GEF

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February 26, 2002

Dear Council Member:

I am writing to notify you that UNDP, the Implementing Agency for the project entitled, ***China: Demonstration of Fuel Cell Bus Commercialization in China (Phase II-Part I)***, has submitted the proposed project document for CEO endorsement prior to final approval of the project in accordance with UNDP procedures.

Over the next four weeks, the Secretariat will be reviewing the project document to ascertain that it is consistent with the proposal included in the work program approved by the Council in May 2001, and with GEF policies and procedures. The Secretariat will also ascertain whether the proposed level of GEF financing is appropriate in light of the project's objectives.

If by March 26, 2002, I have not received requests from at least four Council Members to have the proposed project reviewed at a Council meeting because in the Member's view the project is not consistent with the Instrument or GEF policies and procedures, I will complete the Secretariat's assessment with a view to endorsing the proposed project document.

We have today posted the proposed project document on the GEF website at www.gefweb.org. If you do not have access to the Web, you may request the local field office of UNDP or the World Bank to download the document for you. Alternatively, you may request a copy of the document from the Secretariat. If you make such a request, please confirm for us your current mailing address.

Sincerely,

for Mohamed T. El-Ashry
Chief Executive Officer and
Chairman

Cc: Alternates, Implementing Agencies, STAP

United Nations Development Programme

GLOBAL ENVIRONMENT FACILITY (GEF)

February 06th, 2002.

Dear Mr. El-Ashry,

Subject: "**CPR/01/G31: "Demonstration for Fuel-Cell Bus Commercialization in China - Part I" (PIMS # 764)**

I am pleased to enclose the UNDP project document entitled: "*Demonstration for Fuel-Cell Bus Commercialization in China* – Part I" approved by the GEF Executive Council in the May 2001 Council Meeting. Following the May 2001 Council Meeting, we received written comments from Council Members representing the constituencies of Australia, France and Germany. The attached note indicates how Council comments have been reflected in the project document (Attachment 1). We hope that you will bring this note to the attention of the GEF Council.

As per paragraph 29 and 30 of the GEF Project Cycle, we are submitting this project to you for circulation to the Executive Council Members for comments and, subsequently, for your final endorsement.

Thank you in advance for expediting the review and approval of this project.

Yours sincerely,

Frank Pinto
Executive Coordinator

Mr. Mohamed El-Ashry
Chief Executive Officer
Global Environment Facility
Room G6005
1776 G Street N.W.
Washington, D.C. 20433

Attachment 1: Response to Council Comments
Attachment 2: UNDP Project Document

Cc: Ms. Nandita Mongia, UNDP/GEF Regional Manager
Mr. Manuel Soriano, UNDP/GEF Regional Coordinator

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DEMONSTRATION FOR FUEL-CELL BUS COMMERCIALIZATION IN CHINA: RESPONSE TO COMMENTS FROM COUNCIL MEMBERS

AUSTRALIA

Comment 1:

"In collaboration with the Chinese national government, the municipal governments of Beijing and Shanghai, and the private sector, the GEF and UNDP will assist the public transit companies of Beijing and Shanghai to obtain 6 fuel-cell buses (FCBs) each and to operate these over a combined total of 1.6 million kilometers.

The knowledge and experience gained through this project will enable the technology suppliers to identify cost reduction opportunities and the host public transit operators to gain valuable experience needed to adopt larger fleets of FCBs in the future.

This is one of the five FCB projects that are being funded by GEF.

- The project documentation contains only the summary, thus making it impossible to make any comments on the project.
- Governing council in November 2000 (GC16) decided that "GEF should develop the five fuel cell bus project currently in its pipeline…" These project will serve as demonstration projects and be part of the proposed GEF Fuel Cell Bus Strategy."

Response 1:

Major goals of this project are indeed to enhance knowledge and experience and to facilitate long-term cost reduction opportunities and future adoption of larger fleets of FCBs. The Project Brief contains the complete documentation on the project, as does the Project Document. Any background information on the project can also be obtained through the main contacts at UNDP as listed in the Project Brief and the Project Document.

FRANCE

Comment 1:

"As we have observed in the past regarding fuel-cell bus projects, such projects absorb significant public subsidies without any assurance of real gains down the road."

Response 1:

Since the formulation of the Operational Strategy in 1995, GEF has offered support for fuel-cell buses, initially under OP 7 "Reducing Long-Term Costs of Low GHG-emitting Energy Technologies"; and more recently, under OP 11 "Sustainable Transport". The Development Objective of the Program is to reduce the long-term GHG emissions from the transport sector in GEF program countries by providing support to the commercialization of FCBs.

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 completely commercialized: analysis based on experience learned through the commercialization of other technologies shows that early investments in the technology can reduce its costs to a commercially competitive level within 7 to 15 years. The sooner this technology becomes fully commercialized, the greater can be the impact that the technology plays in the stabilization of GHGs by the year 2100, as intended in IPCC scenarios.

By supporting deployment of FCBs in GEF program countries, 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 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, because FCBs are hydrogen fueled, the GEF will also be assisting developing countries in preparing for a future transition to newer, cleaner and more efficient fuel-supply systems.

The risks associated with achieving the anticipated GHG benefits have been addressed thorough a strategic programmatic framework that was developed to focus and govern the GEF support in this area by ensuring the optimum level of support and anticipating and managing the risks involved. This strategic programmatic framework was presented to the GEF Council in November 2000, and the Council agreed that the GEF should develop the five fuel cell bus projects currently in its pipeline taking into account the recommendations made by STAP and the technical comments of Council Members[1]. However, before proceeding with any fuel cell bus projects beyond the initial five projects, the Council asked that a strategy on the further development of FCB activities be presented by the Secretariat and Implementing Agencies. This strategy would be based upon the experience and lessons learned from the five demonstration projects.

Comment 2:

"The research objectives are unclear. Moreover, the project is not really a demonstration project, since fuel-cell technology for transport (12 buses) is not yet very far advanced."

Response 2:

The development objective for this project is to reduce GHG emissions and air pollution in the long term through widespread commercial introduction of fuel cell buses in urban areas of China. The immediate objectives of the project are (i) to determine the technical and commercial viability of fuel cell buses and the associated fuel supply systems; (ii) establish the necessary technical, operational, managerial and planning capacity within the bus companies, scientific and industrial communities, and national and municipal-level policy makers to maximize the likelihood of long-term sustainable use of FCBs; and, (iii) create a national-level awareness of FCBs and their long-term potential and develop a strategy for pursuing that potential.

[1] Joint Summary of the Chairs, GEF Council Meeting November 1-3, 2000.

As part of the research activities intended to enhance scientific, technical, and industrial capacity in China relating to manufacturing and commercial utilization of FCBs and their associated fuel supply systems, an annual research competition to provide funding aimed at accelerating the commercialization of FCBs in China. MOST, the NPD and the NPC, with cooperation of the project teams, will organize these annual competitions with the objective of encourage the wider development of varied expertise (science, engineering, manufacturing, management, etc.) in China relating to commercialization of fuel cell vehicles. The objective of this activity is to enhance ongoing research, development, demonstration, and commercialization activities supported by national funding sources. While the research plan is to be developed prior to Phase II of this project, activities to be supported are anticipated to include applied research at universities, technical institutes and private companies, feasibility studies of setting up manufacturing facilities, development of business plans for joint ventures with foreign companies, and other activities. A selection committee and selection process, under the direction of the NPC, will be established for decision-making regarding funding.

As stated above, by supporting deployment of FCBs in GEF program countries GEF is acting as an important agent of technology transfer. The demonstrations of this new technology are intended to encourage the early adoption of FCBs in a process of "technological leapfrogging". The timing of these projects is intended to allow the developing countries to gain experience with the FCB early in the product cycle.

GERMANY

Comment 1:
"The financial contribution from the Chinese Government (MOST) and the Cities of Shanghai and Beijing are considerable higher than in other cases of the GEF fuel cell projects. However, the contribution from MOST consists to a large part (37 %) out of import duties which is a questionable way to count for host country co-financing. Reasoning: If the project did not take place, there would be no such income for the government at all."

Response 1:
The Council Member's comment is correct. It is not normal UNDP practice to count avoided import duties as co-financing to a project—any equipment purchased under a UNDP project is normally imported duty-free. The intent, however, was to ensure that import duties do not tilt the selection process toward one, perhaps inferior, option and away from another technically superior option merely because the latter contains less local content and is, therefore, more expensive. In order to ensure that the project obtains the best technology available regardless of its country of origin, it was considered better to clearly state that no import duties would be applied and to ensure the firm commitment of the governments to this.

The Project Document for China's FCB project reflects explicitly the import duties under "parallel financing" rather than co-financing. The value of this parallel financing is the approximate value of the avoided import duties. The import duties are reflected in the body of the document as "Import duty waiver".

Comment 2:
" Additionally, the financing of private sector is not on solid ground: " Additionally, private sector contributions of $2.2m (Part I: $1.105M, Part II: $1.095M) are expected through an agreement to buy back the FCBs at the conclusion of the project." (from Project Brief)

Key questions remain: Who will receive the income from the expected buying back? How will it work? Why should the FCBs be bought back at the end of the project?"

Response 2:
The expected private sector contribution is calculated as the excess of the bus costs over the amount being allocated for bus purchases by the GEF and local partners. That is, the private sector contribution, as listed on the Project Brief and Project Document, actually represents a "net" contribution or uncompensated contribution to the project.

The private sector contribution is a corporate contribution to the project made because of the developmental nature of the technology and the benefits anticipated by the corporate collaborators as a direct result of working on the project. The estimation and listing of the private sector contribution as parallel financing is derived both from the desire to show private sector commitment and that the costs used for the buses in the projects is actually less than the projected cost quotations provided to the preparatory teams by industry. The specific form of these contributions cannot be stated at this time, but they are expected to be auditable expenditures based on the supplier's assessment of the project needs and its preliminary FCB commercialization strategy for China. The exact amount and nature of the private sector cost share will be stated in the application for Part II of the project.

Comment 3:
"The expected contribution of the private sector is only 7 % of the overall costs and does therefore not meet the 20% Germany has asked for in the comments to the intersessional work programme in February 2001."

We expect that the financing and co-financing of the public sector in the host country and of the private sector will be described clearly and in every detail. Assumptions and procedures should be plausible and meet common practise in multilateral development co-operation. Again, we would like to stress that it is indispensable that co-financing is provided to a reasonable extent to ensure ownership. Therefore, we would like to repeat our requirement for private sector co-financing of at least 20 % of total project costs.

We acknowledge, however, the substantial contribution by the public sector for the China fuel cell project.

Response 3:
UNDP cannot unilaterally decrease the GEF share of project funding and increase the private sector share with the expectation that the project will go ahead. The buses must be purchased through a standard UNDP competitive procurement process. As such, it will not be possible to know the precise amount of the uncompensated private sector contribution until the procurement process is completed. Even then, the precise amount of such contributions can only be verified

through a corporate-wide audit. Since such an audit lies beyond the scope of our work, the estimate of uncompensated private-sector contribution will remain indicative at best. However, as part of the bidding process, an estimate of the total corporate contribution to the project will be requested. Points will be assigned for both the level of contribution and the quality of the commercialization plan, as already specified. In this way, the seriousness of the corporations' commitments to the FCB commercialization prospects of the country will be gauged. The estimates of private sector contribution will only be available once the winning bid is selected, and the results will be made public as Part II of the project moves ahead.

In addition, as the logical framework developed for the overall FCB program indicates, the largest initial assumption on which project success rests is that industry will respond positively to the request for proposal. The assumption that FCBs can be successfully procured underlies the entire program. As the anticipated costs of the various parties involved in the program have been publicized for over a year, major alternations will only serve to further discourage international corporations from bidding on the project.

To summarize, the UNDP will ask for an estimate of total corporate contribution and a plan for commercialization of FCBs within the host country as part of the request for proposal and procurement process. Both the estimated contribution and the commercialization plan will be awarded points under the scoring system used for evaluation of the bids. The estimate of the expected private-sector contribution for the winning bid will, therefore, be made public when the Part II proposal is submitted for approval. The UNDP-GEF anticipates that the disclosure of the corporate contribution, coupled with the plan for FCB commercialization in the local market after the demonstration project is completed, will adequately demonstrate the seriousness of the private-sector commitment to the project.

UNITED NATIONS DEVELOPMENT PROGRAMME

Project of the Government of the People's Republic of China

PROJECT DOCUMENT

Project Number:	CPR/01/G31/A/1G/99
Project Title:	Demonstration For Fuel-Cell Bus Commercialization In China
Project Short Title:	China FCB
Estimated Start Date:	January 2002
Estimated End Date:	January 2003
Management Arrangement:	National Execution
Executing Agency:	Ministry Of Science & Technology (MOST)
Project Sites:	Beijing & Shanghai
Beneficiary Country:	China
GEF Focal Area:	Climate Change
GEF Operational Program:	Sustainable Transport (Operational Program 11)

GEF inputs:	**Part I**	**Part II**
	5,815,000	5,767,000
GEF Total	11,582,000	
Cost Sharing Inputs:		
UNDP	191,000	196,000
Cost Sharing Subtotals	191,000	196,000
Cost Sharing Total	387,000	
Government Co Financing:		
MOST	2,684,000	3,519,000
Beijing	1,968,000	2,037,000
Shanghai	2,096,000	2,288,000
Co-financing Subtotal	6,748,000	7,844,000
Co-financing Total	14,592,000	
Parallel Financing:		
Import duty	1,950,000	1,650,000
Private sector	1,227,000	973,000
Parallel Finance Subtotal	3,177,000	2,623,000
Parallel Finance Total	5,740,000	
Total Part I	**15,931,000**	
Total Part II	**16,430,000**	
Total Project Cost	**32,361,000**	

Classification Information

ACC sector and sub-sector: Transport and Environment	**Primary type of intervention:** Capacity building and Investigation
DCAS sector & sub-sector: Industry, technological research and development	**Secondary type of intervention:** Direct training
Primary areas of focus/sub-focus: Improvement of the urban environment	**Primary target beneficiaries:** Government organizations
Secondary areas of focus/sub-focus: Promotion of sustainable energy and atmospheric quality	**Secondary target beneficiaries:** Local population at project sites

Brief Description: 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 government, the municipal governments of Beijing and Shanghai, 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. As recommended by GEF, 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. The description of Part II activities has been included in this project document to provide information on the context of the larger project; however, the financial commitment under this project document is limited to Part I activities only.

On behalf of:	**Signature:**	**Date:**	**Name/Title:**
Government:	_____	_____	_____
UNDP:	_____	_____	_____
Executing Agency:	_____	_____	_____

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List of Abbreviations

CICETE – China International Center for Economic and Technical Exchanges
CNG – Compressed natural Gas
CTA – Chief Technical Advisor
FCB – Fuel Cell Bus
GEF – Global Environment Facility
GHG – Green House Gases
GOC – Government of China
IPCC – Intergovernmental Panel on Climate Change
LPG – Liquid Petroleum Gas
MOST – Ministry of Science and Technology
MTBF – Mean Time Between Failure
NPC – National Project Coordinator
NPD – National Project Director
PEMFC – Proton Exchange Membrane Fuel Cell
PMO – Project Management Office
UNDP – United Nations Development Programme
UNFCCC – United Nations Framework Convention on Climate Change

A. CONTEXT

A.1 Development Problem

China is the world's second largest energy consuming country behind the USA in absolute terms, but per-capita energy use is less than one-tenth of that in the USA and less than one-fifth of that in Japan or Western Europe. Primary commercial energy consumption in China in 1998 amounted to 1,360 million tonnes of standard coal equivalent (TCE). The mix was dominated by fossil fuels with coal at 72%, oil at 20% and natural gas at 2%. Oil use has grown far faster than coal or natural gas during the 1990s, with consumption growing 6.4% per year from 1990 to 1998, compared to 3.3% per year for coal and 4.1% per year for natural gas.

In 1998 China was the 7th largest oil producing country, accounting for nearly 10% of non-OPEC oil, but China has been a net importer of oil since 1993. By 1998 imports accounted for 15% of the total 269 million TCE consumed. Oil consumption is projected to nearly double during the next 20 years (3.3% per year growth), while domestic production is expected to be nearly flat. In this scenario, imported oil will account for nearly 60% of China's oil consumption in 2020, with negative impacts on balance of payments and energy security.

The transport sector, which relies almost entirely on oil today, accounted for nearly 20% of China's oil consumption in 1998. This sector is projected to account for most of the incremental demand for oil over the next 20 years. By 2020, the urban vehicle population is expected to be 13 to 22 times larger than it was in 1995.

Air pollution is a major problem in most of the major cities in China today, and the major sources of urban air pollution in China today are coal combustion and vehicle exhaust emissions. CO levels routinely exceed nationally specified limits, as do ozone concentrations. The poor environmental performance of vehicles in China compared to OECD vehicles is a major contributing factor, along with poor traffic management, which contributes to congestion and slow average speeds on the roadways. The projected dramatic growth in vehicle populations over the coming decades will significantly exacerbate the urban air pollution problem.

Respiratory illness, to which vehicle air pollution is a major contributor, is the 4th-leading cause of death in urban areas of China, accounting for 14% of all deaths in urban areas in 1998.[2] While correlating vehicle air pollution with the cost of illness and death is difficult, some such efforts have been made. For example, one study in 1996 estimated the health cost of air pollution in 20 large and medium-sized cities in China. The increase in respiratory disease attributed to air pollution resulted in the direct loss of around 500 million yuan and some 2 million working days.[3] Another study in Chongqing concluded that the development of children's lung function is imperiled by air pollution in typically polluted areas.[4] While an exact correlation cannot be determined, there is little question that air pollution from vehicles exacts a high cost, both in human health and economic terms.

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[2] World Bank, 1999, *Transport in China: An Evaluation of World Bank Assistance*, Report 18865, Operations Evaluation Department, Sector and Thematic Evaluations Group, The World Bank, Washington, DC, Jan. 11.
[3] Anonymous, 1996, "Economic Analysis on Human Health Damage Induced by Air Pollution," *Fujian Environmental Science*, No. 12.
[4] Anonymous, 1996, "Effects of Atmospheric Pollution on Lung Function of Children in Chongqing," *Chongqing Environmental Science*, No. 12.

Fuel cell vehicles hold the prospect for both zero tailpipe emissions of major air pollutants (CO, NO_x, HCs, etc.) and significantly higher fuel efficiency compared to conventional vehicles. In particular, hydrogen fuel cell vehicles hold the promise of very low greenhouse gas emissions (including those associated with the production and delivery of the hydrogen for the fuel cell). Global private investment in fuel cell technology is quite significant (US$0.5 to 1 billion annually), and industry and independent cost projections indicate that fuel cell vehicles will be cost-competitive by late in the first decade of 2000, once mass production is established. For these reasons, hydrogen fuel cells are identified by the Global Environmental Facility (GEF) as a promising future least-cost technology for the reduction of greenhouse gas (GHG) emissions.

Because of the significant private and public sector funding of fuel cell technology development, important progress has been made to reduce the barriers to commercialization. These barriers include technical issues, such as the need for further development of fuel cell design and manufacturing technology, inadequate hydrogen infrastructure, high initial costs, and the need for better storage technology. Other barriers are market issues, including the under-valuation of environmental and other societal benefits, continued availability of cheap fossil energy, limited global demand for clean technologies, an inability to achieve manufacturing economies at current levels of production, an inadequate regulatory framework, and poor public perception. Finally, to commercially introduce fuel cell vehicles in most developing countries, the above challenges and barriers are even further exacerbated due to high costs, modest institutional capacity, and low levels of awareness.

The GEF strategic vision, to support commercialization of fuel cell buses (FCBs) for developing country markets, is consistent with other public sector supports for fuel cell technology development. Much of the public sector support seeks to balance the private sector preference to focus commercialization on the larger and more profitable market for automobiles in industrialized countries. Indeed, several public sector programs in North America and Europe have focussed on public transportation applications. Buses are an especially attractive commercial application for fuel cells because cost and volume constraints are less severe than with cars, and the supply of hydrogen (the preferred fuel for fuel cell vehicles) is facilitated by the centralized refueling that characterizes bus fleet operations. Small fleets of fuel cell buses have been operating in passenger revenue service for two years in demonstration projects in Chicago and Vancouver. Additional demonstration projects will soon place fuel cell buses on the roads in California and in several European cities.

A.2 Development Objective

A.2.1 Government Overall Goals

The Government of China has recognized the increasingly serious air pollution problems in China's cities and has taken several measures to reduce pollution levels. Given the significant public health and economic impacts, reducing urban air pollution is a high priority. Furthermore, the Government of China views climate change as a major threat to its ability to achieve sustainable development through its priority policies, which include poverty eradication, enhancement of food security, and economic development. As evidence of the importance the Government attaches to climate change issues, it signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, and in the same year, the Convention was ratified by the Standing Committee of the Chinese National People's Congress. Thus, China

became one of the first countries to ratify the UNFCCC, and China is committed to developing policies to address global climate change concerns.

There are several ongoing or recently completed GEF projects in China that address the climate change issue through their aim to reduce GHG emissions in the energy sector. UNDP is the implementing agency for many of these. Of particular importance are the coal-bed methane project and the landfill methane recovery projects, which promote the direct reduction of GHG emissions through new, cleaner sources of energy and through the elimination of methane releases to the atmosphere. Projects in renewable energy and energy efficiency also promote direct reductions of GHG emissions. Other projects address capacity building through targeted research in the calculation of GHG inventories and through activities to enable China to fulfill its commitments under the UNFCCC to communicate to the Conference of Parties to the Convention. In addition, China has established an inter-ministerial working group to coordinate national activities relating to climate change, called the National Coordination Committee on Climate Change Policy.

The development objective for this project is to reduce GHG emissions and air pollution in the long term through widespread commercial introduction of fuel cell buses in urban areas of China. In cooperation with similar projects in other developing countries, the cost of FCB technology can be brought down to levels that will enable their widespread cost-competitive introduction in many of the mega-cities of developing countries.

In addition, fuel cell technology is regarded as having significant future potential for both domestic and export applications. Since the early 1990s a variety of scientific and technology institutes throughout China have been involved in research and development relating to fuel cells and their applications.

A.2.2 Expected Impact

The widespread use of FCBs in China can reduce both urban air pollution and GHG emissions. An estimate of the potential impact in terms of GHG reductions was made during the preparation of the GEF Brief. Given the high priority the country is giving to the development of its public bus fleets, the demand for medium to large-size (7 to 18 m) buses was estimated to grow at an average rate of 5% per year between 2000 and 2030, which would result in a Chinese bus population of about 0.72 million in 2030. An expert Chinese team drew on both the scientific and engineering knowledge base in China and internationally regarding FCBs to estimate that based on the expected cost of mass-produced FCBs in China, it appears that FCBs will become cost-competitive with diesel buses on a lifecycle basis. Furthermore, their analysis assumed that hydrogen is produced from coal in a large-scale process that includes capture of the carbon in the coal and sequestering it as CO_2 in depleted natural gas wells. The magnitude of potential reductions in carbon dioxide emissions achievable by widespread introduction of FCBs in China was estimated by assuming that all 0.72 million buses projected to be on the road in 2030 were replaced by hydrogen FCB buses. Under such a scenario, the annual savings in carbon emissions would be 9.1 million tonnes per year. This analysis is presented in Annex 8.

To place this potential impact in context, GHG emissions from the entire transportation sector in China amounted to 60 million tonnes in 1995. By 2030, due to the rapid expected growth in the transportation sector, GHG emissions could increase to over 170 million tonnes per year.

However, with the introduction of FCBs and other clean and energy efficient vehicles, the growth in emissions from this sector could be limited to about 140 million tonnes per year. [5]

In the near-term, this project is expected to lead to the next phase of a long-term four-phase program that will culminate in the market-based commercial production and use of FCBs in China. Phase I involved the preparation of the proposal for this project. Phase II will involve demonstrating a small fleet of FCBs in China (as described in this project document) along with capacity building activities to strengthen the basis for proceeding to Phase III. Phase II was divided into two parts; this Project Document relates to activities and financing approved for Project Part I of Phase II. Phase III, the commercialization phase, is the final phase of potential GEF involvement and is intended to increase China's demand for, and production of, FCBs to the point where the costs become competitive with that of conventional buses. Whether GEF support will continue to be warranted in Phase III, however, will depend largely on the nature of GEF's continuing role in climate change; the degree to which the FCB demonstrations have been successful; and the continued investment and interest in the technology within donor countries. It is anticipated that, between 2010 and 2015, FCBs will be mass produced and cost-competitive to be widely introduced on a commercial basis in Chinese cities.

A.3 Regulatory Framework

A.3.1 National Laws and Regulations

China has in place a large number of laws and regulations on environmental protection and resource utilization, which provide support and guarantee to the project activities. In the *Constitution of the People's Republic of China (1982),* Article 26 proscribes that "The state protects and improves the environment in which people live and the ecological environment. It prevents and controls pollution and other public hazards," and Article 9 proscribes that "the state ensures the rational use of natural resources and protects rare animals and plants. Appropriation or damaging natural resources by any organization or individual by whatever means is prohibited."

The *Environmental Protection Law (1989)* is the basic law of environmental protection in China and is central to the whole system of environmental law since it makes comprehensive prescriptions in principle on the important environmental protection issues. *Environmental Protection Law*, Article 1 claims that the objective of this law is "protecting and improving the living and ecological environment, preventing and controlling pollution and its social effects, as well as promoting the development of modernizing." Article 4 and 5 proscribe that "the government should adopt economical and technical policies and measures which can benefit environmental protection" and that "the research and development of environmental protection science should be strengthened."

The *Law on Prevention and Control of Atmospheric Pollution* (revised in 2000) deals with road traffic pollution. The objective of this law is "preventing atmospheric pollution, protecting and promoting the living and ecological environment, ensuring the health of citizens, and accelerating the development of economy and society." Article 9 claims that the government encourages the research on preventing and controlling atmospheric pollution and the

[5] Future Implications of China's Energy-Technology Choices, Wu Zongxin, et.al., Report to the Working Group on Energy Strategies and Technologies of the China Council for International Cooperation on Environment and Development, July 2001.

popularization of advanced technologies of preventing and controlling atmospheric pollution. Specifically, the in the chapter *Preventing and Controlling Vehicle Pollution*, Article 34 claims that "the government encourages the production and consumption of clean fuel vehicles."

In addition, at least six specific national standards have been promulgated that apply to air pollution from different types of road vehicles.

A.3.2 Laws and Regulations

Beijing
In order to control air pollution, the municipality of Beijing has adopted several measures. Specifically, the municipality released six standards on the control of air pollution in Beijing that parallel the national standards. Given the importance of air pollution in urban areas, the standards in Beijing are stricter than the national standards.

Shanghai
Since 1980, a number of laws, regulations and emission standards were enforced in the municipality of Shanghai, including Measures for Implementation of Law on Provision and Control of Atmospheric Pollution of People's Republic of China in Shanghai. Shanghai has put in place rigorous laws and regulations for urban road construction, applications of clean fuel automobiles and public transportation.

A.3.3 Institutional Framework

China is quite advanced, in comparison to most developing countries, in science and engineering research relating to fuel cell vehicles (catalysts, membranes, stack assemblies, integration in vehicles). This substantial number of knowledgeable scientists and engineers in China provides a strong technical foundation that will help facilitate a transition toward commercial applications in the country.

The Ministry of Science & Technology (MOST) is responsible for coordinating the research and development programs in the area of fuel cell technology and applications. Under the supervision of the State Council, MOST is in charge of formulation and implementation of national plans of fundamental study and development and dissemination of key technologies in energy and transportation fields. MOST oversees technology transfer, including acquisition of foreign technology. It supports manufacturing through the provision of venture capital. For specific programs and objectives, it works in cooperation with the State Development Planning Commission (SDPC), the State Economic & Trade Commission (SETC), and the State Environmental Protection Administration (SEPA).

SDPC is in charge of macro-planning and budget approval. As the state macro control commission, SDPC plays an important role in promoting economic development and social progress. In the energy field, SDPC is responsible for among others formulating the development strategy, national plan policy, as well as infrastructure construction investment. The Pricing Department of SDPC is also responsible for setting up energy prices through public hearing process.

SETC is in charge of industrialization and retrofitting existing industries. SETC is responsible for the co-ordination of major government-led economic initiatives in China and for the technical reform of large/middle-sized state-owned enterprises. In the fields of energy conservation and renewable energy technologies, SETC is responsible for commercialization of new

developments, demonstration of major technical reform projects, transformation of energy-saving mechanisms and formulation and implementation of laws and legislation related to energy conservation.

SEPA is responsible for formulation of policies and legislation relating to environmental protection in China, national planning for environmental protection and formulation of national environmental quality and pollution emission standards. SEPA is responsible for all aspects of environmental policies, the formulation of the national environmental regulations and issuance of the national environmental quality standards. SEPA is entrusted by the State Council for the enforcement of the regulations and standards and the co-ordination of important environmental programs and projects.

A.4 Government Strategy

A.4.1 National Policies and Actions

Chinese government treats the development of new energy and renewable energy as a main measure to resolve environmental issues and energy problems. In the directive document, *The 21st Agenda of China*, a chapter named *Sustainable Production and Consumption of Energy*, states that new energy systems with small damage to the environment are one of the important components of Chinese sustainable development strategy.

Outline of New Energy and Renewable Energy Development, a joint filing made by SDPC (State Development Planning Commission), MOST (Ministry of Science & Technology) and SETC (State Economic & Trade Commission), includes some special clauses on hydrogen energy development. It states that "the development of equipments used for hydrogen production, storage, and utilization should be expedited to achieve some great technical progress. By 2010, some solar-hydrogen and coal-hydrogen systems should be established commercially, which production ability should not below 5000 m^3H_2/day." To achieve this goal, "some privilege policies should be made to accelerate the industrialization of hydrogen energy. International cooperation is needed and advanced technologies and foreign capital should be introduced into this field."

In order to address the increasingly serious air pollution problems in China's cities, Vice-Premier of the State Council, Li Lanqing, recently announced plans to launch the " Air Purification Engineering," or Clean Air Program to reduce air pollution in cities from the two largest sources: motor vehicles and industrial coal boilers. The program is being led by MOST together with 13 other ministries and commissions at the national level. Starting in 2001, the program will strive to demonstrably improve air quality over the next 3 to 5 years in 12 selected model cities, including Beijing, Shanghai, Tianjin, Chongqing, Hainan, and others. One component of the Clean Air Program (Clean Vehicle Action) will emphasize the development of electric, hybrid and fuel cell powered vehicles, and will contain an element for multi-person public transport systems, especially buses.

Substantial national and local financial resources will be committed to this program during the period of the 10th 5-Year Plan (2001-2005). The main development direction of urban transportation is clean transportation technologies and new resources transportation tools. Demonstration projects of clean fuel public vehicles are planned in 13 main cities (such as Beijing, Shanghai, Tianjing and etc.), and demonstration projects of integrated transportation systems are planned in 14 main cities.

A.4.2 Beijing Policies and Actions

In Beijing, the development of public transportation systems has been accelerating. In 1999, the Beijing bus fleet comprised, 4313 using diesel fuel, 2640 running on gasoline, 1600 running on LPG, and 300 using compressed natural gas (CNG). In order to keep up with economic development and to improve air quality Beijing has implemented a plan for moving diesel buses out from the downtown area and replacing them with 1,200 buses CNG buses using US technology in the year 2000 along with 12 CNG fuel stations. This plan is continued in 2001. For improving the public traffic and air quality, the Beijing government is also planning to build an aboveground light rail system and expand the underground system.

Beijing has begun to actively promote the development of fuel cell vehicles. With the strong support of the Mayor, the Beijing municipal government has included fuel cell technology in its Tenth Five-Year Plan, and is now working to finalize a long-term fuel cell vehicle development program. In fact, at least four fuel cell vehicles (all of them made in Beijing) were shown in Beijing from year 1999 to 2001. The government will encourage and coordinate different universities and companies to carry out the program, and identify one or more organizations to take the lead in implementation. On its part, the municipal government will formulate preferential policies to support the commercialization of fuel cell vehicles, special fuel cell buses. After Beijing was awarded the 2008 Olympic game, MOST and the Beijing municipal government joined together to develop some high-tech applications that can be used in year 2008 Olympic game, and fuel cell buses are one of the options under consideration.

A.4.3 Shanghai Policies and Actions

The traffic of Shanghai is the most developed in China. Both the average number of public traffic cars per person and the road density are highest in the nation. In 1999, Shanghai had a fleet of some 17,000 buses, 10,200 of which were diesel fueled and 6,800 of which were gasoline fueled. The city also has 520 electric trolley buses, 450 of which are currently operated. To accommodate economic development and improve public transit, the Shanghai government started a clean-fuel transport plan. Through 1999, 14,000 taxis had been refit to use LPG, and 25,000 taxis and 42,000 taxis will be refit in 2000 and 2005, respectively. In the mean time, the Shanghai local government will refit large buses to use CNG. Some 3000 large buses will be refit and 3 CNG fuel stations will be built in 2000. In addition, the Shanghai government plans to build 10 light railways, expand the underground system, and maintain a bus fleet of about 20,000 units.

Shanghai has begun to actively promote the development of fuel cell vehicles. With the strong support of the Mayor (and catalyzed by an initiative of the W. Alton Jones Foundation), the Shanghai municipal government has included fuel cell technology in its Tenth Five-Year Plan, and is now working to finalize a long-term fuel cell vehicle development program. The government will encourage and coordinate different companies to carry out the program, and identify one or more organizations to take the lead in implementation. On its part, the municipal government will formulate preferential policies to support the commercialization of fuel cell vehicles.

As part of this program, Shanghai is planning to build or assemble a prototype fuel cell car for exhibition at the October 2001 APEC summit in Shanghai. Shanghai believes that this will help to demonstrate the city's commitment to environmental protection. To assist with this effort, a number of private enterprises and investors, including the Suzhou Electrical & Machinery Co.,

Ltd., Beijing Fuyuan Century Fuel Cell Company, and the Pudong Development Group of Shanghai are working to establish a shareholding company to develop fuel cell cars.

Shanghai is also one of five Chinese cities participating in a sustainable transportation project (also sponsored by the W. Alton Jones Foundation). The purpose of this project is to help each city identify the bottlenecks in its urban transportation system and develop appropriate solutions. Local experts will examine a variety of strategies including integrated walk, bicycle and public transit systems; clean fuel vehicles; and public/private financing alternatives. Following visits by city mayors and technical experts to a number of model urban transportation systems, each city will develop an implementation plan for the establishment of a Green Zone in which to demonstrate an integrated urban transportation system.

A.5 Previous Experience and Lessons Learned

Since the early 1990s a variety of scientific and technology institutes throughout China have been involved in programs relating to proton exchange membrane fuel cells (PEMFC) and their application to vehicles. MOST has supported researchers at the Changchun Institute of Applied Chemistry, Tsinghua University, Tianjin University, Fudan University, Shanghai University (in cooperation with Beijing Petroleum University), the Beijing University of Science and Technology, Tianjin Institute of Power Sources, the South China University of Technology, and the Dalian Institute of Chemical Physics. The research programs have involved fundamental work relating to catalysts, electrodes, and/or other components of PEMFCs. The Institute of Engineering Thermal Physics of the Chinese Academy of Science has been involved in studies of gas supply and thermal and water management for fuel cell stacks.

The initiative to commercialize fuel cell bus technology for China was first raised in a 1994 meeting of the Energy Working Group of the China Council on International Cooperation on Environment and Development. High level government officials in China expressed their strong support for such an initiative and inserted special provisions into the 9th 5-Year Plan (1996-2000) to support relevant research and development under the direction of MOST (formerly the State Science and Technology Commission).

One of the activities supported by MOST under the 9th 5-Year Plan, with co-support from UNDP, was a project titled "Capacity Development for Fuel Cell Powered Buses Development and Commercialization in China," which was initiated in 1996. A project report was completed in March 1998, which provided much of the basis for the preparation of this project. As part of the previous project, MOST issued an international request for proposals (RFP) for a one-year demonstration of 1 or 2 fuel cell buses in Beijing. MOST received one response by the closing date (June 1998), but the proposal did not respond adequately to the terms specified in the RFP. The bid price was too high, because the order size (1 to 2 buses) was too small, and the bidder raised intellectual property concerns. Therefore, no demonstration project resulted from the bidding.

Although the previous project did not result in a demonstration, it achieved good results in capacity building, awareness raising and identifying barriers. In addition, the previous UNDP project convinced the Chinese government to accelerate work on fuel cell technologies, and the result has been a burst of technological progress in fuel cell science and engineering in China. However, the project showed that market forces alone are not yet sufficient to drive conversion of bus fleets to FCBs in China. On the other hand, the market analysis that was done as part of

the project confirmed expectations that there will be a substantial commercial market for FCBs in China once the barriers are overcome.

The experience of that project and the fuel cell developments since June 1998 have been incorporated into the design of this demonstration project, and its scope was increased significantly beyond that envisioned in 1998. In January 2000, MOST convened a national workshop to provide government and research organizations with a forum for exchange of information bearing on the design and implementation of this fuel cell bus demonstration project. The current demonstration project will benefit from the progress that has been made in China's science and technology capabilities relating to fuel cells and in the worldwide commercial acceleration of fuel cell bus technology. The 10th 5-Year Plan (2001-2005) includes expanded funding support for the FCB technology, including co-financing of this project.

Recently, a variety of fuel cell stacks have been built and tested in China. In particular, the Dalian Institute has successfully built and tested some 20 PEMFC stacks ranging in size from 1 to 5 kW. In 1998, a 5-kW stack (built by the Beijing Fuyuan New Technology Development Corporation using an imported Nafion membrane) was integrated with an electric drive system in collaboration with the Tsinghua University Automotive Engineering Department and installed in a prototype golf cart to demonstrate the feasibility of developing FC vehicles in China. In 2000, the Beijing Green Energy Institute made a 15 KW PEMFC.

Several fuel cell vehicles are also under development. A 7-meter hydrogen-fueled bus is being developed by the Institute of Electric Engineering of the Chinese Academy of Science for research and demonstration purposes. They are developing the electric drive system and integrating all components of the bus. The Dalian Institute is constructing a 30-kW stack for the vehicle, which will be manufactured in collaboration with engineers at the Technical Center of the Dong Feng Motor Co. (Hubei Province), one of China's largest commercial vehicle manufacturers. In Beijing four different fuel cell vehicle have been demonstrated successfully in the past two years.

A.6 Project Target Beneficiaries

A.6.1 Direct Beneficiaries

Government agencies and institutions: The project will benefit the government agencies and institutions participating in this project by strengthening the capacity and technology knowledge of their scientists and engineers actively working in this area and by promoting the development of policy initiatives that will support fuel cell bus commercialization. Furthermore, the project will stimulate broad development and dissemination of technical knowledge to other Chinese scientists through the conferences and workshops that are an integral part of the project.

Municipal transportation companies: The project will benefit the municipal transportation companies by facilitating capacity building and technology transfer through the procurement, deployment and operation of the FCBs. Specifically, Beijing will benefit in regards to clean technology options for the 2008 Olympic Game. A fuel cell buses public line is being considered, and this project will provide very useful experience towards realization of that option.

Fuel cell and bus manufacturers and suppliers: The project will benefit international manufacturers and suppliers of fuel cells and FCBs by providing them the opportunity to promote their technologies in China, to learn about the market, and to build business

relationships with Chinese companies. The project will also benefit the technical and business communities in China working on fuel cells and FCBs by providing opportunities to closely observe the state of technological development, to increase technical competence by partnering with foreign technology suppliers, and to possibly compete for a part of the project.

A.6.2 Indirect Beneficiaries

In the near-term, the project will benefit local residents in Beijing and Shanghai through reduced air pollution and improved quality of public transit service. In the long-term, the Chinese population as a whole will benefit from reduced environmental pollution.

In the longer-term, the project will also benefit all peoples and nations threatened by climate change, especially small island nations and coastal areas.

A.7 National Resources

The following national resources will be made available for implementation of the project.

A.7.1 Human Resources

MOST will appoint a senior official to act as National Project Director (NPD). The NPD will take overall responsibility for ensuring that all national inputs are mobilized in a timely and effective manner, and be responsible to the Government of China and GEF for achieving project objectives.

To provide overall guidance at the national level, MOST will establish a national committee that will consist of representatives from the Ministry of Science and Technology, the State Development Planning Commission, the State Economic and Trade Commission, the Ministry of Finance, and the State Environmental Protection Agency.

Project oversight committees will be formed in each of the two host municipalities, Beijing and Shanghai. Each committee will be headed by a Vice Mayor of the municipality and will include representatives from the following municipal-level organizations: the Science and Technology Commission, the Economic and Trade Commission, the Development Planning Commission, and the Public Transportation Company.

Each site will establish a Project Management Office and assign a full-time project manager to oversee all project activities and report to the local oversight committee. Within the local PMOs the day-to-day implementation of the project in each city will be under the responsibility of the Beijing Public Transportation General Company and the Shanghai Public Transportation General Company.

A.7.2 Financial Resources

Since 1998 MOST and Chinese Academy of Sciences (CAS) have invested US$ 6 million to support fuel cell research and development in China. During the period of the 10th Five-Year Plan (2001-2005) MOST plans to spend an additional US$ 25 million in this area, including the development in prototype FCBs.

For this project, MOST will provide US$6,203,000 in the form of cash and in-kind support, and $3,600,000 of parallel financing in the form of a waiver of duties for the import of FCB

equipment. For Part I, the in-kind contribution will consist of US$2,684,000 in co-financing, and the parallel financing is estimated at US$1,950,000. For Part II, the cash and in-kind contribution will consist of US$3,519,000 in co-financing, and the parallel financing is estimated at US$1,650,000.

The municipal governments of Shanghai and Beijing will provide US$4,384,000 and US$4,005,000, respectively. The municipal national and local government co-financing will include in-kind contributions. For Beijing, the Part I contribution will consist of US$1,968,000 in co-financing, and the Part II contribution will consist of US$2,037,000 in co-financing. For Shanghai, the Part I contribution will consist of US$2,096 ,000 in co-financing, and the Part II contribution will consist of US$2,288,000 in co-financing.

Additionally, private sector parallel financing of US$2.2 million are expected from the FCB System suppliers (US$1,227,000 in Part I and US$973,000 in Part II). The private sector contribution is a corporate contribution to the project made because of the developmental nature of the technology and the benefits anticipated by the corporate collaborators as a direct result of working on the project. The specific form of these contributions cannot be stated at this time, but they are expected to be auditable expenditures based on the supplier's assessment the project needs and its preliminary FCB commercialization strategy for China. The exact amount and nature of the private sector cost share will be stated in the application for Part II of the project.

B. STRATEGY FOR USE OF UNDP RESOURCES

B.1 Context

UNDP has six working areas: 1) poverty alleviation, 2) democratic governance, 3) sustainable energy and environment, 4) crisis prevention and recovery; 5) HIV/AIDS; and 6) information and communications technology for development. In the field of sustainable energy and environment, UNDP China aims to promote environmentally sustainable development to reduce human poverty. UNDP China supports the Government of China (GOC) to realized sustainable environmental management and energy development to improve the livelihoods and security of the poor. UNDP China also assists the GOC to improve the national policy, legal and regulatory framework for environmentally sustainable development and to have environmental and energy sustainability objectives integrated in macroeconomic and sector policies.

UNDP's mandate as a GEF implementing agency is consistent with its objectives for sustainable energy and environment, as stated above. The GEF has offered support for fuel-cell buses (FCBs), under Operation Program 11, Sustainable Transport, based on the dramatic reductions in system-wide air pollution and GHG emissions that FCBs offer over conventional diesel buses. Although fuel cells are technically proven, they are not yet completely commercialized. However, early investments in the technology can reduce costs to a commercially competitive level within 7 to 15 years. Once fully commercialized, the technology can then play an important role in the stabilization of GHGs by the year 2100, as intended in IPCC scenarios.

The strategic vision for GEF programmatic support of FCBs in developing countries is to reduce the long-term GHG emissions from the transport sector in GEF program countries by providing long-term support to the commercialization of FCBs. The achievement of this development objective will likely require GEF support for preparatory activities, demonstration projects, and commercialization efforts.

Preparatory activities involve the evaluation of the conditions for successful FCB operation and commercialization in key developing countries. To date, China, along with Brazil, Egypt, Mexico and India have completed this process, which has involved assessing the strength of the local bus market, verifying local and national political and financial support, evaluating the bus industry's capabilities, studying the availability of hydrogen supplies, and developing an indicative plan for FCB commercialization.

Demonstration activities, of which this project is a part, will focus on the operational viability of FCBs for urban transit in major developing country markets. This phase will provide significant operational experience with FCBs in order for decision-makers in the targeted developing countries and the GEF to make informed decisions about the viability of, and interest in, expanded deployment of FCBs. The focus will be on gaining significant operational experience, providing feedback to manufacturers, establishing hydrogen supply systems, providing training, increasing awareness, and revising plans for commercialization activities.

By supporting deployment of FCBs in GEF program countries, 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 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, because FCBs are hydrogen fueled, the GEF is also assisting developing countries in preparing for a future transition to newer, cleaner and more efficient fuel-supply systems.

B.2 Project Focus

The development objective of the project is to reduce GHG emissions in the long term through widespread commercial introduction of fuel cell buses in urban areas of China. Together with similar projects that GEF is supporting in other developing countries, a major overall intent is to accelerate buying-down the cost of FCB technology to levels that will enable widespread cost-competitive introduction of FCBs in many of the mega-cities of developing countries.

By comparison to most developing countries, China has relatively strong research and development (R&D) activities in fuel cell science and technology relevant to fuel cell buses. In spite of this, there are a number of major barriers to commercializing FCBs in China that this project will address.

?? Because fuel cell buses (FCBs) are not yet commercially established, their costs are too high to be competitive with diesel buses, the conventional alternative in China and most other countries. Through both the experience and the technical insights gained during this project, it is expected that progress will be made in reducing the cost of FCBs.
?? There is no FCB operating experience or technical and institutional capacity relating to commercial operation, maintenance, or manufacturing of FCBs in China. This project will build significant capacity in Beijing and Shanghai, which can be transferred to other cities in China.
?? There is a lack of awareness and acceptance of FCB technology among key actors, including policy makers and potential investors, and among the general public. This project is

designed with multiple mechanisms to build awareness among policy makers potential investors, and the general public.

?? The policy and planning capacity in the public transport sector in China is weak, resulting in less-than-optimal management, infrastructure, and operating conditions for maximizing the likelihood of sustainable introduction of FCBs. This project will also address the general issue of public transport policy and planning.

B.3 Project Strategy

B.3.1 Background

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.

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.

The FCB project in China has several unique features that contribute to the overall GEF FCB portfolio of projects. This project will involve carrying out simultaneous projects in two Chinese cities in order to compare and contrast FCBs operating under the wide range of institutional, social and market conditions found in cities across China; and to maximize future wide-scale implementation of FCBs throughout China. FCB operations will be demonstrated under different physical conditions than the other cities under the program, in particular the higher frequency of short, steep grades on the roadways and high relative humidity in Shanghai. Finally, the project will explore the Chinese market, which is a significant market unto itself, while allowing for expansion into the Asia and the Pacific-rim markets.

The China project, as part of the larger GEF FCB portfolio of projects, will benefit from the coordination that is planned between projects. Three key coordination approaches are planned. First, 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 China project with those from other FCB projects. Second, the FCB Private Sector Advisory Group is intended to provide guidance and support to all of the GEF FCB projects, including China. Third, 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.

The project proposed here constitutes Phase II of a four-phase program that will culminate in the market-based commercial production and use of FCBs in China. Phase I, which culminated in

the preparation of the proposal for this project, has involved research and data collection and analysis by Chinese experts to provide a basis for the design of the overall program. Phase II of the program, as described in this project document, will involve demonstrating a small fleet of FCBs (12 in total) in China, along with capacity building activities to strengthen the basis for proceeding to Phase III. Phase II of this program was divided into two parts: Part I and Part II. The description of Part II activities has been included in this project document to provide information on the context of the larger project; however, the financial commitment under this project document is limited to activities of Phase II Part I only. Phase III will involve an order-of-magnitude larger demonstration effort. Possible project concepts envisioned at this time for Phase III include setting up a commercial FCB manufacturing facility to maximize Chinese content in the buses and achieve major cost reductions by volume production of improved-design FCBs, and converting and operating an entire garage fleet of FCBs to provide a basis for subsequent replication to other bus garages in China. MOST, the executing agency for Phase II, has a strong commitment to insuring the success of all four phases of the program.

B.3.2 Project Approach

The project will facilitate the commercial introduction of FCBs in China through three broad objectives: 1) determining the current technical and operational viability of FCBs and accumulating knowledge regarding their current and future potential cost and performance, 2) building the technical, operational, managerial and planning capacity for long-term use of FCBs, and 3) stimulating national-level awareness of FCBs and developing a coordinated strategy for the next phase of FCB commercialization in China.

The first objective to determine the current technical and operational viability of FCBs will be achieved through an initial demonstration of FCBs in China and a series of activities to accumulate a substantial body of knowledge regarding FCBs. The FCB demonstration will consist of parallel projects in Beijing and Shanghai. Six hydrogen-fueled buses will be operated in each city over a period of 4 years. In both Beijing and Shanghai, the hydrogen will be made by on-site, small-scale steam reforming of natural gas. In each city, a first batch of three buses will be introduced, followed by a second set of 3 buses after one year of operating the first batch.

The decision to carry out simultaneous projects in two cities was made based on the objective of maximizing the chances for future wide-scale implementation of FCBs throughout China. Beijing and Shanghai were selected as the demonstration host cities in large part because they present a significant contrast in market, institutional, and cultural conditions. Furthermore, each is representative of a large number of other cities in China, in terms of the pace of economic and institutional reform.

The decision to demonstrate a minimum of 6 buses in each city was based on prior experience with the introduction of CNG buses in Beijing and in Shanghai. The 6-bus design in each city will enable a total of about 800,000 bus-km of FCB operation to be logged in each city. This is the typical lifetime of a bus in Beijing today, and it is adequate to evaluate mean time between failures (MTBF) at the end of the project period. It will also enable each bus to operate a total of 115,000 to 150,000 km, which is 3 or 4 times the target for MTBF and thus should be sufficient to identify likely failure modes. The rationale for these decisions is discussed further in Annex 9: Analysis of Project Size and Scope.

Guidelines will be established to evaluate the project performance, collect and analyze data, disseminate information within the technical, government and business communities in China, and share information with other international FCB project teams through newsletters and reports. Significant emphasis will be placed on an analysis of the lifecycle costs of FCBs based on their performance and operating costs as determined in this project.

The second objective of capacity building regarding the long-term use of FCBs will be accomplished by training a cadre of operators, technicians and managers within the two municipal transportation companies, creating a certification program for training future operators & technicians, preparing a public transit policy planning study, and stimulating FCB research and development through workshops and competitive research grants. The policy and planning study will include an assessment of the policies, programs and incentives needed to promote commercialization of FCBs.

The third objective of stimulating national-level awareness of FCBs and developing a coordinated strategy for the next phase of FCB commercialization in China will be accomplished through seminars focused on policy-makers, business leaders, investors, the media and other key actors. The project results will be presented at national and international conferences and publicized through a newsletter, a website and the news media. Phase III feasibility studies will be carried out for several cities, conceptual designs for Chinese manufactured FCB will be developed, and a hydrogen production assessment will be performed. These assessments along with the lifecycle cost analysis and the policy and planning study will support preparation of a strategy document for FCB commercialization in China. The strategy document will define the Phase III commercialization project and lay out a proposed course for the mass-production of cost-competitive FCBs in China.

B.3.3 Project Parts

This project has been structured into two parts: Part I and Part II. Part I will correspond approximately to the first year of the project, and will principally involve the purchase of the hydrogen fueling stations and the first set of six FCBs. Part II will correspond approximately to years two through five of the project, and it will principally involve the purchase of the second set of six buses, system operating and maintenance costs and the capacity building activities to prepare for a Phase III demonstration project. The activities for this project have been organized as belonging to either Part I or Part II, and the total project budget has been divided into corresponding Part I and Part II budgets.

The initial project authorization from GEF will commit only its portion of the Part I funds. GEF commitment of its portion of the funds for Part II of the project is expected to be subject to both the availability of funds from the GEF donor countries and the satisfactory completion of the Part I project activities, as per Part I Success Indicators setforth in this project document. For planning purposes, the start of Part II activities is planned for one year following the initiation of Part I activities.

C. IMMEDIATE OBJECTIVES, OUTPUTS, INDICATORS and ACTIVITIES

The long-term development objective is to reduce air pollution and GHG emissions through widespread commercial introduction of FCBs in urban areas of China. In cooperation with similar projects in other developing countries, the cost of FCB technology can be brought down to levels that will enable their widespread cost-competitive introduction in many of the mega-cities of developing countries.

The project will be executed in two parts, as discussed in Section B.3.3 above. Even though the description of Part II activities has been included in this project document to provide information on the context of the larger project, the financial commitment under this project document is limited to activities of Part I only. An overview of the project immediate objectives and outputs is provided in Figure 1, and detailed activities for each output are provided below.

C.1 Immediate Objective 1 - Determine the technical and commercial viability of fuel cell buses and the associated fuel supply systems

Output 1.1: Operational basis for project management established. Local officials and technical experts familiarized with FCBs, the project development objective and immediate objectives, and issues related to sustainable transportation, environmental protection and improved transportation services.

Activities associated with Output 1.1 will be carried out by the Beijing and Shanghai teams, jointly or in parallel as appropriate, with information sharing between the two teams to the fullest extent possible.

Part I Success Criteria/Indicators

- Project Advisory Committee and Local Oversight Committees are in place.
- The Inception Workshop is attended by appropriate representatives of UNDP, state and local government, administrative and project officials, technical experts, support staff and the media (70 to 100 people total). The attendees gain a clear understanding of the project, its goals and approach. The workshop results in the development of a detailed work plan and more refined success criteria as documented in the Inception Report.
- Two semiannual management reports are issued that provide comprehensive discussion of the project study tours, FCB system specification development, FCB system procurement process and outcome.
- Regular and effective information sharing at the national and municipal levels of the project results in well coordinated activities between the two teams.

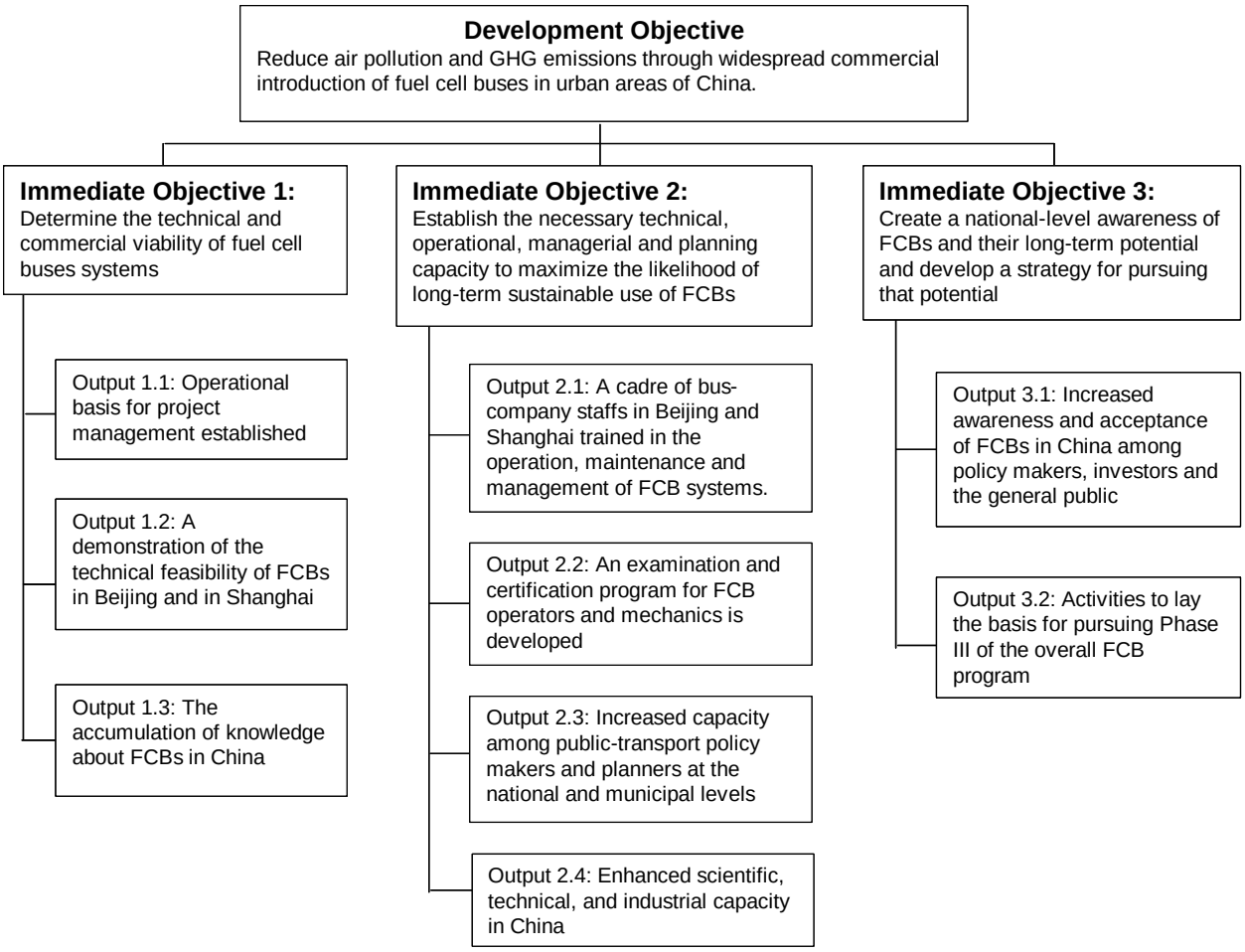


Figure 1. Immediate Objectives and Outputs for the China FCB Project

Part I Activities

1.1.1 Hold Inception Workshop. An Inception Workshop for both the Beijing and Shanghai project teams will be held in Beijing to finalize project administrative, institutional and management arrangements. The Inception Workshop will be organized by the NPD with support from the NPC and the CTA. A detailed Inception Report, including work plan to guide project implementation will be prepared by the CTA and the NPC with inputs from each project team. The Inception Report will be prepared within six weeks following the Inception Workshop.

1.1.2 Prepare and distribute semi-annual management reports in English. Each project team will prepare a semi-annual report summarizing the overall progress in the project and the data collected to date. The reports will be submitted to UNDP, MOST and other interested parties. Each project team will maintain a mailing list of recipients of these reports, and copies of the reports will be provided to all interested parties.

Part II Success Criteria/Indicators

- Annual Meetings are well organized and attended by appropriate UNDP, Advisory Committee, Local oversight Committee, state and local government, administrative and project officials, technical experts, support staff and representatives of the media (50 to 75).
- Each team accomplishes its activities according to the work plan, milestone schedule and budget as documented in project reports, technical papers and presentations, newsletters and web site.

Part II Activities

1.1.2 Prepare and distribute semi-annual reports in English. This activity will be continued from Part I.

1.1.3 Hold Annual Coordination/Review Meetings. An Annual Meeting of both project teams will be held to review and coordinate project activities. The Annual Review meetings will be organized by the NPD with support from the NPC. The first Annual Meeting will be held in Shanghai, at the end of the first year of project activities, and subsequent meetings will alternate between Beijing and Shanghai.

1.1.4 Prepare Comprehensive Evaluation Report. A comprehensive evaluation report will be prepared by an independent expert to assess the project experience, lessons-learned, data evaluation, training program, ridership surveys, planning studies, and commercialization plans, including recommendations and conclusions on key economic, technical and institutional factors needed for successful FCB implementation in China.

Output 1.2: A commercially relevant demonstration of the technical feasibility of FCBs and their refueling infrastructure in Beijing and in Shanghai.

Activities associated with Output 1.2, with the exception of 1.2.1 and 1.2.2, will be carried out in parallel by the Beijing and Shanghai project teams, with information sharing between the two teams to the fullest extent possible. Activities 1.2.1 and 1.2.2 will be carried out jointly by the two teams.

Part I Success Indicators

- Study tours are conducted to manufacturers and suppliers in at least the USA, Europe and Japan by teams (6 to 8 people) from each city consisting of members from MOST, the bus companies and national experts.
- Study tours result in up-to-date knowledge gathering by the teams that is incorporated into the system specifications and bid packages.
- Multiple qualified bids for FCB systems are received in each city five months after the start of the project.
- Contracts are signed in each city for delivery of complete FCB systems with private sector cost share.

Part I Activities

1.2.1 Undertake vendor communications and study tours. Each project team will undertake communications with as many potential fuel cell engine suppliers, bus manufacturers and hydrogen fueling system suppliers as possible. In cooperation with the CTA and the NPC, the teams will organize joint national and international study tours to visit selected

suppliers and manufacturers in order to: 1) to understand the present status of specific companies' technologies, their capabilities for supplying FCBs to the project, and their level of interest in responding to a bid and 2) to maximize the likelihood of receiving multiple bids by encouraging wide participation in the bidding.

1.2.2 Develop system specifications. Both project teams will work in cooperation with the CTA and the NPC to develop technical performance specifications for the buses and fueling system, such that they will meet the needs of the project. Completely assembled fuel cell buses will be procured in order to reduce the specification and procurement time and effort, and most importantly to minimize technological risks.

1.2.3 Select system suppliers. The Beijing and Shanghai project teams will issue separate calls for tenders for each city and select suppliers for complete FCB systems. Tenders from different combinations of fuel cell engine, bus chassis/body manufacturers and fuelling system vendors will be sought and encouraged. However, a single supplier will be required to contract for the whole system (buses plus fueling system) with appropriate sub-contracting arrangements. Different suppliers will be selected for Beijing and for Shanghai, if possible. The system supplier(s) will be selected on the basis of lowest total cost for Part I and Part II, subject to meeting the specified technical and performance requirements. Criteria for evaluating proposals will be published as part of the call for tenders. Important evaluation criteria will be the amount and nature of cost sharing, the strength of a preliminary commercialization plan, and the level of participation by Chinese companies or other Chinese organizations.

Part II Success Criteria/Indicators

- The hydrogen fueling systems and the first six FCBs are delivered and operate as specified.
- The second set of six FCBs are delivered and function according to specifications.
- The FCB systems can be reliably operated and maintained by each municipal public transportation company.
- Twelve buses are operated for a total of 1.6 million vehicle-km.
- Breakdowns are limited in frequency to acceptable levels, e.g., >50,000km between breakdowns.
- Refueling station operates reliably to supply sufficient H_2 at all times.

Part II Activities

1.2.4 Install hydrogen fueling system. In each city, the primary contractor will manage the installation and start-up of the hydrogen generation and refueling system at the host bus garage. Each project team will oversee the installation and start-up activities. Installation of the fueling system will precede the arrival of the initial set of buses.

1.2.5 Place initial set of 6 buses in operation. In each city, the primary contractor will arrange the manufacture and delivery of the initial 3 buses, which will be checked-out and placed into service. Each project team will work with its primary contractor to place the initial set of 3 buses in operation.

1.2.6 Operate and maintain the hydrogen fueling infrastructure. In each city, the primary contractor will oversee the operation and maintenance of the hydrogen generation and refueling system at the host bus garage.

1.2.7 Operate the initial set of 6 buses, 3 for each city. Following the training seminars and an initial non-revenue shake-down/testing period, these buses will be operated by the Beijing and Shanghai Public Transportation Companies for approximately 4 years, in revenue service under realistic operating conditions.

1.2.8 Place second set of 6 buses in operation. In each city, the primary contractor will arrange the manufacture and delivery of the second set of 3 buses, which will be checked-out and placed into service approximately one year after the first set of buses begins operation. Each project team will work with the primary contractor to place these buses in operation.

1.2.9 Operate the second set of 6 buses, 3 for each city. Following an initial non-revenue shake-down/testing period, these buses will be operated by the Beijing and Shanghai Public Transportation Companies for approximately 3 years, in revenue service under realistic operating conditions.

Output 1.3: The accumulation of a substantial body of knowledge about reliability and failure modes, opportunities for improving the design and reducing the cost of FCBs in China, and Chinese public ridership responses to FCBs.

Activities associated with Output 1.3 (with the exception of 1.3.1, 1.3.5, and 1.3.7) will be undertaken in parallel by the Beijing and Shanghai teams, with sharing of information between the two teams. Activity 1.3.1 will be carried out jointly by the two teams, and Activities 1.3.5, and 1.3.8 will be carried out by the NPD, with the support of the NPC and both project teams.

Part I Success Criteria/Indicators

✍ Guidelines are established for clear and complete documentation of the project performance.

✍ Data collection system is designed and installed.

✍ Project newsletters are published regularly in English and Chinese and widely disseminated to relevant government agencies, research institutes, universities and private organizations inside and outside China, including other GEF projects.

✍ Initial ridership survey is completed and documented to establish the baseline.

Part I Activities

1.3.1 Formulate guidelines for quarterly reports on in-service performance of each FCB system. Through a consultative process involving the CTA, the NPC, each project team, the suppliers, and other experts, a protocol will be developed for quarterly reporting on the technical operations of the bus fleets and refueling system. (The following is a partial list of the items to be included: hours and kilometers of operation by individual vehicles and fleet, availability of vehicles, in-service reliability, failure modes, energy consumption, fuel consumption, operator and maintenance personnel training and achievement, MTBF (mean time between failures) and FMA (failure mode analysis) for both vehicles and the fueling system, etc.)

1.3.2 Design data collection systems. Each project team will utilize local experts to design and purchase the equipment to collect, analyze, and evaluate operating data on the FCBs and the refueling system. Each data collection system will collect information in a form consistent with the reporting guidelines developed in Activity 1.3.1.

1.3.3 Collect ridership data. Each project team will collect regular survey data from general-public bus riders or focus groups to help identify potential improvements to FCB technology for China. An initial survey will be carried out prior to the operation of the FCB fleets. The survey will be conducted and analyzed by recognized experts.

1.3.4 Exchange experiences with other fuel cell bus projects. With the support of the CTA and the NPC, each project team will maintain regular information exchange with other GEF fuel cell bus projects (Sao Paulo, Mexico City, Cairo, New Delhi) and other non-GEF FCB projects (Chicago, Vancouver, California, Europe, and elsewhere) during each year of project implementation.

1.3.5 Publish a project newsletter. The NPD, with the support of the NPC, will regularly publish a project newsletter, covering all aspects of the project activities, and disseminate the newsletter to other fuel cell bus projects and interested parties. Each project team will provide timely information to be used in the newsletter.

Part II Success Criteria/Indicators

- Technical data on both FCB systems is collected, according to the guidelines, analyzed and reported on a quarterly basis.
- Project newsletters are published and distributed regularly to relevant government agencies, research institutes universities and private organizations inside and outside China, including other GEF projects.
- Follow-up ridership surveys are completed and documented annually.
- A lifecycle analysis of the FCB systems is completed and documented and identifies possible system improvements and potential long-term benefits.
- The International FCB seminar is attended by several hundred national and international participants to discuss their knowledge and experiences from FCB projects around the world, and results in increased information exchange between Chinese and international colleagues.
- Thirty to fifty papers and reports are published over the project life demonstrating the accumulated experience and knowledge.

Part II Activities

1.3.3 Collect ridership data. This activity will be continued from Part I. Surveys will be conducted and analyzed by recognized experts, and the surveys will be carried out during and following operation of the FCB fleets.

1.3.4 Exchange experiences with other fuel cell bus projects. This activity will be continued from Part I.

1.3.5 Publish a project newsletter. This activity will be continued from Part I.

1.3.6 Collect and evaluate operating data on the FCBs and the refueling system. In collaboration with the suppliers, each project team will engage in systematic logging, evaluation and interpretation of operating parameters paying particular attention to reliability, failure modes and potential improvements in design and operation of the buses.

1.3.7 Prepare lifecycle analysis of the FCBs operating data. In collaboration with the suppliers, each project team will perform a detailed lifecycle analysis of the costs, emissions and resource-use efficiency of the FCBs based on the collected data. Particular attention will be paid to the projections for FCB operating costs and lifetimes. In addition, comparisons will be made to similar lifecycle analyses for other bus technologies.

1.3.8 Prepare quarterly data analysis performance reports in English. Each project team will prepare quarterly reports, in accordance with the format developed in Activity 1.3.1, detailing the data collected to date along with analysis and evaluation of that data. A mailing list of recipients of these reports will be maintained and copies of the reports will be provided to all interested parties. These reports will also serve as the basis for proposals for further product development and improvement.

1.3.9 Host an international FCB seminar. In order to establish personal interactions and foster more effective communications and information exchanges, the NPD will host an open international FCB seminar that will involve participants from other GEF FCB projects, other non-GEF FCB projects, and other parties engaged in FCB technology development and deployment.

C.2 Immediate Objective 2 – Establish the necessary technical, operational, managerial and planning capacity within the bus companies, scientific and industrial communities, and national and municipal-level policy makers to maximize the likelihood of long-term sustainable use of FCBs

Output 2.1: A cadre of bus-company staffs in Beijing and Shanghai trained in the operation, maintenance and management of FCB systems.

Activities associated with Output 2.1 will be undertaken in parallel by the Beijing and Shanghai teams, taking advantage of any opportunities for joint activity to reduce costs and improve effectiveness.

Part I Activities
None

Part II Success Criteria/Indicators

- Training program is developed within three months following the start of Part II.
- The training seminars are attended by 40 to 50 operators, technicians, repairmen and managers from the bus company in each city.
- Training seminars are well run as evidenced by quality surveys of attendees and the number of trainees qualified through appropriate testing.

✍ The training programs effectively prepare the trainees for the responsibility of operating, maintaining and managing the FCB systems as evidenced by their work/performance records.

Part II Activities

2.1.1 Develop training program. Working together with their respective FCB system suppliers and in cooperation with the CTA, the NPC and other international and national FCB training experts, each project team will develop a training program for FCB operators, repairmen, technicians, and managers.

2.1.2 Hold on-the-job training seminars. The project team in each city will implement on-the-job training seminars for operators, repairmen, technicians, and managers based on the program developed in Activity 2.1.1. Support will be provided by the CTA, the NPC and other international and national FCB training experts as appropriate. This activity must ensure the training of sufficient numbers of operating and maintenance personnel to ensure both proper execution of the immediate project and preparation for a larger follow-on demonstration.

Output 2.2: An examination and certification program for FCB operators and mechanics is developed.

Activities associated with Output 2.2 will be undertaken in jointly by the Beijing and Shanghai teams.

Part I Activities

None

Part II Success Criteria/Indicators

✍ An examination and certification program is developed that reflects project experience.

✍ The program is submitted for approval to China State Bureau of Quality and Technical Supervision.

Part II Activities

2.2.1 Develop an examination and certification program for FCB operators and mechanics. The project teams will cooperate with the NPC to develop an examination and certification program for FCB operators and mechanics that can be used at the national level. The program will be based on the material and methods developed for the training programs.

2.2.2 Refine and submit the examination and certification program for FCB operators and mechanics. The project teams will cooperate with the NPC to incorporate experience and lessons-learned from operation of each FCB system to improve the requirements and methods for training, examination and certification. MOST will be responsible for submitting the program to China State Bureau of Quality and Technical Supervision for approval (or preliminary approval).

Output 2.3: Increased capacity among public-transport policy makers and planners at the national and municipal levels and at bus companies in Beijing and Shanghai for policy and planning to optimize public-transport management, technologies (including FCBs), infrastructure, and operations.

Activity 2.3.1 will be undertaken in parallel by the Beijing and Shanghai teams, and Activity 2.3.2 will be undertaken jointly.

Part I Success Criteria/Indicators

- The study tours consisting of 6 to 8 people (total) from MOST and each city visit a number (6 to 8) and broad variety of public transit authorities worldwide and the participants increase their understanding of other approaches to public transit policy and planning.
- A report summarizing findings of study tours and identifying sustainable transportation development best practices that could be applied in China is prepared by each group and consolidated.

Part I Activities

2.3.1 Undertake a study tour to visit selected public transport planners, policy makers, and service providers worldwide. In cooperation with the CTA and the NPC, each city will organize an international study tour to visit selected public transport planners, policy makers, and service providers. The purpose of the study tours will be to better understanding policy and planning approaches that could be applied to improve public bus systems in China. The tours will include cities with well-managed public transit systems and cities operating FCBs. Each study tour team will visit a different set of cities in the US, Canada, Europe and elsewhere and compare/compile their findings.

Part II Success Criteria/Indicators

- A completed policy and planning study for Beijing and Shanghai that incorporates the information learned during the study tours and provides a basis for sustainable transportation development.

Part II Activities

2.3.2. Prepare a transit system policy and planning study. In cooperation with the NPC, the project teams will establish an expert group to prepare a planning study that evaluates and recommends options for improving/optimizing bus-company management, technologies, infrastructure, and operations in Beijing and in Shanghai. The planning study is intended to provide a basis for strengthening the capacity of the bus companies and to identify policies, programs and incentives that will help insure sustainable, wide-scale introduction of FCB in the long term.

Output 2.4: Enhanced scientific, technical, and industrial capacity in China relating to manufacturing and commercial utilization of FCBs and their associated fuel supply systems.

Activities associated with Output 2.4 will be undertaken jointly by the Beijing and Shanghai teams, in consultation with the Ministry of Science and Technology (MOST), and these activities will focus on enhancing the replicability of FCB project in China.

Part I Activities

None

Part II Success Criteria/Indicators

- Two national workshops are conducted that attract attendees (several hundred) from government agencies, bus companies, bus manufacturers, investors and the media from a wide variety of Chinese cities.
- An increase in the number of research organizations, technicians, manufacturers, and other organizations working on, or interested in, the development of fuel cell vehicles as evidenced by their attendance at the national workshops.
- Results are published from the competitive awards (three to five) made to research, manufacturing and business entities in Beijing and Shanghai each year.

Part II Activities

2.4.1 Organize national technical workshops. Under the sponsorship of UNDP and MOST, the NPD and the NPC in cooperation with the project teams, will jointly organize and hold two workshops (once every two years) to promote the exchange of technical information relating to fuel cell vehicles among relevant organizations in China. The purpose of the workshops is both to keep organizations informed of progress in the GEF project and to help foster the advancement of China's scientific, technical, and manufacturing capabilities relating to fuel cell vehicles.

2.4.2 Organize an annual competition to provide funding aimed at accelerating the commercialization of FCBs in China. Under the sponsorship of MOST, the NPD and the NPC, with cooperation of the project teams, will organize annual competitions for funding of Chinese organizations aimed at accelerating the commercialization of FCBs in China. The objective of this activity is to encourage the wider development of varied expertise (science, engineering, manufacturing, management, etc.) in China relating to commercialization of fuel cell vehicles. The activity is designed to enhance ongoing research, development, demonstration, and commercialization activities supported by national funding sources. Activities to be supported could include applied research at universities, technical institutes and private companies, feasibility studies of setting up manufacturing facilities, development of business plans for joint ventures with foreign companies, and other activities. A selection committee and selection process, under the direction of the NPC, will be established for decision-making regarding funding.

C.3 Immediate Objective 3 – Create a national-level awareness of FCBs and their long-term potential and develop a strategy for pursuing that potential

Output 3.1: Increased awareness and acceptance of FCBs in China among key actors (government policy makers, news media, and investors), as well as the general public.

Activities associated with Output 3.1 will be undertaken jointly or separately by the Beijing and Shanghai teams, as appropriate, and will be carried out during Part II of the project.

Part I Activities

None

Part II Success Criteria/Indicators

- A national awareness seminar is conducted and attended by public transport sector decision-makers, other policy makers, media, investors and other key actors.
- Presentation of papers on the project by project team members at a minimum of two national and two international meetings on fuel cells vehicles or public transit.
- Widespread knowledge of this FCB demonstration project within the technical community and the general public through multiple media outlets.
- Public awareness and acceptance of FCBs shown in the ridership surveys and media reactions.

Part II Activities

3.1.1. Hold a national awareness seminar. Under the sponsorship of MOST, the NPD, with the support of the NPC and the project teams, will organize a national seminar to raise awareness and support for commercialization of FCBs. The seminar will be aimed at public transport sector decision-makers, other policy makers, media, investors and other key actors.

3.1.2. Participate in national and international meetings. In cooperation with the NPC, each project team will prepare papers and send representatives to participate in national and international meetings to disseminate the results of the project activities. This activity will seek to make the results of this demonstration project widely known inside and outside of China.

3.1.3. Publicize the project results. In cooperation with the NPC, each project team will use information media (newspapers, TV, radio, billboards, internet site, etc.) to publicize results of the demonstration project and plans for future projects with the objective of developing widespread public support for the expansion of FCB programs in China and other countries.

Output 3.2: Activities to lay the basis for pursuing Phase III of the overall FCB program.

Activities associated with Output 3.2 will be led by MOST, and will be carried out during Part II of the project. One overall objective of this activity is to identify policy barriers and discuss removal of these with policy makers.

Part I Activities

None

Part II Success Criteria/Indicators

- Workshops and meeting are held with a wide variety of Chinese organizations in each geographical region of the country.
- Assessment reports are prepared on the feasibility of FCB mass-production in China and on the evaluation of H_2 supply alternatives.
- A commercialization strategy is developed for FCBs in China that includes Phase III feasibility studies for at least three cities and a commitment of funds and/or policy changes from key government, business and financial decision-makers.

✍ Standards are developed for FCBs, along with guidelines for their operation and maintenance, and standards for H_2 supply systems, and are submitted to China State Bureau of Quality and Technical Supervision for approval.

Part II Activities

3.2.1 Conduct information exchange workshops. The NPD, with the support of the NPC, will organize and conduct information exchange workshops and meetings with targeted sets of key potential Phase III/IV actors, including mayors of cities, financiers, and policy makers. The purpose of these workshops and meetings will be to inform the respective audiences about developments toward FCB commercialization and tentative Phase III/IV plans, while also eliciting information to help develop a detailed strategy for Phase III/IV.

3.2.2 Carry out feasibility studies for candidate Phase III cities. Under the direction of the NPD and with the support of the NPC, MOST will fund and manage feasibility studies with three candidate Phase III cities. The studies will investigate the technical, institutional, and financial aspects of possible Phase III projects in each city.

3.2.3 Develop a conceptual design for a hydrogen-powered fuel cell bus. Under the direction of the NPD and with the support of the NPC, MOST will fund and manage an expert design team that will develop a conceptual design for a hydrogen-powered fuel cell bus that might ultimately be manufactured commercially in China. Based on information generated during the demonstration project, the expert design team will carry out detailed engineering design and costing of an FCB for large-scale manufacture (in China) for use in Chinese cities. The economic feasibility of Chinese mass production of the bus in the relatively near-term will also be investigated. The expert design team will formulate Chinese standards for hydrogen fuel cell buses and prepare an initial set of operating and maintenance guidelines.

3.2.4 Develop fuel supply assessments and protocols for large-scale utilization of H_2 FCBs. Under the direction of the NPD and with the support of the NPC, MOST will fund and manage a special study team that will develop fuel supply alternatives and protocols for large-scale utilization of H_2 FCBs. This work will include a detailed evaluation of the technical and economic feasibility of the most promising schemes for H_2 supply to bus depots in the major urban areas of China. The special study team will evaluate the possibility of separating carbon dioxide during H_2 production from fossil fuels and sequestering the CO_2 underground. The special study team will also develop hydrogen fuel standards and refueling protocols for electrolysis and reformer-based hydrogen supply systems. This will include H_2 quality standards, safety standards, etc.

3.2.5 Prepare a detailed Phase III strategy document. The NPD, with the support of the NPC, will prepare a document detailing a strategy for Phase III and for achieving widespread commercial introduction of FCBs in the major urban areas of China. This activity will build on Activities 1.3.7, 2.3.2, and 3.2.1 to 3.2.4 and will include strategies for commercial production of FCBs in China and for production of the associated fuel supply system. The strategy will take into consideration the experience with the Phase II demonstration and outside evaluations of this experience (Activity 1.1.4), as well as FCB project developments elsewhere in the world.

D. INPUTS

The following tables summarize the inputs to be provided by the participants in the project.

D.1 UNDP/GEF Inputs

UNDP/TRAC – Part I

Support for bus tenders	$	24,000
FCB Procurement Expert (2.5 w/m)	$	20,000
Mission costs	$	3,000
Policy study tour	$	144,000
Total UNDP for Part I	$	191,000

UNDP/TRAC – Part II

Policy and planning study (Subcontract to expert group)	$	143,000
Mission costs	$	12,000
National Technical Workshops (2)	$	41,000
Total UNDP for Part II	$	196,000
Total UNDP for Parts I and II	$	387,000

GEF – Part I

Inception Workshop	$	10,000
International consultants	$	111,500
(1) Chief Technical Advisor (7 w/m)		
National consultants	$	128,000
(1) National Project Coordinator (18 w/m)		
(2) National PEMFC Expert (7 w/m)		
(3) National H2 Supply Expert (7 w/m)		
(4) National FCB Expert (6 w/m)		
(5) Natl Procurement Experts (16 w/m)		
Partial payment toward fuel cell bus system subcontracts	$	5,378,000
Mission Audit costs	$	1,000
Monitoring & Evaluation	$	20,000
Sundries	$	500
Operations	$	166,000
Total GEF for Part I	$	5,815,000

GEF – Part II

International consultants	$	425,000
(1) Chief Technical Advisor (10 w/m)		
(2) Intl. FCB Training Expert (2 at 3 w/m each)		
(3) Intl. FCB Operations Experts (8 at 1 w/m each)		
(4) Intl. FCB Design Experts (2 at 6 w/m each)		
Mission Audit costs	$	5,000
Monitoring & Evaluation	$	25,000
Annual coordination/review meetings	$	20,000
Comprehensive evaluation report	$	20,000
Partial payment toward fuel cell bus system subcontracts	$	4,528,000
Participate in national and international meetings	$	51,000
Carry out Phase III feasibility studies	$	150,000
Develop conceptual design for a H2-powered FCB	$	240,000
Develop H2 fuel supply assessment for FCBs	$	80,000

Prepare a detailed Phase III strategy document	$	37,000
Sundries	$	25,000
Operations	$	161,000
Total GEF for Part II	$	5,767,000
Total GEF for Parts I and II	$	11,582,000

D.2 National Government Inputs

The equipment to be purchased will not be subject to any import duties.

Ministry of Science and Technology - Part I

Co-financing

Partial payment toward fuel cell bus system subcontracts	$	806,000
Monitoring systems	$	1,200,000
National consultants & NPD staff	$	30,000
(1) NPD		
(2) Support to NPD		
PMO Offices	$	100,000
Publish a project newsletter	$	10,000
Office equipment	$	50,000
Vehicles	$	70,000
Communications	$	10,000
Contingency	$	408,000
Subtotal Co-financing	$	2,684,000

Parallel Financing

Import duty waiver	$	1,950,000
Total MOST for Part I	$	4,634,000

Ministry of Science and Technology - Part II

Co-financing

Partial payment toward fuel cell bus system subcontracts	$	1,128,000
National consultants & NPD staff	$	240,000
(1) NPD		
(1) National Coordinator (30 w/m)		
(2) National PEMFC Expert (3 w/m)		
(3) National FCB Expert (3 w/m)		
(4) National H2 Supply Expert (2 w/m)		
(5) FCB Training Experts (8 at 1 w/m each)		
(6) Support to NPD (16 w/m)		
PMO Offices	$	300,000
Publish a project newsletter	$	30,000
Office equipment	$	20,000
Communications	$	15,000
Operator & Mechanic Training	$	145,000
Operator Certification Program	$	28,000
Lifecycle analysis of FCB operating data	$	90,000
Annual funding competition	$	500,000

National awareness seminars & meetings	$	75,000
Publicity campaign	$	150,000
Phase III planning		
(1) Information exchange workshops	$	75,000
(2) Feasibility studies for candidate Phase III cities	$	150,000
(3) Conceptual design of Chinese FCB system	$	240,000
(4) Fuel supply assessment/protocols	$	80,000
(5) Strategy document for Phase III/IV	$	38,000
Contingency	$	215,000
Subtotal Co-financing	$	3,519,000
Parallel Financing		
Import duty waiver	$	1,650,000
Total MOST for Part II	$	5,169,000
Total MOST for Part I and Part II	$	9,803,000

D.3 Local Government Inputs

Public Transportation Companies - Part I	**Shanghai**	**Beijing**
Co-financing		
Partial payment toward fuel cell bus system subcontracts	$ 250,000	$ 250,000
Fueling station (included in fuel cell bus system subcontracts)	$ 771,000	$ 720,000
FCB Vendor study tours	$ 46,000	$ 46,000
Fuel cell bus O&M	$ 909,000	$ 832,000
Data collection system design	$ 45,000	$ 45,000
Ridership survey (subcontract by each city)	$ 11,000	$ 11,000
Newsletter	$ 11,000	$ 11,000
PMO Staff and reporting	$ 53,000	$ 53,000
Total for Part I	$ 2,096,000	$ 1,968,000

Public Transportation Companies - Part II	**Shanghai**	**Beijing**
Co-financing		
Fueling station O&M	$ 1,228,000	$ 1,034,000
Fuel cell bus O&M	$ 681,000	$ 624,000
Operator & Mechanic Training	$ 45,000	$ 45,000
Newsletter	$ 44,000	$ 44,000
Data collection	$ 100,000	$ 100,000
Lifecycle analysis	$ 61,000	$ 61,000
Ridership survey experts (subcontract by each city)	$ 44,000	$ 44,000
International FCB Seminar	$ 29,000	$ 29,000
PMO Staff and reporting	$ 56,000	$ 56,000
Total for Part II	$ 2,288,000	$ 2,037,000
Total for Part I and Part II	$ 4,384,000	$ 4,005,000

E. RISKS AND PRIOR OBLIGATIONS

E.1 Risks

E.1.1 Procurement Risks

There is some risk that the fuel cell engine industry is not sufficiently developed for FCBs to be secured through commercial bidding. Assessing this risk has been one of the preparatory activities for this project. Based on contacts that have been made with potential overseas fuel cell engine suppliers, it is very likely that at least one bid will be received. In fact, one of the leading firms in the industry has visited China several times in anticipation of bidding. Multiple potential suppliers will be contacted again shortly after project inception to inform them of the project's intent to solicit bids and to encourage bidding. Also, given the rapid development in fuel cell vehicle engineering ongoing in China, it is not unrealistic that a bid relying on a Chinese-made fuel cell engine could be received. Given the preparatory work for the project and the strong efforts that are planned to encourage multiple bids, the risk of not receiving any bids is considered small.

There is also some risk that prices on bids will be unacceptably high. This was the experience with the prior competition described in Section A.5. However, several factors mitigate against this risk. First, there is an improved likelihood since the last competition that multiple bids will be received, including the possibility of a bid structured with only Chinese involvement. Second, the competition will be for many more buses than in the prior competition (12 versus 2), which provides opportunities for reductions in overhead costs. Third, the winning bidder is likely to be in a favorable bidding position for subsequent large orders that will be sought during Phase III and IV. Fourth, FCB technology has developed considerably in the last two to three years, which should be reflected in reduced costs. Fifth, one of the leaders in the fuel cell engine industry has shared their cost projections for FCBs with the GEF, and these cost projections are the basis for budgeting Phase II. Thus, the circumstances today are such that this risk of unduly high bids being received can be considered relatively minor.

There is a somewhat greater concern that it will not be possible to agree on contract terms with the winning bidder. One issue may be delivery time. If the supplier is unable to deliver on a schedule that satisfies the Phase II design, project completion will obviously be delayed. While this is a risk, it is not a project-ending one. Of greater concern is reaching an agreement, especially with a foreign technology supplier that satisfactorily protects the technology supplier's intellectual property rights. While this risk cannot be ignored, there are several mitigating factors: 1) China has in place national laws protecting intellectual property rights and, in light of its joining the World Trade Organization, has increased its commitment to enforcing these regulations; 2) the fact that one of the leading foreign fuel cell engine companies submitted a bid in the previous competition suggests that at least one foreign supplier is prepared to try to negotiate contract terms; 3) the foreign technology component for which intellectual property rights are perhaps the most sensitive is the fuel cell stack. In the long term (with commercial mass-production of fuel cell buses) the stack is projected to constitute a small fraction (under 10%) of the total value of an FCB, which reduces the incentive to violate intellectual property rights; 4) the Phase II project design envisions a lease arrangement, whereby the FCBs are returned to the supplier at project end; and 5) if foreign suppliers will not participate in the project out of concerns over intellectual property rights or other issues, there remains the possibility of Chinese companies supplying the project.

E.1.2 FCB Development Risks

Long-term financial and institutional sustainability of FCBs in China requires that cost reductions be achieved and technical and institutional capacity be developed that can support widespread dissemination of FCBs in China. Phase II is designed to initiate this development in China, in part by identifying technology improvements and cost reductions. As with any technology commercialization effort, there is a risk of slower-than-expected progress in Phase II due to unexpected problems—permitting delays, construction delays, equipment breakdowns, accidents, etc. The net risk associated with such occurrences is the possibility of not obtaining sufficient vehicle-kilometers of experience with the demonstration fleet of 12 buses within a short enough period of time to provide relevant feedback to the design of the next generation of fuel-cell buses and stacks. If bus availability does not increase as rapidly as foreseen or performance falls short, the experience may not provide sufficient insight into the design of the next generation of buses and thus there will not be a firm basis for achieving cost reductions needed to move forward with the envisioned Phase III. The best safeguard against this risk is the strength and quality of the technical and management team to be selected for the project and close and continuous monitoring of all aspects of the project. During the supplier selection process, the project team will scrutinize supplier capabilities and long-term commitments to cost reduction, as the selection of the supplier will be perhaps the most important decision of the project. Together with the project team, UNDP and CICETE will monitor all contractual transactions to further insure that the project runs as effectively as possible. In the worst case, if insufficient progress is made to move forward with Phase III as envisioned, a redesign of Phase III will be required.

E.2 PRIOR OBLIGATIONS

There will be a few prerequisites to UNDP/GEF support to this project. First, the relevant government agencies (state and local) must contribute or commit to contributing the necessary resources. These resources include commitment of the necessary staff to provide guidance and administrative management to the project. MOST will need to assign the NPD, and the Public Transportation Companies in both Beijing and Shanghai will each need to establish a Project Management Office, and assign a Project Manager. The Project Advisory and Oversight Committees at the national and local levels will also need to be established.

F. MANAGEMENT

F.1 Implementation Arrangements

The GEF and UNDP TRAC funded project activities will be executed by two different executing agencies. The GEF funded project activities will be executed by MOST, and the project activities funded by the UNDP TRAC resources will be executed by the China International Centre for Economic and Technical Exchanges (CICETE).

For the GEF input, whose activities will be executed by MOST, CICETE will provide implementation support services at the request of the NPD in securing deliverables (personnel, training, equipment, etc.) and facilitating the preparation of financial and administrative reports. UNDP China will be responsible for monitoring and evaluation.

The Ministry of Science and Technology (MOST) will appoint a senior official to act as National Project Director (NPD). The NPD will take overall responsibility for ensuring that all national inputs are mobilized in a timely and effective manner, and be responsible to the Government of China and UNDP/GEF for achieving project objectives and for all project reporting, including the submission of work plans and financial reports. The project will be executed fully in line with UNDP national execution procedures, as detailed in the China NEX Manual. A preliminary organization chart for the project is shown in Figure 2.

Each site will establish a Project Management Office and assign a full-time project manager to oversee all project activities and report to the local oversight committee. Within the local PMOs the day-to-day implementation of the project in each city will be under the responsibility of the Beijing Public Transportation General Company and the Shanghai Public Transportation General Company. The project will hire a part-time international expert in the area of FCB technology as the Chief Technical Advisor to provide guidance to the NPD and to the local project managers. The project will also hire a National Project Coordinator (NPC) to ensure regular communication and coordination between the NPD, the project managers and UNDP, between the activities in each city and to lead the Phase III development activities. The NPC will be responsible for consolidating reports provided by each site and providing information on implementation and performance for the project as a whole.

F.2 Coordination Mechanisms

MOST will head an Advisory Committee that will provide overall advice and guidance to the project at the national level, review the project work plan, attend the semi-annual meetings and receive all project reports. The Advisory Committee will consist of representatives from the United Nations Development Programme (UNDP), the Ministry of Science and Technology, the State Development Planning Council, the State Economic and Trade Commission, the Ministry of Finance, the State Environmental Protection Agency and UNDP. The NPD and the Advisory Committee will seek advice from outside experts, as needed.

A local project Oversight Committee will be formed in each of the two host municipalities, Beijing and Shanghai. Each local committee will be headed by a Vice Mayor of the municipality and will include representatives from the following municipal-level organizations: the Science and Technology Commission, the Economic and Trade Commission, the Development Planning Commission, and the Public Transportation Company. The project managers and the municipal oversight committees will seek advice from outside experts, as needed. The local oversight committees will meet quarterly.

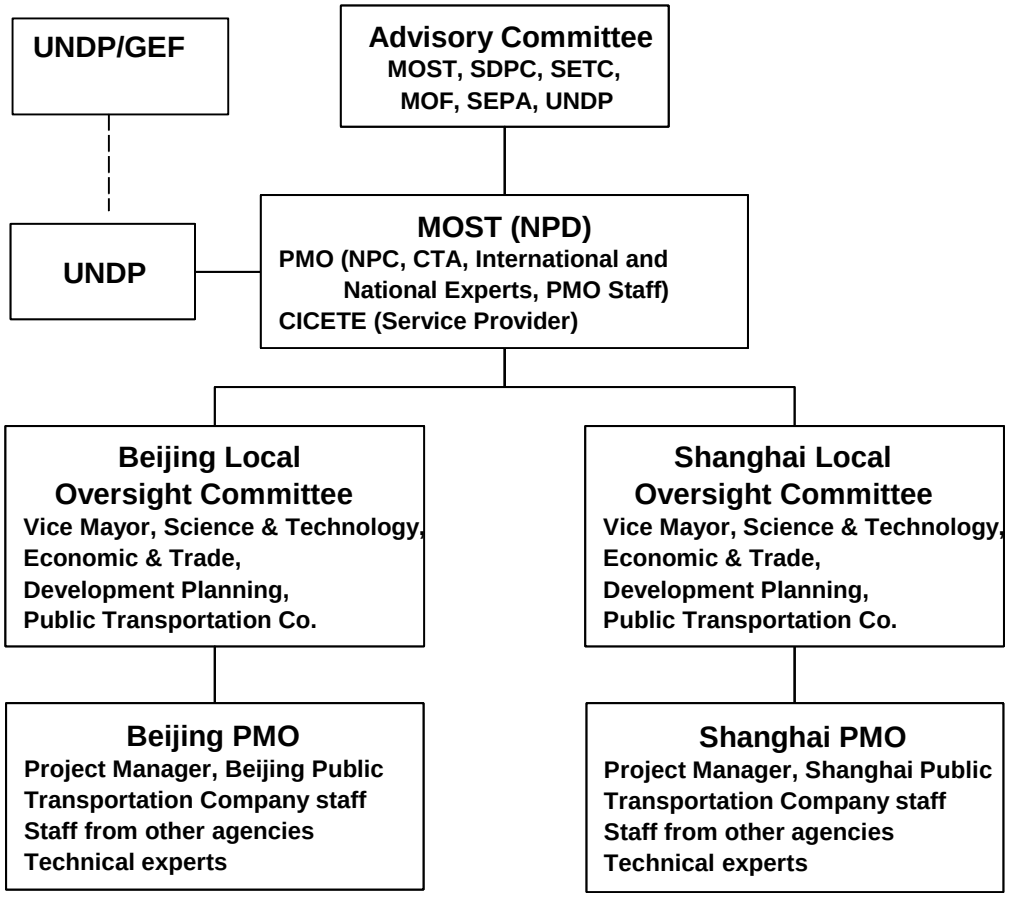


Figure 2. Preliminary Project Organization Chart

G. MONITORING AND EVALUATION

Project Review. The project will be subject to a tripartite review (joint review by representatives of the Government, executing agency and UNDP) at least once every 12 months. The first such meeting will be held within 12 months of the start of the implementation.

Project Reporting. On an annual basis, in connection with the tripartite review meeting, the executing agency will prepare a progress report that documents project results, progress, implementation issues, and steps being taken to address these issues, as well as presents the detailed work plan for the following year. In addition, periodic special reports will be prepared as results are obtained from major activities. Reports will be distributed to energy management agencies, project funders, and other interested parties. These reports will be complemented by other independent reports coming out of the project. Furthermore, project accomplishments will be promoted to the general public and lighting professionals as part of consumer and professional education and information dissemination activities.

GEF Recognition. Recognition of GEF support for this project shall be included in all project reports, documents, communications and marketing materials. In addition, the GEF logo shall appear prominently on the actual FCBs.

Project Monitoring and Evaluations. Continuous project monitoring and evaluation are key to maximizing the benefits of the project, and measuring project success. Pre-agreed targets will be set to help monitor and evaluate the project. These targets will be developed as part of the detailed project work plan (with milestones), which will be prepared at the inception of the project. A proposed set of targets follows:

1. Timely execution of specification-setting, solicitation and procurement activities in the first year.
2. Delivery and commissioning of buses, fuelling system, spares inventories, software, etc in the second and third years.
3. Submittal of semi-annual reports in English by each PMO on overall project management progress to NPC, who will be responsible for producing a consolidated document.
4. Timely completion of quarterly performance reports documenting the in-service performance of each FCB system.
5. Periodic reports by each PMO on proposed engineering modifications and the communication of these to vendors, plus confirmation of actions taken to NPC, who will be responsible for producing a consolidated document..
6. Regular publication by the NPD of the China FCB Project Newsletter.
7. Periodic reports by each PMO of ridership survey results to NPC, who will be responsible for producing a consolidated document..
8. Annual review/coordination meetings, organized by the NPD, including of progress towards cost reduction, reliability improvement and increased durability; and
9. Annual records of communication activities by the NPC and the PMOs regarding participation in national and international meetings, information dissemination within China, etc.

Financial Reporting. Financial reporting will be handled through the issuance of quarterly project delivery reports by CICETE and annual project budget revisions. Technical reports, mission reports and terms of reference of commissioned studies will be evaluated by UNDP/GEF.

Intellectual Property Rights. Effective technology transfer will be key to the success of this project and the achievement of the programmatic goals. Therefore, one of UNDP's roles will be to monitor the issue of intellectual property rights - to the maximum extent possible - as it applies to the fuel cell technology used in this project. Further, the contract with the equipment supplier may stipulate that their representatives and/or technicians may be continually present during the demonstration. However, the exact terminology of this arrangement remains to be negotiated when the system supplier is selected.

H. LEGAL CONTEXT

This project document shall be the instrument referred to as such in Article 1 of the Standard Basic Assistance Agreement between the Government of the Peoples' Republic of China and the United Nations Development Programme signed by the parties on 29 June, 1979. The host country, implementing and executing agencies shall, for the purpose of the Standard Basic Assistance Agreement, refer to the Government cooperating agency described in that Agreement. The following types of revisions may be made to this Project Document with the signature of the

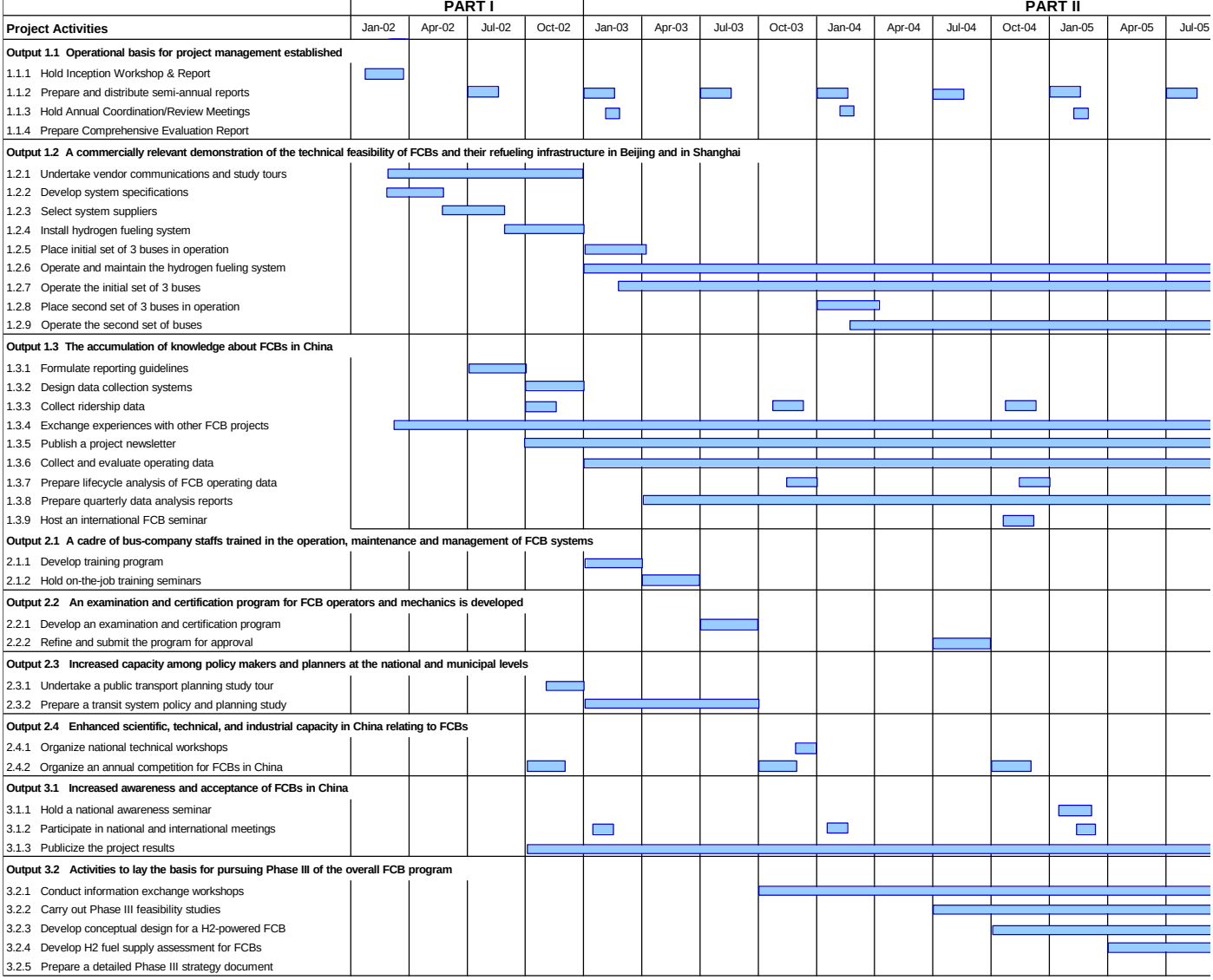
UNDP Resident Representative only, provide she or he is assured that the other signatories of the Project Document have no objections to the proposed changes:

1. Revisions in, or additions to, any of the annexes of the Project Document;
2. Revisions which do not involve significant changes in the immediate objectives, outputs or activities of the Project, but are caused by rearrangements on inputs already agreed to or by cost increases due to inflation; and
3. Mandatory annual revisions, which rephrase the delivery of, agreed project inputs or increased expert or other costs due to inflation or taking into account agency expenditure flexibility.

I. WORK PLAN

A preliminary project schedule is provided to show the sequence and relationship of the various project activities. The project schedule shows Part II activities starting one year after the initiation of Part I activities. While the schedule for Part I essentially corresponds to the first year of activity, some activity and funds for Part I will carry-over into the second year of the project.

Demonstration for Fuel-Cell Bus Commercialization in China: Preliminary Work Plan and Project Schedule



J. BUDGET

GEF Financing for Part I (US$):

United Nations Development Programme
CPR/01/G31 - Fuel Cell Bus
Budget " A"

Main Source of Funds: 1G - Global Environment Trust Fund
Executing Agency: MOST - Ministry Of Science And Technology

Sbln	Description	Implementing	Funding		Total	2002	2003
010	PERSONNEL						
011	International Consultants						
011.01	Chief Technical Advisor	MOST		Net Amount	111,500	75,000	36,500
				Total	111,500	75,000	36,500
011.99	Line Total	----------		Net Amount	111,500	75,000	36,500
				Total	111,500	75,000	36,500
015	Monitoring and Evaluation						
015.01	Monitoring and Evaluation	MOST		Net Amount	15,000	15,000	
				Total	15,000	15,000	
015.99	Line Total	----------		Net Amount	15,000	15,000	
				Total	15,000	15,000	
017	National Consultants						
017.01	National Project Coordinator	MOST		Net Amount	52,000	34,000	18,000
				Total	52,000	34,000	18,000
017.02	National PEMFC Expert	MOST		Net Amount	27,000	19,000	8,000
				Total	27,000	19,000	8,000
017.03	National FCB Expert	MOST		Net Amount	27,000	19,000	8,000
				Total	27,000	19,000	8,000
017.04	National H2 Supply Expert	MOST		Net Amount	22,000	15,000	7,000
				Total	22,000	15,000	7,000
017.05	Monitoring & Evaluation	MOST		Net Amount	5,000	5,000	
				Total	5,000	5,000	
017.99	Line Total	----------		Net Amount	133,000	92,000	41,000
				Total	133,000	92,000	41,000
019	PROJECT PERSONNEL TOTAL	----------		Net Amount	259,500	182,000	77,500
				Total	259,500	182,000	77,500
020	CONTRACTS						
021	Contract A						
021.01	Subcontracts	MOST		Net Amount	5,378,000	4,378,000	1,000,000
				Total	5,378,000	4,378,000	1,000,000
021.99	Line Total	----------		Net Amount	5,378,000	4,378,000	1,000,000
				Total	5,378,000	4,378,000	1,000,000
029	SUBCONTRACTS TOTAL	----------		Net Amount	5,378,000	4,378,000	1,000,000
				Total	5,378,000	4,378,000	1,000,000
030	TRAINING						
032	Other Training						
032.01	Inception Workshop	MOST		Net Amount	10,000	10,000	
				Total	10,000	10,000	
032.99	Line Total	----------		Net Amount	10,000	10,000	
				Total	10,000	10,000	
039	TRAINING TOTAL	----------		Net Amount	10,000	10,000	
				Total	10,000	10,000	
040	EQUIPMENT						
045.01	Operations	MOST		Net Amount	166,000	137,000	29,000
				Total	166,000	137,000	29,000
045.99	Line Total	----------		Net Amount	166,000	137,000	29,000
				Total	166,000	137,000	29,000
049	EQUIPMENT TOTAL	----------		Net Amount	166,000	137,000	29,000
				Total	166,000	137,000	29,000
050	MISCELLANEOUS						
052	Reporting Costs						
052.01	Audit Costs	MOST		Net Amount	1,000		1,000
				Total	1,000		1,000
052.99	Line Total	----------		Net Amount	1,000		1,000
				Total	1,000		1,000
053	Sundries						
053.01	Sundries	MOST		Net Amount	500	500	
				Total	500	500	
053.99	Line Total	----------		Net Amount	500	500	
				Total	500	500	
059	MISCELLANEOUS TOTAL	----------		Net Amount	1,500	500	1,000
				Total	1,500	500	1,000
099	BUDGET TOTAL	----------		Net Amount	5,815,000	4,707,500	1,107,500

United Nations Development Programme
CPR/01/G31 - Fuel Cell Bus
Budget " A"
Main Source of Funds: 1G - Global Environment Trust Fund
Executing Agency: MOST - Ministry Of Science And Technology

Sbln	Donor	Funding		Total	2002	2003
999			Net Contrib.	5,815,000	4,707,500	1,107,500
			Total	5,815,000	4,707,500	1,107,500

UNDP Cost-sharing for Part I (US$):

United Nations Development Programme
CPR/01/334 - Fuel Cell Bus
Budget " A"
Main Source of Funds: 01 - UNDP-IPF / TRAC - (Trac 1.1.1 & 1
Executing Agency: CICETE - China International Centre For Ec

Sbln	Description	Implementing	Funding	Total	2002	2003
010	PERSONNEL					
011	International Consultants					
011.01	FCB Procurement Expert	CICETE	Net Amount	20,000	20,000	
			Total	20,000	20,000	
011.99	Line Total	----------	Net Amount	20,000	20,000	
			Total	20,000	20,000	
016	Mission Costs					
016.01	Mission costs	CICETE	Net Amount	3,000		3,000
			Total	3,000		3,000
016.99	Line Total	----------	Net Amount	3,000		3,000
			Total	3,000		3,000
017	National Consultants					
017.01	Shanghai Natl. Procurement Experts	CICETE	Net Amount	12,000	12,000	
			Total	12,000	12,000	
017.02	Beijing Natl. Procurement Experts	CICETE	Net Amount	12,000	12,000	
			Total	12,000	12,000	
017.99	Line Total	----------	Net Amount	24,000	24,000	
			Total	24,000	24,000	
019	PROJECT PERSONNEL TOTAL	----------	Net Amount	47,000	44,000	3,000
			Total	47,000	44,000	3,000
030	TRAINING					
032	Other Training					
032.01	Shanghai Public Transit Study Tours	CICETE	Net Amount	72,000	72,000	
			Total	72,000	72,000	
032.02	Beijing Public Transit Study Tours	CICETE	Net Amount	72,000	72,000	
			Total	72,000	72,000	
032.99	Line Total	----------	Net Amount	144,000	144,000	
			Total	144,000	144,000	
039	TRAINING TOTAL	----------	Net Amount	144,000	144,000	
			Total	144,000	144,000	
099	BUDGET TOTAL	----------	Net Amount	191,000	188,000	3,000
			Total	191,000	188,000	3,000

United Nations Development Programme
CPR/01/334 - Fuel Cell Bus
Budget " A"
Main Source of Funds: 01 - UNDP-IPF / TRAC - (Trac 1.1.1 & 1
Executing Agency: CICETE - China International Centre For Ec

Sbln	Donor	Funding		Total	2002	2003
999			Net Contrib.	191,000	188,000	3,000
			Total	191,000	188,000	3,000

Government In-Kind Co-Financing for Part I (US$):

Budget Lines	**Ministry of Science and Technology (MOST)**	**Government of Shangai**	**Government of Beijing**	**Total**
Fuel cell bus system subcontracts	806,000	250,000	250,000	1,306,000
Fueling station		771,000	720,000	1,491,000
FCB Vendor study tours		46,000	46,000	92,000
Fuel cell bus O&M		909,000	832,000	1,741,000
Data collection system design		45,000	45,000	90,000
Ridership survey		11,000	11,000	22,000
Monitoring systems	1,200,000			1,200,000
National consultants & NPD staff	30,000			30,000
PMO Offices and Reports	100,000	53,000	53,000	206,000
Newsletter	10,000	11,000	11,000	32,000
Office equipment	50,000			50,000
Vehicles	70,000			70,000
Communications	10,000			10,000
Contingency	408,000			408,000
Total	2,684,000	2,096,000	1,968,000	6,748,000

Annex 1: TORs for International Consultants

Part I – International Consultants

The following draft TOR will be expanded for solicitation of candidates by UNDP and CICETE prior to project implementation.

Post Title:	**Chief Technical Advisor (Part-time throughout Part I, with heavier time effort in first several months) (CMBL 11.01)**
Duration:	9 w/m
	The International Technical Advisor is a key member of the project management team, and will support the National Project Director, the National Project Coordinator, and the Project Managers in Beijing and Shanghai.
Qualifications:	Bachelors or Masters degree
	At least five years diverse experience developing fuel cell vehicles and implementing programs and projects to demonstrate fuel cells vehicles, including programs in developed and developing countries.
	Extensive knowledge of programs, contacts and resources around the world that may be useful as China implements its FCB Demonstration Project.
	Must be willing/able to travel regularly to China.
	Familiarity with GEF projects is desired, but not required.
Language:	English (in addition, Chinese is desirable but not required)
Duties:	Advise the National Project Director in all aspects of program implementation.
	Assist in the identification and recruitment of international experts to work on the project.
	Research relevant international experiences, which provide useful information to help guide project activities; especially in the equipment procurement and O&M training aspects of the project.
	Under the direction of the National Project Director, provide technical support to the National Project Coordinator and the two Project Managers.
Expected Deliverables /Outputs:	With input from others in the NPD, develop lists of candidates for all other international experts, finalize all terms of reference and other materials needed to bring experts into the project, and coordinate and oversee the work of these experts;
	Participate in Inception Workshop and prepare draft Inception Report in cooperation with NPC.
	Provide input, and participate in all international study tours.
	Support development of the FCB and fueling system performance specifications and bid tenders.
	Support drafting various project planning and reporting materials, including periodic reporting to UNDP and the GEF, and other reports as required
	Support development of reporting guidelines.
	Support development of the training program and implementation of the training seminars.
	Support organization of the various workshops and seminars for technical exchange, policy coordination and information dissemination.

	Provide ongoing project technical and management assistance as requested.
Post Title:	**FCB Procurement Expert (CMBL 11.01 UNDP Cost-Sharing)**
Duration:	1.5 w/m
Qualifications:	Bachelors or Masters degree 1. At least five years experience in procurement of advanced technologies. 2. At least two years experience with fuel cell or other clean vehicle technologies. 3. Familiarity with UNDP procurement practices is desired, but not required.
Language:	English (in addition, Chinese is desirable but not required)
Duties:	Under the direction of the NPD, work in coordination with the National Procurement Experts and the National Technical Experts to support preparation of the FCB System procurement documents. Provide advice on all aspects of the procurement including the overall approach, document outline, organization of the specifications, bidder qualification criteria, bid evaluation criteria, evaluation process, etc. Support the bid evaluation as requested.
Expected Deliverables /Outputs:	Advise regarding the procurement approach. Review and comment on all procurement documents. Advise during the bid evaluations

Part II – International Consultants

The following draft TORs are provided for the benefit of the NPD. These experts will be hired directly by MOST, and these TORs will be expanded for solicitation of candidates, subject to adjustment during project implementation. Expected deliverables/outputs are provided, though TORs will be finalized by the NPD following input from the CTA and NPC.

Post Title:	**Chief Technical Advisor (Part-time throughout the Part II, with heavier time effort in first 24 months) (Continued from Part I)**
Duration:	10 w/m The International Technical Advisor is a key member of the project management team, and will support the National Project Director, the National Project Coordinator, and the Project Managers in Beijing and Shanghai.
Qualifications:	Same as Part I.

Post Title:	**International FCB Training Experts (2)**
Duration:	3 w/m each The International FCB Training Experts will support the NPD and work in cooperation with National Technical Coordinator and the Project Managers in each city.
Qualifications:	Bachelors or Masters degree

	At least five years experience developing operating and maintaining hydrogen-based fuel cell vehicles.
	Experience developing and running training programs developing countries.
	Extensive knowledge of programs, contacts and resources around the world that may be useful as China implements its FCB Demonstration Project.
Language:	English (in addition, Chinese is desirable but not required)
Duties:	Under the direction of the NPD, work with the FCB suppliers, the hydrogen refueling system suppliers and the project staff to develop a consistent training methodology for the project.
	Identify and recommend additional FCB operational experts to augment the experts from the FCB and hydrogen refueling system suppliers.
	Support the NPC to hold training seminars in each city.
	Based on the training program, support the NPC in developing an examination and certification program for FCB operators, repairmen and technicians.
	Provide ongoing training advice and assistance as requested.
Expected Deliverables /Outputs:	A comprehensive training program for FCB operators, repairmen, technicians and managers.
	Recommendations for an examination and certification program

Post Title:	**International FCB Operations Experts (8)**
Duration:	1 w/m each
Qualifications:	Bachelors or Masters degree
	At least three years diverse experience developing or operating fuel cell vehicles.
	In depth knowledge of specific technical aspects of FCB and hydrogen refueling system control, operation, maintenance and repair.
Language:	English
Duties:	Under the direction of the International FCB Training Expert, develop and provide specific training courses for the FCB training program.
	Provide training sessions within the training seminars in each city as required.
	Provide ongoing project management assistance as requested.
Expected Deliverables /Outputs:	Training sessions on specific technical topics along with course material and training references.

Post Title:	**International FCB Design Experts (2)**
Duration:	6 w/m each
Qualifications:	Bachelors or Masters degree
	At least five years experience designing and developing hydrogen-based fuel cell vehicles.

	Experience with bus system design issues.
	Knowledge of other FCB design activities around the world.
Language:	English (in addition, Chinese is desirable but not required)
Duties:	Under the direction of the NPD and NPC, support a national team of developing the conceptual design for a Chinese manufactured FCB.
	Provide design options and impacts for specific technical issues relating to FCB system design.
	Facilitate communications and exchange of information regarding other FCB design efforts around the world.
	Provide follow-up design assistance as requested.
Expected Deliverables /Outputs:	Specific design elements within the total FCB system design concept.

Annex 2: TORs for National Consultants

Part I - National Consultants

The following draft TORs are provided for the benefit of the NPD. These experts will be hired directly by MOST, and the NPC should be hired prior to the Inception Workshop. The TORs will be expanded for solicitation of candidates, subject to adjustment during project implementation. Expected deliverables/outputs are provided, though each will be finalized by the NPD following input from the NPC.

Post Title:	**National Project Coordinator (Full-time throughout Part I)) (CMBL 17.01)**
Duration:	18 w/m
	The NPC is a key member of the project management team, and will support the National Project Director and the Project Managers in Beijing and Shanghai to coordinate project activities between the two cities.
Qualifications:	Bachelors or Masters degree
	At least ten years experience planning, implementing and managing technology demonstration projects.
	At least five years experience regarding fuel cells and fuel cell vehicles.
	Extensive knowledge of programs, contacts and resources in China that may be useful to this FCB Demonstration Project.
	Familiarity with Chinese government organizations and procedures
	Thorough understanding of the issues and problems of public transportation systems.
	Good contacts with experts and businesses in the Chinese vehicle manufacturing industry.
Language:	Chinese and excellent English – both verbal and writing are essential
Duties:	Advise and assist the NPD in all aspects of program implementation.
	Assist in the identification and recruitment of national experts to work on the project.
	Under the direction of the NPD, work closely together with the Chief Technical Advisor and the project managers in Beijing and Shanghai to ensure the China FCB project objectives are met.
	Supervise the work of national technical experts, and facilitate communications, cooperation and exchange of information between the activities in Beijing and Shanghai, producing consolidated reports.
	Research relevant national experiences, which provide useful information to help guide the project activities.
	Work with domestic and international agencies and institutions to facilitate communications and dissemination of information.
Expected Deliverables /Outputs:	Participate in Inception Workshop and prepare draft Inception Report in cooperation with the CTA and the NPD.
	With input from the NPD and the two Project Managers, develop lists of candidates for all national experts, finalize all terms of reference and other materials needed to bring experts into the project, and coordinate and oversee the work of these experts.
	Provide input, and participate in drafting various project planning and reporting

materials, including periodic reporting to UNDP and the GEF, and other reports as required

With input from others in the NPD and the CTA, develop lists of potential subcontracting firms for competitive tender, and coordinate the development of tender documents.

Provide input to and support coordination of all international study tours.

Support development of the FCB and fueling system performance specifications and bid tenders.

Support development of reporting guidelines.

Support drafting various project planning and reporting materials, including the Newsletter, periodic reporting to UNDP and the GEF, and other reports as required.

Support development of the training program and implementation of the training seminars.

Coordinate development and submittal of the Certification program.

Support the organization and coordination of the various workshops and seminars for technical exchange, policy coordination and information dissemination.

Coordinate the activities to publicize the project results

Provide ongoing project technical and management assistance as requested.

Coordinate the preparation of, and submit as required, all written reports and presentations required by the NPD, the National Project Manager, UNDP, the GEF and others as needed during project implementation.

Provide ongoing project management assistance as requested.

Post Title: **National PEM Fuel Cell Expert (CMBL 17.02)**

Duration: 7 w/m

Qualifications: Masters or Doctoral degree

At least five years extensive experience in the research, development and application of proton exchange membrane (PEM) fuel cells.

Extensive knowledge of programs, contacts and organizations inside and outside China actively developing PEM fuel cells and fuel cell vehicles.

Thorough understanding of the issues and problems of FCB transportation systems.

Good contacts with experts and businesses in the Chinese engine manufacturing industry.

Language: Chinese and English (both verbal and reading) is essential

Duties: Provide expert advice to the NPD and the NPC on PEM fuel cell technology.

Under the direction of the NPC, work closely together with the International Technical Advisor and the project managers in Beijing and Shanghai to ensure the China FCB project objectives are met.

Provide input to the development of the FCB system specifications, the data-reporting format and content, and the China FCB conceptual design and commercialization strategy.

Provide input to and participate in the training seminars and provide input to the

	development of the certification program for operator and repairmen.
	Attend the international and national study tours of fuel cell engine suppliers.
	At the request of the NPD, attend project-related national and international meetings.
Expected Deliverables /Outputs:	Expert advice on PEM fuel cell technology.
	Participation in drafting various project documents, including FCB system specifications, the data reporting specification, the project newsletter, and the China FCB conceptual design and commercialization strategy report.
	Document study tour findings regarding national and international fuel cell engine suppliers.

Post Title:	**National FCB Expert (CMBL 17.03)**
Duration:	7 w/m
Qualifications:	Masters or Doctoral degree
	At least five years extensive experience in the research, development and application of fuel cell buses or other fuel cell vehicles.
	Extensive knowledge of programs, contacts and organizations inside and outside China actively developing fuel cell buses and fuel cell vehicles.
	Thorough understanding of the issues and problems of FCB transportation systems.
	Good contacts with experts and businesses in the Chinese vehicle manufacturing industry.
Language:	Chinese and English (both verbal and reading) is essential
Duties:	Provide expert advice to the NPD and the NPC on FCB technology.
	Under the direction of the NPC, work closely together with the International Technical Advisor, the other national experts and the project managers in Beijing and Shanghai to ensure the China FCB project objectives are met.
	Provide input to the development of the FCB system specifications, the data-reporting format and content, and the China FCB conceptual design and commercialization strategy.
	Provide input to and participate in the training seminars and provide input to the development of the certification program for operator and repairmen.
	Provide input to the policy and planning study for improvements in the public bus system.
	Attend the international and national study tours of fuel cell engine suppliers and fuel cell bus suppliers.
	At the request of the NPD, attend project-related national and international meetings.
Expected Deliverables /Outputs:	Expert advice on FCB technology.
	Participation in drafting various project documents, including FCB system specifications, the data reporting specification, the project newsletter, and the China FCB conceptual design and commercialization strategy report.
	Document study tour findings regarding national and international FCB suppliers.

Post Title:	**National H2 Supply Expert (CMBL 17.04)**
Duration:	6 w/m
Qualifications:	Bachelor or Masters degree
	At least five years extensive experience in the research, development and application of small-scale hydrogen supply systems.
	Extensive knowledge of programs, contacts and organizations inside and outside China actively developing fuel cell vehicles.
	Thorough understanding of the issues and problems of hydrogen fueling systems.
	Good contacts with experts and businesses in the Chinese chemical industry.
Language:	Chinese and English (both verbal and reading) is essential
Duties:	Provide expert advice to the NPD and the NPC on H2 supply technology.
	Under the direction of the NPC, work closely together with the International Technical Advisor, the other national experts and the project managers in Beijing and Shanghai to ensure the China FCB project objectives are met.
	Provide input to the development of the H2 reformer and fueling system specifications, the data-reporting format and content, and the China FCB commercialization strategy.
	Provide input to and participate in the training seminars and provide input to the development of the certification program for operator and repairmen.
	Attend the international and national study tours of H2 fueling system suppliers.
	At the request of the NPD, attend project-related national and international meetings.
Expected Deliverables /Outputs:	Expert advice on FCB technology.
	Participation in drafting various project documents, including H2 reformer and fueling system specifications, the data reporting specification, the project newsletter, and the China FCB conceptual design and commercialization strategy report.
	Document study tour findings regarding national and international suppliers of H2 reformer and fueling systems.

Post Title:	**National Procurement Experts (2) (CMBL 17.01 and 17.02 UNDP Cost-Sharing)**
Duration:	4 w/m each
Qualifications:	Bachelors or Masters degree
	1. At least five years experience in procurement of advanced technologies.
	2. At least two years experience with transportation technologies.
	3. Familiarity with UNDP procurement practices is desired, but not required.
Language:	Chinese (in addition, English is desirable but not required)
Duties:	Under the direction of the Project Manager, work in coordination with the International Procurement Expert and the National Technical Experts to prepare the FCB System procurement documents., including:
	?? System performance requirements and specifications, including information gathered by the study tours to vendors and using inputs from the technical experts
	?? Requirements for installation, spare parts and start-up technical support

	?? Requirements for training of operators, repairmen, technicians and managers ?? Warranty and on-going technical support requirements ?? Commercial terms and conditions ?? Bid instructions, evaluation criteria and other information needed to ensure a successful procurement. Coordinate all aspects of the procurement process including the overall approach, document development, organization of the specifications (as prepared by the technical experts), bidder qualification criteria, bid evaluation criteria, evaluation process, etc. Provide continuing support during the bid evaluation and contract negotiations
Expected Deliverables /Outputs:	Complete procurement packages – one each for Beijing and Shanghai. - containing all necessary system specifications, technical support and training requirements, warranty requirements, bid instructions, commercial terms and conditions, evaluation criteria, and other information needed to ensure a successful procurement. Support to the procurement of the FCB Systems

Part II – National Consultants

The following draft TORs are provided for the benefit of the Project Managers in Shanghai and Beijing. These experts will be hired directly by each PMO. The TORs will be expanded for solicitation of candidates, subject to adjustment during project implementation. Expected deliverables/outputs are provided, though each will be finalized by the Project Managers following input from the NPC.

Post Title:	**National Project Coordinator (Part-time throughout Part II - Continued from Part I)**
Duration:	31 w/m
	The NPC is a key member of the project management team, and will support the National Project Director and the Project Managers in Beijing and Shanghai to coordinate project activities between the two cities.
Qualifications, Duties, etc.:	Same as for Part I.

Post Title:	**National PEM Fuel Cell Expert (Continued from Part I)**
Duration:	3 w/m
Qualifications, Duties, etc.:	Same as for Part I.

Post Title:	**National FCB Expert (Continued from Part I)**
Duration:	3 w/m
Qualifications, Duties, etc.:	Same as for Part I.

Post Title:	**National H2 Supply Expert (Continued from Part I)**
Duration:	2 w/m
Qualifications, Duties, etc.:	Same as for Part I.

Post Title:	**FCB Training Experts (multiple)**
Duration:	12 w/m
Qualifications:	Bachelors or Masters degree
	At least five years experience developing operating and maintaining hydrogen-based fuel cell vehicles or hydrogen reformer and fueling systems.
	Experience contributing to training programs.
	Extensive knowledge of programs, contacts and resources in China that may be useful to the project.
Language:	Chinese (knowledge of English is very useful but not essential)
Duties:	Under the direction of the NPC and the PMOs, work with the FCB suppliers and the hydrogen refueling system suppliers to contribute expertise to the training program for the project.
	Support the PMOs and the NPC to hold training seminars in each city.
	Provide ongoing training advice and assistance as requested.
Expected Deliverables /Outputs:	Specific contributions to a comprehensive training program for FCB operators, repairmen, technicians and managers.
	Recommendations for an examination and certification program

Annex 3: Descriptions of Subcontracts

The following subcontracts will be executed by CICETE under the direction of UNDP and the NPD. These are draft descriptions that will be expanded into full TORs for competitive tender, and are subject to adjustment during project implementation. Final details of the subcontracts will be developed by the NPD and reviewed by CICETE and UNDP.

Subcontract A: FCB System Supply (CMBL 021.01)

This subcontract to MOST will provide the GEF portion of the funding for procurement of the FCB Systems. Through MOST, the services of a contractor will be sought to design and supply a complete fuel cell bus system to either or both the cities of Beijing and Shanghai. The system will be installed in two Parts. In Part I, the H2 Reformer and Fuel Station will be installed, and three fuel cell buses will be delivered to each city. In Part II, a second set of three buses will be delivered. The timeframe for Part I is expected to be January 1, 2002 through December 31, 2006, and the timeframe for Part II is expected to be January 1, 2003 through December 31, 2006.

This subcontract is expected to have two principle components that will require the system supplier to coordinate the services of several design firms and equipment suppliers. The system supplier will be responsible for coordinating those efforts to ensure that the system meets all system specifications.

H2 Reformer & Fuel Station

The system supplier will provide a H2 Reformer & Fuel Station that will consist of the following systems and services:

A methane reformer system to produce hydrogen with the proper specifications for use in the FCB delivered under the subcontract.

Hydrogen storage system with sufficient capacity for reliable fueling of all six buses.

A hydrogen fueling station for refilling the FCB safely and reliably.

A monitoring and control system that enables easy and reliable operation of the entire H2 fueling station.

Operator training and support during initial operating period.

Warranty services as necessitated by the operation and performance of the fueling station.

On-going technical support.

The budget for the H2 Reformer & Fuel Station is:

H2 Reform & Fuel Station Budget (US$1000)			
Subcontract Components	Beijing	Shanghai	Total
Methane reformers	561	510	1,071
H2 storage	150	150	300
Refill station	60	60	120
Monitoring system	600	600	1,200
Subtotal	1,371	1,320	2,691

Bus Procurement

The system supplier will provide three fuel cell buses along with the following support services:

A complete set of special tools, diagnostic equipment and spare parts as necessary for reliable operation and maintenance of the buses over the project period.

Effective training for drivers, repairmen, technicians and managers in the operation, maintenance and management of the complete FCB system. This training will be provided in cooperation with the International Training Expert and the NPC.

Warranty services as necessitated by the operation and performance of the buses.

On-going technical support that ensures easy and reliable operation of the entire FCB fleet.

The budget for the Fuel Cell Buses is:

Bus Procurement Budget (US$1000)			
Subcontract Components	Beijing	Shanghai	Total
Buy buses-Part 1	3,600	3,600	7,200
Buy spare parts-Part 1	300	300	600
Import duties-Part 1	975	975	1,950
Buy buses-Part 2	3,000	3,000	6,000
Buy spare parts-Part 2	300	300	600
Import duties-Part 2	825	825	1,650
Subtotal	9,000	9,000	18,000

Key Deliverables

A complete operating FCB system for each city consisting of the H2 Reformer and Fuel Station, three fuel cell buses will be delivered during Part I. In Part II, a second set of three buses with training and technical support services will be delivered to each city

A comprehensive training program along with complete operating and maintenance manuals.

All required special tools, diagnostic equipment and spare parts needed for reliable operation and maintenance of the system.

Subcontracts B: Public Transit Policy & Planning Study

During Part II of the project, a contract will be placed with the public policy experts that took part in the Beijing and Shanghai public transit planning study tours to prepare a policy and planning study that evaluates and recommends options for improving/optimizing bus-company management, technologies, infrastructure, and operations in Beijing and in Shanghai. The study will also evaluate policies, programs and incentives for stimulating the commercialization of FCBs in China.

Key Deliverables

A report discussing the current status of policies and regulations governing public transportation in China, and recommending policy and planning options for improving/optimizing bus-company management, technologies, infrastructure, and operations in Beijing and in Shanghai. The report will include the experiences of public transportation systems around the world, and will factor in conditions and factors that are particular to China.

Each study tour team will also provide input to the newsletter. At the request of the NPD, the study tour members will attend project-related national and international meetings.

Annex 4: Work Scopes for Major Project Activities

Draft work scopes are provided for the following project activities, some of which are to be executed by the PMOs and others of which are to be executed by MOST.

The following set of activities will be executed by the PMOs, under the direction of the NPD and in cooperation with the NPC. These are draft descriptions will be subject to adjustment during project implementation.

Activity 1.3.2: Data Collection System Supply (Part I)

Both the Beijing and Shanghai PMOs will seek the services of a contractor to design and install a data collection system for use by their portion of the project. Under the direction of the NPD, the NPC will work with the Chief Technical Advisor and the National Technical Experts to develop specifications for the format and content of the operating data to be delivered to the NPD by the PMO in each city. The NPC will work in cooperation with the Data System Design contractors in each city to ensure timely design of the data collection systems. The timeframe for this subcontract is expected to be January 1, 2002 through December 31, 2003.

The contractors will be responsible for design and installation of a data collection system design that meets the data reporting specification. The data collection system for each city will facilitate systematic logging, analysis and interpretation of operating, maintenance and reliability data that will help lead to potential improvements in design and operation of the next generation of buses. Under this activity, four computers (each city will have two) will be purchased along with ancillary data logging equipment.

Data Collection System Supply Budget (US$1000)			
Components	Beijing	Shanghai	Total
Design system	20	20	40
Purchase equipment	7	7	14
Subtotal	27	27	54

Key Deliverables

A complete data collection system that can be used in each city.

FCB System Operation and Maintenance

The Beijing Public Transportation General Company and the Shanghai Public Transportation General Company will be responsible for operation and maintenance of the complete fuel cell bus in their city. The operating services will be delivered in two Parts. Part I will cover the operation and maintenance of the H2 Reformer and Fuel Station and three fuel cell buses in each city over their four year operating period. Part II will cover the operation and maintenance of the second set of three buses. The timeframe for Part I is expected to be January 1, 2002 through December 31, 2006, and the timeframe for Part II is expected to be January 1, 2003 through December 31, 2006.

Three activities are associated with the FCB system operation. They will require each public transportation company to coordinate the services of several its departments and possible subcontractors. Each public transportation company will be responsible for coordinating those efforts to ensure that the system is operated and maintained reliably and safely.

Activity 1.2.6: Hydrogen Fuel Station Operation (Part II)

Each public transportation company will operate and maintain the H2 Reformer & Fuel Station in accordance with the O&M instructions and procedures provided by the system supplier including:

Providing a full staff of trained operators.

Performing regular maintenance procedures

Ensuring proper safety training and procedures are in followed.

Providing management and supervision of system operations.

The budget for the operation and maintenance of the H2 Fuel Station is shown below. Additional detail is provided in the Project Brief.

Fuel Station Operation Budget (US$1000)			
Components	Beijing	Shanghai	Total
Maintenance	154	154	308
Operating wages	1,074	880	1,954
Subtotal	1,228	1,034	2,262

Activities 1.2.5 (Part I) and 1.2.9 (Part II) Bus Operation

Each public transportation company will operate and maintain the fleet of fuel cell buses in accordance with the O&M instructions and procedures provided by the system supplier including:

Providing a full staff of trained drivers, repairmen and technicians.

Providing all materials such as, natural gas, electricity, water and other consumables.

Performing regular maintenance procedures.

Ensuring proper safety training and procedures are in followed.

Providing management and supervision of bus operations.

The budget for Operation of the Fuel Cell Buses is shown below. Additional details are provided in the Project Brief.

Bus Operation Budget (US$1000)			
Components	Beijing	Shanghai	Total
Materials-Part 1	437	368	805
O&M wages-Part 1	472	464	936
Materials-Part 2	327	276	603
O&M wages-Part 2	354	348	702
Training seminars-Part 2	45	45	90
Subtotal	1,634	1,502	3,136

Activity 1.3.6: FCB System Data Collection (Part II)

Each public transportation company will design, purchase and input data to a data collection system that will collect data on the operation, performance, maintenance, repairs and other data on the FCB System in each city. Specifications for the format and content of the data to be delivered by each city to the NPD will be developed by the NPC, under the direction of the NPD and in cooperation with the National Data Experts and the Project Managers.

Each public transportation company will be responsible for coordinating all data collection efforts to ensure that the system is routinely operated and reliably data collected and reported.

The budget for the Data Collection is shown below.

Data Collection Budget (US$1000)			
Components	Beijing	Shanghai	Total
Manage Data system	33	33	66
Collect FCB data	100	100	200
Subtotal	133	133	266

Key Deliverables

A fully functional fleet of FCBs in each city operated safely and reliably with regular maintenance, data collection and reporting.

Activity 1.3.3: Ridership Surveys (Part I and Part II)

Each PMO will seek the services of a contractor to collect and analyze survey data from the general public, focus groups and bus riders. The goal of the work will be to determine public awareness and attitudes towards FCB technology.

The contractor should be knowledgable about the local public transportation system and understand the issues and problems of public transportation systems. At least five years extensive experience conducting and analyzing public awareness surveys is necessary.

Under the direction of each PMO, and in cooperation with the NPC, the contractor will design and conduct a survey of public awareness and attitudes towards FCB technology. The survey should cover the following groups: the general public, specific focus groups, and bus ridership. Data under the survey should be collected prior to, during and following operation of the FCB fleets. The survey should seek to identify potential improvements to FCB technology that will be needed for acceptance in China.

At the request of the NPD, the contractor will provide input to the newsletter and attend project-related national and international meetings.

The budget for this subcontract is shown below.

Ridership Survey Budget (US$1000)			
	Beijing	Shanghai	Total
Collect & analyze ridership data	106	106	212

Key Deliverables

A report that summarizes the data collected and analyzing public awareness and attitude towards the China FCB Demonstration Project and FCB technology in general.

Activity 1.3.7: Analysis of Life-Cycle Data (Part II)

The services of a contractor will be sought to analyze the project data collected by each city. The contractor will work under the direction of the NPC, acting on behalf of the NPD. The Chief Technical Advisor and the National Technical Experts will review the analysis results. The timeframe for this subcontract is expected to be January 1, 2002 through December 31, 2006.

The contractor will be responsible for analysis and interpretation of all operational and management data paying particular attention to operating costs, system reliability, failure modes and potential improvements in design and operation of the FCBs. Detailed lifecycle analysis of the costs, emissions and resource-use efficiency of the FCBs will be performed on the basis of the collected data. Particular attention will be paid to the projections for FCB operating costs and lifetimes. In addition, comparisons will be made to similar lifecycle analyses for other bus technologies.

The budget for this subcontract is shown below.

Life-Cycle Data Analysis Budget (US$1000)			
	Beijing	Shanghai	Total
Analyze life-cycle data	106	106	212

Key Deliverables

A complete analysis of the life-cycle data with the conclusions regarding the success of the China FCB Demonstration Project in each city and recommendations for improvements in future systems.

Activity 1.3.5: Publish a Project News Letter (Part I and Part II)

The services of a contractor will be sought to publish and transmit a project newsletter every quarter. The contractor will work under the direction of the NPC, acting on behalf of the NPD and each PMO. The contractor will collect relevant information from the PMOs and the various

project Technical Experts as input to the newsletter. The timeframe for this subcontract is expected to be January 1, 2002 through December 31, 2006.

The contractor will be responsible for editing, formatting, printing and transmitting four quarterly newsletters during every year of the project.

The budget for this subcontract is shown below.

Newsletter Budget (US$1000)			
	Beijing	Shanghai	Total
Prepare & disseminate newsletter	55	55	110

Key Deliverables

A professional newsletter providing relevant information on the China FCB Demonstration Project.

The following set of activities will be executed by the NPD under the direction of the NPC and with the support of the PMOs. These are draft descriptions will be subject to adjustment during project implementation.

Activity 2.4.2: Funding Competition (Part II)

Under the direction of the NPD, and in cooperation with the NPC, each PMO will organize an annual competition for funding of Chinese organizations aimed at accelerating the commercialization of FCBs in China. The services of a contractor will be sought to encourage the wider development of varied expertise (science, engineering, manufacturing, management, etc.) in China relating to commercialization of fuel cell vehicles. Contractors to be supported could include universities, technical institutes and private companies, and the activities could include feasibility studies of setting up manufacturing facilities, development of business plans for joint ventures with foreign companies, and other such efforts. A selection committee and selection process will be established for decision-making regarding funding. The timeframe for the funding competition is Part II (January 1, 2003 through December 31, 2006).

Each contractor will be responsible for conducting the proposed research and preparing a final report to document the activity.

An approximate breakdown of the budget for this activity is shown below.

Funding Competition Budget (US$1000)			
	Beijing	Shanghai	Total
University research	100	100	200
Technical Institutes	100	100	200
Manufacturing feasibility studies	40	40	80
Business plan development	10	10	20
Subtotal	250	250	500

Key Deliverables

Research Reports providing relevant information on the proposed research activity.

Activity 3.2.2: Feasibility Studies (Part II)

The services of contractors will be sought to prepare Phase III Feasibility Studies for three candidate cities in China relating to commercialization of fuel cell vehicles. The contractors will work under the direction of the NPC, acting on behalf of the NPD. The contractor will collect relevant information from the PMOs and the various Technical Experts during the preparation of the Feasibility Study. The timeframe for this subcontract is expected to be January 1, 2004 through December 31, 2006.

The contractor will be responsible for conducting the proposed research and preparing a final report to document the activity.

The budget for each subcontract is US$ 100,000.

Key Deliverables

China FCB Phase III Feasibility Study Report.

Activity 3.2.3: FCB Conceptual Design (Part II)

The services of a contractor will be sought to develop a conceptual design for a hydrogen-powered FCB that might ultimately be manufactured commercially in China. The contractor will work under the direction of the NPC, and in cooperation with the international FCB design experts to be provided by the NPD. The contractor will collect relevant information from the PMOs and the various Technical Experts during the preparation of the Conceptual Design. The contractor will be expected to assemble an expert group, made up of hydrogen-powered fuel-cell system experts, electrical engineering experts, auto-control experts, automobile experts and economic analysis expert. The timeframe for this subcontract is expected to be January 1, 2004 through December 31, 2006.

The contractor will be responsible for developing a detailed engineering design and cost estimate of an FCB for large-scale manufacture (in China) for use in Chinese cities. The economic feasibility of Chinese mass production of the bus in the relatively near-term will be investigated, and the contractor will formulate Chinese standards for hydrogen fuel cell buses and prepare an initial set of operating and maintenance guidelines.

The budget for this subcontract is US$ 480,000.

Key Deliverables

Report on the Conceptual Design and Economic Feasibility of a Fuel Cell Bus that could be mass-produced in China.

Activity 3.2.4: Hydrogen Fuel Supply Assessment (Part II)

The services of a contractor will be sought to assess hydrogen fuel supply options for large-scale utilization of hydrogen FCBs in China. The contractor will work under the direction of the

NPC, acting on behalf of the NPD. The contractor will collect relevant information from the PMOs and the various Technical Experts during the preparation of the Fuel Supply Assessment. The timeframe for this subcontract is expected to be January 1, 2004 through December 31, 2006.

The contractor will be responsible for collecting design and cost data on techniques for hydrogen generation and for developing standards for hydrogen quality and security. The contractor will assess the applicability of these techniques to China including their ability to meet acceptable environmental and sustainable development criteria. The contractor will recommend a particular technique, and after acceptance by the NPD, the contractor will develop a design, cost estimate and economic analysis of the proposed system.

The budget for this subcontract is US$ 160,000.

Key Deliverables

Report on the Options for Hydrogen Supply to FCB Systems in China.

Annex 5: Descriptions of Training Activities

These are draft descriptions that will be subject to adjustments during project implementation. The National technical seminars will be funded by UNDP/GEF.

Part I Training Activities

Inception Wokshop

An Inception Workshop for both the Beijing and Shanghai project teams will be held in Beijing to finalize project administrative, institutional and management arrangements. The Inception Workshop will be organized by the NPD with support from the NPC and the CTA. A detailed Inception Report, including work plan to guide project implementation will be prepared by the CTA and the NPC with inputs from each project team. The Inception Report will be prepared within six weeks following the Inception Workshop.

Public Transit Planning Study Tour

During Part I of the project, public transit policy and planning experts from Beijing and Shanghai will be contracted to conduct study tours of selected public transport planners, policy makers, and service providers worldwide. The goal of the tours will be to gather in depth knowledge of other local public transportation system and to understand how these systems are addressing the issues and problems of public transportation.

In cooperation with the NPC, each team will organize and carry-out its study tour such that maximum coverage is obtained of the important public transport planners, policy makers, and service providers worldwide, especially those involved in FCB projects. Emphasis will be placed on better understanding policy and planning approaches that could be applied to improve public bus systems in China.

Key Deliverables

Each team will prepare a summary report documenting the contacts, events and information gathered during its respective study tour. Each study tour team will also provide input to the newsletter. At the request of the NPD, the study tour members will attend project-related national and international meetings.

Part II Training Activities

National Technical Seminars

Under Activity 2.4.1, national technical workshops will be organized to facilitate exchange of technical information relating to fuel-cell vehicles among relevant organizations in China. The meetings will be held once every 2 years and will last 2 days each. The scale of the meetings is expected to be 30 participants. The contents will mainly include presentations on the present condition of the FCB project, including problems existing, system performance, ridership acceptance, and an analysis of the project benefits.

The remaining training activity will be funded by MOST and the city transportation companies.

International FCB Experiences Seminar

Under Activity 1.3.8, a three-day international seminar will be organized and held to exchange information and experiences with other GEF fuel cell projects and cities with non-GEF fuel cell bus projects. Representatives from countries of GEF FCB Project, such as Brazil, Mexico, Egypt, India, etc. will be invited. In addition, relevant representatives from USA, Canada, German, etc. will also be invited to participate. The scale of the meeting is expected to be about 40 persons, including 20 foreign representatives.

Training Seminars

Under Activity 2.1.2, the project will work together with the FCB and refueling system suppliers to develop and hold on-the-job training seminars for drivers, repairmen, technicians and managers of the FCB fleet. Because the total population of operational personnel in Beijing and in Shanghai is quite large, only a selected portion of the staff will be trained to operate and maintain the FCB fleet. The following numbers of personnel are expected to be trained:

	Beijing	Shanghai
	Number of person	Number of person
Drivers	24	24
Repairmen	8	8
Technicians	6	6
Managers	4	4
Total	42	42

An International FCB training Expert will be contracted to coordinate the development of a comprehensive training program, and both national and international experts in the field will be engaged in teaching. Among these will be experts dealing with hydrogen system techniques, fuel-cell system techniques, electrical system techniques, and system running and control. The training seminars will be held sequentially in Beijing and Shanghai in concert with the progress on FCB delivery from the suppliers.

Annex 6: Incremental Cost Analysis

Broad Development Goal

The broad development goal being pursued by the Government of China is the provision of public transport services to its urban inhabitants. It is also interested in doing this in a more environmentally sustainable way.

Baseline

Under the baseline situation, the municipal transport authorities in Beijing and Shanghai will continue to provide bus transport to its population as needed. In the case of Beijing, the Beijing General Company of Public Transport has estimated that 8853 buses fueled by internal combustion engines operated in Beijing in 1999. Of these buses, approximately 6875 were estimated to be large-scale, heavy-duty buses and 4310 were estimated to operate on diesel. Roughly 500 trolley buses were operated in Beijing (see Table 1 in the body of the brief) and the number of buses in Beijing was estimated to have grown at 6.5% per year during the 1990's. In Shanghai, the situation is even more pronounced. In 1999, approximately 17,000 buses were estimated to be under operation, 15,300 of these were considered medium to heavy duty. Of these buses, more than 10,000 are estimated to operate on diesel. Again, only about 500 trolley buses are in operation in Shanghai.

The urban transport sector in these two cities has a major influence on the environmental quality found in the cities. A WHO study undertaken in 1992 found Beijing to be the second most polluted mega-city in world at that time. Shanghai ranked 19th under the same study. Urban transport plays a large role in determining this poor ambient air quality. In Beijing during heating season, traffic-related emissions account for 76% of CO, 94% of HC, and 68% of NOx. During the non-heating seasons, these figures jump to 92%, 98% and 85%, respectively.

Strictly speaking, in the baseline of this project, the test vehicles are estimated to operate for 1.6 m vehicle-kilometers. During this operation, they would be anticipated to emit approximately 320 tonnes of C or 1173 tonnes of CO_2 during the project's lifetime.

Global environmental objectives

The global environmental objective is the reduction of greenhouse gas (GHG) emissions from the urban transport sector in China. Over the immediate term of the project, this will involve the demonstration and testing of fuel cell buses fueled by hydrogen drawn from natural gas. Over the longer term, assuming that this project and its successors perform as designed, this project will lead to an increased production in fuel cell propelled buses, and eventually, the 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". It has also been prepared to be consistent with the "*GEF Strategy to Develop Fuel-cell Buses (FCB) for the Developing World*", approved by the GEF Council in November of 2000.

In order for the long-term programmatic goal of the entire GEF intervention to be achieved, fuel cell buses must be produced for use in other contexts. According to industry projections, after a total of 5000 fuel cell buses have been produced, the costs should fall to where fuel cell buses will be roughly competitive on a lifecycle basis with modern, clean diesel buses.

Global Environmental Benefits

The deployment of fuel-cell buses in China will lead to significant reduction in carbon emissions from the transport sector. Although for this demonstration phase, the project will result in carbon emissions reductions of 178 tonnes C or 653 tonnes of CO_2. However, the target is not a small-scale demonstration project in Beijing and Shanghai, but rather the replacement of all petroleum fueled buses in China. If all petroleum-fueled buses were replaced by hydrogen FCB buses in the year 2030, with hydrogen derived from sources not emitting carbon (or the carbon being sequestered underground), the net savings in carbon emissions would be 9.1 million tonnes per year.

The immense worldwide potential for reducing global carbon emission can be demonstrated in the following example. If all diesel buses in developing countries in operation in the year 2025 were replaced by fuel-cell buses operation from hydrogen produced from natural gas, the emission of nearly 440 million tons of CO_2 would be reduced per year (120 m tons of C).

Costs

The costs of the baseline course of action are measured by the costs of operating conventional diesel buses for 1.6 million vehicle-kilometers in Beijing and Shanghai. These are estimated at US$1.1m over the five-year project lifespan. In addition, the Government of China has funding for fuel cells estimated at $7.8m. This funding will occur even in the absence of the project. The costs of the proposed project activities are estimated at US$31.7m, of which US$22.8m are considered incremental. For the first phase of the project, the total costs are equal to $15.93m, of which the GEF is asked to contribute US$5.815m. For the second part of the project, the total costs are equal to $15.798m to which the GEF will be requested to contribute $5.767m. These incremental costs are shared between the GEF, Chinese sources, and the private sector providers of the technology.

System boundary

Although the boundary for this immediate project is the urban transport sector in Beijing and Shanghai, 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 demonstration project will reduce the emission of NO_x, CO, and THC by 13, 9, and 3 tonnes, respectively, as detailed in the incremental cost matrix. In addition, there will be reductions in SO_x and particulate emissions, for which data do not presently exist. If the same factors are used to scale-up these avoided emissions to anticipated 2030 levels, annual reductions of NO_x, CO, and THC might be expected to decrease by as much as 665 thousand tonnes; 460 thousand tonnes; and 153 thousand tonnes, respectively. There are also significant benefits to the global community, the automotive industry, and the technology providers.

Table 6-1 Incremental Cost Matrix

	Baseline	GEF Project	Increment
National impact	?? Public transit in Beijing and Shanghai continues to rely heavily on petroleum-fueled buses (especially diesel fuel). ?? Diesel fuel consumption continues. ?? Significant local emissions from 1.6m veh-km diesel buses: *CO = 5.8 g/km or 9.28 tonnes* NO_x = 8.4 g/km or 13.44 t THC = 1.79 g/km or 2.86 t ?? Some FCB R&D continues.	?? Commercial development of FCBs accelerated through GEF support. ?? Chinese assimilation of FCB technology accelerated. ?? Zero CO, HC, NO_X, SO_2 and particulate emissions per vehicle-km. ?? Reduced waste heat emission	?? Commercial development of FCBs accelerated through GEF support. ?? Chinese assimilation of FCB technology accelerated. ?? Diesel fuel use reduced. ?? Avoidance of CO, HC, NOx, SO_x, and particulate emissions from diesel bus traffic. Reduction of Local Emissions: CO = 9.28 tonnes NO_x = 13.44 t THC = 2.86 t
Global impact	?? Diesel bus emissions: 1173 tonnes of CO_2 or 320 tonnes of C over the 1.6 m vehicle km traveled in the demo project ?? By 2030, 720,000 Chinese buses are expected to emit over 9m tones of carbon per year (33m tonnes of CO_2).	?? Carbon emissions from natural gas reforming estimated at 142 t C or 520 t CO2 ?? FCB cost reduction and commercialization accelerated. ?? "Sino-ization" of FCB technology accelerated.	?? Carbon emissions reduced by 178 tonnes C or 653 t CO2 during life of demonstration project ?? If all Chinese buses in 2030 are converted to fuel cells, 9.1m tonnes of carbon per year would be avoided (33m tonnes CO_2) ?? FCB cost reduction and commercialization accelerated. ?? "Sino-ization" of FCB technology accelerated.

Cost	?? Beijing diesel bus operation = $0.79/bus-km, or $0.632 million. ?? Shanghai diesel bus operation = $0.69/bus-km, or $0.552 million. ?? MOST R&D funding for FCBs = $7.8m **Total = $8.9 million**	**Part I:** ?? MOST = $4.922 million ?? Beijing municipal government = $1.854 million ?? Shanghai municipal government = $2.040 million ?? Private sector = $1.105 million ?? UNDP-China = $0.194 million ?? GEF = $5.815 million **Part II:** ?? MOST = $4.882 million ?? Beijing municipal government = $1.838 million ?? Shanghai municipal government = $2.024 million ?? Private sector = $1.095 million ?? UNDP-China = $0.193 million ?? GEF = $5.767 million **Total = $ 31.7 million**	**Part I:** ?? MOST = $1 million ?? Beijing municipal government = $1.5 million ?? Shanghai municipal government = $1.8 million ?? Private sector = $1.105 million ?? UNDP-China = $0.2 million ?? GEF = $5.815 million **Part II:** ?? MOST = $1 million ?? Beijing municipal government = $1.5 million ?? Shanghai municipal government = $1.8 million ?? Private sector = $1.095 million ?? UNDP-China = $0.193 million ?? GEF = $5.767 million **Total = $22.8 million**

Annex 7: Logical Framework Project Planning Matrix

7.1 Logical Framework For Project Part I

	(1) Programme or project summary	**(2) Indicators**	**(3) Means of verification**	**(4) External factors (assumptions and risks)**
Development objective	Reduce air pollution and GHG emissions through widespread commercial introduction of fuel cell buses in urban areas of China.	- Air pollution and CO_2 emissions reduced in Beijing and Shanghai during project - Larger reductions in China and elsewhere once FCB technology is commercially deployed.	For project: fuel consumption of FCBs and bus-km traveled.	
Immediate objective 1	Determine the technical and commercial viability of fuel cell buses and the associated fuel supply systems	- Six buses and 2 refueling stations are purchased and placed into operation	Second Semiannual project report	
Output 1.1 <u>Part I Activities</u>	Operational basis for project management established Hold Inception Workshop Prepare and distribute semi-annual reports in English	- Advisory Committee and Local Oversight Committees established - Attendance at Inception workshop	Inception Report	
Output 1.2	A commercially relevant demonstration of the technical feasibility of FCBs and their refueling infrastructure in Beijing and in Shanghai.	- Number of vendor visits completed during study tours - Persons consulted in formulating FCB system	First two Semiannual project reports	Assumptions: 1) The procurement process is adequate so that the buses can be commercially produced, and 2) the suppliers will accept the

	(1) Programme or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
Part I Activities	1.2.1 Undertake vendor communications and study tours 1.2.2 Develop system specifications 1.2.3 Select system suppliers 1.2.4 Install hydrogen fueling system 1.2.5 Place initial set of 3 buses in operation	specifications - Number of qualified bids received - Successful negotiations of contracts for each city - Installation of the hydrogen fuel supply stations - Delivery of the first 6 buses		suppliers will accept the structuring of the contract into two Parts. FCBs can be procured from commercial vendors at satisfactory cost Risk of vendor failure
Output 1.3 Part I Activities	The accumulation of a substantial body of knowledge about reliability and failure modes, opportunities for improving the design and reducing the cost of FCBs 1.3.1 Formulate guidelines for quarterly reports on in-service performance of each FCB system. 1.3.2 Design data collection systems 1.3.3 Collect ridership data 1.3.4 Exchange experiences with other fuel cell bus projects 1.3.5 Publish a project newsletter	- Development of quarterly reporting guidelines - Persons consulted in formulating reporting guidelines - Data collection system installed - Initial ridership survey completed - Publication of bi-monthly newsletter in English and Chinese	First two Semiannual project reports Newsletters	

	(1) Programme or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
Immediate objective 2	Establish the necessary technical, operational, managerial and planning capacity within the bus companies, scientific and industrial communities, and national and municipal-level policy makers	- Publication of documents demonstrating accumulated experience and knowledge		
Output 2.1 Part I Activities	A cadre of bus-company staffs in Beijing and Shanghai trained in the operation, maintenance and management of FCB systems None			
Output 2.2 Part I Activities	An examination and certification program for FCB operators and mechanics is developed. None			
Output 2.3 Part I Activities	Increased capacity among public-transport policy makers and planners at the national and municipal levels and at bus companies in Beijing and Shanghai 2.3.1 Undertake a study tour to visit selected public transport planners, policy makers, and	- Number and breadth of visits successfully completed during study tours	First two Semiannual project reports	

	(1) Programme or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
	service providers worldwide			
Output 2.4 <u>Part I Activities</u>	Enhanced scientific, technical, and industrial capacity in China relating to manufacturing and commercial utilization of FCBs and their associated fuel supply systems None			
Immediate Objective 3	Create a national-level awareness of FCBs and their long-term potential and develop a strategy for pursuing that potential No Part I Outputs or Activities	- Development of a strategy for commercialization of FCBs in China	Phase III Strategy Document	

Logical Framework For Project Part II

	(1) Programme or project summary	**(2) Indicators**	**(3) Means of verification**	**(4) External factors (assumptions and risks)**
Development objective	Reduce air pollution and GHG emissions through widespread commercial introduction of fuel cell buses in urban areas of China.	- Air pollution and CO_2 emissions reduced in Beijing and Shanghai during project - Larger reductions in China and elsewhere once FCB technology is commercially deployed.	For project: fuel consumption of FCBs and bus-km traveled.	
Immediate objective 1	Determine the technical and commercial viability of fuel cell buses and the associated fuel supply systems	- First 6 buses are operated and second 6 buses are purchased and placed into operation.	Semiannual project reports and Annual review meetings	
Output 1.1 <u>Part II Activities</u>	Operational basis for project management established1.1.2 Prepare and distribute semi-annual reports in English 1.1.3 Hold Annual review meetings 1.1.4 Prepare Comprehensive Evaluation report	- Advisory Committee and Local Oversight Committees meet as planned - Annual review meetings held - Comprehensive Evaluation report prepared	Semiannual project reports Annual review meetings Comprehensive Evaluation report	
Output 1.2	A commercially relevant demonstration of the technical feasibility of FCBs and their refueling infrastructure in Beijing and	- Second set of 6 buses is delivered and placed into service - FCB systems reliably	Semiannual project reports	Assumption: Suppliers will accept the structuring of the contract into two Parts.

	(1) Programme or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
Part II Activities	in Shanghai. 1.2.6 Operate and maintain the hydrogen fueling infrastructure 1.2.7 Operate the initial set of 3 buses 1.2.8 Place second set of 3 buses in operation 1.2.9 Operate the second set of buses	operated and maintained by each municipal bus company - Twelve buses are operated for a total of 1.6 million vehicle-km - Breakdowns are limited in frequency to acceptable levels, e.g., >50,000km between breakdowns - Refueling station operates reliably to supply sufficient H_2 at all times.	Annual review meetings Quarterly data reports Vehicle log books and records Operator and mechanic work/performance records	FCBs can be procured from commercial vendors at satisfactory cost Risk of vendor failure
Output 1.3 Part II Activities	The accumulation of a substantial body of knowledge about reliability and failure modes, opportunities for improving the design and reducing the cost of FCBs 1.3.3 Collect ridership data 1.3.4 Exchange experiences with other fuel cell bus projects 1.3.5 Publish a project newsletter 1.3.6 Collect and evaluate operating data on the FCBs and the	- Quarterly reports collected - Project newsletters published - Follow-up ridership surveys completed and documented - Lifecycle analysis completed and documented - Identification of possible	Quarterly data reports Ridership survey reports Lifecycle Analysis report Publications	

	(1) Programme or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
	refueling system 1.3.7 Prepare lifecycle analysis of the FCBs operating data 1.3.8 Prepare quarterly data analysis reports in English 1.3.9 Host an international FCB seminar	system improvements - Determination of potential long-term benefits - International FCB seminar conducted - Papers and reports published	demonstrate accumulated experience and knowledge	
Immediate objective 2	Establish the necessary technical, operational, managerial and planning capacity within the bus companies, scientific and industrial communities, and national and municipal-level policy makers	- 12 buses are operated for 1.6 million vehicle-km and operational statistics are gathered	Semiannual project reports Project comprehensive evaluation	
Output 2.1 Part II Activities	A cadre of bus-company staffs in Beijing and Shanghai trained in the operation, maintenance and management of FCB systems 2.1.1 Develop training program 2.1.2 Hold on-the-job training seminars	- Number of operators and mechanics trained - Timeliness of training program	Training program attendance surveys Operator and mechanic work/performance records	
Output 2.2 Part II Activities	An examination and certification program for FCB operators and mechanics is developed. 2.2.1 Develop an examination and	-Examination and certification program developed and submitted	Acknowledgement by regulatory body	

	(1) Programme or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
Activities	certification program for FCB operators and mechanics 2.2.2 Refine and submit the examination and certification program for FCB operators and mechanics			
Output 2.3 Part II Activities	Increased capacity among public-transport policy makers and planners at the national and municipal levels and at bus companies in Beijing and Shanghai 2.3.2. Prepare a transit system policy and planning study	- Policy/planning study produced	Changes in bus company management, technologies, infrastructure and operations in Beijing and Shanghai.	
Output 2.4 Part II Activities	Enhanced scientific, technical, and industrial capacity in China relating to manufacturing and commercial utilization of FCBs and their associated fuel supply systems 1.2.4. Organize national technical workshops 1.2.5. Organize an annual competition to provide funding aimed at accelerating the commercialization of FCBs in China	- Number of successful workshops held - Number of funding awards made for relevant projects	Semiannual project reports Annul review meetings	

	(1) Programme or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
Immediate Objective 3	Create a national-level awareness of FCBs and their long-term potential and develop a strategy for pursuing that potential	- Development of a strategy for commercialization of FCBs in China	Project media exposure Phase III Strategy Document	
Output 3.1 <u>Part II Activities</u>	Increased awareness and acceptance of FCBs in China among key actors as well as the general public 1.3.3. Hold a national awareness seminar 1.3.4. Participate in national and international meetings 1.3.5. Publicize the project results	- Attendance at national awareness seminars - Number of local, national and international workshops/ meetings held and attended - Number of professional publications produced - Number of reports in media	Public awareness and acceptance of FCBs as shown in the ridership surveys and media reactions	
Output 3.2 <u>Part II Activities</u>	Activities to lay the basis for pursuing Phase III of the overall FCB program 1.2.7. Conduct information exchange workshops 1.2.8. Carry out feasibility studies for candidate Phase III cities 1.2.9. Develop a conceptual design for a hydrogen-powered fuel	- Number and geographical variation of workshops - Assessment reports on Chinese FCB design, mass production and hydrogen supply alternatives. - Phase III strategy for FCB commercialisation	Phase III Strategy Document Commitment of interested Chinese parties in Phase III	

	(1) Programme or project summary	(2) Indicators	(3) Means of verification	(4) External factors (assumptions and risks)
	cell bus 1.2.10. Develop fuel supply assessments and protocols for large-scale utilization of H_2 FCBs 1.2.11. Prepare a detailed Phase III strategy document	FCB commercialization - Standards for FCBs and hydrogen supply, and guidelines for operation and maintenance		

Annex 8: Lifecycle Cost Comparison

During the preparation of the GEF Brief, an expert Chinese team drew on both the scientific and engineering knowledge base in China and internationally regarding FCBs to estimate the capital costs that are likely to be reached by mass production of 12-meter FCBs in China. The team considered two scenarios involving manufacture of the bus glider and integration of the engine and glider in China. One scenario involved importing the fuel cell engine from an OECD country. The second assumed indigenous manufacture of the fuel cell engine. With the imported engine, the estimated cost for a mass-produced FCB was about US$320,000. With a Chinese engine, the cost was about US$237,000. For comparison, the Ballard Company of Vancouver, Canada (the leading FCB developer) has indicated that an FCB mass-produced entirely in Canada/USA could be sold for under $400,000. Ballard has also indicated that the glider would represent about 70% of this cost. Since substantial cost savings in the manufacture of the glider can reasonably be expected in China compared to Canada/USA production, the Chinese FCB cost estimates are consistent with the Ballard projections. Table 1 shows that based on the Chinese estimates of the cost of FCBs, it appears that mass-produced FCBs will become cost-competitive on a lifecycle basis with diesel buses.

Table 1: Lifecycle Cost Comparison, US$/bus-km (constant 1999 $)

	Beijing Diesel Bus		**Shanghai Diesel Bus**		**Fuel Cell Bus, 2025(c)**	
	2000(a)	**2025**(b)	**2000**(a)	**2025**(b)	**Domestic engine**	**Foreign engine**
Capital	0.14	0.14	0.13	0.13	0.25	0.34
Fuel	0.08	0.08	0.10	0.10	0.37	0.37
O&M	0.53	1.07	0.44	1.06	0.71	0.71
TOTAL	0.76	1.3	0.67	1.3	1.3	1.4

(a) Diesel 2000: average costs for primary public bus companies in Beijing and Shanghai, with diesel fuel at 2.4 RMB/lit for Beijing and 2.5 RMB/lit for Shanghai.

(b) Diesel 2020: 5% real escalation in salaries, 2000-2025

(c) FCB 2025: 10% discount rate, 20-year life, $25/GJ fuel (2.6 RMB/$m^3$), 1.174 m^3H_2/km, O&M cost is 2/3 of average diesel 2020 O&M cost.

Aside from the capital cost estimates for the FCB, four key assumptions underlie the numbers in this table. One assumption is that the operating and maintenance (O&M) cost for the FCB will be two-thirds of the O&M cost for the diesel bus. This is based on the assumption that FCBs will suffer less wear and tear than a diesel bus due to relatively low temperatures of operation of the fuel cell (~80^{o}C) together with the absence of vibrations that accompany reciprocating engines. The second assumption, that the FCB will last 20 years compared to a typical diesel bus life of 10 years, follows from this argument as well. The third assumption is that Chinese labor costs continue their increasing trend: a 5% per year real increase in the salaries of operators and mechanics is assumed in the results in the table. The fourth assumption is that the capital cost for a diesel bus does not increase in real terms between now and 2025. (This is a conservative assumption, since it is likely that diesel bus costs will increase as manufacturers strive to meet stricter emissions limits, provide more on-board amenities, etc.)

Table 1 assumes a hydrogen cost of 2.6 RMB/m^3, which is the cost estimated for making hydrogen from coal in a large-scale process that includes capture of the carbon in the coal and sequestering it as CO_2 in depleted natural gas wells. A preliminary analysis of alternative low-carbon emission options indicated that this would be the lowest-cost and most abundant means for providing hydrogen with low CO_2 emissions in the coastal cities of China in the long term. Natural gas is another potential feedstock for hydrogen production, and this is envisioned as the hydrogen source for this demonstration project.

The magnitude of potential reductions in carbon dioxide emissions achievable by widespread introduction of FCBs in China can be estimated based on the earlier projections for the bus population in China in 2030. If all 0.72 million buses projected to be on the road in 2030 were to operate on petroleum fuels, carbon dioxide emissions in a single year would amount to about 9.1 million tonnes. Thus, if all petroleum-fueled buses were replaced by hydrogen FCB buses, with hydrogen derived from sources not emitting carbon, the net savings in carbon emissions would be 9.1 million tonnes per year.

Annex 9: Analysis of Project Size and Scope

The decision to carry out simultaneous projects in two cities was made based on the objective of maximizing the chances for future wide-scale implementation of FCBs throughout China. The most important consideration in this regard is the need to demonstrate FCB viability under the wide range of institutional and market conditions found in cities across China. Differential rates of economic and social reform have created a wide range of market and institutional conditions in different cities today. Demonstrating the feasibility of FCBs in two cities that span this range will help catalyze future spread of the technology to cities that have market and institutional conditions similar to one or the other of the demonstration cities. Additional reasons for carrying out parallel demonstrations in two cities include:

?? Raising greater awareness in China of FCBs, and thereby generating a broader base of support and more momentum for large-scale implementation in the longer-term.

?? Demonstrating FCB operations under different physical conditions, most significantly the higher frequency of short, steep grades (flyovers) on the roadways and high relative humidity in Shanghai.

?? Facilitating the participation of more equipment suppliers, which is desirable from the standpoint of developing an FCB industry: involving two cities will enhance the likelihood that a larger number of equipment suppliers can be involved in the project.

?? Fostering friendly competition between cities to improve the likelihood of success in each.

Beijing and Shanghai were selected as the two demonstration host cities in large part because these cities present a significant contrast in market, institutional, and cultural conditions: each is representative of a large number of other cities in China, with the pace of economic and institutional reform most advanced in Shanghai. Market-oriented reform in Beijing is far behind Shanghai, but is representative of the conditions still found in many Chinese cities. The performance of the local public bus companies reflects the different market and institutional environments. Additional factors leading to the choice of these two cities include the following:

?? Pollution problems are already severe in Beijing and are approaching severe in Shanghai, and the municipal governments in both of these cities are highly committed to reducing air pollution.
?? The municipal governments in both of these cities have pledged to strongly support the projects.
?? The public bus companies in these cities have demonstrated their commitment to technology innovation, e.g., as evidenced by earlier LPG and CNG bus programs,
?? These are the two largest bus markets and the two largest cities in China,
?? These cities are well-known in China and throughout the world and hence the national and the global impact of successful projects in these cities will be greater than if the demonstrations were undertaken in lesser-known cities,
?? The strongest possible teams can be assembled in these cities to carry out the projects,

The decision on the number of buses to demonstrate in each city considered both higher and lower numbers than 6 in each city. The possibility of demonstrating a much larger number of buses at each site, e.g., > 20, was considered unfeasible due to the limited supply capabilities of

vendors, the difficulty of effectively operating such a large number of units in China with no prior experience, and the higher project cost (and hence project risks) that would be entailed.

The decision to demonstrate a minimum of 6 buses in each city was based on prior experience with the introduction of CNG buses in Beijing and in Shanghai. The CNG test programs that preceded the wide-scale introduction of CNG buses in Beijing consisted of a 3-bus test over an 18-month period. A minimum of 3 buses was needed to generate statistically significant results. A relatively short test period of 18 months was sufficient because the CNG technology was already well established outside of China, and several cities elsewhere in China (including in Sichuan and Xingjiang provinces) had already introduced CNG buses.

As with the CNG bus tests, a minimum of 3 FCBs will be required in the testing to establish statistically significant results. However, there is no prior experience in China with FCBs and operating availabilities for the demonstration vehicles will not reach normal bus operating availabilities, so longer duration testing will be required than with the CNG program in order to identify potential problems. The testing period cannot be extended indefinitely, however, because FCB technology is evolving very rapidly, and thus lessons learned during an extended initial test period may be irrelevant to the technology that would be adopted for Phase III of the Chinese FCB commercialization program.

To avoid an unduly extended testing period, a second batch of 3 buses will be introduced after one year of operating the first batch of 3 buses. This staged introduction approach has several advantages over introducing 6 buses all at once: 1) it allows the project to start with the minimum statistically-acceptable number of units, which will facilitate overcoming startup issues, 2) it provides for a lower cost project, since the second batch of buses can be expected to be lower in cost than the first batch, and 3) it provides for the possibility of technological improvements (by the suppliers) in the second batch of buses compared to the first batch.

The 6-bus design in each city will enable a total of about 800,000 bus-km of FCB operation to be logged in each city. This is the typical lifetime of a bus in Beijing today, and it is adequate to evaluate mean time between failures (MTBF) at the end of the project period. It will also enable each bus to operate a total of 115,000 to 150,000 km, which is 3 or 4 times the target for MTBF and thus should be sufficient to identify likely failure modes.

The estimate of 800,000 bus-km overall is based on the assumption that the FCB will operate at 70 to 85% of the availability of Beijing's diesel buses. FCB suppliers who have been contacted have indicated that initial demonstration FCBs will not be able to achieve operating availabilities greater than 50 to 70% of diesel-bus availability. However, since these availability levels are based on diesel bus travel distances typically found in large cities outside China, they underestimate the availabilities achievable in Beijing, where diesel buses average only 48,000 km per year of operation, compared to much higher distances elsewhere. For example, buses in Sao Paulo and in Cairo operate about 84,000 km/year and 105,000 km/year, respectively.