Cover Note

Project Name: Egypt: Fuel Cell Bus Demonstration Project in Cairo
Date: 26 January 2001

	I. WORK PROGRAM INCLUSION	II. REFERENCE/NOTE
1. Country Ownership		
• Country Eligibility		• Cover Sheet page 1 (Ratified UNFCCC 5 December 1994
• Country Drivenness	Clear description of project' s fit within: • National reports/communications to Conventions • National or sector development plans	• Pg. 4-5 *(para. 2-6)* address national priorities in this sector • Pg. 4 *(para. 2)* addresses national plar and specific in-country institutional support.
• Endorsement	• Endorsement by national operational focal point.	• OFP endorsement letter for this projec is on file (attached as annex D)
2. Program & Policy Conformity		
• Program Designation & Conformity	• Describe how project objectives are consistent with Operational Program objectives or operational criteria.	• Pg. 7-8 *(para.16-22)* and Annex A-1
• Project Design	Describe: • sector issues, root causes, threats, barriers, etc., affecting global environment. • Project logical framework, including a consistent strategy, goals, objectives, outputs, inputs/activities, measurable performance indicators, risks and assumptions. • Detailed description of goals, objectives, outputs, and related assumptions, risks and performance indicators. • Brief description of proposed project activities, including an explanation how the activities would result in project outputs (in no more than 2 pages). • Global environmental benefits of the project. • Incremental Cost Estimation based on the project logical framework. • Describe project outputs (and related activities and costs) that result in *global* environmental benefits • Describe project outputs (and related activities and costs) that result in joint *global and national* environmental benefits. • Describe project outputs (and related activities and costs) that result in *national* environmental benefits. • Describe the process used to jointly estimate incremental cost with in-country project	• Sector and root cause issues are in pg. to 7 (*para. 2-17*); barriers on pg. 10-1 *(para. 32 – 35)* • Pg. 6-8 (*para. 11-14*); Annex B (pg. B 1 to B-3) • Objectives on pg. 7-8 *(para. 17-19)*; outputs on pg 9-12 (*para 24-44*) risks on pg. 19-20 *(para. 80-83)*; indicators pg. B1 to B3 in Annex B • Activities on pg. 13 to 18 *(para.45 – 72)* • Global benefits on pg.6-7 *(para.15-16); and* table 2 on pg 25 • Section VI (pg. 24-26); and Annex A detail incremental costs • Pg 8-10, 12-13 *(para. 23-31; 40-44)* • Annex A describes global and nationa environmental benefits; pg 11 (*para 37-39)* • Page 10-11 *(para 32-35)* • pg. 24 (*para. 98*), tables 2 and 3 on pg 25 and table on pg. A5-A6 details

	I. WORK PROGRAM INCLUSION	II. REFERENCE/NOTE
	partner. • Present the incremental cost estimate. If presented as a range, then a brief explanation of challenges and constraints and how these would be addressed by the time of CEO endorsement.	incremental costs sharing among partners. • Chapter 6 pg. 24 to 26 presents cost estimates as well as tables on pg. A5-6
• Sustainability (including financial sustainability)	• Describe proposed approach to address factors influencing sustainability, within and/or outside the project to deal with these factors.	• Sustainability is addressed in pg. 18-19 *(para. 73-78)* and in tables A1&2 pg. A4-5
• Replicability	• Describe the proposed approach to replication (for e.g., dissemination of lessons, training workshops, information exchange, national and regional forum, etc) (could be within project description).	• Pg. 6 (*para. 14*); pg. 11 (*para. 37-39)*; pg. 14 (*para. 48*); pg. 18 (*para. 72)*; p 18-19 (*para. 73-76)*.
• Stakeholder Involvement	• Describe how stakeholders have been involved in project development. • Describe the approach for stakeholder involvement in further project development and implementation.	• Stakeholder involvement in project development is addressed on pg 16 (*para 84*) • Ongoing stakeholder involvement is o pg. 21 (*para. 85*) and in pg. 4 to 8 (*para. 1-22*) see also comments to STAP review in annex C1
• Monitoring & Evaluation	• Describe how the project design has incorporated lessons from similar projects in the past. • Describe approach for project M&E system, based on the project logical framework, including the following elements: • Specification of indicators for objectives and outputs, including intermediate benchmarks, and means of measurement. • Outline organizational arrangement for implementing M&E. • Indicative total cost of M&E (maybe reflected in total project cost).	• Lessons learned from similar projects on pg. 5 (*para. 7-8)*; pages 6 (*para. 20);* page 11 (*para. 35-36)*, page (*para. 29, and 37-39)*. • Monitoring and evaluation is describe on pg. 27 *(para.101-105)* • Indicators are addressed on pg. B1 to B3 in Annex B • M&E implementation on pg. 27 *(para 101-105)* and pages 17-18 (*para 64-69* • Cost of M&E in tables on pg. A5-6
3. Financing		
• Financing Plan	• Estimate total project cost. • Estimate contribution by financing partners. • Propose type of financing instrument.	• Financing plan including total project cost and co-financing is in pg. 24 to 26 table 3&4; tables on pg. A5-6 details the contributions of financing partners
• Implementing Agency Fees	• Propose IA fee.	• The CO fee under a cost recovery structure
• Cost-effectiveness	• Estimate cost effectiveness, if feasible. • Describe alternate project approaches considered and discarded.	• Page 8 (*para. 21), page 9 (para. 26*), page 9-10 (*para. 28-29*), page 10 (*para. 31*), and page 11 (*para. 36*) • Page 9-10 (*para 28-31*)

	I. WORK PROGRAM INCLUSION	II. REFERENCE/NOTE
4. Institutional Coordination & Support		
IA Coordination and Support • Core commitments & Linkages	Describe how the proposed project is located within the IA's: • Country/regional/global/sector programs. • GEF activities with potential influence on the proposed project (design and implementation).	• This project is part of the global framework to develop fuel-cell buses for the developing world.
• Consultation, Coordination and Collaboration between IAs, and IAs and EAs, if appropriate.	• Describe how the proposed project relates to activities of other IAs (and 4 RDBs) in the country/region. • Describe planned/agreed coordination, collaboration between IAs in project implementation.	• Two related activities take place in Egypt; the UNDP/GEF funded MSP o electric buses (see *para 7-8*) and the USAID funded program on CNG buse (see *para 5*); coordination between those programs and the current proposal is ensured through the involvement of GCBC, EEAA and UNDP in those programs.
5. Response to Reviews		
Council	Respond to Council Comments at pipeline entry.	Council did not provide comments at that stage
Convention Secretariat	Respond to comments from Convention Secretariats.	
GEF Secretariat	Respond to comments from GEFSEC on draft project brief.	
Other IAs and 4 RDBs	Respond to comments from other IAs, 4RDBss on draft project brief.	
STAP	Respond to comments by STAP at work program inclusion	
Review by expert from STAP Roster	Respond to review by expert from STAP roster.	• See annex C1

PROJECT BRIEF

1. IDENTIFIERS

PROJECT NUMBER	**EGY/**
PROJECT NAME	**Egypt: Fuel Cell Bus Demonstration Project in Cairo, Phase I**
DURATION	5 Years, divided into two implementation segments of 1 and 4 years duration
IMPLEMENTING AGENCY	United Nations Development Programme
EXECUTING AGENCY	Egyptian Environmental Affair Agency (EEAA) Great Cairo Bus Company (GCBC)
REQUESTING COUNTRY	Arab Republic of Egypt
ELIGIBILITY	Egypt ratified the FCCC on December 5, 1994
GEF FOCAL AREA	Climate Change
GEF PROGRAMMING FRAMEWORK	Sustainable Transport, Operational Programme No. 11

2. SUMMARY

This project, Part I of a two-part project, proposes a five-year demonstration program to operate eight fuel cell buses (FCBs) for public transport in Cairo under actual revenue service conditions. The major objective is to introduce this zero emission bus technology in Egypt as a long-term solution to the severe urban transport pollution problem in Cairo and to reduce global GHG emission. It will assist the Egyptian transport sector to gain experience in operating, and servicing FCBs under local conditions. It will also help increase the initial volume demand for FCBs and provide much needed feedback of fleet operating experience for the manufacturers to further improve their products and accelerate the commercialization.

This project has been prepared and submitted consistent with the *GEF FCB Strategy*, presented and discussed by the Council at its meeting in November 2000. The Egypt project contributes uniquely to the FCB commercialization portfolio in two ways. First, while the project will obtain hydrogen from electrolysis, Egypt has an abundant supply of natural gas and huge wind, solar, and hydro resources. The Egypt case presents significant flexibility in fuel supply. Second, Egypt represents an important part of the global market for buses, notably it is the largest country and the key to the market in the Middle East and Africa.

The project is designed to be consistent with the terms of GEF Operational Program 11 on Sustainable Transport.

3. COSTS AND FINANCING (MILLION US$)

GEF	**Implementation Part 1**	6.190
	PDF A	0.025
	PDF B	0.295
	Implementation Part 2	5.724
	GEF Subtotal	**12.234**
CO-FINANCING	**Implementation Part 1**	
	IA	0.321
	Government (MF)	1.220
	Government in-kind	1.537
	Private	0.720

Implementation Part 2	
IA	0.465
Government (MF)	2.223
Government in-kind	2.804
Private	1.497
Co-financing Subtotal	**10.787**
Total Project Cost	**23.021**

4. ASSOCIATED FINANCING (MILLION US$) **NONE**

5. OPERATIONAL FOCAL POINT ENDORSEMENT

Name: Dr. Ibrahim Abdel Gelil Title: CEO
Organization: Egyptian Environmental Affairs Agency Date: August 29, 2000

6. IA CONTACT

Mr. Marcel Alers, GEF Regional Coordinator, Regional Bureau for Arab States, UNDP
Mr. Richard Hosier, Principal Technical Adviser, Climate Change, UNDP-GEF

LIST OF ACRONYMS/ABBREVIATIONS

CAIP	Cairo Air Improvement Program
CNG	Compressed natural gas
CTA	Cairo Transit Authority
EEA	Egyptian Electricity Authority
EEAA	Egyptian Environmental Affairs Agency
EGPC	Egyptian G eneral Petroleum Company
FCB	Fuel cell bus
GCBC	Greater Cairo Bus Company
GHG	Green house gas
MP	Ministry of Petroleum
NREA	New and Renewable Energy Authority
OEP	Organization of Energy Planning
PEM	Proton exchange membrane
USAID	U.S. Agency of International Development

I. BACKGROUND AND CONTEXT

1. Cairo has been identified as one of the 20 mega-cities in the world, with a population of more than 13 million. The urban transport in Cairo emits intensive amount of GHG and causes serious air pollution problem. The proposed project is intended to introduce the highly efficient, clean, and potentially low cost fuel cell technology for public transport in Egypt to reduce the global GHG emission and air pollution in Cairo.

2. Due to the serious air pollution and GHG emission problems from urban transport, the Egyptian Environmental Affairs Agency (EEAA) has compiled a Climate Change Action Plan with the following initiatives:

(a) Use clean fuels, such as CNG (compressed natural gas) and hydrogen, for cars and buses;
(b) Review and revise current vehicle emission limits in the Environmental Law #4 for more stringent standards;
(c) Impose vehicle emission testing as a pre-requirement for vehicle license issuance or renewal by a technical unit within traffic management authorities;
(d) Retrofit or replace two-stroke engines of motorcycles by four-stroke engines with CNG as fuel;
(e) Introduce applicable traffic management plans to reduce urban transport congestion and vehicle on-road time;
(f) Conduct public awareness campaign on air pollution;
(g) Expand the current underground electric metro system in three stages to cover the greater Cairo, including the Cairo airport;
(h) Improve public bus comfort by mandating air conditioning for all new buses purchased; and,
(i) Increase the use of River Nile for public transport.

3. The last three initiatives are geared to attract private car passengers for using public transport, as recent dramatic increase of passenger cars in Cairo and other Egyptian cities is a major cause of the urban transport pollution. To implement the traffic management in Initiative (e) above, the Egyptian government has already taken actions by introducing traffic light synchronization, one-way streets, and free intersection, in greater Cairo, and using commuter lanes in Alexandria in rush-hours.

4. Cairo currently has two public bus companies: Cairo Transit Authority (CTA) and Greater Cairo Bus Company (GCBC). GCBC is a wholly owned subsidiary of CTA, formed to avoid cumbersome and restrictive government rules as to provide more efficient bus services. It will be the host for the proposed project. CTA and GCBC at present have approximately 3,600 full size (12 m long) buses and 17 garages. All the buses are diesel buses manufactured and assembled locally in Egypt.

5. As part of the Climate Change Action Plan implementation, CTA and GCBC are currently introducing CNG buses through a demonstration project under the USAID funded Cairo Air Improvement Program (CAIP). CNG engines are commercial technology and are an immediate

solution to the pollution problem in Cairo. However, they are basically modified diesel engines and thus cannot completely get rid of the air pollutants and still have high maintenance cost. More importantly, CNG engines have 30% lower efficiency than diesel engines and this diminishes their value in terms of CO_2 emission reduction.

6. In comparison, fuel cell engines have higher efficiency than diesel engines and the hydrogen used can be produced with very little or no CO_2 emission. Besides, methane leakage from the CNG compression and dispensing cannot be always avoided. Thus, only FCBs are an effective ultimate solution to the GHG emission and air pollution problems in Cairo. As the hydrogen refueling uses essentially the same technology as CNG refueling and the hydrogen production in Egypt will be most likely based on natural gas, the buildup of infrastructure for natural gas distribution and CNG fueling in the current pursuit of CNG buses will provide a good base for future switching to FCBs. As the CNG buses are still being introduced to Egypt, the diesel buses are the baseline case for this project.

7. GEF is sponsoring another project in Cairo to demonstrate electric buses to be used as shuttles around the great pyramids. These shuttle buses, being procured under the GEF-sponsored MSP entitled "Introduction of Viable Electric and Hybrid Electric Bus Technology in Egypt", are expected to begin operation in early 2001. As described in the proposal, electric, hybrid-electric, and fuel cell buses are all based on the same propulsion technology; namely, electric motors with power electronics. The difference among the three is the energy conversion or storage device. Issues such as drive-train maintenance, operator training, technology training of engineers, must begin and are common to all three platforms. Both projects are integral parts of Egypt's strategy to develop clean, sustainable transport for its long-term development.

8. The funding of the electric and hybrid electric bus pilot project will enhance the chances of success of the fuel cell program since the technical challenges arising from the vehicle-specific technologies will already be addressed. It should further be pointed out that the electric buses will be used in very specific situations, in particular for shuttle services in congested areas and on specific tourist sites, where they offer a sound solution. Replacement of the batteries in a 5-10 km circular route is easily achieved once or twice per day. This system is the preferred choice for some of the US national parks in especially environmentally-sensitive areas. The fuel cell initiative is targeting a much wider application of regular bus transport throughout the city of Cairo and eventually in other major urban centers.

9. In Egypt, the bus manufacturing/assembly industry was established more than 40 years ago. There are four major bus manufactures (NASCO, MCV, GEG, and Ghabbour Egypt), which produce more than four thousand buses annually. All the buses produced are consumed domestically, one third for inter-city and city transport and the rest mainly as tourist buses due to the flourishing tourist industry in Egypt.

10. Except NASCO which is state owned, all other bus manufactures are privately owned either through joint ventures with local firms or under direct license with the three global truck and bus manufactures: Mercedes-Benz, MAN, and Scania. These privately owned companies are all equipped with the state-of-the-art bus manufacturing and assembly facilities. For the proposed demonstration project, Mercedes-Benz has already planned to engage their local bus manufacture

in Egypt, MCV, to respond to the tender. Thus, the buildup of local capability to manufacture and supply FCBs in Egypt is expected to have a high probability to succeed.

II. RATIONALE AND OBJECTIVES

11. At the GEF Council Meeting in November 2000, the GEF held discussions led jointly by the GEF Secretariat and UNDP on a "***GEF Strategy to Develop Fuel-cell Buses (FCB) for the Developing World***". This meeting summarized the outputs of a series of workshops sponsored under the UNEP Medium-Sized Project "Fuel Cell Bus and Distributed Power Generation Market Prospects and Intervention Strategy Options**".** These workshops – which included participants from private industry, public sector transit agencies in both developed and developing countries, and members of the GEF Secretariat and Implementing Agencies – shaped the *GEF FCB Strategy* for the development of FCBs in GEF recipient countries, consistent with the objectives of Operational Program (OP) 11, Sustainable Transport.

12. The Council decision that "…GEF should develop the five fuel cell bus projects currently in its pipeline…" is consistent with the strategy presented. That strategy proposed GEF support for preparatory, demonstration, and commercialization phases. This project, which has met all of the quality criteria developed as part of the GEF strategy development process, represents a demonstration phase project. Its results will be carefully monitored prior to submitting any future commercialization phase proposal.

13. The FCB project based in Cairo is unique in that it deals with the Middle Eastern and African bus market. The conditions in Egypt will allow the opportunity for performance testing of fuel cells that will provide valuable information for similar climatic/geographic regions in the world. This project will also use a centralized natural gas reforming plant with the product hydrogen delivered to the bus garages by a gas pipeline and CO_2 recovered and sequestered in a spent gas well.

14. Given that the Egypt project is as part of the larger GEF FCB portfolio of projects, this project will benefit from the planned coordination between all GEF FCB projects. Three key coordination approaches are planned: (i) to maximize lessons learned and the sharing of knowledge between the FCB projects, a series of workshops will be organized by the UNDP-GEF that will bring together key stakeholders from the Egypt project with those from other FCB projects; (ii) the FCB Private Sector Advisory Group is intended to provide guidance and support to all of the GEF FCB projects, including Egypt; (iii) a GEF FCB website will be developed and maintained, and will host information on progress, lessons learned, and research associated with all FCB projects. This website is intended to facilitate communication between the FCB projects.

15. Currently, almost every major automobile company in the world is pursuing the development and commercialization of fuel cell technology (mainly Proton Exchange Membrane fuel cells) in earnest. This is because the technology has the following major advantages:

(a) It is highly efficient (30-100% more so than internal combustion engines, depending on the driving cycle) even after taking into account the required fuel conversion to hydrogen; the high efficiency is derived from its direct power extraction from fuel without converting fuel to heat and then heat to power; it is also a result of the fuel cell engine' s special characteristics of which the engine efficiency actually increases when the engine load decreases; i.e. no part load efficiency penalty

(b) It is absolutely clean due to the lack of combustion (zero emission with water vapor as the only exhaust) and has low noise and vibration
(c) It is highly reliable and thus has low maintenance cost; this is due to its low operating temperature (80 C) and the lack of moving parts
(d) It has very high cost reduction potential; this is due to its need of only low temperature construction materials and intrinsic simplicity of the fuel cell stacks and supporting system

16. But more importantly from the global climate change perspective, the fuel cell technology can substantially reduce or eliminate GHG emission. This is due to its high efficiency and the ability to use low carbon fuel (such as natural gas) or renewable energy (such as wind/solar/hydro power) to produce the hydrogen required. In the case of using renewable energy, there is no CO_2 emission at all. In the case of using low carbon fuel, high concentration of CO_2 can be recovered and sequestered very easily and economically from the hydrogen production process to eliminate most of the GHG emission.

17. Egypt is endowed with abundant supply of natural gas at an estimated reserve of more than 50 years. It also has large resources of wind power (20,000 MW), solar power (4,000 MW), and hydropower (2,500 MW), although only the hydropower has been fully exploited. Just the wind power potential alone is more than sufficient to meet the nation' s total power consumption of 13,000 MW. Thus, Egypt is an ideal country to implement the fuel cell technology for the global GHG reduction. Egypt currently has a net import of diesel fuel. The fuel cell technology would also allow Egypt to use the indigenous energy resources to replace diesel import.

18. The proposed demonstration project has the following specific objectives:

(a) Verify the efficiency, operability, reliability, and maintenance requirements of FCB
(b) Build up the local experience and capability in both personnel and parts supply for operating and maintaining FCBs and hydrogen facilities
(c) Demonstrate to the public and gain acceptance from them the operability, safety, high performance, and low emission of FCBs and hydrogen production and fueling facilities
(d) Provide opportunities for the local bus manufactures to integrate and assemble FCBs with imported engines and chassis
(e) Induce the universities and research institutes in Egypt to get more involved in fuel cell technology
(f) Establish policy changes and codes/standards to promote the use of fuel cell technology
(g) Increase the volume demand of FCBs, jointly with other GEF FCB demonstration projects, to accelerate the commercialization
(h) Accumulate experience as input to FCB developers to further improve their products and accelerate commercialization

19. Most of the objectives above are geared for the FCB technology to take root in Egypt so that a full commercial implementation of the technology can be materialized later to contribute to the global GHG reduction. These objectives are also set to lead Egypt to become a regional or worldwide FCB supplier. This will be accomplished by building upon the manufacturing expertise gained during the demonstration project and the low labor cost in Egypt. The new business created can contribute significantly to the nation's economy.

20. The fuel cell vehicles are currently very close to being ready for market entry. Two FCB demonstration projects (Chicago Transit Authority in Chicago and B.C. Transit in Vancouver), each involved three buses in actual revenue services, have successfully concluded their two-year operation recently. Under the California Fuel Cell Bus Alliance Program, the Sunline Transit Bus in Palm Desert and AC Transit Bus in Oakland each just started to operate two FCBs from Xcellsis, also in actual revenue services. The total number of buses could increase to ten by expanding the program into other California cities. The European community has initiated a program to purchase thirty FCBs from Evobus (a DaimlerChrysler's bus company) based on Xcellsis' technology for demonstration in nine major European cities in early 2002. MAN bus company in Germany has just delivered a FCB (based on Siemens' fuel cell technology) for demonstration in Munich and Erlangen under the Bavarian Government funding. By the end of 2000, MAN will deliver another FCB (based on deNora's fuel cell technology) for exhibition demonstration in several European cities, such as Berlin and Lisbon.

21. The prospect of overcoming the high initial cost barrier of fuel cell engines in order to reach commercialization is probably to be realized first in the bus fleet application because:

(a) The power train is a smaller fraction of the total cost of a bus than a car
(b) The weight and volume constraint imposed by the power train and hydrogen storage is less a challenge for a bus than a car
(c) Buses have substantially higher operating hours than cars, resulting in better utilization of the capital investment
(d) Mass transit buses operate more often than cars at low engine load where the efficiency advantage of fuel cell engines over internal combustion engines is largest
(e) The bus refueling can be scheduled such that no excessive hydrogen production and storage capacity is required while this is difficult to do for passenger cars

22. Due to the reasons given above, the public buses in Cairo are chosen for the demonstration of the fuel cell technology.

III. PROJECT ACTIVITIES AND EXPECTED RESULTS

MAJOR OUTCOMES

23. The demonstration project is expected to generate five major outcomes.

Outcome #1: The performance, operability, reliability, and safety of FCBs and hydrogen facility (production, compression, storage, and dispensing) are verified

24. The demonstration project will purchase the 8 FCBs in two batches as shown in Table 1.

Table 1
Fuel Cell Bus Purchase and Operation Plan

	Number of Buses	Test Duration, year	Bus Availability, %	Hours Driven/Bus	km Driven
1st Delivery	3	3.5	60	12,264	666,855
2nd Delivery	5	2.5	70	10,220	926,188
Total	8			22,484	1,593,043

25. The test duration is three and half years for the first 3 buses and one year shorter for the next 5 buses as the second bus delivery will be one year after the first phase. Allowing one and half years for the bus procurement, fabrication, assembly, and delivery, the total project duration is five years.

26. The FCB technology advances rapidly as demonstrated by the significant weight/size reduction, efficiency improvement, and system simplification in their recently debuted demonstration units. The staged delivery of buses proposed for this project will allow testing of more advanced bus models and also provide a gauge of the technology advancement by a comparison between the first and second batches of buses.

27. These 8 buses will be put into regular revenue service to gain real-time test data and experience. In the regular service, each bus runs on the average 16 hours and 290 km a day, every day of the year. The first and second batches of buses will be operational in 2002 and 2003 and their estimated availabilities according to this time frame are 60% and 70%, respectively. Over the entire test period, this bus fleet will accumulate a total of about 1.6 million km.

28. A system optimization study conducted as part of the PDF-B for the proposed project shows that the best system to supply hydrogen for a full-scale commercial deployment of FCBs in Cairo is a centralized natural gas reforming plant with the product hydrogen delivered to the bus garages by a gas pipeline and CO_2 recovered and sequestered in a spent gas well. This system was selected among eight different cases based on the energy supply and other local conditions in Egypt and several selection criteria, such as the cost of CO_2 reduction, amount of CO_2 reduced, cost of bus driving, capital required, ability to undertake investment, etc.

29. For the demonstration project, it is not practical to construct a centralized natural gas reforming plant. Thus, a packaged electrolyzer unit, including high pressure hydrogen gas storage cylinders, hydrogen compressors, and dispensers, will be purchased and installed at the host garage to meet the hydrogen requirement. The centralized reforming plant, hydrogen pipeline, and CO_2 sequestration facility (pipeline and injection pumps) are all proven technologies and thus it is not essential to demonstrate them in this project.

30. According to the general test experience of new public transportation vehicle technologies, the minimum cumulative driving distance needed to encounter all likely failures in the bus

service is 1 million km. This minimum driving distance will also allow the operators to analyze the causes for the failures and identify possible solutions. The number of buses and test duration chosen in this project will provide an accumulated bus driving distance of 1.6 million km. Thus, it is expected to be sufficient to allow a realistic verification and assessment of the performance, operability, reliability, failure modes, and safety of the FCBs and hydrogen facility. Details of the parameters to be verified are given in Section 2.4 below.

31. In the system optimization study, it was found that FCBs could be more economical than diesel buses even with the additional costs of hydrogen production, transport, storage, compression, and dispensing. One of the main reasons is that public buses run very long hours everyday and the maintenance cost is the single largest cost item of bus operation. The saving on the maintenance cost and reduction on the backup buses required as a result of the higher reliability of FCBs is more than enough to compensate for the hydrogen cost. Thus, the test program of the demonstration project will especially emphasize the verification of the bus reliability and maintenance requirements.

Outcome #2: Local operation/maintenance capability of FCBs and hydrogen facility is built up

32. To ensure this project outcome can be achieved, the bus maintenance crew for the demonstration project will be sent to the bus supplier to observe and participate in the bus integration, manufacturing, and assembly so that they can gain an in-depth understanding of the bus structure and engine function. After the buses are delivered to the garage and start to operate, the technical specialists from the bus manufacture and the engine/chassis supplier will train the maintenance crew on the job until the crew accumulate enough practical experience and knowledge to conduct the maintenance all by themselves.

33. Fuel cell buses are basically electric buses, and as such, they pose different operational challenges than diesel buses. As a result, the maintenance crew will not be drawn from GCBC's current staff. Instead, they will be hired from outside with adequate background skill and education to embrace the new technology. As these personnel need to be exceptionally good and have the responsibility to train other maintenance people as the number of FCBs increases in Egypt in the future, they will be offered higher salaries.

34. Egypt has eight major refineries, several petrochemical complexes, three fertilizer plants, and a chemical plant, which produce large quantities of hydrogen by either natural gas reforming or water electrolysis for their internal consumption Thus, Egypt already has local operating and maintenance capability of hydrogen production facilities. However, this project is still budgeted to obtain technical support from the hydrogen facility supplier for training and facility installation, startup, and operation. This is to guarantee a continuous full supply of hydrogen for the FCBs during the entire project operation.

35. According to B.C. Transit' s experience in the Vancouver demonstration project, each bus operator required only two hours training before they could operate the FCBs and knew how to respond to the road emergency situation. Thus, the build-up of local capability to operate FCBs is not a critical issue.

II. Outcome #3: Local bus suppliers have the FCB manufacturing capability

36. The current full size diesel bus price (without spare parts) is about US$120,000 in Egypt while it is US$235,000 in US/Canada. This large price differential is due to the low labor cost in Egypt and the higher US/Canada bus standards. For these reasons, most of the FCB developers realize that the only effective way to market their products in Egypt is to have the buses manufactured and assembled locally, even for the demonstration project. To ensure this will happen so that the local FCB manufacturing capability can be built up, the tender to procure the buses will stipulate the buses be assembled locally with imported fuel cell engine or chassis. Not all the bus manufactures in Egypt are just assemblers. Some have their own bus body designs built on imported chassis. They can provide design for integrating the glider with imported fuel cell engine or chassis.

III. Outcome #4: Public accepts the use ofFCBs

37. According to the demonstration project experience in Chicago and Vancouver, FCBs can respond to load and speed changes faster than diesel buses and are quieter with less vibration. Most of the passengers who used the service either could not tell the difference from diesel buses or actually felt the FCBs performed better. Thus, the bus performance is not expected to be a key issue for leaving a good impression to the passengers and general public in the proposed project. The key issue would be how to operate the buses reliably and safely under the tough driving condition (dusty air, hot weather, bad roads, and heavy traffic) in Cairo.

38. To address the issue above, the project will devote a special effort in preparing the bus specification to ensure the buses purchased can handle the tough driving condition in Cairo. The project will also work closely with the bus and hydrogen facility suppliers to structure a sound maintenance and safety program, such as the establishment of a preventive maintenance schedule and an extensive review of the hydrogen monitoring/detection/alarm system.

39. Once the buses run well in the regular revenue services, the remaining work to gain public acceptance is relatively straightforward. The project will basically try to establish a good public relation in terms of news release and holding public awareness workshops for the FCB technology.

Outcome #5: Fuel cell bus technology can be sustained in Egypt after the demonstration project

40. All previous outcomes are actually pre-requisitions to achieve this outcome. But to ensure this outcome can be fully attainable, the proposed project needs to and will engage the following activities:

(a) Generate a master plan and schedule for the follow-on activities or projects beyond the demonstration project to finally lead to a full-scale commercial deployment in Egypt

(b) Develop jointly with the Egyptian Government an incentive program for the FCB manufactures and hydrogen facility suppliers to venture into commercial production and marketing in Egypt
(c) Mobilize the technical/scientific societies and regulatory agencies in Egypt to develop necessary codes and standards for a safe use of hydrogen
(d) Entice the research community in Egypt to engage in fuel cell vehicle development as to generate a talent pool to support commercial deployment

41. The master plan mentioned above will include a realistic assessment of the buildup rate and schedule for the number of buses and hydrogen infrastructure required to lead to commercial deployment. The assessment will consider labor, materials, and financial resources availability and limits in Egypt. Part of the assessment will be based on the technology readiness determined from the demonstration project and projected performance improvement and cost reduction from the suppliers. It will also consider the impact of the incentive program on the acceleration rate of the commercial deployment.

42. The incentive program can be direct incentives such as import duty exemption, tax credit for the products, or a soft loan guarantee from the government or World Bank or other multilateral funding sources for the investment required. It also can be indirect incentives, such as eliminating the subsidy from or even adding user tax to the diesel fuel cost, tightening the air emission limits, or imposing tax on air emission or carbon emission. Whatever the final choice is, the project will secure the government' s commitment and establish an implementation schedule to ensure the incentive program will be indeed in place according to the time table in the master plan.

43. To entice the pursuit of fuel cell technology by the research community in Egypt, the project will award several research grants annually for a few selected topics judged useful for the capacity building purpose. Beyond the demonstration project, the master plan will include an element to continue this effort by tax credit to the fuel cell research funded by the bus manufactures and companies of related business.

44. Potential research opportunities under this program are:

- improvements of fuel cell stack components (such as the cell membrane and separator plate) to make them more efficient, cheaper, lighter, or reliable;
- new or improved power train system design to make the system simpler, more efficient, lower cost, dynamically more responsive, or operable over a wider range;
- improvements of power train components (such as the inverter, blower, and electric motor) to make them cheaper, lighter, and reliable; and,
- new or improved hydrogen production processes which are more efficient, require lower cost, or have lower CO_2 emissions.

In addition to the enticement of scientific community to conduct fuel cell related research as discussed above, the project will pursue other scientific involvement as following:

- The scientific community in Egypt will be invited to participate in the planning of the test program and review of the test results. The major technical problems encountered in the bus operation and hydrogen production/refueling will be feedback to the researchers for identifying the research needed;

- Paragraphs 92 and 93 in the Project Brief indicates that the project will issue monthly progress report and also topical reports to monitor and document the project progress. The topical reports related to the test results of the bus and hydrogen facility operation and maintenance would be the key reports to document the technologically relevant outcomes of the projects. These reports will be issued twice a year and distributed to the scientific community in Egypt after the bus and hydrogen facility operation is commissioned; and,
- The project staff and several selected researchers from the scientific community in Egypt will participate in key international fuel cell conferences or workshops to exchange operation experience with other fuel cell bus demonstration projects and to learn the latest technical advancements of fuel cell technologies.

PROJECT ACTIVITIES

45. The overall proposed project will be carried out with five major tasks, conducted under two parts. Part I deals primarily with the fuel cell bus purchase and the establishment of the basic infrastructure (Output 1). Part II involves the production and startup of the complete fleet of FCBs and the hydrogen facility. Parts I and II are closely linked, as the success and outputs of Part I (e.g., successful tendering for the first 3 FCB) are criteria and inputs to Part II (Outputs 2 – 5). A logical framework matrix is shown in Annex B, which links the project output with the major activities described below.

PART I

Ouput 1 – Significant Demonstration of the Procurement of FCBs and their Refueling Infrastructure under Egyptian Conditions

IV. Task 1: Fuel Cell Bus Purchase

Tasks 1.1: Finalize Bus Specification

46. In this task, a technical specification for the FCB will be finalized as the basis for the bus purchase. It will reflect the tough driving condition in Cairo and GCBC' s service requirements. It will also specify the shop inspection and testing requirements, warranty and technical support to be provided, spare parts to be furnished, and required delivery schedule.

47. The specification will be divided into chassis and bus body. The chassis will include fuel cell engine, H2 fuel tank and feeding system, air cleaner, cooling system, exhaust system, transmission, axles and axle reduction, suspension, brake system, steering, instrument panel, towing, etc. The body will include floor, roof, sides, doors, windows, stepwell, seats, stanchion and rail, lighting, air conditioning and ventilation, exterior finish, undercoating, etc. This specification preparation will take advantage of GCBC' s current specification for the diesel buses, particularly that for the bus body.

48. A research program will be established under Part I of the FCB project. This research program will deal with: (a) improvements of fuel cell stack components; (b) new or improved power train system design to make the system simpler, more efficient, lower cost, dynamically more responsive, or operable over a wider range; (c) improvements of power train components and,(d) new or improved hydrogen production processes which are more efficient, require lower cost, or have lower CO2 emissions. An awareness plan will be also be developed, including a marketing strategy and communications plan. All marketing and communications will recognize GEF support for the project, which will include GEF' s logo(s) on the actual FCBs. The communications plan will include outreach efforts that will encompass the larger private sector community as a target for the project results and will facilitate engagement of the FCB Private Sector Advisory Group, as outlined in the UNDP-GEF FCB Strategy Note.

Tasks 1.2: Issue Tender and Award Contract for the Fuel-Cell Buses

49. In this task, a bid package for the buses will be issued to potential suppliers, the bids received will be reviewed and evaluated, and then a contract will be negotiated with and awarded to a selected supplier. The bid package will include the technical specification described above, payment method and schedule, contractual conditions and requirements, and the stipulation of using the local bus integrator/assembler as discussed under Outcome #3.

V. Task 2: Hydrogen Facility Purchase and Installation

Tasks 2.1: Engineering and Site Design

50. In this task, the project team will:

(a) Prepare a technical specification for the packaged hydrogen facility as the basis for the purchase of this facility
(b) Conduct design for the site improvement civil work
(c) Design the hydrogen facility foundation and grounding system
(d) Design the utility supply and connection system, such as the electric supply line, transformer, switch gears, motor control centers, water supply line, and drainage line
(e) Design the required garage modifications to adapt the use of FCBs, including safety monitoring, hydrogen detection/alarm system, and fire protection system

51. Engineering drawings and specifications, such as site layout, piping and instruments diagrams, and electric connection diagrams, will be developed for installation of the hydrogen facility. Technical specifications for the equipment required in the utility support system will be prepared.

Tasks 2.2: Permitting

52. In this task, the necessary documents for obtaining permits to construct and operate the hydrogen facility and FCBs will be prepared and submitted to the relevant agencies. As this

project involves the use of hydrogen and the technology involved is new in Egypt, the permitting process could be lengthy and difficult. The project will prepare the permitting documents and approach the permitting agencies, particularly the fire marshal, as early as possible.

Tasks 2.3: Major Equipment/Facility Purchase

53. In this task, the hydrogen facility and major equipment required for the utility support system will be procured, fabricated, and delivered in a similar fashion as described above for the FCBs (see Tasks 1.2 and 1.3).

Tasks 2.4: Utility Hookup and Site Construction

54. In this task, a construction subcontract bid package will be prepared and issued to potential bidders, the bids received will be reviewed and evaluated, and a contract will be negotiated with and awarded to a selected subcontractor. The subcontractor will install the hydrogen facility and make the utility hookup according to the engineering drawings and specifications developed in Task 2.1.

Part II

Output 2 – Production and Startup of FCBs and H2 Facility

VI. Task 1: Fuel Cell Bus Purchase (continued)

VII. Tasks 1.3: Fabrication and Delivery of the First 3 Buses

55. In this task, the selected bus supplier will fabricate and deliver the buses. Prior to the fabrication, the supplier will submit detailed engineering drawings to the project for review, comments, and approval.

56. At various stages of the fabrication, the project will send technical specialists to check the quality of the key system components and witness any performance test conducted by the supplier on those components. This shop inspection is to ensure the buses are being manufactured according to the specification and to expedite the schedule if necessary.

VIII. Tasks 1.4: Fabrication and Delivery of the Next 5 Buses

57. The scope of work for this task is the same as Task 1.3.

IX. Task 2: Hydrogen Facility Purchase and Installation (continued)

X. Tasks 2.4: Utility Hookup and Site Construction (continued)

58. In this task, a construction subcontract bid package will be prepared and issued to potential bidders, the bids received will be reviewed and evaluated, and a contract will be negotiated with and awarded to a selected subcontractor. The subcontractor will install the hydrogen facility and

make the utility hookup according to the engineering drawings and specifications developed in Task 2.1.

XI. Tasks 2.5: Mechanical Shakedown and Facility Startup (continued)

59. After the hydrogen facility and the utility support system are installed, GCBC, with the assistance from the hydrogen facility supplier and the international/national consultants who provide the engineering, will check the completion of the construction and start up the facility.

Output 3 – Local Operational/Maintenance Capacity in FCBs and H2 Facilities is Built Up

XII. Task 3: Bus/H2 Facility Operation and Maintenance

Tasks 3.1: Operation and Maintenance of the First 3 Buses

60. As mentioned previously (Outcome #1 in Section 2.3), the first 3 FCBs will be operated for three and half years. The training required for the bus operators and maintenance crew and how it is to be provided have also been discussed previously under Outcome #2 in Section 2.3.

Tasks 3.2: Operation and Maintenance of the Next 5 Buses

61. The activity under this task is the same as that described for Task 3.1.

Tasks 3.3: Operation and Maintenance of Hydrogen Facility

62. The hydrogen facility will not be installed in two stages to coincide with the bus purchase. It will be built once to satisfy the hydrogen consumption of all the 8 buses. This is because it can provide significant cost saving due to the economy of scale.

63. The hydrogen facility is designed for unattended operation. Thus, the operator training required prior to the startup and during the startup is expected to be minimum and will concentrate more on the troubleshooting in case problems develop during the hydrogen production.

XIII. Output 4 – Accumulation of a Body of Knowledge About FCBs for Egypt

Task 4: Test Data Analysis and Project Management

Tasks 4.1: Prepare Test Plan

64. In this task, a comprehensive test plan will be developed in terms of the specific tests to be conducted, frequency and duration of the tests, data acquisition methods and responsibility, and data analysis methods and responsibility.

65. For the FCB operation and performance, the following parameters will be verified as a minimum:

(a) Fuel economy & its decay rate
(b) Acceleration capability/load response time
(c) Capability to operate under hot weather in Cairo
(d) Capability to operate with frequent stop and go in congested traffic in Cairo
(e) Startup time
(f) Emissions
(g) Noise/vibration level

66. For the hydrogen facility operation and performance, the following parameters will be verified as a minimum:

(a) System efficiency at various load points
(b) Electrolyzer performance decay rate
(c) Startup/shutdown time
(d) H2 purity/quality measurements
(e) Dispensing time
(f) Noise/vibration level (electrolyzer/H2 compressor)
(g) Unattended operation capability
(h) Effectiveness of the safety system

67. For the reliability/availability of the FCBs and hydrogen facility, the following parameters will be verified as a minimum:

(a) Maintenance labor requirements
(b) Maintenance material requirement
(c) Mean time between failures
(d) Stack life
(e) Overall availability
(f) Failure modes and their causes
(g) Required spare parts inventory

Tasks 4.2: Data Acquisition and Analysis

68. In this task, the test data will be collected, stored, and analyzed.

Tasks 4.3: Project Management and Reporting

69. In this task, the project team will submit monthly reports to the steering committee and generate topical reports for the bus and H2 facility test, operating, and maintenance results and the work conducted under the sustainability program. A quarterly review project review meeting will also be held to monitor the project progress. Details of the project monitoring and evaluation are described in Section 7.

Output 5 – Increased Awareness and Support for FCBs in Egypt, and Ongoing Strategy Developed

XIV. Task 5: Sustainability Program

Tasks 5.1: Develop Master Plan/Intervention Measures

70. The activity under this task has been described previously under Project Outcome # 5.

Tasks 5.2: Build Up Codes/Standards and Local Capability

71. The activity under this task has been described previously under Project Outcome # 5.

Tasks 5.3: Disseminate Information

72. The research results will be disseminated through national and international seminars, and workshops to be held in Egypt. Both the communications and research initiatives begun during Part I will be continued throughout Part II. The FCB Private Sector Advisory Group will continue to be consulted on a regular basis regarding project results. International meetings on hydrogen fuel cell technology will be attended for development and joint entrepreneurial purposes, and for widespread dissemination of research results. The research results will be shared with the other GEF FCB projects through meetings and other communications (e.g., FCB Website) coordinated by the UNDP-GEF.

IV. RISKS AND SUSTAINABILITY

XV. SUSTAINABILITY

73. To sustain the fuel cell technology in Egypt after the GEF support, the first activity is for GCBC to expand the demonstration project. As an example, 20 more FCBs could be purchased at the end of the demonstration project to increase the fleet size from 8 to 28 buses. As the hydrogen facility is already oversized, purchasing another electrolyzer module to double the hydrogen production capacity should be sufficient to meet the need of the expanded fleet.

74. The cost of the 8 FCBs to be purchased for the GEF project is 10 times that of diesel buses. By the time the additional 20 buses are purchased (2006), the FCB cost is expected to drop to be 2-3 times of the diesel bus cost. As the cost difference is still too large for the project to proceed on commercial basis, the Egyptian Government will seek finance from various sources to fund the incremental cost. The incremental cost is estimated to be US$ 15 million, including the additional hydrogen production facility, utility consumption, and labor and management cost.

75. This expanded project will operate for 2-3 years. By 2008 or 2009 when it is completed, the FCB cost is expected to be only 10-30% more than the diesel bus cost. At that time, the tax credit or soft loan provided by the government should give enough incentive for the local bus manufactures to launch commercial production and allows GCBC and CTA to convert diesel buses or CNG buses on a garage-by-garage basis (on the average 150 buses per garage) without

government' s financial aid. The incentive for the bus manufactures could also be provided by the increase of diesel fuel cost, tighter air emission standard, or tax on air emission or carbon emission.

76. Meanwhile, the Ministry of Petroleum or private entrepreneurs would be willing to commit to building the centralized hydrogen production plant and distribution system when the fuel cell technology becomes fully proven in the expanded demonstration project and the commercialization prospect becomes certain. To minimize the capital requirement, the centralized hydrogen plant will be built by modular construction in stages to be in progression with the bus garage conversion. This is also true to some degree for the hydrogen distribution by pipelines. Only the trunk line will be built first. The branch lines to the individual garages will be added as more and more garages are converted.

77. The construction of the hydrogen distribution system and also the pipeline for CO_2 sequestration falls into the category of infrastructure buildup. The government needs to either directly finance the project or provide guarantee on the return for investors to take on the project.

78. Other activities, which will be taken to achieve the sustainability, have been described earlier in Project Outcome #5 and project activity Task 5.

XVI. RISK ASSESSMENT

79. This project has two major risks.

Risk #1: The FCBs fall short of expectation on reliability

80. The FCBs in the Chicago and Vancouver demonstration projects have achieved only 30% availability. The major reasons are that this is the first time the stacks were integrated with other engine components and the stacks used had relatively short life of 2,500 hours as compared to the 20,000 hours commercial target.

81. The P3 buses in the Chicago and Vancouver projects and also the P4 buses used in the recent demonstration projects are all experimental buses. The P5 buses, which could be purchased among other bus manufactures for this demonstration project, are Xcellsis' first batch of commercial units and are expected to have significant improvements on the availability and stack life. One of the major objectives of this demonstration project is to verify these improvements. Only by observing the progress from the P3 to P4 and then to P5 buses, the ability of FCBs to reach the reliability goal can be assessed.

Risk #2: Improper bus operation and maintenance

82. Fuel cell buses are basically electric vehicles and many of the engine components, such as the stacks and inverters, are high technology equipment. If they are not properly operated and maintained due to the lack of skilled labor, both the performance and safety of the buses could be jeopardized. The negative image created could then cause this technology to wither. Due to this

concern, the operator and maintenance crew training is of paramount importance and special effort will be taken as described under Project Outcome #2.

83. Both CTA and GCBC are public companies and thus limited by the salary scale they can offer to attract the skilled labor needed. Fortunately, they do have freedom in the amount of incentive payment offered. The ultimate solution to this problem is to privatize these companies. The Egyptian Government currently has intention to privatize GCBC. This needs to be further pursued. For the demonstration project, the maintenance crew will be hired from outside with very high salaries so that the best qualified people can be attracted.

V. STAKEHOLDER PARTICIPATION AND IMPLEMENTATION ARRANGEMENTS

STAKEHOLDER PARTICIPATION

84. The public bus companies in Cairo, CTA and GCBC, are all very committed to the proposed project. Also very supportive of this project are Egyptian General Petroleum Company (EGPC), Egyptian Electricity Authority (EEA), New and Renewable Energy Authority (NREA), and Organization of Energy Planning (OEP). In the development phase of the project all above mentioned stakeholders have been involved and a meeting has already been held with the Engineering chamber and several bus/car manufactures to discuss the project and most of the participants have expressed keen interests to the project.

85. The stakeholders during the implementation phase of the project and their involvement are as follows:

(a) EEAA: national operational focal point, responsible for the execution of the project
(b) MP: provide technical advise to the hydrogen production, participate in the execution of the sustainability program
(c) EEA: participate in providing electricity supply to the project
(d) OEP: assist EEAA to execute the sustainability program regarding energy policy issues and related intervention measures
(e) GCBC: host and execution agency for the project
(f) NREA: assist in electrolyzer operation as a way to use renewable energy
(g) Public: passengers of the public buses in Cairo

86. There are no social issues involved in this project.

IMPLEMENTATION PLAN

87. The project will be implemented according to the schedule shown in Figure 1. The project is expected to start in the 2nd quarter of 2001 and complete by the end of 2006 with a total duration of 5 years.

Figure 1
Project Schedule

Task No. and Description	2001	2002	2003	2004	2005	2006
1. **Fuel Cell Bus Purchase**						
1.1 Prepare Bus Specification	**x**					
1.2 Tender/Award Contract for 1st 3 Buses	**x**					
1.3 Fabrication and Delivery of 1st 3 Buses	**xxxx**	**xxxx**				
1.4 Fabrication and Delivery of 2nd 5 Buses		**xxxx**	**xxxx**			
2. H2 Facility Purchase/Installation						
2.1 Overall Engineering and Site Design	**xxxxxx**	**x**				
2.2 Permitting	**xxx**					
2.3 Major Equipment /Facility Purchase	**xxxxx**	**x**				
2.4 Utility Hookup and Site Construction		**xx**				
2.5 Mechanical Shakedown/Facility Startup		**xx**				
3. Bus/H2 Facility Operation/Maint.						
3.1 Operation and Maint. of 1st 3 Buses		**xx**	**xxxxxx**	**xxxxxx**	**xxxxxx**	**xxxxxx**
3.2 Operation and Maint. of 2nd 2 Buses			**xx**	**xxxxxx**	**xxxxxx**	**xxxxxx**
3.3 Operation and Maint. of H2 Facility		**xx**	**xxxxxx**	**xxxxxx**	**xxxxxx**	**xxxxxx**
4. Test Program/Project Management						
4.1 Prepare Test Plan	**xx**					
4.2 Data Acquisition and Analysis		**xx**	**xxxxxx**	**xxxxxx**	**xxxxxx**	**xxxxxx**
4.3 Project Management and Reporting	**xxxxxx**	**xxxxxx**	**xxxxxx**	**xxxxxx**	**xxxxxx**	**xxxxxx**
5. Sustainability Program						
5.1 Develop Master Plan/Incentive Program					**xxxxxx**	
5.2 Codes/Standards/Local Capability	**xxxxxx**	**xxxxxx**	**xxxxxx**	**xxxxxx**	**xxxxxx**	**xxxxxx**
5.3 Disseminate Information			**xx**	**xx**	**xx**	**xx**

88. To support the hydrogen production schedule above, the H2 facility supplier will generate and provide the project team certified engineering drawings of their unit in the first 1-2 month of their contract. Based on these drawings, the project will start the site work design and engineering of the utility support for the H2 facility. The bulk of the equipment will be purchased and the construction subcontractor will be selected and brought on board. The site construction will start in the 1st quarter of 2002 so that the whole H2 facility will be ready for startup by the second or third quarter of 2002.

89. For the first set of buses, the bus specification preparation, issuing of tender, evaluation of the bids received, and negotiation and award of the contract (Tasks 1.1 and 1.2) will be completed by the 3rd quarter of 2001. Based on the feedback from Xcellsis (the leading FCB developer), fifteen months are allowed for the bus supplier to fabricate and deliver the buses to GCBC. This delivery schedule is much longer than that for diesel buses because FCBs are a new product and the local bus supplier requires engineering effort to integrate and assemble the buses with the engines/chassis imported from the fuel cell developer.

90. For the hydrogen facility, the contract award to the supplier will also be in place by the 2nd quarter of 2001. Twelve months are required for the supplier to fabricate and deliver the packaged H2 unit to GCBC, including the sea and land shipping time. It will be installed, commissioned, and ready to produce and supply hydrogen by the end of the 2nd quarter of 2002 when the FCBs arrive.

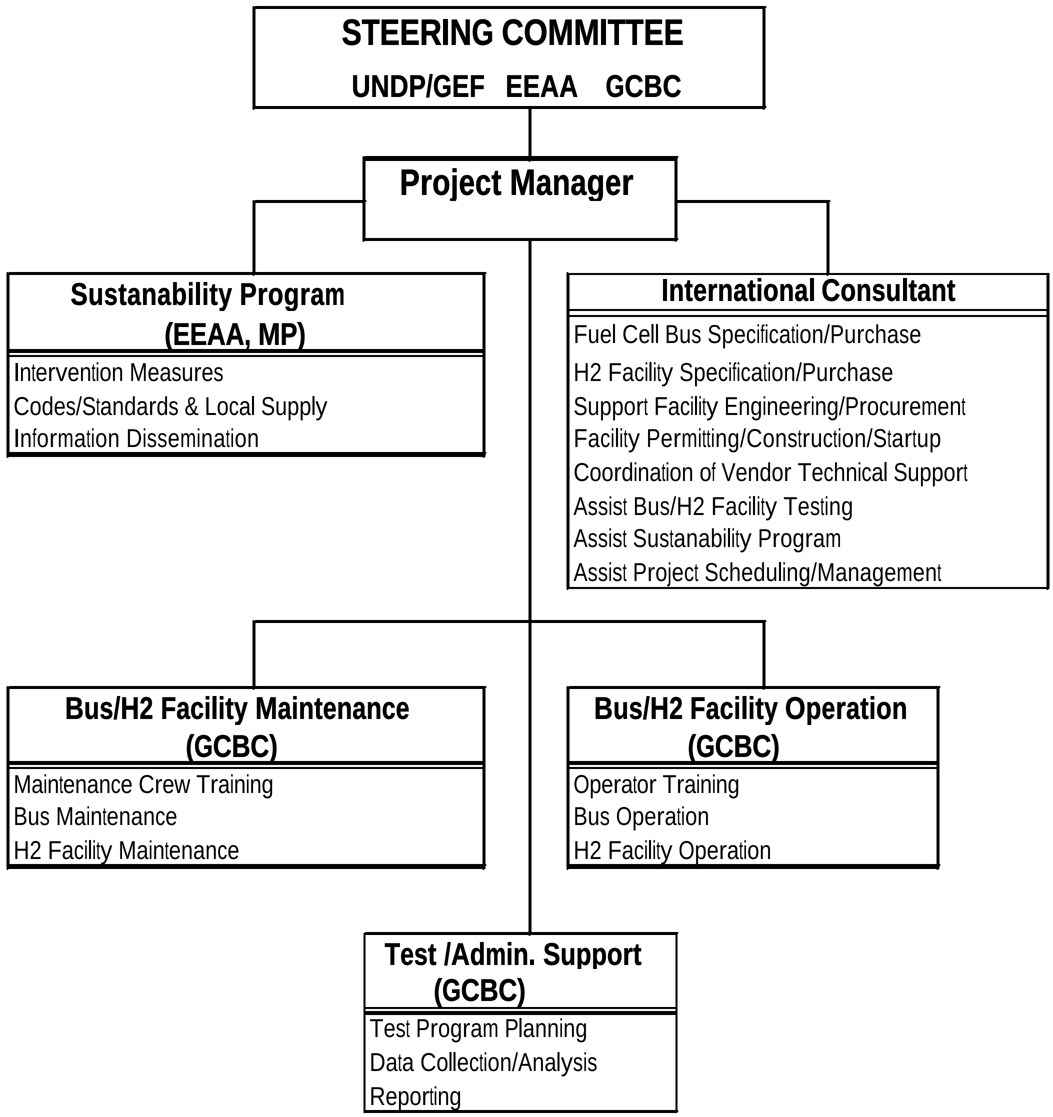
91. The first 3 buses and hydrogen facility will be operational in the 4th quarter of 2002 and the next 5 buses in the 4th quarter of 2003. As indicated previously, the bus drivers will be trained shortly before the buses are put into revenue service. The bus maintenance crew will be trained both before hand during the bus manufacturing period and on the job when the buses start the revenue service.

92. Task 5.1 (master plan for the post-GEF activities, including the intervention measures and incentive program) will start about one year prior to the project completion while Task 5.2 (build codes/standards/local capability will start at the very beginning of the project. Task 5.3 (information dissemination) will occur periodically after the project starts to accumulate enough data and experience from the testing program.

93. To effectively implement the work to meet the objectives, the project will be organized as shown in Figure 2.

94. The project will be mainly executed and managed by EEAA. EEAA is part of Ministry of Environment and will be the national operational focal point for this project. The project manager will be appointed by EEAA/UNDP, hired by UNDP/Cairo, located at GCBC, and report to a steering committee made of a project manager from UNDP/GEF and senior representatives from Egyptian Environmental Affair Agency (EEAA) and Ministry of Petroleum (MP). UNDP/GEF will administer the project fund from both GEF and Egyptian Government. MP is a major stakeholder of this project. Their major interest would be in the buildup of hydrogen production and delivery infrastructure for future commercial deployment of FCBs.

Figure 2
Demonstration Project Organization



95. Under the project manager, there is a permanent staff at GCBC responsible for the operation, maintenance, and testing of the FCBs and H2 facility. The maintenance crew will consist of two engineers, two foremen, and six technicians for the buses and another technician for the H2 facility. The bus operators will be GCBC's current diesel bus drivers with the necessary training. No operator is provided for the hydrogen facility as it is designed for unattended operation. There is a test engineer responsible for the test program that includes the preparation of a test plan and data acquisition, analysis, and reporting. There is also an administrative assistant for the project manager. At initialization of the demonstration project, EEAA will sign a memorandum of understanding with GCBC for implementation of project components relevant to GCBC. Also reporting to the project manager is an international

consultant whose primary responsibility would be the purchase of FCBs and the engineering, procurement, construction of the H2 facility. EEAA, with support from MP, would be responsible for the sustainability program. The EEAA will recruit necessary national consultant to carry out this program in coordination with the project manager.

VI. INCREMENTAL COSTS AND PROJECT FINANCING

96. The incremental costs required for the proposed project (including both parts I and II) are shown in Table 2. Bases for the incremental cost estimate are given in the incremental cost analysis shown in Annex A. The project component financing is shown in Table 3 for Part I and Table 4 for Part II.

97. In the budget allocation, the GEF funds are used mainly for the purchase of the buses and H2 facility, including the spare parts and suppliers' technical support from the H2 facility supplier. The UNDP funds pay a portion of the project management costs and for hiring international consultants to assist engineering, procurement, permitting, and construction of the buses and H2 facility and to participate in the project management, test program, and sustainability program. The Egypt government funds are used mainly for domestic expenses, such as the use of local subcontractor for the H2 facility installation, the cost of bus operators and maintenance crew, pursuit of the intervention measures, etc.

98. Based on the component financing indicated in Table 3 for Part I, the GEF fund requested is approximately 65% of the total increment cost, whereas Part II requests GEF funds of 45% of the total increment. The Egypt government and equipment suppliers will provide most of the shortfall. The Egypt government contribution consists of $ 2.756 million for Part I and US$ 5.026 million for Part II (both cash and in kind, including import duty, garage depreciation, government staff cost, GCBC's bus operating cost and maintenance cost not related to fuel cell engines, etc.).

99. The baseline case in Table 2 represents the current diesel bus operation in Cairo. Both the global and local emissions correspond to the amount released during the test period, i.e. 3 buses for 3.5 years at 60% availability and 5 buses for 2.5 years at 70% availability. The diesel bus CO2 emission is calculated based on GCBC's diesel fuel composition, average bus daily driving distance of 290 km, and fuel economy of 0.71 liters/km. It also has taken into account that fuel oil production from crude in a refinery typically has 90% conversion efficiency. The diesel bus emissions of air pollutants are calculated based on: 1.2 g/km SO2, 13 g/km NOx, 18 g/km CO, 2.9 g/km HC, and 0.8 g/km particulates. The FCBs used have zero emissions for CO2 and air pollutants. The CO2 emission from the power consumption for hydrogen production (electrolyzer) is based on the current grid mix in Egypt: 80% fossil power from natural gas (at 38% generation efficiency) and 20% hydropower.

Table 2
Incremental Costs for Part I and Part II

	Baseline	Alternative	Increment
Global Environmental Benefits			
CO2 emissions from buses, tonnes	3,312		(3,312)
CO2 emissions from H2 production, tonnes		3,127	3,127
Total	3,312	3,127	(185)
National Benefits			
SO2 emissions, tonnes	3		(3)
Nox emissions, tonnes	32		(32)
CO emissions, tonnes	44		(44)
HC emissions, tonnes	7		(7)
Particulates emissions, tonnes	2		(2)
Million passenger km	104	104	-
Part I Cost, US$ million	0.47	9.99	9.52
Part II Cost, US$ million	1.06	12.71	11.65
Total Cost, US$ million	1.53	22.70	21.17

( ) denotes reduction

Table 3
Component Financing – Part I

EGYPT FCB Part I	**Costs ($USM)**				
		Co-funding			
Item	**GEF**	**UNDP**	**Equipment Supplier**	**Egypt Gov't**	**Total**
Bus purchase	4.375	0.045	0.593	1.092	6.104
H2 Facility Purchase	1.555	0.179	0.000	0.861	2.595
O&M	0.200	0.000	0.127	0.399	0.726
Proj Management/Testing	0.000	0.067	0.000	0.087	0.154
Sustainability Program	0.000	0.031	0.000	0.116	0.147
M&E	0.060	0.000	0.000	0.000	0.060
Contingency	0.000	0.000	0.000	0.200	0.200
Total	**6.190**	**0.321**	**0.720**	**2.756**	**9.986**

Table 4
Component Financing – Part II

EGYPT FCB Part II	Costs ($USM)				
		Co-fundin[g]			
Item	GEF	UNDP	Equipmen[t] Supplie[r]	Egypt Gov't	Total
Bus purchase	5.625	0.074	0.988	1.820	8.507
H2 Facility Purchase	0.000	0.000	0.000	0.000	0.000
O&M	0.000	0.000	0.510	1.592	2.102
Proj Management/Testing	0.000	0.266	0.000	0.349	0.616
Sustainability Program	0.000	0.124	0.000	0.465	0.589
M&E	0.100	0.000	0.000	0.000	0.100
Contingency	0.000	0.000	0.000	0.800	0.800
Total	**5.725**	**0.465**	**1.497**	**5.026**	**12.713**

100. The small amount of CO_2 emission reduction shown in Table 2 is not indicative of the GHG emission benefit of FCBs in Egypt. As mentioned earlier, the optimum system to produce hydrogen in Egypt is a central H2 plant based on natural gas reforming with CO_2 sequestration. Shown in Table 5 is the CO_2 reduction when the entire fleet of public buses (3,600 buses) is converted to FCBs and the project scale is large enough to build such a central hydrogen plant. In Table 5, the diesel bus CO_2 emission is calculated on the same basis as in Table 2. As only 62% of CO_2 is recoverable for sequestration in the hydrogen plant, there is still CO_2 emission from the natural gas use. The CO_2 emissions from various power consumptions are based on the same grid mix as described above but the fossil power generation based on natural gas is assumed to improve to 50% when the FCBs are commercialized in Egypt. Overall, the use of FCBs in Cairo can provide close to half million tonnes of global CO_2 reduction annually in the sustainable phase.

Table 5
CO_2 Emission Reduction
(Sustainable Phase)

CO2 Emission, tonnes/year	Diesel Buses	Fuel Cell Buses	Increment
From Bus Operation	561,228	---	(561,228)
From Natural Gas Used in H2 Production	---	115,280	115,280
From Power Consumed in H2 Production	---	3,589	3,589
From Power Consumed in CO2 Sequestration	---	718	718
From Power Consumed in H2 Transport	---	8,373	8,373
From Power Consumed for Hydrogen Fueling	---	4,555	4,555
Total	561,228	132,514	(428,714)

( ) means reduction

VII. **Monitoring, Evaluation & Dissemination**

101. The steering committee shown in the project organization diagram in Figure 2 would be responsible for the project monitoring and evaluation.

102. At the project start, the project team will submit to the steering committee a work plan, showing detailed work scope of each major task, the project schedule and major milestone, staffing requirements, and the projected budget expenditure. During the project execution, the project manager will submit a progress report to the steering committee on a monthly basis, showing the work accomplished, major findings and results, actual budget expenditure vs. planed, problems encountered, and corrective measures taken.

103. The project team will also submit topical reports to the steering committee for review and comments. The reports would summarize the work conducted under the sustainability program and the test results of the bus and H2 facility operation and maintenance.

104. A quarterly project review meeting will be held between the project team and steering committee to review the progress, discuss key issues, and plan for future key events. In case it is necessary, the steering committee may redirect the project in terms of schedule, budget, and scope of work.

105. A mid-term project evaluation meeting will be held with participation of the GEF counselors and UNDP/GEF advisers. This meeting will take place after the first 3 buses have gained one-year operation and testing. It will review the project progress and results and to determine whether to further proceed with the program.

LIST OF ANNEXES

Annex A
Incremental Cost

Broad Development Goal

The broad development goal being pursued by the Government of Egypt, EEAA, and the GCBC is the provision of public transport services to its urban inhabitants.

Baseline

Under the baseline situation, the GCBC would provide urban bus transport services to its population through the continued reliance on diesel or CNG-powered buses. The baseline to this project is the provision of urban bus service through diesel-fueled buses. There are some 3,600 buses in service in the Greater Cairo Metropolitan area.

Diesel buses are one of the major contributors to the air pollution. In the baseline, the measures taken are for 3 buses operated for 3.5 years at 60% availability and 5 buses operated for 2.5 years at 70% availability. For Part I, the baseline relates to the comparative 3 buses operating during the project period; Part II' s baseline relates to the larger fleet of 8 buses. The diesel bus CO_2 emission is calculated based on GCBC' s diesel fuel composition, average bus daily driving distance of 290 km and fuel economy of 0.71 l/km. It also has taken into account that fuel oil production from crude in a refinery typically has 90% conversion efficiency. The diesel bus emissions of air pollutants are calculated based on: 1.2 g/km SO_2; 13 gm/km NO_x, 18 g/km CO, 2.9 g/km HC and 0.8 g/km particulates. Over the life of the project, the baseline estimate of distance driven will be 1.593 million km.

Global environmental objectives

The global environmental objective is the reduction of greenhouse gas (GHG) emissions from the urban transport sector in Egypt. Over the immediate term of the project, this will involve the demonstration and testing of FCBs fueled by electrolytic hydrogen. Over the longer term, this project will lead to an increased production in fuel cell propelled buses, and the eventual reduction in their costs to the point where they will become commercially competitive with conventional, diesel buses.

This project has been prepared to be consistent with GEF Operational Program 11 "Promoting Sustainable Transport".

GEF project activities

This project is designed to develop and operate a demonstration fleet of eight FCBs in Cairo, Egypt. These buses will be procured in two batches: Part I involves the first of three, and Part II the second batch of five buses for a total fleet of 8. They will be designed to operate commercially under Egyptian conditions and will provide the EEAA and GCBC with detailed operating experience of over 1,500,000 vehicle-km. This operating information will be used as feedback both to the bus suppliers and the GCBC so that future FCB activities can successfully build upon the initial activities of this project.

In order for the long-term programmatic goal of this project to be achieved, FCBs must be produced for use in other contexts. According to industry projections, after a total of 2,000 FCBs have been produced, the costs should fall to where FCBs will be roughly competitive on a lifecycle basis with modern, clean diesel buses.

Global Environmental Benefits

The deployment of fuel-cell buses in Egypt will lead to significant reduction in carbon emissions from the transport sector. As the technology is further developed and deployed, these significant global benefits will continue to multiply as fuel-cell buses are deployed around the world.

The eight diesel buses operating in the baseline of 1.59 million vehicle km are expected to emit approximately 3,312 tonnes of CO_2. The fuel-cell buses, as explained elsewhere, will emit nothing at the tailpipe level, but the production of the electricity which will be used to produce hydrogen via electrolysis will result in the emission of 3,127 tonnes of CO_2. The net CO_2 benefits from this demonstration project are therefore equal to 185 tonnes.

Beyond the demonstration phase, the potential exists to move toward a zero net CO_2 system. As the project moves closer to commercialization, other efforts, such as the sequestration of the CO_2 following the steam reforming process become economically viable.

Costs

The costs of the baseline course of action are measured by the costs of operating conventional diesel buses for one million vehicle-kilometers. These are estimated at US$1.527m over the five-year project lifespan, with US$0.466 for Part I and US$1.061. The costs of the proposed project activities are estimated at US$22.71m, of which about US$21m are considered incremental (see Table 2 in main body of this brief). These incremental costs are shared between the GEF, Egyptian sources, and the private sector providers of the technology (see Section VI in main body of this brief).

System boundary

Although the boundary for this immediate project is the Egyptian urban transport sector, extending to the electricity sector. The project will support and draw upon resources from the global automotive industry. It should also provide important feedback for public transport agencies in other parts of the developing world. One of UNDP GEF' s roles is to ensure that the information gathered and experience gained can be shared across national and commercial boundaries. In that context, this project is important internationally for the experience to be gained and shared.

Additional benefits

The project will demonstrate significant additional local benefits in terms of reduced emission of pollutants dangerous to human health and habitat. In particular, the project will reduce the emission of NO_x, SO_x, CO, HC and particulates, as detailed in the incremental cost matrix. As detailed in the text, there are also significant benefits to the global community, the automotive industry, and the technology providers.

Cost

Shown in the following tables are details of the incremental cost analysis for the proposed demonstration project (Part I and II). The basis for each of the cost items is described below for both Part I (Table A-1) and Part II (Table A-2).

Table A-1: Cost Breakdown for Part I

EGYPT FCB Part I	Costs ($USM)					
		Fuel Cell Bus Demonstration Projec				
			Co-funding			
Item	Baseline	GEF	UNDP	Equipmen Supplier	Egypt Gov't	Total
Bus purchase						
Buses	0.093	4.375	0.000	0.277	0.000	4.652
Spare Parts	0.072	0.000	0.000	0.316	0.000	0.316
Bus Specs		0.000	0.045	0.000	0.017	0.062
Import Duties		0.000	0.000	0.000	1.075	1.075
Subtotal	**0.165**	**4.375**	**0.045**	**0.593**	**1.092**	**6.104**
H2 Facility Purchase						
H2 Facility		1.500	0.000	0.000	0.000	1.500
Spare Parts		0.038	0.000	0.000	0.000	0.038
H2 Facility Shipping Costs		0.017	0.000	0.000	0.000	0.017
Import Duties		0.000	0.000	0.000	0.384	0.384
Garage Adapt		0.000	0.000	0.000	0.039	0.039
Site Prep/Utilities		0.000	0.000	0.000	0.244	0.244
H2 Facility Installation		0.000	0.000	0.000	0.133	0.133
Engineering/Permits/		0.000	0.000	0.000	0.000	0.000
Procurement		0.000	0.179	0.000	0.061	0.240
Subtotal		**1.555**	**0.179**	**0.000**	**0.861**	**2.595**
O&M						
Bus Op. Training		0.000	0.000	0.000	0.003	0.003
Bus Maint. Crew Training		0.000	0.000	0.000	0.023	0.023
Tech Support						
by bus supplier		0.000	0.000	0.127	0.000	0.127
by H2 facility supplier		0.200	0.000	0.000	0.000	0.200
Diesel fuel	0.022	0.000	0.000	0.000	0.000	0.000
Electricity		0.000	0.000	0.000	0.201	0.201
Water		0.000	0.000	0.000	0.000	0.000
Garage Deprec	0.033	0.000	0.000	0.000	0.044	0.044
Bus O&M Mat	0.067	0.000	0.000	0.000	0.063	0.063
H2 Facility O&M Mat		0.000	0.000	0.000	0.002	0.002
Bus Op Labor	0.060	0.000	0.000	0.000	0.017	0.017
Bus Insurance/License Fee	0.002	0.000	0.000	0.000	0.002	0.002
Bus/H2 Fac. Maint Labour	0.102	0.000	0.000	0.000	0.044	0.044
Subtotal	**0.286**	**0.200**	**0.000**	**0.127**	**0.399**	**0.726**
Proj Management/Testing						
Proj Management	0.015	0.000	0.067	0.000	0.084	0.151
Testing		0.000	0.000	0.000	0.003	0.003
Subtotal	**0.015**	**0.000**	**0.067**	**0.000**	**0.087**	**0.154**
Sustainability Program						
Master Plan		0.000	0.006	0.000	0.005	0.011
Codes/Standards		0.000	0.017	0.000	0.060	0.077
Information dissemination		0.000	0.008	0.000	0.051	0.059
Subtotal		**0.000**	**0.031**	**0.000**	**0.116**	**0.147**
M&E		**0.060**	**0.000**	**0.000**	**0.000**	**0.060**
Contingency		**0.000**	**0.000**	**0.000**	**0.200**	**0.200**
Total	**0.466**	**6.190**	**0.321**	**0.720**	**2.756**	**9.986**

Table A-2: Cost Breakdown for Part II

EGYPT FCB Part II	Costs ($USM)					
		Fuel Cell Bus Demonstration Projec				
			Co-funding			
Item	Baseline	GEF	UNDP	Equipment Supplier	Egypt Gov't	Total
Bus purchase						
Buses	0.123	5.625	0.000	0.499	0.000	6.124
Spare Parts	0.096	0.000	0.000	0.489	0.000	0.489
Bus Specs		0.000	0.074	0.000	0.000	0.074
Import Duties		0.000	0.000	0.000	1.820	1.820
Subtotal	**0.220**	**5.625**	**0.074**	**0.988**	**1.820**	**8.507**
H2 Facility Purchase						
H2 Facility		0.000	0.000	0.000	0.000	0.000
Spare Parts		0.000	0.000	0.000	0.000	0.000
H2 Facility Shipping Costs		0.000	0.000	0.000	0.000	0.000
Import Duties		0.000	0.000	0.000	0.000	0.000
Garage Adapt		0.000	0.000	0.000	0.000	0.000
Site Prep/Utilities		0.000	0.000	0.000	0.000	0.000
H2 Facility Installation		0.000	0.000	0.000	0.000	0.000
Engineering/Permits/		0.000	0.000	0.000	0.000	0.000
Procurement		0.000	0.000	0.000	0.000	0.000
Subtotal		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
O&M						
Bus Op. Training		0.000	0.000	0.000	0.008	0.008
Bus Maint. Crew Training		0.000	0.000	0.000	0.093	0.093
Tech Support						
by bus supplier		0.000	0.000	0.510	0.000	0.510
by H2 facility supplier		0.000	0.000	0.000	0.000	0.000
Diesel fuel	0.132	0.000	0.000	0.000	0.000	0.000
Electricity		0.000	0.000	0.000	0.804	0.804
Water		0.000	0.000	0.000	0.001	0.001
Garage Deprec	0.132	0.000	0.000	0.000	0.176	0.176
Bus O&M Mat	0.267	0.000	0.000	0.000	0.251	0.251
H2 Facility O&M Mat		0.000	0.000	0.000	0.008	0.008
Bus Op Labor	0.241	0.000	0.000	0.000	0.069	0.069
Bus Insurance/License Fee	0.009	0.000	0.000	0.000	0.009	0.009
Bus/H2 Fac. Maint Labour	0.000	0.000	0.000	0.000	0.175	0.175
Subtotal	**0.781**	**0.000**	**0.000**	**0.510**	**1.592**	**2.102**
Proj Management/Testing						
Proj Management	0.061	0.000	0.266	0.000	0.336	0.603
Testing		0.000	0.000	0.000	0.013	0.013
Subtotal	**0.061**	**0.000**	**0.266**	**0.000**	**0.349**	**0.616**
Sustainability Program						
Master Plan		0.000	0.025	0.000	0.020	0.045
Codes/Standards		0.000	0.068	0.000	0.242	0.310
Information dissemination		0.000	0.031	0.000	0.203	0.234
Subtotal	**0.000**	**0.000**	**0.124**	**0.000**	**0.465**	**0.589**
M&E	**0.000**	**0.100**	**0.000**	**0.000**	**0.000**	**0.100**
Contingency	**0.000**	**0.000**	**0.000**	**0.000**	**0.800**	**0.800**
Total	**1.062**	**5.725**	**0.465**	**1.497**	**5.026**	**12.713**

The above cost estimates are described in greater detail below.

XVII. Bus Costs

The FCB cost is based on the price projection from Ballard Automotive (sales arm of Xcellsis) for their commercial buses (P5 buses): $1.425 million/bus in 2002 and $1.3 million/bus in 2003. As the experience and test data accumulated in the demonstration project will be very valuable input for the future FCB development and improvement, it is assumed that the bus manufacture will provide a purchase price discount of $775,000 for eight buses as their cost contribution to the project. The diesel bus cost is based on the depreciated value of 3 buses for 3.5 years and 5 buses for 2.5 years.

Bus Engine Spare Parts

The cost shown for the diesel bus case is 3.5-year spare parts supply for 3 buses and 2.5-year supply for 5 buses. The cost for the FCB case is extrapolated from the Vancouver and Chicago demonstration projects by adjusting for a longer fuel cell stack life.

Fuel Cell Bus Specification and Procurement

This is estimated from the labor and travel required to conduct Task 1.

Import Duty for the Fuel Cell Buses and H2 Facility (including their spare parts)

The imported duty is 25%.

H2 Facility Cost

This is a cost quote from Stuart Energy based on the H2 facility design.

Spare Parts for the H2 Facility

Stuart Energy estimated this cost to be 2.5% of the facility cost.

H2 Facility Sea/Land Shipping

The shipping cost is a quote from a shipping company.

Garage Adaptation for Fuel Cell Buses

This is based on a preliminary engineering of the garage modification required for operating and maintaining the FCBs and hydrogen facility.

Site Preparation and Utility Hookup for the H2 Facility

This cost is estimated based on a preliminary engineering of the site preparation and utility hookup requirements for the hydrogen facility at the host garage.

H2 Facility Installation

This installation includes constructing foundation and a roof/shelter for the H2 facility.

Engineering/Permitting/Procurement/Startup

This is estimated from the labor and travel required to conduct Task 2.

Bus Operator Training

This cost item includes (1) salaries to cover the two hours training time for each bus operators in the host garage and $10,000 to cover training materials, class room cost, and other miscellaneous expenses. The H2 facility is designed for unattended operation and requires no operator training.

Bus Maintenance Crew Training

The FCB maintenance crew is assumed to consist of two engineers, two foremen, and six technicians. The cost shown is to cover their salaries during the training period and also includes $10,000 to cover training materials, classroom cost, and other miscellaneous expenses.

Technical Support from Bus Supplier

This cost is extrapolated from the Vancouver and Chicago demonstration projects by taking into account reduced technical support for higher reliability FCBs.

Technical Support from H2 Facility Supplier

The cost given is an estimate from Stuart Energy.

Diesel Fuel, Electricity, and Water

These cost items are based on the consumption and the current purchase price.

Garage Depreciation

This cost item is the land depreciation of the garage space required for the demonstration project. The baseline case cost is less because there is no space required for the hydrogen facility.

Bus O&M Materials and Contract Maintenance

For the diesel buses, this is the current maintenance material cost at GCBC. For FCBs, this cost is the same except it excludes the diesel engine contracted maintenance and major overhaul.

H2 Facility Operating and Maintenance Materials

The cost shown is an estimate from Stuart Energy.

Bus Operation Labor (Drivers, Conductors, and Inspectors)

For both diesel buses and FCBs, this cost item is derived from the current cost at GCBC. In the diesel bus case, the cost is based on the entire salary (base salary and incentive payment) of the operation labor. In the FCB case, the cost is based on the base salary only as GEF will not accept incentive payment. It is assumed that GCBC will provide that outside the project budget.

Bus Insurance and License Fee

For both the diesel and FCBs, this cost item is derived from GCBC' s current costs.

Bus/H2 Facility Maintenance Labor

Bus/H2 Facility Maintenance Labor

For the FCB case, this cost is based on the staffing for the bus maintenance mentioned previously plus one additional engineer for the H2 facility maintenance. For diesel bus, this cost item is derived from GCBC' s current expenses.

Project Management/Scheduling/Coordination

This is estimated from the labor, office expenses, and travel required for conducting Task 4.

Testing and Reporting

This cost covers the test engineer' s labor cost for 3.5 years plus $5,000 allowance for computer and other miscellaneous equipment/supplies.

Sustainability Program

This is estimated from the labor, research grants, workshop expenses, and travel required to conduct Task 5.

Project Monitoring and Evaluation

UNDP/GEF Country Officer for the Program	100,000
Monitoring/Field Travel of Program Office Staff	10,000
Tripartite Reviews	20,000
Mid-Term Evaluation	25,000
Communications and Office Supplies	5,000
Total Cost, US$	160,000

Contingency

It is assumed that $1 million will be required as the project contingency and the Egyptian Government is responsible for providing this contingency fund.

Annex B
LOGICAL FRAMEWORK MATRIX

	(1) Program or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
Development Objective	To reduce GHG emissions by introducing a new energy source and propulsion technology for urban transport in Egypt	CO_2 emissions in Egypt are reduced		
Immediate objective	a) Reduce global GHG emissions b) Mitigate air pollution in Cairo c) Reduce Egypt' s use of fossil fuels d) Implant fuel cell vehicle technology in Egypt e) Lead Egypt to be a regional or world-wide FCB manufacturer and contribute to the nation's economy f) Increase the volume demand of FCBs to accelerate commercialization	a) CO_2 emissions from public buses in Cairo are reduced by 3,312 tonnes over the project life b) Cleaner air in Cairo c) More Cairo public buses are converted to FCBs d) Public accepts technology; local operation/maintenance capacity exists e) Local bus manufacturers have production expertise and capacity f) Fuel cell bus price drops	Final project report	
Output 1	**Significant demonstration of the procurement of FCBs and their refueling infrastructure under Egyptian conditions**			
Tasks	TASK 1: FUEL CELL BUS PURCHASE			
	Tasks 1.1: Finalize Bus Specification			
	Tasks 1.2: Issue Tender and Award Contract for the Fuel-Cell Buses	Bids are received, and a contract is negotiated with and awarded to the selected supplier.	Annual/ final project reports	Assumption: Fuel-cell buses can be procured from commercial vendors at satisfactory cost.
	TASK 2: HYDROGEN FACILITY PURCHASE AND INSTALLATION			
	Tasks 2.1: Engineering and Site Design	Engineering drawings and specifications of the hydrogen facility.	Annual and final project reports	

	(1) Program or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
	Tasks 2.2: Permitting Tasks 2.3: Major Equipment/Facility Purchase Tasks 2.4: Utility Hookup and Site Construction	Necessary permits obtained. Bids are received, and a contract is negotiated with and awarded to the selected equipment supplier. Bids are received, and a contract is negotiated with and awarded to the selected company to install the hydrogen facility and make the utility hookup.	Annual and final project reports	
Output 2 **Tasks**	**Production and startup of FCBs and H2 Facility** TASK 1: FUEL CELL BUS PURCHASE (continued) Tasks 1.3: Fabrication and Delivery of the First 3 Buses Tasks 1.4: Fabrication and Delivery of the Next 5 Buses TASK 2: HYDROGEN FACILITY PURCHASE AND INSTALLATION (continued) Tasks 2.4: Utility Hookup and Site Construction (continued) Tasks 2.5: Mechanical Shakedown and Facility Startup	Buses produced to specification and on-time Buses produced to specification and on-time Refueling station operates satisfactorily to supply sufficient H_2 at reasonable cost	Review of the data record Review of the data record Review of the data record	Risk of vendor failure
XVIII. OUTPUT 3 **Tasks**	**Local operational/maintenance capacity in FCBs and H2 Facilities is built up** TASK 3: BUS/H2 FACILITY OPERATION AND MAINTENANCE Tasks 3.1: Operation and Maintenance of the First 3 Buses	Actual record of fuel economy, emissions, safety, load maintenance from the project.	Quarterly and annual project report. Review of the data record	

	(1) Program or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
	Tasks 3.2: Operation and Maintenance of the Next 5 Buses Tasks 3.3: Operation and Maintenance of Hydrogen Facility	Actual record of fuel economy, emissions, safety, load maintenance from the project. Actual record of facility operation, including emissions and safety.	Review of the data record Review of the data record	
XIX. OUTPUT 4 **Tasks**	**Accumulation of a body of knowledge about FCBs for Egypt** TASK 4: TEST DATA ANALYSIS AND PROJECT MANAGEMENT Tasks 4.1: Prepare Test Plan Tasks 4.2: Data Acquisition and Analysis Tasks 4.3: Project Management and Reporting	Test plan prepared Publication of documents and reports demonstrating accumulated knowledge, experience and learning. Test data collected, stored, and analyzed.	Quarterly and annual project report; project files and history.	
XX. OUTPUT 5 **Tasks**	**Increased awareness and support for FCBs in Egypt, and ongoing strategy developed** TASK 5: SUSTAINABILITY PROGRAM Tasks 5.1: Develop Master Plan/Intervention Measures Tasks 5.2: Build Up Codes/Standards and Local Capability Tasks 5.3: Disseminate Information	Intervention measure by government are developed and taken into account. Codes/standards for hydrogen established Positive results are obtained from the ridership survey. Number of report in the media and number of publications produced.	Project reports. Project reports. Survey of public' s opinion on FCBs. Publications produced.	

ANNEX C
STAP ROSTER TECHNICAL REVIEW

Dr. Marc Ross
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Summary of Review. Overall this is an exciting proposal for GEF, involving a promising new technology with the involvement of organizations in Egypt with considerable relevant experience - especially in bus manufacture and use of CNG. The desire shown in this proposal to avoid inessential complications also augers well. Nevertheless, it must be kept in mind that it is a demonstration project involving a new technology system with which there is very little experience anywhere in the world. With this limited experience, chance factors can easily make the difference between success and failure.

Upon reviewing the Egypt proposal after reviewing the Mexico City proposal, I am struck by how much clearer and more specific the Egypt proposal is on most points of interest. Some important items are made clear for the reader. For example, with respect to the hydrogen system, there is: specification of the hydrogen production facility, attention to hydrogen production and handling experience in Egyptian industry, and some discussion of safety issues. In the area of maintenance there is: special training of maintenance staff, the expectation of reduction of routine maintenance (FCBs relative to diesel), and reliability information from the Chicago and Vancouver demonstrations. In addition, the proposal is more realistic about defining the follow on period (after five years), given the uncertainties. Of course a better-written proposal does not necessarily mean a higher project quality.

The proposal indicates an impressively diverse program for traffic and emissions reduction in the Cairo region. I have no way of knowing how vigorously these initiatives will be pursued.

The key issue for this proposal is that this (bus and system) is new technology. Experience to date with FCBs is very limited. The Chicago Transit Authority's 2-year successful demonstration, just concluded with 3 Ballard/XCELLSIS buses, and a similar demonstration in Vancouver are the most important relevant experience (www.transitchicago.com/news). But one or two demonstrations leave a great deal of uncertainty about the use of the technology under different conditions. According to INFORM's study Bus Futures, chapter 7: "As of Jan. 1, 2000, fewer than five FCBs were operating in the US;" and "It is unclear at this point what the operational and maintenance costs of these buses will be, or even what operational and maintenance issues will arise." (www.informinc.org/busfutr.pdf)

Domestic manufacture is an excellent component to the proposal for political and economic reasons. The Egyptian bus manufacturing sector and the affiliation of leading world firms with some of the firms is encouraging. Of course some of the components, fuel cell stack, power electronics controller, and, perhaps, electric drive are not included in this domestic experience.

The design of the FCBs is not a major concern for this proposal, since it's in the hands of some of the best endowed manufacturers in the world, and they have already produced a few successful buses.

The reliability and maintenance cost projections are highly uncertain (item20 and Table 3). There is a substantial contingency fund.

The fueling infrastructure is my biggest concern as it is with the Mexico City proposal. Routine handling of hydrogen, in particular its storage and transfer, is challenging because of its very low density, propensity to leak and perhaps contamination with water. And of course there are safety issues, not necessarily more serious than for conventional fuels, but different. Enclosed spaces can be very dangerous, so design of the hydrogen system and dispenser, as well as the safety monitoring and alarms mentioned, is critical (item 44). It will be very important to gain experience. Although it's not clear how much experience there is in Cairo with CNG, that experience is important. Although easier to handle than hydrogen, CNG is somewhat similar to hydrogen in many respects.

To make the best use of experience, it is important to centralize the production and fueling at a single site in the initial years. This seems to be the plan (item 22.) It would be undesirable to ship hydrogen, at least at first. The range of FCBs between refueling should be larger than the 290 km of projected daily travel, thus allowing for once-a-day slow refueling. Presumably there would be no problem in finding an appropriate site for the production/fueling.

The proposal does not include the preferred hydrogen production facility with CO_2 sequestration. This elimination of complications in the first years is an advantage.

There may not be much of a research component. The stakeholder participation is at management level. I would prefer to see some broader involvement in evaluation.

A quick estimate confirms the rough accuracy of the CO_2 reductions stated in the Tables 2 and 6, although the information given doesn't permit verifying the results in detail. Obviously the benefits of the demonstration program as such are not great. If the demonstration is successful and the longer term costs are moderate, the benefits would be enormous. For detailed estimation of reductions in other pollutants, one has to know the comparison vehicle and its emissions and the assumed sulfur content of its fuel, which are not directly stated. However it is in the nature of this technology that relatively great improvements are involved.

XXI. Summary of Evaluation Against Criteria for Assessing FCB Proposals

[Please note that the information in italics presented below has been added only to provide context to the STAP review.]

1. Climate Change Impact: As the primary objective of GEF activities is to reduce GHG emissions, all demonstration projects--as well as plans for follow-on projects--must demonstrate a favorable GHG balance on a system-wide basis.

The climate change impact is good, a reduction in GHG emissions. (Note that the GHG emissions in the manufacturing and other phases should be small compared to the operating reductions.) However, this is a demonstration program of a quite new technology. Thus the consequences of the small demonstration, as such, are minor. Moreover, it is highly uncertain whether the demonstration will be so successful, including moderate costs for the follow-on HFCB system, that the new technology will be widely adopted on a time schedule like that indicated. If it is successful, the GHG reductions would be large.

2. Replication Potential: Proposals should include preliminary "action plans" for follow-up deployment in the host country bus market and related bus markets elsewhere in the region and globe. Proposals should present clearly how GEF funds will influence follow-on private sector investments for low carbon options in transportation.

With the caveats just stated about the uncertainty of outcome, I speculate that the potential for replication within each country is good, largely because of the domestic bus manufacturing involvement. Replication in other countries is much more doubtful and would at best be slow.

3. Integration in Plans for Rationalization of Urban Transport Systems: Given the uncertainty in technological developments and alternative futures, all participating countries would be well advised to pursue a number of opportunities to improve the urban transport system. The fuel-cell bus demonstrations must build upon and complement the other activities being implemented in the urban transport sector.

The integrated plan for rationalizing urban transport is ambitious for Cairo and much less so for Mexico City. I am not impressed by conventional diesel buses; unlike gasoline automobiles, we don't know if modern diesel vehicles are really clean and what their lifetime emissions will be. Of course only the briefest descriptions are included in the proposals. The list of endeavors for Cairo is impressive.

4. Cost Sharing: The development and utilization of fuel-cell buses will have multiple benefits for the global environment; for the local environment; for the local economy and for private industry. In an ideal situation, the costs of these initiatives would be shared between governments (both local and national); industry; and the GEF.

In both cases the cost sharing is impressive, with less private sector involvement in Egypt than Mexico.

5. Clarity of Indicators to be Used to Measure Success: Another important criteria will be the clarity of indicators proposed for measuring the success and failure of the project.

The indicators of success are not clear in either case, because there are so many. For example, among the potential indicators are bus availability, hydrogen dispensing availability, maintenance costs, manufacturer performance, cost of buses beyond the 5-year program, etc. For this reason, this criterion might be a cause for concern. Both proposals provide for assessment (item 44 for Mexico, task 4 for Egypt).

6. Geographic Diversity: The GEF programmatic intervention will target only the major bus markets of the world. It will seek to avoid duplication and potential overlap in choosing countries in which to support demonstration efforts. Each proposal will have to demonstrate that not only does it target a significant bus market, but that it is the center of a regional or sub-regional bus manufacturing industry.

I'm not an expert on this, but, as I remarked in (3), replication in other countries will not be easy. This technology is more expensive up front, and it primarily offers societal benefits. The benefits to individuals, firms and government units are diffuse.

ANNEX C1
RESPONSE TO STAP

The reviewer' s encouraging words on the value of the proposed project and his compliments on the clarity of the proposal are greatly appreciated.

The reviewer was impressed by the Egyptian government' s diverse program for traffic and emissions reduction in the Cairo region but was not sure whether the initiatives in the program would be aggressively pursued. All the initiatives are being actively pursued now. Some are actually part of continuing efforts for quite some time. For example, the CNG buses were first introduced in 1992 to transport the employees of Ministry of Petroleum. Then in 1997, CNG taxis were introduced with a total of 9,000 CNG taxis running now in Cairo. Under the CAIP program, 50 CNG buses started to operate three months ago for public transport.

The reviewer was concerned that little was known about FCB' s operating and maintenance cost and possible issues. These concerns are definitely valid. This is why one of the major objectives of the proposed project is to provide much needed feedback of fleet operating and maintenance experience for the bus manufactures to improve their products and to accelerate the commercialization.

The reviewer was very much in favor of the buildup of domestic manufacturing capability but commented on that some of the bus components, such as fuel cell stack, power electronics controller, and electric drive, were not included in the capability buildup. These components referred by the reviewer are key parts of the fuel cell engines and are the major technical challenges in the FCB development. As they are still being tested and improved, it is probably premature or too ambitious to transfer these technologies to Egypt in the next five years. However, the demonstration project has specifically put aside portion of the fund to entice the technical communities in Egypt to venture more into fuel cell technology research and development. Thus, Egypt could be ready to build up the manufacturing capability of these advanced components in the following phase of the project.

The reviewer pointed out that enclosed space could be very dangerous in terms of hydrogen accumulation and consequent chances of explosion and fire hazards. This concern was very much noted during the project design. Fortunately, Cairo has sunny and hot climate. As a result, the hydrogen facility and bus maintenance do not need to be in-door and will be sheltered only by a roof structure with open air. This minimizes the hydrogen accumulation and associated risks.

The reviewer commented that the experience related to safety from the current CNG bus project in Cairo would be very valuable to the FCB project but was not sure how much experience there was so far. As mentioned earlier, the use of CNG vehicles has a long history in Egypt. So, there is considerable experience accumulated as how to safely handle flammable gases.

The reviewer recommended to centralize the hydrogen production and refueling at a single site (i.e. no hydrogen transport) in the initial years (such as in the demonstration project phase and possibly beyond) and was wondering whether there would be any problem in finding an appropriate location for the central site. The project has recognized the importance of this comment and has selected GCBC' s Port Said bus garage located in the northwest corner of Cairo as a single site to host all the required facilities for hydrogen production (on-site generation by an electrolyzer), refueling, and bus operation and maintenance. For the small quantity of hydrogen required for the demonstration project, it is simply not justified to take upon the complexity and risks associated with the hydrogen transport. Based on the selected site, a preliminary engineering and site layout has been conducted to assess the requirements of site preparation, utility hookup, facility installation, and facility/bus operation and maintenance. The results were also used as the basis for the cost estimate of the project.

The reviewer indicated that the FCB should have a driving range more than 290 km/d so that the hydrogen refueling needs to be done only once a day. Based on the driving conditions in Cairo, the fuel cell bus manufactures has estimated that the buses would have a fuel economy of 0.1 kg H2/km. As the hydrogen tank in a fuel cell bus can store 50 kg H2, the bus could have a maximum driving range of 500 km. In case the fuel economy estimate is too optimistic, it is believed that there should be still enough margins in the fuel tank capacity to cover the error.

The reviewer commented that the stakeholder participation should be broader than just the management level. This point is well taken. In the development phase of the project, a meeting has already been held with the Engineering chamber and several bus/car manufactures to discuss the project and most of the participants have expressed keen interests to the project. In the implementation phase of the project, the stakeholders will now show the participation of the local bus manufactures and technical communities in Egypt. As indicated in Outcome #3 (Paragraph 29), the local bus manufactures will be involved in integrating and assembling the fuel cell buses based on imported fuel cell engines or chassis to build up local manufacturing capability. As indicated in Outcome #5 (Paragraph 36), the technical communities in Egypt will be involved by conducting fuel cell related research and development to build up local technical capability.

The reviewer indicated that additional information was required to verify rigorously the CO2 reduction stated in Tables 2 and 6 and the pollutants emitted in the base case. By reviewing what has already been provided, the additional information required is as following:

- Diesel fuel composition: 85.57 wt % carbon, 1,000 ppmw S, 0.84 specific density
- Natural gas composition: 0.88 % CO2, 93.42% CH4, 4.57% C2H6, 0.94% C3H8, 0.07% i-C4, 0.07% n-C4 (all on volume basis)
- Natural gas heating value (HHV): 1,052 Btu/scf
- Power consumption for the electrolyzer in the demonstration project: 51.4 kW/kg H2
- Power consumption for hydrogen refueling in the use of electrolyzer in the demonstration project: 3.2 kW/kg H2
- Natural gas consumption for the central reforming plant in the sustainable phase: 5.363 Nm3/kg H2
- Power consumptions for the central reforming plant case in the sustainable phase: 0.48, 0.62, 0.1, and 1.14 kW/kg H2 for hydrogen production, hydrogen refueling, CO2 sequestration, and hydrogen transport, respectively.
- Number of buses operating (excluding spare buses) in the sustainable phase: 2,550

ANNEX D
LETTER OF ENDORSEMENT

FROM : UFDP FAX NO. : + 202 5784847 30-08-00 04:42P P.02

Arab Republic of Egypt
Cabinet of Ministers
Egyptian Environmental Affairs Agency

جمهورية مصر العربية
رئاسة مجلس الوزراء
جهاز شئون البيئة

Mr. Edmund J. Cain
UNDP Resident Representative,
Cairo

29th August 2000

Subject: ***Endorsement Letter for Egypt-Fuel Cell Bus Demonstration project in Cairo***

Dear Mr. Cain

Please be kindly informed that the Government Of Egypt (GOE) is aware that reducing emissions from the transport sector will be fundamental to stabilizing greenhouse gases emissions at levels that will prevent serious anthropogenic interference with climate system.

We have, therefore, participated in the preparation of the project concept to be used to seek GEF funding for the Project Development Fund module A activities and finalized system optimization study for using fuel cells and hydrogen for public transport in Greater Cairo within the course of executing Project Development Fund module B.

As planned for the demonstration project (PDF - C), the project will feature 8 fuel cell buses with associated hydrogen production and supply facilities. It will be five years program with three years of actual driving, monitoring and testing the performance of the buses. The total budget is estimated to be US$ 22.7 million of which GEF will cost share US$12 million, Bus manufacturers will cost share US$ 2.2 million. UNDP Cairo will cost share US$ 0.8 million with US$ 7.8 million contribution from GOE.

We therefore, indicate our deep interest and commitment to the project and request UNDP to seek GEF support for the execution of the PDF-C activities.

Thank you for your cooperation

Best regards

Dr. Ibrhaim Abdel Gelil

CEO, Egyptian Environmental
Affairs Agency, EEAA

٣٠ طريق مصر حلوان الزراعي - خلف فندق سوفيتل - المعادي - القاهرة الرقم البريدي ١١٧٢٨ ت: ٥٢٥٦٤٥٢ فاكس: ٥٢٥٦٤٩٠
30 Misr Helwan El - Zyrae Rd., Maadi Cairo Egypt P. O 11728 Tel :5256452 Fax : 5256490

ANNEX E
PROJECT CATEGORIZATION

<table>
<tr><th colspan="6">a. Focal Area Categories</th></tr>
<tr><th colspan="2">Biodiversity</th><th colspan="2">Climate Change</th><th>International Waters</th><th>Ozone Depletion</th></tr>
<tr><td colspan="2">Conservation</td><td colspan="2">Energy conservation (prod./distribution)</td><td>Transboundary Analysis</td><td>Monitoring:</td></tr>
<tr><td>in situ</td><td>ex situ</td><td>ESCO' s</td><td>Efficient Designs</td><td>Strat. Action Plan Development</td><td>ODS phase out (Production)</td></tr>
<tr><td colspan="2">Sustainable Use</td><td colspan="2">Solar:</td><td>Freshwater Basin</td><td>ODS Phase Out (Consumption)</td></tr>
<tr><td colspan="2">Benefit-sharing</td><td colspan="2">Biomass:</td><td>Marine Ecosystem</td><td>Other:</td></tr>
<tr><td colspan="2">Agrobiodiversity</td><td colspan="2">Wind:</td><td>Wetland Habitat</td><td></td></tr>
<tr><td colspan="2">Trust fund</td><td colspan="2">Hydro:</td><td>Ship-based</td><td></td></tr>
<tr><td colspan="2">Ecotourism</td><td colspan="2">Geothermal:</td><td>Toxic Contaminants</td><td></td></tr>
<tr><td colspan="2">Inventory</td><td colspan="2">Fuel cells: X</td><td>GPA Demonstration</td><td></td></tr>
<tr><td colspan="2">Policy & Legislation</td><td colspan="2">Methane recovery:</td><td>Fisheries Protection</td><td></td></tr>
<tr><td colspan="2">Buffer Zone Dev.</td><td colspan="2">Other:</td><td>Global Support:</td><td></td></tr>
</table>

<table>
<tr><th colspan="4">b. Categories of General Interest</th></tr>
<tr><td>Investment</td><td>Cap.Building/TA
X</td><td>Targeted Research</td><td>Land Degrad.</td></tr>
<tr><td>Technology Transf.
X</td><td>Small Islands</td><td>Info/Awareness
X</td><td>Private Sector
X</td></tr>
</table>

<table>
<tr><th colspan="5">c. Community &NGO Participation</th></tr>
<tr><td>Involvement type</td><td>project design (tech. advise)</td><td>implementation (execution)</td><td>info/awareness activities</td><td>nat./reg./local consultation</td></tr>
<tr><td>Names of Communities and NGOs Involved</td><td></td><td></td><td></td><td></td></tr>
</table>

THE FUEL CELL BUS STRATEGY – BACKGROUND FOR THE PROJECT

Inclusion in the Current Work Program

1. At the GEF Council Meeting in November 2000, a discussion on "***GEF Strategy to Develop Fuel-cell Buses (FCB) for the Developing** World*" was led jointly with the GEF Secretariat and UNDP. This meeting summarized the outputs of a series of workshops sponsored under the UNEP Medium-Sized Project "Fuel Cell Bus and Distributed Power Generation Market Prospects and Intervention Strategy Options". These workshops – which included participants from private industry, public sector transit agencies in both developed and developing countries, and members of the GEF Secretariat and Implementing Agencies – shaped the *GEF FCB Strategy* for the development of FCBs in GEF recipient countries, consistent with the objectives of Operational Program: *Promoting Environmentally Sustainable Transport*

2. As a direct result of these November 2000 discussions, the Joint Summary of the Chairs from the November 2000 GEF Council Meeting issued the following statement:

> "The Council agreed that the GEF should develop the five fuel cell bus projects current in its pipeline taking into account the recommendations made by STAP and the technical comments of Council Members. Before proceeding with additional fuel cell bus projects, the Secretariat and Implementing Agencies should present to the Council a strategy on the further development of activities addressing this technology, taking into consideration the experience and lessons learned from demonstration projects."

3. Based on the above statement and on the *GEF FCB Strategy* presented and supported at the November 2000 meeting, and taking into account that each project be judged on its individual merits according to this Strategy, the following is the submission schedule for this and subsequent Work Programs:

Date (FY)	**Resource Requirements**	**Country Projects**
December 1999 (FY2000)	US$ 12 m	Brazil (Stage I and Stage II)
February 2001 (FY 2001)	US$ 12 m	Mexico (Stage I) Egypt (Stage I)
May 2001 (FY 2001)	US$12 m	China (Stage I) India (Stage I)
February 2002 (FY 2002)	US$ 12 m	Mexico (Stage II) Egypt (Stage II)
May 2002 (FY 2002)	US$12 m	China (Stage II) India (Stage II)

4. This schedule intends to minimize the dominance of the FCB Program on OP 11, to allow for lessons learned from earlier projects to inform later projects, and to reduce the

risks to GEF finances. The order by which the projects are being submitted to Council has been determined by project quality criteria established in the *GEF FCB Strategy*. The two projects being proposed for inclusion in this Work Program have both met the quality criteria.

5. As recognized in the Joint Summary of the Chairs, before proceeding with any FCB projects beyond those scheduled above an assessment of the FCB portfolio will be conducted and a new strategy will be prepared. At that point, the lessons learned from the demonstration project – including incremental costs for phase III, availability of co-financing, and developments in the fuel-cell industry – will be taken into account.

6. To help achieve the overall programmatic goal of increasing the FCB production so that their costs begin to become competitive with those of conventional diesel buses, the World Bank/IFC and other Regional Development Banks have been asked to participate in the monitoring of the demonstration projects. The active participation by these Banks is being sought to increase the probability of successful investment projects being taken up by an implementing agency other than UNDP during the commercialization stage.

7. As part of the FCB projects' awareness strategy, which will target both the public and private sectors, all marketing and communications will recognize GEF support for the project - including profiling the GEF' s logo(s) on the actual FCBs.

Highlights of the GEF Strategy to Develop Fuel-cell Buses (FCB) for the Developing World

8. The strategy presented and discussed at the November 2000 meeting proposed several stages of GEF support for FCBs. In addition, the strategy was crafted in direct response to comments presented by Council members in response to the inclusion of the proposal entitled "Brazil: Hydrogen Fuel Cell Buses for Urban Transport" in the Work Program approved by Council in December 1999. It also incorporates inputs from Council members provided during the rounds of workshops and following the discussion was held at the December 2000 Council meeting.

9. The strategy contains three stages: Preparation; Demonstration; and Commercialization. The Preparation stage began in 1995 with discussions with the various participating countries and included all preparatory activities. The Demonstration stage containing the five demonstration projects included in the program approved by Council, will run for up to five years, helping both the GEF and the recipient countries involved to decide whether or not further pursuit of and support for this technology is warranted. If GEF support is considered desirable (based upon successful future demonstrations), larger, investment-scale projects will be prepared for inclusion in future work programs to achieve the GEF long-term goal of making this clean technology commercially competitive with more conventional alternatives.

10. Using the agreement on the overall structure of the program, each FCB demonstration project will be judged on its individual merits. Each project will be required to

demonstrate a positive GHG balance at both the demonstration and commercialization stages. Demonstration projects are being prepared and presented only for countries with significant bus markets where replication potential is potentially large. They will cover a large range of geographically diverse regions. Each proposal must show that it has been integrated into the overall plans for improvement of the urban transport system and that there is significant cost-sharing so that the costs and risks are borne by both local and national governments, the private sector, and the GEF. All projects will have clearly-defined project-level indicators with a clear monitoring plan.

11. In addition to the requirements that each project be judged on its individual merits, the FCB projects are to be approved over a period of time. This will serve both to minimize its dominance of OP11, "Sustainable Transport" as well as allow for the transfer of lessons and experiences from one project to another.