

OPS5

FIFTH OVERALL PERFORMANCE STUDY OF THE GEF

GEF CLIMATE CHANGE MITIGATION GHG ANALYSIS

OPS5 Technical Document #20

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**GEF Climate Change Mitigation
GHG Analysis**

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1. Introduction

Since 1991, the GEF has provided support for projects that seek to address the drivers of climate change. From work to catalyze greater investment in and deployment of renewable energy technologies, to promotion of energy efficiency and low-carbon transportation systems, to forestry projects that recognize the key role that forests play in the climate system, the GEF has taken a diversified approach to addressing climate change.

This analysis for OPS5, drawing on the complete portfolio of over six hundred GEF climate change projects from GEF inception to June 30, 2013, provides an overview of GEF climate change mitigation funding and efforts to date, including findings from completed projects. Specifically, the paper examines:

- the size, composition and distribution of the GEF CCM portfolio, from the Pilot Phase of the GEF to three quarters of the way through the GEF-5 replenishment;
- the cost per ton of expected mitigation across the full spectrum of GEF strategic approaches to climate mitigation; and
- the degree to which completed projects have met or are on track to meet expected mitigation targets, and the performance of different GEF CCM strategic approaches in this regard.

This paper does not explore questions related to the degree to which market transformation and change has been targeted and achieved by CCM projects. It also does not explore the impacts in terms of policy, regulatory and legal environment. These achievements are explored in detail in the ongoing work of the impact evaluation, especially the “Impact Evaluation of the GEF Support to Climate Change Mitigation: Transforming Markets in Major Emerging Economies.” The analysis undertaken for this paper primarily focuses on greenhouse gas (GHG) emissions reduction.

The key findings are:

- Up to June 30, 2013, the GEF has allocated a total of \$3.3 billion to 615 projects that address climate change mitigation. Of this, \$3.1 billion has been allocated to 547 projects with explicit mitigation targets. The total amount of direct and indirect mitigation expected from these 547 projects is 2.6 and 8.2 billion tons of CO₂eq emissions, respectively, or 10.8 billion tons combined.
- The GEF CCM portfolio exhibits a high degree of variability, both in distribution of funding and expected mitigation, with the Asia region accounting for the largest share of both.
- CCM approaches differ substantially in their cost per expected ton of mitigation, both among and within GEF CCM focal areas. Renewable energy projects tend to be the most costly from a mitigation standpoint, while energy efficiency and forestry projects offer some of the least cost mitigation opportunities. The median and average cost per ton of direct mitigation across all GEF project types is \$5.8 and \$1.2 per tCO₂eq

mitigation, respectively. Given the difference in approach to mitigation and calculation of mitigation benefits, it is difficult to compare the mitigation costs of GEF projects with that of other mitigation approaches, such as the Clean Development Mechanism (CDM). Nonetheless, the overall mitigation costs of GEF projects tend to be of similar order as those of CDM projects.

- For completed projects with revised estimates for direct mitigation (88), 56% are expected to meet or exceed their original mitigation targets. At the project approval stage these 88 projects were expected to yield a combined 726 million tons of direct mitigation. As assessed in terminal evaluations, these projects are now expected to yield 1,363 million tons of direct mitigation. Thus, from a portfolio perspective, GEF projects have been successful in terms of achieving their emission reduction objectives.
- Of the completed projects, 40 projects in the OPS5 cohort and 25 in the OPS4 cohort have revised estimates (at the point of project completion) for direct mitigation. Of these, 53% in the OPS5 cohort are expected to meet or exceed their original mitigation targets compared with 48% of those in the OPS4 cohort. Thus, about half of the GEF projects that address CCM related concerns meet or exceed their mitigation targets.
- A small number of completed projects (10) have revised estimates for indirect emissions. Only 30% of these projects are expected to meet or exceed their original indirect mitigation targets.

2. Methodology

This analysis focuses on climate change mitigation projects - defined as projects that have as one of their objectives the goal of reducing emissions of greenhouse gases, either directly or indirectly, and over the short-, medium-, or long-term. It excludes Enabling Activities that facilitate reporting to the UNFCCC, which although linked to overall climate change mitigation efforts, do not have climate mitigation as a primary goal. It also excludes climate-related funding allocated to the GEF Small Grants Program, as these grants operate according to a different set of criteria from GEF projects. To perform this analysis, data was assembled as follows:

Project data on all GEF projects from GEF inception to June 30, 2013 was downloaded from the GEF Project Management Information System (PMIS) and combined with data on emissions targets assembled by the GEF Secretariat. Missing data on emissions targets, funding, co-financing, and mitigation achieved was added for new and existing projects, and existing project data was cross-checked with data from project documents and terminal evaluations. Where project documents offered two estimates for indirect emissions, an average of the two was used for reporting and analysis.

Projects were classified using the classification system employed by the GEF for reporting to the UNFCCC, except in the case of projects classified in reports as “Technology Transfer” projects. Because Technology Transfer projects typically involve technological approaches

and funding common to other GEF CCM strategies, these projects have been classified here as one of the other four GEF-5 CCM strategies, or “Mixed.”¹ In addition, projects involving short-lived climate forcers (SLCFs), which are substances (primarily methane but also HFCs and black carbon) that contribute to global warming and have relatively short lifetimes in the atmosphere, have been grouped together in a new category. This is reflective of the special role that these pollutants play in climate change, and the recent global interest in addressing these substances with targeted policy approaches.²

From the 3325 projects listed in PMIS, all cancelled³, dropped, Small Grants programs, and Enabling Activity projects were filtered out, as well as all projects that had not yet reached the PIF approval stage in the GEF project cycle. Of these 2265 remaining projects, 917 are Climate Change or Multi-Focal area projects - the two groups in which climate change mitigation projects are found. Further analysis of these remaining projects identified those multi-focal and climate change focal area projects that have climate mitigation as an objective. Among these projects, 7 forestry projects that have some climate mitigation objectives but lack any GEF CCM funding⁴ were excluded because it was not possible to estimate the cost effectiveness of these activities in mitigating climate change. Finally, to avoid double-counting of funding or mitigation targets, so-called “Parent” projects of programmatic approaches were excluded since these programs are eventually implemented as multiple child projects.

The resulting set of 615 projects meeting all criteria for analysis are shown in table 1, along with their funding and co-financing.

¹ Those GEF-5 CCM strategic objectives are Energy Efficiency, Renewable Energy, Transportation, and LULUCF. “Mixed” projects are those with multiple climate change mitigation objectives.

² See for example UNEP 2012, “Near-term Climate Protection and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcers - A UNEP Synthesis Report.” United Nations Environment Programme, Nairobi, Kenya. Many of the projects classified in this category have been classified as “others” in GEF reporting to the UNFCCC.

³ 23 CCM projects were cancelled before project completion but had some GEF funding disbursed. These projects were not included in the overall analysis as the results from these projects are incompatible with results from fully-funded projects. Total funding for these 23 projects is \$54.8 million and total co-financing is \$1,095.3 million.

⁴ Funding instead comes from the GEF Land Degradation and/or Biodiversity Focal areas and SFM/REDD+ set aside.

Table 1. GEF Climate Change Mitigation projects, excluding Enabling Activities and Small Grants Program, by GEF Replenishment Phase and strategic objectives.

Phase		Energy Efficiency	Renewable Energy	Transport	LULUCF	LULUCF & SFM/REDD+ ^A	Mixed ^B	SLCFs ^C	Others ^D	Grand Total
GEF Pilot (1991-1994)	Number of projects	6	12	2	2	-	0	5	3	30
	GEF Funding (millions)	30.1	97.1	9.0	4.0	-	0.0	31.1	28.1	199.4
	Co-financing (millions)	203.5	1,843.5	2.0	0.1	-	0.0	264.7	23.4	2,337.2
GEF-1 (1994-1998)	Number of projects	16	15	0	0	-	2	4	1	38
	GEF Funding (millions)	134.4	142.6	0.0	0.0	-	10.9	22.4	4.4	314.7
	Co-financing (millions)	447.5	795.3	0.0	0.0	-	64.6	47.0	3.4	1,357.8
GEF-2 (1998-2002)	Number of projects	31	47	7	1	-	3	4	2	95
	GEF Funding (millions)	188.8	321.8	31.3	0.9	-	12.9	20.4	2.6	578.6
	Co-financing (millions)	2,023.9	1,980.4	28.6	1.0	-	167.0	24.2	2.0	4,227.1
GEF-3 (2002-2006)	Number of projects	29	56	13	0	-	13	1	1	113
	GEF Funding (millions)	228.2	316.7	88.8	0.0	-	73.9	3.7	3.3	714.6
	Co-financing (millions)	1,310.1	1,690.8	886.1	0.0	-	343.1	5.2	10.3	4,245.6
GEF-4 (2006-2010)	Number of projects	85	52	20	23	-	17	3	0	200
	GEF Funding (millions)	386.8	132.8	108.7	59.2	-	63.8	16.2	0.0	767.3
	Co-financing (millions)	3,865.2	967.2	2,034.6	412.1	-	469.9	78.1	0.0	7,827.1
GEF-5 (through 6/30/2013)	Number of projects	24	30	12	7	32	27	2	5	139
	GEF Funding (millions)	148.8	138.4	72.1	14.5	147.4	150.8	4.0	31.0	707.1
	Co-financing (millions)	2,874.4	1,025.1	1,229.4	50.8	667.5	1,431.0	35.4	187.4	7,500.9
Total	Number of projects	191	212	54	33	32	62	19	12	615
	GEF Funding (millions)	1,117.1	1,149.4	309.8	78.6	147.4	312.2	97.7	69.4	3,281.5
	Co-financing (millions)	10,724.5	8,302.3	4,180.7	463.9	667.5	2,475.6	454.7	226.5	27,495.7

^A LULUCF & SFM/REDD+ projects are forestry projects receiving both CCM funding and SFM/REDD+ funding. Total funding shown includes both CCM and SFM/REDD+ set aside funding.

^B Mixed projects are projects with multiple climate change mitigation objectives.

^C SLCFs are projects involving mitigation of short-lived climate forcers. These are principally projects involving methane (n=16), but also include three projects addressing HFCs, and one project assessing overall SLCF mitigation opportunities.

^D "Others" projects include three projects related to fuel substitution, two projects involving fuel cell technology development, and seven projects involving broad research and support agendas not easily classified.

General notes: GEF funding shown is inclusive of Agency fees and PDA/PPG funds (where applicable). Funding and co-financing figures shown are at GEF CEO Endorsement/Approval stage for 498 projects, and at PIF Approval stage for 117 projects that have not reached GEF CEO Endorsement/Approval stage (5 projects from GEF-4 and 112 projects from GEF-5). Included in Table 1 are 73 multi-focal projects: 21 from GEF-4 and 52 from GEF-5. GEF funding and co-financing shown is CCM funding only.

This paper gives considerable attention to cost per ton of GHG emission abatement. While GHG emission abatement is a valuable indicator for assessing performance of the GEF CCM portfolio, it must be emphasized that it is not the only one. All GEF projects endeavor to support multiple environmental and developmental objectives. Moreover, the desired effects of GEF projects, particularly those that seek to bring about market transformation, primarily target the upstream policy environment and market barriers. Their downstream effects are difficult to quantify and may develop over many years. On the one hand this makes it difficult to estimate the expected benefits at inception (and also at project closure), and on the other hand makes it difficult to compare the expected benefits with projects supported by other organisations that tend to focus on downstream activities, for example with projects supported through the Clean Development Mechanism (CDM). Although in this paper cost comparisons have been made, the intent is to compare the 'order' rather than the exact figures derived from calculations and also to assess whether the cost patterns within the GEF projects and CDM projects are similar.

Emission abatement cost figures for GEF projects differ based on whether or not cofinancing is taken into account. If only the GEF grant is used as a nominator, the cost per unit of abatement is lower. When cofinancing is also taken into account the costs are considerably higher. In some instances inclusion of cofinancing in calculation of abatement costs may be justified, whereas in other instances, for example if the GEF is the only partner that is contributing to meeting the incremental cost of the project, inclusion of only the GEF grant may be justified. The exercise carried out for preparation of this paper did not distinguish projects on this basis. For the sake of simplicity calculations presented in this paper are based exclusively on GEF grant which will lead to a more liberal estimate of abatement costs for GEF projects. Nonetheless, several tables do provide cofinancing involved in GEF projects. Along with the figures on average costs, the estimates of median costs have also been provided so as to present a picture of the abatement costs for a middle of the road project.

3. Distribution of GEF CCM Funding and Mitigation Targets

Total GEF funding for the 615 CCM projects that have reached the PIF approval stage is \$3.3 billion, with \$27.5 billion in co-financing commitments. Of these projects, 547 have explicit direct, and/or indirect mitigation targets (see box 1 for how emissions reductions are classified).⁵ The total amount of direct and indirect mitigation expected from these 547 projects is 2.6 and 8.2 billion tons of CO₂eq emissions respectively, or 10.8 billion tons CO₂eq emissions combined. To put that number in perspective, 10 billion tons of CO₂eq emissions is equivalent to the yearly CO₂ emissions resulting from the energy use of nearly half a billion US homes.⁶ On the other hand, if we consider that the 10.8 billion tons CO₂eq targeted emission reductions are the result of 20+ years of GEF CCM projects, the annual targeted reduction from GEF projects falls to around half a billion tons of CO₂eq emissions. Annual global emissions of GHGs, which need to drop by around 60% by mid-century to achieve climate stabilization⁷, were 47 billion tons of CO₂eq in 2010.⁸ This gives a sense of the scale of the climate problem.

Figure 1 and table 2 show the distribution of GEF CCM funding and expected mitigation by GEF replenishment phase. Note that while GEF funding has increased with every replenishment cycle (GEF-5 figures are incomplete), the expected mitigation has not. In particular, the mitigation expected from the 87 GEF-2 projects with (continued on pg. 9)

Box 1. Classifying Emission Reduction Targets

With inputs from the GEF Scientific Technical Advisory Panel, the GEF has been moving towards a more consistent approach to quantifying and classifying anticipated and realized emission reductions resulting from CCM project activities. The following two classes of emission reduction impacts are defined in the GEF 2008 Manual for Calculating GHG Benefits of GEF Projects (GEF/C.33.Inf.18):

Direct Emission reductions - all emission reductions attributable to investments made during the project's supervised implementation period, and totaled over the respective lifetime of the investments, both during and post implementation. These include investments made using GEF resources or co-financing, and tracked through the project's M&E system.

Indirect Emission reductions – emission reductions resulting from replication of GEF project activities, occurring outside the project's logframe. Estimations of indirect emission reductions rely heavily on assumptions and expert judgment. Because their level of uncertainty is higher than for direct emission reductions, indirect emissions need to be distinguished from direct emission reductions.

⁵ Total GEF funding for the 547 projects with explicit direct and/or indirect mitigation targets is \$3.1 billion, with \$26.0 billion in co-financing commitments.

⁶ Source: US EPA Greenhouse Gas Equivalencies Calculator. Online at: <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

⁷ Presidential Climate Action Plan 2012. *Emissions Reductions Needed to Stabilize Climate*. Available at: <http://www.climatecommunication.org/wp-content/uploads/2011/08/presidentialaction.pdf>

⁸ WRI CAIT 2.0, Climate Data Explorer. Online at: <http://cait2.wri.org/wri#>

Figure 1. Distribution of GEF CCM Funding and expected mitigation for all approved GEF mitigation projects with explicit mitigation targets, by GEF Phase (n=547).

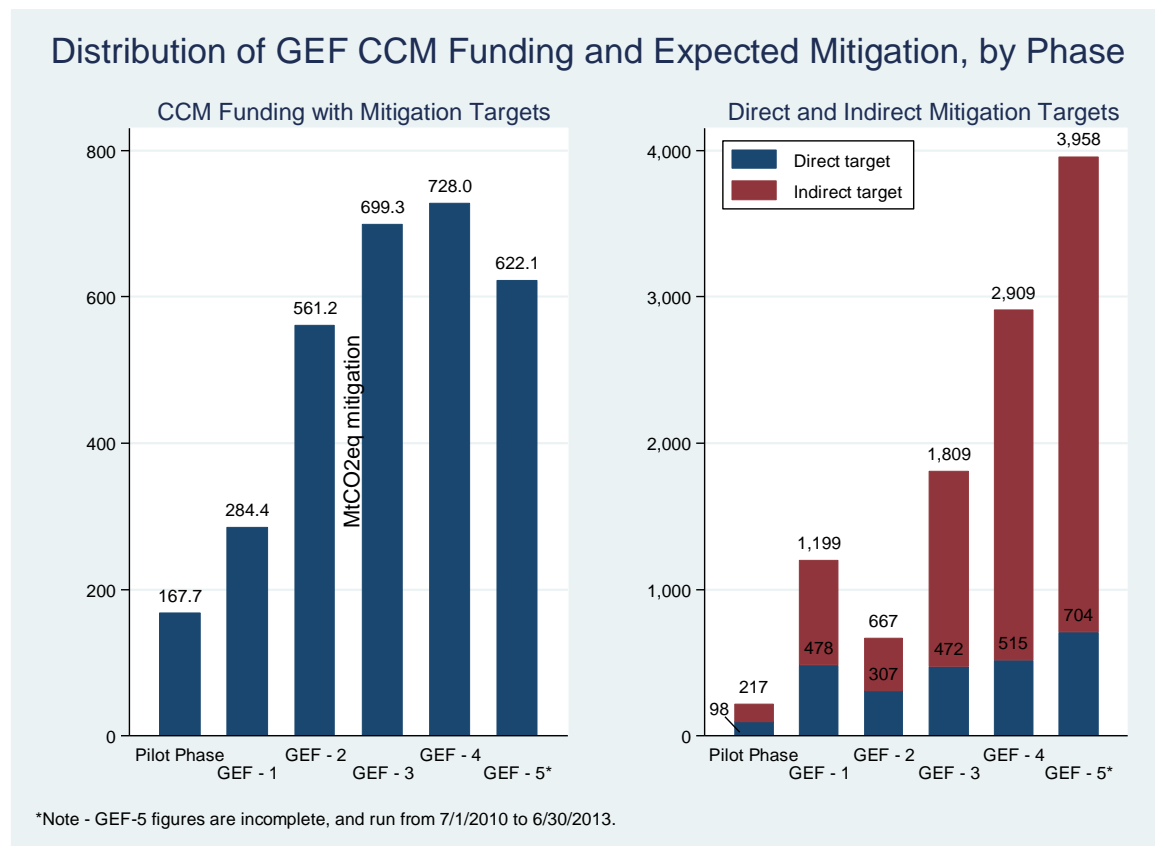


Table 2. GEF funding and co-financing for climate change mitigation and projected emissions reductions, by GEF Phase.

GEF Region	Total GEF CCM Funding			GEF CCM Projects with Explicit Mitigation Targets					
	Number of Projects	GEF Funding (millions)	Co-Financing (millions)	Number of Projects	GEF Funding (millions)	Co-Financing (millions)	Projected Direct Emission Reductions (MtCO2eq)	Projected Indirect Emission Reductions (MtCO2eq)	Projected Direct + Indirect Emission Reductions (MtCO2eq)
Pilot Phase	30	199.4	2,337.2	20	167.7	2,178.9	97.5	119.5	217.1
GEF - 1	38	314.7	1,357.8	31	284.4	1,319.1	477.8	720.8	1,198.6
GEF - 2	95	578.6	4,227.1	87	561.2	4,209.1	306.5	360.9	667.5
GEF - 3	113	714.6	4,245.6	105	699.3	4,223.5	472.5	1,336.4	1,811.3
GEF - 4	200	767.3	7,827.1	181	728.0	7,540.6	515.1	2,393.6	2,908.7
GEF - 5*	139	707.0	7,500.9	123	622.1	6,484.7	703.6	3,254.6	3,958.3
All phases	615	3,281.5	27,495.7	547	3,062.6	25,955.7	2,573.1	8,185.9	10,761.5

* GEF - 5 figures are incomplete and run from 7/1/2010 to 6/30/2013.

(continued from pg. 7) explicit targets is nearly half those of the 31 GEF-1 projects with explicit targets, despite these GEF-2 projects receiving \$276.8 million in additional GEF funding. This is reflective of the different kinds of CCM strategies employed and their associated cost-per-ton of expected mitigation, which is discussed below. Also note the large share of mitigation expected from indirect pathways, particularly in later GEF phases. Figure 1 also shows that the role of indirect emissions reduction has increased after the GEF-2 period.

Figure 2 and table 3 show the regional distribution of GEF CCM funding and expected mitigation. The Asia region has by far the largest share of GEF CCM funding, at \$1,368 million. The other four regions share similar funding levels, ranging from \$543 million in Africa to \$640 million in Latin America and the Caribbean. What is more distinct among regions is the expected mitigation, both direct and indirect, shown on the right side of figure 2. While the direct mitigation anticipated from Asia projects is highest, as would be expected, the expected direct mitigation from the Europe and Central Asia (ECA) region is more than twice as high as that expected from the Latin America and Caribbean region (LAC), despite LAC receiving some \$45.4 million more in total GEF funding than ECA.⁹ This is perhaps explained by the higher level of co-financing supporting ECA projects.

Regional distinctions are even more prominent when considering indirect mitigation expected from GEF CCM projects. The ratio of total indirect mitigation to total direct mitigation is highest in the ECA region, at 3.7 tons of indirect mitigation for every ton of direct mitigation. Asia and LAC are slightly lower at 3.5 and 3.3 tons of indirect to direct mitigation, respectively. In Africa by contrast, the ratio of expected indirect to direct mitigation is nearly 1 to 1. This highlights the great variance in mitigation opportunities due to such factors as potential for market transformation, the speed at which such transformation can be expected to come about, and the available opportunities for leveraging GEF investments.

Turning to the kinds of strategic approaches employed by the GEF in addressing climate change, table 4 provides a breakdown of funding and expected mitigation across CCM strategies. Renewable Energy and Energy Efficiency are the two areas where the GEF has allocated the bulk of its CCM funding. Renewable Energy has the largest share of GEF CCM projects, at 212, followed by 191 Energy Efficiency projects, with both types of projects receiving similar average levels of GEF funding, at \$5.4 and \$5.8 million per project, respectively. Perhaps more significant, the expected mitigation (both direct and indirect) from Energy Efficiency projects in aggregate is more than one and one half times that of Renewable Energy projects, giving an indication of the associated cost per ton, which is discussed in more detail below.

⁹ Difference in funding levels between ECA and LAC regions is for projects with explicit mitigation targets. The difference in funding between ECA and LAC for all CCM projects is a bit higher, at \$60.4 million.

Figure 2. Regional distribution of GEF CCM Funding and expected mitigation for all approved GEF mitigation projects with explicit mitigation targets (n=547).

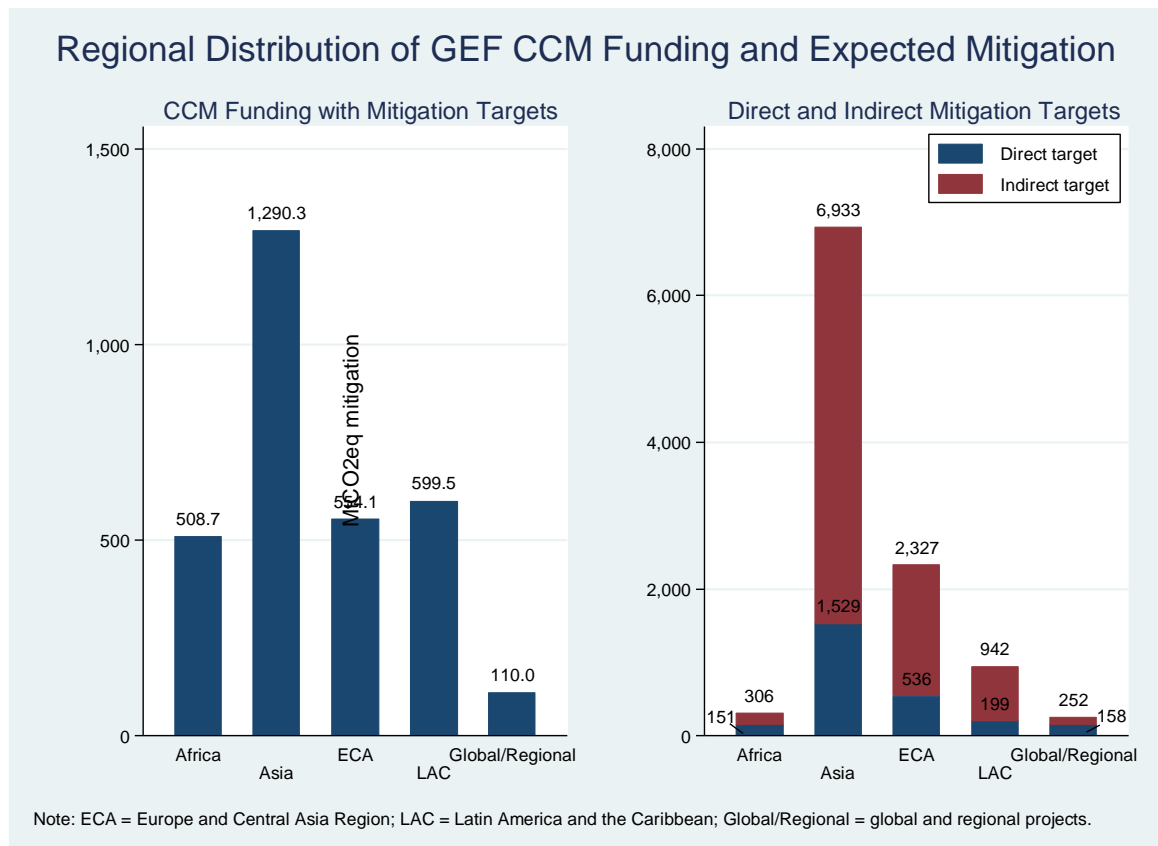


Table 3. GEF funding and co-financing for climate change mitigation and projected emissions reductions, by region.

GEF Region	Total CCM Funding			GEF CCM Projects with Explicit Mitigation Targets					
	Number of Projects	GEF Funding (millions)	Co-Financing (millions)	Number of Projects	GEF Funding (millions)	Co-Financing (millions)	Projected Direct Emission Reductions (MtCO ₂ eq)	Projected Indirect Emission Reductions (MtCO ₂ eq)	Projected Direct + Indirect Emission Reductions (MtCO ₂ eq)
Africa	132	542.61	3,651.8	117	508.7	3,529.6	151.0	155.5	306.4
Asia	208	1,367.7	13,720.3	192	1,290.3	12,889.5	1,529.4	5,403.1	6,932.5
Europe and Central Asia	125	579.8	5,359.2	116	554.1	5,105.9	536.5	1,790.4	2,326.9
Latin America and the Caribbean	116	640.2	4,041.9	104	599.5	3,944.7	198.6	743.0	941.7
Global and Regional Projects	34	151.2	722.6	18	110.0	486.1	157.7	93.9	251.6
All Regions	615	3,281.5	27,495.7	547	3,062.6	25,955.7	2,573.1	8,185.9	10,761.5

In 1999 the GEF Council approved the Operational Program on sustainable urban transport, and these projects have become increasingly prominent in the GEF CCM portfolio from GEF-3 onwards. Also notable, the availability of low cost mitigation opportunities in the forestry and

land management sectors has been increasingly captured in the GEF CCM portfolio. In GEF-5, this has been facilitated through the use of an incentive mechanism that lets countries access additional funding if they allocate a minimum portion of their STAR allocation to projects involving sustainable forest management and/or REDD+ (reduced emissions from deforestation or degradation and enhancement of forest carbon stocks).

Table 4. GEF funding and co-financing for climate change mitigation and projected emissions reductions, by CCM strategic focal area.

GEF Region	Total CCM Funding			GEF CCM Projects with Explicit Mitigation Targets					
	Number of Projects	GEF Funding (millions)	Co-Financing (millions)	Number of Projects	GEF Funding (millions)	Co-Financing (millions)	Projected Direct Emission Reductions (MtCO ₂ eq)	Projected Indirect Emission Reductions (MtCO ₂ eq)	Projected Direct + Indirect Emission Reductions (MtCO ₂ eq)
Energy Efficiency	191	1,117.1	10,724.5	186	1,082.8	10,097.6	1,171.9	3,791.1	4,965.5
Renewable Energy	212	1,149.4	8,302.3	187	1,071.2	8,184.0	486.6	2,579.6	3,066.2
Mixed	62	312.2	2,475.6	56	285.1	2,174.9	297.0	883.7	1,180.7
Transport	54	309.8	4,180.7	48	299.6	4,145.4	96.0	322.0	417.9
LULUCF ^A	65	226.0	1,131.4	46	178.9	832.5	406.4	120.9	527.3
SLCFs ^B	19	97.7	454.7	16	83.5	307.1	98.2	18.3	116.5
Others ^C	12	69.4	226.5	8	61.5	214.3	17.1	470.3	487.4
All Projects	615	3,281.5	27,495.7	547	3,062.6	25,955.7	2,573.1	8,185.9	10,761.5

^A LULUCF projects here include those with or without SFM/REDD+ set aside funding.

^B SLCFs are projects involving mitigation of Short-Lived Climate Forcers. These are principally projects involving methane (n=16), but also include three projects addressing HFCs, and one project assessing overall SLCF mitigation opportunities. While these projects may involve fuel substitution, the primary GHG mitigation comes from abatement of these SLCFs.

^C "Others" projects include three projects related to fuel substitution, two projects involving fuel cell technology development, and seven projects involving broad research and support agendas not easily classified.

4. Cost per Ton of Expected Mitigation

Table 5 shows the expected GEF cost (excluding co-financing) per ton across the range of CCM focal area strategies. Median cost per ton is shown alongside the average sector-wide cost per ton, to give a better sense for mitigation costs in typical CCM projects. As noted in the section on methodology, the cost estimates presented take into account only the GEF grant. The median and average cost per ton of direct mitigation for the GEF across all GEF project types is \$5.8 and \$1.2 per tCO₂eq mitigation, respectively. As might be expected, CCM focal area strategies show significant differences in the expected cost per ton, with Renewable Energy (RE) projects having the highest median costs per ton of direct and direct+indirect mitigation, at \$10 and \$4 dollars per ton, respectively. This is followed by transport and mixed projects. Energy efficiency projects offer relatively low cost per ton of expected mitigation, with a median cost of \$4 per ton of direct and \$1 per ton of direct+indirect mitigation. The lowest cost per ton of expected direct mitigation comes from the forestry sector, at less than \$2 per ton.

Given differences in approach to mitigation and calculation of mitigation benefits, it is difficult to compare the mitigation costs of GEF projects with those of other mitigation programs, such as the Clean Development Mechanism (CDM). Nonetheless, the overall mitigation costs of GEF projects tend to be of the similar order as those of the CDM projects. Consistent with this analysis of GEF CCM costs, studies examining CDM projects find that on average, solar projects are significantly more expensive than other project types. See the Annex for more on how GEF project costs compare with those of the CDM.

Table 5. Estimated GEF cost per ton (excluding co-financing) of GEF CCM projects at project start, across the range of GEF CCM focal strategies (see note below on project groupings).

GEF CCM focal areas		Number of projects with direct cost estimates	Median cost (USD) per ton of direct CO ₂ eq mitigation	Average cost (USD) per ton of direct CO ₂ eq mitigation	Number of projects with direct+indirect cost estimates	Median cost (USD) per ton of direct +indirect CO ₂ eq mitigation	Average cost (USD) per ton of direct+indirect CO ₂ eq mitigation
Energy Efficiency	Appliances	23	1.2	0.4	24	0.5	0.2
	Buildings	50	7.7	0.8	52	0.9	0.2
	Combined EE	14	3.9	0.7	14	1.1	0.1
	Energy Supply/ESCOs	31	3.7	1.2	31	2.6	0.4
	Industrial Processes	33	4.5	1.1	34	2.1	0.4
	Lighting	20	7.3	1.0	20	1.3	0.2
	All EE	182	4.3	0.9	186	1.2	0.2
Renewable Energy	Biomass	32	6.4	4.8	32	3.3	0.6
	Combined RE	70	10.3	1.3	71	4.4	0.3
	Geothermal	7	1.7	1.3	8	0.4	0.2
	Hydro	19	9.9	3.3	19	2.0	0.3
	PV	29	58.2	30.8	29	33.2	12.5
	Solar thermal	11	12.1	9.3	11	5.3	2.0
	Wind	10	8.6	6.1	12	1.2	0.1
All RE	182	10.4	2.1	187	4.1	0.3	
Transport		47	6.9	3.1	48	2.9	0.7
LULUCF	LULUCF (no SFM/REDD+ funding)	17	2.9	0.8	17	1.9	0.3
	LULUCF with SFM/REDD+	29	1.3	0.4	29	1.1	0.4
	All LULUCF	46	1.8	0.4	46	1.2	0.3
Mixed ^A		55	4.9	0.9	56	2.8	0.2
SLCFs		16	2.4	0.9	16	1.9	0.7
All projects		532	5.8	1.2	547	2.2	0.3

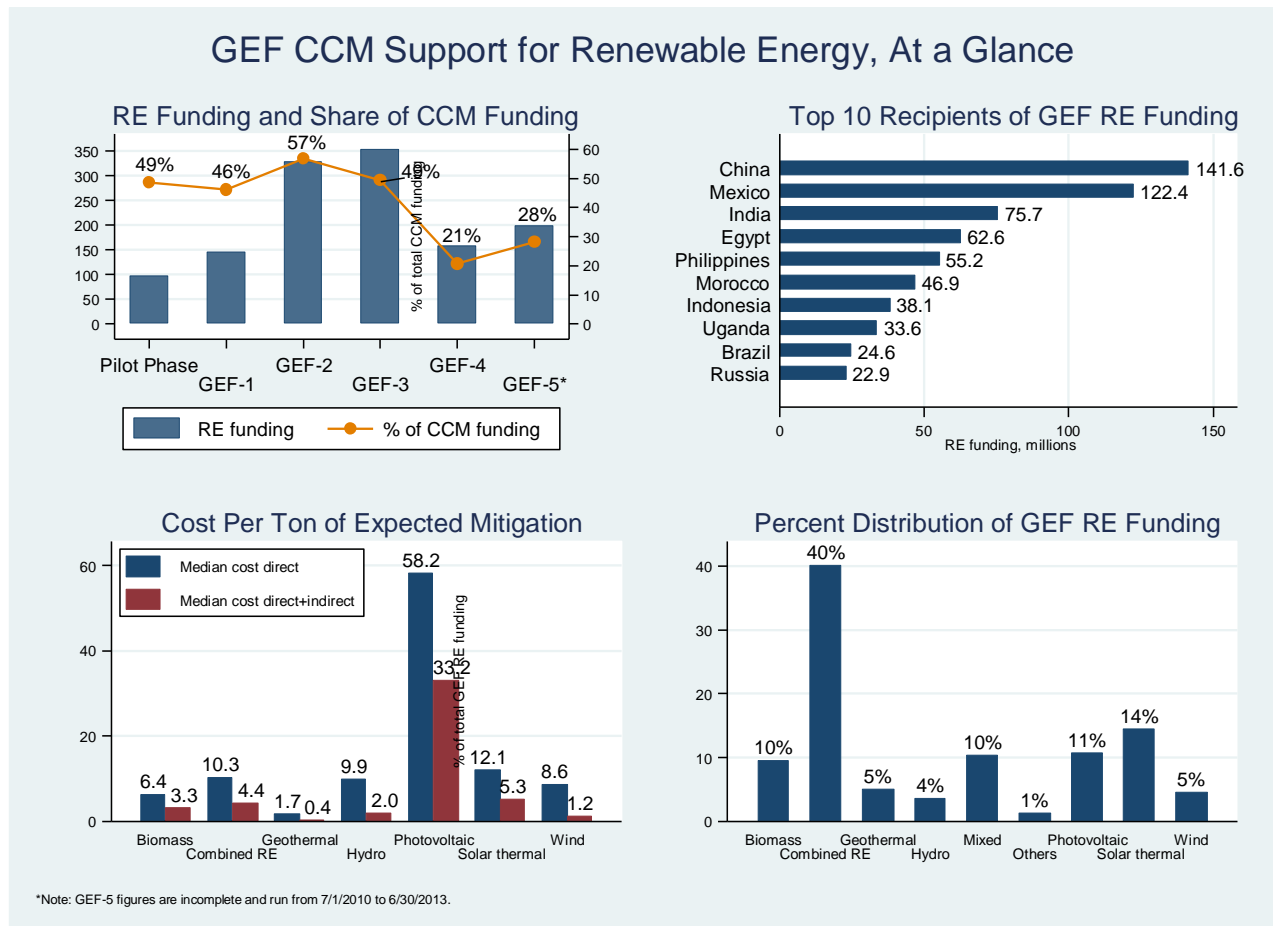
^A Mixed projects are those involving multiple CCM focal strategies.

Note that that average costs are computed over the total focal area and not as an average of individual project cost per ton values. SLCFs is not a GEF CCM strategy. These projects, which primarily involve methane abatement, have largely been grouped with "other" projects in GEF reporting to the UNFCCC.

While cost per ton is a valuable indicator for use in assessing and developing GEF CCM strategies, it must be emphasized that it is not the only one. All GEF projects endeavor to support multiple environmental and developmental objectives. Moreover, the desired effects of GEF projects, particularly those that seek to bring about market transformation, may take place over the long-term. Thus the expected cost per ton of various mitigation opportunities must be factored into a larger discussion about the comparative advantage of the GEF and where GEF funding can be expected to have the highest impact, given the large number of other actors and funds working on climate mitigation.

Figures 4 and 5 provide a more detailed look at GEF CCM support for Renewable Energy and Energy Efficiency, the two areas that have received the greatest share of GEF CCM funds to date. As noted in section 3, the overall share of GEF CCM funding in RE has declined from a peak of 57% in GEF-2 to around 21% in GEF-4. GEF funding for EE has risen from 15% in the Pilot Phase to a peak of 54% in GEF-4. Funding for EE is quite a bit lower in GEF-5 (29%), but it must be noted that all GEF-5 figures are incomplete (up to June 30, 2013) and so likely to change.

Figure 4. GEF CCM support for Renewable Energy technologies.



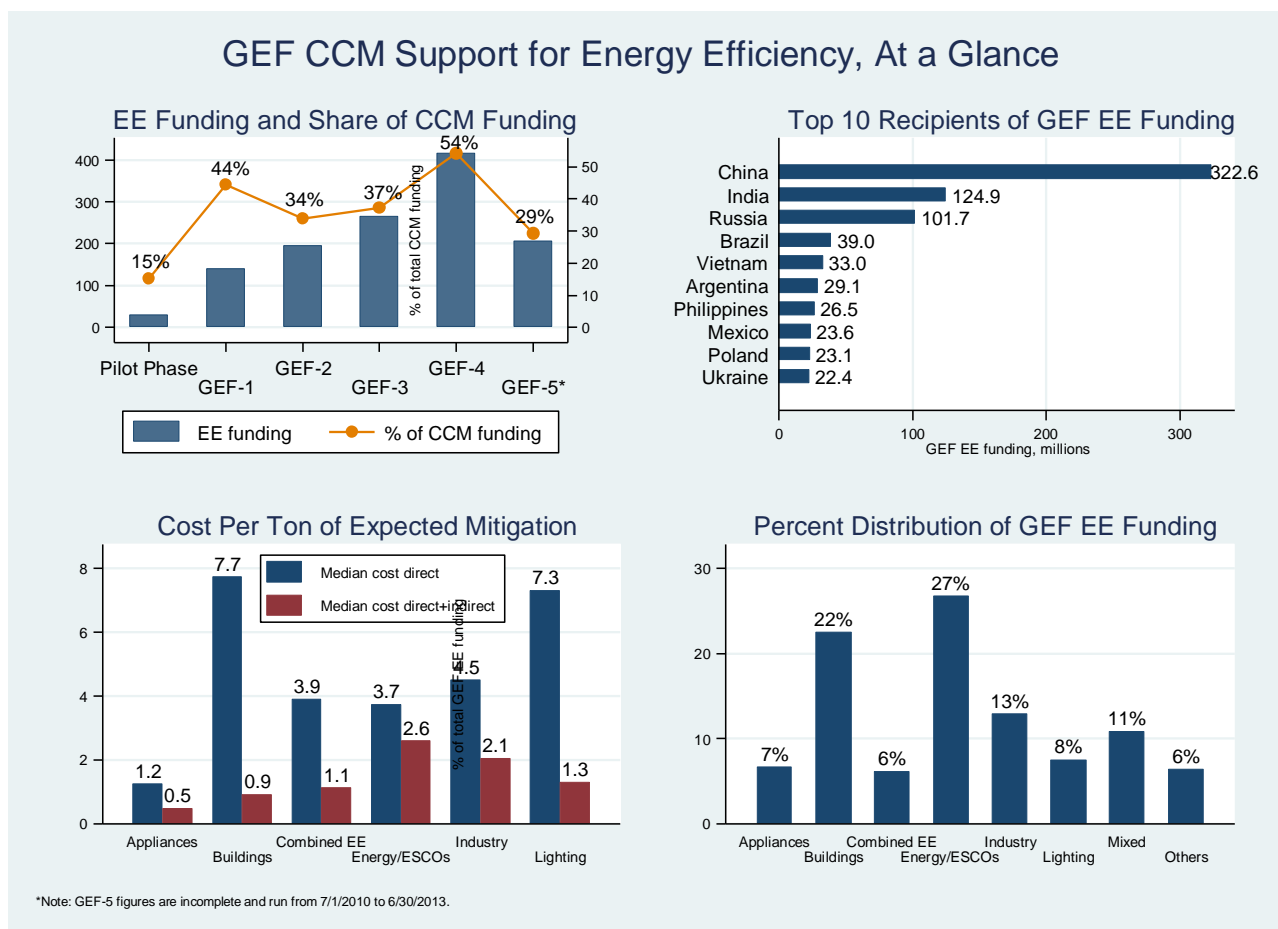
Note: "Mixed" projects are projects involving RE with other CCM strategic objectives (typically energy efficiency). Percent distribution of GEF RE funding in Mixed projects includes only portion of CCM funding going towards RE. "Combined RE" projects are projects involving more than one RE technology. "Others" projects are RE projects not easily classified. Percent distribution of GEF RE funding does not sum to 100 due to rounding.

Among RE projects, the expected cost per ton of mitigation of projects involving energy from photovoltaic (PV) technology dwarfs that of the other technologies in the GEF RE portfolio. This reflects both the significant hurdles that must be overcome to bring PV technology to commercial viability in many applications, and the use of PV technology in many off-grid rural electrification projects, which were a prominent part of the GEF RE portfolio in earlier years. Following on the finding of the 2004 Program Study on Climate Change (CCPS), which highlighted the high cost per ton of certain RE projects, the GEF CCM strategy in GEF-4 moved

away from rural off-grid electrification projects and towards more market-based approaches to on-grid renewable energy.

Among EE projects, Appliances, which include large energy consuming devices such as refrigerators and chillers, offer some of the lowest cost mitigation opportunities, with a cost of \$1.2 and \$0.50 per ton of expected direct and direct + indirect mitigation, respectively. Buildings, which comprise one of the largest sectors of energy use worldwide, have a relatively higher cost per ton of direct mitigation, at \$7.7 per ton. However, if indirect emission reductions are also considered, energy efficient building and heating represents one of the lowest cost opportunities for mitigation, at \$0.90 per ton of direct + indirect mitigation.

Figure 5. GEF CCM support for energy efficiency.



Note: "Mixed" projects are projects involving EE with other CCM strategic objectives (typically renewable energy). Percent distribution of GEF EE funding in Mixed projects includes only portion of CCM funding going towards RE. "Combined RE" projects are projects involving more than one RE technology. "Others" projects are EE projects not easily classified. Percent distribution of GEF RE funding does not sum to 100 due to rounding.

5. Evaluation of Mitigation Results in Completed Projects

Two-hundred and fifty-eight of the 615 CCM projects in the GEF portfolio have reached the project completion and/or financial closure stage. Of these, 163 have terminal evaluations accessible on PMIS as of 8/23/2013. From these 163 projects, 88 allow a comparison between direct migration expected at project start and direct mitigation estimated at terminal evaluation, because these projects have estimates for both. Likewise, 10 projects with terminal evaluations provide revised estimates for indirect emissions and facilitate comparisons. Thus, a preliminary assessment of mitigation performance is possible, with the caveat that the expected mitigation benefits of CCM projects are expected to occur over the entire lifecycle of project investments, which is often after the point of project terminal evaluation. Therefore, estimates of project lifecycle mitigation benefits made in terminal evaluations, while likely more accurate than those made before project implementation, still carry a large degree of uncertainty.

Table 6 shows how projects with revised estimates for direct and indirect emissions overlap with OPS4 and OPS5 cohorts of completed projects.

Table 6. Summary of projects in GEF CCM portfolio in terms of project status, availability of terminal evaluations, availability of revised emission estimates, and overlap with OPS4 and OPS5 cohorts.

	OPS4 Cohort	OPS5 cohort	Additional	Total
Number of projects in GEF CCM portfolio*	47	62	506	615
Number of projects at project completion/financial closure stage	47	62	149	258
Number of completed projects with terminal evaluations	47	62	54	163
Number of completed projects with revised estimates for lifetime direct emissions	25	40	23	88
Number of completed projects with revised estimates for lifetime indirect emissions	2	5	3	10

* As of June 30, 2013

Results by GEF phase for direct mitigation are shown in table 7 below. In total, these eighty eight projects were expected to result in 726 million tons of direct emission abatement. As assessed in terminal evaluations, the total expected mitigation climbs to 1,363 million tons - an increase of 82%. However, further analysis reveals that a relatively small number of projects are responsible for the increase in overall expected mitigation. Among these eighty-eight projects, 68% are anticipated to meet or exceed 80% of their original direct mitigation target. The numbers vary slightly by GEF replenishment phase, with projects from GEF-2 performing better in this regard than projects from other GEF phases. However, the number of reviewed projects is too small to put much stock in this comparison between GEF phases.

Table 8 presents this same analysis, broken down by GEF strategies and sectors. While the small sample size of most focal areas cautions against drawing any firm conclusions, for RE and EE projects - the areas receiving the largest amount of GEF CCM funding - findings are noteworthy. Among the 36 assessed RE projects, 67% are expected to meet or exceed 80% of their direct mitigation target. For the 34 EE projects, the percentage climbs to 76%. This suggests to some degree that the decisions by the GEF to invest relatively more resources in

EE and less in RE in GEF-4 and GEF-5 may result in a higher overall percentage of realized mitigation.

A similar analysis for indirect mitigation is shown in table 9, although only ten projects facilitate this kind of comparison. The combined indirect mitigation expected at project start from these 10 projects was 111 million tons of CO₂eq emissions, while the revised estimate is 38 million tons - only 34% of the original total. Moreover, only 3 of the 10 projects, or 30%, have estimated indirect emissions equal to or greater than 80% of their original target. The results emphasize the greater uncertainty present in indirect emission estimates, and underscore the need to distinguish direct from indirect emission estimates when reporting expected mitigation.

Table 7. CCM direct mitigation results by phase, as assessed in the terminal evaluations of 88 completed projects with full lifecycle mitigation estimates at project start and in terminal evaluations.

GEF phase	Number of projects	Direct emission Target (full lifecycle, MtCO ₂ eq)	Direct emissions realized – TE estimate (full lifecycle, MtCO ₂ eq)	Estimated % of target achieved (full lifecycle, MtCO ₂ eq)	% of projects with estimated reductions equal or greater than target	% of projects with estimated reductions equal or greater than 80% of target
Pilot Phase	8	30.2	17.7	59%	50%	63%
GEF – 1	20	439.4	951.5	217%	50%	70%
GEF – 2	33	197.1	351.6	178%	67%	82%
GEF – 3	26	59.0	41.6	71%	46%	50%
GEF – 4	1	0.02	0.1	500%	100%	100%
Total	88	725.6	1,362.6	188%	56%	68%

Table 8. CCM direct mitigation results by CCM objectives, as assessed in the terminal evaluations of 88 completed projects with full lifecycle mitigation estimates at project start and in terminal evaluations.

CCM strategic objectives	Number of projects	Direct emission Target (full lifecycle, MtCO ₂ eq)	Direct emissions realized – TE estimate (full lifecycle, MtCO ₂ eq)	Estimated % of target achieved (full lifecycle, MtCO ₂ eq)	% of projects with estimated reductions equal or greater than target	% of projects with estimated reductions equal or greater than 80% of target
Renewable Energy	36	178.1	151.7	85%	53%	67%
Energy Efficiency	34	502.9	1,165.3	232%	62%	76%
Mixed	5	6.4	20.6	322%	80%	80%
Transport	4	6.2	3.8	61%	50%	50%
LULUCF	2	1.8	0.9	50%	50%	50%
SLCFs	7	30.2	20.4	68%	29%	43%
Total	88	725.6	1,362.6	188%	56%	68%

Table 9. CCM indirect mitigation results, as assessed in the terminal evaluations of 10 completed projects with indirect mitigation estimates at project start and in terminal evaluations.

Number of projects	Indirect emission Target (full lifecycle, MtCO ₂ eq)	Indirect emissions realized – TE estimate (full lifecycle, MtCO ₂ eq)	Estimated percentage of target achieved (full lifecycle, MtCO ₂ eq)	% of projects with estimated lifecycle reductions equal or greater than target	% of projects with estimated reductions equal or greater than 80% of target
10	111.3	37.9	34%	30%	30%

Annex 1 - Comparison of GEF CCM costs with those of the Clean Development Mechanism

A comparison of estimated GEF mitigation costs with those of other GHG mitigation schemes is useful in assessing the cost effectiveness of GEF mitigation efforts. However, when doing so, it is important to keep in mind that the cost of GHG mitigation is highly variable, and dependent upon several key factors. These factors include:

- The location where greenhouse gas mitigation takes place
- The size and scale of the project or intervention
- The desired degree of certainty over GHG mitigation, with higher levels of certainty (including establishing a credible baseline and monitoring and verification of project activities) associated with higher costs
- Transaction costs
- Policies on GHG emission, at the local, regional, and global levels

Because the GEF operates primarily in developing countries and countries with economies in transition, cost comparisons with mitigation efforts in these countries and regions is most appropriate. While projects supported through the Clean Development Mechanism, established under the Kyoto Protocol, may provide a basis for comparison given that it operates in developing countries on a project by project basis and has an overall scale¹⁰ that is similar to GEF, there are fundamental differences in the two approaches that makes comparisons difficult. Factors that limit the comparability of CDM mitigation costs with those of the GEF are:

- A much higher degree of certainty is required in CDM mitigation projects. This follows from the fact that emissions credits generated through CDM project activities are used to offset emission reductions in compliance markets - that is, they are being used to offset the emissions of companies that are legally bound to reduce their emissions. Thus, the establishment of CDM project baselines and project monitoring and verification should entail additional costs not found in GEF CCM projects.
- All GEF projects endeavor to support multiple environmental and developmental objectives that are likely absent from CDM projects. These are costs born by GEF CCM projects but which are not found in CDM projects. On the other hand, the CDM was envisioned as a platform for promoting technology transfer and capacity building in the sectors and countries in which CDM projects are developed. These are objectives shared by many, if not all, GEF CCM projects.
- GEF projects, including CCM projects, typically benefit from the addition of co-financing. Determining the degree to which co-financing of CCM projects contributes towards these projects' CCM objectives, and how much of the CCM benefits to

¹⁰ 2001 was the first year that CDM projects could be registered.

attribute to GEF funding is problematic. For this comparison we assume that all CCM benefits are attributable to GEF funding. However, it is acknowledged that other interpretations are valid, and that cost estimates for GEF CCM mitigation would vary accordingly.

Nonetheless some general comparisons have been made between GEF and CDM projects so as to assess whether the order of the abatement costs is similar and whether the cost patterns within the two sets of projects are similar. The UNFCCC has published studies on the benefits of the CDM, which include cost estimates across project types. The most recent (UNFCCC 2012)¹¹ finds that average mitigation costs across all CDM project types is \$5 per ton for projects with longer lifetimes (lifetimes with a maximum of 21 years, which covers about 60% of all CDM projects) and \$25 per ton for projects with shorter lifetimes (maximum of ten years).¹² Taking the \$5.8/tCO₂eq median cost estimate for all GEF CCM projects arrived at in this study¹³ we see that overall, GEF mitigation costs are of a similar order as costs of CDM projects. Consistent with this study on GEF CCM costs, the UNFCCC study find that on average, solar projects are significantly more expensive than other project types. Average mitigation costs for all CDM solar photovoltaic and solar thermal projects are \$326/tCO₂eq and \$200/tCO₂eq respectively, while solar cooking and water heating projects are much cheaper at \$3/tCO₂eq and \$2/tCO₂eq respectively.¹⁴

A study by Castro (2010)¹⁵ looked at mitigation costs for 29 technologies using data from 252 registered CDM projects in 8 countries. Twenty-two of the project types (75%) have mitigation costs of \$5/tCO₂eq or less, which again is comparable to GEF projects costs. Of the 18 GEF project types shown in table A,¹⁶ half have median costs below \$5/ton (see footnote 11).

A study of CDM costs by Rahman et al. (2012)¹⁷ of the World Bank found average mitigation costs of forestry projects to be the most costly. In contrast, forestry projects were found to be among the lowest cost mitigation projects in the GEF portfolio.

¹¹ UNFCCC, 2012. Benefits of the Clean Development Mechanism 2012. Available at: http://cdm.unfccc.int/about/dev_ben/ABC_2012.pdf.

¹² These two CDM project groupings are particular to the CDM, and must be chosen by project developers at the time of project submission to the CDM executive board.

¹³ The median cost estimate for GEF CCM projects is more comparable to the average costs of CDM projects as the average cost for GEF CCM projects (shown in table 5) is arrived at by dividing total GEF funding over total mitigation, whereas the average CDM cost estimates from the UNFCCC are averages of individual project costs, not total expenditures in CDM projects. Furthermore, indirect abatement is not considered in CDM projects and so we limit the comparison of GEF costs to those for direct emission reductions only.

¹⁴ Ibid 9, pg 51.

¹⁵ Castro, P., 2010. Climate change mitigation in advanced developing countries: Empirical analysis of the low hanging fruit issue in the current CDM, Working paper 54, Center for Comparative and International Studies, Swiss Federal Institute of Technology Zurich and University of Zurich, Zurich.

¹⁶ Excluding the “all EE” and “all RE” and “all LULUCF” groupings there are 18 distinct GEF CCM project types shown in table 5.

¹⁷ Rahman, S.M., Larson, D., Dinar, A., 2012. The Cost Structure of the Clean Development Mechanism, World Bank, Washington, DC.

Annex 2 - Cost Per Ton Analysis Distinguishing Technology Transfer and non-Technology Transfer Projects

Table A2. Estimated GEF cost per ton (excluding co-financing) of GEF CCM projects at project start, across the range of GEF CCM focal strategies. Compared with the analysis presented in the body of the report in table 5, projects defined by the GEF CCM team as “technology transfer” projects are here distinguished from non-technology transfer CCM projects. This analysis reveals that technology transfer projects have higher median costs per ton than non-technology transfer projects for EE and RE project categories. However, the sample size is too small to draw any firm conclusions in this regard.

GEF CCM focal areas		Number of projects with direct cost estimates	Median cost (USD) per ton of direct CO2eq mitigation	Average cost (USD per ton) of direct CO2eq mitigation	Number of projects with direct+indirect cost estimates	Median cost (USD) per ton of direct +indirect CO2eq mitigation	Average cost (USD) per ton of direct+indirect CO2eq mitigation
Technology Transfer	EE Tech Transfer	7	4.5	3.5	7	3.1	0.3
	RE Tech Transfer	14	76.0	1.8	14	6.2	0.1
	Other Tech Transfer	18	2.1	1.6	21	1.9	0.2
	All Tech Transfer	39	5.8	1.8	42	2.6	0.2
Energy Efficiency	Appliances	23	1.2	0.4	24	0.5	0.2
	Buildings	48	6.5	0.8	50	0.8	0.2
	Combined EE	13	5.0	0.7	13	1.2	0.2
	Energy Supply/ESCOs	31	3.7	1.2	31	2.6	0.4
	Industrial Processes	32	4.3	1.1	33	2.0	0.3
	Lighting	18	8.5	1.0	18	1.5	0.2
	All EE	175	4.2	0.9	179	1.2	0.2
	Renewable Energy	Biomass	28	7.2	5.2	28	3.3
Combined RE		67	10.5	1.7	68	4.4	1.2
Geothermal		7	1.7	1.3	8	0.4	0.2
Hydro		19	9.9	3.3	19	2.0	0.3
PV		27	54.4	29.2	27	33.2	12.7
Solar thermal		8	5.9	1.9	8	3.3	0.4
Wind		9	8.2	5.1	11	1.0	0.1
All RE		168	10.3	2.3	173	4.1	0.6
Transport		45	6.9	3.1	46	2.9	0.7
LULUCF	LULUCF (no SFM/REDD+ funding)	15	2.9	0.7	15	1.9	0.2
	LULUCF with SFM/REDD+	29	1.3	0.4	29	1.1	0.4
	All LULUCF	44	1.8	0.4	44	1.2	0.3
Mixed ^A		48	4.9	0.8	49	2.7	0.2
SLCFs		12	3.1	0.9	12	3.1	0.9
All projects		532	5.8	1.2	547	2.2	0.3

^A Mixed projects are those involving multiple CCM focal strategies.

Note that that average costs are computed over the total focal area and not as an average of individual project cost per ton values. SLCFs is not a GEF CCM strategy. These projects, which primarily involve methane abatement, have largely been grouped with “other” projects in GEF reporting to the UNFCCC.

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