GEF/CRP.2
May 20, 2003

GEF/UNDP FUEL-CELL BUS PROGRAMME: UPDATE

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At the May 2002 Global Environment Facility Council Meeting, the GEF Council requested that UNDP provide a yearly progress report on the GEF/UNDP Fuel-Cell Bus (FCB) Programme. The purpose of this paper, therefore, is to inform the GEF Council on the implementation of the FCB projects and progress made in deploying FCB's worldwide. Therefore, this paper is constructed with three sections. The first section briefly outlines the objective and strategy of the FCB Programme, while the second section focuses on the implementation status of each project and overarching coordination efforts. Because the implementation of the GEF-UNDP FCB Programme is greatly impacted by developments in the FCB market, the third section presents the status of non-GEF FCB activities. Additional detailed information on each GEF/UNDP project is provided in an Annex.

1 Overview of the GEF/UNDP Fuel-Cell Bus Programme

To help catalyze the commercialization of FCB technology for urban areas of developing countries, the GEF and UNDP launched a program to set the stage for large-scale commercial deployment of FCBs in developing countries. The GEF-UNDP FCB Programme is supporting commercial demonstrations of FCB and associated refueling systems in the largest bus markets in the developing world: Beijing, Cairo, Mexico City, New Delhi, Sao Paulo, and Shanghai. The Development Objective of the Program is to reduce the long-term greenhouse gas (GHG) emissions from the transport sector in GEF program countries. The achievement of this development objective involves GEF support for preparatory activities and demonstration projects. For the five projects, the total proposed GEF commitment is US$ 59.6 million, with approximately US$ 36 million already approved.

Through the support of FCBs in GEF program countries, the GEF is fulfilling its role as an important agent of technology transfer in support of the UNFCCC. By encouraging the early adoption of these buses in a process of "technological leapfrogging", GEF/UNDP is helping developing countries gain experience with the FCB early in its product cycle. GEF program countries can then develop partnerships with technology developers, thereby increasing technological competence and adapting the technology to local needs. GEF Program countries will also benefit from reduced local air pollution, new export opportunities attributable to local manufacturing, and improved quality of public transit service. Finally, the GEF-UNDP will also be assisting developing countries in preparing for a future transition to newer, cleaner and more efficient fuel-supply systems based on hydrogen.

The GEF's interest in FCBs is justified on the basis of the reduced GHG emissions that FCBs offer over conventional diesel buses. Fuel cells fired by hydrogen can offer dramatic reductions in system-wide GHG emissions from the urban transport sector if the system is carefully designed. Although fuel cells are technically proven, they are not yet economically competitive in commercial applications: early investments in the technology can reduce its costs to a commercially competitive level within 7 to 15 years. The volume of production required to attain this goal is estimated at between 2000 and 5000 buses, in both developed and GEF program countries. Once fully commercialized, the technology can then play an important role in the stabilization of GHGs by the year 2100, as represented in IPCC scenarios.[1]

[1] *Climate Change 2001: Mitigation* - Contribution of Working Group III to the third assessment report of the Intergovernmental Panel on Climate Change. Edited by B. Metz *et al.* 2001, p 240.

The GEF/UNDP strategy for FCB commercialization involves a working partnership between GEF, private industry, and local/national governments in GEF Program Countries. The GEF will play three important roles. The first role is funding the incremental costs of FCB projects in recipient countries. The second is facilitating the process of FCB commercialization in developing countries by convening various parties to discuss, collaborate in, and finance the commercialization program. The final role is that of enabling information exchange within and between program countries, industry, and other FCB demonstrations in both donor and recipient countries. By assuming each of these roles, the GEF is placing a reciprocal responsibility on the counterparts in the partnerships. Their contributions to the partnership will include the provision of financing, cooperation, and information to the FCB development process.

To meet the development objective of this programmatic initiative, the GEF/UNDP strategy of support involves three distinct phases of support: (I) Preparatory Phase; (II) Demonstration Phase; and (III) Commercialization Phase. GEF is now funding Phase II — the Demonstration Phase — with countries in early implementation of full demonstration activities and proposals for follow-on commercialization work. Whether GEF support will continue to be warranted in Phase III will depend largely on the nature of the GEF's continuing role in climate change; the degree to which the developing country demonstrations have been successful; and the continued investment and interest in the technology within donor countries. Therefore, at present, it is not recommended to commit the GEF to one specific program of support for Phase III projects. Rather, the GEF must make an informed decision most likely between the years 2004 and 2006.

2 FCB PROGRAMME IMPLEMENTATION

Consistent with the FCB Programme strategy, the five projects in the FCB Programme are being implemented in a phased manner as requested by the GEF Council. The major advantage of this phased approach to implementation is to maximize the structured learning from the earlier projects to the later projects. The Brazil project was first approved by the GEF Council in November 1999 and began implementation in November 2001. Mexico's FCB project began implementation in January 2002, followed by China in November 2002. Both Egypt and India's FCB projects have not yet been finalized. The status of each project is outlined below, with additional details on the project provided in Annex I.

2.1 Brazil

The extended GEF Council deliberations on the FCB programme and an electricity supply crisis in Brazil delayed the signing of the Project Document until November 2001. In early 2002, Brazil's "*Hydrogen Fuel Cell Buses for Urban Transport*" project initiated a study to update the FCB market analysis conducted during the PDFB stage. This government-funded analysis included study tours of key FC manufacturers and FCB demonstrations, and drew conclusions to help direct the FCB bidding process.

Also in 2002, eligible companies/consortium were invited to express their interest in providing the following equipment for the Brazil FCB project: hydrogen fuel cell buses; hydrogen supply equipment; and hydrogen storage and fuelling equipment. Based on the outcome of the solicitation for expressions of interest, negotiations with technology providers are now underway. Discussions have been held to prepare the technical requirements for the local market; to establish the timing for finalization of MOU; to establish the first prototype; to finalize the release of the final technical design; and to launch the production of buses.

2.2 Mexico

The project entitled "*Demonstration Project of Hydrogen Fuel Cell Buses and an Associated System for Hydrogen Supply in Mexico City*" officially began on January 25, 2002, with the signature of the Project Document. The Mexico project team is currently coordinating a series of studies and workshops that focus on updating the information from the PDF B and on finalizing the technical specifications. These activities are being funded by the Government's counterpart contributions.

As preparation for the FCB bidding process, activities to be undertaken prior to August 2003 include: identification of local and international companies potentially interested in participating; finalization of technical specifications for FCBs; organization of a workshop focusing on hydrogen suppliers; study tours of FCB programs and producers in the United States and Europe; training and participating in international conferences on fuel-technology; preparation of the request for expressions of interest in supplying FCBs and hydrogen infrastructure.

2.3 China

The "*Demonstration for Fuel-Cell Bus Commercialization in China*" project was launched at an Inception Workshop in Beijing held on March 27, 2003. This workshop was attended by representatives from UNDP, the Government of China (MOST and associated State Ministries), the municipalities of Beijing and Shanghai, the Beijing and Shanghai municipal bus companies, technical experts at the national and municipal levels, project officials from MOST, Beijing and Shanghai project management offices, companies (domestic and foreign) involved in FCB development and hydrogen production, and representatives of the media.

The first Project Team Meeting was held in conjunction with the Inception Meeting in order to familiarize the project team members with each other; to review and seek comments on the goals, organization and approach to the project; and to review and discuss the detailed work plan for Part I of the project.

The main conclusions of the Inception Meeting and Team Meeting are that the project has all the right ingredients to be successful. The first is the political support of MOST and the two municipal governments. The second is the level of technical skills that already exists in China regarding fuel cell vehicles, which provides a solid base from which to build the technical infrastructure needed to support this project. The third is the "golden opportunities" represented by the 2008 Beijing Olympic Games and the 2010 Shanghai World Exposition, which should provide significant motivation to the FCB suppliers and the project proponents to ensure the success of the project. Finally, the high level government officials in attendance all provided clear indication that this is an important project for China, while the private sector's participation signaled their early interest in this project.

The activities to be performed over the next few months include: the review of system specifications and the design of the bid package, including the contractual terms and conditions; planning of study tours; assessment of hydrogen supply; and publishing of a bi-monthly newsletter. Both Beijing and Shanghai municipality governments have appointed a vice major who will head the project. The national and local oversight committees are in place and project managers, who will be responsible for local project implementation in Beijing and Shanghai, have been nominated. However, SARS has impacted the project to the extent that the second team meeting planned for late April has been postponed. The teams are doing their best to maintain the project schedule, but at this time it is not possible to predict what impact the restrictions to eliminate the SARS threat will have on the project schedule.

2.4 Egypt and India

Egypt's "*Fuel Cell Bus Demonstration Project in Cairo*" project was approved at the February 2001 Intersessional, and the Project Document will be undergoing finalization in the coming months to ensure that early lessons learned from Brazil, China and Mexico are incorporated into the work plan. This detailed project plan will be developed prior to submission of the Project Document to the GEF Secretariat for CEO Endorsement.

The "*Fuel-Cell Bus Development in India*" project was approved as part of the May 2001 Work Programme. UNDP is facilitating negotiations between the GEF Focal Point — the Ministry of Environment and Forests — and the Local Implementing Agency — the Ministry of Non-Conventional Energy Sources. These negotiations are expected to resolve issues surrounding the final implementation arrangements for the project.

GEF Council has requested that both the Egypt and the India FCB Project Documents be re-circulated to Council prior to GEF CEO endorsement.

2.5 FCB Programme Activities: Networking Initiatives

Opportunities for effective information exchange serve to strengthen GEF/UNDP's FCB Programme. UNDP facilitated one such opportunity in October 2002, when representatives from Brazil and Mexico's project teams — supported through cofinancing from their countries' FCB projects — participated in the California Fuel Cell Partnership (CaFCP) Summit Meeting. This meeting provided an opportunity for participants in fuel cell vehicle demonstration projects worldwide to share experiences and future plans. The CaFCP also hosted a second less formal meeting after the Summit that focused on discussing the potential value and possible mechanisms for coordinating, sharing information, and building a worldwide database between fuel cell bus demonstration projects. Together, the two meetings provided an opportunity to talk with some of the key potential technology providers for GEF/UNDP FCB projects, as well as to hear the experiences of two of the three transit companies involved in CaFCB bus demonstration projects.

To help formally support networking activities associated with the FCB Programme, UNDP has recently committed internal funding for a FCB "Networking Initiative". This initiative is structured to help meet the long-term objective of promoting the adoption of sustainable transportation initiatives in developing countries through technology transfer and capacity building promoting effective information exchange. The intent is to yield increased FCB expertise in the GEF/UNDP's three FCB programme countries currently under implementation by focusing on the following immediate objective: to develop and strengthen the exchange of information and expertise on FCBs between China, Mexico and Brazil.

Two main activities are envisaged:

(i) establishing a network to increase sharing of information on GEF/UNDP FCB Projects under implementation; and,

(ii) setting up a "twinning" arrangement between FCB cities to foster exchange of experience between GEF/UNDP FCB Projects under implementation and other demonstration projects around the world.

Communication Network — To help ensure coordination between country activities, and to maximize the sharing of lessons-learned, a FCB website will be developed and maintained. There will be two "sides" to this website: for the external audience/general public; and for the internal audience/programme countries and direct project stakeholders. The site for the general public will host general FCB-related information, press releases and updates, reports, and contact information and is expected to be launched in the 3rd quarter of 2003 (see www.undp.org/gef/ later this year). The private site will host information on progress, lessons learned, and research associated with all FCB projects and is intended to facilitate communication between the GEF/UNDP FCB projects.

To maximize the sharing of knowledge within the portfolio of FCB projects, a series of meetings will also be organized that will bring together key stakeholders from all of the GEF/UNDP FCB projects. During the duration of this project, one International Meeting will be organized. International Meeting costs could be covered in part by sponsors, project budgets, and UNDP. Effort will be required to mobilize financing and organize this meeting and future initiatives to be held during the FCB programme implementation.

Twinning Initiatives — To increase the sharing of lessons learned, "twinning" of the GEF FCB cities with others around the world will be initiated. Currently, these other FCB projects include the EU's 10 countries involved in CUTE (Clean Urban Transport for Europe) and Australia's coordinated demo project; California's Fuel Cell Partnership (with 3 transit companies — AC Transit, SunLine Transit Agency, and Santa Clara Valley Transit Authority); Georgetown University, the Canadian Alliance and the IVECO demo in Torino, Italy. The local transit authorities involved in the GEF programme would be linked with those in the EU (CUTE), CaFCP, Italian and/or other demonstrations. The links would be between the transit authorities rather than the fuel cell or bus suppliers. One approach would be to match cities with similar proposed fuel-supply arrangements. GEF/UNDP would help ensure the matching and communication arrangements between cities.

The FCB twinning-of-cities concept relies on the interest of other FCB cities in partnering. It is possible that suitable matches will not be found for all of the three GEF/UNDP programme countries. However, to date there has been interest expressed by the FCB initiative in Iceland (ECTOS's FCB demonstration in Reykjavik), and other expressions of interest from the California Partnership and EU's CUTE programmes. This risk, which is considered to be relatively small, will be mitigated through extensive project work on soliciting willing "twins" and choosing the most appropriate partner cities.

3 NON-GEF FUEL-CELL BUS ACTIVITIES

This section reviews non-GEF FCB development and demonstration activities ongoing worldwide. There are two major FCB demonstrations — the Clean Urban Transport for Europe (CUTE) and the California Fuel Cell Partnership's Program — and several smaller initiatives worldwide. UNDP is closely monitoring these activities and, through activities such as those described in the section above, is trying to establish active links between the GEF/UNDP project teams and other project teams wherever possible and appropriate.

3.1 Clean Urban Transport for Europe (CUTE)

CUTE is a program to demonstrate the viability of FCBs in urban transit applications in 10 European cities, plus Perth, Australia (http://www.fuel-cell-bus-club.com/). Three "Citaro" model buses (made by Evobus, which is owned 100% by Daimler-Chrysler) powered by Ballard fuel cell engines will be delivered with a two-year drivability guarantee to transit agencies in Amsterdam, Barcelona, Hamburg, London, Luxembourg, Madrid, Porto, Reykjavik (ECTOS - Ecological City Transport System), Stockholm, Stuttgart, and Perth.2 Some or all of the buses will be operated in revenue service. Delivery of all 33 buses will begin in mid-2003 (to Madrid), with all buses to be delivered by mid-2004. A different hydrogen refueling station design is being demonstrated in each city.[3] The H2 sources include on-site production by steam reforming of natural gas and electrolysis of water using different sources of electricity (including renewable electricity), as well as trucking-in liquid H_2 from a refinery. Ballard has established a program at their headquarters in Vancouver to train CUTE participants. In addition, one Ballard and one Evobus technician will be posted to each demonstration site.

CUTE is funded (30%) under the European Union's Fifth Framework for Research and Development (Transport). National and local governments, transit agencies, and other companies involved are covering the balance of costs. For example, in Amsterdam, the Dutch government provides 15% of the funding in addition to the 30% provided by the EU; the rest is paid for by the City of Amsterdam and by the transit agency. The Amsterdam Transit Agency chairs the "fuel cell bus club," which meets every six months. Club membership is limited to CUTE bus companies in Europe and Perth.

Industrial participants in CUTE include BP, DaimlerChrylser, Shell Hydrogen, and electric utilities in the participating countries. Several European universities are involved in data collection. Data will be collected for human, environmental and technical areas. Reports will be prepared and sent to EU. The EU retains confidentiality and ownership of any reports prepared for this program. At this time it is unclear what information will be public, and what information will be DaimlerChrysler/Ballard proprietary information.

3.2 California's FCB Program

As part of the California Fuel Cell Partnership (http://www.drivingthefuture.org), fuel cell bus demonstrations are being undertaken at three large transit agencies. An important driver for transit agencies' participation in the demonstration programs is the California regulatory requirement for transit agencies on the "diesel path" to demonstrate zero emission buses by mid-2003. Transit agencies on the "diesel path" are required to purchase 15% of new buses as zero emission buses by 2008. All transit agencies will be required to purchase zero emission buses by 2010.

Ultimately, up to 20 FCB's will be demonstrated in California. Initially, seven "first generation" fuel cell buses will be demonstrated at three transit agencies. Three buses will be operated by the Alameda-Contra (AC) Costa County Transit Agency (with Golden Gate). Three buses will be

[2] The Citaro design includes a "roof assembly" module containing storage tanks, fuel cells, air conditioning system, and power electronics. The engines will have a 250 kW power rating, with driving range over 200 km. Hydrogen will be stored on-board at 5,000 psi pressure.

[3] The refueling station specifications include a required maximum rate of dispensing 99.95% purity H2 of 120 kg/day, bus refueling time of less than 15 minutes, and a maximum of 20 minutes between sequential fills.

operated by the Santa Clara Valley Transit Authority (with San Mateo), and one bus will be operated by the Sunline Transit Agency. The AC Transit and Sunline demonstrations will utilize VanHool buses with engines from United Technologies Center Fuel Cells (UTCFC) and overall bus integration by ISE. The Santa Clara Valley Transit Authority will demonstrate buses made by Gillig, with Ballard fuel cell engines. Delivery of buses is expected in early 2004, with the in-service demonstration period lasting two years.[4] From 2004-2006, transit operations will collect data to evaluate operating and maintenance costs, range and fuel economy, reliability of the fuel cell stack, service availability (hours in operation), implementation/training experience, fleet/consumer/public acceptance, performance expectations, and safety.

The AC Transit project is especially notable because it is the only significant announced FCB project that will utilize UTCFC engines. Compared to Ballard, which is taking an aggressive role in demonstration efforts, UTCFC is moving more cautiously, but nevertheless quite deliberately (see below). Ballard is delivering stacks for small fleets in 2003 and 2004 (as discussed above). UTCFC personnel have indicated that they will be ready to deliver stacks for small fleets starting in 2006.

As part of the California FCB activity, the California Energy Commission (one of the participants in the CaFCP) hosted a fuel cell bus "summit" at which participants from all significant FCB projects worldwide had the opportunity to share experience and future plans. A key discussion topic at this meeting was the potential value and possible mechanisms for coordinating, sharing information, and building a worldwide database between fuel cell bus demonstration projects.

3.3 Canadian Transportation Fuel Cell Alliance (Canada)

The Canadian Transportation Fuel Cell Alliance (http://ctfca.nrcan.gc.ca) is a $23 million CAD (16.6 USD) federal government initiative that will demonstrate and evaluate fuelling options for fuel cell vehicles in Canada. Different combinations of fuels and fuelling systems will be demonstrated by 2005 - for light, medium and heavy-duty vehicles. The first fuelling station is expected in the Vancouver area in 2003. The initiative will also develop standards and training and testing procedures as related to fuel cell and hydrogen technologies. One 30-member working group on heavy-duty vehicles within the Canadian program is assessing markets for buses and possible demonstration projects. This effort is led by Hydrogenics, a potential future fuel cell engine supplier.

3.4 Georgetown University, Washington, DC

Georgetown University has a long-standing fuel cell bus R&D program aimed at providing industry with tools and a knowledge base to develop commercially viable fuel cell transit buses (http://fuelcellbus.georgetown.edu/). The program includes hardware testing, improvement of systems integration, engineering feedback to suppliers, and education of the public and operators. The program is focused exclusively on methanol-fueled buses. The program recently acquired a 40-foot bus with a Ballard PEM fuel cell engine hybridized with electric battery storage. Four prior buses in the program operated with phosphoric-acid fuel cell engines.

[4] The publicly-announced average purchase price for a bus in the California program is $3.13 million, which includes an initial warranty of 2 years or 200,000 miles. Considering that the average speed of an operating FCB might be 20 to 30 miles per hour (there will be a mix of urban and highway miles), the 200,000 mile lifetime suggests that the expected stack life is in the range of 6,600 to 10,000 hours. While this stack life is not yet sufficiently long for commercial viability, it represents considerable progress over previous-generation fuel cell engines.

3.5 Japan

The Japan Hydrogen and Fuel Cell Demonstration Project (http://www.jhfc.jp/) is a government co-sponsored effort aimed at bringing fuel cell technology to market maturity. Relatively little of this effort is focusing on FCBs, and the only bus demonstration activity appears to be the recent road-certification of a 10-meter Hino FC bus. This bus is right-hand drive with a Toyota PEM fuel cell engine. Japanese representatives who attended the California FCP summit in late October 2002 indicated that the Japanese program is looking to other bus projects around the world to help them decide how to go forward with their own bus demonstration program.

3.6 United Technologies Center Fuel Cells (UTCFC)

At this time, Ballard and UTCFC can be considered the leading competitors in the potential future commercial market for fuel cell engines for buses. Ballard's activities have been well publicized. UTCFC has chosen to take a lower profile, but is active nonetheless. As of mid-2002, UTCFC projections for the market for fuel cells in 2005 was $1 billion, 20% of which was in trucks/buses and 50% of which was in stationary applications (near zero for cars). By 2010, their projection is for a $20 billion market, 30% of which would be trucks/buses and 20 to 30% cars, with the balance in stationary applications.[5]

UTCFC's involvement in the fuel cell engines for transportation began in earnest in 1998 with their supplying a 200 kW phosphoric acid fuel cell to Georgetown University for a bus fueled with methanol. In 1999, UTCFC provided BMW with a 5 kW PEM fuel cell for application as an auxiliary power unit. In 2000, UTCFC unveiled its Series 200 PEM fuel cell, a 50 kW unit operating on reformate from a gasoline reformer.[6] Series 200 PEM, 50 kW, gasoline reformer. In late 2000, Hyundai introduced its Santa Fe SUV with a Series 300 UTCFTC stack (75 kW). Two of these vehicles are operating in California (Sacramento) on a daily basis. Two units are operating in Korea, and an additional unit is maintained at UTC headquarters. As of 2002, UTCFC was testing its 3rd generation cell-stack assembly, the Series 500, with output greater than 75 kW.

Especially significant for FCB development is the fitting of Series 300 stacks into an Iris bus and a Thor bus in a hybrid configuration (with battery). The Iris bus was unveiled at the 2001 meeting of the UITP (International Association of Public Transport) in London in 2001, and has been operating since then at the Fiat research center in Italy. Plans are to operate the bus in revenue service in Turin, Italy. The Thor bus ("E-Z Rider" 30 foot bus) is or soon will be operating at Sunline Transit in California, as mentioned above.

All bus engines provided by UTCFC to date have been based on engines originally designed with automobile applications in mind. UTCFC's plans for call for design and development by the end of 2003 of a 170 to 200 kW unit intended for bus applications. VanHool buses using these FC engines will be operated by AC Transit as part of the FCB demonstrations in California during 2004 to 2005 (described above). Small fleets based on second-generation FC designs will be available for demonstration beginning in 2006.

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[5] I. Munoz, Program Manager, Commercial Vehicles, UTCFC, South Windsor, CT, personal communication, 23 July 2002.

[6] UTCFC's product numbering convention: even-number models (200, 400, 600) run on reformate; odd-number models run on pure H_2.

4 CONCLUSIONS

To maximize structured learning from the earlier projects to the later projects, the five GEF/UNDP FCB projects in the Programme are being implemented in a phased manner. Brazil, China and Mexico's FCB projects are all underway, with Egypt and India pending document finalization and implementing arrangement clarification. The FCB market is continuing to progress, albeit at a slower pace than anticipated in 1999/2000. The progress of the two major FCB demonstrations – CUTE and CaFCP – continue to be monitored as are other smaller initiatives worldwide. To support project implementation, UNDP is facilitating the establishment of a communication network to increase sharing of information between GEF/UNDP FCB Projects under implementation. Further, links between GEF/UNDP and non-GEF/UNDP projects are being explored and pursued with the intent of establishing a network or "twinning" arrangement to increase sharing of information on FCBs.

Annex I: Detailed Information on FCB Projects

Project Title, City and Country:	**Hydrogen Fuel Cell Buses for Urban Transport in São Paulo, Brazil**
Project Participants and Sponsors:	GEF/UNDP, Ministry of Mines and Energy (GoB), the Empresa Metropolitana de Transportes Urbanos de São Paulo S/A - EMTU/SP and Private Sector
Project Budget and Funding:	GEF/UNDP US$12,274,000 GoB US$4,597,000 EMTU US$1,698,000 Private sector US$2,611,000
Project Description and Objectives:	This project is designed to stimulate the development and utilization of fuel cell buses by supporting a significant operational test of fuel cell buses in the greater São Paulo Metropolitan Area. It will assist the Brazilian Government and the Empresa Metropolitana de Transportes Urbanos de São Paulo S/A - EMTU/SP in obtaining and operating 8 fuel cell buses in order to provide feedback to the technology developers and to gain meaningful experience in the operation and management of buses powered by fuel cell drive trains. This project will both pave the way for further projects in Brazil that will be required for fuel cell buses to be commercially produced and provide experience and increased demand for the fuel cell buses. Thus, it will contribute to cost-reductions, making the technology more available to other developing countries over the long run.
Project Technical Goals:	To demonstrate the operational viability of fuel cell drives in urban buses, together with the requisite re-fueling infrastructure, under Brazilian conditions. It will begin the process of commercialization and adaptation of the fuel-cell buses in Brazilian market.
Project Approval:	The Project Brief was approved as part of the December 1999 Work Programme.

Project Title, City and Country:	**Demonstration Project of Hydrogen Fuel Cell Buses and an Associated System for Hydrogen Supply in Mexico City, Mexico (Part I)**
Project Participants and Sponsors:	GEF/UNDP, SETRAVI (Secretary of Transport of the Mexico City Government), STE (Electric Transport Service of Mexico City), Private Sponsors and Private Sector
Project Budget and Funding:	Part I: GEF/UNDP US$5,078,800 STE US$2,342,000 Private Sponsors US$125,000 Private Sector US$2,455,000
Project Description and Objectives:	This project intends to foster the development, manufacture and large-scale commercialization of hydrogen-fuel cell buses (HFCBs) in Mexico through the initial operation of a fleet of 10 fuel cell buses in Mexico City during an estimated 5-year period. This project represents the first part of an anticipated two-part project designed to test – under conditions of commercial operation – a zero emissions technological option for public transport in a dynamic metropolitan area situated at 2,200 meters above sea level. A total of 3,000,000 km of accumulated use will be gained by the end of the demonstration period. In Part I of the project, system specifications and bid documents will be developed, and the complete FCB system suppliers will be selected. The hydrogen fueling systems will be installed, and the first set of 3 buses will be purchased, delivered, and prepared for operations during Part II of the project.
Project Technical Goals:	To demonstrate the operational viability of fuel cell drives in urban buses, together with the requisite re-fueling infrastructure, under Mexican conditions, through the initial operational test of 3 hydrogen fuel cell buses. It will begin the process of commercialization and adaptation of the fuel-cell buses in Mexican markets; buses will operate under high altitude conditions, generating vital information for urban areas situated above 1,000 meters above sea level.
Project Approval:	The Project Brief was approved as part of the February 2001 Intersessional.

Project Title, City and Country:	**Demonstration for Fuel-Cell Bus Commercialization in Beijing and Shanghai, China (Part I)**
Project Participants and Sponsors:	GEF/UNDP, Ministry of Science & Technology (MOST), Government of Beijing, Government of Shanghai and Private Sector
Project Budget and Funding:	Part I - GEF/UNDP US$5,815,000, UNDP US$191,000, MOST US$2,684,000, Beijing US$1,968,000, Shanghai US$2,096,000
Project Description and Objectives:	This project will help catalyze the cost-reduction of fuel-cell buses (FCBs) for public transit applications in Chinese cities and stimulate technology transfer activities by supporting significant parallel demonstrations of FCBs and their fueling infrastructures in Beijing and Shanghai. In collaboration with the Chinese national and municipal governments, and the private sector, the GEF and UNDP will assist the public transit companies of Beijing and Shanghai to obtain 6 FCBs each and to operate these over a combined total of 1.6 million km. The project will be implemented in two parts. In Part I of the project, a number of study tours will be conducted to gather up-to-date information on fuel cell bus technologies, hydrogen fueling systems and equipment suppliers. System specifications and bid documents for each city will be developed, and the complete FCB system suppliers will be selected. The hydrogen fueling systems will be installed, and the first set of 3 buses will be purchased, delivered, and prepared for operations during Part II of the project.
Project Technical Goals:	To demonstrate the operational viability of fuel cell drives in urban buses, together with the requisite re-fueling infrastructure, under Chinese conditions, through the initial operational test of 3 hydrogen fuel cell buses. It will begin the process of commercialization and adaptation of the fuel-cell buses in Chinese market.
Project Approval:	The Project Brief was approved as part of the May 2001 Work Program.

Project Title, City and Country:	**Fuel Cell Bus Demonstration Project in Cairo, Egypt (Part I)**
Project Participants and Sponsors:	GEF/UNDP, Egyptian Environmental Affair Agency (EEAA), Great Cairo Bus Company (GCBC) and Private Sector
Project Budget and Funding:	Part I - GEF/UNDP US$6,190,000, UNDP US$321,000, EEAA US$1,298,000, Private Sector t.b.d.
Project Description and Objectives:	This project will establish a demonstration program to operate 8 (eight) FCBs for public transport in Cairo over an estimated period of 5 years. The major objective is to introduce this zero emission bus technology in Egypt as a long-term solution to reduce global GHG emissions and to address the severe urban transport pollution problem in Cairo. The project 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 on fleet operating experience for the manufacturers to further improve their products and accelerate commercialization. The project will be implemented in two parts. In Part I of the project, system specifications and bid documents will be developed, and the complete FCB system suppliers will be selected. The hydrogen fueling systems will be installed, and the first set of 3 buses will be purchased, delivered, and prepared for operations during Part II of the project.
Project Technical Goals:	To demonstrate the operational viability of fuel cell drives in urban buses, together with the requisite re-fueling infrastructure, under Egyptian conditions, through the initial operational test of 3 hydrogen fuel cell buses. It will begin the process of commercialization and adaptation of the fuel-cell buses in Egyptian market.
Project Approval:	The Project Brief was approved as part of the February 2001 Intersessional.

Project Title, City and Country:	**Fuel Cell Bus Demonstration Project in New Delhi, India (Part I)**
Project Participants and Sponsors:	GEF/UNDP, Ministry of Non-Conventional Energy Sources (MNES), Delhi Transport Corporation (DTC) and Private Sector
Project Budget and Funding:	Part I - GEF/UNDP US$5,982,500, Government US$ 5,010,000 and Private Sector US$ 831,000.
Project Description and Objectives:	This project proposes a demonstration program of operating and testing 8 (eight) FCBs for public transport in Delhi. The major objective is to introduce this zero emission and highly efficient bus technology in India for reducing global Greenhouse Gas (GHG) emissions and local air pollution. It will assist the Indian transport sector to gain capability of manufacturing, operating, and servicing FCBs under local conditions. It will also help create an initial volume demand and provide useful feedback of operating experience for the FCB developers/manufacturers to further improve the bus design and reduce the bus cost. The project will be implemented in two parts. Part I deals primarily with the purchase of 3 FCBs and the establishment of the basic infrastructure, and establishing the research and communication programs to be followed in Part II. Part II involves the production and startup of the complete fleet of FCBs and the hydrogen facility, and related testing, research and communications activities.
Project Technical Goals:	To demonstrate the operational viability of fuel cell drives in urban buses, together with the requisite re-fueling infrastructure, under Indian conditions, through the initial operational test of 3 hydrogen fuel cell buses. It will begin the process of commercialization and adaptation of the fuel-cell buses in Indian market.
Project Approval:	The Project Brief was approved as part of the May 2001 Work Program.

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