

RECAST ENERGY LOUISVILLE FUEL SWITCH FROM COAL TO BIOMASS



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PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project is a fuel switch conducted by Recast Energy Louisville by converting an existing coal boiler to biomass combustion in Louisville, Kentucky. The project will generate approximately 53,600 (tCO₂e) GHG reductions annually over a 10 year period by replacing the coal production with renewable biomass combustion. Prior to the project steam was generated using a combination of coal and natural gas boilers for three existing chemical companies that shared some utilities and infrastructure. The project involved the acquisition of the boiler house from one of the chemical companies which was discontinuing operations at the location. Recast Energy continued to use natural gas to generate steam for the remaining two chemical companies while implementing the conversion of the existing coal boiler to biomass combustion. The project (boiler conversion) began in June 2011 and went into operation on Dec 10, 2012. The plant has been in continuous operation since then. The total GHG emission reductions generated in this period are 56,331 tCO₂e in 2015, 49,922 tCO₂e in 2016, and 53,362 tCO₂e in 2014

1.2 Sectoral Scope and Project Type

Sectoral Scope: 01 Energy (renewable/non-renewable) UNFCCC Clean Development Mechanism AMS-I.C. for Small Scale Thermal Energy Projection without Electricity – Version 19

This project is not grouped.

1.3 Project Proponent

Organization name	Recast Energy Louisville, LLC
Contact person	Jamie Howell
Title	Plant Manager
Address	4200 Bells Lane, Louisville, KY 40211
Telephone	502-772-4135
Email	JHowell@recastenergy.com

1.4 Other Entities Involved in the Project

There are no other entities involved in the development of the Project.

1.5 Project Start Date

December 10, 2012 is the project start date.

1.6 Project Crediting Period

As a non-AFOLU project focusing on the reduction of CO₂ from fossil fuels, the Project Crediting Period is 10 years, with the possibility to renew twice. The projected start date for the initial 10 year crediting period is April 1, 2013 and ending March 31, 2023.

1.7 Project Location

The project is located in Louisville, Kentucky on land owned by one of the project customers, Lubrizol. The project site is leased to the project company, Recast Energy Louisville, LLC under a long term lease. The address and approximate coordinates are as follows: 4200 Bells Lane Louisville, KY 40211 Latitude: 38.2226280 Longitude:-85.8235880.

The boundary of the project encompasses the following equipment i) The Recast Energy facility including: (1) The truck tipper (2) Truck scales (Lubrizol truck scales) (3) The wood yard and associated material sizing equipment (4) Material handling equipment, including front end loader, reclaim and wood conveyors. (5) Biomass Fuelled Boiler and emission controls (6) Ash and blowdown handling systems (7) Control rooms (8) Other ancillary equipment ii) Steam and Return Condensate lines interconnecting the project activity with the project customers iii) Project Customers: Lubrizol Advanced Material, Inc. and Zeon Chemicals, LP, both located on Bells Road, Louisville, KY.

1.8 Title and Reference of Methodology

Title: Indicative simplified baseline and monitoring methodology for selected small-scale CDM project activities. Reference of VCS methodology: Appendix B of the simplified modalities and procedures for small-scale CDM project activities. Type I: Renewable Energy Projects Type I.C. Thermal energy with or without electricity (Version 19) Tools Applied: "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion", Version 02 "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Version 01 "Tool to calculate the emission factor for an electricity system", V 4.0 Guidance Applied: "General guidelines for SSC CDM methodologies", v20. "Indicative Simplified Baseline and Monitoring Methodologies for Selected Small-Scale CDM Project Activity Categories, General guidance on leakage in biomass project activities" Version 03 "Annex 18, Definition of Renewable Biomass" "Guidelines of the Demonstration of Additionality of Small-Scale Project Activities" Version 09.

1.9 Other Programs

Emission Trading Programs and Other Binding Limits: The project has not reduced GHG emissions from activities that are included in any emission trading program or any other mechanism that includes GHG allowance trading.

- Other Forms of Environmental Credit: The project has not sought or received another form of GHG related environmental credit during this monitoring period.
- Participation under Other GHG Programs: The project is not registered, nor is it seeking at this time to register under any other GHG program.

1.10 Sustainable Development

For this project, sustainable development criteria were not monitored during the current verification period.

The requirements to monitor and report on sustainable development were introduced by VCSA after the project validation and registration, and therefore are not included in the verification or monitoring reports for the current crediting period.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The implementation status of the project is as follows:

- For the initial verification period (2013, 2014), the project operated continuously during the verification period supplying steam to the project customers as needed for their manufacturing operations. The normal demand for steam fluctuates with operational needs and the need for building heat during cold weather. However, on 11/4/2013, the biomass boiler was shut down when the de-aeration (DA) tank serving the boiler house failed and had to be replaced. A smaller temporary tank was installed, that resulted in a lower feedwater temperature until the full-sized permanent tank was installed on 6/24/2014. The lower temperature of the feedwater resulted in lower feedwater enthalpy and increased fuel usage for the period. This DA tank that failed was a part of the original boiler house and not installed or modified for the biomass boiler conversion project.
- For the current verification period (2015, 2016, 2017), the project operated continuously supplying steam to the project customers as needed for their manufacturing operations. The normal demand for steam fluctuates with operational needs and the need for building heat during cold weather. Increases and decreases from year to year are primarily the result of fluctuations in demand for building heat for the manufacturing complex.
- There were no changes to the project activity, proponents or other entities.

2.1.1 Methodology Deviations

- 1. Parameter: Qsteam, : AMS-I.C Requirement: In case the project is exporting heat to other facilities, the metering shall be carried out at the recipient's end. Deviation: Measure thermal energy produced directly from the steam and feed water meters on the biomass boiler, not at the customer meters. Justification: Steam for delivery to two separate customers is generated by one biomass boiler and up to 4 natural gas boilers. If steam is measured at the customer's meters, steam and feed water measurements will combine mass and energy from all boilers will be used to calculate thermal energy generated by the biomass boiler alone. Recast proposes simply measuring the steam and feed water only at the biomass boiler to eliminate the inaccuracy introduced by deriving the thermal energy using 12 measuring points instead of 2 direct measuring points. Accordingly, the enthalpy values, hsteam and hfeedwater will be determined at the biomass boiler. This deviation will result in increased accuracy of the baseline by directly measuring the energy produced from biomass.
- 2. Parameter: ECy, AMS-I.C Requirement: Use "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Deviation from Requirement: Electricity consumption is measured based on the difference in equipment (motor ratings) on Boiler #4 before and after conversion. Justification: Reliable data is not available for electricity consumption of the boiler house prior to conversion. The converted boiler is one part of a complex boiler house system consisting of other boilers, water pumps, water treatment systems etc. that did not change with the project. A study will be prepared that identifies the changes in equipment for Boiler #4 and the maximum capacity for electricity usage before and after the project. Once per verification period, the list of equipment used to calculate the net change in electricity will be reviewed for any equipment and usage updates, and the net change in electricity recalculated for inclusion in the project emissions calculations. This deviation is conservative, as it measures the maximum potential electricity usage for Boiler #4 pre and post project, which will be larger than the actual usage of the boiler. The deviation is also more accurate, as it is very difficult to isolate the electrical usage of Boiler #4 and the boiler house in general both pre and post project
- 3. Parameter: EFgrid, CM,y AMS-I.C Requirement: Use "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Deviation: Data from the US Environmental Protection Agency eGRID tables is used in place of calculating a combined margin emission factor per the Tool. . Justification: The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States. Emission factors are generated for the US based on the electricity generation in each sub-region. This deviation is more accurate than a default factor (Option A2) and is

more accurate than using Option A1 to calculate a combined margin emission factor based on the closest power producers. The project is connected to a large power grid that will pool electricity from many sources over the project life, so a regional average will include the full range of fuels producing GHG's in the region of the project

- 4. Parameter: FCDiesel, loader, y AMS-I.C Requirement: Use "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion"
- Deviation: Purchased fuel invoices are used to monitor the quantity of diesel fuel used to calculate the project CO2 emissions from fossil fuel.
- Justification: The diesel fuel is metered into the onsite storage tank by the fuel supplier and recorded on the invoices, and this deviation assumes all fuel purchased during the monitoring period is used in the onsite fuel moving equipment. This deviation is conservative by assigning all purchased fuel at the facility to the project emissions calculations.

Note: These deviations were approved in the Validation and Initial Verification by VCS and have not changed for this reporting period

2.1.2 Project Description Deviations

There are no Project Description Deviations for this monitoring report.

2.2 Grouped Project

The project is not grouped.

2.3 Safeguards

2.3.1 No Net Harm

For this project, negative environmental and socio-economic impacts were not monitored during the current verification period.

The requirements to monitor and report on negative impacts were introduced by VCSA after the project validation and registration, and therefore are not included in the verification or monitoring reports for the current crediting period.

2.3.2 Local Stakeholder Consultation

For this project, communication with local stakeholders was not monitored during the current verification period.

The requirements to solicit and document local stakeholder communication were introduced by VCSA after the project validation and registration, and therefore are not included in the verification or monitoring reports for the current crediting period.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	NCVDiesel, y
Data unit	GJ/gallon
Description	Weighted average net calorific value of fuel (diesel) in year y
Source of data	Transportation Energy Data Book, Edition 36.1, Table B.4, published by Oak Ridge National Labs on April 2018. https://cta.ornl.gov/data/appendix_b.shtml Table B04
Value applied	0.1464
Justification of choice of data or description of measurement methods and procedures applied	Data source (c), selected as national default value since preferred source (a) is not available. To be reviewed annually
Purpose of the data	<i>Indicate one of the following:</i> • Calculation of project emissions • Calculation of leakage
Comments	Values reviewed for verification period. No change to parameter value for verification period.

3.2 Data and Parameters Monitored

Data / Parameter	EGthermal,y
Data unit	TJ
Description	The net quantity of steam/heat supplied by the project activity during the year y
Source of data	Calculation

Description of measurement methods and procedures to be applied	The net quantity of steam calculated from the quantity of steam (Q _{steam}) and enthalpy (h) during the verification period
Frequency of monitoring/recording	At least annually.
Value monitored	For 2015: 543.80 For 2016: 483.26 For 2017: 515.65
Monitoring equipment	NA
QA/QC procedures to be applied	NA
Purpose of the data	: • Calculation of baseline emissions
Calculation method	$EG_{thermal,y} = Q_{steam,y} \cdot (h_{steam} - h_{feedwater}) \cdot 1.055E-9$
Comments	No comments

3.3 Monitoring Plan

Recast Energy applies a disciplined approach to managing the real-time operations and performance of its facilities. This includes detailed operational guidelines and procedures as well as an array of management reporting metrics and tools. The purpose of monitoring is to:

- Ensure accurate and timely communications
- Facilitate operational decision making
- Retain records for mandatory reporting to government regulators and
- Verify GHG emission reductions. The reference manual “Louisville Operating Procedures” details the project’s general operating procedures, including data monitoring and reporting. A copy is stored onsite and revised from time to time.

Table 3.3 lists the project-specific parameters monitored for the purposes of verifying GHG emission reductions; additional parameters generated from third-party sources are monitored as needed and specified in later sections of this document

Table 3.3 Project-specific Parameters Monitored Under Monitoring Plan

Data Parameter	Units	Frequency	Measured, Estimated, Reported	Party Responsible for Recording Data
Steam	Lbs	Continuous with at least monthly recording	Measured	Recast Operator
Steam Pressure	Psi	At least hourly and recorded at least daily	Measured	Recast Operator
Feed water Temperature	°F	At least hourly and recorded at least daily	Measured	Recast Operator
Feed water Flow	Gal/hr	At least hourly and recorded at least daily	Measured	Recast Operator
Electricity consumption	KWh	Once per monitoring period	Engineering Study	Recast EHS
Diesel fuel consumption (at project)	Gallons	Each delivery	Reported by Supplier	Recast Accounting
Diesel fuel consumption for	Gallons	Annually	Estimated	Recast EHS

biomass processing				
Biomass delivery weight	Lbs	Each delivery	Measured	Recast Accounting
Biomass Origin		Each delivery	Reported by Supplier	Recast Accounting
Distance to origin	Km	Each delivery	Estimated	Recast EHS
Ash transportation weights	Loads	Each delivery	Measured	Recast Accounting
Ash destinations		Each delivery	Estimated	Recast EHS

Recast Energy operators are located at the facility in Louisville KY. Recast Energy Accounting and EHS are located at the corporate headquarters in Richmond VA. The organization structure is as follows:



Recast Operators are trained in boiler house operations, equipment maintenance and process record keeping. The boiler house is staffed at all times by at least two operators who are responsible for monitoring operations and delivery of steam to the project customers.

Recast Accounting is responsible for Accounts Payable, Accounts Receivable and all associated record keeping for financial audits. Recast EHS is responsible for maintaining all environmental permits, monitoring environmental data and submitting required reports to designated agencies.

The project emissions are monitored with a combination of project-specific parameters and data published by third part authorities. Project-specific parameters include those listed in Table 3.3. The parameters used to calculate baseline emissions are monitored using a continuous steam mass flow rate meter and the integrated digital display; flow, temperature and pressure readings are computer-logged. The boiler system is configured to operate at pre-set conditions, as needed to deliver required steam loads to the project customer's steam tie-in point using primarily the biomass boiler supplemented by the natural gas boilers as needed. The instrumentation is calibrated on a schedule that is consistent with the manufacturer recommendations.

Steam mass flow and pressure are measured as it leaves the biomass boiler and prior to combining with steam from other boilers, conditions at which the legacy baseline boiler system would also have delivered steam. Condensate return and make-up water temperature is also measured as feed water entering the biomass boiler. These measurements and standard thermodynamic reference tables are used to calculate the net enthalpy rise in the fluid, thereby determining the useful energy generated. These parameters are monitored and recorded using either: 1) direct visual measuring and manual recording or 2) automated telemetric meter reading.

Process data from the automated telemetric meter reading used to calculate the baseline emissions is recorded in raw form by the process control computer system in daily data files. From this data, cumulative data (ie. Daily steam flow) is recorded both manually by operators onto daily log sheets and in various spreadsheets.

Procedures have been implemented to prevent data loss. All data used to calculate the baseline is recorded in the daily operators log sheet and transferred to spreadsheets after quality review. Data summaries are also transferred electronically into spreadsheets stored within the data system. And finally, all process data files and spreadsheets are backed up to a second off site location at least daily.

Electricity consumption from the grid is determined from an engineering study that will be reviewed during each monitoring period for updated equipment information. With the exception of the front-end loader, all major pieces of equipment at the project site are powered with electricity supplied by the grid. Diesel fuel consumption by the onsite front-end loader(s) used in the biomass fuel yard is reported with each invoice/statement from the diesel fuel supplier. The net weight of biomass is monitored by the truck scale and recorded either on the delivery ticket issued and signed for each delivery or by an automated system. The biomass origin is used to calculate the transportation and account for the diesel fuel consumed for processing of certain biomass residues. Note that due to the use of contractors who collect and process fuels and their use of subcontractors to haul the fuels, exact mileage from in-woods or in-field job sites is not tracked. Instead, the county of origin is tracked and all deliveries from a specific county are assumed to have originated from the center of the county for the purpose of calculating distance.

The procedures used for handling any internal auditing performed and any non-conformities identified are as follows:

For information collected and recorded by operators, the data is transferred daily to a master spreadsheet (dashboard) by a supervisor and any anomalies or suspected errors are investigated and corrected immediately. This data is reviewed and used for multiple purposes in operations

For information collected by the accounting department, invoices are reviewed when received and approved by the plant manager. Any suspected errors are investigated and corrected prior to payment. Wood tickets are reviewed and recorded daily at the plant and the accounting department compares the list to the invoices from vendors. Anomalies and suspected errors are investigated and corrected.

The EHS group reviews the information recorded on each wood ticket and works with the wood manager to confirm the origin location and type of material based on knowledge of the vendor and source locations associated with the vendor. Any corrections to source location and type of

material is documented on the wood log used to calculate distances the fuel travels to the project.

All documents and records used in this monitoring plan shall be stored in a secure and retrievable manner for at least two years after the end of the project crediting period.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

For this project, the simplified baseline is the fuel consumption of the technology that would have been used in the absence of the project activity, times the emission factor for the fossil fuel displaced.

The conversion of the boiler to wood burning is displacing the use of coal in the same boiler. Therefore, the net quantity of steam/heat generated by the wood-fuelled boiler will be measured, corrected for efficiency of the coal-fuelled boiler and multiplied by the CO₂ emission factor of the coal.

Baseline emissions for this project will be calculated using equation (2) from paragraph 22 “Baseline emissions for power and heat production” of the methodology: $BE_{thermal, CO_2, y} = (EG_{thermal, y} / \eta_{BL, thermal}) * E_{FF, CO_2}$

Where

$BE_{thermal, CO_2, y}$	=	The baseline emissions from steam/heat displaced by the project activity during the year y (tCO ₂)
$EG_{thermal, y}$	=	The net quantity of steam/heat supplied by the project activity during the year y (TJ)
E_{FF, CO_2}	=	The CO ₂ emission factor of the fossil fuel that would have been used in the baseline plant (coal)
$\eta_{BL, thermal}$	=	The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity

Calculation of $EG_{thermal}$:

$EG_{thermal}$ represents the thermal energy produced by combusting biomass fuel in Boiler #4. It is calculated from the quantity of steam produced and the difference in heat content (enthalpy) between the boiler feedwater and steam produced.

$$EG_{thermal, y} = Q_{steam, y} * (h_{steam} - h_{feedwater}) * 1.055E-9$$

Where:

Q_{steam}	=	The quantity of steam generated by the project activity
$(h_{\text{steam}} - h_{\text{feedwater}})$	=	The difference in enthalpy of the steam and feedwater

Monitoring Period Baseline Emissions Calculation Results:

		<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>Units</u>
$EG_{\text{thermal},y}$	=	543.8	483.26	515.65	TJ
$\eta_{\text{BL,thermal}}$	=	83.43	83.43	83.43	%
$EF_{\text{FF},\text{CO}_2}$	=	88.42	88.42	88.42	tCO ₂ e/TJ
BE_{thermal}	=	57,643	51,226	54,659	tCO ₂ e

Quantify the baseline emissions and/or removals, providing sufficient information to allow the reader to reproduce the calculation. Attach electronic spreadsheets as an appendix or separate file to facilitate the verification of the results.

4.2 Project Emissions

Project emissions are in accordance with paragraph 45 of CDM “AMS-I.C and include:

- CO₂ emissions from on-site consumption of diesel fuel in equipment used to move wood fuel within the facility.
- CO₂ emissions from electricity consumption by the project activity that is in excess of the electricity used by the boiler prior to the activity

Project Emissions from diesel fuel.

The CO₂ emissions from on-site consumption of diesel fuel will be measured in accordance with CDM “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion. The emissions will be calculated by multiplying the quantity of fuel purchased in the reporting period (from fuel supplier invoices) by the emission factor for diesel fuel:

$$PE_{\text{FC,loader},y} = FC_{\text{Diesel, loader},y} * COEF_{\text{Diesel},y}$$

Where:

$FC_{\text{Diesel,loader},y}$	=	The quantity of diesel fuel combusted to operate the fuel moving equipment during the year
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$COEF_{Diesel,y}$	=	The CO ₂ emissions coefficient for diesel fuel during the year y; tCO ₂ e/gal
$COEF_{Diesel,y}$	=	$NCV_{Diesel,y} * EF_{CO2,Diesel,y}$
$NCV_{Diesel,y}$	=	is the weighted average net calorific value of the fuel type (diesel) in year y
$EF_{CO2,Diesel,y}$	=	is the weighted average CO ₂ emission factor of the fuel type (diesel) in year y

Project emissions from power consumption

No electricity is generated by the project activity and no captive power plant supplies any of the electricity consumed by the project activity; all electric power is purchased from the local utility, Louisville Gas and Electric (LG&E).

$$PE_{EC,y} = EC_y * EF_{EL,y} * (1 + TDL_y)$$

Where:

$EF_{EL,y}$	=	the CO ₂ emission factor for the grid purchased electricity; tCO ₂ e/MWh
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And under Scenario A:, Option A1:

$EF_{EL,y}$	=	$EF_{grid, CM,y}$ = Combined margin emission factor for the grid in year y
EC_y	=	the electricity consumed by the project activity during year y; MWh
TDL_y	=	Average technical transmission and distribution losses for providing electricity to project in year y

Monitoring Period Project Emission Calculation Results:

The following estimates the annual project emissions for the project activity:

$$PE_y = PE_{FC,loader,y} + PE_{EC,y}$$

		2015	2016	2017	Units
$PE_{FC,loader,y}$	=	128.03	112.90	112.70	tCO ₂ e
$PE_{EC,y}$	=	1,108.33	1,108.33	1,108.33	tCO ₂ e
PE_y		1,236.36	1,221.24	1,221.03	tCO ₂ e

4.3 Leakage

The project boundary includes the immediate site leased by Recast Energy. Activities relating to the project outside this boundary include: the collecting, processing and transporting of biomass. Emissions outside the project boundary are estimated as the project leakage. The following equation is used to determine the annual project leakage:

$$LE_y = LE_{biomass\ process,y} + LE_{biomass\ transp,y} + LE_{ash\ transp,y} + LE_{L2,y}$$

Where:

LE_y	=	The project leakage during the year y; tCO ₂ e
$LE_{\text{biomass process},y}$	=	The emissions from off-site consumption of diesel fuel during the collecting and processing of biomass residues into a transport-ready fuel format; tCO ₂ e
$LE_{\text{biomass transp},y}$	=	The emissions from off-site consumption of diesel fuel during the transporting of biomass residues from more than 200km to the project site; tCO ₂ e
$LE_{\text{ash transp}}$	=	The emissions from off-site consumption of diesel fuel during the transportation of ash (combustion residuals) from the Project to beneficial use outlets or other final destination; tCO ₂ e
$LE_{L2,y}$	=	The emissions from type L2, if applicable; tCO ₂ e

Project leakage from biomass collecting and processing

$LE_{\text{process},y}$	=	$\sum_j (Q_{\text{biomass } j,y} * EFF_{\text{Diesel process } j,y}) * COEF_{\text{Diesel},y}$
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Where:

$Q_{\text{biomass } j,y}$	=	The quantity of biomass residues of type j during the year y; tons
$EFF_{\text{Diesel, process } j,y}$	=	The diesel fuel efficiency of processing biomass of type j during the year y; gal/ton
$COEF_{\text{Diesel},y}$	=	The CO ₂ emissions coefficient for diesel fuel during the year y; tCO ₂ e/gal

Project leakage from biomass transportation:

Biomass residues transported over a distance of more than 200 kilometres due to the implementation of the project activity must be considered a leakage source attributed to the transportation.

$LE_{\text{biomass transp},y}$	=	$\sum_{\text{deliveries}} (DAF_{\text{biomass delivery}}) * COEF_{\text{Diesel},y} / EFF_{t,y}$
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Where:

$DAF_{\text{biomass delivery}}$	=	The roundtrip distance of each delivery; km
$COEF_{\text{Diesel},y}$	=	The CO ₂ emissions coefficient for diesel fuel during the year y; tCO ₂ e/gal
$Eff_{t,y}$	=	The fuel efficiency of a typical tractor trailer during the year y; km/gal

Project leakage from ash transportation

Ash residues transported over a distance of more than 200 kilometres due to the implementation of the project activity are considered a leakage source attributed to the transportation.

$LE_{\text{ash transp},y}$	=	$\sum_{\text{deliveries}} (DAF_{\text{ash delivery}}) * COEF_{\text{Diesel},y} / EFF_{t,y}$
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Where:

$DAF_{\text{ash delivery}}$	=	The roundtrip distance of each delivery; km
$COEF_{\text{Diesel},y}$	=	The CO ₂ emissions coefficient for diesel fuel during the year y; tCO ₂ e/gal
$EFF_{t,y}$	=	The fuel efficiency of a typical tractor trailer during the year y; km/gal

Project Leakage Forecast

The following estimates the annual project leakage for the project activity:

$$LE_y = LE_{\text{biomass transp},y} + LE_{\text{biomass process},y} + LE_{L2,y} + LE_{\text{ash transp},y} + LE_{L2,y}$$

Where

		<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>Units</u>
$LE_{\text{process},y}$	=	0	0	0	tCO ₂ e
$LE_{\text{biomass transp},y}$	=	75.42	82.32	76.90	tCO ₂ e
$LE_{\text{ash transp},y}$	=	0	0	0	tCO ₂ e
LE_y	=	75.42	82.32	76.90	tCO ₂ e

4.4 Net GHG Emission Reductions and Removals

The estimated emissions reductions (ERy) are calculated as the difference between the baseline emissions and the project emissions and project leakage.

$$ERy = BEy - PEy - Ley$$

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2015	57,642.9	1,236.4	75.4	56,331.1
2016	51,225.8	1,221.2	82.3	49,922.3
2017	54,659.4	1,221.0	76.9	53,361.5
Total	163,528.1	3,678.6	234.6	159,614.9