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

A.1. Title of the proposed methodology:

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The name of the monitoring methodology is: **"RFID based electronic monitoring methodology for the road transport sector"**

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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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.

2. The fuel purchase, fuel consumption and mileage data can assist in determining the factors responsible for:
    a. New baseline for GHG and other general emissions in the road transport sector in any country
    b. Changes in the baseline emissions from any fuel using any engine technology and in any country provided all retail outlets are electronically connected for high speed data transfers and RFID tags and readers are used to identify the vehicle and transfer of data from the vehicle to the retail outlet's servers.

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

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The strength of the proposed new monitoring methodology is that by using the latest Radio Frequency Identification (RFID) technology and electronic cash-less payment system at the RO, it would be physically possible to accurately monitor:

3. the fuel purchase data of every vehicle
4. the mileage data of every vehicle
5. the fuel consumption data during idling time for every vehicle

With these 3 data captured from every vehicle, it would be possible to calculate the GHG emissions in any project retailing any fuel in the transport sector.

To the best of our knowledge, no weakness has been found in the proposed new monitoring methodology.

SECTION B. Proposed new monitoring methodology

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B.1. Brief description of the new methodology:

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1. After extensive research and investment towards the development of the hardware and the software, compatible to the Radio Frequency Identification (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%.

2. 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.

3. 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.

4. 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 RO country wide for a refill of fuel. Therefore, whenever a user needs to refuel his/her vehicle, all that he/she will be required to use the RFID to purchase fuel. 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:

   a. 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,

b. The information collected ensure a high safety standard to prevent any potential accidents due to leakage of fuel resulting in an accident or a blow out.

c. 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.

d. 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.

e. 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.

f. 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%.

g. Since most countries prefer to allow vehicles 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 or diesel. With the dual-fuel option, the driver may have to switch to gasoline/diesel, in the event of the alternative fuel running out. With the change in the solenoid switch, the electronic recording system shuts down completely, on changing from alternative fuel to gasoline/diesel. This would enable to record only the data for the alternative fuel but not for gasoline/diesel.

h. 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).

i. 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 of CDM_PDD and visit www.ti-rfid.com.

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

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B.2.1. Data to be collected or used 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 B.7)*	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/kilometre

** = Monitoring/fuel consumption

***= Monitoring/Fuel purchased

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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The only gas which is being monitored in the project activity is LPG. However, by using the proposed monitoring methodology, emissions from vehicles using any liquid or gaseous fuel, hybrid electric or hydrogen fuel cells, can be successfully monitored in any country, provided the proposed monitoring technology is deployed to do so.

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 B.2.1, will be recorded from every vehicle using RFID technology.

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	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/KM**	*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 -*

B/M*= baseline kilo metres
B/FC** = baseline fuel consumption
B/FP*** = baseline fuel purchase

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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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 of CDM_PDD.

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

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Not applicable.

B.3.1. Data to be collected or used 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 B.7)*	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.

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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Not applicable.

B.4. Treatment of leakage in the monitoring plan:

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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 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 the country and possibly higher usage of diesel and petrol, which can take place only on account of fall in liquid fuel costs.

Further, the emissions on sea shipments are ignored, as they are negligible. Finally, these emissions would have occurred anyway, while importing crude oil for production of petrol and diesel and during 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. 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 but 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.

B.4.1. 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 B.7)*	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

No leakage as explained in B.4 above, hence not applicable.

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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Not applicable.

B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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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 AutoLPG under the project activity.

B.6. Assumptions used in elaborating the new methodology:

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No assumptions have been made in the new proposed monitoring methodology. All data collected and archived would be done electronically from every vehicle when the vehicle comes for a refill of AutoLPG from any RO in the country. The data would be collected on a country-wide basis and would be open to annual verification by the DoE. The accuracy of the data will be to the tune of 99%.

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items 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/KM**	*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.*

M/M* = monitoring kilo metres
M/FC** = monitoring fuel consumption
M/FP# = monitoring fuel purchase

Since the baseline is static and historical, thereby may not need to monitor the baseline for the first 7 year crediting cycle. The baseline would only be reviewed prior to the second 7 year renewable period and changes in the baseline emission data, if any, would be adjusted accordingly.

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

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To the best of our knowledge the proposed methodology has not been used elsewhere. However, the proposed RFID based electronic monitoring methodology can be easily replicated anywhere in the world to monitor both the GHG and general emissions from the road transport sector.