

**OPERATIONAL PROGRAM NUMBER 7
REDUCING THE LONG-TERM COSTS
OF LOW GREENHOUSE GAS-EMITTING ENERGY TECHNOLOGIES**

7.1 The United Nations Framework Convention on Climate Change (UNFCCC) seeks to stabilize atmospheric greenhouse gas concentrations at levels that would prevent dangerous anthropogenic interference with global climate. Clearly, this stabilization will require greatly increased utilization of renewable energy technologies (RETs). In fact, widespread application of RETs offers some of the best prospects for achieving deep reductions in greenhouse gas emissions at the global level over the next century while satisfying some of the increased demand for commercial energy. The Operational Strategy of the GEF puts initial emphasis, among others, on three Operational Programs that address long-term program priorities of the Convention to mitigate climate change. This, the third of these, deals with the reduction of the long-term costs of low greenhouse gas-emitting energy technologies.

GUIDANCE

7.2 At its first meeting, the Conference of the Parties (CoP) of the UNFCCC asked the GEF, as the interim operating entity of the financial mechanism...

...to adopt a mixed strategy wherein projects will be selected with a double set of program priorities as described in paragraph 9(c) of the [GEF] report, that is, if they meet either one of the long-term program priorities or one of the short-term program priorities.

7.3 The CoP also provided the following initial guidance that the GEF, as the interim operating entity of the financial mechanism of the Convention, should support agreed activities in Parties not included in Annex I to the Convention¹ that:

- (a) are country driven and in conformity with, and supportive of, national development priorities;
- (b) are consistent with and supportive of internationally agreed programs of action for sustainable development;
- (c) transfer technology that is environmentally sound and adapted to suit local conditions;

¹ When the GEF provides assistance outside the Convention's financial mechanism, it will ensure that such assistance is also fully consistent with the guidance provided by the CoP.

- (d) are sustainable and lead to wider application;
- (e) are cost-effective;
- (f) strive to leverage other funds; and
- (g) mitigate climate change.

PROGRAM OBJECTIVE

7.4 The stabilization of greenhouse gases (GHGs) at levels that will prevent serious anthropogenic interference with the climate system can be achieved only through dramatically increased utilization of the so-called “backstop” technologies, such as renewable energy technologies with low emissions of greenhouse gases. The GEF has been requested to promote these backstop technologies as a strategy to accelerate their reduction in costs and their increase in market share.

7.5 The objective of this Operational Program is to reduce greenhouse gas emissions from anthropogenic sources by increasing the market share of low greenhouse gas-emitting technologies that have not yet become widespread least-cost alternatives in recipient countries for specified applications. The objective will be achieved by GEF’s promotion of such technologies so that, through learning and economies of scale, the levelized energy costs will decline to commercially competitive levels. Programmatic benefits also can result from structured learning from projects implemented. The effectiveness of this learning is estimated by more qualitative performance indicators. Meeting the overall programmatic objectives depends, however, on two key assumptions, which concern replication and scope.

Replication

7.6 The first assumption is that when technologies have been reduced in cost to levels competitive with fossil fuels, the technologies will be implemented wherever it is economic to do so. In order to reduce the risk that this does not occur, technologies “graduating” from this Operational Program may need some additional support in countries where barriers exist. In this case, they would be included in Operational Program Number 6 which deals specifically with removing the barriers to renewable energy.

Scope

7.7 The second assumption is that successful outcomes will be achieved in many of the various promising new energy technologies that will be needed to reduce GHG emissions in the long term. Initial GEF activities would focus on those technologies that have been proven or demonstrated on a commercial scale but that have not found significant application in recipient countries because of high technology transfer costs, replication costs, or commercial risks associated with the new technologies in new operational environments. For cost-effectiveness, the scope of the technologies covered by the Operational Program needs to be limited to those whose costs will drop significantly with economies of scale in manufacture and application. However, to reduce the portfolio risks and to widen the geographical coverage², the scope of the technologies covered should not be too narrow. Therefore several backstop technologies for both supply and demand sides will be considered.³ Initially, following STAP consultations, the following supply-side technologies would be emphasized:

- (a) photovoltaics for grid-connected bulk power and distributed power (grid reinforcement and loss reduction) applications;
- (b) advanced biomass power through biomass gasification and gas turbines;
- (c) advanced biomass feedstock to liquid fuels conversion processes;
- (d) solar thermal-electric technologies in high insulation regions, initially emphasizing the proven parabolic trough variant for electric power generation;
- (e) wind power for large-scale grid-connected applications;
- (f) fuel cells, initially for mass transportation and distributed combined heat and power applications; and

² Although many projects under this Operational Program will be in countries where the technology will directly replace (or reduce) fossil fuels, no eligible recipient country will be excluded from the program's scope for this reason. The technology is the focus of attention, rather than the market or region. The most cost-effective applications, wherever they are, will then help build a market for the technology and thus help reduce GHGs in the long term. The cost-effectiveness of GEF operations in this program can be enhanced by financing the incremental costs of appropriate technologies with steep learning curves and where the GEF has the ability to make a difference.

³ Following STAP's initial review of these technologies, we expect the following considerations to be important in the selection of a technology-application in ensuring the cost-effectiveness of GEF operations: extent to which basic RD&D has already been done (for technologies where the markets are both in recipient and developed countries) or significant prior operational experience exists; size of remaining technological barriers and risks; technology's current cost; prospects for reduction in costs of the technologies in question (steep learning curves); contribution that GEF financing can make to cost reductions; and the primary market is in the recipient countries because of resource endowment and potential for that technology, when commercial, to reduce greenhouse gas emissions.

- (g) advanced fossil fuel gasification and power generation technologies, initially to include integrated coal gasification/combined cycle technologies.

7.8 One of the risks with technology promotion programs worldwide, experience has shown, is that “surprises” are common. To minimize the risk of backing a loser or not backing a potential winner, the scope above will not be fixed indefinitely but will be reviewed and modified on the basis of experience in the portfolio and new information. While the above technology options are expected to attract the bulk of initial GEF funding under this program, an application of a technology could be removed from this program (for example, upon reaching cost goals). Likewise, a new application of a technology could be added. Thus for example, other solar thermal technologies (central receivers or parabolic dishes) or other fuel cell technologies (molten carbonate, solid oxide, and proton exchange membrane) may be considered for programmatic support in the future.

EXPECTED OUTCOMES

7.9 GEF will achieve its program objective of GHG emission reduction if the selected technologies become increasingly competitive and penetrate energy markets in recipient countries. A project leads to reduction in GHG emissions not only directly but also indirectly by being one of a series of projects that induce cost reductions in the technology and help it penetrate energy markets. The specific outcomes expected are the increased market shares for each of the technologies, beyond that comprising the GEF projects themselves.

7.10 A monitorable indicator of such outcomes is the diffusion or market share of the technologies in specified applications financed by the GEF. The indicator of cost-effectiveness of the use of GEF resources would be the increase in market share (over and above what it would have been) per unit expenditure of GEF resources.

PROJECT OUTPUTS

7.11 There are two main types of project output. The direct outputs of the low GHG emitting technology project are the amount of energy generated, the amount of GHG emissions avoided, etc. The indirect project output, of greater programmatic interest, is the reduction in cost (for future procurements) that it caused. These cost reductions should carry over to applications of the same technologies in other sectors and countries. Thus for example, a decline in the cost of PV cells induced by GEF projects

for electricity generation will also affect the competitiveness of producing (solar) hydrogen by electrolysis using PV cells.

7.12 While most of the reductions in levelized energy costs will come from declines in manufacturing costs and increases in process efficiencies, reductions are also likely to arise from other stages such as installation, operation, and maintenance. Therefore, besides monitoring the declines in quoted prices of the technology in international markets, the operational performance of plants will also have to be monitored closely. In order to determine the extent to which this reduction in prices is leading to the desired outcome of increased market share, the prices of competing technologies will also need to be monitored.

7.13 There are three key assumptions for cost reductions to lead to increased competitiveness and market share. One is that cost reductions will in fact be passed on; two, that cost reductions are not limited to the enterprises receiving GEF financing, and three, that there are no countervailing reductions in international prices of competing fuels (particularly fossil fuels) and competing technologies.⁴ The long-term dynamics of a competitive market, given its potential size, will help to ensure that cost reductions will be passed on.

GEF ACTIVITIES

7.14 GEF activities under this Operational Program will address identified national priorities and needs, and build upon previous GEF, bilateral, and multilateral experience. National priorities and future project opportunities are expected to be identified in National Communications and the several on-going enabling activity projects.

7.15 The activities would be coordinated with past⁵, ongoing, and prospective work of the Implementing Agencies (in both their GEF and non-GEF capacities) and others to avoid duplication. Primary coordination is required between UNDP, UNEP, and the World Bank to ensure that targeted research addresses information gaps on technology status and suitability; and that technical assistance, capacity-building, pre-investment, and pilot demonstration activities fit with follow-on investment priorities. Work has

⁴ This risk is generic to all long-term Operational Programs in the energy sector.

⁵ The GEF Pilot Phase offered only modest support for projects fitting the presently defined operational program on low GHG emitting technologies. Project investment and supporting technical assistance were limited in the Pilot Phase to essentially two projects. The UNDP/GEF engineering technical assistance project supporting the development of the Brazil Biomass Gasification/Gas Turbine stands out as the only applied R&D activity in the portfolio to date. A growing pipeline of medium scale grid-connected PV applications is materializing in the India Alternative Energy Project.

also to be coordinated with bilateral, multilateral agencies, and governments, as they provide the resources for baseline funding.

7.16 GEF will finance activities, including project preparation, on an incremental cost basis. The types of activities that can be financed include targeted activities in research, capacity building, technical assistance, and investments.

- (a) **targeted research** on cost reduction curves; on integrating information on country resource endowment with cost-effectiveness of potential applications; on the present and prospective readiness; on potential costs and benefits of selected technologies and adaptation to local conditions;
- (b) **capacity-building and technical assistance** for reducing uncertainties about costs, performance, and benefits; for strengthening local capabilities to operate, manage, maintain, and evaluate new technologies and their applications; for improving local capacity to integrate new energy sources into conventional supply systems, and for identifying, planning, and implementing follow-on projects. This category also includes institutional strengthening to adopt supportive regulatory frameworks; and
- (c) **investment** in the most promising applications conforming with operational program guidance. Cost reductions will be accomplished by promoting technology transfers, joint ventures, local manufacturing, learning by doing, and achieving economies of scale.

7.17 The cost-effectiveness of GEF activities will be higher where:

- (a) the resource base is near the project site;
- (b) stakeholders participate in the technology development and commercialization;
- (c) the market can mobilize complementary domestic, bilateral, multilateral, and private sector resources in support of program objectives;
- (d) there is a National Communication or other information about opportunities and priorities;
- (e) there are conducive sectoral policies and a lack of barriers;
- (f) the prospects for local manufacturing are good;

- (g) the technologies can be introduced in commercial environments as opposed to purely demonstration environments;
- (h) project structures assign technological and operational risks to those parties best able to control and mitigate them (e.g., independent power producers); and
- (i) there are financial incentives for continued operations rather than a need for subsidizing recurrent costs.

7.18 Each GEF project proposal document will show which of the above characteristics pertain and how the activities will be coordinated. It will also:

- (a) justify the choice of the technology based on scientific and technical considerations, the resource base in the host country, and the prospects for sustainability and replicability;
- (b) set out the programmatic cost reduction objective;
- (c) estimate the level of funding required to achieve the programmatic cost reduction objective and identify the necessary capacity building, targeted research, and investment needs;
- (d) assess the programmatic impact of the GEF;
- (e) estimate the financial requirements and time horizon of the activities; and
- (f) show how the programmatic benefits will be monitored and evaluated.

7.19 The success of these activities would be monitored by appropriate performance indicators of quality (e.g., were best practices used?) and of efficiency with which the inputs were used.

PUBLIC INVOLVEMENT

7.20 It is one of ten basic operational principles for GEF that its projects will provide for consultation with, and participation as appropriate of, the beneficiaries and affected groups of people. In many instances the direct participants in this Operational Program will be parastatal organizations. In cases of projects dealing with decentralized energy production, especially in rural areas, public participation of affected beneficiaries will not only be appropriate, but also essential for the success of

the project. Recently the GEF Council approved a paper on *Public Involvement in GEF-Financed Projects* that defines policies for information dissemination, consultation, and stakeholder participation in projects financed by the GEF.

RESOURCES

7.21 Given the long lead times for the development and deployment of highly capital intensive backstop technologies, as well as the time required to move down learning curves, time horizons for the achievement of program objectives will typically be on the order of decades. The technologies identified under this program will require the security of funding and long-term commitment of GEF support. Analysis of indicative project pipelines and estimates of minimum “critical mass” of support for the various technologies under this program suggest an initial requirement of \$100 million per year in GEF grant resources, gradually rising to \$200 million per year, over 5 to 10 years as investment demand and absorptive capacity grow.

7.22 One analysis of the median amount of resources required to induce cost reductions in just one of the technology-applications listed in the Operational Program (for large scale electricity production using PV cells) is around US\$ 3.3 billion, about half of which would be for applications in developing countries. It is therefore clear that the GEF should choose technologies for this Operational Program where it can leverage resources of other “players” as well. The GEF will undertake further work on determining the longer term resource requirements.