CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
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SECTION A. General description of project activity

A.1 Title of the project activity:

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AutoLPG in India - A Road Transport Sector Fuel-Switching Project"

A.2. Description of the project activity:

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Until 2000, retail of all petroleum products was a monopoly of the Government of India. Four Government owned oil companies, namely Indian Oil, Bharat Petroleum, Hindustan Petroleum & IBP Ltd controlled the retail market of all petroleum products totally. With the dismantling of the Administered Price Mechanism (APM), two Government oil companies and three private companies have also been given licenses to retail petrol and diesel. They are ONGC-Mangalore Refinery, Numaligarh Refinery and Reliance Petroleum, Essar Oil and Shell. This retail license came with the clause that the licensee must have an investment of Rs. 10,000 crores (US$ 2.0 b) in upstream area either in exploration or production of oil or gas, a refinery, pipelines or terminals. However, retail of alternative fuels like CNG or LPG were not only exempted from this stipulation but also allowed in India's private sector. (See Annex 5).

The project activity will be the first private sector initiative to introduce LPG as an automobile fuel in India. CNG, however has been introduced in Delhi by Indraprastha Gas Ltd (IGL), a Government of India company, while in Mumbai by Mahanagar Gas Ltd (MGL), a subsidiary of British Gas.

The project activity plans to develop, design, engineer, procure, finance, construct, own, operate and maintain 1493 retail outlets (RO's) to exclusively market AutoLPG (Autogas).). AutoLPG is a tried and tested automobile fuel, working successfully in over 40 countries world-wide. Over 8 million tons of AutoLPG is consumed annually by more than 15 million vehicles retailed through 31,960 LPG refueling stations. Please see Annex 8.

E F Energy Ltd has been specially set up by the project proponents to offer AutoLPG as an alternative automobile fuel in India to 2 wheeler 4 stroke motorcycles & scooters, 3 wheeler 4 stroke, private cars, taxis, multi-utility vehicles (MUV's), mini buses & light commercial vehicles (LCV) etc, with the aim to:

- Convert these targeted vehicles using petrol and diesel to AutoLPG thereby offering clean, environmentally-friendly automobile fuel, and
- electronically capture the data of fuel consumption and vehicle's mileage to accurately compute the GHG & other general emissions reduction

It is proposed to build AutoLPG RO's in all the coastal states located on both the east and the west coast of India (See Annex 12). This decision was influenced by the AutoLPG Gazette notification (Annex 5), declaring AutoLPG as an alternative automobile fuel by the Ministry of Surface Transport and the Ministry of Petroleum & Natural Gas, Government of India as of 1st August 2001, provided that locally produced LPG is not used as an automobile fuel because it is reserved for domestic cooking fuel. Therefore, LPG for automobile consumption has to be imported. Imports will be by sea, and to be cost effective against traditional fuels, states in the coastal belt were selected for marketing of AutoLPG.

In addition to building ROs, the following project activity should be undertaken:

1. To drive the demand for Auto LPG, every RO will be equipped with a retrofit centre for conversion of spark ignition vehicles by installing the LPG conversion kit and gas tank in the vehicle. All 4 stroke engine scooters/motorcycles, 3 wheeler auto-rickshaws, cars and LCV can be converted to LPG.

2. All the 1493 RO's are connected through a Virtual Private Network (VPN) broad-band electronic network for data transfer.

3. With the use of RFID (Radio Frequency Identification) technology, to electronically identify the vehicle, take payment authorization and to monitor every vehicle's mileage and fuel consumption data in order to calculate the GHG emissions.

4. Maintain high Health, Safety and Environmental (HSE) standards by ensuring quarterly checks of the LPG systems in every vehicle

5. Since all retail outlets will be working under the Co-Co (Company owned-Company operated) retail model, the project activity will generate in excess of 18,000 direct new jobs in both rural and urban areas

6. Create new indirect employment opportunities, particularly in the conversion kits, LPG tanks and automotive industry, nation wide

7. Sharing the data of GHG & general emissions with the regional and national Pollution Control Boards, NGO's, vehicle manufacturers & other national and international agencies

The project activity shall be implemented in 3 phases:

- Pilot phase of 10 RO's – in Oct 2004- March 2005 - capital cost US$ 2.5m
- 1st post-pilot phase of 205 RO's – in April 2005- March 2006 - capital cost US$ 34m
- 2nd post-pilot phase of 1278 RO's – April 2006- March 2010 - capital cost US$ 213m

Justification of the project activity:

- Vehicle population, in India, is increasing over 11% from the year 2002 onwards. See Annex 9.
- With increased automobile population, the demand for petrol & diesel is also increasing. See Annex 10. With high fuel consumption, the GHG & general emission levels, particularly in urban areas will also be increasing, thereby creating a strong demand for environmentally friendly alternative transport fuels
- India has a shortage of locally produced LPG
- LPG consumed in the domestic sector is subsidized
- AutoLPG is not subsidized and its pricing is market driven, therefore more expensive than domestic subsidized LPG
- Diversion of imported AutoLPG to the subsidized domestic fuel market will not take place thereby eliminating any leakage
- With the present international prices of LPG and current import duties, taxes and VAT, AutoLPG will be retailed at prices 50% lower than petrol and 25% below diesel prices in India. This substantial price difference is attractive and will give a financial incentive to vehicle owners to convert to LPG

- AutoLPG can be used by all spark ignition (SI) engine vehicles, be it 2 wheelers, 3 wheelers, cars, LCV or mini-buses. Converting compression engine diesel vehicles to LPG is not recommended
- Under Euro III specs for fuel, as per World LPG Association, LPG reduces GHG emissions by between 11-15% compared to petrol, See Annex 7.
- Contribute directly to improving air quality in urban areas of the country by reducing both general and GHG emissions
- The Auto Fuel Policy, 2002 adopted by the Government of India clearly states that "Gaseous auto fuels like CNG/LPG should be encouraged in the cities where pollution due to automobile emissions is very high to enable the vehicle owner to have the choice of fuel and technology combination to meet tighter emission norms in such cities."

A.3. Project participants:

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A.3.1: Project Promoter - E F Energy Limited

E F Energy Limited shall be the lead and nodal entity for all communication with the CDM Executive Board and Secretariat. The details of CER allocation at the point of issuance shall be furnished at the time of PDD registration.

A.3.2: The Ministry of Environment & Forest, Government of India, is the local Designated National Authority for authorizing CDM project activities in the country. The Republic of India is the host country, is a party to the Kyoto Protocol and has acceded to the Kyoto Protocol in 2002.

A.3.3: Buyers of CER's – will be added at the time of PDD registration.

Contact information on the main project participant has been provided in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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India

A.4.1.1. Host Party(ies):

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India

A.4.1.2. Region/State/Province etc.:

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On the East Coast:
States of W Bengal, Bihar, Jharkhand, Orissa, Andhra Pradesh, Tamil Nadu and Pondicherry

On the West Coast:
States of Kerala, Karnataka, Goa, Maharashtra, and Gujarat

A.4.1.3. City/Town/Community etc:

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All the capital cities, large and small towns in the targeted coastal belt, having a population of over 100,000.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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The project activity is spread over all the coastal belt states of India. After extensive research, keeping the vehicle population and numbers of existing traditional fuel outlets in mind, the following AutoLPG RO's will be built in the targeted markets:

EAST COAST:			
W Bengal	-	75 Stations	
Bihar	-	43 Stations	
Jharkhand	-	30 Stations	
Orissa	-	42 Stations	
Tamil Nadu	-	222 Stations	
Andhra Pradesh	-	189 Stations	601 RO's
WEST COAST:			
Kerala	-	125 Stations	
Karnataka	-	166 Stations	
Goa	-	16 Stations	
Maharashtra	-	363 Stations	
Gujarat	-	222 Stations	892 RO's
	TOTAL	**- 1493 RETAIL OUTLETS**	

Please refer to the attached political map of India in Annex 12.

The reasons for selecting the markets in the coastal states of the country are:

1. AutoLPG has to be imported. No locally produced LPG gas can be used, because it is reserved for domestic cooking fuel and is subsidised. Since all imports will be by sea, coastal states have been targeted. Import ports on the east coast of India, i.e., Haldia, Paradip, Vizag, Kakinada and Tuticorin have established LPG storage terminals. While ports of Cochin, Mangalore, Ratnagiri, Mumbai, Kandla and Pipavav on the west coast also have LPG terminals.
2. In the project activity, transportation of LPG from the storage terminal at the import port to the RO will be done by lorry tankers.
3. With almost all the RO's located within 500 km one-way driving distance of the offloading port, AutoLPG will be cost effective against traditional fuels like petrol or diesel.
4. 64% of all categories of vehicles in India are in the targeted market giving the project a large customer base. See Annex 14.

A.4.2. Category(ies) of project activity:

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Transport sector (Category 7, as per Sectoral scope).

The title of the project activity is: **"AutoLPG in India - A Road Transport Sector Fuel-switching Project"**

A.4.3. Technology to be employed by the project activity:

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A chain of 1493 RO's or fuelling stations are to be built on the coastal states of India. Each RO will have the following configuration of equipment:

The technology used retailing the AutoLPG and conversion of vehicles will consist of the following:

1. A Minimum 2 AutoLPG dispensers, each with dual nozzles, electronic volume and flow meters
2. One high-speed submersible pump for delivering the AutoLPG from storage tanks to the dispensers
3. A 20 ton water-capacity LPG storage tank, installed underground
4. Fire fighting systems
5. A 4 or 6 bay retrofit centre for installing conversion kits and AutoLPG gas tanks

The technology used for collection and monitoring of the emission data will consist of following:

1. Connecting all the RO's on high speed broad-band creating a virtual private network (VPN) for voice and data transfers
2. Electronic point-of-sale computers with broad-band connectivity to the main server in back office and the Operational Control Room
3. RFID (Radio Frequency Identification) antenna for vehicle identification
4. RFID readers located near the Point-of-Sale (PoS) on the forecourt for payment authorisation and to capture the vehicle's mileage and fuel consumption data from each vehicle's RFID tag

To house the above equipment, a pre-fabricated steel roof structure will be built on top of the dispensing area. A back-office for the RO will be located in a 2 storied office block on the forecourt.

The dispensers, high speed submersible pumps, RFID antennas, readers and tags are not available in India. The selected equipment will be imported from the Netherlands and Malaysia/USA.

Conversion kits, especially for 2 wheelers, will also be imported from the Netherlands and Italy.

The autoLPG gas for the project activity also needs to be imported. Possible supply sources are the Middle East, Malaysia, Indonesia, CIS States and Australia.

AutoLPG is a tried and tested technology, successfully used in over 40 countries worldwide. Please refer to Annex 8, the statistical data of World LPG Association.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

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Around 70% of India's crude oil demand is met by imports from the Middle East, Africa and more recently from South America. The impact of rising global prices of crude oil poses a serious threat to the transportation sector and the overall health of Indian economy.

In the long run, Indian policy-makers will need to explore other avenues for energy security in the country. As is implicit in the "Indian Hydrocarbon Vision – 2025", ethanol blended petrol and CNG has been introduced, AutoLPG is allowed and work on introduction of bio-diesel has begun to reduce India's dependence on imported crude oil. In spite of all the new initiatives petrol and diesel still maintain their increasing presence in the transport industry and additional new refining capacity has been added by the Government owned oil companies. Please see the following extract from the Indian Hydrocarbon Vision -2025:

"The country attained self-sufficiency in refining capacity, which now stands at 116.5 Million Tonnes Per Annum (MMTPA) almost doubled from about 62.2 MMTPA as on April 1, 1998. The country benefits by not importing expensive products like petrol and diesel and local value addition to crude by converting to more expensive products within the country. Two new grass-root refineries were commissioned at Jamnagar, Gujarat by Reliance Industries Limited and in Assam by Numaligarh Refineries Limited. In addition, three new refineries are being constructed at Paradip (Orissa) by Indian Oil Corporation Limited (9 million tonne), Bhatinda (Punjab) by Hindustan Petroleum Corporation Ltd. (9 million tonne) and Bina (Madhya Pradesh) by Bharat Petroleum Corporation Limited (6 million tonne). The total investment in these three new Refineries would be about Rs. 25,000 crore." Source: http://pib.nic.in/archieve/ppinti/achieve2003/english/31.html

Presently, approximately 18,000 refuelling stations retailing petrol and diesel are operated by the Government owned oil companies. In addition, permission has been given to Reliance Petroleum (5,849 outlets), Essar Oil (1,700 outlets), ONGC-Mangalore Refinery (600 outlets), Numaligarh Refinery (510 outlets) and recently to Royal Dutch Shell (1500 outlets). Please visit: http://pib.nic.in/archieve/ppinti/achieve2003/english/31.html

According to the recommendations in the Executive Summary (page 12) of the "Auto Fuel Policy 2002", it is stated:

"In view of the energy security and environmental concerns, the Committee considers it imperative for the country to have a policy which aims at:

(i) achieving the twin objective of providing assured supply of fuels at minimum costs and meeting the environmental concerns by making available:
  (a) liquid fuels of the specified quality as the main auto fuel throughout the country
  (b) alternative auto fuels, along with liquid auto fuels, in the cities having high vehicular population to enable the vehicle owners to meet the prescribed emissions norms in such cities by choosing appropriate combination of fuel and engine technology.

(ii) protecting the consumer against supply disruptions and price risks."

As a key aspect in the role of legislation in the project activity, one needs to clarify the Government's stand on the issue. The Auto Fuel Policy, 2002 adopted by the Government of India, clearly states that "Gaseous auto fuels like CNG/LPG should be encouraged in the cities where pollution due to

automobile emissions is very high to enable the vehicle owner to have the choice of fuel and technology combination to meet tighter emission norms in such cities." The Auto Fuel Policy 2002 does not stipulate the use of any particular fuel, be it diesel, petrol, CNG or LPG, only the emission standards. Moreover, the policy does not stipulate either normative levels on what constitutes "very high" emission levels, or any particular fuel and technology combination that may be used to meet the "tighter norms". In the absence of this information, the Policy is a prescription at best, which cannot be mistaken for legislation.

The project activity of introducing AutoLPG is, therefore, not based on any direct or indirect legislative obligation to fulfill any National and / or Sectoral policies or circumstances.

With the increase in refining capacity and the high penetration of petrol and diesel retail infrastructure, it is unlikely that CNG, an alternative fuel will make a major difference in the current auto fuel mix in India. In the absence of any existing pipeline network for transporting CNG, the same cannot be made available in other cities of India, which are equally or more polluted.

It is useful to assess the role of the proposed AutoLPG project activity in contrast to CNG and the currently used fuels like petrol & diesel. CNG was introduced in Delhi through a Supreme Court Order. Petrol & diesel have a dominant presence. AutoLPG, though allowed as an automobile fuel is not mandated by any Government body or the Judiciary. Bio-diesel is still in the pilot stage and the phased launch of bio-diesel will only begin in 2008.

Therefore, the most appropriate emissions baseline for automobiles in India is by using emissions data of gasoline and diesel vehicles, as they will remain to be the most predominant fuel for the next 10-15 years business as usual (BAU).

Against this baseline, the monitoring methodology in the project activity will establish that CO2 emissions can be reduced more than 15% by switching the fuel from the presently available quality of gasoline/diesel to AutoLPG. Under Euro III specifications of fuel, the World LPG Association states that LPG brings down CO2 emissions between 11-15% compared to petrol. However, in India, the quality of fuel available is only as per equivalent Euro II specs, hence the CO2 emissions should be higher than 15%.

It may also be noted that the baseline of CO2 emissions will increase dramatically in India, as vehicle sales here are growing at more than 11% from the year 2002 onwards (Annex 9). These new cars will generate additional CO2, too. Hence, there will always be more gasoline/diesel cars on road than LPG vehicles and LPG cars will make a small difference in the absolute emissions from the transport sector.

Under the project activity, AutoLPG will focus on reduction of GHG in comparison to the baseline scenario of petrol and diesel.

One of the most important features of the project is that LPG can be transported in a lorry tanker, unlike CNG. By making AutoLPG available in cities, not connected on a CNG pipeline grid, a significant reduction of GHG emissions can be achieved by vehicles switching to AutoLPG.

As far as the environmental issues are concerned, there have been several reports highlighting the relative advantages of gas-based fuels over petrol and diesel. Compared to gasoline, AutoLPG yields:

- 50% less carbon monoxide
- 40% less hydrocarbons
- 12% less carbon dioxide
- 35% less oxides of nitrogen

- 50% less ozone forming potential

Source: World LPG Association, Also see Annex 7.

It is also inferred that with LPG being lower in price, people will drive more, which could generate a situation that the proposed intervention ends up generating GHG emissions that are higher than projected. However, while the miles travelled in India per vehicle are rising, incremental rise due specifically to the fuel price elasticity of vehicle use is marginal. In other words, the change in the number of miles driven following a fall in fuel prices is negligible, since any vehicle is put to use with a destination in mind and travelling without a destination is the exception. Therefore the rise in miles travelled per vehicle is more a factor of the overall income and economic health of the households and a host of other factors, but not significantly due to lower fuel prices. It is not realistic to assume that the average person will drive aimlessly in an overcrowded and dirty metropolitan city like Calcutta just because fuel is cheaper by 50%. In the present example, overdriving solely on account of a fall in vehicular fuel prices shall tantamount to irrationality on the part of the consumer.

Also one is not aware of any empirical evidence that alternative fuel programs (like LPG/CNG) cause *more* driving than conventional fuels. The reason is that in the early years, the owner of a converted LPG vehicle must also bear the cost of the conversion kit. This means that though his net financial situation, over the life of the vehicle may be better, it is not so, on an annual cash flow basis – he is actually worse off in the early years till the cost of conversion has been offset by the lower fuel cost.

Further, there may be an argument to the effect that, after the kit is paid off the vehicle miles travelled may increase. This is hard to predict, since there will undoubtedly be other changes in the transport sector that could make the situation better or worse.

Finally, any non-standard shifts in consumer patterns may occur due to changes beyond the control of the project. Any shifts in the emissions baseline, due to such issues, will be dealt with appropriately during renewals of the baseline that will occur during the 7^{th} and the 14^{th} year; as under the project activity we plan to ask for a renewable 7 year period for baseline, allowing for a total potential of 21 years. See C 2.1.1 and C 2.1.2.

Even after the Government notification of August 2001, allowing use of imported LPG as auto fuel, no major AutoLPG project has occurred in India. This issue has also been touched upon in the Auto Fuel Policy 2002. The primary reason for this seems to be the reluctance of commercial banks to provide financing for such a project activity in India's private sector, though Government owned oil companies in India have set up almost 100 AutoLPG retail outlets. The project promoters, being a private sector entity, have received more than 24 regrets from financial institutions because of various barriers or risks associated with the project. The final financial closure occurred only after the project promoter has used personal funds for equity and an international bank with strong emission reduction portfolio agreed to provide debt financing for the pilot phase with an agreement, subject to:

a) the new proposed baseline and monitoring methodology is approved by the Meth Panel, and
b) the project will sell 1.5million tons of CER's to the Bank at a pre-agreed price.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

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As stated earlier, the project activity will be commissioned in 3 phases:

- Pilot phase of 10 RO's – commissioned in March 2005
- 1st post-pilot phase of 205 RO's – commissioned in March 2006
- 2nd post-pilot phase of 1278 RO's – commissioned between April 2006 to March 2010

According to the "Motor Transport Statistics of India 2001-02" published by the Transport Research Wing, Ministry of Road Transport & Highways, Government of India, there are approx. 58 million vehicles in India. See Annex 9. The vehicle population in India is growing by 11% per annum. With the 1493 RO's, approximately 3 million vehicles will be targeted for conversion to AutoLPG between 2005-2010.

Table showing CO2 emissions from use of petroleum fuels, given below, clearly show that CO2 emissions from the transport sector in India have and will be rising steadily.

Growth of CO2 Emissions from Petroleum Fuel in the USA, China, and India (1991-2000)
(million metric tonnes of carbon equivalent)

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
USA	57.6	57.8	58.8	60	59.6	61.9	62.5	63.4	65.8	65.8
China	102.3	107.4	121.2	125	132	137.6	140.9	147.6	155.8	170.6
India	45.7	48.8	52.4	53.7	58.5	61.8	65	69.5	71.4	72.6

Source: Anthropogenic Emissions from Vehicular Transport in India – Dr. M Mittal & Dr. C Sharma

Projected Growth of CO2 Emissions from Petroleum Fuel in the USA, China & India (1990-2020)
(million metric tonnes of carbon equivalent)

Country	1990	1998	1990	2005	2010	2015	2020
USA	590	635	650	705	711	835	891
China	94	152	160	196	251	317	390
India	45	69.5	71.4	85.3	106.7	131.6	157.6

Source: Anthropogenic Emissions from Vehicular Transport in India – Dr. M Mittal & Dr. C Sharma

The construction activities on the pilot phase (10 RO's) will begin in early November 2004. Construction time being 4-5 months. The project developer plans to commission the pilot phase of 10 stations in Calcutta by late March 2005.

Within 6 months of commissioning the pilot phase in March 2005, the project activity aims to achieve the target of 19,254 vehicle conversions.

The construction of the 1st post-pilot phase will begin in the second quarter of 2005 and be commissioned by end of the first quarter of 2006. The targeted number of vehicle conversions for this 1st post-pilot phase is estimated at 165,272 vehicles.

The expansion into the 2nd post-pilot phase will start from April 2006 onwards and within 4 years, the target of 1278 RO's will be achieved @ 320 RO's per year. The number of vehicles targeted for conversion during this phase are:

Year	No. of RO's	Vehicles Targeted
2007	320	302,816
2008	320	793,526
2009	320	853,480
2010	318	916,297

Please refer to the data on targeted vehicles in the GHG calculation sheet in Annex 17.

Therefore the targeted number of vehicles over the first 7 year renewable period (2005- 2012) will be as follows:

Phase	Year	Vehicles Targeted
Pilot – 10 RO's	2005	19,268
1st post-pilot phase – 205 RO's	2006	165,487
2nd post-pilot phase - 1278 RO's	2007-2010	2,866,376
Total	2005-2010	3,051,131

The estimated CER's generated by the above mentioned converted vehicles will be:

Phase	Year	CER in tCO2e
Pilot	2006	8,972
1st post-pilot phase	2007	79,727
2nd post-pilot phase	2008-2012	2,454,024*
Total	**2006-2012**	**2,542,723**

* = the GHG emissions of 2,454,024 tons is the aggregate of emissions between 2008 to 2012.

The chosen period for GHG emission reduction under the project activity will therefore be for a renewable period of 21 years i.e., first 7 years + 2 renewable options of 7 years each.

A.4.5. Public funding of the project activity:

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No ODA funding has been sought by the project proponents until now. However, in case public funding is sought, the proponents shall duly ensure that it is additional to any ODA.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

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This new baseline methodology is called **"Baseline methodology for Road Transport Sector in India"**

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

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The baselines emissions are result of yearly emissions and future emission forecasting based on technological parameter and other relevant issues, such as fuel type, fuel quality, growth in vehicle demand, engine quality, the Government's Auto Fuel Policy and Transport Rules & Regulations.

In the transport sector, both general and GHG emissions are measured in:

- grams/km during the driving cycle of the vehicle
- grams/hour during the idling time of the vehicle
- the data of fuel purchase is also required to cross check the mileage data

The methodology is applicable to project activities of environmentally friendly fuels in the transport sector displacing the traditional liquid fuels like petrol and diesel in India, provided that:

- the project activity is using any alternative fuel in the transport sector like ethanol blended petrol, bio-diesel, CNG, LPG, hybrid electric vehicles, hydrogen fuel cells etc
- there is an abundant supplies of ethanol, which can easily be produced from the existing sugar manufacturing plants
- there is an abundant supplies of Jatropha plantations to produce bio-diesel
- there is a pipeline infrastructure to transport CNG is established
- there are facilities to import and transport LPG is available in the country
- there is a negligible impact on the cost of the existing retail infrastructure of traditional fuels, as both ethanol blended petrol and bio-diesel can be stored and retailed from the same facility
- there is little impact on the cost of conversion of petrol or diesel engine vehicles to use gaseous fuels. No conversion would be required in the vehicles using ethanol blended petrol or bio-diesel.

The project activity will significantly reduce GHG emissions from the public, commercial and private vehicles in all urban centres of the targeted market in the coastal belt of India and assist in saving on national health costs while introducing new technology and at the same time fulfilling sustainable development.

B.2. Description of how the methodology is applied in the context of the project activity:

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The baselines emissions are result of yearly emissions and future emission forecasting based on technological parameter and other relevant issues, such as fuel type, fuel quality, growth in vehicle demand, engine quality, the Government's Auto Fuel Policy and Transport Rules & Regulations.

In the transport sector, both general and GHG emissions are measured in:

- gms/km during the driving cycle of the vehicle
- gms/hour during the idling time of the vehicle
- the data of fuel purchase is also required to cross check the mileage data

The methodology describes the conversion of a projected number of vehicles to AutoLPG from petrol or diesel. Based on the steps indicated below and the spreadsheet calculations given in Annex 17, the following conservative estimate of vehicles converting to AutoLPG over a 4 -5 year period can be made.

1. The all-India growth in vehicle population has been tabulated between years 1998 to 2002. A compounded annual growth rate (CAGR) has been derived based on the year 2002.

Vehicle Sales in India:

	FY* 98	FY 99	FY 00	FY 01	FY 02	CAGR-01	CAGR-02
Cars	345,486	410,992	417,736	409,624	638,632	5.8%	16.6%
MUV**	65,969	134,558	133,629	111,703	123,472	19.2%	17.0%
LCV***	128,779	84,109	62,925	56,344	60,239	-24.1%	-17.3%
M&HCV#	128,094	151,475	93,628	83,645	111,326	-13.2%	-3.4%
Scooters	1,223,425	1,309,963	1,262,293	1,325,860	1,253,880	2.7%	0.6%
M/cycles	809,527	978,725	1,132,533	1,395,650	1,796,783	19.9%	22.1%
Mopeds	627,079	674,012	648,843	679,526	724,395	2.7%	3.7%
3 W##	174,057	220,238	233,733	210,220	205,265	6.5%	4.2%
Tractors	191,196	224,802	249,794	253,188	251,601	9.8%	7.1%
Total	3,693,612	4,188,874	4,235,114	4,525,760	5,165,593	7.0%	8.7%

*= Financial Year, ** = Multi Utility vehicles, *** = Light commercial vehicle
= Medium & heavy commercial vehicle, ## = 3 wheeler

2. Even though the weighted average CAGR for FY 02 for all vehicle growth comes to 8.7%, a conservative growth rate of only 7% has been assumed for cars and taxis and 4% growth for 3 wheelers. Lower growth rate numbers have been taken to build a cushion against un-certainties. With the lower conservative growth rate, the projected all-India vehicle population for the year 2003-2012 comes to:

Vehicle sales projections:

	Growth	2003	2004	2005	2006	2007	2008
Cars	7%	589,363	630,619	674,762	721,995	772,535	826,612
Taxis	7%	49,269	52,718	56,408	60,356	64,581	69,012
MUV	7%	123,472	132,115	141,363	151,259	161,847	173,176
3W	4%	205,265	213,476	222,015	230,895	240,131	249,736
Buses	2%	22,156	22,599	23,051	23,512	23,982	24,462

3. A discard rate of 3% per annum has been assumed for all categories of vehicles. The 3% discard include vehicles which are scrapped, unworthy for road conditions, damaged or destroyed in accidents etc. With that a final projected all-India vehicle population between the years 2003 to 2012 has been calculated.

All-India vehicle population:

	Discard	2003	2004	2005	2006	2007	2008
Cars	3%	4,648,301	5,139,470	5,660,048	6,212,242	6,798,410	7,421,070
Taxis	3%	573,099	608,624	646,773	687,726	731,676	778,827
MUV	3%	1,092,750	1,192,083	1,297,683	1,410,011	1,529,557	1,656,847
3W	3%	1,598,650	1,764,166	1,933,256	2,106,153	2,383,100	2,464,343
Buses	3%	539,670	546,079	552,748	559,677	566,869	574,325
Total		8,452,470	9,250,422	10,090,508	10,975,810	11,909,612	12,895,412

4. From the all-India vehicle data, the vehicle population of the targeted coastal states has been selected.

Vehicle population in the targeted coastal states of India:

	% share	2003	2004	2005	2006	2007	2008
Cars	58%	2,675,945	2,958,703	3,258,391	3,576,279	3,913,725	4,272,180
Taxis	73%	416,857	442,696	470,445	500,233	532,201	566,497
MUV	65%	705,548	769,684	837,866	910,392	987,579	1,069,764
3W	80%	1,271,400	1,403,034	1,537,511	1,675,015	1,815,740	1,959,882
Buses	58%	311,020	314,714	318,557	322,551	326,695	330,992
Total		5,380,770	5,888,831	6,422,769	6,984,470	7,575,940	8,199,316

5. From the projected vehicle numbers in the coastal belt, it has been assumed that starting with small percentage of conversions, the following annual percentage of vehicles may convert to AutoLPG:

% switch to AutoLPG

Vehicles	Year 1	Year 2	Year 3	Year 4	Year 5
Cars	1.0%	2.0%	3.9%	7.6%	15%
Taxis	1.0%	2.7%	7.1%	18.8%	50%
MUV	1.0%	2.3%	5.5%	12.8%	30%
3 Wheelers	1.0%	2.8%	7.7%	21.6%	60%
Buses	1.0%	1.8%	3.2%	5.6%	10%
Weighted average	0.6%	1.4%	3.3%	7.9%	19.1%

.

It is useful to point out that because of the Supreme Court Order, 100% buses, taxis and 3 wheelers, all commercial vehicles, converted to CNG. AutoLPG is not mandated by any Judiciary order or Government legislation, hence lower numbers of conversion as mentioned above have been assumed.

6. From the percentage of vehicles which may convert, the final total number of converted vehicles in the targeted coastal belt markets has been calculated.

Population of AutoLPG vehicles in the targeted coastal belt states:

	2004	2005	2006	2007	2008
Cars	32,584	70,381	151,578	325,625	697,979
Taxis	4,704	13,302	37,632	106,519	301,642
MUV	8,379	21,306	54,092	137,129	347,193
3 Wheelers	15,375	46,618	140,647	422,516	1,264,587
Buses	3,186	5,736	10,331	18,613	33,544
Sub-total	64,228	157,343	394,280	1,010,402	2,644,945

7. Out of the total number of vehicles which are projected to convert, the project activity aims to target only 30% of the vehicles, as it would be presumptuous to assume that 100% market share can be achieved under the project activity. This 30% market share is again assumed conservatively.

Population of AutoLPG vehicles under the project activity:

	2004	2005	2006	2007	2008
Cars	9775	21,114	45,473	97,688	209,394
Taxis	1411	3991	11,290	31,956	90,493
MUV	2514	6392	16,228	41,139	104,158
3 Wheelers	4613	13,985	42,194	126,755	379,376
Buses	956	1721	3099	5,584	10,063
Sub-total	19,268	47,203	118,284	303.121	793,484

8. Of the 30% market share, the annual mileage of different types of vehicles has been factored. The source of this mileage data is Central Pollution Control Board, Government of India publication, which can be seen in Annex 15.

Total distance travelled per annum (in million km):

	Kmpa	2004	2005	2006	2007	2008
Cars	15,000	147	317	682	1,465	3,141
Taxis	30,000	42	120	339	959	2,715
MUV	37,000	93	237	600	1,522	3,854
3 Wheelers	40,000	185	559	1,688	5,070	15,175
Buses	30,000	29	52	93	168	302
Total		495	1,284	3,402	9,184	25,186

9. Thereafter, the percentage reduction of GHG emissions has been multiplied with the total mileage of different types of vehicles to arrive at the annual GHG emission reductions.

GHG emissions reduced in the project activity in tons/year:

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Cars	5,103	11,022	23,737	50,993	109,303	118,822	128,951	139,735	151,221
Taxis	1,600	4,525	12,802	36,238	102,619	109,329	116,522	124,234	132,498
3 W	2,269	6,881	20,759	62,363	186,653	200,078	213,861	228,022	242,582
Total	8,982	22,428	57,299	149,594	398,575	428,229	459,335	491,991	526,300

10. Finally, the GHG emissions from multi-utility vehicles (MUV) and buses have not been factored in the GHG calculations.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

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Article 43 of CDM modalities and procedures states: "A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity."

In the project activity, it is estimated that AutoLPG will bring down greenhouse gas emissions by more than 15% compared to available automobile fuels like gasoline and diesel in India.

For demonstration of additionality, the following steps have been followed:

Step 0 – Preliminary screening of project:

The proposed date for start of construction of the pilot phase of the project is November 2004. The construction time for the proposed 10 RO's is 5 months, i.e., they would be ready for operation by end March 2005. Therefore, the proposed start up date for commercial operations is March 31, 2005.

Since the starting date of the project activity falls between 1 January 2000 and prior to 31 December 2005, it is confirmed that incentive provided by the CDM was seriously considered in the decision to proceed with the project activity.

Evidence can be produced for verification by the DoE to confirm that the project meets this requirement such as:

(i) Project Idea Note (PIN) dated 23 November 2002
(ii) First draft Project Design Document dated 26 October submitted to buyers and previously to a DoE.
(iii) Soft commitment(s) from buyers of CER's

Step 1 – Identification of alternatives to the project activity consistent with current laws and Regulations:

As described in detail in the earlier section (A.4.4), in the absence of the certified (proposed) CDM project activity, the baseline scenario involves the application of petrol and diesel as the primary automotive fuels in the country. By virtue of an already established infrastructure, the application of diesel and petrol may still continue to dominate the automobile industry, at least for the next 10-15 years, as confirmed in the "Auto Fuel Policy 2002". As such, a BAU scenario supports the continued use of liquid petroleum fuels.

The second alternative is CNG.

The widespread use of CNG as a transport fuel is however dependent on five critical factors:

1. On the challenge of laying a pipeline grid connecting every part of the country.
2. The domestic supply of CNG, which might go up as new gas fields are developed, shall be supplied to priority sectors like power generation, fertiliser plants, sponge iron plants and other industrial and infrastructure sectors. Quantities available for transport sector will be very limited.
3. Establishing dedicated CNG retail network

4. Capital cost of establishing the pipeline network and the CNG retail infrastructure is very high. Cost of a CNG retail outlet is 150% more than a LPG retail outlet
5. Government regulations or Judiciary support in mandating CNG

In April 1998, the Supreme Court of India passed an order making CNG mandatory in Delhi for all commercial vehicles be it buses, taxis or 3 wheelers. Please see details of the Supreme Court order at http://transport.delhigovt.nic.in/pc/pc6.html. This order was not applicable to other parts of the country.

In Delhi, CNG is retailed by Indraprastha Gas Limited (IGL), a JV between Gas Authority of India (GAIL), Bharat Petroleum Corporation Limited (BPCL), both being Government of India companies and the Government of Delhi.

The third alternative is bio-diesel.

The Planning Commission set up a National Mission for introduction of bio-diesel in India. The rationale behind this major programme for production of bio-diesel is:

- Bio-diesel being a superior fuel than diesel from the environmental point of view;
- Use of bio-diesel becomes compelling in view of the tightening of automotive vehicle emission standards and court interventions;
- The need to provide energy security, specially for the rural areas;
- The need to create employment;
- Providing nutrients to soil, checking soil erosion and land degradation;
- Rehabilitating degraded lands through greening;
- Addressing global concern relating to containing carbon emissions as provided in the Framework Convention on Climate Change; and
- Reduce dependence on crude oil imports.

Beginning with a 5% blend of bio-diesel, the objectives of the National Mission is to increase the blending to 20% by 2011-12. It is estimated that the diesel demand by the year 2011-12 will be 66.9 million tons requiring 13.38m tons of bio-diesel, which in turn will require plantation of *Jatropha curcas* over 11.2m ha of land.

Year wise projected consumption of diesel, the requirement of bio-diesel for different rates of blending and the area that needs to be brought under *Jatropha* plantation are given in the following table.

Diesel & Bio-diesel demand, area required under Jatropha for different blending rates

Year	Diesel Demand MMT	Bio-Diesel @ 5% MMT	Area for 5% Mha	Bio-Diesel @ 10% MMT	Area for 10% Mha	Bio-Diesel @20% MMT	Area for 20% Mha
2001-02	39.81	1.99	N.A.	3.98	N.A.	7.96	N.A
2006-07	52.33	2.62	2.19	5.23	4.38	10.47	8.76
2011-12	66.90	3.35	2.79	6.69	5.58	13.38	11.19

The financial requirement of the demonstration project has been estimated at Rs.14960m (US$ 332.5m). This includes government contribution of Rs.13840m including Rs.12000m for nursery, plantation and protection as well as the R&D and administrative expenses of Rs.680m each.

The recommendations of the National Mission on bio-diesel were:

- A National Mission on bio-diesel should be launched with the objective of producing by the year 2011-12 bio-diesel enough to enable its blending with diesel to the extent of 20%. A demonstration project in its first phase should be taken up immediately.

- After the completion of the demonstration project in the year 2007, the next phase of the National Mission should be a self sustaining expansion of plantation and setting up of corresponding facilities for seed collection, oil extraction etc.

Large scale introduction of CNG and bio-diesel will require heavy financial support from the Government. Both these fuels enjoy the backing of Government legislation and the Supreme Court of India.

CNG has already been introduced in Delhi and Mumbai. CNG is also expanding in Gujarat and suburbs of National Capital Region (NCR) of Delhi. However, CNG, though complying with all applicable regulations and legislations, its availability is certainly not widespread. It is only available in certain pockets of the country.

Bio-diesel on the other hand is still in its demonstration stage and commercial availability will only begin from 2008 onwards. Hence it is also not widespread, though complying with all applicable regulations and legislations of the country.

Therefore, the alternatives to the project activity are:
- Petrol and diesel
- CNG
- Bio-diesel

Step 3 – Barrier Analysis:

Sub-step 3 a:

Investment barrier

In the project activity, investments from strategic partners like oil & gas majors like Shell, BP, Petronas, StatOil, Indian Oil, Bharat Petroleum, Hindustan Petroleum or Reliance Petroleum could not be raised because, for the oil majors

a) AutoLPG is not a priority, but petrol & diesel is;

b) all of oil companies have sufficient in-house capability and finances to undertake the project themselves. They understand the retail business very well having over 30 years of experience in retail of petroleum products. The oil companies in India produce large volumes of petrol and diesel but less than 5% of LPG is produced from the annual throughput of crude oil in their respective refineries,

c) the LPG produced by the Indian oil refineries goes to the domestic gas supplies. As per the AutoLPG rules, the oil companies in India would have to import the LPG for retail in the automobile sector,

d) by introducing AutoLPG, the oil companies in India would be reducing their own market share of petrol & diesel, as AutoLPG is a cost effective substitute

e) with all these factors, the oil companies in India did not feel the need to tie up with the project activity to launch AutoLPG in India.

Investment barriers have also been difficult to overcome considering the project proponents failed to raise the money for the project from any Venture Capital funds, Project Financing Funds, Private Equity Funds, Banks and Financial Institutions.

International Bankers, though familiar with the technology, perceived risks in the form of

- ✓ Lack of Government regulations supporting AutoLPG
- ✓ a new innovative project – pioneers with electronic payment systems, a unique automotive fuel retail project in India's private sector
- ✓ lack of support from Indian Financial Institutions or Banks to the project
- ✓ lack of knowledge of the Indian fuel retail market
- ✓ lack of strategic partner like an oil & gas major

Indian Bankers expressed doubts about

- ✓ their unfamiliarity with the technology,
- ✓ a "first-of-a-kind" alternative fuel retail project in India's private sector,
- ✓ the capability of project proponents and the management team to undertake a project of this size and magnitude, and
- ✓ private sector entry into the automobile fuel retail market which until now has been a state monopoly
- ✓ lack of strategic partner like an oil & gas major

Interestingly, both International and local Bankers agreed that the project is of a high quality, the feasibility and financial model are good. They advised that with the pilot project the following would be established:

- ✓ The capability of the project proponent and the management team would be demonstrated
- ✓ The financial model of the project would be verified
- ✓ With more than 10,000 customers, the product, i.e., AutoLPG would be seen as acceptable fuel in India

The Bankers also stated that, after the approval of the PDD by the Host-country DNA and the approval of the methodology by the Meth Panel, they would be willing to support the project with the required investments only in the 1st post-pilot stage.

International Bankers, including FMO and Rabobank International, Netherlands, have given soft-commitments for equity and debt financing for the 1st post-pilot phase (205 RO's), subject to positive results of the pilot phase.

The funding of the 2nd phase of post-pilot (1278 RO's) would be made from internal accruals and short-term debts.

However, all Bankers regretted their inability to fund the pilot phase (US$ 2.5m) for this first-of-a-kind fuel-switching transport CDM project in India's private sector.

The project proponents faced many challenges and barriers but failed to raise the capital for the pilot phase, even with reasonable IRR, and the potential CER revenue stream in the project activity.

Apart from the initial project development costs of US$ 0.75m invested by the project proponents, the financial closure for the pilot phase of 10 RO's will only be possible once the money is released by Bankers upon signing of the emission reduction purchase agreement with buyers, which is conditional upon successful registration of the project activity by the CDM Executive Board.

Vehicle owners also face an investment barrier. The cost of the LPG conversion kit is a respectable amount of investment for the owners of 2 wheelers and 3 wheelers, the largest targeted audience. Even with several financial packages designed to ease the financial burden of upfront investment for the conversion kit, the overall cost for the conversion kit still has to be paid by the vehicle owners, over 12-18 months.

Under the project activity, the vehicle owners are within the project boundary. They will also have a share of up to 50% of the CER revenue, though not in cash, but in free AutoLPG. The amount of CER revenue per vehicle owner can be verified from the RFID technology deployed in the project activity.

Technology barrier:

Though AutoLPG has been introduced on a very limited basis by the Government owned oil companies, large pool of trained manpower to operate and maintain the equipment on the RO's is not available in India.

Further, since all RO's will be cash-less and operate on pre-paid cards, debit or credit card payment systems, backed by RFID, all transactions will be electronic. Special training also needs to be imparted to operate fully automated electronic systems & dispensers installed at the RO's.

In the project activity, proper training in the following areas need to be given:

- product quality, dispensing, operating and handling of dispensing equipment & electronic systems
- health and safety, and
- environmental issues

Necessary training will be imparted to all the 18,000 employees of the project activity. This will be done to qualify for the IS0 9000 (for product and quality), 14000 (for environment) and 18000 (for health & safety) series of certification.

No company retailing any automobile fuel in India has all the three ISO certifications. Special and regular training will be given to all the skilled operators and maintenance personnel in the project activity.

Barrier due to prevailing practice:

The project activity is a "first-of-a-kind" green-field project taken up in India's private sector. Please see A.2 above. Until now, retail of all petroleum products, be it, petrol, diesel or CNG has been done by State owned Oil & Gas companies in India. The project activity would be the first private sector initiative to retail gaseous fuel in the transport sector in India.

Internationally, more than 40 countries successfully use AutoLPG. The largest user is South Korea, followed by Italy, Turkey, Japan, Australia, the Netherlands and recently the UK. See Annex 8. The

technology of AutoLPG and AutoLPG refuelling stations is proven in other countries and can be successfully replicated and deployed, particularly since AutoLPG is now a legal automotive fuel in India.

It is expected that with the greater availability of petroleum based fuels in India, the introduction of the proposed project activity shall build up capacity, in a variety of regions, the use of AutoLPG, which is a likely automotive fuel for the country in the short to medium term. The proposed project activity shall seek to introduce this environmentally friendly fuel across 12 states and 3 Union territories, thereby covering a significant portion of the country.

Sub-step 3b:

It must be clarified that CNG, one of the alternatives considered in Step 1 above, was introduced in Delhi on orders from the Supreme Court of India. CNG was introduced by IGL, a subsidiary of GAIL & BPCL, both being Government of India companies and the Government of Delhi.

IGL, a Government of India undertaking, did not face any Investment barrier or technology barrier. However, also being a "first-of-a-kind" project activity in India, the time taken to ramp up the construction of 106 CNG retail outlets, availability of conversion kits, acceptability with vehicle owners did take some time. But once the initial resistance by consumers and supply bottlenecks were overcome, CNG became a major success. Earlier this year, IGL had a very successful IPO (Initial Public Offering) in the Indian Stock Market. They are now listed in the Bombay Stock Exchange and the National Stock Exchange.

For more information, please refer to http://www.outlookindia.com/pti_news.asp?id=73671 for a media review, and http://wwwcseindia.org/campaign/apc/press_20011122.htm for a research body's views on the transition, and http://www.flonnet.com/fl1909/19090380.htm for a detailed review.

Step 4 – Common Practice Analysis:

Sub-step 4 a – Analyse other activities similar to the proposed project activity:

Soon after declaring AutoLPG as a legal fuel on 1 August 2001, the Ministry of Petroleum & Natural Gas, Government of India, announced that the three Government owned Oil companies, i.e., Indian Oil, Bharat Petroleum & Hindustan Petroleum will set up 228 AutoLPG retail outlets in the country.

Initially the four metropolitan cities of Delhi, Chennai, Mumbai and Calcutta were targeted. The reach was subsequently extended to Bangalore, Hyderabad and Ahmedabad also.

Until April 2004, less than 100 AutoLPG retail outlets have been set up by these three oil companies, which are in various stages of starting commercial operations.

These AutoLPG retail outlets of Indian Oil, Bharat Petroleum and Hindustan Petroleum should be considered similar, because:

1. They are in the same country
2. Similar storage and dispensing technology has been used by these three Govt. oil companies, however, to the best of our knowledge, all the three oil companies have not taken CDM benefits of GHG reductions achieved by AutoLPG in their activities

3. The AutoLPG retail outlets, being set up by the three oil companies, have taken place in comparable environment with respect to regulatory framework, access to technology and investment climate.

Noteworthy is that access to financing was not a barrier with these three Government owned oil companies, unlike the project activity. The three oil companies are very large with large financial reserves. Investment in AutoLPG was small compared to their annual profits.

Sub-step 4b – Discuss any similar options that are occurring:

The main distinction between the 3 Government owned oil companies in India and the project activity is the ability to raise finances for introduction of AutoLPG in India. Indian Oil, Bharat Petroleum and Hindustan Petroleum and "Navratna" companies – 9 jewel companies owned by the Government of India. They have huge financial resources and did not have to go to any Bank or a financial institute to raise the required funding for implementing their AutoLPG project activity.

The project activity on the other hand does not have the required financial resources like the three oil majors in India. The project activity will have to raise the required funding from banks and financial institutes. Besides, it is for the first time that a project activity has been undertaken in India's private sector to retail environmentally friendly automobile fuel. The other only other company retailing environmentally friendly automobile fuel is Indraprastha Gas Ltd, which is also a subsidiary of Bharat Petroleum, Gas Authority of India (both Government of India companies) and Government of Delhi. They also did not have to raise any funding from commercial banks or financial institutes to introduce CNG in Delhi.

Therefore the barriers faced under the project activity are:

- Investment barriers
- Technology barriers
- Barriers due to prevailing practice

Step 5 – Impact of CDM Registration:

The approval of the proposed new methodology and registration of the project activity by the CDM EB will alleviate the investment & technological barriers and barriers due to prevailing practice with the benefits and incentives of CDM registration.

The financial closure of the pilot phase and the 1st post pilot phase can be achieved on approval of the PDD and subsequent registration of the project activity by CDM EB. Commitment letters from bankers for providing funding for the project activity has already been secured, though subject to registration with CDM EB.

Once the financial closure has been achieved, the investment and technological barriers and barriers to the prevailing practice would be mitigated with the incentives of CDM registration.

The project activity will also achieve:

- substantial volumes of anthropogenic greenhouse gas emission reductions
- the financial benefits of the revenue obtained by selling the CO2-equivalent emission reductions internationally

- may attract new players who are not exposed to the same barriers, not only in India but internationally, who will benefit from the approved methodology for measurement of GHG emissions in the transport sector, which is probably the most challenging of all CDM projects.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

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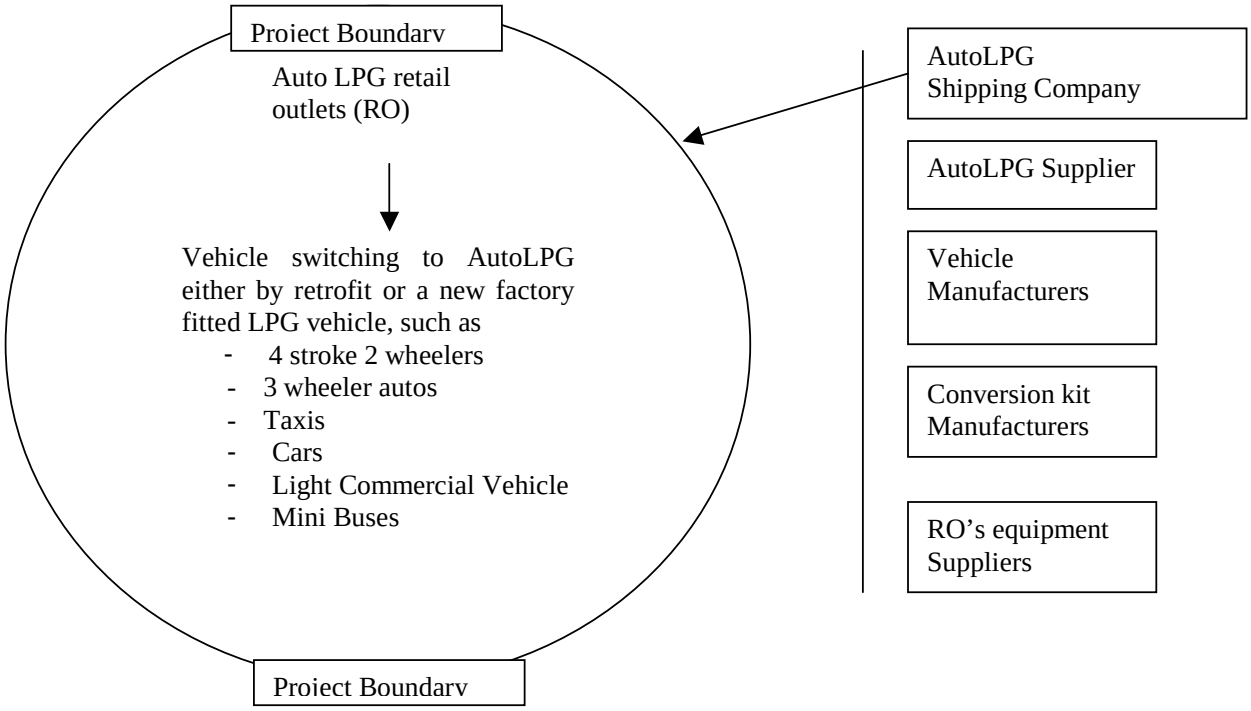
The baseline methodology related project activity scope is defined by boundaries shown in the figure below:



Article 52 of the Modalities and Procedures for a CDM Project defines the project boundary as the boundary that shall encompass all anthropogenic emissions by sources of GHGs under control of the project participants that are significant and reasonably attributable to the CDM project activity.

As elucidated in the figure above, the project boundary includes the planned retail outlets and the vehicles that shall use AutoLPG as automotive fuel, purchased from the RO's. The other key participants who are within the project's commercial framework, but whose GHG emissions are not within the control of the project participants and not reasonably attributable to the CDM project activity, are defined as follows:

- The equipment suppliers for the RO's, AutoLPG suppliers, shipping company, vehicle manufacturers and the conversion kit manufactures and fitment centres are all out of the project boundary.

- Only the actual vehicle owner, be it a 2 wheeler, 3 wheeler, car, taxi, LCV or a mini-bus and the project i.e., E F Energy's autoLPG gas stations are within the project boundary.

- The GHG emissions of vehicles operating on AutoLPG dispensed by the project's RO's will be electronically monitored and recorded.

- To a maximum limit of 50% the revenue from the sale of GHG CER's will be shared with the vehicle owners, though not in cash, but in equivalent amount of free AutoLPG.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

The project developer, Mr. Kailash Mishra has determined the baseline data for the road transport sector in India in August 2004. His contact details are available in Annex 1.

However, he has based his data on the study:
"Anthropogenic emissions from Energy Activities in India: General and Source Characterization – Emissions from Vehicular Transport in India – Part II"

This study is jointly written by Dr. Moti Mittal and Dr. C Sharma. Details of the study can be seen at http://www.osc.edu/research/pcrm/emissions/index.shtml and scroll down to Part II of the report. See Annex 13.

GHG emission data for different types of vehicles can also be seen in Section E and Annex 17.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

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By end March 2005. The start up date is subject to the registration of the project by the Host Country DNA and submission of the Methodology in October 2004 to the Meth Panel for approval.

C.1.2. Expected operational lifetime of the project activity:

>>
Minimum 25 years starting from the start up date.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>
April 2006

C.2.1.2. Length of the first crediting period:

>>
7 years i.e., until March 2012 with two renewable options of 7 years each, therefore a total of 21 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
Not Applicable

C.2.2.2. Length:

>>
Not Applicable

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

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No approved monitoring methodology can be applied to this fuel-switching transport sector project. A new monitoring methodology is proposed.

The name of the monitoring methodology is: **"Radio frequency identification (RFID) based electronic monitoring methodology for road transport sector"**

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

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1. In the transport sector, the unit of measurement of GHG & other general emissions are:

   - grams/km during driving cycle
   - grams/hour during idling time
   - the data of fuel purchases is also required to cross check the mileage data. See annex 4.

2. With the targeted 3 million vehicles of different categories from 2 wheeler 4 stroke engine motorcycles and scooters, to 3 wheelers autorickshaws, cars, taxis, light commercial vehicles (LCV) etc., the task of monitoring the fuel consumption and mileage data for every vehicle is awesome and challenging.

3. After extensive research and investment towards the development of the hardware and the software, compatible to the RFID, it became clear after successful trials that it is possible to collect the mileage and fuel consumption data from every vehicle to an accuracy level that is as high as 99%.

4. RFID is a semi-conductor technology developed by Texas Instruments (TI) and Phillips, the two world market leaders. Under the project activity TI's RFID application has been considered. The TI's RFID line of 13.56 MHz badges (tags) and readers, bring the access control market the superior security, faster transfer speed and a 2000-bit memory of the ISO/IEC 15693 vicinity card.

   The Texas Instruments's RFID Tags and Readers allow innovative solutions from retail and logistics tracking to wireless payment systems. Each tag with its own unique and tamper-proof ID provide the assurance that no two tags or people, anywhere in the world will be misidentified or mistaken for another.

   With the 2000 bit of data chip on the tag, more than 20 times more powerful than that of 125 kHz cards, the solution has the data depth to deploy powerful security and authorisation applications. For additional information on RFID, please visit - www.ti-rfid.com

5. Until now first-generation RFID Tag & Reader has been successfully used by Shell (Easy Pay system in Holland & Belgium) and Caltex (Pegasus in the USA) in petroleum retail sector, to identify their customer, the vehicle, take payment authorisation for the customer's credit/debit card and most important assist in a brand-loyalty program. In both these RFID

applications, the vehicle's odometer mileage data, however, is not captured electronically, but fed manually in the recording system by the vehicle owners.

6. The second-generation RFID now developed in the project activity will be able to carry out the following functions:
   - identification of the vehicle,
   - secure payment authorisation for credit/debit cards from the customer's Bank
   - record the data of fuel purchased
   - record the data of fuel consumption during idling time, and
     record the odometer mileage of the individual vehicle electronically

   This would be done every time the vehicle comes to any LPG RO country wide for a refill of AutoLPG. Therefore, whenever a user of the AutoLPG would need to refuel his vehicle, all that he will be required to do will be to use his card to refuel. In the process, relevant data on the vehicular fuel use shall be sent back to the server that stores and processes information.

7. To do so, the following electronic data recording and transfer system is required to be put in place:

   - The first thing required to monitor the fuel consumption and the mileage data. It is thus imperative to electronically register every customer & vehicle in the data base The following data is recorded:
     - Personal & medical details of the customer including address
     - Type, model and vintage of vehicle owned
     - Registration number of the conversion kit
     - Name and address of authorised agency responsible for fitting the conversion kits
     - Details of debit or credit cards and the Bankers reference of the vehicle owner,

     The information collected ensure a high safety standard to prevent any potential accidents due to leakage of LPG resulting in a blow out.

   - On completion of registration, the customised RFID tag is issued free-of-charge to the vehicle owner, with all his relevant information embedded in the 2000 bit memory chip. A credit card size RFID reader will be installed in the vehicle to read both the analogue or digital odometer's mileage and the fuel consumption of the vehicle during the driving cycle and idling time.

   - Since no control can be exercised on when and where a vehicle fills up fuel, it is imperative to monitor every vehicle's fuel purchase data, electronically. It was decided to connect all the RO's through a broad-band connection, operational 24x7, to collect every vehicle's fuel purchase, fuel consumption and odometer mileage data to the data bank during the time of refills.

   - With this 256 kbps broad-band Virtual Private Network (VPN), connecting all the 1493 RO's, it is technologically possible to transfer data for all transactions for every vehicle to the data bank at high speeds.

   - With the data of fuel purchase, fuel consumption and the odometer data, it is possible to accurately calculate the GHG emissions of every individual vehicle to an accuracy of 99%.

- Since all vehicles in India have to be on a dual-fuel mode, the RFID tag and reader is designed to stop recording the mileage and the fuel consumption data of gasoline. With the dual-fuel option, the driver may have to switch to gasoline, in the event of AutoLPG running out. With the change in the solenoid switch, the electronic recording system shuts down completely, on changing from AutoLPG to gasoline. This would enable to record only the data for AutoLPG but not for gasoline.

- A brand loyalty program will be introduced based on the mileage, fuel consumption and the fuel purchase data. This would enable accurate monitoring of emissions of the individual vehicle. The data generated will enable the project proponents to share up to 50% of the CER revenue with the vehicle owner in direct proportion to the GHG emissions reductions achieved by the vehicle(s).

- The proposed RFID based electronic monitoring methodology can be easily be replicated anywhere in the world to monitor the GHG and other general emissions from the transport sector.

Please see Annex 16 and visit www.ti-rfid.com.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
*3.1 M/KM**	*Odometer mileage*	*Vehicle's odometer mileage using RFID*	*Gms/km*	*Measured (m) electronically*	*At every refill of fuel*	*100%*	*Electronic*	*To monitor the emission during the driving cycle, it is imperative to gather the mileage data to calculate the GHG emissions from every individual vehicle.*
*3.2M/ FC***	*AutoLPG Consumption*	*Fuel sensor backed by RFID*	*Gms/hr*	*Measured (m) electronically*	*At every refill of fuel*	*100%*	*Electronic*	*To monitor the emissions during the idling time of the vehicle, it is necessary to know the fuel consumption during the idling time to calculate the GHG emissions.*
*3.3M/FP****	*AutoLPG Purchase data*	*Electronic dispenser's data*	*Litres of LPG sold*	*Measured (m) electronically*	*At every refill of fuel*	*100%*	*Electronic*	*Amount of AutoLPG sold to every customer will be recorded against the vehicle's data to cross-check the amount of mileage achieved*

* = Monitoring/kilometer
** = Monitoring/fuel consumption
***= Monitoring/Fuel purchased

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

The only gas which is being monitored here is LPG.

The two units of measurement for estimation of CO2 emissions in the transport sector are:

During Driving Cycle:
The quantity of emissions in grams (x) multiplied by the distance driven in Kilometers

During idling time:
The quantity of AutoLPG consumed during idling in grams (x) multiplied by the length of idling time in minutes or hours

Both these data, as stated in D.2.1.1, will be recorded from every vehicle using RFID technology.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
*3.4 B/M**	*Odometer Mileage*							*Based on the emissions information provided by the report of Dr. Mittal and Dr. Sharma, the project applies a historical, static baseline. Therefore, the parameters of the commission reductions are provided as constant rates. The report serves as the baseline for the first 7 years of the project, following which it may get altered if the baseline shifts.*
*3.5 B/FC***	*Fuel consumption*							*- do -*
*3.6B/FP****	*Fuel purchase data*							*- do -*

* = Baseline/mileage

** = Baseline/fuel consumption

*** = Baseline/fuel purchase

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

The baseline emission data has been generated from the report of Dr. M Mittal and Sr. C Sharma. The details of the CO2 emissions from different types of vehicles at the speed of 20km/hr are reproduced below:

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Gasoline Cars	Diesel Taxis*	Buses
CO2 (gms/km)	24.2	82.917	232	252	499.1
CO2 (gms/hr)	483.2	1658.4	4640	5040	9982.3

Taxi* = In India all Taxis are of In-Direct Injection (IDI) diesel engines.

For additional details, please download the pdf file mentioned in Annex 13.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Not applicable. However, please see the attached New Methodology Baseline (NMB) & New Methodology Monitoring (NMM) document.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable. However, please see the attached New Methodology Baseline (NMB) & New Methodology Monitoring (NMM) document.

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

Not applicable. However, please see the attached New Methodology Baseline (NMB) & New Methodology Monitoring (NMM) document.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Leakage is defined as the emissions outside the project boundary that is directly attributable to the project activity. In the project, the project boundary is defined as the vehicles using AutoLPG and the Retail Outlets selling the LPG. The principal sources of leakage are emissions on import of the fuel by sea and inland transport in India and possibly higher usage of diesel and petrol by AutoLPG vehicles, which can take place only on account of fall in fuel costs.

The first source of leakage is ruled out due to the fact that the RO's are chosen along the coast; thereby reducing the travel distance. Further, the emissions on sea shipments are ignored, as they are negligible. Further, these emissions would have occurred anyway, even in the absence of the project activity to import crude oil for production of petrol and diesel and for inland transportation of liquid fuels to the retail outlets.

Otherwise, there will be no leakage effects of the project activity. The reasons eliminating leakage are as follows:

1. As per the directives of the LPG Gazette notification of 1st August, 2001 (Annex 5) locally produced LPG, by domestic refineries or gas fractionators, is reserved for domestic cooking fuel. So the possibility of diverting LPG from domestic markets is eliminated
2. In India, the Government subsidises LPG supplied for domestic cooking purposes
3. LPG as automobile fuel, therefore, needs to be imported
4. LPG for automobile application is not subsidized and its pricing is market driven based on international prices

5. LPG for automobile application would be imported by sea and stored in the shore-based import terminals
6. Retail price of the imported AutoLPG will always be higher by minimum 20% compared to subsidised domestic LPG, thereby excluding the possibility of diversion of the AutoLPG for domestic cooking purposes
7. It can be safely concluded that the expensive AutoLPG will not be diverted to subsidized domestic cooking LPG markets
8. Prices for petrol and diesel and monitored and controlled by the Ministry of Petroleum, Government of India.
9. It is envisaged that not more than 5% of registered Indian vehicles will convert to LPG
10. AutoLPG will therefore, not be a threat to the Government of India owned oil companies and it can therefore be safely assumed that at no point in the short or medium term the Government of India will drastically bring down the prices of petrol or diesel to make AutoLPG uncompetitive
11. It is also not envisaged that the Ministry of Petroleum, Government of India may impose a higher rate of import and/or excise duty on LPG with spiralling demand for AutoLPG. Reason for this assessment is that India is still a net importer of domestic LPG too. Both the domestic and the AutoLPG have the same mix of propane and butane, same specifications, same sources of supply, identical shipping systems and shore-based import terminals.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>
NOT APPLICABLE

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>
For driving cycle:
(Total baseline emissions from petrol or diesel vehicles of a particular category * distance travelled in kilometres)
minus
(Total emissions from AutoLPG vehicles of the same category * distance travelled in kilometres)

For Idling cycle:
(Total fuel consumption from petrol or diesel vehicles of a particular category * time in minutes of the idling cycle)
minus
(Total emissions from AutoLPG vehicle of the same category * time in minutes of the idling cycle)

This data would be recorded by the RFID technology installed in every vehicle running on AutoLPG under the project activity.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
3.1 M/M	*Low*	*The two important data generated with the electronic monitoring are the mileage and the fuel consumption data of every vehicle. This monitoring is being done electronically using the RFID technology, as explained earlier in the PDD. The QA/QC procedures planned for these data collection will be electronic based and cannot be deviated from. For example, to transfer the vehicle's mileage and fuel consumption data, the vehicle owner must create an electronic handshake between the RFID tag and the RFID reader, installed on the Point-of-sale (PoS) computer near the AutoLPG dispensers. Failing which, AutoLPG will not be dispensed by the dispensers, until the data transfer has been completed. There is no over-riding mechanism which can be exercised at the RO. This system is similar to punching the PIN number of one's ATM card without which one cannot access their bank accounts or withdraw cash.* *Electronic RFID application would enable on-line monitoring of the CO2 emissions from all vehicles converted to LPG, at every refill of AutoLPG, from any RO located anywhere in the country.*
3.2 M/FC	*Low*	*-do-*
3.3 M/FP	*Low*	*Fuel purchase data will be generated from the dispensing machines. Since all the payment transactions are electronic based, it will be relatively easy to monitor the fuel purchase of every vehicle using RFID technology and cross-checked with the fuel sales figures of the RO against the fuel purchased by the identified RFID tag.*

Since the baseline is static and historical, thereby may not need to monitor the baseline. The baseline would only be reviewed prior to the second 7 year renewable period.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

The project would be run by Mr. Kailash Mishra, the project proponent, as the CEO.
Directly under him would be Presidents responsible for Marketing, Finance, Technical, Project Implementation, Supplies & Logistics, Human Resources and Environment divisions.
Each divisional President would have minimum 1 to maximum 3 supporting vice presidents.
In the case of the Environment Division, the roles have been defined as follows:
President – overall responsibility of the implementation of the monitoring RFID technology, collection of all data from every vehicle from all RO's, internal assimilation and verification of data. The data will be submitted for subsequently verification by the DoE. Issuance of CER certification by DoE, Registration of CER generated with the Host Country DNA. Registration of CER's with CDM EB and finally marketing of the CER's depending upon the market conditions internationally.

3 Vice Presidents would provide support in:
- Registering of every vehicle, collection of the vehicle owner's data and issuance of an individual RFID tag to the vehicle
- Monitoring the emission data from every registered vehicle, fuel purchase data, mileage data, fuel consumption data during idling and driving cycles and cross-reference it against the sales of LPG from each RO
- Support the President in DoE verification, issuance of the CER certification etc.

All the three VP's would be supported by three Environmental Managers placed in every state of the targeted market.

The Environmental Managers placed in every state of the targeted market would support all the three VP's in ensuring that the information collection process through the VPN performs well. This would also imply monitoring of the overall RFID technology application in context of the proposed project.

D.5 Name of person/entity determining the monitoring methodology:

>>

Mr. Kailash Mishra. He is also a project participant and his details are in Annex 1.He will be supported by the President – Environment of the project activity.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

Therefore, the anthropogenic emissions by sources of greenhouse gases in the project activity will be as follows:

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Gasoline Cars	Diesel Taxis*	Buses
CO2 (gms/km)	20.6	70.617	197.2	214.2	424.15
CO2 (gms/hr)	410.5	1409.7	3944	4284	8484.7

Taxi* = In India all Taxis are of In-Direct Injection (IDI) diesel engines.

E.2. Estimated leakage:

>>

NIL

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>

Therefore, the sum of GHG emissions under the project activity will be:

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Gasoline Cars	Diesel Taxis*	Buses
CO2 (gms/km)	20.6	70.617	197.2	214.2	424.15
CO2 (gms/hr)	410.5	1409.7	3944	4284	8484.7

Taxi* = In India all Taxis are of In-Direct Injection (IDI) diesel engines.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Gasoline Cars	Diesel Taxis*	Buses
CO2 (gms/km)	24.2	82.917	232	252	499.1
CO2 (gms/hr)	483.2	1658.4	4640	5040	9982.3

Taxi* = In India all Taxis are of In-Direct Injection (IDI) diesel engines.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>>

The difference between baseline emissions and the anthropogenic emissions by sources of greenhouse gases in the project activity will therefore be:

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Gasoline Cars	Diesel Taxis*	Buses
CO2 (gms/km)	3.6	12.3	34.8	37.8	74.95
CO2 (gms/hr)	72.7	248.7	696	756	1497.6

Taxi* = In India all Taxis are of In-Direct Injection (IDI) diesel engines.

The difference in emissions for the different categories of vehicles stated above multiplied by the distance travelled by the vehicle multiplied by the number of vehicles in each category will give a fairly accurate amount of CO2 emission reductions.

E.6. Table providing values obtained when applying formulae above:

>>

The estimated CER's generated by the above mentioned converted vehicles will be:

Phase	Year	CER in tCO2e
Pilot	2006	8,972
1st post-pilot phase	2007	79,727
2nd post-pilot phase	2008-2012	2,454,024
Total	**2006-2012**	**2,542,723**

For additional details on GHG calculation, please refer to Annex 17.

The chosen period for GHG emission reduction under the project activity will therefore be for a renewable period of 21 years i.e., first 7 years + 2 renewable options of 7 years each.

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

SECTION G. Stakeholders' comments

>>

G.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

G.2. Summary of the comments received:

>>

G.3. Report on how due account was taken of any comments received:

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	E F Energy Limited
Street/P.O.Box:	Chowringhee Road
Building:	56
City:	Calcutta
State/Region:	West Bengal
Postfix/ZIP:	700 071
Country:	India
Telephone:	033-2282 0945
FAX:	033-2282 6891
E-Mail:	Kailash_m@vsnl.net
URL:	
Represented by:	Mr. Kailash Mishra
Title:	Chief Executive
Salutation:	
Last Name:	Mishra
Middle Name:	-
First Name:	Kailash
Department:	Management
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Direct tel:	+ 91 11 5155 2422
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project activity is proposed to be financed by the project promoter (equity) and debt financing subject to registration of the project by CDM EB. Soft commitments from potential financial participants for the 1st post-pilot phase of the project have been secured, subject to the successful performance of the pilot phase.

No ODA funding has been sought by the project proponents until now. However, in case public funding is sought, the proponents shall duly ensure that it is additional to any ODA.

Annex 3

BASELINE INFORMATION

The new baseline methodology is called **"Baseline methodology for Road Transport Sector in India"**

In choosing the approach to determine the baseline scenario, the following application as contained in clause 48 (a) of the CDM modalities and procedures has been selected as the most appropriate for the project activity.

Clause 48(a) states:
"In choosing a baseline methodology for a project activity, project participants shall select from among the following approaches the one deemed most appropriate for the project activity, taking into account any guidance by the executive board, and justify the appropriateness of their choice:

(a) Existing actual or historical emissions, as applicable"

During the initial research for the project between the years 2000 to 2002, it was found that the Central Pollution Control Board (CPCB), India's national authority on monitoring of various emissions only records data for general emissions like CO, HC, Nox and PM (particulate matter). CPCB admits that their infrastructure is not geared to monitor GHG emissions, particularly from the transport sector. Please see Transport Fuel Quality for Year 2005, published by CPCB, available on website: http//:envfor.nic.in/cpcb

However, in mid 2003, the USAID sponsored a study called – Anthropogenic emissions from Energy Activities in India: General and Source Characterization – Emissions from Vehicular Transport in India – Part II, jointly written by Dr. Moti Mittal of University of Ohio, USA and Dr. S C Sharma of National Physical Laboratory, New Delhi. .Please visit http://www.osc.edu/research/pcrm/emissions/index.shtml and scroll down to Part II of the report. See Annex 13.

This study covers various emissions in 7 cities of India including Delhi and also gives GHG emission data of different types of vehicles from the available fuels. GHG & general emissions data for the year 1997 in India, from all vehicles in the transport sector from the report is produced below:

Emission	Million tons per year
Carbon di-oxide – CO2	42.884
Carbon mono-oxide-CO	2.163
Oxides of Nitrogen-Nox	4.829
Hydrocarbons-HC	1.485
Sulphur dioxide-Sox	0.897
Particulate matter-PM	2.073

The basis for determining the baseline scenario is as follows:

- In compliance with the article 45 (e) of CDM modalities and procedures i.e., "Taking into account relevant national and/or sectoral policies and circumstances, such as sectoral reforms initiative, local fuel availability, power sector expansion plans, and the economic situation in the project sector." mandate, the Gazette Notification dated August 1, 2001 issued by the Ministry of Transport, Government of India, states that locally produced LPG is not allowed for use in the automotive sector. This is because the locally produced LPG is in short supply.

India is a net importer of LPG and the locally produced LPG is, therefore, rightly reserved for domestic cooking fuel. Diversion of volumes of local LPG as fuel for the transport sector would create a shortage of domestic cooking gas supplies. This situation creates an operational difficulty that renders the introduction of imported LPG as the gas for the automotive industry, a more difficult exercise.

- The country's Auto Fuel Policy (2002) also makes an observation on the fact that the current infrastructure is not geared to retail AutoLPG as an automobile fuel. Finally, at the Policy level, no recommendation has been made to mass replace diesel or petrol by any alternative fuel. Thus the baseline emissions depend heavily upon the continuation on the use of diesel and petrol in Euro-II vehicles.

- In consonance with the above view, the Auto Fuel Policy 2002, released by the Government of India and electronically hosted in the web site of the Ministry of Petroleum and Natural Gas, Government of India (http://petroleum.nic.in/afp_con.htm), makes a special reference to the need to import LPG for automobiles, and also on the need to improve on storage and handling facilities for the fuel (Refer to Chapter 7 – Demand and Supply Analysis, for more information). This underlines the fact that the transportation sector has not geared up to introduce LPG as a transport fuel, thereby eliminating the application of LPG as an automobile fuel in the baseline (business-as-usual) scenario.

- The project activity will significantly reduce GHG emissions from the public, commercial and private vehicles in all urban centres of the targeted market in the coastal belt of India and assist in saving on national health costs with the introduction of AutoLPG as an alternative fuel.

Since historic and static baseline has been used, the details of emissions, in grams/kilometre for the driving cycle and grams/hour, during idling time, can be seen in the report of Dr. Mittal and Dr. Sharma. Emission details have also shown in chapter E of PDD is reproduced below for immediate reference.

The anthropogenic emissions by sources of greenhouse gases of the baseline will be as follows:

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Gasoline Cars	Diesel Taxis*	Buses
CO2 (gms/km)	24.2	82.917	232	252	499.1
CO2 (gms/hr)	483.2	1658.4	4640	5040	9982.3

Taxi* = In India all Taxis are of In-Direct Injection (IDI) diesel engines.

And, the anthropogenic emissions by sources of greenhouse gases in the project activity will be as follows:

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Gasoline Cars	Diesel Taxis*	Buses
CO2 (gms/km)	20.6	70.617	197.2	214.2	424.15
CO2 (gms/hr)	410.5	1409.7	3944	4284	8484.7

Taxi* = In India all Taxis are of In-Direct Injection (IDI) diesel engines.

The difference between baseline emissions and the anthropogenic emissions by sources of greenhouse gases in the project activity will therefore be:

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Gasoline Cars	Diesel Taxis*	Buses
CO2 (gms/km)	3.6	12.3	34.8	37.8	74.95
CO2 (gms/hr)	72.7	248.7	696	756	1497.6

Taxi* = In India all Taxis are of In-Direct Injection (IDI) diesel engines.

No algorithms or formulas can be produced except the above data on emissions on grams/km and grams/hour for different categories of vehicles. On asking the authors several times to give details of algorithms or formulas on the baseline, they have repeatedly said that the details can be seen from the web site of the report. Please therefore refer to: http://www.osc.edu/research/pcrm/emissions/index.shtml and scroll down to Part II of the report. Also see Annex 13.

For additional details on the baseline methodology, please refer to the PDD_NMB. For details on GHG emission calculation, please refer to Annex 17.

Annex 4

MONITORING PLAN

1. In the transport sector, the unit of measurement of GHG & other general emissions are:

   - gms/km during driving cycle
   - gms/hour during idling time, and
   - the data of fuel purchases is also required to cross check the mileage data

2. With the targeted 2.2 to 2.3 million vehicles of different categories from 2 wheeler 4 stroke engine motorcycles and scooters, to 3 wheelers autorickshaws, cars, taxis, LCV etc., the task of monitoring the fuel consumption and mileage data for every vehicle is very challenging.

3. Radio Frequency Identification (RFID) is a semi-conductor technology developed by Texas Instruments (TI) and Phillips, the two world market leaders. Under the project activity TI's RFID application has been selected. The TI's RFID line of 13.56 MHz badges (tags) and readers, bring the access control market the superior security, faster transfer speed and a 2000-bit memory of the ISO/IEC 15693 vicinity card.

   The TI's RFID tags and readers allow innovative solutions from retail and logistics tracking to wireless payment systems. Each tag with its own unique and tamper-proof ID provide the assurance that no two tags or people, anywhere in the world will be misidentified.

   The 2000 bit of data on the tag, more than 20 times that of 125 kHz cards, the solution has the data depth to deploy powerful security and authorisation applications. For additional information on RFID, please visit - www.ti-rfid.com

5. First-generation RFID reader are being used by Shell (Easy Pay system in Holland & Belgium) and Caltex (Pegasus in the USA) in petroleum retail sector, to identify their customer, the vehicle, take payment authorisation for the customer's credit/debit card and most important assist in a brand-loyalty program. However, in both these RFID applications, the vehicle's odometer mileage data is not captured electronically, but fed manually in the recording system by the vehicle owners.

6. The proposed second-generation RFID to be deployed in the project activity will be able to carry out the following functions:
   - identification of the vehicle,
   - secure payment authorisation for credit/debit cards from the customer's Bank
   - record the data of fuel purchased
   - record the data of fuel consumption during idling time, and
     record the odometer mileage of the individual vehicle electronically

   This would be done every time the vehicle comes to any LPG RO country wide for a refill of AutoLPG.

7. For easy compatibility with RFID, the following electronic data recording and transfer system is required to be put in place:

- The first thing required in monitoring the fuel consumption and the mileage data is to register every customer & vehicle in the data base The following data will be fed into the data base:
  - Personal & medical details of the customer including address
  - Type, model and vintage of vehicle owned
  - Registration number of the conversion kit
  - Name and address of authorised agency responsible for fitting the conversion kits
  - Details of debit or credit cards and the Bankers reference of the vehicle owner,

  The information collected will ensure that a high safety standard is maintained to prevent any potential accidents due to leakage of LPG resulting in a blow out.

- On completion of registration, a customised RFID tag will be issued free-of-cost to the vehicle owner, with all his personal information embedded in the 2000 bit memory chip. A credit card size RFID reader will be installed in the vehicle to read both the analogue or digital odometer's mileage and the fuel consumption of the vehicle during the driving cycle and idling time.

- Since no control can be exercised on when and where a vehicle fills the AutoLPG, it is important to monitor every vehicle's fuel purchase data, electronically. All RO's will be connected through a 256 kbps broad-band connection, operational 24x7, to collect every vehicle's data for every fuel purchase, fuel consumption and odometer mileage.

- This 256 kbps broad-band Virtual private Network (VPN), connecting all the 1493 RO's, allows transfer of data for each purchase transaction of every vehicle to the data bank at high speeds.

- With the data of fuel purchase, fuel consumption and the mileage data, it is possible to accurately calculate the GHG emissions of every individual vehicle to an accuracy of 99%.

- Since all vehicles in India have to be on a dual-fuel mode, the RFID tag and reader is designed to stop recording the mileage and the fuel consumption data of gasoline. With the dual-fuel option, the driver may have to switch to gasoline, in the event of AutoLPG running out. With the change in the solenoid switch, the electronic recording system shuts down completely, on changing from AutoLPG to gasoline. This would enable to record only the data for AutoLPG but not for gasoline.

- A brand loyalty program will be introduced based on the mileage, fuel consumption and the fuel purchase data. This would enable accurate monitoring of emissions of the individual vehicle. The data generated will enable the project proponents to share up to 50% of the CER revenue with the vehicle owner in direct proportion to the GHG emissions reductions achieved by the vehicle(s).

- For additional information on the electronic data management system using RFID, please refer to Annex 17.

Annex 6

LPG & CNG SPECS:

LPG is a by-product of natural gas processing or a product that comes from crude oil refining and is composed primarily of propane and butane with similar amounts of propylene and butylenes. Since LPG is largely propane, the characteristics of propane sometimes are taken as a close approximation of those of LPG.

Composition of LPG & CNG is given in the table below:

% Composition	CNG	LPG
Methane	84.50	-
Ethane	7.70	0.2
Propane	2.40	57.3
Butane	0.58	41.1
Pentane	0.37	1.4

When Natural Gas is produced, it contains methane and other light hydrocarbons that are separated in a gas processing plant. Because propane boils at -44 degree F and ethane boils at -127 degrees F, separation from methane is accomplished by combining increasing pressure and decreasing temperature. The natural gas liquid components recovered during processing including ethane, propane and butane and other heavier hydrocarbons. Propane and butane along with other gases are also processed during crude oil refining as a by-product of the process that rearrange or break down the molecular structure to obtain more desirable petroleum compounds.

ADVANTAGES OF LPG:

Some of the benefits of LPG as automotive fuel are:

- Reduction in emissions
- Very little carbon build-up increases life of engine parts like spark plugs
- Fuelling is akin to that of conventional diesel or gasoline and the time needed is also similar
- Service life of a vehicle increases with LPG
- Light or no damage to soil and water if it is spilled, due to its rapid evaporation
- Higher octane number

Safety Issues:

Safety is an issue with LPG, however standards for application, storage and distribution already exists. The hazard associated with an on-board storage tank should be similar to that of gasoline especially if reinforced cylinders similar to that of CNG tanks are used. LPG fuel systems have many in-built safety features and they generally maintain their integrity in severe collisions and do not permit massive leaks. LPG is about twice as heavier than air and unlike CNG does not disperse in air. Its flammability limes (2.1-9.5% vol) and auto ignition temperatures (450 degrees C) are also lower than natural gas and as such should not be handled carelessly. Accident statistics, though limited, indicate that LPG is as safe as gasoline.

Source: PARIVESH – Alternative Transport Fuel – An Overview – April 2003
Central Pollution Control Board, Ministry of Environment & Forest, Government of India

Annex 7

EMISSION ADVANTAGES OF LPG:

Autogas or AutoLPG is an outstanding fuel for vehicles that must comply with increasing stringent emissions requirements. Low emissions of particulates (PM), carbon monoxide (CO), nitrogen oxide (NOx), and non-burned hydrocarbons (HC) enable Autogas to outscore conventional fuels and most alternatives for environmental benefits.

It also plays an important role in mitigating climate change, because it is amongst the lowest life-cycle greenhouse gas emissions of all commercially available fuels. Moreover, Autogas is a non-toxic and non-poisonous fuel that will not contaminate aquifers or soil if spilled.

AutoLPG is simply a clean transportation fuel. Its impressive environmental benefits are influencing fuel choice decisions, and are rapidly driving increased use in many countries.

Compared to gasoline, AutoLPG yields:

- 50% less carbon monoxide
- 40% less hydrocarbons
- 12% less carbon dioxide
- 35% less oxides of nitrogen
- 50% less ozone forming potential

AUTOLPG's ENVIRONMENTAL PERFORMANCE:

Tailpipe emissions (gms/km)	AutoLPG	Diesel	Gasoline
Particulates (PM)	<0.001	0.040	0.001
Nitrogen Oxides (Nox)	0.04	0.40	0.06
Hydrocarbons (HC)	0.05	0.06	0.08
Greenhouse gas (CO2)	170	170	190
Carbon Monoxide (CO)	0,3	0.5	0.6

Source: World LPG Association
http://www.worldlpgas.com/gain/mainpipes/advantages/index.php

Annex 8

WORLD LPG DATA WITH CONSUMPTION, NUMBER OF VEHICLES AND DISPENSING STATIONS

COUNTRY	CONSUMPTION	NUMBER OF VEHICLES			NO. OF DISPENSING
	Thousand Tonnes	1999	2000	2001	SITES
Austria	14	1,450	2,000	2,000	15
Algeria	217	70,000	70,000	95,000	252
Australia	**1,370**	**555,000**	**590,000**	**600,000**	**3,500**
Belarus	27	10,000	16,000	18,000	30
Belgium	100	80,000	85,000	90,000	625
Bulgaria	215	80,000	120,000	165,000	1000
Canada	350,000	100,000	100,000	100,000	2500
China	390	50,000	65,000	84,760	206
Croatia	13	12,000	12,000	13,000	32
Czech Republic	70	145,000	150,000	150,000	350
Denmark	10	1,250	2,750	2,770	51
Dominican Rep.	84	9,000	12,000	15,000	30
France	210	180,000	200,000	210,000	1,962
Germany	14	6,500	8,000	10,000	300
Greece	16	3,500	3,750	3,750	34
Hong Kong	111	1,700	5,000	14,100	20
Hungary	39	29,000	60,000	100,000	350
Iran	300	70,000	75,000	75,000	41
Ireland	2	1,200	1,200	1,000	150
Italy	**1,394**	**1,200,000**	**1,234,000**	**1,250,000**	**2,052**
Japan	**1,538**	**295,000**	**290,000**	**287,540**	**1,862**
Mexico	**1,042**	**320,000**	**350,000**	**400,000**	**1,363**
Netherlands	521	325,000	323,000	360,000	2,200
New Zealand	25	15,000	10,000	10,300	650
Pakistan	30	15,000	20,500	65,000	20
Poland	**800**	**450,000**	**470,000**	**700,000**	**2,900**
Portugal	20	33,000	37,000	37,000	172
Russian Federation	700	240,000	250,000	500,000	400
South Korea	**3,326**	**786,000**	**1,214,000**	**1,428,000**	**846**
Spain	28	8,000	7,600	7,100	40
Sri Lanka	14	12,000	15,000	18,000	20
Sweden	1	500	200	200	11
Taiwan	14	25,000	20,000	20,000	10
Thailand	248	12,500	40,000	40,000	60
Turkey	**1,230**	**500,000**	**950,000**	**975,000**	**3,300**
Ukraine	44	20,000	22,000	25,000	100
USA	750	266,000	272,190	276,600	3,320
United Kingdom	50	18,000	39,000	65,000	1012
Venezuela	10	12,000	12,000	12,000	15
Miscellaneous	393	92000	100000	125000	555
TOTAL WORLD	**15,415**	**6,016,700**	**7,367,090**	**8,284,430**	**31,960**

SOURCE: *World LPG Association Statistics, 2002*

Annex 9

Total Number of Registered Motor Vehicles in India

(in thousands)

Year As on 31 March	All Vehicles	Two Wheelers	Cars, Jeeps & Taxis	Buses	Goods Vehicles	Others*	Annual % Growth
1997	37332	25729	4672	484	2343	4104	
1998	41368	28642	5138	538@	2536	4514	9.75%
1999	44875	31328	5556	540@	2554	4897	7.8%
2000	48857	34118	6143	562@	2715	5319	8.15%
2001	54991	38556	7058	634@	2948	5795	11.1%
2002(P)	58863	41478	7571	669@	3045	6100	6.6%

* : Others include tractors, trailers, 3 wheeler (passenger vehicles) and other miscellaneous vehicles which are not separately classified.

@ : Include Omni buses

(P) : Provisional

Source: Table 1, Motor Transport Statistics of India 2001-2002, Transport Research Wing, Ministry of Road Transport & Highways, Government of India

Annex 10
Consumption data of Petrol & Diesel in the targeted states of India

Petrol Consumption ('000MT)

State	Share	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	FY 99	FY 00
Gujarat	8.5%	276	311	327	393	416	443	466	503
Daman	0.1%	-	-	-	3	4	4	4	5
Dadra	0.1%	-	-	-	4	4	5	5	5
Maharashtra	14.2%	557	582	629	722	759	777	805	837
Goa	0.6%	25	27	28	32	34	35	34	37
Karnataka	6.5%	232	252	275	316	338	350	355	382
Kerala	4.9%	144	157	174	206	233	250	260	289
Tamil Nadu	8.3%	244	262	291	338	373	397	431	491
Pondicherry	0.6%	-	-	-	12	13	15	17	20
Andhra	7.4%	225	242	270	314	340	370	395	437
Orissa	1.6%	56	59	63	72	76	81	88	96
Bihar	2.9%	155	136	144	156	157	157	161	169
W Bengal	2.9%	142	144	150	159	157	156	166	173
Sub Total	58.3%	2,056	2,172	2,351	2,727	2,904	3,040	3,187	3,444
All India	100%	3,595	3,834	4.141	4.679	4,955	5,182	5,508	5,909
Share of target states	%	57.2%	56.7%	56.8%	58.3%	58.6%	58.7%	57.9%	58.3%
Growth rate	%		6.6%	8.0%	13.0%	5.9%	4.6%	6.3%	7.3%

Diesel Consumption ('000 MT)

State	Share	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	FY 99	FY 00
Gujarat	7.5%	1303	1480	1586	1984	2277	2429	2418	2429
Daman	0.1%	0	0	0	7	12	15	19	24
Dadra	0.3%	0	0	0	32	55	74	84	82
Maharashtra	10.8%	2343	2481	2666	3154	3330	3397	3558	3494
Goa	0.6%	105	118	138	140	156	167	171	181
Karnataka	5.5%	1066	1160	1253	1467	1654	1647	1624	1769
Kerala	3.3%	671	802	871	974	1079	1116	1042	1078
Tamil Nadu	8.9%	1792	1865	2019	2368	2458	2600	2823	2860
Pondicherry	0.4%	0	0	0	87	94	104	112	122
Andhra	8.8%	1763	1830	2001	2367	2463	2480	2513	2832
Orissa	1.8%	421	446	473	521	563	602	591	594
Bihar	4.4%	1279	1110	1204	1293	1326	1337	1411	1428
W Bengal	4.9%	1190	1173	1245	1370	1448	1406	1475	1580
Sub Total	57.3%	11936	12466	13455	15765	16915	17373	17841	18473
All India	100%	20309	21618	23344	26624	28859	29686	30592	32255
Share of target states				57.6%	59.2%	58.6%	58.5%	58.3%	57.3%
Growth rate	6.8%		6.4%	8.0%	14.1%	8.4%	2.9%	3.1%	5.4%

Annex 11

Commitment letters from Banks/FI's

Letter from FMO, Netherlands

E F Energy Limited
To: Mr. Kailash Mishra
56 Chowringhee Road
Calcutta – 700 071, India

The Hague, April 10, 2003

Re: Your 1500 Auto LPG retail outlets project

Dear Mr. Mishra,

With this letter we inform you that FMO will not be in the position to fund part of the pilot phase (USD 2,5 mln) of your project.

Although we recognise the opportunities we feel that the risk to share in the financing, where a strong (sponsor) shareholder or other (local) financial institutions are not in place, and the management has not yet a proven track record, for us its too high.

If you succeed in setting up a successful pilot with other financiers, we do indicate to study a further partly financing of the post-pilot phase (USD 35 mln).

Yours sincerely,

Arno de Vette
Investment Officer Asia Department

Annex 12

Political map of India highlighting the targeted coastal belt markets

Annex 13

Anthropogenic emissions from Vehicle Transport in India – a Study by Dr. Moti Mittal and Dr. C Sharma

Please see: http://www.osc.edu/research/pcrm/emissions/index.shtml and scroll down to Part II of the report.

Annex 14

Date of vehicle population & composition in the target coastal belt states of India

Target vehicle population (FY 2000)		**Cars**	**Taxis**	**MUV**	**3W**	**Buses**
Gujarat	9%	366,395	37,905	100,800	234,200	42,200
Daman & Diu	0%	6,897	50	1,454	450	200
Dadra & Nagar Haveli	0%	3,357	193	550	400	200
Maharashtra	16%	619,028	88,272	214,100	383,000	53,200
Goa	1%	39,566	6,205	9,579	4,000	3,000
Karnataka	7%	306,522	31,178	50,350	154,900	44,470
Kerala	7%	251,377	79,623	67,850	188,700	36,500
Tamil Nadu	8%	419,570	51,430	45,300	101,500	33,900
Pondicherry	0%	16,324	1,876	1,450	1,850	1,250
Andhra Pradesh	5%	172,306	27,694	53,100	116,650	30,900
Orissa	1%	41,561	7,039	30,100	12,300	11,600
Bihar	3%	117,810	38,840	55,200	48,250	20,600
West Bengal	6%	315,232	46,553	75,715	25,200	33,000
Subtotal	64%	**2,675,945**	**416,857**	**705,548**	**1,271,400**	**311,020**
All India	100%	**4,648,301**	**573,099**	**1,092,750**	**1,598,650**	**539,670**
Share of target states		**58%**	**73%**	**65%**	**80%**	**58%**

From the above data it can be seen that average 64% of all the vehicles in India are in the targeted states where AutoLPG will be introduced

Annex 15

Table of average service life and annual distance (km) traveled by Indian Vehicles

Vehicle	Life Years	Annual kms
2 Wheeler	15	10,000
3 Wheeler	10	40,000
Passenger Car	15	15,000
Taxis	10	30,000
MUV	15	37,000
Trucks	15	40,000
Buses	8	30,000
LCV	5	60,000

MUV = Multi-Utility vehicle

LCV = Light Commercial Vehicle

Source:
Transport Fuel Quality for Year 2005, Central Pollution Control Board, New Delhi

Annex 16

Details of RFID technology

Annex 17

GHG Emission Calculation