the end of the conversion period. On the other hand, given that many of those cost reductions would be sensitive to global-scale changes, it is unlikely that any specific country could yield an appreciable reduction. Thus, for more modest increases in reductions (e.g., approaching 25%), there is unlikely to be would be any appreciable change in CE.

An update based on weighted average cost-effectiveness for each sector and for groups of countries, based on all HPMPs, HCFC demonstration projects and individual investment projects approved by the 64th ExCom meeting, taking into account special circumstances and experiences by certain A5 Parties;

- At the 64th ExCom meeting a large number of HPMPs for LVC countries were approved as well as 6 HPMPs for larger countries (Brazil, China, Cameroon, Indonesia, Lebanon, Mexico). The aggregate weighted cost-effectiveness information from those approvals is influenced principally by the cost-effectiveness figures arising from the Chinese HPMP, because of China's much higher levels of consumption. Since the HPMP for China was agreed to after substantial political negotiations, it does not seem valid on a technical basis to use cost-effectiveness values established on the basis of the HPMP for China as the basis for determination of funding requirements in other countries. The issue then becomes whether the HPMPs for other countries provide enough detailed information on cost-effectiveness for relevant sectors. Clearly, there is insufficient information on the RAC sector (with only one AC conversion for Indonesia) and there are significant deficiencies in information on the foam sector despite the larger number of foam conversions in funded HPMPs .

In section 5.2, the cost-effectiveness values are given for refrigeration and air conditioning as they have been applied in calculations for this report.

(d) Provide a list of the alternatives that had been included under low-GWP calculations and provide an overview on how the ICC and IOC in table 5-7 were calculated for low-GWP alternatives, explaining the reasons for the large range of costs;

- The costs for low-GWP alternatives were estimated according to judgement of the experts based on the following. For each alternative for each sub-sector, ICC and IOC were estimated according to the various contributing cost elements. For ICC this included: production line equipment (refrigerant supply, charging, evacuation, pressure/leak, heat

exchanger forming, safety system for flammables), product redesign, training. For IOC, this included: refrigerant cost, heat exchanger materials, piping, compressors, electrical and safety systems (for flammable, higher toxicity fluids). Cost data were obtained from existing HPMP proposals, real costs from demonstration projects and experience of experts. The overall ICC and IOC were then weighted according to the average annual HCFC consumption for that sub-sector, in order to obtain a combined value for refrigeration and for air conditioning.

Table 5-1 below lists the various low-GWP refrigerants (and in some cases the associated system type) according to sub-sectors.

Table 5-1 Application of various low-GWP refrigerants in different subsectors

Condensing units	Unsaturated HFC/HFC blends
	HC-290, HC-1270, etc
	R-744
	HC-290, HC-1270, etc + indirect
	Unsaturated HFC (HFC-1234yf, etc)
Centralised systems	Unsaturated HFC/HFC blends
	R744 (sub/transcritical)
	HC + R-744 (cascade)
	Unsaturated HFC + R-744 (cascade)
	HC + indirect liquid/ indirect CO2/distributed indirect
	Unsaturated HFC + indirect liquid/ indirect CO2/distributed indirect
Chillers	Unsaturated HFC/HFC blends
	HC-290, HC-1270, etc
	R717
	R744
	Unsaturated HFC (HFC-1234yf, etc)
Unitary air conditioning	Unsaturated HFC/HFC blends
	HC (R290, R1270, etc), HFC-161
	R744
	Unsaturated HFC (HFC-1234yf, etc)
Multi-split	Unsaturated HFC/HFC blends
	R744
	Unsaturated HFC (HFC-1234yf, etc)
Heating only heat pumps	Unsaturated HFC/HFC blends
	HC (R290, R1270, etc), HFC-161
	R744
	Unsaturated HFC (HFC-1234yf, etc)

5.2 Cost-effectiveness values used

In the May 2011 RTF /RTF11/ report the following text is given:

““[…This implies a cost-effectiveness of US$ 10.8 /kg for (current) commercial refrigeration (IOC capped at US$ 3.8/kg) and a cost-effectiveness of 10.3 US$/kg for (current) air conditioning (IOC capped at US$ 6.3/kg), excluding the increase of up to 25%, where needed, for the application of climate friendly low-GWP options. The share of low-GWP options is currently assumed at 25% for both commercial refrigeration and air conditioning on a combined HCFC-22 mass basis (Table 5-7, scenario 2A).

Table 5-7 Estimated cost-effectiveness values for a combination of various refrigerant options; scenario 2 considers a share of about 25% low-GWP options for the current situation and a share of about 90% for the long term

Scenario	Time scale	Average incremental costs			
		Comm. refrigeration		Air conditioning	
		ICC	IOC	ICC	IOC
Scenario 1 High GWP only	Current	7	10	4	8
	Longer term	5	9	3	6
Scenario 2A- Low-GWP split	Current (~25%)	7	26	4	8
	Longer term (~90%)	3	36	2	23
Scenario 2B- Only low-GWP	Current	7	72	4	11
	Longer term	3	54	2	25

Assuming a share of about 70% for AC in the total HCFC-22 consumption for manufacturing (averaged per country), the cost-effectiveness value can be determined. With a 30 percent share of commercial refrigeration in the total manufacturing one can derive a value of US$ 3.24/kg; a 70 percent share of air conditioning in the total yields a value of US$ 7.21/kg.

On the total cost-effectiveness of US$ 10.45/kg an addition has to be applied for the introduction of low-GWP options. With the 25% share assumed for low-GWP options, it has been assumed that this number should be increased by 25%, which can be applied at maximum (needed because of the assumed higher cost-effectiveness); it equals about US$ 0.65/kg. This then yields a cost-effectiveness for the “averaged” HCFC-22 manufacturing sectors of US$ 11.1/kg.

The cost-effectiveness of US$ 11.1 per kg has been applied in the calculations for the triennium 2012-2014 for those countries with no approved HPMPs, when investigation the impact of the reduction percentage from the baseline and different reduction packages……]””.

This supplement report assumes a reduction of the cost-effectiveness value for commercial refrigeration and for air conditioning. As previously indicated,

cost-effectiveness figures in approved projects are significantly lower than those assumed in the original analysis of the triennium 2012-2014. Accordingly, for the revised analysis for the triennia after 2014 cost-effectiveness figures have been adjusted downwards by about 15%.
A cost-effectiveness of US$ 8.8 /kg for commercial refrigeration after 2014 was assumed (ICC at US$ 5/kg IOC capped at US$ 3.8/kg). For air conditioning (after 2014) a cost-effectiveness of 8.8 US$/kg after 2014 was also assumed (ICC at US$ 3.5 and IOC at US$ 5.3/kg, which is lower than the cap), excluding the increase of up to 25%, where needed, for the application of climate friendly low-GWP options. This is the cost-effectiveness used for refrigeration and air conditioning for the triennia after 2014; it is independent of the shares of the sub-sectors.

On the cost-effectiveness of US$ 8.8/kg an addition has to be applied for the introduction of low-GWP options. With the 25% share assumed for low-GWP options, it has been assumed that this number should be increased by 25%, which can be applied at maximum (needed because of the assumed higher cost-effectiveness); it equals about US$ 0.55/kg. This then yields a cost-effectiveness for the HCFC-22 R/AC manufacturing sectors of US$ 9.35/kg.

6 Production sector and funding stability issues

6.1 Production sector

In chapter 3, the funding requirement for the triennium 2012-2014 was calculated on the basis of the Stage I HPMPs approved up to and during ExCom-64 in July 2011, as well as new Stage I HPMPs for all remaining Article 5 Parties, plus all other funding commitments and obligations.

Table 6-1 Estimates for the total funding requirement, the production closure costs as well as the separate production closure costs for the chemicals HCFC-141b/-142b and HCFC-22 (US$ million), for comparison see Table 3-2

Reduction from baseline	Total funding requirement 2012-2014	Total production closure funding	Production closure funding HCFC-141b/-142b	Production closure funding for all HCFC-22	Production closure funding for HCFC-22 - *without swing plants**
Reduction package 75-15-10%					
10%	471.7	194.56	90.56	104.01	85.29
15%	505.2	205.47	96.52	108.95	89.34
20%	544.5	218.17	103.43	114.74	94.09
Reduction package 90-0-10%					
10%	463.1	193.14	92.43	100.71	82.58
15%	491.2	203.17	99.56	103.61	84.96
20%	523.8	214.82	107.81	107.01	87.75

Note*: This refers to swing plants outside China. There is one swing plant in China that was not funded for CFC phase-out.

The estimated production closure funding varies from 40.1% to 41.2% of the total funding requirement in the case of the reduction package 75-15-10%, and from 41.0% to 41.7% in the case of the 90-0-10% package. Each assessment is based on compensation of US$ 3 per kg for the total quantity of all HCFCs for which phase-out funding has been (or will be) provided in Stage I HPMPs for the triennium. Hence only 59% of the total estimated funding requirement would be required in the next triennium if production closure funding was not considered.

From the figures above a number of production sector funding ranges can be derived. Each of the ranges used in this analysis been calculated on the basis of the average of the six scenarios with a 10% spread.

6.1.1 Swing plants

Swing-plants are able to produce either CFC or HCFC-22. All swing plants currently operating in Article 5 countries were supported to cease CFC production on the condition that the relevant countries would not apply for

further assistance from the Multilateral Fund. The Article 7 production data submitted to UNEP show that, over the last 3 years, the proportion of HCFC-22 produced in swing plants in Article 5 countries amounts to about 18%. For this reason Table 6-1 contains a column showing production closure costs without the funding of these swing plants in Article 5 countries.

As presented in Chapter 3, the total funding requirement for the triennium 2012-2014, including all categories of production closure (funded at US$ 3 per kg) is US$ 459.5-539.5 million. If swing plants were excluded from the funding the range would be US$ 442.2-518.4 million.

6.1.2 Reduced compensation (cost-effectiveness)

If the production closure compensation was reduced to US$ 1.5 per kg, the funding requirement for the 2012-2014 triennium would decrease substantially. It would then be US$ 367.7-427.3 million.

6.1.3 Diversion of HCFC-22 production to feedstock uses

China is a major producer of HCFC-22 for feedstock (for (P)TFE and other products) and has increased production over the last decade from a low level (about 10-15,000 tonnes around the year 2000) to around 200,000 tonnes of HCFC-22 in 2010. Article 7 data submitted to UNEP show a doubling of feedstock production every three years during the last decade. This means that, to date, the increase in feedstock production has been far greater than the forthcoming reductions in HCFC-22 production for dispersive uses following either the Montreal Protocol reduction schedule or the reductions contained in the Stage I HPMP for China. It is not known at this stage whether most or all dispersive use production can be converted to feedstock production; this would depend on the chemical quality of the HCFC-22 produced in the existing smaller (and older) plants in China and on logistics and commercial issues. Nonetheless there is a *prima facie* case for examining the financial implications of the diversion of production of HCFC-22 in China from dispersive to feedstock use.

Additionally it is noted that a number of older HCFC-22 plants are CDM-approved. It is not within the ambit of this study to assess the implications of CDM approval, however it could be expected to have an impact on plant rationalisation, including diversion of production to feedstock uses.

If all potentially eligible HCFC-22 production plants were able to undergo conversion to feedstock production, production closure funding for HCFC-22 in China might not have to be considered.

This would decrease the total funding requirement for production closure by slightly more than 50%, that is, some US$ 100-115 million.

The total funding requirement range for the triennium 2012-2014 would in this case be US$ 363.4-422.5 million.

In this option, the production sector part of the funding would be provided for closure of HCFC-141b and -142b production plants. Current Article 7 data indicates that 20-25% of HCFC-142b consumption in Article 5 countries may be imported from non-Article 5 (developed country) producers (further data on HCFC production and consumption can be found in the May 2011 report /RTF11/). This resulting uncertainty leads to a corresponding uncertainty in the possible funding level related to HCFC-141b and -142b, which could be about US$ 6 million lower than indicated above.

If swing plants in other countries were to be compensated, while HCFC production in China was diverted for feedstock use, the funding requirement indicated above would increase by US$ 18-20 million.

6.1.4 Compensation for reductions from Montreal Protocol baseline production levels

Thus far, assessment of compensation for the phase-out of HCFC production has been based on the assumption that the quantity to be compensated for is equal to the sum of the quantities of HCFC consumption per sector or sub-sector calculated from the levels of funding provided for phase-out per sub-sector in each approved Stage I HPMP. For the remaining anticipated HPMPs these quantities were determined in a spreadsheet analysis. While this amounted to the best information available at the time, the methodology contains some significant uncertainties and raises other, broader issues.

For instance, while a substantial level of detail about sub-sectoral consumption and proposed cost-effectiveness values can appear in some project documents, there is less detail in others. Notwithstanding substantial interaction with and assistance from the Fund Secretariat, the Task Force has of necessity had to make best assessments in all cases where the detail necessary for accurate calculations has not been available. Additionally, project plans are, by design, flexible and implementation may vary significantly. Hence few checks and balances are available. It is possible that actual peak consumption could vary significantly from that calculated on the basis of both project data and spread sheet analysis.

More broadly, it is for consideration whether production sector compensation should be based on peak levels of consumption, particularly in circumstances where there are few avenues for verification of consumption levels in advance of publication of consumption and production data for the last year prior to the freeze. This data will not be available until October 2013 at the earliest.

Therefore, rather than assuming parallel reductions of consumption and production, compensation for production phase-out could be considered according to the Montreal Protocol schedule. That is, the determination of funding for compensation on the basis of a reduction of 10% from the total baseline production level, which can be estimated from data submitted for 2009 and, if available, from data submitted for both 2009 and 2010. If this methodology was adopted, in view of the preponderance of foam sector phase-out in Stage I HPMPs, it would be appropriate in the first triennium to assume that the first 10% reduction step would consist of HCFC-141b (which is only produced in China).

Production closure funding could thus be the funding for the closure of 10% of the total baseline consumption in ODP tonnes, expressed in tonnes of HCFC-141b production. At a value of US$ 3 per kg this would be exactly US$ 80 million. If this value was added to the triennium funding assessment calculated without production closure funding, it would result in a funding requirement range of US$ 347.4-402.3 million.

6.1.5 Discussion of production sector approaches

The impact of options for production sector funding on the total funding requirement for the triennium 2012-2014 are summarised in Table 6-2 below.

Table 6-2 Assessment of the impact of options for production funding on the total funding requirement for the triennium 2012-2014

Option	***(US$ million)***
1. Production closure funding at US$ 3.0 per kg	459.5-539.5
2. Production closure at US$ 3.0 per kg without compensation for swing plants	442.6-518.4
3. Production closure funding at US$ 1.5 per kg	367.5-427.2
4. Production closure funding only for HCFC-141b/-142b (with HCFC-22 diverted for feedstock use and no swing plant compensation)	363.4-422.5
5. Production closure for 10% of the total MP baseline expressed in HCFC-141b production	347.4-402.3

It is noted that options 3, 4 and 5 produce 2012-2014 triennium funding estimates lower than the levels decided for all previous triennia and the current triennium.

For the triennium 2015-2017, the funding requirement as calculated in Chapter 3 is US$ 790 million including production closure funding (for all HCFCs) at US$ 208.6 million. The funding requirement without production closure funding would be US$ 581.5 million.

Applying option 4 and calculating production sector funding with diversion of HCFC-22 to feedstock uses (with no swing plant compensation) would bring the funding requirement to US$ 654.6 million

Applying option 5, with a linear reduction profile between the 2015, 10% and 2020, 35% reduction steps, the 2015-2017 triennium would involve funding compensation for a reduction in the production baseline level of 15%. If the total was again expressed as closure of HCFC-141b production, the assessed production sector funding would be US$ 120 million. This would provide a total triennium funding requirement of US$ 701 million. It is noted that this is US$ 45.4 million higher than the assessment based on exclusion of compensation for HCFC-22 production.

Judgments about the relative merits of the five options involve policy issues. Such policy issues are beyond the remit of the Task Force. Accordingly no recommendations are made about choosing between the options.

It can also be seen that options could be further combined, for instance, diversion of HCFC-22 to feedstock use with closure funding only for HCFC-141b/142b plants, but for quantities associated solely with reductions from baseline consumption (a combination of options 4 and 5).

Parties may wish to undertake more detailed consideration of certain production sector funding options as part of the process of arriving at an agreed replenishment level for the 2012-2014 triennium. It is, however, recommended that such detailed considerations do not fail to take into account assessment of the effects on subsequent replenishments of options being considered for 2012-2014. Some of these implications are presented below.

6.2 Funding stability

The ‘base-case’ assessments for all non-production sector costs (referred to below as the consumption sector) and for production sector costs on a full compensation basis for the three triennia are indicated in Table 6-3 below.

Table 6-3 Funding requirements for the consumption 'base case' and production sector options for all three triennia (in US$ million)

Funding category	Triennium 2012-2014	Triennium 2015-2017 (indicative)	Triennium 2018-2020 (indicative)
Consumption sector	276-315	581	568
Production option 1, base-case: US$ 3/kg for all HCFCs - quantity equal to funded consumption sector phase-out	184-225	209	229
Production option 2: base-case with no funding for swing plants	167-204	185	202
Production option 3: base-case funded at US$ 1.50/kg	92-113	104.	114
Production option 4: HCFC-22 to feedstock; compensation only for HCFC-141b/142b at US$ 3/kg	88-108	73	81
Production option 5: US$ 3/kg compensation for reductions from MP baseline consumption for all HCFCs	72-88	120	132

It can be seen from Table 6-3 that the consumption sector indicative estimates for subsequent triennia are 80%-105% higher than the estimate for 2012-2014. The principal reasons for this (as detailed in various sections of Chapter 3) are:

- the proportion of more costly RAC sector conversions to be addressed in Stage II HPMPs will increase and the proportion of less costly foam sector conversions will decrease;
- reassessment of the foam and R/AC sector has given rise to an increase in cost-effectiveness values which will apply principally to Stage II HPMPs in the second and third triennia; these are still higher (in US$ per kg) than the average cost effectiveness values in HPMP approvals up to and at ExCom-64;
- the second and third triennia will need to include provision for the funding of reductions of 15% and 16.5% of baseline consumption, respectively, in each triennium;
- some 45 percent of total Stage I HPMP costs have been (or are expected to be) approved for expenditure in 2011, thus reducing the requirement for funding of baseline consumption reductions in the triennium 2012-2014.

While significant uncertainties remain in the indicative estimates for the second and third triennia, the factors prevailing above indicate a clear trend that consumption sector funding requirements for each of these triennia will continue to be substantially higher than the requirement for 2012-2014. The amount of funding approved so far (and which will be approved) at ExCom-65 and possibly ExCom-66 for all Stage I HPMPs (with a reduction from baseline by 2015) can be estimated at around US$ 450 million.

The achievement of a stable overall funding profile at historical levels will therefore depend to a large extent on the ability to design a complementary funding profile for the production sector. The financial implications of various policy options for production sector funding, as set out in Table 6-3 have been assessed to facilitate this objective. It can be seen that policy options 3 to 5 result in funding levels that approach most closely the magnitude of previous replenishments. However even with these options the imbalance between the first and subsequent two triennia will remain.

7 Inflation for IS and lower non-investment costs

7.1 Inflation for Institutional Strengthening

The "Co-chairs Summary of Suggestions from the Contact Group" (see Annex 1) requests the TEAP Replenishment Task Force to present a study in which the rate of inflation would be varied for Institutional Strengthening (the request did not specify the percentages to be applied).

Funding levels for Institutional Strengthening as well as administrative costs the Treasurer are agreed upon by the Executive Committee. Under current arrangements they do no contain automatic adjustments for inflation. In accordance with Executive Committee decisions, the CAP Programme and the Agency Core Unit costs are already subject to annual increases of up to 3%, which can be considered a global inflation correction. Funding provisions for the Executive Committee and the Secretariat are subject to a 1.98% annual increase.

The TEAP Replenishment Task Force has studied the impact of inflation on the funding requirement for Institutional Srengthening for the period 2012-2014 as well as for the period 2015-2017. The funding was estimated at the 2011 price level. Inflation was applied for the year 2012, 2013 and 2014. It should be noted that the Executive Committee will review Institutional Strengthening activities and their funding before the replenishment triennium 2015-2017. The methodology adopted is similar to that used in its study on the impact of inflation undertaken in the context of its 2008 report.

In order to determine which inflation percentages to include in this study, the Task Force examined various literature sources, from the International Monetary Fund, the World Bank, the International Finance Co-operation etc. However none of these reports considered a single global inflation rate. Most included separate inflation rates for industrialised and less industrialised countries or for developed countries and the so-called emerging economies.

Inflation rates in the emerging or developing economies are estimated to be relatively high but can vary from zero to about 10%, with higher percentages for a few countries (source: World Bank publications). On this basis, a global annual average inflation rate of 3% was chosen, which would also be consistent with the annual adjustments allowed by the Executive Committee for CAP, Agency Core Unit funding etc. Just for comparison, the impact of a global annual inflation percentage of 5% was calculated as well.

An annual 3% inflation correction would increase the IS funding by US$ 1.34 million for the triennium 2012-2014 (on a total replenishment funding requirement of the order of US$ 500 million). An annual 5% correction would

add almost one more million, i.e., would increase the IS funding by US$ 2.27 million.

Table 7-1 Influence of different inflation percentages on Institutional Strengthening funding for the triennia 2012-2014 and 2015-2017 (year 2011 assumed constant) (US$ million)

Inflation percentage	2012-2014	2015-2017
0%	22.00	27.10
3%	23.34	31.42
5%	24.27	34.61

An annual 3% inflation correction would increase the IS funding by US$ 4.32 million for the triennium 2015-2017 (on a total funding requirement assumed in the range of about US$ 790 million). An annual 5% correction would increase the IS funding by US$ 7.51 million. In the case of the triennium 2015-2017 it should be noted that the correction for inflation is occurring annually as of the year 2011, which implies higher amounts the further one goes out into the future.

7.2 Lower non-investment costs

The "Co-chairs Summary of Suggestions from the Contact Group" (see again Annex 1) requests the TEAP Replenishment Task Force to also study the impact of zero and -3% growth rates for relevant supporting activities.

The supporting activities currently subject to annual funding increases are the Compliance Assistance Programme (3%), Core Unit funding (3%) and the ExCom and Secretariat costs (1.98%).

For the purpose of this analysis, the amounts for the triennium 2009-2011 are taken as the starting point, and amounts for the subsequent triennia are then given assuming business as usual (BAU), 0% and -3% growth per year. The results are presented in Table 7-2 below.

Table 7-2 clearly shows that the BAU scenario applied to the three supporting activities (where the ExCom and Secretariat costs have a lower growth percentage than CAP and Core Unit funding) results in about US$ 6 million increase per triennium for the triennia 2012-2014 and 2015-2017.

It is obvious that the 0% growth assumption results in equal numbers for each triennium. The -3% growth scenario results in about US$ 5 million less funding per triennium, where the amount decreases from US$ 64.4 million in the 2009-2011 triennium to US$ 53.6 million in the triennium 2015-2017.

Table 7-2 Amounts per triennium for CAP, Core Unit and ExCom and Secretariat costs, assuming the current practice, zero and minus three percent growth (US$ million)

Supporting activity	Amount 2009-2011	Amount 2012-2014	Amount 2015-2017
Assumption growth BAU			
CAP	29.119	31.898	34.856
Core Unit	16.616	18.542	20.261
ExCom/ Secretariat	18.630	19.759	20.956
Total	**64.365**	**70.199**	**76.073**
Assumption 0% growth			
CAP	29.119	29.119	29.119
Core Unit	16.616	16.616	16.616
ExCom/ Secretariat	18.630	18.630	18.630
Total	**64.365**	**64.365**	**64.365**
Assumption -3% growth			
CAP	29.119	26.576	24.255
Core Unit	16.616	15.165	13.841
ExCom/ Secretariat	18.630	17.003	15.518
Total	**64.365**	**58.744**	**53.614**

Table 7-3 Differences in the amounts per triennium between the BAU and 0% growth and between the BAU and -3% growth scenarios for CAP, Core Unit and ExCom and Secretariat costs (US$ million)

Supporting activity	Amount 2009-2011	Amount 2012-2014	Amount 2015-2017
Difference between BAU and 0% growth assumption			
CAP	0	2.779	5.737
Core Unit	0	1.926	3.645
ExCom/ Secretariat	0	1.129	2.326
Total	**0**	**5.834**	**11.708**
Difference between BAU and -3% growth assumption			
CAP	0	5.322	10.601
Core Unit	0	3.377	6.420
ExCom/ Secretariat	0	2.756	5.438
Total	**0**	**11.454**	**22.459**

Table 7-3 shows the differences between the BAU and the 05 and -3% scenarios. Assuming 0% growth results in US$ 5.8 million less funding in the triennium 2012-2014 and US$ 11.7 million less funding in the triennium 2015-2017. Assuming a -3% growth leads to US$ 11.4 million less funding in the triennium 2012-2014 and US$ 22.5 million less funding in the triennium 2015-2017 (and would even result in about US$ 35 million less funding compared to BAU in the triennium 2018-2020).

The first calculations for the triennium 2012-2014 in chapter 3 give a range of US$ 500 million plus/minus US$ 40 million (8%). This is the amount, which the differences of US$ 5.8 and US$ 11.7 million should be compared to.

In relation to the zero growth option, given past experience and the discussion on inflation, and noting that UN salary scales typically contain steps that provide annual increases, The Task Force observes that zero growth may not be easily achievable.

It is also noted that many supporting activities are related to HPMPs, their approvals and their implementation. The Replenishment Task Force is not in a position to comment on whether a negative 3% growth would be consistent with the work on HPMPs in the 2012-2014 triennium.

8 Concluding remarks

This supplement report addresses the funding requirements for the triennium 2012-2014 and subsequent triennia as they were first reported in the May 2011 RTF report /RTF11/. It does this on the basis of a number of requests to the TEAP and its RTF by Parties, which were summarised in a note by the Co-chairs of the contact group that met during the OEWG meeting in Montreal, August 2011 (see Annex 1).

Many of the requests involve changes to one or more aspects of the funding assessment through variation of the input parameters. Because of the detail involved and the significant numbers of requests, they have been incorporated in a revised spreadsheet analysis the result of which is a full update of the overall funding requirements for the three triennia. This analysis is presented in Chapter 3. In view of its impact on overall levels of replenishment, the production sector is also addressed separately in Chapter 6. The requests relating to inflation and administrative costs did not affect the spreadsheet analysis and are dealt with on a stand-alone basis in Chapter 7.

The revised funding assessment takes into account the impact of the HPMPs approved at ExCom-64 on all three triennia, with particular attention to the triennium 2012-2014. The assessment also incorporates revised Montreal Protocol baselines using consumption and production data submitted by Article 5 Parties until 1 September 2011.

Reassessment of the total funding requirement for the triennium 2012-2014 yields the range **US$ 460-540 million** for the triennium 2012-2014 (that is, **US$ 500 million +/- 8%**).

The significant front loading that has taken place in Stage I HPMPs through the approval of relatively large funding allocations in 2011 has removed up to US$ 200 million from what would otherwise have been the funding requirement for the first triennium. The reassessed funding requirement for the 'consumption sector' only (that is, all costs other than the production sector) is in the range US$ 276-315 million.

The funding requirements in the production sector are now higher than estimated in the May report /RTF11/. Estimates for production sector compensation are based on the level of phase-out for which funding is provided in HPMPs. These range up to 30% of the relevant baseline for a country. Hence the average level of phase-out funded in approved HPMPs for non-LVC countries has been significantly higher than the levels assumed in the assessment contained in /RTF11/, leading to a corresponding increase in

the re-assessed costs for the production sector. The range for the production sector 'base case' is US$ 184-225 million.

The revised assessment continues to be based on the on the three reduction scenarios and two reduction packages applied in the May 2011 report /RTF11/. Different reduction packages containing varying proportions of activity in the foam, RAC and servicing sectors were investigated but did not change the funding values to a significant degree. Similarly, variations in the percentages of low GWP options considered in the refrigeration and air conditioning sector do not change the values to any significant degree either.

A key factor is that such variations would apply only to those HPMPs yet to be considered for approval. Their combined consumption phase-out is assessed as no more than 20% of the total consumption being funded for phase-out in Stage I HPMPs.

In determining the funding requirements for the two triennia after 2014, the cost-effectiveness values used in the May report /RTF11/ were reduced by about 15% for PU foam, refrigeration and air conditioning conversions, and were increased by about 80% for XPS conversions. These adjustments were based on further information from approved HPMPs (particularly in the case of XPS foam), on additional research about the XPS industry and on consideration of non-Article 5 ownership in the PU foam sector.

The single reduction package used for the two triennia was adjusted to 55-20-25% in the foam, RAC and servicing sectors respectively. The percentage of foam in the package is limited because complete sectoral phase-out will have been reached in some countries. The reduction packages remained unchanged at 15% and 16.5% respectively.

On the above basis the indicative funding requirements determined for the two triennia after 2014 are **US$ 790 million** and **US$ 797 million** respectively

Noting both the significance of production sector funding levels and the requests contained in the co-chairs summary, a number of options for assessing production sector costs have been examined. The results are summarised in the table below, which also appeared in Chapter 6 of this report.

The consumption sector requirements for the second and third triennia are approximately double the requirement for the first triennium. Despite the indicative nature of assessments for the later triennia and overall uncertainties in the assessment process, this structural imbalance is likely to persist. The reduction of the HPMP funding requirement in the first triennium arising from

the ability to commit a significant proportion of Stage I HPMP funding in 2011 has increased the visibility of the imbalance.

Funding category	Triennium 2012-2014	Triennium 2015-2017 (indicative)	Triennium 2018-2020 (indicative)
Consumption sector	276-315	581	568
Production option 1, base-case: US$3/kg for all HCFCs - quantity equal to funded consumption sector phase-out	184-225	209	229
Production option 2: base-case with no funding for swing plants	167-204	185	202
Production option 3: base-case funded at US$1.50/kg	92-113	104.	114
Production option 4: HCFC-22 to feedstock; compensation only for HCFC-141b/142b at US$3/kg	88-108	73	81
Production option 5: US$3/kg compensation for reductions from MP baseline consumption for all HCFCs	72-88	120	132

Production option 1, the 'base-case' is the assessment using the methodology adopted in the May 2011 report /RTF111/, with production sector compensation based on the levels of phase-out for which funding has been provided in Stage I HPMPs. These figures form a component of the overall funding assessments for each triennium appearing earlier in this chapter.

Production options 2-5 are based on the alternative compensation modalities indicated in the table. The effects on the overall cost assessment are significant. However, none of the options so far considered offer an opportunity for front loading of production sector phase-out costs to assist in stabilising funding levels between triennia.

As well as the requirement for additional technical information and assessment, a choice between these modalities involves policy judgements. Accordingly, no recommendation on selection of options is offered.

The report has also studied the impact of inflation on the funding for institutional strengthening. With a base year of 2011, an annual allowance of

3% for inflation would increase the funding for institutional strengthening by US$ 1.34 million for the triennium 2012-2014 and by US$4.32 million for the triennium 2015-2017. Although significant for the funding of institutional strengthening, these amounts have a minor effect on the overall funding requirement.

Funding for supporting activities (CAP, core unit funding and ExCom and Secretariat costs) currently increases by a total of about US$ 6 million from the 2009-2011 to the 2012-2014 triennium, and again to the next (which is about 10% of the total funding for support activities). Keeping this funding component constant or applying a 3% reduction would result in saving of US$ 6 or 12 million respectively. Again, although significant for these expenditure categories, the impact on overall funding requirement is modest. The removal of current annual increases would appear to involve administrative policy issues.

9 Acronyms

CAP	Compliance Assistance Programme
CE	Cost-effectiveness
HPMP	HCFC Phase-out Management Plan
ICC	Incremental Capital Cost
IOC	Incremental Operating Cost
IS	Institutional Strengthening
Low GWP	GWP lower than (100-)300 (see TEAP XXI/9 Task Force report)
LVC	Low Volume Consuming Country (HCFC consumption < 360 tonnes)
MB	Methyl Bromide
MEA	Multilateral Environmental Agreement
ODP	Ozone Depletion Potential
ODS	Ozone Depleting Substance
RMP	Refrigerant Management Plan
RTF	Replenishment Task Force
TEAP	Technology and Economic Assessment Panel
GWP	Global Warming Potential

10 References

/RTF08/ Report of the Technology and Economic Assessment Panel, May 2008, Volume 2, "Assessment of the Funding Requirement for the Replenishment of the Multilateral Fund for the Period 2009-2011", UNEP Nairobi, May 2002

/RTF11/ Report of the Technology and Economic Assessment Panel, May 2011, Volume 2, "Assessment of the Funding Requirement for the Replenishment of the Multilateral Fund for the Period 2012-2014", UNEP Nairobi, May 2011

/TEAP11/ Report of the Technology and Economic Assessment Panel, May 2011, Volume 1, "Progress Report", UNEP Nairobi, May 2011

Annex 1 Specific elements for which elaboration was requested; co-chairs summary of suggestions for elaboration in the Supplementary RTF Report

TEAP to update all funding requirements as presented in its May 2011 report taking into account:

a) All ExCom decisions and approvals up to the 64th Meeting;
b) Most recent HCFC consumption and production data reported to UNEP under Article 7 by 1 September 2011, which would have impact on baselines.

TEAP to present scenarios considering:

a) IS in combination with certain inflation rates over the next three triennia;
b) Sector distribution with higher servicing sector ratio (via package of 75-5-20%) and different manufacturing sectors ratios (70-20-10%);
c) Including for all scenarios the reduction amounts in metric tonnes, in ODP tonnes and reductions in CO2-eq.;
d) Funding and no funding for swing plants;
e) Allocating some funding tranches for the HCFC production sector phase-out to replenishments after 2014;
f) Zero and -3% growth rates for relevant "supporting activities";
g) Changes in cost-effectiveness figures and their consequent impact on the next three replenishments, taking into account:
    1) Possible economies-of-scale in large consuming countries;
    2) Possible improvements in cost-effectiveness over time;
    3) Possible improved cost-effectiveness for those HPMPs that go beyond 10% reductions;
    4) An update based on weighted average cost-effectiveness for each sector and for groups of countries, based on all HPMPs, HCFC demonstration projects and individual investment projects approved by the 64th ExCom meeting, taking into account special circumstances and experiences by certain A5 Parties;
    5) Higher penetration rates of low-GWP alternatives;
    6) Higher and lower cost-effectiveness figures for the HCFC production sector compared to the CFC production sector phase-out.

h) The 25% additional funding for low-GWP alternatives only in the sectors: XPS foam, PU foam and commercial refrigeration that have established CE (IOC and ICC) thresholds as per ExCom decision 60/44;
i) Zero, 25% and 50% penetration rates of low-GWP alternatives in the R/AC sector with 10% and 20% R/AC manufacturing ratios for the periods 2012-2014 and 2015-2017.

Furthermore, TEAP to:

(a) To the extent possible, present alternative production phase-out scenarios, taking into account the possible redirection of dispersive HCFC production to feedstock production;
(b) To the extent possible, present a range of approaches for swing plants and their funding implications;
(c) For each consumption scenario, estimate the replenishment for each production scenario;
(d) Provide a list of the alternatives that had been included under low-GWP calculations and provide an overview on how the ICC and IOC in table 5-7 were calculated for low-GWP alternatives, explaining the reasons for the large range of costs;
(e) Provide information on alternative growth rates for HCFCs between 2009 and 2013 taking into account available Article 7 data up to September 1, 2011.

Annex 2 Funding requirement for three trienniums (May 2011 report, chapter 8)

Introduction

Estimated requirements for individual expenditure categories other than HCFC phase-out (both consumption and production) were discussed in previous chapters (chapter 7). These requirements have been combined with HCFC phase-out estimates for the four-year period 2011-2014 (chapter 6), calculated for a total of six funding scenarios:

- three HCFC phase-down levels (10, 15 and 20% reduction from the baseline consumption) and, for each phase-out level,
- two reduction packages addressing different combinations of HCFC consumption in the foam, refrigeration and AC manufacturing and servicing sub-sectors (90-0-10% and 75-15-10% in ODP tonnes, respectively, see earlier chapter).

This produces a total funding requirement for the four-year period 2011 to 2014. It includes actual project funding approved at the 63rd Executive Committee Meeting in April 2011. The funding for the triennium 2012-2014 is obtained by subtracting from the four-year figure the funding available for commitment in the remainder of 2011 according to the Consolidated Business Plan. After the conclusion of the third Executive Committee meeting for 2011, the triennium estimate can be automatically refined by subtracting from the four-year estimate the actual Fund expenditure for the balance of 2011, i.e. project and other expenditure approvals from the 64th and 65th Meetings.

The process assumes that any projects not approved in 2011 will be automatically transferred into the 2012-2014 triennium, together with their associated funding, which can and should occur. Accordingly, a discussion on carryover may not be required because any funding not approved in 2011 will automatically move to the next triennium, when it will be needed for the project for which it was allocated in 2011, to assist relevant Article 5 countries to meet their compliance obligations.

Funding requirement for the 2012-2014 triennium

Table 8-1 below, demonstrates the calculation of the total funding requirement for the "constant" part, i.e., the part not related to the funding of HCFC consumption and production phase-out. The contents of Table 8-1 are as follows:

- Funding commitments already approved by the Executive Committee for both the remainder of non-HCFC phase-out, including methyl bromide consumption and production
- Funding estimated for destruction projects

- Estimated project preparation funding for stage II HPMPs
- Existing commitments for HCFC phase-out approved prior to 2011 and at the 63rd Executive Committee meeting,
- Funding for Institutional Strengthening including approvals at the 63rd Executive Committee meeting
- Other non-investment funding estimated on the basis of current practice (see Chapter 7)

Table 8-1 Elements that determine the 2011-2014 total funding requirement (US$ million)*

Funding Elements for 2011- 2014 (*including agency support costs where appropriate)*	**(US$ million)**
Commitments for non-HCFC phase-out	2.36
Commitments for MeBr phase-out in consumption and production**	11.2
Destruction	9.00
Preparation of stage II HPMPs	4.80
Existing commitments for HPMPs (for LVCs and non-LVCs) and individual HCFC phase-out projects	40.8
Technical Assistance (TAS)**	1.0
Institutional Strengthening	32.7
Other non-investment funding for 2011-2014:	
-CAP	41.92
-Agencies' Core Unit Costs	24.37
-Secretariat	26.09
-Treasurer	2.00
Subtotal	**195.2**
Plus new HPMPs	**Funding requirements as per scenarios in Table 8-2**
Plus production sector closure costs	**Funding requirements as per scenarios in Table 8-2**

Note *: based on actual approvals at the 63rd meeting plus anticipated approvals for the remainder of 2011 as per the Consolidated Business Plan, plus Task Force estimates for 2012-2014.
Note **: slightly changed, total remains the same

To obtain the triennium funding requirement 2012-2014 it is necessary to deduct from the four-year estimate 2011-2014 the balance of funding remaining available for commitment in 2011. This is demonstrated in Table 8-2 below for each of the six scenarios studied. The table presents the estimated costs under each scenario for new HPMPs, HCFC-141b/142b production closure, HCFC-

22 production closure and the established costs as indicated in Table 8-1 (constant for each scenario). These costs are added to give a total 4-year funding requirement for each scenario. From each of these 4-year scenario totals is deducted the funding available for the balance of 2011, after taking account of all approvals at the 63rd Meeting, as provided by the Fund Secretariat. This amount is also constant for each scenario. The estimated funding requirement for each scenario appears in the final column of Table 8-2.

Table 8-2 Total funding requirement for the triennium 2012-2014 for six scenarios, (three baseline consumption reduction levels (in percentages, ODP tonnes) and two sub-sector reduction packages) (US$ million)

Reduc-tion from baseline	**Assessed costs for the 4-year period 2011-2014**					Planned funding available for the balance of 2011	**Funding requirmt for triennium 2012-2014 for each scenario**
	New HPMPs	Production Closure HCFC-141b/-142b	Production Closure HCFC-22	Established costs from Table 8-1b	**Total 4-year funding requirement per scenario**		
	Sub-sector reduction package 75-15-10%						
10%	240.7	65.0	57.6	195.2	558.8	(252.7)	**306.1**
15%	354.6	97.0	84.2	195.2	734	(252.7)	**481.3**
20%	471.3	129.0	110.7	195.2	906.2	(252.7)	**653.5**
	Sub-sector reduction package 90-0-10%						
10%	190.3	77.7	34.7	195.2	497.9	(252.7)	**245.2**
15%	277.9	116.0	49.7	195.2	638.8	(252.7)	**386.1**
20%	367.6	154.4	64.8	195.2	782	(252.7)	**529.3**

Consideration of the Six Scenarios

In the HPMPs so far approved by the Executive Committee, the proportion of baseline consumption funded for phase out in the project has varied widely. Only two out of ten non-LVC countries have sought funding for the minimum of 10 percent of baseline consumption. The HPMP for one non-LVC country includes funding to phase out consumption equivalent to 63 percent of its baseline. In HPMPs so far funded for non-LVC countries the average level of funded consumption exceeds 20 percent. The Executive Committee is considering HPMPs on their individual merits. While the number so far approved for non-LVC countries is still low, amounting to some 10 projects Rather than the reduction being dependent on the sub-sectoral composition, it appears that the percentage reduction being approved is related principally to the cost-effectiveness realised in the project, as a result of the scale of the manufacturing operations and the relative sizes of the sub-sectors in the country concerned.

These uncertainties, together with the small sample of non-LVC HPMPs approved to date do not provide an adequate basis for a quantitative assessment of likely funding levels within the range created by the six scenarios. However it is possible to make qualitative observations.

The use of funded phase-out reduction percentages varying from 10 to 20% is based on a number of considerations. Firstly, the Montreal Protocol 10 percent reduction step defines the minimum requirement for funded phase-out. Many of the larger consuming countries with HCFC-based manufacturing activities are experiencing industrial expansion in these sectors which will need to be curtailed or converted to enable compliance with the freeze in 2013. Secondly, the Executive Committee has generally approved reductions of 10-35 percent to date, dependent on cost-effectiveness. Thirdly, assessments that would be based on funding reductions of 30 percent in the stage I HPMPs and standard cost-effectiveness values as derived in this study, together with corresponding reductions in the production sector, would result in a total annual funding requirement in the order of US$ 800 million, far beyond what has so far been allocated, implemented and disbursed, in any previous triennium.

The assessment of 15 percent as a mid-point percentage for both sub-sector divisions scenario carries two important qualifications. As indicated above, so far a relatively small number of large investment projects and HPMPs for larger consuming countries has been approved.

Additionally, the reductions (from the baseline) of 20 percent and larger were generally approved in circumstances where the country concerned had been in a position to offer consumption reductions that were substantially less costly than specified by the cost-effectiveness thresholds (as indicated in Chapter 4), for instance they were realised mostly in one major industry that was converted, and/or under circumstances where foreign ownership resulted in a substantial proportion of the phase-out cost not being eligible for funding.

Taking the above into consideration, a prudent course of action would be to acknowledge that future HPMPs (no further stand alone projects are to be submitted) could be based on a level of phase-out consistent with that in projects so far approved, that is, of the order of 15-30 percent, but to acknowledge that the cost-effectiveness of these projects may give rise to lower project costs than those resulting from a purely technical analysis. The corollary would also apply. Specifically, for projects that may be approved for lower levels of phase-out, approaching the minimum of 10 percent of the baseline, it would be expected that their cost-effectiveness would give rise to higher project costs than predicted from a technical analysis.

For the above reasons, there are qualitative grounds for suggesting that the most likely funding outcome, comprising funding for both consumption reduction and production closure could lie in the mid-range of the scenarios presented. ***For instance, the average of the two scenarios with different reduction package compositions for a 15 percent funded reduction from the baseline, with a 10% spread, would yield the range of US$ 390.2-477.0 million for the triennium 2012-2014***.

However, these figures are very much dependent on the eventual HCFC production plant closure funds that might be approved and disbursed in the triennium 2012-2014.

As indicated in Table 8-3 below, production closure costs for each of the six scenarios range from 38 percent to 46 percent of the total funding requirement.

Table 8-3 2012-2014 HCFC production closure funding for six scenarios as a proportion of total funding requirement

Reduction to 2013 baseline and to further reductions from baseline as indicated	Total Funding requirement for triennium 2012-2014 (from Table 8.3)	HPMPs. other ODS, non-investment and supporting costs	HCFC production closure costs	
			In US$ millions	As a percentage of Total Funding Requirement
Sub-sector reduction 75-15-10%				
10%	**306.1**	183.5	122.6	40.1
15%	**481.3**	362.4	181.2	37.6
20%	**653.5**	413.8	239.7	36.6
Sub-sector reduction 90-0-10%				
10%	**245.2**	132.8	112.4	45.8
15%	**386.1**	220.4	165.7	42.9
20%	**529.3**	306.1	223.2	42.1

While, as previously indicated, the Task Force has no guidance or data on which to base a production sector analysis, there would appear to be opportunities for producers to arrange their industrial activities, for example through increased diversion of production to feedstock uses, to mitigate or avoid the need for early closure of plants.

The anticipated approval of a significant number of HPMPs for larger consuming countries at the two Executive Committee meetings remaining for this year, possible including the largest consuming country, China, can be expected to provide a substantial amount of additional reference data and therefore add to the certainty of estimations.

Estimates for funding requirements are based on the actual costs incurred and year 2011 prices.

Funding Requirement for Subsequent Triennia

Indicative funding requirements for the triennia 2015-2017 and 2018-2020 have also been determined as requested in the Terms of Reference. Table 8-4 below gives the calculation of the total funding requirement for the period 2015-2017, Table 8-5 for 2018-2020. The contents of Tables 8-4 and 8-5 are as follows:

1. Estimated funding requirements for HCFC phase-out via HPMPs for LVCs
2. Funding estimated for destruction projects
3. Funding for Institutional Strengthening after ExCom-63
4. Non-investment funding estimated on the basis of current practices (see Chapter 7)
5. Estimates for the cost of stage II HPMPs for large consuming countries and for commitments for HPMPs for LVCs approved after ExCom-63
6. Production closure funding for HCFC-141b/-142b and HCFC-22
7. Totals for all elements for two subsector reduction packages (75-15-10 and 90-10)
8. Average of the two values

Table 8-4 Elements that determine the 2015-2017 total funding requirement (US$ million) for two scenarios related to the subsector reduction package

Funding Requirement for the period 2015-2017		**US$ million**
Existing Commitments HPMPs (for LVCs and non-LVCs)		9.75
Destruction		0
Institutional Strengthening after ExCom-63		25.76
Non-investment funding for 2015-2017:		
-CAP		37.27
-Core		20.26
-Secretariat		20.96
-Treasurer		1.50
HPMPs new for large countries	75-15-10 reduction package	90-0-10 reduction package
HPMPs stage II	395.6	297.0
Production closure HCFC-141b/-142b	96.0	115.2
Production closure HCFC-22	79.5	45.2
TOTAL	**686.6**	**572.9**
(average)		629.8

In the period 2015-2017, the remaining payments for HPMPs for LVC countries that were approved in 2011-2012 decrease significantly compared to the period 2011-2014 (from about 27 to 9 million). This also applies for the triennium 2018-2020 where the costs for LVCs further decrease to US$ 3.44 million. This is because the funding disbursement schedules yields smaller amounts for later years.

For all funding elements other than stage II HPMPs, and assuming that the baseline consumption has been achieved in 2015 for all countries, the total funding requirement for the period 2015-2017 would consist of four elements namely: (1) existing commitments, (2) institutional strengthening, (3) non-investment funding, (4) production closure costs and (5) destruction project funding (the zero value assumed in Table 8-4 is reflecting decisions taken by the Parties at their 20th and 21st Meetings and decisions taken by the Executive Committee at their 60-62nd meetings for the triennium 2012-2014, where it concerns addressing funding of pilot projects under the Multilateral Fund. There is no policy guidance available to provide a basis for funding in subsequent triennia after 2012-2014).

For the two funding scenarios with different reduction packages, it is assumed that countries can submit requests for the funding of stage II HPMPs in the year 2015 (or in the year 2014 for the year 2015 and beyond). At present the Executive Committee has no rules or policies contrary to this position, even when the approved project funding in the period 2011-2014 accommodates a phase-out of more than a 10% reduction from the baseline.

It is also assumed that projects in this category will again be considered by the Executive Committee individually on their merits.

For the period 2015-2017 one scenario for the reduction has been considered, i.e., a 15% further reduction during those three years, together with two reduction packages that consist of 75% foam, 15% RAC manufacturing and 10% servicing, as well as 90% foam and 10% servicing. These packages have been maintained for all countries, even those for which there may be difficulties in identifying enough foam operations to support the 90% foam scenario in this triennium. In these scenarios the cost-effectiveness values used are those established in this report which accommodate significant numbers of low GWP conversions.

The funding requirement consists of amounts of US$ 395.6 and 297.0 million for stage II HPMPs for the two subsector divisions, HPMP commitments from 2011-2012 of US$ 3.3 million and assumed costs for HCFC phase-down in production (closure compensation) of US$ 175.5 and 160.4 million for the two scenarios. Agency support costs are included in each item as appropriate. The

total is determined at US$ 686.6 and 572.9 million; one might consider the average value of US$ 629.8 million.

It might be expected that in the triennium 2015-2017 additional RAC manufacturing would need to be addressed in the HPMP, giving a higher average cost-effectiveness. However, costs for RAC are likely to have decreased due to the availability of more mature and more cost-effective low-GWP solutions.

Furthermore more investment will be needed in the servicing sector at a cost of US$ 4.5 per kg phased-out. Both effects are difficult to estimate; it is therefore difficult to present a sensitivity analysis at this stage.

Table 8-5 Elements that determine the 2018-2020 total funding requirement (US$ million) for two scenarios related to the subsector reduction package

Funding Requirement for the period 2018-2020		**US$ million**
Existing Commitments HPMPs (for LVCs and non-LVCs)		3.44
Destruction		0
Institutional Strengthening after ExCom-63		23.30
Non-investment funding for 2018-2020:		
-CAP		40.78
-Core		22.14
-Secretariat		22.23
-Treasurer		1.50
HPMPs new for large countries	75-15-10 reduction package	90-0-10 reduction package
HPMPs stage II	430.3	321.5
Production closure HCFC-141b/-142b	105.6	126.8
Production closure HCFC-22	126.8	49.7
TOTAL	**776.1**	**611.4**
(average)		693.7

Existing HPMP commitments in the period 2018-2020 are reduced to US$ 3.44 million. The funding requirement consists of amounts of US$ 430.3 and 321.5 million for stage II HPMPs for the two subsector divisions, and for HCFC phase-down in production (closure compensation) costs are assumed at of US$ 232.4 and 176.5 million for the two subsector division scenarios (75-15-10 and 90-10). Agency support costs are included in each item as appropriate. The total is determined at US$ 776.1 and 611.4 million; one might consider the average value of US$ 693.7 million.

For the 15 percent baseline reduction case given in Table 8-2 one can calculate an average value for the two subsector reduction packages. This amounts to

US$ 439.9 million. Similar average values for the two subsequent triennia 2015-2017 and 2018-2020 are given in Tables 8-4 and 8-5. These average values are presented in Table 8-6, together with the average overall triennium funding.

Table 8-6 also indicates the corresponding values for the same combination of scenarios but incorporating a hypothetical case in which production closure costs are halved to US$ 1.50 per kg.

Table 8-6 Funding requirement for three triennia using the 15 % baseline reduction case and the average of the two subsector reduction packages (US$ million)

Production closure	**Triennium 2012-2014**	**Triennium 2015-2017**	**Triennium 2018-2020**	**(Average funding per triennium)**
US$ 3.0 per kg	439.9	629.8	693.7	587.8
US$ 1.5 per kg	403.0	545.7	591.1	513.3

It needs to be underlined that the lower funding requirement for the triennium 2012-2014 is due to the high level of funding available in 2011 for stage I HPMPs, that the amounts for the triennium 2015-2017 concern a further 15% HCFC consumption reduction, and that the amount for the triennium 2018-2020 concerns a 16.5% consumption reduction (due to the higher annual reduction percentage required under the Montreal Protocol reduction schedule from the beginning of 2020 onwards).

Using the closure costs of US$ 3.00 per kg adopted for this analysis the average replenishment level across the three triennia is US$ 587.8 million. This value would decrease by US$ 75.4 million to US$ 513.3 million if the production closure funding was halved. Although this would give a stable profile, it would still imply a considerably higher level of replenishment than agreed previously for any triennium.

While the Task Force cannot further elaborate on these values at this stage, it may be useful to consider a wider variety of production closure funding scenarios in further studies once additional information and data becomes available.

In all the calculations presented above, the same non-eligible foreign ownership and export and non-eligible proportions have been applied in each of the triennia.