CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: BASELINE (CDM-NMB)
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SECTION A. Identification of methodology

A.1. Proposed methodology title:

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

A.2. List of category(ies) of project activity to which the methodology may apply:

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Transport sector – category 7 – as per sectoral scope.

A.3. Conditions under which the methodology is applicable to CDM project activities:

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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
- 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.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

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The new methodology calculates the expected emission reductions from vehicles converting to alternative fuels from petrol and diesel. The basis of the new methodology has been derived from the only study on GHG and general emissions in India's transport sector called "Anthropogenic emissions from Vehicular transport in India" by Dr. Moti Mittal and Dr. C Sharma. See to http://www.osc.edu/research/pcrm/emissions/index.shtml and scroll down to Part II of the report (the Study).

The USAID office of Environment, Energy and Enterprise in India, along with the Ohio State University (OSU) and Ohio Supercomputer Center (OSC) and the National Physical Laboratory, New Delhi have joined efforts to prepare this Study on Anthropogenic emissions from vehicular transport in India.

Contribution of latest and verified data for the Study was made by various agencies both Government agencies and the private sector. Some of the contributors are: Bajaj Auto Ltd (India's largest 3 wheeler and 2 wheeler scooter manufacturers); Ashok Leyland Ltd (one of the largest lorry and bus manufacturers); Mahindra and Mahindra (a petrol and diesel MUV manufactuer); Bombay Suburban Transport Company (BEST); Indian Oil Corporation R&D Division; Indian Institute of Petroleum (IIP); National Environment Engineering Research Institute (NEERI); Central Pollution Control Board (CPCB), Government of India and the Society of Indian Automobile Manufacturers (SIAM).

The calculations giving GHG and general emission data from the Study have the inherent assumption of a new engine without any fuel or oil leakage, and the estimates do not account for engine deteriorations due to aging or vehicle overloads.

The Study does not take into account any emission control devices such as catalytic converters (from 1997, the only control measure in place was the use of unleaded gasoline) to limit emissions. At present in India, catalytic converters are not mandatory for all the vehicles except in a few metropolitan cities. Hence, the estimates of species emissions for which control devices are used would be lower.

Following are some other limitations of the Study:

1. The automobile industry is a private industry in India. The data about fuel consumption and air-to fuel ratio at different speeds is considered proprietary.

2. These values are computed based on the operation of a new engine. This means that perfect maintenance of the vehicles is assumed. The deterioration in engine performance relating to age is not taken into account. Emissions from older engines will only be higher than the computed data on baseline.

3. Other parameters that are not accounted for are road roughness and vehicle overload.

4. HC emissions are from exhaust of two-stroke engines only. HC emissions while fueling the vehicle or from other sources are not accounted for this inventory.

5. A number of policy options are available to reduce the emissions of pollutants. These include both technical options (like changes in vehicle technologies and changes in fuel types and characteristics) as well as traffic management options. The latter can be easily implemented and provides a low cost option.

6. The computed values for emissions of different pollutants from various vehicles as mentioned earlier clearly show that if traffic management increases the average cruising speed of the vehicles to 30 to 50 km/hr, it would result in a substantial decrease in the emission levels of most of the species. City authorities and urban local bodies throughout India can implement these measures for traffic management.

   Further, rising emission levels and traffic flow should be given consideration in long-term planning of land use by city authorities.

7. This Study provides valuable tools for inventory preparation of emissions from vehicular transport in actual as well as simulated conditions. Simulations include changes in driving patterns, vehicles or technology, and fuel composition.

8. Emission estimates given in the Study are based on a theoretical ideal and the input data available from published information and personal communications.

There are no approved methodologies in the transport sector which can be applicable to any project activity in India.

SECTION B. Overall summary description:

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The proposed baseline methodology is country specific and can be applied for alternative fuel road transport projects in India.

The baseline methodology uses the CO2 emission data for petrol and diesel vehicles of different types, i.e., 2 wheeler 4 stroke, 3 wheeler 4 stroke, petrol cars, diesel taxis and buses, This baseline data is taken from the report – "Anthropogenic Emissions from Vehicular Transport in India" by Dr. Moti Mittal and Dr. Sharma.

The baseline data for CO2 emissions from petrol and diesel vehicles is given below:

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Petrol 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.

In the methodology, the expected emission reductions are based on the projected number of vehicles converting to alternative fuel from petrol or diesel. A conservative estimate of vehicles converting to alternative fuel over a 4 -5 year period has been addressed in detail in chapter E.1 of CDM_NMB.

From the above percentage of petrol and diesel vehicles converting to alternative fuel, a market share of only 30% has been assumed.

The actual emissions would be calculated on the real time measurement of:

- Fuel purchase data
- Mileage data during the driving cycle, and
- Fuel consumption data during idling cycle

of the vehicles converted to alternative fuel, using the Radio Frequency Identification (RFID) backed electronic monitoring methodology.

The projected 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 the baseline emissions and the projected emissions from the vehicles converted to alternative fuel, multiplied by the distance travelled in kilometres and the fuel consumption during idling time will be actual CER's of the project activity.

The project activity will be considered additional and not the baseline scenario, if the following conditions prevail:

- no regulatory support has been used to implement the project
- if the project for introducing an alternative fuel faces either economic or financial barriers
- if the alternative fuel project faces technology barriers associated with the introduction of a new fuel, training to operate and maintain the dispensing systems, new vehicle engine technology and combustion systems will be needed for employees
- if the project is a first-of-a-kind project. If yes, any project implemented by the private sector may face barriers, unless the project activity is being implemented by an oil company with large cash reserves
- availability of the newly introduced alternative fuel has to be made available in the targeted market at a competitive price, which means transport infrastructure and logistics problems need to be addressed
- the revenue from CDM activity will assist in overcoming most of the barriers faced by a private sector initiative of introduce a new alternative fuel

SECTION C. Choice of and justification as to why one of the baseline approaches listed in paragraph 48 of CDM modalities and procedures is considered to be the most appropriate:

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C.1. General baseline approach:

➢ Existing actual or historical emissions, as applicable;

? Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

? The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

C.2. Justification of why the approach chosen in 3.1 above is considered the most appropriate:

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No approved methodology exists for the same condition of application in the transport sector.

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

The USAID Office of Environment, Energy & Enterprise in India released the second part of their 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. Also 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

With the availability of GHG emission data in the transport sector in India, the approach stated in paragraph 48 (a) of CDM modalities and procedures, i.e., "existing actual or historical emissions, as applicable" has been used for the baseline.

Selection of this baseline has been made bearing in mind that:

- 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.

- 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 achieving the twin objective of providing assured supply of fuels at minimum costs and meeting the environmental concerns by making available:

  - liquid fuels of the specified quality as the main auto fuel throughout the country
  - 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.
  - protecting the consumer against supply disruptions and price risks."

- All project activities with alternative fuels like ethanol blended petrol, bio-diesel, LPG or electric hybrid vehicles 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 a basket of alternative fuels, the alternative fuel retail network, the transport & logistics support sector will generate large employment opportunities. In the proposed project activity of AutoLPG alone, new employment opportunities in excess of 18,000 direct new jobs will be created.

- In addition to the above, alternative fuel industry will create new indirect employment opportunities, particularly in the conversion kits and the automotive industry, nation wide. Thus the alternative fuel industry will create sustainable development opportunities both directly and indirectly.

- The data on GHG & general emission generated using the baseline methodology should be shared with the regional and national Pollution Control Boards, NGO's, vehicle manufacturers & other national and international agencies to build the national data base for emissions.

SECTION D. Explanation and justification of the proposed new baseline methodology:

D.1. Explanation of how the methodology determines the baseline scenario (that is, indicate the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity):

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As far as transportation fuel for the country is concerned, 97% dependence is totally upon petrol and diesel. CNG being only available in Delhi & Mumbai, fulfil less than 3% of transport fuel demand in India.

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", a basket of alternative fuels like 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 as the Business As Usual (BAU) scenario, in the transport industry and additional new refining capacity has been added by the Government owned oil companies.

"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. 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 (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

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 BAU scenario 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.

Ethanol blended petrol will only impact on 5% of the petrol demand, while bio-diesel project in India is still in its pilot phase. The commercial availability of 5% to 20% blended bio-diesel on a national level would only begin from 2008 onwards.

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.

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 years.

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 10). These new cars will generate additional CO2, too. Hence, there will always be more gasoline/diesel cars on road than any other alternative fuel vehicles.

Under the proposed methodology for alternative fuel, it focuses on reduction of GHG in comparison to the BAU scenario of petrol and diesel.

One of the most important features of the project is that ethanol blended petrol, bio-diesel and LPG can be transported in the existing lorry tanker infrastructure, unlike CNG. By making these alternative fuels available in cities, not connected on a CNG pipeline grid, a significant reduction of GHG emissions can be achieved.

It is also inferred that with alternative fuels 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 rather naïve to imagine the average person driving aimlessly in an overcrowded and dirty metropolitan city like Calcutta just because fuel is cheaper. 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 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 7th and the 14th year. The proposed methodology will address the revision of the GHG emission baseline data at the end of the first and second renewable period should there be a major shift or change.

D.2. Criteria used in developing the proposed baseline methodology:

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The criteria used in developing the baseline methodology are:

1. Section 48 (a) of CDM Modalities & Procedures on existing actual or historic emissions
2. Static baseline data generated on GHG emissions in the transport sector by the report on "Anthropogenic Emissions from Vehicular Transport in India" released by the USAID Office of Energy, Environment & Enterprise in India authored by the University of Ohio and National Physical Laboratory, New Delhi.
3. Motor Transport Statistics of India 2001-2002, Transport Research Wing, Ministry of Road Transport & Highways, Government of India
4. For data on Indian driving cycle and development trends - Society of Indian Automobile Manufacturers (SIAM)
5. Auto Fuel Policy 2002, Government of India
6. Transport Fuel Quality for the Year 2005 of Central Pollution Control Board, Government of India
7. "Indian Hydrocarbon Vision – 2025", Ministry of Petroleum & Natural Gas, Government of India
8. "Commission on Bio-diesel", Planning Commission, Government of India

D.3. Explanation of how, through the methodology, it can be demonstrated that a project activity is additional and therefore not the baseline scenario (section B.3 of the CDM-PDD):

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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."

For demonstration of additionality, the following steps should be followed as laid down in the "Consolidated tools for demonstration of additionality".

Step 0 – Preliminary screening of project:

If the starting date of the project activity falls between 1 January 2000 and the date of registration of a first CDM project activity and prior to 31 December 2005, evidence should be provided that the incentive provided by the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on official documentation clearly showing that the CDM incentive played a role at or before the moment of decision making to start the project.

Evidence, like the ones mentioned below, can be produced for verification by the DoE to confirm that the project meets this requirement:

(i) Project Idea Note was submitted with the above dates
(ii) Project Design Document was submitted to UNFCCC within these dates
(iii) Host country approval secured,
(iv) Soft commitment(s) from buyers of CER's

If the project participants can provide adequate evidence, the project activity can proceed through to the next step.

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

Realistic and credible alternatives to the project activity should be defined, that can be part of the baseline scenario. To do so, the following steps should be followed:

- Alternatives to the project activity should be defined, and
- Enforcement with applicable laws and regulations

In any alternative fuel project, all the alternatives to alternative fuel should be clarified:

- Starting with the predominant BAU fuels like petrol and diesel should be addressed first, followed by other alternatives fuels. Each fuel should be addressed as an alternative and it should be determined whether the project activity of introducing the alternative fuel is consistent with current laws and regulations.

- All the comparative alternative fuels must deliver similar output and services in the comparable markets.

The second step is to establish that the alternatives can be enforced with applicable laws and regulations. This step has three sub-steps.

In the first sub-step, it should be first checked whether the alternative is in compliance with all applicable legal and regulatory requirements. If not, then the alternative should be eliminated.

In the second sub-step, if the project does not comply with the applicable regulations and legislations, it should then be determined that the non-complying element of the alternative is currently widespread. If the alternative availability is widespread, then the alternative should be eliminated from further consideration.

The last sub-step is to establish if the project activity is the only alternative amongst the considered options.

After this step, the project participant can proceed directly Step 2 (Investment barrier) or choose to proceed directly to Step 3 (Barrier Analysis) or may consider to complete both the Steps 2 and 3.

Step 3 – Barrier Analysis:

If this step is used, it should be determined whether the proposed project activity faces barriers that:

a) prevent a wide spread implementation of this activity and thus preventing the baseline scenarios from occurring; and
b) do not prevent a wide spread implementation of at least one of the alternatives.

To determine the barrier analysis, the following steps should be used:

Sub-step 3 a:

Investment barrier:

The first barrier to be determined in this sub-step is investment barrier.

In this barrier is must be established that the project activity cannot be undertaken because lack of financial support from Banks of Financial Institutions. The risks perceived by the Bankers and Financial Institutions should be elaborated quoting reasons for risks. Risks perceived by bankers on "innovative projects" should also be addressed.

Technology barrier:

In this barrier it must be established that the skilled or properly trained labour force to operate and maintain the technology is not available, which might lead to malfunction or equipment disrepair, thereby reducing operational efficiency and output of the project activity.

It should be determined if

a) training is required for the new technology introduced for retail of alternative fuels,
b) if yes, then which areas – such as - safety measures to prevent leakage or explosions of the alternative fuel storage system, maintenance of engines, dispensing equipments etc.

Barrier due to prevailing practice:

Under barriers due to prevailing practice, it must be established that the developers lack familiarity with the start-of-the-art technologies and are reluctant to use them or the project is the "first-of-a-kind".

Under this barrier, it should also be established if the project is a "first-of-a-kind" in the country and what are the barriers being faced by any first-of-a-kind project in the road transport sector. These barriers should be explained in detail. If the developers lack familiarity with the new technologies deployed in the project, they may be reluctant to use these technologies.

Other barriers:

Under this barrier, it should be established that the project proponents and their management team is familiar with the latest state-of-the-art technology deployed in the project activity. Examples or models of projects using similar technology overseas should be studied to learn more of the latest technologies.

Even after the studying similar projects, the management of the project may feel that the project is too high-tech or technically sophisticated, they may give low priority to the project, even though the project shows potential as a CDM project.

These identified barriers are sufficient grounds for additionality only if they would prevent potential project proponents from carrying out the proposed project activity were it not registered as a CDM project. These identified barriers must be supported by transparent and documented evidence.

Sub-step 3b:

Must show that the identified barriers would not prevent a wide spread implementation of at least one of the alternatives. It must be explained that how the identified barriers are not preventing a wide spread implementation of at least one of the alternatives. Any alternative prevented by the barriers identified in sub-step 3a is not a viable alternative, and should be eliminated from consideration.

Out of all the alternatives being considered, at least one viable alternative should be identified.

Step 4 – Common Practice Analysis:

This generic additionality test shall be complemented with an analysis of the extent to which the proposed project type has already diffused in the relevant sector and region. This test is a credibility check to complement the barrier analysis (step 3).

Two sub-steps can be used to determine this.

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

This chapter analyses that any other activity implemented previously or currently underway which may be similar to the proposed project activity. By similar types of projects, it is meant that the project is implemented in the same country, using similar technology, of similar scale and take place in similar environment with respect to regulatory framework, investment climate, access to technology, access to financing etc.

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

This stub-step must demonstrate that why the existence of these activities does not contradict the claim that the propose project activity is financially unattractive (step 2) or subject to barriers (step 3).

This can be done by pointing out the essential distinctions between them that explain why similar activities enjoyed certain benefits that rendered it financially attractive like subsidies or financial flows, or did not face the barriers to which the proposed project activity may be subjected to.

Step 5 – Impact of CDM Registration:

Finally, in this chapter it must be explained that how with the approval and registration of the project as a CDM activity, and all benefits and incentives derived from the project, will alleviate the financial hurdles or barriers and thus enable the project to be undertaken.

It should be established how 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.

Lastly, through the methodology, a project must also be able to 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, who will benefit from the approved methodology for measurement of GHG emissions in the road transport sector.

D.4. How national and/or sectoral policies and circumstances can been taken into account by the methodology:

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- As a key aspect in the role of legislation, 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 autofuels 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 petrol, diesel, ethanol-petrol, bio-diesel, 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.

- For additional details on the "Auto Fuel Policy 2002, please visit the web site of the Ministry of Petroleum and Natural Gas, Government of India (http://petroleum.nic.in/afp_con.htm),

- It must be remembered that CNG has been introduced by an order of the Supreme Court.

- Ethanol blended petrol and bio-diesel are initiatives of Government owned oil companies, financially supported by the Government.

- With the rising crude oil prices, a basket of fuels are needed to reduce the dependence on very expensive imported crude oil and improve the energy security concerns of the country.

- AutoLPG is also a viable alternative automobile fuel which can be considered, apart from several other options, which is the basis of this proposed methodology.

- The methodology is, therefore, not based on any direct or indirect legislative obligation to fulfill any National and / or Sectoral policies or circumstances.

D.5. Project boundary (gases and sources included, physical delineation):

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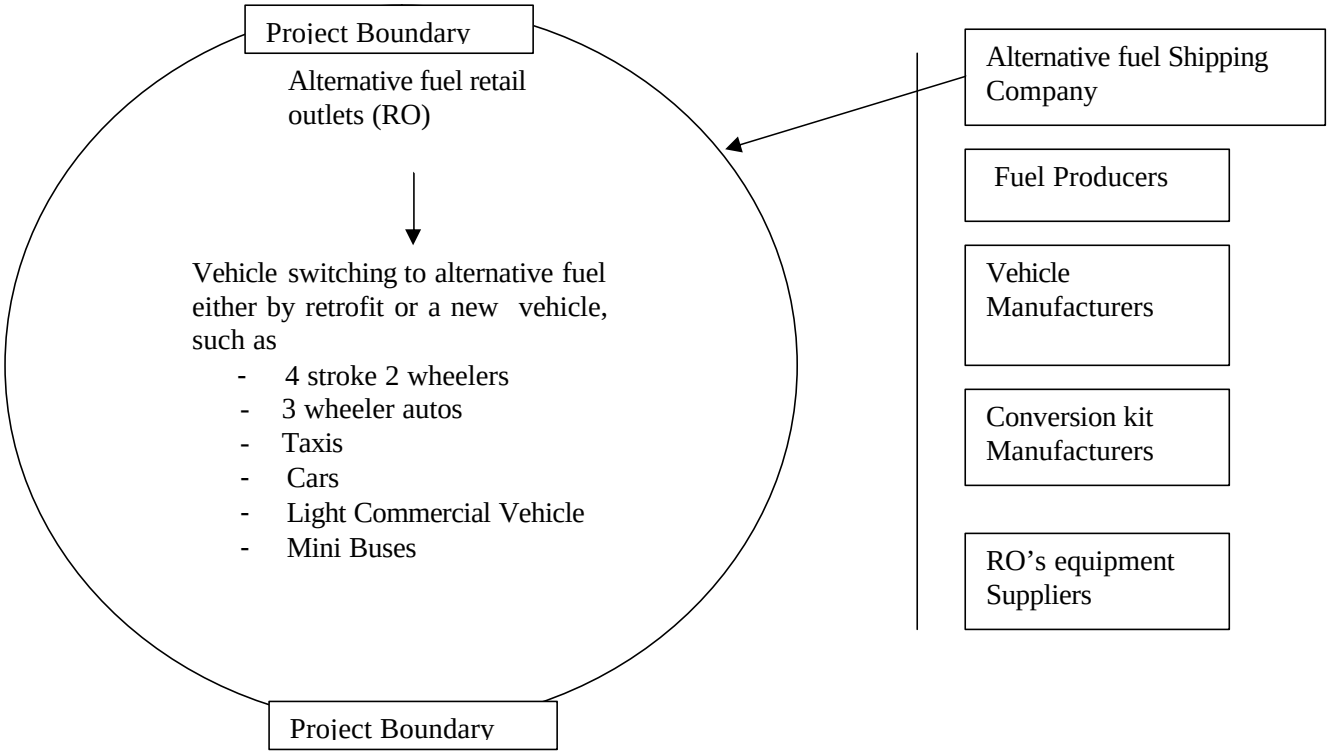
The baseline methodology related project scope is defined by boundaries shown in the figure below:



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 (RO) and the vehicles that shall use AutoLPG as automotive fuel, purchased from the RO's. The other participants which are within the project's commercial framework, but whose GHG emissions are not within the control of the project participants and not reasonably attributed to the CDM project activity.

50% of 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.

D.6. Elaborate and justify formulae/algorithms used to determine the baseline scenario. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

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Based on the emissions information provided by the report of Dr. Mittal and Dr. Sharma, the methodology is based on a historical, static baseline. The report provides the baseline data for the first 7 years of the crediting cycle, following which it may get altered if the baseline shifts.

The formulae/algorithms used to determine the emissions in the baseline methodology from petrol and diesel vehicles are:

During Driving Cycle:

The quantity of emissions in grams (x) multiplied by the distance driven in Kilometers

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

The details of the baseline emission data from different types of petrol and diesel vehicles at the speed of 20km/hr are reproduced below:

Emissions	2 Wheeler 4 stroke	3 wheeler 4 stroke	Petrol 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.

D.7. Elaborate and justify formulae/algorithms used to determine the emissions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

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The only gas which is being monitored in the project activity is AutoLPG.

The formulae/algorithms used to determine the emissions from the project activity

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, will be recorded from every vehicle using RFID technology.

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.

D.8. Description of how the baseline methodology addresses any potential leakage of the project activity:

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In the proposed baseline methodology, leakage is defined as the emissions outside the project boundary that is directly attributed to the project activity. In the methodology, the project boundary is defined as the vehicles using alternative fuel and the retail outlets selling the alternative fuel. 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, which may take place only on account of fall in international fuel costs. But this seems unlikely with the spiralling crude oil prices.

Further, the emissions on sea shipments will be negligible. Lastly, these emissions would have occurred anyway, even in the absence of the project activity, during import crude oil for production of petrol and diesel and for inland transportation of liquid fuels to the retail outlets.

The reasons eliminating leakage in the baseline methodology are:

1. If the alternative fuel is reserved for a priority sector, like cooking fuel in India. The cooking fuel in India – LPG – is only available in cylinders. The cylinders have one safety valve. These cylinders are not designed for use in automobiles and may cause explosions. The fear of such explosions and safety reasons will prevent vehicle owners to use the alternative fuel reserved for priority sector, thereby preventing any possibility of diversion from the priority sector to the automobile sector
2. If the alternative fuel is subsidised for the priority sector and legislation/regulations prevent using the subsidised fuel in automobiles
3. If the alternative fuel is imported, hence more expensive than the subsidised prices
4. When the prices of petrol and diesel, the BAU fuels, are controlled by the Government is higher than the alternative fuels

D.9. Elaborate and justify formulae/algorithms used to determine the emissions reductions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

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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 alternative fuel.. 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.

SECTION E. Data sources and assumptions:

E.1. Describe parameters and or assumptions (including emission factors and activity levels):

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For details on data sources and assumptions used, please refer to the GHG emission calculation given on Annex 17 of CDM_PDD. In this spread sheet, the following steps have been followed:

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 market should be selected.

5. From the projected vehicle numbers in the targeted market, it should be assumed that not all vehicles will switch to the new alternative fuel in the first year. The switch will be gradual starting with small percentage of conversions in the first year and growing in subsequent years till it reaches a peak level. An illustration of conversion is proposed as follows.

% switch to Alternative fuels

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%

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Though the proposed conversions are fairly conservative, it is useful to point out that because of the Supreme Court Order, in Delhi, 100% buses, taxis and 3 wheelers, all commercial vehicles, converted to CNG within 4 years of the Order of the Supreme Court.

6. From the percentage of vehicles which may convert, the final total number of converted vehicles in the targeted market should be derived.

7. Out of the total number of vehicles which are projected to convert to alternative fuels, a market share should be determined, as it would be presumptuous to assume that 100% market share can be achieved by any one project activity. There could be several projects implemented by different oil retail companies, whether Government owned or belonging to the private sector. Several reasons will limit achieving 100% market share. They could either the large geographical size of the market, transport and logistics problems, costs for transportation making product expensive against existing fuels, availability of retail infrastructure etc. It would however be safe to assume a conservative target only 30% of the market share for any one project using the methodology.

8. Of the 30% market share, the annual mileage of different types of vehicles should be factored. The source of this mileage data is Central Pollution Control Board, Government of India publication, which can be seen below and also 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 should be multiplied with the total mileage of different types of vehicles to arrive at the annual GHG emission reductions.

E.2. List of data used indicating sources (e.g. official statistics, expert judgement, proprietary data, IPCC, commercial and scientific literature) and precise references and justify the appropriateness of the choice of such data:

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The source of the data is a report available on http://www.osc.edu/research/pcrm/emissions/index.shtml and scroll down to Part II of the report.

This report was funded by the USAID Office of Environment, Energy & Enterprise in India. The authors of the report are Dr. Moti Mittal of the University of Ohio, USA and Dr. C Sharma of the National Physical Laboratory, New Delhi.

E.3. Vintage of data (e.g. relative to starting date of the project activity):

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March 2003. The anticipated date for starting the commercial operations in the project activity is late March 2005.

E.4. Spatial level of data (local, regional, national):

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National – all India data covering 7 major cities in the east, west, north and south of the country.

SECTION F. Assessment of uncertainties (sensitivity to key factors and assumptions):

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The USAID sponsored study "Anthropogenic Emissions from Vehicular Transport in India" clearly expresses:

1. That the GHG emission data from vehicles is based on a model
2. That computed and measured emissions may differ
3. The emission data has been assumed to be from new vehicles
4. Emission data from older vehicles will only increase with the increasing age of engines and maintenance standards of vehicles
5. Catalytic converters are not mandated for all vehicles in India
6. The baseline data will be subject to revision at the end of the first 7 year crediting cycle taking into account the new technology and engines for vehicles, introduction of Euro III norms for petrol and diesel in India, better traffic management resulting in higher speeds of vehicles in the urban areas etc.

SECTION G. Explanation of how the baseline methodology allows for the development of baselines in a transparent and conservative manner:

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In most cases, the development of baseline has been done in a very conservative manner. Some of the factors taken into account while developing the baseline have been addressed in section E.1 above. They are:

1. Compounded annual growth rate of vehicles in India has been dropped from 8.7% to 7% & 4% for cars, taxis and 3 wheelers respectively.
2. Market share has only been conservatively assumed at 30%
3. With better quality of roads and highways, the annual vehicle mileage in India is increasing annually. However, the data on annual mileage used for development of baseline data is again on a very conservative side
4. The total 2 wheeler population in India is over 45m vehicles. Of this about 8 million are 4 stroke engine motorcycles and scooters, rest being 2 stroke vehicles. The population and emissions data of 4 stroke 2 wheelers motorcycles and scooters have not been taken into account in the development of baseline at all. 4 stroke 2 wheelers will one of targeted vehicles under the project activity
5. Similarly, percentage of conversion of vehicles from petrol or diesel to alternative fuel has been done in a very conservatively over a 5 year period, as shown below:

% switch to alternative fuel

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%

Finally, all the data generated used for development of baseline will be open and available to the DoE for scrutiny during the validation of the PDD in a transparent way, prior to registration of the project with the CDM EB.