UNDP Project Document

Government of the People's Republic of China
United Nations Development Programme

Global Environment Facility

Full Project - Demonstration for Fuel-Cell Bus Commercialization in China (Phase II)
PIMS 2933

Brief Description - This project will help catalyze the cost-reduction of fuel-cell buses (FCBs) for public transit applications in Chinese cities by supporting significant parallel demonstrations of FCBs and their refueling infrastructures in Beijing and Shanghai. In collaboration with the Chinese national government, the municipal governments of Beijing and Shanghai, and the private sector, GEF and UNDP will assist the public transit companies of Beijing and Shanghai to obtain and operate 6-9 FCBs. 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. Additionally, some activities will help build capacity relating to FCBs, including strengthening policy and planning capabilities of the public transit companies and line government institutes; enhancing scientific, technical, and industrial capacity for commercializing FCBs; and increasing the understanding of FCBs to climate change among government, investment, media, and other key actors. Finally, a series of activities will focus on defining a detailed strategy for large-scale FCB commercialization in China.

Signature Page

Country: People's Republic of China

UNDAF Outcome(s)/Indicator(s):	End-use energy efficiency and application of new and renewable energy technologies improved
CP Output(s)/Indicator(s):	1) Commercialization of new and renewable energy technologies promoted; 2) Regulation, codes, guidelines, standards, and labels for energy efficiency and conservation developed, improved, and widely applied to residential buildings, as well as to industrial, residential and service equipments 3) Strategies and favorable policies for China's 2010 and 2020 renewable and new energy targets developed, notably a roadmap for new and renewable energy industry and technologies
Implementing Partner:	Ministry of Science and Technology, China
Other Partner(s):	National Development and Reform Commission, State Environmental Protection Administration, Ministry of Finance, DC, BP, Tongfang, etc

Programme Period: 2006-2010
Programme Component: Environment and Energy
Project Title: Demonstration for Fuel-Cell Bus Commercialization in China (Phase II)
Award ID: 00051247
Project ID: Pims 2933
Project Duration: 4 years
Management Arrangement: National Execution

Total budget: US$18,625,000

- GEF/UNDP resources: US$5,963,000
- Government MoST: US$3,519,000
- Government Beijing: US$3,536,000
- Government Shanghai: US$4,384,000
- Others: US$1,223,000

Agreed by:

	Signature	Date	Name and Title
MOF: Government for GEF Funds:	[signature]	2007-04-05	Kuilin Ju Deputy Director General
MoST: Implementing Partner	[signature]	04/01/2007 (Jan)	Jing Xu Deputy Director General
UNDP:	[signature]	14 May 2007	Khalid Malik Resident Representative

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Acronyms

CICETE	China International Center for Economic and Technical Exchanges
CPD	Country Programme Document (UNDP China)
CTA	Chief Technical Advisor
DC	Daimler Chrysler Corporation, Germany
EV	Electric Vehicles
FCB	Fuel Cell Bus
FCV	Fuel Cell Vehicle
GEF	Global Environment Facility
GHG	Greenhouse Gases
HRS	Hydrogen Refueling Station
IPCC	Intergovernmental Panel on Climate Change
IPHE	International Partnership for the Hydrogen Economy
M&E	Monitoring and Evaluation
METI	Ministry of Economy, Trade and Industry, Japan
MOST	Ministry of Science and Technology, P.R. China
MOC	Ministry of Commerce, P.R. China
MOF	Ministry of Finance, P.R. China
NPD	National Project Director
NDRC	National Development and Reform Commission
PEM	Polymer Electrolyte Membrane
PMO	Project Management Office
SEPA	State Environmental Protection Administration
STAP	Scientific and Technical Advisory Panel
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNDP CO	UNDP Country Office
UNDP TRAC	UNDP Targets for Resource Assignment from the Core
UNFCCC	United Nations Framework Convention on Climate Change

SECTION I Elaboration of the Narrative

Situation Analysis

1 Introduction

1. The Demonstration for Fuel Cell Bus (FCB) Commercialization in China project has been formulated in two Phases, with Phase I approved by the GEF Council and received GEF CEO endorsement on 13 September 2002. Phase II, already in the GEF pipeline, is subject to GEF Council approval when submitted as part of a GEF Work Programme. Proceeding with Phase II of the project is triggered by the procurement of the first set of buses under Phase I. This document outlines Phase II of the project and includes information on the evaluation of Phase I.

2. The Phase I project document was signed in November 2002, and the project officially began operation on 27 March 2003 after a few months of preparation. In late 2003, China International Center for Economic and Technical Exchanges (CICETE), entrusted by the project executing agency to lead the procurement activities, launched the international procurement process for the project. Bids were evaluated by a committee in March 2004, and DaimlerChrysler was announced as the winner. In May 2004, intense negotiations were conducted with DaimlerChrysler and a supply contract for FCBs was signed on 26 May 2004. Three Citaro fuel cell buses are to be delivered to Beijing in September 2005. These three Citaro FCBs are similar, in terms of performance and service, to those being demonstrated in ten European cities. The added value of demonstrating Citaro buses in China includes: the technical information gained from operating the buses under Chinese conditions as compared to the other demonstrations (benefit to Chinese stakeholders and also FCB suppliers); experience gained by the Chinese project participants and other stakeholders regarding the operation of FCBs and the hydrogen supply; increased technical and managerial capacity of the Chinese to procure, test, operate, and monitor FCBs; related increase in technical capacity of research institutions participating in the project; development of standards, protocols, appropriate policies, etc. conducive to increasing the introduction of fuel cells for transport in China; awareness raised among Chinese stakeholders and even general public regarding possibilities of hydrogen economy to contribute to a sustainable transportation system.

3. In addition, a memorandum has been signed with BP for the construction of a hydrogen refueling station in Beijing on 9 May 2004. Beijing SinoHytec Limited, BP and Beijing Tongfang Co. Ltd signed agreement on cooperative construction of hydrogen refueling station in Beijing in May 2005. The quality and quantity of hydrogen supplied by this station will fully meet the FCB demonstration requirement in Beijing. The initial source of hydrogen will be electrolysis, with hydrogen generated off-site by means of water electrolysis and transported with tube trailers. The production of hydrogen from natural gas is under development, targeted for 2007. By 2008, work by the Chinese government with the US Department of Energy in Beijing will allow for the use of renewable sources of electricity, such as photovoltaic and wind for hydrogen. In Phase II Project, Shanghai will obtain hydrogen from a plentiful by-product from a steel plant and other sources. The Project Team anticipates that by the time the FCBs are in commercial use, a substantial portion of electricity mix in China will be from renewable energies. The study that will be carried out on

the assessment of hydrogen production routes for China will examine other options and their feasibility over the longer term.

4. The evaluation of Phase I was conducted by an expert group appointed by UNDP China on 15-26 November 2004 to examine the methodologies used, and results of, the selection of FCB technologies and relevant supporting infrastructure for commercializing environmentally-friendly public transportation in Chinese cities; to assess the efforts made and results achieved in partnership building among the 12 respective agencies and companies; and, to review the approaches to access potential partners. Major observations of the evaluation included:

   - The Phase I project performance and results were found to be satisfactory despite that the project had faced technical regulations, standards and national policies constraints, which caused some difficulties with project implementation and coordination.
   - FCBs were purchased only for Beijing under the Phase I project due to budgetary constraints. The evaluation mission suggested that Shanghai procured a newer generation FCB in Phase II of the project. Because of the current active state of fuel cell development in China and abroad, a new generation of FCBs will likely be available within two years. These new FCBs will likely have improved energy efficiency, reliability and durability characteristics, as well as lower costs. Thus introducing FCBs in Shanghai that were different from those implemented in Beijing will help to enlarge the benefits of the overall project. Furthermore, this phased approach would better meet the overall project objectives of advancing FCBs towards commercialization.
   - The project was found to have effectively built capacity within various Chinese academic and government agencies, and a major positive impact of the project to date has been to create a wider awareness within China of FCBs and the use of hydrogen fuel.
   - Considering that China has the world's largest public transit sector and has become the world's second largest energy consumer of fossil fuels, the overall impact of a successful FCB demonstration in China was considered to be extremely significant in reducing GHG emissions and sustainability. Furthermore, the opportunity of internationally showcasing FCBs during the 2008 Olympics and possibly the World Expo 2010 was recognized as significant.

5. Final Phase I activities including building of the maintenance workshop and garage, FCB certification in China, data acquisition, staff training, organization and management on route are in progress.

6. The FCB program in China has been fully supported by the Chinese Central Government, and the Beijing and Shanghai Municipal Governments. Since no FCBs were purchased for Shanghai as originally envisaged during the Phase I project due to financial and technical restrictions, the Phase II project will focus on the FCB purchase and hydrogen refueling station construction for Shanghai, together with FCB commercial demonstration operation in both Beijing and Shanghai as planned.

2 Environmental context and global significance

7. In 2003, Primary energy consumption in China was 1178.3 million tons oil equivalent, making up 12% of the total and establishing China as the second largest consumer of energy in the world behind the United States (23.6%). China is also the second largest emitter of CO_2 in the world.

8. China's primary energy consumption consisted of 67.8% coal and 23.4% oil in 2003, constituting 91.2% of the total primary energy consumption, providing a major source of air pollution.

9. Since 2002, China has continuously ranked second of the world's largest oil consumption countries. According to the National Environment Bulletin of 2002, two-thirds of the 343 cities in China under air monitoring failed to achieve "2^{nd} Class" (Air Pollution Index between 50-100, which is acceptable for outdoor activities) of National Air Quality Standard; the population residing in these below "2^{nd} Class" cities accounted for approximately 75% of the total population of monitored cities. Major pollutants were particulates, SO_2 and NOx, and carbon monoxide.

10. In 2003, the daily average concentration of the SO2, NOx, CO, inhaled particle and suspended particle were 0.061, 0.072, 2.4, 0.141 and 0.252 (Table 1). In urban areas about 70% of the pollutants came from vehicle emissions (Table 2).

11. Both in Beijing and Shanghai, public buses were one of the major contributors to air pollution due to the large fleets, high engine power, large fuel consumption, long daily running distance and operation in city areas with heavy population densities.

Table 1: Daily average pollutants in Beijing urban areas (unit: mg/Nm^3)[1]

Year	**SO_2**	**NOx**	**Inhaled Particle**	**Suspension Particle**	**CO**
2002	0.067	0.076	0.166	0.373	2.5
2003	0.061	0.072	0.141	0.252	2.4
2nd Class of air quality standard	0.060	0.080	0.100	0.200	---

Table 2: Contribution of the air pollutants from vehicle emissions in urban areas

	Beijing (%)		**Shanghai (%)**
	heating period	*non-heating period*	*non-heating period*
CO	63.4	80.3	86
HC	73.5	79.1	96
NOx	46.0	54.8	56

12. In 2003, the annual vehicle production volume in China was 4.44M units and the total number of vehicles in operation in China was 24.21M units. Based on a 1.3 billion average population in China, there are only 18.6 vehicles per every 1000 people. In 2003, global vehicles in operation are total 850M units, or 127 vehicles per 1000 people. In the developed countries, there are typically between 500 and 700 vehicles per 1000 people. Based on the projection of 8M units of vehicle production volume in 2010 and 15M units of vehicle production volume in 2020 in China, the total vehicles in operation will reach 120M to 150M units by 2020.

13. The National Environmental Protection Center predicts that by 2010 the percentage of emissions from big cities will represent 64% of total emissions from all cities in China. So far, auto CO_2 emissions are only 10% of total CO_2 emission in China. But if no action is taken to reduce the emission and save energy, it is predicted that by 2020 the percentage will reach 30%.

[1] Beijing Environment Bulletin of 2003

14. In 2003, China produced 169.319M tons of oil, and imported 119.36 M tons (since part of domestic petroleum was exported, net imported oil was 91.4M tons) or a 35.8% dependence on imported oil. Given that the maximum domestic oil production is 160M-200M ton, increased automobile usage indicates that dependence on imported oil will reach over 40% and 60%, by 2010 and 2020 respectively.

15. The project also has key linkages with the recently approved United Nations Development Assistance Framework (UNDAF) for China (2006-2010) that supports more efficient management of national resources, with a special focus on energy, to ensure environmental sustainability. This project is consistent with the recently approved UNDP China Country Programming Document (CPD) (2006 – 2010) which supports continued assistance to China in application of new and renewable energy technologies and in refueling its obligations under multilateral environmental agreements.

3 Fuel-cell Bus Research and Development

1.3.1 International Status of Fuel Cell Vehicle (FCV) Research and Development

16. Hydrogen drive transportation offers great potential for sustainable development of the transportation system. Presently, global automotive transportation almost wholly relies on gasoline and diesel fuels. However, since oil is a non-renewable resource, at the present production rate proven reserves will be depleted in the next forty years. Moreover, about 65% of the explored oil reserves are located in the Middle East where political and social instability contributes uncertainty for energy supply for many countries.

17. Vehicles are mobile, widely dispersed and need to be continually charged with a fuel at different locations. To date, two kinds of “energy carriers” — electricity and hydrogen — are recognized as the most promising “fuels” for vehicles. Since the energy density of batteries is still low, large quantities of electricity cannot be stored on board vehicles. Hydrogen from renewable primary energy is the best future energy carrier for vehicles, especially when used in a fuel cell engine with zero emissions and high efficiency.

18. The U.S. government has emphasized the importance of the use of hydrogen in transportation many times, as in President Bush’s speech at the Washington National Architecture Museum on 6 February 2003 where it was stated that “the hydrogen fuel cell represents the most innovative and encouraging technology in our era”. In the State of the Union Message submitted to the Congress dated 28 January 2003, the President noted “As a new commitment made by the country, our scientists and engineers will overcome different obstacles to bring forward these (fuel cell) vehicles from lab to showroom, the first car driven by a child born today could be powered by hydrogen and be pollution-free.” President Bush requested an appropriation of 1.2 billion USD in the next 5 years for FreedomCAR Programme. Together with the previously approved 0.5 billion USD for the Hydrogen Fuel Initiative, the total funds amount to 1.7 billion USD.

19. European Union Chairman Prodi made a statement at the 2004 Europe Hydrogen Technology Platform Convention that “our target is to gradually convert to a completely integrated hydrogen

economy based on renewable energy". According to the white book of the European Committee entitled "European Strategy on Approaching Energy Security", 20% of gasoline and diesel will be replaced by alternative fuel by 2020 with 5% being hydrogen. Chairman Prodi also declared that the European Union will invest 2 billion Euros (approximately 2.4 billion USD) for hydrogen and fuel cell related study in the next 5 years.

20. Japan's Premier Koizumi has expressed his support for the fuel cell vehicle (FCV) many times since he first rode in a FCV on 31 December 2001. He stated in the 154th State Council speech on 4 February 2002 that "the fuel cell is the key to open the hydrogen economy gate". Japanese METI (Ministry of Economy, Trade and Industry) developed an ambitious plan for FCV development: 50,000 units by 2010, 5 million units by 2020. The funds that the Japanese Government allocated for their fuel cell plan was 23 billion JPY (approximately 0.22 billion USD) in the 2002 fiscal year, and 32.5 billion JPY (approximately 0.3 billion USD) in the 2003 fiscal year.

21. On 20 November 2003, representatives from 15 countries and the European Union attended an inaugural ministerial meeting signing an agreement to establish the International Partnership for Hydrogen Economy. The 15 countries are: U.S, U.K, France, Germany, Italy, Canada, Russia, Norway, Iceland, Australia, Brazil, Japan, Korea, India and China. In the next 10 years, they will cooperate on the study of fuel cells, hydrogen production, storage, fuel cell, code/standard/regulation, and hydrogen socio-economics. Up to now, three Steering Committee meetings and four Implementation and Liaison Committee meetings have been held. The first group of joint study programs will begin soon.

22. All major automobile manufacturers and energy companies around the world have invested significant amounts of effort in the research and development of FCVs and hydrogen energy infrastructure. According to media sources, 25% of the research and development funds of General Motors are spent on FCVs, hundreds of employees at Toyota East Fuji Research Institute work on FCV research and development, and 100 DaimlerChrysler FCVs were in demonstration operation globally in 2004.

23. Based on these efforts made by the major automobile manufacturers and energy companies, and experience obtained from previous FCV and FCB demonstration programs, the Prime Minister of Canada, Paul Martin, announced in Apri1 2004 in Vancouver that the first hydrogen highway in the world will be constructed in Canada from Vancouver to Whistler with the total length of 120 km. Seven hydrogen refueling stations will be constructed along the highway, on which millions of visitors will be transported when Whistler hosts 2010 Winter Olympics. Shortly after, the U.S. California Governor Schwarzenegger announced a goal of constructing hydrogen refueling stations along the major highways in California, with an eventual target of approximately one station every 20 miles, and total number of 150 to 200 stations. In May 2005, the Norway government announced a plan to construction a hydrogen highway.

1.3.2 Significant progress on fuel cell and fuel cell vehicle technology

24. Over the recent years, great progress has been made on some key specifications of fuel cell and FCV technology:

- **Significant improvement in power density -** Due to its limited space and capacity, vehicle applications have a relatively high requirement to reduce the size and mass of the fuel cell engine. Ballard's fuel cell stack volume power density increased 25 times from 1989 to 2001. The fuel cell system (engine) HY-80, with a maximum output 65 KW, produced by Ballard includes fuel cell stack and related accessories. Its volume and weight power density (309 watt/litre and 309 watt/kg respectively) have almost met the 2010 target set by the U.S. Department of Energy for FreedomCAR.
- **Significant reduction of noble metal usage -** Platinum is used as the primary catalyst for fuel cells. However, platinum has a limited global reserve and a high price. Platinum consumption within the fuel cell stack has dropped to < 0.5 milligram/cm^2 now from ~5 milligram/cm^2 in 1990 with continued improvement expected.
- **Significant progress on fuel cell energy conversion efficiency -** According to the fuel cell car NECAR4 test done by DaimlerChrysler using the Ballard fuel cell system, the energy conversion efficiency of the fuel cell stack reaches 62%. Given all fuel cell accessory loss (16.4%) and the loss caused by motor drive and driveline (8.1%), the tank-to-wheel energy source efficiency is 37.7%, much higher than those of the typical gasoline engine vehicle (16-18%) and diesel engine vehicle (20-24%).
- **Substantial improvements on the reliability and durability of FCVs -** Daimler Chrysler's fuel cell car NECAR5 traveled from San Francisco to Washington, DC in May 2002, covering 5,220 km with an average speed of 112 km/hour with only one failure, which involved a cooling hose. GM's fuel cell car also completed a trip across Europe in mid 2004, covering 9,696km. UPS is now beginning delivery service in Michigan, using a GM fuel cell van. Admittedly, there is still much work to do to improve FCV's reliability and durability, since the life span of the current fuel cell stack is only approximately 2000 hours.
- **Gigantic potential for cost drop of fuel cell systems -** The current commercial price of the fuel cell system is estimated at an average of 3,000-5,000USD/KW. However, because the fuel cell system is still a product under research and development, users require suppliers to provide 2 year or 4000 hours durability warranty and free maintenance. The requirement usually makes suppliers price the fuel cell vehicle at a relatively unaffordable 10,000USD/KW. A 2004 United States Department of Energy (DOE) study indicated that FC system price was 216USD/KW in 2003, based on a projection of mass production of 500,000 fuel cell systems (engine) with 50KW per unit and assuming present technology development and cost reduction, the report. However, there is still a big gap between this price and the requirement by the US DOE of 45USD/KW by 2010 and 30USD/KW by 2015 (equal to current gasoline engine price). Ballard is investigating significant improvements in key fuel cell stacks, and announced in April 2005 that the fuel cell stack cost will be reduced to 30USD/KW in 2010 from 60USD/KW in 2007, and durability will be improved to 5,000 hours in 2010 from 3,200 hours in 2007.
- There have also been many improvements in other performance areas of the FCV, such as environmental adaptability, dynamic performance, safety protection and cold starting performance. For instance, Ballard's projected start-up time to 50% maximum power is 100 seconds at -20°C in 2005 and 25 seconds at -30°C in 2010.

1.3.3 Progress of fuel-cell bus technology

25. In recent years, FCB research and development and demonstrations have received special attention from many countries due to the FCB having been recognized as one of the FCVs with the highest potential for early commercialization because:

- FCB has ample internal space and load capacity and therefore reduces requirements on the volume and mass of its fuel cell system;
- Achieves low emissions and noise when traveling in densely populated urban regions;
- Urban area bus driving cycles may be primarily met by current fuel cell technology;
- Buses are operated on a specified route and timing, making the central hydrogen refueling stations and service stations possible;
- Buses are a public service business that can easily obtain financial support from governments and social communities. Public incentives are necessary now because of the current high price of the technology; and,
- Buses are used by many people and can become an effective tool to advertise environmental protection and sustained development concepts. It also performs as a "mobile classroom" teaching people about new transportation technologies and their advantages through their real experience.

26. By the end of 2003, a total of over 65 FCBs around the world have been developed since 1993 when the first PEM (Polymer Electrolyte Membrane) FCB was developed by Ballard Power Systems. Among the 65 FCBs, 70% were developed by DaimlerChrysler-Ballard.

27. There have been more than 15 FCB demonstration projects globally, covering 12 countries in four continents. Briefly, among these projects are:

- *1998-2000 Chicago-Vancouver project* with three buses in each city. The six buses have driven a total of 118,000 km in 10,559 hours with 205,000 passengers. Thanks to its low noise, zero emissions, and performance equal to Diesel engine bus, the FCBs were well accepted by the drivers and the passengers. However, its durability still needed improvement since the availability percentage for the two cities was only 56% and 55% respectively.
- *California projects:* A one-year driving test was performed during 2000-2001 on a FCB supplied by Ballard Company to Sunline Transit Agency in Los Angeles. As compared to the FCB in Chicago-Vancouver project, the fuel cell system volume in this vehicle was reduced by 50%, vehicle mass was accordingly reduced by 1550kg, and the maintenance cost was reduced by 90%. In 2002-2003, the Sunline Transit Agency carried out a second FCB (with hybrid configuration) demonstration, jointly developed by Thunder Power-ISE and UTC with 70% uptime. There will be seven FCBs demonstrated by AC Transit, Sunline, and Santa Clara Transit in California during 2004-2005.
- *Tokyo FCB projects:* Japan Toyota-Hino Motors Corporation developed 1st and 2nd generation hybrid FCBs in 2001 and 2002, respectively, and carried out a demonstration drive in Tokyo in the summer of 2003. The demonstration indicates the acceleration performance of hybrid FCB is better than the same level diesel engine bus and its energy efficiency is 66% higher than the diesel engine bus. The 66% improvement includes 17.6% from braking energy regeneration

and 5% from optimizing the engine control strategy. Toyota-Hino has provided transportation service using 8 FCBs in 2005 at the time of World Expo in Ai-chi City.

- *US Georgetown University FCB demonstration project*: Georgetown has a 10-year R&D history in FCB technology, and has demonstrated FCBs on the campus and within Washington, D.C.
- *FCB demonstration project in 10 cities of 8 European countries:* With the support of the European Union, ten European countries including, Stuttgart, Hamburg, London, Madrid, Barcelona, Amsterdam, Porto, Stockholm, and Iceland have FCB projects. Since May 2003, demonstration drives have been performed successively with a duration of two years on 30 FCBs provided by DaimlerChrysler (3 units per city). By May 2005, bus fleets have driven a total of 750,000 km in 55,000 hours, with availability reaching 75%.

Apart from the above-mentioned well-known demonstration projects, other demonstration projects are ongoing in cities such as Perth, Toronto, and Berlin. These projects also contribute experience to further technology development.

28. In the International FCB workshop held in Long Beach, California on 19-20 November 2003, the project representative of FCB technology for the Federal Highway Administration (United States Department of Transportation) introduced the National FCB Technology Initiative. This project with a total investment of 150M USD and duration of six years aims to solve the technical issues of FCB operation and to reduce costs. The plan will include demonstration projects for public education and to generate public support for the technology. He also made prediction that in 2015, 10% of new purchased buses in the United States will use fuel cells.

4 Institutional, sectoral and policy context

1.4.1 Relevant policies of the Chinese Government

29. At the Second Session of the 10th National People‘s Congress that opened on 5 March 2005, Premier Wen Jiabao delivered the government’s work report. He pointed out, “New energy and renewable energy will be explored, as important elements for a cyclic economy... The friendly-environmental and energy-saving vehicles will be encouraged. Energy-saving production and consumption manners will be advocated with great effort, to accelerate construction of a society featured with resources saving.”

30. As reflected in the national scientific and technical development plan for 2005-2020, hydrogen and fuel cell technology research has been considered as one of important subject. Vehicles fueled by hydrogen, and especially FCVs, are anticipated to be the primary component of urban public transit systems in the future. Indeed, fuel-cell buses and taxis will be one of the main transit methods showcased during the Shanghai World Expo in 2010.

31. Ma Songde, Vice Minister of Ministry of Science and Technology and Chairman of the FCB Project National Committee, stressed during the project kick off meeting on 27 March 2003 that “the Chinese Government always pays great attention to sustainable development strategy and supports the research and usage of clean energy and new generation clean vehicles.” The Chinese Government actions include:

- *Implementing more stringent vehicle* emission and fuel consumption standards -
    - 1 January 2000 – stopped production of leaded gasoline nation wide;
    - 1 July 2000 – stopped selling leaded gasoline nation wide;
    - 1 April 2000 – adopted vehicle emission standard GB18352-I nation-wide (equal to Euro I);
    - 1 July 2002 – stopped the production of vehicle with carburetors nationwide;
    - 1 January 2003 – adopted vehicle emission standard GB18352-II (equal to Euro II) first in Beijing, and adopted nationwide on Jan 1st, 2005;
    - 1 July 2005 – adopted vehicle emission standard GB18352-III (equal to Euro III) first in Beijing and Shanghai, and 2008 in the whole country;
    - 1 July 2005 - adopted *Limits of Fuel Consumption for Passenger Car 162.*

- *Actively driving the development of alternative fuel vehicles* - In 1999, the Chinese Government carried out "clean vehicle activity" program, which was demonstrated first in 12 cities and then in 16 cities. By the end of 2003, the volume of CNG and LPG vehicles reached 190,000 units in the 16 cities, with 560 refueling stations established. In 2003, over 2,000 CNG buses are in use in Beijing, making Beijing the city with one of the most CNG buses in the world. The Chinese Government also encourages the use of renewable fuel from biological sources. Biological material can be processed into ethanol or as bio-diesel. Three provinces in China have built factories producing ethanol, and five provinces require that all gasoline include 10% ethanol. Additionally, biological diesel and methanol gasoline are being tried in demonstrations. A Shenhua project makes oil directly from coal with an investment of 24.5 billion RMB (about $3 billion USD) was formally started on 25 August 2004 in the Inner Mongolia Autonomous Region. It is estimated to be completed in 2007, with a capacity of 9.7 million ton of coal producing 500,000 ton of gasoline, 2.15 million ton of diesel, and 310,000 ton of LPG annually.
- *Actively carrying out electric vehicle research and trials* - Starting from 1992, research and development of electric vehicle and related batteries, electric motor, management systems have been a part of the national research plan. Significant progress has been made on the development of NiMH-Battery, Li-ion-Battery, and the AC synchronous and asynchronous motor and controller. Battery electric sedan, wagon and bus prototypes have been in pilot operation. In 1998, a National Electric Vehicle test and Demonstration Zone was established in Shantou city of Guangdong province. Twenty electric vehicles (including 5 RAV4 EV of Toyota, 2 EV-1 and 3 S-10 of GM and 10 China-made sedans, wagons and mini-buses) are under testing. China has become the largest production country of electric bicycles with a production of 6 million units in 2004. Small low-speed electric vehicles are used more and more often in parks and residential areas. Electric vehicles are still used in Beijing Tsinghua University with a 16-seat electric shuttle bus in use on campus for over four years. To promote the "Green Olympic 2008", Beijing announced that 90% vehicles for the Olympic Games are to be clean vehicles, including a projected 1,000 electric vehicles. In addition, fifteen new generation battery-powered buses are being operated in Beijing in 2005.

32. With the development of China's economy, people continue to move to urban areas. In 1949, there were only 136 cities and about 5,400 towns with a population of 57.65 million, or about 12% of the total population. By 2001, there were 662 cities and 20,358 towns with a population of 480 million, 37.7% of the total population. For a moderately developed country, urban population is normally

about 60% of the whole population, and for a fully developed country is 75%. Over the next 20-50 years, the proportion of urban population in China will continue to rise. There are now four cities whose population is over 10 million, and 18 cities over 5 million. It is estimated that by 2050, the urban population in China will reach 1 to 1.1 billion.

33. The Chinese Government has set a priority to develop the public transportation. The plan developed at the national city public transportation conference held in May 2004, makes it clear that in the next five years public transportation will make up 30% of the urban transit passengers, and large cities will have a traffic configuration using large size vehicles.

34. With the growing urban population and the help of government policy, the bus industry has rapidly grown in recent years. Now China is the largest bus production country in the world (see Table 3 below). By the end of 2004, the total number of public buses in operation was 260,000.

Table 3: Production of large and medium buses in China

Year	**Large and Medium Bus Production (unit)**	**Large Bus Production (length: 10-12 M)**	**Medium Bus Production (length: 7-10M)**
1998	23,000	6,025	16,952
1999	37,400	7,400	30,000
2000	43,891	7,953	35,938
2001	59,660	11,431	48,169
2002	81,871	17,296	64,575

1.4.2 China's research and development on fuel cells and fuel cell vehicles

35. Shanghai is the center of industry, business and finance for China. Shanghai is also the hub of road, railway, air, and water and sea transportation. The area of Shanghai is 6,700 km^2 and its population is 20 million including 4 million temporary inhabitants. Shanghai faces great environmental and energy challenges under such conditions.

36. Shanghai follows a sustainable development policy and is attempting to build an environmentally sustainable city. The vehicle emission control policy in Shanghai is as strict as that in Beijing and public transportation is a priority. There are more than 18,000 buses running. Shanghai made substantial contributions to the demonstration project. Shanghai established an advisory committee headed by a Vice Mayor, a project management office set up and a project manager appointed. The Shanghai team developed the preliminary specifications for FCBs and HRS and selected the demonstration route and hydrogen station site. They also undertook many study tours to communicate with potential suppliers. In addition, Shanghai has substantial hydrogen fuel resources due to its industrial operations. Industry by-product gases are annually over 2 billion m^3, and these rich hydrogen gases can be easily purified into hydrogen for fuel cell.

37. China's research on fuel cells has made great progress in recent years. Fuel cell systems, fuel cell sedans and city buses are listed in the nation's 10th "863" 5 year plan of high technology and science development. The Chinese Government contributed 120 million RMB (USD 15.3 million) towards support for FCB-related activities in China during the 10th 5 Year Plan. In 2002-2004, three city bus prototypes with PEM (Polymer Electrolyte Membrane) fuel cells were developed, with fuel cell systems supplied by Dalian Chemical and Physics Institute, and Shanghai Shenli

Science and Technology Company. The rated output power of the three buses is 50, 60 and 100 KW. The three hybrid FCBs, now undergoing testing, used NiMH-battery or Li-ion-batteries and were assembled by Tsinghua University.

38. The Chinese government has adopted the strategies of “sustainable development” and “developing the country by science and education”, and the policy of “priority development of public transportation in cities”. A series of measures have been carried out to push the development of clean and energy saving vehicles, especially the CNG vehicles during these years. The government also supports the development of electric vehicles and FCVs, forming a solid base for the UNDP-GEF China FCB project.

1.4.3 International cooperation

China attaches great importance to hydrogen development within the country. Under the support of the US Department of Energy, the Ministry of Science and Technology (MOST) is developing a Chinese Hydrogen Development Roadmap, which includes a description of the hydrogen economy and strategy to realize this goal. It includes a China hydrogen vision and timeframe, and the goal and timeframe of using hydrogen in transportation, power and infrastructure. Three phases were identified:

- By 2020 - Technology Development Phase: Research to meet customer requirements and to establish the business case leading to a commercialization decision.
- By 2050 - Market Penetration Phase: Electric power and transport market begin to develop; infrastructure investment begins with government policies.
- Beyond 2050 - Fully Developed Market and Infrastructure Phase: The hydrogen economy is realized.

MOST held consultations for the Roadmap in 2004 and a draft of China’s Hydrogen Vision has been developed, still to be finalized and endorsed in the future. A 3 phase strategy is in place, focusing on initial demonstration and R&D for FCB (2005-2020) (the demonstration of FCBs at the Beijing Olympics 2008 and the Shanghai World Expo 2010). Together with support activities for commercialization, this should lead to greater market penetration with focus on urban areas along with functional and stable infrastructure.

It is expected that the FCB will undergo several technical breakthroughs aimed at enhancing durability and reliability, decreased cost, capability of startup at low temperature, low-cost hydrogen supply, and availability and affordability of hydrogen infrastructure. The hybrid bus systems will allow a substantial amount of regenerative energy to be recovered, boosting fuel economy and greatly reducing brake maintenance, and allows the bus developer to leverage the large investment that has been made in light duty fuel cell engines. This project is a key step in achieving competitiveness with existing buses, and in getting FCBs in China on track for commercial development.

MOST and the Federal Ministry of Traffic, Construction and Housing of Germany signed the Cooperation memorandum of understanding on New Renewable Energy in transportation application in Dec. 2003. The first steering committee meeting was held in Beijing 2004. The meeting discussed the sustainable transportation energy cooperation contents. The focus of cooperation will be to jointly investigate and apply alternative energy for China, and to explore the feasibility of developing and using bio-fuel and hydrogen in the transportation field.

39. China and France also have had cooperation in clean energy vehicles, especially in Electric Vehicles. The electric vehicles sponsored by France are being demonstrated favorably in Shantou and Tianjin.

40. A memorandum of technology cooperation had been signed by China and Canada, with the hydrogen and fuel cell technology cooperation as the priority. In addition, China has set up good cooperation relationship with many international energy and auto companies, such as Ballard, BP, DC, GM, Toyota and Hyundai etc.

41. China is already a member of the International Partnership for Hydrogen Economy (IPHE). The Team has undertaken many visits to other countries to understand their experience and capability in this area, and has hosted reciprocal visits from many countries. In addition, the Team is a participant in the data-sharing project of the International Fuel Cell Bus Working Team (which includes the CUTE project and the California Fuel Cell Partnership), and will get support from the data-sharing project throughout Phase II Project.

5 Stakeholder analysis and participation in project development

42. The Chinese Government strongly supports FCB development and commercialization in China. In the 9th 5 Year Plan (1996-2000), the government started to support relevant research and development under the direction of the State Science and Technology Commission (MOST). The 10th 5 Year Plan (2001-2005) provided $15.3 million RMB to support for the technology, including co-financing of the UNDP-GEF FCB project.

43. Since the project's inception in 2003, the officials from MOST and local governments (Beijing and Shanghai), Beijing Public Transit Company, Tsinghua University, domestic and international private companies have participated in the project as project stakeholders.

44. The private sector has shown great interest in supporting China in developing FCBs and hydrogen refueling systems. During Phase I of the project, DaimlerChrysler, Hyundai, UTC, Ballard and GM all contacted the project team. Shanghai Automotive Industry Corporation (Group), Dongfeng Automobile Company, and Tsinghua Coway participated in the bidding process. BP provided approximately US$3.5 million of technical assistance to build the hydrogen refueling station. During Phase II, UNDP/GEF will continue to assist the project authorities in mobilizing interest from the private sector in supporting the project. Additional details of the Stakeholder Involvement Plan are provided in Section IV.

6 Baseline Analysis

45. Under the baseline situation, the municipal transport authorities in Beijing and Shanghai will continue to provide bus transport to its population as needed. In 2003 in Beijing, there were 16,022 buses fueled by internal combustion engines, of which nearly 5,700 operate on diesel. By April

2005[2], there were over 18,000 buses in service, of which 8,026 were diesel fueled. Roughly 500 trolley buses operate in Beijing. In Shanghai, the situation is even more pronounced. In 2005, approximately 18,015 buses were under operation, with 16,364 of these considered medium to heavy duty. Of these buses, more than 10,000 are estimated to operate on diesel.

46. The urban transport sector in these two cities has a major influence on the environmental quality 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 a total of 400,000 vehicle-kilometers. During this operation, they would be anticipated to emit approximately 44.6 tons of C or 163 tons of CO_2 during the project's lifetime.

[2] Statistics of Beijing Public Sector

Strategy

7 Project Rationale and Policy Conformity

2.1.1 UNDP-GEF FCB Programme

47. UNDP-GEF adopted four Energy Priorities, including Strengthening national policy frameworks, Promoting rural energy services, Promoting clean energy technology and increasing access to financing for energy. Energy and environment service lines focus on two sectors: **Sustainable Energy -**Rapid economic growth and urbanization without proper consideration on environmental protection have created serious challenges for China's sustainable development. If growth continues to be based on excessive use of natural resources, China will be unable to achieve the environmental targets of the Millennium Development Goals; **Greenhouse Gases and Pollutants-** Since 1993, UNDP-GEF has supported many small and medium-sized Chinese enterprises in converting production and industrial cleaning processes to ozone-friendly alternatives, and helped build technical and managerial capacity to ensure an efficient and timely phase-out at the national level.

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

49. At the GEF Council Meeting in November 2000, the GEF jointly with UNDP summarized the outputs of a series of workshops sponsored under the UNEP Medium-sized Project "FCB and Distributed Power Generation Market Prospects and Intervention Strategy Options". GEF made the Council decision "…GEF should develop the five FCB projects currently in its pipeline…" consistent with the objectives of OP 11.

50. 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 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.

51. By supporting deployment of FCBs in GEF program countries, GEF is refueling 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 programme countries can then develop partnerships with technology developers, thereby increasing technological competence and adapting the technology to local needs. GEF programme 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, GEF will also be assisting developing countries in preparing for a future transition to newer, cleaner and more efficient fuel-supply systems.

52. The risks associated with achieving the anticipated GHG benefits have been addressed through 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 GEF should develop the five FCB projects currently in its pipeline taking into account the recommendations made by STAP and the technical comments of Council Members. However, before proceeding with any FCB 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.

2.1.2 Review of Implementation Phase I

53. The Project Evaluation of the implementation of Phase I was undertaken from 15-26 November 2004 by an expert group appointed by UNDP. The report of the Evaluation Mission has been prepared and is available upon request. As the Report noted; “The China FCB project can take the global lead amongst other GEF FCB projects”.

54. The major achievements of Phase I are summarized below:

- A National Project Advisory Committee headed by Deputy Minister was set up, including members from MOST, National Development & Reform Commission, Ministry of Finance, Ministry of Public Security, Ministry of Construction, and UNDP;
- The Beijing and Shanghai Municipal Advisory Committees were set up also, each headed by a Vice Mayor;
- National Project Management Office was established, National Project Director, Deputy Director, and national and international experts were selected. Beijing and Shanghai Municipal Project Management offices were also established. Project management and working staffs were appointed;

- The Preliminary Technical Specification of FCB and hydrogen fueling station were released on 20 August 2003;
- During September to November 2003, three delegations conducted study tours to the potential FC, FCB and HRS Suppliers for exchanging information, and discussing concerning problems. The 20 companies visited are located in North America, Europe and Japan, and the potential suppliers included Daimler Chrysler, GM, Toyota, Georgetown University, Thunder Power-ISE, Ballard, UTC, Hydrogenics, Stuart, Sunline, Panasonic and several suppliers of HRS units;
- Tender Document for FCB was released on 18 December 2003;
- Four bidders submitted their bidding documents by 18 March 2004, and Daimler Chrysler won the bidding after an open, fair, impartial, transparent evaluation process that considered best value-for-money;
- On 26 May 2004, the procurement contract was signed with Daimler Chrysler to deliver three Citaro FCBs to Beijing in September 2005, with similar specifications and after-sale service as that for the ten European FCB Demonstration cities. DC provides a guarantee for FCB operation for 2 years or 4,000 hours (whichever occurs first);
- On 9 May 2004, a memorandum of cooperation to build a Hydrogen Refueling Station in Beijing was signed by representatives of MOST and BP in London. The cooperation agreement for building the hydrogen station in Beijing was signed after the feasibility study was completed, and refueling service is targeted to begin before the arrival of the FCBs;
- Three delegations conducted a “Policy Study Tour” to Europe with 29 members from national Commission, Ministries and Bureaus to study the policy, planning, management of developing hydrogen-power vehicles, and public transportation as well as European FCB demonstration projects in Stuttgart, Hamburg, Stockholm, Reykjavik, and Luxembourg; UNDP Sao Paulo FCB project , California Fuel Cell Partnership;
- Eight issues of the Project Newsletter were published. The Project Website (www.chinafcb.org.cn) was set up in both English and Chinese versions. Semi-annual report and Annual Project Implementation Reports (PIRs) have been produced;
- The UNDP-GEF China FCB project was presented in four International FCB workshops, three national academic and technology conferences. Also, national and local TV and radio station, newspaper and periodicals reported on the activities many times.

55. The Evaluation report indicated that good management and careful preparations have maximized the effectiveness of capacity building efforts of the project. The evaluation suggested continued efforts to foster and maintain working relationships between all project participants. Regarding the next steps for the project, a number of recommendations were provided including support for the GEF’s approval for Phase II project funding given that:

- the project conforms with GEF requirements and contribution to the global environment;

- valuable information can be provided from the operation of a new generation of FCBs;
- optimism that the cost reduction curve for fuel cell technologies will be steeper in the coming years;
- the Government of China strongly supports the project at all levels; the overall impact of a successful FCB demonstration in China is enormous considering the size of its public transit sector and the potential to showcase FCBs during the 2008 Olympics and 2010 Shanghai World Expo; and,
- the China FCB project can effectively share its successes with other GEF FCB projects.

Corresponding to evaluation report suggestions, some measures have been taken as follows:

Suggestions	**Measure**
Time for completion of some of the activities outstanding from Phase 1.	• Construction of maintenance workshop and FCB garage will be completed in October 2005.
	• Management mode, organization and operational guideline of FCB demonstration were completed in August 2005.
	• 3 FCBs delivered to local authority of Beijing in September 2005.
	• Temporary hydrogen refueling system will be available at the end of October 2005.
	• Professional training for approximately 50 by October 2005. (20 from local transport authority, 25 from hydrogen refueling station and 5 from government agencies.)
	• Data collection system (software) to be completed by end of September 2005.
	• The construction of the hydrogen refueling station in Beijing will be completed before March 2006.
Maintain and improve the working relationships	• A coordination committee was set up for the implementation of Beijing FCB project, members including national PMO, Beijing PMO, UNDP, CICETE, BP, DC and CTA. Two working groups under the committee are FCB demonstration group and hydrogen refueling station group.
	• Six coordination meetings have been held from May 2004 to August 2005.
	• Meetings for the hydrogen group were held every 1-2 month, and one telephone meeting every 1-2 weeks.
	• Email communication frequently.
Funding	• Co-financing budget increased

2.1.3 Market Assessment for Phase II

56. To further guide the development of the Phase II project, an assessment of the FCB market in China was undertaken focusing on market requirements, competing technologies, and FCB technology in particular. FCBs have attracted considerable attention and investment over the last 5 years due to their potential to provide zero emissions, high fuel efficiency, the ability to use renewable sources of energy, and their ability to encourage the use of public transportation. For this potential to be

realized, FCB technology must offer a commercially attractive alternative to municipalities and other bus operators. This will require a clear understanding of the requirements for commercial success, the capability of FCBs to meet those requirements, and the relative value equation of fuel cell technology as compared to existing technologies such as diesel, CNG, and electric trolley.

57. ***Market Requirements*** - Bus operators attempt to provide attractive low cost transportation to public transit consumers. Although many bus operators are municipalities that have an obligation to promote societal benefits, these obligations are not absolute, and have to be balanced against operating costs, capital costs, and consumer acceptance.

58. The global bus market is dominated by the Chinese and other Asian developing countries and South America. Although there are many buses in use in the developed countries of the US, Europe, and Japan, private automobile use is so prevalent that these areas are a relatively small portion of the global bus market. The Chinese market alone is well in excess of 70,000 units per year, with a fleet of over 300,000 units in use. Because these vehicles are large and operate under very difficult stop and go duty cycles, fuel cost is a major component of the operating cost of the vehicle. A typical bus may use 25 gallons or more of fuel in a shift, and as the global price of oil increases, this will represent an increasing burden on the transit operator and its customers. The major bus markets have a relatively low labor cost, so fuel is a larger fraction of overall operating cost than it is in the United States.

59. Bus engine life is currently expected to be about 12,000 hours of operation. Depending on the duty cycle and market expectations, the bus chassis can either be repowered, or a new bus purchased, so that bus depreciation can be roughly approximated by dividing the capital cost by 12,000 hours. Brake maintenance cost is also a major contributor to operating cost, approaching that of fuel cost in areas where labor is expensive. A very crude per hour cost breakdown in a low labor cost market would be as follows: depreciation -- $3, fuel -- $12.50, brake repair -- $4, labor $2, for a total of $21.50 per hour.

60. Consumer expectations are also rising, and consumer demand for clean, quiet transportation is increasing. Bus transportation is constantly competing with alternative transport approaches such as light rail and private automobiles. A perception of buses as dirty, noisy, and uncomfortable lowers the value of bus transportation to the consumer, and promotes an image of buses as the lowest value transportation alternative.

61. ***Competing Technologies*** - By far the most common bus technology today is the diesel ICE. Its advantages of low cost, easy maintenance, reliability, durability, with readily available fuel infrastructure have allowed it to dominate the global market. However, it also has the disadvantages of low fuel economy, emissions, and noise which are becoming a greater concern to both society and bus customers. The CNG technology can offer low emissions and some improvement in noise but does not improve fuel economy and has a significantly greater cost. Electric trolleys are very

fuel efficient, have no local emissions, low noise profiles, and are regarded as a "premium" or desirable mode of transportation, but have an extremely high capital cost as well as requiring significant investments in infrastructure.

62. Currently, 2500 CNGs are in operation in Beijing with 4000 anticipated by 2008. There are 1,700 LPGs operating currently in Beijing, and 543 trolleys have been running in Beijing since the end of 2004. In Shanghai, there are 300 CNGs and nearly 500 trolleys.

63. ***FCB Technology*** - FCB technology is still immature, and is in a technological research and small-scale demonstration phase. Due to the relative immaturity of the technology, it is difficult to calculate the purchase cost and operational cost of FCB and hydrogen station installation. As indicated in Section I Part 1, U.S., Europe and Japan have targeted 2020 for the development of FCVs. Ten percent of new buses purchased in 2015 will be FCB according to the U.S. Department of Transportation.

64. Significant progress is being made in developing better technologies for commercial applications. A primary change has been the development of hybrid bus systems using light duty vehicle fuel cell engines coupled with hybrid electric batteries. This allows a substantial amount of regenerative energy to be recovered, boosting fuel economy and greatly reducing brake maintenance, and allows the bus developer to leverage the large investment that has been made in light duty fuel cell engines. Although fuel efficiencies are over twice that of competing technologies, fuel cost depends on the relative price of hydrogen in the using market. The following is a table of the current technologies, and how they compare to today's fuel cell technology. Obviously, the key issue will be to retain the advantages in operating costs while reducing the capital costs and increasing the life of the engine.

Table 4: Comparison of current technologies (Costs in USD for US & European markets)[3]

	Diesel	CNG	Trolley	Fuel Cell
Annual Fuel Cost	$40,000	$40,000	$10,000	$20,000
Annual Brake Repair	$12,000	$12,000	$2000	$2000
Emissions	--	0	+++	+++
Noise	--	-	++	+
Capital Cost	$200,000	$375,000	$750,000	$1,400,000
Life (hours)	12,000	8000	15,000	3000

65. Because of the high capital cost of trolley buses, and the requirement for very expensive infrastructure, in the shorter term FCBs will become competitive with trolley buses and, therefore, the initial commercial acceptance of fuel cell buses is anticipated to be with transit authorities that are considering trolley installations. This requires cost reductions of at worst 50%, and because of the infrastructure investment, it may be that FCBs are very close to being competitive today for capital cost. This

[3] Fuel costs during Phase I Project will be determined through negotiation between BP and the Beijing Public Transportation Corporation. Long-term costs have been estimated in many studies as between $3 to $4 per kg.

strategy takes into account the time required for fuel cell technology to mature before it will be competitive, with the final goal of displacing diesel buses. The roadmap to do so is being informed by the experience gained from the GEF demonstration programs and from early commercialization. Over the longer term, commercialization of fuel cell buses is expected to reduce costs and increase value thereby allowing for displacement of diesel buses. The key issue is the durability of the fuel cell engine. Commercialization is completely dependent on developing very durable and long life fuel cell engines that are comparable to the competing technologies. Cost reductions are necessary, but do not have the impact of increases in operating life.

66. Since fuel cell technology is not mature, for example reliability and durability have not been fully tested, whether the FCBs can operate for two years and 4,000 hours cannot be guaranteed. However, the cost reduction of FCB in the future is expected as evidenced by several sources.

67. Because China is the largest bus manufacturer and exports a large number of middle and low level buses, if fuel cell systems or FCBs will be produced in China the costs should be lower than if it produced in America, Europe and Japan. More advanced technologies such as CNG buses are also exported. FCB production is requiring a large number of workers instead of production lines, which is a good fit in China where worker's salaries are one tenth of the price in developed countries. In addition, material and management costs are low as well. Overall, the FCB production costs in China should be low. If national fuel cell propulsion system research succeeds in China, the FCBs made in China will be competitive in the future.

68. An initial ridership survey was held in July-August 2004 in Beijing, which involved two parts: one for the survey of Beijing public awareness of FCB, the other for the survey of energy, environmental and transport consciousness among Beijing public. The investigators designed several sites in each of Beijing's eight zones and surveyed focus passengers randomly. According to the surveys, 36.5% of the interviewees preferred to take bus as the primary method regarding the premium form of transportation. The survey also investigated the willingness to pay for a FCB ride and found that over 30% surveyed were willing to pay a premium to ride a FCB.

69. While FCBs are not yet operational in China, a hydrogen and FCB development roadmap for China s will be prepared in the project. As the immediate objective, FCV fleets will be operated in service in Beijing for the 2008 Olympics and in Shanghai for Expo 2010. A hybrid configuration, with a lower-power FC engine combined with batteries, can guarantees good-driving performance required. Costs and hydrogen consumption can be significantly reduced by braking regeneration and reducing the wear of braking. In addition, petrol price increases also make the FCB more competitive than in the past. The China FCB project's Phase III intends to increase the demonstration scale to tens of FCBs operating in several cities in China.

70. To summarize, the major outcomes of the FCB market assessment are as follows:

- Initial FCB commercial market will be to replace new trolley applications, then trolley expansions, then CNG buses;
- Advantages of FCB for operating costs are substantial, but they cannot overcome large capital cost disadvantages;
- Hybrid technology is very desirable to improve operating cost advantage and to lower capital cost;
- Increasing the life of the fuel cell engine is the highest leverage technology improvement toward commercialization; and,
- It will take several more generations (at least 10 years) of improvement before commercialization will begin.

8 Project Goal, Objective, Outcomes and Outputs/Activities

71. The goal of the project is to reduce GHG emissions and air pollution through widespread commercial introduction of FCBs in urban areas of China.

72. The objective of this project is to demonstrate the operational viability of FCBs and their refueling infrastructure under Chinese conditions.

73. The FCB project in China has several unique features that contribute to the overall GEF FCB Portfolio of projects, and will be carried out in two cities—Beijing and Shanghai which have different geography, climate, road, traffic, social and market conditions.

2.2.1 Project Phase II outcomes

74. The satisfactory progress of the Phase I project provides a basis for the success of the Phase II project implementation. All outputs of Phase I have been delivered, with the outputs of Phase I including the following:

- 3 FCBs for Beijing procured;
- A hydrogen refueling station built;
- FCB workshop and garage built;
- Data collection system design complete;
- Study tours conducted;
- Staff trained;
- Ridership survey conducted; and,
- Eleven newsletter and various reports submitted and workshops conducted.

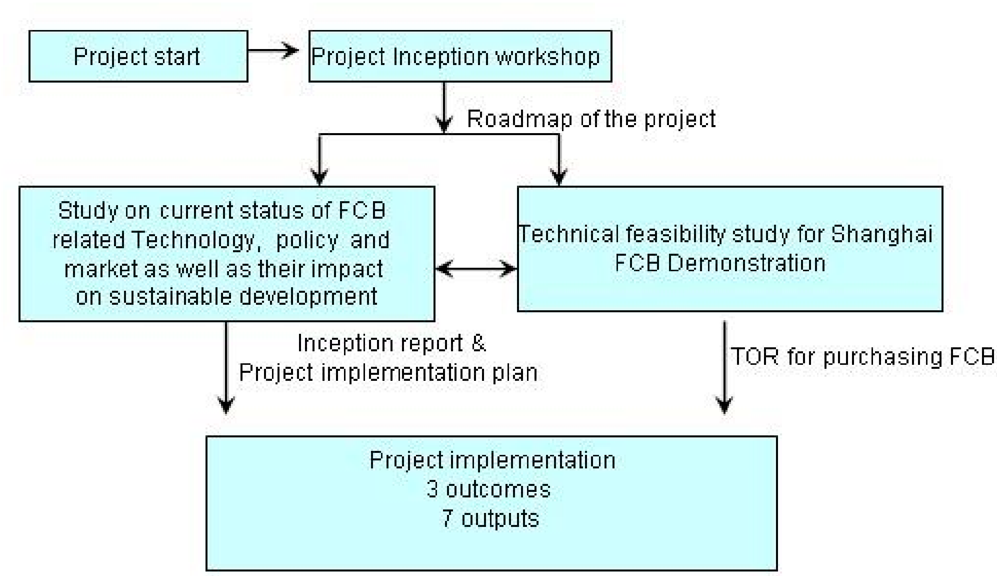
The three main expected outcomes of Phase II are:

- Outcome A - To demonstrate the operational viability of FCBs and their refueling infrastructure by setting up FCB fleets and supportive facilities in China ;
- Outcome B – To accumulate technical, policy knowledge for advancing commercialization of FCB technology and hydrogen refueling system

- Outcome C – Promote enabling environment for FCB expansion and support the design of roadmap for commercialization of Fuel Cell buses in China

75. The main strategies that shape the Phase II project are summarized as follows:

The technology, policy and market study related to FCB will be the main issues to be address in the Phase II. The strategy to implement them is show as below:



In summary, the underlying strategy of the Phase II Project is to build on the experience gained from Phase I, and to use this experience to advance the technology in Phase II. The program is aware of the risks in seeking new technology in Phase II, however the gains in terms of advancing the state of the technology are considered worthwhile. This includes the development of hybrid technologies to improve fuel economy and to reduce costs, as well as potentially developing lower cost sourcing of key parts of FCBs from China and elsewhere. The program will be looking carefully at the proposals from various FCB suppliers. Partnerships with established global suppliers, and verifiable performance experience, testable prototypes and other mechanisms will be used to minimize the risk profile. The use of the RFP format for bidding allows for extensive interaction and negotiation with suppliers during the bidding process that will enable the Project Team to make a proper evaluation of the risks associated with the proposals.

2.2.2 Project Activities and Expected Outputs

76. Phase II implementation will draw on the experience and lessons learned from Phase I. Outcome A relates to Output 1 and Outputs 2; Outcome B relates to Output 3 and 4; and Outcome C relates to Output 5, Output 6 and Output 7.

- Output 1: A commercially-relevant demonstration of the technical feasibility of FCBs and their refueling infrastructure and staff training related to their operation in Beijing and in Shanghai.
- Output 2: Performance analyzed including reliability and failure modes, supporting improvement the design and reducing the cost of FCBs in China.
- Output 3: Set up the FCB knowledge base, and analyze the technical issues related to FCB value chain .
- Output 4: Promote the FCB related technology development.
- Output 5: Policy and market studies on FCB related value chain
- Output 6: Set up the platform to strengthen the cooperation between national and international stakeholders including policy makers, investors, industries and the general public
- Output 7: Support and engage in the FCB development roadmap design including expanded demonstration feasibility study.

77. The following set of activities will be associated with each of the outputs. Thesequence and timing of activities and the breakdown of activities of Phase II are described in chart form in Section II (Table 10). The full logical framework is provided in Section II.

Activities related to Output 1
Activity 1.1: Purchase the FCBs.

The project team will undertake communications with as many potential fuel cell engine/bus suppliers as possible and select site visits for selecting appropriate FCB and HRS manufacturers. The communications will help the project team : 1) to understand the present status of specific companies' technologies; and 2) to maximize the likelihood of wide participation in responding to FCB supply to Shanghai； 3）to investigate the possibility to build the partnership with the fuel cell vehicles and energy companies for long term strategy.

After the communications with the suppliers, the project team will specify the preliminary specification of the buses and the refueling system, such that they will meet the needs of the project. The current assumption is that complete FCBs will be procured. This will be done to reduce the specification and procurement time and effort, and most importantly to minimize technological risks.

The vendor(s) will be selected on the basis of best value for money for the complete Phase II period, subject to meeting the specified technical and performance requirements. The Project team will use the advice of specialists, both National and International, in evaluating the claims of the prospective bidders. In addition the RFP process allows the team to request data to support claims, including providing special testing if necessary. At least 3 FCBs and its spare parts and services for Shanghai will be purchased.

Activity 1.2: Install, operate and maintain the fueling infrastructure.

The primary fuel infrastructure contractors will oversee the installation, operation, and maintenance of the hydrogen generation and refueling system. Installation of the refueling system will precede the arrival of the initial set of buses in Shanghai. It will involve the installation, start-up, operation and maintenance of the refueling infrastructure. The hydrogen quality and amount from hydrogen refueling station requirements must meet the FCB demonstration requirements.

Activity 1.3: Working together with the suppliers, hold training for drivers, maintenance and refueling station staff.

This activity must ensure the training of sufficient numbers of operating and maintenance personnel to ensure both the execution of the immediate project and the preparation for a larger follow-on demonstration. Training consists of basic training professional training and on-the-job training when the buses are in operation throughout Phase II of the project.

Activity 1.4: Place the buses in operation.

Place the 3 buses for Beijing in service. These Beijing and Shanghai buses will be operated for maximum 2-3 years or 4000 operation hours per bus in revenue service under realistic operating conditions.

Activities related to Output 2

Activity 2.1: Collect, analyze, and evaluate operating data on efficiencies, reliability, failures, and potential improvements.

Through a consultative process involving the project team, the suppliers, and other experts, a protocol will be developed for quarterly reporting on the technical operations of the bus fleet (e.g., in-service reliability, failure modes, operation hours & mileage, energy consumption, etc.).

Develop database of FCB operation and maintenance in both cities. In collaboration with the suppliers, the project team will engage in systematic logging, analysis and interpretation of operating parameters paying particular attention to reliability, failure modes and potential improvements in design and operation of the buses. The project team will also establish the FCBs and refilling station related incidents recording, analysis and action taken database. The FCB related operation data will be compared under different traffic condition.

Activity 2.2: Develop operation guideline for FCB and HRS operation and maintenance.

After integrating with the operation experience and lessons learned from the Phase I, the PMO and local PMO will establish FCB and hydrogen refilling station operation guidelines. The guideline will be developed for use of the FCB and hydrogen refilling station operators, mechanics and managers.

Activity 2.3: Social and environment research

The CO2 emission reduction will be calculated after the FCBs demonstration. The analysis report related the environmental issues will be developed by comparing with the diesel and CNG buses operation and FCB demonstration in Beijing and Shanghai. Also, the related survey will be conducted to investigate the local bus riders and local citizens' response before and after the FCBs operation. Based on the surveys and analysis, the project team can understand the social and environment impact of the demonstration project.

Activities related to Output 3

Activity 3.1: Learn the international experience related to FCBs value chain

Many countries are undertaken FCB related R&D and demonstration. The information and experience sharing is very important to promote the technology improvement and successful demonstration. This activity gives special emphasis to interactions with the UNDP/GEF FCB project and other non-GEF FCB projects.

Activity 3.2: Research on the technical development related to FCBs value chain

The study will include hydrogen production, hydrogen storage, fuel cell system and FCV system integration development in and outside China. These studies will facilitate FCBs related technology improvement.

Activities related to Output 4

Activity 4.1 Promote the future certification development for FCB and refilling station in China.

This work will collect national and international standards, regulations and codes related to FCB and hydrogen refueling station. After exchanges and on-site visits to foreign institutions that have developed the FCB standards, regulations and codes, the team will investigate and prepare the draft documents, mainly about FCB and fueling station safety. After integrating the lessons learned from FCB demonstrations in Beijing and Shanghai and other cities, the team will then prepare FCB technical certification proposals for related authority. And the team will also study and prepare the policy proposal for the FCB market entry.

Activity 4.2: Provide the suggestions for future FCB design that might better meet Chinese operational conditions.

Based on information generated during the demonstration project in Beijing and Shanghai, the project team will provide the suggestions for future FCB design that might better meet Chinese operational conditions.

Activity 4.3: FCB related life cycle analysis.

The existing hydrogen resources, production and storage will be thoroughly investigated. The related analysis model will be established based on the local boundary conditions. The well to wheel life cycle analysis including *CO2 emission reduction and energy efficiency analysis* will be conducted.

Activities related to Output 5

Activity 5.1: Policy and market study to promote the FCB commercialization

The purpose of the study is to help provide a basis for strengthening the capacity of the decision makers and policy planners, which will help insure sustainable, wide-scale introduction of FCBs in the long term. The policy studies will be used as inputs for the Commercialization Roadmap, and will also provide suggestions for improving any later demonstrations. The study tours will be organized to visit the planners and policy makers of public transport and FCB demonstration projects in the world.

The market survey related FCBs value chain will also be conducted to understand the future FCB development in the world.

Activities related to Output 6

Activity 6.1: Partnership building

The project will try to establish the partnership with vehicle manufacturers, energy companies, FC companies, public transportation corporations, research institutes, universities and infrastructure operators, authorities. After establishing the data base of the industrial stakeholders, authorities, investors and other possible partners, the comprehensive set of FCB and hydrogen refueling station operational data are shared among the possible partners. It will enable them to make key decisions on investments in FCB and hydrogen infrastructures.

Activity 6.2 Set up the project website to provide technical, policy and market information

The project related information including the progress, experience and events will be presented on the website to provide the detailed information to the stakeholders and public. The website is the information sharing platform which will promote the information exchanging and public involvement. The project website will be updated and be linked with UNDP/GEF and other projects websites.

Activity 6.3 Organize the national and international conference/workshop to promote the cooperation among stakeholders.

The project team will take the opportunity to promote the cooperation between national and international stakeholders including policy makers, investors, industries. The workshops are both to keep organizations, institutions, universities and government informed of progress in the UNDP/GEF project and to help foster the advancement of China's scientific, technical, and manufacturing capabilities relating to FCBs. The workshops will be held every two years. The project will solicit and review feedback from the workshop participants on the relevance and quality of the workshop.

Activity 6.4 Public awareness and education

Some major events will come during the project, including the FCB operation ceremony, 2008 Beijing Olympic Games and Shanghai 2010 World Expo. Therefore, the project will definitely draw the attention around the world at above great events.

The project will use the media (newspapers, TV, radio, billboards, internet site, etc.) to publicize results of the demonstration project and plans for future projects and prepare the multi-media materials and brochures.

The team will organize more public education activities. The team will arrange the VIP guests, students and government officials and some international conference guests to take the ride of the FCBs

To improve the awareness of the hydrogen and FC technology, the project team will cooperate with other UNDP/GEF projects which connect to the environmental awareness and energy efficiency.

Activities related to Output 7

Activity 7.1: Carry out technical, institutional, and financing feasibility studies for future expanded demonstration cities.

The cities that which have some experiences with Electric Vehicle demonstration or EV, HEV &FCB R&D are all candidate to undertake FCB demonstration. Besides Beijing and Shanghai, other cities like Wuhan, Chongqing, Dalian etc. are being demonstrated EV, HEV, FCB or CNG buses on the road. These cities had gained some experience from the clean vehicle demonstration, which will lay the sound foundation for the future FCB demonstration. The experts panel will be formed to investigate the possibility to have FCB demonstration in these cities. The best 3-6 cities will be selected as the future FCB demonstration cities in Phase III based on their own feasibility study reports.

Activity 7.2: Support the FCB development roadmap in China.

The roadmap study will take into consideration the experience with the Phase II demonstration and outside evaluations of this experience, as well as developments elsewhere in the world. Comparing with diesel, alternative fuel vehicles and hydrogen FCB etc various technologies, the project team will carry out research on urban environmental pollution, energy efficiency, cost, infrastructure construction and lifecycle analysis.

9 Project Indicators, Risks, Assumptions and Lessons Learned

2.3.1 Indicators

78. The project indicators are described in detail in Section II of the Project Document (Logical Framework). Briefly, the indicators at the project level include the following: CO2 emissions associated with the demonstration vehicles are reduced in Beijing and Shanghai during the project; larger reductions in China and elsewhere once FCB technology is commercially deployed.

79. Also provided in Section II are the outcome-level indicators, summarized below:

Outcome A: Six to nine FCBs and two hydrogen refueling stations operational in Beijing and Shanghai (including 3 FCBs procured and 1 station constructed in Phase I)

- 3 to 6 FCBs procured in Phase II
- 6 to 9 buses in operation for at least average 4000 hours or 2 years per bus
- 2 refueling stations placed into operation
- Installation of the hydrogen fuel supply stations
- Enough H2 station operators and FCB drivers and mechanics trained in Beijing and Shanghai
- hydrogen production and quality projected target for satisfaction of FCB demonstration requirements
- Reporting and FCB operation guidelines
- As many as possible experts consulted
- 24 quarterly reports collected in both cities
- Ridership survey conducted
- The social and environment research report developed

Outcome B: Knowledge accumulated, available and accessible for advancing commercialization of FCB technology and hydrogen refueling system

- The FCBs value chain research reports developed
- Bi-monthly newsletters; semi-annual reports; annual review reports; public awareness materials (semi-annual); study tour reports (post tours); and other technical, operational, managerial and planning reports and documents prepared and made available for broad use by stakeholders
- FCB or vehicle related association be supported
- Experience exchanged and shared through visit GEF or non-GEF projects (like: HyFleet-CUTE)

- Fuel Cell Bus Certification technical proposals developed
- Document of improving Chinese FCB design prepared
- The Well-to-Wheel life cycle analysis reports prepared

Outcome C: Awareness promoted among stakeholders and creation of an enabling environment for FCB expansion and the Phase III (expanded demonstration) Project in China

- Learning and sharing the FCB related policies and planning through the international policy study tours
- Beijing and Shanghai FCB demonstration information exchange annually
- More than two policy study reports submitted by 2010
- Website built and updated
- More local, national and international workshops/seminars held and attended; whole team workshops held every year; international workshops held every two years
- More professional presentations/ publications produced
- As many as media reports
- Public education activities organized
- Workshops held related to expand the FCBs demonstration
- Feasibility studies for expanding FCB demonstrations in Chinese cities prepared
- FCB roadmap documents prepared

2.3.2 Risks and Assumptions

80. The first set of risks relates to difficulties that may arise with bids from fuel cell bus suppliers. Particular concerns include a lack of bidders to supply the project, unacceptably high bid prices, and difficulties reaching agreement on contract terms with the winning bidders.

81. 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 fuel cell engine suppliers, it is very likely that at least two bids will be received for Shanghai. 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... 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 very small for Phase II.

82. There is also some risk that prices of bids will be unacceptably high. This was the situation during the Phase I bid causing only 3 FCBs to be purchased. Several factors mitigate against this risk: 1) 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; 2) 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; 3)

FCB technology has developed considerably in the last two to three years, which should be reflected in reduced costs because of the increasing gasoline price; and 4) Increasing the private sector inputs. The 2008 Olympic and 2010 World Expo will provide the good opportunity for the advanced FCB showcase. Moreover, China represents a considerable potential for commercial development.

83. There is a somewhat greater concern about the technology transfer. 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 probably will not be a problem because China has in place national laws protecting intellectual property rights and, in light of its joining the World Trade Organization, has shown increasing commitment to enforcing these regulations.

84. The FCB power train technology is immature, especially in cost, durability, reliability, and ability to operate under low temperature extremes. The power train working condition relies on the climate, geographical features, environment and traffic features. Its reliability and durability will be improved after more auto makers conduct more research and development and more demonstrations are undertaken. The UNDP-GEF FCB demonstration projects provide an opportunity to further develop the technology to meet these challenges, additionally the lowest temperature in Shanghai is higher that in Beijing.

85. The delay with the Phase I refueling station was primarily one of obtaining the land and necessary approvals. This delay in securing permitting and approvals has been a common experience for all installations worldwide, at least partially explained by the immaturity of appropriate standards and regulations, and was not unique to the Chinese project. Nevertheless, the lessons have been learned and the Phase II Project will take necessary steps to avoid the delays. These issues faced by Phase I will not be a significant risk in Phase II, as the permitting for Shanghai is already being pursued and the permission experiences from Phase I will benifit to Phase II. In addition, to ensure that delays in the hydrogen refueling component of the project do not delay the FCB operations, a temporary refueling system will be used to allow initial operation for a few months. If similar delays are experience in the hydrogen refueling station of Shanghai, a temporary refueling system can also be used.

86. The lack of appropriate policy and regulations support is another risk to guarantee the successful demonstration project. The FCB and hydrogen refilling station related codes, standards and regulation are not completely established in the world. Every FCB demonstration project faces the policy barrier. Therefore, the related standards and policy study are the key activities in Phase II.

2.3.3 Lessons Learned

87. From the implementation of the Phase I project, several lessons were identified in Phase I. Some of these lessons, as outlined in the table below, have been incorporated into the current design of the Phase II project.

Table 5: Lessons from the mid-term evaluation incorporated in the Phase II project

Lessons	Notes	Design Features
GEF and UNDP resources on this project have been effective most notably in the building of partnerships and the successful completion of the FCB procurement process.	• The Phase I project made extensive use of national and international experts to advise on the procurement process including partnership building.	• It will be necessary to continue outreach to partners in the FCB industry during entire procurement process. Use of international experts will be crucial to achieve successful outreach.
Good management and careful preparations have maximized the effectiveness of capacity building efforts of the project.	• To ensure the timely deliveries of the FCBs and refueling station, the Government should provide project management leadership and close monitoring of progress of the Daimler Chrysler FCB contract and the Beijing BP refueling station. • Regular project coordination meeting was set up participants from all the major partners to discuss and solve all the barriers and concerns, for example, 9 meetings were held since May 2004 for Beijing project.	• Management teams as established in Phase I will continue to operate in Phase II. • A Project Management Specialist can be used to provide peer guidance • Information sharing during workshops and closer collaboration between all project participants including selected institutes and private sector equipment suppliers will be emphasized.
There could have been more careful and realistic planning of the FCB procurement during the project design and Inception stages of the project.	• The budget per bus was underestimated in Phase I. To have successful procurement of FCBs it was necessary to rephrase the purchase of buses between cities and to reduce the total number of buses purchased.	• Phase II project specifies a range of FCBs that can be purchased rather than a specific number.
Phase II FCB demonstrations should use different FCBs considering anticipated fuel cell advances over the next 18 to 24 months.	• The rapidly changing technology warrants the procurement of new FCBs to ensure that the Phase II project benefits from advances made in the technology.	• A flexible procurement process in Phase II will allow for procurement of the latest in FCB technology.
The necessity of strong stakeholder support from all levels for a successful project.	• The effective communication between Beijing personnel on the refueling station and the foreign suppliers should be strengthened to secure the project progress as planned.	• Adopt measure to ensure continued support from all stakeholders and partnership building including auto industry, energy companies, high level officials of central and municipal governments
Continual efforts to foster and	• More effective	• The communication

Lessons	Notes	Design Features
maintain working relationships between all project participants is necessary.	communications need to foster an improved understanding of each other main issues.	mechanism will be decided when the suppliers are selected.
The importance of strong technical and administrative personnel is key to a successfully implemented project.	• The Phase I project established a strong technical support system.	• The technical and administrative support established in Phase I should be continued in Phase II.
The importance of market and policy study	• The special permissions were given to guarantee the FCBs and hydrogen refilling station demonstration, including FCB driving licenses, FCB purchasing duty waiver and hydrogen refilling station operation license be coordinating all related governments.	• The policy study is the key activity and FCB policy and market entry research will be conducted. And the FCB certification technical proposal will be developed in Phase II.
The close liaison between the UNDP FCB demonstration and the national EV projects.	• The national EVs projects laid the technical foundation for the UNDP FCB demonstration. And the UNDP FCBs demonstration project provided more opportunities to promote the national technical R&D forward.	• The information sharing at different levels will be strengthened to maximum the knowledge dissemination and sharing. More national companies and institutes will involve in the FCB related value chain research in Phase II.

88. As part of its obligation to the GEF Council, UNDP-GEF has provided yearly progress reports (see UNDP-GEF Fuel-cell bus Programme Update, May 2005) on the implementation of the UNDP-GEF Fuel-Cell Bus (FCB) Programme. The purposes of the report are to provide an update on the status of the FCB portfolio of projects and also to provide additional information on the deployment of FCBs around the world.

10 Expected global, national and local benefits

89. The oil demand around the world are continuously increased with the rapid increase of vehicles. With the commercialization of FCBs, the global fossil dependence, shortage and GHG problems will be addressed. The hydrogen is promised as the primary fuel component of urban public transit systems in the future. As the second oil consumption and 3rd oil import country in the world, China and even the globe will benefit from the FCBs commercialization and hydrogen economy.

90. The widespread use of FCBs in China can reduce both urban air pollution and GHG emissions. 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 more than 0.72 million by 2030. The magnitude of potential reductions in carbon dioxide emissions achievable by widespread introduction of FCBs in China was estimated by assuming that nearly 30% of the buses projected to be on the road in 2030 (i.e., 200,000) were replaced by hydrogen FCB buses. Under such a scenario, the annual savings in carbon emissions would be 9.3 million tonnes CO_2 per year.

91. The benefits in terms of reduced emission of pollutants dangerous to human health and habitat can be attributed to the project. In particular, the demonstration project will reduce the emission of NOx, CO, and THC (see the Incremental Cost Matrix in section II). In addition, there will be reductions in Sox and particulate emissions. There are also significant benefits to the global community, the automotive industry, and the technology providers.

92. In China, the Chinese GDP increase will also benefit from the FCBs' commercialization. For example, the 3.05% GDP loss was due to the pollution in China according to the National . In Shenyang, the total loss was over 5.3 billion RMB accounting for 2.3% of city GDP due to air pollution in 2005. Now the green GDP will become the one of the main indicators to evaluate the local economy. The mass production of FCBs will greatly contribute to the Chinese economy and raise the competitive capabilities of Chinese automotive industry toward sustainable development. With the coming of hydrogen economy new technologies development and employment opportunities will be created.

93. In addition, the local R&D and management and operation as well as the policy and decision making capacity related to the FCB technology will be improved. The related standards and codes and policy need to established with the FCBs expanded demonstration.

    The new technology demonstration like the FCBs and hydrogen station will also provide the citizens more opportunity to learn and accept them. The general education and performance level will be improved, which is consistent with the national policy "Developing the country by science and education".

11 Country Ownership: Country Eligibility and Country Drivenness

94. 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. This project has been endorsed by the GEF Operational Focal Point for China; the endorsement letter is included in Section IV.

95. The China FCB project is part of the UNDP-GEF FCB Programme as outlined in Section I, Part 2 (2.1.1). As such, it is subject to the annual update report as requested by the GEF Council. In addition, UNDP-GEF provides assistance with knowledge management activities that bring together the projects of China and Brazil in various information exchange forums including workshops and virtual discussion groups.

96. The project is very consistent with the Chinese Renewable Energy Laws. China attached great importance to promote the sustainable development. After the renewable energy laws came into effect, the hydrogen and FCBs related technology was given priority to support its development. In the long term, the widespread use of hydrogen produced from the renewable energy will provide more clean and green energy to the world.

97. As reflected in the National Scientific and Technical Development plan for 2005-2020, hydrogen and fuel cell technology research has been considered as one of important subject. Vehicles fueled by hydrogen, and especially FCVs, are anticipated to be the primary component of urban public transit systems in the future.

98. The project has key linkages with the recently approved United Nations Development Assistance Framework (UNDAF) for China (2006-2010). The UNDAF Outcome 3 identifies: “More efficient management of natural resources and development of environmentally friendly behavior in order to ensure environmental sustainability (with special focus on energy, biodiversity and water resources)” and UNDP Outcome 3 targets: “End-use energy efficiency improved and applications of new and renewable energy technologies enhanced”.

99. The FCB project is also consistent with the China Country Programming Document (CPD) (2006 – 2010) approved in June 2005, in particular regarding sustainable energy services for sustainable human development. As outlined in the CPD, continued assistance will be provided to fulfill obligations under multilateral environmental agreements, especially regarding China’s membership of the Kyoto Protocol. Expected results include the commercialization of new and renewable energy technologies, including fuel cells, supported through demonstration and development of strategies, guidelines, standards and regulations.

100. The China Human Development Report (HDR) published in 2002 with title “Making Green Development A Choice” is also relevant to the FCB project. This report notes that road transport is one of the principal sources of outdoor air pollution in China and highlights health issues associated with heightened local pollution levels. Finally, the Millennium Development Goals (MDG) China Report identifies that China’s energy consumption ranks second in the world, and that the use of enhanced technologies may therefore lead to a further rapid increase in energy efficiency.

12 Sustainability

101. There are over 660 cities in China that vary in geography, climate, environment, economic and transit characteristics. At the moment, LPG and CNG demonstrations are being implemented in 16 primary cities in China, and five provinces of China have developed ethanol gasoline demonstrations. The test and demonstration of pure electric vehicles and hybrid electric vehicles have, or will be, implemented in Beijing, Tianjing, Shanghai, Shantou, Wuhan, Hangzhou, Chongqing, and Shenzhen to collect operational data.

102. In addition, there are various buses under operation in China such as conventional diesel/petrol ICE buses, LPG/CNG buses, pure electric and hybrid buses (with or without tracks), hydrogen ICE buses, hythane buses. The FCB, however, has advantages including driving features, energy conversion efficiency, noise, emissions, and fuel availability from various renewable energies. At the same time, the FCB should undergo several technical breakthroughs aimed at enhancing of durability and reliability, decreased cost, capability of startup at low temperature, low-cost hydrogen supply, and availability and affordability of hydrogen infrastructure, before it achieves competitiveness. This project is a key step in achieving competitiveness with the existing above-mentioned buses, and in getting FCBs in China on track for commercial development.

103. The research, development and demonstration of electric vehicle began in 1992 in China, which was then integrated into the Eighth Five-Year Program on High-Tech Research and Development. The support from the Chinese government increased drastically from then on. In the Ninth Five-Year Plan (1996-2000), the total investment in the electric vehicle program (including hydrogen and fuel cells) was about 20 times that of the Eighth Program. During the Tenth Five-Year Plan (2001-2005), the relevant investment increases 15 times compared to Ninth Five-Year Plan. The Chinese government is now drafting its Mid-to-Long Term Plan on Sci-Tech Development, in which hydrogen and fuel cell R&D is given high priority. It is reasonably anticipated that greater support will be allocated to this field.

104. Some work conducted to prepare for the expanded demonstration (Phase III), includes the following:

- Feasibility study on expanding the demonstration bus fleet and replicating it in other cities;
- Conceptual design of FCBs that fits China's situation;
- Life-cycle analysis on the development of FCBs in China; and,
- Study on codes, standards and regulations relevant to FCB and hydrogen refueling station.

105. China actively participates in the International Partnership for Hydrogen Economy (IPHE), and has developed a cooperative relationship with the US, European Commission, Canada, France, Italy and the UK in the sectors of sustainable development, renewable energies and hydrogen/fuel cell. All of these activities

demonstrate that China considers the UNDP/GEF FCB program as an important factor in reaching its mid-to-long term goal of commercializing FCB technology in China.

13 Replicability

106. As mentioned in Phase I 1.4 (Section I), China is developing a scientific and technical mid-and-long-term development plan (2005-2020 Year), and hydrogen and fuel cell technology research has been considered as important within the energy field. The Chinese Hydrogen Development Roadmap includes a description of the hydrogen economy and strategy to realize this goal. Three phases were identified:

- By 2020 - Technology Development Phase: Research to meet customer requirements and to establish the business case leading to a commercialization decision.
- By 2050 - Market Penetration Phase: Electric power and transport market begin to develop; infrastructure investment begins with government policies.
- Beyond 2050 - Fully Developed Market and Infrastructure Phase: The hydrogen economy is realized.

107. The project proposed here constitutes the second of a four-phase long-term program intended to culminate in the market-based commercial production and use of FCBs in China. The four phases are (1) preparation, (2) demonstration, (3) expanded demonstration and (4) mass production in China of cost competitive FCBs. Therefore, this project, in the near-term, is expected to lead to the next phase of a long-term four-phase program. Phase III, the commercialization phase, 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. GEF support for Phase III, however, is not currently established and 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.

108. To ensure replication, this project includes components that involve dissemination of lessons from the project. Under Outputs 3 through 7 there is heavy emphasis on data collection, training, studies, workshops, seminars, strategy development, information exchange, public awareness and media coverage. In addition, the FCB related certification preparation, and the candidate demonstration cities selection are intended to promote the project's replication within China and abroad. The total budget associated with replication under these activities is $2,660,000. Of this $2.66 million, $1.534 million will come from MOST (within Outcome 3 in budget), with $558,000 from GEF (Outcome 3 in budget) and remainder from Shanghai government (under Outcome 2 under budget line 74100) and Beijing government (under Outcome 2 under budget line 74100).

109. Under the UNDP-GEF FCB Programme, communication between UNDP-GEF projects and networking with non-GEF projects is emphasized and supported. The intent is to increase technical information transfer among developing countries and between developed and developing countries. The China UNDP-GEF FCB project has become a formal member of Fuel-Cell-Bus Club (an organization of ten European FCB Demonstration Cities and Perth, Australia), eligible for participating in two workshops for information and experience exchange.

110. UNDP-GEF projects have participated in the First and Second International Fuel Cell Bus Workshops held in 2003 and 2004, respectively. These meetings were attended by representatives of FCB demonstration projects from the European FCB Project (CUTE); Japanese Transit Operation; and the California Fuel Cell Partnership; in addition to UNDP-GEF FCB projects.

111. In an effort to promote an exchange of experiences and technical information within the UNDP-GEF FCB Programme, representatives from the Brazil, China, and Mexico participated in a workshop held in London on 16 June 2004. The challenges associated with data collection systems, and potential approaches to sharing data acquired through the projects, were explored. In addition, the UNDP-GEF project representatives attended a conference hosted by the CUTE and ECTOS projects (14-15 June 2004) where an overview of the CUTE/ECTOS project was provided, FCBs and hydrogen refueling station were demonstrated, and an introduction to the evaluation process and methodology used under the program was discussed.

Management Arrangements

a. FINANCING

14 Financing Plan and Co-Financing

The GEF/ UNDP budget for the project is US $5963,000, which will be used for project activities. The Government of China will provide US $11,439,000 as co-financing, which will be used for government staff, FCB operation, fuel costs, infrastructure O&M and complementary activities.

GEF Outcome	Responsible Party	Source of Funds	ERP/ ATLAS Budget	ERP/ATLAS Desciption	Amount (USD) 2007	Amount (USD) 2008	Amount (USD) 2009	Amount (USD) 2010	Total
• Outcome A - To demonstrate the operational viability of FCBs and their refueling infrastructure by setting up FCB fleets and supportive facilities in China ;									
Activity 1.1. *Purchase the FCBs.*	MoST	GEF	72200	Equipment-FCB	850,000	3,350,000	0	0	4,200,000
	MoST	GEF	71200	International consultant	40,000	0	0	0	40,000
	MoST	GEF	71300	National Consultant	15,000	0	0	0	15,000
	MoST	GEF	74500	Miscellaneous	15,000	0	0	0	15,000
	MoST	GEF	71600	Travel	5,000		5000	0	10,000
Activity 2.2 *Develop operation guideline for FCB and HRS operation and maintentance.*	MoST	GEF	71300	National Consultant	0	10,000	0	0	10,000
	MOST	GEF	74500	Miscellanous	0	10,000	5,000	5,000	20,000
Activity 2.3 *Social and environment research.*	MOST	GEF	72100	Contractual Serv	25,000	28000	0	0	53,000
• Outcome B – To accumulate technical, policy knowledge for advancing commercialization of FCB technology and hydrogen refueling system									
Activity 3.1 *Learn the*	MoST	GEF	71300	National Consultant	15,000	25,000	15,000	5,000	60,000

international experience related to FCBs value chain.	MOST	GEF	74500	Miscellanous	32,000	33,000	5,000	5,000	75,000
	MoST	GEF	71600	Travel	0	15,000	0	0	15,000
Activity 3.2 *Research on the technical development related to FCBs value chain.*	MoST	GEF	71200	International consultant	5,000	5000	5000	0	15,000
	MoST	GEF	71300	National Consultant	10,000	5000	5000	0	20,000
	MoST	GEF	72100	Contractual Serv	28,000	29000	0	0	57,000
	MoST	GEF	74500	Miscellaneous	15,000	15,000	10,000	0	40,000
Activity 4.1 *Promote the future certification development for FCB and refilling station in China.*	MoST	GEF	71200	International consultant	5,000	5000	0	0	10,000
	MoST	GEF	71300	National Consultant	15,000	15,000	10,000	10,000	50,000
	MoST	GEF	74500	Miscellaneous	20,000	15,000	15,000	11,000	61,000
	MoST	GEF	72100	Contractual Serv	30,000	30000	0	0	60,000
Activity 4.2 *Provide the suggestions for future FCB*	MoST	GEF	71200	International consultant	0	10000	5000	0	15,000
	MoST	GEF	71300	National Consultant	0	15000	5000	5000	25,000
	MoST	GEF	74500	Miscellaneous	0	10000	5000	0	15,000

design.									
Activity 4.3 *FCB related life clcye ananlysis.*	MoST	GEF	71200	International consultant	10,000	25,000	25,000	0	60,000
	MoST	GEF	71300	National Consultant	15,000	15,000	5000	5000	40,000
	MoST	GEF	74500	Miscellaneous	5,000	10000	10000	5000	30,000
	MoST	GEF	72100	Contractual Serv	27,000	18000	0	0	45,000
• Outcome C – Promote enabling environment for FCB expansion and support the design of roadmap									
Activity 5.1 *Policy and market study to promote the FCB Certification.*	MoST	GEF	71400	Service contracts/admin	40,000	70,000	25,000	26,000	161,000
	MoST	GEF	74500	Miscellaneous	10,000	15,000	15,000	5,000	45,000
	MoST	GEF	71600	Travel	0	5,000	0	0	5,000
	MoST	GEF	71300	National Consultant	10,000	10,000	10,000	0	30,000
	MoST	GEF	72100	Contractual Serv	25,000	25,000	25,000	0	75,000
	Most	UNDP	74500	Miscellaneous	53,000	52,500	53,000	37,500	196,000
Acticity 6.1 *Partnership building.*	MoST	GEF	71300	National Consultant	0	5,000	5,000	5,000	15,000
	MoST	GEF	74500	Miscellaneous	5,000	5,000	5,000	0	15,000
Activity 6.2 *Set up the project website.*	MoST	GEF	71300	National Consultant	0	5000	5000	0	10,000
	MoST	GEF	74500	Miscellaneous	5,000	5000	0	0	10,000
Activity 6.3 *Organize the national& int'l*	MoST	GEF	71300	National Consultant	0	5000	5000	5000	15,000
	MoST	GEF	74500	Miscellaneous	5,000	5000	5000	0	15,000

conference/ workshop.									
Activity 6.4 *Public awareness and education.*	MoST	GEF	71200	International consultant	0	0	10,000	10,000	20,000
	MoST	GEF	72100	Contractual Serv	25,000	25,000	0	0	50,000
	MoST	GEF	74500	Misellaneous	0	0	10,000	10,000	20,000
Activity 7.1 *Carry out technicaland financing feasibility studies.*	MoST	GEF	74500	Miscellaneous	0	0	10,000	10,000	20,000
	MoST	GEF	71300	National Consultant	0	0	10,000	10,000	20,000
	MoST	GEF	71600	Travel	0	0	5,000	0	5,000
	MoST	GEF	72100	Contractual Serv		0	30000	30000	60,000
	MoST	GEF	71200	International consultant	0	0	15,000	15,000	30,000
Activity 7.2 *Support the FCB development roadmap design.*	MoST	GEF	71300	National Consultant	0	0	5,000	5,000	10,000
	MoST	GEF	71200	International consultant	0	0	0	25,000	25,000
	MoST	GEF	72100	Contractual Serv	0	0	28000	27000	55,000
				Summary of Account					
				GEF	**1,307,000**	**3,873,000**	**353,000**	**234,000**	**5,767,000**
				UNDP	**53,000**	**52,500**	**53,000**	**37,500**	**196,000**

a) **Total budget** (no IA/ExA staff cost to be funded)

Project Outcomes	Co-financing ($)	GEF ($)	Total ($)
1. Outcome A: To demonstrate the operational viability of FCBs and their refueling infrastructure by setting up FCB fleets and supportive facilities in China ;	9934,500	4,365,000	14,299,000
2. Outcome B: Knowledge accumulated, available and accessible for advancing commercialization of FCB technology and hydrogen refueling system	875,500	796,000	1,671,500
3. Outcome C: Awareness promoted among stakeholders and creation of an enabling environment for FCB expansion and the Phase III (expanded demonstration) Project in China	629,000	606,000	1,235,000
4. CICETE commission		161,000	161,000
5. Project management cost*		951,000	
Total budget/cost			

* This item is the aggregate cost of project management; breakdown of the aggregate amount should be presented in the table in b) below:

b**)** **MANAGEMENT BUDGET/COST**[4]

Component	Estimated Staff weeks	GEF($)	Other Sources ($)	Project Total ($)
Local recruited Personnel*	800	280,000		280,000
International consultants*	250	190,000		190,000
Office equipment, communication		30,000		30,000
Travel		35,000		35,000
Miscellaneous		351,000		351,000
Total		886,000		886,000

* Local and international consultants in this table are those who are hired for functions related to the management of project. For those consultants who are hired to do a special task, they would be referred to as consultants providing technical assistance. For these consultants, please provide details of their services in c) below:

c) **CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS**:

Component	Estimated Staff Weeks	GEF	Other Sources	Project Total

[4] For all consultants hired to manage project or provide technical assistance, please attach a description in terms of their staff weeks, roles and functions in the project, and their position titles in the organization, such as project officer, supervisor, assistants or secretaries.

		($)	($)	($)
Personnel				
Local consultants	30	40,000		
International consultants	2	25,000		
Total	21	65,000		

d) **DETAILED CO-FINANCING** (as part of total budget)

Co-financing Sources				
Name of Co-financier (source)	Classification	Type	Amount	
			Confirmed ($)	Unconfirmed ($)
MoST	Implementing agency	Co-financing	3,519,000	
Beijing	Local government	Co-financing	3,536,000	
Shanghai	Local government	Co-financing	4,384,000	
Private Sector	Private Sector	In kind	1,223,000	
Subtotal co-financing			12,662,000	

B. INSTITUTIONAL COORDINATION AND SUPPORT

112. The first phase of the project validated the effectiveness of the organizational structure (see Section IV, Part 2 for the organigram of the project). This structure will be revised as appropriate as further experience is gained. Overall guidance at the national level will be provided by a committee consisting of representatives from the Ministry of Science and Technology (which will head the national committee), the National Development & Reform Commission, the Ministry of Finance, the Ministry of Public Security, and the Ministry of Commerce. This national guidance committee will seek advice from outside experts, as needed.

113. The project will be nationally executed. The GEF funded project activities will be implemented by MOST, and the project activities funded by the UNDP TRAC resources will be implemented by China International Centre for Economic and Technical Exchanges (CICETE). 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 will be responsible to the Government of China and UNDP/GEF for achieving project objectives. The day-to-day implementation of the project will be conducted by the national project management office (PMO) to be recruited by MOST. CICETE will provide implementation support services for the GEF input at the request of the NPD in securing deliverables (personnel, training, equipment, etc.) and facilitating the preparation of financial and administrative reports.

114. A local project advisory committee 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 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 municipal advisory committees will seek advice from outside experts, as needed. The advisory committee will meet quarterly.

115. The day-to-day implementation of the project in each city will be under the local project management office (LPMO) and FCB operation will be under the responsibility of the Beijing Public Transportation General Company and the Shanghai Bus Electric Limited Company. In Phase I, the Beijing Municipal Advisory Committee and the Shanghai Municipal Advisory Committees meeting were held 4 and 8 times, respectively, and they exchanged experiences and lessons at the annual review meeting. Regular communication between these committees is through the annual meeting, official documents, and project implementation reports and newsletters, and study tour reports.

116. Six coordination meetings for the Beijing project were held after the project started in 2003. The representatives from MOST, Beijing Municipal Science & Technology Commission, Beijing Public Transit Company, CICETE, National PMO, BP, DaimlerChrysler, and SinoHytec Company participated in the meetings intended to improve the project's implementation step-by-step. The Project Team has taken steps to strengthen the coordination among the involved parties. They have assigned several project management specialists to the team. They have also organized coordination meetings with Daimler Chrysler and BP on a regular basis to ensure smooth communication and problem solving among the three groups. At the coordination meetings, all information and problems faced were shared and raised among the participants, including the FCB delivery schedule, hydrogen station building progress, and spare parts and FCB garage issues. Regular communication had a significant influence on project implementation, for example, local government approval procedure was greatly shortened. In addition, by June 2005 the national PMO has conduced six teamwork meetings to exchange information and experiences between Beijing and Shanghai. Both the Beijing and Shanghai Municipal Advisory Committees attended these communication meetings.

117. In order to accord proper acknowledgement to GEF for providing funding, a GEF logo should appear on all relevant GEF project publications, including among others, project hardware and vehicles purchased with GEF funds. Any citation on publications regarding projects funded by GEF should also accord proper acknowledgment to GEF. The UNDP logo should be more prominent -- and separated from the GEF logo if possible, as UN visibility is important for security purposes.

Monitoring and Evaluation Plan and Budget

118. Project monitoring and evaluation will be conducted in accordance with established UNDP and GEF procedures and will be provided by the project team and the UNDP Country Office (UNDP CO) in Beijing with support from UNDP-GEF. The Logical Framework Matrix in Section II (Part 2) provides performance and impact indicators for project implementation along with their corresponding means of verification. These will form the basis on which the project's Monitoring and Evaluation system will be built.

119. The following sections outline the principle components of the Monitoring and Evaluation Plan and indicative cost estimates related to M&E activities. The project's Monitoring and Evaluation Plan will be presented and finalized at the Project's Inception Report following a collective fine-tuning of indicators, means of verification, and the full definition of project staff M&E responsibilities.

MONITORING AND REPORTING

Project Inception Phase

120. A Project Inception Workshop will be conducted with the full project team, relevant government counterparts, co-financing partners, the UNDP-CO and representation from the UNDP-GEF Regional Coordinating Unit, as well as UNDP-GEF (HQs) as appropriate.

121. A fundamental objective of this Inception Workshop will be to assist the project team to understand and take ownership of the project’s goals and objectives, as well as finalize preparation of the project's first annual work plan on the basis of the project's logframe matrix. This will include reviewing the logframe (indicators, means of verification, assumptions), imparting additional detail as needed, and on the basis of this exercise finalize the Annual Work Plan (AWP) with precise and measurable performance indicators, and in a manner consistent with the expected outcomes for the project.

122. Additionally, the purpose and objective of the Inception Workshop (IW) will be to: (i) introduce project staff with the UNDP-GEF expanded team which will support the project during its implementation, namely the CO and responsible Regional Coordinating Unit (RCU) staff; (ii) detail the roles, support services and complementary responsibilities of UNDP-CO and RCU staff and the project team; (iii) provide a detailed overview of UNDP-GEF reporting and monitoring and evaluation (M&E) requirements, with particular emphasis on the Annual Project Implementation Reviews (PIRs) and related documentation, the Annual Project Report (APR), Tripartite Review Meetings, as well as mid-term and final evaluations. Equally, the IW will provide an opportunity to inform the project team on UNDP-GEF project related budgetary planning, budget reviews, and mandatory budget rephasings.

123. The IW will also provide an opportunity for all parties to understand their roles, functions, and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff and decision-making structures will be discussed again, as needed, to clarify each party's responsibilities during the project's implementation phase.

Monitoring Project Implementation Progress

124. A detailed schedule of project reviews meetings will be developed by the project management, in consultation with project implementation partners and stakeholder representatives and incorporated in the Project Inception Report. Such a schedule will include: (i) tentative time frames for Tripartite Project Reviews, Steering Committee Meetings, (or relevant advisory and/or coordination mechanisms) and (ii) project related Monitoring and Evaluation activities.

125. Day to day monitoring of implementation progress will be the responsibility of the Project Coordinator, Director or CTA (depending on the established project structure) based on the project's Annual Work Plan and its indicators. The Project Team will inform the UNDP-CO of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely and remedial fashion.

126. The Project Coordinator and the Project Chief Technical Advisor will fine-tune the progress and performance/impact indicators of the project in consultation with the full project team at the Inception Workshop with support from UNDP-CO and assisted by the UNDP-GEF Regional Coordinating Unit. Specific targets for the first year implementation progress indicators together with their means of verification will be developed at this Workshop. These will be used to assess whether implementation is proceeding at the intended pace and in the right direction and will form part of the Annual Work Plan. The local implementing agencies will also take part in the Inception Workshop in which a common vision of overall project goals will be established. Targets and indicators for subsequent years would be defined annually as part of the internal evaluation and planning processes undertaken by the project team.

127. Measurement of impact indicators related to global benefits will occur according to the schedules defined in the Inception Workshop and tentatively outlined in the indicative Impact Measurement Template at the end of this Annex. The measurement, of these will be undertaken through subcontracts or retainers with relevant institutions or through specific studies that are to form part of the projects activities.

128. Periodic monitoring of implementation progress will be undertaken by the UNDP-CO through quarterly meetings with the project proponent, or more frequently as deemed necessary. This will allow parties to take stock and to troubleshoot any problems pertaining to the project in a timely fashion to ensure smooth implementation of project activities.

129. UNDP Country Offices and UNDP-GEF RCUs as appropriate, will conduct yearly visits to projects that have field sites, or more often based on an agreed upon scheduled to be detailed in the project's Inception Report / Annual Work Plan to assess first hand project progress. Any other member of the Steering Committee can also accompany, as decided by the SC. A Field Visit Report will be prepared by the CO and circulated no less than one month after the visit to the project team, all SC members, and UNDP-GEF.

130. Annual Monitoring will occur through the Tripartite Project Review (TPR). This is the highest policy-level meeting of the parties directly involved in the implementation of a project. The project will be subject to TPR at least once every year. The first such meeting will be held within the first twelve months of the start of full implementation. The project proponent will prepare an Annual Project Report (APR) and submit it to UNDP-CO and the UNDP-GEF regional office at least two weeks prior to the TPR for review and comments.

131. The APR will be used as one of the basic documents for discussions in the TPR meeting. The project proponent will present the APR to the TPR, highlighting policy issues and recommendations for the decision of the TPR participants. The project proponent also informs the participants of any agreement reached by stakeholders during the APR preparation on how to resolve operational issues. Separate reviews of each project component may also be conducted if necessary.

Terminal Tripartite Project Review (TTPR)

132. The terminal tripartite project review is held in the last month of project operations. The National Project Director is responsible for preparing the Terminal Report to be assisted by the Chief Technical Advisor and submitting it to UNDP-CO and UNDP-GEF's Regional Coordinating Unit. It shall be prepared in draft at least two months in advance of the TTPR in order to allow review, and will serve as the basis for discussions in the TTPR. The terminal tripartite project review considers the implementation of the project as a whole, paying particular attention to whether the project has achieved its stated objectives and contributed to the broader environmental objective. It decides whether any actions are still necessary, particularly in relation to sustainability of project results, and acts as a vehicle through which lessons learnt can be captured to feed into other projects under implementation of formulation.

133. The TPR has the authority to suspend disbursement if project performance benchmarks are not met. Benchmarks are provided in Annex will be developed at the Inception Workshop, based on delivery rates, and qualitative assessments of achievements of outputs.

Project Monitoring Reporting

134. The Project Coordinator in conjunction with the UNDP-GEF extended team will be responsible for the preparation and submission of the following reports that form part

of the monitoring process. Items (a) through (f) are mandatory and strictly related to monitoring, while (g) through (h) have a broader function and the frequency and nature is project specific to be defined throughout implementation.

(a) Inception Report (IR)

135. A Project Inception Report will be prepared immediately following the Inception Workshop. It will include a detailed First Year/ Annual Work Plan divided in quarterly time-frames detailing the activities and progress indicators that will guide implementation during the first year of the project. This Work Plan would include the dates of specific field visits, support missions from the UNDP-CO or the Regional Coordinating Unit (RCU) or consultants, as well as time-frames for meetings of the project's decision making structures. The Report will also include the detailed project budget for the first full year of implementation, prepared on the basis of the Annual Work Plan, and including any monitoring and evaluation requirements to effectively measure project performance during the targeted 12 months time-frame.

136. The Inception Report will include a more detailed narrative on the institutional roles, responsibilities, coordinating actions and feedback mechanisms of project related partners. In addition, a section will be included on progress to date on project establishment and start-up activities and an update of any changed external conditions that may effect project implementation.

137. When finalized the report will be circulated to project counterparts who will be given a period of one calendar month in which to respond with comments or queries. Prior to this circulation of the IR, the UNDP Country Office and UNDP-GEF's Regional Coordinating Unit will review the document.

(b) Annual Project Report (APR)

138. The APR is a UNDP requirement and part of UNDP's Country Office central oversight, monitoring and project management. It is a self -assessment report by project management to the CO and provides input to the country office reporting process and the ROAR, as well as forming a key input to the Tripartite Project Review. An APR will be prepared on an annual basis prior to the Tripartite Project Review, to reflect progress achieved in meeting the project's Annual Work Plan and assess performance of the project in contributing to intended outcomes through outputs and partnership work.

139. The format of the APR is flexible but should include the following:

- An analysis of project performance over the reporting period, including outputs produced and, where possible, information on the status of the outcome
- The constraints experienced in the progress towards results and the reasons for these
- The three (at most) major constraints to achievement of results

- Annual Work Plan, Combined Delivery Report and other expenditure reports (ERP generated)
- Lessons learned
- Clear recommendations for future orientation in addressing key problems in lack of progress.

(c) Project Implementation Review (PIR)

140. The PIR is an annual monitoring process mandated by GEF. It has become an essential management and monitoring tool for project managers and offers the main vehicle for extracting lessons from ongoing projects. Once the project has been under implementation for a year, a Project Implementation Report must be completed by the CO together with the project. The PIR can be prepared any time during the year (July-June) and ideally prior to the TPR. The PIR should then be discussed in the TPR so that the result would be a PIR that has been agreed upon by the project, the executing agency, UNDP CO and the concerned RC.

141. The individual PIRs are collected, reviewed and analysed by the RCs prior to sending them to the focal area clusters at the UNDP/GEF headquarters. The focal area clusters supported by the UNDP/GEF M&E Unit analyse the PIRs by focal area, theme and region for common issues/results and lessons. The TAs and PTAs play a key role in this consolidating analysis.

142. The focal area PIRs are then discussed in the GEF Interagency Focal Area Task Forces in or around November each year and consolidated reports by focal area are collated by the GEF Independent M&E Unit based on the Task Force findings.

143. The GEF M&E Unit provides the scope and content of the PIR. In light of the similarities of both APR and PIR, UNDP/GEF has prepared a harmonized format for reference.

(d) Quarterly Progress Reports

144. Short reports outlining main updates in project progress will be provided quarterly to the local UNDP Country Office and the UNDP-GEF regional office by the project team. See format attached.

(e) Periodic Thematic Reports

145. As and when called for by UNDP, UNDP-GEF or the Implementing Partner, the project team will prepare Specific Thematic Reports, focusing on specific issues or areas of activity. The request for a Thematic Report will be provided to the project team in written form by UNDP and will clearly state the issue or activities that need to be reported on. These reports can be used as a form of lessons learnt exercise, specific oversight in key areas, or as troubleshooting exercises to evaluate and overcome obstacles and difficulties encountered. UNDP is requested to minimize its

requests for Thematic Reports, and when such are necessary will allow reasonable timeframes for their preparation by the project team.

(f) Project Terminal Report

146. During the last three months of the project the project team will prepare the Project Terminal Report. This comprehensive report will summarize all activities, achievements and outputs of the Project, lessons learnt, objectives met, or not achieved, structures and systems implemented, etc. and will be the definitive statement of the Project's activities during its lifetime. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the Project's activities.

(g) Technical Reports (project specific- optional)

147. Technical Reports are detailed documents covering specific areas of analysis or scientific specializations within the overall project. As part of the Inception Report, the project team will prepare a draft Reports List, detailing the technical reports that are expected to be prepared on key areas of activity during the course of the Project, and tentative due dates. Where necessary this Reports List will be revised and updated, and included in subsequent APRs. Technical Reports may also be prepared by external consultants and should be comprehensive, specialized analyses of clearly defined areas of research within the framework of the project and its sites. These technical reports will represent, as appropriate, the project's substantive contribution to specific areas, and will be used in efforts to disseminate relevant information and best practices at local, national and international levels.

148. The technical reports to be included in Phase II will include, at a minimum, bus technical summary, H2 station operation summary, and reports of comparing different hydrogen fueling methods.

(h) Project Publications (project specific- optional)

149. Project Publications will form a key method of crystallizing and disseminating the results and achievements of the Project. These publications may be scientific or informational texts on the activities and achievements of the Project, in the form of journal articles, multimedia publications, etc. These publications can be based on Technical Reports, depending upon the relevance, scientific worth, etc. of these Reports, or may be summaries or compilations of a series of Technical Reports and other research. The project team will determine if any of the Technical Reports merit formal publication, and will also (in consultation with UNDP-GEF, the government and other relevant stakeholder groups) plan and produce these Publications in a consistent and recognizable format. Project resources will need to be defined and allocated for these activities as appropriate and in a manner commensurate with the project's budget.

INDEPENDENT EVALUATION

The project will be subjected to at least two independent external evaluations as follows:

(i) Mid-term Evaluation

150. An independent Mid-Term Evaluation will be undertaken at the end of the second year of implementation. The Mid-Term Evaluation will determine progress being made towards the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organization, terms of reference and timing of the mid-term evaluation will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-term evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF.

(ii) Final Evaluation

151. An independent Final Evaluation will take place three months prior to the terminal tripartite review meeting, and will focus on the same issues as the mid-term evaluation. The final evaluation will also look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental goals. The Final Evaluation should also provide recommendations for follow-up activities. The Terms of Reference for this evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF.

AUDIT CLAUSE

152. The MoST will provide the Resident Representative with certified periodic financial statements, and with an annual audit of the financial statements relating to the status of UNDP (including GEF) funds according to the established procedures set out in the Programming and Finance manuals. The Audit will be conducted by the legally recognized auditor of the Government, or by a commercial auditor engaged by the Government.

LEARNING AND KNOWLEDGE SHARING

153. Results from the project will be disseminated within and beyond the project intervention zone through a number of existing information sharing networks and forums. In addition:

- The project will participate, as relevant and appropriate, in UNDP/GEF sponsored networks, organized for Senior Personnel working on projects that share common characteristics. UNDP/GEF shall establish a number of networks, such as

Integrated Ecosystem Management, eco-tourism, co-management, etc, that will largely function on the basis of an electronic platform.

- The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation though lessons learned.

154. The project will identify, analyze, and share lessons learned that might be beneficial in the design and implementation of similar future projects. Identify and analyzing lessons learned is an on- going process, and the need to communicate such lessons as one of the project's central contributions is a requirement to be delivered not less frequently than once every 12 months. UNDP/GEF shall provide a format and assist the project team in categorizing, documenting and reporting on lessons learned. To this end a percentage of project resources will need to be allocated for these activities.

155. The project's Monitoring and Evaluation Plan will be presented and finalized at the Project's Inception Report following a collective fine-tuning of indicators, means of verification, and the full definition of project staff responsibilities. The principle components of the Monitoring and Evaluation Plan and indicative cost estimates related to M&E activities are provided in the table below. Full details on the Monitoring and Evaluation Plan are provided in Section IV (Part 4).

Table 6: Indicative monitoring and evaluation work plan and corresponding budget

Type of M&E activity	Responsible Parties	Budget US$*	Time frame
Inception Workshop	▪ National Project Director ▪ UNDP CO	10,000	Within first two months of project start up
Inception Report	▪ Chief Technical Advisor ▪ Project Coordinator ▪ UNDP CO	None	Immediately following IW
Measurement of Means of Verification for Project Success Indicators	▪ Project Coordinator will oversee the hiring of specific studies and institutions, and delegate responsibilities to relevant team members	To be finalized in Inception Phase and Workshop	Start, mid and end of project
Measurement of Means of Verification for Project Progress and Performance (measured on an annual basis)	▪ Advisory by Project Technical Advisor and Project Coordinator ▪ Measurements by Regional Coordination Unit officers and local IAs	To be determined as part of the Annual Work Plan's preparation.	Annually prior to APR/PIR and to the definition of annual work plans
APR/PIR including lessons learned	▪ Project Coordinator ▪ UNDP-CO	None	Annually
TPR and TPR report	▪ National Project Director ▪ UNDP CO ▪ Project team ▪ UNDP-GEF Regional Coordinating Unit	10,000 (2,500/y)	Every year, upon receipt of APR/PIR
Steering Committee Meetings	▪ National Project Director ▪ UNDP CO	None	Following Project IW and subsequently at least once a year

Type of M&E activity	Responsible Parties	Budget US$*	Time frame
Semi-annual reports and Technical reports	▪ Project team ▪ Hired consultants as needed	10,000	To be determined by Project team and UNDP CO
Mid-term Evaluation	▪ UNDP Country Office ▪ UNDP-GEF Regional Coordinating Unit	15,000	Two years after the inception workshop
Final External Evaluation	▪ Project team, ▪ UNDP-CO ▪ UNDP-GEF Regional Coordinating Unit ▪ External Consultants (i.e. evaluation team)	25,000	At the end of project implementation
Terminal Report	▪ National Project Director ▪ Chief Technical Advisor ▪ UNDP-CO	None	At least one month before the end of the project
Audit	▪ UNDP-CO ▪ Project team	4,000 (average $1000 per year)	Yearly
Visits to field sites (UNDP staff travel costs to be charged to IA fees)	▪ UNDP Country Office ▪ UNDP-GEF Regional Coordinating Unit (as appropriate) ▪ Government representatives	5,000	Yearly
TOTAL indicative COST * Excluding project team staff time and UNDP staff and travel expenses		US$ 79,000	

Legal Context

156. This Project Document shall be the instrument referred to as such in Article I of the Standard Basic Assistance Agreement between the Government of China and the United Nations Development Programme, signed by the parties on 29 June 1979. The host country implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the government co-operating agency described in that Agreement.

157. The UNDP Resident Representative in China is authorized to effect in writing the following types of revision to this Project Document, provided that he/she has verified the agreement thereto by the UNDP-GEF Unit and is assured that the other signatories to the Project Document have no objection to the proposed changes:

a) Revision of, or addition to, any of the annexes to the Project Document;
b) Revisions which do not involve significant changes in the immediate objectives, outputs or activities of the project, but are caused by the rearrangement of the inputs already agreed to or by cost increases due to inflation;
c) Mandatory annual revisions which re-phase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility; and,

d) Inclusion of additional annexes and attachments only as set out here in this Project Document.

SECTION II Strategic Results Framework and GEF Increment

Incremental Cost Analysis

Baseline

158. Under the baseline situation, the municipal transport authorities in Beijing and Shanghai will continue to provide bus transport to its population as needed. In 2003 in Beijing, there were 16,022 internal combustion engine buses. Of these 5,693 were estimated to operate on diesel. By April 2005, there were 18,693 buses[5] of which 8,026 were estimated to operate on diesel. In Shanghai, the situation is even more pronounced. In 2003, 18,625 buses in Shanghai were estimated to be under operation, 16,419 of these were considered medium to heavy duty. Of these buses, more than 10,000 are estimated to operate on diesel.

159. 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 the 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.

160. Strictly speaking, in the baseline of this project, the FCB vehicles are estimated to operate for a total of 400,000 vehicle-kilometers. During this operation, they would be anticipated to emit approximately 44.6 tons of C or 163 tons of CO_2 during the project's lifetime.

161. The baseline cost, from which the incremental cost is determined, consists of two components. One is the cost of operating a fleet of conventional diesel buses providing the same service (total number of bus-km) as the FCBs will provide during the project. This is approximately 200,000 bus-km in Beijing and 200,000 bus kilometers in Shanghai, or a total of 400,000 bus-km. Based on the actual cost per bus-km incurred by the Beijing and Shanghai public bus systems (see Table below), the contribution to the baseline cost from diesel bus operation is US$158,000 (Beijing) plus $138,000 (Shanghai), for a total of $296,000[6].

[5] Statistics of Beijing Public Sector

[6] The total operational distance has been revised from when the Phase I project was approved. Therefore, the baseline costs have been updated to reflect that there will be fewer FCBs running fewer revenue-generating km).

Table 7: Current public transit bus costs (RMB) per bus-km

	Beijing	Shanghai
Fuel	0.68	0.85
Salaries	1.86	2.14
Maintenance	0.95	1.09
Depreciation	1.19	1.04
Insurance	0.0	0.07
Administration	1.14	0.36
Other	0.47	0.0
Tax	0.30	0.16
TOTAL	6.59	5.71
TOTAL (US$/km)	0.79	0.69

The typical cost of a new diesel public transit bus in Beijing or Shanghai is 400,000 RMB ($48,200). A depreciation period of 8 years is used for accounting purposes by the Beijing and Shanghai bus companies.

162. The second component of the baseline cost is the funding support that the Central Government plans to provide for research, development, and demonstrations relating to FCBs in China regardless of whether a GEF project is undertaken. Some of the activities defined for the project are aimed at enhancing such efforts. The central governments contributed 50 million RMB (US$ 5.4 million) toward broadly supporting all FCB-related activities in China during the 10th 5-Year Plan, with US$ 5.4M considered baseline for this project (not including any waived import duties). [7]

163. Since this project was originally envisaged as a single project, the incremental cost was calculated for both the Phase I and Phase II projects together. The baseline for Phase I was $2,684,000 and for Phase II is $3,012,000.

Global environmental objectives

164. 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 FCBs fueled by hydrogen drawn from natural gas and bi-product gases with rich hydrogen. 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.

165. In order for the long-term programmatic goal of the entire GEF intervention to be achieved, FCBs must be produced for use in other contexts. According to projections,

[7] According to national FCB R&D officials, the funds allocated for FCB R&D were 50M RMB (UDS$5.4M) under the "tenth-five" plan

after a total of 5,000 FCBs have been produced, the costs should fall to where FCBs will be roughly competitive on a lifecycle basis with modern, clean diesel buses.[8]

166. The deployment of FCBs 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 44.6 tons of C (or 163 tons of CO_2). However, the ultimate target is not a small-scale demonstration project in Beijing and Shanghai, but rather the replacement of all petroleum fueled buses in China. If 720,000 petrol -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 tons per year. While the Project expects that the penetration of hydrogen fuel cell buses for new applications will be very high, a more conservative estimate of the overall share of the market will be at least 30% or approximately 200,000 buses by 2030.

167. 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 FCB 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 Carbon).

Alternative

168. With GEF assistance, this project will procure FCBs for operation; build hydrogen refueling stations; accumulate knowledge for advancement towards commercialization of FCB technology and hydrogen refueling system; and, promote awareness among stakeholders and create an enabling environment for FCB expansion in China.

169. MOST is contributing $3,519,000 to the Phase II project ($6,203,000 to the total Phase I and Phase II project). Beijing will contribute $3,536,000 to the project. This represents an increase of $1,153,000 over the initial estimate contribution (made during the formulation of the Phase I and Phase II project) due to the increased funds for the refueling station O&M. As Shanghai did not purchase their FCBs under the Phase I project, they have allocated their funds to the Phase II project. Therefore, Shanghai will contribute $4,384,000 in Phase II. The GEF is requested to contribute $5,767,000 (or approximately 31% of the total project). The total Phase II project will cost $18,625,000.

System boundary

170. 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

[8] R. Hosier and E.D. Larson, "GEF Participation in Fuel Cell Bus Commercialization," working document, UNDP/GEF, New York, Feb. 2000

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

171. 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 NOx, CO, and THC by 3.4, 2.3, and 0.7 tonnes, respectively, as detailed in the incremental cost matrix. In addition, there will be reductions in SOx 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 (200,000 buses by 2030), annual reductions of NOx, CO, and THC might be expected to decrease by as much as 184,000 tonnes; 127,800 tonnes; and 41,700 tonnes, respectively. There are also significant benefits to the global community, the automotive industry, and the technology providers.

172. Carbon emissions that will be avoided by operating FCBs in lieu of diesel buses in the project are an estimated 44.6 metric tons (22.3 metric tons avoided in Beijing and the same in Shanghai).[9] However, it is not meaningful to calculate a cost of saved carbon for this project alone, given that the objective of the project is to help achieve cost reductions in the technology that will ultimately enable it to be widely introduced on commercial (unsubsidized) terms. A more meaningful measure of the cost of saved carbon is based on the carbon savings that can be expected in the long term in China (once the FCBs are being used routinely on a commercial basis) and on the total incremental costs required to reach commercial cost-competitiveness. It is difficult to make such a calculation for China alone since cost-reduction developments achieved through projects throughout the world will help reduce FCB costs in China. However, Hosier and Larson have estimated the total incremental cost for the FCB technology to reach commercially-competitive costs, along with the amount of carbon that would be saved globally during one year of operation if all diesel buses in developing countries were to be converted eventually to FCBs using hydrogen made from natural gas. With these assumptions they have calculated a cost of saved carbon of about $14/tC. This suggests that the effort to buy down the cost of

[9] The carbon savings is estimated as follows. The carbon (C) emissions from diesel buses traveling 400,000 km (the total bus-km for the project) with an average fuel consumption of 26 liters per 100km would be 0.26 lit/km * 400,000 km * 0.77 kgC/lit * 0.001 t/kg = 80.1 tC. For FCBs using H_2 produced from natural gas by steam reforming, the C emissions (assuming energy use per km for a FCB will be half that of the equivalent diesel bus) would be 14 kgC/GJ_{CH4} *1.25 GJ_{CH4}/GJ_{H2} * 0.5 $GJ_{H2}/GJ_{diesel\ replaced}$ * 0.26 $lit_{diesel\ repl}$/km * 0.039 Gi_{ddies}/lit * 400,000 km * 0.001 t/kg = 35.5 tC. The net savings of C emissions for the project is 80.1 – 35.5 = 44.6 tC.

FCBs to cost-competitive levels will be very cost effective from a carbon mitigation standpoint.

Summary of Costs

173. The total costs of the Phase II project are equal to $ 18,625,000 to which the GEF will be requested to contribute $5,767,000 (or approximately 31%). Incremental costs are shared between the GEF, Chinese sources, and the private sector providers of the technology. The costs for baseline, GEF alternative, and increment, including changes made in the cost estimates since the approval of the Phase I project, are provided in the table below.

174. It should be noted that import duties are not included in the total cost of the project. While the relevant import duties for this project will still be waived, they are not included in the calculation of co-financing for this project.

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 0.4 m veh-km diesel buses: CO = 5.8 g/km or 2.32 tones NO_x = 8.4 g/km or 3.36 t THC = 1.79 g/km or 0.72 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. • If there are 6 FCBs operational in Phase II, reduction of Local Emissions: CO = 2.32 tones NO_x = 3.36 t THC = 0.72 t
Global impact	• Diesel bus emissions: 80.1 tonnes of Carbon or 293.6 tonnes of CO_2 during the project's lifetime (over the 0.4 m vehicle km traveled in the demo project) • By 2030, 200,000 Chinese buses (30% of the market) are expected to emit over 2.5 m tones of carbon per year (9.3 m tonnes of CO_2).	• Carbon emissions from natural gas reforming estimated at 35.5 t C or 130.1 t CO_2 • FCB cost reduction and commercialization accelerated. • "Sino-ization" of FCB technology accelerated.	• Carbon emissions reduced by 22.3 tonnes C or 81.5 t CO_2 during life of demonstration project based on 3 FCBs for Beijing under Phase I. • Carbon emissions reduced by 22.3 tonnes C or 81.5 t CO_2 during life of demonstration project based on 3 FCBs for Shanghai under Phase II. • The max CO_2 emissions reduced by 66.9 t C or 244.5 t

	Baseline	GEF Project	Increment
			CO_2 both in Beijing and Shanghai based on 9 FCBs. • If all Chinese buses in 2030 are converted to fuel cells, 9.1m tonnes of carbon emission per year would be avoided (33m tonnes CO_2); If 30% of the Chinese buses in 2030 are converted to fuel cells, 2.5 m tonnes of carbon emission per year would be avoided (9.3 m tonnes CO_2) • FCB cost reduction and commercialization accelerated. • "Sino-ization" of FCB technology accelerated.

	Baseline	GEF Project	Increment
Cost	**Phase I:** • MOST R&D funding for FCBs = $2.684 million Phase I TOTAL: $2.684 million **Phase II:** • MOST R&D funding for FCBs = $2.716 million • Beijing diesel bus operation = $0.79/bus-km, or $0.158 million *** • Shanghai diesel bus operation = $0.69/bus-km, or $0.138 million *** Phase II TOTAL = 3.012 million **Phase I & II** TOTALS: • MOST = $5.4 million • Beijing = $0.158 million*** • Shanghai diesel bus operation = $0.138 million*** Total = $ 5.696 million	**Phase I:** • MOST = $2.684 million • Beijing municipal government = $ 1.968 million • Shanghai municipal government = $0.2 million* • Private sector = $1.227 million • GEF/ UNDP = $6.006 million Phase I TOTAL = $12.085 million **Phase II:** • MOST = $3.519 million • Beijing municipal government = $ 3.536 million** • Shanghai municipal government = $4.384 million* • Private sector = $1.223 million • GEF UNDP/= $5.963 million Phase II TOTAL = $18.625 million **Phase I & II** TOTALS • MOST = $6.203 million • Beijing municipal government = $ 5.504 million** • Shanghai municipal government = $4.584 million* • Private sector = $2.450 million • GEF/ UNDP = $11.969 million Total = $ 30.710 million	**Phase I:** • MOST = $0 million • Beijing municipal government = $1.968 million • Shanghai municipal government = $0.2 million • Private sector = $1.227 million • GEF/ UNDP = $6.006 million Phase I TOTAL = $9.401 million **Phase II:** • MOST = $0.803 million • Beijing municipal government = $3.378 million • Shanghai municipal government = $4.246 million • Private sector = $1.223 million • GEF/ UNDP = $5.963 million Phase II TOTAL = $15.613 million **Phase I & II** TOTALS: • MOST = $0.803 million • Beijing municipal government = $5.346 million • Shanghai municipal government = $4.446 million • Private sector = $2.450 million • GEF/ UNDP = $11.969 million Phase II TOTAL = $15.613 million Total = $25.014 million

* As Shanghai did not purchase their FCBs under the Phase I project, they have allocated their funds to the Phase II project.

** This represents an increase over the initial estimate contribution (made during the formulation of the Phase I and Phase II project) due to the increased funds for the refueling station O&M.

*** The total operational distance has been revised from when the Phase I project was approved. Therefore, the baseline costs have been updated to reflect that there will be fewer FCBs running fewer revenue-generating km).

Logical Framework Analysis

Table 8: Logical Framework and Objectively Verifiable Impact Indicators

Project Strategy	**Objectively verifiable indicators**				
Goal	To reduce GHG emissions via the introduction of hydrogen FCBs for urban public transport.				
	Indicators	**Baseline**	**Target**	**Sources of verification**	**Risks and Assumptions**
Objective of the project: To demonstrate the operational viability of FCBs and their refueling infrastructure under Chinese conditions	• CO_2 emissions reduced in Beijing and Shanghai during project • Larger reductions in China and elsewhere once FCB technology is commercially deployed • FCBs t operational statistics gathered and analyzed • Refueling stations placed into operation	44.6 tones of C or 163 tones of CO_2 during the project's lifetime By 2030, 200,000 Chinese buses are expected to emit over 2.5 m tones of carbon per year (9.3m tones of CO_2)	6 to 9 FCBs in operation for at least 400,000 vehicle-km in both Beijing and Shanghai 2 hydrogen refueling stations purchased and place into operation	Final project report Semi-annual project report	Assumptions: - The technology is adequate so that the FCBs and hydrogen infrastructure can be commercially produced. - The procurement process is adequate so that the buses can be commercially produced. - FCBs and hydrogen stations can be procured from commercial vendors at satisfactory cost in a timely manner. .

Project Strategy	Objectively verifiable indicators				
Goal	To reduce GHG emissions via the introduction of hydrogen FCBs for urban public transport.				
	Indicators	**Baseline**	**Target**	**Sources of verification**	**Risks and Assumptions**
Outcome A: **To demonstrate the operational viability of FCBs and their refueling infrastructure by setting up FCB fleets and supportive facilities in China ;**	• Enough H2 station operators and FCB drivers and mechanics trained in Beijing and Shanghai • hydrogen production and quality projected target for satisfaction of FCB demonstration requirements • As many as possible experts consulted • 24 quarterly reports collected in both cities • Ridership survey conducted • Reporting and FCB operation guidelines • The social and environment research report developed	No such vehicles in operation No operational data available No such stations in operation Not enough FCB operation data collected and analyzed No FCB and hydrogen refilling station guideline No social and environment research report	Installation of the hydrogen fuel supply stations H2 available for FCB refueling 12 quarterly reports collected for both cities The operation guideline for FCB and HRS operation and maintenance developed and published	annual and final project reports and newsletters Vehicle log books and records Survey reports	Assumption: The procurement process is adequate so that the buses can therefore be commercially produced. Risk that an insufficient number of FCB bids is received for Shanghai; risk that it is not possible to agree on contract terms with the winning bidder Risk that the FCBs cannot be procured from commercial vendors at satisfactory cost and in a timely manner Risk that the FCB and hydrogen suppliers cannot meet the supply requirements/ Risk of vendor failure.

Project Strategy	**Objectively verifiable indicators**				
Goal	To reduce GHG emissions via the introduction of hydrogen FCBs for urban public transport.				
	Indicators	**Baseline**	**Target**	**Sources of verification**	**Risks and Assumptions**
Outcome B: To accumulate technical, policy knowledge for advancing commercialization of FCB technology and hydrog en refueling system	● The FCBs value chain research reports developed ● Bi-monthly newsletters; semi-annual reports; annual review reports; public awareness materials (semi-annual); study tour reports (post tours); and other technical, operational, managerial and planning reports and documents prepared and made available for broad use by stakeholders ● FCB or vehicle related association be supported ● Experience exchanged and shared through visit GEF or non-GEF projects (like: HyFleet-CUTE) ● Fuel Cell Bus Certification technical proposals developed ● Document of improving Chinese FCB design prepared ● The Well-to-Wheel life cycle analysis reports prepared	Not enough communications documented Continue newsletters prepared No such association supported No FCB certification technical proposal Not enough suggestions proposed No LCA analysis	At least4 information sharing tours conducted and tour reports submitted 2-3 technical reports relating to the FCB value chain finalized Bi-monthly newsletters, annual review report, Well –to-Wheel FCB related life cycle analysis reports finalized based on Chinese conditions	annual and final project reports	Risk that the FCBs cannot be procured from commercial vendors at satisfactory cost and in a timely manner Risk that the FCB and hydrogen suppliers cannot meet the supply requirements/ Risk of vendor failure

Project Strategy	**Objectively verifiable indicators**				
Goal	To reduce GHG emissions via the introduction of hydrogen FCBs for urban public transport.				
	Indicators	**Baseline**	**Target**	**Sources of verification**	**Risks and Assumptions**
Outcome C: Promote enabling environment for FCB expansion a nd support the design of roadmap for commercialization of Fuel Cell buses in China	● Learning and sharing the FCB related policies and planning through the international policy study tours ● Beijing and Shanghai FCB demonstration information exchange annually ● More than two policy study reports submitted by 2010 ● Website built and updated ● More local, national and international workshops/seminars held and attended; whole team workshops held every year; international workshops held every two years ● More professional presentations/ publications produced ● As many as media reports ● Public education activities organized ● Workshops held related to expand the FCBs demonstration ● Feasibility studies for expanding FCB demonstrations in Chinese cities prepared ● FCB roadmap documents prepared	Not comprehensive policy and market study reports available More information and workshops and publications available No FCB expanded feasibility study reports No FCB development roadmap	4 study tours conducted and the policy report submitted Beijing and Shanghai FCB demonstration exchange information regularly Int’l and national workshops held FCB expanded demonstration studies reports finalized FCB development roadmap developed	annual and final project reports Feedback from the workshop participants on the relevance and quality of the workshop Workshop proceedings Feedback from the workshop participants on the relevance and quality of the workshop Publications/pres entations Media releases Annual reports	

Outputs	Activities	Responsibilities
Output 1 A commercially-relevant demonstration of the technical feasibility of FCBs and their refueling infrastructure and staff training related to their operation in Beijing and in Shanghai.	1.1. *Purchase the FCBs.* 1.2. *Install, operate and maintain the fueling infrastructure.* 1.3. *Working together with the suppliers, hold on-the-job training for drivers, maintenance and refueling station staff.* 1.4. *Place the buses in operation.*	PMO,SH PMOPMO, ,SH PMO, BJ PMO PMO, ,SH PMO, BJ PMO SH PMO,PMO
Output 2 Performance analyzed including reliability and failure modes, support improvement the design and reducing the cost of FCBs in China.	2.1. *Collect, analyze, and evaluate operating data* 2.2. *Develop operation guideline for FCB and HRS operation and maintenance.* 2.3. *Social and environment research*	BJ PMO,SH PMO,PMO BJ PMO, SH PMO,PMO PMO, BJ PMO, SH PMO
Output 3 Set up the FCB knowledge base, and analyze the technical issues related to FCB value chain	3.1. *Learn the international experience related to FCBs value chain* 3.2. *Research on the technical development related to FCBs value chain*	PMO, BJ PMO, SH PMO PMO, BJ PMO, SH PMO
Output 4 Promote the FCB related technology development	4.1 *Promote the future standards development for FCB and refilling station in China.* 4.2 *Provide the suggestions for future FCB design that might better meet*	PMO, BJ PMO, SH PMO PMO, BJ PMO, SH PMO PMO, BJ PMO, SH PMO

Outputs	Activities	Responsibilities
	Chinese operational conditions. *4.3 FCB related life cycle analysis*	
Output 5 Policy and market research on FCB related value chain	5.1. *Policy and market study to promote the FCB commercialization* Certification document	PMO, BJ PMO, SH PMO PMO, BJ PMO, SH PMO
Output 6 Set up the platform to strengthen the cooperation between national and international stakeholders including policy makers, investors, industries and the general public	*6.1. Partnership building* *6.2. Set up the project website to provide technical, policy and market information* *6.3. Organize the national and international conference/workshop to promote the cooperation among stakeholders.* *6.4 Public awareness and education*	PMO, BJ PMO, SH PMO PMO, BJ PMO, SH PMO PMO, BJ PMO, SH PMO PMO, BJ PMO, SH PMO
Output 7 Support and engage in the FCB development roadmap design including expanded demonstration feasibility study.	7.1. Carry out technical, institutional, and financing feasibility studies for future expanded demonstration cities 7.2. *Support the FCB development roadmap in China.*	PMO, BJ PMO, SH PMO PMO, BJ PMO, SH PMO

PMO – Project Management Office (entire project)
SH PMO – Shanghai Project Management Office
BJ PMO- Beijing Project Management Office
CICETE – China International Center for Economic and Technical Exchanges

SECTION III Total Budget and Workplan

Project Costs

175. The cost of the Phase II project is US$18.625 million. The breakdown of contributions is provided below. Budget details are provided in this section.

GEF/UNDP:	5,963,000
Co-financing:	
Ministry of Science & Technology (MOST) (not including waived duties)	3,519,000
Municipal government of Beijing	3,536,000
Municipal government of Shanghai	4,384,000
Private sector	1,223,000
Total Implementation	US$18,625,000

176. Co-financing for the project will be provided from several sources. The central government, through the Ministry of Science and Technology, will provide $3,519,000 and the municipal governments of Shanghai and Beijing will provide $4,384,000 and $3,536,000 respectively. The national, municipal and local government co-financing will include both cash and in-kind contributions as outlined in the table below. Additionally, private sector contributions of $1,223,000 are expected due to parts supplied, training provided, R&D allocated, and related costs. UNDP China will provide $196,000 to support policy-related activities. GEF funds in the amount of $5,767,000 are being requested, the bulk of which will cover the cost of purchasing the FCB vehicles, since their high incremental cost (relative to conventional diesel buses) represents the greatest barrier to the dissemination of the new technology today. Phase II will procure 3-6 FCBs., with an additional 3 from Phase I supported in their operations. The refueling stations will be financed by the Shanghai and Beijing municipal governments as indicated in the total budget and workplan under their respective columns.

Detailed Breakdown of Budget and Work Plan

Award: 0051247
Award Title: PIMS 2933 CC FSP: Demonstration of Fuel Cell Bus Commercialization in China (Phase II)
Project ID: 0043802
Project Title: PIMS 2933 CC FSP: China FCB

GEF Outcome	Responsible Party	Source of Funds	ERP/ ATLAS Budget	ERP/ATLAS Desciption	Amount (USD) 2007	Amount (USD) 2008	Amount (USD) 2009	Amount (USD) 2010	Total
• Outcome A - To demonstrate the operational viability of FCBs and their refueling infrastructure by setting up FCB fleets and supportive facilities in China ;									
Activity 1.1. *Purchase the FCBs.*	MoST	GEF	72200	Equipment-FCB	850,000	3,350,000	0	0	4,200,000
	MoST	GEF	71200	International consultant	40,000	0	0	0	40,000
	MoST	GEF	71300	National Consultant	15,000	0	0	0	15,000
	MoST	GEF	74500	Miscellaneous	15,000	0	0	0	15,000
	MoST	GEF	71600	Travel	5,000		5000	0	10,000
	MoST	MoST	72200	Equipment	212,000	388,000	125000	124000	849,000
	MoST	MoST	71300	National Consultant	15,000	15,000	15,000	15,000	60,000
	MoST	MoST	71600	Travel	20,000	20,000	20,000	20000	80,000
	MoST	Shanghai	72200	Equipment	0	250,000			250,000
	MoST	PS	72200	Equipment	366000	857,000	0	0	1,223,000
	MoST	MoST	74500	Misc- Workshop	18,750	18,750	0	0	37,500
								Sub total	**6,779,500**

Activity 1.2 *O&M the fueling infrastructurd.*	MoST	MoST	71300	National Consultant	50,000	50,000	50,000	50,000	200,000
	MoST	Shanghai	73400	Maintenance	375,000	375,000	375,000	500,000	1,625,000
	MoST	Beijing	73400	Maintenance	475,000	475,000	475,000	475,000	1,900,000
								Sub total	**3,725,000**
Activity 1.3 *Working together with the suppliers, hold training for staff.*	MoST	Shanghai	74500	Miscellaneous	100,000	100,000	100,000	100,000	400,000
	MoST	Beijing	74500	Miscellaneous	100,000	100,000	100,000	100,000	400,000
	MoST	MoST	71300	National Consultant	8,000	8,000	8,000	8,000	32,000
								Sub total	**832,000**
Activity 1.4 *Place the buses in operation.*	MoST	MoST	71600	Travel	0	0	30,000	24,000	54,000
	MoST	MoST	71300	National Consultant	0	0	20,000	20,000	40,000
	MOST	MoST	72100	Contractual Serv	210,000	210,000	210,000	210,000	840,000
	MoST	Beijing	73400	Maintenance	200,000	200,000	200,000	200,000	800,000
	MoST	Shanghai	73400	Maintenance	237,500	237,500	257,500	257,500	990,000
								Sub total	**2,724,000**
Activity 2.1 *Collect, analyze, and evaluate operating data.*	MoST	MoST	71300	National Consultant	10,000	10,000	10,000	10,000	40,000
	MoST	MoST	71600	Travel	10,000	10,000	10,000	10,000	40,000
	MoST	Beijing	74500	Miscellaneous	29,000	29,000	29,000	29,000	116,000
	MoST	Shanghai	74500	Miscellaneous	40,000	40,000	20,000	20,000	120,000
	MOST	MoST	72100	Contractual Serv	60,000	60,000	60,000	60,000	240,000
								Sub total	**556,000**

	MoST	GEF	71300	National Consultant	0	10,000	0	0	10,000
	MOST	GEF	74500	Miscellanous	0	10,000	5,000	5,000	20,000
Activity 2.2 *Develop operation guideline for FCB and HRS operation and maintenance.*	MoST	MoST	71300	National Consultant	25,000	50,000	50,000	50,000	175,000
	MoST	MoST	74500	Miscellaneous	20,000	20,000	20,000	20,000	80,000
	MoST	MoST	74500	Travel	25,000	25,000	25,000	25,000	100,000
	MoST	MoST	74500	Misc- Workshop	20,000	20,000	20,000	20,000	80,000
	MoST	Shanghai	74500	Misc Expense	90,000	90,000	90,000	37,000	307,000
								Sub total	**465,000**
Activity 2.3 *Social and environment research.*	MOST	GEF	72100	Contractual Serv	25,000	28000	0	0	53,000
	MoST	MoST	71600	Travel	16,000	16,000	16,000	16,000	64,000
	MoST	MoST	74500	Misc- Workshop	3,750	3,750	3,750	3,750	15,000
								Sub total	**132,000**
• Outcome B – To accumulate technical, policy knowledge for advancing commercialization of FCB technology and hydrogen refueling system									
Activity 3.1 *Learn the international experience related to FCBs value chain.*	MoST	GEF	71300	National Consultant	15,000	25,000	15,000	5,000	60,000
	MOST	GEF	74500	Miscellanous	32,000	33,000	5,000	5,000	75,000
	MoST	GEF	71600	Travel	0	15,000	0	0	15,000
	MoST	Shanghai	74500	Misc Expense	13,000	13,000	13,000	13,000	52,000
	MST	Beijing	74500	Misc Expense	54,000	54,000	54,000	54,000	216,000
								Sub total	**202,000**
Activity 3.2 *Research on*	MoST	GEF	71200	International consultant	5,000	5000	5000	0	15,000

the technical development related to FCBs value chain.	MoST	GEF	71300	National Consultant	10,000	5000	5000	0	20,000
	MoST	GEF	72100	Contractual Serv	28,000	29000	0	0	57,000
	MoST	GEF	74500	Miscellaneous	15,000	15,000	10,000	0	40,000
								Sub total	**132,000**
Activity 4.1 *Promote the future certification development for FCB and refilling station in China.*	MoST	GEF	71200	International consultant	5,000	5000	0	0	10,000
	MoST	GEF	71300	National Consultant	15,000	15,000	10,000	10,000	50,000
	MoST	GEF	74500	Miscellaneous	20,000	15,000	15,000	11,000	61,000
	MoST	GEF	72100	Contractual Serv	30,000	30000	0	0	60,000
	MOST	MoST	72100	Contractual Serv	60,000	60,000	60,000	60,000	240,000
	MoST	Shanghai	74500	Misc Expense	75,000	75,000	75,000	75,000	300,000
	MoST	MoST	74500	Misc- Workshop	0	0	18,750	18,750	37,500
								Sub total	**758,500**
Activity 4.2 *Provide the suggestions for future FCB design.*	MoST	GEF	71200	International consultant	0	10000	5000	0	15,000
	MoST	GEF	71300	National Consultant	0	15000	5000	5000	25,000
	MoST	GEF	74500	Miscellaneous	0	10000	5000	0	15,000
								Sub total	**85,000**
Activity 4.3 *FCB related life clcye anantlysis.*	MoST	GEF	71200	International consultant	10,000	25,000	25,000	0	60,000
	MoST	GEF	71300	National Consultant	15,000	15,000	5000	5000	40,000
	MoST	GEF	74500	Miscellaneous	5,000	10000	10000	5000	30,000
	MoST	GEF	72100	Contractual Serv	27,000	18000	0	0	45,000
	MoST	MoST	71600	Travel	7,500	7,500	7,500	7,500	30,000

								Sub total	**205,000**
• Outcome C – Promote enabling environment for FCB expansion and support the design of roadmap									
Activity 5.1 *Policy and market study to promote the FCB Certification.*	MoST	GEF	71400	Service contracts/admin	40,000	70,000	25,000	26,000	161,000
	MoST	GEF	74500	Miscellaneous	10,000	15,000	15,000	5,000	45,000
	MoST	GEF	71600	Travel	0	5,000	0	0	5,000
	MoST	GEF	71300	National Consultant	10,000	10,000	10,000	0	30,000
	MoST	GEF	72100	Contractual Serv	25,000	25,000	25,000	0	75,000
	MoST	MoST	71600	Travel	10,000	10,000	10,000	10000	40,000
	Most	UNDP	74500	Miscellaneous	53,000	52,500	53,000	37,500	196,000
								Sub total	**552,000**
Acticity 6.1 *Partnership building.*	MoST	GEF	71300	National Consultant	0	5,000	5,000	5,000	15,000
	MoST	GEF	74500	Miscellaneous	5,000	5,000	5,000	0	15,000
								Sub total	**30,000**
Activity 6.2 *Set up the project website.*	MoST	GEF	71300	National Consultant	0	5000	5000	0	10,000
	MoST	GEF	74500	Miscellaneous	5,000	5000	0	0	10,000
								Sub total	**20,000**
Activity 6.3 *Organize the national& int'l conference/ workshop.*	MoST	GEF	71300	National Consultant	0	5000	5000	5000	15,000
	MoST	GEF	74500	Miscellaneous	5,000	5000	5000	0	15,000
	MoST	MoST	74500	Misc- Workshop	10,000	10,000	10,000	10,000	40,000
								Sub total	**70,000**
Activity 6.4 *Public awareness and*	MoST	GEF	71200	International consultant	0	0	10,000	10,000	20,000
	MoST	GEF	74500	Misellaneous	0	0	10,000	10,000	20,000

education.	MoST	GEF	72100	Contractual Serv	25000	25000	0	0	50,000
	MoST	Beijing	74500	Misc Expense	6000	6000	6000	6000	24000
	MoST	Shanghai	74500	Misc Expense	60000	60000	60000	60000	240000
	MoST	MoST	71300	National Consultant	15,000	15,000	15,000	15,000	60,000
								Sub total	**414,000**
Activity 7.1 *Carry out technicaland financing feasibility studies*	MoST	GEF	74500	Miscellaneous	0	0	10,000	10,000	20,000
	MoST	GEF	71300	National Consultant	0	0	10,000	10,000	20,000
	MoST	GEF	71600	Travel	0	0	5,000	0	5,000
	MoST	GEF	72100	Contractual Serv		0	30000	30000	60,000
	MoST	GEF	71200	International consultant	0	0	15,000	15,000	30,000
								Sub total	**135,000**
Activity 7.2 *Support the FCB development roadmap design.*	MoST	GEF	71300	National Consultant	0	0	5,000	5,000	10,000
	MoST	GEF	71200	International consultant	0	0	0	25,000	25,000
	MoST	GEF	72100	Contractual Serv		0	28000	27000	55,000
	MoST	Beijing	74500	Misc Expense	0	0	40000	40000	80,000
	MoST	Shanghai	74500	Misc Expense	0	0	50000	50000	100,000
	MoST	MoST	71300	National Consultant	0	0	35000	10,000	45,000
								Sub total	**315,000**
	MoST	Beijing		Co-financing					**3,536,000**
	MoST	Shanghai		Co-financing					**4,384,000**
	MoST	Private Sec		Co-financing					**1,223,000**

				Summary of Account					
				GEF	**1,307,000**	**3,873,000**	**353,000**	**234,000**	**5,767,000**
				UNDP	**53,000**	**52,500**	**53,000**	**37,500**	**196,000**
				MoST					**3,519,000**
				Beijing					**3,536,000**
				Shanghai					**4,384,000**
				Private Sec					**1,223,000**

Annual Work Plan

Year 2007

EXPECTED CP OUTPUTS and indicators including annual targets	PLANNED ACTIVITIES List all activities including M&E to be undertaken during the year towards stated CP outputs	TIMEFRAME Q1	Q2	Q3	Q4	RESPONSIBLE PARTY	PLANNED BUDGET Source of Funds	Budget Description	Amount
Output 1: A commercially-relevant demonstration of the technical feasibility of FCBs and their refueling infrastructure and staff training related to their operation in Beijing and in Shanghai. **Indicators:** ➢ 3-6 FCBs procured in Phase II ➢ 6-9 Buses in operation for 4000hours ➢ 2 hydrogen refilling station put into service **Target for 2007** Six FCBs procured for Shanghai and FCBs in Beijing operate total 4000hours .	Activity 1.1. Purchase the FCBs.		×	×	×	MOST	GEF Trustee (62000)	71200-International consultant	40,000
			×	×	×	MOST	GEF Trustee (62000)	71300-National Consultant	15,000
			×	×	×	MOST	GEF Trustee (62000)	74500Miscellaneous	15,000
Output 2: Performance analyzed including reliability and failure modes, support improvement the design and reducing the cost of	Activity 2.2. Develop operation guideline for FCB		×	×	×	MOST	GEF Trustee (62000)	71300-National Consultant	5,000

FCBs in China **Indicators:** Development of quarterly reporting forms. Persons consulted in formulating reporting guidelines Quarterly reports collected Semi-annual publication of documents demonstrating accumulated experience and knowledge **Target for 2007** Knowledge accumulated from Beijing FCBs operation, data collected, analyzed and evaluated	and HRS operation and maintenance.		×	×	×	MOST	GEF Trustee (62000)	72200-Contractual Serv	25,000
			×	×	×	MOST	GEF Trustee (62000)	74500-Miscellaneous	5,000
	Activity 2.3 Social and environment research		×	×	×	MoST	GEF Trustee (62000)	72200-Contractual Serv	25,000
Output 3: Set up the FCB knowledge base, and analyze the technical issues related to FCB value chain **Indicators:** Experience exchanged and shared through visit GEF or non-GEF projects **Target for 2007** Experience learned	Activity 3.1 Learn the international experience related to FCBs value chain		×	×	×	MoST	GEF Trustee (62000)	71300 – Local Consultants	5,000
			×	×	×	MoST	GEF Trustee (62000)	74500 - Miscellaneous Expenses	10,000
Output 4: Promote the FCB related technology development **Indicators:** Trained operators and mechanics	Activity 4.1 Promote the future certification development for FCB and refilling station in China		×	×	×	MoST	GEF Trustee (62000)	71300-National Consultant	10,000
			×	×	×	MoST	GEF Trustee (62000)	74500-Miscellaneous	5,000

Target for 2007 Enough operators, mechanics and drivers trained			×	×	×	MoST	GEF Trustee (62000)	72200-Contractual Serv	27,000
	Activity 4.3 FCB related life cycle analysis		×	×	×	MoST	GEF Trustee (62000)	71200-International consultant	5,000
			×	×	×	MoST	GEF Trustee (62000)	71300-National Consultant	5,000
			×	×	×	MoST	GEF Trustee (62000)	72200-Contractual Serv	27,000
Output 5: Policy and market research on FCB related value chain **Indicators:** Study tours completed **Target for 2007** 1 study tour be undertaken	Activity 5.1. Policy and market study to promote the FCB		×	×	×	MoST	GEF Trustee (62000)	72200-Service contracts/admin	40,000
			×	×	×	MoST	GEF Trustee (62000)	74500-Miscellaneous	5,000
			×	×	×	MoST	TRAC	71300-National Consultant	10,000
			×	×	×	MoST	TRAC	74500-Miscellaneous	20,000
Output 6: Set up the platform to strengthen the cooperation between national and international stakeholders including policy makers, investors, industries and the general public. **Indicators:** Workshop held **Target for 2007** Attendees from the governments, FCBs and hydrogen refueling station manufacturers, organizations, and experts around the world	Activity 6.1. Partnership building		×	×	×	MoST	GEF	74500 - Miscellaneous Expenses	5,000
			×	×	×	MoST	GEF Trustee (62000)	72200-Contractual Serv	20,000
	6.2. Set up the project website		×	×	×	MoST	GEF Trustee (62000)	74500-Miscellaneous	5,000
	6.3. Organize the national& int'l conference/workshop				×	MoST	GEF Trustee (62000)	74500-Miscellaneous	20,000

	6.4 Public awareness and education			×	×	MoST	GEF Trustee (62000)	72100-Contractual Serv	25,000
TOTAL									374,000

The Annual Work Plan (AWP) Monitoring Tool Year 2007

CP Component: Reduce GHG emissions and air pollution through widespread commercial introduction of FCBs in urban areas of China

Implementing Partner: FCB PMO, MoST

EXPECTED CP OUTPUTS AND INDICATORS INCLUDING ANNUAL TARGETS	**PLANNED ACTIVITIES** List all the activities including monitoring and evaluation activities to be undertaken during the year towards stated CP outputs	**EXPENDI-TURES** List actual expenditures against activities completed	**RESULTS OF ACTIVITIES** For each activity, state the results of the activity	**PROGRESS TOWARDS ACHIEVING CP OUTPUTS** Using data on annual indicator targets, state progress towards achieving the CP outputs. Where relevant, comment on factors that facilitated and/or constrained achievement of results including: Whether risks and assumptions as identified in the CP M&E Framework materialized or whether new risks emerged Internal factors such as timing of inputs and activities, quality of products and services, coordination and/or other management issues
Output 1: A commercially-relevant demonstration of the technical feasibility of FCBs and their refueling infrastructure and staff training related to their operation in Beijing and in Shanghai. **Indicators:** 3-6 FCBs procured in Phase II 6-9 Buses in operation for 4000hours Hydrogen station put into service **Target for 2007** Six FCBs procured for Shanghai and FCBs in Beijing operate 4000hours H2 station put into service	Activity 1.1. Purchase the FCBs.	952,000		

Output 3: Set up the FCB knowledge base, and analyze the technical issues related to FCB value chain **Indicators:** Experience exchanged and shared through visit GEF or non-GEF projects **Target for 2007** Experience exchanged and shared through visit GEF or non-GEF projects	Activity 3.1 Learn the international experience related to FCBs value chain	47,000		
	Activity 3.2 Research on the technical development related to FCBs value chain.	30,000		
Output 4: Promote the FCB related technology development **Indicators:** Trained operators and mechanics **Target for 2007** Enough operators, mechanics and drivers trained	Activity 4.1 Promote the future certification development for FCB and refilling station in China	110,000		
	Activity 4.3 FCB related life cycle analysis	57,000		
Output 5: Policy and market research on FCB related value chain **Indicators:** Study tours completed **Target for 2007** 1 study tour undertaken	Activity 5.1 Policy and market study to promote the FCB	113,000		
Output 6: Set up the platform to strengthen the cooperation between national and international stakeholders including policy makers, investors, industries and the general public. **Indicators:** Workshop held **Target for 2007** Attendees from the governments, FCBs and hydrogen refueling station manufacturers, organizations, and experts around the world	Activity 6.1 Partnership building	5,000		
	Activity 6.2 Set up the project website	5,000		
	Activity 6.3 Organize the national& int'l conference/workshop	15,000		

Table 9: Indicative Activities and Annual Workplan

ACTIVITY	2007	2008	2009	2010
1.1 Purchase the FCBs	→	→		
1.2 Fueling infrastructure	→	→	→	
1.3 Hold training	→	→	→	→
1.4 Place the buses in operation	→	→	→	→
2.1 Collect and analyze data	→	→	→	
2.2 Develop operation guideline		→	→	→
2.3 Social and environment research	→	→	→	→
3.1 Learning the international experience	→	→	→	→
3.2 Research on the technical development		→	→	→
4.1 Promote the standards development	→	→	→	→
4.2 Provide the suggestions for FCB design			→	→
4.3 FCB related LCA		→	→	
5.1 Policy and market study	→	→	→	→
6.1 Partnership building	→	→		
6.2 Set up the project website	→	→	→	→
6.3 National and international workshops	→	→	→	→
6.4 Public awareness and education	→	→	→	→
7.1 Feasibility studies			→	→
7.2 Support the FCB development roadmap			→	→

SECTOR IV Additional Information

PART 1: Other Agreements

中华人民共和国科学技术部
THE MINISTRY OF SCIENCE AND TECHNOLOGY
THE PEOPLE'S REPUBLIC OF CHINA

Mr. Khalid Malik
Resident Representative
UNDP China
Beijing

Subject: Final project document submission

Dear Mr. Khalid Malik: Aug 18, 2005

Enclosed please find the final document of Demonstration for Fuel Cell Bus Commercialization in China Project Part II. It is much appreciated if UNDP could submit it to GEF secretariat for approval. As we knew, GEF will continue to provide 5.767 million USD in FCB procurement and related capacity building. UNDP will contribute 0.196 million USD for the project. In addition, Chinese government will provide co-financing of 11.439 million USD in cash and in-kind.

Your strong support to this project is greatly appreciated.

Yours sincerely

Xu Jing

XU Jing
Deputy Director-General
Department of High-Tech Development and Industrialization
Ministry of Science&Technology
P.R.China

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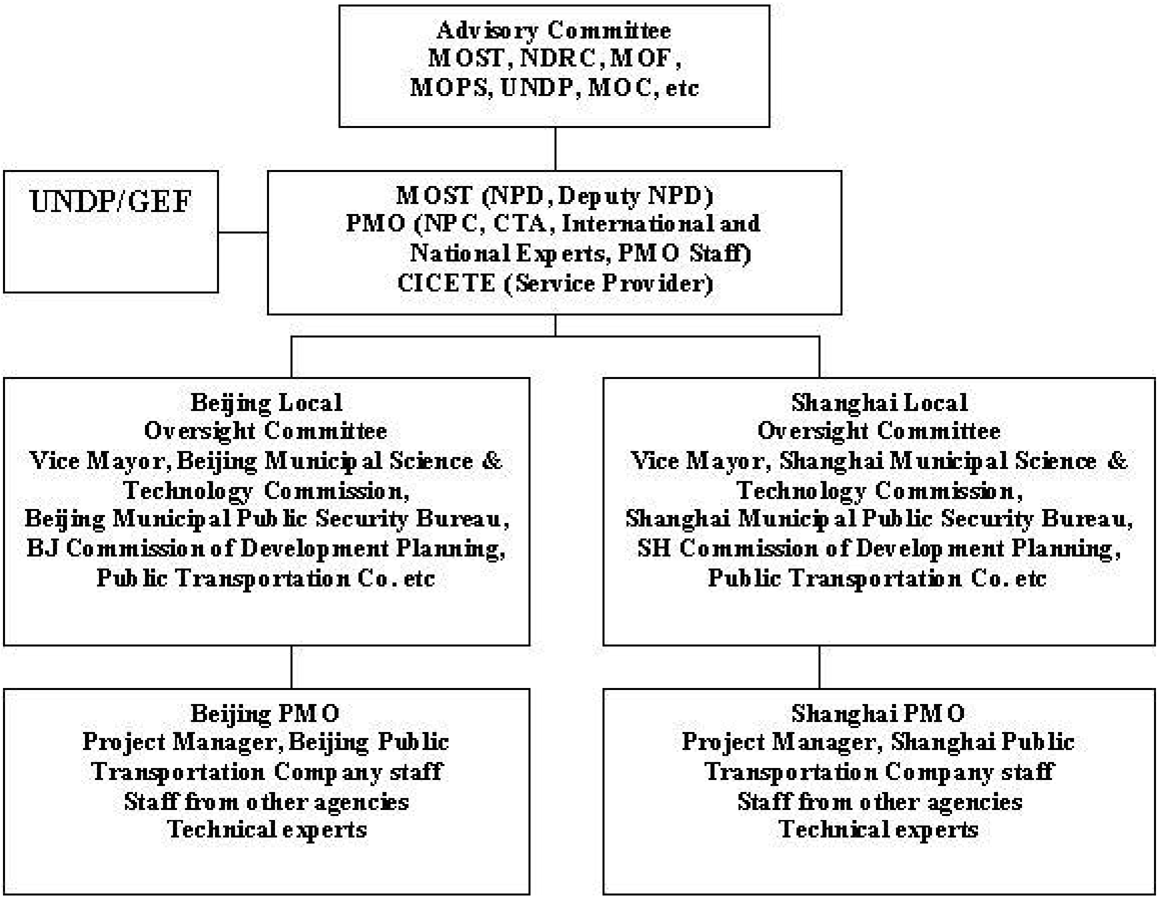
PART 2: Organigram of Project



PART 3: Stakeholder Involvement Plan

177. Technology providers, which have been major stakeholders in the Phase I project, became involved in the FCB project through the international procurement process and some as actual suppliers to the project. Technology-related stakeholders included:

- DaimlerChrysler as FCB supplier;
- BP, as hydrogen fueling station co-partner, responsible for technology and operation;
- CUTE (Clean Urban Transportation for Europe) for exchange and sharing FCB demonstration experiences of the ten European cities and Perth of Australia (Beijing FCB demonstration project became the member of CUTE FCB Club. EU contributed Euro 160,000 to the China FCB project.);
- US Department of Energy for provision of assistance for a study on China’s hydrogen roadmap, and cooperation and funding for construction of Beijing Hydrogen Energy Transportation Park. (Solar & wind power hydrogen production);
- Westport (Canada) and Cummins (USA) for the demonstration of Hythane Vehicles (H2+CNG ICE Vehicle) in Hydrogen park;
- Beijing Public Transportation Corporation- in charge of FCB operation;
- SinoHytec responsible for Beijing Hydrogen Energy Transportation Park Construction, including the hydrogen fueling station;
- Tsinghua TongFang Co. Ltd. a partner responsible for construction of hydrogen fueling station;
- Tsinghua University for provision of technical support and consultation on FCB preliminary specifications, technical document translation, training, and data collection system.

178. Phase II of the project will again include technology suppliers as stakeholders through the flexible procurement process. Potential stakeholders may include: General Motors, Hyundai Motors Corp of Korea, BP, UTC, Ballard, some Chinese FCB developers, China Petrol, Tongji University, TongFang auto company, SinoHytec, etc.

179. Other stakeholders in the FCB project are governmental which include:

- MOST;
- The National Development and Reform Commission;
- The Ministry of Finance;
- The State Environmental Protection Agency;
- Beijing Science and Technology Commission; and,
- Shanghai Science and Technology Commission.

180. 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 National Development and Reform Commission, the Ministry of Finance, the State Environmental Protection Administration.

PART 4: List of Documents Available Upon Request

Summary report of the January 2000 stakeholder workshop held in Beijing.

State Science and Technology Commission (now Ministry of Science & Technology), 1998, *Capacity Development for Fuel Cell Powered Buses Development and Commercialization in China*, final report on UNDP-GEF project CPR/96/313, Beijing, March.

Mao, Z., Yan, J., and Liu, L., 1999, "The history, current situation and prospect for fuel cells in China," *Proceedings of EVS-16, the 16th International Electric Vehicle Symposium*, Beijing, China, 12-16 October. The World Bank, 1996, *China's Urban Transport Development Strategy: Proceedings of a Symposium in Beijing*, November 8-10, 1995 (World Bank Discussion Paper No. 352), Washington, D.C.

UNDP-GEF, 2000, *Commercialization of Fuel-Cell Buses: Potential Roles for the GEF*, Proceedings of the April 27-28 workshop held at UN Headquarters, New York, 6 June.

Wong, R., and Bao-lian, Y. 2004, *Evaluation of UNDP/GEF Project: Demonstration for Fuel Cell Bus Commercialization in China Phase I (CPR/01/G31): Report of the Evaluation Mission*. November.

Hosier, R. and Larson, E.D., 2000. "GEF Participation in Fuel Cell Bus Commercialization," Working Document, UNDP/GEF, New York, Feb. 2000.

Documents generated by the Phase I project:

- Two semi-annual reports in November 2003 and July 2005
- Two Project Implementation Reports (PIR) in June 2004 and June 2005
- Reports of the two study tours: one to Canada and Japan in September 2003 and one to America in November 2003.
- Reports of three policy study tours to Germany in September 2003, European countries in September 2004, and USA and Brazil in March 2005.
- Evaluation report in November 2004.
- Two Tri-partite project review (TPR) reports in June 2004 and August 2005 respectively.
- Eleven newsletters in English and Chinese

PART 5: GEF Council comments

China: Demonstration of Fuel Cell Bus Commercialization (Phase 2)
Responses to GEF Council Comments (France)

Comments & Responses	Reference
<u>Comment</u>: **A first phase of the project was presented to the Council in 2002. Some Council members raise some concerns considering a number of technical issues remain to be tackled to allow fuel cell technology to be workable on a commercial basis. At the document stage, it was not clear how the project could deliver new and consistent results.** **<u>Response</u>**: Research into fuel cell technology is continuing throughout the world, with significant advances being made in the areas of operating fuel cell buses (FCB) at temperatures below freezing, fuel cell stack durability and reliability, and the reduction of the overall fuel cell system cost. In China, the government has supported the development of FCBs through the ratification of the National Electric Vehicle Program in 2001, committing resources to promote technology designed to decrease both the usage of oil and amount of air pollution and CO_2 emissions from land transport vehicles. During the past four years, China has successfully developed its own fuel cell buses and vehicles. These are currently being operated on a pilot scale basis. Furthermore, as outlined in its new Five-Year Plan, the Government of China will continue to commit resources to support advancement in FCV R&D and commercialization. The demonstration and piloting of FCBs are part and parcel of the country's program on the development and commercialization of fuel cell technology. It is critical to collect essential operating data on the performance (technical, economic, environmental) of FCBs in order to evaluate and ascertain their commercial viability. Moreover, there is also the need to study further the adaptability of the FCB technology in the Chinese context, which is essential in ensuring the applicability and sustainability of the FCBs considering the various conditions (climatic, topographical, economic, etc) in the country. For one thing, the repair and maintenance aspects of the technology needs to be studied and made well known to the users of the technology. The empirical evidences and data gathered will allow researchers to make the necessary adjustments and recommendations for improvements on the FCBs in preparation for commercial use. Activities proposed under Phase II will allow the FCB team to aggregate and collect economic and technical data including operation, maintenance, and failure modes for analysis and improvement. Based on the findings, critical FCB technical, operational, and management experience can be accumulated which will result in a strong foundation for future FCB commercialization. The demonstrations under Phase II will also provide a good test bed for further developing FCB standards and regulations, increasing public awareness and acceptance, and	

allowing public officials a better understanding of the technology's capabilities. One of the main strategies under the Phase II project is to identify new generations of FCB technologies that features high energy efficiency, low hydrogen consumption, reasonable price and long durability. These new improvements will be critical towards the development of a truly commercial FCB market in China. Fuel cell hybrid technology will be among the new FC options explored in Phase II which promises better performance, significantly lower fuel consumption, and reduction of capital costs. These capabilities have been initially introduced and demonstrated by the Toyota Hybrid FCB presentation at the 2005 World Expo in Aichi, Japan (energy efficiency 66% higher than diesel bus); the hybrid FCB by Sunline Transit Authority in the United States, as well as by the Chinese hybrid FCB shown at the Bibbendum Challenge held in October 2005 in Shanghai. Activities under Phase II will help identify and further enhance the new technologies to enable FCBs to become an economically viable option for transportation. The Phase II Project will directly address the technical barriers to Fuel Cell Bus (FCB) commercialization—cost, fuel economy, durability and reliability—and is an important part of the global effort to further develop this technology.	
<u>Comment</u>: **Phase 1 review concludes that one of the main achievement of phase 1 was "to create a wider awareness within China of FCB; in the meantime though, phase 1 seems not succeeding to mobilize some crucial stakeholders, with a short fall of cofinancing: US$6.27 million (according to Phase 2 document) instead of US$10.11 million (according to the proposal submitted to the GEF Council in 2002).** **<u>Response</u>**: The decrease from US$10.11 million (Phase I) to US$6.27 million was mainly due to technicality and shifting of funds rather than the project's inability to mobilize stakeholders. The two primary reasons for the difference are the following: 1. The import duty of US$1.95 million was excluded in the Phase I calculations, since, as per GEF co-financing guidelines, import duties are not considered as co-financing; and 2. As Shanghai did not purchase their FCBs under Phase I, they have committed to allocate their funds (US$1.89 million) to Phase II of project as shown in their co-financing commitment letter. Furthermore, contrary to what is stated in the comment, Phase I was able to successfully mobilize and increase the participation of FCB stakeholders than what was originally planned in the document. This was facilitated and influenced by the activities conducted under Phase I. They consist of the	

following: 1. To support FCB infrastructure, approximately US$7 million was mobilized during Phase I for the construction of a Beijing hydrogen re-filling station. In order to showcase the different hydrogen producing technology and educate the public, the station will be built to accommodate three types of technology - onsite tube trailers and electrolysis, natural gas reformer and finally, the use of renewable resources from photovoltaic and wind to produce hydrogen – all located inside Beijing's Hydrogen Park. With the anticipation of increased demand for the hydrogen in the coming years and the Olympic Games in 2008, the station capacity will be designed at 4,000 standard m3 per day. In this connection, BP signed an agreement with the Chinese counterpart to commit equipment and services totaling US$3.5 million; the national EV project contributed US$2 million for the development of the fueling stations, and the Beijing municipal government provided land estimated to be worth US$1.5 million. The tube trailer and electrolysis section of the hydrogen re-filling station began construction in late-2005 and will be operational by April 2006. The re-filling services for natural gas reformer and renewable resources will be completed in 2006-07. 2. In addition, DaimlerChrysler supported the Phase I project activities by manufacturing and delivering the 3 FCBs for a significantly lower price than the market rate. The savings, which are estimated at approximately USD 5 millions, can largely be attributed to in-kind contributions for R&D investment, FCB maintenance services, spare parts, training, and warranty. 3. Facilitated and influenced by the FCB Phase I activity, a mobile hydrogen refilling vehicle was developed in Shanghai. In this connection, the city is planning to build a permanent hydrogen refilling station and has successfully mobilized the Shell Company to provide financial and technical contributions accordingly.	
Comment: **The same review admits that phase 1 only reached half its objectives in terms of technical demonstration setting one 3 FCB fleet in Beijing only (instead one Beijing and one Shanghai); this shortfall is accounted for by budget constraints; it confirms that FCB technology is far from being commercially sustainable.** **Response**: The objective of FCB demonstration projects is to further the development of the technology in order to enable commercialization. The demonstrations, therefore, represents a critical step towards and necessary requirement towards the promotion of, and commercialization of the FCB technology. Many countries such as the United States, Japan, Australia and the European Union have sponsor similar demonstration projects to support the research	

and advancements in FCBs as a means of sustainable development and transport for the future. In Phase I, the 3 FCBs in Shanghai were not deployed as originally planned in the project document. This was primarily due to capacity constraints of the FCB supplier and not entirely on budgetary constraints as implied. The FCB market has since changed rapidly and there are now more providers of the technology in Europe, U.S.A, Japan and Korea. In China alone, the government has commissioned local producers to develop 5 prototype FCBs for Beijing while Shanghai is also developing its own FCBs. The increase in the number of players in this special field and the maturation of the FCB market will further increase the awareness of FCB technology among the public, obtain government support, promote international standards and contribute towards the commercialization of FCBs in the country. To further support the development of the FCB market, prices of fuel cell systems have substantially decreased in recent years. The current price is about US$ 5,000/kW, and the use of locally developed FCB technology could further reduce this by 20%. The primary reason for the high cost of fuel cell systems is the low volume of sales /demand and amortization of the significant R&D investment. According to a US Department of Energy (DOE) study, the forecast cost of a fuel cell system manufactured in volumes of 500,000 units would be about US$ 100/kW. With FC technical improvement and the concomitant increased cost for conventional ICE due to requirements for higher fuel economy, coupled with increased fossil prices and demands/requirements for lower emissions, fuel cell vehicles has the potential to become competitive with conventional vehicles. The US DOE has set the target for fuel cell commercialization for 2015 with Ballard recently announcing they could reach this target by 2010. The US Department of Transportation announced in November 2003 that 10% of the newly purchased buses will be fuel cell powered by 2015. In this connection, Ballard announced in April 2005 the following fuel cell stack targets by 2010: • The power density of their fuel cell stack will reach over 2500 w/l • Durability will be 5000 hours (now is about 2000 hours) • Cost of stack will be US$ 30/kW (equivalent to gasoline engine price) • The fuel cell system can be started at –30°C temperature. As outlined, rapid advances in fuel cell technology has helped support the progress towards FCB as an economically and commercially viable option. From a technical viewpoint, fuel cell system reliability and durability are key issues that need to still be resolved. Continued piloting and demonstration of FCBs as proposed in the Phase II document will further support the development of fuel cell technology as a viable solution to sustainable transport. Breakthroughs in fuel cell life and technology from findings based on the demonstrations will enable private sector investments necessary for the	

commercialization of FCBs.	
<u>Comment</u>: **With reduced global objectives (6 FCB tested instead of the 12 announced initially for phase 1+ phase 2), it is not clear whether the program will be bring new elements instrumental into turning FCB into a replicable, commercially sound alternative. Some more detailed elements should be provided to address these issues.** **<u>Response</u>**: The GEF/UNDP FCB project is a catalyst to promote the FCB R&D development around the world. The Phase I program successfully leveraged its activities and objectives to support China's commitment to FCB technology development. During Phase I, the Government of China allocated resources for the development of 5 local FCB prototypes that are currently being piloted. To support FCB commercial viability and replicability, in Phase II, the project will focus on the procurement of FCB hybrid technology, which introduces additional reduction of costs (engine power requirements for the basic operations of the buses will be lower) and improved performance (potential fuel consumption reduced upto 30-50% depending on the traffic and topography). Additionally, to support FCB replication, the pilot FCBs in Beijing and Shanghai will be monitored, analyzed and evaluated on their performances vis-a-vis the environment (i.e, topography, etc) and climate conditions. The results will serve as a baseline and model to promote/replicate FCBs as a commercially viable alternative for other cities in China that share similar environmental characteristics and conditions as Beijing and Shanghai. Further studies on new FCB and infrastructure technologies will also be rigorously undertaken during Phase II to investigate and identify suitable technologies for future FCB commercialization in China. In this connection, a FCB strategy and feasibility plan will be developed to achieve and enable FCBs to be commercially-viable and replicable in China. A PPP strategy on FCB will be designed to encourage dialogue and participation from both the private sector and government to support means to reduce costs and improve the performances of FCBs. In 2006, 6 FCBs will be introduced and utilized as means of public transport in Beijing, including 3 buses from DaimlerChrysler (procured under Phase I of the GEF/UNDP FCB project) and another 3 from domestic developers under the condition of receiving the certification approval. The domestically developed FCBs could be demonstrated in parallel under the framework of GEF/UNDP project. The target of number of FCBs to be deployed in Phase II is also 6. Furthermore, there are plans for Beijing to have at least 15 FCB demonstration units in time for the 2008 Olympic Games. Planned production	

volume of FCB is 30 per year by 2010. The Shanghai government commits to demonstrate more than 10 FCBs by 2008 and to expand the demonstration to a larger scale by 2010 for the World Expo. The commitments expressed by the Government of China further strengthen the impact and case for FCB commercialization as an alternate means of transportation. With FCB technical development around the world, it is evident that FCB manufacturers, including Chinese FCB manufacturers, are acquiring increasing capability to produce sophisticated new technologies with lower production costs. The Phase II strategy is to use global sourcing, including local capacities to reduce FCB costs and enable further progress toward commercialization. Considering all of these factors, coupled with the dominant position of the Chinese market for transit buses globally, Phase II of the UNDP/GEF FCB program will play an important role in promoting the commercialization of the FCB technology.	
<u>Comment</u>: **Issues about the sustainability and the reliability of the project should be addressed and précised in the project document.** **<u>Response</u>** Phase II project targets for cost, durability and reliability, fuel economy, and other key parameters are significantly better than FCBs already procured in Phase I. These advances are a major step toward commercialization. Some key pre-project activities will be carried out during the inception period of Phase II to prepare for the new demonstration activities. This will include:: • Developing detailed strategy for achieving FCB commercial production in China • Feasibility study on expanding the demonstration buses and replicating it in other cities which have some experiences with Electric Vehicle demonstration or FCB R&D; • Study on codes, standards and regulations relevant to FCB and hydrogen refilling station. To keep the sustainability of the hydrogen economy, Beijing is cooperating with the US DOE to begin using renewable sources of electricity, such as photovoltaic and wind energy. Shanghai has already made substantial progress to reduce the price of hydrogen by using by-product hydrogen, which can be purified to meet the requirement for FCVs. Government of Shanghai will allocate more inputs and develop new energy vehicles including fuel cell vehicles to promote the sustainability of the FCB technology applications. Currently, a fleet demonstration with 10 fuel cell cars, developed in Shanghai, is on-going. The experience from these	ProDoc: pp. 34-35

activities can benefit the Phase II project. The demonstration's experience indicates that operational cost of FCVs using by-product hydrogen is potentially lower than that of current gasoline-fed vehicles. To permit replication of this project in other cities, Phase II will emphasize data collection, training, studies, workshops, seminars, strategy development, information exchange, public awareness and media coverage. In addition, the FCB related certification preparation, and the candidate demonstration cities selection are intended to promote the project's replication within China. The total budget associated with replication under these activities is about USD$2M**.**	

PART 6: Responses to the GEF Secretariat Review

China: Fuel Cell Bus Phase II

Comment	Response	Reference
Country Drivenness 1. Has the Roadmap been completed? What specific goals and strategies does it contain with respect to the development of FC technologies for transportation?	MOST held consultations for the Roadmap in 2004 and a draft of China's Hydrogen Vision has been developed, still to be finalized and endorsed in the future. A 3 phase strategy is in place, focusing on initial demonstration and R&D for FCB (2005-2020) (the demonstration of FCBs at the Beijing Olympics 2008 and the Shanghai World Expo 2010). Together with support activities for commercialization, this should lead to greater market penetration with focus on urban areas along with functional and stable infrastructure.	Executive Summary 3 c) Replicability Prodoc Section II. 1.4.3 International Cooperation
Replicability 2. The total budget associated with replication is $2.66 million. Is this all GEF allocation?	Of this $2.66 million, $1.534 million will come from MOST (within Outcome 3 in TPW), with $558,000 from GEF (Outcome 3 in TPW) and remainder from Shanghai government (under Outcome 2 BL 74100) and Beijing government (under Outcome 2 BL 74100).	Prodoc Section I. 2.7 Replicability
Stakeholder Involvement 3. Similarly, Organigram of the Project also needs to be revised accordingly, including municipal level agencies. P.12 also mentions the Ministry of Public Security -- is this correct?	The organigram has been updated to reflect local government partners. Ministry of Public Security (MOPS) serves as member of the Advisory Committee at the national level to provide advice to MOST and partners on issues related to the hydrogen fuel station, as a safety concern.	Exec Sum Figure 1. Organigram of project Prodoc Section III. Part 3.
Financing Plan 4. Please explain what kind of arrangements have been made or will be made with respect to private sector contributions and how they will be delivered.	An informal private sector forum will be established by MOST after programme inception with participation by companies such as Toyota, GM, Hyundai and local companies with research & development programmes for clean transport, to participate in all relevant activities of the programme, such as maintenance supply, FC commercialization. The companies have already expressed interest through communication with the PMO.	
5. A budget plan is needed that includes all co-financing sources and the related activities and outcomes.	The Total Work Plan has been updated to include not only UNDP and GEF cash contributions, but also the parallel co-financing amounts from MOST, and Shanghai and Beijing municipal governments.	Section 3 Page 59
6. Status of co-financing commitment both refers to Phase I. Shouldn't this be Phase II Prodoc?	The "Part 1" referred to the section entitled Part 1 under Section III of the text in the prodoc, not the "Phase I" FCB project. Therefore, this is indeed a reference to Phase II.	Prodoc Section III Part I. Project Budget

Comment	Response	Reference
7. Is this correct -- 6-9 FCBs for Phase II? With respect to refueling stations, will they also be paid for by GEF funds?	Phase II will procure 3-6 FCBs., with an additional 3 from Phase I supported in their operations. The refueling stations will be financed by the Shanghai and Beijing municipal governments as indicated in the TWP under their respective columns. .	Exec Sum 4. Financial modality and cost effectiveness
8. But the evaluation report does not discuss whether the co-financing from the various sources have come through (how much?) and what outputs have been contributed to (from which source?) Please explain, with reference to Phase I Prodoc.	The $6.27 million co-financing in Phase I came through. The breakdown by output was as follows: ■ Hydrogen refueling station by MoST and the Beijing Government (Output 1.2) ■ FCBs garage by Beijing Government (Output 1.2) ■ Data collection system design by Beijing Government (Output 1.3) ■ Study tours by UNDP, MoST, Shanghai and Beijing Governments (Output 2.2.3) ■ Training of Beijing project staff by Beijing Government (Output 2.1) ■ Ridership survey by Beijing government (Output 1.3) ■ Newsletters, reports and workshops by MoST and the city governments (Output 1.3, 2.3, 2.4, 3.1)	See prodoc Phase I
General Comments: 9. Please provide an update of the Phase I project activities that were outstanding	■ Construction of maintenance workshop and FCB garage will be completed in October 2005. ■ 3 FCBs delivered to local authority of Beijing in September 2005. ■ Temporary hydrogen refueling system will be available at the end of October 2005. ■ Professional training for approximately 50 by October 2005. (20 from local transport authority, 25 from hydrogen refueling station and 5 from government agencies.) ■ Data collection system (software) to be completed by end of September 2005. ■ With temporary fueling systems in place by October for FCB launch, the construction of the hydrogen refueling station in Beijing will be completed by 1st Quarter of 2006.	Prodoc Section I. 2.1.2 Review of implementation Part I.

Comment	Response	Reference
10. Executive Summary states that "Proceeding with Phase II of the project is triggered by the procurement of the first set of buses under Phase I." Does this refer to just the three buses in BJ? Is this the only trigger for Phase II?	During Phase I, MOST and UNDP have facilitated dialogues and lessons sharing that went beyond Beijing, highlighting to sister cities in China the positive role that FCB technology can play in achieving national and local targets for clean urban transport. Shanghai in particular was a strong partner, with good cooperation achieved to expand FCB commercialization into Shanghai for Phase II. This process of regional sharing of lessons and FCB benefits would continue to expand opportunities for commercialization across China's urban centers.	Exec Sum STAP Review Response 11
11. Will there be new bus procurement for BJ in Phase II? Please clarify and make sure that outcome, outputs, etc. of the current proposal refers to only Phase II.	The GEF funds for FCB procurement will go solely towards Shanghai. The programme will support Beijing, but only for operation of the 3 FCBs from Phase I. There will be no further FCB procurement in Beijing using GEF funds during Phase II. Therefore, all outputs described in the prodoc are purely for Phase II activities.	Exec Sum 1.a) Project rational and objectives
12. There needs to be a clear description of the boundary between Phase I and Phase II and a clear explanation, in terms of outputs and budgets, etc., on what has been accomplished in Phase I, (and what will be "abandoned", not to be delivered), and what will be "transferred" to Phase II. This also applies to the targets etc. in the logframe ("6 to 9 FCBs in operation for at least 200,000 vehicle km in both Beijing and Shanghai"?)	All outputs of Phase I being delivered, with nothing transferred to Phase II. The outputs of Phase I have included: ■ 3 FCBs for Beijing procured and demonstrated ■ A hydrogen refueling station built and operation ■ FCB workshop and garage built ■ Data collection system design complete ■ Study tours conducted ■ Staff trained ■ Ridership survey conducted ■ Eleven newsletter and various reports submitted and workshops conducted During Phase II, the 3 FCBs that will become operational in Beijing will have 210,000 km (70,000 km/bus), while the 3 FCB's in Shanghai will have 210,000 km (70,000 km/bus).	Exec Sum 1.a) Outcomes, outputs and activities Prodoc Section I. 2.2
13. No commitment letter from UNDP is provided	Letter from UNDP Country Office regarding its contribution is provided.	

Updated Organigram of the Project for