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SECTION A. General description of project activity

A.1 Title of the project activity:

Khon Kaen fuel ethanol project
Version 2
Completed 29/06/05

A.2. Description of the project activity:

The project is located in North Eastern Thailand and involves the production of anhydrous ethanol from sugar cane molasses. The bio-ethanol will be blended with gasoline and used in transportation. The proportion of bio-ethanol in the final blend is expected to be 10% by volume, and the bio-ethanol will act as an oxygenate and extender.

The project has a capacity of 85,000 litres of anhydrous ethanol per day and is expected to be commissioned in September 2005.

The project will contribute significantly to sustainable development not only through the production of a renewable fuel but also via a number of other mechanisms. It will reduce Thailand's dependence on imports of crude oil and thus have a positive effect on the trade balance and exchange rate. (In 2003 Thailand imported 45,025 million litres of crude oil.) There will also be a potential budgetary benefit to the Thai economy as it will reduce the potential liability inherent in the Oil Price Stabilisation Fund, which seeks to maintain a fixed price for petrol products in Thailand.

The plant will contribute to the development of the area in which it is located. The plant is located in Khon Kaen province in the North East of Thailand, an area that has not seen the same growth rates as central Thailand and the metropolitan areas. The location of the plant will therefore provide valuable direct employment to those in rural areas and provide a further indirect stimulus to economic activity in the area. It is expected that 60 new jobs will be created through the production of bio-ethanol.

The bio-ethanol plant will use existing molasses supplies as feedstock. This ensures that the project activity is unlikely to result in an increase in the area of sugar cane grown and hence potentially lead to deforestation.

A.3. Project participants:

Name of Party involved	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as a project participant
Thailand (host)	Private entity: Khon Kaen Alcohol Company Limited Public entity: Ministry of Natural Resources and Environment	No
Denmark	Public entity: Royal Danish Ministry of Foreign Affairs	Yes
United Kingdom	Private entity: Agrinergy Ltd. Public entity: Department of Environment, Food and Rural Affairs	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Thailand

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

Khon Kaen Province, 40140

A.4.1.3. City/Town/Community etc:

Nampong

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

43 Moo 10, Nampong-Kranuan Road
The plant is located at grid reference, 16°72'79.0"N, 102°84'58.8"E

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

Transport

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

There are two stages to the production of bio-ethanol, the fermentation of sugars to ethanol and then the further dehydration of ethanol to a quality suitable as a fuel substitute. The technology involved in the first stage of the process is readily available and well known. However the dehydration technology is more specialised involving the use of molecular sieves. In the case of the project activity the dehydration

technology utilised will be EcoMol Molecular Sieve Technology, which will be installed under licence from Delta T Corporation, USA Praj.

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

The reduction in anthropogenic emissions of GHGs will occur through the substitution of gasoline and MTBE with bio-ethanol, a renewable fuel. The total emission reductions arising from the project activity are estimated at 46,000 tonnes of CO_2e per annum.

There has been a drive in Thailand to employ more domestic natural resources and reduce dependence on imported oil. To this end, the government has embarked on a programme to foster the development of an anhydrous ethanol sector. There is currently a tax break for the blender of gasohol whereby the excise tax payable on the ethanol component of the marketed fuel is forgone and there is also an exemption of excise tax on all ex-refinery anhydrous ethanol. Ethanol blended with gasoline neither contributes to the Oil Fund nor the Energy Conservation Fund. It is estimated that the demand for ethanol in a 10% gasohol blend will be over two million litres per day. To satisfy this demand the Thai government introduced a round of bids for licences in 2002 and again in 2004. In 2002 seven licences for the manufacture and production of anhydrous ethanol were given, the project under consideration receiving one of these licences. However actual commissioning of investments has been extremely slow due to the barriers facing investment in ethanol production facilities. To date only two of the licence holders have commissioned plants – one is a relatively small plant (operating at 25,000 litres per day), whilst the second investment was made by the largest hydrous ethanol producer in Thailand (and is therefore likely to be of a different scale and nature involving only the investment in dehydration).

In the absence of the project activity, because of the production constrained system (lack of supply) the volume of ethanol would not be produced and therefore gasoline and MTBE would be combusted. That the project is not the baseline is demonstrated by the number of barriers facing the project activity - in the absence of the CDM the project would not be undertaken.

The production and use of bio-ethanol in transportation will result in a reduction in GHG emissions, with the volume of emission reductions calculated on a lifecycle basis.

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

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
Year 1	45,719
Year 2	45,719
Year 3	45,719
Year 4	45,719
Year 5	45,719
Year 6	45,719
Year 7	45,719
Year 8	45,719
Year 9	45,719
Year 10	45,719
Total estimated reductions	**457,190**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**45,719**

A.4.5. Public funding of the project activity:

The project has received no public funding.

SECTION B. Application of a baseline methodology

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

To date, no suitable methodology for the proposed project activity has been approved, and therefore a new methodology is proposed. The proposed title of the new methodology is: **Baseline methodology for production of sugar cane based anhydrous bio-ethanol for transportation using LCA**.

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

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The methodology is directly relevant to the project activity – the project activity is an investment in sugar cane based bio-ethanol fuel production facilities. In terms of the specific applicability criteria:

1. The relevant national bio-ethanol fuel market is production constrained, and therefore the factor prohibiting the use of bio-ethanol fuel is lack of supply.

As outlined in section A.4 the Thai government has provided incentives for the blending of bio-ethanol in gasoline, and issued seven ethanol production licences in 2002. However only two of these facilities have been commissioned, accounting for total capacity of 125,000 litres per day, and the smaller of these plants we believe is not currently operating. In terms of the 75% rule outlined in the methodology, this is nowhere near being reached despite Thailand being the world's third largest

sugar cane producing country. The following table shows the most recent data for consumption of fuels in Thailand. The table also shows the potential demand for bio-ethanol given the permitted 10% blending ratio for premium gasoline based on the historic figures outlined in the table (there is also the ability to blend bio-ethanol in regular gasoline but demand originating from this source has not been included).

Table 1: Sales of fuel, million litres

Type of fuel	2001	2002	2003	2004 (until June)
Gasoline	6,857.1	7,326.0	7,635.1	3,964.3
Regular	3,856.0	4,341.4	4,550.3	2,347.5
Premium	3,001.0	2,984.7	3,084.8	1,616.8
Potential bio-ethanol demand	300.1	298.5	308.5	161.7

Source: www.eppo.go.th/info/T31.html

2. There does not exist an effectively enforced mandate on the use of bio-ethanol in transportation in the relevant national market.

The Thai government has provided tax incentives for the blending of bio-ethanol, but no mandate on its use exists in Thailand. There is talk of a ban on MTBE, although this has not been implemented, and would not act to mandate ethanol as there are also other fossil fuel based octane enhancers available.

3. It can be readily verified that the bio-ethanol will be used as a transportation fuel within the relevant national market.

The anhydrous bio-ethanol produced by the facility will be sold to PTT, the largest retailer of gasoline in Thailand. It will be used by PTT for blending with gasoline for final sale as a transport fuel. This can be verified through sale and delivery receipts and also written confirmation from PTT that the bio-ethanol was blended and sold as a transport fuel.

4. The anhydrous bio-ethanol will be blended with gasoline at a maximum level of 20%. (This ensures that use of the subsequent bio-ethanol/gasoline mix (gasohol) does not require vehicle modifications, and hence will assist in baseline determination.)

The anhydrous bio-ethanol produced by the facility will be blended at the level of 10% bio-ethanol and 90% gasoline as per the specification for gasohol in Thailand.

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

Having determined that the methodology is applicable, we must outline the baseline scenario. The project activity consists of the installation of a bio-ethanol fuel production facility and the subsequent production and sale of bio-ethanol for transportation. Baseline determination consists of two elements. The first element is the baseline at the site that will produce the bio-ethanol. Options considered consist of no investment, investment in other transport fuel capacity and the project activity not carried out as a CDM project activity. Where investment in other transport fuel capacity is found to be a feasible alternative, the methodology does not apply. The methodology then uses the additionality tool developed by the EB to evaluate whether investment in anhydrous bio-ethanol production capacity at the project site is a plausible baseline scenario.

The second element of the baseline is the baseline fuel that will be displaced by the anhydrous bio-ethanol produced by the project activity. Alternative fuels in the Thai market consist of LPG, NGV and bio diesel. All of these require conversion to utilise gasohol. The retail price of gasohol is marginally below that of gasoline (gasohol is sold at 93% of the cost of gasoline). The conversion cost for LPG is Baht 30,000 and that for NGV is Baht 60,000. Give the low production and availability of gasohol, conversion costs and the modest gasohol discount to the gasoline price, the project activity is extremely unlikely to result in a fuel switch from LPG, NGV or bio diesel to gasohol. Therefore bio-ethanol production from the project activity is unlikely to lead motorists to switch from other alternative fuels to gasohol, and therefore the baseline fuel is selected as gasoline[1]. In Thailand, to entice motorists to purchase gasohol, it is priced at the pump marginally below gasoline. Therefore if the CDM stimulates productions and allows production constraints to be overcome, gasoline will start to be replaced by gasohol in transportation.

As outlined in the methodology, both project and baseline fuel emissions are calculated on a lifecycle basis. In terms of baseline emissions, PTT Research and Technology Institute have conducted tests on direct emissions from fuels. Under these tests an average gasoline emission coefficient of 2298.97 gCO_2/l is derived[2], for Tank-to Wheel (TTW). Inherent in this calculation of emissions was a fuel efficiency figure that assumed 13.46 km/l, however the figure for fuel efficiency in the methodology is 12.26 km/l, a more conservative figure and therefore no amendment to the baseline methodology figure is required with respect to fuel efficiency. The overall PTT emissions figure is comparable to the TTW emissions data for gasoline of 2269.93 gCO_2e/l outlined in the methodology using the LBST data, highlighting the conservativeness of using the LBST as a data source[3]. The methodology states that if local data are more conservative they should be adopted, but in this case the data in the methodology is the most conservative and we therefore apply a baseline well to wheel (WTW) gasoline lifecycle GHG emission factor of 2689.11 gCO_2e/l (EFP) to the project activity.

Project emissions are calculated ex-post each year as part of the monitoring plan.

We are required to derive a figure for Q, the relative fuel efficiency of anhydrous bio-ethanol with respect to gasoline. PTT have carried out tests on the fuel efficiency of gasohol and gasoline. The average fuel efficiency of gasoline in the tests is 13.36 km/l whilst that for gasohol is 13.31 km/l (with a 10% bio-ethanol blend). We use the following formulae to derive a figure for Q:

$$Q = \frac{FEP - FEG \bullet X}{FEG - FEG \bullet X}$$

Where:

Q = Relative fuel efficiency coefficient of anhydrous bio-ethanol
FEG = Fuel efficiency of gasohol (l/km)
FEP = Fuel efficiency of gasoline (l/km)
X = Blend of gasoline in gasohol (0.8>X<1)

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[1] The project activity may also result in some displacement of MTBE. MTBE has higher LCA emissions than gasoline and therefore taking gasoline as the baseline fuel is conservative.

[2] http://www.pttplc.com/servlet/ipscustDesktop?pageid=10&page=product&right=product_fuel_gasohol_06.html
This is calculated from the average emissions of carbon dioxide and average fuel efficiency of the sample taken by PTT.

[3] The figures derived are also more conservative than the TTW IPCC figure for gasoline emissions of 3172.31gCO_2e/kg, which at a specific density of 0.75 kg/l gives an emissions factor of 2379 gCO_2e/l.

Using the above formulae, we arrive at a figure for Q of **0.89**. Therefore 1 litre of anhydrous bio-ethanol will displace 0.89 litres of gasoline. (This is conservative. Many studies show that the lower calorific value of ethanol is compensated with a higher combustion efficiency, leaving no net effect on fuel economy).

Turning to transport emissions, the contract with PTT has not as yet been finalised. There is some uncertainty as to whether the bio-ethanol would have to be delivered to Saraburi, near Bangkok, for blending or whether it would be possible to blend the bio-ethanol in Khon Kaen. Under the latter case it is unlikely that there will be a requirement to calculate transport emissions but a final decision on whether transport emissions should be incorporated into the calculation of emission reductions for the project activity will be taken at a later date.

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

We have demonstrated that the anhydrous bio-ethanol market in Thailand is production constrained and that the increase in anhydrous bio-ethanol production resulting from the project activity will not lead to a fuel switch from other alternative fuels to gasohol but will instead lead to displacement of gasoline. Investment in capacity for another alternative fuel is not an option as the project activity is undertaken by a sugar mill. We must also demonstrate that for the Khon Kaen Alcohol Company and the KSL Group, investment in capacity for other alternative fuels is not a feasible option - The Khon Kaen Alcohol Company Limited is part of the KSL group which owns the Khon Kaen Sugar Company. The KSL group has neither the expertise nor access to raw materials to invest in LPG, NGV or bio diesel production capacity and therefore investment in capacity for another alternative fuel is not an option.

If the project activity investment in anhydrous bio-ethanol production capacity is demonstrated not to be part of the baseline, the project activity will directly result in gasoline being displaced with anhydrous bio-ethanol in transport and hence in a reduction in GHG emissions. We use the additionality tool developed by the EB to show that the project activity is not part of the baseline:

Step 0. Preliminary screening of projects started after 1 January 2000 and prior to 31 December 2005.

The project activity was submitted to a CDM purchase tender in March 2004 whilst the plant is expected to be commissioned in July 2005. The formal submissions to the CDM purchase tender will be made available to the validator.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulation.

Sub-step 1a

Define alternatives to the project activity. Investment in capacity for other alternative fuels has been ruled out, and the alternatives to the project activity can therefore be restricted to:

- The proposed project not undertaken as a CDM project activity
- Continuation of the current situation (no project activity undertaken)

Sub-step 1b

Compliance with applicable laws and regulations. The above alternatives are both in compliance with applicable legal and regulatory requirements. Moreover, there is no foreseeable regulatory change that would make the above alternatives non-compliant.

Step 2. Investment Analysis.

Sub-step 2a

As the project activity generates revenues other than those related to the CDM and the proposed project and plausible baseline alternatives do not involve investments of comparable scale, Option III (benchmark analysis) is undertaken.

Sub-step 2b – Option III

The selected benchmark used is the IRR. Both equity and project IRRs are calculated. The benchmark hurdle that the project IRR must overcome is the weighted average cost of capital (WACC). This is a standard benchmark used in investment appraisal and reflects the costs of resources to the company. For a project to be worthwhile, its return must exceed the company's WACC. The WACC is derived from the cost of debt adjusted for tax relief on interest payments, the cost of equity and the shares of debt and equity in the total company market valuation. The benchmark hurdle for the equity IRR is the cost of equity.

Comparing the project IRR to the WACC is a standard capital decision making tool. A large diversified company will tend to decide on a specific ratio of equity to debt and thus the total cost of capital is the relevant hurdle rate. An increase in the amount of debt a company has will increase the return on equity required by investors in the company (due to increased company risk), leaving the WACC the same. Thus it is the firms total cost of capital that is the relevant hurdle, not the immediate source of funds used for an individual investment.

The cost of debt and relative share of debt and equity in the company's valuation are relatively easy to establish. In emerging markets, estimating the cost of equity can be difficult. The standard approach to this is the capital asset pricing model (CAPM), which estimates the premium over the risk free interest rate required by investors. Looking at Thai stock market returns and government bond yields for the period 1999-2003[4], and taking a conservative estimate of 0.7 for beta, gives a cost of equity of 30%. This figure however may be artificially high, reflecting recent stock market volatility. Two independent studies have therefore been used to estimate a cost of equity for Thailand. One study has restricted access, but will be supplied to the validator, whilst the second is publicly available[5] and gives a cost of equity for Thailand of 20.64%. To maintain conservatism, we have taken the lower cost of equity figure of 14.1%. This figure is felt by the management of KSL to be a lower bound reflection of the return expected by equity investors given the risks inherent in investing in Thailand.

Sub-step 2c

Taking a cost of equity of 14.1%, a cost of debt of 5.5% which is the current 18 year government bond yield in Thailand, an equity/debt valuation split of 0.58:0.42 and a corporate income tax rate of 30%, we arrive at a WACC of 9.8%. The project IRR before CDM revenue is 4.6%, well below the WACC, and the equity IRR before CDM is 9.6%, demonstrating that the project is not financially attractive and is not

[4] Government bond data are available at: http://www.thaibdc.or.th/yieldcurve/YieldTTM.aspx

[5] The Cost of Equity in Emerging Markets: A Downside Risk Approach. JAVIER ESTRADA, IESE business school, Barcelona.

part of the baseline scenario. The key assumptions underlying this analysis will be outlined in the final completed PDD.

Sub-step 2d
Sensitivity analysis mainly revolves around the price of the substrate for the production of bio-ethanol (the price of the substrate accounts for 70% of the final price of the product). In terms of sensitivity analysis we have adjusted the price of the substrate and the price of ethanol in the following table to yield a set of project IRRs. Whilst this does show a potential set of outcomes one would expect the price of bio-ethanol and the price of the substrate to tend to move in line maintaining the current level of margin.

Table 1: Price of substrate and impact on project IRR

IRR		Price of ethanol, Baht/l				
		11.5	12.0	12.5	13.0	13.5
Price of substrate, Baht/mt	1500	5.31%	8.52%	11.53%	14.39%	17.13%
	1600	2.17%	5.60%	8.80%	11.80%	14.65%
	1700	-1.27%	2.49%	5.91%	9.08%	12.06%
	1800	-5.14%	-0.91%	2.82%	6.21%	9.36%
	1900	-9.70%	-4.73%	-0.56%	3.14%	6.50%

Step 4. Common practice.
As mentioned above, only two bio-ethanol facilities have been commissioned to date in Thailand with a total capacity of 125,000 litres/day. The larger of these facilities, representing 100,000 litres/day, is operated by the largest hydrous ethanol manufacturer in Thailand and therefore the investment has been limited to dehydration technology.

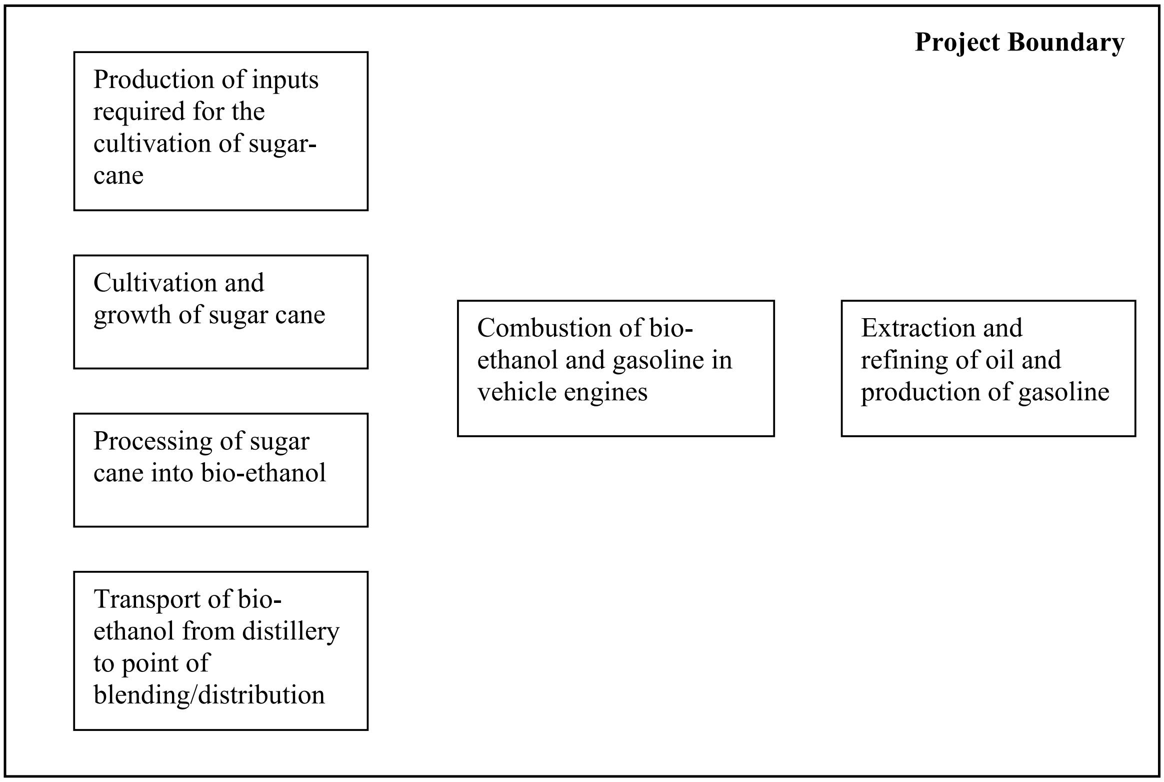
Step 5. Impact of CDM registration.
CDM registration and the resulting revenue from CER sales helps the project to overcome the investment barrier outlined above. The impact of CER revenue improves the project IRR by 5% and increases the equity IRR by 11% (both of which are significant impacts in their own right) and moreover, the inclusion of CDM revenue lifts the project IRR above the WACC. The financial risks outlined in the sensitivity analysis are also significant but through the inclusion of CER revenue there is an important buffer added in case of rises in substrate prices or falls in bio-ethanol prices.

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

The methodology used follows a lifecycle approach, and therefore the project boundary encapsulates all emissions related to the production and combustion of both bio-ethanol and gasoline. The boundary seeks to incorporate emissions from carbon dioxide through the combustion of gasoline and also nitrous oxide and methane in the production and cultivation of sugar cane. Whilst methane emissions may be slightly lower for bio-ethanol in comparison to gasoline when combusted in engines this difference is small and for the sake of conservatism we have not included these in the overall calculation of emission reductions.

The project boundary extends to include the cover the final use of the anhydrous bio-ethanol in transportation. The DNA is to be made aware of this fact and will therefore not approve project activities

that conflict with this boundary and could result in double counting of emission reductions. Monitoring of CDM project activities registered in Thailand is included in the monitoring plan and as outlined in the baseline methodology, written confirmation will be provided by the Thai DNA that no other projects will be approved that use the bio-ethanol that is produced by the project activity.



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

August 2004
Ben Atkinson/Robert Taylor, Agrinergy Ltd, as listed in Annex I.

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:

September 2005

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

20 years

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

Fixed.

C.2.1. Renewable crediting period

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

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

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

01/09/2005

C.2.2.2. Length:

10 years

SECTION D. Application of a monitoring methodology and plan

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

A new methodology has been proposed for the project activity. The title of the methodology is **Monitoring methodology and Life Cycle Assessment (LCA) for the production of sugar cane based anhydrous bio-ethanol for transportation use.**

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

Without an appropriate existing methodology a new methodology has been proposed. The monitoring methodology is directly related to the baseline methodology used for the project activity.

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

D.2.1.1. Data to be collected 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
1	Raw sugar recovery rate from cane	*Factory data*	*%*	*M*	*Annual*	*100%*	*electronic*	
2	Molasses recovery rate from cane	*Factory data*	*%*	*M*	*Annual*	*100%*	*electronic*	
3	Total reducing sugars content of molasses	*Factory data*	*%*	*M*	*Annual*	*100%*	*electronic*	
4	Total reducing sugars content of raw sugar	*Factory data*	*%*	*M*	*Annual*	*100%*	*electronic*	
5	Tonnes of molasses required to make 1 kilolitre of bio-ethanol	*Factory data*	*t/kl*	*M*	*Annual*	*100%*		
6	Molasses yield from tonne of sugar cane	*Factory data*	*Kg/t*	*M*	*Annual*	*100%*	*electronic*	
7	Sugar cane yield per	*Factory data*	*t/ha*	*M*	*Annual*	*100%*	*electronic*	

	hectare							
8	Recommended fertiliser application for cane farmers supplying bio-ethanol factory	*Extension service*	*l/ha*	*M*	*Annual*	*100%*	*electronic*	
9	Average diesel consumption in tractors from agricultural operations for cane farmers supplying bio-ethanol factory	*Extension service*	*l/ha*	*M*	*Annual*	*100%*	*electronic*	
10	Percentage of sugar cane land where trash is burned before harvest	*Extension service*	*%*	*E*	*Annual*	*100%*	*electronic*	
11	Fossil fuel combusted on site to supply non-electrical energy to the bio-ethanol factory	*Factory data*		*M*	*Annual*	*100%*	*electronic*	*Qualitative Variable*
12	Emissions factor for fossil fuel combusted	*Factory data*	tCO_2e/t	*C*	*Annual*	*100%*	*electronic*	
13	Electricity utilised by bio-ethanol factory	*Factory data*		*M*	*Annual*	*100%*	*electronic*	

14	Shares of electricity supplied by grid and captive	*Factory data*	*%*	*M*	*Annual*	*100%*	*electronic*	
15	Source of captive power	*Factory data*		*M*	*Annual*	*100%*	*electronic*	
16	Emissions factor for captive power source	*Factory data*	*tCO_2e/MWh*	*C*	*Annual*	*100%*	*electronic*	
17	Grid combined margin emissions factor	*Factory data*	*tCO_2e/MWh*	*C*	*Annual*	*100%*	*electronic*	
18	Average distance travelled by trucks transporting cane from fields to sugar factory	*Extension service*	*Km*	*E*	*Annual*	*100%*	*Electronic*	
19	Share of cane transported by truck to factory	*Extension service*	*%*	*E*	*Annual*	*100%*	*Electronic*	
20	Average truck capacity	*Extension service*	*%*	*E*	*Annual*	*100%*	*Electronic*	
21	Truck Fuel efficiency	*Manufacturer's data*	*km/l*	*M*	*Annual*	*100%*	*Electronic*	*This will be taken from vehicle records.*
22	Truck fuel carbon emission factor	*IPCC*	*CO_2/l*	*M*	*Annual*	*100%*	*Electronic*	
23	Average return	*Proprietary*	*Km*	*E*	*Annual*	*100%*	*Electronic*	*Distance is measured if the*

	distance travelled from bio-ethanol factory to place of blending	*data*							*contract is for delivered bio-ethanol by the project activity and will be estimated if the project activity has a factory gate contract.*
24	Bio-ethanol transporter capacity								
25	Bio-ethanol transporter fuel efficiency	*Manufacturer's data*	*km/l*	*M*	*Annual*	*100%*	*Electronic*		*This will be taken from vehicle records.*
26	Transporter fuel carbon emission factor	*IPCC*	*CO_2/l*	*M*	*Annual*	*100%*	*Electronic*		
27	TEC_y Operator	*Determined from evaluation of gasoline supply at blending/ distribution points*	*0/1*	*C*	*Annual*	*100%*	*Electronic*		*If value is set to 1 then transport emissions are calculated, if it is set to zero then transport emissions do not apply.*
28	AH_y Volume of anhydrous bio-ethanol produced and used in transportation	*Factory and purchaser records*	*l*	*M*	*Annual*	*100%*	*Electronic*		*The verifier must obtain confirmation from the buyer that the volume of fuel has been used in transportation*

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

GHG emissions associated with the production of a tonne of sugar cane are calculated as follows:

1. Diesel consumption during agricultural operations:

$$PEDy = EFD \bullet \frac{ACDy}{Yy}$$

Where:

PEDy = Project emissions from diesel consumption in agricultural operations ($kgCO_2e$/tonne cane)
EFD = Emissions factor for diesel ($kgCO_2e$/kilolitre)
ACD_y = Average diesel consumption per hectare on agricultural land supplying project activity (kilolitre/ha)
Y_y = Average yield on land agricultural supplying project activity (tonnes cane per hectare)

2a. Emissions from the production of synthetic fertiliser used

$$PEFy = EFP \bullet \frac{ACFy}{Yy}$$

Where:

PEFy = Emissions from production of fertiliser used ($kgCO_2e$/tonne cane)
EFP = Fertiliser production emissions coefficient ($kgCO_2e$/kg fertiliser)
ACFy = Recommended fertiliser application rate (kg/ha)
Y_y = Average yield on land agricultural supplying project activity (tonnes cane per hectare)

2b. Soil N_2O emissions from organic and synthetic fertiliser use.

$$N2Odirect - N = (FSN + FAM) \bullet EF1$$

Where

N_2O_{Direct} -N = Emissions of N_2O in units of Nitrogen
F_{SN} = Annual amount of synthetic fertiliser nitrogen applied per hectare adjusted for the amount that volatilises as NH_3 and NOx
F_{AM} = Annual amount of animal manure nitrogen intentionally applied per hectare adjusted to account for the amount that volatilises as NH3 and NOx
EF_1 = Emission factor for emissions from N inputs (kg N2O-N/kg N input)

Conversion of N_2O-N emissions to N2O emissions per tonne of cane is performed by using the following equation:

$$N2Ofert = \frac{N2Odirect - N \bullet 44/28}{Yy} \bullet 310 \quad \text{or} \quad \frac{N2Odirect - N \bullet 487}{Yy}$$

Where
N2Ofert = Direct N_2O emissions from Nitrogen fertilizer use (kgCO_2e/tonne cane)
N2Odirect –N = Emissions of N_2O in units of Nitrogen
Yy = Average yield on agricultural land supplying the project activity (tonnes cane per hectare)

3. *Emissions associated with the field burning of crop residues*

Carbon released/tonne cane = 0.14 • percentage of cane trash burned in field • fraction oxidised • carbon fraction (0.45)

CH_4 and N_2O emissions per tonne of cane are then calculated (in CO_2e) as:

$$CH4trash = Carbon\_released / tonne\_cane \bullet 0.005 \bullet \frac{16}{12}$$

$$N2Otrash = Carbon\_released / tonne\_cane \bullet 0.015 \bullet 0.007 \bullet \frac{16}{12}$$

And

$$ETBy = CH4trash \bullet 23 + N2Otrash \bullet 310$$

Where
ETBy = Emissions from the field burning of crop residues (kgCO_2e/tonne cane)

and 23 and 310 are the GWP for CH_4 and N_2O respectively

4. Emissions associated with the transport of cane to the sugar/bio-ethanol factory

$$TEF_y = \frac{Dy \bullet CEFi \bullet \beta}{FE \bullet TC}$$

Where:

TEF_y = Emissions from the transportation of sugar cane from the field to the bio-ethanol factory (kgCO_2e per tonne cane)
D_y = Average return distance from field to factory (km)
FE = Fuel efficiency of transporter (km/l)
CEF_t = CO_2 emissions factor (kgCO_2/l)
ß = percentage of cane transported to factory by truck
TC = Truck capacity, tonnes

Total "Field" emissions on a kgCO_2e per tonne cane are thus:

$$EFFy = PEDy + PEFy + N2Ofert, y + ETBy + TEFy$$

Where:

EFFy = Emissions from "Field" operations (kgCO_2e per tonne cane)
PEDy = Project emissions from diesel consumption in agricultural operations (kgCO_2e/tonne cane)
PEFy = Emissions from production of fertiliser used (kgCO_2e/tonne cane)
N2Ofert,y = Direct N_2O emissions from Nitrogen fertilizer use (kgCO_2e/tonne cane)
ETBy = Emissions from the field burning of crop residues (kgCO_2e/tonne cane)
TEF_y = Emissions from the transportation of sugar cane from the field to the bio-ethanol factory (kgCO_2e per tonne cane)

As part of the calculation of total project emissions, the above emissions factor must be converted from a kgCO_2e per tonne cane basis to a kgCO_2e per kilolitre anhydrous bio-ethanol basis:

$$EFMy = \frac{M.SM}{M.SM + S.SS} \bullet \frac{1}{M} \bullet EFFy$$

Where:

EFM,y = Emissions from "Field" operations (kgCO_2e per tonne molasses)
M = Molasses recovery rate from cane (%)
S = Raw sugar recovery rate from cane (%)
SM = Total reducing sugars (TRS) content of molasses
SS = Total reducing sugars (TRS) content of raw sugar
EFFy = Emissions from "Field" operations (kgCO_2e per tonne cane)

And:

$$EFAmol, y = MC \bullet EFMy$$

Where:

EFAmol,y = Total "Field" emissions factor where bio-ethanol feedstock is sugar cane molasses (kgCO_2e/kl)
MC = Sugar cane molasses to anhydrous bio-ethanol conversion factor (t/kl)
EFM,y = Emissions from "Field" operations (kgCO_2e per tonne molasses)

5. Emissions from the industrial production of bio-ethanol

$$PPEy = FFy \bullet CEFF + GMy \bullet CEFG + CPy \bullet CEFC$$

Where:

PPEy = Total emissions from the industrial production process of bio-ethanol (kgCO_2e)
FFy = Fossil fuel combusted to provide non-electrical energy to the bio-ethanol factory (tonnes)
CEFF = Emission factor for fossil fuel (kgCO_2e/tonne)
GMy = Imports from the grid to the bio-ethanol factory (kWh)
CEFG = Combined margin grid emission factor (kgCO_2e/kWh)
CPy = Captive electrical energy generation for the bio-ethanol factory (kWh)
CEFC = Captive generation emission factor (kgCO_2e/kWh)

6. Emissions associated with the transport of bio-ethanol to the place of blending/distribution

The methodology states that these emissions are to be added to the project lifecycle emissions only if the current distribution of the displaced gasoline does not involve similar transport of fuel to a blend/distribution location. Transport emissions are calculated from the volume of bio-ethanol transported and the

fuel efficiency and appropriate CO_2 emissions factor of the transport vehicle. (The CO_2 emissions factor is taken from the IPCC again adding to the conservatism of the methodology.) As these transport emissions are only be included if the current distribution of gasoline does not involves the transport of fuel to a blend/distribution location, the variable TEC_y is set to 1 if the calculation is required under this test and 0 if their calculation is not required, the calculation of transport emissions are carried out through the following equation:

$$TE_y = \frac{D_y}{FE}.CEF_t.TEC_y$$

Where:

TE_y = Additional emissions from the transportation of bio-ethanol to the blend/distribution location, tCO_2e
D_y = Distance travelled by transporters in year y, km
FE = Fuel efficiency of transporter, km/l
CEF_t = CO_2 emissions factor, tCO_2/l
TEC_y = whether the calculation of transport emissions required (value = 0 or 1)

Total Project Emissions

Total project emissions are calculated as:

$$PEy = AHy \bullet EFAmol, y + PPEy + TEy$$

Where:

PEy = Project emissions, tCO_2e
AHy = Volume of anhydrous bio-ethanol produced and used in transportation, kl
EFAmol,y = Emissions from agricultural operations , tCO_2e/kl
PPEy = Emissions from the industrial production of bio-ethano, tCO_2e
TEy = Additional emissions from the transportation of bio-ethanol to the blend/distribution location, tCO_2e

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
29	*AH_y*	*Factory and PTT records*	*l*	*M*	*Annually*	*100%*	*Electronic*	*Written confirmation will be provided by PTT of the volume of anhydrous bio-ethanol that has been blended with gasoline.*
30	*Q*	*PTT Data*	*N/A*	*Constant*	*N/A*	*100%*	*Electronic*	
31	*EFP Carbon emission factor*	*LBST study*	*tCO_2e/l*	*Constant*	*N/A*	*100%*	*Electronic*	
32	*M Share of national gasoline consumption imported*	*National /International Statistics*	*%*	*C*	*Annual*	*100%*	*Electronic*	

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

$$BE_y = AH_y \bullet Q \bullet EFP$$

Where:

BE_y = Baseline emissions, tCO_2e

AH_y = Volume of anhydrous bio-ethanol produced by the project activity and used in transportation, l

Q = Relative fuel efficiency of anhydrous bio-ethanol compared to gasoline ($0<Q<1$)

EFP = Gasoline lifecycle emissions coefficient, tCO_2e/l

As discussed in the baseline methodology, the baseline emissions factor must be adjusted to take account of the share of national gasoline supply provided for by imports. Thus:

$$EFP = M.TTW + (1 - M) \bullet WTW$$

Where:

M = Share of total gasoline supply provided for by imports (%)
TTW = Tank-to-Wheel baseline coefficient
WTW – Well-to-Wheel baseline coefficient

And as outlined in the baseline methodology, Q is calculates as:

$$Q = \frac{FEP - FEG \bullet X}{FEG - FEG \bullet X}$$

Where:

Q = Relative volumetric fuel efficiency coefficient of anhydrous bio-ethanol
FEG = Fuel efficiency of gasohol (l/km)
FEP = Fuel efficiency of gasoline (l/km)
X = Blend of gasoline in gasohol (0.8>X<1)

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

This section has been left blank as we have chosen option 1.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

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

D.2.3. Treatment of leakage in the monitoring plan

Given the wide project boundary, coverage of emissions associated with transportation of bio-diesel and the LCA approach to emissions taken, leakage analysis is focused on land use changes. As outlined in the attached baseline methodology an evaluation must be made of whether the project activity has led to an increase in the area of sugar cane and whether deforestation has occurred in the host country. In the case that both these has occurred, the conservative assumption is that the increase in sugar cane area resulting from the project activity has led to an equivalent area of deforestation and leakage must be calculated as outlined in the attached NMB. However we do not envisage that the project activity will lead to an increase in the area of sugar cane as existing molasses supplies will be utilised. Nonetheless, monitoring of the cane area and factors driving it, and data on deforestation, is included as part of the monitoring plan.

As part of the monitoring process all CDM project activities registered in the host country are to be recorded to ensure that none conflict with the project boundary for the project activity. This will ensure no double counting of emissions reductions occurs.

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

	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
33	*Data on deforestation in last 5 years*	*National/ International Statistics*	*n/a*	*m,e*	*Annual*	*100%*	*Electronic*	
34	*Increase in cane area resulting from project activity.*	*Company/Extension Service/National statistics. Evaluation of cropping patterns and revenues.*	*Qualitative and Quantitative*	*m,e*	*Annual*	*100%*	*Electronic*	
35	*Thai CDM Projects registered*	*CDM EB*	*Qualitative*	*m*	*Annual*	*100%*	*Electronic*	

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

As outlined in the methodology, project proponents must first establish whether deforestation has occurred in the project host country. This may well not be possible to determine at the time of annual verification due to a lack of data. Should up-to-date data be available and these show no deforestation in the host country has occurred, then leakage can be excluded. Where data are not available or where deforestation has occurred, an evaluation is to be made of whether the area of sugar cane supplying the project activity facility has increased as a result of the project activity. Should the cane area be found to have increased as a result of the project activity, the conservative assumption is that an equivalent area of land will be deforested. Leakage emissions from this deforestation are calculated and deducted from CERs. The project activity is not to receive any CERs until cumulative emission reductions exceed cumulative leakage.

Where bio-ethanol is produced from sugar cane molasses, any increase, as a result of the project activity, in the cane area supplying the sugar factory(ies) which provide molasses to the project activity, must be apportioned between sugar and molasses. This apportionment is to be carried out on the basis of sucrose content, in the same way as with project emissions from agricultural operations in the production of a tonne of sugar cane.

In the case that land-use leakage cannot be ruled out, it should be calculated as per as per IPCC good practice guidelines. The cane area increase that is attributable to the project activity is multiplied by the biomass dry matter stock of forest before conversion (available in Annex 3A.1 of the GPG-LULUCF, 2003). This should be multiplied by 0.5 to obtain the carbon stock and by 44/12 to arrive at CO_2e.

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

$$CER_y = BE_y - PE_y - LE_y$$

Where:

BE_y = Baseline emissions, tCO_2e
PE_y = Project emissions, tCO_2e
LE_y = Leakage, tCO_2e

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1-10	*Low/Med*	*Factory and extension service data. These figures will be crossed checked with farmers and with national norms to ensure consistency.*
11	*Low*	*Fuel purchase records will form basis of QA/QC*
12	*Low*	*IPCC data*
13-17	*Low*	*Standard data. No QA/QC required.*
18-26	*Low*	*Figures can be crossed checked with other factories for reality check.*
27	*Low*	*Qualitative variable.*
28	*Low*	*This data will be taken from records which form the basis of revenue streams for the factory and may therefore be checked against. Written confirmation of the volume and its use will be provided by the buyer (PTT).*
33	*Low/Med*	*Where available, data will be from official sources.*
34	*Low/Med*	*Data on cane area may be verified by official figures. Reasons for any increase will be corroborated with sugar industry analyses and publications.*
35	*Low*	*Readily available from CDM EB website.*

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

There will be put in place a system to monitor the emission reductions arising from the project on a monthly basis through the collection of data on the sales of bio-ethanol to blenders. This information will be held at the head-office in Bangkok and will form the basis of monthly reporting so that the resultant emission reduction position may be continuously adjusted.

Key extension personnel and technical factory staff will be identified to co-ordinate data collection required for calculation of project emissions.

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

Theera Sanguandeekul, KSL Group
Robert Taylor, Agrinergy Ltd

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

Actual GHG LCA emissions for the anhydrous bio-ethanol produced by the project activity will be calculated on an ex-post basis. However, the following provides an estimate using existing extension service and factory data:

"Field" emissions

For all calculations, average yield of cane is taken as 56 tonnes cane/ha

1. Diesel consumption
We take IPCC diesel emissions factor for diesel, and diesel consumption in agricultural operations of 62.5 l/ha to arrive at a figure for PEDy of **2.55** kgCO2e/tonne cane.

2a. Emissions from the production of synthetic fertiliser
Farmers supplying KSL utilise 625 kg/ha (100 kg/rai) of compound fertiliser, with an average Nitrogen content of 16%. We take a figure for EFP of 0.39 kgCO2e/kg fertiliser and therefore arrive at a figure for emissions from fertiliser production equivalent to **4.35** kgCO2e/tonne cane.

2b. Soil N_2O emissions from organic and synthetic fertiliser use
Fertiliser application rates are as outlined above, FSN is 90 and EF1 1.25% and total soil emissions are estimated at **9.79** kgCO2e/tonne cane.

3. Emissions associated with the field burning of crop residues
Based on residue burning on 80% of crop land, total CH_4 and N_2Oemissions from burning of crop residues are **9.28** kgCO2e/tonne cane.

4. Emissions associated with transport of cane from fields to factory are estimated as **1.86**kgCO2e/tonne cane.

Total field emissions per tonne of cane are thus **27.83** kgCO2e/tonne cane. These must be converted to a kgCO2e/tonne molasses basis. This is done taking a raw sugar recovery rate of 11.5%, a molasses recovery rate of 4%, a raw sugar content of 80% and a molasses sugar content of 45% to give a figure of 113. 83 kgCO2e/tonne molasses. It takes 4.16 tonnes of molasses to make 1 kl of anhydrous bio-ethanol and thus "Field" emissions are **473.54** kgCO2e/kl bio-ethanol.

"Industrial" emissions

5. Emissions from industrial production of bio-ethanol. The KSL bio-ethanol factory will use electricity and steam that will be generated from the bagasse produced by the factory. As such this is renewable and industrial emissions are zero. (We have accounted for emissions from the growing of the sugar cane that will provide this bagasse).

"Transportation to end-use" emissions

6. As highlighted in Section B.2., there is uncertainty as to whether the bio-ethanol will be transported to Bangkok for blending or whether this can be done on-site. As such we have not estimated emissions associated with the transport of the bio-ethanol to the place of blending. (These emissions will of course be accounted for if required at the time of verification).

Total Project Emissions:

Based on annual production of bio-ethanol and its subsequent use in transportation of 22,950 kl, total project emissions are **10 867 tonnes CO2e.** ***(It should be noted that this figure is similar, but marginally higher than, the figure derived using the fixed emissions coefficient from Macedo et al and presented in the original submission NM0082).***

E.2. Estimated leakage:

The project will use only partially existing molasses supplies already available from the KSL sugar factory. We do not envisage therefore that the project activity will induce an increase in can area and thus have not estimated any leakage. Monitoring of the potential for such leakage is however an integral pat of the monitoring plan.

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

10 867 tonnes CO_2e

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

Baseline emissions are calculated as:

$$BE_y = AH_y \bullet Q \bullet EFP$$

Where:
BE_y = Baseline emissions, tCO_2e
AH_y = Volume of anhydrous bio-ethanol produced by the project activity and used in transportation, l
Q = Relative fuel efficiency of anhydrous bio-ethanol compared to gasoline ($0<Q<1$)
EFP = Gasoline lifecycle emissions coefficient, tCO_2e/l

We use a value for Q of 0.89, and EFP of 2.68911 tCO_2e/kl and assume a value for AH_y of 22,950 kl, and therefore arrive at total baseline emissions of 54,926 tCO_2e.

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

Emissions reductions are calculated as:

$$CER_y = BE_y - PE_y - LE_y$$

Hence annual emissions reductions are estimated as 44,058 tCO_2e.

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

Year	Estimation of project activity emission reductions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
Year 1	9,207	54,926	-	45,719
Year 2	9,207	54,926	-	45,719
Year 3	9,207	54,926	-	45,719
Year 4	9,207	54,926	-	45,719
Year 5	9,207	54,926	-	45,719
Year 6	9,207	54,926	-	45,719
Year 7	9,207	54,926	-	45,719
Year 8	9,207	54,926	-	45,719
Year 8	9,207	54,926	-	45,719
Year 9	9,207	54,926	-	45,719
Year 10	9,207	54,926	-	45,719
Total	92,070	549,260	-	457,190

SECTION F. Environmental impacts

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

>>

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

>>

SECTION G. Stakeholders' comments

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

>>

G.2. Summary of the comments received:

>>

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

>>

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project activity has received no public funding.

Annex 3

BASELINE INFORMATION

Data	Type	Source	Reference	Appropriateness
Data	Type	Source	Reference	Appropriateness
EFP	Baseline (gasoline) lifecycle emissions coefficient	LBST Report. Data taken from pages 42, 80, 86, 91	GM well-to-wheel analysis of energy use and greenhouse emissions of advanced fuel/vehicle systems – a European study. (http://www.lbst.de/gm-wtw/)	This study is based on European data, and its use for CDM host countries is deemed conservative.
FEP	Fuel efficiency of gasohol	PTT Study	http://www.pttplc.com/servlet/ipscustDesktop?pageid=10&page=product&right=product_fuel_gasohol_06.html	Directly applicable
FEG	Fuel efficiency of gasoline	PTT Study	http://www.pttplc.com/servlet/ipscustDesktop?pageid=10&page=product&right=product_fuel_gasohol_06.html	Directly applicable
EFD	Emissions factor for diesel	IPCC	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual	
EFP	Fertilser production emission coefficient	Wood & Cowie, 2004	www.joanneum.ac.at/iea-bioenergy-task38/publications/GHG_Emission_Fertilizer%20Production_July2004.pdf	Deemed conservative as methodology takes highest factor for fertiliser type
CEFt	CO2 emission factor transportation vehicle fuel	IPCC	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual	
Dy	Haulage distance to blend/distribution location	Proprietary data		Primary data used to calculate transport emissions, verified annually
FE	Fuel efficiency of haulage vehicles	Manufacturers' data	Will be taken from vehicle model used for transportation.	Obtaining vehicle specific data will provide the most

				exact measure of these sources of emissions.
TECy	Whether the calculation of transport emissions is required	Proprietary date	Taken from location of depots and blending stations	
AHy	Volume of bio-fuel produced and sold for use in transportation	Proprietary data		Primary data used to calculate baseline emissions, verified annually.

Annex 4

MONITORING PLAN

There will be put in place a system to monitor the emission reductions arising from the project on a monthly basis through the collection of data on the sales of bio-ethanol to blenders. This information will be held at the head-office in Bangkok and will form the basis of monthly reporting so that the resultant emission reduction position may be continuously adjusted.

Monitoring of Thai CDM project activities will be carried out by Agrinergy Ltd.

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