CLEAN DEVELOPMENT MECHANISM

PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)

Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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Energy Efficiency Improvement through Plate Type Combined Feed Exchanger

Version 01

29/03/2008

A.2. Description of the small-scale project activity:

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The purpose of the project activity is to improve the energy efficiency of the Pacol reactor unit in the Linear Alkyl Benzene Plant of Tamil Nadu Petroproducts Limited (TPL) through the replacement of Rod & Baffle type combined feed exchanger with a technically superior high efficiency plate type combined feed exchanger. This leads to energy savings as it would result in lesser fuel oil and electricity consumption, and therefore mitigate GHG emissions. The heat transfer area in the plate type combined feed exchanger is higher than that in the Rod & Baffle type combined feed exchanger and also has a lower pressure drop. The Hot end Approach Temperature (HAT) has reduced from 60^0C to 40^0C in the new plate type combined feed exchanger resulting in fuel oil savings. The preheat temperature has increased from 400^0C to 420^0C reducing the amount of fuel oil needed for further preheating. Moreover, the reduced pressure drop in the system as a result of the project activity results in lower electricity consumption of the compressor.

The contributions of project activity towards sustainable development are explained in the following paragraphs:

1. **Economic benefits:**

The project activity would reduce the fuel oil consumption and thereby contributes to reducing the fossil fuel imports and therefore saves on foreign exchange to the national economy.

2. **Environmental benefits:**

The project activity reduces the consumption of fuel oil and electricity thereby mitigating the corresponding quanta of GHG emissions. The project activity reduces pollution associated with fuel oil combustion in the vicinity of the plant location.

3. **Technological benefits:**

The project activity reduces the quantity of fuel oil consumption thereby mitigating GHG emissions. The project activity adopts "Packinox" type heat exchangers that employ advanced technology to improve the effectiveness. The project activity will serve as a successful model for this technology and encourage similar industries to implement it thereby resulting in further emission reductions.

A.3. Project participants:

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Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India	Tamil Nadu Petroproducts Limited	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

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India

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

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Tamil Nadu

A.4.1.3. City/Town/Community etc:

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Manali, Chennai

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

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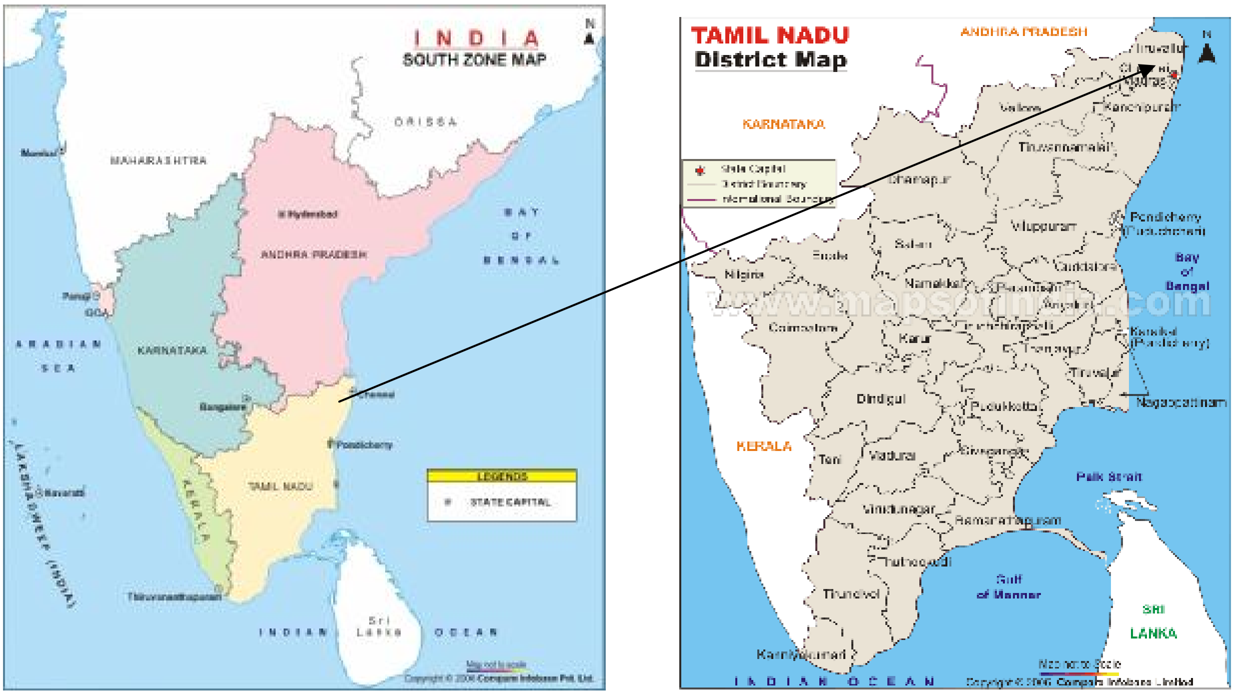
The project activity is located at Manali, Chennai, Tamil Nadu (latitude: +32.16, Longitude: +77.10)[1], India. The plant is located on Manali Express Highway. The nearest airport is Chennai airport, which is 30 km from the plant location. The nearest port is the Chennai Port which is 6 km from the plant location. The geographical location of the project activity is depicted in the following map:



[1] Source: http://www.mapsofworld.com/lat_long/india-lat-long.html

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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Type II – Energy Efficiency Improvement projects

Category D – Energy efficiency and fuel switching measures for industrial facilities

The approved baseline methodology has been referred from the indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories - version 11 – Sectoral Scope: 04, EB 35.

Technology of the project activity:

The project activity comprises of one welded plate type combined feed exchanger supplied by "Packinox". The technology is environmentally sound and safe as described below:

Clean and safe operation[2]:

Double-containment design minimizes the risk of leakage and attendant fire hazard. By allowing other equipment to burn less fuel, Packinox keeps harmful emissions to the atmosphere in check.

Packinox combined feed/effluent plate heat exchangers comprise a welded bundle block and a pressure vessel. Heat transfer takes place exclusively within the bundle block so that no process fluids circulate inside the shell. The pressure vessel is filled with higher pressure fluid for compression of the bundle block. Bundle plates are exposed only to the differential pressure of the flowing fluids; thus Packinox heat exchangers operate safely even in high pressure applications.

Moreover, the mechanical design of Packinox heat exchangers ensures safe operation for plant personnel and the environment. With its double containment feature and few flanges, chances of leaks are marginal and the risk of fire or harmful emissions to the atmosphere almost non-existent.

The technical specifications of the heat exchanger are provided below:

Heat exchanged = 26.07 x 10^6 kcal/h

[2] Literature of Packinox heat exchangers

Inlet	Hot Fluid				Cold Fluid			
	Temp ^{0}C	**MW**	**Flow kg/h**	**10^6 kcal/h above 15.6 ^{0}C**	**Temp ^{0}C**	**MW**	**Flow kg/h**	**10^6 kcal/h above 15.6 ^{0}C**
Total flow	468	27.0	100701	42.53	145	27.6	100598	12.54
Vapor (total)	-	27.0	100701	42.53	-	16.3	54570	9.34
Vapor HCBN	-	104.9	95007	-	-	80.5	49039	-
Vapor H_2	-	2.0	5694	-	-	2.0	5531	-
Free liquid H_2O	-	-	-	-	-	160.9	46028	3.19

Outlet	Hot Fluid				Cold Fluid			
	Temp ^{0}C	**MW**	**Flow kg/h**	**10^6 kcal/h above 15.6 ^{0}C**	**Temp ^{0}C**	**MW**	**Flow kg/h**	**10^6 kcal/h above 15.6 ^{0}C**
Total flow	157	27.0	100701	16.46	430	27.6	100598	38.61
Vapor (total)	-	26.4	98062	16.26	-	27.6	100598	38.61
Vapor HCBN	-	103.8	92368	-	-	106.3	95065	-
Vapor H_2	-	2.0	5694	-	-	2.0	5533	-
Liquid HCBN	-	164.8	2639	0.20	-	-	-	-
Free liquid H_2O	-	-	-	-	-	160.9	46028	3.19

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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Years	Annual estimation of emission reduction (in tonnes of CO_2e)
July 2009 – June 2010	15,501
July 2010 – June 2011	15,501
July 2011 – June 2012	15,501
July 2012 – June 2013	15,501
July 2013 – June 2014	15,501
July 2014 – June 2015	15,501
July 2015 – June 2016	15,501
July 2016 – June 2017	15,501
July 2017 – June 2018	15,501
July 2018 – June 2019	15,501
Total estimated reductions (tonnes of CO_2e)	**155,010**
Total number of crediting years	**10 years**
Annual Average over the crediting period of estimated reduction (tonnes of CO_2e)	15,501

A.4.4. Public funding of the small-scale project activity:

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No public funding as part of project financing from parties, included in Annex I of the convention is involved in the project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

The guideline for de-bundling mentioned in paragraph 2 of appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities is given as follows:

A proposed small scale project activity shall be deemed to be a de-bundled component of a large project activity, if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity.

- *With the same project participants;*
- *In the same project category and technology/measure; and*
- *Registered within the previous 2 years*
- *Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.*

The project proponent is not promoting another small scale CDM project activity in the same category and technology/measure whose project boundary is within 1 km of the proposed project activity and registered within the previous 2 years. Therefore, the proposed project activity is not a de-bundled component of a large project activity.

SECTION B. Application of a baseline and monitoring methodology

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

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Title: Type II – Energy Efficiency Improvement Projects

Category: D – Energy efficiency and fuel switching measures for industrial facilities

Reference: The approved baseline methodology has been referred from the Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories - version 11.

B.2 Justification of the choice of the project category:

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The basic applicability criteria of the project activity for a small scale CDM project activity of Type II – Energy Efficiency Improvement projects is tabulated as below:

Methodology applicability criteria	Project activity in accordance with applicability criteria
This category comprises any energy efficiency measure for specific industrial or mining and mineral production processes implemented at a single industrial or mining and mineral production facility	The project activity comprises of a new plate type combined feed exchanger which is more efficient than the rod & baffle type heat exchanger in operation prior to the Packinox exchanger. The project activity is implemented in the Pacol reactor of the Linear Alkyl Benzene plant (LAB) at TPL (which is a single industrial facility). Hence this applicability condition is satisfied.
The measures may replace, modify or retrofit existing facilities or be installed in a new facility	The plate type combined feed exchanger replaces the rod & baffle type heat exchanger. Hence this applicability condition is also satisfied.
The aggregate energy savings of a single project	The project activity results in both electrical and

may not exceed the equivalent of 60 GWh_e per year (equivalent of maximal saving of 180 GWh_{th} per year in fuel input)	thermal energy savings. The aggregate thermal energy savings of the project activity is 40 GWh_{th}. The aggregate electrical energy savings of the project activity is 5.73 GWh_e, which is equivalent to 17.2 GWh_{th} (arrived as 5.73 X 3). The total thermal equivalent of thermal and electrical energy savings is only 57.2 GWh_{th} which is within the limit of 180 GWh_{th} equivalent per year in fuel input. Hence the project activity qualifies as a small scale CDM project and would remain under the limits of the small scale project activity type during every year of the crediting period.

B.3. Description of the project boundary:

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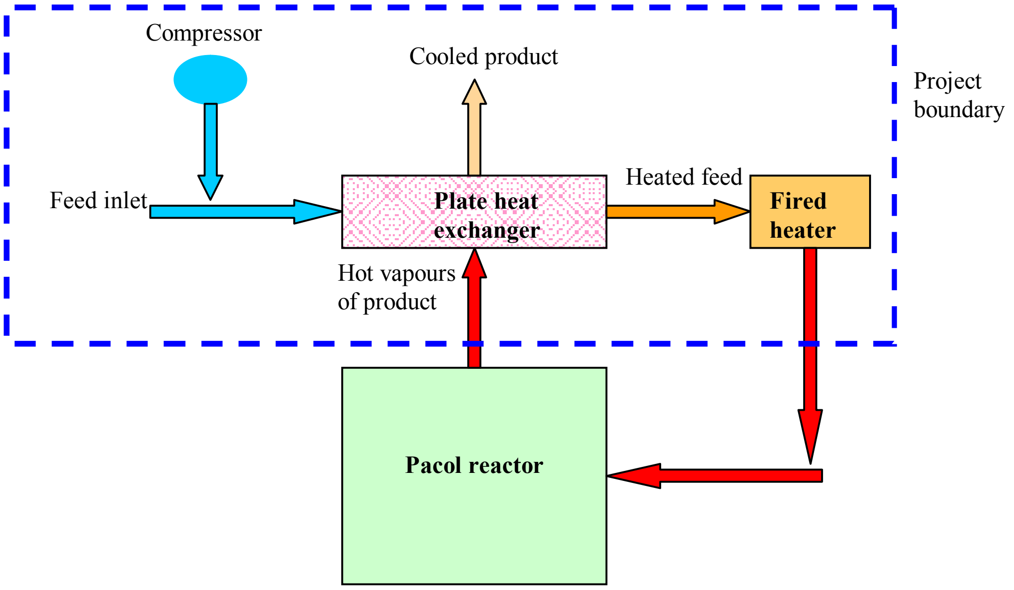
As prescribed by the methodology AMS II.D, the project boundary is the physical, geographical site of the industrial production facility or equipments that are affected by the project activity. For this project activity, the project boundary includes the plate type heat exchanger and its components and the feed gas compressor system.


Compressor
Cooled product
Project boundary
Feed inlet
Plate heat exchanger
Heated feed
Fired heater
Hot vapours of product
Pacol reactor

B.4. Description of baseline and its development:

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Energy baseline:

The methodology states that "In the case of replacement, modification or retrofit measures, the baseline consists of the energy baseline of the existing facility or sub-system that is replaced, modified or retrofitted."

Thus, the energy baseline is calculated based on the energy consumption of the existing facility. This corresponds to;

- The fuel oil consumption of the fired heater with the rod and baffle type heat exchanger in operation. Historic fuel oil consumption data would be averaged to arrive at the energy baseline.
- The electricity consumption of the compressor with the rod and baffle type heat exchanger in operation. Historic electricity consumption data would be averaged to arrive at the energy baseline.

Emission coefficient:

The methodology states that "Each energy form in the emission baseline is multiplied by an emission coefficient. For the electricity displaced, the emission coefficient is calculated in accordance with provisions under category I.D. For fossil fuels, the IPCC default values for emission coefficients may be used."

For this project activity, the emission coefficients of the fuel oil used in the fired heater and that of the electricity consumed by the compressor are to be adopted. The emission coefficient of fuel oil is adopted from the IPCC default values and is further described in Annex 3 of the PDD. As prescribed by AMS II.D, the emission coefficient of electricity is adopted as per AMS I.D as 0.8 tCO_2/MWh. This is the emission coefficient value for electricity sourced from diesel or fuel oil fired generators. The electricity consumed by the compressor is generated in fuel oil fired generators and therefore the choice of the baseline emission coefficient is appropriate.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

In accordance with the simplified modalities and procedures for small-scale CDM project activities, it is required to demonstrate how the project activity (or the emission reduction) would not have occurred in the absence of the CDM project activity by showing that one or more barriers would have prevented its implementation. The barriers faced by the promoters in case of this energy efficiency project activity have been described below.

For TPL, the alternative to the project activity is to have continued with the existing rod and baffle type heat conventional exchanger as was common practice in similar industries of the region. The project activity involved the replacement of the conventional system with advanced high efficiency technology. The project activity uses advanced plate type heat exchanger (called Packinox) from the global supplier Packinox, France. The Packinox system had a very low market penetration in the region and meant a major technological leap for TPL. The lack of success stories on the performance of Packinox technology, lack of skilled manpower to operate such systems and absence of local product service facilities posed as major barriers to TPL and are described below:

Technological barrier:

- ***Performance uncertainties***

At the time of conceptualisation of the project activity, TPL was one of the first in the country to adopt the Packinox type heat exchanger. Other similar petroproducts industries were operating on the conventional type heat exchangers. The design, construction and operation of the Packinox system are significantly different from that of a conventional rod and baffle type system. The Packinox system is of welded type plate heat exchanger which has a large contact surface area over which the fluid flow and heat transfer happens.

The lack of prevalence of Packinox type systems in the region raised uncertainties about the performance, efficiency and trouble-free operation of such systems. Any performance loss or frequent disturbances in the system would correspondingly reduce the quantity and temperature of feed to the reactor. TPL was wary that such a situation would not only impact the feasibility of the project activity but also affect the primary manufacturing process.

It may be noted that TPL’s apprehension about the performance uncertainty and lack of experienced and trained manpower was justified shortly after implementation of the project activity. In February 2005, higher pressure drop and lower performance was noticed in the system. Performance analysis showed that spray bar inlet strainers were plugged due to improper working of the feed filters.

- ***Lack of skilled manpower***

The Operation and Maintenance (O&M) of the Packinox system is complicated and requires frequent monitoring and control of critical parameters which is possible only with a trained and experienced O&M team. The absence of the Packinox system in the region also meant a limited availability of skilled manpower to operate such systems. The trained manpower capable of handling a high-pressure cogeneration system was not readily available to TPL. TPL was apprehensive of this lack of experienced and trained manpower that could transform into unscheduled shutdowns, performance loss or degradation of equipment life.

- ***Lack of logistics for maintenance of technology***

During conceptualization of the project in year 2003, Packinox did not have a product service centre in India. All service queries would have to be addressed to the overseas service offices. TPL envisaged that it would involve higher expenses since service personnel would have to travel from overseas. Site visit of service personnel to inspect the system would also involve higher cost and longer time delay. The convenience of frequent and immediate site visits possible by a local service centre would not be available to TPL and all service and trouble shooting processes would be tedious and involve longer time period. This would translate to higher down times of the project equipment and reduced productivity of the primary manufacturing process. TPL was wary of this lack of convenient maintenance logistics.

Prevailing practice barrier:

At the time of conceptualisation of the project activity, TPL was one of the first in the country to adopt the Packinox type heat exchanger. Other similar petroproducts industries were operating on the conventional rod and baffle type heat exchangers. Being the first to implement this type of technology, TPL was concerned about the successful operation of the technology and its performance in local conditions.

Applicable national policies and circumstances:

There are no national policies that prescribe guidelines or norms for heat exchanger effectiveness in petroproducts industries. National policies and circumstances do not require the installation of high performance plate type heat exchanger, nor do they restrict the continued operation of the existing conventional rod and baffle type heat exchanger.

CDM Consideration and background:

TPL learnt about CDM when their representative attended a seminar conducted during December 2002. The idea and prospect of CDM revenues were put forward while evaluating the implementation of the energy efficient Packinox technology. The project activity was taken forward for implementation by TPL in view of the prospective carbon funds through the CDM that would help offset the technological and other risks. TPL initiated correspondence with some parties towards the realization of CDM funds soon after the commencement of the project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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B.6.1.1: Emission Reductions

The emission reductions can be calculated as the multiple of the energy savings (fuel savings) achieved as a result of the project activity and the emission coefficient as follows:

$$ER_y = (EC_{th,baseline,y} - EC_{th,project,y}) \times EF_{th} + (EC_{el,baseline,y} - EC_{el,project,y}) \times EF_{el}$$

Where,

ER_y = Emission reductions in year y

$EC_{th,\ baseline,y}$ = Thermal energy consumption in the baseline scenario (MWh)

$EC_{th,\ project,y}$ = Thermal energy consumption in the project scenario (MWh)

EF_{th} = Emission coefficient of the electricity used expressed in tCO_2/MWh_{th}

$EC_{el,\ baseline,y}$ = Electrical energy consumption in the baseline scenario (MWh)

$EC_{el,\ project,y}$ = Electrical energy consumption in the project scenario (MWh)

EF_{el} = Emission coefficient of the electricity consumed expressed in tCO_2/MWh_{el}

B.6.1.1.a: Energy consumption in the baseline scenario (*ECbaseline,y*):

Thermal energy consumption in the baseline scenario:

$$EC_{th,baseline,y} = SEC_{th,historic} \times H_y$$

$SEC_{th,\ historic}$ = Specific energy consumption (thermal) of the (pre-heating) system in pre-project historic years (MWh of fuel input/MWh of heat added to the feed)

Hy = Total quantity of heat added to feed in year y (MWh) calculated as the enthalpy difference between the feed outlet of the fired heater and the feed input to the heat exchanger

- ***Calculation of $SEC_{th,\ historic}$:***

$$SEC_{th,historic} = \frac{(FC_{historic,y} \times NCV_{historic,y})}{H_{historic,y}}$$

Where,

$FC_{historic,y}$ = Fuel consumption recorded for historic year y (Tonnes)

$NCV_{historic,y}$ = Net calorific value of fuel oil used in historic year y (MWh/Tonne of fuel)

$H_{historic,y}$ = Total quantity of heat added to feed in historic year y (MWh) calculated as the enthalpy difference between the feed outlet of the fired heater and the feed input to the heat exchanger

- ***Calculation of H_y and $H_{historic,y}$:***

$$H_y = \sum_y \left[\left[Q_{CF} * T_{out,CF} * C_{p,CF}\right] - \left[Q_F * T_{in,F} * C_{p,F}\right] - \left[Q_G * T_{in,G} * C_{p,G}\right]\right]$$

Where,

Q_{CF} is the quantity of combined feed outlet of the fired heater in Tonnes

$T_{out,CF}$ is the temperature of combined feed outlet of the fired heater in ºC

$C_{p,CF}$ is the specific heat of combined feed outlet of the fired heater in MCal/TºC

Q_F is the quantity of feed inlet to the heat exchanger in Tonnes

$T_{out,F}$ is the temperature of feed inlet of the heat exchanger in ºC

$C_{p,F}$ is the specific heat of feed inlet of the heat exchanger in MCal/TºC

Q_G is the quantity of recycle gas inlet to the heat exchanger in Tonnes

$T_{out,G}$ is the temperature of recycle gas inlet of the heat exchanger in ºC

$C_{p,G}$ is the specific heat of recycle gas inlet of the heat exchanger in MCal/TºC

H_y is the heat added in the preheating system (heat exchanger and fired heater) in year y

For calculation of $H_{historic,y}$, historic values of Q_{CF}, $T_{out,CF}$, $C_{p,CF}$, Q_F, $T_{out,F}$, $C_{p,F}$, Q_G, $T_{out,G}$, and $C_{p,G}$ shall be applied in the above formula.

Electrical energy consumption in the baseline scenario:

$$EC_{el,baseline,y} = SEC_{el,historic} \times Q_{CF}$$

$SEC_{el,\ historic}$ = Specific energy consumption (electrical) of the compressor system in pre-project historic years (MWh of electricity/MT feed compressed)

Q_{CF} = Total quantity of gas feed compressed in year y (MT)

- ***Calculation of $SEC_{el, historic}$:***

$$SEC_{el,historic} = \frac{EC_{el,historic,y}}{Q_{CF,historic,y}}$$

Where,

$EC_{el, historic,y}$ = Electricity consumption of compressor recorded for historic year y (Tonnes)

$Q_{CF, historic,y}$ = Total quantity of gas feed compressed in historic year y (MT) recorded

B.6.1.1.b: Energy consumption in the project scenario (*$EC_{project,y}$*):

Thermal energy consumption in the project scenario:

$$EC_{th,project,y} = FC_y \times NCV_y$$

Where,

FC_y = Fuel consumption recorded in year y (Tonnes)

NCV_y = Net calorific of fuel oil used in year y (MWh/Tonne of fuel)

Electrical energy consumption in the project scenario:

$EC_{el, project,y}$ is the measured electricity consumption of the compressor in year y (MWh)

B.6.1.1.c: Emission coefficient (EF):

Emission coefficient of fuel oil (EF_{th}):

The emission coefficient of the fuel oil used in the fired heater is adopted from the IPCC default values. The default emission coefficient for fuel oil as per IPCC 2006 guidelines is 0.272 tCO_2/MWh[3].

Emission coefficient of electricity (EF_{el}):

As prescribed by AMS II.D, the emission coefficient of electricity is adopted as per AMS I.D as 0.8 tCO_2/MWh. This is the emission coefficient value for electricity sourced from diesel or fuel oil fired generators. The electricity consumed by the compressor is generated in fuel oil fired generators and therefore the choice of the baseline emission coefficient is appropriate.

[3] Based on IPCC 2006 guidelines default values: Emission factor 75500 kgCO2/TJ. Refer Table 2.2 page 2.16.

B.6.1.2: Project emissions:

The project activity does not result in any incremental energy consumption and therefore emissions due to the project activity are nil.

B.6.1.3: Leakage:

As per AMS II.D, leakage is to be considered only if the energy efficiency technology is equipment transferred from another activity or if the existing equipment is transferred to another activity. Since the project activity does not result in either of the above, leakage is not applicable.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**$SEC_{th, historic,y}$**
Data unit:	MWh of fuel input per MWh of heat added to the feed
Description:	Quantity of heat input as fuel for a unit of heat added to the feed in the preheating system during the historic year y
Source of data used:	TPL log books / Daily/monthly reports
Value applied:	0.401
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data has been computed based on historic records
Any comment:	-

Data / Parameter:	**$SEC_{el, historic,y}$**
Data unit:	MWh of electricity per MT of gas feed compressed in historic year y
Description:	Quantity of electricity consumed by the feed gas compressor during the historic year y
Source of data used:	TPL log books / Daily/monthly reports
Value applied:	0.02026
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data has been computed based on historic records
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

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B.6.3.1: Calculation of emission reductions:

As per formula defined in section B.6.1 above,

$$ER_y = (EC_{th,baseline,y} - EC_{th,project,y}) \times EF_{th} + (EC_{el,baseline,y} - EC_{el,project,y}) \times EF_{el}$$

S.No	Notation	Parameter	Unit	Value	Comments
1	$EC_{th, baseline,y}$	Baseline thermal energy consumption	MWh	126595.6	Refer section B.6.3.2 below
2	$EC_{th, project,y}$	Project thermal energy consumption	MWh	86456.3	Refer section B.6.3.6 below
3	EF_{th}	Emission coefficient (thermal)	tCO_2/MWh	0.272	IPCC default value for fuel oil
4	$EC_{el, baseline,y}$	Baseline electrical energy consumption	MWh	17856	Refer section B.6.3.2 below
5	$EC_{el, project,y}$	Project electrical energy consumption	MWh	12127	Refer section B.6.3.6 below
6	EF_{el}	Emission coefficient (electricity)	tCO_2/MWh	0.8	Adopted from AMS I.D
7	ER_y (1-2)*3 + (4-5)*6	Emission reductions	tCO_2/yr	15501	Methodology formula.

B.6.3.2: Calculation of baseline energy consumption (ECbaseline):

As per formula defined in section B.6.1 above,

$$EC_{th,baseline,y} = SEC_{th,historic} \times H_y$$

$$EC_{el,baseline,y} = SEC_{el,historic} \times Q_{CF}$$

S.No	Notation	Parameter	Unit	Value	Comments
1	$SEC_{th, historic,y}$	Specific thermal energy consumption in historic year y	MWh fuel input/MWh of heat added	0.4017	Refer section B.6.3.3 below
2	Hy	Heat added to the feed in the preheating system in year y	MWh of heat added	315105.5	
3	$EC_{th, baseline,y}$ (1*2)	Baseline thermal energy consumption	MWh of fuel input	126595.6	Methodology formula.
4	$SEC_{el, historic,y}$	Specific electricity consumption in historic year y	MWh/MT	0.02026	Refer section B.6.3.3 below
5	Q_{CF}	Quantity of feed gas compressed in year y	MT	881238	
6	$EC_{el, baseline,y}$ (4*5)	Baseline electricity consumption	MWh	17856	

B.6.3.3: Calculation of historic specific fuel consumption ($SEC_{historic}$):

As per formula defined in section B.6.1 above,

$$SEC_{th,historic} = \frac{(FC_{historic,y} \times NCV_{historic,y})}{H_{historic,y}}$$

$$SEC_{el,historic} = \frac{EC_{el,historic,y}}{Q_{CF,historic,y}}$$

S.No	Notation	Parameter	Unit	Value	Comments
1	$FC_{historic,y}$	Actual fuel consumption in historic year y	Tonnes	8369.5	Historic data from TPL
2	$NCV_{historic,y}$	Net calorific value of fuel consumed in historic year y	MWh/Tonne of fuel	11.384	Historic data from TPL
3	$H_{historic,y}$	Heat added to the feed in the	MWh	241886.8	Historic data from TPL

		preheating system in historic year y			
4	$SEC_{th, historic}$ (1*2)/3	Historic specific energy consumption	MWh of fuel input /MWh of heat added to feed	0.4017	Methodology formula.
5	$EC_{el,historic,y}$	Electricity consumption of the compressor in historic year y	MWh	13823	Historic data from TPL
6	$Q_{CF,historic,y}$	Quantity of feed gas in historic year y	MT	682183	Historic data from TPL
7	$SEC_{el, historic}$ (5/6)	Historic specific energy consumption	MWh/MT	0.02026	Methodology formula.

B.6.3.4: Calculation of heat added to the feed in the preheating system (Qy):

As per formula defined in section B.6.1.1.a above,

$$H_y = \sum_y \left[\left[Q_{CF} * T_{out,CF} * C_{p,CF}\right] - \left[Q_F * T_{in,F} * C_{p,F}\right] - \left[Q_G * T_{in,G} * C_{p,G}\right]\right]$$

S.No	Notation	Parameter	Unit	Value	Comments
1	Q_{CF}	Quantity of combined feed outlet of the fired heater	Tonnes	881238.5	
2	$T_{out,CF}$	Temperature of combined feed outlet of the fired heater	ºC	483.6	
3	$C_{p,CF}$	Specific heat of combined feed outlet of the fired heater	MCal/T ºC	0.88	
4	Q_F	Quantity of liquid feed inlet to the preheating system	Tonnes	709560	
5	$T_{in,F}$	Temperature of feed inlet to the preheating system	ºC	213	
6	$C_{p,F}$	Specific heat of feed inlet to the	MCal/T ºC	0.6	

		preheating system			
7	Q_G	Quantity of recycle gas inlet to the preheating system		171678.5	
8	$T_{in,G}$	Temperature of recycle gas inlet to the preheating system		93	
9	$C_{p,G}$	Specific heat of recycle gas inlet to the preheating system		0.82	
10	(1*2*3)	Enthalpy of combined feed at outlet of fired heater		435656.2	
11	(4*5*6)	Enthalpy of feed at inlet to preheating system		105341.9	
12	(7*8*9)	Enthalpy of recycle gas at inlet to preheating system		15208.8	
13	Hy (10-11-12)	Heat added to the combined feed in preheating system		315105.5	

B.6.3.5: Calculation of heat added to the feed in the preheating system in historic period (Qhistoric,y):

As per formula defined in section B.6.1.1.a above,

$$H_y = \sum_y \left[\left[Q_{CF} * T_{out,CF} * C_{p,CF} \right] - \left[Q_F * T_{in,F} * C_{p,F} \right] - \left[Q_G * T_{in,G} * C_{p,G} \right] \right]$$

S.No	**Notation**	**Parameter**	**Unit**	**Value**	**Comments**
1	$Q_{CF,historic}$	Quantity of combined feed outlet of the fired heater in historic year	Tonnes	682183.6	

2	$T_{out,CF,historic}$	Temperature of combined feed outlet of the fired heater in historic year	ºC	483.6	
3	$C_{p,CF}$	Specific heat of combined feed outlet of the fired heater	MCal/T ºC	0.88	
4	$Q_{F,historic}$	Quantity of liquid feed inlet to the preheating system in historic year	Tonnes	583395.7	
5	$T_{in,F,historic}$	Temperature of feed inlet to the preheating system in historic year	ºC	213	
6	$C_{p,F}$	Specific heat of feed inlet to the preheating system	MCal/T ºC	0.6	
7	$Q_{G,historic}$	Quantity of recycle gas inlet to the preheating system in historic year		98787.84	
8	$T_{in,G,historic}$	Temperature of recycle gas inlet to the preheating system in historic year		93	
9	$C_{p,G}$	Specific heat of recycle gas inlet to the preheating system		0.82	
10	(1*2*3)	Enthalpy of combined feed at outlet of fired heater		337249.8	
11	(4*5*6)	Enthalpy of feed at inlet to preheating system		86611.5	
12	(7*8*9)	Enthalpy of recycle gas at inlet to preheating system		8751.5	
13	$H_{historic,y}$	Heat added to the		241886.8	

	(10-11-12)	combined feed in preheating system in historic year			

B.6.3.6: Calculation of project energy consumption (ECproject):

As per formula defined in section B.6.1 above,

$$EC_{th,project,y} = FC_y \times NCV_y$$

S.No	Notation	Parameter	Unit	Value	Comments
1	FCy	Fuel consumption in year y	Tonnes	7446	850 kg/hr
2	NCV_y	Net calorific value of fuel consumed in year y	MWh/Tonne of fuel	11.384	Based on historic average
3	$EC_{th, project,y}$ (1*2)	Project thermal energy consumption	MWh	86456.3	As per formula

Electrical energy consumption in the project scenario $EC_{el, project,y}$ is equal to the electricity consumption of the feed gas compressor and is measured directly through energy meters and recorded. Based on rated feed gas compressed quantity of 881238.5 Tonnes per year and compressor specific electricity consumption of 0.01376 MWh/MT in the project scenario, the estimated energy consumption of the compressor is = 881238.5 X 0.01376 = 12126.8 MWh per year.

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Operating Year	Estimation of Project Activity Emissions (tCO_2e)	Estimation of Baseline Emissions (tCO_2e)	Estimation of Leakage (tCO_2e)	Estimation of Overall Emission Reductions (tCO_2e)
2009-10	0	15,501	0	15,501
2010-11	0	15,501	0	15,501
2011-12	0	15,501	0	15,501
2012-13	0	15,501	0	15,501
2013-14	0	15,501	0	15,501
2014-15	0	15,501	0	15,501
2015-16	0	15,501	0	15,501
2016-17	0	15,501	0	15,501
2017-18	0	15,501	0	15,501
2018-19	0	15,501	0	15,501
Total (tCO_2e)	0	**155,010**	**0**	**155,010**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**$Q_{F,y}$**
Data unit:	Tonnes
Description:	Quantity of liquid feed inlet to the preheating system during the year y
Source of data to be used:	TPL log books / Daily/monthly reports
Value of data	709560
Description of measurement methods and procedures to be applied:	The feed quantity would be measured in meters of TPL
QA/QC procedures to be applied:	The meters used to monitor the feed quantity would be calibrated periodically
Any comment:	

Data / Parameter:	**$Q_{G,y}$**
Data unit:	Tonnes
Description:	Quantity of recycle gas inlet to the preheating system during the year y
Source of data to be used:	TPL log books / Daily/monthly reports
Value of data	171678.5
Description of measurement methods and procedures to be applied:	The gas quantity would be measured in meters of TPL

QA/QC procedures to be applied:	The meters used to monitor the gas quantity would be calibrated periodically
Any comment:	

Data / Parameter:	**$Q_{CF,y}$**
Data unit:	Tonnes
Description:	Quantity of combined feed outlet of the fired heater during the year y
Source of data to be used:	TPL log books / Daily/monthly reports
Value of data	881238.5
Description of measurement methods and procedures to be applied:	The combined feed quantity would be measured in meters of TPL
QA/QC procedures to be applied:	The meters used to monitor the combined feed quantity would be calibrated periodically
Any comment:	

Data / Parameter:	**$T_{in,F}$**
Data unit:	ºC
Description:	Temperature of feed inlet to the preheating system during the year y
Source of data to be used:	TPL log books / Daily/monthly reports
Value of data	213
Description of measurement methods and procedures to be applied:	The temperature would be measured in meters of TPL
QA/QC procedures to be applied:	The meters used to monitor the temperature would be calibrated periodically

Any comment:	

Data / Parameter:	$\mathbf{T_{in,G}}$
Data unit:	ºC
Description:	Temperature of recycle gas inlet to the preheating system during the year y
Source of data to be used:	TPL log books / Daily/monthly reports
Value of data	93
Description of measurement methods and procedures to be applied:	The temperature would be measured in meters of TPL
QA/QC procedures to be applied:	The meters used to monitor the temperature would be calibrated periodically
Any comment:	

Data / Parameter:	$\mathbf{T_{in,CF}}$
Data unit:	ºC
Description:	Temperature of combined feed outlet of the fired heater during the year y
Source of data to be used:	TPL log books / Daily/monthly reports
Value of data	483.6
Description of measurement methods and procedures to be applied:	The temperature would be measured in meters of TPL
QA/QC procedures to be applied:	The meters used to monitor the temperature would be calibrated periodically
Any comment:	

Data / Parameter:	**FCy**
Data unit:	Tonnes
Description:	Quantity of fuel consumed in the fired feed heater during the year y
Source of data to be used:	TPL log books / Daily/monthly reports
Value of data	7446
Description of measurement methods and procedures to be applied:	The fuel quantity would be measured in meters of TPL
QA/QC procedures to be applied:	The meters used to monitor the fuel quantity would be calibrated periodically
Any comment:	

Data / Parameter:	**NCVy**
Data unit:	MWh/Tonne of fuel
Description:	Net calorific value of fuel consumed during the year y
Source of data to be used:	Third party analysis
Value of data	11.84
Description of measurement methods and procedures to be applied:	The calorific value will be analysed by a third party agency on a quarterly frequency
QA/QC procedures to be applied:	-
Any comment:	

Data / Parameter:	$\mathbf{EC_{el,project,y}}$
Data unit:	MWh

Description:	Electricity consumed by the feed gas compressor during the year y
Source of data to be used:	Energy meters of TPL
Value of data	12126.8
Description of measurement methods and procedures to be applied:	Energy meters will measure the data continuously which would be recorded in log books on a daily basis
QA/QC procedures to be applied:	Periodic calibration of energy meter would be done
Any comment:	

B.7.2 Description of the monitoring plan:

>>

TPL will incorporate a special team for implementing the monitoring procedures as described in section B7.1. The team will comprise of relevant personnel from various departments, who will be assigned the task of monitoring and recording specific CDM parameters relevant to their department. The monitored values will be periodically cross-checked by the respective department heads and sent to the CDM team head for compilation and analysis. Any deviation of monitored values from estimated values will be investigated and appropriate action would be taken. The monitored values would be recorded and stored in paper and electronically for verification.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

Date of completion and application of baseline and monitoring methodology: 29/03/2008

Name of responsible person:

Mr.D.Senthi Kumar

Head (Support Services)

Tamil Nadu Petroproducts Limited

Manali Express Highway, Manali,

Tamil Nadu – 600 068, India.

Tel: +91 9840429605

Email: senthi@tnpetro.com

The entity is a project participant listed in Annex 1 to this document

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:

>>

29/09/2003

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

>>

20 years 0 months

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

C.2.1. Renewable crediting period

Not Applicable

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

>>

Not Applicable

C.2.1.2. Length of the first crediting period:

>>

Not Applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

01/07/2008 or upon registration of project activity with UNFCCC whichever is later

C.2.2.2. Length:

>>

10 years 0 months

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

As per the Environment Impact Assessment (EIA) Notification "S.O.60(E)"[4], dated 27/01/1994 and further amendment on 14th September 2006, this project activity does not fall under the purview of Environmental Impact Assessment notification of the Ministry of Environment and Forests -Government of India. Therefore, an analysis of the environmental impacts of the project activity is not required.

D.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:

>>

As described in the above section D.1, the EIA notification does not require an assessment of the environmental impacts of the project activity.

[4] Source: http://envfor.nic.in/legis/eia/so-60(e).html

SECTION E. Stakeholders' comments

>>

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

>>

The following are the stakeholders identified for the project activity:

1. Local residents / panchayat
2. NGOs
3. Employees
4. Neighbouring Industries
5. Consultants and equipment suppliers

Tamil Nadu Petroproducts Limited sent individual invitation letters to all the stakeholders through mal well in advance of the meeting indicating the date, time and venue of the stakeholder consultation process. The consultation process was conducted at TPL's Manali facility on 24.07.2007. TPL informed the stakeholders about the environmental and social impacts of the project activity followed by discussions with the stakeholders. TPL has obtained the written feedback from the stakeholders.

E.2. Summary of the comments received:

>>

Local governing body/residents: The local governing body has appreciated the efforts of TPL in implementing this project activity that would reduce fossil fuel combustion and its associated benefits. They have not raised any negative comments on the project activity.

Employees: The employees had expressed their support on understanding the various benefits of the project activity. They acknowledged that the project activity would not only result in savings of electricity but also reduce GHG emissions. There were no major comments/concerns raised by the employees.

NGOs: NGOs did not put forward any concerns against the project activity.

Neighbouring Industries: Representatives from the neighbouring industries had attended the stakeholder meeting. They appreciated TPL's effort in implementing the project activity.

To summarize, there were no negative concerns raised by any of the stakeholders regarding the project activity.

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

>>

There were no negative comments or concerns raised during the consultation with the local stakeholders. Further, as required by the CDM modalities and procedures, the PDD would be published at the DOE's web site for the global stakeholder comments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Tamil Nadu Petroproducts Limited
Street/P.O.Box:	Manali Express Highway, Manali
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URL:	www.tnpetro.com
Represented by:	
Title:	Mr
Salutation:	Head (Support Services)
Last Name:	D
Middle Name:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding as part of project financing from parties included, in Annex I of the convention is involved in the project activity.

Annex 3

BASELINE INFORMATION

Parameter	Unit	Value	Reference
CO_2 Emission Factor of Fuel oil	$kgCO_2/TJ$	75500	Refer Table 2.2 page 2.16 of IPCC Guidelines 2006
CO_2 Emission Factor of Fuel oil	$kgCO_2/MJ$	0.0755	(75500/1000000 = 0.0755). Conversion Factor 1 TJ = 1000000 MJ
CO_2 Emission Factor of Fuel oil	$kgCO_2/MWh$	271.8	(0.0755*3600). Conversion factor 3600 MJ = 1 MWh

Annex 4

MONITORING INFORMATION

Please refer section B.7.2 for details of the monitoring plan for the project activity

Annex 5

Abbreviations

CDM	Clean Development Mechanism
CO_2e	Carbon-di-Oxide equivalent
DOE	Designated Operational Entity
EB	Executive Board
EIA	Environmental Impact Assessment
GHG	Green House Gases
GWh	Giga Watt hour
H_2	Hydrogen
H_2O	Water
HAT	Hot end Approach Temperature
HCBN	Notation for the feed compound
IPCC	Intergovernmental Panel on Climate Change
kCal/h	kilo Calories per hour
kg/h	kilo gram per hour
km	kilo metres
LAB	Linear Alkyl Benzene
MCal	Mega Calories
MW	Mega Watt
MWh	Mega Watt hour
NGOs	Non-Governmental Organisations
O&M	Operation and Maintenance
ºC	degree Celsius
tCO_2	Tonnes Carbon-di-Oxide
TPL	Tamilnadu Petroproducts Limited